Total Maximum Daily Load Document
North Fork Edisto River, Chinquapin Creek & Horse Pen Creek (Hydrologic Unit Codes: 030502030101, -03, -06 & Stations E-084, E-091, E-102, & RS-01004) Fecal Coliform Bacteria, Indicator for Pathogens

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Bureau of Water

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Abstract

Total Maximum Daily Loads (TMDLs) have been developed for Chinquapin and Horse Pen Creeks and North Fork Edisto River in Aiken, Lexington, and Saluda Counties, SC. The N F Edisto River at E-084 and E-102, and tributaries, Chinquapin Creek (E-091) and Horse Pen Creek (RS-01004), were included on South Carolina's 2006 list of impaired waters (commonly called 303(d) list). During the assessment period for the 2006 303(d) list (2000-2004), 64 % of samples for E-091 exceeded the water quality standard (400 cfu/100 ml). The percentage of samples that exceeded the standard for RS-01004, E-084, and E-102 were less: 29 % for RS-01004, 13 % for E-084, and 11 % for E-102. The watershed of N F Edisto River is mostly forest, cultivated land, grassland, and pasture. The drainage area for E-091 has a higher percentage of developed land than do the drainage areas. The Town of Batesburg-Leesville, which is half within the watershed, has a WWTP on a tributary of Chinquapin Creek. There are currently no MS4s in the watershed. The probable sources of fecal coliform bacteria to the N F Edisto River are agricultural runoff, failing septic tanks, and cattle in the streams. An additional source to Chinquapin Creek is likely to be urban runoff.

The load-duration curve methodology was used to calculate the existing loads and the TMDL loads for these streams. Existing loads and TMDL loads are presented in Table Ab-1. Chinquapin Creek requires a much greater reduction in the existing load of fecal coliform bacteria than does the North Fork Edisto River. Resources and several TMDL implementation strategies to bring about these reductions are suggested.

Table Ab-1. Total Maximum Daily Loads for the N F Edisto River, Chinquapin and Horse Pen Creeks.

Station ID	TMDL (cfu/day)	MOS (cfu/day)	WLA		LA (cfu/day)	Existing Load (cfu/day)	% Reduction to Meet Load Allocation[3]
			Continuous Sources[1] (cfu/day)	Intermittent Sources[2] (% Reduction)			
E-084	4.60E+11	2.30E+10		6.9 %	4.37E+11	4.69E+11	6.9%
E-091	1.10E+11	5.50E+09	1.89E+10	78 %	1.05E+11	4.84E+11	78%
E-102	2.36E+12	1.18E+11		16 %	2.24E+12	2.68E+12	16%
RS-01004	7.28E+09	3.64E+08		62 %	6.92E+09	1.84E+10	62%

Table Notes:

1 - WLA is expressed as total monthly average.

2 - Percent reduction applies to all NPDES-permitted stormwater discharges, including future MS4s, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet percentage reduction or the existing instream standard for pollutant of concern, whichever is less restrictive, to the maximum extent practicable.

3 - Percent reduction applies to existing load; Where Percentage Reduction = (Existing Load-Load Allocation) / Existing Load

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1.0 INTRODUCTION

1.1 Background

Fecal coliform bacteria are widely used as an indicator of pathogens in surface waters and wastewater. Acute gastrointestinal illnesses affect millions of people in the United States and cause billions of dollars of costs each year (Gaffield *et al*, 2003). Of these illnesses many are caused by contaminated drinking water. Untreated storm runoff has been associated with a number of disease outbreaks, most notably the outbreak in Milwaukee that caused many deaths.

Though occurring at low levels from natural sources, the concentration of fecal coliform bacteria can be elevated in water bodies as the result of pollution. Sources of fecal coliform bacteria are usually diffuse or nonpoint source, such as stormwater runoff, failing septic systems, and leaking sewers. Occasionally, the source of the pollutant is a point source. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water bodies that are not meeting designated uses under technology-based pollution controls. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and in stream water quality conditions so that states can establish water quality-based controls to reduce pollution and restore and maintain the quality of water resources (USEPA, 1991).

1.2 Watershed Description

The North Fork Edisto River (N F Edisto) is formed from the junction of Chinquapin and Lightwood Knot Creeks. The upper part of the N F Edisto watershed is in Saluda, Aiken and Lexington Counties and is within the Southeastern Plains Sand Hills Eco-region (Figure 1) (HUC 0305020301). Chinquapin Creek, Horse Pen Creek, and the North Fork Edisto River are impaired by fecal coliform bacteria. Lightwood Knot Creek (E-101) is not impaired. Chinquapin Creek is also impaired by pH, which is not addressed by this TMDL. While the upper part of Chinquapin's watershed has significant urban development; the remainder of these watersheds does not. Duncan Creek, a tributary of Chinquapin Creek, is the receiving stream for a wastewater treatment plant (WWTP). Chinquapin Creek and the NF Edisto River form the boundary between Aiken and Lexington Counties. About half of the Town of Batesburg-Leesville is in the watershed, mostly within Chinquapin Creek's. Table 1 provides the drainage areas and populations (2000 US Census) of the watersheds of the four impaired sites. These TMDLs apply to the parts of the watershed upstream of each water quality station as defined in Table 1.

The most recent available land use data is the National Land Cover Data 2001 (NLCD 2001), which represents land uses in 2001. Table 2 describes the land use in the watershed for each sampling site. The areas are cumulative, that is area for each land use for RS-01004 is included in E-091, which is also included in E-084 and so on. Forest was the largest land use in all four areas. Grasslands/ Herbaceous, which is not primarily an agricultural land use, was the second largest land use, except for E-091 where cultivated crops were second. The agricultural land uses, which include cultivated crops and pasture/hay were third and fourth, respectively, except for E-091. Wetlands and

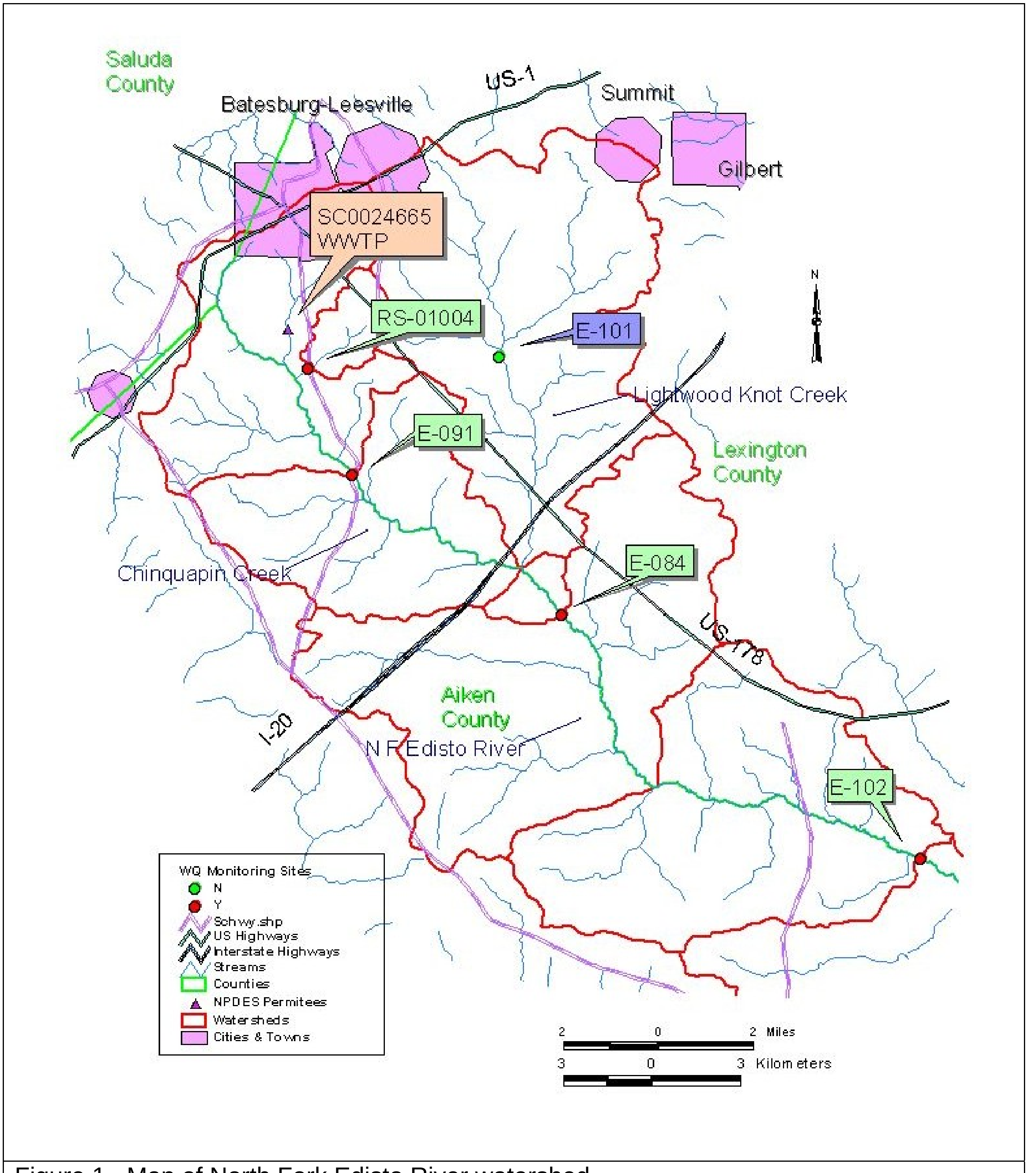

Figure 1. Map of North Fork Edisto River watershed.

developed land accounted for almost all the remainder. Land use is displayed in a map format in Figure 2.

Table 1. North Fork Edisto River water quality monitoring sites description.

Watershed	Station ID	Sampling Station Description	Drainage Area		Population
			km^2	mi^2	
Horse Pen Creek	RS-01004	Horse Pen Creek at SC-391	6.6	2.6	257
Chinquapin Creek	E-091	Chinquapin Creek at SC-391	60.9	23.5	3,741
North Fork Edisto River	E-084	North Fork Edisto River at S-02-74	210	81.1	9,414
North Fork Edisto River	E-102	North Fork Edisto River at S-02-110	398	154	12,463

Table 2. Land uses in the upper North Fork Edisto River watershed in 2001.

Landuse Class		**Area (km^2)**					**Percentages**			
		RS-01004	**E-091**	**E-084**	**E-102**		**RS-01004**	**E-091**	**E-084**	**E-102**
Water		0.11	0.77	2.28	3.47		1.7%	1.3%	1.1%	0.9%
Developed		0.56	7.48	18.3	27.8		8.4%	12.3%	8.7%	7.0%
Forest		2.76	22.6	89.3	176.0		41.8%	37.2%	42.5%	44.2%
Scrub/Shrub		0.08	0.64	2.11	2.95		1.2%	1.1%	1.0%	0.7%
Grassland/Herbaceous		1.26	8.93	32.9	74.6		19.0%	14.7%	15.7%	18.7%
Pasture/Hay		0.70	6.27	18.0	32.2		10.6%	10.3%	8.6%	8.1%
Cultivated Crops		0.82	10.4	27.8	47.4		12.4%	17.1%	13.2%	11.9%
Wetlands		0.32	3.75	19.3	33.7		4.9%	6.2%	9.2%	8.5%
Total		6.6	60.9	210.1	398.2		100.0%	100.0%	100.0%	100.0%

1.3 Water Quality Standard

The impaired stream segments of Chinquapin and Horse Pen Creeks and North Fork Edisto River are designated as Class Freshwater. Waters of this class are described as follows:

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

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

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

Insufficient data are available to evaluate the 30-day geometric mean for these TMDLs. These TMDLS will be based on the instantaneous portion of the standard.

Primary contact recreation is not limited to large streams and lakes. Even streams that are too small to swim in, will allow small children the opportunity to play and immerse their hands and faces. Regulation mandates that all perennial streams should be protected for recreational use.

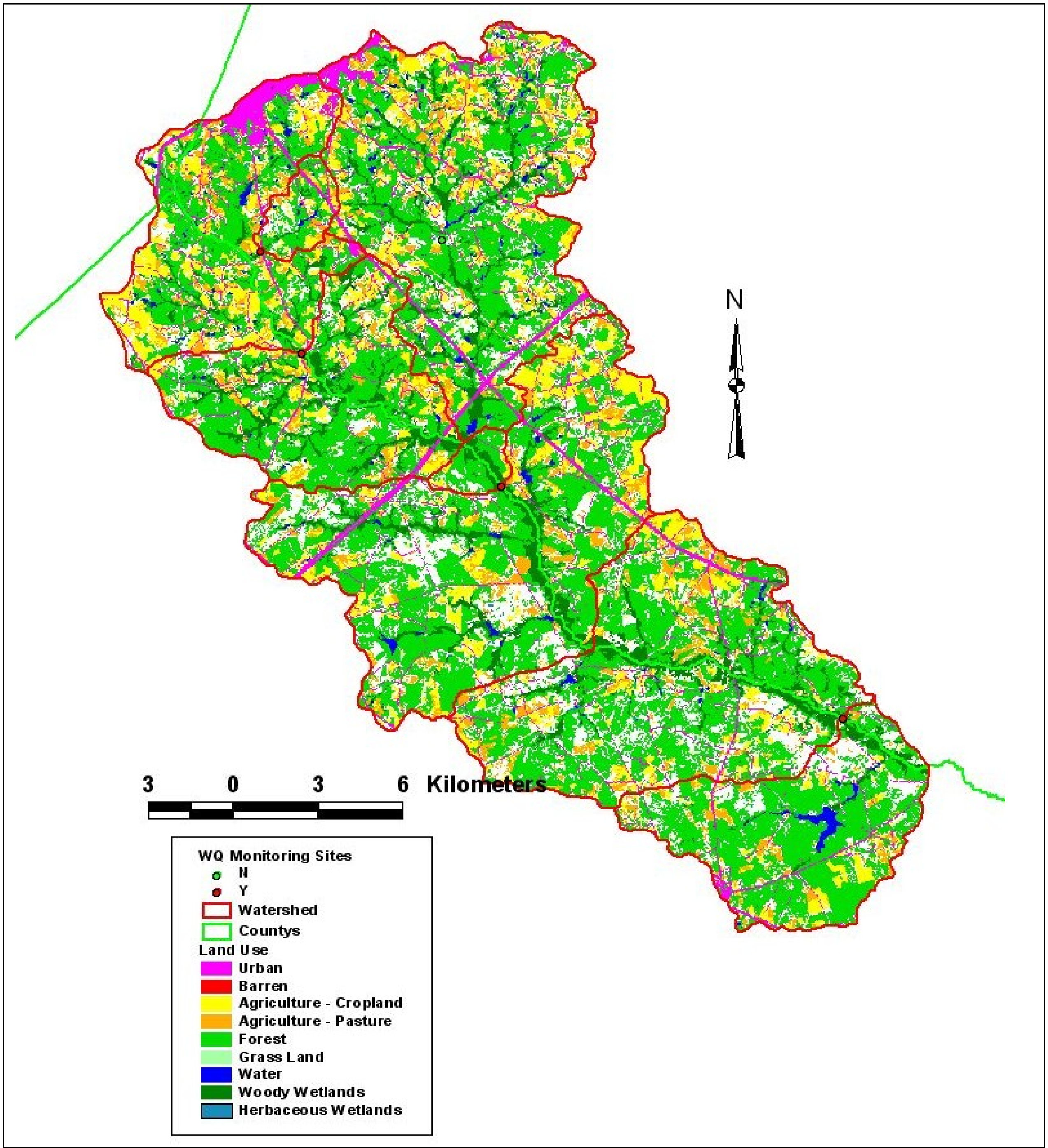

Figure 2. Map showing land uses in the upper N F Edisto River watershed in 2001.

2.0 WATER QUALITY ASSESSMENT

DHEC has five water quality monitoring stations (Not counting biological monitoring sites.) on the upper North Fork Edisto River and tributaries: Chinquapin, Horse Pen and Lightwood Knot Creeks (Table 1 and Figure 1). An assessment of water quality data collected from 2000 through 2004 for the 2006 303(d) list found that four of the stations were impaired for recreational use (Table 3). Lightwood Knot Creek (E-101) was found to be unimpaired; 4 % of samples exceeded the standard. During the 2000-2004 monitoring period 13 % of samples at E-084, 64 % at E-091, 11 % at E-102, 29 % for RS-01004 exceeded the standard for fecal coliform bacteria. Waters in which no more than 10% of the samples collected over a five year period are greater than 400 fecal coliform counts or cfu / 100 ml are considered to comply with the South Carolina water quality standard for fecal coliform bacteria. Waters with more than 10 percent of samples greater than 400 cfu/ 100 ml are considered impaired for fecal coliform bacteria and placed on South Carolina's 303(d) list.

Table 3. Statistics for fecal coliform data collected in North Fork Edisto River during the 2000 – 2004 assessment period.

Location	Stream	Number of Samples	Geometric Mean (cfu/ 100ml)	Minimum	Maximum	% Exceeding Standard
RS-01004	Horse Pen Creek	7	272	20	3800	28.6%
E-084	North Fork Edisto River	47	108	16	2000	12.8%
E-091	Chinquapin Creek	24	474	10	2600	63.9%
E-102	North Fork Edisto River	47	87	5	1200	10.6%

Chinquapin Creek was sampled from 1999 through 2001, while the two locations on North Fork Edisto River were sampled beginning in 2001 through 2005. The random monitoring site RS-01004 on Horse Pen Creek was sampled during 2001 only. The plot in Figure 3 shows all the data collected since Jan 1, 1999, with the data collected during the assessment period identified. Only in 2001 were data collected at all four stations. Precipitation measured at Batesberg-Leesville indicates that 1999 through 2002 were below normal and 2003 was much wetter than normal. However, as Figure 4 shows, there is little correlation between precipitation (sum of day of sampling and two prior days) and fecal coliform bacteria concentrations in these waters, except for Horse Pen Creek where fecal coliform concentrations correlated with precipitation (r^2=0.9283). This suggests that the major source or sources of fecal coliform bacteria are continual, such as failing septic systems, leaking sewer lines, or illicit discharges, except in the Horse Pen Creek watershed where runoff from land surfaces appears to be the principal source.

Descriptive statistics for data collected since 1999 at these locations is provided in Appendix A Table A-2. All of the data is provided in Appendix A Table A-1

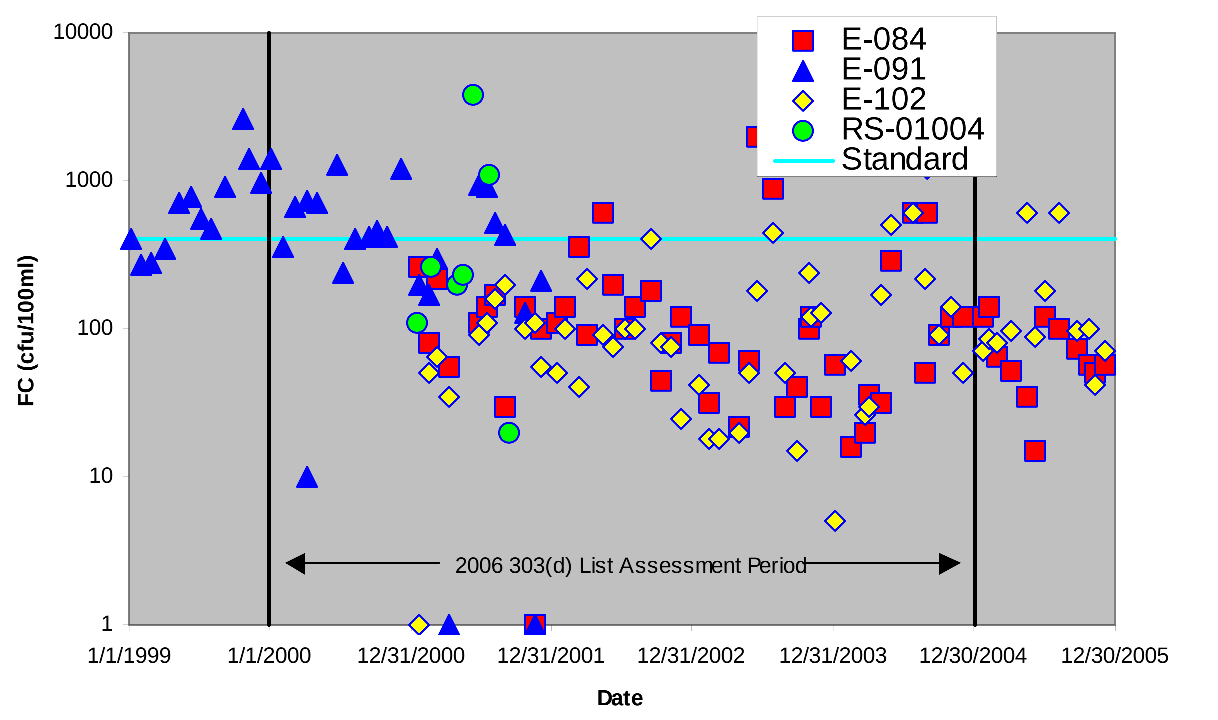

Figure 3. Fecal coliform concentrations at the four impaired locations.

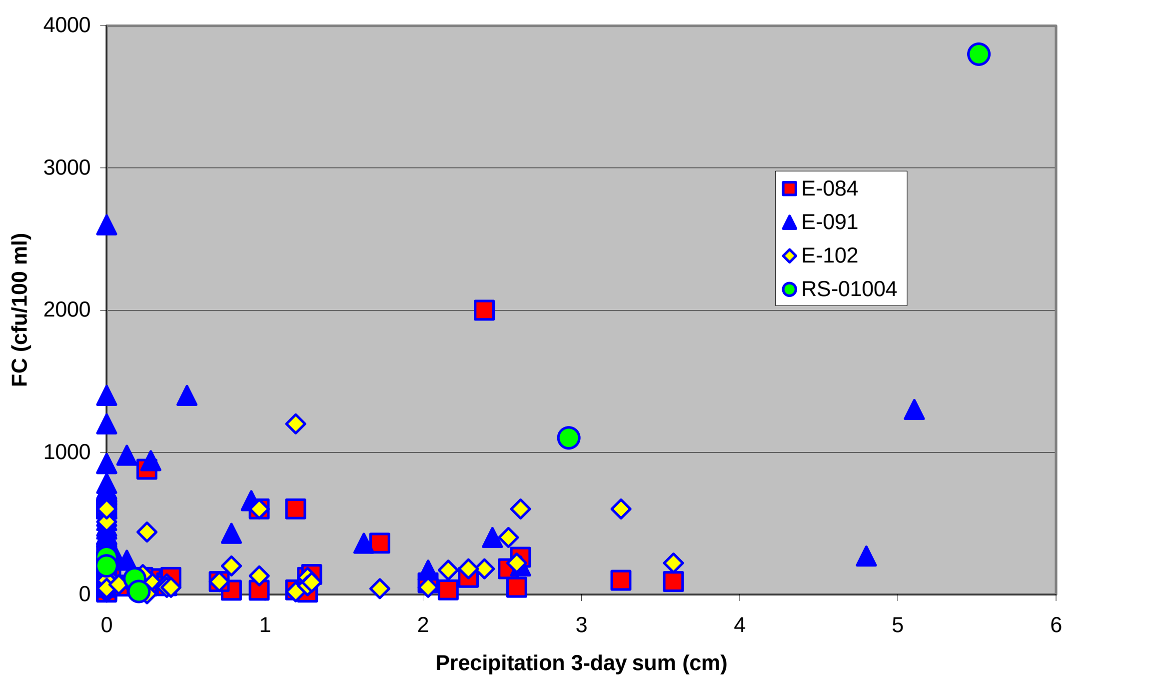

Figure 4. Precipitation at Batesburg-Leesville vs fecal coliform at four locations.

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

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

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

3.1 Point Sources in the upper N F Edisto River Watershed

3.1.1 Continuous Point Sources

Currently there is one NPDES discharger in the North Fork Edisto watershed that has a permit to discharge wastewater containing fecal coliform bacteria. The Town of Batesburg-Leesville (SC0024465) discharges wastewater into Duncan Creek, a tributary of Chinquapin Creek, some 6.4 km (4 miles) upstream of E-091. This facility has a permit to discharge 2.5 mgd of wastewater. At this flow rate and the permitted limit of 400 cfu/ 100ml (Daily Maximum), the facility could discharge as much as 3.8 E+10 cfu/day of fecal coliform bacteria. This facility reported several permit violations between 1998 and 2000 but has not reported a violation since February 2001.

The Town of Batesburg-Leesville's sewage collection system is not extensive. Sewer lines lie adjacent to several short stream segments of the upper Chinquapin Creek. Because of the limited proximity of sewers to streams, the sewage collection system seems unlikely to be a major contributor to the impairment of Chinquapin Creek. Leaking sewers and Sanitary Sewer Overflows (SSO) are illicit discharges and do not receive allocations. SCDHEC responds to illicit discharges through compliance and enforcement mechanisms under the NPDES program. DHEC has reports of four SSO incidents for this facility during 1999 – 2003. The largest incident released an estimated 5000 gallons. It is not clear if any wastewater reached surface water. None of these incidents appears to be related to a fecal coliform excursion in Chinquapin Creek or the North Fork Edisto River.

3.1.2 Intermittent Point Sources

This primarily rural watershed has no designated NPDES Municipal Separate Storm Sewer System (MS4) permits at the time these TMDLs are being developed. However, there maybe industrial or construction activities going on at any time that could produce stormwater runoff. Industrial facilities that have the potential to cause or contribute to a violation of a water quality standard are covered by the Storm Water Industrial General Permit (SCR000000). Construction activities are covered by the Storm Water Construction General Permit (SCR100000). Where the construction has the potential to affect water quality of a water body with a TMDL, the Storm Water Pollution Prevention Plan (SWPPP) for the site must address any pollutants of concern and adhere to any wasteload allocations in the TMDL.

3.1.3 Animal Feeding Operations

Owners/operators of most commercial animal growing operations are required by R. 61-43, Standards for the Permitting of Agricultural Animal Feeding Operations (AFOs), to obtain permits for the handling, storage, treatment (if necessary) and disposal of the manure, litter and dead animals generated at their facilities (SC DHEC 2002). The requirements of R. 61-43 are designed to protect water quality; therefore, we have a reasonable assurance that facilities operating in compliance with this regulation should not contribute to downstream water quality impairments.

While there are currently no confined animal feeding operations (CAFOs) in South Carolina, there are some 84 active state-permitted poultry operations and associated fields in the watershed. Sixteen of these entities are in the drainage area for E-091, three of which are in the drainage area for RS-01004. Another 40 poultry operations are in the drainage area for E-084 but downstream of E-091. The remaining 28 are in the drainage to E-102 but downstream of E-084. These facilities are routinely inspected for compliance with their permits. Permitted agricultural facilities that operate in compliance with their permit are not considered to be sources of impairment.

3.2 Nonpoint Sources in the N F Edisto Watershed

3.2.1 Wildlife

In these rural and suburban watersheds wildlife (mammals and birds), which is a source of fecal coliform bacteria, is likely significant. Wildlife in this area includes deer and other mammals as well as a variety of birds. Wildlife wastes are carried into nearby streams by runoff following rainfall or deposited directly in streams. Waterfowl also may be significant contributors of fecal coliform bacteria, particularly in urban and suburban ponds, which often provide a desirable habitat for geese and ducks. Forest lands, which typically have only low concentrations of wildlife as sources of fecal coliform bacteria, usually have low loading rates for fecal coliform bacteria.

3.2.2 Grazing Animals Activities

Agricultural activities that involve grazing livestock are also potential sources of fecal coliform contamination of surface waters. Fecal matter can enter the waterway through wash off from the land by runoff or by direct deposition into the stream.

Livestock, especially cattle, are frequently major contributors of fecal coliform bacteria to streams. Cattle on average produce some 1 E+11 cfu/day per animal of fecal coliform bacteria (ASAE, 1998). Grazing cattle and other livestock may contaminate streams with fecal coliform bacteria indirectly by runoff from pastures or directly by defecating into streams and ponds. The grazing of unconfined livestock (in pastures) is not regulated by SCDHEC. The 2002 USDA Agricultural Census of Agriculture reported 10,634 cattle and calves in Aiken County, 9804 cattle and calves in Lexington County, and 26,667 cattle and calves in Saluda County (http://www.nass.usda.gov/Census_of_Agriculture/index). Using the ratio of pastureland in the each part of the watershed to that of the appropriate county, 43 cattle and calves were estimated to be in the RS-01004 drainage area, 376 in the watershed draining to E-091, 1077 in the watershed draining to E-084, and 1892 for E-102 (These numbers are cumulative.). Direct loading by cattle or other livestock to the creeks is likely to be a significant source of fecal coliform bacteria to Chinquapin Creek and the N F Edisto River.

3.2.3 Failing Septic Systems

Failing septic systems can contribute to bacterial contamination of downstream waterbodies (US EPA, 2001). Loading to streams from failing septic systems is likely to be continual rather than precipitation related. The population and number of households that use septic systems were estimated by comparing the 2000 census GIS layer to the sewer line and city boundary GIS layers for each of the impaired watersheds. Three of the impaired waterbodies have predominantly rural populations that presumably use septic systems for wastewater treatment (Table 4). Only Chinquapin Creek has a larger urban population. Chinquapin Creek's fecal coliform excursions are mostly during under low flow conditions. Excursions at the other three impaired locations are not so linked to low flows. Failing septic systems and other continual sources likely predominate loading to Chinquapin Creek, but not to the other streams.

Table 4. Population and number of households by urban and rural breakdown for the four impaired sites.

Impaired Site	Urban		Rural	
	Population	Households	Population	Households
RS-01004	0	0	257	117
E-091	2190	966	1618	678
E-084	3180	1413	5922	2432
E-102	3180	1413	8972	3571

3.2.4 Urban Runoff

Urban and suburban stormwater runoff from streets, parking lots and lawns can contribute large bacterial loads to receiving waters (Gaffield, 2003). The Town of Batesburg-Leesville and the community of Summit are urban areas that are located along the northern border of the watershed (Figure 1). These communities are not presently covered by a NPDES MS4 permit. Urban runoff from Batesburg-Leesville may be contributing to the impairment of Chinquapin Creek at E-091.

These urban areas are unlikely to be significant sources of fecal coliform bacteria to the two impairments on the N F Edisto given their distance upstream of the impaired stations.

4.0 LOAD-DURATION CURVE METHOD

The load-duration curve method was developed as a means of incorporating natural variability, uncertainty, and risk assessment into TMDL development (Bonta and Cleland, 2003). The analysis is based on the range of hydrologic conditions for which there is appropriate water quality data. The load-duration curve method uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the existing and the TMDL loads for a water body. Development of the load-duration curves for North Fork Edisto River and Chinquapin Creek are described in this chapter.

The load-duration curve method requires flow data to calculate the loads. Chinquapin and Horse Pen Creeks are not gauged. Though the North Fork Edisto River is gauged, the gauges are far downstream where the drainage area is much larger. Brushy Creek, near Wrens, GA (USGS 02197600), a similar sized stream to Chinquapin Creek was used to estimate the flow for the creek (Table 5). The Brushy Creek gauge was also used for Horse Pen Creek, even though Horse Pen Creek has a much smaller drainage area. No gauges with data for the time period of interest and of a suitable size were found. Because Horse Pen Creek's drainage area is part of Chinquapin Creek's, it seems preferable to use the same gauge. Black Creek, near McBee, SC (USGS 021030900) was used to estimate the flow for the N F Edisto River at E-084 and E-102. Table 5 provides information about the streams and drainage areas. Table 6 shows the land use data for the two reference watersheds. Mean daily flow data from the two gauges for the periods of record were used to generate the flow-duration curves (Appendix D Figures D-1 – D-3).

Table 5. TMDL stream and gauged stream information.

Station	Stream	Drainage Area (ha)	Gauged Stream	Drainage Area (ha)	Date Range Used
E-084	N F Edisto River	21,007	Black Creek	27,322	1/1/1995 - 12/19/2006
E-091	Chinquapin Creek	6,091	Brushy Creek	7,575	1/1/1995 - 06/13/2005
E-102	N F Edisto River	39,825	Black Creek	27,322	1/1/1995 - 12/19/2006
RS-01004	Horse Pen Creek	662	Brushy Creek	7,575	1/1/1995 - 06/13/2005

The flows for Chinquapin Creek and North Fork Edisto River at the three water quality monitoring sites were estimated by multiplying the daily flow rates from the reference gauges by the ratio of the TMDL drainage areas to that of the reference gauges. The flows were ranked from low to high and the values that exceed certain selected percentiles determined. The load-duration curve was generated by calculating the load from the observed fecal coliform concentrations, the flow rate that corresponds to the date of sampling, and a conversion factor. Fecal coliform data from 1999 through 2001 was used for Chinquapin Creek and 2001-2005 for the N F Edisto River locations.

The load was plotted against the appropriate flow recurrence interval to generate the curve (Figures 5 - 8). The target line was created by calculating the allowable load from the flow and the appropriate fecal coliform standard concentration in the same manner. Sample loads above this line are violations of the standard, while loads below the line are in compliance.

The water quality target was set at 380 cfu/100ml for the instantaneous criterion, which allows a Margin of Safety of 20 cfu/100ml (5 % of 400 cfu/100ml). This explicit Margin of Safety (MOS) was reserved from the water quality criteria rather than an implicit MOS. Only the instantaneous water quality criterion was targeted because there is insufficient data to evaluate against the 30-day geometric mean.

An existing load was determined for each hydrologic category for the TMDL calculations. The 90th percentile of measured fecal coliform concentration within each hydrologic category was multiplied by the flow at each category midpoint (i.e., flow at the 25% duration interval for the Moist Conditions, 50% interval for Mid-Range, and 75% for Dry Condition). The high and low flow categories are excluded because they occur infrequently. Existing loads are plotted on the load-duration curves presented in Figures 5 - 8. These values were compared to the target load (which includes an explicit 5% MOS) at each hydrologic category midpoint to determine the percent load reduction necessary to achieve compliance with the WQS. This TMDL assumes that if the highest percent reduction is achieved then the WQS will be attained under all flow conditions.

The TMDL load is calculated from the target fecal coliform concentration and the mid-point flow for each hydrologic category. The Load Allocation (LA) values are derived from the 380 cfu/100ml water quality target, which is the standard minus the explicit Margin of Safety. Calculations for both existing and TMDL loads are provided in Appendix C.

Table 6. Land uses for watersheds used for flow calculations.

	Brushy Creek at USGS Gauge		**Black Creek at USGS Gauge**	
Land Use Class	**Hectares**	**Percent**	**Hectares**	**Percent**
Water	45	0.3%	151	0.6%
Developed	1,415	8.5%	1,704	6.2%
Barren	35	0.2%	219	0.8%
Forest	6,336	38.2%	13,115	47.9%
Scrub/Shrub	557	3.4%	456	1.7%
GrasslandHerbaceous	2,279	13.7%	5,475	20.0%
Pasture/Hay	1,408	8.5%	1,196	4.4%
Cultivated Crops	3,192	19.2%	1,915	7.0%
Wetlands	1,324	8.0%	3,155	11.5%
Total	16,591	100.0%	27,385	100.0%

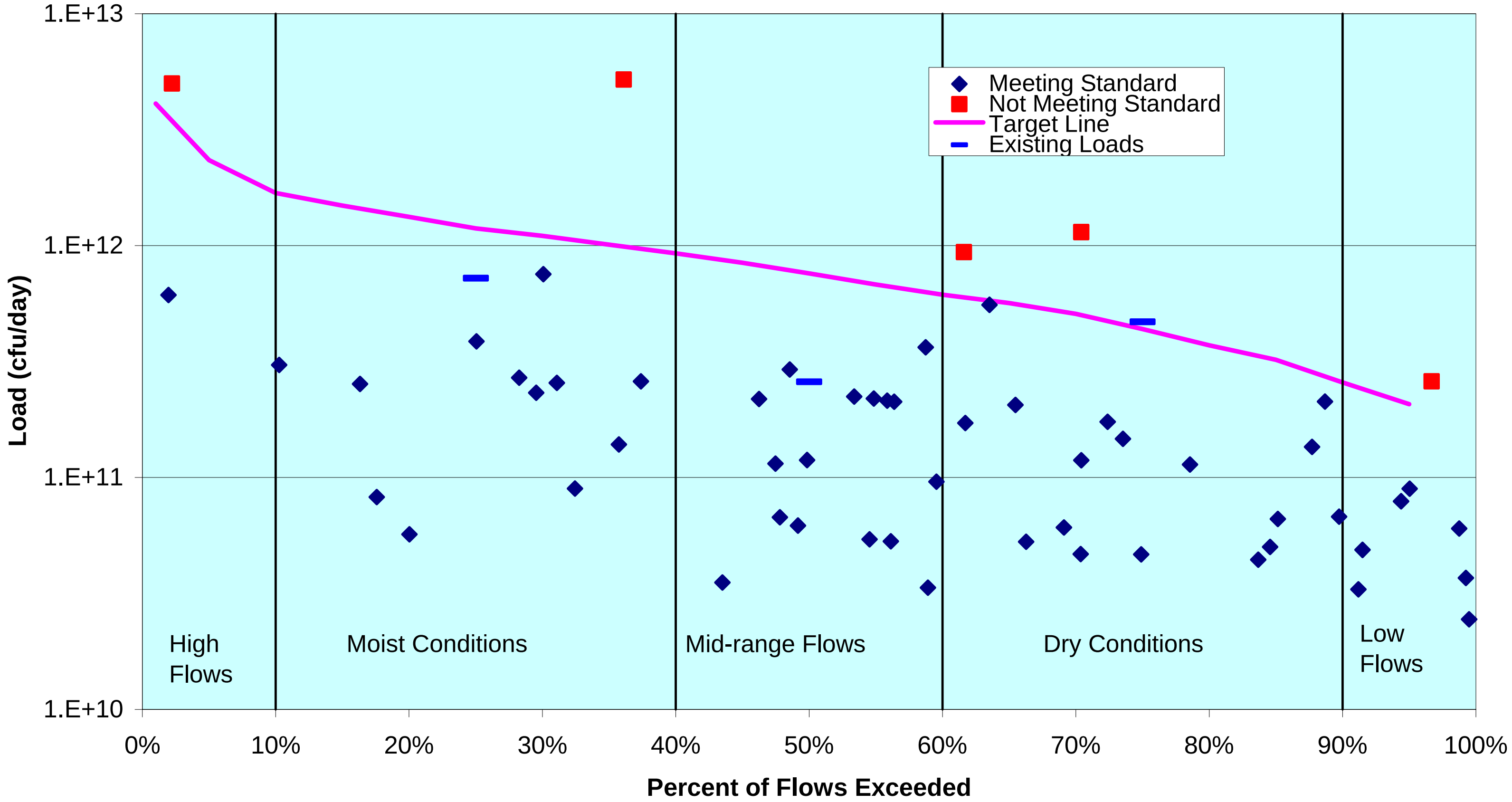

Figure 5. Load-Duration Curve for North Fork Edisto River at E-084.

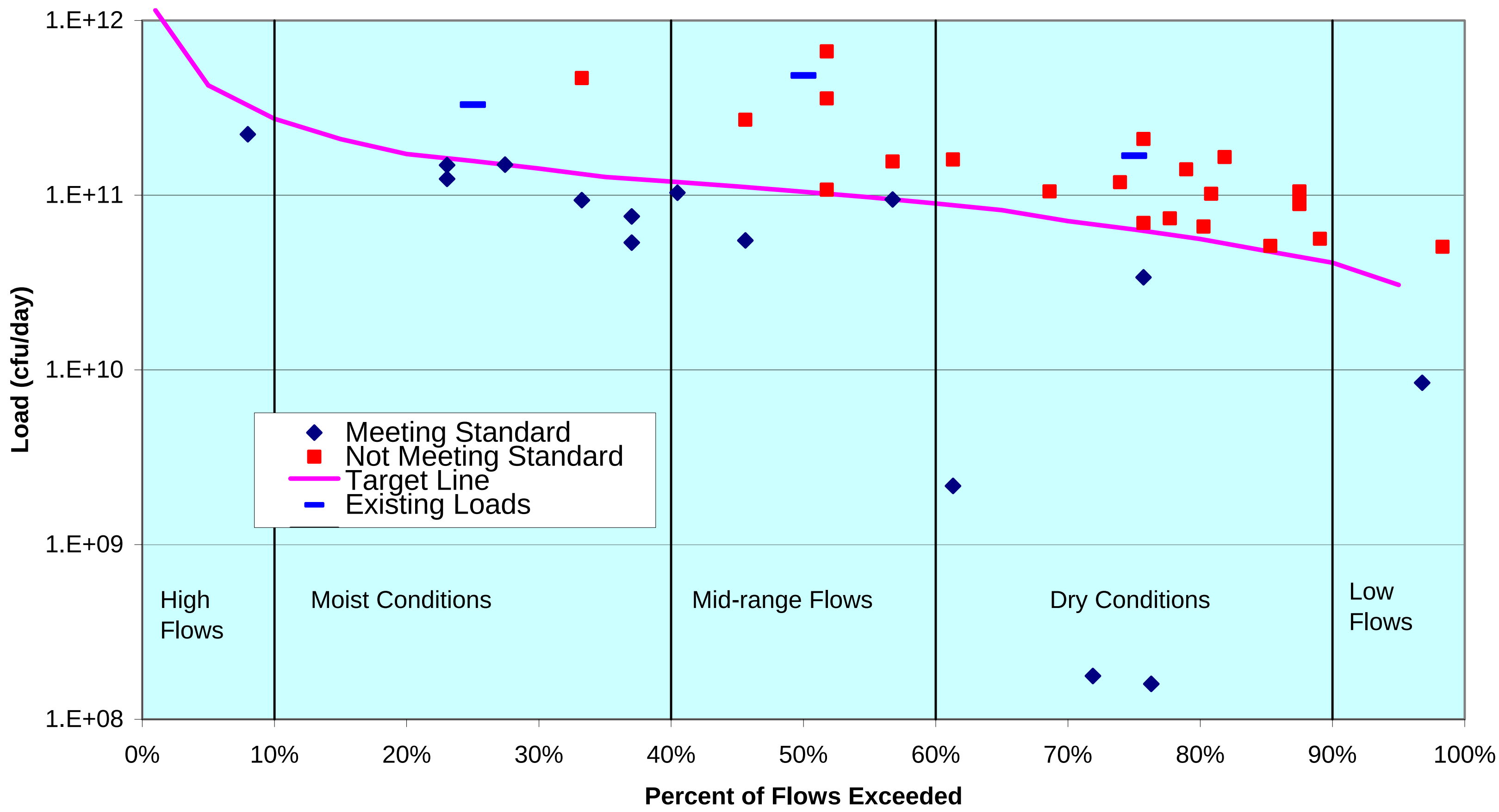

Figure 6. Load-Duration Curve for Chinquapin Creek at E-091.

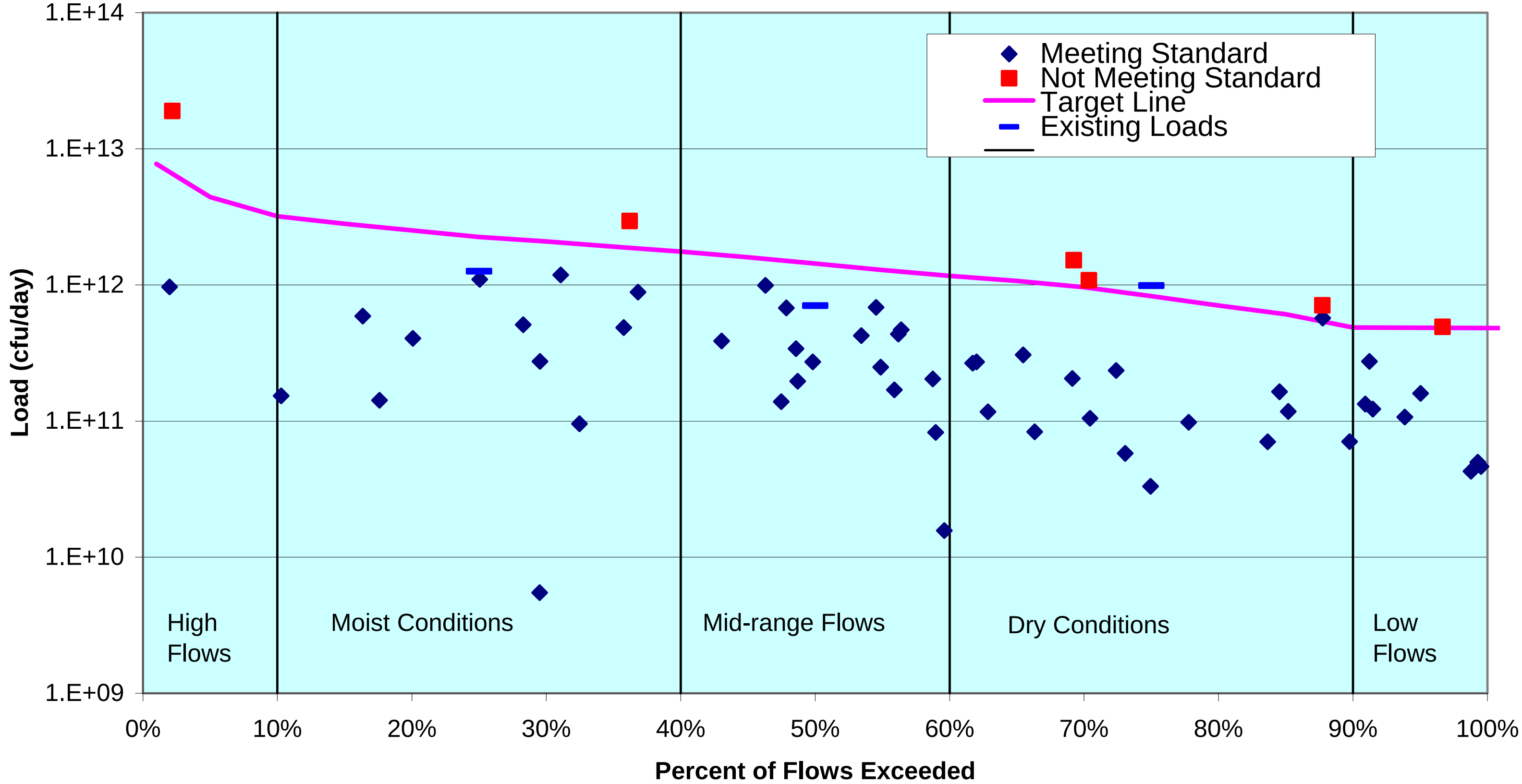

Figure 7. Load-Duration Curve for North Fork Edisto River at E-102.

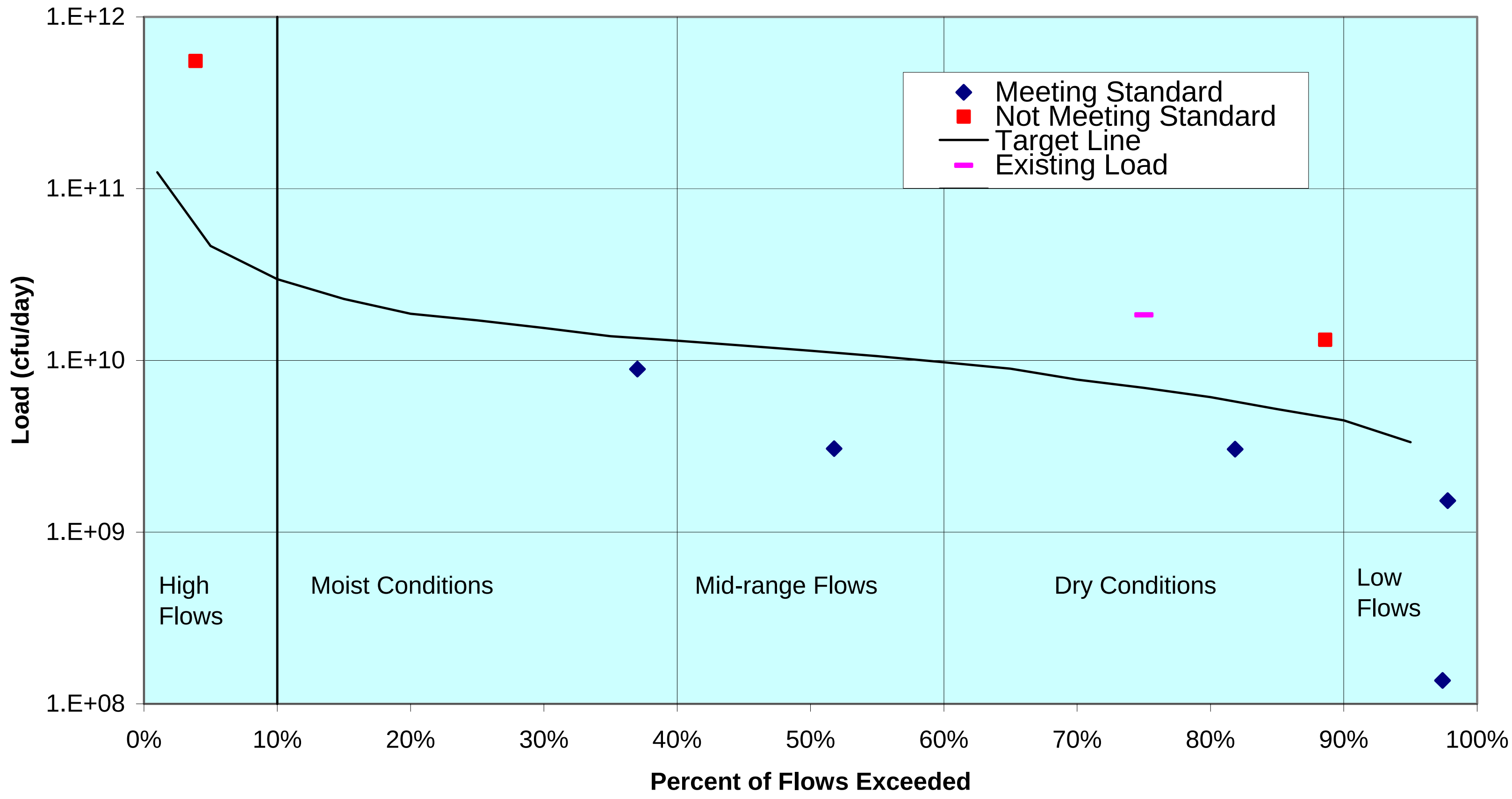

Figure 8. Load-Duration Curve for Horse Pen Creek at RS-01004.

5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

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

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

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

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

5.1 Critical Conditions

This TMDL is based on the flow recurrence interval between 10 % and 90 %, which excludes the more extreme low and high flow conditions. The TMDL is determined from the hydrologic category that requires the largest percent reduction in load. The critical flow condition for both locations on the N F Edisto were dry conditions (Table 7). However, for Chinquapin Creek mid-range flows were the critical condition.

Table 7. Critical flow conditions for TMDLs.

Stations	Waterbody	Moist Conditions	Mid-Range Flows	Dry Conditions
E-084	N F Edisto River	NRN	NRN	6.9%
E-091	Chinquapin Creek	52.5%	78.4%	62.7%
E-102	N F Edisto River	NRN	NRN	16.3%
RS-01004	Horse Pen Creek	NRN	NRN	62.4%

Highlighted cells indicate critical flow conditions
NRN indicates No Reduction Required; load is below target.

5.2 Wasteload Allocation

The wasteload allocation (WLA) is the portion of the TMDL allocated to point sources (US EPA, 1999).

5.2.1 Continuous Point Sources

The single continuous point source, the Town of Batesburg-Leesville WWTF (SC0024465), has a WLA of 3.8E+10 cfu/day, based on the daily maximum of 400 cfu/100 ml.

5.2.2 Intermittent Point Sources

Intermittent point sources include all NPDES-permitted stormwater discharges, including current and future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction instead of a numeric loading due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet the TMDL percentage reduction or the existing instream standard for the pollutant of concern, whichever is less restrictive, to the maximum extent practicable. The percent reduction applied is the same as that applied to the existing load. This watershed has no MS4s at the time that this TMDL is being completed.

5.3 Load Allocation

The Load Allocation is determined by subtracting the MOS and any WLA from the TMDL load and applies to the nonpoint sources of fecal coliform bacteria. It is expressed both as a load and as a percent reduction.

5.4 Existing Load

The existing loads were calculated from the 90 th percentile fecal coliform concentrations and the mid-point flow by hydrologic category. The hydrologic range below 10 % and above 90 % were excluded because of the extreme nature of these flows. Loadings from all sources are included in this value: runoff, cattle-in-streams, and failing septic systems. The existing loads for all stations are provided in Table 8.

5.5 Margin of Safety

The margin of safety (MOS) for these TMDLS is explicit. The explicit margin of safety is 5 % of the TMDL calculated as the difference between the instantaneous criterion of 400 cfu/100 ml and the target load which is calculated from 95% of the standard. The calculated values of the Margin of Safety are given in Table 8.

5.6 TMDL

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of cfu or organism counts per day, in accordance with 40 CFR 130.2(l). The water quality target was set at 380 cfu/100ml for the instantaneous criterion. Only the instantaneous water quality criterion was targeted because there is insufficient data to evaluate against a 30-day geometric mean.

The target loading value is the load to the creek that it can receive and meet the water quality standard. It is simply the TMDL minus the MOS. Values for each component of the TMDL for the four locations in the North Fork Edisto watershed are provided in Table 8. The required reductions in load, expressed as a percentage are also provided.

Table 8. TMDL components for Chinquapin and Horse Pen Creeks and N F Edisto River.

Station ID	TMDL	MOS	WLA		LA	Existing Load	% Reduction to Meet
	(cfu/day)	(cfu/day)	Continuous Sources[1] (cfu/day)	Intermittent Sources[2] (% Reduction)	(cfu/day)	(cfu/day)	Load Allocation[3]
E-084	4.60E+11	2.30E+10		6.9 %	4.37E+11	4.69E+11	6.9 %
E-091	1.10E+11	5.50E+09	1.89E+10	78 %	1.05E+11	4.84E+11	78 %
E-102	8.72E+11	4.36+10		16 %	9.90E+11	2.68E+12	16 %
RS-01004	7.28E+09	3.64E+08		62 %	6.92E+09	1.84E+10	62 %

Table Notes:

1 - WLA is expressed as total monthly average.

2 - Percent reduction applies to all NPDES-permitted stormwater discharges, including future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet percentage reduction or the existing instream standard for pollutant of concern, whichever is less restrictive, to the maximum extent practicable.

3 - Percent reduction applies to existing load; Where Percentage Reduction = (Existing Load-Load Allocation) / Existing Load

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

SCDHEC is empowered under the State Pollution Control Act to perform investigations of and pursue enforcement for activities and conditions, which threaten the quality of waters of the state.

In addition, other interested parties (universities, local watershed groups, etc.) may apply for section 319 grants to install BMPs that will implement the load allocation portion of this TMDL and reduce non-point source fecal coliform loading to Chinquapin Creek and the N F Edisto River. TMDL implementation projects are given highest priority for 319 funding.

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

Using existing authorities and mechanisms, these measures will be implemented in these two watersheds in order to bring about the required reductions in fecal coliform bacteria loading to Chinquapin Creek and N F Edisto River. DHEC will continue to monitor, according to the basin monitoring schedule, the effectiveness of implementation measures and evaluate stream water quality as the implementation strategy progresses.

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APPENDIX A Fecal Coliform Data

Table A-1 Fecal coliform data for Chinquapin & Horse Pen Creeks and N F Edisto River.

Station	Date	C	FC (cfu/100ml)
E-091	1/5/1999		400
E-091	2/3/1999		270
E-091	3/1/1999		280
E-091	4/6/1999		350
E-091	5/12/1999		700
E-091	6/10/1999		780
E-091	7/7/1999		550
E-091	8/2/1999		480
E-091	9/8/1999		920
E-091	10/26/1999		2600
E-091	11/8/1999		1400
E-091	12/7/1999		980
E-091	1/5/2000		1400
E-091	2/2/2000		360
E-091	3/6/2000		660
E-091	4/5/2000		740
E-091	4/5/2000		10
E-091	5/4/2000		720
E-091	6/22/2000		1300
E-091	7/11/2000		240
E-091	8/7/2000		400
E-091	9/13/2000		420
E-091	10/3/2000		460
E-091	11/2/2000		420
E-091	12/6/2000		1200
E-091	1/22/2001		200
E-091	2/15/2001		170
E-091	3/12/2001		300
E-091	4/10/2001	>	1
E-091	6/28/2001		940
E-091	7/17/2001		920
E-091	8/6/2001		520
E-091	9/4/2001		430
E-091	10/22/2001		130
E-091	11/19/2001	>	1
E-091	12/5/2001		210

Station	Date	C	FC (cfu/100ml)
E-084	1/22/2001		260
E-084	2/15/2001		80
E-084	3/12/2001		220
E-084	4/10/2001		55
E-084	6/28/2001		110
E-084	7/17/2001		140
E-084	8/6/2001		170
E-084	9/4/2001		30
E-084	10/22/2001		140
E-084	11/19/2001	>	1
E-084	12/5/2001		100
E-084	1/17/2002		110
E-084	2/4/2002		140
E-084	3/13/2002		360
E-084	4/2/2002		90
E-084	5/13/2002	>	600
E-084	6/11/2002		200
E-084	7/9/2002		100
E-084	8/6/2002		140
E-084	9/18/2002		180
E-084	10/10/2002		45
E-084	11/5/2002		80
E-084	12/5/2002		120
E-084	1/16/2003		90
E-084	2/12/2003		32
E-084	3/12/2003		68
E-084	4/30/2003		22
E-084	5/27/2003		60
E-084	6/18/2003	>	2000
E-084	7/31/2003		880
E-084	8/27/2003		30
E-084	9/30/2003		40
E-084	10/28/2003		100
E-084	11/6/2003		120
E-084	12/1/2003		30
E-084	1/7/2004		58
E-084	2/18/2004		16
E-084	3/24/2004		20
E-084	4/5/2004		36
E-084	5/5/2004		32
E-084	6/1/2004		290
E-084	7/27/2004	>	600

Station	Date	C	FC (cfu/100ml)
E-084	8/25/2004		50
E-084	9/1/2004	>	600
E-084	10/4/2004		90
E-084	11/2/2004		120
E-084	12/2/2004		120
E-084	1/25/2005		120
E-084	2/10/2005		140
E-084	3/3/2005		65
E-084	4/5/2005		52
E-084	5/18/2005		35
E-084	6/7/2005		15
E-084	7/6/2005		120
E-084	8/10/2005		100
E-084	9/26/2005		74
E-084	10/24/2005		58
E-084	11/9/2005		50
E-084	12/5/2005		58

Station	Date	C	FC (cfu/100ml)
E-102	1/22/2001	>	1
E-102	2/15/2001		50
E-102	3/12/2001		65
E-102	4/10/2001		35
E-102	6/28/2001		90
E-102	7/17/2001		110
E-102	8/6/2001		160
E-102	9/4/2001		200
E-102	10/22/2001		100
E-102	11/19/2001		110
E-102	12/5/2001		55
E-102	1/17/2002		50
E-102	2/4/2002		100
E-102	3/13/2002		40
E-102	4/2/2002		220
E-102	5/13/2002		92
E-102	6/11/2002		75
E-102	7/9/2002		100
E-102	8/6/2002		100
E-102	9/18/2002		400
E-102	10/10/2002		80
E-102	11/5/2002		75
E-102	12/5/2002		25
E-102	1/16/2003		42

Station	Date	C	FC (cfu/100ml)
E-102	2/12/2003		18
E-102	3/12/2003		18
E-102	4/30/2003		20
E-102	5/27/2003		50
E-102	6/18/2003		180
E-102	7/31/2003		440
E-102	8/27/2003		50
E-102	9/30/2003		15
E-102	10/28/2003		240
E-102	11/6/2003		120
E-102	12/1/2003		130
E-102	1/7/2004		5
E-102	2/18/2004		60
E-102	3/24/2004		26
E-102	4/5/2004		30
E-102	5/5/2004		170
E-102	6/1/2004		510
E-102	7/27/2004	>	600
E-102	8/25/2004		220
E-102	9/1/2004	>	1200
E-102	10/4/2004		90
E-102	11/2/2004		140
E-102	12/2/2004		50
E-102	1/25/2005		72
E-102	2/10/2005		86
E-102	3/3/2005		80
E-102	4/5/2005		96
E-102	5/18/2005	>	600
E-102	6/7/2005		87
E-102	7/6/2005		180
E-102	8/10/2005	>	600
E-102	9/26/2005		98
E-102	10/24/2005		100
E-102	11/9/2005		42
E-102	12/5/2005		70

Station	Date	C	FC (cfu/100ml)
RS-01004	1/18/2001		110
RS-01004	2/20/2001		260
RS-01004	4/30/2001		200
RS-01004	5/16/2001		230
RS-01004	6/13/2001		3800
RS-01004	7/25/2001		1100
RS-01004	9/12/2001		20

Table A-2 Statistics for all fecal coliform data in Chinquapin and Horse Pen Creeks and N F Edisto River (1999-2005) (cfu/100ml).

Location	**Stream**	**Geometric Mean (cfu/ 100ml)**	**Mean (cfu/ 100ml)**	**Minimum**	**Maximum**	**% Exceeding Standard**
E-084	North Fork Edisto River	87	167	1	2000	8.5%
E-091	Chinquapin Creek	332	607	1	1200	58.3%
E-102	North Fork Edisto River	83	150	1	1200	10.2%
RS-01004	Horse Pen Creek	272	817	20	3800	28.6%

APPENDIX B DMR Data

Table B-1. DMR Data for Batesburg-Leesville WWTF SC0024465.

Date		Mean FC (cfu/100 ml)
1/31/1998		130
2/28/1998		170
3/31/1998		170
4/30/1998		80
5/31/1998		40
6/30/1998		40
7/31/1998		20
8/31/1998		20
9/30/1998		230
10/31/1998		40
11/30/1998		130
12/31/1998		80
1/31/1999		20
2/28/1999		20
3/31/1999		40
4/30/1999		80
5/31/1999		40
6/30/1999		230
7/31/1999	<	20
8/31/1999		230
9/30/1999		130
10/31/1999		40
11/30/1999		80
12/31/1999		130
1/31/2000		80
2/29/2000		20
3/31/2000		40
4/30/2000		40
5/31/2000		20
6/30/2000		80
7/31/2000		170
8/31/2000		230
9/30/2000		130
10/31/2000		20
11/30/2000		170

Date		Mean FC (cfu/100 ml)
12/31/2000		20
1/31/2001		300
2/28/2001		230
3/31/2001	<	20
4/30/2001	<	2
5/31/2001		23
6/30/2001		2
7/31/2001		2
8/31/2001		4
9/30/2001		2
10/31/2001		17
11/30/2001		50
12/31/2001		23
1/31/2002		4
2/28/2002		4
3/31/2002		2
4/30/2002		8
5/31/2002		27
6/30/2002		30
7/31/2002		50
8/31/2002		30
9/30/2002		11
10/31/2002		170
11/30/2002		50
12/31/2002		33
1/31/2003		8
2/28/2003		8
3/31/2003		33
4/30/2003		8
5/31/2003		13
6/30/2003		8
7/31/2003		23
8/31/2003		170
9/30/2003		17
10/31/2003		70
11/30/2003		50
12/31/2003		110
1/31/2004		11
2/29/2004		11
3/31/2004		17
4/30/2004		11
5/31/2004		33

Date		Mean FC (cfu/100 ml)
6/30/2004		17
7/31/2004		17
8/31/2004		11
9/30/2004		30
10/31/2004		11
11/30/2004		30
12/31/2004		30
1/31/2005		23
2/28/2005		13
3/31/2005		14
4/30/2005		30
5/31/2005		22
6/30/2005		17
7/31/2005		30
8/31/2005		22
9/30/2005		17
10/31/2005		30
11/30/2005		17
12/31/2005		7
2/28/2006		4
3/31/2006		8
4/30/2006		8
5/31/2006		17
6/30/2006		30
7/31/2006		8
8/31/2006		8

APPENDIX C Calculation of Existing and TMDL Loads

Existing Load = Mid-Point Flow *x* 90th Percentile Conc *x* 10000
Target Load = Mid-Point Flow *x* 380 x 10000
Percent Reduction = (Existing Load – Target Load) / Existing Load

Table C-1. Calculation of existing loads, target loads, and percent reductions for E-091 Chinquapin Creek.

Date	FC (cfu/ 100ml)	Rank of Flows	Percen- tile	Mid-point Flow (m^3/day)	90th Percentile FC Conc	Existing Load (cfu/day)	Target Load	Percent Reduction
High Flows								
2/3/1999	270	3512	8.0%					
Moist Conditions (Midpoint: 25%)				4.13E+04	800	3.30E+11	1.57E+11	52.5%
1/5/2000	1400	2548	33.2%					
1/5/1999	400	2770	27.4%					
2/2/2000	360	2937	23.1%					
3/12/2001	300	2937	23.1%					
3/1/1999	280	2548	33.2%					
7/11/2000	240	2404	37.0%					
2/15/2001	170	2404	37.0%					
Mid-Range Flows (Midpoint: 50%)				**2.75E+04**	**1760**	**4.84E+11**	**1.05E+11**	**78.4%**
10/26/1999	2600	1841	51.8%					
11/8/1999	1400	1841	51.8%					
12/7/1999	980	2076	45.6%					
3/6/2000	660	1651	56.7%					
9/13/2000	420	1841	51.8%					
8/7/2000	400	1651	56.7%					
4/6/1999	350	2272	40.5%					
1/22/2001	200	2076	45.6%					
Dry Conditions (Midpoint: 75%)				1.65E+04	1018	1.68E+11	6.27E+10	62.7%
6/22/2000	1300	927	75.7%					
12/6/2000	1200	693	81.8%					
6/28/2001	940	804	78.9%					
9/8/1999	920	477	87.5%					
6/10/1999	780	477	87.5%					
4/5/2000	740	1477	61.3%					
5/4/2000	720	732	80.8%					
5/12/1999	700	995	73.9%					
7/7/1999	550	1198	68.6%					
8/6/2001	520	418	89.0%					
8/2/1999	480	851	77.7%					
10/3/2000	460	754	80.2%					
9/4/2001	430	927	75.7%					
11/2/2000	420	561	85.3%					
12/5/2001	210	927	75.7%					

4/5/2000	10	1477	61.3%					
4/10/2001	1	1073	71.9%					
11/19/2001	1	905	76.3%					
Low Flows								
10/22/2001	130	123	96.8%					
7/17/2001	920	64	98.3%					

Table C-2. Calculation of existing loads, target loads, and percent reductions for E-084 N F Edisto River.

Date	FC (cfu/ 100ml)	Rank of Flows	Percen-tile of Flows	Mid-point Flow (m^3/day)	90th Percentile FC Conc	Existing Load (cfu/day)	Target Load	Percent Reduction
High Flows								
9/1/2004	600	3659	2.3%					
5/27/2003	60	3669	2.0%					
Moist Conditions (Midpoint: 25%)				3.12E+05	232	7.24E+11	1.19E+12	-63.8%
6/18/2003	2000	2390	36.2%					
1/22/2001	260	2616	30.1%					
7/6/2005	120	2804	25.1%					
8/10/2005	100	2342	37.5%					
10/4/2004	90	2684	28.3%					
4/2/2002	90	2578	31.2%					
2/15/2001	80	2636	29.6%					
3/12/2003	68	3358	10.3%					
3/3/2005	65	3131	16.4%					
4/5/2005	52	2404	35.8%					
2/12/2003	32	2527	32.5%					
4/30/2003	22	3084	17.7%					
2/18/2004	16	2992	20.1%					
Mid-Range Flows (Midpoint: 50%)				1.99E+05	130	2.59E+11	7.56E+11	-192.3%
3/12/2001	220	1542	58.8%					
2/10/2005	140	1924	48.6%					
11/6/2003	120	1743	53.5%					
1/25/2005	120	1688	54.9%					
12/2/2004	120	1650	55.9%					
11/2/2004	120	1631	56.4%					
10/28/2003	100	2010	46.3%					
12/5/2005	58	1875	49.9%					
1/7/2004	58	1512	59.6%					
4/10/2001	55	1964	47.6%					

5/5/2004	32	1952	47.9%					
8/27/2003	30	1901	49.2%					
9/4/2001	30	1700	54.6%					
12/1/2003	30	1640	56.2%					
3/24/2004	20	1536	59.0%					
6/7/2005	15	2113	43.6%					
Dry Conditions (Midpoint: 75%)				**1.15E+05**	**408**	**4.69E+11**	**4.37E+11**	**6.9%**
7/31/2003	880	1105	70.5%					
5/13/2002	600	1435	61.7%					
3/13/2002	360	1363	63.6%					
6/1/2004	290	421	88.8%					
9/18/2002	180	457	87.8%					
7/17/2001	140	1290	65.6%					
2/4/2002	140	1031	72.5%					
12/5/2002	120	988	73.6%					
6/28/2001	110	1431	61.8%					
1/17/2002	110	800	78.6%					
12/5/2001	100	381	89.8%					
1/16/2003	90	1105	70.5%					
11/5/2002	80	553	85.2%					
10/24/2005	58	575	84.6%					
11/9/2005	50	608	83.8%					
10/10/2002	45	1154	69.2%					
9/30/2003	40	937	75.0%					
4/5/2004	36	1260	66.4%					
5/18/2005	35	1107	70.4%					
Low Flows								
7/27/2004	600	121	96.8%					
6/11/2002	200	44	98.8%					
8/6/2001	170	183	95.1%					
10/22/2001	140	207	94.5%					
8/6/2002	140	25	99.3%					
7/9/2002	100	16	99.6%					
9/26/2005	74	315	91.6%					
8/25/2004	50	327	91.3%					
11/19/2001	1	337	91.0%					

Table C-3. Calculation of existing loads, target loads, and percent reductions for E-102 N F Edisto River.

Date	FC (cfu/ 100ml)	Flow (m^3/day)	Rank	Percen-tile	Mid-point Flow (m^3/day)	90th Percentile FC Conc	Existing Load (cfu/day)	Target Load	Per-cent Reduction
High Flows									
9/1/2004	1200	1.58E+06	3660	2.3%					
5/27/2003	50	1.94E+06	3668	2.1%					
Moist Conditions (Midpoint: 25%)					5.92E+05	212	1.26E+12	2.25E+12	-79.2%
8/10/2005	600	4.92E+05	2386	36.3%					
4/2/2002	220	5.38E+05	2578	31.2%					
7/6/2005	180	6.10E+05	2804	25.1%					
6/18/2003	180	4.92E+05	2363	36.9%					
4/5/2005	96	5.06E+05	2403	35.8%					
10/4/2004	90	5.67E+05	2683	28.4%					
3/3/2005	80	7.38E+05	3130	16.4%					
2/18/2004	60	6.74E+05	2990	20.2%					
2/15/2001	50	5.49E+05	2636	29.6%					
4/30/2003	20	7.10E+05	3083	17.7%					
3/12/2003	18	8.52E+05	3357	10.4%					
2/12/2003	18	5.31E+05	2526	32.6%					
1/22/2001	1	5.49E+05	2637	29.6%					
Mid-Range Flows (Midpoint: 50%)					3.80E+05	185	7.03E+11	1.44E+12	-105%
10/28/2003	240	4.14E+05	2008	46.4%					
9/4/2001	200	3.42E+05	1700	54.6%					
5/5/2004	170	3.99E+05	1950	47.9%					
11/2/2004	140	3.35E+05	1630	56.5%					
12/1/2003	130	3.35E+05	1638	56.3%					
11/6/2003	120	3.53E+05	1741	53.5%					
6/7/2005	87	4.46E+05	2130	43.1%					
2/10/2005	86	3.96E+05	1923	48.7%					
1/25/2005	72	3.46E+05	1687	55.0%					
12/5/2005	70	3.89E+05	1876	49.9%					
3/12/2001	65	3.14E+05	1542	58.8%					
8/27/2003	50	3.92E+05	1918	48.8%					
12/2/2004	50	3.39E+05	1649	56.0%					
4/10/2001	35	3.96E+05	1964	47.6%					
3/24/2004	26	3.17E+05	1534	59.0%					
1/7/2004	5	3.14E+05	1510	59.7%					
Dry Conditions (Midpoint: 75%)					**2.18E+05**	**454**	**9.90E+11**	**8.28E+11**	**16.3%**
5/18/2005	600	2.53E+05	1149	69.3%					

6/1/2004	510	1.39E+05	457	87.8%					
7/31/2003	440	2.46E+05	1107	70.4%					
9/18/2002	400	1.43E+05	456	87.8%					
7/17/2001	110	2.78E+05	1290	65.6%					
2/4/2002	100	2.35E+05	1031	72.5%					
10/24/2005	100	1.64E+05	576	84.6%					
5/13/2002	92	2.96E+05	1420	62.1%					
6/28/2001	90	2.96E+05	1431	61.8%					
10/10/2002	80	2.57E+05	1153	69.2%					
11/5/2002	75	1.57E+05	552	85.3%					
12/5/2001	55	1.28E+05	381	89.8%					
1/17/2002	50	1.96E+05	829	77.9%					
1/16/2003	42	2.50E+05	1104	70.5%					
11/9/2005	42	1.68E+05	609	83.7%					
3/13/2002	40	2.92E+05	1388	62.9%					
4/5/2004	30	2.78E+05	1258	66.4%					
12/5/2002	25	2.32E+05	1006	73.1%					
9/30/2003	15	2.21E+05	935	75.0%					
Low Flows									
7/27/2004	600	8.20E+04	122	96.7%					
8/25/2004	220	1.25E+05	326	91.3%					
8/6/2001	160	9.99E+04	183	95.1%					
11/19/2001	110	1.21E+05	337	91.0%					
10/22/2001	100	1.07E+05	227	93.9%					
8/6/2002	100	4.99E+04	24	99.4%					
7/9/2002	100	4.64E+04	15	99.6%					
9/26/2005	98	1.25E+05	316	91.6%					
6/11/2002	75	5.71E+04	43	98.9%					

Table C-4. Calculation of existing loads, target loads, and percent reductions for RS-01004 Horse Pen Creek.

Date	FC (cfu/ 100ml)	Rank of Flows	Percen- tile	Mid-point Flow (m^3/day)	90th Percentile FC Conc	Existing Load (cfu/day)	Target Load	Percent Reduction
High Flows								
6/13/2001	3800	3669	3.9%					
Moist Conditions (Midpoint: 25%)				4.49E+03	260	1.17E+10	1.71E+10	-46.2%
2/20/2001	260	2404	37.0%					
Mid-Range Flows (Midpoint: 50%)				2.99E+03	110	3.29E+09	1.14E+10	-245.5%
1/18/2001	110	1841	51.8%					
Dry Conditions (Midpoint: 75%)				**1.82E+03**	**1010**	**1.84E+10**	**6.92E+09**	**62.4%**
7/25/2001	1100	435	88.6%					
4/30/2001	200	693	81.8%					
Low Flows								
5/16/2001	230	84	97.8%					
9/12/2001	20	99	97.4%					

APPENDIX D Flow-duration Curve

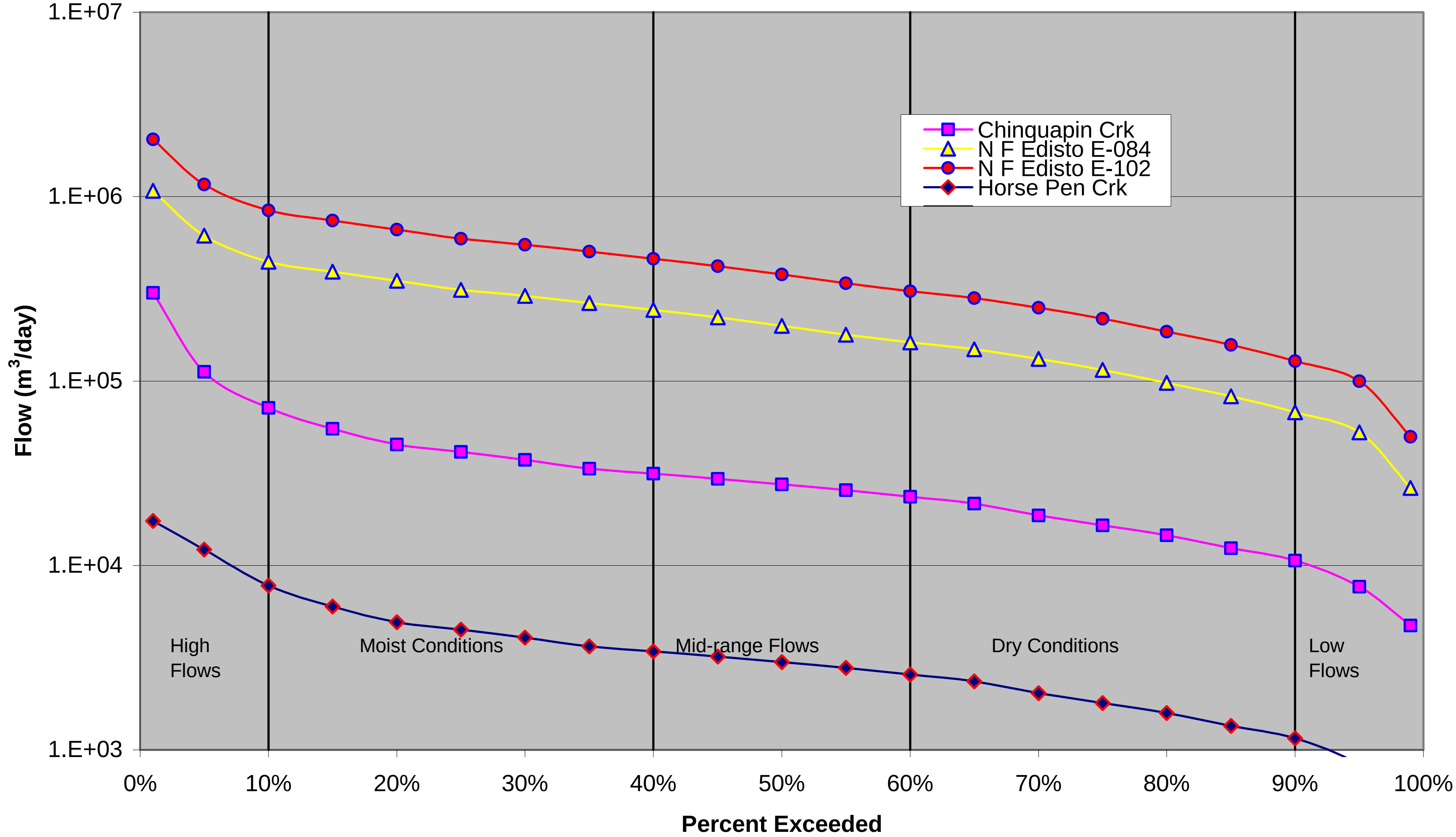

Figure D-1 Flow-duration curves for Chinquapin and Horse Pen Creeks and N F Edisto River.