EPA FINALIZED TMDL

Upper Saluda River Basin (Hydrological Unit Code: 03050109-010, -020, -030, -040, -050, -060, and -070); Stations: S-004, S-005, S-007, S-087, S-103, S-171, S-250, S-252, S-267, S-299, S-300, S-301, and S-302 Fecal Coliform Bacteria

September 29, 2004

DHEC

PROMOTE PROTECT PROSPER

South Carolina Department of Health and Environmental Control

Bureau of Water
2600 Bull Street
Columbia, SC 29201

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 Upper Saluda Basin. Subsequent actions must be consistent with this TMDL.

James D. Giattina, Director   Date
Water Management Division

Abstract

The upper Saluda River basin (11-digit HUCs 03050109-010, -020, -030, -040, -050, -060, and -070) is located in parts of Greenville, Pickens, and Anderson counties of South Carolina, extending into North Carolina along the northern most ridgeline and the Blue Ridge ecoregion (Figure 1-1). Thirteen water quality monitoring stations in the watershed have been placed on the South Carolina §303(d) list of impaired waters for violations of the fecal coliform standard (Table 1-1). The 460 square mile basin is composed of mostly forest (78%) with some pastureland (9%), urban area (7%) and cropland (5%). The basin includes the City of Easley and unincorporated portions of Anderson, Greenville and Pickens Counties, which have or may receive Municipal Separate Storm Sewer (MS4) permits. Also, there are 19 active continuous point sources discharging fecal coliform bacteria in the upper Saluda River basin of South Carolina.

The load-duration curve methodology was used to establish allowable fecal coliform loads in the watershed. The existing load was determined using measured data from the impaired water quality monitoring stations. Loads were established from measured concentrations and a representative trend line was fit to samples violating the instantaneous standard. The existing load and allowable total maximum daily load (TMDL) for impaired stations is presented in Table I. To achieve the TMDL target, reductions of fecal coliform bacteria loads will be necessary, as shown in Table I.

Table I Total Maximum Daily Loads for Impaired Water Quality Stations in the upper Saluda River Basin (03050109-010, -020, -030, -040, -050, -060, -070)

Station ID	Existing Waste Load	TMDL WLA		Existing Load	TMDL LA	MOS	TMDL[3]	Percent Re-duction[4]
	Continuous (counts/day)	Continuous[1] (counts/day)	MS4[2]	(counts/day)	(counts/day)	(counts/day)	(counts/day)	
S-004	1.02E+10	1.02E+10	60%	3.61E+12	1.36E+12	7.60E+10	1.44E+12	60%
S-005	1.24E+10	1.24E+10	64%	1.17E+11	2.75E+10	2.22E+09	4.21E+10	64%
S-007	1.08E+11	1.08E+11	33%	9.77E+12	6.10E+12	3.45E+11	6.55E+12	33%
S-087	2.27E+08	2.27E+08	NA	1.66E+12	8.92E+11	4.96E+10	9.42E+11	43%
S-103	5.30E+08	5.30E+08	NA	2.95E+12	8.65E+11	4.81E+10	9.14E+11	69%
S-171	3.17E+10	3.17E+10	72%	6.12E+11	1.31E+11	9.07E+09	1.72E+11	72%
S-250	3.81E+10	3.81E+10	57%	1.30E+13	5.24E+12	2.93E+11	5.57E+12	57%
S-252	NA	NA	NA	2.97E+12	8.76E+11	4.87E+10	9.25E+11	69%
S-267	NA	NA	NA	7.94E+10	1.49E+10	8.30E+08	1.58E+10	80%
S-299	2.79E+10	2.79E+10	NA	4.82E+12	3.09E+12	1.73E+11	3.29E+12	32%
S-300	1.38E+10	1.38E+10	64%	7.80E+11	2.51E+11	1.47E+10	2.79E+11	64%
S-301	5.68E+10	5.68E+10	52%	6.49E+11	2.36E+11	1.63E+10	3.09E+11	52%
S-302	NA	NA	NA	3.04E+11	1.55E+11	8.64E+09	1.64E+11	46%

Table Notes:
1. Total monthly wasteload (#/30day) for each facility cannot exceed loads listed in Table 3-3.
2. MS4 expressed as percent reduction equal to LA reduction.
3. TMDLs expressed as monthly load (#/30day) by station are listed in Table B-1.
4. Percent reduction applies to LA and MS4 components when an MS4 is in the watershed.

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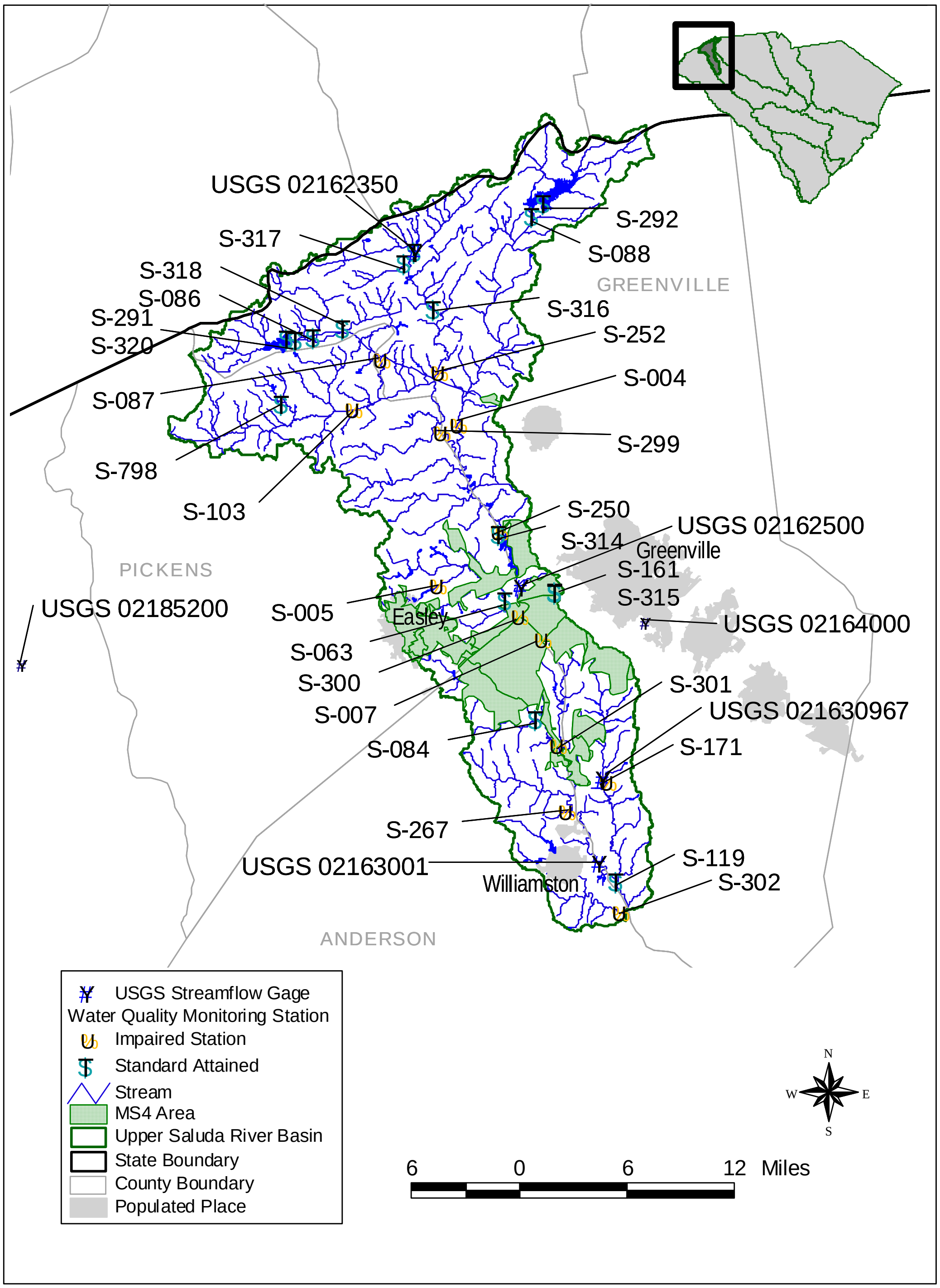

Figure 1-1 Upper Saluda River Basin (03050109-010, -020, -030, -040, -050, -060, -070)

1.0 INTRODUCTION

1.1 Background

Levels of fecal coliform bacteria can be elevated in waterbodies 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 waterbodies 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 waterbody based on the relationship between pollution sources and instream 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).

The State of South Carolina has placed 29 monitoring stations in the upper Saluda River basin (11-digit HUCs 03050109-010, -020, -030, -040, -050, -060, -070) on South Carolina's 2002 Section §303(d) list for impairment due to fecal coliform bacteria. These stations are identified in Table 1-1.

Table 1-1 Water Quality Monitoring Stations Impaired by Fecal Coliform in the upper Saluda River Basin (03050190-010, -020, -030, -040, -050, -060, -070)

/aterbody Name	Waterbody ID	Waterbody Location
N Saluda River	S-004	North Saluda River at Bridge above Junction with Saluda River, East of SC 186
S Saluda River	S-087	South Saluda River at S-23-101
iddle Saluda River	S-252	Middle Saluda River at SC 288 2.3 miles west-southwest of Slater
S Saluda River	S-299	South Saluda River at SC 186
olenoy River	S-103	Oolenoy River at S-39-47
aluda River	S-007	Saluda River at SC 81, southwest of Greenville
rove Creek	S-171	Grove Creek at Unnamed Road Below J P Stevens Estes Plant
aluda River	S-250	Saluda Lake at Farrs Bridge on SC 183, 7 miles northeast of Easley
aluda River Tributary	S-267	Tributary to Saluda River, 350 feet Below West Pelzer STP on S-23-53
Georges reek Branch	S-005	Branch of Georges Creek at S-39-192, 2.6 miles northeast of Easley
eorges Ck	S-300	Georges Creek at S-39-28
Big Brushy Creek	S-301	Big Brushy Creek at S-04-143
Big Creek	S-302	Big Creek at S-04-116

1.2 Watershed Description

The upper Saluda River basin (11-digit HUC 03050109-010, -020, -030, -040, -050, -060, -070) (Figure 1-1) is located in northwestern South Carolina in the Piedmont and Blue Ridge regions. The basin is comprised of seven 11-digit HUCs including the North, Middle, and South Saluda Rivers that confluence north of Greenville. Big Bushy Creek, draining the City of Easley, and Grove Creek, draining Greenville, meet the Saluda River in the lower portion of the basin. The Saluda River basin extends just over 50 miles in length through Anderson, Greenville, and Pickens counties covering 460 square miles.

Based on 1996 USGS Multi-Resolution Land Characteristic (MRLC) land use data, 78 percent of the watershed is forested. The remaining 22 percent is composed of pastureland (9%), urban area (7%), cropland (5%), and a small mix of water and barren land uses (1%). The majority of urban land is located in the middle of the basin between Greenville and Easley. Table 1-2 presents the percentage of total watershed area for each aggregated land use. Table A-1 (Appendix A) presents the percentage of land use area in each monitoring station and USGS streamflow station drainage area. The areas are also represented in miles squared in Table A-2. Figure 1-2 illustrates land use for the upper Saluda River basin.

Table 1-2 MRLC Aggregated Land Use for the upper Saluda River Basin (03050109-010, -020, -030, -040, -050, -060, -070)

Aggregated Land Use	Percent of Total Area	Total Area ($miles^2$)
Urban	6.9%	31.7
Barren	0.2%	1.0
Row Crops	5.1%	23.2
Pasture	9.4%	43.4
Forest	77.5%	356
Water	0.9%	3.9

1.3 Water Quality Standard

The impaired stream segments of the upper Saluda River basin are designated as Class Freshwater. Waters of this class are described as:

> "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)

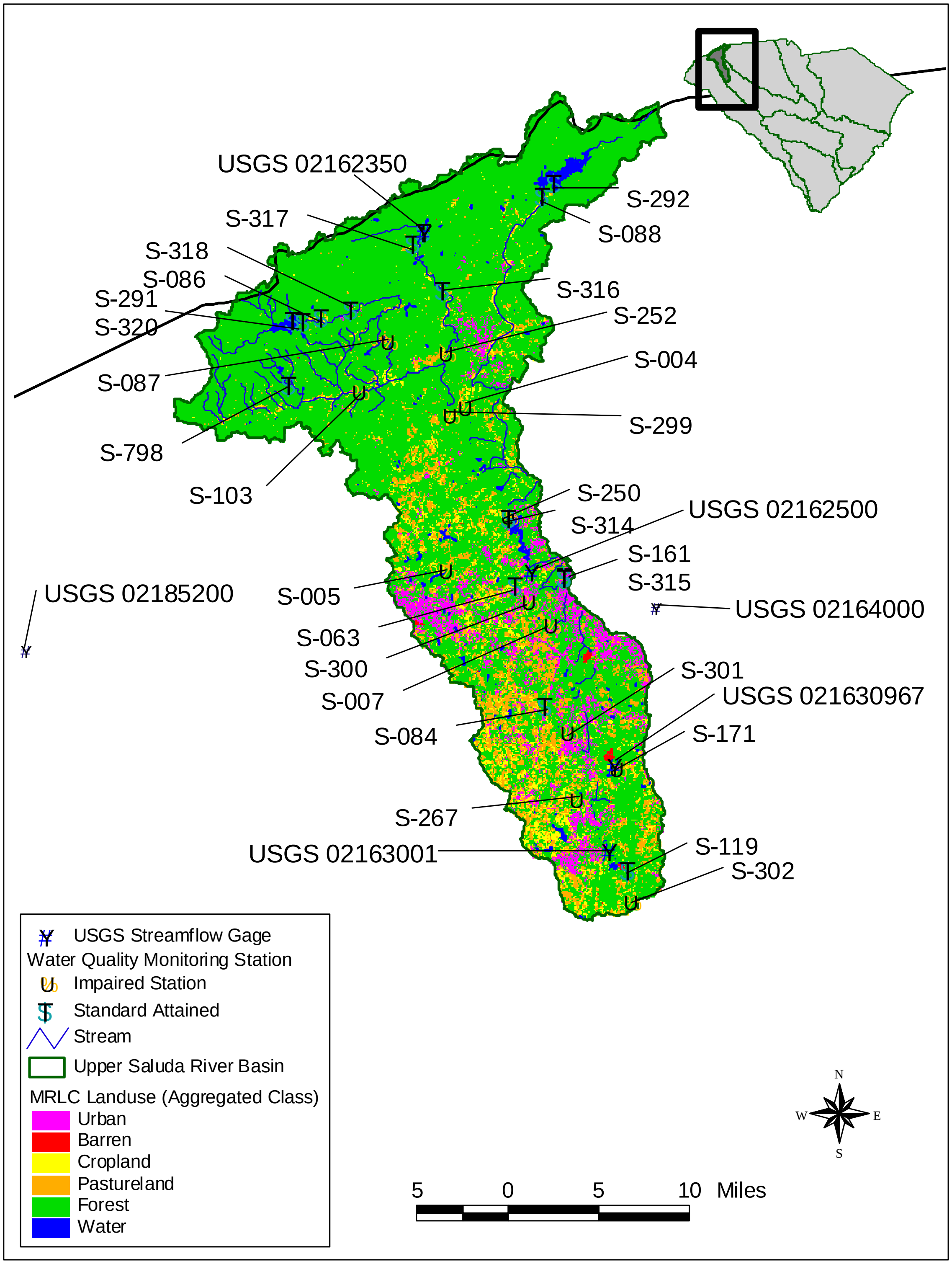

Figure 1-2 Upper Saluda River Basin Land Use

South Carolina's standard for fecal coliform bacteria 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 percent of the total samples during any 30 day period exceed 400/100 mL." (R.61-68).

2.0 WATER QUALITY ASSESSMENT

Fecal coliform bacteria data collected in the upper Saluda River basin from 1990 through 2001 were assessed to determine impairment of standards for recreational use. The State of South Carolina monitors fecal coliform bacteria at 29 stations in the watershed. Figure 1-1 shows the location of water quality monitoring stations in the watershed.

Thirteen quality monitoring stations in the basin have been identified on the State of South Carolina's Section §303(d) list for 2002 as impaired (Table 1-1). Statistical analysis of fecal coliform bacteria data collected is presented in Table 2-1 in support of the listing of impaired water quality monitoring stations. Waters in which no more than 10 percent of the samples collected over a five year period are greater than 400 fecal coliform counts per 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 counts per 100 mL are considered impaired and were listed for fecal coliform bacteria on the State of South Carolina's Section §303(d) list. All the data collected from 1990 though 2001 at each station is listed in Table A-3 of the Appendix.

Table 2-1 Statistical Assessment of Fecal Coliform Bacteria Observed from 1996 - 2000

Station	Total Number of Samples	Total Number of Samples >400 #/100 mL	Percent of Samples >400 #/100 mL
S-004	40	19	48%
S-005	29	23	79%
S-007	59	10	17%
S-087	30	5	17%
S-103	17	4	24%
S-171	31	10	32%
S-250	58	9	16%
S-252	28	4	14%
S-267	29	9	31%
S-299	16	3	19%
S-300	17	9	53%
S-301	16	3	19%
S-302	16	2	13%

The timeframe, both annually and seasonally, of water quality monitoring at each station varies greatly. The statistical assessment presented in Table 2-1 was based on data collected over the five-year period from 1996 through 2000.

After determining compliance with water quality standards, observed violations were assessed to determine conditions critical to impairment. Data were compared with estimated streamflows to establish a relationship between instream concentrations and hydrologic conditions. Due to limited streamflow data in the watershed, observed data were plotted with the load-duration curves generated based on area-weighted flows. The development of load-duration curves is discussed further in Section 4.0 of this report. Load-duration curves plotted for each station in Figures B-1 through B-12, and in Figure 2-1 (for S-004) are equal to the TMDL target based on the criteria for instantaneous events. The observed fecal coliform bacteria data were also converted from counts per 100 mL to loads in counts per day to assess hydrologic conditions when the standard is not attained.

The percent of flow exceeded in Figure 2-1 and Figures B-1 through B-12 represent flow conditions at each monitoring station. Hydrologic conditions for very dry events, likely to be exceeded in 99.99 percent of measured events, are represented as 99.99 percent. Extremely wet events that rarely occur are represented as 0.01 percent. Data collected at most impaired stations in the basin have violations during all flow conditions. Violations during various flow events suggest both overland, instream, and continuous sources, such as groundwater, of fecal coliform bacteria.

Data at three stations specifically did not show violations during all flow conditions. Violations at S-103 occurred during average to high flow events suggesting that overland contributions and or direct sources of fecal coliform bacteria are the likely cause of impairment. However, impaired water quality monitoring station S-299 is influenced by contributions during base and average flow conditions. Sources during these periods may also be from direct input to the stream, from overland contributions during small rain events, or from leaking septic systems. At S-302, no violations have been measured during extreme flow events indicating that small runoff events or instream direct sources may be attributed to the violations.

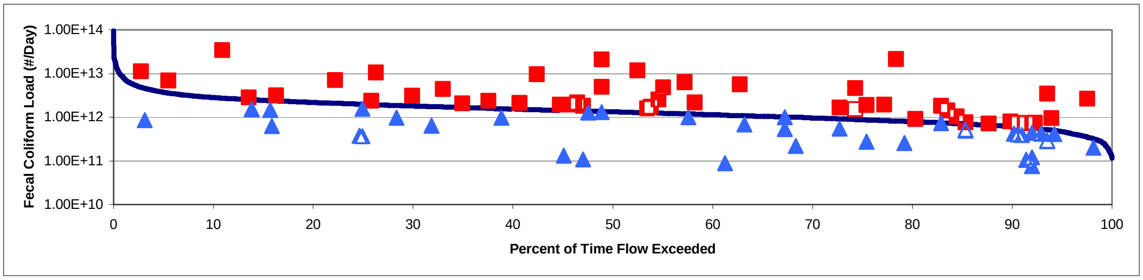

Figure 2-1 Fecal Coliform Bacteria Load-Duration Curve for Station S-004 Illustrating Observed Fecal Coliform Bacteria Loads Over Various Hydrologic Conditions

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

Fecal coliform bacteria enter surface waters of the upper Saluda River basin from both point and nonpoint sources. Point sources are facilities that discharge at a specific location through pipes, outfalls, and/or conveyance channels. All point sources must have a National Pollutant Discharge Elimination System (NPDES) permit and are often municipal wastewater treatment plants or industrial waste treatment facilities. Nonpoint sources are diffuse sources that have multiple routes of entry into surface waters. Some nonpoint sources are related to land use activities that accumulate fecal coliform bacteria on the land surface (i.e. pastureland) and runoff during storm events.

3.1 Point Sources

There are 19 active continuous point sources discharging fecal coliform bacteria in the upper Saluda River basin and Municipal Separate Storm Sewer (MS4) permits for the City of Easley and unincorporated portions of Anderson, Greenville and Pickens counties.

3.1.1 Continuous Point Sources

Facilities with continuous discharges of fecal coliform bacteria are listed in Table 3-1 and illustrated in Figure 3-1. In South Carolina, NPDES permittees that discharge sanitary wastewater must meet the State criteria for fecal coliform bacteria at the point of discharge (i.e. a daily maximum concentration of 400 counts per 100 mL, and a 30-day geometric mean of 200 counts per 100 mL).

The TMDLs presented in this report were developed using permitted flows, or design flows when no permitted flow is given, and permitted concentrations for fecal coliform bacteria. Limited information was available to determine the survival rate of fecal coliform bacteria discharging from permitted facilities to establish the impact downstream. Therefore, for the purpose of fecal coliform bacteria TMDL development in the upper Saluda River basin, wasteloads for continuous discharges are cumulative for a given drainage area. Estimated existing loads and the permitted geometric mean concentration of 200 counts per 100 mL and instantaneous concentration of 400 counts per 100 mL are listed in Table 3-3.

The collection systems of domestic wastewater treatment facilities are also possible sources of pollutants. 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.

Table 3-1 Permitted Facilities Discharging Fecal Coliform Bacteria into Waterbodies of the upper Saluda River Basin

Facility Name	NPDES No.	Flow Limits * (MGD)	Receiving Stream
HSL INC	SC0001155	0.066	HAMILTON CREEK
ALICE MFG/ELLISON PLANT	SC0001171	0.026	BURDINE/GEORGES/SALUDA RIVER
MILLIKEN/GAYLEY PLANT	SC0003191	1.792	SOUTH SALUDA RIVER
EASLEY/GEORGES CREEK LAGOON	SC0023043	792	GEORGES CREEK
MOHAWK IND/BELTON PLANT	SC0023213	Inactive 05/04/98	BIG CREEK TO SALUDA RIVER
WCRSA/PIEDMONT PLANT	SC0023906	1.2	SALUDA RIVER
WCRSA/GROVE CREEK PLANT	SC0024317	2.0	GROVE CREEK
SC DPRT/TABLE ROCK STATE PARK	SC0024856	0.035	TRIBUTARY TO CARRICK CREEK
WEST PELZER WWTF	SC0025194	0.2	SALUDA RIVER TRIBUTARY
WILLIAMSTON/BIG CREEK EAST	SC0025976	Inactive 08/01/99	BIG CREEK/SALUDA RIVER
WREN SCHOOL/ANDERSON DIST I	SC0026760	Inactive 10/01/98	LITTLE BRUSHY CREEK TRIBUTARY
WCRSA/SLATER-MARIETTA	SC0026883	0.672	N SALUDA RIVER
GERBER CHILDRENSWEAR	SC0027677	Inactive 11/13/98	SALUDA RIVER
H & H HOMETOWN FOOD STORE	SC0028371	Inactive 12/02/98	SALUDA RIVER TRIBUTARY
FOREST HILL SD	SC0028525	0.008	TRIBUTARY TO SALUDA RIVER
UNITED UTILS/VALLEYBROOK SD	SC0028673	0.096	TRIBUTARY TO GROVE CREEK
DACUSVILLE EL & HS/PICKENS CO	SC0028754	Inactive 03/22/01	DITCH-SHOAL CREEK/SALUDA RIVER
ASBURY HILLS CAMP & RETREAT	SC0029742	0.015	MATTHEWS CREEK/SALUDA RIVER
WCRSA/SALUDA RIVER PLANT	SC0034568	0.5	SALUDA RIVER
WCRSA/AVICE DALE PLANT	SC0036072	0.035	SALUDA RIVER
WCRSA/PARKER PLANT	SC0037451	0.2	SALUDA RIVER
WCRSA/LAKESIDE PLANT	SC0037460	0.7	SALUDA RIVER
CROSSWELL ELEM SCH/PICKENS CO	SC0037486	Inactive 02/28/01	HAMILTON/GEORGES/SALUDA RIVER
EASLEY/MIDDLE BRANCH WWTP	SC0039853	3.75	MIDDLE BRANCH/BUSHY CREEK
TOWN OF PELZER	SC0040797	0.2	SALUDA RIVER
WCRSA/GEORGES CREEK	SC0047309	3.0	SALUDA RIVER

* Note: Flow limits are either permit limits or design limits.

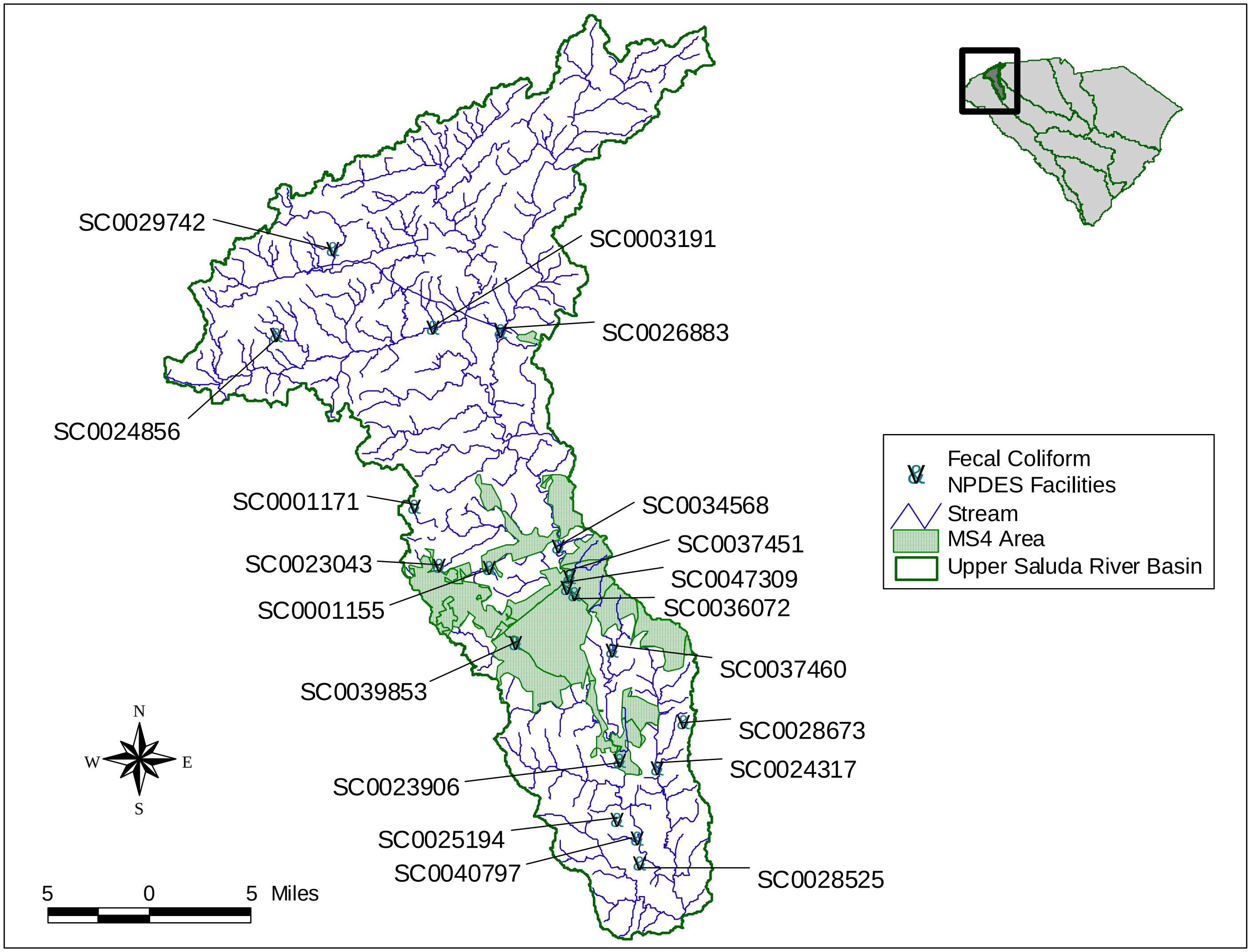

Figure 3-1 Active Fecal Coliform Bacteria Discharging NPDES Facilities

Table 3-2 Impaired Water Quality Monitoring Stations Draining NPDES Facilities in the upper Saluda River Basin

S-007	S-250	S-171
SC0029742	SC0029742	SC0028673
SC0023043	SC0024856	SC0024317
SC0001171	SC0026883	
SC0024856	SC0003191	**S-087**
SC0026883		SC0029742
SC0001155	**S-299**	
SC0003191	SC0029742	**S-103**
SC0036072	SC0024856	SC0024856
SC0047309	SC0003191	
SC0037451		**S-004**
SC0034568	**S-300**	SC0026883
	SC0023043	
S-301	SC0001171	**S-005**
SC0039853	SC0001155	SC0023043

Table 3-3 Estimated Existing Fecal Coliform Bacteria Loads for Facilities in the upper Saluda River Basin

NPDES Facility	Flow (MGD)	Existing Loading (counts/days)	Existing Loading (counts/30days)
SC0001155	0.066	9.99E+08	1.50E+10
SC0001171	0.026	3.94E+08	5.91E+09
SC0003191	1.792	2.71E+10	4.07E+11
SC0023043	0.82	1.24E+10	1.86E+11
SC0023906	1.2	1.82E+10	2.73E+11
SC0024317	2.0	3.03E+10	4.54E+11
SC0024856	0.035	5.30E+08	7.95E+09
SC0025194	0.2	3.03E+09	4.54E+10
SC0026883	0.672	1.02E+10	1.53E+11
SC0028525	0.008	1.21E+08	1.82E+09
SC0028673	0.096	1.45E+09	2.18E+10
SC0029742	0.015	2.27E+08	3.41E+09
SC0034568	0.5	7.57E+09	1.14E+11
SC0036072	0.035	5.30E+08	7.95E+09
SC0037451	0.2	3.03E+09	4.54E+10
SC0037460	0.7	1.06E+10	1.59E+11
SC0039853	3.75	5.68E+10	8.52E+11
SC0040797	0.2	3.03E+09	4.54E+10
SC0047309	3.0	4.54E+10	6.81E+11

3.1.2 Municipal Separate Storm System (NPDES)

The City of Easley and unincorporated areas of Anderson, Greenville, and Pickens counties (Figure 1-1) 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 for modeling purposes all urban areas will be evaluated together as urban nonpoint sources.

In 1990, EPA developed rules establishing Phase I of the National Pollutant Discharge Elimination System (NPDES) storm water program, designed to prevent harmful pollutants from being washed by storm water runoff into Municipal Separate Storm Sewer Systems (MS4s) (or from being dumped directly into the MS4) and then discharged into local waterbodies (SCDHEC, 2002). Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or greater) to implement a storm water management program as a means to control polluted discharges from MS4s. Approved storm water management programs for medium and large MS4s are required to address a variety of water quality related issues including roadway runoff management, municipal owned operations, and hazardous waste treatment.

Phase II of the rule extends coverage of the NPDES storm water program to certain small MS4s. Small MS4s are defined as any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES Storm Water Program. Phase II requires operators of regulated small MS4s to obtain NPDES permits and develop a storm water management program. Programs are to be designed to reduce discharges of pollutants to the "maximum extent practicable", protect water quality, and satisfy appropriate water quality requirements of the Clean Water Act.

3.2 Nonpoint Sources

The land use distribution of the upper Saluda River Basin provides insight into determining nonpoint sources of fecal coliform bacteria (Figure 1-2). In the watershed, 78 percent of the land area is classified forested, 9 percent is pastureland, nearly 6 percent is urban, 5 percent of the area is cropland and the remaining watershed area is water or barren land. Key nonpoint sources identified in the watershed include livestock, manure application, failing septic systems, illicit discharges (including leaking and overflowing sewers), and natural sources.

3.2.1 Wildlife

Fecal coliform bacteria are found in forested areas, pastureland, and cropland due to the presence of wild animal sources such as deer, raccoons, wild turkeys and waterfowl. The Department of Natural Resources in South Carolina estimates the deer habitat in the basin at a density of less than 15 deer per square mile in the headwaters of Greenville and

Pickens counties up to 45 deer per square mile in the lower portion of the basin in Greenville and Anderson counties (SC Deer Density 2000 map). Deer habitat was assumed to include forests, cropland, and pastureland. Wildlife waste is transported over land surfaces during rainfall events or may be directly deposited by animals into streams. The high percentage of permeable surfaces in forested areas increases the infiltration rate over the watershed area. This process ultimately reduces the runoff reaching streams by overland flow and reduces the significance of fecal coliform contributions transported overland.

3.2.2 Agricultural Activities and Grazing Animals

Agricultural land can be a source of fecal coliform bacteria. Runoff from grazing pastures, improper land application of animal wastes, livestock operations, and livestock with access to waterbodies are all agricultural sources of fecal coliform bacteria. Agricultural best management practices (BMPs) such as buffer strips, alternative watering sources, limiting livestock access to streams, and the proper land application of animal wastes reduce fecal coliform bacteria loading to waterbodies.

The number of animals in the watershed, shown in Table 3-4, was estimated by area-weighting the 1997 USDA census data over the pastureland in the watershed for Anderson, Greenville, and Pickens counties. Census data show that grazing cattle are of more relevance in the upper Saluda River basin than confined animal operations. Livestock, except for dairy cattle, are not usually confined and are typically grazing in the pastures where deposited manure is a source of nonpoint pollution. The time that cattle spend in streams is assumed to be 0.15 percent of their total gazing time. Hogs are anticipated to be generally confined, whereas sheep are expected to spend all of their time grazing. Horses and ponies are expected to spend the majority of spring, summer, and fall months grazing in pastureland where manure is a source of nonpoint pollution.

Table 3-4 1997 USDA Agricultural Census Data Animal Estimates

Animal	1997 Census Estimate
Beef Cow	5019
Dairy Cow	329
Hog	4295
Sheep	49
Horses and Ponies	603

3.2.3 Failing Septic Systems and Illicit Discharges

Failing septic systems and illegal discharges represent a nonpoint source that can contribute fecal coliform to receiving waterbodies through surface, subsurface malfunctions or direct discharges. Based on 1990 census information, population change from 1990 and 2000, and assuming an average of 2.5 people per household (U.S. Census, 2000), greater than 50,000 people in the upper Saluda River basin use septic systems. Though the precise failure rate is unknown, Schueler (1999) suggests an average septic failure rate of 20 percent. Many of these areas are also on sewer systems that may leak and/or overflow during rain events contributing significant loads of fecal coliform bacteria directly to streams.

3.2.4 Urban Runoff

Runoff from urban areas not permitted under the MS4 program are a potentially significant source of fecal coliform bacteria in the upper Saluda River basin. The towns of Pelzer, Slater-Marietta, West Pelzer, and Williamston have not been designated as MS4s. Water quality data collected from streams draining these communities show that some of these streams are impaired by fecal coliform bacteria. Best management practices (BMPs) such as buffer strips and the proper disposal of domestic animal wastes reduce fecal coliform bacteria loading to waterbodies.

4.0 TECHNICAL APPROACH – LOAD-DURATION METHOD

Load-duration curves were developed for water quality stations in the upper Saluda River basin to establish allowable fecal coliform bacteria loads under various hydrologic conditions. The load-duration methodology uses the cumulative frequency distribution of streamflow and pollutant concentration (fecal coliform bacteria) data to estimate the allowable loads for a waterbody. Allowable load-duration curves were established in the basin using the instantaneous concentration of fecal coliform bacteria, minus a five percent margin of safety (MOS), and streamflow measured at various USGS stations in the upper Saluda River basin and surrounding watersheds, as shown in Figure 1-1 and listed in Table 4-1.

Table 4-1 USGS Stations Used to Establish Area-Weighted Flows

Site Number	Site Name	From	To	Drainage Area (mile^2)
0212350	Middle Saluda River near Cleveland, SC	10/01/1980	09/30/2001	21
021630967	Grove Creek near Piedmont, SC	07/07/1994	09/30/2001	18.9
02164000	Reedy River near Greenville, SC	11/12/1941	09/30/2001	44
02185200	Little River near Walhalla, SC	3/4/1967	9/30/2001	72

Streamflow data was not available at each impaired water quality monitoring station to develop load-duration curves. Therefore, flows were determined by area-weighted data collected at USGS stations listed in Table 4-1. Data collected at these stations through 2001 were used in the analysis. For USGS station 021630967, Grove Creek near Piedmont, where data were not collected from 1990 through July 1994, the program MOVE.1 was used to interpolate streamflow by comparing overlapping records with

USGS station 02164000, Reedy River near Greenville, SC. Statistical analysis from matched stations and technical clarification of the MOVE.1 methods can be found in Appendix D.

Watershed characteristics (including the distribution of land use activities, ecoregions, and topography) for the USGS stations and impaired water quality monitoring sites were compared to associate stations to develop load-duration curves. Table 4-2 lists the impaired water quality monitoring stations and associated streamflow stations used to develop area-weighted flow relationships. The location of both USGS and water quality monitoring stations are identified in Figure 1-1. Figure 4-1 illustrates the water yield for S-004 associated with USGS station 02185200. Water yields established at other stations in the basin are in Appendix B, Figures B-13 through B-15.

Table 4-2 USGS Stations and Associated Water Quality Stations

USGS Gage	Waterbody ID	Waterbody Name
USGS 02162350	S-103	Oolenoy Rvr
	S-087	S Saluda Rvr
	S-267	Saluda Rvr Trib
USGS 021630967	S-005	Georges Ck Branch
	S-171	Grove Ck
	S-300	Georges Ck
	S-301	Big Brushy Ck
	S-302	Big Creek
USGS 02185200	S-004	N Saluda Rvr
	S-007	Saluda Rvr
	S-250	Saluda Rvr
	S-252	Middle Saluda Rvr
	S-299	S Saluda Rvr

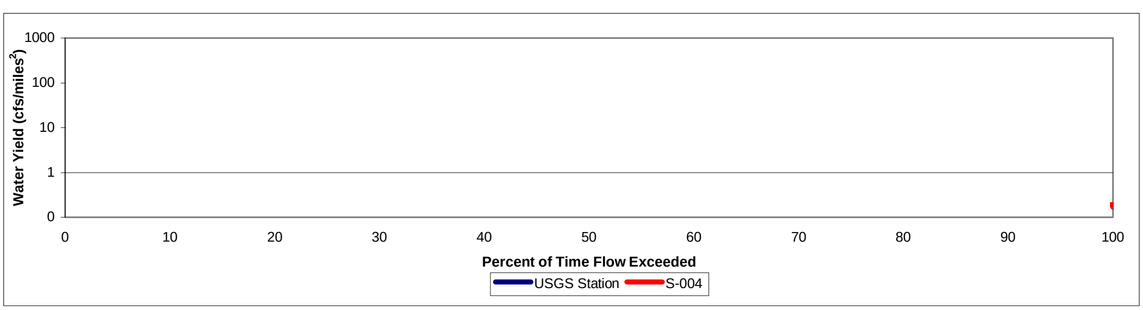

Figure 4-1 Water Yield (cubic feet per second per square mile) at S-004 Based on Measured Daily Streamflow from USGS station 02185200

After calculating streamflow for each impaired monitoring station the data were ranked to determine the percent of time streamflow was exceeded. The streamflow was then multiplied by a concentration of 380 counts/100 mL (based on the instantaneous concentration and a five percent MOS) to generate a load-duration curve for each impaired station, shown in Figures B-1 through B-12 of Appendix B. The result of the load-duration curve is the TMDL target.

To define the TMDL for each station, an average of the load-duration curve was calculated. The average was calculated using loads at five percent intervals from the 10^{th} percentile of flow exceeded to the 90^{th} percentile of flow exceeded. Loads occurring at less than the 10^{th} percentile of flow exceeded are extreme high flow events and the data collected at greater than the 90^{th} percentile of flow exceeded are extreme low flow events and therefore were not considered in developing theses TMDLs. Loads established for each interval and the mean load for each station can be found in Appendix B, Table B-1.

5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

A total maximum daily load (TMDL) for a given pollutant and waterbody 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 waterbody. Conceptually, this definition is represented by the equation:

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

The TMDL is the total amount of a pollutant that can be assimilated by the receiving waterbody 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 some pollutants, TMDLs are expressed on a mass-loading basis (e.g., pounds per day). For bacteria, however, TMDLs can be expressed in terms of organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l).

5.1 Critical Conditions

Critical conditions for fecal coliform bacteria in the upper Saluda River basin occur at various flow regimes. The load-duration curve methodology used to establish TMDLs in the watershed considers various hydrologic conditions critical in maintaining water quality standards.

5.2 Existing Load

The existing load for each impaired station was established using observed fecal coliform bacteria data and area-weighted streamflow. The measured data occurring at less than the 10^{th} percentile of flow exceeded is an extreme high flow event and the data collected at greater than the 90th percentile of flow exceeded is an extreme low flow event and therefore not considered as critical conditions for these TMDLs.

The data violating the instantaneous concentration were isolated and a best-fit trendline was fit to violating data. The trendline was determined using a best-fit relationship that was most representative of the violating data. In the upper Saluda River basin violating data collected at all stations, with the exception of two, were best represented by power curves. Impaired water quality monitoring stations S-252 and S-299 had very few violations and the best-fit was represented by determining the root mean square relationship between the TMDL target line and the violating data. The best-fit lines for these stations are illustrated in Figures B-7 and B-9 of Appendix B, respectively. The equation representing the trendline for each station was then used to calculate the average violating load that occurred between the 10th and 90th percentiles, at every fifth percentile. This average load is equal to the total instream existing fecal coliform bacteria load at the associated station. The existing nonpoint source load is equal to the existing instream load minus the wasteload from point sources in the drainage area.

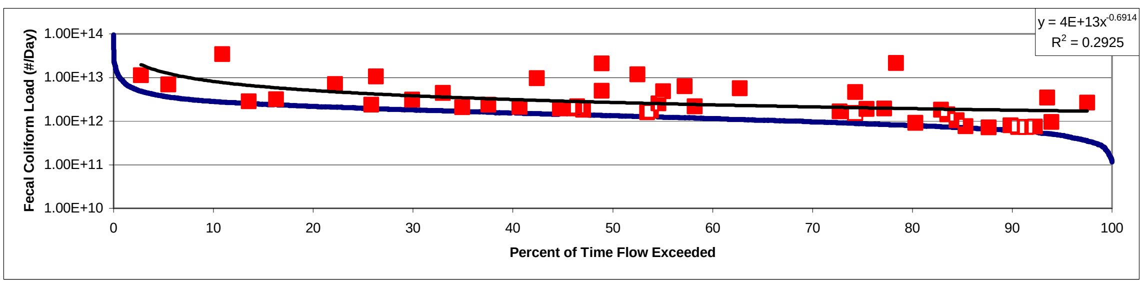

Figure 5-1 Power Trendline Generated from Violating Fecal Coliform Bacteria Measured at S-004

Table 5-1 Existing Loads for Impaired Water Quality Stations in the upper Saluda River Basin

Station ID	Existing Load (counts/day)
S-004	3.61E+12
S-005	1.17E+11
S-007	9.77E+12
S-087	1.66E+12
S-103	2.95E+12
S-171	6.12E+11
S-250	1.30E+13
S-252	2.97E+12
S-267	7.94E+10
S-299	4.82E+12
S-300	7.80E+11
S-301	6.49E+11
S-302	3.04E+11

Figure 5-1 presents the power best-fit trendline for station S-004, an impaired station on the North Saluda River. Interval loads calculated for existing instream conditions are presented in Table B-2 (Appendix B). Trendlines are presented in Figures B-1 through B-12. Existing loads calculated for each station are listed in Table 5-1.

5.3 Existing Wasteload

The existing wasteload was calculated for each NPDES permitted continuous discharge. The facilities were assumed to discharge at permitted flows, or design flows when a flow limit was not designated in the permit, and permitted limits of fecal coliform bacteria equal to the State criteria for both instantaneous and geometric mean loads. In South Carolina, NPDES permittees that discharge sanitary wastewater must meet the State's criteria for fecal coliform bacteria at the point of discharge (i.e. a daily maximum concentration of 400 counts per 100 mL, and a 30-day geometric mean of 200 counts per 100 mL). Under these permitted concentrations facilities should not be in exceedance of the fecal coliform bacteria water quality criteria, and therefore, not considered to be a major contributing source. If facilities are discharging at greater than permitted concentrations this is an illicit discharge and regulated through the NPDES program. Allowable TMDL wasteloads for impaired stations (Table 5-2) are equal to loads calculated for facilities in the basin.

Table 5-2 Wasteloads from NPDES Continuous Discharges to Impaired Water Quality Stations in the upper Saluda River Basin

Station ID	Existing Waste Load Continuous (counts/day)
S-004	1.02E+10
S-005	1.24E+10
S-007	1.08E+11
S-087	2.27E+08
S-103	5.30E+08
S-171	3.17E+10
S-250	3.81E+10
S-252	NA
S-267	NA
S-299	2.79E+10
S-300	1.38E+10
S-301	5.68E+10
S-302	NA

5.4 Margin of Safety

There are two methods for incorporating a margin of safety (MOS) in the analysis: a) by implicitly incorporating the MOS using conservative assumptions to develop allocations; or b) by explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations. For the upper Saluda River basin TMDLs, both methods were applied to incorporate a MOS. An implicit MOS was incorporated through the use of conservative assumptions in developing the TMDL, such as the use of the design or permitted flow for NPDES facilities and the use of a trendline to establish a total instream load. A five percent explicit MOS was reserved from the water quality criteria in developing the load-duration curves. Specifically, the water quality target was set at 190 counts per 100 mL for the geometric mean 30-day period and 380 counts per 100 mL for the instantaneous criterion, which is five percent lower than the water quality criteria of 200 and 400 counts per 100 mL, respectively.

5.5 Total Maximum Daily Load

The TMDL represents the maximum fecal coliform bacteria load the stream may carry and still meet water quality standards. The TMDL is presented in fecal coliform counts to be protective of both the instantaneous, per day, and geometric mean, per 30-day, criteria. The methods used to develop these TMDLs assume that waters entering the State are meeting South Carolina’s water quality standards for fecal coliform bacteria. Table 5-3 defines the fecal coliform bacteria total maximum daily load (TMDL) for protection of water quality standards for impaired stations in the upper Saluda River basin.

There are four municipalities in the watershed that have or will have NPDES MS4 permits. Greenville County became covered under NPDES Phase I in August of 2000. The Town of Easley and Anderson and Pickens Counties will eventually be covered under one or more 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.

Table 5-3 Total Maximum Daily Loads for Impaired Water Quality Stations in the upper Saluda River Basin (03050109-010, -020, -030, -040, -050, -060, -070)

Station ID	Existing Waste Load	TMDL WLA		Existing Load	TMDL LA	MOS	TMDL[3]	Percent Reduction[4]
	Continuous (counts/ day)	Continuous[1] (counts/ day)	MS4[2]	(counts/ day)	(counts/ day)	(counts/ day)	(counts/ day)	
S-004	1.02E+10	1.02E+10	60%	3.61E+12	1.36E+12	7.60E+10	1.44E+12	60%
S-005	1.24E+10	1.24E+10	64%	1.17E+11	2.75E+10	2.22E+09	4.21E+10	64%
S-007	1.08E+11	1.08E+11	33%	9.77E+12	6.10E+12	3.45E+11	6.55E+12	33%
S-087	2.27E+08	2.27E+08	NA	1.66E+12	8.92E+11	4.96E+10	9.42E+11	43%
S-103	5.30E+08	5.30E+08	NA	2.95E+12	8.65E+11	4.81E+10	9.14E+11	69%
S-171	3.17E+10	3.17E+10	72%	6.12E+11	1.31E+11	9.07E+09	1.72E+11	72%
S-250	3.81E+10	3.81E+10	57%	1.30E+13	5.24E+12	2.93E+11	5.57E+12	57%
S-252	NA	NA	NA	2.97E+12	8.76E+11	4.87E+10	9.25E+11	69%
S-267	NA	NA	NA	7.94E+10	1.49E+10	8.30E+08	1.58E+10	80%
S-299	2.79E+10	2.79E+10	NA	4.82E+12	3.09E+12	1.73E+11	3.29E+12	32%
S-300	1.38E+10	1.38E+10	64%	7.80E+11	2.51E+11	1.47E+10	2.79E+11	64%
S-301	5.68E+10	5.68E+10	52%	6.49E+11	2.36E+11	1.63E+10	3.09E+11	52%
S-302	NA	NA	NA	3.04E+11	1.55E+11	8.64E+09	1.64E+11	46%

Table Notes:

1. Total monthly wasteload (#/30day) for each facility cannot exceed loads listed in Table 3-3.
2. MS4 expressed as percent reduction equal to LA reduction.
3. TMDLs expressed as monthly load (#/30day) by station are listed in Table B-1.
4. Percent reduction applies to LA and MS4 components when an MS4 is in the watershed.

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 upper Saluda River watershed. Local sources of nonpoint source education and assistance include Clemson Extension Service, the Natural Resource Conservation Service (NRCS), the Greenville, Pickens, and Anderson 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.

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, other interested parties (universities, local watershed groups, etc.) may apply for section 319 grants to install BMPs that will reduce fecal coliform loading to the Saluda River and its impaired tributaries. TMDL implementation projects are given highest priority for 319 funding.

In addition to the resources cited above for the implementation of this TMDL in the upper Saluda River 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.

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 Data

Table A-1 Percent of Watershed Area Aggregated by Land Use Class for Areas Draining to Streamflow and Water Quality Monitoring Stations in the upper Saluda River Basin

Monitoring Station ID	Water	Urban	Row Crop	Pasture	Forest	Barren
S-004	2.2%	2.7%	2.9%	2.9%	89.3%	0.0%
S-005	0.1%	25.0%	4.5%	7.6%	62.6%	0.1%
S-007	1.0%	3.2%	3.5%	5.6%	86.6%	0.1%
S-087	1.6%	0.2%	0.7%	1.3%	96.1%	0.0%
S-103	0.3%	0.1%	1.6%	2.5%	95.5%	0.0%
S-171	0.2%	18.8%	2.7%	14.0%	62.6%	1.7%
S-250	0.9%	1.2%	2.7%	4.0%	91.1%	0.0%
S-252	0.2%	0.9%	1.2%	1.4%	96.3%	0.0%
S-267	0.0%	9.7%	16.6%	28.2%	45.5%	0.1%
S-299	0.6%	0.4%	1.6%	2.5%	94.9%	0.0%
S-300	0.4%	12.3%	9.8%	15.1%	62.3%	0.1%
S-301	0.5%	17.4%	8.6%	23.9%	49.4%	0.4%
S-302	1.0%	9.3%	19.9%	23.9%	45.9%	0.1%
USGS 02162350	0.2%	0.1%	0.5%	0.5%	98.7%	0.0%
USGS 02162500	1.1%	1.7%	2.8%	4.2%	90.3%	0.0%
USGS 02163001	0.9%	6.2%	4.5%	8.5%	79.7%	0.1%
USGS 021630967	0.2%	19.5%	2.2%	14.2%	62.0%	1.8%
USGS 02164000	0.3%	52.5%	3.1%	6.3%	37.5%	0.4%
USGS 02185200	0.5%	0.4%	1.5%	4.1%	92.3%	1.2%

Table A-2 Watershed Area in Square Miles Aggregated by Land Use Class for Areas Draining to Streamflow and Water Quality Monitoring Stations in the upper Saluda River Basin

Monitoring Station ID	Water	Urban	Row Crop	Pasture	Forest	Barren	Total
	(miles^2)						
S-004	1.6	2.0	2.2	2.1	66	0.0	74
S-005	0.0	1.2	0.2	0.4	3.1	0.0	5.0
S-007	3.3	11	12	19	292	0.2	337
S-087	0.7	0.1	0.3	0.6	43	0.0	44
S-103	0.1	0.0	0.7	1.1	41	0.0	43
S-171	0.0	3.8	0.5	2.9	13	0.4	20
S-250	2.7	3.3	7.7	12	262	0.1	287
S-252	0.1	0.5	0.6	0.7	46	0.0	48
S-267	0.0	0.1	0.1	0.2	0.3	0.0	0.7
S-299	1.0	0.7	2.8	4.2	161	0.0	169
S-300	0.1	4.0	3.2	5.0	21	0.0	33
S-301	0.2	6.3	3.1	8.7	18	0.1	37
S-302	0.2	1.8	3.9	4.6	8.9	0.0	19
USGS 02162350	0.0	0.0	0.1	0.1	21	0.0	21
USGS 02162500	3.1	4.9	8.2	12	267	0.1	295
USGS 02163001	3.7	26	19	36	335	0.6	420
USGS 021630967	0.0	3.7	0.4	2.7	12	0.3	19
USGS 02164000	0.1	25	1.5	3.1	18	0.2	48
USGS 02185200	0.4	0.0	1.1	2.9	66	0.9	72

Table A-3 Fecal Coliform Data Collected between 1990 and 2001 at Water Quality Monitoring Stations in the upper Saluda River Basin

S-004	
Date	Value
5/2/90	990
6/5/90	780
7/6/90	740
8/1/90	560
9/7/90	720
10/18/90	3500
5/8/91	300
6/21/91	740
7/18/91	2100
8/16/91	1300
9/27/91	530
10/24/91	200
5/14/92	350
6/12/92	430
7/16/92	230
8/6/92	440
9/1/92	470
10/1/92	500
5/12/93	230
6/3/93	200
7/27/93	2000
8/18/93	380
9/22/93	420
10/13/93	320
5/13/94	380
6/9/94	2000
7/22/94	4800
8/12/94	2000
9/23/94	530
5/12/95	600
6/5/95	480
7/13/95	880
8/25/95	940
9/14/95	700
10/23/95	370
6/14/96	2500
7/26/96	1500
8/16/96	480
9/20/96	240
10/25/96	120
11/22/96	320
12/16/96	30
1/21/97	35

S-004	
Date	Value
2/20/97	140
3/12/97	71
4/3/97	71
5/2/97	100
6/3/97	510
7/1/97	530
8/28/97	270
9/16/97	500
10/1/97	700
11/24/97	30
12/4/97	570
1/16/98	900
2/6/98	71
5/12/98	230
6/23/98	6000
7/22/98	840
8/7/98	420
9/3/98	480
10/6/98	520
9/1/99	2900
8/26/99	2600
7/14/99	650
6/22/99	290
5/6/99	650
10/19/99	270
10/11/00	240
9/8/00	210
8/8/00	300
7/13/00	220
6/13/00	520
5/18/00	120
4/10/00	240
12/12/01	300
11/14/01	52
10/9/01	82
9/25/01	1400
8/21/01	260
7/13/01	490
6/7/01	260
4/17/01	*Present >Q
3/26/01	85
2/22/01	660
1/17/01	71

Table A-3 (Continued)

S-005	
Date	Value
5/24/90	340
6/18/90	260
7/24/90	780
8/29/90	550
9/13/90	24000
10/23/90	1100
5/13/91	250
6/27/91	490
7/16/91	450
8/28/91	340
9/18/91	24000
10/14/91	130
5/14/92	230
6/12/92	7400
7/16/92	250
8/6/92	5100
9/1/92	510
10/1/92	260
5/20/93	390
6/4/93	760
7/21/93	560
8/9/93	270
9/20/93	440
10/14/93	740
5/26/94	280
6/17/94	2700
7/28/94	5000
8/18/94	2800
10/16/94	820
5/4/95	270
6/8/95	500
7/25/95	620
8/25/95	8400
9/22/95	390
10/13/95	780
5/29/96	260
6/21/96	600

S-005	
Date	Value
7/19/96	900
8/29/96	600
9/20/96	1100
10/28/96	660
5/28/97	660
6/19/97	440
7/24/97	1700
8/7/97	1600
9/18/97	1500
10/17/97	140
5/27/98	580
6/5/98	1900
7/28/98	580
8/13/98	610
9/10/98	520
10/16/98	380
6/10/99	290
5/13/99	190
10/14/99	460
9/16/99	600
8/19/99	490
7/8/99	840
10/6/00	390
9/6/00	1200
8/10/00	6000
7/18/00	*Present <QL
5/1/00	180
3/9/01	6
2/8/01	42
1/3/01	84
6/5/01	390
4/3/01	330
12/17/01	140
11/19/01	83
10/8/01	490
9/24/01	*Present >QL
8/2/01	500
7/16/01	650

Table A-3 (Continued)

S-007	
Date	Value
1/18/90	35
2/15/90	42
3/8/90	50
4/19/90	68
5/24/90	60
6/18/90	190
7/23/90	180
8/16/90	105
9/19/90	140
10/9/90	100
11/1/90	50
12/13/90	52
1/10/91	58
2/4/91	70
3/6/91	240
4/12/91	110
5/7/91	400
6/14/91	110
7/24/91	150
8/5/91	130
9/17/91	140
10/15/91	100
11/8/91	100
12/6/91	570
1/7/92	130
2/20/92	120
3/5/92	54
4/9/92	18
5/11/92	140
6/18/92	310
7/13/92	82
9/17/92	82
10/28/92	140
11/9/92	72
12/2/92	32
1/6/93	570
3/1/93	90
3/23/93	1900
4/8/93	60
5/6/93	1200
6/11/93	100
7/29/93	180
8/30/93	20000
9/13/93	90
10/7/93	180
11/4/93	100
12/2/93	270
1/12/94	120
1/19/94	76

S-007	
Date	Value
2/3/94	94
3/24/94	100
4/6/94	260
5/18/94	190
6/24/94	320
7/22/94	560
8/17/94	2700
9/1/94	2500
10/14/94	510
11/4/94	56
12/2/94	120
2/3/95	46
3/7/95	160
4/26/95	520
5/5/95	120
6/15/95	240
7/28/95	110
8/30/95	840
9/29/95	110
10/13/95	110
11/16/95	99
12/14/95	62
1/3/96	100
2/1/96	99
3/14/96	26
4/17/96	29
5/16/96	86
6/12/96	88
7/11/96	220
8/23/96	110
9/6/96	660
10/30/96	60
11/20/96	64
12/5/96	150
1/24/97	1200
2/5/97	350
3/4/97	220
4/2/97	40
5/1/97	220
6/2/97	4000
7/1/97	210
8/20/97	52
10/10/97	130
11/6/97	160
12/4/97	400

S-007	
Date	Value
1/2/98	120
2/12/98	160
3/4/98	100
4/2/98	84
5/14/98	120
6/12/98	850
7/1/98	250
8/5/98	180
9/1/98	150
10/27/98	86
11/23/98	82
12/9/98	74
2/12/98	160
12/15/99	440
11/30/99	420
10/19/99	490
9/1/99	150
8/26/99	170
7/14/99	230
6/22/99	110
5/6/99	160
4/26/99	140
3/31/99	52
2/16/99	71
1/20/99	44
11/2/00	60
10/11/00	77
9/8/00	200
8/8/00	790
7/13/00	840
6/13/00	280
5/18/00	86
4/3/00	6000
3/27/00	90
2/22/00	92
1/5/00	220
12/5/00	70
12/13/01	140
11/19/01	35
10/22/01	62
9/21/01	100
8/1/01	84
7/13/01	80
6/5/01	80
4/3/01	110
3/1/01	54
2/15/01	44
1/2/01	97

Table A-3 (Continued)

S-087	
Date	Value
5/2/90	160
6/5/90	230
7/6/90	400
8/1/90	1400
9/7/90	560
10/18/90	1600
5/8/91	100
6/21/91	230
7/18/91	580
8/16/91	150
9/27/91	270
10/24/91	240
5/14/92	640
6/12/92	130
7/16/92	330
8/6/92	210
9/1/92	200
10/1/92	120
5/12/93	160
6/3/93	310
7/27/93	140
8/18/93	210
9/22/93	260
10/13/93	190
5/13/94	260
6/9/94	290
7/22/94	480
8/12/94	170
9/23/94	220
5/12/95	300
6/5/95	320
7/13/95	270
8/25/95	260
9/14/95	330
10/23/95	83
6/14/96	340
7/26/96	640
8/16/96	180

S-087	
Date	Value
9/20/96	230
10/25/96	220
5/28/97	120
6/19/97	77
7/25/97	600
8/7/97	120
9/18/97	420
10/17/97	120
5/27/98	200
6/5/98	600
7/28/98	270
8/13/98	220
9/10/98	230
10/16/98	140
10/14/99	220
9/16/99	100
8/19/99	140
7/8/99	160
6/10/99	120
5/13/99	160
10/11/00	130
9/8/00	270
8/8/00	530
7/13/00	120
6/13/00	50
5/18/00	180
4/10/00	87
12/13/01	150
11/19/01	80
10/22/01	92
9/21/01	330
8/1/01	*Present >QL
7/13/01	82
6/5/01	60
4/3/01	99
3/1/01	70
2/15/01	65
1/2/01	40

Table A-3 (Continued)

S-103	
Date	Value
5/14/1992	260
6/12/1992	190
7/16/1992	180
8/6/1992	240
9/1/1992	220
10/1/1992	110
9/9/1996	120
11/22/1996	200
12/16/1996	50
1/16/1997	1100
2/20/1997	40
3/12/1997	30
4/3/1997	20
5/28/1997	540
6/19/1997	180
7/25/1997	300
8/7/1997	480
9/18/1997	320
10/17/1997	200
11/24/1997	30
12/4/1997	680
1/16/1998	240
2/6/1998	35
2/14/2001	58
1/16/2001	*Present <QL
10/18/2001	120
9/26/2001	390
9/5/2001	86
8/20/2001	130
7/25/2001	*Present >QL
6/27/2001	210
5/23/2001	*Present >QL
3/15/2001	550
12/6/2001	36
11/14/2001	110

Table A-3 (Continued)

S-171	
Date	Value
5/1/90	530
6/4/90	2100
7/5/90	470
8/2/90	2300
9/12/90	18000
10/12/90	14000
5/17/91	320
6/6/91	340
7/22/91	2300
8/8/91	480
9/26/91	1300
5/7/92	550
6/16/92	440
7/14/92	560
8/5/92	400
9/3/92	340
10/27/92	210
5/13/93	220
6/17/93	540
7/28/93	300
8/27/93	290
9/14/93	500
10/6/93	1900
5/12/94	220
6/22/94	700
7/5/94	440
8/11/94	860
9/22/94	290
5/17/95	590
6/28/95	520
7/14/95	620
8/18/95	320
9/8/95	410
10/3/95	270
5/2/96	270
6/5/96	1100
7/1/96	360
8/8/96	2000

S-171	
Date	Value
9/4/96	32000
10/16/96	110
5/1/97	600
6/3/97	560
7/1/97	250
8/20/97	220
9/30/97	220
10/10/97	140
5/14/98	190
6/12/98	440
7/1/98	350
8/5/98	450
9/1/98	7200
10/27/98	70
10/13/99	300
9/2/99	140
8/4/99	80
7/7/99	180
6/1/99	200
5/18/99	250
7/31/00	4600
6/1/00	230
5/9/00	340
4/17/00	290
10/12/00	330
9/26/00	1400
8/15/00	220
12/3/01	84
11/1/01	110
10/4/01	170
9/14/01	100
8/2/01	5500
7/3/01	1100
6/4/01	290
4/2/01	8
3/1/01	140
2/1/01	84
1/3/01	590

Table A-3 (Continued)

S-250	
Date	Value
1/18/90	28
2/8/90	60
3/1/90	30
4/5/90	62
5/24/90	150
6/18/90	160
7/24/90	1100
8/29/90	220
9/13/90	2200
10/23/90	1800
11/2/90	155
12/7/90	68
1/2/91	260
2/1/91	80
3/1/91	36
4/4/91	80
5/13/91	4300
6/27/91	210
7/16/91	84
8/28/91	590
9/18/91	420
10/14/91	80
11/14/91	68
12/5/91	130
1/2/92	34
1/5/92	1500
2/14/92	40
3/2/92	64
4/6/92	32
5/26/92	280
6/23/92	98
7/20/92	160
9/17/92	160
10/14/92	69
11/4/92	230
12/10/92	79
1/5/93	1500
2/19/93	20
3/3/93	26
4/15/93	68
5/20/93	420
6/4/93	100
7/21/93	1100
8/9/93	520
9/20/93	140
10/14/93	100
11/5/93	160
12/7/93	70

S-250	
Date	Value
1/12/94	460
1/12/94	1200
2/1/94	27
3/10/94	110
4/13/94	250
5/26/94	140
6/17/94	4100
7/28/94	13000
8/18/94	4300
10/16/94	46
10/24/94	270
11/4/94	90
12/2/94	68
2/3/95	170
3/7/95	96
4/26/95	200
5/4/95	160
6/8/95	240
7/25/95	340
8/25/95	1200
9/22/95	200
10/13/95	160
11/16/95	78
12/14/95	72
1/3/96	200
2/1/96	78
3/14/96	40
4/17/96	96
5/29/96	370
6/21/96	640
7/10/96	240
8/23/96	170
9/25/96	220
10/22/96	260
11/20/96	100
12/5/96	98
1/24/97	35
2/5/97	120
3/4/97	660
4/11/97	36
5/28/97	300
6/19/97	180
7/24/97	1200
8/7/97	290
9/18/97	140
10/17/97	170
11/24/97	36
12/4/97	760

S-250	
Date	Value
1/16/98	180
2/6/98	110
3/2/98	84
4/1/98	150
5/27/98	170
6/5/98	1200
7/28/98	260
8/13/98	160
9/10/98	100
10/16/98	180
11/4/98	440
12/9/98	170
2/3/99	120
1/21/99	40
12/9/99	80
11/30/99	87
10/14/99	310
8/19/99	16
7/8/99	740
6/10/99	33
5/13/99	96
4/28/99	380
3/2/99	14
12/4/00	78
11/1/00	230
10/6/00	140
9/6/00	580
8/10/00	700
7/18/00	160
5/1/00	80
4/12/00	65
3/14/00	90
2/23/00	55
1/11/00	340
1/2/01	34
12/12/01	590
11/14/01	23
10/9/01	58
8/21/01	61
7/17/01	14
6/5/01	87
4/3/01	42
3/1/01	20
2/15/01	39

Table A-3 (Continued)

S-252	
Date	Value
5/2/90	430
6/5/90	200
7/6/90	570
8/1/90	1200
9/7/90	360
10/18/90	11000
5/8/91	100
6/21/91	200
7/18/91	340
8/16/91	150
9/27/91	230
10/24/91	290
5/14/92	500
6/12/92	510
7/16/92	190
8/6/92	240
9/1/92	65
10/1/92	160
5/12/93	110
6/3/93	81
7/27/93	120
8/18/93	140
9/22/93	120
10/13/93	81
5/13/94	150
6/9/94	440
7/22/94	460
8/12/94	140
9/23/94	150
5/12/95	240
6/5/95	250
7/13/95	120
8/25/95	200
9/14/95	390
10/23/95	120
6/14/96	860
7/26/96	480

S-252	
Date	Value
8/16/96	220
10/25/96	110
5/2/97	10
6/3/97	240
7/1/97	160
8/28/97	80
9/16/97	170
10/1/97	280
5/12/98	340
6/23/98	1300
7/22/98	270
8/7/98	130
9/3/98	180
10/6/98	240
10/19/99	270
9/1/99	140
8/26/99	300
7/14/99	240
6/22/99	220
5/6/99	140
9/8/00	150
8/8/00	520
7/13/00	110
5/18/00	80
4/10/00	65
10/11/00	72
12/13/01	68
11/19/01	40
10/22/01	60
9/21/01	370
8/1/01	75
7/13/01	*Present >QL
6/5/01	46
4/3/01	56
3/1/01	18
2/15/01	60
1/2/01	44

Table A-3 (Continued)

S-267	
Date	Value
5/1/90	380
6/4/90	1200
7/5/90	5900
8/2/90	2500
9/12/90	42000
10/12/90	32000
5/17/91	180
6/6/91	60
7/22/91	270
8/8/91	570
9/26/91	770
5/11/92	300
6/18/92	660
7/13/92	760
9/17/92	290
10/28/92	180
5/13/93	220
6/17/93	5300
7/28/93	220
8/27/93	1100
9/14/93	100
10/6/93	200
5/12/94	710
6/22/94	55
7/5/94	84
8/11/94	5
9/22/94	5
5/17/95	80000
6/28/95	980
7/14/95	7100
8/18/95	1800
9/8/95	310
10/3/95	310
5/2/96	5
6/5/96	440
7/1/96	390

S-267	
Date	Value
8/8/96	600
9/4/96	600
10/16/96	62
5/9/97	1400
6/6/97	160
7/2/97	340
8/28/97	120
9/19/97	130
10/17/97	140
5/14/98	220
8/20/98	160
10/19/98	240
10/4/99	13000
9/13/99	280
8/25/99	770
7/29/99	38
6/17/99	590
5/11/99	210
10/12/00	290
9/26/00	170
9/27/00	110
8/15/00	110
7/31/00	1100
6/1/00	420
5/9/00	320
4/17/00	230
7/5/01	*Present >QL
6/8/01	160
4/9/01	80
3/12/01	200
2/5/01	40
1/9/01	810
12/6/01	130
11/26/01	200
10/17/01	38
9/5/01	390

Table A-3 (Continued)

S-299	
Date	Value
5/14/1992	880
6/12/1992	240
7/16/1992	110
8/6/1992	420
9/1/1992	140
10/1/1992	140
11/22/1996	110
12/16/1996	68
1/21/1997	5
2/20/1997	15
3/12/1997	15
4/3/1997	5
5/28/1997	400
6/19/1997	120
7/25/1997	600
8/7/1997	280
9/18/1997	1000
10/17/1997	180
11/24/1997	15
12/4/1997	550
1/16/1998	360
2/6/1998	35
2/22/2001	110
12/12/2001	600
11/14/2001	48
10/9/2001	84
8/21/2001	110
7/13/2001	86
6/7/2001	96
4/17/2001	60
3/26/2001	40

Table A-3 (Continued)

S-300	
Date	Value
5/11/1992	410
6/18/1992	500
7/13/1992	450
9/17/1992	400
10/28/1992	380
11/22/1996	2200
12/16/1996	660
1/16/1997	140
2/20/1997	180
3/12/1997	400
4/3/1997	280
5/20/1997	170
6/5/1997	450
7/30/1997	8100
8/29/1997	220
9/25/1997	4000
10/10/1997	220
11/6/1997	2300
12/4/1997	1000
1/2/1998	1800
2/12/1998	520
4/25/2000	46
7/30/2001	140
6/27/2001	600
4/19/2001	100
3/7/2001	36
2/9/2001	190
1/24/2001	130
12/6/2001	84
11/14/2001	52
10/11/2001	220
9/27/2001	310

Table A-3 (Continued)

S-301	
Date	Value
5/11/1992	260
6/18/1992	220
7/13/1992	230
9/17/1992	390
10/28/1992	120
11/7/1996	170
12/3/1996	720
1/23/1997	120
2/19/1997	120
3/20/1997	390
4/2/1997	360
5/1/1997	300
6/3/1997	1000
7/1/1997	240
8/20/1997	120
9/30/1997	170
10/10/1997	190
11/6/1997	81
12/4/1997	400
1/2/1998	450
2/12/1998	200
11/26/2001	60
10/17/2001	75
9/5/2001	1500
7/5/2001	*Present >QL
6/8/2001	190
4/9/2001	37
3/12/2001	100
2/5/2001	34
1/9/2001	130
12/6/2001	56

Table A-3 (Continued)

S-302	
Date	Value
5/11/1992	250
6/18/1992	320
7/13/1992	310
9/17/1992	320
10/28/1992	500
11/7/1996	120
12/3/1996	500
1/23/1997	240
2/19/1997	220
3/20/1997	300
4/2/1997	150
5/9/1997	160
6/6/1997	440
6/23/1997	2
7/2/1997	340
8/28/1997	180
9/19/1997	280
10/17/1997	240
11/6/1997	160
12/30/1997	180
1/29/1998	180
11/1/2001	20
10/17/2001	50
7/5/2001	2200
6/8/2001	260
4/9/2001	100
3/12/2001	45
2/5/2001	32
1/9/2001	190
12/6/2001	220

APPENDIX B Calculations

Table B-1 TMDL Target Loads

Station	S-004	Station	S-005	Station	S-007
Instantaneous Conc. (#/100 ml)	**380**	**Instantaneous Conc. (#/100 ml)**	**380**	**Instantaneous Conc. (#/100 ml)**	**380**
Geo. Mean Conc. (#/100 ml)	**190**	**Geo. Mean Conc. (#/100 ml)**	**190**	**Geo. Mean Conc. (#/100 ml)**	**190**

Mean	1.44E+12	Mean	4.21E+10	Mean	6.55E+12
Allowable Load (#/day)	1.44E+12	**Allowable Load (#/day)**	4.21E+10	**Allowable Load (#/day)**	6.55E+12
Geometric Mean Load (#/30days)	2.17E+13	**Geometric Mean Load (#/30days)**	6.32E+11	**Geometric Mean Load (#/30days)**	9.83E+13

Percent Exceedance (%)	Load(#/Day)	Percent Exceedance (%)	Load(#/Day)	Percent Exceedance (%)	Load(#/Day)
10	2.82E+12	10	1.01E+11	10	1.28E+13
15	2.42E+12	15	7.83E+10	15	1.10E+13
20	2.17E+12	20	6.61E+10	20	9.85E+12
25	1.97E+12	25	5.87E+10	25	8.93E+12
30	1.81E+12	30	5.38E+10	30	8.19E+12
35	1.66E+12	35	4.65E+10	35	7.54E+12
40	1.54E+12	40	4.35E+10	40	6.97E+12
45	1.43E+12	45	3.91E+10	45	6.49E+12
50	1.34E+12	50	3.67E+10	50	6.06E+12
55	1.24E+12	55	3.32E+10	55	5.62E+12
60	1.14E+12	60	2.94E+10	60	5.18E+12
65	1.06E+12	65	2.69E+10	65	4.79E+12
70	9.61E+11	70	2.45E+10	70	4.36E+12
75	8.84E+11	75	2.29E+10	75	4.01E+12
80	7.97E+11	80	2.06E+10	80	3.62E+12
85	7.11E+11	85	1.91E+10	85	3.22E+12
90	6.05E+11	90	1.66E+10	90	2.74E+12

Table B-1 (Continued)

Station	S-087	Station	S-103	Station	S-171
Instantaneous Conc. (#/100 ml)	**380**	**Instantaneous Conc. (#/100 ml)**	**380**	**Instantaneous Conc. (#/100 ml)**	**380**
Geo. Mean Conc. (#/100 ml)	**190**	**Geo. Mean Conc. (#/100 ml)**	**190**	**Geo. Mean Conc. (#/100 ml)**	**190**

Mean	9.42E+11	**Mean**	9.14E+11	**Mean**	1.72E+11
Allowable Load (#/day)	9.42E+11	**Allowable Load (#/day)**	9.14E+11	**Allowable Load (#/day)**	1.72E+11
Geometric Mean Load (#/30days)	1.41E+13	**Geometric Mean Load (#/30days)**	1.37E+13	**Geometric Mean Load (#/30days)**	2.58E+12

Percent Exceedance (%)	Load(#/Day)	Percent Exceedance (%)	Load(#/Day)	Percent Exceedance (%)	Load(#/Day)
10	2.02E+12	10	1.96E+12	10	4.11E+11
15	1.73E+12	15	1.68E+12	15	3.20E+11
20	1.51E+12	20	1.47E+12	20	2.70E+11
25	1.35E+12	25	1.31E+12	25	2.40E+11
30	1.22E+12	30	1.18E+12	30	2.20E+11
35	1.10E+12	35	1.07E+12	35	1.90E+11
40	1.00E+12	40	9.71E+11	40	1.78E+11
45	9.03E+11	45	8.76E+11	45	1.60E+11
50	8.24E+11	50	8.00E+11	50	1.50E+11
55	7.65E+11	55	7.43E+11	55	1.36E+11
60	6.87E+11	60	6.66E+11	60	1.20E+11
65	6.28E+11	65	6.09E+11	65	1.10E+11
70	5.69E+11	70	5.52E+11	70	1.00E+11
75	5.10E+11	75	4.95E+11	75	9.37E+10
80	4.51E+11	80	4.38E+11	80	8.41E+10
85	3.92E+11	85	3.81E+11	85	7.80E+10
90	3.53E+11	90	3.43E+11	90	6.80E+10

Table B-1 (Continued)

Station	S-250	Station	S-252	Station	S-267
Instantaneous Conc. (#/100 ml)	380	Instantaneous Conc. (#/100 ml)	380	Instantaneous Conc. (#/100 ml)	380
Geo. Mean Conc. (#/100 ml)	190	Geo. Mean Conc. (#/100 ml)	190	Geo. Mean Conc. (#/100 ml)	190

Mean	5.57E+12	Mean	9.25E+11	Mean	1.58E+10
Allowable Load (#/day)	5.57E+12	Allowable Load (#/day)	9.25E+11	Allowable Load (#/day)	1.58E+10
Geometric Mean Load (#/30days)	8.36E+13	Geometric Mean Load (#/30days)	1.39E+13	Geometric Mean Load (#/30days)	2.37E+11

Percent Exceedance (%)	Load(#/Day)	Percent Exceedance (%)	Load(#/Day)	Percent Exceedance (%)	Load(#/Day)
10	1.09E+13	10	1.81E+12	10	3.39E+10
15	9.34E+12	15	1.55E+12	15	2.89E+10
20	8.38E+12	20	1.39E+12	20	2.53E+10
25	7.60E+12	25	1.26E+12	25	2.27E+10
30	6.97E+12	30	1.16E+12	30	2.04E+10
35	6.41E+12	35	1.06E+12	35	1.84E+10
40	5.93E+12	40	9.84E+11	40	1.68E+10
45	5.52E+12	45	9.16E+11	45	1.51E+10
50	5.15E+12	50	8.55E+11	50	1.38E+10
55	4.78E+12	55	7.93E+11	55	1.28E+10
60	4.41E+12	60	7.32E+11	60	1.15E+10
65	4.08E+12	65	6.76E+11	65	1.05E+10
70	3.71E+12	70	6.15E+11	70	9.53E+09
75	3.41E+12	75	5.66E+11	75	8.55E+09
80	3.08E+12	80	5.10E+11	80	7.56E+09
85	2.74E+12	85	4.55E+11	85	6.57E+09
90	2.33E+12	90	3.87E+11	90	5.92E+09

Table B-1 (Continued)

Station	S-299
Instantaneous Conc. (#/100 ml)	380
Geo. Mean Conc. (#/100 ml)	190

Mean	3.29E+12
Allowable Load (#/day)	3.29E+12
Geometric Mean Load (#/30days)	4.94E+13

Percent Exceedance (%)	Load(#/Day)
10	6.43E+12
15	5.51E+12
20	4.95E+12
25	4.49E+12
30	4.11E+12
35	3.79E+12
40	3.50E+12
45	3.26E+12
50	3.04E+12
55	2.82E+12
60	2.60E+12
65	2.41E+12
70	2.19E+12
75	2.01E+12
80	1.82E+12
85	1.62E+12
90	1.38E+12

Station	S-300
Instantaneous Conc. (#/100 ml)	380
Geo. Mean Conc. (#/100 ml)	190

Mean	2.79E+11
Allowable Load (#/day)	2.79E+11
Geometric Mean Load (#/30days)	4.19E+12

Percent Exceedance (%)	Load(#/Day)
10	6.66E+11
15	5.18E+11
20	4.37E+11
25	3.89E+11
30	3.56E+11
35	3.08E+11
40	2.88E+11
45	2.59E+11
50	2.43E+11
55	2.20E+11
60	1.94E+11
65	1.78E+11
70	1.62E+11
75	1.52E+11
80	1.36E+11
85	1.26E+11
90	1.10E+11

Station	S-301
Instantaneous Conc. (#/100 ml)	380
Geo. Mean Conc. (#/100 ml)	190

Mean	3.09E+11
Allowable Load (#/day)	3.09E+11
Geometric Mean Load (#/30days)	4.64E+12

Percent Exceedance (%)	Load(#/Day)
10	7.38E+11
15	5.75E+11
20	4.85E+11
25	4.31E+11
30	3.95E+11
35	3.41E+11
40	3.19E+11
45	2.87E+11
50	2.69E+11
55	2.43E+11
60	2.15E+11
65	1.97E+11
70	1.80E+11
75	1.68E+11
80	1.51E+11
85	1.40E+11
90	1.22E+11

Table B-1 (Continued)

Station	S-302
Instantaneous Conc. (#/100 ml)	380
Geo. Mean Conc. (#/100 ml)	190

Mean	1.64E+11
Allowable Load (#/day)	1.64E+11
Geometric Mean Load (#/30days)	2.46E+12

Percent Exceedance (%)	Load(#/Day)
10	3.92E+11
15	3.05E+11
20	2.57E+11
25	2.29E+11
30	2.10E+11
35	1.81E+11
40	1.69E+11
45	1.52E+11
50	1.43E+11
55	1.29E+11
60	1.14E+11
65	1.05E+11
70	9.54E+10
75	8.93E+10
80	8.01E+10
85	7.43E+10
90	6.48E+10

Table B-2 Existing Loads

Station	S-004
Trend Line:	**Power**
Equation: y=4E+13*x^(-0.6914)	
Existing Load (#/Day):	**3.32E+12**
Average (#/Day):	**3.32E+12**

Percent Exceedance(%)	Load(#/Day)
10	8.14E+12
15	6.15E+12
20	5.04E+12
25	4.32E+12
30	3.81E+12
35	3.42E+12
40	3.12E+12
45	2.88E+12
50	2.68E+12
55	2.50E+12
60	2.36E+12
65	2.23E+12
70	2.12E+12
75	2.02E+12
80	1.93E+12
85	1.85E+12
90	1.78E+12

Station	S-005
Trend Line:	**Power**
Equation: y=7E+12*x^(-1.1423)	
Existing Load (#/Day):	**1.29E+11**
Average (#/Day):	**1.29E+11**

Percent Exceedance(%)	Load(#/Day)
10	5.04E+11
15	3.17E+11
20	2.29E+11
25	1.77E+11
30	1.44E+11
35	1.21E+11
40	1.04E+11
45	9.05E+10
50	8.02E+10
55	7.20E+10
60	6.52E+10
65	5.95E+10
70	5.46E+10
75	5.05E+10
80	4.69E+10
85	4.38E+10
90	4.10E+10

Station	S-007
Trend Line:	**Power**
Equation: y=1E+14*x^(-0.6405)	
Existing Load (#/Day):	**9.88E+12**
Average (#/Day):	**9.88E+12**

Percent Exceedance(%)	Load(#/Day)
10	2.29E+13
15	1.76E+13
20	1.47E+13
25	1.27E+13
30	1.13E+13
35	1.03E+13
40	9.42E+12
45	8.73E+12
50	8.16E+12
55	7.68E+12
60	7.26E+12
65	6.90E+12
70	6.58E+12
75	6.30E+12
80	6.04E+12
85	5.81E+12
90	5.60E+12

Table B-2 (Continued)

	Station	S-087
Trend Line:		Power
Equation: y=2E+13*x^(-0.6906)		
Existing Load (#/Day):		1.66E+12
Average (#/Day):		1.66E+12

Percent Exceedance(%)	Load(#/Day)
10	4.08E+12
15	3.08E+12
20	2.53E+12
25	2.17E+12
30	1.91E+12
35	1.72E+12
40	1.57E+12
45	1.44E+12
50	1.34E+12
55	1.26E+12
60	1.18E+12
65	1.12E+12
70	1.06E+12
75	1.01E+12
80	9.70E+11
85	9.30E+11
90	8.94E+11

	Station	S-103
Trend Line:		Power
Equation: y=4E+14*x^(-1.4349)		
Existing Load (#/Day):		2.95E+12
Average (#/Day):		2.95E+12

Percent Exceedance(%)	Load(#/Day)
10	1.47E+13
15	8.21E+12
20	5.44E+12
25	3.95E+12
30	3.04E+12
35	2.43E+12
40	2.01E+12
45	1.70E+12
50	1.46E+12
55	1.27E+12
60	1.12E+12
65	1.00E+12
70	9.01E+11
75	8.16E+11
80	7.44E+11
85	6.82E+11
90	6.28E+11

	Station	S-171
Trend Line:		Power
Equation: y=6E+13*x^(-1.3135)		
Existing Load (#/Day):		6.44E+11
Average (#/Day):		6.44E+11

Percent Exceedance(%)	Load(#/Day)
10	2.92E+12
15	1.71E+12
20	1.17E+12
25	8.75E+11
30	6.89E+11
35	5.62E+11
40	4.72E+11
45	4.04E+11
50	3.52E+11
55	3.11E+11
60	2.77E+11
65	2.49E+11
70	2.26E+11
75	2.07E+11
80	1.90E+11
85	1.75E+11
90	1.63E+11

Table B-2 (Continued)

	Station	S-250
Trend Line:		Power
Equation: y=3E+14*x^(-0.8819)		
Existing Load (#/Day):		1.30E+13
Average (#/Day):		1.30E+13

Percent Exceedance(%)	Load(#/Day)
10	3.94E+13
15	2.75E+13
20	2.14E+13
25	1.76E+13
30	1.49E+13
35	1.30E+13
40	1.16E+13
45	1.05E+13
50	9.52E+12
55	8.76E+12
60	8.11E+12
65	7.56E+12
70	7.08E+12
75	6.66E+12
80	6.29E+12
85	5.96E+12
90	5.67E+12

	Station	S-252
Trend Line:		Power
Root Mean Square Best-Fit		
Existing Load (#/Day):		2.97E+12
Average (#/Day):		2.97E+12

Percent Exceedance(%)	Load(#/Day)
10	5.80E+12
15	4.98E+12
20	4.48E+12
25	4.05E+12
30	3.71E+12
35	3.42E+12
40	3.16E+12
45	2.94E+12
50	2.74E+12
55	2.55E+12
60	2.35E+12
65	2.17E+12
70	1.97E+12
75	1.82E+12
80	1.64E+12
85	1.46E+12
90	1.24E+12

	Station	S-267
Trend Line:		Power
Equation: y=4E+12*x^(-1.12)		
Existing Load (#/Day):		7.94E+10
Average (#/Day):		7.94E+10

Percent Exceedance(%)	Load(#/Day)
10	3.03E+11
15	1.93E+11
20	1.40E+11
25	1.09E+11
30	8.87E+10
35	7.46E+10
40	6.42E+10
45	5.63E+10
50	5.00E+10
55	4.50E+10
60	4.08E+10
65	3.73E+10
70	3.43E+10
75	3.18E+10
80	2.96E+10
85	2.76E+10
90	2.59E+10

Table B-2 (Continued)

Station	**S-299**
Trend Line:	**Power**
Root Mean Square Best-Fit	

Existing Load (#/Day):	**4.85E+12**
Average (#/Day):	**4.85E+12**

Percent Exceedance(%)	**Load(#/Day)**
10	9.48E+12
15	8.13E+12
20	7.32E+12
25	6.61E+12
30	6.06E+12
35	5.58E+12
40	5.16E+12
45	4.81E+12
50	4.48E+12
55	4.16E+12
60	3.84E+12
65	3.55E+12
70	3.22E+12
75	2.97E+12
80	2.68E+12
85	2.39E+12
90	2.03E+12

Station	**S-300**
Trend Line:	**Power**
Equation: y=9E+13*x^(-1.3766)	

Existing Load (#/Day):	**7.94E+11**
Average (#/Day):	**7.94E+11**

Percent Exceedance(%)	**Load(#/Day)**
10	3.78E+12
15	2.16E+12
20	1.46E+12
25	1.07E+12
30	8.33E+11
35	6.74E+11
40	5.61E+11
45	4.77E+11
50	4.13E+11
55	3.62E+11
60	3.21E+11
65	2.87E+11
70	2.60E+11
75	2.36E+11
80	2.16E+11
85	1.99E+11
90	1.84E+11

Station	**S-301**
Trend Line:	**Power**
Equation: y=2E+13*x^(-0.9444)	

Existing Load (#/Day):	**7.05E+11**
Average (#/Day):	**7.05E+11**

Percent Exceedance(%)	**Load(#/Day)**
10	2.27E+12
15	1.55E+12
20	1.18E+12
25	9.57E+11
30	8.05E+11
35	6.96E+11
40	6.14E+11
45	5.49E+11
50	4.97E+11
55	4.54E+11
60	4.19E+11
65	3.88E+11
70	3.62E+11
75	3.39E+11
80	3.19E+11
85	3.01E+11
90	2.85E+11

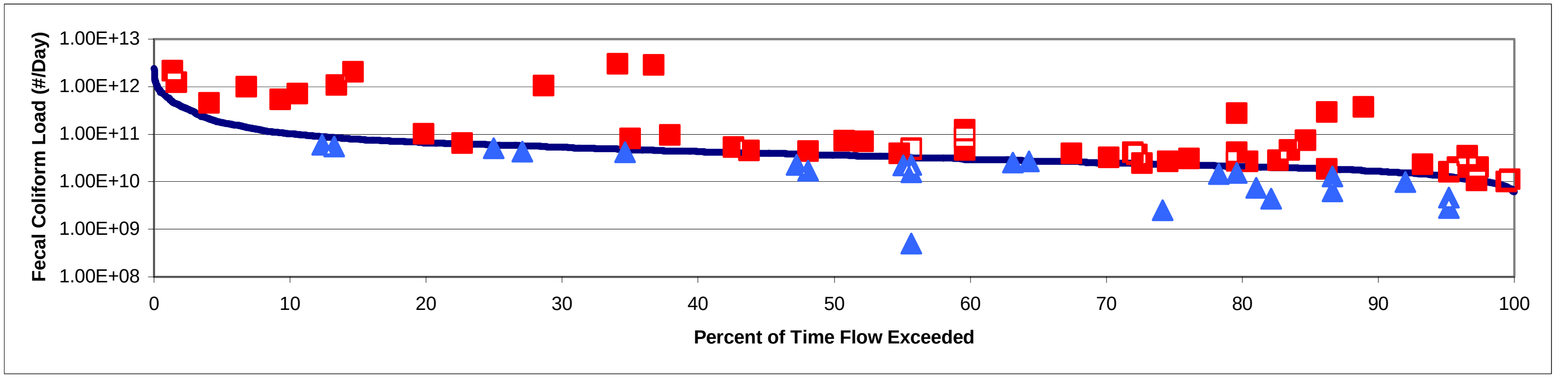
Table B-2 (Continued)

Station	**S-302**
Trend Line:	**Power**
Equation: y=3E+13*x^(-1.3318)	

Existing Load (#/Day):	**3.04E+11**
Average (#/Day):	**3.04E+11**

Percent Exceedance(%)	**Load(#/Day)**
10	1.40E+12
15	8.14E+11
20	5.55E+11
25	4.12E+11
30	3.24E+11
35	2.63E+11
40	2.21E+11
45	1.89E+11
50	1.64E+11
55	1.44E+11
60	1.29E+11
65	1.16E+11
70	1.05E+11
75	9.55E+10
80	8.76E+10
85	8.08E+10
90	7.49E+10

Figure B-1 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-005



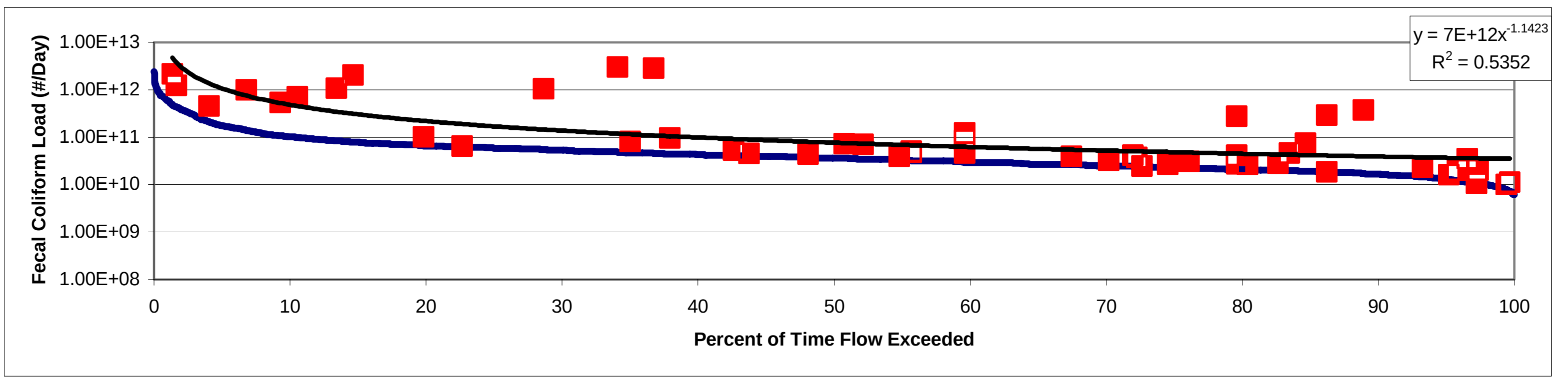
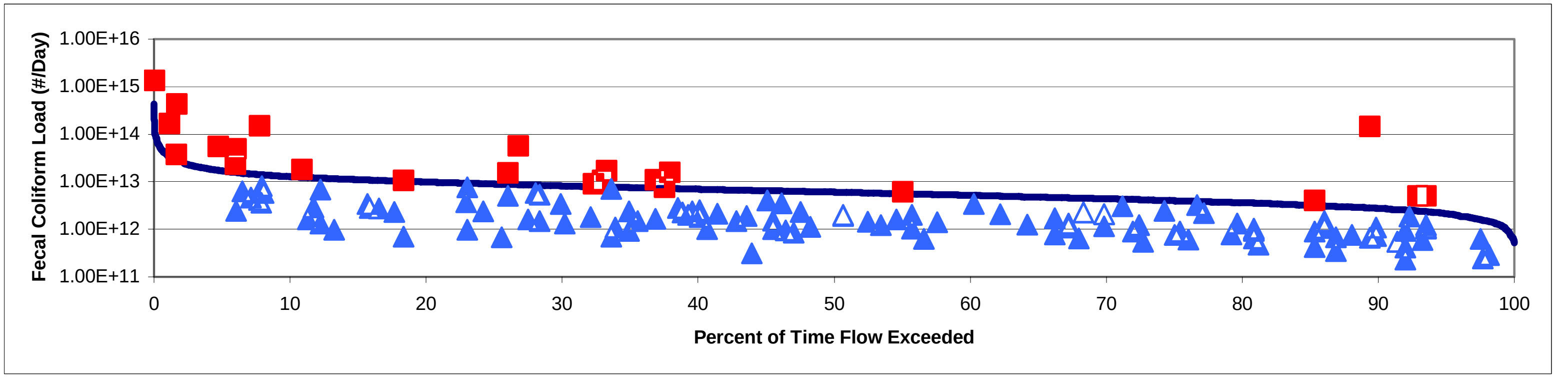


Figure B-2 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-007



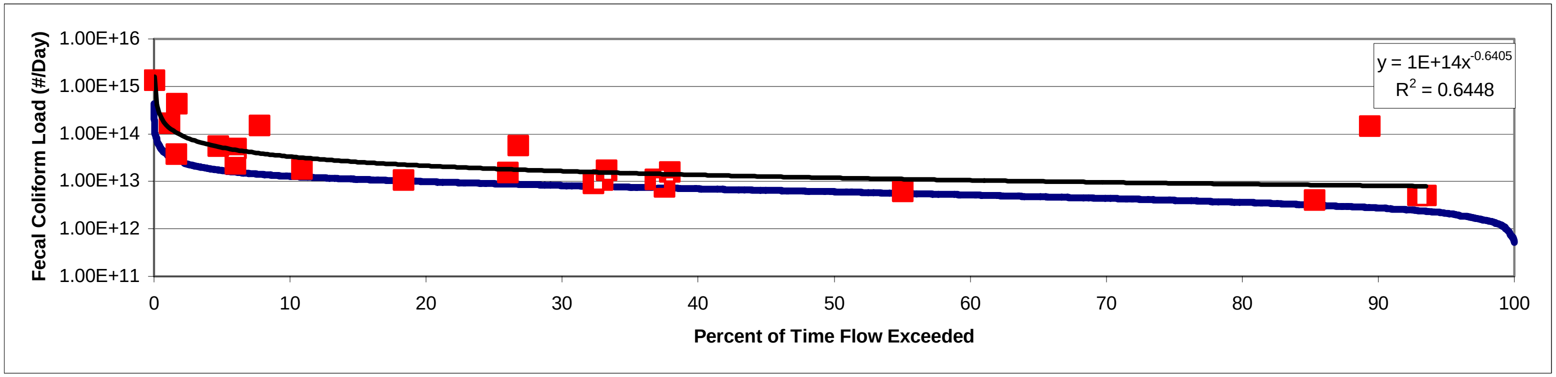
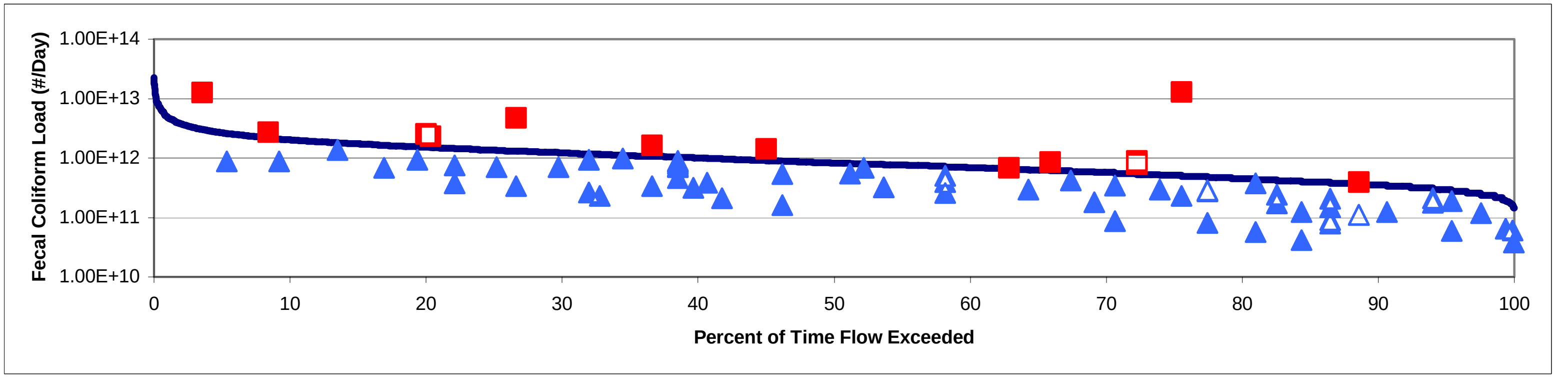


Figure B-3 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-087



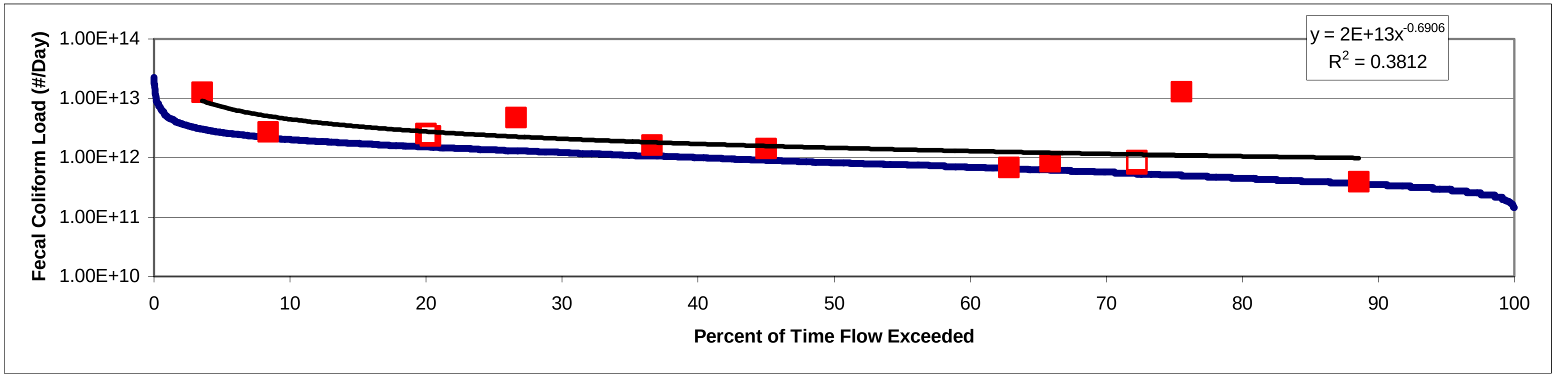
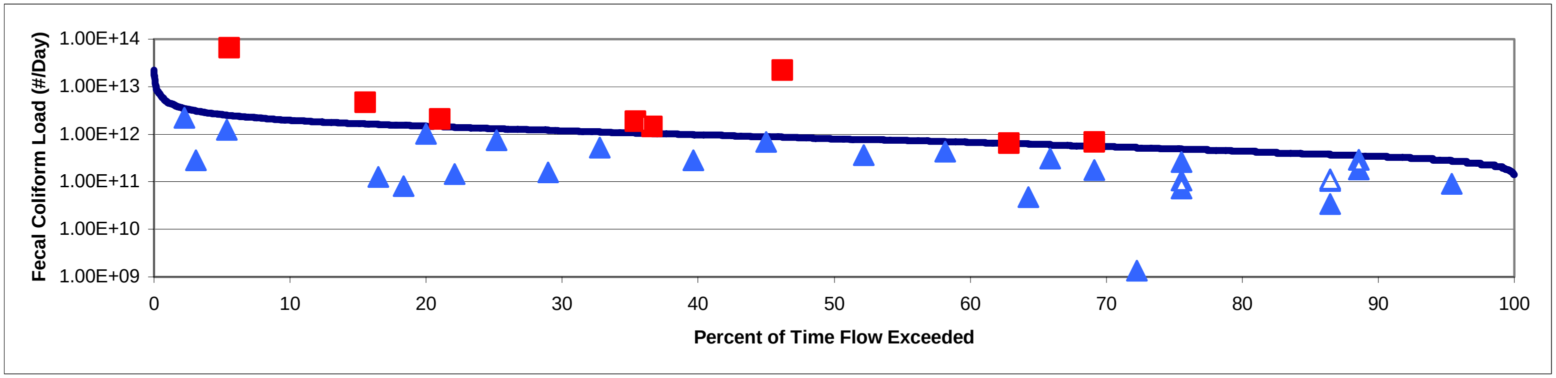


Figure B-4 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-103



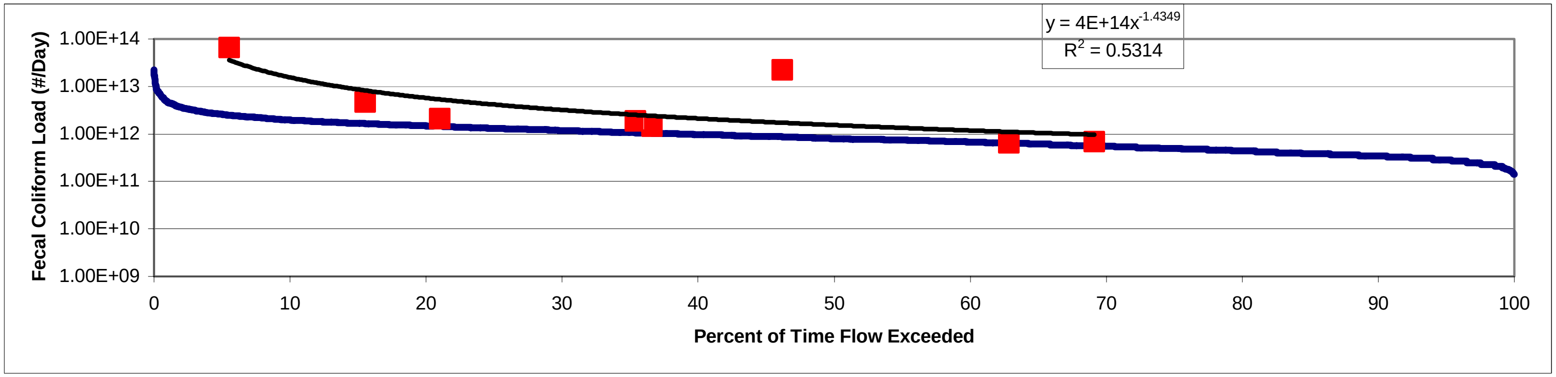
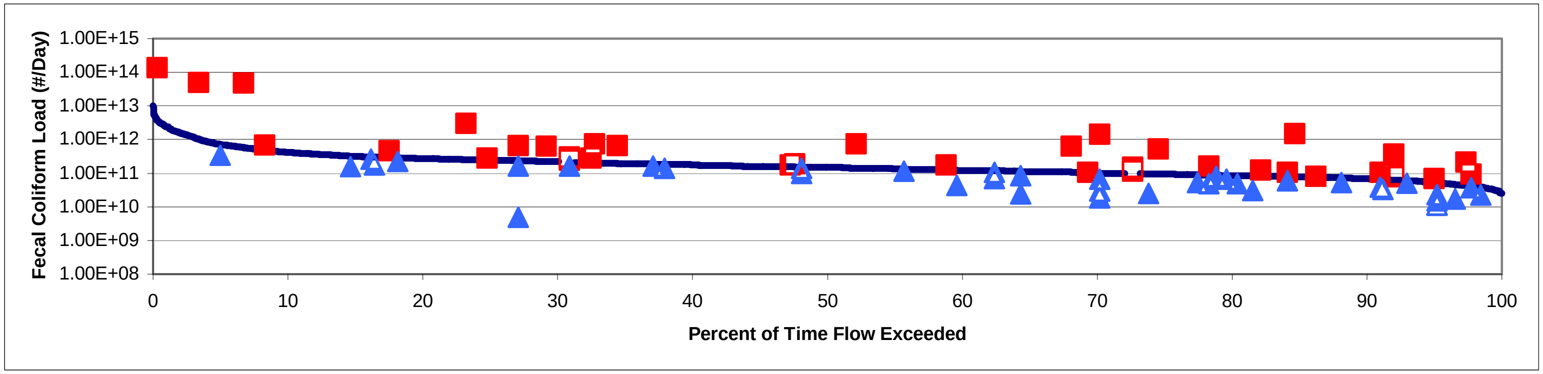


Figure B-5 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-171



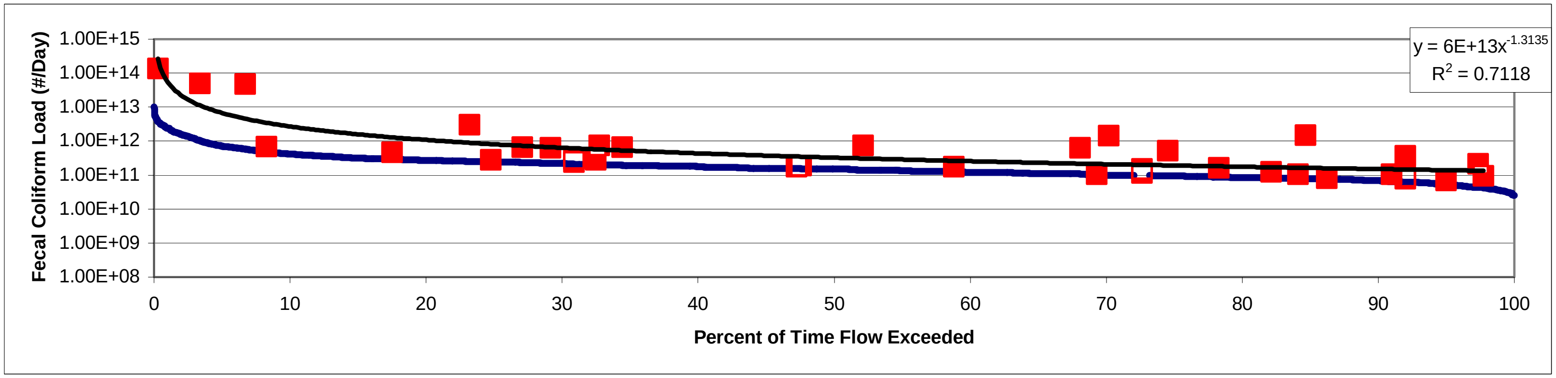
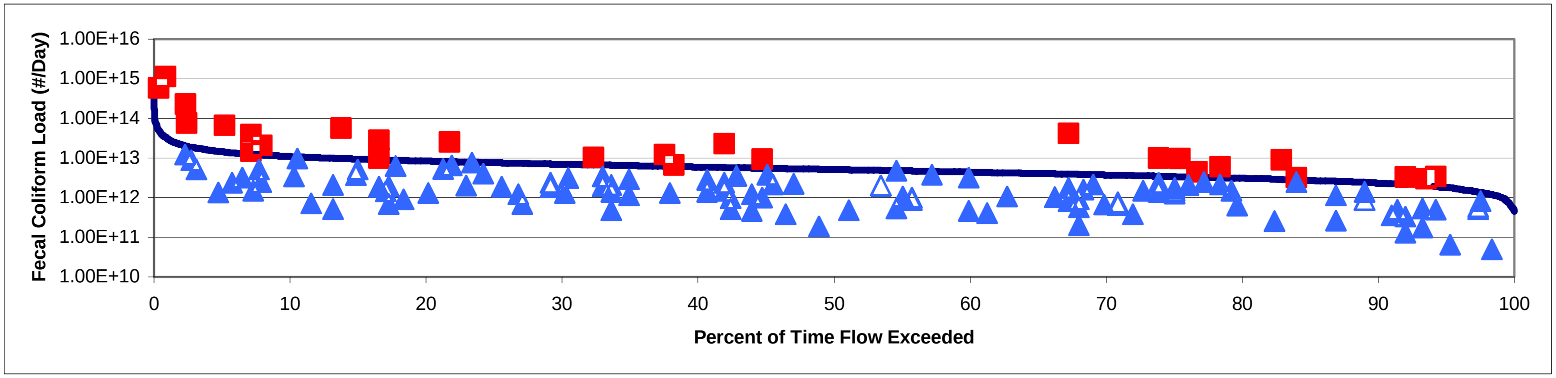


Figure B-6 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-250



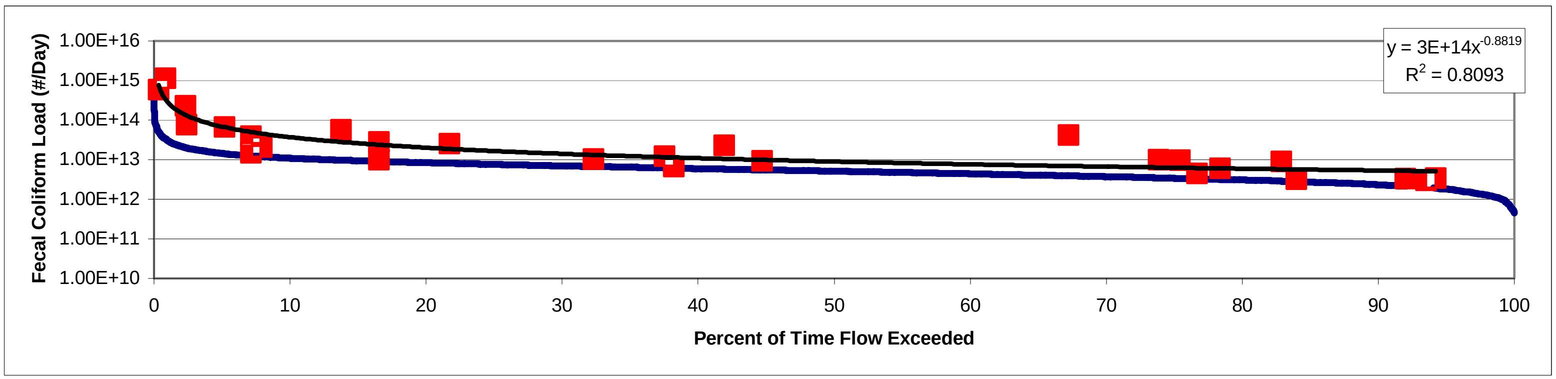
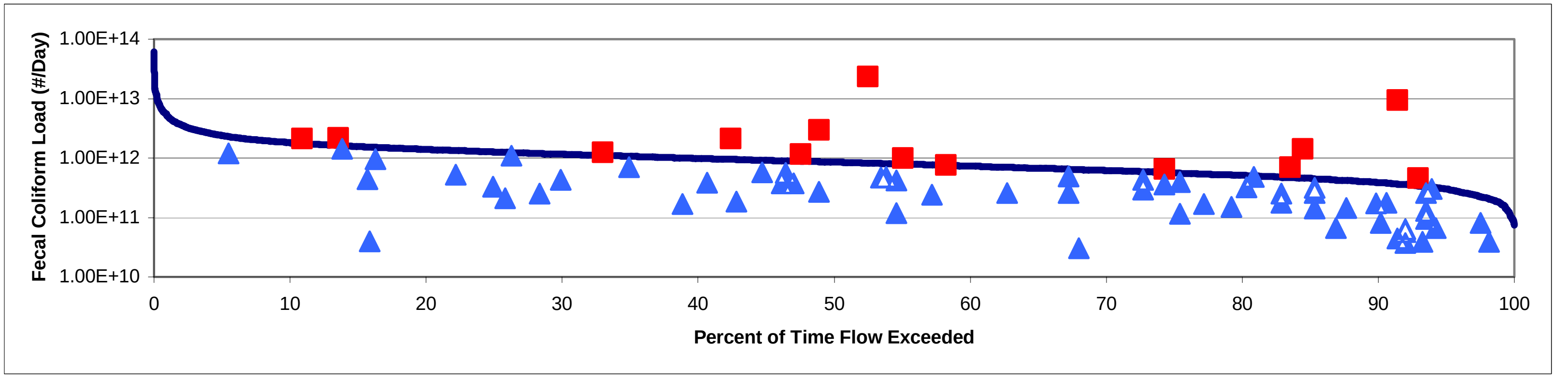


Figure B-7 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-252



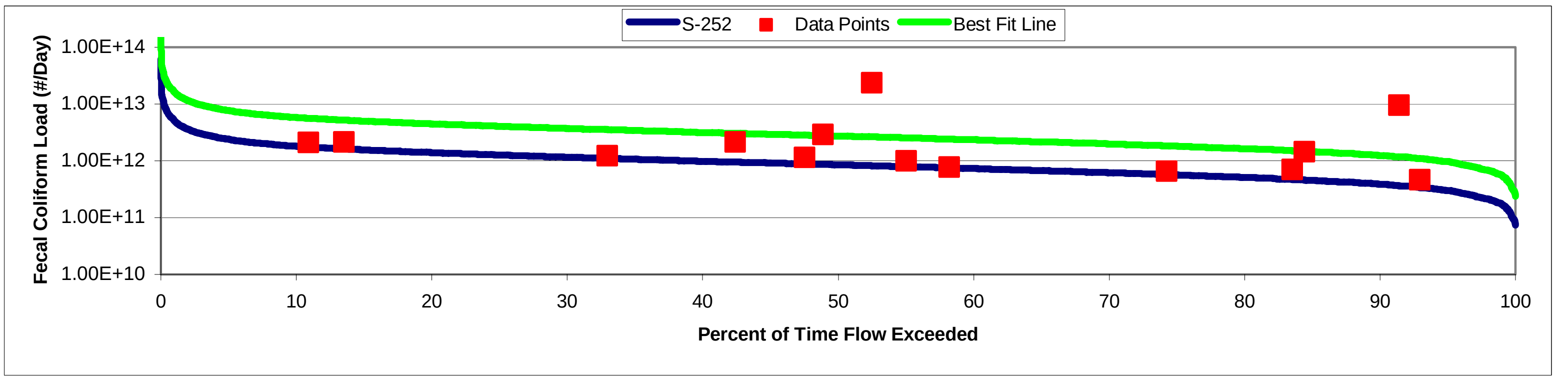
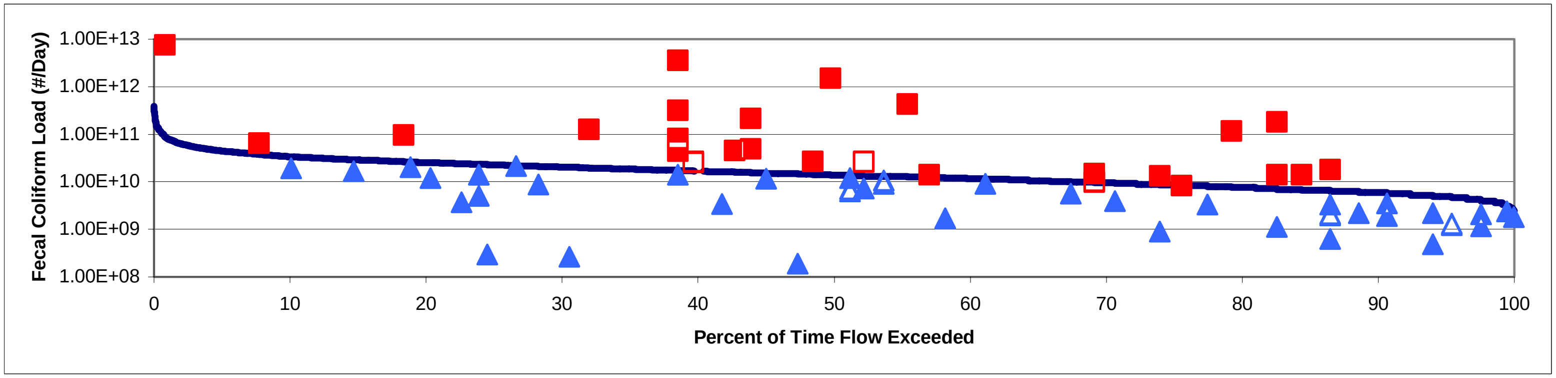


Figure B-8 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-267



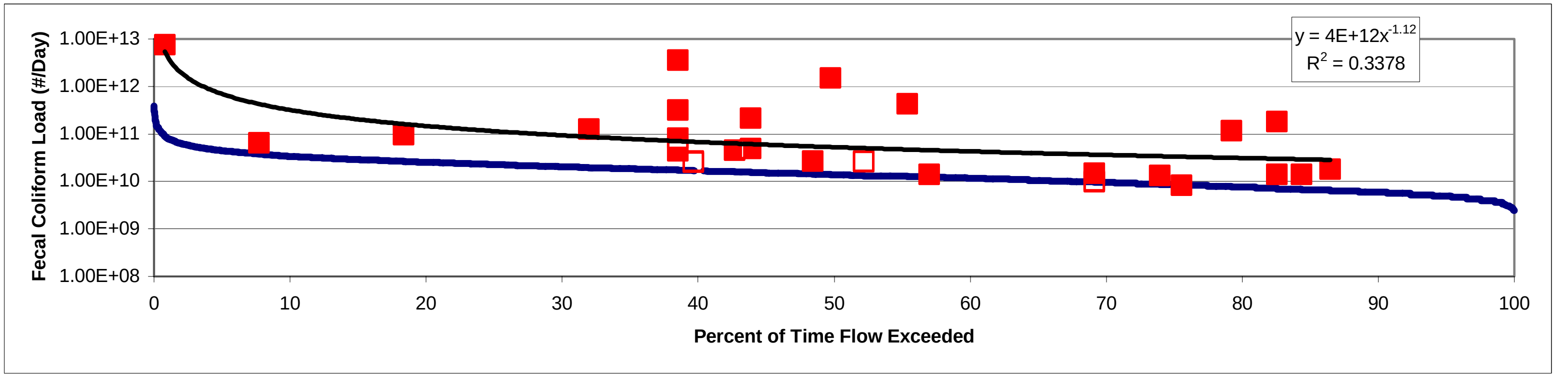
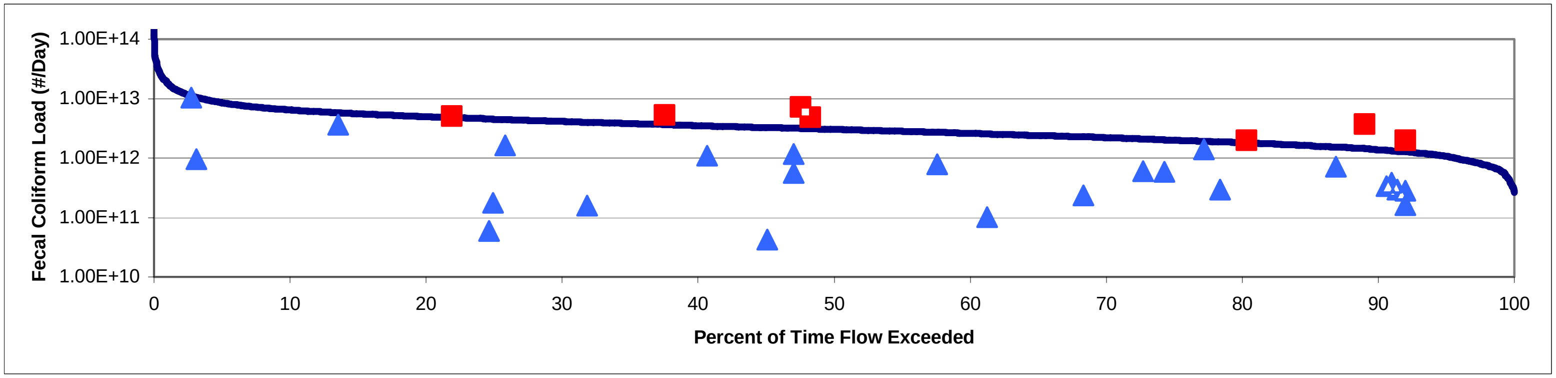


Figure B-9 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-299



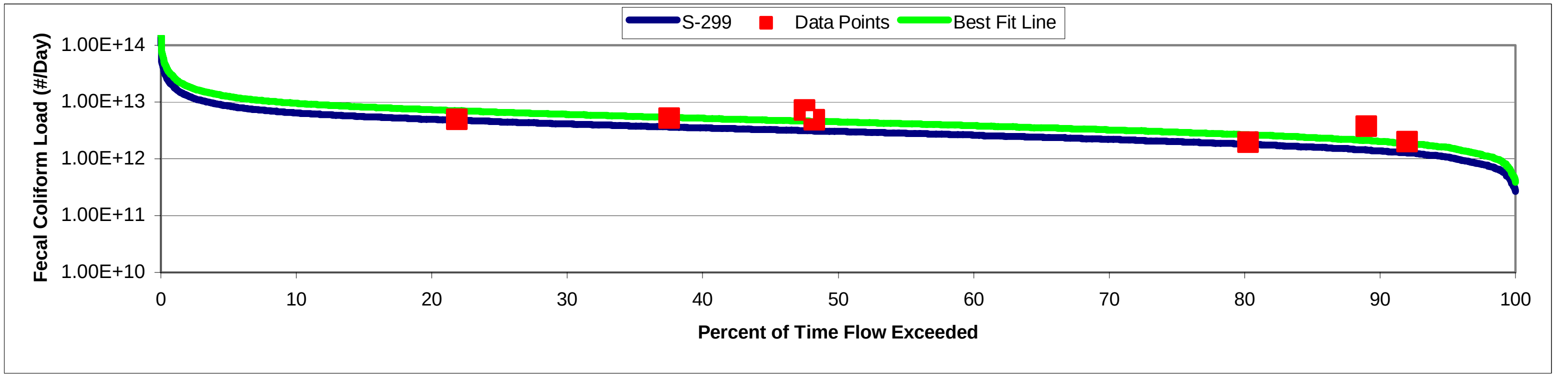
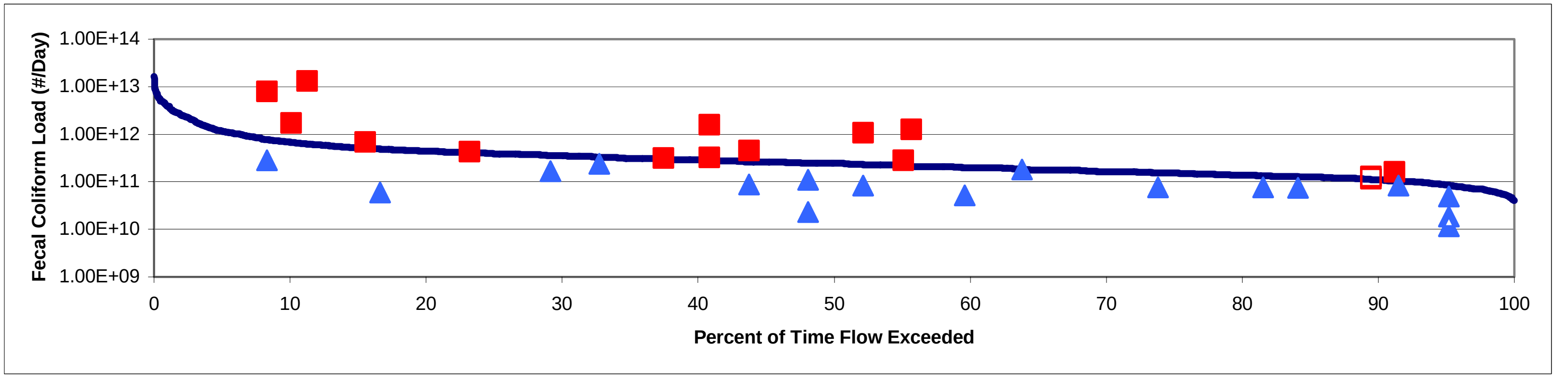


Figure B-10 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-300



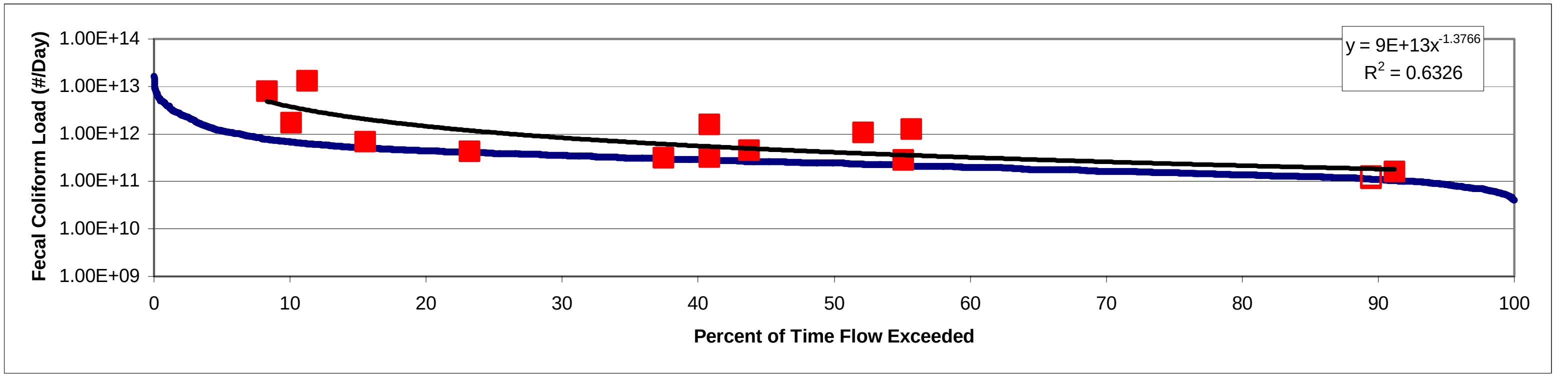
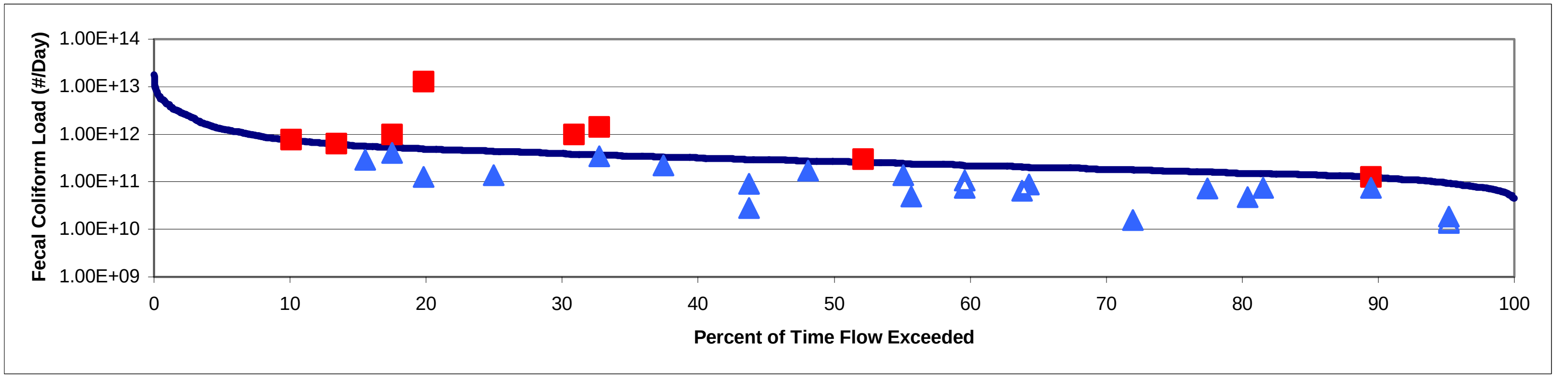


Figure B-11 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-301



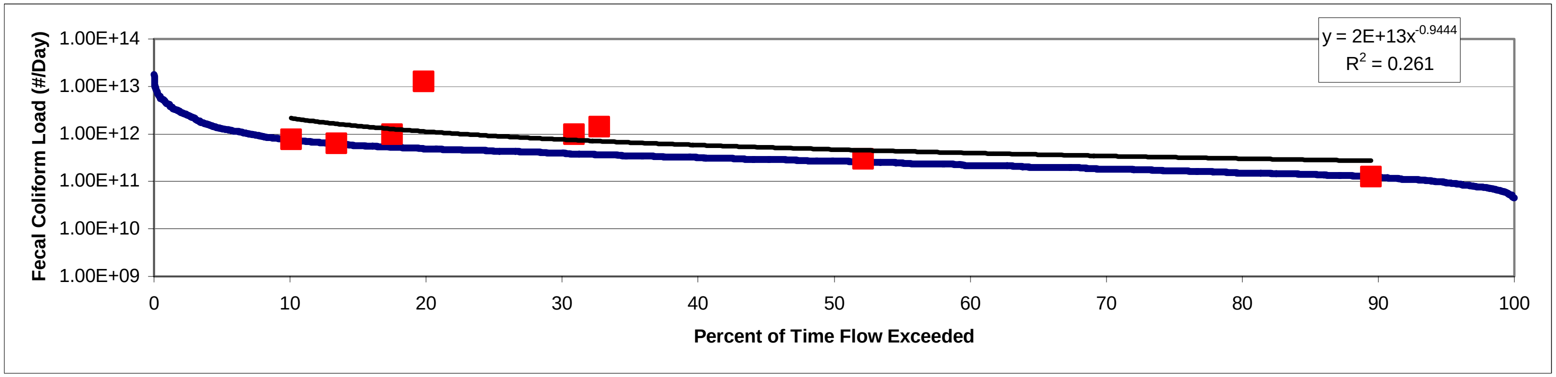


Figure B-12 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-302

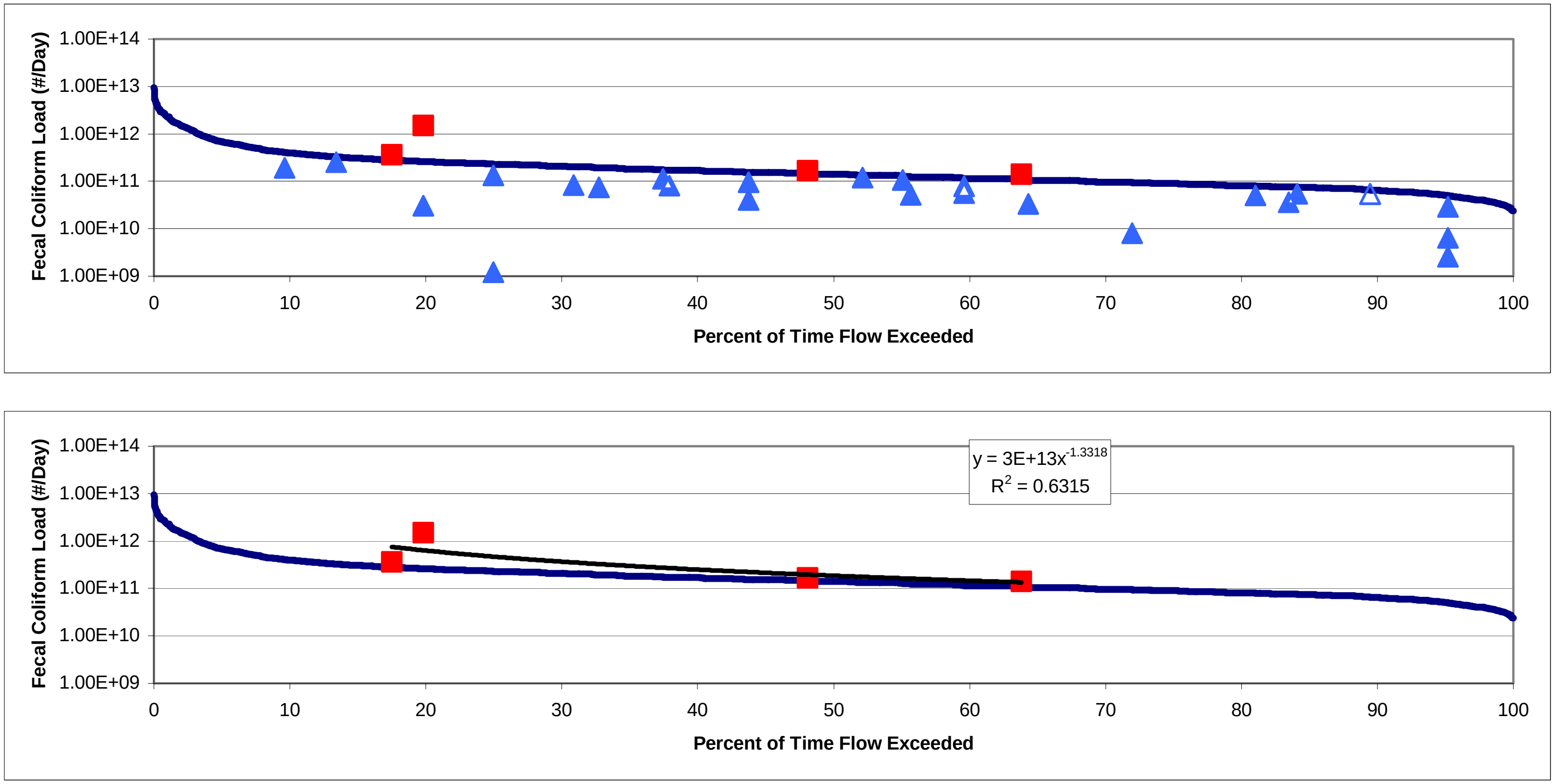
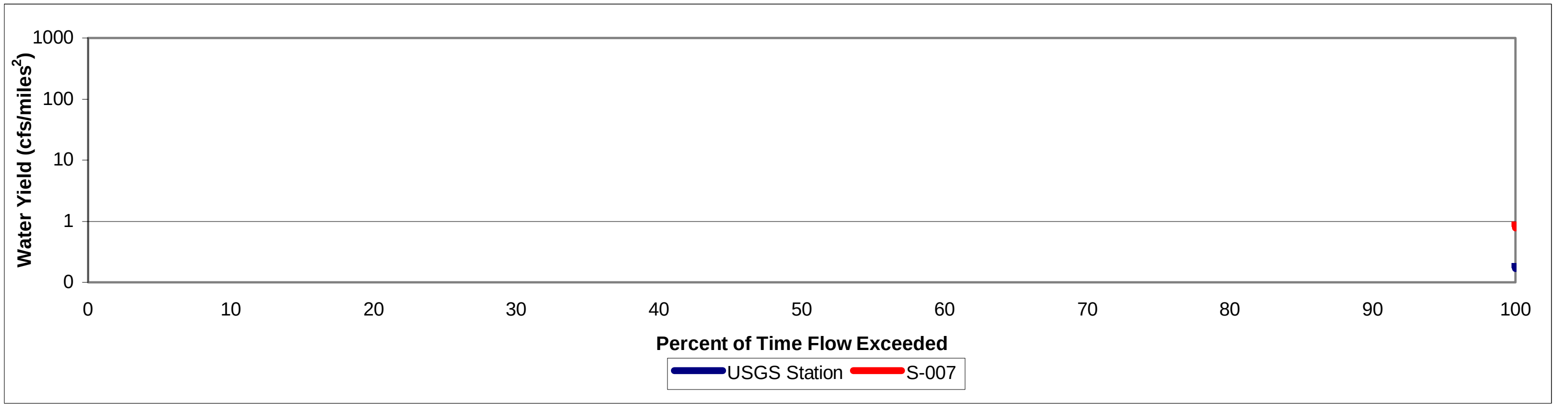


Figure B-13 Water Yield (cubic feet/second/square mile) Based on Measured Daily Streamflow from USGS Station 02185200 for Designated Stations



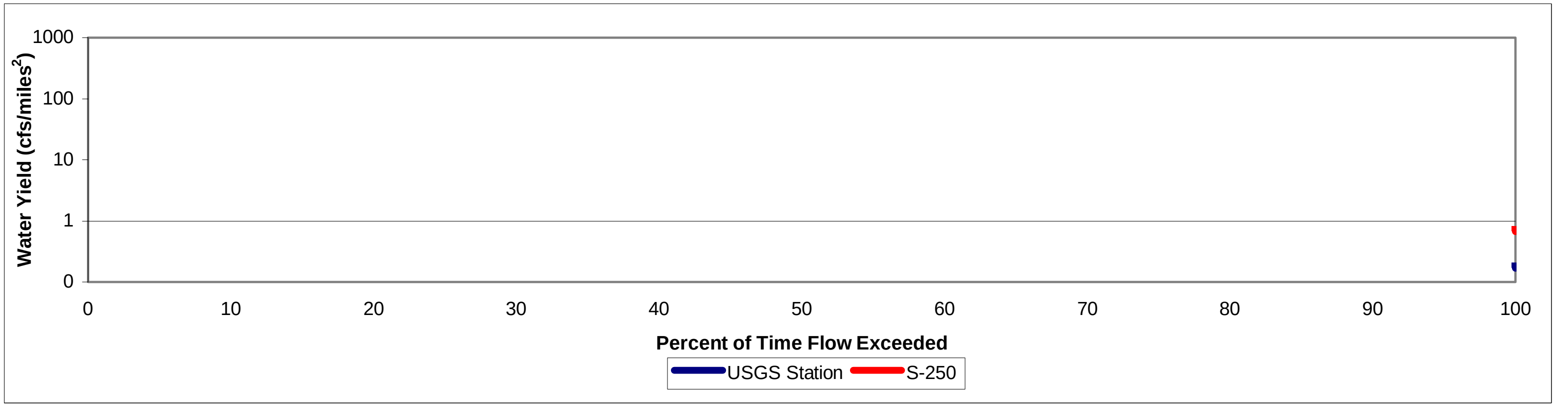
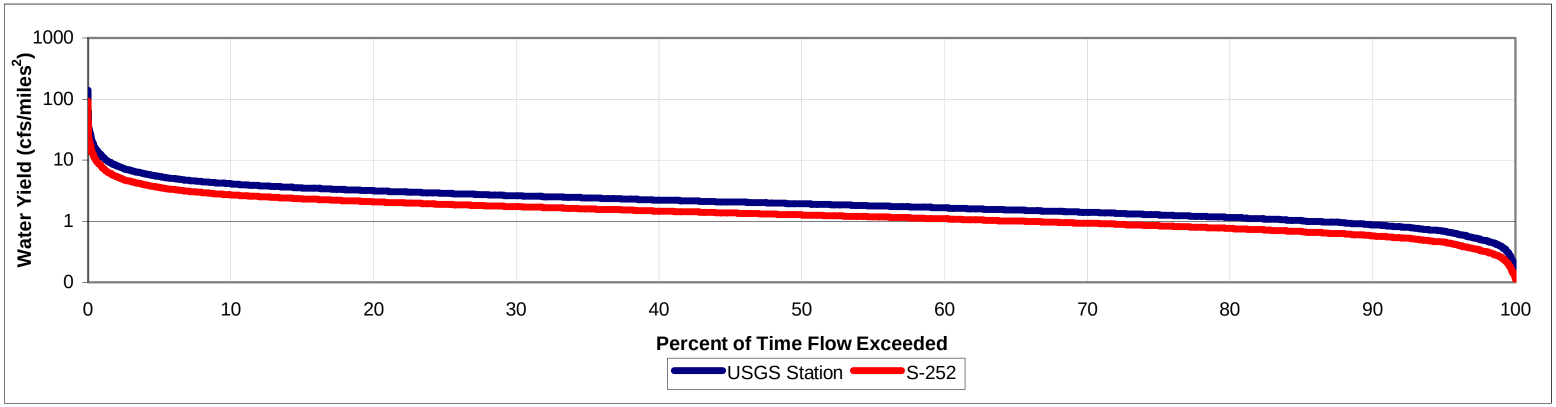


Figure B-13 (Continued)



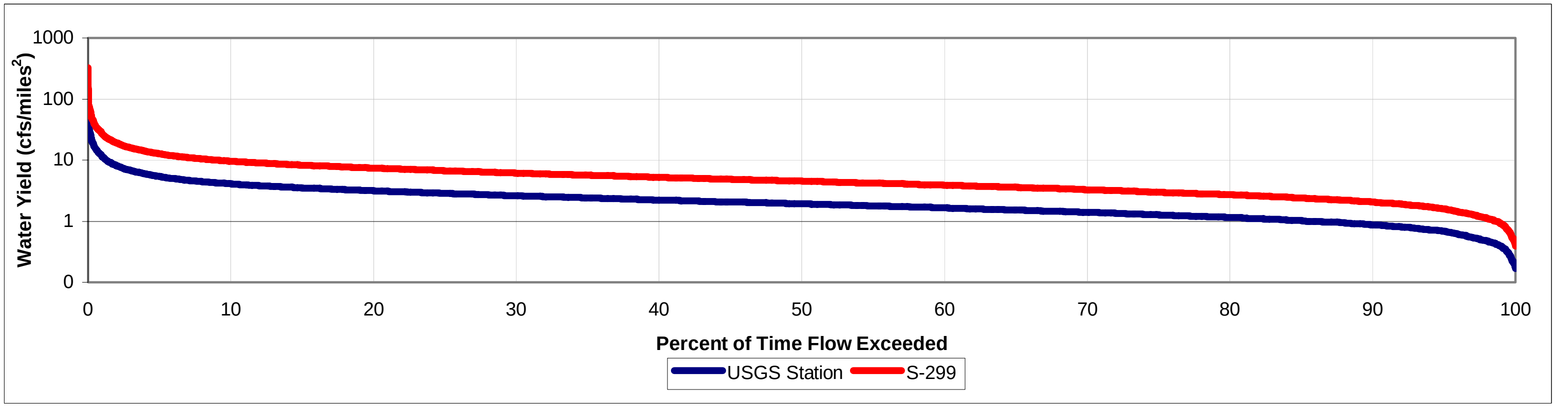
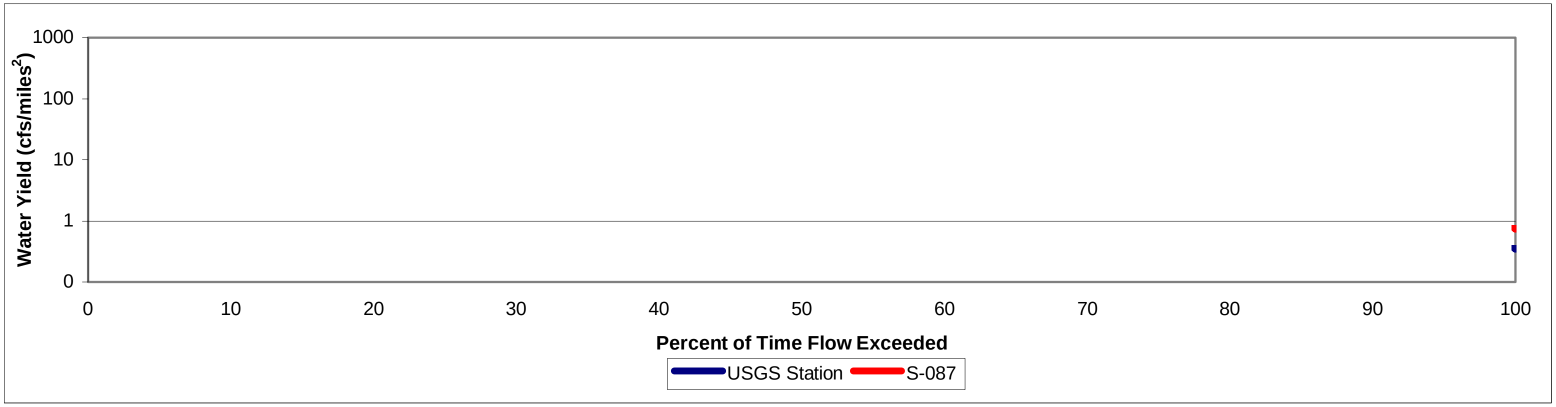


Figure B-14 Water Yield (cubic feet/second/square mile) Based on Measured Daily Streamflow from USGS Station 02162350 for Designated Stations



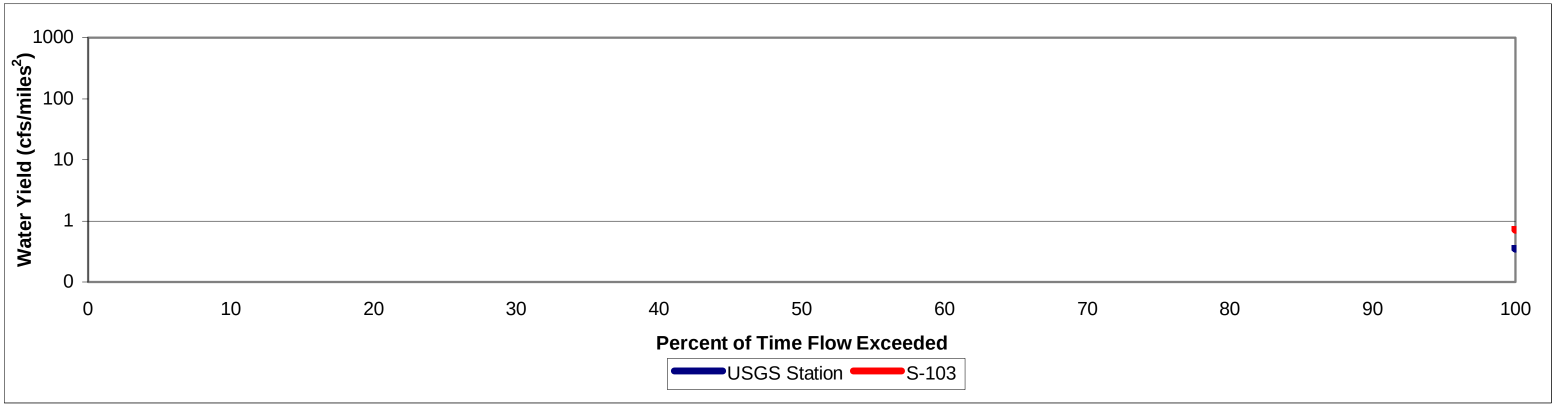


Figure B-14 (Continued)

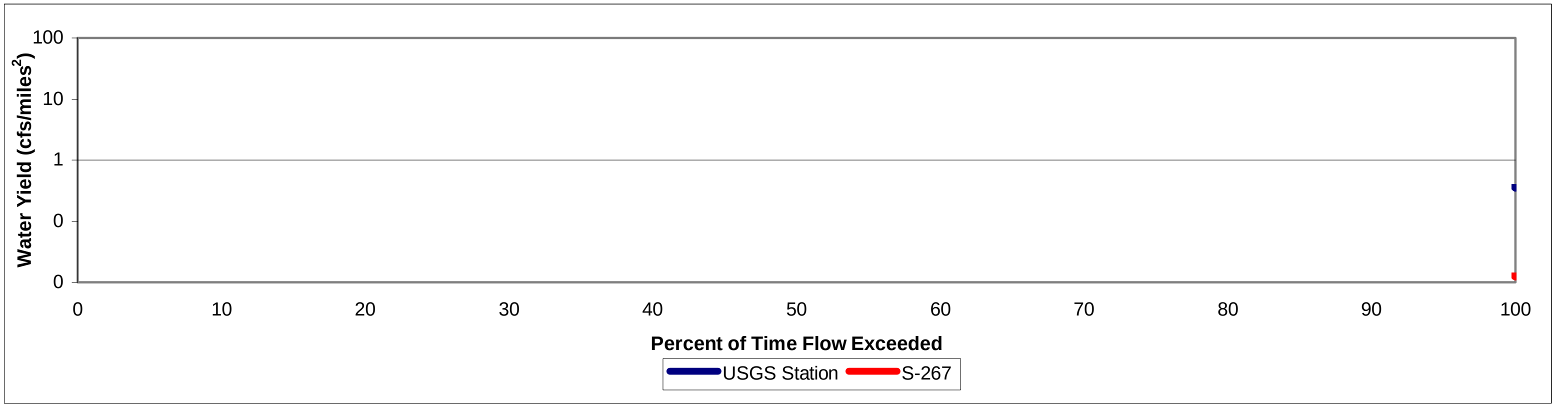
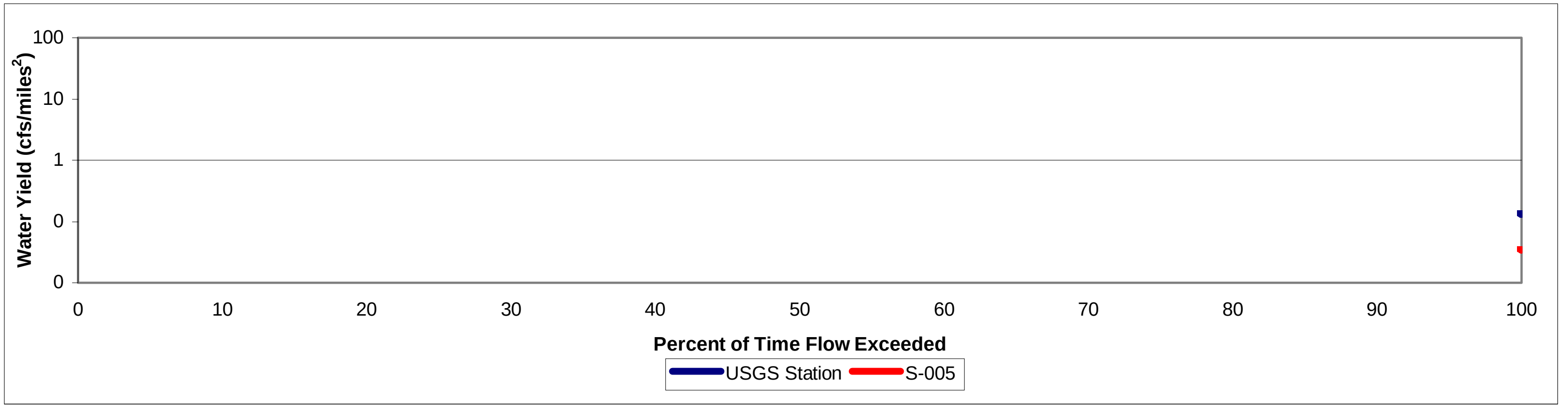


Figure B-15 Water Yield (cubic feet/second/square mile) Based on Measured Daily Streamflow from USGS Station 021630967 for Designated Stations



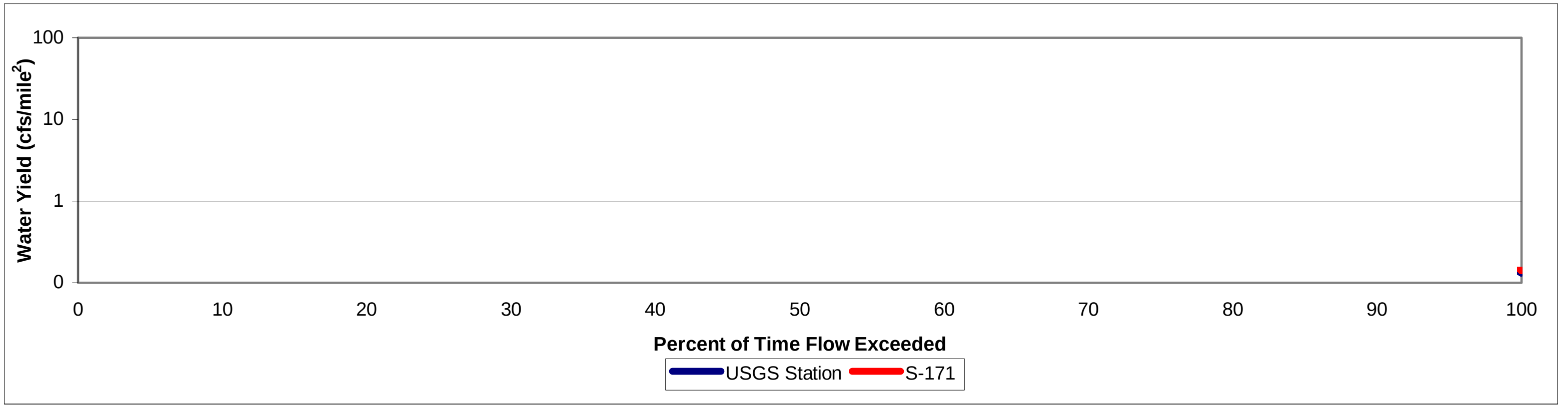
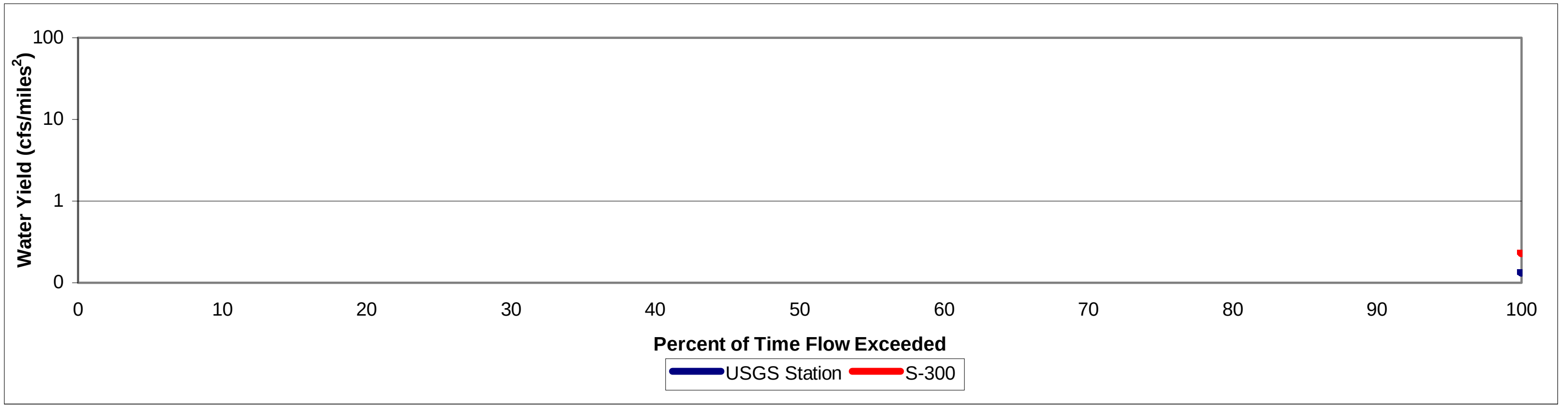


Figure B-15 (Continued)



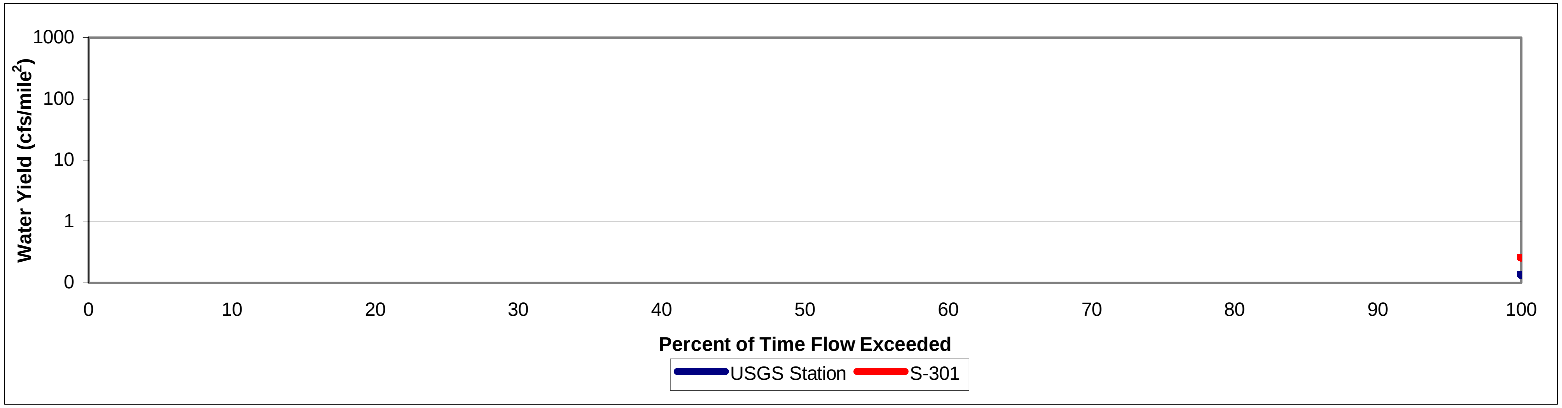
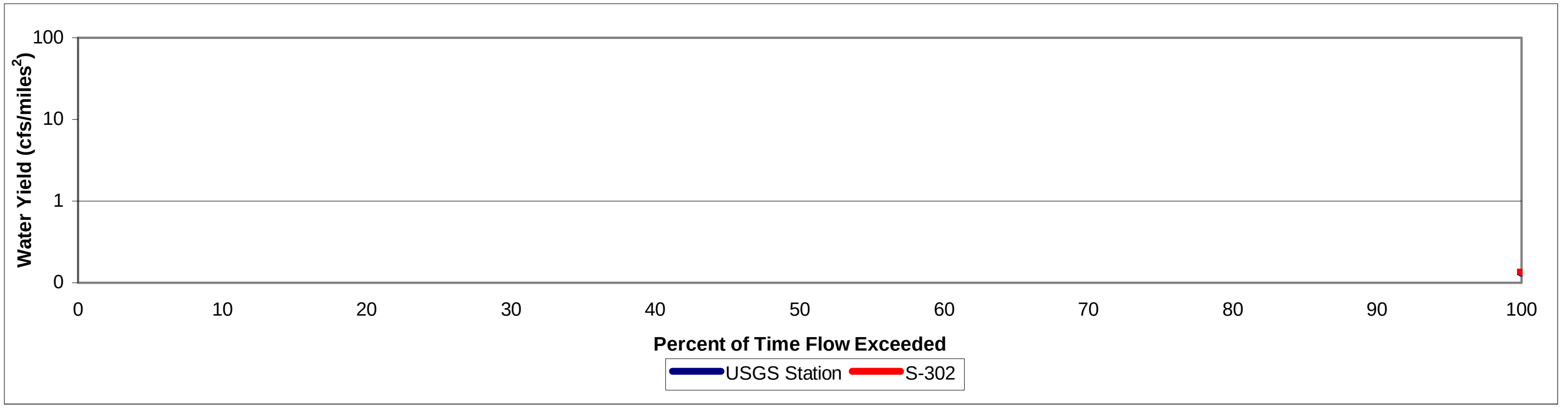


Figure B-15 (continued)



APPENDIX C Public Notification and Response to Comments

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 Saluda Basin in Greenville, Pickens, and Anderson Counties.

Waterbody Name	Station ID	§303(d) List Pollutants
BIG BRUSHY CK AT S-04-143	SC-S-301	Fecal Coliform Bacteria
BIG CK AT S-04-116	SC-S-302	Fecal Coliform Bacteria
GEORGES CK AT S-39-28	SC-S-300	Fecal Coliform Bacteria
GEORGES CK BRANCH AT S-39-192, 2.6 MI NE EASLEY	SC-S-005	Fecal Coliform Bacteria
GROVE CK AT UN# RD BELOW J P STEVENS ESTES PLANT	SC-S-171	Fecal Coliform Bacteria
MIDDLE SALUDA RVR AT SC 288 2.3 MI WSW SLATER	SC-S-252	Fecal Coliform Bacteria
NORTH SALUDA RVR AT BRDG AB JCT WITH SALUDA RVR E OF SC 186	SC-S-004	Fecal Coliform Bacteria
OOLENOY RVR AT S-39-47	SC-S-103	Fecal Coliform Bacteria
SALUDA RVR AT FARRS BRDG ON SC 183 7 MI NE EASLEY	SC-S-250	Fecal Coliform Bacteria
SALUDA RVR AT SC 81 SW OF GREENVILLE	SC-S-007	Fecal Coliform Bacteria
SALUDA RVR TRIB ON S-23-53	SC-S-267	Fecal Coliform Bacteria
SOUTH SALUDA RIVER AT S-23-101	SC-S-087	Fecal Coliform Bacteria
SOUTH SALUDA RVR AT SC 186	SC-S-299	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 _______, 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/region4

/s/

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

Responsiveness Summary
Upper Saluda River Basin - Fecal Coliform TMDLs
September 21, 2004

Commenters: County of Anderson

1. Comment: The commenter expressed concerns about impaired stations that fell upstream of the Anderson County urbanized area. Anderson County does not have jurisdiction over other Greenville and Pickens Counties.

Percentage reductions in TMDLs apply to entire watersheds above monitoring sites. The TMDL percentage reductions apply to the urbanized areas within SMS4 jurisdictional areas; however, percent reductions apply to watersheds and not political boundaries.

2. Comment: The commenter requested a rationale for why regulated NPDES MS4s are treated as point sources in the TMDL calculation.

A November 2002 USEPA memo stated that regulated NPDES MS4s are considered point sources (http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf): "NPDES-regulated *storm water discharges must be addressed by the wasteload allocation component of a TMDL. See 40 C.F.R. § 130.2(h).”*

3. Comment: The commenter suggested that SCDHEC be more specific and forthcoming about how the MS4 program will be monitored and enforced.

This concern cannot be appropriately addressed in the scope of the TMDLs. The commenter should contact SCDHEC MS4 staff for more information.

4. Comment: The commenter requested a rationale for why wasteload allocations were not established for nonpoint sources of fecal coliforms.

By definition, wasteload allocations are for point sources, and load allocations are for nonpoint sources. USEPA does not require load allocations for individual nonpoint sources; however, USEPA does require individual or categorical wasteload allocations for point source dischargers.

5. Comment: Section 5.5 of the Upper Saluda River Basin TMDL states: “Compliance by these municipalities with the terms of their individual MS4 permits will fulfill any obligations they have toward implementing this TMDL.” The commenter recommended removing this sentence from the document.

This sentence has been deleted.

6. Comment: Section 6 in the documents states: “The iterative BMP approach as defined in the General Storm Water NPDES MS4 permit is expected to provide significant implementation of this TMDL.” The commenter suggested that this sentence be deleted.

This sentence has been deleted.

7. Comment: Section 6 of the Upper Saluda River Basin TMDL states: “Using existing authorities and mechanisms, these measures will be implemented in the Saluda River Watershed in order to bring about the necessary reductions in fecal coliform bacteria loading to Saluda River and its tributaries”. The commenter recommended that this sentence be deleted.

This sentence has been deleted.

8. Comment: The commenter expressed concerns about identifying fecal coliform as a source of impairment. The commenters believe that fecal coliform is an indicator of pollution not an actual pollutant.

Per South Carolina Regulation 61-68, Water Classifications and Standards, the standard in South Carolina for bacterial pollution is fecal coliform. TMDLs must address the pollutant specified in state standards

APPENDIX D   MOVE.1

Constructing Flow Curves Using MOVE.1

The concept of record extension is to transfer the characteristics of distribution shape, serial correlation, and seasonality from the base station to the short-record station with adjustments of location and scale appropriate to the short-record station. MOVE.1 is a statistical technique developed by the USGS (Hirsch, 1982) for extending discharge records at partial or discontinued gages using continuous records at a base station having a common period of record as the partial station. Record extension is based on the following equation:

$$Y(i) = m(y_1) + (S(y_1)/S(x_1))(x(i) - m(x_1)) \qquad \text{Equation 1}$$

Where: Y = discharge at partial record station on particular date
$m(y_1)$ = mean value at partial record station
$S(y_1)$ = standard deviation of discharge record at partial station
$S(x_1)$ = standard deviation of discharge record at continuous station
X(i) = discharge at continuous gage on a particular date
$m(x_1)$ = mean value at continuous record station

Application of the MOVE.1 technique is explained below; however, for more information on the derivation of the equations used in the analysis, please refer to Hirsch (1982).

The record extension procedure can be easily performed in a spreadsheet, such as Excel, having the "analysis toolpak" feature loaded as an add-in program. In Excel, the "descriptive statistic" feature in the "analysis toolpak" is used to compute the complex statistical parameters described in Equation 1. The first step in utilizing MOVE.1 is to compute the logarithms of the discharges at each gage during the concurrent time period. By selecting the "descriptive statistic" feature from the data analysis menu (in Excel, this is located under the "tools" menu bar), and highlighting the cells containing the logarithms of the discharges at both the partial and continuous record stations, the summary statistics used in Equation 1 can be calculated. Flows at other time periods at the partial record station can be estimated by using Equation 1, the summary statistics from the analysis toolpak, and flow at the continuous record station.

A partial flow record is available for Grove Creek near Piedmont, SC at USGS station 021630967. MOVE.1 was used to establish the missing period of record between 1990 and 1994. The partial station was matched with a USGS station with complete records. The USGS station 02164000 on the Reedy River near Greenville was used to extend the record at USGS station 021630967. The concurrent time period for each pair was used in the MOVE.1 analysis. Statistical parameters derived from the MOVE.1 analysis are shown in Table D-1. The resulting flow duration curve is presented in Figure D-1.

Table D-1 Statistical Parameters Derived from the MOVE.1 Analysis Comparing USGS 02164000 and USGS 021630967

log 02164000		***log 021630967***	
Mean	1.679	Mean	1.179
Standard Error	0.007	Standard Error	0.007
Median	1.653	Median	1.146
Mode	1.415	Mode	1.041
Standard Deviation	0.342	Standard Deviation	0.350
Sample Variance	0.117	Sample Variance	0.123
Kurtosis	2.017	Kurtosis	2.600
Skewness	0.912	Skewness	1.078
Range	2.891	Range	2.602
Minimum	0.724	Minimum	0.398
Maximum	3.615	Maximum	3.000
Sum	4436.819	Sum	3114.785
Count	2643	Count	2643
Standard Deviation Y/Standard Deviation X = 1.025			

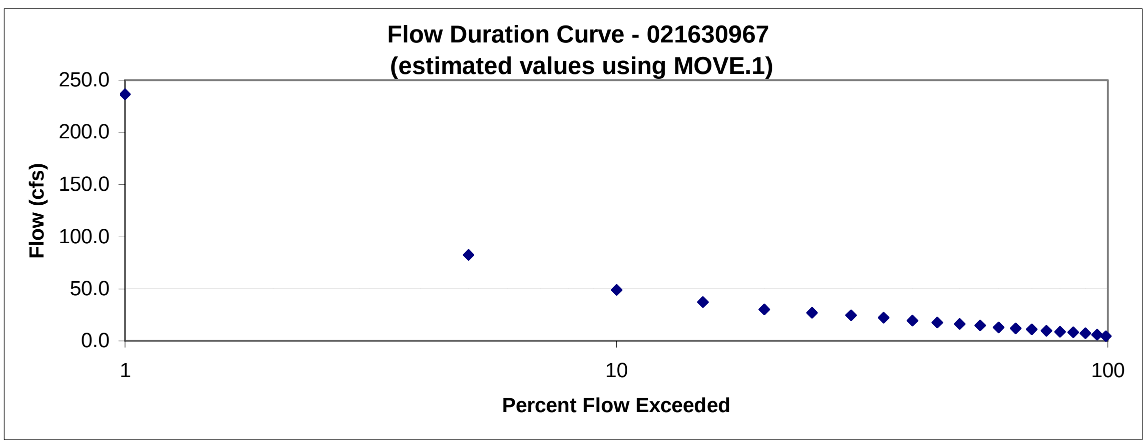


Figure D-1 Flow Duration Curve for Grove Creek Near Piedmont, SC (Estimated Using MOVE.1)