Total Maximum Daily Load
Jeremy Inlet and Scott Creek
(Hydrologic Unit Code 030502060308)
Impaired Stations 13-23 and 13-22
Fecal Coliform Bacteria

April 2010

Prepared for:
Bureau of Water
SCDHEC Technical Document Number:07J-15

D H E C
PROMOTE PROTECT PROSPER
South Carolina Department of Health and Environmental Control

Prepared by:
Ann-Marie Altman

Abstract

The delineated watershed surrounding impaired stations 13-22 and 13-23 (Scott Creek and Jeremy Inlet) consists of approximately 1.24 square miles of shellfish growing area habitat located in Colleton County, South Carolina. Water quality monitoring stations 13-22 and 13-23 are listed on the 2008 303(d) list as impaired for shellfish use support due to exceeding the fecal coliform standard. Both stations have been on the list previously in 2004 and 2006. Stations are listed as impaired on the basis of at least 30 monthly samples taken over a period of 3 years as required by the National Shellfish Sanitation Program. The department believes that meeting each percentage reduction or the water quality standard (WQS) will effectively protect the shellfish harvesting beds in the referenced watershed for human consumption. Station 13-22 requires a reduction of 70 % while station 13-23 requires a reduction of 66 % (Table Ab-1). This TMDL document is based on 77-157 data This TMDL document is based on 77-157 data points per each monitored station from 1994-2007 to ensure greater temporal variability. The primary land use of the watershed is wetlands/open water (50.4%) followed by forested area (25.76%). Probable sources of fecal coliform (FC) bacteria are large populations of waterfowl and wildlife.

Existing conditions and percent reductions for this system were calculated using cumulative probability distributions. Compliance with terms and conditions of existing and future NPDES sanitary and stormwater permits (including all construction, industrial and MS4) may effectively implement the wasteload allocation (WLA) and demonstrate consistency with the assumptions and requirements of the TMDL. Required load reductions in the load allocation (LA) portion of this TMDL can be implemented through voluntary measures.

The Department recognizes that **adaptive management/implementation (i.e. WLA and LA)** of this TMDL might be needed to achieve the water quality standard and we are committed towards targeting the load reductions to improve water quality in the watershed used in the development of this TMDL document. As additional data and/or information becomes available, it may become necessary to revise and/or modify the TMDL target accordingly.

Table Ab-1. Total Maximum Daily Load for the Jeremy Inlet TMDL Watershed. Loads are expressed as colony forming units (cfu) per day.

Station ID	90th %tile of Existing Load (cfu/100ml)	TMDL[1,2] (cfu/100ml)	WQ Target (cfu/100ml)	Margin of Safety (MOS) (cfu/100ml)	WLA			LA
					Continuous Sources[3] (cfu/100ml)	Non-Continuous Sources[4,6] (% Reduction)	Non-Continuous SCDOT[5,6] (% Reduction)	% Reduction to Meet Load Allocation[6]
13-22	137	43	40.9	2.1	N/A	70%	0%	70%
13-23	121	43	40.9	2.1	N/A	66%	0%	66%

Table Notes:

1. TMDL is expressed as a concentration. If daily average tidal exchange estimates were available, this number could be converted to load in cfu/day by multiplying flow by concentration and a conversion factor.
2. Shellfish WQS = No more than 10% of the samples shall exceed 43cfu/100 ml.
3. WLA is expressed as a daily maximum; N/A=not applicable. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern. Loadings were developed based upon permitted flow and an allowable permitted maximum concentration of 43cfu/100ml.
4. Percent reduction applies to 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 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.
5. As long as the conditions within the SCDOT MS4 area remain the same the Department deems the current contributions from SCDOT negligible and no reduction of FC bacteria is necessary. SCDOT must continue to comply with the provisions of its approved NPDES stormwater permit.
6. Percent reduction applies to existing concentration.

TABLE OF CONTENTS

TABLES AND FIGURES

1.0 INTRODUCTION

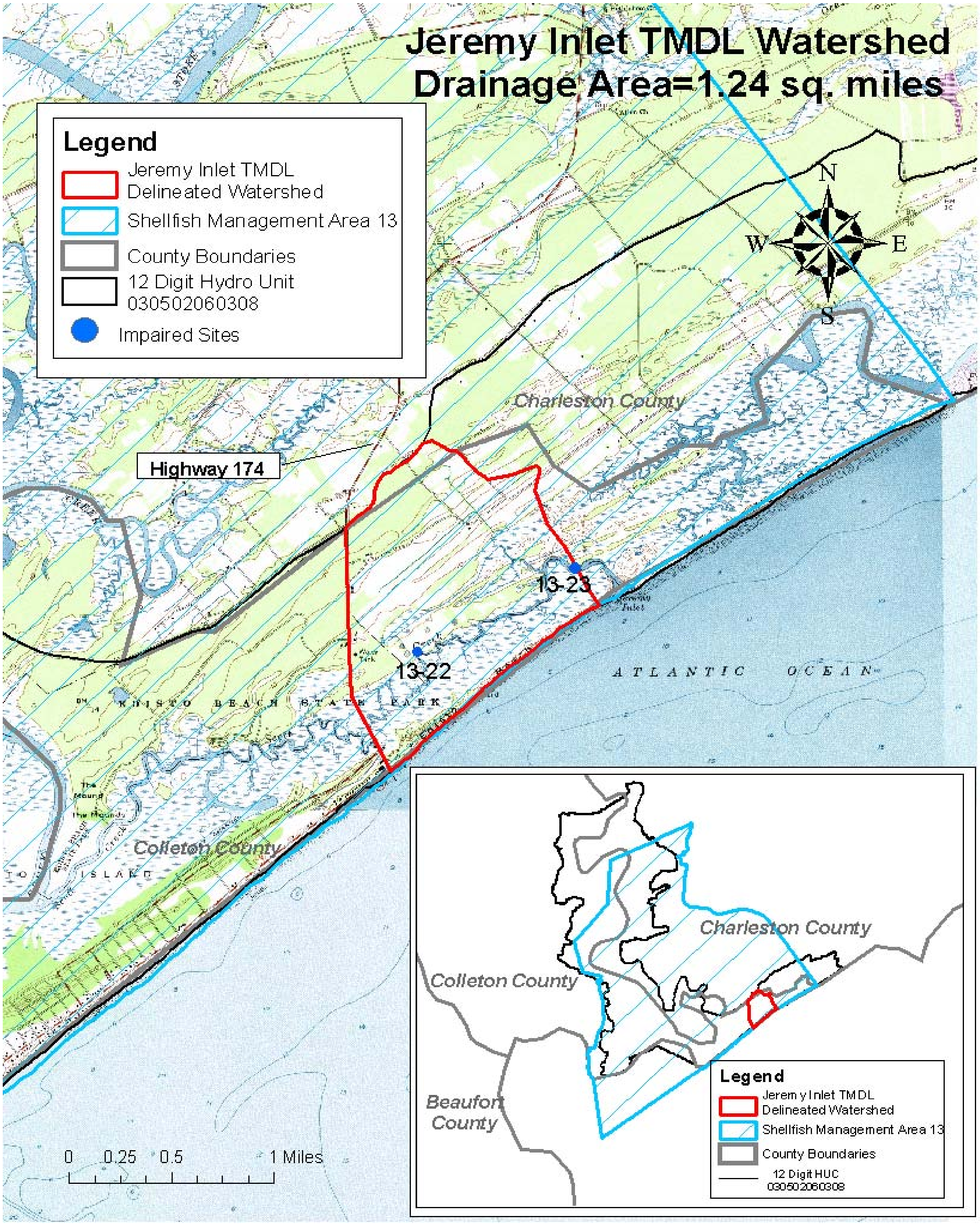
1.1 Background

A Total Maximum Daily Load (TMDL) is a written plan and analysis to determine the maximum pollutant load a waterbody can receive and still meet applicable water quality standards. The TMDL process includes estimating pollutant loadings from all sources, linking pollutant sources to their impacts on water quality, allocation of pollutant loads to each source and establishment of control mechanisms to achieve water quality standards (US EPA, 1999). All TMDLs include a wasteload allocation (WLA) for all National Pollutant Discharge Elimination System (NPDES) permitted discharges, a load allocation (LA) for all nonpoint sources, and an explicit and/or implicit margin of safety (MOS). TMDLs are required to be developed for each waterbody and pollutant combination on the State 303(d) list by 40 CFR 130.31(a) (US EPA, 1999).

1.2 Watershed Description

The Jeremy Inlet TMDL watershed is located in Colleton County and Charleston County, South Carolina within Shellfish Management Area 13 and Hydrologic Unit Code 030502060308 (see Figure 1). The drainage area of the delineated watershed is 1.24 square miles. Highway 174 defines the western border of the watershed while the Atlantic Ocean is the southern border. This watershed is located within the Ace Basin National Estuarine Research Reserve and a portion of Edisto Beach State Park lies within the southeastern portion of the watershed.

Figure 1. Location of Jeremy Inlet TMDL Watershed- Colleton County and Charleston County, Shellfish Management Area 13
SCDHEC Impaired Monitoring Sites 13-22(Scott Creek) and 13-23 (Jeremy Inlet)



1.2.1 Tides

Tides in the Jeremy Inlet watershed are semidiurnal, consisting of two low and two high tides occurring each lunar day. The highest tidal ranges of the year occur from September through December. Wind direction and intensity, as well as atmospheric pressure, typically cause variations in predicted tidal ranges.

1.2.2 Precipitation

Precipitation in the watershed is heaviest during late summer and early autumn. Tropical storms and hurricanes occasionally produce extremely large amounts of rainfall. During winter months heavy rainfall events are uncommon, yet occasional intense thunderstorms associated with rapidly moving low-pressure systems generate heavy rains. Precipitation rarely occurs in the form of snow or ice. Spring weather patterns may be dynamic with associated thunderstorms and severe weather conditions.

The closest meteorological station for this watershed area is located on Edisto Beach. It has recorded an average yearly rainfall of 49 inches. Approximately 40% of the annual rainfall falls in the three-month period from June to August, with August typically being the wettest month. Weather patterns during this time period are often characterized by thunderstorms and shower activity of short duration. The months of July, August, and September historically have the greatest numbers of days with rainfall exceeding 1.00".

1.2.3 Winds

Prevailing wind direction during January through February is generally from the west to northwest with an average speed of 8-12 MPH. During the months of March through August, wind direction is typically a southerly component at an average speed of 7-10 MPH and September through December normally maintains a north-north easterly wind direction with an average speed of 6-8 (NOAA).

1.2.4 River Discharges

The South Edisto River is the main means of freshwater impact in this area. However the Jeremy Inlet watershed is well to the east of the South Edisto River.

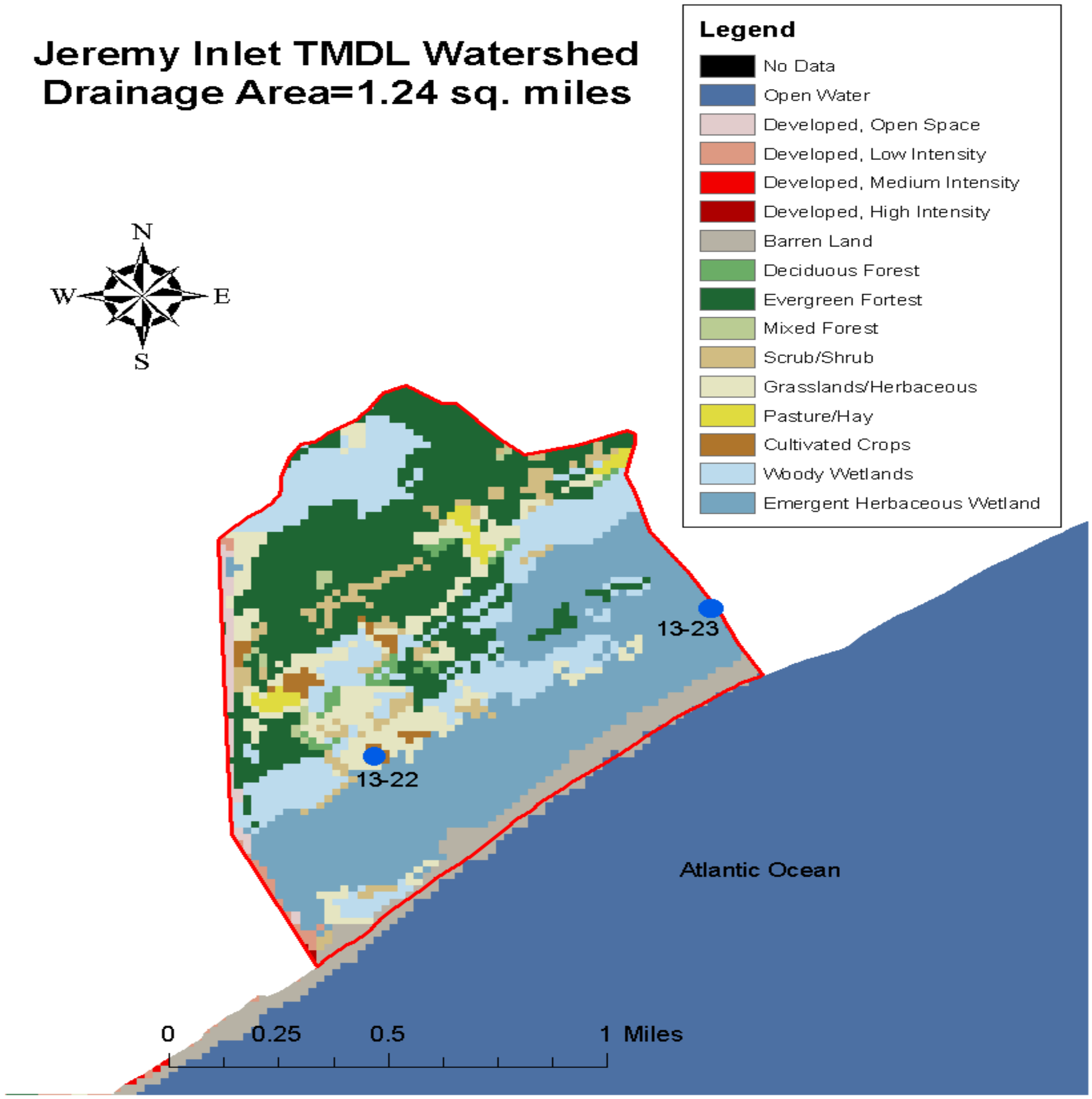
1.2.5 Land Use and Soils

Land use was assessed for the 12 digit hydrologic unit code that the Jeremy Inlet watershed encompasses. The primary land use of this watershed is wetlands/ open water (50.4%), followed by forested area (25.76%). There is very little agricultural land or urban development in the area (Table 1; Figure 2). The land is relatively high in elevation and drains well. Soils types are Wando, Wagrum, Lakeland, and Charleston.

Table 1. Land Use Within the Jeremy Inlet TMDL Watershed

Land Use (NLCD 2001)	Area (mi^2)	Percent
Woody Wetlands	0.22	18.0%
Open Water	0.002	0.19%
Emergent Herbaceous Wetlands	0.40	32.17%
Total Wetlands/Open Water	***0.62***	***50.4%***
Evergreen Forest	0.31	25.2%
Deciduous Forest	0.01	0.08%
Mixed Forest	0.01	0.48%
Total Forested	***0.33***	***25.76%***
Cultivated Crops	0.01	1.2%
Pasture/Hay	0.01	1.2%
Total Agricultural	***0.02***	***2.4%***
Developed, Open Space	0.02	1.54%
Developed, Low Intensity	0.01	0.7%
Developed, Medium Intensity	0.00	0.00%
Developed, High Intensity	0.001	0.08%
Total Developed	***0.03***	***2.32%***
Scrub/Shrub	0.05	4.06%
Barren Land	0.07	5.5%
Grassland/Herbaceous	0.12	8.91%
Total Other	***0.24***	***18.47%***
Total Area	**1.24**	**100%**

Figure 2. Land Use Within the Jeremy Inlet TMDL Watershed



1.3 Water Quality Standard

Water quality standards (WQS) are based on the classification of the waterbody and are designed to protect the designated uses of that classification. Jeremy Inlet and Scott Creek are designated as Outstanding Resource Waters (ORW). Standards for class ORW waters are those applicable to the classification of the waterbody immediately prior to reclassification to Class ORW. In this case, waters would be required to meet SFH standards. ORW waters are described as:

> "freshwaters or saltwaters which constitute an outstanding recreational or ecological resource or those freshwaters suitable as a source for drinking water supply purposes with treatment levels specified by the department." (SC DHEC, 2004b p.22).

Guided by the minimum requirements of the National Shellfish Sanitation Program Model Ordinance (US FDA, 2005), the State of South Carolina has implemented a Water Quality Standard (WQS) for fecal coliform in Shellfish Harvesting Waters as:

> "Not to exceed an MPN fecal coliform geometric mean of 14/100 ml; nor shall more than 10% of the samples exceed an MPN of 43/100 ml." (SC DHEC, 2004b).

The National Shellfish Sanitation Program (NSSP) is the federal/state cooperative program recognized by the U. S. Food and Drug Administration (FDA) and the Interstate Shellfish Sanitation Conference (ISSC) for the sanitary control of shellfish produced and sold for human consumption. The purpose of the NSSP is to promote and improve the sanitation of shellfish (oysters, clams, mussels and scallops) moving in interstate commerce through federal/state cooperation and uniformity of State shellfish programs. Participants in the NSSP include agencies from shellfish producing and non-producing States, FDA, EPA, NOAA, and the shellfish industry. Under international agreements with FDA, foreign governments also participate in the NSSP. Other components of the NSSP include program guidelines, State growing area classification and dealer certification programs, and FDA evaluation of State program elements (US FDA, 2005).

2.0 WATER QUALITY ASSESSMENT

The Department currently utilizes a systematic random sampling (SRS) strategy within the watershed in lieu of sampling under adverse pollution conditions. In order to comply with National Shellfish Sanitation Program (NSSP) guidelines, a minimum of thirty samples are required to be collected and analyzed from each station during the review period. Sampling dates are computer generated prior to the beginning of each quarterly period thereby insuring random selection with respect to tidal stage and weather. Day of week selection criteria is limited to Mondays, Tuesdays and Wednesdays due to shipping requirements and laboratory manpower constraints. Sample schedules are rarely altered.

During July 1998, an updated shellfish water quality data scheduling and collection procedure was formalized. Samples utilized for classification purposes are limited to those samples collected in accordance with the SRS for a 36-month period beginning January 1 and ending December 31. This allows for a maximum of 36 samples per station, yet provides a six-sample 'cushion' (above the NSSP required 30 minimum) for broken sample bottles, lab error, breakdowns, etc. This also allows each annual report's water quality data to meet the requirements for the NSSP Triennial Review sampling criteria.

Water quality sample data was used for this document during the period of 01/01/04 through 12/31/06. The samples were collected in 120 ml amber glass bottles, immediately placed on ice and transported to South Carolina Department of Health and Environmental Control Region 8 Environmental Quality Control laboratory located in Burton, South Carolina. Each bacteriological sample run included a 120 ml water temperature control sample maintained at less than or equal to 10 degrees Celsius. Upon receipt at the laboratory, sample sets that exceeded a 30-hour holding period or contained a temperature control greater than 10 degrees Celsius were discarded (APHA, 1970).

Surface water temperatures are measured utilizing hand-held, laboratory-quality calibrated centigrade thermometers. Salinity measurements were measured in the laboratory using an automatic temperature compensated refractometer. Additional field data include ambient air temperature, wind direction, tidal stage and date and time of sampling. Tidal stages are determined by using Nautical Software's *Tides & Currents*, Version 2 (1996).

There are 2 monitoring stations within the delineated watershed (Appendix A). These stations are listed on the 2008 303(d) list. Station 13-22 exceeds the fecal coliform MPN geometric mean value of 14cfu/100ml. Both 13-22 and 13-23 exceed the estimated 90th percentile value of 43cfu/100ml and therefore are classified as restricted. Data used in this document can be found on EPA's Storet website (http://www.epa.gov/storet/).

Table 2. Fecal Coliform Data Summary

Station	# Samples	Geometric Mean	90th Percentile	2008 303(d) List	Shellfish Classification
13-22	34	**26.2**	**137**	Yes	Restricted
13-23	33	13.8	**121**	Yes	Restricted

90th percentile calculated per US FDA Model Ordinance (2005).
Numbers in bold and yellow exceed standard.

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

FC 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 a risk to public health. Indicators such as FC bacteria, enteroccoci, or *E. coli* are easier to measure, have similar sources as pathogens, and persist in surface waters for a similar or longer length of time. These bacteria are not in themselves disease causing, but indicate the potential presence of organisms that may result in sickness.

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 continuous point sources, such as factories and wastewater treatment facilities, has been greatly reduced. These point sources are required by the Clean Water Act (CWA) 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 FC bacteria pollution. However, if these facilities are discharging wastewater that meets their permit limits, they are not causing impairment provided that a daily maximum limit is being met as specified in the Total Maximum Daily Load. If any of these facilities is not meeting its permit limits, enforcement actions/mechanisms are required

Other non-continuous point sources required to obtain NPDES permits that may be a source of pathogens include Municipal Separate Storm Sewer Systems (MS4s) and stormwater discharges from industrial or construction sites. MS4s may require NPDES discharge permits under the

NPDES Stormwater regulations. These sources are also required to comply with the state standard for the pollutant(s) of concern. If MS4s and discharges from construction sites meet the percentage reduction or the water quality standard as prescribed in Section 5 of this TMDL document and required in their permit(s), they should not be causing or contributing to an instream FC bacteria impairment.

3.1 Point Sources

3.1.1 Continuous Point Sources

Domestic Wastewater

There are currently two domestic wastewater treatment systems within the delineated watershed (see Table 3). Jeremy Cay neighborhood has a lagoon and spray field of 2 acres designed to serve up to 42 homes and The Hammocks neighborhood has a septic tank and drip irrigation system designed to serve up to 51 homes (see map, Appendix F). ND or “No Discharge” permits are not allowed a legal discharge to waters of the state including Jeremy Inlet and Scott Creek. Systems/facilities with ND permits that discharge to waters of the state are illegal and subject to compliance/enforcement mechanisms.

Industrial Wastewater

There are no industrial wastewater dischargers within the delineated watershed.

Table 3. NPDES Dischargers in the Jeremy Inlet TMDL Watershed

Permit Number	Name	Type
ND0077534	Hammocks at Jeremy Inlet	Drip Irrigation
ND0071510	Jeremy Cay	Spray Irrigation- field near Scott Creek

Marinas

S.C. Regulation 61-47, South Carolina Shellfish (2007) defines *Marina* as “any of the following: (1) locked harbor facility; (2) any facility which provides fueling, pump-out, maintenance or repair services (regardless of length); (3) any facility which has effective docking space of greater than 250 linear feet or provides moorage for more than 10 boats; (4) any water area with a structure which is used for docking or otherwise mooring vessels and constructed to provide temporary or permanent docking space for more than ten boats, such as a mooring field; or (5) a dry stack facility.”

There are currently no marinas or commercial boat docking facilities located within the Jeremy Inlet watershed. The nearest commercial boat docking facility is Edisto Marina located on Big Bay Creek a few miles west of the watershed. There is no impact from this marina to the Jeremy Inlet watershed.

3.1.2 Non-Continuous Point Sources

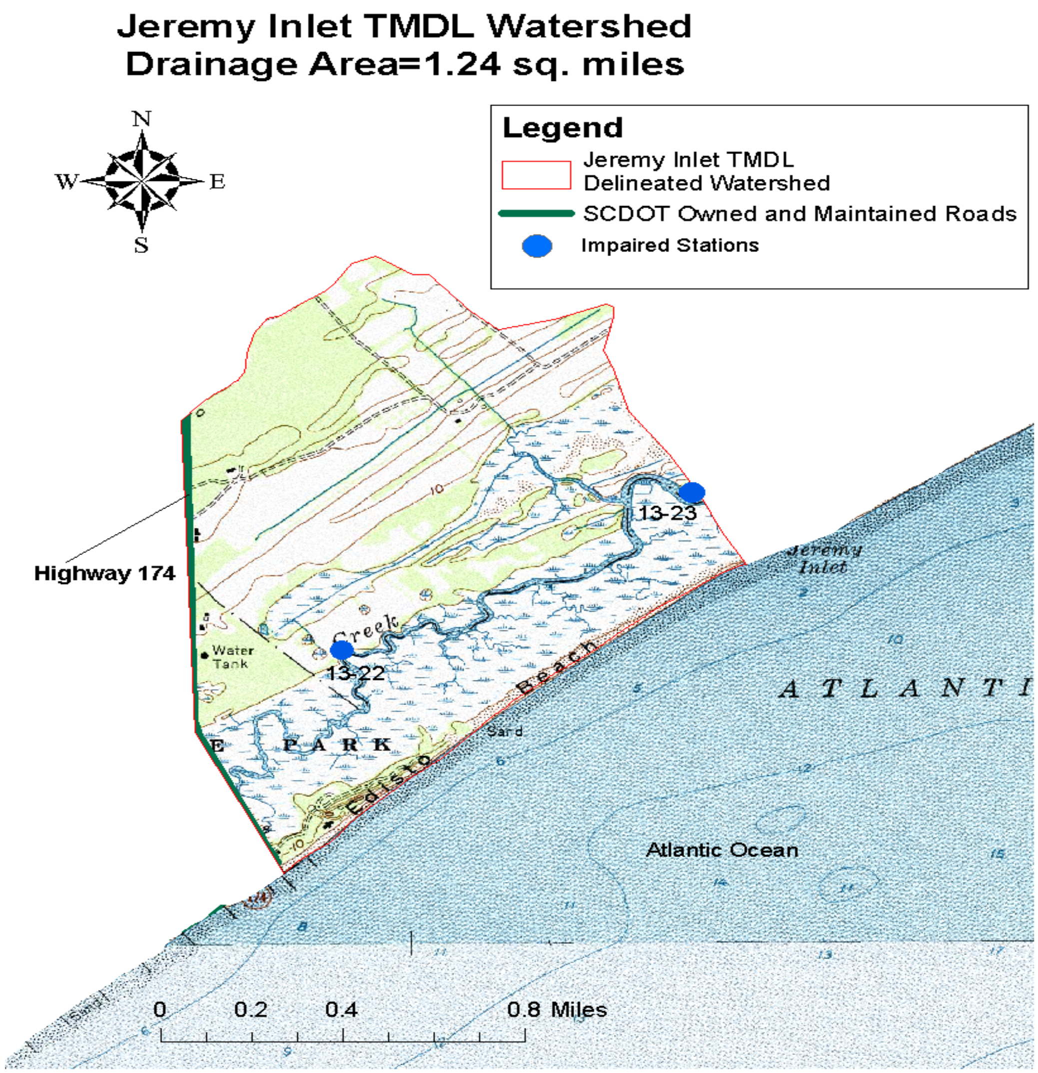
Non-continuous point sources include all NPDES-permitted stormwater discharges, including current and future MS4s, construction and industrial discharges covered under permits numbered SCS and SCR and regulated under SC Water Pollution Control Permits Regulation 122.26(b)(14)&(15). All regulated MS4 entities have the potential to contribute FC pollutant loadings in the delineated drainage area used in the development of this TMDL.

If future MS4 permits are applicable to this watershed, then those discharges will be subject to the assumptions and requirements of the WLA portion of this TMDL. However, there may be industrial or construction activities going on at any time that could produce stormwater runoff.

The current overall developed land use in this watershed is 2.32%. Based on current Geographic Information System (GIS) information (available at time of TMDL development) there are currently no SCDOT rest areas or other facilities located in the referenced watershed area.

Industrial facilities that have the potential to cause or contribute to a violation of a water quality standard are covered by the NPDES Storm Water Industrial General Permit (SCR000000). Construction activities may be covered by the NPDES Storm Water Construction General Permit from DHEC (SCR100000). Where permitted construction activities have 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 WLAs in the TMDL. Note that there may be other stormwater discharges not covered under permits numbered SCS and SCR that occur in the referenced watershed. These activities are not subject to the WLA portion of the TMDL.

Figure 3. SCDOT Owned and Maintained Roads in the Jeremy Inlet Watershed



3.2 Nonpoint Sources

Nonpoint source pollution is defined as pollution that is not released through pipes but rather originates from multiple sources over a relatively large area. Nonpoint sources can be divided into source activities related either to land or water use including failing septic tanks, improper animal-keeping practices, agriculture, forestry practices, wildlife and urban and rural runoff.

Nonpoint source pollution is likely the major contributing factor to lower water quality in the watershed. Stormwater runoff impacts water quality by transporting FC bacteria from land to the shellfish growing area. The Department recognizes that there is likely wildlife, agricultural activities, grazing animals, septic tanks and/or other nonpoint source contributors located within unregulated areas, such as the referenced Watershed (at time of TMDL development). Nonpoint sources located in unregulated areas are subject to the LA and not the WLA component of the TMDL.

3.2.1 Urban and Suburban Stormwater Runoff

Dogs, cats and other domesticated pets are the primary source of fecal coliform deposited on the urban landscape. There are also "urban" wildlife, such as squirrels, raccoons, pigeons and other birds, all of which contribute to the fecal coliform load. There is little urban development within the delineated watershed, therefore, urban non-point sources are considered to be negligible. The Army Corps of Engineers has not conducted any dredging projects recently in the watershed used in the development of this document.

As previously stated, SCDOT is currently the only permitted MS4 in the referenced watershed and is subject to the WLA component of the TMDL. Similar to regulated MS4 entities, potentially designated MS4 entities (as listed in 64 FR, P.68837) or other unregulated MS4 communities located in the Jeremy Inlet and Scott Creek watershed may have the potential to contribute FC bacteria in stormwater runoff. These unregulated entities are subject to the LA for the purposes of this TMDL.

3.2.2 Agricultural Runoff

Owners/operators of most commercial animal growing operations are required by R. 61-43, Standards for the Permitting of Agricultural Animal Facilities, 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. In addition to the state permit, animal operations that are Concentrated Animal Feeding Operations (CAFOs) are also required to have an NPDES Permit if they have a discharge to surface waters. There are currently no permitted CAFOs in South Carolina. During a source assessment it was noted that there are a few small farms.

South Carolina does have an AFO (animal feeding operation) permit program in place.
There are currently no permitted AFOs located in the watershed. The lack of concentrated agricultural activity near the shoreline of the growing waters precludes agricultural runoff as a contributing source of fecal coliform in the watershed.

3.2.3 Failing Septic

Failed septic tanks can contribute to bacterial contamination of downstream waterbodies (US EPA, 2001). There are two neighborhoods located within the watershed (Jeremy Cay and The Hammocks) that are on septic. Currently there are 15 houses in Jeremy Cay and 21 houses in The Hammocks. Studies demonstrate that wastewater located four feet below properly functioning septic systems contain on average less than one fecal coliform bacteria organism per 100 mL (Ayres Associates 1993). Failed or non-conforming septic systems, however, can be a major contributor of fecal coliform to Jeremy Inlet watershed. Wastes from failing septic systems enter surface waters either as direct overland flow or via groundwater. Although loading to streams from failing septic systems is likely to be a continual source, wet weather events can increase the rate of transport of pollutants from failing septic systems because of the wash-off effect from runoff and the increased rate of groundwater recharge.

3.2.4 Wildlife and Domestic Animals

The watershed supports significant populations of both wildlife and domestic animals such as horses, white-tailed deer, and a substantial bird population. There is an area near impaired site 13-22 that may have suitable habitat for waterfowl. A portion of Edisto Beach State Park is also located near site 13-22. Campgrounds may attract various wildlife such as raccoons.

A special study, "*Characterization and Identification of NPS Fecal Coliform Bacteria in Shellfish Growing Areas"*, was initiated by NOAA in January 2002. Primary goals were to determine the sources of fecal coliform contamination (e.g. human, domesticated animals, wild animals, etc.) at selected impaired shellfish waters. Methods used included Multiple Antibiotic Resistance (MAR), typing of F+RNA coliphages (viruses that attack *E.coli*), and typing with ribosomal DNA isolated from the E. coli. Portions of Scott, Big Bay, Fishing, Sandy, and Store Creeks and Jeremy and Frampton Inlets were included in the study. The report, "*Use of Three Microbial Source Tracking Methods to Analyze Shellfish Harvesting waters in South Carolina"*, was published in August 2004. The report states that the results of all three microbial source-tracking techniques are consistent with animal–source fecal contamination for the majority of tested sites. Surface water site 13-23 (Jeremy Inlet at Atlantic Ocean) had type I coliphages and a MAR index of zero, suggesting an animal impact. Station 13-22, in the headwaters of Jeremy Inlet, had type I and III coliphages, suggesting a mix of animal and human contamination at the time of sampling.

In 2008, SCDNR estimated that there are 30-45 deer per square mile within the delineated watershed within Colleton County (SCDNR 2008). SCDNR estimated deer density based on suitable habitat (forests, croplands, and pastures). The fecal coliform production rate for deer has been shown to be 3.47 x 10^3 cfu/head-day in a study conducted by Yagow (1999), of which only a portion will enter the watershed.

3.2.5 Boat Traffic

Recreational boat traffic is moderate throughout shellfish area 13 except during the winter months, however the Jeremy Inlet area is not navigable.

3.2.6 Hydrographic Modification

Hydrographic and habitat modification in estuarine areas requires both State and Federal approval. An earthen causeway, used as a bike path, was installed to connect Edisto Beach to Edisto Island. This earthen causeway crosses the headwaters of Scott Creek. At one time a 40-foot bridge crossed over this tidal creek. In 1939 the causeway was filled in and a road was paved, essentially damming the headwaters. Some local citizens are concerned that this constriction of tidal flow is in part the cause of silting and water quality problems in Scott Creek and have been pursuing actions to replace the causeway with a bridge.

4.0 METHODS

Creating a functional hydrodynamic model of this system would be resource intensive. However, through statistical and graphical methods a general understanding of the system can be obtained and necessary percent reductions in fecal coliform loading can be calculated.

Cumulative probability distributions were used to calculate existing conditions and percent reduction necessary to meet shellfish waters standards for fecal coliform. All available water quality data were used in calculations to provide a more robust dataset. To create a cumulative probability graph, water quality measurements are first sorted in ascending order to determine rank and then assigned a probability plotting position using the following function:

$$p(\%) = \frac{100M}{N+1}$$

where M = rank and N = number of samples (Novotny, 2004). In this case, the log base 10 of fecal coliform is used. If the data follows a log-normal distribution, the data points on the plot will approximate a straight line (the normal distribution). This straight line is then compared to the water quality standard at the appropriate percentile. For SC shellfish waters this equates to 43 cfu/100ml minus a 5% margin of safety (40.9 cfu/100ml) at the 90th percentile. If the fit line crosses the 90th percentile reference line above the standard, the site is considered to not meet the standard for single sample maximums, if the line crosses below the standard reference the site does meet the water quality standard. If the data does not meet the single sample standard, a line is drawn parallel to the original normal distribution line that intersects the standard at the 90th percentile point (Appendix C). Drawing the line parallel to the original distribution makes the assumption that the coefficient of variation remains the same for the original data and the desired water quality data (Novotny, 2003). The necessary percent reduction is calculated as the difference between the distributions at the 90th percentile point:

$$\frac{\text{Existing Load - (Standard - MOS)}}{\text{Existing Load}} * 100$$

There are no stations that currently exceed the geometric mean criteria that do not also exceed the single standard sample.

If sufficient approximations of tidal exchange and flow patterns were available, this method could be extended to calculate the total maximum daily fecal coliform loading in cfu/day for locations within the watershed. Average daily tidal exchange would be multiplied by the water quality standard of 43 cfu/100ml and a conversion factor. This number would represent the maximum daily load for all waters within the delineated watershed.

5.0 DEVELOPMENT OF TMDL

5.1 Critical Conditions

Critical conditions are the "worst-case" environmental conditions for exceedance of water quality standards and which occur at an acceptable frequency (US EPA, 1999). Due to the tidal nature of this system, it is unclear what a critical flow would be. By including all data in the calculations, inclusion of the critical condition is implicit. Seasonal variation is also taken into account by including all monitoring data.

5.2 Wasteload Allocation

The WLA is the portion of the TMDL allocated to NPDES-permitted point sources (US EPA, 1999). The wasteload summation is determined by subtracting the margin of safety and the sum of the load allocation from the total maximum daily load. Note that all illicit dischargers, including SSOs, are illegal and not covered under the WLA of this TMDL.

5.2.1 Continuous Point Sources

There are currently no dischargers within the Jeremy Inlet TMDL area.

5.2.2 Non-Continuous Point Sources

Non-continuous point sources include all NPDES-permitted stormwater discharges, including current and future MS4s, construction and industrial discharges covered under permits numbered SCS & SCR and regulated under SC Water Pollution Control Permits Regulation 122.26(b)(14) & (15). Illicit discharges, including SSOs, are not covered under any NPDES permit and are subject to enforcement mechanisms. All areas defined as "Urbanized Area" by the US Census are required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater. Other non-urbanized areas may be required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater.

Waste load allocations for stormwater discharges are expressed as a percentage reduction instead of a numeric concentration due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet the percentage reduction or the existing instream standard for the pollutant of concern. The percent reduction is based on the maximum percent reduction (critical condition) within any hydrologic category necessary to achieve target conditions. Table 4 presents the reduction needed for the impaired segments.

The reduction percentages in this TMDL also applies to the fecal coliform waste load attributable to those areas of the watershed which are covered or will be covered under NPDES MS4 permits. As appropriate information is made available to further define the pollutant contributions for the Permitted MS4, an effort can be made to revise these TMDLs. This effort will be initiated as resources permit and if deemed appropriate by the Department. For the Department to revise these TMDLs the following information should be provided, but not limited to:

1. An inventory of service boundaries of the MS4 covered in the MS4 permit, provided as ARCGIS compatible shape files.
2. An inventory of all existing and planned stormwater discharge points, conveyances, and drainage areas for the discharge points, provided as ARCGIS compatible shape files. If drainage areas are not known, any information that would help estimate the drainage areas should be provided. The percentage of impervious surface within the MS4 area should also be provided.
3. Appropriate and relevant data should be provided to calculate individual pollutant contributions for the MS4 permitted entities. At a minimum, this information should include precipitation, water quality, and flow data for stormwater discharge points.

Compliance with terms and conditions of existing and future NPDES sanitary and stormwater permits (including all construction, industrial and MS4) may effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. However, the Department recognizes that SCDOT is not a traditional MS4 in that it does not possess statutory taxing or enforcement powers. SCDOT does not regulate land use or zoning, issue building or development permits.

5.3 Load Allocation

The Load Allocation applies to the nonpoint sources of FC bacteria and includes unregulated processes/entities. It is expressed both as a concentration and as a percent reduction and is initiated through implementation. The load allocation is calculated as the difference between the target concentration under the critical condition and the point source WLA. The load allocation for each station is 40.9 cfu/100ml (Table 4). The department believes that meeting the highest percentage reduction or the WQS, whichever is less restrictive, will effectively protect the shellfish harvesting beds in the referenced watershed for human consumption. There are no designated or potentially designated MS4s located in the drainage area. There may be other stormwater discharges located in the watershed that are subject to the LA component of this TMDL. At such time that the referenced entities, or other future unregulated entities become regulated NPDES MS4 entities and subject to applicable provisions of SC Regulation 61-68 D, they will be required to meet load reductions prescribed in the WLA component of the TMDL. This also applies to future discharges associated with industrial and construction activities that will be subject to SC R. 122.26(b)(14) & (15).

5.4 Existing Load

Due to the tidal nature of the system it is extremely difficult to calculate an existing load for this system. For this reason, existing conditions are given as a concentration. Existing concentration is calculated as the concentration of fecal coliform at the 90^{th} percentile point based on the normal line fit to the monitoring data. Existing conditions range from 110 cfu/100ml to 217 cfu/100ml (Table 4, Appendix C).

5.5 Margin of Safety

A margin of safety (MOS) allows for an accounting of the uncertainty in the relationship between pollutant loads and receiving water quality (US EPA, 1999). Incorporation of a MOS can be done either explicitly within the TMDL calculation or implicitly by using conservative assumptions (US EPA, 1999). This TMDL has an explicit 5% margin of safety, all water quality data is compared to 40.9 cfu/100ml which is the water quality single sample standard of 43 cfu/100ml minus five percent. There is also an unspecified implicit margin of safety in the percent reduction calculations derived from the cumulative probability graphs due to the assumption of independence of the data points (Novotny, 2004).

5.6 Calculation of the TMDL

A TMDL represents the loading capacity (LC) of a waterbody, which is the maximum loading a waterbody can receive without exceeding water quality standards (US EPA, 1999). The TMDL is the sum of the WLA for point sources, the load allocation (LA) for non-point sources and natural background, and a margin of safety (MOS). The TMDL can be represented by the equation:

TMDL = LC = WLA + LA + MOS (US EPA, 2001).

This equation results in reductions of concentrations ranging from 0% to 70% to consistently meet the instantaneous water quality standard for fecal coliform (Table 4). Applying the required percent reduction to each data point in the 2004-2006 dataset also results in the geometric mean criteria being met for all stations (Table 5).

Based on the information available at this time, the portion of the watershed that drains directly to a regulated MS4 and that which drains through the non-regulated MS4 has not been clearly defined. Loading from both types of sources (regulated and non regulated) typically occur in response to rainfall events, and discharge volumes as well as reccurrence intervals are largely unknown. Therefore, the regulated MS4 is assigned the same percent reduction as the non-regulated sources in the watershed. Compliance with the MS4 permit in regards to this TMDL document is determined at the point of discharge to waters of the state. The regulated MS4 entity is only responsible for implementing the TMDL WLA in accordance with their MS4 permit requirements and is not responsible for reducing loads prescribed as LA in this TMDL document.

Table 4. TMDL Components of Jeremy Inlet TMDL

Station ID	90th %tile of Existing Load (cfu/100ml)	TMDL[1,2] (cfu/100ml)	WQ Target (cfu/100ml)	Margin of Safety (MOS) (cfu/100ml)	WLA			LA
					Continuous Sources[3] (cfu/100ml)	Non-Continuous Sources[4,6] (% Reduction)	Non-Continuous SCDOT[5,6] (% Reduction)	% Reduction to Meet Load Allocation[6]
13-22	137	43	40.9	2.1	N/A	70%	0%	70%
13-23	121	43	40.9	2.1	N/A	66%	0%	66%

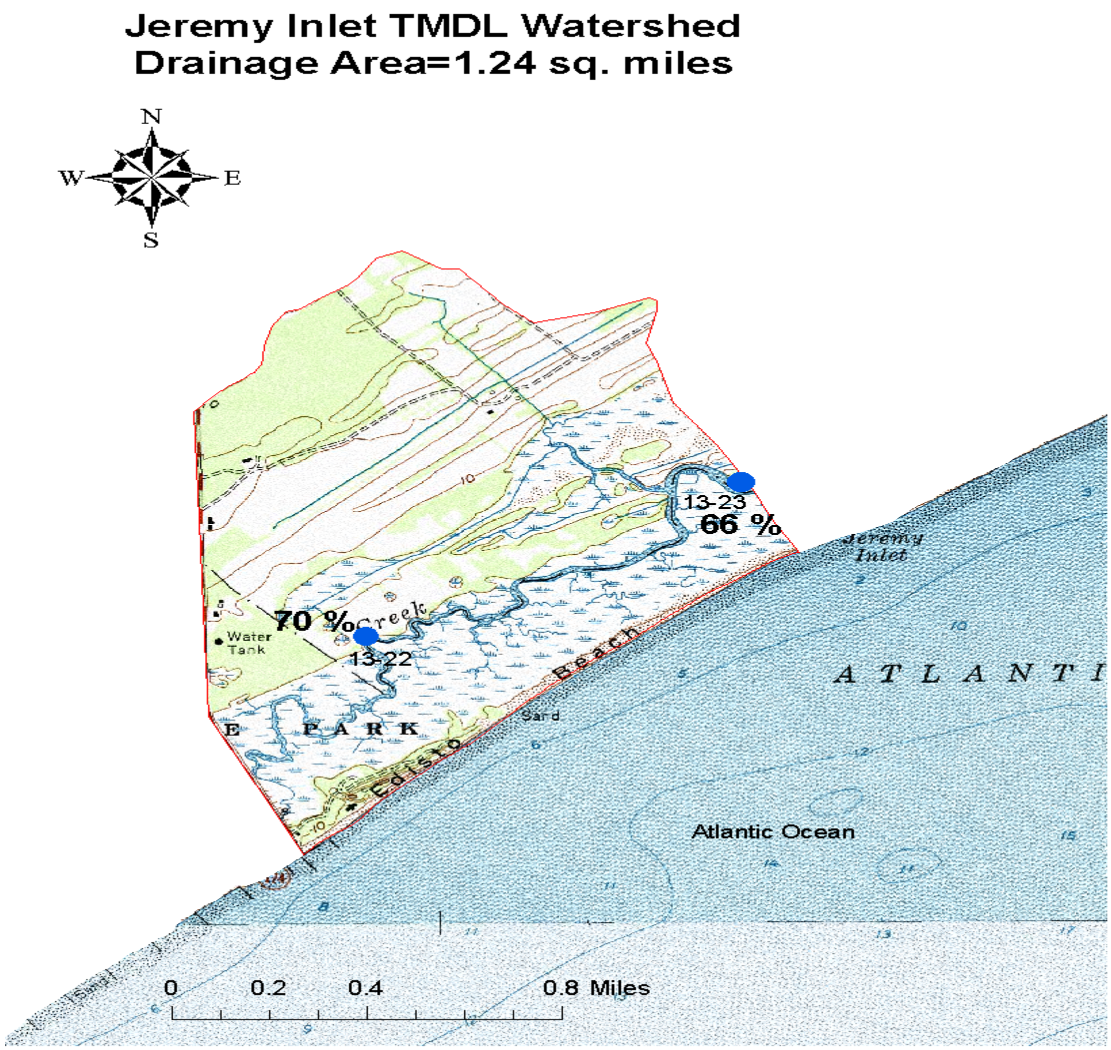
Table Notes:

1. TMDL is expressed as a concentration. If daily average tidal exchange estimates were available, this number could be converted to load in cfu/day by multiplying flow by concentration and a conversion factor.
2. Shellfish WQS = No more than 10% of the samples shall exceed 43cfu/100 ml.
3. WLA is expressed as a daily maximum; N/A = not applicable. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern. Loadings were developed based upon permitted flow and an allowable permitted maximum concentration of 43cfu/100ml.
4. Percent reduction applies to 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 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 in accordance with their NPDES permit.
5. As long as the conditions within the SCDOT MS4 area remain the same the Department deems the current contributions from SCDOT negligible and no reduction of FC bacteria is necessary. SCDOT must continue to comply with the provisions of its approved NPDES stormwater permit.
6. Percent reduction applies to existing concentration.

Table 5. Geometric Means

Station ID	Geometric Mean Actual Data (2004-2006)	TMDL % Reduction	Geometric Mean w/ % Reduction Applied
13-22	26.2	70%	6.7
13-23	13.8	66%	4.3

Figure 4. Percent Reductions



6.0 IMPLEMENTATION

The implementation of both point (WLA) and non-point (LA) source components of the TMDL are necessary in order to bring about the required reductions in FC bacteria loading to Jeremy Inlet and its tributaries in order to meet water quality standards. Using existing authorities and mechanisms, an implementation plan providing information on how point and non point sources of pollution are being abated or may be abated in order to meet water quality standards is provided. Sections 6.1.1-6.1.7 presented below correspond with sections 3.1.1-3.2.5 of the source assessment presented in the TMDL document. As the implementation strategy progresses, DHEC may continue to monitor the effectiveness of implementation measures and evaluate water quality where deemed appropriate.

Point sources are discernible, confined, and discrete conveyances of pollutants to a water body including but not limited to pipes, outfalls, channels, tunnels, conduits, man-made ditches, etc. The Clean Water Act's primary point source control program is the National Pollutant Discharge Elimination System (NPDES). Point sources can be broken down into continuous and non-continuous point sources. Some examples of a continuous point source are wastewater treatment facilities (WWTF) and industrial facilities. Non-continuous point sources are related to stormwater and include municipal separate storm sewer systems (MS4), construction activities, etc. Current and future NPDES discharges in the referenced watershed are required to comply with the load reductions prescribed in the wasteload allocation (WLA).

Nonpoint source pollution originates from multiple sources over a relatively large area. It is diffuse in nature and indistinct from other sources of pollution. It is generally caused by the pickup and transport of pollutants from rainfall moving over and through the ground. Nonpoint sources of pollution may include, but are not limited to: wildlife, agricultural activities, illicit discharges, failing septic systems, and urban runoff. Nonpoint sources located in unregulated portions of the watershed are subject to the load allocation (LA) and not the WLA of the TMDL document.

South Carolina has several tools available for implementing the non-point source component of this TMDL. The *Implementation Plan for Achieving Total Maximum Daily Load Reductions From Nonpoint Sources for the State of South Carolina* (SCDHEC 1998) document is one example. Another key component for interested parties to control pollution and prevent water quality degredation in the watershed would be the establishment and administration of a program of Best Management Practices (BMPs). Best management practices may be defined as a practice or a combination of practices that have been determined to be the most effective, practical means used in the prevention and/or reduction of pollution.

Interested parties (local stakeholder groups, universities, local governments, etc.) may be eligible to apply for CWA §319 grants to install BMPs that will implement the LA portion of this TMDL and reduce nonpoint source FC loading to Jeremy Inlet and its tributaries. Congress amended the Clean Water Act (CWA) in 1987 to establish the Section 319 Nonpoint Source Management Program. Under Section 319, States receive grant money to support a wide variety of activities including the restoration of impaired waters. TMDL implementation projects are given highest priority for 319 funding. CWA §319 grants are not available for implementation of the WLA component of this TMDL nor within any MS4 jurisdiction boundary/coverage areas. Additional resources are provided in Section 7.0 of this TMDL document.

SCDHEC will also work with the existing agencies in the area to provide nonpoint source education in the Jeremy Inlet watershed. Local sources of nonpoint source education and assistance include the Natural Resource Conservation Service (NRCS), the Clemson University Cooperative Extension Service, and the South Carolina Department of Natural Resources.

The Department recognizes that **adaptive management/implementation** of this TMDL might be needed to achieve the water quality standard and we are committed towards targeting the load reductions to improve water quality in the Jeremy Inlet Watershed. As additional data and/or information becomes available, it may become necessary to revise and/or modify the TMDL target accordingly.

6.1 Implementation Strategies

The strategies presented in this document for implementation of the referenced TMDL are not inclusive and are to be used only as guidance. The strategies are informational suggestions which may or may not lead to the required load reductions being met for the referenced watershed while demonstrating consistency with the assumptions and requirements of the TMDL. Application of certain strategies provided within may be voluntary and they are not a substitute for actual NPDES permit conditions.

<u>Point Sources</u>

6.1.1 Continuous Point Sources

Continuous point source WLA reductions will be implemented through NPDES permits. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern and demonstrate consistency with the assumptions and requirements of the TMDL.

6.1.2 Non-Continuous Point Sources

An iterative BMP approach as defined in the general storm water NPDES MS4 permit is expected to provide significant implementation of the WLA. Permit requirements for implementing WLAs in approved TMDLs will vary across waterbodies, discharges, and pollutant(s) of concern. The allocations within a TMDL can take many different forms – narrative, numeric, specific BMPs – and may be complimented by other special requirements such as monitoring.

The level of monitoring necessary, deployment of structural and non-structural BMPs, evaluation of BMP performance, and optimization or revisions to the existing pollutant reduction goals of the SWMP or any other plan is TMDL and watershed specific. Hence, it is expected that NPDES permit holders evaluate their existing SWMP or other plans in a manner that would effectively address implementation of this TMDL with an acceptable schedule and activities for their permit compliance. The Department staff (permit writers, TMDL project managers, and compliance staff) is willing to assist in developing or updating the referenced plan as deemed necessary. Please see Appendix E which provides additional information as it relates to evaluating the effectiveness of an MS4 Permit as it related to compliance with approved TMDLs. Compliance with terms and conditions of existing and future NPDES sanitary and stormwater permits (including all construction, industrial and MS4) may effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL

The Department acknowledges that progress with the assumptions and requirements of the TMDL by MS4s is expected to take one or more permit iteration. Achieving the WLA reduction for the TMDL may constitute MS4 compliance with its SWMP, provided the MEP definition is met, even where the numeric percent reduction may not be achieved in the interim.

Regulated MS4 entities are required to develop a SWMP that includes the following: public education, public involvement, illicit discharge detection & elimination, construction site runoff control, post construction runoff control, and pollution prevention/good housekeeping. These measures are not exhaustive and may include additional criterion depending on the type of NPDES MS4 permit that applies. These examples are recognized as acceptable stormwater practices and may be applied to unregulated MS4 entities or other interested parties in the development of a stormwater management plan.

An informed and knowledgeable community is crucial to the success of a stormwater management plan (USEPA, 2005). MS4 entities may implement a public education program to distribute educational materials to the community, or conduct equivalent outreach activities about the impacts of stormwater discharges on local waterbodies and the steps that can be taken to reduce stormwater pollution. Some appropriate BMPs may be brochures, educational programs, storm drain stenciling, stormwater hotlines, tributary signage, and alternative information sources such as web sites and bumper stickers (USEPA, 2005).

The public can provide valuable input and assistance to a MS4 program and they may have the potential to play an active role in both development and implementation of the stormwater program where deemed appropriate. There are a variety of practices that can involve public participation such as public meetings/citizens panels, volunteer water quality monitoring, volunteer educators, community clean-ups, citizen watch groups, and “Adopt a Storm Drain” programs which encourage individuals or groups to keep storm drains free of debris and monitor what is entering local waterways through storm drains (USEPA, 2005).

Illicit discharge detection and elimination efforts are also necessary. Discharges from MS4s often include wastes and wastewater from non-stormwater sources. These discharges enter the system through either direct connections or indirect connections. The result is untreated discharges that contribute high levels of pollutants, including heavy metals, toxics, oil and grease, solvents, nutrients, viruses, and bacteria to receiving waterbodies (USEPA, 2005). Pollutant levels from these illicit discharges have been shown in EPA studies to be high enough to significantly degrade receiving water quality and threaten aquatic, wildlife, and human health. MS4 entities may have a storm sewer system map which shows the location of all outfalls and to which waters of the US they discharge to. If not already in place, an ordinance prohibiting non-stormwater discharges into MS4 with appropriate enforcement procedures may also be developed. Entities may also have a plan for detecting and addressing non-stormwater discharges. The plan may include locating problem areas through infrared photography, finding the sources through dye testing, removal/correction of illicit connections, and documenting the actions taken to illustrate that progress is being made to eliminate illicit connections and discharges.

A program might also be developed to reduce pollutants in stormwater runoff to their MS4 from construction activities. An ordinance or other regulatory mechanism may exist requiring the implementation of proper erosion and sediment controls on applicable construction sites. Site plans should be reviewed for projects that consider potential water quality impacts. It is recommended that site inspections should be conducted and control measures enforced where applicable. A procedure might also exist for considering information submitted by the public (USEPA, 2005). For information on specific BMPs please refer to the SCDHEC Stormwater Management BMP Handbook online at: http://www.scdhec.com/environment/ocrm/pubs/docs/SW/BMP_Handbook/Erosion_prevention.pdf

Post-construction stormwater management in areas undergoing new development or redevelopment is recommended because runoff from these areas has been shown to significantly affect receiving waterbodies. Many studies indicate that prior planning and design for the minimization of pollutants in post-construction stormwater discharges is the most cost-effective approach to stormwater quality management (USEPA, 2005). Strategies might be developed to include a combination of structural and/or non-structural BMPs. An ordinance or other regulatory mechanism may also exist requiring the implementation of post-construction runoff controls and ensuring their long term-operation and maintenance. Examples of non-structural BMPs are planning procedures and site-based BMPs (minimization of imperviousness and maximization of open space). Structural BMPs may include but are not limited to stormwater retention/detention BMPs, infiltration BMPs (dry wells, porous pavement, etc.), and vegetative BMPs (grassy swales, filter strips, rain gardens, artificial wetlands, etc.).

Pollution prevention/good housekeeping is also a key element of stormwater management programs. Generally this requires the MS4 entity to examine and alter their actions to ensure reductions in pollution are occurring. This could also result in a reduction of costs for the MS4 entity. It is recommended that a plan be developed to prevent or reduce pollutant runoff from municipal operations into the storm sewer system and it is encouraged to include employee training on how to incorporate pollution prevention/good housekeeping techniques. To minimize duplication of effort and conserve resources, the MS4 operator can use training materials that are available from EPA or relevant organizations (USEPA, 2005).

MS4 communities are encouraged to utilize partnerships when developing and implementing a stormwater management program. Watershed associations, educational entities, and state, county, and city governments are all examples of possible partners with resources that can be shared. For additional information on partnerships contact the SCDHEC Watershed Manager for the waterbody of concern online at: http://www.scdhec.gov/environment/water/shed/contact.htm For additional information on stormwater discharges associated with MS4 entities please see the USEPA NPDES website online at http://cfpub.epa.gov/npdes/home.cfm?program_id=6 for information pertaining to the National Menu of BMPs, Urban BMP Performance Tool, Outreach Documents, etc.

Nonpoint Sources

6.1.3 Wildlife

Suggested forms of implementation for wildlife will vary widely due to geographic location and species. There are many forms of acceptable wildlife BMPs in practice and development at the present time. During a source assessment it was noticed that waterfowl were present and there is an area of privately owned lands near impaired site 13-22 that may have suitable habitat to support waterfowl. Deterrents could be used to keep waterfowl away from docks and lawns in close proximity to surface waters. These include non-toxic spray deterrents, decoys, eagles, kites, noisemakers, scarecrows, and plastic owls. Planting a shrub buffer along greenways adjacent to impoundments may also be effective. In addition, homeowners and the hunting community should be educated on the impacts of feeding wildlife or planting wildlife food plots in close proximity to surface waters. Please check local and federal laws before applying deterrents or harassing wildlife. A portion of Edisto Beach State Park is in the watershed. Campgrounds may attract various wildlife such as raccoons. Additional information may be obtained from the "Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water" bulletin provided by USEPA (2001).

6.1.4 Agricultural Activities

Suggested forms of implementation for agricultural activities will vary based on the activity of concern. Agricultural BMPs can be vegetative, structural or management oriented. When selecting BMPs, it is important to keep in mind that nonpoint source pollution occurs when a pollutant becomes available, is detached and then transported to nearby receiving waters. Therefore, for BMPs to be effective the transport mechanism of the pollutant, fecal coliform, needs to be identified. It has been shown that installing water troughs within a pasture area reduced the amount of time livestock spent drinking directly from streams by 92% (ASABE 1997). An indirect result of this was a 77% reduction in stream bank erosion by providing an alternative to accessing the stream directly for water supply.

For row crop farms in the referenced watershed, many common practices exist to reduce FC contributions. Unstabilized soil directly adjacent to surface waters can contribute to FC loading during periods of runoff after rain events. Agricultural field borders and filter strips (vegetative buffers) can provide erosion control around the border of planted crop fields. These borders can provide food for wildlife, may possibly be harvested (grass and legume), and also provide an area where farmers can turn around their equipment (SCDNR 1997). A study conducted in 1998 by the American Society of Agricultural and Biological Engineers (ASABE) has shown that a vegetative buffer measuring 6.1 meters in width can reduce fecal runoff concentrations from 2.0E+7 to an immeasurable amount once filtered through the buffer. A buffer of this width was also shown to reduce phosphorous and nitrogen concentrations by 75%.

The agricultural BMPs listed above are a sample of the many accepted practices that are currently available. Many other techniques such as conservation tillage, responsible pest management, and precision agriculture also exist and may contribute to an improvement in overall water quality in the watershed. Education should be provided to local farmers on these methods as well as acceptable manure spreading and holding (stacking sheds) practices.

For additional information on accepted agricultural BMPs you can obtain a copy of the "Farming for Clean Water in South Carolina" handbook by contacting Clemson University Cooperative Extension Service at (864) 656-1550. In addition, 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. You can access Farm-A-Syst by going onto the Clemson Extension Service website: http://www.clemson.edu/waterquality/FARM.HTM or contact the local NRCS district conservationist.

NRCS provides financial and technical assistance to help South Carolina landowners address natural resource concerns, promote environmental quality, and protect wildlife habitat on property they own or control. The cost-share funds are available through the Environmental Quality Incentives Program (EQIP). EQIP helps farmers improve production while protecting environmental quality by addressing such concerns as soil erosion and productivity, grazing management, water quality, animal waste, and forestry concerns. EQIP also assists eligible small-scale farmers who have historically not participated in or ranked high enough to be funded in previous sign ups. Please visit www.sc.nrcs.usda.gov/programs/ for more information, including eligibility requirements.

Also available through NRCS, the Grassland Reserve Program (GRP) is a voluntary program offering landowners the opportunity to protect, restore and enhance grasslands on their property. NRCS and the Farm Service Agency (FSA) coordinate implementation of the GRP, which helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable grazing operations. A grazing management plan is required for participants. NRCS has further information on their website for the GRP as well as additional programs such as the Conservation Reserve Program, Conservation Security Program, Farm and Ranch Lands Protection Program, etc. You can visit the NRCS website by going to: www.sc.nrcs.usda.gov/programs/

6.1.5 Leaking Sanitary Sewers and Illicit Discharges

Leaking sanitary sewers and illicit discharges, although illegal and subject to enforcement, may be occuring in the watershed at any time. It should be recognized that these activities may occur in unregulated portions of the watershed. Due to the high concentration of pollutant loading that is generally accociated with these discharges, their detection may provide a substantial improvement in overall water quality in the Jeremy Inlet watershed. Detection methods may include, but are not limited to: dye testing, air pressure testing, static pressure testing, and infrared photography.

SCDHEC recognizes illicit discharge detection and elimination activities are conducted by MS4 entities as pursuant to compliance with existing MS4 permits. Note that these activities are designed to detect and eliminate illicit discharges that may contain FC bacteria. It is the intent of SCDHEC to work with the MS4 entities to recognize FC load reductions as they are achieved. SCDHEC acknowledges that these efforts to reduce illicit discharges and SSOs are ongoing and some reduction may already be accountable (i.e. load reductions occurring during TMDL development process). Thus, the implementation process is an iterative and adaptive process. Regular communication between all implementation stakeholders will result in successful remediation of controllable sources over time. As recreational uses are restored, SCDHEC will recognize efforts of implementers where their efforts can be directly linked to restoration.

6.1.6 Failing Septic Systems

A septic system is defined as failing when it is not treating or disposing of sewage in an effective manner. The most common reason for failure is improper maintenance by homeowners. Untreated sewage water contains disease-causing bacteria and viruses, and well as unhealthy amounts of nitrate and other chemicals. Failed septic systems can allow untreated sewage to seep into wells, groundwater, and surface water bodies, where people get their drinking water and recreate. Pumping a septic tank is probably the single most important thing that can be done to protect the system. As noted in Section 3, there is a drainfield and a spray field located in this watershed. If the buildup of solids in the tanks becomes too high and solids move to the drainfield, this could clog and strain the system to the point where a new drainfield will be needed.

The Office of Coastal Resource Management (OCRM) has created a toolkit for homeowners and local governments which includes tips for maintaining their systems. These septic system Do’s and Don’t’s are as follows:

Septic System Do's and Don'ts from SCDHEC Office of Coastal Resource Management:

Do's:

- Conserve water to reduce the amount of wastewater that must be treated and disposed of by your system. Doing laundry over several days will put less stress on your system.
- Repair any leaking faucets or toilets. To detect toilet leaks, add several drops of food dye to the toilet tank and see if dye ends up in the bowl.
- Divert down spouts and other surface water away from your drainfield. Excessive water keeps the soil from adequately cleansing the wastewater.
- Have your septic tank inspected yearly and pumped regularly by a licensed septic tank contractor.

Don'ts:

- Don't drive over your drainfield or compact the soil in any way.

- Don't dig in your drainfield or build anything over it, and don't cover it with a hard surface such as concrete or asphalt.
- Don't plant anything over or near the drainfield except grass. Roots from nearby trees an shrubs may clog and damage the drain lines.
- Don't use your toilet as a trash can or poison your system and the groundwater by pouring harmful chemicals and cleansers down the drain. Harsh chemicals can kill the bacteria that help purify your wastewater.

For additional information on how septic systems work and how to properly plan a septic system, please visit the DHEC Environmental Health Onsite Wastewater page at the following link: http://www.scdhec.gov/health/envhlth/onsite_wastewater/septic_tank.htm

6.1.7 Urban Runoff

Urban runoff is surface runoff of rainwater created by urbanization outside of regulated areas which may pick up and carry pollutants to receiving waters. Pavement, compacted areas, roofs, reduced tree canopy and open space increase runoff volumes that rapidly flow into receiving waters. This increase in volume and velocity of runoff often causes stream bank erosion, channel incision and sediment deposition in stream channels. In addition, runoff from these developed areas can increase stream temperatures that along with the increase in flow rate and pollutant loads negatively affect water quality and aquatic life (USEPA 2005). This runoff can pick up FC bacteria along the way. Many strategies currently exist to reduce FC loading from urban runoff and the USEPA nonpoint source pollution website provides extensive resources on this subject which can be accessed online at: http://www.epa.gov/nps/urban.html.

Some examples of urban nonpoint source bmps are street sweeping, stormwater wetlands, pet waste receptacles (equipped with waste bags), and educational signs which can be installed adjacent to receiving waters in the watershed such as parks, common areas, apartment complexes, trails, etc. Low impact development (LID) may also be effective. LID is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product. There are many practices that have been used to adhere to these principles such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements (USEPA, 2009).

Some additional urban BMPs that can be adopted in public parks are doggy dooleys and pooch patches. Doggy dooleys are disposal units, which act like septic systems for pet wastes, and are installed in the ground where decomposition can occur (USEPA, 2001). This requires the pet owner to place the waste into the disposal units. During a source assessment it was noted that many campers in the Edisto Beach State Park had dogs. Installing doggy doolies in the park may be one way to reduce FC bacteria loading in the area.

Although the Jeremy Inlet watershed is rural in nature, many of the urban runoff practices discussed in this section can be applied to individual households in the watershed. Education should be provided to individual homeowners in the referenced watershed on the contributions to

FC loading from pet waste. Education to homeowners in the watershed on the fate of substances poured into storm drain inlets should also be provided. For additional information on urban runoff please see the SCDHEC Nonpoint Source Runoff Pollution homepage at http://www.scdhec.gov/environment/water/npspage.htm.

Clemson Extension's Home-A-Syst handbook can also help homeowners reduce sources of NPS pollution on their property. This document guides homeowners through a self-assessment of their property and can be accessed online at: http://www.clemson.edu/waterquality/HOMASYS.HTM.

7.0 REFERENCES

American Public Health Association, Inc. *Procedures for the bacteriologic examination of sea water and shellfish,* 1970. p. 28-47. In *Recommended procedures for the examination of sea water and shellfish*, 4th ed. Library of Congress, Washington, D.C.

Ayres Associates 1993. Onsite Sewage Disposal Systems Research in Florida. The Capacity of Fine Sandy Soil for Septic Tank Effluent Treatment: A Field Investigation at an In-Situ Lysimeter Facility in Florida.

Novotny, V. 2003. *Water Quality: Diffuse pollution and watershed management*, Wiley, Hoboken, N.J.

Novotny, V. 2004. "Simplified Databased Total Maximum Daily Loads, or the World is Log-Normal." *Journal of Environmental Engineering*., 130(6), 674-683.

South Carolina Department of Health and Environmental Control (SC DHEC) Bureau of Water. 1998. Implementation Plan for Achieving Total Maximum Daily Load Reductions from Nonpoint Sources for the State of South Carolina.

South Carolina Department of Health and Environmental Control (SC DHEC) Bureau of Water. 2002. Standards for the Permitting of Agricultural Animal Facilities (R.61-43). Effective June 28,2002. [Electronic Version]; 105pp.

South Carolina Department of Health and Environmental Control (SC DHEC) Office of Environmental Quality Control. 2003. Water Pollution Control Permits (R.61-9).

South Carolina Department of Health and Environmental Control (SC DHEC) Bureau of Water. 2004a. Classified Waters (R.61-69). Amended May 28, 2004. Printed April 2005; 36pp.

South Carolina Department of Health and Environmental Control (SC DHEC) Bureau of Water. 2004b. Water Classifications & Standards (R.61-68). Amended June 25, 2004. Printed April 2005; 56pp.

South Carolina Department of Health and Environmental Control (SC DHEC) Bureau of Water. 2008. State of South Carolina Section 303(d) List for 2008. [Electronic Version].

South Carolina Department of Health and Environmental Control (SC DHEC) Bureau of Water. 2007. South Carolina Shellfish (R.61-47). Amended February 23, 2007. [Electronic Version]; 54pp.

Stormwater Program (Phase II); Municipal Sewer Systems and Construction Sites, 64 Federal Register 235 (8 December 1999), pp. 68837.

United States Department of Agriculture, Soil Conservation Service (USDA), 1971. Soil Survey of Charleston County, South Carolina. In cooperation with South Carolina Agricultural Experiment Station and South Carolina Land Resources Conservation Commission, National Cooperative Soil Survey, Washington, D.C. 78pp.

United States Environmental Protection Agency (US EPA). 1999. Draft Guidance for Water Quality-based Decisions: The TMDL Process. Second Edition. Office of Water, EPA 841-D-99-001.

United States Environmental Protection Agency (US EPA). 2001. Protocol for Developing Pathogen TMDLs. First Edition. Office of Water, EPA 841-R-00-002.

United States Food and Drug Administration (US FDA). 2005. Guide for the Control of Molluscan Shellfish, II. Model Ordinance. http://www.cfsan.fda.gov/~ear/nss3-toc.html.

Water Quality Planning and Management, Title 40 Code of Federal Regulations, Pt. 130.2(i). 2006 ed.

Yagow, G. 1999. Unpublished monitoring data. Mountain Run TMDL Study.
Submitted to Virginia Department of Environmental Quality. Richmond, Virginia.

Appendix A- Watershed Water Quality Sampling Stations Descriptions

Station	Description
13-22	Headwaters of Scott Creek at Jeremy Inlet at the boat landing
13-23	Jeremy Inlet at Atlantic Ocean

Appendix B- Water Quality Data by Station

13-22

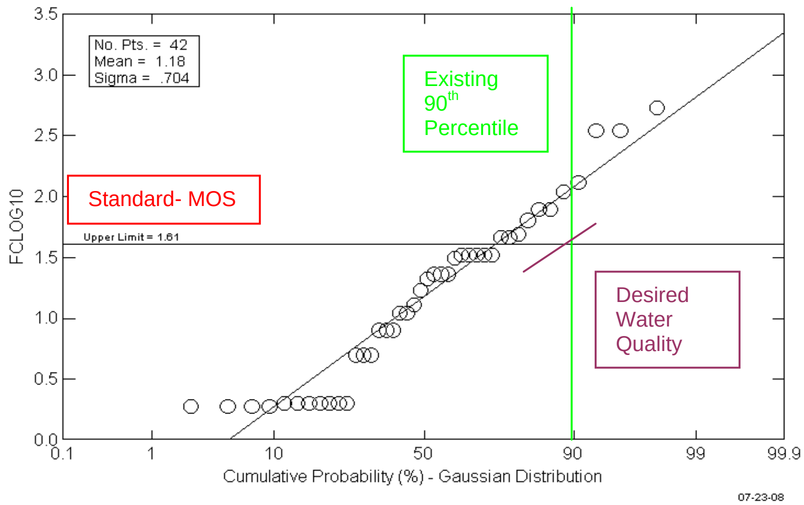
Date	# / 100 ml	Date	#/ 100 ml	Date	# / 100 ml
1/6/1999	1.9	1/9/2002	13	1/10/2005	21
2/1/1999	17	2/4/2002	21	2/2/2005	6
3/17/1999	8	3/12/2002	110	3/8/2005	170
4/19/1999	13	4/15/2002	8	4/20/2005	130
5/16/1999	8	5/6/2002	17	5/17/2005	130
6/30/1999	70	6/3/2002	14	6/8/2005	2
7/26/1999	130	7/1/2002	70	7/12/2005	70
8/11/1999	27	8/2/2002	2	8/24/2005	110
9/21/1999	220	9/24/2002	33	9/6/2005	7
10/20/1999	140	10/1/2002	5	10/3/2005	6
11/3/1999	49	11/17/2002	2500	11/9/2005	110
12/20/1999	17	12/15/2002	2	12/19/2005	9
1/11/2000	2	1/14/2003	46	1/3/2006	95
2/1/2000	1.9	2/4/2003	2	2/8/2006	17
3/15/2000	8	3/17/2003	2	3/6/2006	23
4/19/2000	2	4/7/2003	33	4/4/2006	130
5/8/2000	13	5/27/2003	7	5/2/2006	46
6/5/2000	2	6/9/2003	350	6/7/2006	350
7/19/2000	33	7/15/2003	31	7/10/2006	140
8/21/2000	2	8/18/2003	49	8/1/2006	350
9/25/2000	110	9/22/2003	95	9/25/2006	49
10/3/2000	2	10/14/2003	23	10/3/2006	80
11/6/2000	17	11/4/2003	33	11/8/2006	5
12/12/2000	5	12/9/2003	33	12/13/2006	17
1/17/2001	79	1/13/2004	1.9	1/9/2007	79
2/13/2001	9	2/9/2004	23	3/28/2007	23
3/21/2001	350	3/16/2004	79	4/3/2007	2
4/2/2001	33	4/14/2004	79		
5/22/2001	2	5/24/2004	920		
6/13/2001	1.9	6/16/2004	22		
7/11/2001	1.9	7/19/2004	540		
8/27/2001	920	8/4/2004	110		
9/18/2001	7	9/20/2004	49		
10/16/2001	1.9	10/20/2004	26		
11/6/2001	4	11/8/2004	140		
12/17/2001	4	12/7/2004	11		

13-23

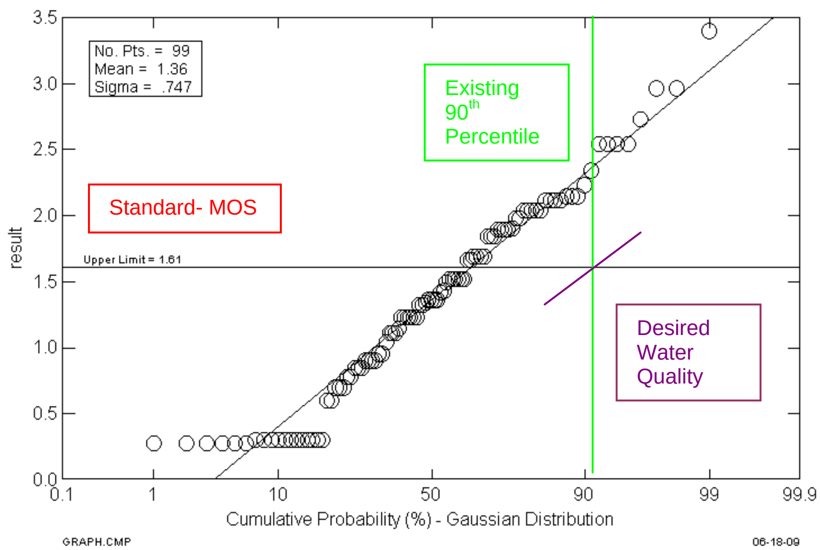
Date	# / 100 ml	Date	# / 100 ml	Date	# / 100 ml	Date	# / 100 ml
1/6/1999	2	1/9/2002	11	1/13/2004	1.9	1/3/2006	31
2/1/1999	23	2/4/2002	46	2/9/2004	2	2/8/2006	33
3/17/1999	8	3/12/2002	220	3/16/2004	49	3/6/2006	64
4/19/1999	1.9	4/15/2002	220	4/14/2004	46	4/4/2006	350
5/16/1999	13	5/6/2002	33	5/24/2004	2	5/2/2006	46
6/30/1999	79	6/3/2002	8	6/16/2004	1.9	8/1/2006	70
7/26/1999	17	7/1/2002	49	7/19/2004	2	9/25/2006	8
8/11/1999	23	8/2/2002	5	8/4/2004	11	10/3/2006	30
9/21/1999	42	10/1/2002	140	9/20/2004	23	11/8/2006	2
10/20/1999	350	11/17/2002	2500	10/20/2004	1.9	12/13/2006	2
11/3/1999	64	12/15/2002	7	11/8/2004	21	1/9/2007	4
12/20/1999	33	1/14/2003	79	12/7/2004	23	3/28/2007	2
1/11/2000	5	2/4/2003	2	1/10/2005	13	4/3/2007	2
2/1/2000	1.9	3/17/2003	33	2/2/2005	5		
3/15/2000	7	4/7/2003	23	3/8/2005	540		
4/19/2000	4	5/27/2003	2	4/20/2005	33		
5/8/2000	5	6/9/2003	350	5/17/2005	130		
6/5/2000	2	7/15/2003	8	6/8/2005	11		
7/19/2000	14	8/18/2003	1.9	7/12/2005	33		
8/21/2000	2	9/22/2003	33	8/24/2005	5		
9/25/2000	220	10/14/2003	8	9/6/2005	2		
10/3/2000	1.9	11/4/2003	79	10/3/2005	8		
11/6/2000	1.9	12/9/2003	17	11/9/2005	110		
12/12/2000	11			12/19/2005	2		
1/17/2001	11						
2/13/2001	1.9						
3/21/2001	95						
4/2/2001	4						
5/22/2001	1.9						
6/13/2001	5						
7/11/2001	1.9						
8/27/2001	14						
9/18/2001	1.9						
10/16/2001	2						
11/6/2001	2						
12/17/2001	2						

Appendix C- Cumulative Probability Plots

Jeremy Inlet Station 13-23
Required Percent reduction = 66%
Existing 90th percentile = 121 cfu/100ml



Scott Creek Station 13-22
Required Percent Reduction = 70%
Existing 90th Percentile = 137



Appendix D- Watershed Photos

Private dirt road in neighborhood with waterfowl present

Near Impaired Station 13-22
Waterfowl present


Scott Creek houses


Scott Creek


Jeremy Inlet (Impaired Station 13-23)


Privately owned land with suitable habitat for waterfowl

Horse paddock within spray field

Appendix E. Evaluating the Progress of MS4 Programs:

Meeting the Goals of TMDLs and Attaining Water Quality Standards

BUREAU OF WATER

August 2008

Described below are potential approaches that may be used by MS4 permit holders. These are recommendations and examples only, as SCDHEC-BOW recognizes that other approaches may be utilized or employed to meet compliance goals.

1. Calculate pollutant load reduction for each best management practice (BMP) deployed:
    - Retrofitting stormwater outlets
    - Creation of green space
    - LID activities (e.g., creation of porous pavements)
    - Creations of riparian buffers
    - Stream bank restoration
    - Scoop the poop program (how many pounds of poop were scooped/collected)
    - Street sweeping program (amount of materials collected etc.)
    - Construction & post-construction site runoff controls

2. Description & documentation of programs directed towards reducing pollutant loading
    - Document tangible efforts made to reduce impacts to urban runoff
    - Track type and number of structural BMPs installed
    - Parking lot maintenance program for pollutant load reduction
    - Identification and elimination of illicit discharges
    - Zoning changes and ordinances designed to reduce pollutant loading
    - Modeling of activities & programs for reducing pollutant reductions

3. Description & documentation of social indicators, outreach, and education programs
    - Number/Type of training & education activities conducted and survey results
    - Activities conducted to increase awareness and knowledge – residents, business owners. What changes have been made based on these efforts? Any measured behavior or knowledge changes?
    - Participation in stream and/or lake clean-up events or activities
    - Number of environmental action pledges

4. Water quality monitoring: A direct and effective way to evaluate the effectiveness of stormwater management plan activities.

- ➢ Use of data collected from existing monitoring activities (e.g., SCDHEC data for ambient monitoring program available through STORET; water supply intake testing; voluntary watershed group's monitoring, etc)
- ➢ Establish a monitoring program for permitted outfalls and/or waterbodies within MS4 areas as deemed necessary– use a certified lab
- ➢ Monitoring should focus on water quality parameters and locations that would both link pollutant sources and BMPs being implemented

5. Links:

- ➢ Evaluating the Effectiveness of Municipal Stormwater Programs. September 2007. EPA 833-F-07-010

- ➢ The BMP database - http://www.bmpdatabase.org/BMPPerformance.htm (this link is specifically to the BMP performance page, and lot more)

- ➢ EPA's STORET data warehouse - http://www.epa.gov/storet/dw_home.html

- ➢ EPARegion 5: STEPL – Spreadsheet tool for estimating pollutant loads http://it.tetratech-ffx.com/stepl/

- ➢ Measurable goals guidance for Phase II Small MS4 - http://cfpub.epa.gov/npdes/stormwater/measurablegoals/index.cfm

- ➢ Environmental indicators for sotrmwater program- http://cfpub.epa.gov/npdes/stormwater/measurablegoals/part5.cfm

- ➢ National menu of stormwater best management practices (BMPs) - http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

- ➢ SCDHEC – BOW: 319 grant program has attempted to calculate the load reductions for the following BMPs:

  - Septic tank repair or replacement
  - Removing livestock from streams (cattle, horses, mules)
  - Livestock fencing
  - Waste Storage Facilities (aka stacking sheds)
  - Strip cropping
  - Prescribed grazing
  - Critical Area Planting
  - Runoff Management System
  - Waste Management System
  - Solids Separation Basin
  - Riparian Buffers

Appendix F. Map of Jeremy Inlet TMDL Area Showing Potential Sources and Flow Direction

Responsiveness Summary
Jeremy Inlet TMDL Document

Comments were received from the following:

South Carolina Department of Natural Resources

Comments from South Carolina Department of Natural Resources

Comment 1:

"First of all, the SCDNR commends DHEC for developing a protective TMDL for fecal coliform in this relatively undeveloped watershed. The SCDNR supports all reasonable efforts to improve and sustain water quality to the greatest extent possible, particularly in Shellfish Harvesting (SFH) and Outstanding Resource (ORW) waters."

Response 1:

SCDHEC (the Department) appreciates SCDNR's support of this TMDL effort.

Comment 2:

"The SCDNR recognizes that wildlife, particularly deer, raccoons and other fur-bearing mammals, may be a significant source of fecal coliform bacteria in this watershed. We also acknowledge that birds, particularly wading birds, seabirds and shorebirds, contribute at least a small fraction of the total fecal coliform load; however, we disagree that waterfowl are likely to be a significant source of fecal coliform bacteria, primarily because of the scarcity of suitable habitat for waterfowl within the boundaries of the TMDL area. In addition, there does not appear to be any discernable pattern in the occurrence of high fecal coliform concentrations that would suggest waterfowl management units are a major source of fecal coliform bacteria in this area. In fact, it appears that the highest fecal coliform concentrations (i.e., those >200 cfu/ml) were measured more frequently during the summer and early fall, when one would expect a greater volume of stormwater runoff due to thunderstorms, than in the spring, when one would expect waterfowl habitat managers to release large volumes of water from their management units."

Response 2:

As noted during a source assessment of the watershed, waterfowl are present in and around this watershed. The Department believes that they are one of the potential sources of FC bacteria in this watershed.

Comment 3:

"Finally, the TMDL states that a "wildlife management area" near impaired site 13-22 supports waterfowl, however no other information is provided regarding the identity of this site, or the actual management practices used at this site. The SCDNR believes that this property may be privately owned and managed, and that the description of this site as a "wildlife management area" could be misleading. The TMDL document should clearly identify the name of this property as well as the owner, and make it clear that this parcel is neither owned nor managed by the SCDNR as a state Wildlife Management Area (WMA)."

Response 3:

The words “wildlife management area” have been removed from the document and replaced with the following: “There is an area of privately owned lands that may have suitable habitat for waterfowl”.