Final Total Maximum Daily Load (TMDL)
for Fecal Coliform

August 2002
(Approved September, 2002)

Grants Creek (Subbasin 03-07-04)
Yadkin-Pee Dee River Basin
North Carolina

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INDEX OF TMDL SUBMITTAL

303(d) List Information

State	North Carolina
Basin	Yadkin-Pee Dee River Basin

303(d) Listed Waters

Name of Stream	Description	Class	Index #	8 Digit CU	Miles
Grants Creek	From source to Yadkin River	C	12-110	03040103	17.9

8 Digit Cataloging Unit(s)	03040103
Area of Impairment	17.9 miles
WQS Violated	Fecal Coliform
Pollutant of Concern	Fecal Coliform
Sources of Impairment	Point and nonpoint sources from entire watershed

Public Notice Information

Form of Public Notification: A draft of the Grants Creek Fecal Coliform TMDL was publicly noticed through various means, including notification in a local newspaper and published Cooperative Extension Newsletter. The TMDL was also available from the Division of Water Quality's website (http://h2o.enr.state.nc.us/tmdl/draft_TMDLS.htm) during the comment period. A public comment period was held for the 30 days prior to May 24, 2002. A public meeting was held in Salisbury on May 8, 2002.

Did notification contain specific mention of TMDL proposal? Yes

Were comments received from the public? Yes

Was a responsiveness summary prepared? A summary of the comments and DWQ's responses are included in Appendix VII of the TMDL document

TMDL Information

Critical condition	wet weather, spring
Seasonality	Modeled from 1995 - May 2001 to include fluctuations in seasonal fecal coliform loading.
Development tools	Coliform Routing and Allocation Program (CRAP)
Supporting documents	"Final Total Maximum Daily Load for Fecal Coliform, Grants Creek"

TMDL(s)

Loading allowed at critical condition:

Wasteload Allocation (WLA): 1.75×10^{11} cfu per 30 days
Load Allocation (LA): 2.18×10^{13} cfu per 30 days

Total Maximum Daily Load (TMDL)	Sources	Sub-Watershed	Wet Weather Fecal Coliform Loading Reductions	Dry Weather Fecal Coliform Loading Reductions
Wasteload Allocation (WLA)	WWTP	WS02-WS3	0%	0%
Load Allocation (LA)	High Density Development	WS01-WS03	94%	33%
	Low Density Development	WS01-WS03	94%	33%
	Livestock Grazing/Manure Application (Pastureland)	WS01-WS02	97%	60%
		WS3	85%	40%
	Manure Application (Cultivated)	WS01-WS02	97%	60%
	Wildlife	WS01-WS03	0%	0%

Margin of Safety	Explicit margin of safety of 25 cfu/100ml.

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1.0 INTRODUCTION

The North Carolina Division of Water Quality (DWQ) has identified a 17.9 mile segment (12-110-20) of Grants Creek in the Yadkin River Basin as impaired by fecal coliform bacteria as reported in the 2000 North Carolina 303(d) list. The creek is impaired from its source near the Town of Landis to its confluence with theYadkin River. This section of the stream is located in subbasin 03-07-04 and is designated as a class C water.[1]

Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. This list, referred to as the 303(d) list, is submitted biennially to the U.S. Environmental Protection Agency (EPA) for review. The 303(d) process requires that a Total Maximum Daily Load (TMDL) be developed for each of the waters appearing on Part I of the 303(d) list. The objective of a TMDL is to estimate allowable pollutant loads and allocate to known sources so that actions may be taken to restore the water to its intended uses (USEPA, 1991). Generally, the primary components of a TMDL, as identified by EPA (1991, 2000a) and the Federal Advisory Committee (FACA, 1998) are as follows:

Target identification or selection of pollutant(s) and end-point(s) for consideration. The pollutant and end-point are generally associated with measurable water quality related characteristics that indicate compliance with water quality standards. North Carolina indicates known pollutants on the 303(d) list.

Source assessment. All sources that contribute to the impairment should be identified and loads quantified, where sufficient data exist.

Reduction target. Estimation or level of pollutant reduction needed to achieve water quality goal. The level of pollution should be characterized for the waterbody, highlighting how current conditions deviate from the target end-point. Generally, this component is identified through water quality modeling.

[1] Class C waters are freshwaters that are protected for secondary recreation, fishing, aquatic life including propagation and survival of wildlife.

Allocation of pollutant loads. Allocating pollutant control responsibility to the sources of impairment. The wasteload allocation portion of the TMDL accounts for the loads associated with existing and future point sources. Similarly, the load allocation portion of the TMDL accounts for the loads associated with existing and future non-point sources, stormwater, and natural background.

Margin of Safety. The margin of safety addresses uncertainties associated with pollutant loads, modeling techniques, and data collection. Per EPA (2000a), the margin of safety may be expressed explicitly as unallocated assimilative capacity or implicitly due to conservative assumptions.

Seasonal variation. The TMDL should consider seasonal variation in the pollutant loads and end-point. Variability can arise due to stream flows, temperatures, and exceptional events (e.g., droughts, hurricanes).

Critical Conditions. Critical conditions indicate the combination of environmental factors that result in just meeting the water quality criterion and have an acceptably low frequency of occurrence.

Section 303(d) of the CWA and the Water Quality Planning and Management regulation (USEPA, 2000a) require EPA to review all TMDLs for approval or disapproval. Once EPA approves a TMDL, then the waterbody may be moved to Part III of the 303(d) list. Waterbodies remain on Part III of the list until compliance with water quality standards is achieved. Where conditions are not appropriate for the development of a TMDL, management strategies may still result in the restoration of water quality.

The goal of the TMDL program is to restore designated uses to water bodies. Thus, the implementation of bacteria controls will be necessary to restore uses in Grants Creek. Although an implementation plan is not included as part of this TMDL, reduction strategies are needed. The involvement of local governments and agencies will be critical in order to develop implementation plans and reduction strategies. DWQ will begin developing the implementation plan during public review of the TMDL.

1.1 Watershed Description

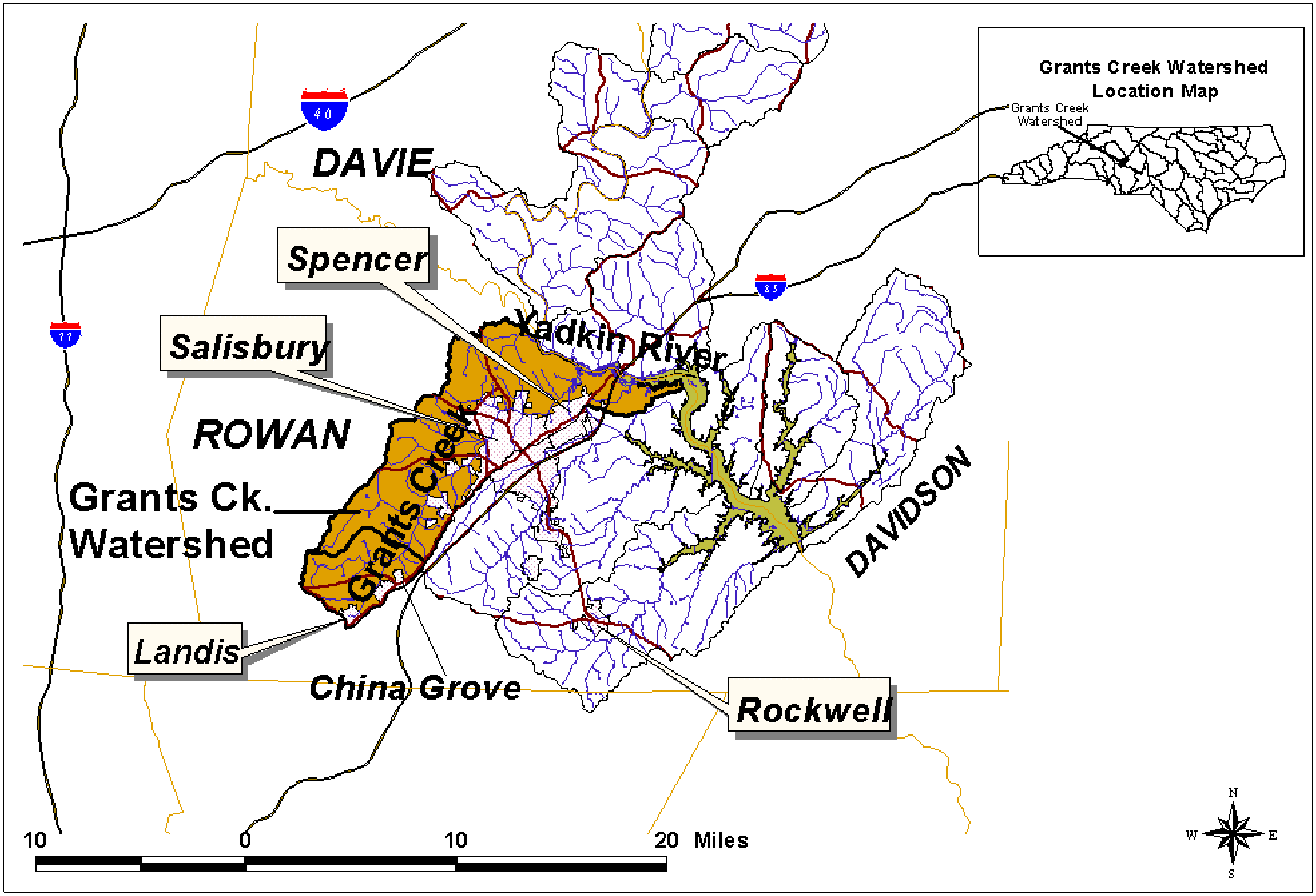
Grants Creek, located in the Yadkin-Pee Dee River Basin, drains into the Yadkin River. Figure 1 depicts the location of Grants Creek in North Carolina. The creek originates near the Town of Landis, and continues flowing for 17.9 miles through China Grove, Salisbury and Spencer to the Yadkin River. The Grants Creek watershed in the TMDL includes the drainage area above the confluence of Grants Creek and Yadkin River. The creek's watershed lies entirely within the High Rock Lake and Muddy Creek Watersheds (Subbasin # 03-07-04) in Rowan County. The USGS 14-digit hydraulic unit code (HUC) for Grants Creek is 03040103010010. The Grants Creek watershed comprises a total area of approximately 43,227 acres or 67.5 square miles. The creek flows near numerous industrial sites and multiple municipalities including Landis, China Grove, Rowan Mills, Salisbury, and Spencer. DWQ has an ambient water quality monitoring station near Spencer.

The land use/ land cover characteristics of the watershed were determined using 1996 land cover data. The North Carolina Center for Geographic Information and Analysis (NCCGIA), in cooperation with the NC Department of Transportation and USEPA Region IV Wetlands Division, contracted Earth Satellite Corporation (EarthSat) of Rockville, Maryland to generate comprehensive land cover data for the entire state of North Carolina. The majority of the Grants Creek Watershed is in upland hardwood forest. Pasture and uncultivated agricultural fields comprise the second largest land use group. Cultivated fields comprise the third largest land use. Developed areas are split into high and low intensity groups. The difference between these developed groups depends upon the concentration of impervious surfaces in an area mapped. The Grants Creek Watershed is considered a rural watershed, which means that approximately 10% of the watershed is covered with impervious surfaces (Schueler 1994). Land cover/land use coverage for the Grants Creek watershed is shown in Table 1.

Table 1. Estimated Land Use/Land Cover in the Grants Creek Watershed

Land Use/Land Cover	Description	% Of Watershed	Acres
Forested	Mostly Upland Hardwoods	57	24,639.39
Managed Herbaceous Cover	Pasture/Uncultivated Fields	23	9,942.21
Cultivated Lands	Crop lands	10	4,322.70
High Intensity Development	Over 80% Impervious Material	5	2,161.35
Low Intensity Development	50-80% Impervious	5	2,161.35
	Total:	**100**	**43,227.00**

Figure 1. Grants Creek Watershed



1.2 Water Quality Monitoring Program

Water quality data available from Grants Creek monitoring stations show high levels of fecal coliform bacteria in the creek. Water quality data from fecal coliform monitoring of Grants Creek comes from five primary sources. Figure 2 shows the locations of the monitoring stations in the Grants Creek watershed.

Data from DWQ's ambient monitoring station at Spencer (Q4600000 - Grants Creek below Salisbury and Spencer WWTP) were used to determine the impaired status of the creek. The fecal coliform samples were collected on a monthly interval beginning in April 1995 to the present. The fecal coliform concentrations of the samples collected at the DWQ ambient monitoring station ranged from 10cfu/100ml to 17,000 colony-forming-units (cfu)/100ml (Figure 3). The fecal coliform concentrations of the samples collected by the discharger coalition at stations Q4540000 and Q4600000 ranged from 1 cfu/100ml to 4,900 cfu/100ml, and 18 cfu/100ml to 6000 cfu/100mL, respectively, between July 1998 and April 2001 (Appendix III). Samples are collected at the DWQ ambient monitoring station and at the discharger coalition stations on a monthly basis. As a result, the 30-day geometric mean of the samples could not be calculated using the minimum required 5 samples in 30 days.

The Grants Creek and Spencer WWTPs monitored instream fecal coliform concentrations at upstream and downstream locations in years prior to the discharger coalition monitoring. The upstream/downstream fecal coliform concentration data are shown in figures 4 and 5, and Appendix IV and V.

Yadkin-Pee Dee River Basin Association discharger coalition (YRBA) has been monitoring fecal coliform levels at third street extension near Spencer, and below Salisbury and Spencer WWTPs since 1998. Data collected at discharger coalition stations are shown in Appendix III.

The Rowan County Environmental Services has conducted fecal coliform monitoring at three stations in the creek in 2000 and 2001 in support of Grants Creek Watershed Management Planning study funded by the Clean Water Management Trust Fund (CWMTF). Figure 6 shows the fecal coliform monitoring data from this study.

Finally, the most recent fecal coliform monitoring data come from a special study conducted by DWQ's Environmental Sciences Branch (ESB) in the spring of 2001 to support the TMDL development. In this study, 10 samples were collected from three sites over a six and one-half week period. The samples were collected at the ambient monitoring site, at the YRBA coalition site, and downstream of the Grants Creek WWTP. The purposes of this study were to evaluate whether the creek was complying with state fecal coliform standard, and to provide information on potential bacteria sources in the watershed. The data summary from this study is given in Table 2.

Figure 2. Grants Creek Fecal Coliform Bacteria Monitoring Location

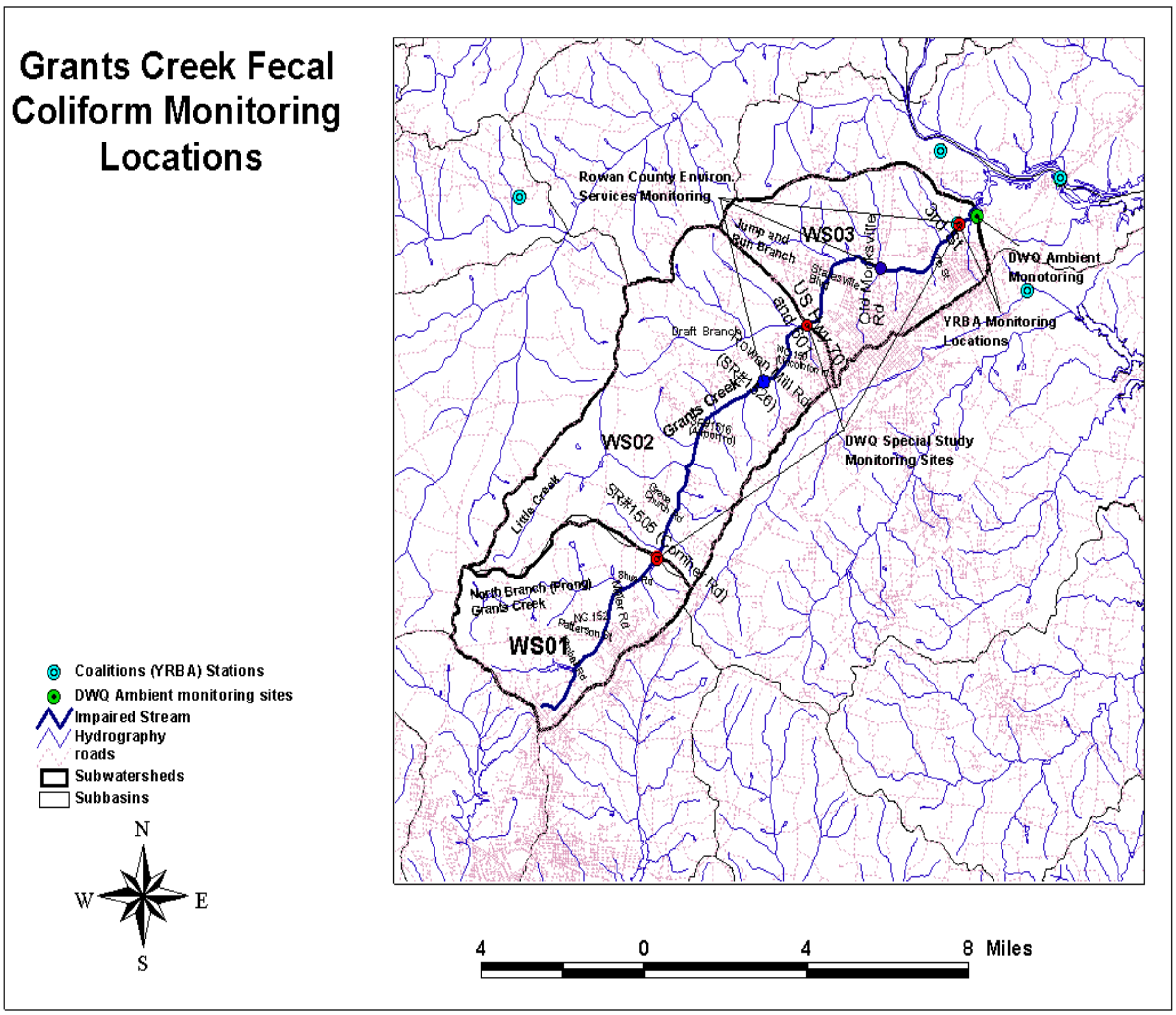


Figure 3. Grants Creek Fecal Coliform Levels at Spencer (DWQ Ambient Monitoring data)

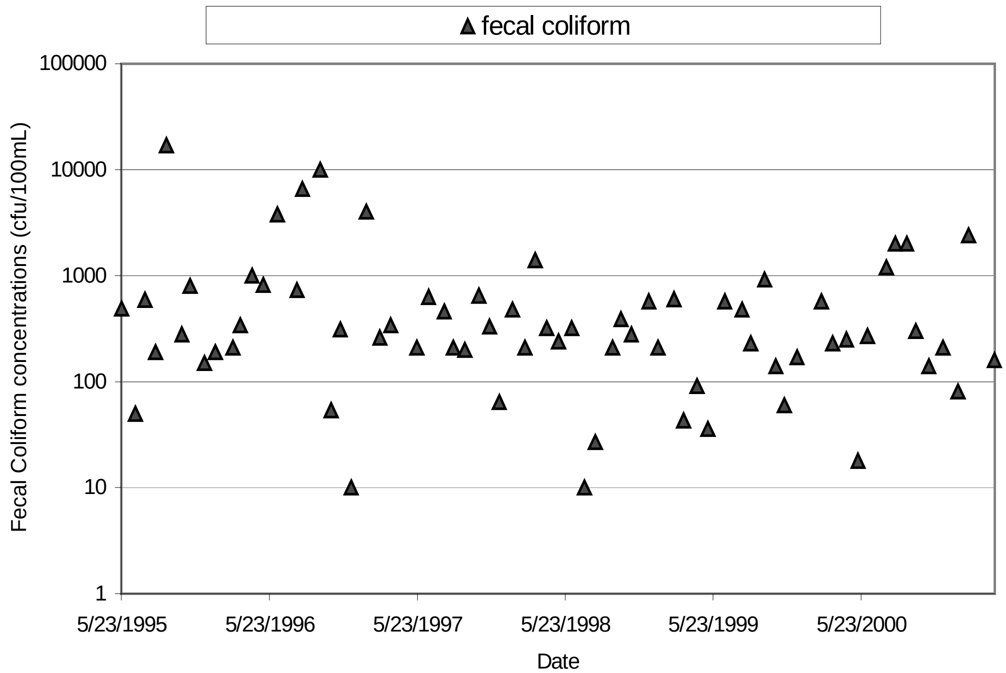


Figure 4. Grants Creek WWTP Upstream / Downstream 30-day Rolling Geometric Mean of Fecal Coliform Concentration (NC0023884)

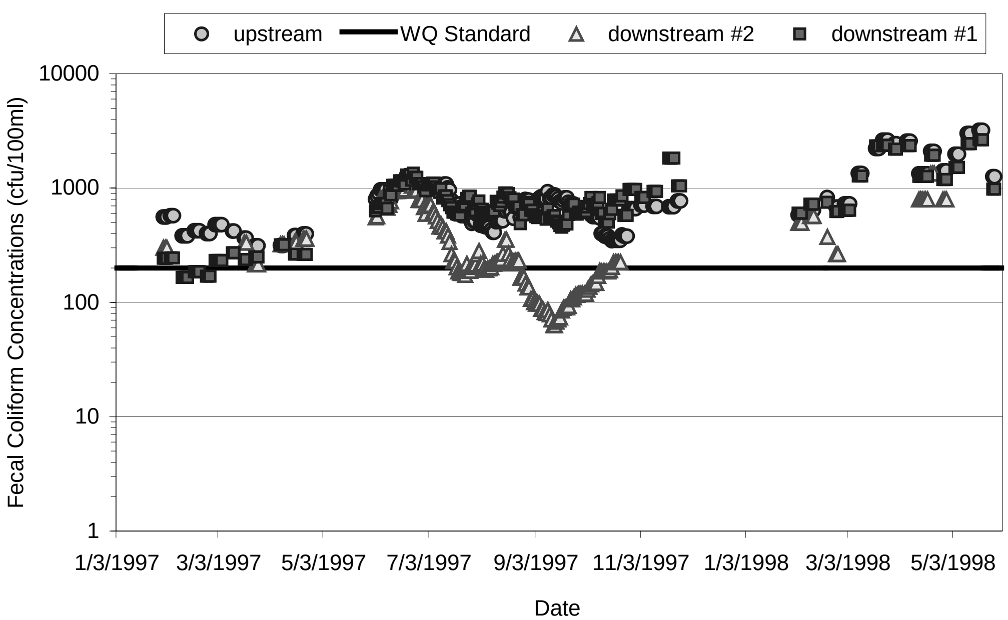


Figure 5. Grants Creek Spencer WWTP Upstream / Downstream 30-day Rolling Geometric Mean of Fecal Coliform Concentration (NC0025593)

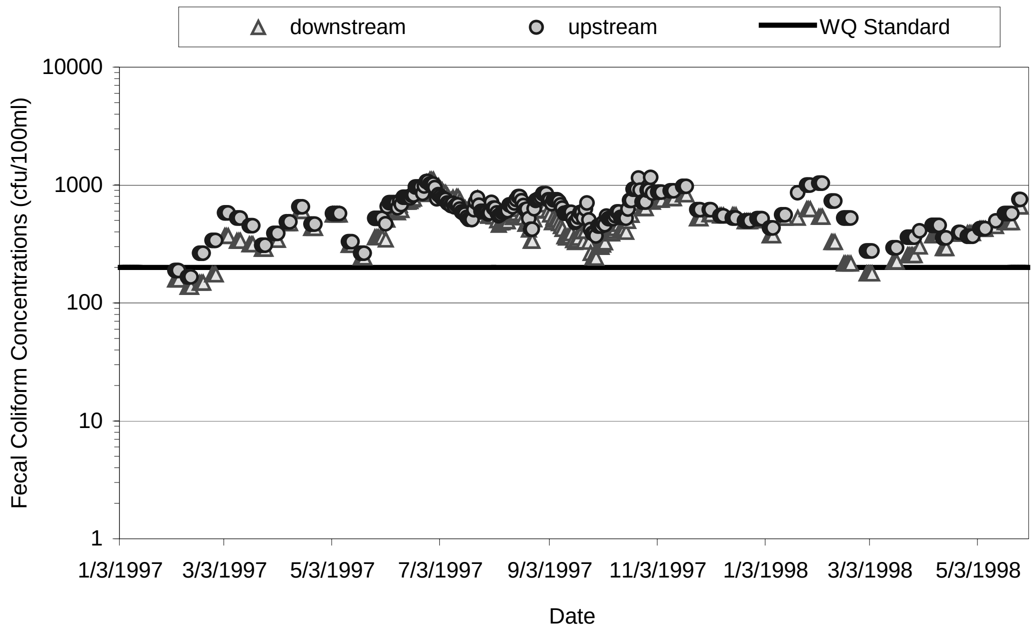


Figure 6. Rown County Environmental Services Grants Creek Fecal Coliform Monitoring data (Geometric Mean)

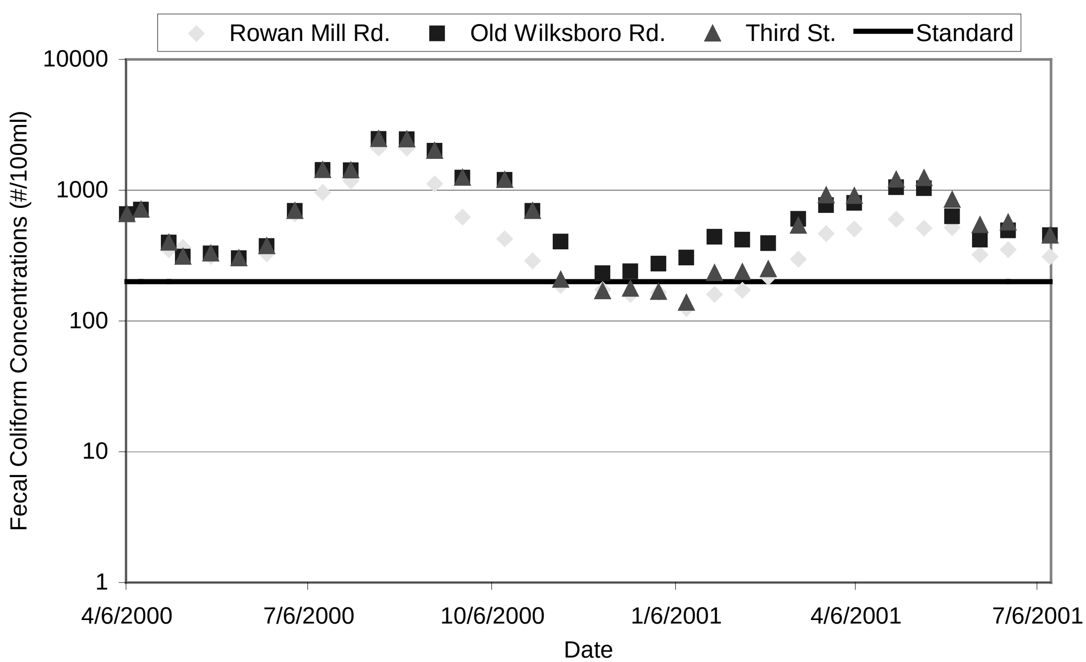


Table 2. Summary of Grants Creek Fecal Coliform Data from DWQ Special Study[2]

			Fecal Coliform Levels (Geometric Mean)		
Dates	Number of days	Observations	Downstream of Spencer WWTP Outfall	Rowan Co. at 70-601	Rowan Co. at SR 1505
4/11/2001 to 5/9/2001	29	15	284	469	662
4/18/2001 to 5/16/2001	29	15	338	473	852
4/25/2001 to 5/23/2001	29	15	678	758	1187
5/2/2001 to 5/30/2001	29	15	528	474	855

2 The complete data from the study is given in Appendix II

2.1 Water Quality Target

The North Carolina fresh water quality standard for Class C waters for fecal coliform (T15A: 02B.0211) states:

> Organisms of the coliform group: fecal coliforms shall not exceed a geometric mean of 200/100ml (MF count) based upon at least five consecutive samples examined during any 30 day period, nor exceed 400/100 ml in more than 20 percent of the samples examined during such period; violations of the fecal coliform standard are expected during rainfall events and, in some cases, this violation is expected to be caused by uncontrollable non-point source pollution; all coliform concentrations are to be analyzed using the membrane filter technique unless high turbidity or other adverse conditions necessitate the tube dilution method; in case of controversy over results, the MPN 5-tube dilution technique will be used as the reference method.

The instream numeric target, or endpoint, is the restoration objective expected to be reached by implementing the specified load reductions in the TMDL. The target allows for the evaluation of progress towards the goal of reaching water quality standards for the impaired stream by comparing the instream data to the target. For Grants Creek fecal coliform TMDL, the water quality target is the geometric mean concentration of 200cfu/100ml over a 30-day period. The TMDL also addresses the portion of the standard that limits the percentage of instantaneous excursions over 400cfu/100ml to twenty percent.

In order to evaluate the fecal coliform model, monitor water quality conditions and assess progress of the TMDL, an evaluation location was established for the Grants Creek watershed. The evaluation location of this watershed is located in Grants Creek downstream of the Grants Creek WWTP, which is the location of the ambient monitoring stations.

2.0 SOURCE ASSESSMENT

A source assessment is used to identify and characterize the known and suspected sources of fecal coliform bacteria in the watershed. The source assessment of Grants Creek will be used in the water quality model and in the development of the TMDL.

2.1 Point Source Assessment

General sources of fecal coliform bacteria are divided between point and non-point sources. Facilities that treat domestic waste which are permitted through the National Pollutant Discharge Elimination System (NPDES) are the primary point sources of fecal coliform bacteria.

2.1.1 Individually Permitted NPDES Dischargers

There are six NPDES permitted dischargers in the Grants Creek watershed. Table 3 shows individually permitted NPDES wastewater treatment facilities in the watershed. The City of Salisbury Grants Creek WWTP previously discharged to Grants Creek (until September 2000), but now discharges to the Yadkin River. This WWTP primarily serves, the northern side of Salisbury, and the towns of Landis and China Grove. The Town of Spencer WWTP (NC0025593), now called Sowers Ferry WWTP, directly discharges into Grants Creek. The Spencer WWTP operates at 0.75 MGD, and has a maximum permitted effluent fecal coliform concentration of a 30-day geometric mean of 200 cfu/100ml, and a weekly geometric mean of 400 cfu/100ml. The Grants Creek WWTP land applies a percentage of the residuals generated during the wastewater treatment process. A percentage of the residuals is land applied within the Grants Creek watershed (Helms Communication, 2002). The other four facilities are minor discharges and their contribution to the fecal coliform loading is not significant.

2.1.2 General Permitted NPDES Dischargers

There is one general permitted facility located in the Grants Creek watershed. This facility is permitted to discharge non-contact cooling water, boiler blowdown, cooling tower blowdown, and other similar wastewaters. The effluent of this facility is not limited or monitored for fecal coliform.

Table 3. Permitted NPDES wastewater treatment facilities in Grants Creek Watershed.

Facility Name	Permitted Flow (MGD)	Site Address	Site City	Receiving Stream	Permit #	Ownership
Fieldcrest Cannon-Plant 16	0.05	5200 South Main Street	Salisbury	UT Grants Ck.	NC0004286	Non-Municipal
Spencer, Town – WWTP	0.75	600 Sower Ferry Road	Spencer	Grants Ck.	NC0025593	Municipal
Landis, Town – WTP		255 Tranquil Lake Drive	Chaina Grove	Grants Ck.	NC0027502	Non-Municipal
Oak Haven Mobile Home Park	0.006	775 Airport Road	Salisbury	UT Grants Ck.	NC0037184	Non-Municipal
Westside Swim & Raquet Club	0.003		Salisbury	Draft Branch	NC0042439	Non-Municipal
Majestic Properties-Rowan Site	0.005	2001 South Main Street	Salisbury	UT Grants Ck.	Minor	Non-Municipal
Rowan-Salisbury Sch/ Knollwood	0.011		Salisbury	Little Creek	NC0034703	Non-Municipal
Inman Asphalt – Salisbury		1825 Jake Alexander Blvd. West	Salisbury	UT Grants Ck.	NC0049905	Non-Municipal

2.2 Non-point Source Assessment

Non-point sources of fecal coliform bacteria include those sources that can not be identified as entering the waterbody at a specific location (e.g., a pipe). Non-point source pollution can include both urban and agricultural sources. Fecal coliform bacteria may originate from human and non-human sources. Table 4 lists the potential human and animal non-point sources of fecal coliform bacteria (Center for Watershed Protection, 1999). The non-point sources of fecal coliform bacteria in Grants Creek include wildlife, livestock (land application of agricultural manure and grazing), concentrated animal feed-lots, urban development (stormwater), failing septic systems, and sewer line systems (illicit connections, leaky sewer lines and sewer system overflows).

Table 4. Potential sources of fecal coliform bacteria in urban and rural watersheds (Center for Watershed Protection, 1999).

Source Type		**Source**
Human Sources	Sewered watershed	Combined sewer overflows
		Sanitary sewer overflows
		Illegal sanitary connections to storm drains
		Illegal disposal to storm drains
	Non-sewered watershed	Failing septic systems
		Poorly operated package plant
		Landfills
		Marinas
Non-human Sources	Domestic animals and urban wildlife	Dogs, cats
		Rats, raccoons
		Pigeons, gulls, ducks, geese
	Livestock and rural wildlife	Cattle, horse, poultry
		Beaver, muskrats, deer, waterfowl
		Hobby farms

2.2.1 Livestock

Rowan County, with a total area of 327,296 acres is a producer of cattle, beef and milk cows, chickens, hogs and pigs. According to the 1997 Agricultural Census, there were 48 poultry farms, 473 beef farms and 36 dairy farms in Rowan County. There is one certified dairy cattle farm, and one beef cattle farm (150 head) in the Rowan County portion of Grants Creek. There are no permitted concentrated animal feedlot operations (CAFOs) in the watershed. There are also several small livestock farms scattered throughout the watershed (Cowden communications, 2002). In 1997 there were 154 horse and pony farms throughout Rowan County (Agriculture Census, 2001).

2.2.1.1 Livestock Grazing/Horse and Pony Grazing

Cattle, including both dairy and beef cows, and horses graze on pasture land and deposit feces onto the land. During a rainfall runoff event, a portion of the fecal material that contains coliform bacteria is transported to the streams. In addition, when cattle have direct access to streams, feces may be deposited directly into a stream. There are small, scattered animal operations which may have access to streams for their animals in the Grants Creek Watershed. (Cowden communication, 2001).

2.2.1.2 Agricultural Manure Application/Concentrated Animal Feedlot Operations

The registered dairy cattle operations in Rowan County have onsite lagoons. The average cattle population of the registered dairy operation in the Grants Creek watershed is 175 head of cattle. There are about 340 dairy cattle in the farm currently. The estimated number of cattle in the beef cattle operation is about 150. Overall, it is estimated that there are about 2500 head of dairy and beef cattle in the Grants Creek area (Rider communications, 2002). The cattle may have limited access to streams. Dairy manure is mostly applied to cropland with some to pasture /hayland. Manure is generally applied to cropland from March to June and from September to November. Manure is typically applied to pastureland during the same periods, although application extends through December. Poultry litter produced by the chickens is routinely collected and applied as an alternative to fertilizer and applied predominately to pasture/hayland (Rowan SWCD communications, 2002). The City of Salisbury is permitted to land apply residuals from its wastewater treatment process. The applications fields are scattered in the south and southwest of Rowan county. Some of these fields are located within the Grants Creek watershed (Helms communications, 2002).

2.2.2 Failed Septic Systems

Failing septic systems have been cited as a potential source of fecal coliform bacteria to water bodies (USEPA, 2000). The Department of Environmental Health has estimated that Rowan County has approximately 25,365 housing units on septic systems (DEH, 1999). Septic system failure rate data in North Carolina are very limited. A study conducted in 1981 by the North Carolina Office of State Budget and Management suggested that approximately 11% of systems that were surveyed experienced malfunctions or failures over a year (DEH, 2000).

2.2.3 Urban Development/Sanitary Sewer Overflows

Fecal coliform bacteria can originate from various urban sources. These sources include pet waste, runoff through stormwater sewers, illicit discharges/connections of sanitary waste, leaky sewer systems and sewer systems overflows. The City of Salisbury owns and operates the Grants Creek WWTP and the sewage collection system. The Sowers Ferry WWTP (Previously operated by the town of Spencer) is currently operated by the City of Salisbury. In the last two years (July 1999 - June 2001), Salisbury reported at least 10 sanitary sewer overflows (SSOs) ranging from 500 gallons to 37,500 gallons (Salisbury, 2002).

2.4 Wildlife

Wildlife can be a source of fecal coliform bacteria in forested, wetland, pasture and cropland areas. Wildlife deposit fecal material in these areas which can be transported to a stream in a rain event. Wildlife in the Rowan county area include deer, raccoons, squirrels, and birds (including waterfowl).

3.0 MODELING APPROACH

3.1 Model Framework

The Coliform Routing and Allocation Program (CRAP), a geographic information system (GIS) based tool (ArcView), was selected for the Grants Creek fecal coliform bacteria TMDL evaluation in order to satisfy a variety of modeling objectives. CRAP is designed to be an easy to use GIS based model for fecal coliform TMDL development. In 1998 the Modeling Unit staff reviewed the available tools potentially suitable for use in fecal coliform TMDLs and determined that most of the models examined tended to be either overly complex for the modeling objectives or too simple and inflexible. With the notable exception of a few major urban areas, most fecal impaired streams are located in watersheds where relatively little information is available on sources and stream/watershed morphology. Monthly instream fecal concentration data, collected at DWQ ambient stations, tends to comprise the bulk of the available data on fecal coliform bacteria in these watersheds.

Hence, in 1999 Modeling Unit staff began development of a simple, flexible, steady state modeling tool which could be applied in a variety of watersheds for which there is limited available data. CRAP is a customized ArcView project, written in Avenue, ArcView’s scripting language. Output from the model is intended to represent ‘typical’ instream fecal coliform concentrations within a given time step, for predefined design (critical) conditions.

3.2 Model Setup

The Grants Creek watershed was delineated into 3 subwatersheds. The land areas of each of the subwatersheds are shown in Table 5. The subwatersheds range in size from 15.9 mi^2 to 33.9 mi^2 and encompass pasture, cultivated lands, forest, and low and high density development lands.

Table 5. The areas of the subwatersheds of the Grants Creek watershed.

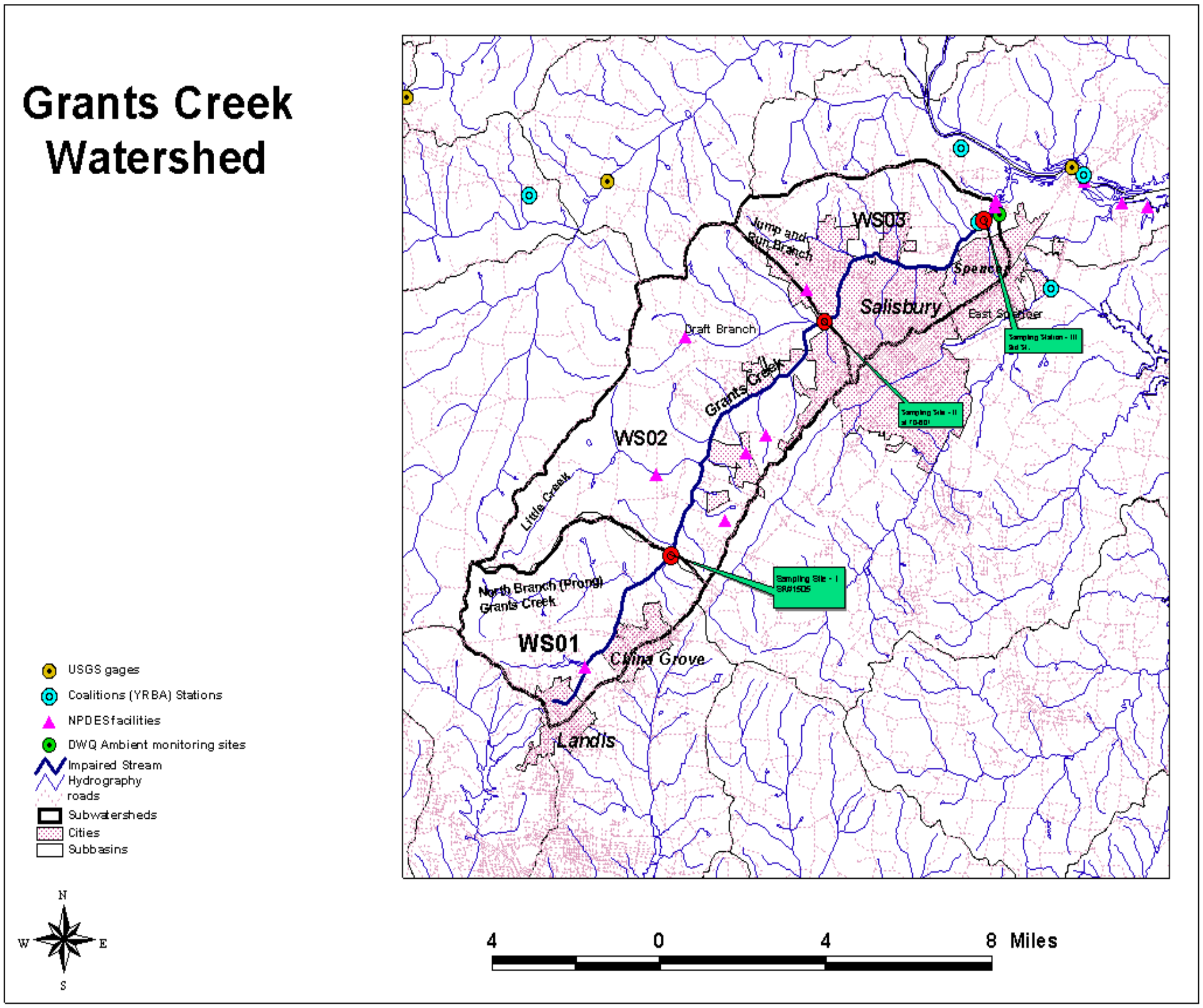
Subwatershed	Area (square miles)
WS01	15.9
WS02	33.9
WS03	17.9

Figure 7 illustrates the subwatershed delineations for the Grants Creek watershed. The subwatershed delineations were based, in part, on the location of the ambient and discharger coalition monitoring sites, the location of WWTPs, and the geographic extent of the impaired segment of Grants Creek. Subwatershed WS01 contains the upstream areas including the source of the creek near the Town of Landis, and the Town of China Grove. The outlet of subwatershed WS01 is the located at SR1505, the site a DWQ's special study sampling station. Subwatershed WS02 covers the area upstream of Salisbury. The outlet of subwatershed WS02 is the located at US 70 and 601, which is a monitoring location of DWQ's special study. Subwatershed WS03 is located downstream of the impaired segment and above the confluence of Grants Creek and Yadkin River. This part of the watershed includes the City of Salisbury and is more developed than the other two. The outlet of subwatershed WS03 is located downstream of the WWTP, the site of the ambient monitoring station. The land cover coverage for the subwatersheds is shown in Table 6.

Table 6. The land cover/land use coverage of the subwatersheds in the Grants Creek watershed.

Land Cover	Watershed 01 acres (%)	Watershed 02 acres (%)	Watershed 03 acres (%)
Cultivated	829 (8.1%)	1323 (6.1%)	293 (2.5%)
High Intensity Development	163 (1.6%)	716 (3.3%)	1078 (9.4%)
Low Intensity Development	36 (0.4%)	130 (0.6%)	77 (0.7%)
Forest	4545 (44.6%)	12,454 (57.4%)	7290 (63.6%)
Herbaceous Cover	4526 (44.4%)	7030 (32.4 %)	2700 (23.6 %)
Open Water	93 (0.9%)	44 (0.2%)	19 (0.2%)
Total	10192	21697	11457

Figure 7. Grants Creek Watershed Subwatershed Delineations



3.2.1 Hydrology

Since Grants Creek is not gaged, flow information for Grants Creek was estimated using flow data from the Second Creek USGS gage station near Barber, North Carolina (Station Number 02120780). This method of calculating flows for Grants Creek is based on the assumption of equal flow and runoff per square mile for Grants and Second Creeks. Given the close proximity and similarities in land cover between the two watersheds, this is a reasonable assumption. Prior to calculating the flow of Grants Creek using areal weighting, the Second Creek flow was adjusted to account for flows from WWTPs.

To estimate the daily flow of Grants Creek, an adjustment coefficient was established by dividing the drainage area of Grants Creek (67.7 square miles) by the drainage area of the Second Creek gage (118.00 square miles). This coefficient (0.57) was multiplied by the adjusted daily flow of Second Creek to arrive at the estimates for Grants Creek. The flows from the effluent of the WWTPs within the Grants Creek watershed were added to the subwatersheds downstream of these facilities.

3.2.2 Hydraulics

There are several methods to estimate stream velocity based on stream flow data. The water quality model utilized the power function to calculate the hydraulics of Grants Creek.

The power function: $V = aQ^b$

V = velocity (feet per second)
Q = stream flow (cubic feet per second)
a = flow coefficient (unitless)
b = exponent for flow (unitless)

Time-of-travel data (TOT) from die studies performed by the Environmental Sciences Branch (ESB) in 1976 and 1986 along Grants Creek are used to estimate the values of the coefficient and exponent for the Grants Creek hydraulics. The following values were used in the Grants Creek model to calculate stream velocity: a = 0.19 and b = 0.33.

3.3 Fecal Coliform Source Representation

Both point sources and non-point sources of fecal coliform are represented in the Coliform Routing and Allocation Program (CRAP) model. Figure 8 depicts the process the CRAP model utilizes to calculate the fecal coliform loading from the non-point sources. Each of the non-point sources of fecal coliform is linked to one or more land cover types (i.e., cattle grazing is linked to herbaceous cover). Based on the assumption that flow yields from each of the land covers in the watershed are equal per square mile, CRAP calculates the portion of the Grants Creek stream flow that originates from each land cover type. To calculate the fecal coliform load from a specific source, the calculated flow from the land cover type was multiplied by the assumed monthly average or typical fecal coliform concentration under the modeled condition (either dry or wet weather). The fecal coliform loading was calculated on a daily basis in the model runs. Table 7 outlines the assumed average fecal coliform concentrations for both dry weather and wet weather conditions.

Figure 8. A schematic diagram of the non-point source fecal coliform loading calculations

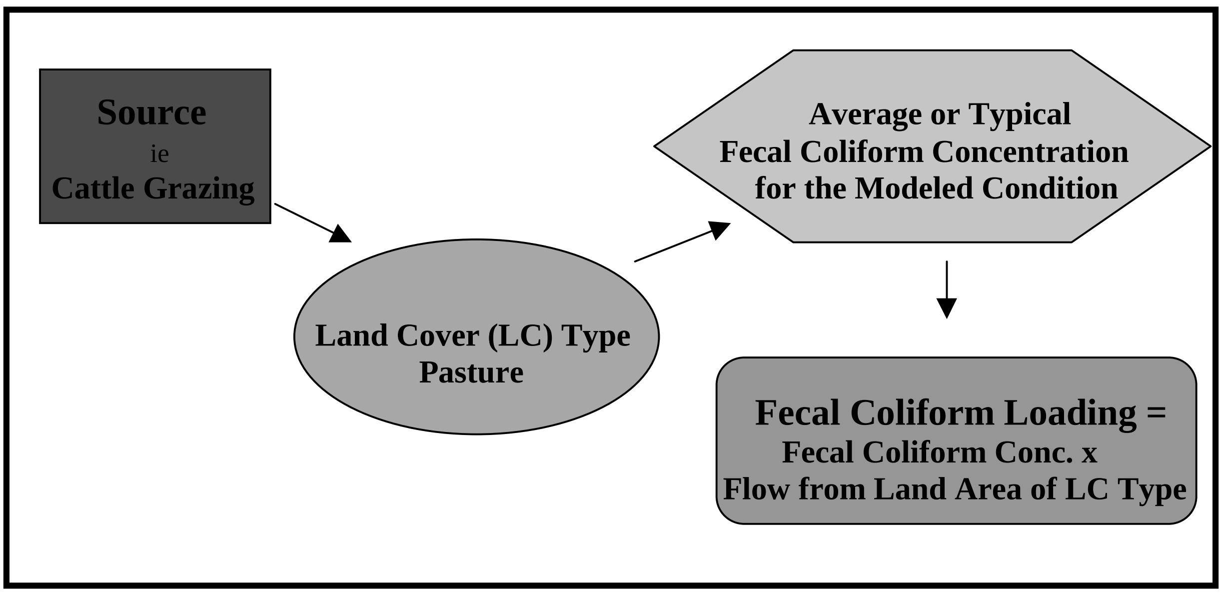


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Table 7. Assumed Instream Fecal Coliform Concentrations by Source Category and Land Cover for the Mean Flow Condition in the Subwatersheds.

Source Category	Source Sub-Category	Subwatershed	Land Cover/ Land Use	Wet Weather Assumed FC Instream Concentration (cfu/100ml)	Dry Weather Assumed FC Instream Concentration (cfu/100ml)
Point Source	WWTP	WS02-WS03		Daily Loading (From DMR)	Daily Loading (From DMR)
Non-Point Source	Wildlife	WS01 – WS03	Forest	90	30
	Livestock Grazing	WS01 - WS02	Herbaceous/ Pasture	5000	500
	Livestock Grazing/ Land Application	WS03	Herbaceous/ Pasture	1,000	500
	Manure Application (Mar. – June; Sept. – Dec.)	WS01, WS02	Herbaceous/ Pasture	5,000	500
	Manure Application (Mar. – June; Sept. – Nov.)	WS01, WS2	Cultivated	5,000	500
	High Intensity Development (SSOs, stormwater, sewer infiltration)	WS01- WS03	High Intensity Developed	8,700	1,500
	Low Intensity Development (include septic system failure, stormwater)	WS01 – WS03	Low Intensity Developed	8,700	1,500

3.3.1 Wet Weather Versus Dry Weather Fecal Coliform Loading

The CRAP model can calculate fecal coliform loading on a daily time step during both dry and wet weather conditions. For the Grants Creek TMDL application of the CRAP model, dry weather conditions were defined as three consecutive days without recorded rainfall in Salisbury, North Carolina. Wet weather days account for all of the remaining days. To calculate the daily fecal coliform loadings, different in-stream concentrations are used for dry and wet weather conditions.

3.3.2 NPDES Discharge

Grants Creek WWTP, a 7.5 MGD NPDES individually permitted facility, and Spencer WWTP, a 0.75 MGD plant, are located in subwatershed WS03. The daily fecal coliform loads from the WWTPs within the subwatersheds were calculated by using the daily fecal coliform concentration and daily discharges from the facilities as reported in the discharge monitoring reports (DMR). The daily fecal coliform loads from January 1995 to September 2000 were used as point source inputs in the model.

3.3.3 Livestock

3.3.3.1 Livestock Grazing

Fecal coliform loading from grazed areas was calculated using an instream fecal coliform concentration for the portion of the stream flow that originates from pasturelands (managed herbaceous and upland herbaceous land cover). Different fecal coliform concentrations were used to calculate the fecal coliform bacteria loading during wet weather and dry weather events. The increased fecal coliform loading on wet weather takes into account the increased fecal coliform concentrations in stormwater runoff.

Site specific information on annual grazing patterns was not available, therefore it was assumed that there is no monthly variation in animal grazing on pastureland throughout the year. Several studies have indicated that grazing cattle increases instream fecal coliform concentrations. Stephenson and Street (1978) observed that the presence of cattle on rangelands increased fecal coliform concentrations in stream from 0 to 2500/100ml (Khaleel et al., 1980). Fecal coliform concentrations from grazed pasture runoff have been measured in the range of 120 – 1.3×10^6 cfu/100ml (Doran et al, 1981). A fecal coliform concentration of 5,000 cfu/100ml for wet weather days was input into the model to calculate the fecal coliform load from grazing livestock in subwatersheds WS01 and WS02. Due to the small number of cattle in subwatershed WS03 a fecal coliform concentration of 1,000 cfu/100ml was used to calculate the loads for wet weather in WS03. The fecal coliform concentration used to calculate the load from grazing on dry weather days was 500cfu/100ml for all subwatersheds. The fecal coliform concentrations used in the CRAP model fall within the range of fecal coliform concentrations found in the literature.

3.3.3.2 Land Application of Agricultural Manure/Concentrated Animal Feedlot Operations

Fecal coliform loading values from the land application of manure, poultry litter and concentrated animal feedlot operations were calculated in the model using an instream fecal coliform concentration for the portion of the stream flow that originates from cultivated lands and pasturelands (herbaceous land cover). Based on the information from Rowan Soil & Water Conservation District and Cooperative Extension Offices, manure application is applied to cropland from March-June and September-November (Rowan SWCD communications, 2002). Manure is applied to pastureland during the same period but extending through December. Due to a lack of site specific data on these sources, cattle and poultry manure application were grouped together as one source, the land application of agricultural manure. Under wet weather conditions, the manure application contribution to the instream fecal coliform concentration was represented by a concentration of 5,000 cfu/100ml for the portion of the stream flow that originates from pasturelands (herbaceous land cover) in WS01 and WS02. The application of manure on cultivated lands was represented in the model by an input of 5,000 cfu/100ml fecal coliform concentration for the portion of the stream flow that originates from cultivated land in WS01 and WS02. Under dry weather conditions, the application of manure on cultivated lands was represented in the model by an input of 500 cfu/100ml fecal coliform concentration for the portion of the stream flow that originates on cultivated land. The fecal coliform loading from manure application on pastureland in dry weather was calculated using an in-stream fecal coliform concentration of 500 cfu/100ml for the portion of stream flow that originates on pastureland.

3.3.4 Low Density Development/Septic Systems

Fecal coliform loading from developed land includes septic systems failure, leaking sanitary sewers, illicit sanitary sewer connections and stormwater runoff (which can include waste from domesticated animals and urban wildlife). Due to a lack of site specific data on these sources, the fecal coliform loading from these sources were lumped together into one source category, low density development. Several studies have been conducted to evaluate the effects of development on stormwater runoff and instream fecal coliform concentrations. Farrell-Poe et al. (1997) evaluated the effects of small rural municipalities on instream fecal coliform concentrations in agricultural watersheds. Samples collected from perennial streams downstream of four small municipalities (populations ranged from 561 to 4,829) were statistically significantly higher than the upstream samples. Two of the four towns were serviced by sanitary sewers, but none of the towns had stormwater drains. The mean differences of the fecal coliform concentrations of upstream and downstream samples ranged from 21 to 294 cfu/100ml.

Geldreich et al. studied fecal coliform concentration levels in urban runoff from a suburban area of Cincinnati, Ohio. The average fecal coliform concentrations of runoff water, collected throughout the year, from a wooded hillside, street gutters and a business district were 635cfu/100ml, 13,420 cfu/100ml and 14,950 cfu/100ml respectively (Khaleel et al., 1980). Fecal coliform concentration levels have been studied in Onondaga Lake and seven of its tributaries in metropolitan Syracuse, New York (Canale et al., 1993). The dry weather fecal coliform concentrations of the tributaries, which were monitored daily throughout the summer of 1987, ranged from 108 cfu/100ml to 25,525 cfu/100ml. Intensive sampling during two storm events was conducted from the onset of the storms until the hydrographs returned to base flow conditions. The mean wet weather fecal coliform concentrations of the tributaries ranged from >8,720 to 240,046 cfu/100ml. In the supporting documentation of P-Load, a component of the USEPA BASINS model, the geometric mean of fecal coliform concentrations in stormwater runoff from residential land in the Atlanta area was cited as 8,700 cfu/100ml. This fecal coliform concentration value was based on the Atlanta Regional Storm Water Characterization Study (ARSWCS) (BASINS, 2001).

Fecal coliform loading values from septic system failure, leaking sanitary sewers and stormwater runoff from low intensity development were calculated in the model using an instream fecal coliform concentration for the portion of the stream flow that originates from the low intensity developed lands in the subwatersheds. The wet weather fecal coliform loading from low intensity developed land was calculated in the model by multiplying a fecal coliform concentration of 8700 cfu/100ml by the portion of the stream flow that originates from low intensity developed land. The dry weather fecal coliform loading was calculated by multiplying

1500cfu/100ml by the portion of the stream flow that originates from low intensity developed land.

3.3.5 High Density Development/ Sanitary Sewer Overflows

Fecal coliform bacteria from high intensity developed areas can originate from various sources including runoff through storm sewers, illicit discharges of sanitary waste, overflowing sanitary sewer systems, and leaking collection lines. Due to a lack of data on site specific fecal coliform loadings from these sources, they were grouped together into one source class. The wet weather, high density urban development loading was represented in the model by multiplying the instream fecal coliform concentration of 8700 cfu/100ml to the portion of the stream flow that originates from the high intensity developed lands. The dry weather loading was calculated by multiplying the instream fecal coliform concentration of 1500 cfu/100ml by the portion of the stream flow that originates from high intensity developed lands. This value falls within the range of the urban dry weather instream fecal coliform concentrations which have been measured in Mecklenburg County, North Carolina for the Fecal Coliform Total Maximum Daily Load for Irwin, McAlpine, Little Sugar and Sugar Creek Watersheds (Mecklenburg County, 2001)

3.3.6 Wildlife

To represent the wildlife fecal coliform loading in dry weather conditions, a concentration of 30 col/100ml was multiplied by the portion of the Grants Creek stream flow that originates in forested or shrubland areas. Under wet weather conditions, a concentration of 90 cfu/100ml was used to calculate the wildlife loading. The State of South Carolina has estimated that the geometric mean of fecal coliform concentrations in waterbodies that flow through forested areas in South Carolina during all flow conditions is 30 col/100ml (SCDHEC, 1999). The Center for Watershed Protection (1999) has cited a fecal coliform concentration range of 10-100 cfu/100ml for forest runoff.

3.4 Instream Decay Rate

Once fecal coliform bacteria reach a waterbody, environmental factors influence the extent of their growth and decay. Physical factors that influence the bacteria populations include photo-oxidation, adsorption, flocculation, coagulation, sedimentation and temperature (USEPA, 1985). Chemical toxicity, pH, nutrient levels, algae and the presence of fecal matter may also influence the fecal coliform populations. The water quality model utilizes a first order decay rate to calculate instream decay of fecal coliform bacteria.

$$C_t = C_o e^{-kt}$$

C= coliform concentration (cfu/100ml)
C_o= initial coliform concentration (cfu/100ml)
C_t= coliform concentration at time t (cfu/100ml)
k= decay rate constant (day^{-1})
t = exposure time (days)

Bacterial die-off has been modeled as a first-order decay equation, using a decay rate value between 0.7/day and 1.5/day (Center for Watershed Protection, 1999). In the Grants Creek model, a decay rate value of 0.8/day was used for the existing condition and allocation runs.

3.5 Uncertainty

The lack of agreement between modeled and observed fecal coliform concentrations is due in part to the high degree of uncertainty associated with predicting any water quality variable, especially fecal coliform. The inability to accurately predict specific observed fecal coliform concentrations can be attributed to model error, lack of sufficient information in source assessment, gaps in our scientific knowledge, natural variability in instream fecal coliform concentrations, field and laboratory measurement error, and lack of current site specific model input parameters including decay rate, flow, rainfall data and landuse information. The available models used to predict fecal coliform concentrations are not adept at characterizing prediction uncertainty. The Coliform Routing and Allocation Program (CRAP) was intended to predict daily average fecal coliform concentrations based on land use information. Due to the lack of site specific information, literature values were used to calculate the fecal coliform loadings from the various landuses. Because uncertainty associated with CRAP is expected to be large, the model results should be interpreted in light of the model limitations and prediction uncertainty. Simple models like CRAP can be used to guide initial decision making but continued observation of the watershed and stream, as fecal coliform controls are implemented (e.g., exclusion fencing, leaky sanitary sewer repairs), is expected to be our best approach for determining the appropriate level of management.

3.6 Critical Conditions

Fecal coliform pollution in the Grants Creek watershed originates from both point and non-point sources. The critical conditions for waterbodies impaired by point sources typically occur during periods of dry weather, while those impaired by non-point sources generally occur in periods of wet weather. The Grants Creek fecal coliform monitoring data indicate that elevated levels of fecal coliform occur during both dry and wet weather conditions. The model was run for a 5.75 year simulation period using estimated daily stream flows. The highest 30-day geometric mean of the predicted daily fecal coliform concentration, 1433 cfu/100ml, occurred between April 14 and May 13, 1998. Rain was recorded in Salisbury 14 days during the 30 day period. As a result, wet weather days accounted for 28 of the 30 day critical period.

3.7 Model Results

The predicted daily fecal coliform concentrations over the 5.75 years simulation period along with the ambient monitoring data collected by DWQ at the model evaluation location are shown in Figures 9. The observed 30-day geometric mean fecal coliform concentrations at downstream locations of Spencer WWTP and Grants Creek WWTP between January, 1997 and May, 1998 were compared to the predicted concentrations at the same location. The results are shown in Figures 10 and 11. The model evaluation location is located at the DWQ ambient monitoring station downstream of the Grants Creek WWTP near Spencer. The modeling results indicate that non-point source fecal coliform loading has a significant impact on instream fecal coliform concentrations in the Grants Creek watershed. The Spencer WWTP (Sowers Ferry WWTP) is permitted to discharge a monthly geometric mean fecal coliform concentration of 200 cfu/100ml with a maximum permitted discharge of 0.75 MGD. While the WWTP is permitted at the 200cfu/100ml level, the plant has discharged much less than the permitted load. The Grants Creek WWTP (7.5 MGD) has moved its discharge location to the Yadkin River since September, 2000. Therefore, the fecal coliform load from this WWTP is only used in the model prior to September 2000.

The predicted 30-day rolling geometric mean fecal coliform concentrations for the 5.75 year simulation period are shown in Figure 12. Throughout the 5.75 year modeled period, 96 percent of the rolling 30-day geometric means of the predicted values are greater than 200cfu/100ml. The 30-day geometric means range in value from 115 cfu/100ml to 1433 cfu/100ml.

Figure 9. Grants Creek Simulated and Observed Fecal Coliform Bacteria Concentrations at DWQ's Ambient Monitoring Location

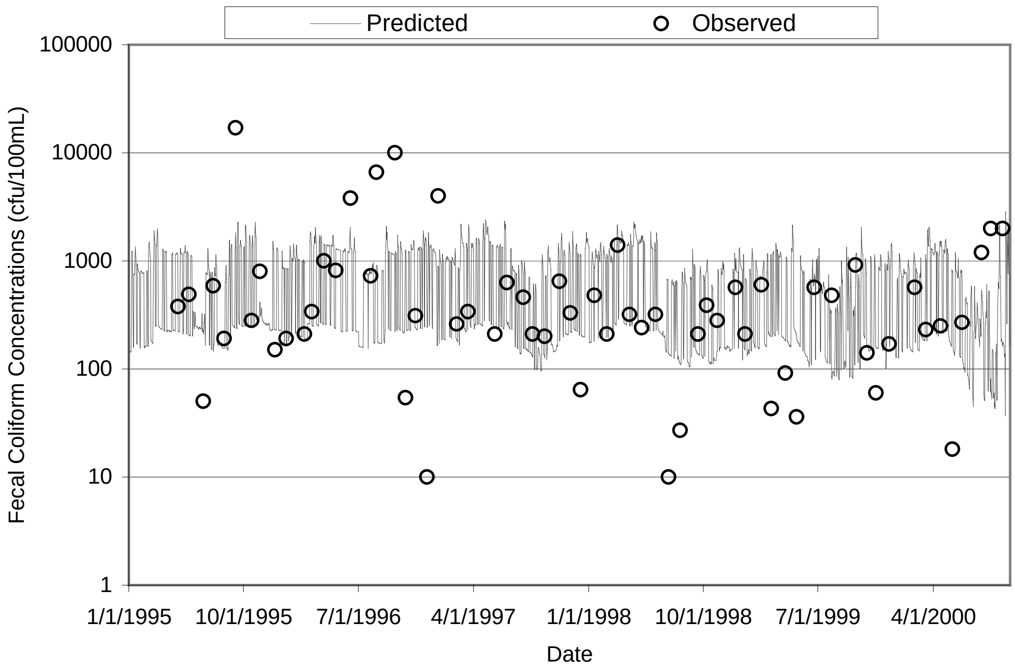


Figure 10. Grants Creek 1997-1998 Predicted Vs. Observed 30-day Rolling Geometric Mean of FC Concentrations (Data from Spencer WWTP (NC0025593) downstream Monitoring)

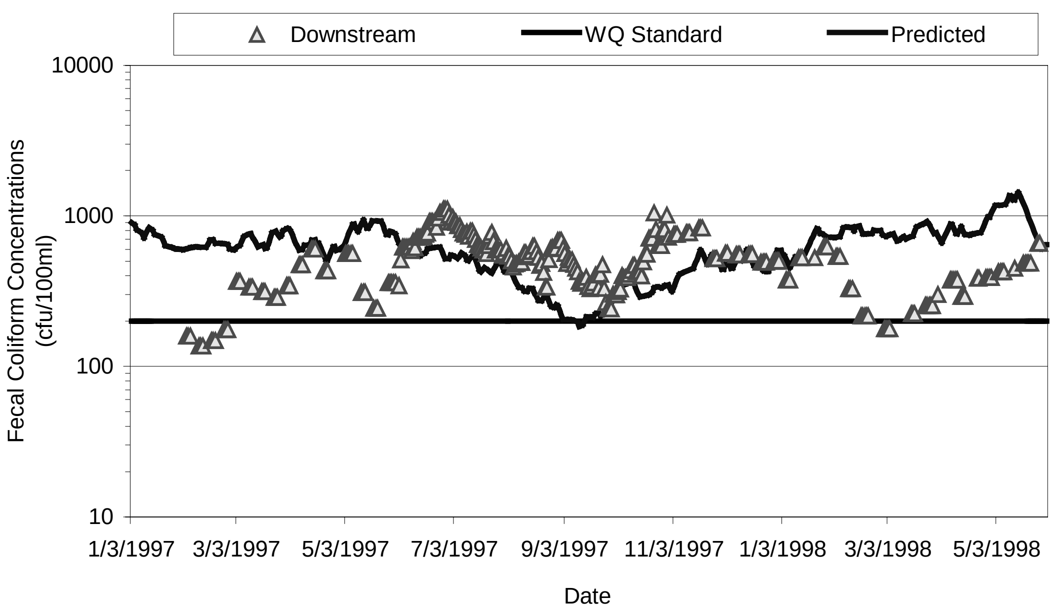


Figure 11. Grants Creek 1997-1998 Predicted Vs. Observed 30-day Rolling Geometric Mean of FC Concentrations (Data from Salisbury WWTP(NC0023884) downstream Monitoring)

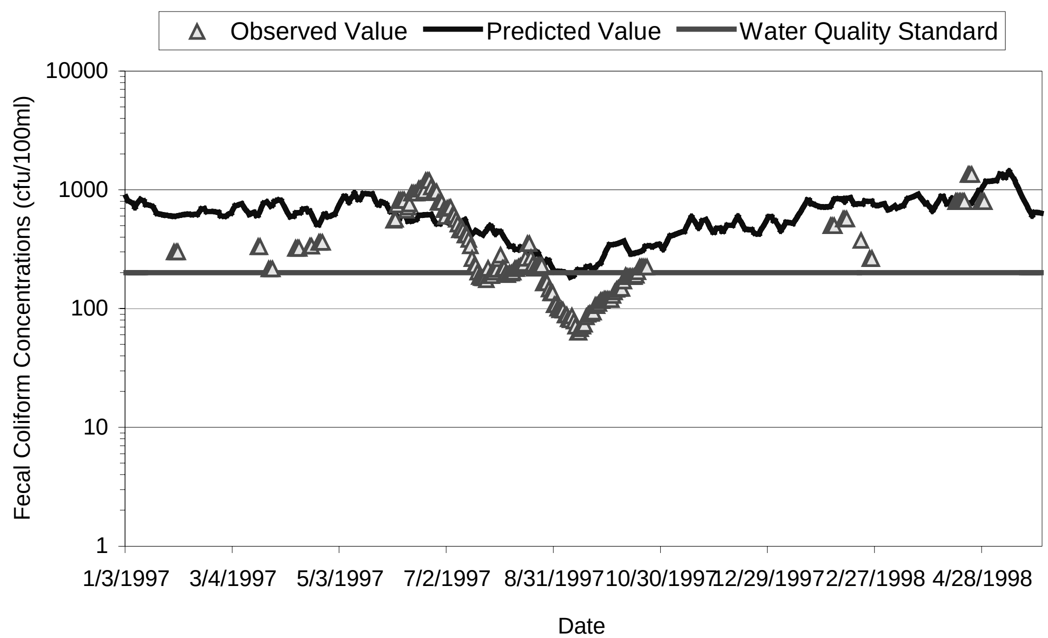
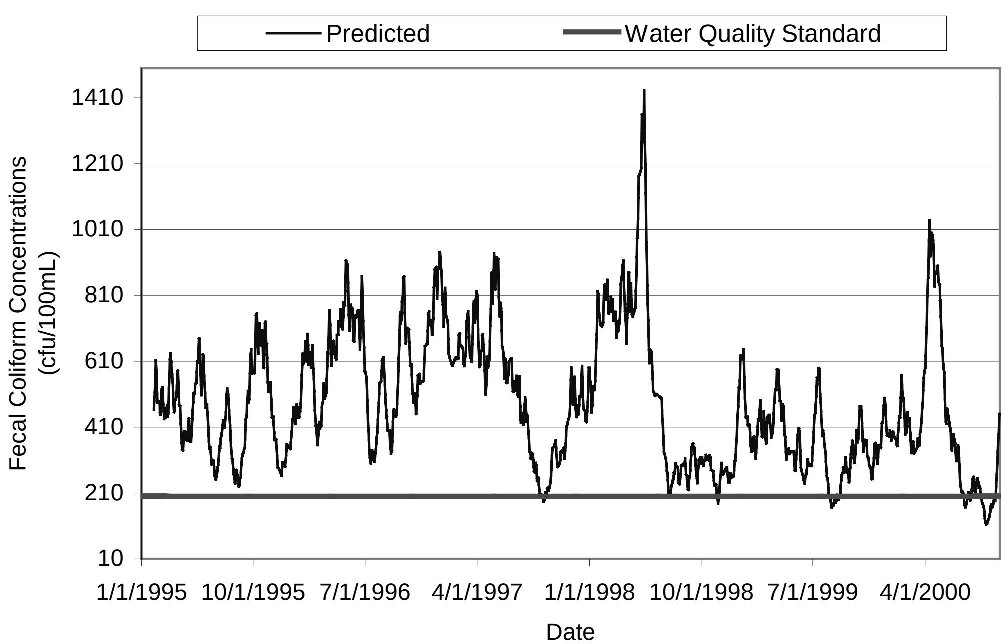


Figure 12. Grants Creek Simulated 30-day Rolling Geometric Mean of Fecal Coliform Bacteria Concentrations at DWQ's Ambient Monitoring Location



4.0 ALLOCATION

4.1 Total Maximum Daily Load

A total maximum daily load is the total amount of pollutant that can be assimilated by the receiving water body while achieving water quality standards. A TMDL is comprised of the sum of wasteload allocations (WLA) for point sources, load allocations (LA) for non-point sources and a margin of safety (MOS). This definition is expressed by the equation:

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

The objective of the TMDL is to estimate allowable pollutant loads and to allocate to the known pollutant sources in the watershed so the appropriate control measures can be implemented and the water quality standard can be achieved. The Code of Federal Regulations (40 CFR §130.2(1)) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures. In the Grants Creek fecal coliform TMDL, loads are calculated based on stream flow and instream fecal coliform concentrations that originate from a specific source/land cover.

4.2 Seasonal Variation

The model was run over a 5.75 years simulation period under varying daily flow conditions in order to capture seasonal flow fluctuations. The contribution of fecal coliform bacteria from the various sources also varied throughout the year to reflect changes in fecal coliform loading due to monthly changes in agricultural management practices.

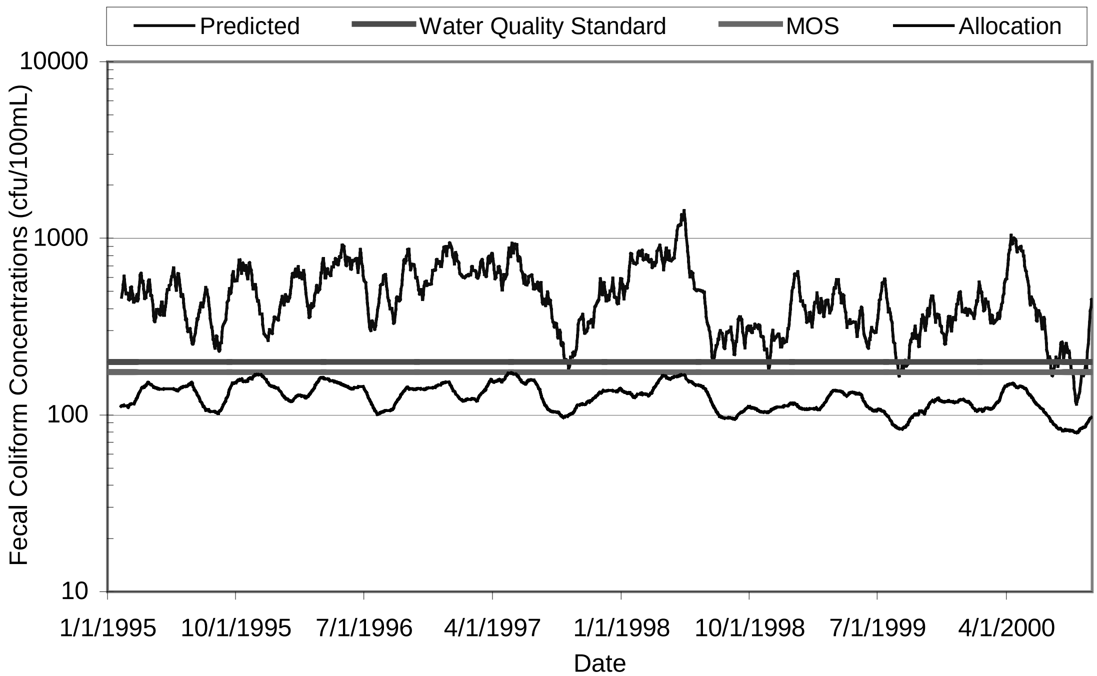
4.3 Margin of Safety

The margin of safety (MOS) may be incorporated into a TMDL either implicitly, through the use of conservative assumptions to develop the allocations, or explicitly through a reduction in the TMDL target. For the Grants Creek watershed, an explicit margin of safety was incorporated in the modeling analysis by setting the TMDL target at 175cfu/100ml, which is 25cfu/100ml lower (12.5%) than the water quality target of 200cfu/100ml.

4.4 Load Reduction

Figure 13 shows the predicted 30-day rolling geometric mean of fecal coliform concentrations with the final allocation to meet the 175 cfu/100ml target.

Figure 13. Grants Creek 30-day Rolling Geometric Mean of Fecal Coliform Bacteria Concentrations for the Simulated and the Allocation Scenarios



The final allocation of fecal coliform loads are shown in Table 8 (wet weather) and Table 9 (dry weather). The values given in Tables 8 and 9 represent the fecal coliform concentrations from each landuse category and the load allocations necessary to meet the water quality standard at the evaluation location. The 30-day running geometric means of the predicted fecal coliform concentrations with the final fecal coliform allocations at the evaluation location are shown in Figure 13.

In order to reach the water quality target of 200 cfu/100ml, with a 25 cfu/100ml explicit margin of safety, the non-point source fecal coliform loading needs to be reduced by 33%-60% for the various sources in dry weather conditions and 85%-97% reductions in wet weather conditions. The NPDES individually permitted Grants Creek WWTPs discharge a small portion of the modeled fecal coliform loading into the Grants Creek watershed and have consistently met their monthly discharge limit. Therefore, the TMDL allocation is limited to the fecal coliform loading reductions on the non-point sources. Table 10 presents the Total Maximum Daily Load of fecal coliform bacteria.

The TMDL allocation model shows that the reduction scenario that meets the 200 cfu/100ml geometric mean standard also meets the instantaneous standard of 400 cfu/100ml over the 5.75 year model period. Therefore, the load reduction scenario presented in Tables 8 and 9 satisfy the portion of the standard that limits the percentage of instantaneous excursions over 400cfu/100ml to twenty percent.

Table 8. Wet Weather instream Fecal Coliform Load Reductions for Subwatersheds in the Grants Creek Watershed.

Source Category	Source Sub-Category	Subwatershed	Simulation FC Concentration (cfu/100ml)	Allocation FC Concentration (cfu/100ml)	% Reduction
Point-Source (WLA)	WWTP	WS03	Daily Loading (From DMR)	200	0%
Non-Point Source (LA)	Wildlife	WS01-WS03	90	90	0%
	High Density Development (stormwater, SSOs, sewer exfiltration)	WS01-WS03	8,700	500	94%
	Low Density Development (septic systems)	WS01-WS03	8700	500	94%
	Livestock Grazing/Manure Application (Pastureland)	WS1-WS02	5,000 grazing 5,000 manure application	300 (150 grazing/ 150 man. app.)	97%
	Manure Application (Cultivated)	WS01-WS02	5,000	150	97%
	Livestock Grazing/Land Application	WS03	1000	150	85%

Table 9. Dry Weather instream Fecal Coliform Load Reductions for Subwatersheds in the Grants Creek Watershed.

Source Category	Source Sub-Category	Subwatershed	Simulation FC Concentration (cfu/100ml)	Allocation FC Concentration (cfu/100ml)	% Reduction
Point-Source (WLA)	WWTP	WS02-WS3	Daily Loading (From DMR)	200	0%
Non-Point Source (LA)	Wildlife	WS01-WS03	30	30	0%
	High Density Development (stormwater, SSOs, sewer exfiltration)	WS01-WS03	1500	1000	33%
	Low Density Development (septic systems)	WS01-WS03	1500	1000	33%
	Livestock Grazing/Manure Application (Pastureland)	WS01-WS02	500 grazing/ 500 manure application	400 (200 grazing/ 200 man. app.)	60%
	Manure Application (Cultivated)	WS01-WS02	500	200	60%
	Livestock Grazing/Land Application	WS03	500	300	40%

Table 10. Total Maximum Daily Load of fecal coliform bacteria during the critical period.

Wasteload Allocation (WLA) (counts/30 days)	Load Allocation (LA) (counts/30 days)	Explicit Margin of Safety (MOS) (counts/30 days)	TMDL (counts/30 days)
1.75×10^{11}	2.18×10^{13}	3.14×10^{12}	2.51×10^{13}

5.0 SUMMARY AND FUTURE CONSIDERATIONS

The sources of fecal coliform in the Grants Creek watershed include urban sources in the Landis, China Grove and Salisbury areas, livestock grazing and manure application on agricultural lands and pasture lands, and wildlife in the forested areas of the watershed. The Coliform Routing and Allocation Program was utilized to simulate instream fecal concentrations and to allocate the fecal coliform loads to the various sources. In order for the water quality target to be met, the final allocation of the fecal coliform loads requires a non-point source load reduction between 33%-60% under dry weather conditions and 85%-97% under wet weather conditions for the various non-point sources of fecal coliform. The model estimated that the Grants Creek WWTPs contribute insignificant percentage of the total fecal coliform loading in the watershed. Therefore, the reduction allocation focuses on the fecal coliform loading from non-point sources.

5.1 Monitoring

Fecal coliform monitoring will continue on a monthly interval at the ambient monitoring site (at Spencer) and at the discharger coalition monitoring sites. The continued monitoring of fecal coliform concentrations will allow for the evaluation of progress towards the goal of reaching water quality standards by comparing the instream data to the TMDL target. In addition to this data collection, further fecal coliform monitoring may be considered. Additional monitoring beyond the ambient and discharger stations' monitoring could aid in a fecal coliform source assessment in the watershed and further aid in the evaluation of the progress towards meeting the water quality target and the water quality standard. A bacteria source tracking study of the Grants Creek watershed, to help determine the portion of fecal coliform loads derived from humans versus animals throughout the watershed, is considered as a part of the future monitoring of Grants Creek.

To comply with EPA guidance, North Carolina may adopt new bacteria standards utilizing Escherichia coli (E. coli) and enterococci in the near future. Thus, future monitoring efforts to measure compliance with this TMDL should include using the E. coli and enterococci. Per EPA recommendations (EPA, 2000c), if future monitoring for E. coli/enterococci indicates the standard has not been exceeded, these monitoring data may be used to support delisting the water body from the 303(d) list. If a continuing problem is identified using E. coli/enterococci, the TMDL may be revised.

5.2 Implementation

An implementation plan is not included in this TMDL. The involvement of local governments and agencies will be needed in order to develop implementation plans. The Rowan County Environmental Services, Rowan County Soil and Water Conservation District and, the Land Trust of Central North Carolina have shown interest in use restoration projects in the Grants Creek Watershed. The Land Trust of Central North Carolina is already undertaking projects along the Grants Creek Corridor. The Division of Water Quality will assist the local governments and agencies in developing the implementation plan for this TMDL.

6.0 PUBLIC PARTICIPATION

The City of Salisbury, and Rowan County have been notified of DWQ's intention to develop the Grants Creek Fecal Coliform TMDL. Rowan County Environmental Services, Cooperative Extension Service and Soil and Water Conservation District have supplied agricultural information to aid in the source assessment portion of the TMDL.

A draft of the Grants Creek Fecal Coliform TMDL was publicly noticed through various means, including notification in a local newspaper and published Cooperative Extension Newsletter. The TMDL was also available from the Division of Water Quality's website (http://h2o.enr.state.nc.us/tmdl/draft_TMDLS.htm) during the comment period. A public meeting to discuss the Grants Creek Fecal Coliform TMDL was held in Salisbury on May 8, 2002. A public comment period was held for the thirty days prior to May 24th, 2002.

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Appendix I. Grants Creek Ambient Monitoring Station Q4600000 Fecal Coliform Concentration Monitoring Data

Date	Instream Fecal Coliform Concentration (cfu/100ml)	Date	Instream Fecal Coliform Concentration (cfu/100ml)
04/27/95	380	05/06/98	240
05/23/95	490	06/08/98	320
06/26/95	50	07/09/98	10
07/20/95	590	08/05/98	27
08/15/95	190	09/17/98	210
09/11/95	17000	10/08/98	390
10/19/95	280	11/02/98	280
11/08/95	800	12/15/98	570
12/14/95	150	01/07/99	210
01/10/96	190	02/15/99	600
02/22/96	210	03/11/99	43
03/11/96	340	04/13/99	91
04/09/96	1000	05/10/99	36
05/07/96	820	06/21/99	570
06/11/96	3800	08/02/99	480
07/29/96	730	08/24/99	230
08/12/96	6600	09/27/99	920
09/25/96	10000	10/25/99	140
10/22/96	54	11/15/99	60
11/13/96	310	12/16/99	170
12/10/96	10	02/15/00	570
01/16/97	4000	03/13/00	230
02/19/97	260	04/17/00	250
03/18/97	340	05/15/00	18
05/21/97	210	06/07/00	270
06/19/97	630	07/24/00	1200
07/28/97	460	08/15/00	2000
08/19/97	210	09/12/00	2000
09/17/97	200	10/05/00	300
10/22/97	650	11/06/00	140
11/17/97	330	12/11/00	210
12/11/97	64	01/17/01	81
01/13/98	480	02/12/01	2400
02/12/98	210	03/17/01	
03/10/98	1400	04/17/01	160
04/07/98	320	04/17/01	160

*L= Actual value is known to be greater than value given.
J= Estimated value.
A= Value reported is the mean of two or more determination.

Appendix II. Grants Creek DWQ Special Study Monitoring Data

Grants Creek in Rowan Co. at SR 1505

Dates	Number of days	Observations	Geometric Mean
4/11/2001 to 5/9/2001	29	15	662
4/18/2001 to 5/16/2001	29	15	852
4/25/2001 to 5/23/2001	29	15	1187
5/2/2001 to 5/30/2001	29	15	855

Grants Creek in Rowan Co. at 70-601

Dates	Number of days	Observations	Geometric Mean
4/11/2001 to 5/9/2001	29	15	469
4/18/2001 to 5/16/2001	29	15	473
4/25/2001 to 5/23/2001	29	15	758
5/2/2001 to 5/30/2001	29	15	474

Grants Creek downstream Spencer WWTP outfall

Dates	Number of days	Observations	Geometric Mean
4/11/2001 to 5/9/2001	29	15	284
4/18/2001 to 5/16/2001	29	15	338
4/25/2001 to 5/23/2001	29	15	678
5/2/2001 to 5/30/2001	29	15	528

All Station Summary

Dates	Number of days	Observations	Geometric Mean
4/11/2001 to 5/9/2001	29	45	445
4/18/2001 to 5/16/2001	29	45	514
4/25/2001 to 5/23/2001	29	45	848
5/2/2001 to 5/30/2001	29	45	598

Appendix III. Yadkin Pee-Dee River Basin Association Discharger Coalition Fecal Coliform Concentration Monitoring Data

Date	Instream Fecal Coliform Concentration (cfu/100ml)	Date	Instream Fecal Coliform Concentration (cfu/100ml)
Grants Creek at Third Extension near Spencer (Q4540000)		Grants Creek below Salisbury & Spencer WWTP at DWQ's Ambient Station NC02120975 (Q4600000)	
6/3/1998	330	6/3/1998	400
7/16/1998	130	7/16/1998	1
8/4/1998	700	8/4/1998	150
9/2/1998	6000	9/2/1998	87
10/21/1998	293	10/21/1998	268
11/12/1998	360	11/12/1998	310
12/4/1998	590	12/4/1998	205
1/7/1999	340	1/7/1999	420
2/10/1999	180	2/10/1999	240
3/11/1999	26	3/11/1999	3
4/8/1999	250	4/8/1999	520
5/6/1999	180	5/6/1999	200
6/9/1999	440	6/9/1999	340
7/15/1999	100	7/15/1999	370
8/4/1999	350	8/4/1999	200
9/15/1999	680	9/15/1999	370
10/14/1999	190	10/14/1999	300
11/4/1999	190	11/4/1999	250
12/9/1999	100	12/9/1999	64
1/13/2000	840	1/13/2000	840
2/14/2000	5500	2/14/2000	4900
3/20/2000	3900	3/20/2000	4300
4/27/2000	48	4/27/2000	100
5/4/2000	130	5/4/2000	340
6/15/2000	520	6/15/2000	760
7/19/2000	240	7/19/2000	280
9/12/2000	550	9/12/2000	100
10/23/2000	260	10/23/2000	260
11/13/2000	180	11/13/2000	240
12/26/2000	63	12/26/2000	120
1/22/2001	210	1/22/2001	140
2/12/2001	1000	2/12/2001	1700
3/21/2001	2900	3/21/2001	4800
4/9/2001	210	4/9/2001	230
5/14/2001	390	5/14/2001	130
6/6/2001	500	6/6/2001	140
7/17/2001	18	8/7/2001	53
8/7/2001	41	9/11/2001	290
9/11/2001	220	10/9/2001	5
10/9/2001	180		

Appendix IV. Spencer WWTP Upstream/ Downstream Fecal Coliform Bacteria Monitoring Data (NC0025593)

Date	upstream	Downstream	Date	Upstream	Downstream	Date	Upstream	Downstream
01/06/97	1420	1350	**07/08/97**	583	367	**09/30/97**	5400	5400
01/13/97	195	240	**07/09/97**	416	533	**10/01/97**	460	260
01/20/97	60	92	**07/14/97**	235	368	**10/06/97**	290	255
01/27/97	72	16	**07/15/97**	290	285	**10/13/97**	180	165
02/03/97	198	208	**07/16/97**	381	210	**10/20/97**	5100	4900
02/10/97	750	650	**07/21/97**	500	300	**10/28/97**	3700	3600
02/17/97	1980	360	**07/22/97**	7300	3000	**11/03/97**	500	320
02/24/97	207	210	**07/23/97**	6000	6000	**11/10/97**	333	290
03/03/97	1080	660	**07/28/97**	567	600	**11/17/97**	275	240
03/10/97	119	132	**07/29/97**	517	633	**11/25/97**	520	470
03/17/97	358	459	**07/30/97**	367	165	**12/02/97**	3700	5400
03/24/97	292	233	**08/04/97**	195	215	**12/08/97**	280	290
03/31/97	647	510	**08/05/97**	260	140	**12/15/97**	270	300
04/07/97	3360	3300	**08/06/97**	767	867	**12/22/97**	205	130
04/14/97	523	438	**08/11/97**	2550	3150	**12/29/97**	640	520
04/21/97	66	86	**08/12/97**	560	550	**01/05/98**	1500	1250
05/01/97	2130	2640	**08/13/97**	480	250	**01/12/98**	1000	1600
05/03/97	250	170	**08/18/97**	295	205	**01/21/98**	2400	300
05/12/97	212	168	**08/19/97**	190	175	**01/26/98**	433	300
05/19/97	168	132	**08/20/97**	195	81	**02/02/98**	767	250
05/27/97	2010	600	**08/25/97**	76000	76000	**02/09/98**	260	105
06/02/97	1260	2130	**08/26/97**	5800	5500	**02/16/98**	190	200
06/03/97	1365	1200	**08/27/97**	980	760	**02/26/98**	270	260
06/04/97	1000	1650	**09/02/97**	185	155	**03/01/98**	153	130
06/09/97	350	430	**09/03/97**	760	185	**03/12/98**	1300	1250
06/10/97	1800	1800	**09/04/97**	65	26	**03/16/98**	210	67
06/11/97	400	283	**09/08/97**	500	205	**03/24/98**	533	366
06/16/97	700	783	**09/09/97**	285	220	**03/31/98**	500	620
06/17/97	1300	1000	**09/10/97**	260	195	**04/07/98**	267	387
06/18/97	867	933	**09/15/97**	620	810	**04/13/98**	383	358
06/23/97	239	360	**09/16/97**	100	58	**04/22/98**	350	270
06/24/97	4750	4750	**09/17/97**	165	195	**04/27/98**	367	386
06/25/97	3000	3000	**09/22/97**	155	32	**05/04/98**	1075	950
06/30/97	433	333	**09/23/97**	6000	6000	**05/13/98**	567	517
07/01/97	43	235	**09/24/97**	3700	3600	**05/18/98**	780	520
07/02/97	2700	2550	**09/29/97**	200	225	**05/26/98**	1400	1250
07/07/97	287	417						

Appendix V. Grants Creek WWTP (Salisbury) Upstream/ Downstream Fecal Coliform Bacteria Monitoring Data (NC0023884)

Date	upstream	DS-I[1]	DS-II[1]	Date	upstream	DS-I	DS-II	Date	upstream	DS-I	DS-II
1/2/97	370	200	230	**7/1/97**	727	330	109	**9/17/97**	330	209	127
1/6/97	4100	3000	2700	**7/2/97**	6000	6000	6000	**9/22/97**	250	6000	127
1/14/97	520	91	240	**7/7/97**	664	380	200	**9/23/97**	450	6000	590
1/21/97	320	240	127	**7/8/97**	918	460	155	**9/26/97**	370	440	380
1/27/97	210	64	127	**7/9/97**	746	470	91	**10/1/97**	420	700	109
2/3/97	420	210		**7/14/97**	400	240	136	**10/6/97**	410	164	182
2/10/97	550	410		**7/15/97**	550	230	64	**10/13/97**	250	127	
2/17/97	855	164	1182	**7/16/97**	45	310	9	**10/23/97**	480	9900	
2/24/97	240	155	155	**7/21/97**	3600	500	136	**10/27/97**	6000	6000	6000
3/1/97	520	310	540	**7/22/97**	27	6000	164	**11/3/97**	600	310	380
3/11/97	220	450	145	**7/25/97**	10000	34000	5500	**11/10/97**	360	300	
3/18/97	270	210	280	**7/28/97**	8	10	490	**11/19/97**	240	3700	
3/24/97	400	210	136	**7/29/97**	927	1300	420	**11/24/97**	855	590	
4/1/97	155	240	200	**7/31/97**	3700	3000	2100	**1/5/98**	320	136	33
4/8/97	818	673	3100	**8/4/97**	370	280	64	**1/12/98**	600	3800	6000
4/16/97	610	182	178	**8/5/97**	390	340	127	**1/20/98**	1700	1600	4700
4/21/97	310	200	400	**8/6/97**	580	590	320	**1/26/98**	400	340	360
5/5/97	570	440	440	**8/11/97**	6500	7800	310	**2/2/98**	500	280	91
5/12/97	220	182	145	**8/12/97**	580	460	300	**2/9/98**	510	340	64
5/20/97	280	182	127	**8/13/97**	470	370	280	**2/19/98**	2200	4500	736
5/27/97	6100	5800	10900	**8/18/97**	1127	764	10	**2/24/98**	645	636	818
6/2/97	1464	1164	591	**8/19/97**	360	270	46	**3/1/98**	560	390	
6/3/97	1236	936	609	**8/20/97**	430	340	73	**3/9/98**	10700	8700	
6/4/97	1164	727	4000	**8/25/97**	664	410	64	**3/19/98**	6200	7000	4400
6/9/97	382	364	209	**8/26/97**	2100	6000	191	**3/23/98**	5200	4800	5700
6/10/97	540	11100	1100	**8/28/97**	330	360	82	**3/30/98**	450	440	145
6/11/97	770	460	1300	**9/2/97**	470	200	46	**4/6/98**	710	550	410
6/16/97	2400	2400	1900	**9/3/97**	300	320	64	**4/13/98**	400	390	210
6/18/97	2900	900	1146	**9/4/97**	6000	210	82	**4/20/98**	60000	60000	60000
6/19/97	855	709	570	**9/8/97**	520	460	36	**4/27/98**	727	410	420
6/23/97	673	430	295	**9/9/97**	755	300	64	**5/4/98**	2400	1500	
6/24/97	636	6300	290	**9/10/97**	7100	10900	220	**5/11/98**	5800	6000	
6/25/97	850	470	1191	**9/15/97**	570	136	155	**5/18/98**	550	570	340
6/30/97	600	470	118	**9/16/97**	460	320	127	**5/26/98**	560	420	173

[1]DS-I = Downstream, DS-II= Downstream II

Appendix VI. Public Notification of Grants Creek Fecal Coliform TMDL

Rocky River, Yadkin-Pee Dee River Basin
Grants Creek, Yadkin-Pee Dee River Basin

Now Available Upon Request

Rocky River (in Subbasin 03-07-11)
Fecal Coliform Total Maximum Daily Load

Grants Creek (in Subbasin 03-07-04)
Fecal Coliform Total Maximum Daily Load

Are now available upon request from the North Carolina Division of Water Quality. These TMDL studies were prepared as a requirement of the Federal Water Pollution Control Act, Section 303(d). The studies identify the sources of pollution, determine allowable loads to the surface waters, and suggest allocations for pollutants of concern.

TO OBTAIN A FREE COPY OF THE TMDL REPORTS:

Please contact Ms. Robin Markham (919) 733-5083, extension 558 or write to:

Ms. Betsy Albright
Water Quality Planning Branch
NC Division of Water Quality
1617 Mail Service Center
Raleigh, NC 27699-1617

Interested parties are invited to comment on the draft TMDL study by May 24, 2002. Comments and questions concerning the reports should be directed to Ms. Betsy Albright (ext. 514) at the above number and address. The draft TMDLs are also located on the following website: http://h2o.enr.state.nc.us/tmdl

Public Meetings Notice

Rocky River TMDL

A public meeting to discuss the Rocky River Fecal Coliform TMDL will be held On Wednesday, May 8th at 11:00am at the following address:

DENR Mooresville Regional Office
919 North Main Street
Mooresville, NC 28115

Grants Creek TMDL

A public meeting to discuss the Grants Creek Fecal Coliform TMDL will be held on Wednesday, May 8th at 3:30pm at the following address

Rowan County Center
2727-A Old Concord Road
Salisbury, NC 28146

Salisbury Post

AFFIDAVIT OF PUBLICATION

Div. of Water Quality

Paid: $63.26

Availability of the Grants Creek Fecal Coliform Total Maximum Daily Load (TMDL). Copies of the TMDL may be obtained by calling Robin Markham at (919)733-5083 ext. 558 or on the Internet at http://h2o.enr.state.nc.us/tmdl. A public meeting will be held at 3:30pm, May 8th at the Rowan County Center at 2727-A Old Concord Road, Salisbury. Written comments regarding the TMDL will be accepted until May 24, 2002. Please mail comments to Ms. Betsy Albright, TMDL Coordinator-Yadkin Pee-Dee River Basin, Water quality Planning Branch, NC Division of Water Quality, 1617 Mail Service Center, Raleigh, NC 27699-1617.

NORTH CAROLINA
ROWAN COUNTY

Before the undersigned a Notary Public of said County and State, duly commissioned, qualified, and authorized by law to administer oaths, personally appeared WINFRED MENTION, who being first duly sworn, deposes and says that he is ASSISTANT ADVERTISING DIRECTOR of the Salisbury Post, published, issued and entered as second class mail in the City of Salisbury, in said County and State, that he is authorized to make this affidavit and sworn statement, that the notice or other legal advertisement a true copy of which is attached hereto, was published in the Salisbury Post, on the following dates:

May 1, 2002

and that the said newspaper is which such notice, paper document or legal advertisement was published was, at the time of each and every such publication, a newspaper meeting all of the requirements and qualifications of Section 1-597 of the General Statutes of North Carolina and was a qualified newspaper within the meaning of Section 1-597 of the General Statutes of North Carolina.

This 29th day of May, 2002
Sworn and subscribed before me
This 29th day of May, 2002

NOTARY PUBLIC

My Commission Expires 2-29-04

PO Box 4639 Salisbury, NC 28145-4639 (704) 633-8950

North Carolina Cooperative Extension Service

NC STATE UNIVERSITY

College of Agriculture and Life Sciences
Rowan County Extension
2727-A Old Concord Road
Salisbury, NC 28146
Phone: 704-633-0571
Fax: 704-636-2840
URL: http://rowan.ces.state.nc.us/

Ag Acres

MAY 2002

Dear Field Crop Producer:
With the warm temperatures of spring upon us, the numbers of cereal leaf beetles in small grain crops starts to become a problem. The insect has been around North Carolina for quite awhile. It can become very numerous in small grain fields and the larva are capable of reducing grain yield by eating the green leaf tissue.

■ Management of Cereal Leaf Beetle In Small Grains

The North Carolina Department of Agriculture has released several species of exotic parasites throughout the state. These parasites develop within cereal leaf beetle eggs and larvae and have the potential to keep populations below an economic level. Parasite release programs have worked well in several other states but have had limited success in our state up to the current time. Efforts are to introduce new and better adapted parasites for North Carolina are continuing. Native biological control agents, especially lady beetles, appear to consume cereal leaf beetle eggs and, perhaps, young larvae in early spring. Whereas farmers can do little to stimulate the development of these biological control agents, unnecessary or excessively early insecticide application may cause cereal leaf beetle problems by removing these valuable predators. Therefore, insecticides should be applied only on the basis of a need as determined by proper scouting and threshold use. Avoid using insecticide with top dressed nitrogen application as this has been demonstrated to enhance populations in some cases. Several effective insecticides are registered for use on small grains (see sections on scouting and insecticides). In addition, where cereal leaf beetles are present and the Hessian fly has not been a problem, avoiding late planting may be beneficial. Late-planted fields are more attractive to cereal leaf beetles for egg laying in the spring. Additionally, thick planted/tillered wheat fields are less subject to develop high cereal leaf beetle populations. In general, following sound agronomic practices for high yield small grain production reduces the impact of cereal leaf beetle.

■ Scouting For Cereal Leaf Beetle In Small Grains

Scouting Method: Scouting should be done after peak egg laying has occurred and the majority of eggs have hatched, usually in early to late April. Development will occur earlier in the Piedmont vs the Mountains and Coastal Plain; earlier in south, later in north. On warm springs scouting should be done earlier than on cooler springs. Scouting should be done when both eggs and mostly small larvae are in the field (counts should include both forms). If the population is mainly made-up of eggs, then scouting should be at a later date, when a minimum of 50% is in the larval stage.

Grants Creek Watershed

A study by the North Carolina Department of Environment and Natural Resources, Division of Water Quality, on the Grants Creek Watershed has identified the fecal coliform total maximum daily level. These TMDL studies were conducted as a requirement of the Federal Water Pollution Control Act, Section 303(d). The studies identify the sources of pollution, determine allowable loads to the surface waters, and suggest allocations for pollutants of concern.

A public meeting to discuss the Grants Creek Fecal Coliform TMDL will be held on Wednesday, May 8, 3:30 p.m. at the Rowan County Ag Center. Anyone residing within the Grants Creek Watershed would be especially interested in this meeting. All the general public is invited.

Pesticide Disposal Collection Day

Have any unused pesticides sitting around your farm or home that you'd like to dispose of? Mark down the date of Wednesday, May 8, 10:00 a.m. - 2:00 p.m., at the Rowan County Ag Center. Any pesticide, including insecticides, fungicides, herbicides, etc.) that are in original containers and are clearly labeled will be accepted. There is no charge to the participant for this service; however, no products with unknown identities, unlabeled products, products not in pesticide containers, paints, or other hazardous waste will be accepted.

No pre-registration is required. However, participants that have pesticide products that are in containers greater than 5 gallons in size will need to pre-register in advance of May 8.

Small Grains Field Day

Several North Carolina State Crop Science Specialists will be in our area to discuss issues related to wheat, barley, and other small grains. Janet Spears, Randy Weisz, and Alan York plan to be here on Monday, May 13, 2002. Their tentative agenda is to be at the wheat test plots on McLain Farms, Statesville, at 10:30 a.m. They will then proceed to Gene Hunter's Farm in Cornelius about 1:00 p.m. They plan to finish at the Piedmont Research Station at 3:30 p.m. For specific directions to any of the sites contact: McLain Farms (Iredell County), Mike Miller, 704-873-0507; Hunter Farm (Mecklenburg County), Jim Monroe, 704-336-2561; Piedmont Research Station (Rowan County), 704-278-2624.

James C. Cowden

James C. Cowden
County Extension Director

Appendix VII. Public Comments and Response to Comments on the Public Review Draft of the Grants Creek Fecal Coliform TMDL

NORTH CAROLINA FARM BUREAU FEDERATION

TELEPHONE (919) 782-1705 / P. O. BOX 27766 / RALEIGH, NORTH CAROLINA 27611

May 24, 2001

Ms. Betsy Albright
TMDL Coordinator-Yadkin-Pee Dee River Basin
Water Quality Planning Branch
NC Division of Water Quality
1617 Mail Service Center
Raleigh, NC 27699-1617

Dear Ms. Albright:

The North Carolina Farm Bureau Federation is the state's largest general farm organization, representing the interests of farmers and rural families all across our state. This letter is to comment on DWQ's Public Review Drafts of Total Maximum Daily Loads (TMDL) for fecal coliform in the Rocky River and Grants Creek, both in the Yadkin-Pee Dee River Basin. Farm Bureau is very concerned about the proposed TMDL's and opposes them in their current form.

In the draft TMDL for fecal coliform, you attribute most of the blame for excessive fecal coliform levels on non-point source pollution, especially livestock operations within these subbasins. We believe that this assertion is unfair and based on faulty assumptions, estimates, and other unknowns that are part of the Coliform Routing and Allocation Program (CRAP) model. The model (which determines the sources of fecal coliform pollution and allows the monthly input of stream flow and fecal coliform loading concentrations) contains entirely faulty assumptions regarding what happens on real-world farms.

The document indicates that there are no permitted CAFOs in the watersheds, but that there are several small livestock operations in the lower portion of the watersheds. In other parts of the document, the CRAP model assumes 100% of herbaceous cover is occupied by livestock and grazed daily, 100% of cultivated land is receiving animal waste, herbaceous lands are contributing fecal coliform at maximum levels of 5,000 cfu/100ml every wet day of the year, fecal coliform continues to be deposited instream at 500cfu/100ml on all dry weather days and that point sources aren't a problem at all. All of these assumptions misrepresent fecal coliform contributions from nonpoint sources, especially agriculture, and therefore unfairly allocate the majority of the proposed reductions to these nonpoint sources.

These issues are discussed in further detail in this letter. Because the same model is used in both subbasins, we will refer to the Rocky River document; however, the comments also apply to the Grants Creek document.

The model assumes that cattle populations were evenly distributed on herbaceous land throughout the counties (page 20). Since no information on site specific annual grazing patterns were available, it was assumed that there is no monthly variation in grazing on grazed pastureland throughout the year. On real cattle farms this cannot happen. The cattle eat grass in one pasture, and then are moved to another pasture, in order for the grass in the first pasture to grow. Therefore, some grazed pastureland is idle at all times.

Also, you assume (page 20) that all herbaceous land is grazed. This is certainly not correct. Based on our experience with the data on land cover, we know that the category "herbaceous and/or pasture land" can include grazed pasture. But it also includes hayland (used for hay production and not grazed), idle land, land in conservation easements (such as Conservation Reserve Program (CRP) land), and even golf courses and parks. However your model description says, "cattle grazing is linked to herbaceous cover" (page 18.) To claim that all pasture and herbaceous land is grazed and has animal manure on it is a ridiculous assumption.

Your report acknowledges that one study (Stephenson and Street, p. 20) observed that the presence of cattle on rangelands increased fecal coliform concentrations from 0 to 2500/100ml instream. First, rangelands are out in the western US and have little relevance in North Carolina. We feel that if you contact North Carolina State University you will find that they have more relevant work on this. The other study cited (Doran) is from 1981, which is really old, and it does not measure instream contributions. Get information from North Carolina. Contact NCSU and get more recent information.

Also, rather than choosing an amount some where in the middle of the range of 0 – 2500 (page 22), you choose instead to go with a level of 5000/100ml for wet days and 500/100ml for dry days. Using the highest instream measured number, the maximum it could be, based on your limited data cited here, is 2500. Further, if the same method were used for the development category, the highest measurement "in the tributary," meaning instream, is 240,046. Had the same tactic been used when calculating the fecal coliform load from development, levels would have been set at 240,046/100ml rather than the proposed level of 8,700 /100ml.

There is no justification given in the document for the 500/100ml (p. 20) for dry weather contributions at all from pasture and herbaceous cover. Where did this come from? Further, regarding the dry weather contributions, we assume that when there is no surface contribution that what is being transported is in the surficial groundwater. Based on residence time in groundwater a contribution of 500/100ml of fecal coliform for dry days just does not make sense when calculating the fecal coliform load from herbaceous cover, whether or not that land has livestock grazing on it. Keep in mind that herbaceous cover includes much more than just pastureland and certainly does not have animals on it. Also, herbaceous cover will have microbial activity in the surface layers to destroy the fecal coliform where impervious areas will not.

Appendix VII. DWQ Response to Public Comment on the Public Review Draft of the Grants Creek Fecal Coliform TMDL

The North Carolina Division of Water Quality welcomes the comments from the North Carolina Farm Bureau Federation. As sited in the TMDL, the Coliform Routing and Allocation Program is a simple model and is used by DWQ when there is a dearth in site-specific fecal coliform concentration data. DWQ recognizes that there is uncertainty associated with the modeling and input data used in the modeling. Where there was not site specific or North Carolina based data available, an extensive literature review was conducted in order to determine the most appropriate input values for the CRAP model. DWQ recognizes that the land cover/land use is from 1996 and uncertainty in the modeling exists because of the age of this data. However, DWQ has recently conducted watershed reconnaissance and feels that the model appropriately approximates the presence and absence of livestock throughout the watershed. Watershed specific livestock data was obtained from Rowan County Soil and Water Conservation District office, and North Carolina Cooperative Extension office.

The hydrology portion of the model is based on daily flow values which were calculated using an aerial weighting approach utilizing a gaged stream in a nearby watershed. These flows were adjusted to account for the discharge from Waste Water Treatment Plants (WWTPs) within the watershed.

The model assumes that livestock grazing and manure application occur mainly in watersheds 01-02. Livestock grazing and land applications were minimal in watershed 03. Therefore, the area around Salisbury (WS03) did not include manure application in the model. The CRAP model is based on average conditions, while manure might not be deposited or applied every day throughout a specified period, fecal coliform polluted runoff does occur after manure has been deposited or applied. Stephenson and Street (1978), and Jawson et al. (1982) have determined that elevated levels of bacteria may persist in pasture runoff months after cattle have been removed from the pastureland.

Due to the level of uncertainty in the modeling assumptions and the input data, the DWQ supports an adaptive management approach to reducing the fecal coliform levels within Grants Creek. We very much welcome the North Carolina Farm Bureau Federation’s involvement in developing a fecal coliform management strategy for the Grants Creek.

References:

Stephenson, G.R. and L.V. Street. 1978. Bacterial Variations in streams from a southwest Idaho rangeland watershed. J. Environ. Qual. 7:150-57

Jawson, M.D., L.F. Elliot, K.E. Saxton, and D.M. Fortier. 1982. The effect of cattle grazing on indicator bacteria in runoff from a Pacific Northwest watershed. J. Environ. Qual. 11:621-7