Total Maximum Daily Load Document

Potato Creek Watershed: ST-035, RS-03501

(Hydrologic Unit Code 030501110108)

Fecal Coliform Bacteria

Indicator for Pathogens

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Prepared for:

Bureau of Water

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Abstract

§303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water bodies that are not meeting designated uses under technology-based pollution controls. A TMDL is the maximum amount of pollutant a waterbody can assimilate while meeting water quality standards for the pollutant of concern. 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). A fecal coliform (FC) TMDL was developed for two impaired stations within the Potato Creek watershed located in Clarendon County, SC. Two stations along Potato Creek and tributaries are listed as impaired on the State's 2008 §303(d) list due to excessive FC numbers documented during the 2002-2006 assessment period. In addition, ten percent of the samples collected between 1998 and 2006 at the impaired monitoring stations exceeded the water quality standards.

There are currently no active NPDES permitted sanitary waste dischargers within the watershed. Probable sources of fecal contamination include wildlife, agricultural runoff, failing septic systems, illicit connections, leaking sewers, sanitary sewer overflows and urban runoff. The load-duration curve methodology was used to calculate existing and TMDL loads for each impaired segment. Existing pollutant loadings and proposed TMDL reductions for critical hydrologic conditions are presented in Table Ab-1. Critical hydrologic conditions were defined as either moist, mid-range, or dry depending on which condition demonstrated the highest load reductions necessary to meet water quality standards. In order to achieve the target load (slightly below water quality standards) for Potato Creek and tributaries, reductions in the existing loads of up to 34% will be necessary at some stations. 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. For SCDOT, compliance with terms and conditions of its NPDES MS4 permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP). Required load reductions in the LA portion of this TMDL can be implemented through voluntary measures and are eligible for CWA §319 grants.

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 Potato Creek Watershed. 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 Loads for the Potato Creek Watershed. Loads are expressed as colony forming units (cfu) per day.

				Wasteload Allocation (WLA)			Load Allocation (LA)	
Station	Existing Load (cfu/day)	TMDL (cfu/day)	Margin of Safety (MOS) (cfu/day)	Continuous Sources[1] (cfu/day)	Non-Continuous Sources[2,3] (% Reduction)	Non-Continuous SCDOT[3,4](% Reduction)	Load Allocation(cfu/day)	% Reduction to Meet LA[3]
ST-035	5.25E+10	3.67E+10	1.83E+09	N/A	34%	34%	3.49E+10	34%
RS-03501	8.05E+10	5.86E+10	2.93E+09	N/A	31%	31%	5.56E+10	31%

Table Notes:

1. WLAs are expressed as a daily maximum; NA = not applicable, no point sources. 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 400cfu/100ml.
2. 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.
3. Percent reduction applies to existing instream load
4. By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform, the SCDOT will comply with this TMDL and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.

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1.0 Introduction

1.1 Background

FC bacteria are widely used as an indicator of pathogens in surface waters and wastewater. The presence of FCs in surface waters may signify a presence of pathogens, which in turn leads to a greater risk of health for individuals participating in recreational activities within the water body (USEPA, 2001). Acute gastrointestinal illnesses affect millions of people in the United States and cause billions of dollars of costs each year (Gaffield et al., 2003). Infections including respiratory, eye, ear, nose, throat, and skin diseases may also occur, of which many are caused by contaminated drinking water (USEPA, 1986). Improperly treated wastewater and untreated stormwater runoff has also been associated with a number of disease outbreaks, most notably an outbreak in Milwaukee affecting an estimated 403,000 people in 1993 (Corso et al., 2003).

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

The State of South Carolina has placed 2 monitoring stations in the Potato Creek watershed on South Carolina's Section 2008 §303(d) list for impairment due to FC bacteria. These stations are identified in Table 1 and Figure 1.

Table 1. Potato Creek Watershed FC Impaired Waters.

Waterbody	Station Number	Description
Potato Creek	ST-035	Potato Creek at S-14-127, 3.2 miles south of Summerton
Potato Creek	RS-03501	Potato Creek at S-14-715 (Rogers Road), 5.5 miles southeast of Summerton

1.2 Watershed Description

The headwaters of Potato Creek flow in a southern direction across Clarendon County into the northeastern part of Lake Marion. Potato Creek enters the lake approximately 6.1 miles southeast of the City of Summerton and it accepts the drainage of Wyboo Swamp, Church Branch, and Big Branch (SCDHEC 2004). The watershed also consists of a portion of the Santee National Wildlife Refuge.

Land use within the watershed is predominately pasture and cultivated crops (40.26%) along with forest and shrubs at an estimated 27% (Table 2). Developed lands (residential, commercial, industrial, or open urban space) comprise approximately 7% of the watershed. Wetlands comprise approximately 16% of the Potato Creek watershed, as determined by the 2001 National Land Cover Data Set (NLCD 2001).

Figure 1. SCDHEC Monitoring Stations Impaired with Excessive FC Numbers.

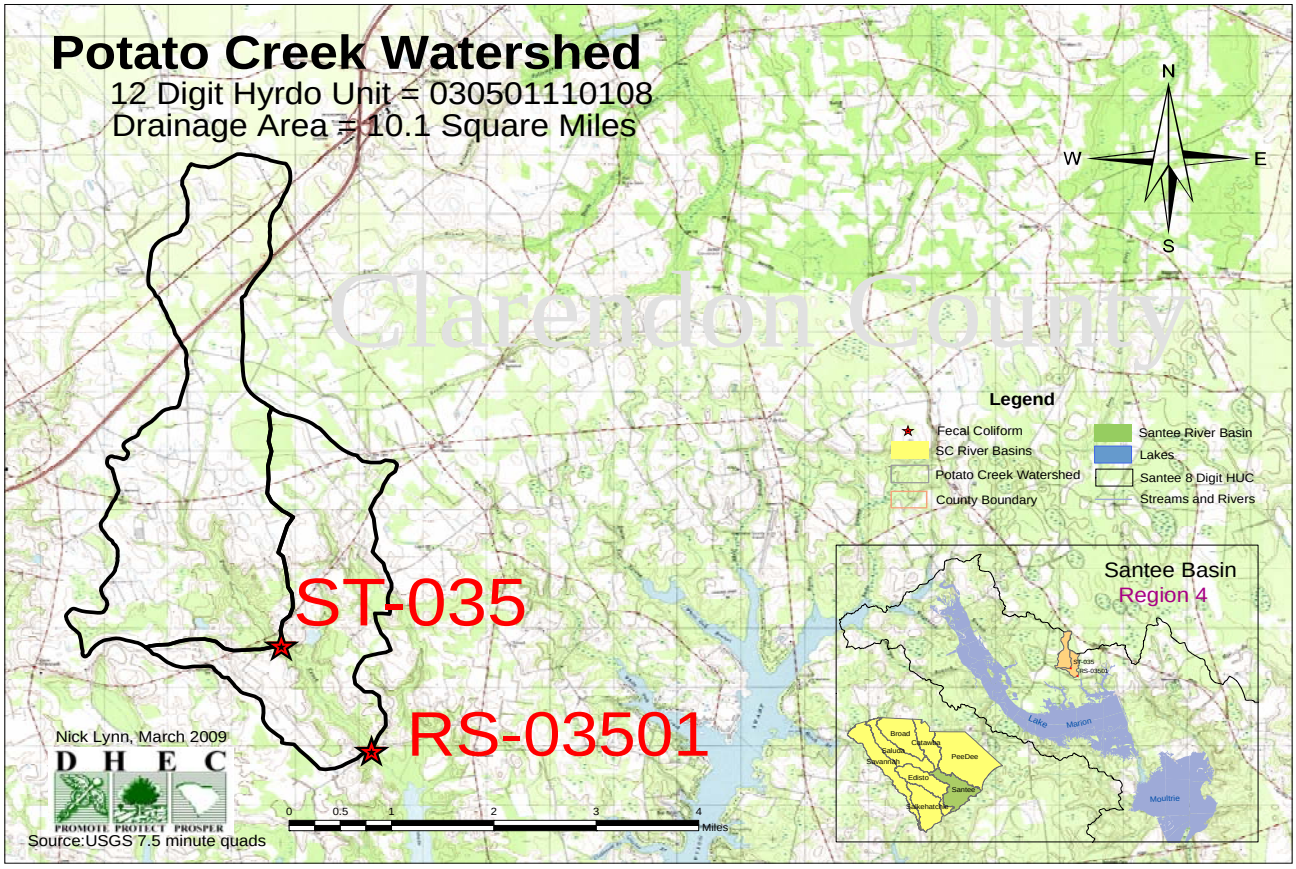


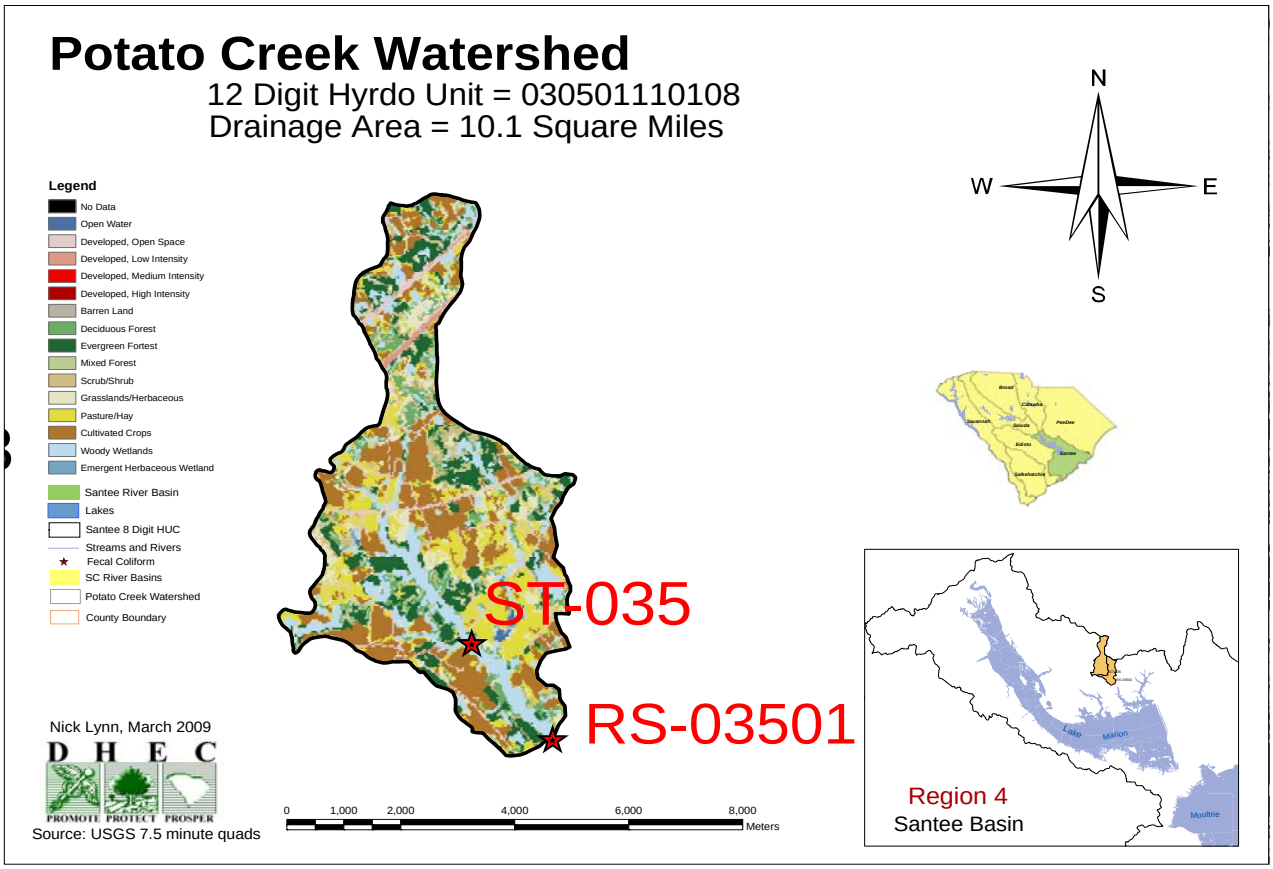
Table 2a. Potato Creek Watershed Land Use (derived from NLCD 2001).

Land Use	Potato Crk Watershed (ac)	%	Clarendon County (ac)	%
Developed (residential, commercial, industrial)	480	7.49	22,746	5.12
Forest or otherwise vegetated (non-cultivated)	1756	27.41	111,360	25.03
Wetlands	1020	15.92	116,092	26.09
Open Water	19	0.31	50,387	11.33
Pasture/crop	2592	40.46	118,989	26.74
Barren	539	8.42	25,341	5.7
Total	**6406**	**100**	**444,915**	**100**

Table 2b. Potato Creek Watershed Developed Land Use by Station Reach (derived from NLCD 2001).

Station	Total Drainage Area of Station Reach (ac)	Total Developed Area (ac)	Percent Developed Area (%)
Headwaters to ST-035	4011.5	325.4	8.1
ST-035 to RS-03501	2394.8	153.4	6.4

Figure 2. Land Use within Potato Creek Watershed (NLCD 2001).



The predominant soil types of the Potato Creek watershed are of the Noboco-Bonneau-Paxville-Rutledge series (SCDHEC 2004). These series of soils are poorly - well drained, and moderately permeable. They are also rated as having a low to medium surface runoff speed. The erodibility of the soil (K-value) in the watershed averages 0.15 which implies that the soils are minutely susceptible to soil detachment (USDA 2008). Slope of the terrain averages 2% and ranges from 0-10% in the watershed.

1.3 Water Quality Standard

The impaired stream segments of the Potato Creek basin are designated as Class Freshwater. Waters of this class are described as:

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

South Carolina's Water Quality Standard (WQS) for FC in freshwater is:

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

Primary contact recreation is not limited to large streams and lakes. Even streams that are too small to swim in, will allow small children the opportunity to play and immerse their hands and faces. The current WQS protect all surface waters for primary recreational use.

2.0 WATER QUALITY ASSESSMENT

The South Carolina Department of Health and Environmental Control (SCDHEC) currently conducts monitoring at 3 locations within the Potato Creek watershed (SCDHEC 2004). Waters in which no more than 10% of the samples collected over a five year period are greater than 400 FC counts or cfu/100 ml are considered to comply with the South Carolina WQS for FC bacteria. Waters with more than 10% of samples greater than 400 cfu/100 ml are considered impaired for FC bacteria and placed on South Carolina's §303(d) list[1].

Both locations are considered impaired due to FC WQS exceedances. Table 3 provides a summary of the number of samples collected, number of exceedances and exceedance percentage. Figure 3 illustrates samples exceeding the water quality standard for monitoring conducted at ST-035 between 1998 and 2006 (shown in green), as well as precipitation data shown in blue.

For ST-035, a positive correlation was observed between FC and rain (r = 0.66) and a weak positive correlation was observed for FC and flow (r = 0.025). For RS-03501 a weak negative correlation was observed between FC and rain (-0.003) and a negative correlation was observed between FC and flow (-0.48).

Table 3. FC Data Summary for Impaired Stations (1999-2006)

Station	Waterbody	Number of Samples	Number Samples >400/100mL	% Samples Exceed WQS
ST-035	Potato Creek	71	15	21.1%
RS-03501	Potato Creek	12	3	25%
Total		**83**	**18**	**21.6%**

[1] The frequency of sampling was fewer than five samples within a 30 day period, therefore the water quality assessment was based on the 10% standard (400/100 mL).

Figure 3. Precipitation and FC Data by Date for ST-035.

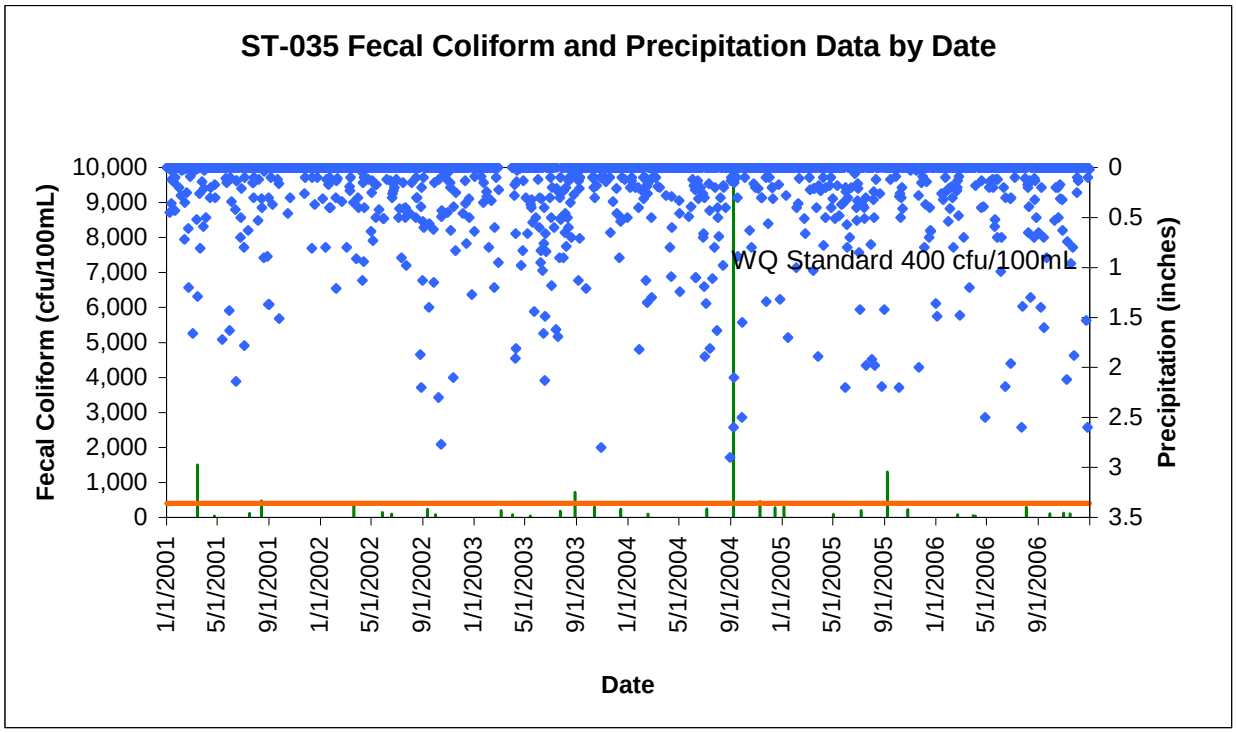
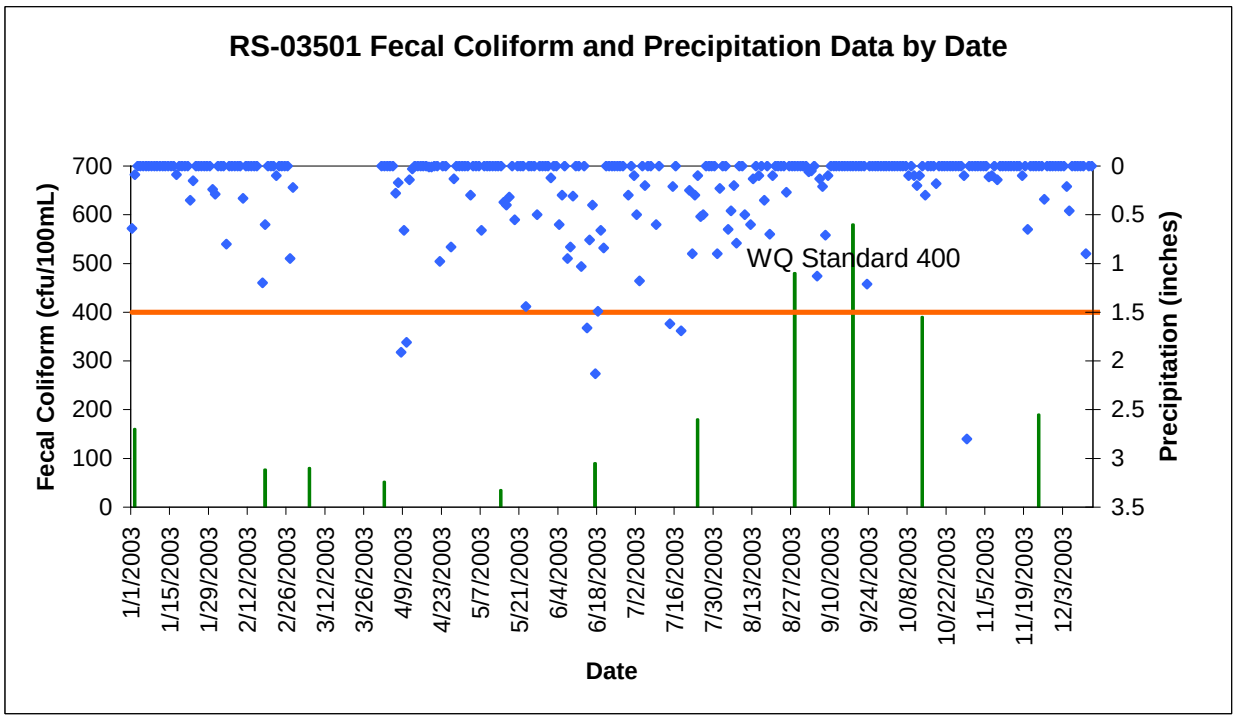


Figure 4. Precipitation and FC Data by Date for RS-03501.



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 FC 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. 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 for industrial and construction activities 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 MS4 permits, they should not be causing or contributing to an instream FC bacteria impairment.

3.1 Point Sources

3.1.1 Continuous Point Sources

There are currently no active NPDES discharges in this watershed. Future NPDES discharges in the referenced watershed are required to comply with the load reductions prescribed in the WLA and demonstrate consistency with the assumptions and requirements of the TMDL.

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.

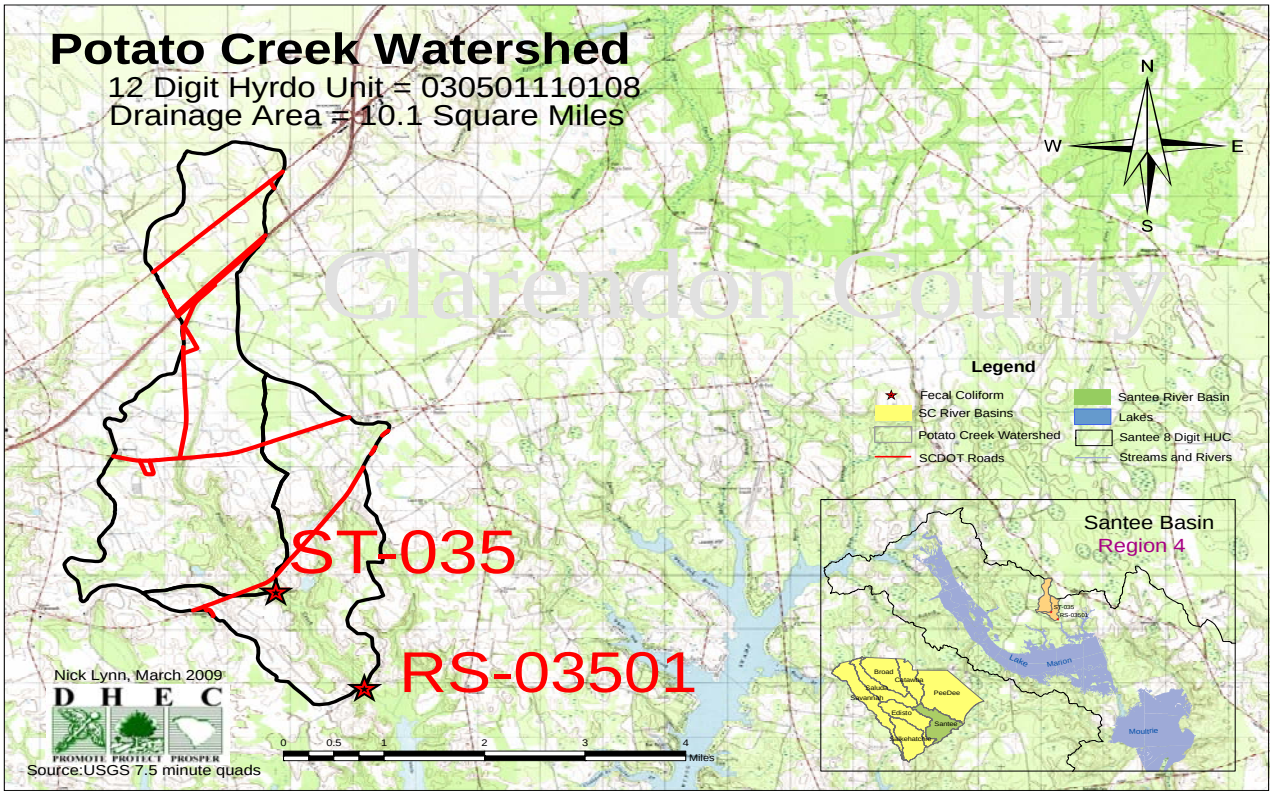
The South Carolina Department of Transportation (SCDOT) is currently the only designated Municipal Separate Storm Sewer System (MS4) within the watershed. The SCDOT operates under NPDES MS4 SCS040001 and owns and operates roads in the watershed (Figure 4). However, the Department recognizes that SCDOT 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.

Other than SCDOT, there are currently no other designated Municipal Separate Storm Sewer Systems (MS4) within the watershed. 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.

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 are usually covered by the NPDES Storm Water Construction General Permit from DHEC (SCR100000). Where the construction has the potential to affect water quality of a water body with a TMDL, the Storm Water Pollution Prevention Plan (SWPPP) for the site must address any pollutants of concern and adhere to any wasteload allocations in the TMDL. It is believed that the Potato Creek watershed has a moderate potential for growth and development including new subdivisions and golf courses (SCDHEC 2005).

Sanitary sewer overflows (SSOs) to surface waters have the potential to severely impact water quality. These untreated sanitary discharges result in violations of the WQS. It is the responsibility of the NPDES wastewater discharger, or collection system operator for non-permitted 'collection only' systems, to ensure that releases do not occur. Unfortunately releases to surface waters from SSOs are not always preventable or reported. There were 9 reported releases in Clarendon County between 1998 and 2006, resulting in the release of over 513,000 gallons of untreated sanitary waste. It is not known what percentage of these releases occurred specifically in the Potato Creek watershed. It has been shown that FC concentrations in typical SSOs are reported as 10^5 to 10^7 MPN/100mL (Novotny et al., 1989). Installation of a sufficient riparian buffer between sanitary sewers and surface waters is one suggested form of implementation for the Potato Creek watershed TMDL.

Figure 5. SCDOT Owned and Maintained Roads in the Potato Creek Watershed



The Department acknowledges that progress with the assumptions and requirements of the TMDL by MS4s is expected to take one or more permit iteration. Progress towards 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.

3.2 Nonpoint Sources

The Department recognizes that there may be wildlife, agricultural activities, grazing animals, septic tanks, and/or other nopoint source contributors located within unregulated areas (outside the permitted area) of the Potato Creek watershed. Nonpoint sources located in unregulated areas are subject to the load allocation and not the waste load allocation of the TMDL document.

3.2.1 Wildlife

Wildlife (mammals and birds) can be a significant contributor of FC bacteria. Wildlife in this area typically includes alligators, deer, squirrels, raccoons, and other mammals as well as a variety of birds. The northern portion (North of Interstate 95) of the delineated watershed used in the development of this TMDL is also home to the endangered red-cockaded woodpecker (Picoides Borealis) which is known to live in mature pine forests found in this portion of the watershed. Wildlife wastes are carried into nearby streams by runoff following rainfall or deposited directly in streams. Waterfowl may be a significant contributor of FC bacteria in this watershed, especially in impounded areas, which provide a desirable habitat for geese and ducks (Figure A-1).

In 2008, SCDNR estimated that there were 30-45 deer per square mile within the Potato Creek watershed of Clarendon County (SCDNR 2008). SCDNR estimated deer density based on suitable habitat (forests, croplands, and pastures). The FC production rate for deer has been shown to be 3.47×10^8 cfu/head-day in a study conducted by Yagow (1999), of which only a portion will enter the watershed. Based on a site assessment, wildlife is considered to be a significant contributor to the FC load within the rural portions of the watershed as numerous waterfowl were seen.

3.2.2 Agricultural Activities

Agricultural activities that involve livestock, animal wastes, or unstabilized surfaces are potential sources of FC contamination of surface waters. Fecal matter can enter the waterway via runoff from the land or by direct deposition into the stream. Agricultural activities may represent a significant source in the Potato Creek watershed due to the fact that these activities constitute a large portion of the land use. Unstabilized soil directly adjacent to surface waters can contribute to FC loading during periods of runoff after rain events. During these events, wildlife wastes can be transported into the creek and carried downstream. Installation of a riparian buffer in areas where creek banks have been disturbed may be appropriate in reducing FC bacteria loading to receiving waters.

3.2.2.1 **Agricultural Animal Facilities**

Owners/operators of most commercial animal growing operations are required by SC Regulation 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 (SCDHEC 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. South Carolina currently does not have any confined animal feeding operations (CAFOs) under NPDES coverage; however, the State does have permitted animal feeding operations (AFOs) covered under R. 61-43. These permitted operations are not allowed to discharge to waters of the State and are covered under 'no discharge' (ND) permits. Discharges from these operations to waters of the State are illegal and are subject to enforcement actions by SCDHEC.

There are currently two active animal feeding operations (AFOs) with regulated structures or activities in the Potato Creek watershed (Table 5). These facilities consist of a broiler poultry operation and a swine factory. Both the Patterson Swine Factory and Palmetto Poultry (Figures A-2 and A-3) are considered to be large AFO's as defined by Section 122.23 of SC Regulation 61-9, Water Pollution Control Permits. Palmetto Poultry is a dry spreader operation consisting of 4 houses while the Patterson Swine Factory is considered a wet spreader by way of spray irrigation. During a March 2009 site visit it appeared that Palmetto Poultry was not rearing poultry at the time. Patterson Swine Factory was observed to have a

large number of cattle grazing. An aerial view of the Patterson Swine Factory shows a lagoon that was not visible during the site assessment and could be a contributing factor to FC loading in the watershed during periods of rainfall. The waterway that leads onto the property was dry during the source assessment.

These facilities are routinely inspected for compliance. Permitted agricultural facilities that operate in compliance with their permit are not considered to be sources of impairment. Land application sites are required by permit to apply no closer than 100' to surface waters.

Table 5. Active Animal Feeding Operations with Regulated Structures or Activities within the Potato Creek Watershed.

Downstream Impaired	AFO Permit	Facility	Type of Livestock	Number Animals	Total Permitted Acres
ST-035, RS-03501	ND0078182	Patterson Swine Factory	Swine (Nursery Pigs)	5,200	135.8
ST-035, RS-03501	ND0073318	Palmetto Poultry	Poultry (Broilers)	125,000	132

3.2.2.2 Grazing Animals

Livestock, especially cattle, are frequently major contributors of FC bacteria to streams. Cattle on average produce some 1.0E+11 cfu/day per animal of FC bacteria (ASAE 1998). Grazing cattle and other livestock may contaminate streams with FC bacteria indirectly by runoff from pastures or directly by defecating into streams and ponds. The grazing of unconfined livestock (in pastures) is not regulated by SCDHEC. The United States Department of Agriculture's National Agricultural Statistics Service reported 4,833 cattle and calves in Clarendon County respectively in 2007 (USDA 2007). Direct loading by cattle or other livestock to surface waters within the Potato Creek watershed is likely to be a significant source of FC. Pasture and crop land use within the Potato Creek watershed is estimated to be 2,592 acres, which was derived from NLCD 2001. Pasture and crop land use within Clarendon County is estimated to be 118,989 acres. By taking the ratio of the above land use, the Potato Creek watershed is proportional to approximately 2.2% of the Clarendon County pasture/crop land use, assuming an even distribution across Clarendon County. This relates to an estimated 106 cattle and calves within the Potato Creek watershed, which combined, produces an average of 1.06E+13 cfu/day of FC bacteria.

During a site visit conducted in March of 2009, numerous livestock were observed such as domesticated horses, sheep, chickens, ducks, and cattle (Figures A-4 – A-8) of which most appeared to be properly fenced away from surface waters and not contributing to FC loading in the watershed. Waterfowl, however, were seen accessing impounded areas directly connected to Potato Creek and could be a significant source. With limited access to farms a potential contributor of FC loading could be unseen areas where livestock have direct access to surface waters.

BMP installation could minimize the impact of grazing animals to surface waters of the State. A study conducted in 1998 by the American Society of Agricultural and Biological Engineers (ASABE 1998) has shown that a vegetative buffer can reduce fecal runoff concentrations from 2.0E+7 cfu/100mL to an immeasurable amount once filtered through the buffer. The buffer in this study was also shown to reduce phosphorous and nitrogen concentrations by 75%. Installing fencing along the streams within the watershed where livestock are present would also eliminate the direct contact of cattle with the streams. It has also been shown that installing water troughs within a pasture area in a West Virginia study reduced the amount of time cattle spent drinking directly from streams by 92% (ASABE 1997). An indirect result of this was a 77% reduction in stream bank erosion.

3.2.3 Leaking Sanitary Sewers and Illicit Discharges

Leaking sewer pipes and illicit sewer connections represent a direct threat to public health since they result in discharge of partially treated or untreated human wastes to the surrounding environment. Quantifying these sources is extremely speculative without direct monitoring of the source because the magnitude is directly proportional to the volume and its proximity to the surface water. Typical values of FC in untreated domestic wastewater range from 10^4 to 10^6 MPN/100mL (Metcalf and Eddy 1991).

Illicit sewer connections into storm drains result in direct discharges of sewage via the storm drainage system outfalls. The existence of illicit sewer connections to storm drains is well documented in many urban drainage systems. Monitoring of storm drain outfalls during dry weather is needed to document the presence or absence of sewage in the drainage systems.

3.2.4 Failing Septic Systems

Studies demonstrate that wastewater located four feet below properly functioning septic systems contains on average less than one FC bacteria organism per 100 mL (Ayres Associates 1993). Failed or non-conforming septic systems, however, can be a major contributor of FC to Potato Creek and its tributaries. 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.

Based on the 2000 U.S. population census (U.S. Census Bureau 2000), there are estimated to be 8,358 septic systems within Clarendon County. Of the 15,303 households within the county, an estimated 3,040 people rely on a community sewer system. It is estimated that there is a total population of 471 people, living in 222 households, inside the drainage area. Assuming one septic tank per household that is not serviced by a community sewer system, it is estimated that there are 222 septic tanks within the Potato Creek watershed. At the time of TMDL development, their status in relation to function is unknown.

3.2.5 Urban Runoff

Dogs, cats, and other domesticated pets are the primary source of FC deposited on the urban landscape. According to a 2002 study conducted by the American Veterinary Medical Association (AVMA 2002), there are 0.58 dogs and 0.66 cats on average per each household within an urban setting. Based on U.S. census data (U.S. Census Bureau 2000), it is estimated that there are 15,303 households within the County of Clarendon, of which 222 are within the Potato Creek watershed. This results in approximately 128 dogs in the delineated area. It has been shown that dogs produce approximately 0.32 pounds of fecal waste per day (Geldrich, et al., 1962). This results in an estimated 41 pounds of waste deposited by domesticated dogs in the watershed per day. Based on the AVMA study and observations by Geldrich and others, there are approximately 146 cats in the drainage area producing 20 pounds of waste per day. There are also 'urban' wildlife, squirrels, raccoons, pigeons, and other birds in the watershed, all of which contribute to the FC load.

During a March 2009 site visit, numerous dogs were seen traveling the roads within the watershed (Figure A-9). FC can be conveyed from these roads to surface waters during periods of rainfall that lead to erosion. Figure A-10 shows a roadway that has eroded into a portion of Potato Creek. Rainwater will pick up FC from the roads and transport it directly into the creek. A sufficient curb that is unsusceptible to erosion around creek beds is one method of implementation suggested to lower FC loadings from domesticated dogs and cats into the watershed. Another would be to have designated washout areas (constructed wetlands/sediment basins) away from the creek where rain water can travel off of the road into a designated area to settle. A dog kennel was also seen directly adjacent to a portion of Potato Creek during the site visit (Figure A-11). This concentrated source of FC could contribute to loading in the watershed during rain events and routine clean up of the kennel. It is suggested that owners of dogs in the watershed should be educated on the effects of FC loading to Potato Creek.

4.0 LOAD-DURATION CURVE METHOD

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

The load-duration curve method depends on an adequate period of record for flow data. USGS gauge 02174250, Cow Castle Creek, was used to provide an adequate record. This gauge began recording daily flows in 1970 and provides the flow data required to establish the flow duration curves for ST-035 and RS-03501.

Flow data for a ten year period (1997-2006) was used to establish flow duration curves. The records for this period were complete (i.e., no missing dates). The flow records were used to estimate flow at both of the impaired monitoring stations. Drainage areas of each sampling station were delineated using USGS topographic maps and ArcMap software. The cumulative area drained was calculated and used to estimate flow based on the ratio of the monitoring station drainage area to the downstream USGS gauge. For example, the USGS Cow Castle Creek gauge records flow from 23.4 square miles (sq mi). The cumulative drainage area at monitoring station ST-035 (Potato Creek at SC 702 5.2 Miles ESE of 96) is approximately 6.3 sq mi or 26.9% of the area drained at the Bowman, SC gauge. Mean daily flow for the ST-035 monitoring location was assumed to be 26.9% of the daily flow at the Cow Castle Creek gauge.

Flow duration curves were developed by ranking flows from highest to lowest and calculating the probability of occurrence (presented as a percentage or duration interval), where zero corresponds to the highest flow. The duration interval can be used to determine the percentage of time a given flow is achieved or exceeded, based on the period of record. Flow duration curves were divided into five hydrologic condition categories (High Flows, Moist Conditions, Mid-Range, Dry Conditions and Low Flows). Categorizing flow conditions can assist in determining which hydrologic conditions result in the greatest number of exceedances. A high number of exceedances under dry conditions might indicate a point source or illicit connection issue, whereas moist conditions may indicate nonpoint sources. Data within the High Flow and Low Flow categories are generally not used in the development of a TMDL due to their infrequency.

A target load-duration curve was created by calculating the allowable load using daily flow, the FC WQS concentration and a unit conversion factor. The water quality target was set at 380 cfu/100ml for the instantaneous criterion, which is five percent lower than the water quality criteria of 400 cfu/100ml. A five percent explicit Margin of Safety (MOS) was reserved from the water quality criteria in developing target load-duration curves. The load-duration curve for station ST-035 is presented in Figure 4 as an example. Load-duration curves for all FC impaired stations are provided in Appendix A.

For both curves the independent variable (X-Axis) represents the percentage of estimated flows greater than value x. The dependent variable (Y-Axis) represents the FC loading at each estimated flow expressed in terms of colony forming units per day (cfu/day). In each of the defined flow intervals for stations ST-035 and RS-03501, existing and target loadings were calculated by the following equations:

Existing Load = Mid-Point Flow in Each Hydrologic Category x 90th Percentile FC Concentration x 10000

Target Load = Mid-Point Flow in Each Hydrologic Category x 380 (WQ criterion minus a 5% MOS) x 10000

Percent Reduction = (Existing Load – Target Load) / Existing Load

Instantaneous loads for each of the impaired stations were calculated. Measured FC concentrations from 1998 through 2006 were multiplied by measured (or estimated flow based on drainage area) flow on the day of sampling and a unit conversion factor. These data were plotted on the load-duration graph based on the flow

duration interval for the day of sampling. Samples above the target line are violations of the WQS while samples below the line are in compliance (Figure 6,7). Only the instantaneous water quality criterion was targeted because there is insufficient data to evaluate against the 30-day geometric mean.

Figure 6. Load Duration Curve for Potato Creek Station ST-035.

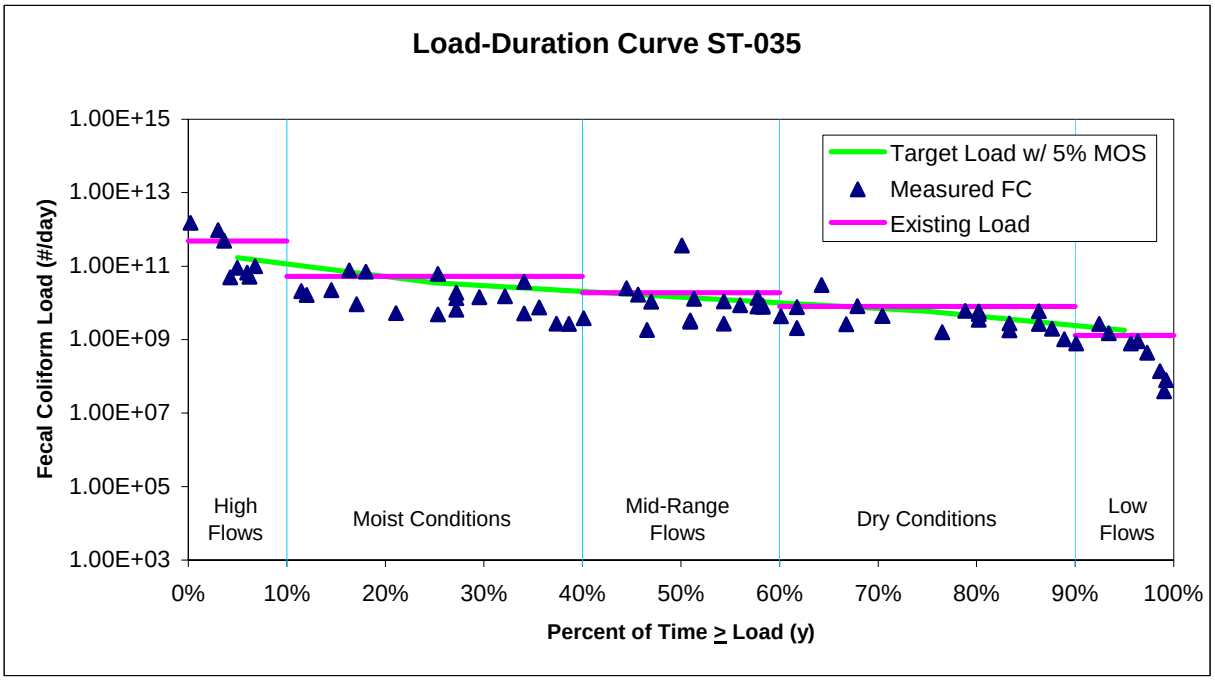
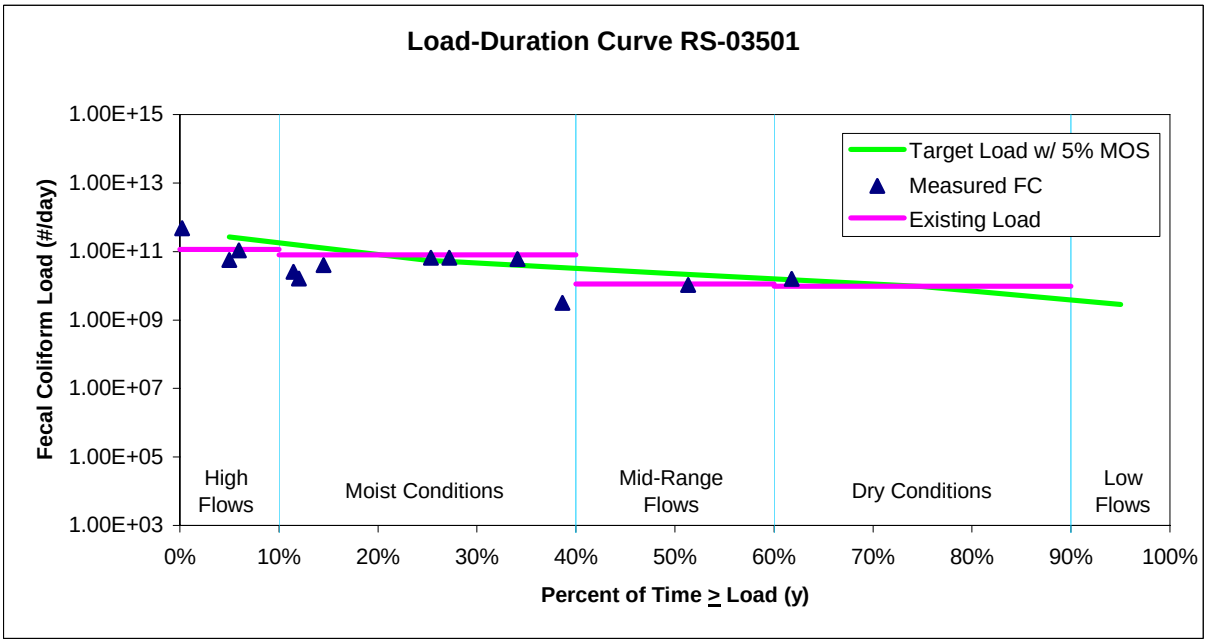


Figure 7. Load Duration Curve for Potato Creek Station RS-03501.



An existing load was determined for each hydrologic category for the TMDL calculations. For stations ST-035 and RS-03501, the 90th percentile of measured FC concentrations within each hydrologic category were multiplied by the flow at each category midpoint (i.e., flow at the 25% duration interval for the Moist Conditions, 50% interval for Mid-Range, and 75% for Dry Condition).

Existing loads are plotted on the load-duration curves presented in Figures 6 and 7. These values were compared to the target load (which includes an explicit 5% MOS) at each hydrologic category midpoint to determine the percent load reduction necessary to achieve compliance with the WQS. This TMDL assumes that if the highest percent reduction is achieved than the WQS will be attained under all flow conditions.

5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

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

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while still achieving compliance with WQS. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis to establish water quality-based controls. For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of number (#), colony forming units (cfu), organism counts (or resulting concentration), or MPN (Most Probable Number), in accordance with 40 CFR 130.2(l).

5.1 Critical Conditions

This TMDL is based on the flow recurrence interval between 10% and 90% and excludes extreme high and low flow conditions; flows that are characterized as 'Low' or 'High' in Figures 6 and 7 were not included in the analysis. The critical condition for each monitoring station is identified as the flow condition requiring the largest percent reduction, within the 10-90% duration intervals. Critical conditions for the Potato Creek watershed pathogen impaired segments are listed in Table 6. These data indicate that for the majority of the stations, wet weather results in larger bacteria loads and is therefore the critical condition for those stations. Moist flow is the critical condition for the two impaired segments.

5.2 Existing Load

An existing load was determined for each hydrologic category for the TMDL calculations as described in Section 4.0 of this TMDL. The existing load under the critical condition, described in Section 5.1 above was used in the TMDL calculations. Loadings from all sources are included in this value: urban runoff, cattle-in-streams, leaking sewers, failing septic systems as well as all point sources. The existing load for each station in the Potato Creek watershed is provided in Appendix D.

Table 6. Percent Reduction Necessary to Achieve Target Load by Hydrologic Category.

Station	Waterbody	Moist Conditions	Mid-Range Flow	Dry Conditions
ST-035	Potato Creek	34		
RS-03501	Potato Creek	31		

Highlighted cells indicate critical condition.
NRN = no reduction needed. Existing load below target load.

5.3 Wasteload Allocation

The wasteload allocation (WLA) is the portion of the TMDL allocated to NPDES-permitted point sources (USEPA 1991). The WLA 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.

5.3.1 Continuous Point Sources

There are currently no permitted domestic dischargers in the Potato Creek watershed. Future continuous discharges are required to meet the prescribed loading for the pollutant of concern based on permitted flow and an allowable permitted maximum concentration of 400cfu/100mL.

5.3.2 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 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.

Based on the available information at this time, the portion of the watershed that drains directly to a regulated MS4 and that which drains through the unregulated MS4 has not been clearly defined within the MS4 jurisdictional area. Loading from both types of sources (regulated and unregulated) typically occurs in response to rainfall events, and discharge volumes as well as recurrence intervals are largely unknown. 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.

Waste load allocations for stormwater discharges are expressed as a percentage reduction instead of a numeric loading due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet the 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 8 presents the reduction needed both of the impaired segments. The reduction percentages in this TMDL also apply to the FC waste load attributable to those areas of the watershed which are covered or will be covered under NPDES MS4 permits. 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 no regulate land use or zoning, issue building or development permits.

Table 7. Percent Reduction Necessary to Achieve Target Load.

Station	Waterbody	% Reduction
ST-035	Potato Creek	34
RS-03501	Potato Creek	31

5.4 Load Allocation

The Load Allocation applies to the nonpoint sources of FC bacteria and is expressed both as a load and as a percent reduction. The load allocation is calculated as the difference between the target load under the critical condition and the point source WLA. The load allocation for each station is listed in Table Ab-1 and table 8. There may also be potentially designated and unregulated MS4s 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 Regulations 61-68D, 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) (SCDHEC 2003).

5.5 Seasonal Variability

Federal regulations require that TMDLs take into account the seasonal variability in watershed loading. The variability in this TMDL is accounted for by using a 10-year hydrological data set and 12 month water quality sampling data set, which includes data collected from all seasons.

5.6 Margin of Safety

The margin of safety (MOS) may be explicit and/or implicit. The explicit margin of safety is 5% of the TMDL or 20 counts/100mL of the instantaneous criterion of 400 cfu/100 mL (380 cfu/100mL). Target loads are therefore 95% of the assimilative capacity (TMDL) of the waterbody. The MOS is expressed as the value calculated from the critical condition defined in Section 5.1 and is the difference between the TMDL and the sum of the WLA and LA. The calculated values of the MOS for each station are given in Table 8.

5.7 TMDL

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of cfu or organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l). Only the instantaneous water quality criterion was targeted because there is insufficient data to evaluate against the 30-day geometric mean. The target load is defined as the load (from point and nonpoint sources) that a stream segment can receive while meeting the WQS. The TMDL value is the median target load within the critical condition (i.e., the middle value within the hydrologic category that requires the greatest load reduction) plus WLA and MOS. Values for each component of the TMDL for the impaired segments of the Potato Creek watershed are provided in Table 8.

While TMDL development was primarily based on instantaneous water quality criterion, terms and conditions of NPDES permits for continuous discharges require facilities to demonstrate compliance with both geometric mean and instantaneous water quality criteria for FC bacteria in treated effluent. NPDES permits for continuous dischargers require data collection sufficient to monitor for compliance of both criteria at the point of outfall.

Table 8 indicates the percentage reduction or water quality standard required for each subwatershed (WQM Station). Note that all future regulated NPDES-permitted stormwater discharges will also be required to meet

the prescribed percentage reductions, or the water quality standard. It should be noted that in order to meet the WQS for FC bacteria, prescribed load reductions must be targeted from all sources, including NPDES permitted and nonpoint sources.

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 recurrence 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 8. TMDL Components for the FC Impaired Segments in the Potato Creek Watershed. Loads are expressed as colony forming units (cfu) per day.

				Wasteload Allocation (WLA)			Load Allocation (LA)	
Station	Existing Load (cfu/day)	TMDL (cfu/day)	Margin of Safety (MOS) (cfu/day)	Continuous Sources[1] (cfu/day)	Non-Continuous Sources[2,3] (% Reduction)	Non-Continuous SCDOT[3,4] (% Reduction)	Load Allocation(cfu/day)	% Reduction to Meet LA[3]
ST-035	5.25E+10	3.67E+10	1.83E+09	N/A	34%	34%	3.49E+10	34%
RS-03501	8.05E+10	5.86E+10	2.93E+09	N/A	31%	31%	5.56E+10	31%

Table Notes:

1. WLAs are expressed as daily maximum; NA = not applicable, no point sources. 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 400cfu/100ml.
2. 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.
3. Percent reduction applies to existing instream load
4. By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform, the SCDOT will comply with this TMDL and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.

6.0 IMPLEMENTATION

The implementation of both point (WLA) and non-point (LA) source components of the TMDL are necessary to bring about the required reductions in FC bacteria loading to Potato Creek and its tributaries in order to achieve 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 will 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 Potato Creek 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 permitted jurisdictional MS4 area. 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 Potato Creek watershed. Local sources of nonpoint source education and assistance include the Natural Resource Conservation Service (NRCS), the Clarendon County Soil and Water Conservation Services, 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 Potato Creek 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 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 are not a substitute for actual NPDES permit conditions.

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. Loadings are developed based upon permitted flow and assume an allowable permitted maximum concentration of 400 cfu/100ml.

6.1.2 Non-Continuous Point Sources

An iterative BMP approach as defined in the general stormwater 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 D 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. For SCDOT, compliance with terms and conditions of its NPDES MS4 permit is effective implementation of the WLA to the MEP.

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. The following 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, bumper stickers, etc (USEPA, 2005).

The public can provide valuable input and assistance to a stormwater management program and they may have the potential to play an active role in both the development and implementation of the stormwater program where deemed appropriate by the entity. 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 for instance. If not already in place, an ordinance prohibiting non-stormwater discharges into a 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 the MS4 area 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 programs or activities to ensure reductions in pollution are occurring. 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 and document 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 organizations, 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 SCDHEC's NPDES web page online at http://www.scdhec.gov/environment/water/swnpdes.htm as well as 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.

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. For example, contiguous forested areas could be set up and managed to keep wildlife from bedding down and defecating near surface waters. This management practice relies on concentrating wildlife away from water bodies to minimize their impact to pollutant loading. Additionally, contributions from wildlife could be reduced in protected areas by developing a management plan which would allow hunting access during certain seasons. Although this strategy might not work in all situations, it would decrease FC loading from wildlife in areas where wildlife may be a significant contributor to the overall watershed.

Deterrents may also be used to keep wildlife away from docks and lawns in close proximity to surface waters. Non-toxic spray deterrents, decoys, eagles, kites, noisemakers, scarecrows, and plastic owls are a sample of what is currently available. During a source assessment it was noticed that waterfowl were present in impoundments in the watershed as shown in figure A-1. Many waterfowl species are deterred by foreign objects on lawns and the planting of 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. 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. For livestock in the referenced watershed, installing fencing along the streams within the watershed and providing an alternative water source where livestock are present would eliminate direct contact with the streams. Numerous livestock and hobby farms were present in the watershed at the time a source assessment was conducted (Figures A-4 to A-7). If fencing is not feasible, 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 1998) 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.

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 Progrom, 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 regulated or unregulated portions of the watershed at any time. 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 Potato Creek 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 regulated 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 designated 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, also known as an onsite wastewater 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, as 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. 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.

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

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, how to properly plan and maintain a septic system, or to link to the OCRM toolkit mentioned above, 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 recieving 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 treats 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 waste, and are installed in the ground where decomposition can occur (USEPA, 2001). This requires that pet owners place the waste into the disposal units. During a source assessment, numerous dogs were noticed unattended in the referenced watershed (Figure A-8). A dog pen was also seen directly adjacent to Potato Creek. Although the Potato Creek 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 RESOURCES FOR POLLUTION MANAGEMENT

This section provides a listing of available resources to aid in the mitigation and control of pollutants. There are examples from across the nation, most of which are easily accessible on the world wide web.

7.1 General for Urban and Suburban Stormwater Mitigation

- National Management Measures to Control Nonpoint Source Pollution from Urban Areas – Draft. 2002. EPA842-B-02-003. Available at: http://www.epa.gov/owow/nps/urbanmm/index.html
- Stormwater Management Volume Two: Stormwater Technical Manual. Massachusetts Department of Environmental Management. 1997. Available at: http://www.mass.gov/dep/brp/stormwtr/stormpub.htm
- Fact Sheets for the six minimum control measures for storm sewers regulated under Phase I or Phase II. Available at: http://cfpub1.epa.gov/npdes/stormwater/swfinal.cfm?program_id=6
- A Current Assessment of Urban Best Management Practices. 1992. Metropolitan Washington Council of Governments. Washington, DC
- Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. 1987. Metropolitan Washington Council of Governments. Washington, DC
- 2004 Stormwater Quality Manual. Connecticut Department of Environmental Protection 2004. Available at: http://dep.state.ct.us/wtr/stormwater/strmwtrman.htm
- Stormwater Treatment BMP New Technology Report. California Department of Transportation. 2004. SW-04-069-.04.02 Available at: http://www.dot.ca.gov/hq/env/stormwater/special/newsetup/_pdfs/new_technology/CTSW-RT-04-069.pdf
- Moonlight Beach Urban Runoff Treatment facility: Using Ultraviolet Disinfection to Reduce Bacteria Counts. Rasmus, J. and K. Weldon. 2003. StormWater, May/June 2003. Available at http://www.forester.net/sw_0305_moonlight.html
- Operation, Maintenance, and Management of Stormwater Management Systems. Livingston, Shaver, Skupien, and Horner. August 1997. Watershed Management Institute. Call: (850) 926-5310.
- Model Ordinances to Protect Local Resources – Stormwater Control Operation and Maintenance. USEPA Webpage: http://www.epa.gov/owow/nps/ordinance/stormwater.htm
- Stormwater O & M Fact Sheet Preventive Maintenance. USEPA 1999. 832-F-99-004. Available at: http://www.epa.gov/owm/mtb/prevmain.pdf
- The MassHighway Stormwater Handbook. Massachusetts Highway Department. 2004. Available at: http://166.90.180.162/mhd/downloads/projDev/swbook.pdf

- University of New Hampshire Stormwater Center: Dedicated to the protection of water resources through effective stormwater management. Available at: http://www.unh.edu/erg/cstev/index.htm#
- EPA's Stormwater website: EPA's Stormwater website: http://cfpub.epa.gov/npdes/home.cfm?program_id=6

7.2 Illicit Discharges

- Illicit Discharge Detection and Elimination Manual - A Handbook for Municipalities. 2003. New England Interstate Water Pollution Control Commission. Available at: http://www.neiwpcc.org/PDF_Docs/iddmanual.pdf
- Model Ordinances to Protect Local Resources – Illicit Discharges. USEPA webpage: http://www.epa.gov/owow/nps/ordinance/discharges.htm

7.3 Pet Waste

- National Management Measure to Control Non Point Source Pollution from Urban Areas – Draft. USEPA 2002. EPA 842-B-02-2003. Available from: http://www.epa.gov/owow/nps/urbanmm/index.html
- Septic Systems for Dogs? Nonpoint Source News-Notes 63. Pet Waste: Dealing with a Real Problem in Suburbia. Kemper, J. 2000. New Jersey Department of Environmental Protection. Available from: http://www.state.nj.us/dep/watershedmgt/pet_waste_fredk.htm
- Stormwater Manager's Resource Center. Schueler, T., Center for Watershed Protection, Inc. http://www.stormwatercenter.net
- Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. U.S. EPA, Office of Water 1993. Washington, DC.
- National Menu of Best Management Practices for Stormwater Phase II. USEPA. 2002. Available at: http://www.epa.gov/npdes/menuofbmps/menu.htm
- Welcome to NVRC'S Four Mile Run Program. NVRC 2001. Available at: http://www.novaregion.org/fourmilerun.htm
- Boston's ordinance on dog waste. City of Boston Municipal Codes, Chapter XVI. 16-1.10A Dog Fouling. Available at: http://www.amlegal.com/boston_ma/
- Pet Waste and Water Quality. Hill, J.A., and D. Johnson. 1994. University of Wisconsin Extension Service. http://cecommerce.uwex.edu/pdfs/GWQ006.PDF
- Long Island Sound Study. Pet Waste Poster. EPA. Available at: http://www.longislandsoundstudy.net/pubs/misc/pet.html
- Source Water Protection Practices Bulletin: Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water. USEPA. 2001. EPA 916-F-01-027. Available at: http://www.epa.gov/safewater/protect/pdfs/petwaste.pdf

7.4 Wildlife

- An example of a bylaw prohibiting the feeding of wildlife: Prohibiting Feeding of Wildlife. Town of Bourne Bylaws Section 3.4.3. Available at: http://www.townofbourne.com/Town%20Offices/Bylaws/chapter__3.htm

- Integrated Management of Urban Canadian Geese. M Underhill. 1999. Conference Proceedings, Waterfowl Information Network.

- Urban Canadian Geese in Missouri. Missouri Conservationist Online. Available at: http://www.conservation.state.mo.us/conmag/2004/02/20.htm

7.5 Septic Systems

- National Management Measures to Control Nonpoint Source Pollution from Urban Areas – Draft. Chapter 6. New and Existing Onsite Wastewater Treatment Systems. USEPA 2002. EPA842-B-02-003. Available at: http://www.epa.gov/owow/nps/urbanmm/index.html

- Septic Systems. USEPA Webpage: http://cfpub.epa.gov/owm/septic/home.cfm

7.6 Field Application of Manure

- Conservation Standard Practice-Irrigation Water Management. Number 449. United States Department of Agriculture (USDA) Natural Resources Conservation Service. 2003. Available at: http://www.nrcs.usda.gov/technical/Standards/nhcp.html

- Conservation Standard Practice-Filter Strip. Number 393. USDA Natural Resources Conservation Service (NRCS). 2003. Available at: http://www.nrcs.usda.gov/technical/Standards/nhcp.html

- Buffer Strips: Common Sense Conservation. USDA Natural Resource Conservations Service. No Date. Website. Available at: http://www.nrcs.usda.gov/feature/buffers/

- Conservation Standard Practice-Riparian Forest Buffer. Number 391. USDA Natural Resource Conservation Service. 2003. Available at: http://www.nrcs.usda.gov/technical/Standards/nhcp.html

- Conservation Standard Practice-Riparian Herbaceous Cover. Number 390 USDA Natural Resource Conservation Service. 2003. Available at: http://www.nrcs.usda.gov/technical/Standards/nhcp.html

7.7 Grazing Management

- Conservation Standard Practice-Stream Crossing. Number 578. USDA Natural Resource Conservation Service. 2003. Available at: http://www.nrcs.usda.gov/technical/Standards/nhcp.html

- Guidance Specifying Management Measures for Nonpoint Source Pollution in Coastal Waters. Chapter 2. Management Measures for Agricultural Sources. Grazing Management. USEPA. Available at: http://www.epa.gov/owow/nps/MMGI/Chapter2/ch2-2e.html

7.8 Animal Feeding Operations and Barnyards

- National Management Measures to Control Nonpoint Source Pollution from Agriculture. USEPA 2003. Report: EPA 841-B-03-004. Available at: http://www.epa.gov/owow/nps/agmm/index.html
- Livestock Manure Storage. Software designed to asses the threat to ground and surface water from manure storage facilities. USEPA. Available at: http://www.epa.gov/seahome/manure.html
- National Engineering Handbook Part 651. Agricultural Waste Management Field Handbook. NRCS. Available At: http://www.wcc.nrcs.usda.gov/awm/awmfh.html
- Animal Waste Management. NRCS website: http://www.wcc.nrcs.usda.gov/awm/
- Animal Waste Management Software. A tool for estimating waste production and storage requirements. Available at: http://www.wcc.nrcs.usda.gov/awm/awm.html
- Manure Management Planner. Software for creating manure management plans. Available at: http://www.agry.purdue.edu/mmp/
- Animal Feeding Operations Virtual Information Center. USEPA website: http://cfpub.epa.gov/npdes/afo/virtualcenter.cfm

7.9 Federal Agriculture Resources: Program Overviews, Technical Assistance, and Funding

- USDA-NRCS assists landowners with planning for the conservation of soil, water, and natural resources. Local, state, and federal agencies and policymakers also rely on NRCS expertise. Cost shares and financial incentives are available in some cases. Most work is done with local partners. The NRCS is the largest funding source for agricultural improvements. To find out about potential funding, see: http://www.ma.nrcs.usda.gov/programs/. To pursue obtaining funding, contact a local NRCS coordinator. Contact information is available at:: http://www.ma.nrcs.usda.gov/contact/employee_directory.html
- NRCS provides a wealth of information and BMP fact sheets tailored to agricultural and conservation practices through the NRCS Electronic Field Office Technical Guide at: http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=SC
- The 2002 USDA Farm Bill (http://www.nrcs.usda.gov/programs/farmbill/2002/) provides a variety of programs related to conservation. Information can be found at: http://www.nrcs.usda.gov/programs/farmbill/2002/products.html. The following programs can be linked to from the USDA Farm Bill website:
  - Conservation Security Program (CSP): http://www.nrcs.usda.gov/programs/csp/
  - Conservation Reserve Program (CRP): http://www.nrcs.usda.gov/programs/crp/
  - Wetlands Reserve Program (WRP): http://www.nrcs.usda.gov/programs/wrp/
  - Environmental Quality Incentives Program (EQIP): http://www.nrcs.usda.gov/programs/eqip/
  - Grassland Reserve Program (GRP): http://www.nrcs.usda.gov/programs/GRP/
  - Conservation of Private Grazing Land Program (CPGL): http://www.nrcs.usda.gov/programs/cpgl/
  - Wildlife Habitat Incentives Program (WHIP): http://www.nrcs.usda.gov/programs/whip/
  - Farm and Ranch Land Protection Program (FRPP): http://www.nrcs.usda.gov/programs/frpp/

- Resource Conservation and Development Program (RC&D): http://www.nrcs.usda.gov/programs/rcd/

- CORE4 Conservation Practices. The common sense approach to natural resource conservation. USDA-NRCS (1999). This manual is intended to help USDA-NRCS personnel and other conservation and nonpoint source management professionals implement effective programs using four core conservation practices: conservation tillage, nutrient management, pest management, and conservation buffers, available at: http://www.nrcs.usda.gov/technical/ECS/agronomy/core4.pdf

- County soil survey maps are available from NRCS at: http://soils.usda.gov

- Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. U.S. EPA, Office of Water (1993). Developed for use by State Coastal Nonpoint Pollution Control Programs, Chapter 2 of this document covers erosion control, animal feeding operation management, grazing practices, and management of nutrients, pesticides, and irrigation water, available at:: http://www.epa.gov/owow/nps/MMGI/Chapter2/index.html.

- Farm-A-Syst is a partnership between government agencies and private business that enables landowners to prevent pollution on farms, ranches, and in homes using confidential environmental assessments, available at: http://www.uwex.edu/farmasyst/

- State Environmental Laws Affecting South Carolina Agriculture: A comprehensive assessment of regulatory issues related to South Carolina agriculture has been compiled by the National Association of State Departments, available at: http://www.nasda-hq.org/nasda/nasda/Foundation/state/states.htm

- Waterborne Pathogens in Agricultural Wastewater. Rosen, B. H., 2000. USDA, NRCS, Watershed Science Institute. Available at: ftp://ftp-fc.sc.egov.usda.gov/WSI/pdffiles/Pathogens_in_Agricultural_Watersheds.pdf

8.0 REFERENCES AND BIBLIOGRAPHY

American Society of Agricultural Engineers (ASAE). 1998. ASAE Standards, 45th edition. D384.1 DEC93. Manure production and characteristics St. Joseph, Mich.

American Society of Agricultural and Biological Engineers (ASABE). 1997. Off-Stream Water Sources for Grazing Cattle as a Stream Bank Stabilization and Water Quality BMP. *Transactions of the ASAE*, Vol. 40(3): 595-604

American Society of Agricultural and Biological Engineers (ASABE). 1998. Vegetative Filter Strip Removal of Cattle Manure Constituents in Runoff. *Transactions of the ASAE*, Vol. 41(5): 1375-1381

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.

Bonta, J.V. and B. Cleland. 2003. Incorporating Natural Variability, Uncertainty, and Risk into Water Quality Evaluations Using Duration Curves. *Journal of American Water Resource Association* 39(12):1481-1496

Corso PS, Kramer MH, Blair KA, Addiss DG, Davis JP, Haddix AC. 2003 Cost of illness in the 1993 Waterborne *Cryptosporidium* outbreak, Milwaukee, Wisconsin. Emerg Infect Dis: April 2003

Gaffield, S. J., R. L. Goo, L.A. Richards, and R. J. Jackson. 2003. Public Health Effects of Inadequately Managed Stormwater. in Runoff. *American Journal of Public Health* 93(9): 1527-1533. September 2003.

Geldrich, E., R. Borden, C. Huff, H. Clark and P. Kabler. 1962. Type Distribution of Coliform Bacteria in the Feces of Warm Blooded Animals. Journal of Water Pollution Control Federation (34):295

Metcalf and Eddy 1991. Wastewater Engineering: Treatment, Disposal, Reuse. Third Edition.

National Land Cover Data Set (NLCD). 2001. Nation-wide Landsat-7 Imagery 1999. Available through the Multi-Resolution Land Characteristics (MRLC) Consortium. http://www.mrlc.gov/

Novotny, V., K.R. Imhoff, M. Olthof, and P.A. Krenkel. 1989. Karl Imhoff's Handbook of Urban Drainage and Wastewater Disposal. Wiley, New York.

SCDHEC. 1998. Implementation Plan for Achieving Total Maximum Daily Load Reductions from Nonpoint Sources for the State of South Carolina.

SCDHEC. 2002. Standards for the Permitting of Agricultural Animal Facilities (Regulation 61-43). Bureau of Water. Columbia, SC

SCDHEC. 2003. Water Pollution Control Permits (Regulation 61-9) Office of Environmental Quality Control, Columbia, SC.

SCDHEC. 2004. Classified Waters (R.61-68). Amended June 28, 2004. Printed April 2005;36pp.

SCDHEC. 2004. Watershed Water Quality Assessment: Saluda River Basin. Technical Report No. 004-04.

SCDNR. 1997. Farming for Clean Water in South Carolina.

SCDNR. 2000. Deer Density Map. http://www.dnr.sc.gov/wildlife/deer/img/deerden2000.pdf

Schueler, T. R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Publ. No. 87703. Metropolitan Washington Council of Governments, Washington, DC.

Schueler, T. R. 1999. Microbes and Urban Watersheds: Concentrations, Sources, and Pathways. *Watershed Protection Techniques* 3(1): 554-565.

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

United States Department of Agriculture (USDA). 2002. National Agriculture Statistics Service. 2002 Cattle statistics by county. Available at http://www.nass.usda.gov/Statistics_by_State/South_Carolina/Publications/County_Estimates/index.asp

United States Environmental Protection Agency (USEPA). 1986. Ambient water quality criteria for bacteria – 1986. Office of Water, EPA-A440/5-84-002.

United States Environmental Protection Agency (USEPA). 1991. Guidance for Water Quality-Based Decisions: The TMDL Process. Office of Water, EPA 440/4-91-001.

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

United States Environmental Protection Agency (USEPA). 2001 Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water. EPA 916-F-01-027 http://www.epa.gov/safewater/sourcewater/pubs/fs_swpp_petwaste.pdf

United States Environmental Protection Agency (USEPA). 2005. National Pollutant Discharge Elimination System (NPDES). Available at http://cfpub.epa.gov/npdes/home.cfm?program_id=6

US Geological Survey. 2008. Water-Resources Real-time Data South Carolina Water Year. United States Geological Survey. Available at http://waterdata.usgs.gov/nw

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.

Wise, Karl. J., et al. 2002. Results of the AVMA Survey on Companion Animal Ownership in US Pet-Owning Households. Journal of the American Veterinary Medical Association, Vol. 221(11): 1572-1573

Appendix A

FIGURES

Figure A-1. Waterfowl grazing near impoundment

Figure A-2. Palmetto Poultry

Figure A-3. Patterson Swine Facility

Figure A-4 – A-7. Livestock Grazing in Fields, Kennels, and Coops

Figure A-8. Dogs in Road Adjacent to Creek Bed

Figure A-9. Erosion of Gravel Road Immediately up-grade of Stream

Figure A-10. Dog Kennel Located 5-10’ From Creek Bed

Figure A-11. Headwaters of Potato Creek off Highway 301

Figure A-12. Potato Creek at Highway 127 (SCDHEC Monitoring Station ST-035)

Figure A-13. Potato Creek at Highway 715 (SCDHEC Monitoring Station RS-03501)

Appendix B

EVALUATING THE PROGRESS OF MS4 PROGRAMS

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 C

FC DATA SUMMARY

ST-035									
Date	1/16/2001	2/22/2001	3/15/2001	4/24/2001	5/2/2001	7/17/2001	8/14/2001	9/19/2001	10/3/2001
FC (cfu/day)	170	900	1500	43	86	120	480	420	280
Date	11/15/2001	12/3/2001	1/8/2002	2/20/2002	3/21/2002	4/29/2002	5/28/2002	6/19/2002	7/24/2002
FC (cfu/day)	350	290	160	470	390	230	150	100	300
Date	8/26/2002	9/12/2002	10/1/2002	11/13/2002	12/10/2002	1/2/2003	2/18/2003	3/6/2003	4/2/2003
FC (cfu/day)	140	240	86	140	230	140	100	200	83
Date	5/14/2003	6/17/2003	7/24/2003	8/28/2003	9/18/2003	10/13/2003	11/24/2003	12/15/2003	1/20/2004
FC (cfu/day)	47	460	180	720	580	300	370	240	160
Date	2/17/2004	3/22/2004	4/29/2004	5/12/2004	6/2/2004	7/6/2004	8/4/2004	9/7/2004	10/6/2004
FC (cfu/day)	100	83	120	230	640	250	400	10,000	280
Date	11/9/2004	12/15/2004	1/5/2005	2/22/2005	3/22/2005	4/19/2005	5/2/2005	6/1/2005	7/7/2005
FC (cfu/day)	460	280	300	70	50	71	93	260	200
Date	8/23/2005	9/7/2005	10/26/2005	11/22/2005	12/13/2005	1/3/2006	2/21/2006	3/30/2006	4/4/2006
FC (cfu/day)	570	1300	230	560	380	290	80	57	47
Date	5/30/2006	6/7/2006	7/26/2006	8/3/2006	9/28/2006	10/31/2006	11/15/2006	12/12/2006	
FC (cfu/day)	180	260	540	290	110	130	110	80	

RS-03501									
Date	5/26/1999	6/2/1999	7/6/1999	8/4/1999	9/27/1999	10/4/1999	5/18/2000	6/19/2000	7/10/2000
FC (cfu/day)	140	260	100	100	0	160	120	280	450
Date	8/21/2000	9/13/2000	10/25/2000						
FC (cfu/day)	300	100	160						

Appendix D

DATA TABLES

90th Percentile FC Concentrations (#/100 mL)

Hydro Categ Range	High Flow 0-10	Moist Cond. 10-40	Mid Range 40-60	Dry Flow 60-90	Low Flow 90-100	Samples
ST-035	1080	572	510	504	276	71
RS-03501	162	550	190	390	N/A	12

Mid Point Hydrologic Category Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
ST-035	18.21	3.75	1.53	0.64	0.19
RS-03501	29.06	5.98	2.44	1.03	0.30

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
ST-035	4.81E+11	5.25E+10	1.91E+10	7.93E+09	1.28E+09
RS-03501	1.15E+11	8.05E+10	1.13E+10	9.79E+09	N/A

Target Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
ST-035	1.69E+11	3.49E+10	1.42E+10	5.98E+09	1.77E+09
RS-03501	2.70E+11	5.56E+10	2.26E+10	9.54E+09	2.82E+09

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
ST-035	N/A	1.76E+10	N/A	N/A	N/A
RS-03501	N/A	2.49E+10	N/A	N/A	N/A

% Load Reduction Necessary

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
ST-035	N/A	34	N/A	N/A	N/A
RS-03501	N/A	31	N/A	N/A	N/A

Responsiveness Summary
Potato Creek TMDL Document

Comments were received from the following:
South Carolina Department of Transportation

Comments from South Carolina Department of Transportation

Comment 1:

"It is important that the SCDHEC develop TMDLs that are implementable, defensible, reasonable, and which achieve the goal of the waterbody meeting the state standard for its appropriate use designation. It is also important that the SCDHEC understands the role and responsibility of the SCDOT in carrying out its mission to provide transportation for the citizens of South Carolina and its limited ability to affect activities not covered under its regulatory authority. The issues related to this TMDL and all others are watershed-based. Only SCDHEC has the authority to develop basin-wide plans to address the regulated and non-regulated contributors to the impairments that lead to the development of this TMDL in the first place."

Response 1:

SCDHEC understands the role and responsibilities of SCDOT. It is part of the Department's mission to develop reasonable, implementable, and scientifically defensible TMDLs which help waterbodies achieve water quality standards. It is further acknowledged that SCDHEC has the authority to develop watershed and basin-wide plans to address regulated and unregulated processes contributing to water quality impairments and the Potato Creek TMDL is an example of such a plan.

Comment 2:

"TMDLs must consider **all** potential sources of fecal coliform, not just permitted MS4s. These existing sources of pollutants, or other causes of impaired water quality, must be quantified as part of the TMDL process. In this TMDL, DHEC has identified these sources but has not quantified them for use in water quality models. Without this quantification step, there is no basis for determining the effect of the assigned waste load allocation. In the case of this TMDL, if the SCDOT reduced its FC contribution by 100% (because its FC contribution is minimal and it accounts for less than 2% of the watershed area), the stream would still be impaired for FC. However, since the SCDOT is the only identified permitted entity, it possibly could be held in violation of its NPDES permit and subject to sanctions by SCDHEC and the USEPA as well as third party actions. Therefore, all existing point and nonpoint sources that may impact a receiving waterbody must be identified, their contribution quantified, and assigned an appropriate load or waste load allocation.

A TMDL in and of itself carries no regulatory authority over any entity which it names as a contributor of a pollutant. Therefore, no regulatory authority is needed for DHEC to name any entity as a contributor, if they are in fact one. The regulatory authority of a TMDL comes only by way of an NPDES permit held by named entity. Simply because DHEC may not issue an NPDES permit to a flock of geese, a herd of cattle or collectively all leaking sanitary sewers, does not

mean that such groups should be excluded from consideration and quantification of the overall water quality in TMDL area."

Response 2:

Reductions from all sources, including point and nonpoint sources, are required to meet the overall percentage reductions of the referenced TMDL and achieve the water quality standard for the pollutant of concern. Therefore, SCDOT is not the sole source responsible for reducing FC loading to the referenced watershed. At the present time however, SCDOT is currently the only regulated entity in the watershed subject to the WLA portion of the TMDL. Should future permits become applicable to this watershed, those discharges will be subject to the assumptions and requirements of the WLA portion of the referenced TMDL.

Wildlife, agricultural runoff, failing septic systems, illicit connections, leaking sewers, sanitary sewer overflows and urban runoff are nonpoint sources of pollution and as such are covered under the load allocation portion of the TMDL document. Percent reductions, including the load allocation portion of the TMDL, are provided in Table Ab-1, Table 8, and are further discussed in detail in section 5.4 of this TMDL document. All existing point and nonpoint sources that may impact a receiving waterbody have been identified, their contributions have been quantified where applicable, and they have been assigned an appropriate load or waste load allocation consistent with 40 CFR Part 130 and with concurrence from EPA Region 4.

It should be noted that unauthorized discharges to Waters of the State, including leaky septic tanks and leaking sewer lines, are illegal and subject to compliance and enforcement mechanisms. Sections 3.2.3 and 3.2.4 (p. 8-9) of the referenced TMDL document discuss leaking sanitary sewers, illicit discharges, and failing septic systems. Maintenance of septic tanks is the responsibility of individual owners. Maintenance of sewer lines is the responsibility of the collection system owner. NPDES permitted stormwater entities (regulated MS4s) must have an illicit discharge detection program in place to help identify illegal discharges, such as those referenced above, in order to ensure that they are eliminated.

Comment 3:

"DHEC should recognize that fecal coliform is not a pollutant of concern for SCDOT and thus SCDOT should not be required under the TMDL to reduce its "contribution." Other than in locations where SCDOT owned rest areas and maintenance facilities exist, no original source of fecal coliform bacteria (e.g. warm blooded animals) is under the regulatory authority of SCDOT and thus SCDOT is legally unable to make any quantifiable reduction in FC levels in any waterbody. In previously drafted TMDL documents, DHEC has indicated a concern that SCDOT may contribute FC through "conveyance" in locations where a SCDOT roadway lies adjacent to animal feeding operations or land application sites, or in the case of wildlife contributions. These are direct sources of FC bacteria which are outside of the control of SCDOT. Each of these sources should be addressed separately as indicated in Comment 2 above."

Response 3:

By definition of MS4 as prescribed in R.61-9 section 122.26(b), "Municipal separate storm sewer" means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains)". SCDOT is a phase I MS4 which may have the potential to **contribute** or **convey** fecal coliform loading to waters of the State. It is the responsibility of the MS4 operator (SCDOT) to ensure

that contributions to or the conveyance of FC bacteria loading does not occur within its regulated jurisdictional MS4 area.

AFOs are inspected by SCDHEC for permit compliance. Permitted agricultural facilities that operate in compliance with their permit are not considered to be sources of impairment. Discharges from these operations to waters of the State are illegal and are subject to compliance and enforcement actions by SCDHEC and are therefore not provided a percentage reduction.

TMDL Excerpt 4 (p. ii):

"A fecal coliform (FC) TMDL was developed for two impaired stations within the Potato Creek watershed located in Clarendon County, SC."

Comment 4:

"The Potato Creek watershed drains 6406 acres including Wyboo Swamp, Church Branch, Big Branch, and a portion of the Santee National Wildlife Refuge. To base a TMDL for this entire watershed on sampling from two (2) stations (one of which was sampled only 12 times) is scientifically inadequate and is not an accurate reflection of current water quality conditions."

Response 4:

72 samples were taken from Potato Creek at S-14-127, 3.2 miles south of Summerton from January 2001 - December 2006. 12 Samples were taken from Potato Creek at S-14-715 (Rogers Road), 5.5 miles southeast of Summerton from May 1999 – October 2000. The results were considered for use in development of the 2000 and 2008 303(d) lists (as required by 40 CFR Part 130) and, subsequently, the data was used for development of the referenced TMDL in the Potato Creek watershed. The Department believes the methods used and presented in the referenced TMDL document, with concurrence from EPA Region 4, are valid and scientifically defensible.

TMDL Excerpt 5 (p. ii):

"Probable sources of fecal contamination include wildlife, agricultural runoff, failing septic systems, illcit connections, leaking sewers, sanitary sewer overflows and urban runoff."

Comment 5:

"SCDOT agrees with this statement. These sources should be addressed by appropriate reduction requirements in the TMDL. Listing these nonpoint sources collectively in the load allocation portion of the TMDL is inadequate and arbitrary. Each individual source should be quantified as indicated in Comment 2. Requiring only SCDOT to reduce loading will not in any way address the impaired station."

Response 5:

Wildlife, agricultural runoff, failing septic systems, illicit connections, leaking sewers, sanitary sewer overflows and urban runoff are nonpoint sources of pollution and as such are covered under the load allocation portion of the TMDL document. Load allocations are provided in Table Ab-1, Table 8, and are further discussed in detail in section 5.4 of this TMDL document. Reductions from all sources, including point and nonpoint sources, are required for meeting the overall percentage reduction in the referenced TMDL and to achieve the water quality standard

for the pollutant of concern. All existing point and nonpoint sources that may impact a receiving waterbody have been identified, their contributions have been quantified where applicable, and they have been assigned an appropriate load or waste load allocation consistent with 40 CFR Part 130 and with concurrence from EPA Region 4.

TMDL Excerpt 6 (p. ii):

"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."

Comment 6:

"Any reduction in FC from SCDOT would have no measurable impact on the overall FC levels since SCDOT roads produce essentially no FC. Therefore, reduction from SCDOT would not effectively implement the WLA. Any FC that may be contributed to the watershed through conveyance over SCDOT roadways should be attributed to its direct source as indicated in Comment 2."

Response 6:

It is stated in the Potato Creek TMDL document that compliance with terms and conditions of existing and future NPDES sanitary and stormwater permit (including all construction, industrial and MS4) may effectively implement the WLA. However, reductions from all sources, including point (WLA) and nonpoint (LA) sources, are required to meet the overall percentage reductions of the referenced TMDL and achieve the water quality standard for the pollutant of concern.

By definition, nonpoint source pollution is diffuse in nature and indistinct from other sources of pollution. All portions of unregulated sources of nonpoint source pollution that may be contributed to the watershed through conveyance over SCDOT roadways cannot be attributed to their direct source. It is the responsibility of the MS4 operator (SCDOT) to ensure that contributions to or the conveyance of FC bacteria loading does not occur within its regulated jurisdictional MS4 area.

TMDL Excerpt 7 (p. 1):

"Infections including respiratory, eye, nose, throat, and skin diseases may also occur, of which many are caused by contaminated drinking water (USEPA, 1986)."

Comment 7:

"Ingestion (drinking) is not a supported use for the waters of Big Creek. Much stricter water quality standards than a TMDL govern drinking water quality. A document about drinking water quality is not applicable to a document concerning storm water."

Response 7:

Because this comment was received in relation to the Potato Creek TMDL it is believed by the Department that the referenced excerpt should read as follows:

> "Ingestion (drinking) is not a supported use for the waters of **Potato Creek**. Much stricter water quality standards than a TMDL govern drinking water quality. A document about drinking water quality is not applicable to a document concerning storm water."

The Department believes that the referenced document stating that infections including respiratory, eye, nose, throat, and skin diseases may also occur due to the presence of fecal coliform bacteria in surface and drinking water is applicable to the development of the Potato Creek TMDL. TMDLs establish the allowable loading for specific pollutants that a waterbody can receive without exceeding water quality standards. TMDLs developed for waterbodies apply to stormwater, drinking water, wastewater, etc. as they are intricately related in a watershed. Fecal coliform bacteria present in stormwater may affect drinking water in a watershed.

It should also be noted that Potato Creek is designated as Class Freshwater. Waters of this class are described as:

> "Freshwaters (FW) are freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department." (R. 61-68)

Designated as Class Freshwater, drinking water supply **is** a supported use for the waters of Potato Creek after conventional treatment.

TMDL Excerpt 8 (p. 1):

"Improperly treated wastewater and untreated stormwater runoff has also been associated with a number of disease outbreaks, most notably an outbreak in Milwaukee affecting an estimated 403,000 people in 1993 (Corso et al., 2003)."

Comment 8:

"The article referenced in this paragraph has been removed from the bibliography (Section 8.0) of the subject TMDL but remains in the text of the TMDL. The statement is a blatant misrepresentation of the referenced article. The article is entitled *Cost of illness in the 1993 Waterborne Cryptosporidium outbreak*. Although a disease outbreak due to the protozoa Cryptosporidium did occur in Milwaukee in 1993, Corso does not mention either wastewater or stormwater anywhere in the paper; Corso instead states the cause of this outbreak was "an ineffective filtration process" in one of the municipal drinking water plants. The source of the Cryptosporidium was never officially identified, but the suspected sources were cattle wastes, slaughterhouse wastes, and sewage."

Response 8:

The reference for the above mentioned article has not been removed from the bibliography section of the Potato Creek TMDL document. The reference was never inserted into the bibliography. The Department will insert a reference into the bibliography for the above mentioned article.

The suspected sources of fecal coliform bacteria as noted by SCDOT are "cattle wastes, slaughterhouse wastes, and sewage". These sources qualify as **wastewater** and **untreated**

stormwater runoff and have been associated with a number of disease outbreaks, including the above mentioned outbreak in Milwaukee affecting an estimated 403,000 people in 1993.

As defined by the Department in the SC Pollution Control Act Section 48-1-10, sewage is:

> "water-carried human or animal wastes from residences, buildings, industrial establishments or other places, together with such ground water infiltration and surface water as may be present and the admixture with sewage of industrial wastes or other wastes shall also be considered sewage."

Since surface waters are commonly used as drinking water after filtration and generally contain untreated stormwater runoff and wastewater prior to treatment, they were in fact suspected sources in the Crytosporidium outbreak in Milwaukee, 1993.

TMDL Excerpt 9 (p. 1):

"Sources of FC bacteria are usually diffuse or nonpoint in nature and originate from stormwater runoff, failing septic systems, agricultural runoff and leading sewers among other sources."

Comment 9:

"Why are other sources listed throughout the TMDL until it comes to the percent reduction table, in which SCDOT is the only entity listed? SCDOT should have a waste load allocation of 0% reduction since its roads produce essentially no FC. Also, there is a failure in the TMDL to acknowledge that leaking septic tanks are regulated by DHEC and the local health department and leaking sanitary sewer lines are also regulated by DHEC. Such unauthorized discharges are illegal and should be subject to regulation by DHEC in the TMDL, not by SCDOT."

Response 9:

Wildlife, agricultural runoff, failing septic systems, illicit connections, leaking sewers, sanitary sewer overflows and urban runoff are nonpoint sources of pollution and as such are covered under the load allocation portion of the TMDL document. Percent reductions, including the load allocation portion of the TMDL, are provided in Table Ab-1, Table 8, and are further discussed in detail in section 5.4 of this TMDL document. Reductions from all sources, including point and nonpoint sources, are required to meet the overall percentage reductions of the referenced TMDL and achieve the water quality standard for the pollutant of concern. Therefore, SCDOT is not the sole source listed as responsible for reducing FC loading to the referenced watershed. In addition, future NPDES discharges applicable to the referenced watershed are also required to comply with the load reductions prescribed in the WLA.

By definition of MS4 as prescribed in R.61-9 section 122.26(b), "Municipal separate storm sewer" means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains)". SCDOT is a phase I MS4 which may have the potential to **contribute** or **convey** fecal coliform loading to waters of the State. Stormwater runoff may be diffuse in nature but can be conveyed to a single point through an MS4. It is the responsibility of the MS4 operator (SCDOT) to ensure that contributions to or the conveyance of FC bacteria loading does not occur within its regulated jurisdictional MS4 area.

Unauthorized discharges to Waters of the State, including leaky septic tanks and leaking sewer lines, are illegal and subject to compliance and enforcement mechanisms. Sections 3.2.3 and 3.2.4 (p. 8-9) of the referenced TMDL document discuss leaking sanitary sewers, illicit discharges, and failing septic systems. Maintenance of septic tanks is the responsibility of individual owners. Maintenance of sewer lines is the responsibility of the collection system owner. NPDES permitted stormwater entities (regulated MS4s) must have an illicit discharge detection program in place to help identify illegal discharges, such as those referenced above, in order to ensure that they are eliminated.

TMDL Excerpt 10 (p. 4-5):

Water Quality Assessment – Including Table 3. and Figures 3 & 4.

Comment 10:

• Where were these samples tested and what protocols were used in this testing?
• Sampling from two (2) stations (one station only 12 times) for the entire 6406 acre watershed is not an adequate amount of data to provide a representative picture of water quality in the watershed.
• Data from 1999 is not a good indicator of current water quality conditions. Current data is a more accurate reflection. The data for RS-03501 is all from 1999-2000.

Response 10:

Samples used in the development of this TMDL document were taken from stations ST-035 and RS-03501 as described in section 1.1 and provided in Table 1 and Figure 1 of the referenced document. The exact location is listed under the "Description" column of Table 1 on p. 1.

Table 1. Potato Creek Watershed FC Impaired Waters.

Waterbody	Station Number	Description
Potato Creek	ST-035	Potato Creek at S-14-127, 3.2 miles south of Summerton
Potato Creek	RS-03501	Potato Creek at S-14-715 (Rogers Road), 5.5 miles southeast of Summerton

The EPA approved membrane filter method is currently used to sample fecal coliform bacteria in freshwater streams. Guided by 40 CFR Part 136, this approach was used and is outlined in 'Standard Methods', 9222D (APHA et al., 2006). Sampling is conducted under an approved Quality Assurance Project Plan (QAPP), which must be approved by the State Quality Assurance Management Officer (SQAMO) or Quality Assurance (QA) Officer (within SCDHEC Bureau of Environmental Services). In addition, a SCDHEC EQC (Environmental Quality Control) standard operating procedures (SOP) and quality assurance manual is also used. Ambient monitoring is covered under section 7, part 2 of the SOP and QA manual.

72 samples were taken from Potato Creek at S-14-127, 3.2 miles south of Summerton from January 2001 - December 2006. 12 Samples were taken from Potato Creek at S-14-715 (Rogers Road), 5.5 miles southeast of Summerton from May 1999 – October 2000. The results were considered for use in development of the 2000 and 2008 303(d) lists (as required by 40 CFR Part 130) and, subsequently, the data was used for development of the referenced TMDL in the Potato

Creek watershed. The Department believes the methods used and presented in the referenced TMDL document, with concurrence from EPA Region 4, are valid and scientifically defensible.

TMDL Excerpt 11 (p. 6):

Indicators such as FC, enteroccoci or E. coli are measured to represent pathogens

Comment 11:

"In 1986 the EPA recommended moving from FC to enteroccoci or E. coli since FC has been shown to not correspond well with the presence of pathogens. Since SCDHEC has not accepted this recommendation there is not a basis for developing this TMDL. A TMDL should not be based on an invalid indicator."

Response 11:

The current water quality standard for indicators of pathogens in the State of South Carolina is based on FC bacteria. South Carolina's Water Quality Standard (WQS) for fecal coliform in freshwater is:

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

TMDLs are developed for pollutants that are listed on the section 303(d) list which do not meet the existing promulgated water quality standard. As presented on p. 1 of the referenced TMDL document, the presence of FCs in surface waters may signify a presence of pathogens, which in turn leads to a greater risk of health for individuals participating in recreation activities within water bodies (USEPA, 2001).

TMDL Excerpt 12 (p. 6):

"In South Carolina NPDES permits require that dischargers of sanitary wastewater must meet the state standard for FC 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."

Comment 12:

"Even if these facilities are discharging wastewater that meets their permit limit, unless they are discharging zero FC, they are still point sources of FC in the watershed, are contributing to the impairment of the watershed and should be given a wasteload allocation in the TMDL.

In the alternative, if SCDOT is meeting the measurable goals in their NPDES permits to the maximum extent practicable (MEP), they should be held to the same standard as WWTFs and not be subject to percent reduction requirements. In fact, DHEC's own statement in the Comment 6 above acknowledges that permit changes may have to be made for other permitted entities to achieve the TMDL goals."

Response 12:

All regulated point sources in the Potato Creek watershed are presented with a wasteload allocation in the referenced TMDL document. Table Ab-1 and Table 8 present the wasteload allocation for continuous and non-continuous point sources. For non-continuous point sources, a percentage 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 rather than a loading due to the uncertatin nature of stormwater discharge volumes and recurrence intervals.

It should be noted that dischargers of sanitary wastewater must meet the state standard for fecal coliform at the point of discharge. If these facilities are discharging wastewater that meets state water quality standards and their permit limits, they are not causing impairment. The Department could not find any statement in comment 6 relating to permit changes having to be made to allow other permitted entities to achieve TMDL goals. Since loading is expressed as a concentration, permit changes will not have to be made for other entities to achieve the TMDL goals because concentration is not accumulative.

TMDL Excerpt 13 (p. 6):

"Due to the presence of SCDOT roads and/or facilities in the Potato Creek watershed, SCDOT is considered to be a contributing source of FC bacteria in the delineated drainage area used in the development of this TMDL document."

Comment 13:

"The presence of SCDOT roads in the watershed does not constitute a contribution FC to the watershed. SCDOT roads produce essentially no FC. Therefore, reduction from SCDOT would not effectively implement the WLA. Any FC that may be contributed to the watershed through conveyance over SCDOT roadways should be attributed to its direct source as indicated in Comment 2. Therefore, SCDOT is not a contributing source of FC to the watershed."

Response 13:

By definition of MS4 as prescribed in R.61-9 section 122.26(b), "Municipal separate storm sewer" means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains)". SCDOT is a phase I MS4 which may have the potential to **contribute** or **convey** fecal coliform loading to waters of the State.

It is stated in the Potato Creek TMDL document that compliance with terms and conditions of existing and future NPDES sanitary and stormwater permit (including all construction, industrial and MS4) <u>may</u> effectively implement the WLA. However, reductions from all sources, including point (WLA) and nonpoint (LA) sources, are required to meet the overall percentage reductions of the referenced TMDL and achieve the water quality standard for the pollutant of concern.

By definition, nonpoint source pollution is diffuse in nature and indistinct from other sources of pollution. All portions of unregulated sources of nonpoint source pollution that may be contributed to the watershed through conveyance over SCDOT roadways cannot be attributed to their direct source. It is the responsibility of the MS4 operator (SCDOT) to ensure that

contributions to or the conveyance of FC bacteria loading does not occur within its regulated jurisdictional MS4 area.

TMDL Excerpt 14 (p. 7):

"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 Permit (SCR000000)."
"Sanitary sewer overflows (SSOs) to surface waters have the potential to severely impact water quality."

Comment 14:

"These and all other sources of FC in the watershed should be quantified and given percent reduction requirements in the TMDL as indicated in Comment 2."

Response 14:

Wildlife, agricultural runoff, failing septic systems, illicit connections, leaking sewers, sanitary sewer overflows and urban runoff are nonpoint sources of pollution and as such are covered under the load allocation portion of the TMDL document. Percent reductions, including the load allocation portion of the TMDL, are provided in Table Ab-1, Table 8, and are further discussed in detail in section 5.4 of this TMDL document. All existing point and nonpoint sources that may impact a receiving waterbody have been identified, their contributions have been quantified where applicable, and they have been assigned an appropriate load or waste load allocation consistent with 40 CFR Part 130 and with concurrence from EPA Region 4.

It should be noted that unauthorized discharges to Waters of the State, including leaky septic tanks and leaking sewer lines, are illegal and subject to compliance and enforcement mechanisms. Sections 3.2.3 and 3.2.4 (p. 8-9) of the referenced TMDL document discuss leaking sanitary sewers, illicit discharges, and failing septic systems. Maintenance of sewer lines is the responsibility of the collection system owner. NPDES permitted stormwater entities (regulated MS4s) must have an illicit discharge detection program in place to help identify illegal discharges, such as those referenced above, in order to ensure that they are eliminated.

There are currently no industrial facilities in the Potato Creek watershed covered under NPDES Storm Water Industrial Permit SCR000000 which are permitted to discharge fecal coliform bacteria. If future NPDES permits are applicable to this watershed, those discharges will be subject to the assumptions and requirements of the WLA portion of this TMDL.

TMDL Excerpt 15 (p. 8):

"The Department recognizes that there may be wildlife, agricultural activities, grazing animals, septic tanks, and/or other nopoint source contributors located within unregulated areas (outside the permitted area) of the Potato Creek watershed. Nonpoint sources located in unregulated areas are subject to the load allocation and not the waste load allocation of the TMDL document."

Comment 15:

- "Nopoint" should replaced be replaced with "nonpoint"
- Nonpoint sources should be quantified as indicated in Comment 2.

Response 15:

The Department agrees that "Nopoint" should be replaced with "nonpoint" and this revision will take place prior to the Potato Creek TMDL document being placed on Notice of Proposed Decision.

Wildlife, agricultural runoff, failing septic systems, illicit connections, leaking sewers, sanitary sewer overflows and urban runoff are nonpoint sources of pollution and as such are covered under the load allocation portion of the TMDL document. Percent reductions, including the load allocation portion of the TMDL, are provided in Table Ab-1, Table 8, and are further discussed in detail in section 5.4 of this TMDL document. All existing point and nonpoint sources that may impact a receiving waterbody have been identified, their contributions have been quantified where applicable, and they have been assigned an appropriate load or waste load allocation consistent with 40 CFR Part 130 and with concurrence from EPA Region 4.

TMDL Excerpt 16 (p. 8-9):

3.2.1 Wildlife, 3.2.2 Agricultural Activities

Comment 16:

"SCDHEC admits that wildlife and agricultural activities are significant contributors of FC to this and other TMDL areas. Specifically, it is admitted that wildlife is a significant contributor to FC loads in the rural portions of the watershed as numerous waterfowl were seen and that animal feeding operations contribute FC to surface waters. These sources should be quantified as indicated in Comment 2. DHEC has authority to assigned percent reductions to all sources of FC in the watershed, regardless of whether it is a permitted activity.

If agricultural sources are acknowledged as significant contributors to the FC bacteria load, they should not be exempt from the TMDL simply because their contribution may be difficult to ascertain or they are already permitted separately. They should be listed as contributors and assigned a percent reduction. Short of listing each source, the percent reduction for other contributors should at the very least be reduced to account for these non-urban sources."

Response 16:

It is acknowledged in the referenced TMDL document that wildlife and agriculutural activities are significant contributors of fecal coliform bacteria to the Potato Creek watershed. The Department could not find in section 3.3.2 (Agricultural Activities) a statement that "animal feeding operations contribute FC to surface waters". The sentence SCDOT may be referring to in the referenced TMDL document under section 3.3.2 reads as follows:

> Agricultural activities that involve livestock or animal wastes are potential sources of FC contamination of surface waters.

It should be noted that animal feeding operations (AFOs) are not allowed to discharge to waters of the State and are covered under 'no discharge' (ND) permits. Discharges from these operations to waters of the State are illegal and are subject to compliance and enforcement actions by SCDHEC.

Wildlife, agricultural runoff, failing septic systems, illicit connections, leaking sewers, sanitary sewer overflows and urban runoff are nonpoint sources of pollution and as such are covered under the load allocation portion of the TMDL document. Percent reductions, including the load allocation portion of the TMDL, are provided in Table Ab-1, Table 8, and are further discussed in detail in section 5.4 of this TMDL document. All existing point and nonpoint sources that may impact a receiving waterbody have been identified, their contributions have been quantified where applicable, and they have been assigned an appropriate load or waste load allocation consistent with 40 CFR Part 130 and with concurrence from EPA Region 4.

TMDL Excerpt 17 (p. 8):

Regarding AFOs, "These permitted operations are not allowed to discharge to waters of the State and are covered under 'no discharge' (ND) permits. Discharges from these operations to waters of the State are illegal and are subject to enforcement actions by SCDHEC."

Comment 17:

"These are the same AFOs which in previously drafted TMDLs are said to be a contributing source "through conveyance." If they convey FC to waters of the state either directly or through SCDOT facilities, they are not a "no discharge" facility. If these discharges are "subject to enforcement actions by SCDHEC," then they should be allocated a percent reduction and SCDOT should not be held liable for their reduction by way of the TMDL."

Response 17:

The statement referred to by SCDOT in a previously drafted TMDL reads as follows:

> "SCDOT owned or operated roads relative to the numerous animal feeding operations (AFOs) and land application sites in the referenced watershed may also be a contributing source of FC bacteria through conveyance."

This statement clearly says that <u>SCDOT owned or operated roads</u> may be a contributing source of FC bacteria through conveyance and not the AFOs. AFOs are inspected by SCDHEC for permit compliance. Permitted agricultural facilities that operate in compliance with their no discharge (ND) permit are not considered to be sources of impairment. Discharges from these operations to waters of the State are illegal and are subject to compliance and enforcement actions by SCDHEC and are therefore not provided a percentage reduction.

TMDL Excerpt 18 (p. 10):

"Leaking sewer pipes and illicit sewer connections represent a direct threat to public health since they result in discharge of partially treated or untreated human wastes to the surrounding environment." …. "Failed or non-conforming septic systems, however, can be a contributor of FC to the Potato Creek watershed. Wastes from failing septic systems enter surface waters either as direct overland flow or via groundwater. Although loading to steams 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."

Comment 18:

"Since leaking sanitary sewers, illicit discharges and failing septic systems are acknowledged as significant contributors to the FC bacteria load and are regulated, the entities that operate and maintain them should not be exempt from the TMDL simply because their contribution may be difficult to ascertain or they are already permitted separately. They should be listed as contributors and assigned a percent reduction. Short of listing each source, the percent reduction for other contributors should at the very least be reduced to account for these sources.

Unauthorized discharges to waters of the State, including leaking sewer lines and other illicit discharges, are illegal and subject to compliance and enforcement mechanisms. Therefore, quantifying these sources as indicated in Comment 2 should be a significant compliance and enforcement mechanism under the regulatory authority of DHEC."

Response 18:

The load duration curve method is a regionally and nationally accepted approach used to develop TMDLs and this method has been used extensively by SCDHEC with concurrence from EPA Region 4. This TMDL is based on the flow recurrence interval between 10% and 90% and excludes extreme high and low flow conditions. Flows that are characterized as 'Low' or 'High' in Figure 5 of the TMDL document (p. 18) are considered extremes and were not included in the analysis. The remaining 23 data points were used. The critical condition for S-092 is "Moist Conditions", which is the flow condition requiring the largest percent reduction within the 10-90% duration intervals. In addition, federal regulations require that TMDLs take into account the seasonal variability in watershed loading. The variability in this TMDL is accounted for by using a 10-year hydrological data set and 12 month water quality sampling data set (12-96 data points per water quality monitoring station), which includes data collected from all seasons.

TMDL Excerpt 19 (p. 10):

"222 septic tanks within the Potato Creek watershed. At the time of TMDL development, their status in relation to function is unknown."

Comment 19:

"Many studies show that septic tank discharge is a major source of FC in a stream. The TMDL gives no indication of efforts made prior to developing the TMDL to estimate the impact of failing septic systems to FC loadings. To say that "their status in relation to function is unknown" is unacceptable. DHEC is charged with permitting and ensuring compliance of septic systems. Unauthorized discharges to waters of the State, including failing septic systems, are illegal and subject to compliance and enforcement mechanisms. Therefore, quantifying these sources as indicated in Comment 2 should be a significant compliance and enforcement mechanism under the regulatory authority of DHEC."

Response 19:

Maintenance of septic tanks is the responsibility of the individual onsite wastewater system owners. The most common reason for failure is improper maintenance by homeowners. Pumping a septic tank is probably the single most important thing that can be done to protect the system. At present, the Department does not have the resources to check the status of all onsite wastewater systems in the watershed.

TMDL Excerpt 20 (p. 10):

Failure to acknowledge Sanitary Sewer Overflows (SSOs)

Comment 20:

SSOs have concentrations on the order of about 10^5 to 10^7 CFU/100ml. That is 5 to 7 orders of magnitude over the WQS. There were 9 reported releases in Clarendon County between 1998 and 2006. The number of releases which actually occurred in the study area is unknown but because, with the very small number of samples used to calculate the TMDL, even capturing one of these would greatly skew the results. The difficulty or feasibility of including SOS [SSO] contributions in the TMDL is irrelevant. SOSs [SSOs]certainly contribute to the FC impairment of the watershed and should be quantified as indicated in Comment 2.

Response 20:

The Department acknowledges the potential for fecal coliform loading from sanitary sewer overflows in section 3.1.2 of the referenced TMDL document which reads as follows:

> Sanitary sewer overflows (SSOs) to surface waters have the potential to severely impact water quality. These untreated sanitary discharges result in violations of the WQS. It is the responsibility of the NPDES wastewater discharger, or collection system operator for non-permitted 'collection only' systems, to ensure that releases do not occur. Unfortunately releases to surface waters from SSOs are not always preventable or reported. There were 9 reported releases in Clarendon County between 1998 and 2006, resulting in the release of over 513,000 gallons of untreated sanitary waste. It is not known what percentage of these releases occurred specifically in the Potato Creek watershed. It has been shown that FC concentrations in typical SSOs are reported as 10^5 to 10^7 MPN/100mL (Novotny et al., 1989). Installation of a sufficient riparian buffer between sanitary sewers and surface waters is one suggested form of implementation for the Potato Creek watershed TMDL.

Limited data is available to quantify the location of SSOs and the quantity/volume of spills that reach surface waters within the watershed. All existing point and nonpoint sources that may impact a receiving waterbody have been identified, their contributions have been quantified where applicable, and they have been assigned an appropriate load or waste load allocation consistent with 40 CFR Part 130 and with concurrence from EPA Region 4.

TMDL Excerpt 21 (p. 10):

"Dogs, cats, and other domesticated pets are the primary source of FC deposited on the urban landscape."

"There are also 'urban' wildlife, squirrels, raccoons, pigeons, and other birds, all of which contribute to the FC load."

March 2009 site visit – Numerous dogs were seen walking down a road.

Comment 21:

"This source should be addressed when assigning SCDOT the only allocated load for the impaired stations within this TMDL watershed. SCDOT has no regulatory authority over dogs, cats, and other domesticated pets. The contributions from domesticated pets and 'urban' wildlife should be quantified as indicated in Comment 2 and should not be attributed to SCDOT."

"DHEC suggests that SCDOT rid its roads of wildlife and educate kennel owners on the dangers of FC as part of its effort to bring Potato Creek into compliance with the WQS. SCDOT has no regulatory authority over wildlife in its right of way and it is most certainly DHEC's responsibility to educate kennel owners on the effects of FC loading. Again, SCDOT has no authority over any of these sources such that any change in FC could be affected."

Response 21:

Wildlife and urban runoff are nonpoint sources of pollution and as such are covered under the load allocation portion of the TMDL document. Percent reductions, including the load allocation portion of the TMDL, are provided in Table Ab-1, Table 8, and are further discussed in detail in section 5.4 of this TMDL document. All existing point and nonpoint sources that may impact a receiving waterbody have been identified, their contributions have been quantified where applicable, and they have been assigned an appropriate load or waste load allocation consistent with 40 CFR Part 130 and with concurrence from EPA Region 4.

The Department could not find in sections 3.2.1 (Wildlife) or 3.2.5 (Urban Runoff) or any other section of the TMDL document any suggestion for SCDOT to "rid its roads of wildlife and educate kennel owners on the dangers of FC as part of its effort to bring Potato Creek into compliance with the WQS". The referenced sections of the TMDL document read as follows:

> ***3.2.1 Wildlife***
>
> Wildlife (mammals and birds) can be a significant contributor of FC bacteria. Wildlife in this area typically includes alligators, deer, squirrels, raccoons, and other mammals as well as a variety of birds. The northern portion (North of Interstate 95) of the delineated watershed used in the development of this TMDL is also home to the endangered red-cockaded woodpecker (Picoides Borealis) which is known to live in mature pine forests found in this portion of the watershed. Wildlife wastes are carried into nearby streams by runoff following rainfall or deposited directly in streams. Waterfowl may be a significant contributor of FC bacteria in this watershed, especially in impounded areas, which provide a desirable habitat for geese and ducks (Figure A-1).
>
> In 2008, SCDNR estimated that there were 30-45 deer per square mile within the Potato Creek watershed of Clarendon County (SCDNR 2008). SCDNR estimated deer density based on suitable habitat (forests, croplands, and pastures). The FC production rate for deer has been shown to be 3.47×10^8 cfu/head-day in a study conducted by Yagow (1999), of which only a portion will enter the watershed. Based on a site assessment, wildlife is considered to be a significant contributor to the FC load within the rural portions of the watershed as numerous waterfowl were seen.

3.2.5 Urban Runoff

Dogs, cats, and other domesticated pets are the primary source of FC deposited on the urban landscape. According to a 2002 study conducted by the American Veterinary Medical Association (AVMA 2002), there are 0.58 dogs and 0.66 cats on average per each household within an urban setting. Based on U.S. census data (U.S. Census Bureau 2000), it is estimated that there are 15,303 households within the County of Clarendon, of which 222 are within the Potato Creek watershed. This results in approximately 128 dogs in the delineated area. It has been shown that dogs produce approximately 0.32 pounds of fecal waste per day (Geldrich, et al., 1962). This results in an estimated 41 pounds of waste deposited by domesticated dogs in the watershed per day. Based on the AVMA study and observations by Geldrich and others, there are approximately 146 cats in the drainage area producing 20 pounds of waste per day. There are also 'urban' wildlife, squirrels, raccoons, pigeons, and other birds in the watershed, all of which contribute to the FC load.

During a March 2009 site visit, numerous dogs were seen traveling the roads within the watershed (Figure A-9). FC can be conveyed from these roads to surface waters during periods of rainfall that lead to erosion. Figure A-10 shows a roadway that has eroded into a portion of Potato Creek. Rainwater will pick up FC from the roads and transport it directly into the creek. A sufficient curb that is unsusceptible to erosion around creek beds is one method of implementation suggested to lower FC loadings from domesticated dogs and cats into the watershed. Another would be to have designated washout areas (constructed wetlands/sediment basins) away from the creek where rain water can travel off of the road into a designated area to settle. A dog kennel was also seen directly adjacent to a portion of Potato Creek during the site visit (Figure A-11). This concentrated source of FC could contribute to loading in the watershed during rain events and routine clean up of the kennel. It is suggested that owners of dogs in the watershed should be educated on the effects of FC loading to Potato Creek.

The Department does state that wildlife can be a significant contributor of fecal coliform loading to Potato Creek and that dog owners in the watershed should be educated on the effects of fecal coliform loading to the watershed.

By definition of MS4 as prescribed in R.61-9 section 122.26(b), "Municipal separate storm sewer" means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains)". SCDOT is a phase I MS4 which may have the potential to **contribute** or **convey** fecal coliform loading to waters of the State. It is the responsibility of the MS4 operator (SCDOT) to ensure that contributions to or the conveyance of FC bacteria loading does not occur within its regulated jurisdictional MS4 area.

TMDL Excerpt 22 (p. 10):

"An existing load was determined for each hydrologic category for the TMDL calculations. The 90^{th} percentile of measured FC concentration within each hydrologic category was multiplied by the flow at each category midpoint."

Comment 22:

"The proposed percent reduction really only represents the FC sample which fell into the critical hydrologic category. Furthermore, in order to meet the "no more than 10% of samples" criteria in the state's water quality standard, the FC value used to calculate the TMDL is the 90th percentile value of the FC samples in the Critical hydrologic Condition category. The standard is no more than 10% of samples not the 90th percentile magnitude of the samples. The methodology assumes these two values are the same, but this is not a valid assumption unless the sample size is sufficiently large (i.e. >> 6). DHEC's use of statistics in this manner is mathematically invalid and therefore the TMDL is not scientifically supportable."

Response 22:

The Potato Creek TMDL is based on the flow recurrence interval between 10% and 90% and excludes extreme high and low flow conditions. The critical condition for stations ST-035 and RS-03501 is identified as the flow condition requiring the largest percent reduction within the 10-90% duration intervals. This TMDL assumes that if the highest percent reduction is achieved than the water quality standard will be attained under all flow conditions.

Waters in which no more than 10% of the samples collected over a five year period are greater than 400 fecal coliform counts or cfu/100 ml are considered to comply with the South Carolina water quality standard for fecal coliform bacteria. Waters with more than 10% of samples greater than 400 cfu/100 ml are considered impaired for fecal coliform bacteria and placed on South Carolina's §303(d) list. There is no correlation between the state water quality standard percentage of 10% and the 90^{th} percentile used to calculate the existing load. The 90^{th} percentile is a conservative assumption and is considered part of the implicit margin of safety. This method was developed with concurrence from EPA Region 4 and the Department believes it is mathematically valid and scientifically defensible.

TMDL Excerpt 23 (p. 16):

Table 9

Comment 23:

"SCDOT should not be assigned responsibility to attain the target load since there are other identified sources of FC in the watershed and since SCDOT roads produce essentially no FC. Though DHEC states that nonpoint sources are covered under the load allocation portion of the TMDL, the values in Table 7 indicate that the overall "percent reduction necessary to achieve target load" in the watershed is 34% at ST-035 and 31% at RS-03501, and then subsequently in Table 9, that SCDOT is required to meet a percent reduction of 34% at ST-035 and 31%at RS-03501. It is evident, though DHEC mentions other sources of FC, that when calculating how water quality standards in the watershed will be met, the only entity considered is SCDOT."

Response 23:

A reduction of 34% at ST-035 and 31% at RS-035 from all sources, including point (WLA) and nonpoint (LA) sources, is required to meet the overall percentage reductions of the referenced TMDL and achieve the water quality standard for the pollutant of concern. Therefore, SCDOT is not the sole source responsible for reducing FC loading to the referenced watershed. At the present time however, SCDOT is currently the only regulated entity in the watershed subject to

the WLA portion of the TMDL. Should future permits become applicable to this watershed, those discharges will be subject to the assumptions and requirements of the WLA portion of the referenced TMDL.

Wildlife, agricultural runoff, failing septic systems, illicit connections, leaking sewers, sanitary sewer overflows and urban runoff are nonpoint sources of pollution and as such are covered under the load allocation portion of the TMDL document. Percent reductions, including the load allocation portion of the TMDL, are provided in Table Ab-1, Table 8, and are further discussed in detail in section 5.4 of this TMDL document. All existing point and nonpoint sources that may impact a receiving waterbody have been identified, their contributions have been quantified where applicable, and they have been assigned an appropriate load or waste load allocation consistent with 40 CFR Part 130 and with concurrence from EPA Region 4.

TMDL Excerpt 24 (p. 18):

6.1 Implementation Strategies

Comment 24:

"Why does DHEC address wildlife, agricultural activities, leaking sanitary sewers and illicit discharges and failing septic systems in the implementation section of the TMDL when no specific level of reduction FC levels is placed on these sources in the LA or WLA sections of the TMDL? As per SC Regulation 61-110 SCDHEC is required to provide a load allocation to the background conditions as well as all sources of FC identified in the watershed."

Response 24:

Wildlife, agricultural runoff, failing septic systems, illicit connections, leaking sewers, sanitary sewer overflows and urban runoff are nonpoint sources of pollution and as such are covered under the load allocation portion of the TMDL document. Percent reductions, including the load allocation portion of the TMDL, are provided in Table Ab-1, Table 8, and are further discussed in detail in section 5.4 of this TMDL document. All existing point and nonpoint sources that may impact a receiving waterbody have been identified, their contributions have been quantified where applicable, and they have been assigned an appropriate load or waste load allocation consistent with 40 CFR Part 130 and with concurrence from EPA Region 4.

The Department is required to provide "load allocations for nonpoint sources and natural background". The load allocations for nonpoint sources and natural background are not separated for the purposes of this TMDL. The load allocation provided in the referenced TMDL document includes loading from both nonpoint sources and natural background conditions as required by SC Regulation 61-110.

Amendments to the Potato Creek TMDL Document

As a result of comments received by the Department during the public comment period from October 14th, 2009 to November 13th, 2009 the following amendments have been made to the Potato Creek TMDL Document. Changes are shown as bold font and are reflected in the most recent version of the referenced TMDL document.

Amendment Location 1:

Abstract

Amendment:

The following paragraph has been revised:

> "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. **For SCDOT, compliance with terms and conditions of its NPDES MS4 permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP).** Required load reductions in the LA portion of this TMDL can be implemented through voluntary measures and are eligible for CWA §319 grants."

Amendment Location 2:

Table Ab-1 and Table 8 Footnote

Amendment:

Table notes 2 and 4 have been revised as follows:

Table Notes:

1. WLAs are expressed as a daily maximum; NA = not applicable, no point sources. 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 400cfu/100ml.
2. 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.**
3. Percent reduction applies to existing instream load
   By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform, the SCDOT will comply with this TMDL and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.
4. **By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform, the SCDOT will comply with this TMDL and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.**

Amendment Location 3:

Section 3.1.2, Page 8

Amendment:

Section 3.1.2 has been revised to read as follows:

> 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.**
>
> **The South Carolina Department of Transportation (SCDOT) is currently the only designated Municipal Separate Storm Sewer System (MS4) within the watershed. The SCDOT operates under NPDES MS4 SCS040001 and owns and operates roads in the watershed (Figure 4). However, the Department recognizes that SCDOT is not a traditional MS4 in that it does not possess statutory taxing or has enforcement powers. SCDOT does not regulate land use or zoning, issue building or development permits.**

Amendment Location 4:

Section 3.2.5, Page 10

Amendment:

The first paragraph of section 3.2.5 has been revised to read as follows:

> 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 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.

Amendment Location 5:

Section 5.3.2, Page 14

Amendment:

The last paragraph of section 5.3.2 has been revised to read as follows:

> 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.

Amendment Location 6:

Section 5.7, Page 15

Amendment:

The last 2 paragraphs of section 5.7 have been revised to read as follows:

> **Table 8 indicates the percentage reduction or water quality standard required for each subwatershed** (WQM Station). Note that all future regulated NPDES-permitted stormwater discharges will also be required to meet the prescribed percentage reductions, or the water quality standard. It should be noted that in order to meet the WQS for FC bacteria, prescribed load reductions must be targeted from all sources, including NPDES permitted and nonpoint sources.
>
> **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 recurrence 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.**

Amendment Location 7:

Section 6.0, Page 19

Amendment:

The following paragraph in the implementation section of the Potato Creek TMDL document has been revised to read as follows:

> 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. **For SCDOT, compliance with terms and conditions of its NPDES MS4 permit is effective implementation of the WLA to the MEP.**