Total Maximum Daily Load Document
Stevens Creek and Tributaries
Stations: RS-06016, SV-351, and SV-330
(Hydrologic Unit Codes: 030601070101, 030601070102, 030601070103, 030601070104, 030601070105, 030601070106, 030601070107, 030601070108,)
Escherichia coli Bacteria,
Indicator for Pathogens

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Prepared for:

Bureau of Water

D H E C

PROMOTE PROTECT PROSPER

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Prepared by:

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Photographs on Title Page

Photographs, counterclockwise, beginning with the top center photograph: **a)** proximity of the South Carolina Department of Health and Environmental Control's (SCDHEC) Water Quality Monitoring Station SV-330 in Stevens Creek at County Route S-33-21 in McCormick County, SC (date of photography: December 19, 2014); **b)** proximity of the SCDHEC's Water Quality Monitoring Station SV-351 in Cuffytown Creek at County Route S-33-138 in McCormick County, SC (date of photography: December 18, 2014); and, **c)** proximity of the SCDHEC's Water Quality Monitoring Station RS-06016 in Church Branch at County Route S-24-375 east of the Town of Bradley in Greenwood County, SC (date of photography: December 17, 2014).

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 included on the §303(d) list of impaired waters. 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 waste load 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). Fecal coliform (FC) TMDLs were developed for two (2) impaired water quality monitoring (WQM) stations, SV-330 and RS-06016, in Stevens Creek and Church Branch, a tributary to Stevens Creek, located in McCormick and Greenwood Counties, SC. These two (2) WQM stations are included as impaired on the State's final 2012 §303(d) list and draft 2014 §303(d) list due to excessive fecal FC bacteria (included on the list as *Escherichia coli* in 2014). In addition, a revision was made to an existing FC bacteria TMDLs approved by the U.S. Environmental Protection Agency, Region IV in June 2005 for impaired WQM station SV-351 in Cuffytown Creek, another tributary to Stevens Creek, in McCormick County, SC. Because South Carolina has recently adopted a change from FC bacteria to *Escherichia coli (E. coli)* bacteria as a recreational use standard in all freshwaters, the aforementioned three sites will be included on future §303(d) lists due to exceedances of the current *E. coli* water quality standard (WQS) until such time such that sufficient *E. coli* data are collected and demonstrate the standard is attained, or such time that TMDLs are developed and approved to address the parameter of concern. In addition to addressing FC bacteria impairments, this TMDL document also includes converted *E. coli* TMDLs for the three aforementioned impaired stations for the purposes of implementation of the current recreational use standard. At least eleven (11) percent of the samples collected between February 1999 and December 2006 at the impaired WQM stations exceeded the water quality standards.

Probable sources of fecal contamination include direct loading by livestock, failing septic systems, surrounding wildlife, and other agricultural activities. 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 high, moist, or dry depending on which condition demonstrated the highest load reductions necessary to meet water quality standards. In order to achieve the target load for the Stevens Creek and tributaries, the following reductions in the existing loads at the respective stations will be necessary: **a)** up to 68% at RS-06016; **b)** up to 51% at SV-351; and, **c)** up to 37% at SV-330. For the South Carolina Department of Transportation (SCDOT), existing and future NPDES municipal separate storm sewer system (MS4) permittees, compliance with terms and conditions of its NPDES permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP) and demonstrates consistency with the assumptions and requirements of the TMDLs. For existing and future NPDES construction and Industrial stormwater permittees, compliance with terms and conditions of its permit is effective implementation of the WLA. Required load reductions in the LA portion of these TMDLs can be implemented through voluntary measures and are eligible for *CWA* §319 grants.

The Department recognizes that adaptive management/implementation of these TMDLs might be needed to achieve the water quality standard and we are committed towards targeting the load reductions to improve water quality in the Stevens Creek and tributaries watersheds. As additional data and/or information become available, it may become necessary to revise and/or modify these TMDLs targets accordingly.

Table Ab-1. Total Maximum Daily Loads for the Stevens Creek and Tributaries Watersheds
Loads are expressed as FC bacteria or *E. coli* count/day

	Existing FC Load (count/day)	TMDL (count/day)		Margin of Safety (MOS) (count/day)		Waste Load Allocation (WLA)				Load Allocation (LA)		
						Continuous Source[1] (count/day)		Non-Continuous Sources[2,3] (% Reduction)	Non-Continuous SCDOT[3] (% Reduction)	Load Allocation (count/day)		% Reduction to Meet LA[3]
March 2015 Total Maximum Daily Loads												
Station	FC (CFU/day)	FC (CFU/day)	*E. coli* (MPN/day)[6]	FC (CFU/day)	*E. coli* (MPN/day)[6]	FC (CFU/day)	*E. coli* (MPN/day)[6]	(Percent)	(Percent)	FC (CFU/day)	*E. coli* (MPN/day)[6]	(Percent)
RS-06016	2.06E+10	6.86E+09	*5.98E+09*	3.43E+08	*2.99E+08*	See Note Below	See Note Below	68	0[4]	6.52E+09	*5.69E+09*	68
SV-330	7.34E+12	4.95E+12	*4.32E+12*	2.48E+11	*2.16E+11*	5.07E+10	*4.43E+10*	37	37[5]	4.65E+12	*4.06E+12*	37
March 2015 Total Maximum Daily Loads (revised from June 2005)												
Station	FC (CFU/day)	FC (CFU/day)	*E. coli* (MPN/day)[6]	FC (CFU/day)	*E. coli* (MPN/day)[6]	FC (CFU/day)	*E. coli* (MPN/day)[6]	(Percent)	(Percent)	FC (CFU/day)	*E. coli* (MPN/day)[6]	(Percent)
SV-351	6.40E+11	3.28E+11	*2.86E+11*	1.64E+10	*1.43E+10*	See Note Below	See Note Below	51	51[5]	3.12E+11	*2.72E+11*	51

Table Notes:

1. WLAs are expressed as a daily maximum. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern. For the purposes of NPDES permitting, continuous discharges may be required to meet a loading equivalent of FC bacteria, based upon permitted flow and an allowable permitted maximum FC bacteria concentration of 400 cfu/100ml, until such time that *E. coli* limits are incorporated into individual permits. *E. coli* limits will be developed based upon permitted flow and an allowable permitted maximum *E. coli* concentration of 349 MPN/100ml.
2. Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future municipal separate storm sewer system (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 FC bacteria or *E. coli.*
4. As long as the conditions within the SCDOT MS4 area remain the same the Department deems the current contributions from SCDOT negligible and no reduction of FC bacteria or *E. coli* is necessary. SCDOT must continue to comply with the provisions of its approved NPDES stormwater permit.
5. By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform or *E. coli,* the SCDOT will comply with these TMDLs and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.
6. Expressed as *E. coli* (MPN/day). Loadings are developed by applying a conversion factor to values calculated for FC bacteria. This conversion is derived from an established relationship between FC bacteria and *E. coli* water quality standards in freshwaters.

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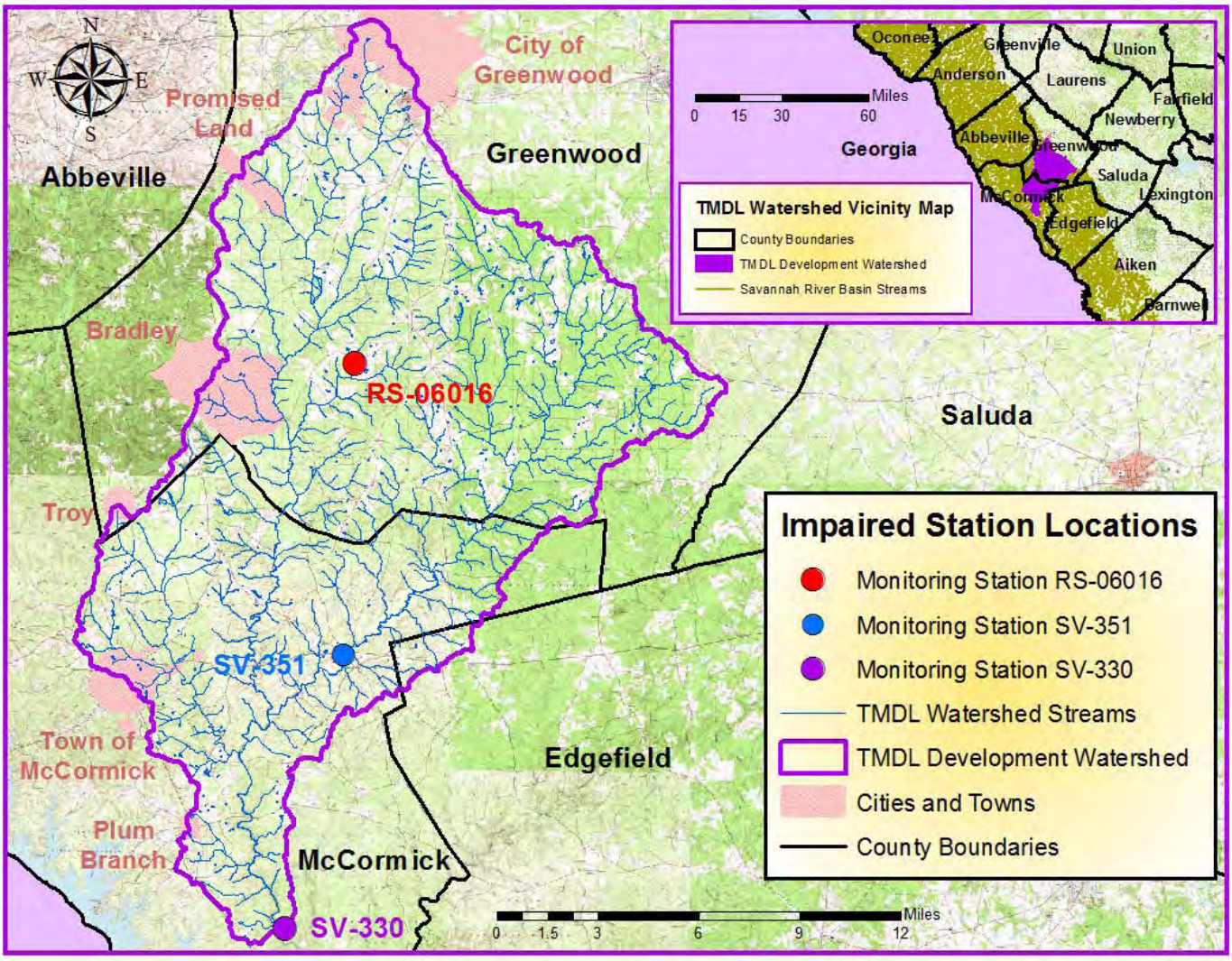
1.0 Introduction

1.1 Background

The Federal Clean Water Act *(CWA)* directs each state to review the quality of its waters every two years to determine if water quality standards are being met. If it is determined that the water quality standard is not being met, the states are to list the impaired water bodies under §303(d) of the *CWA*. Included in the water bodies placed on South Carolina's 2012 §303(d) list by the South Carolina Department of Health and Environmental Health (SCDHEC) for impairment due to FC bacteria exceedances were: **a)** Stevens Creek (determined by water quality monitoring results from Water Quality Monitoring (WQM) Station SV-330 in McCormick County to be impaired); and, **b)** Church Branch, a tributary to Stevens Creek, (determined by results from WQM Station RS-06016 in Greenwood County to be impaired). And, prior to the 2012 listing, one of the water bodies placed on the State's 1998 §303(d) list by the SCDHEC for impairment due to FC bacteria exceedances was Cuffytown Creek, also a tributary to Stevens Creek (determined by results from WQM Station SV-351 in McCormick County to be impaired). These three WQM stations are identified in Figure 1 and Table 1.

Figure 1. Location of Water Quality Monitoring Stations RS-06016, SV-351, and SV-330 Impaired with Excessive FC Numbers



A Total Maximum Daily Load (TMDL) is a written plan and analysis to determine the maximum pollutant load a waterbody can receive and still meet applicable water quality standards. The TMDL process includes estimating pollutant loadings from all sources, linking pollutant sources to their impacts on water quality, allocation of pollutant sources to each source and establishment of control mechanisms to achieve water quality standards (US EPA, 1999).

Table 1. Stevens Creek and Tributaries Watersheds FC Impaired Waters

Waterbody	Station Number	Description
Church Branch	RS-06016	Church Branch at S-24-375, 3.6 mi. E. of Bradley in Greenwood County
Cuffytown Creek	SV-351	Cuffytown Creek at S-33-138 in McCormick County
Stevens Creek	SV-330	Stevens Creek at S-33-21 in McCormick County

All TMDLs include a waste load allocation (WLA) for all National Pollutant Discharge Elimination System (NPDES) permitted discharges, a load allocation (LA) for all unregulated nonpoint sources, and an explicit and/or implicit margin of safety (MOS). TMDLs are required to be developed for each waterbody and pollutant combination on the States' §303(d) lists by 40 CFR 130.31(a) (US EPA, 1999).

Escherichia coli *(E. coli)* bacteria are members of the FC group of bacteria and are part of the normal flora of the gastrointestinal tract of warm-blooded animals including humans. These harmless bacteria play an important role in preventing the growth of harmful bacteria, vitamin K production, and lactose digestion as well as producing compounds necessary for fat metabolism (Starr and Taggart, 1992; Wolfson and Harrigan, 2010). Some verotoxin producing strains of *E. coli*, such as 0157:H7, a major cause of foodborne illnesses, can cause gastrointestinal illnesses, kidney failure and death (Nadakavukaren, 1995; Wolfson and Harrigan, 2010).

E. coli bacteria in surface waters are indicators of recent human or animal waste contamination and originate from failing septic systems, agricultural runoff, leaking sewers among other sources. Section §303(d) of the *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).

This TMDL document documents the development of fecal coliform (FC) TMDLs for WQM Station RS-06016 in Church Branch in Greenwood County and WQM Station SV-330 in Stevens Creek in McCormick County, two WQM stations the SCDHEC placed on South Carolina's final 2012 §303(d) list and draft 2014 §303(d) list for impairment due to FC bacteria exceedances (included on the list as *E. coli* in 2014). The SCDHEC first placed WQM Station SV-351 in Cuffytown Creek in McCormick County on the State's 1998 §303(d) list due to FC bacteria exceedances. On May 27, 2005, the U.S. Environmental Protection Agency (USEPA) approved a FC TMDL that was developed internally by the SCDHEC for WQM Station SV-351 (SCDHEC Technical Report No.: 018-05; see Section 1.3 of this TMDL document) (USEPA, 2005). This TMDL document also documents the revision of the FC TMDL for WQM Station SV-351 due to availability of more recent data collected at the monitoring location.

Recently SC adopted a change from FC bacteria to *E. coli* bacteria as a recreational use standard in all freshwaters. Accordingly, this TMDL document also includes converted *E. coli* TMDLs for WQM stations RS-06016, SV-351, and SV-330, for purposes of implementation of the current recreational use standard.

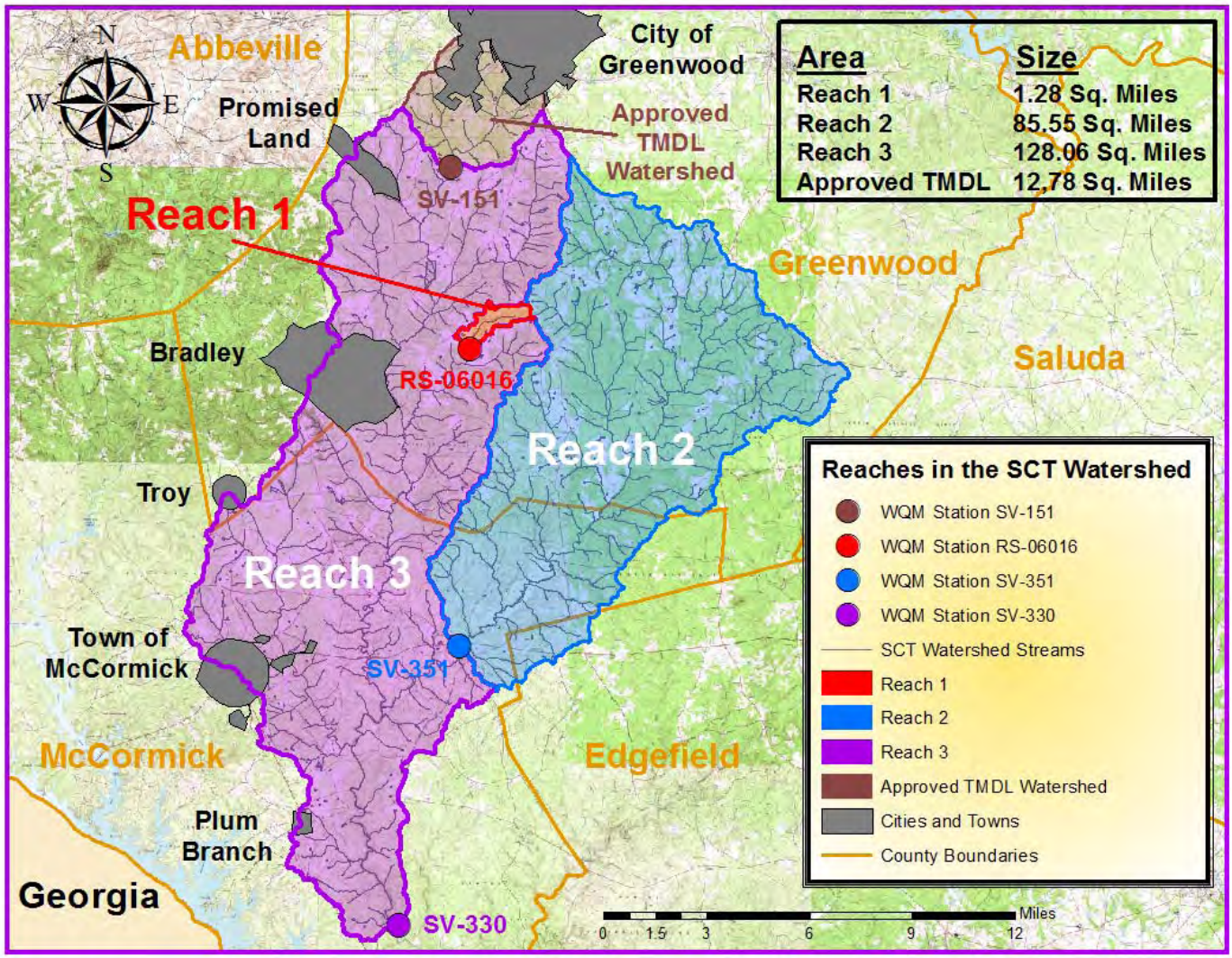
1.2 Watershed Descriptions

The watersheds for the three (3) aforementioned WQM stations were placed on South Carolina's §303(d) list for impairment due to FC bacteria are addressed in this TMDL document. In addition to the watersheds for the three aforementioned WQM stations, the watershed for WQM Station SV-151 in Hard Labor Creek in Greenwood County is addressed. On May 27, 2005, the U.S. Environmental Protection Agency (USEPA) approved a FC TMDL that was developed internally by the SCDHEC for WQM Station SV-151 (SCDHEC Technical Report No.: 019-05) (USEPA, 2005). The watershed for SV-151 is described in Section 1.4.1 of this TMDL document. All four watersheds are hydrologically connected. Drainage from all four watersheds ultimately flows through WQM Station SV-330. Collectively, the four (4) watersheds are referred to as the Stevens Creek and Tributaries (SCT) Watershed in this TMDL document.

The entire SCT Watershed is 227.67 mi^2 (145,748.11 acres) in size, is located in Greenwood, McCormick, and Edgefield Counties in South Carolina, and lies in the Piedmont ecoregion of the State. The general stream flow direction in the SCT Watershed is in the southern direction. The upper northern part of the watershed is located at the City of Greenwood in Greenwood County, and includes the watershed for the TMDL developed for Hard Labor Creek. The lower southern part of the watershed is located in McCormick County about three miles southeast of the Town of Plum Branch.

The three (3) WQM station watersheds in the SCT Watershed for which TMDLs are developed in this TMDL document are addressed as separate distinct reaches in the SCT Watershed. The three reaches are: **a)** Reach 1 - the watershed draining through WQM Station RS-06016 in Church Branch; **b)** Reach 2 - the watershed draining through WQM Station SV-351 in Cuffytown Creek; and, **c)** Reach 3 - the watershed draining through WQM Station SV-330 in Stevens Creek. The reaches of the SCT Watershed, and the approved TMDL watershed in Hard Labor Creek, are shown in Figure 2.

Figure 2. Location of Stevens Creek and Tributaries Watershed Station Reaches

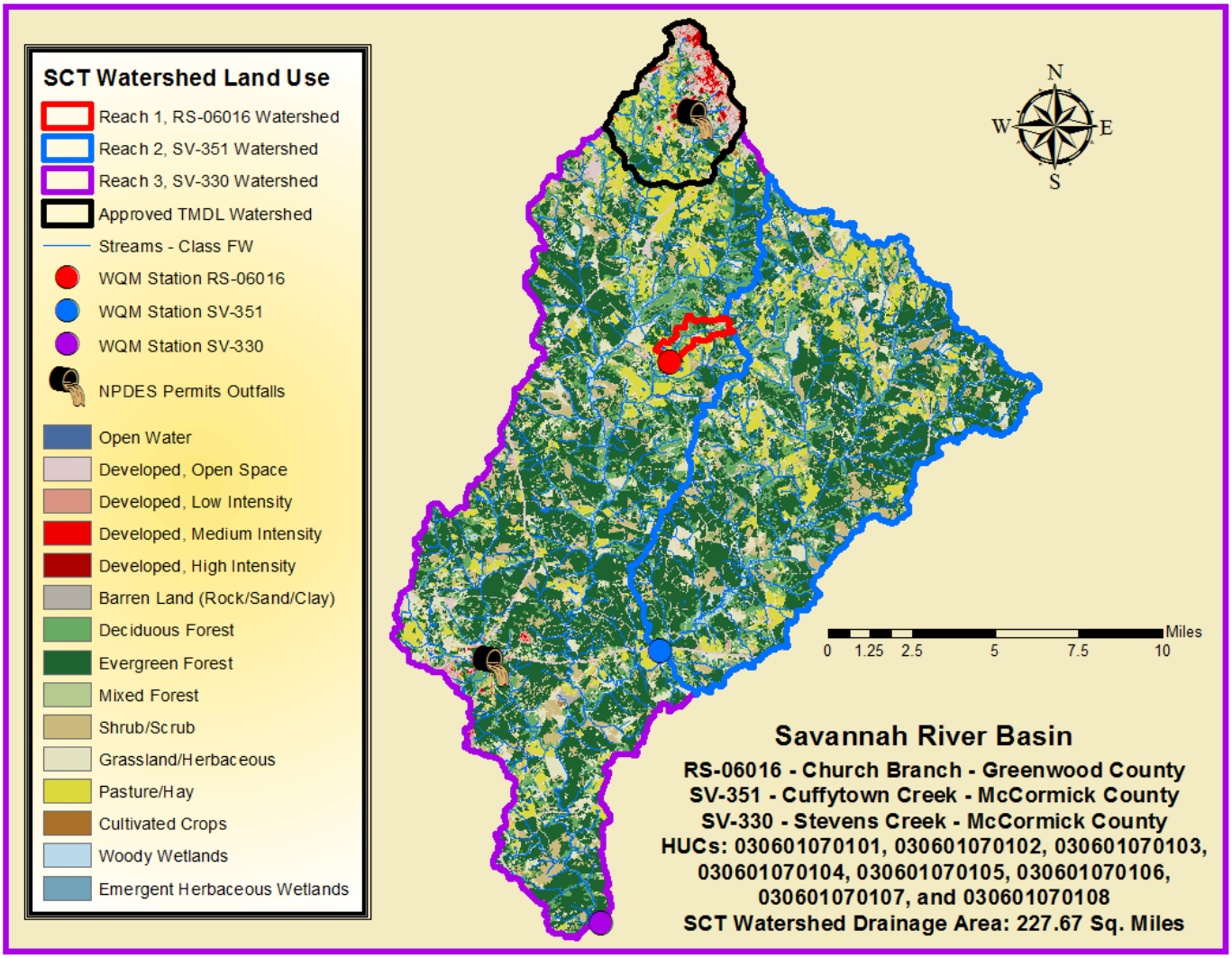


Land use within the entire SCT Watershed is predominately Evergreen Forest (41.35%), and Deciduous Forest (18.61%) (Figure 3). Following are detailed descriptions for each reach in the SCT Watershed.

1.2.1 Reach 1 of the SCT Watershed; Terminal WQM Station RS-06016

Reach 1 of the SCT Watershed covers a drainage area of 1.28 mi^2 (817.30 acres) in size that drains into Church Branch and its tributaries from the headwaters of Church Branch approximately 0.5 mile south of the Community of Breezewood in Greenwood County, in a general southwestern fashion to impaired station

Figure 3. Land Use Diagram for the Stevens Creek and Tributaries Watershed



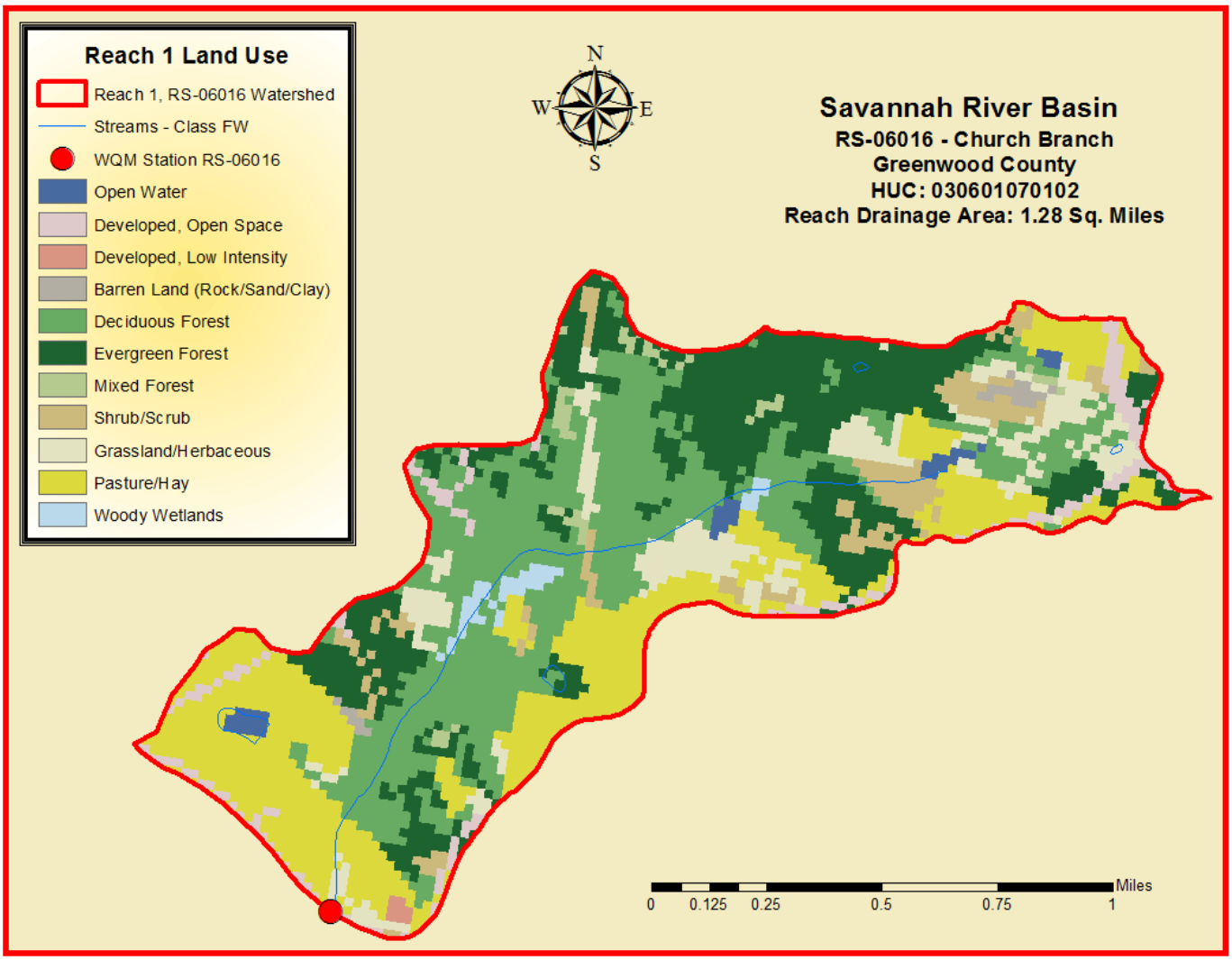
RS-06016 in Church Branch at County Route S-34-375, approximately 3.6 miles east of the Town of Bradley in Greenwood County (Figure 2). The reach lies in the Piedmont ecoregion of the State. Land use within Reach 1 of the SCT Watershed is predominately Deciduous Forest (29.58%), and Pasture/Hay (24.76%) (Figure 3a, Table 2a). Developed lands (residential, commercial, industrial, or open urban space) only comprise approximately 4.57% of the reach (Table 3). At the time of development of this TMDL, there were no active animal feeding operations in the reach.

According to GIS information, there are approximately 2 miles of streams within Reach 1 of the SCT Watershed. The streams are all classified as freshwater (FW). From WQM Station RS-06016, Church Branch flows for approximately one-half (0.5) stream miles to Cunning Ford Creek approximately 2 miles east of the Town of Bradley in Greenwood County.

1.2.2 Reach 2 of the SCT Watershed; Terminal WQM Station SV-351

Reach 2 of the SCT Watershed covers a drainage area of 85.55 mi^2 (54,765.18 acres) in size that drains into Cuffytown Creek and its tributaries from an area approximately 2 miles southeast of the City of Greenwood in Greenwood County, in a general southwestern fashion to impaired station SV-351 in Cuffytown Creek at County Route S-33-138, approximately 5.5 miles east of the Town of McCormick in McCormick County (Figure 2). The reach lies in the Piedmont ecoregion of the State. Reach 2 corresponds to the watershed for the approved TMDL being revised in this document (SCDHEC Technical Report No.: 018-05; see Section 1.3 of this TMDL document) (USEPA, 2005).

Figure 3a. Land Use Diagram for Reach 1 in Stevens Creek and Tributaries Watershed



Land use within Reach 2 of the SCT Watershed is predominately Evergreen Forest (42.55%), and Deciduous Forest (19.29%) (Figure 3b, Table 2b). Developed lands (residential, commercial, industrial, or open urban space) only comprise approximately 6.24% of the reach (Table 3). At the time of the development of this TMDL, there were no animal feeding operations in the reach.

According to GIS information, there are approximately 216 miles of streams within Reach 2 of the SCT Watershed. The streams are all classified as freshwater (FW). From WQM Station SV-351, Cuffytown Creek flows for approximately 3.8 stream miles to Hard Labor Creek approximately 3.25 miles east-southeast of the Town of McCormick in McCormick County.

1.2.3 Reach 3 of the SCT Watershed; Terminal WQM Station SV-330

Reach 3 of the SCT Watershed covers a drainage area of 128.06 mi^2 (81,977.75 acres) in size that drains into Stevens Creek and its tributaries from an area approximately 1 mile south of the City of Greenwood in Greenwood County, in a general southern fashion to impaired station SV-330 in Stevens Creek at County Route S-33-21, approximately 3.7 miles southeast of the Town of Plum Branch in McCormick County (Figure 2). The northern border of the reach joins the watershed for WQM Station SV-151 in Hard Labor Creek, the station for which the USEPA approved a FC TMDL in 2005 (see Section 1.4 of this TMDL document). The reach lies in the Piedmont ecoregion of the State.

Land use within Reach 3 of the SCT Watershed is predominately Evergreen Forest (43.31%), and Deciduous Forest (18.05%) (Figure 3c, Table 2c). Developed lands (residential, commercial, industrial, or

Table 2a. Stevens Creek and Tributaries Watershed: Land Use in Reach 1 (WQM Station RS-06016) (Derived from National Land Cover Database (NLCD) 2011)

Description	Area (Acres)	Area (Mile^2)	Percent
Deciduous Forest	241.74	0.38	29.58%
Pasture/Hay	202.38	0.32	24.76%
Evergreen Forest	183.92	0.29	22.50%
Grassland/Herbaceous	72.95	0.11	8.93%
Shrub/Scrub	44.03	0.07	5.39%
Developed, Open Space	35.58	0.06	4.35%
Mixed Forest	10.67	0.02	1.31%
Woody Wetlands	9.79	0.02	1.20%
Open Water	9.34	0.01	1.14%
Barren Land (Rock/Sand/Clay)	5.12	0.01	0.63%
Developed, Low Intensity	1.78	0.00	0.22%
Totals	**817.30**	**1.28**	**100.00%**

Table 3. Developed Areas from Reach to Reach in the Stevens Creek and tributaries Watershed

Reach	Reach Description	Total Drainage Area of Station Reach (Sq. Miles)	Total Developed Area (Sq. Miles)	Percent Developed Area (%)
1	From an area approximately 0.5 miles south of the Community of Breezewood, to impaired station RS-06016 in Church Branch at County Route S-34-375, 3.6 miles east of Bradley in Greenwood County.	1.28	0.06	4.57%
2	From an area approximately 2 miles southeast of Greenwood in Greenwood County, to impaired station SV-351 in Cuffytown Creek at County Route S-33-138, approximately 5.5 miles east of McCormick in McCormick County.	85.55	5.34	6.24%
3	From an area approximately 1 mile south of Greenwood in Greenwood County, to impaired station SV-330 in Stevens Creek at County Route S-33-21, approximately 3.7 miles southeast of Plum Branch in McCormick County.	128.06	8.97	7.00%
All	*Total for All Reaches	214.88	14.37	6.69%

*The total area does not include the area of the approved TMDL watershed for WQM Station SV-151.

open urban space) only comprise approximately 7.00% of the reach (Table 3). At the time of the development of this TMDL, there were no animal feeding operations in the reach.

According to GIS information, there are approximately 311 miles of streams within Reach 3 of the SCT Watershed. The streams are all classified as freshwater (FW). From WQM Station SV-330, Stevens Creek flows for approximately 28 stream miles to the Savannah River approximately 2 miles northwest of the City of North Augusta in Edgefield County.

Figure 3b. Land Use Diagram for Reach 2 in Stevens Creek and tributaries Watershed

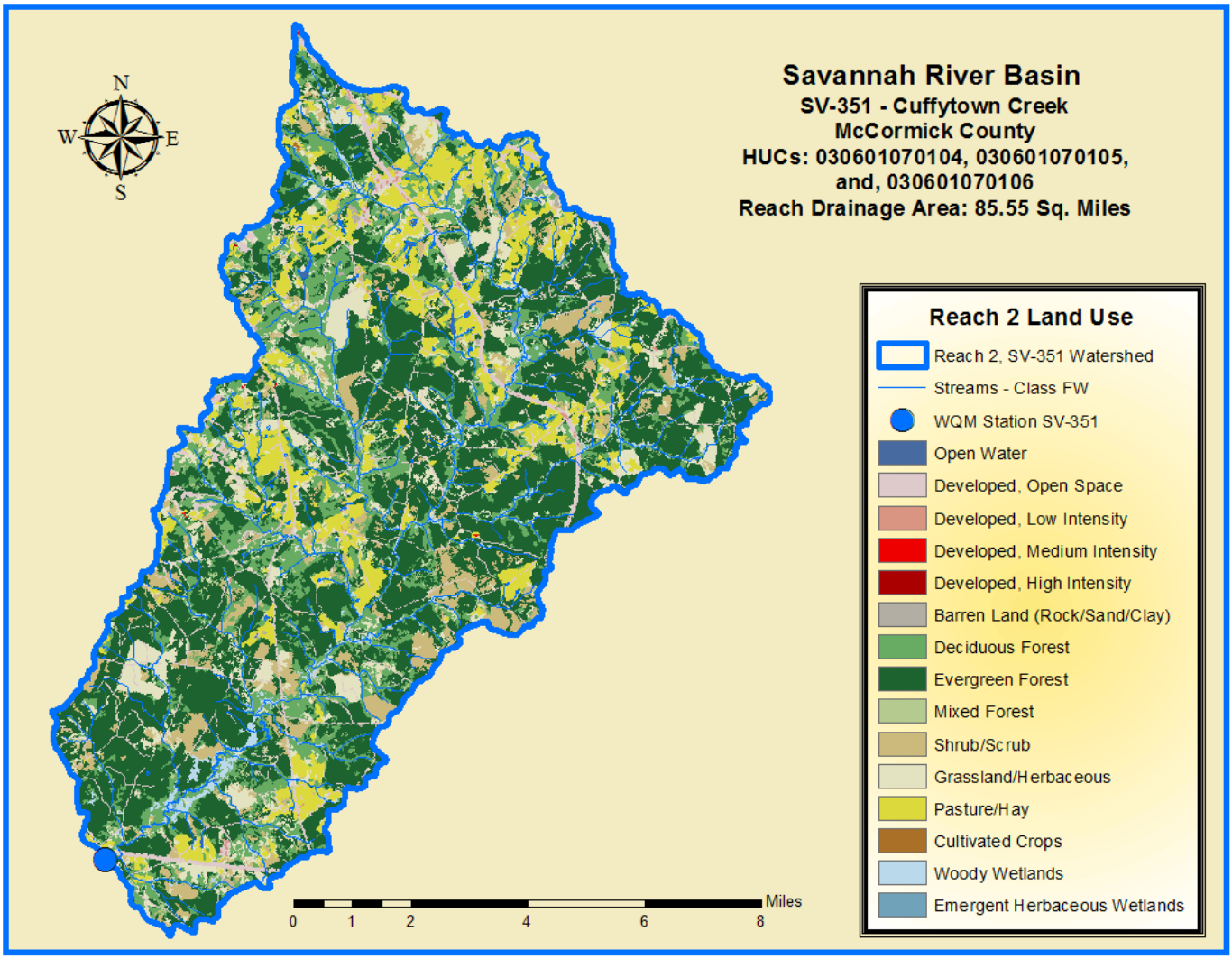


Table 2b. Stevens Creek and Tributaries Watershed: Land Use in Reach 2 (WQM Station SV-351)
(Derived from National Land Cover Database (NLCD) 2011)

Description	Area (Acres)	Area (Mile^2)	Percent
Evergreen Forest	23,300.88	36.40	42.55%
Deciduous Forest	10,561.71	16.50	19.29%
Pasture/Hay	5764.01	9.00	10.52%
Grassland/Herbaceous	5497.58	8.59	10.04%
Shrub/Scrub	4209.47	6.58	7.69%
Developed, Open Space	3289.87	5.14	6.01%
Woody Wetlands	1202.93	1.88	2.20%
Mixed Forest	511.06	0.80	0.93%
Barren Land (Rock/Sand/Clay)	131.43	0.21	0.24%
Open Water	116.98	0.18	0.21%
Developed, Low Intensity	111.64	0.17	0.20%
Emergent Herbaceous Wetlands	43.59	0.07	0.08%
Developed, Medium Intensity	15.79	0.02	0.03%
Cultivated Crops	6.45	0.01	0.01%
Developed, High Intensity	1.78	0.00	0.00%
Totals	**54,765.18**	**85.55**	**100.00%**

Figure 3c. Land Use Diagram for Reach 3 in Stevens Creek and Tributaries Watershed

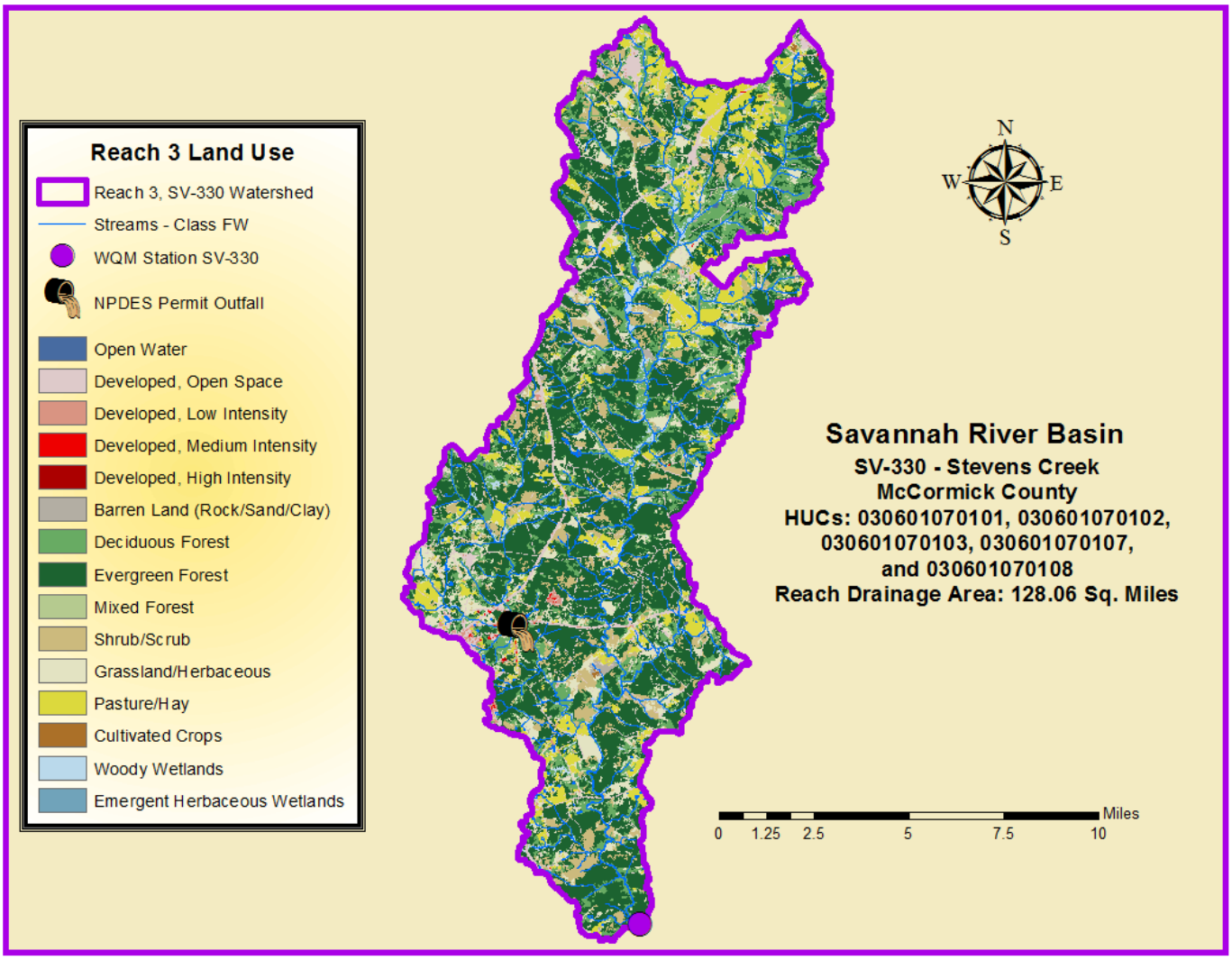


Table 2c. Stevens Creek and Tributaries Watershed: Land Use in Reach 3 (WQM Station SV-330) (Derived from National Land Cover Database (NLCD) 2011)

Description	Area (Acres)	Area (Mile^2)	Percent
Evergreen Forest	35,508.31	55.47	43.31%
Deciduous Forest	14,800.10	23.12	18.05%
Grassland/Herbaceous	8045.32	12.57	9.81%
Pasture/Hay	7804.69	12.19	9.52%
Shrub/Scrub	6907.11	10.79	8.43%
Developed, Open Space	5226.93	8.16	6.38%
Woody Wetlands	1768.03	2.76	2.16%
Mixed Forest	686.09	1.07	0.84%
Developed, Low Intensity	423.88	0.66	0.52%
Barren Land (Rock/Sand/Clay)	380.29	0.59	0.46%
Open Water	246.63	0.39	0.30%
Developed, Medium Intensity	82.29	0.13	0.10%
Emergent Herbaceous Wetlands	52.04	0.08	0.06%
Cultivated Crops	37.14	0.06	0.05%
Developed, High Intensity	8.90	0.01	0.01%
Totals	**81,977.75**	**128.06**	**100.00%**

1.3 Revision of Existing Cuffytown Creek TMDL

The SCDHEC first placed WQM Station SV-351 in Cuffytown Creek in McCormick County on the State's 1998 §303(d) list due to excessive fecal FC bacteria. A description of the watershed for WQM Station SV-351 is given in Section 1.2.2 of this TMDL document. On May 27, 2005, the USEPA approved a FC TMDL for WQM Station SV-351 based on water quality monitoring data from November 14, 1995 to December 13, 2000 (SCDHEC Technical Report No.: 018-05) (USEPA, 2005). Table 4 summarizes the sampling data supporting the USEPA approved 2005 TMDL for WQM Station SV-351.

Table 4. FC Bacteria Observed at WQM Station SV-351 (1995-2000)[1]

Station	Waterbody	Number of Samples	Maximum Concentration Cfu/100 mL	Number of Samples >400/100 mL	% Samples Exceed WQS
SV-351	Cuffytown Creek	26	1200	5	19%

[1]Source: United States Environmental Protection Agency (USEPA), Region IV. 2005

The 2005 TMDL for WQM Station SV-351 in Cuffytown Creek identified mid-range stream flows as the critical conditions, i.e., the stream flow conditions requiring the greatest percentage of FC loading reduction to meet the LA in the TMDL (see Section 5.1 of this TMDL document). An 11% reduction was established to meet the LA. Extreme high and low flow conditions were not evaluated during the 2005 TMDL for WQM Station SV-351. Table 5 gives the components of the 2005 TMDL.

Table 5. Total Maximum Daily Load for Cuffytown Creek (WQM Station SV-351), June 2005[1]

Station	Existing FC Load (cfu/day)[2]	TMDL (cfu/day)	Margin of Safety (MOS) (cfu/day)	Load Allocation (LA) (cfu/day)	Reduction To Meet LA (Percent)	Reduction to Meet LA (cfu/day)	Critical Condition
SV-351	**5.60E+11**	**5.24E+11**	**2.62E+10**	**4.98E+11**	**11**	**6.20E+10**	**Mid-Range**

[1]Source: USEPA, Region IV. 2005

[2]Existing FC Load (CFU/day) at the time of TMDL development in June 2005

Additional monitoring data has been compiled for WQM Station SV-351 since the USEPA approved the TMDL for this station on May 27, 2005. An examination of that monitoring data from 1999 through 2005 shows that South Carolina's water quality standards for recreational use in freshwaters for FC bacteria continue to be exceeded. Therefore, this TMDL document documents the revision of the original FC TMDL for WQM Station SV-351.

1.4 Existing Total Maximum Daily Load for Hard Labor Creek

1.4.1 Watershed Description for Water Quality Monitoring Station SV-151

The watershed for WQM Station SV-151 covers a drainage area of 12.78 mi^2 (8181.48 acres) in size that drains into Hard Labor Creek and its tributaries from near the intersection of West Cambridge Avenue and Calhoun Avenue in the central part of the City of Greenwood, in a general southern fashion to WQM Station SV-151 in Hard Labor Creek at the County Route S-24-34 bridge, approximately 1.6 miles south of the City of Greenwood in Greenwood County (Figure 2). The southern border of the watershed joins the northern border of Reach 3 in the SCT Watershed (terminal WQM Station SV-330).

The watershed for WQM Station SV-151 lies in the Piedmont ecoregion of the State. According to the 2011 NLCD, land use within the watershed is predominately Developed, Open Space (19.92%), and Pasture/Hay (18.64%) (Figure 3). According to GIS information, there are approximately 27 miles of streams within the watershed. The streams are all classified as freshwater (FW). Flows within the watershed for WQM Station SV-151 in the SCT Watershed penultimately flow through WQM Station SV-151, and ultimately flow through WQM Station SV-330.

1.4.2 2005 TMDL Development for Hard Labor Creek (Terminal WQM Station SV-151)

The SCDHEC first placed WQM Station SV-151 in Hard Labor in Greenwood County on the State's 1998 §303(d) list due to excessive fecal FC bacteria. On May 27, 2005, the USEPA approved a FC TMDL for WQM Station SV-351 based on water quality monitoring data from May 7, 1990 to November 6, 2000 (SCDHEC Technical Report No.: 019-05) (USEPA, 2005). Table 6 summarizes the sampling data supporting the USEPA approved 2005 TMDL for WQM Station SV-151.

Table 6. FC Bacteria Observed at WQM Station SV-151 (1990-2000)[1]

Station	Waterbody	Number of Samples	Maximum Concentration Cfu/100 mL	Number of Samples >400/100 mL	% Samples Exceed WQS
SV-151	Hard Labor Creek	111	3000	45	41%

[1]Source: United States Environmental Protection Agency (USEPA), Region IV. 2005

The 2005 TMDL for WQM Station SV-151 in Hard Labor Creek identified dry stream flows as the critical conditions, i.e., the stream flow conditions requiring the greatest percentage of FC loading reduction to meet the LA in the TMDL. A 64% reduction was established to meet the LA. The 2005 TMDL for WQM Station SV-151 also established a FC WLA for the Greenwood Metropolitan District's West Alexander facility, a domestic wastewater treatment plant (WWTP) discharging into Hard Labor Creek (authorized under the SCDHEC's NPDES Permit No. SC0022870). Extreme low flow conditions were not evaluated during the 2005 TMDL. Table 7 gives the components of the 2005 TMDL.

Table 7. Total Maximum Daily Load for Hard Labor Creek, June 2005[1]

Station	Existing FC Load (cfu/day)[2]	TMDL (cfu/day)	Margin of Safety (MOS) (cfu/day)	Waste Load Allocation (WLA) (cfu/day)[3]	Load Allocation (LA) (cfu/day)	Reduction To Meet LA (Percent)	Reduction to Meet LA (cfu/day)	Critical Condition
SV-151	3.22E+11	1.38E+11	6.05E+09	1.66E+10	1.15E+11	64	2.07E+11	Dry

[1]Source: USEPA, Region IV. 2005.
[2]Existing FC Load (CFU/day) at the time of TMDL development in June 2005.
[3]FC discharges authorized under the SCDHEC's NPDES Permit No. SC0022870, issued for the Greenwood Metropolitan District's West Alexander WWTP .

1.4.3 CWA §319 Load Reduction Project in the Hard Labor Creek TMDL Watershed

Congress amended the *CWA* in 1987 to establish the §319 Nonpoint Source Management Program. Under §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 TMDLs, but may be available for the LA component of a TMDL within permitted MS4 jurisdictional boundaries.

1.4.3.1 CWA §319 Grant for the Hard Labor Creek TMDL Watershed

Pursuant to Section 319, of the *CWA,* in FY 2008, the SCDHEC entered into a grant agreement with the Ninety-Six Resource Conservation and Development Council (NSRCDC) for funding the "Hard Labor Creek Watershed Water Quality Improvement Project" to improve water quality in the watershed for WQM Station SV-151. However, due to FY 2011 federal budget cuts, the NSRCDC was unable to complete the project. The grant agreement between the SCDHEC and the NSRCDC was terminated on June 3, 2011. In the interest of completing outstanding work in the project, the SCDHEC entered into a new grant agreement with the Upper Savannah Council of Governments (USCoG). Under the new agreement, the USCoG was to utilize the necessary portion of the remaining grant budget to primarily install agricultural and septic Best Management Practices (BMPs). The SCDHEC obtained approval from the USEPA for the new grant agreement with the USCoG on May 13, 2011.

1.4.3.2 The Hard Labor Creek Watershed Water Quality Improvement Project

Phase 1 of the Hard Labor Creek Watershed Water Quality Improvement Project to improve water quality in the WQM Station SV-151 watershed was conducted by the NSRCDC prior to the June 2011 termination of the *CWA* §319 grant. According to the SCDHEC records, the NSRCDC conducted twenty-one (21) septic system installations or improvements in the watershed during Phase 1 of the water quality improvement project.

According to the workplan for the USCoG's work in the water quality improvement project in the WQM Station SV-151 watershed, there were an estimated 575 households in the watershed using septic systems. Figuring a 20% septic system failure rate, the workplan estimated at least 100 septic systems in the watershed needing attention. According to the SCDHEC records, the USCoG conducted twenty-five (25) septic system installations or improvements in the watershed during Phase 2 of project. However, also including the 21 septic system installations or improvements by the NSRCDC in the watershed, this represented only 46% of the systems in the watershed estimated as needing attention according to the USCoG's work plan.

The USCoG installed only two (2) agricultural BMPs in the SV-151 watershed during the watershed water quality improvement project. According to the USCoG's workplan, because the Natural Resources Conservation Service District in Greenwood County, a cooperating organization in the USCoG's workplan, had conservation plans and Environmental Quality Incentive Program contracts with approximately half of the livestock producers in the area, the probability of water quality degradation caused by livestock was considered to be less than the probability of degradation caused by failing septic systems. The USCoG's work on Phase 2 of the watershed water quality improvement project was completed in June 2012.

Because resources have been deployed in the past for water quality improvement and additional 319 funds are not expected to be allocated in this watershed for TMDL implementation, the Department has elected not to revise the 2005 approved Hard Labor Creek FC bacteria TMDL at this time.

1.5 Water Quality Standard

The impaired stream segments of the Stevens Creek and tributary basins are designated as Class Freshwater (FW), which is defined in SC Regulation 61-69 (2012) as:

> "Freshwaters are 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 aquatic community of fauna and flora. Suitable also for industrial and agricultural uses."

South Carolina's current water quality standard (WQS) for recreational use in freshwater is *E. coli* (R.61-68):

> "Not to exceed a geometric mean of 126/100 ml based on at least four samples collected from a given sampling site over a 30 day period, nor shall a single sample maximum exceed 349/100 ml (SCDHEC, 2012)."

Prior to February 28, 2013, South Carolina's WQS for recreational use in freshwaters was FC bacteria (R.61-68):

> "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 and secondary 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. Essentially all perennial streams should therefore be protected from pathogen impairment.

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. Essentially all perennial streams should therefore be protected from pathogen impairment.

2.0 WATER QUALITY ASSESSMENT

In 1986, the USEPA documented that *E. coli* and *Enterococcus* bacteria are better indicators than FC bacteria group in predicting the presence of human gastroenteritis (upset stomach, nausea, diarrhea, vomiting) causing pathogenic bacteria in fresh waters. The USEPA study was based on data collected when swimmers were directly exposed in freshwater lakes with established public swimming areas. In almost all cases of water-borne illnesses, pathogens come from inadequately treated waste of humans or other warm-blooded animals. Also, *Enterococcus* and *E. coli* are more specific to sewage and fecal sources than the FC bacteria group. In light of this information, USEPA has recommended the use of either *E. coli* or *Enterococcus* as the pathogen indicator for fresh waters.

In order to determine which pathogen indicator bacteria is better suited in South Carolina as the recreational use water quality standard in fresh waters, the SCDHEC designed a Pathogen Indicator Study (PIS) and conducted the study during 2009. Weekly water samples were collected from 73 stations statewide and analyzed for *E. coli, Enterococcus* and for FC bacteria group. PIS results showed *E. coli* (a member of the FC bacteria group) is a better indicator for predicting the presence of pathogens in South Carolina freshwaters.

During 2012 and following the public participation, public comment period and legislative processes, the SDHEC submitted a proposed amendment to EPA to change the pathogen indicator from FC bacteria to *E. coli* in R. 61-68. Details of this process as well as PIS raw data can be found at: http://www.scdhec.gov/environment/water/fwater.htm. The proposed amendment was approved by EPA on February 28, 2013 and *E. coli* has been promulgated in R. 61-68. *E. coli* is the applicable water quality standard for recreational use in fresh waters.

Beginning with the 2014 §303(d) list of impaired waters, sites included as impaired for recreational use FC bacteria on the 2012 §303(d) lists will be listed as impaired for *E. coli.* Once sufficient *E. coli* data are collected from impaired stations, future TMDLs will be calculated based on *E. coli* data. Until sufficient data are collected, TMDLs for currently FC impaired stations can be calculated using FC data. Then, these FC TMDLs can be converted to *E. coli* TMDLs by multiplying the FC TMDL number by 0.8725. A 0.8725 ratio was derived by dividing the current single sample maximum (SSM) WQS for *E. coli*, 349 MPN/100ml by former SSM WQS for FC bacteria, 400 cfu/100 ml.

The SCDHEC currently has four (4) monitoring locations within the watersheds described earlier in this document. Two (2) of the monitoring sites (WQM Stations RS-06016 and SV-330) were included in the State's final 2012 §303(d) list and draft 2014 §303(d) list due to excessive fecal FC bacteria (included on the list as *E. coli* in 2014). And, two of the monitoring sites (WQM Stations SV-151 and SV-351) were listed for the first time in the State's 1998 §303(d) list for exceeding the FC bacteria WQS. 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 former freshwater FC bacteria recreational use WQS. Waters with more than 10% of samples greater than 400 cfu/100 ml are considered impaired for FC bacteria and were placed on South Carolina's §303(d) list[1]. These stations will be included on future §303(d) lists due to exceedances of the current *E. coli* WQS until such time such time that sufficient *E. coli* data are collected and demonstrate the WQS is attained or such time that TMDLs are developed and approved to address the

[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% FC bacteria standard (400/100 mL).

parameter of concern. As discussed previously, this TMDL documents addresses the development of FC TMDLs for two of these four impaired WQM stations in the SCT Watershed (i.e., WQM stations RS-06016 and SV-330) based on FC samples. This TMDL document also addresses the revision of a FC TMDL for a third WQM station in the SCT Watershed (i.e., WQM Station SV-351). Table 8 provides a summary of number of samples collected, number of exceedences and exceedence percentages.

Table 8. FC WQS Exceedence Summary for Impaired Stations (1999-2010)

Station	Waterbody	Number of Samples	Number of Samples >400/100mL	% Samples Exceed WQS
2015 Total Maximum Daily Loads				
RS-06016	Church Branch	12	9	75%
SV-330	Stevens Creek	35	4	11%
March 2015 Total Maximum Daily Loads (revised from June 2005)				
SV-351	Cuffytown Creek	26	5	19%

Figure 4 illustrates precipitation and FC by data and date for WQM Station SV-330. The graph and Table 9 show that there is little or no correlation between the amount of precipitation and the temporal FC exceedences of water quality standards (r = 0.000). The graphs for precipitation and FC by data and date for the other two WQM stations are shown in Appendix A. Table 9 and the graphs (in Appendix A) show that, for WQM Stations RS-06016 and SV-351, there is little or no correlation between the amount of precipitation and the temporal FC exceedences of water quality standards.

Figure 4. Precipitation and FC Data by Date for Water Quality Monitoring Station SV-330

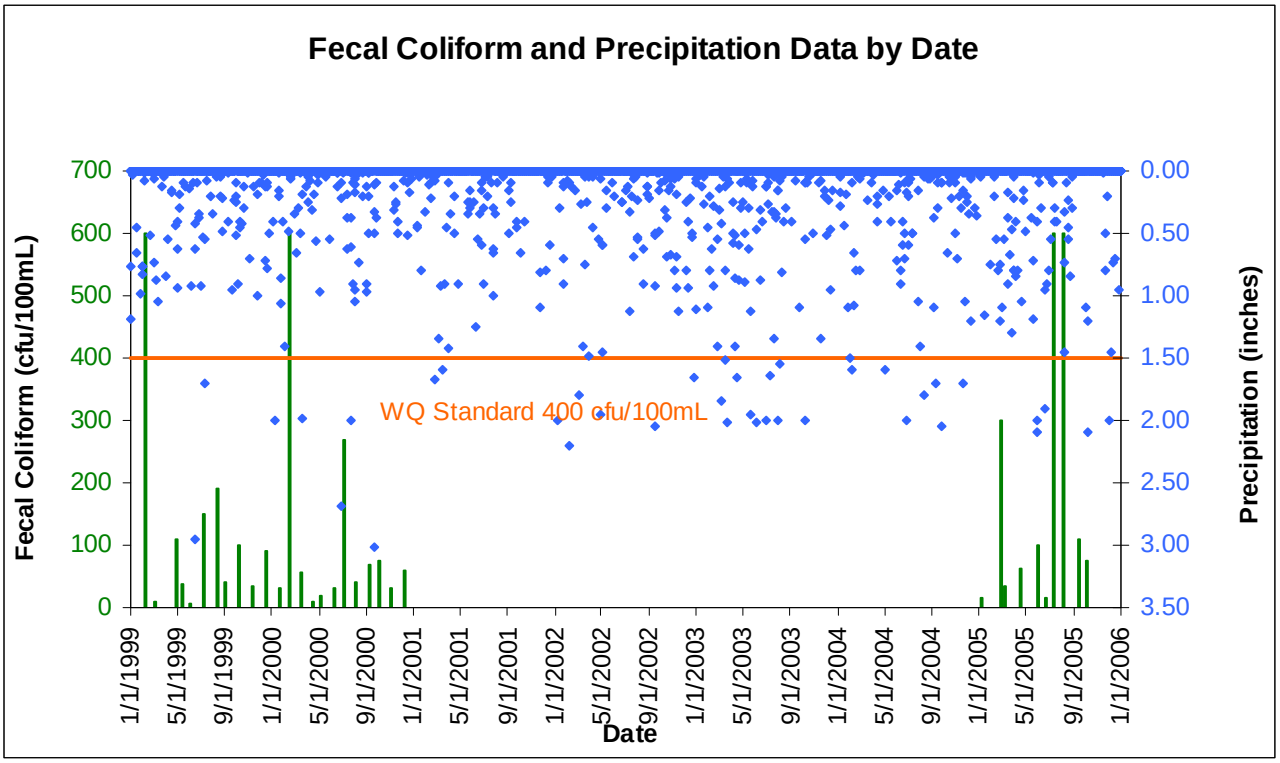


Table 9. Correlations Between Rainfall and FC in the Stevens Creek and Tributaries Watershed

Station	Waterbody	Correlation Coefficient (r)	Coefficient of Determination (r^2)
March 2015 Total Maximum Daily Loads			
RS-06016	Church Branch	0.279	0.078
SV-330	Stevens Creek	0.031	0.001
March 2015 Total Maximum Daily Loads (revised from June 2005)			
SV-351	Cuffytown Creek	0.000	0.000

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

The SCDHEC has adopted a change of its pathogen indicator from FC bacteria to *E. coli* during 2012. The new WQS were approved by EPA on February 28, 2013. Starting with the effective date of February 28, 2013, *E. coli* is the new pathogen indicator for recreational use in freshwaters.

Even though there are tests for specific pathogens, it is difficult to determine beforehand which organism may be present, and test for those specific organisms. Indicators such as FC bacteria, enteroccoci, or *E. coli*, which are indicators for human pollution, are easier to measure, have similar sources as pathogens, and persist in surface waters for a similar or longer length of time (Tchobanoglous & Schroeder, 1987). These bacteria are not in themselves disease causing, but indicate the potential presence of organisms that may result in illness.

E. coli is 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 *CWA* to obtain a NPDES permit. In South Carolina NPDES permits require that dischargers of sanitary wastewater must meet the state standard for the relevant pathogen indicator at the point of discharge. Municipal and private sanitary wastewater treatment facilities may occasionally be sources of pathogens. 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 MS4s and stormwater discharges from construction or industrial 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 pathogen impairment.

3.1 Point Sources

Point sources are defined as pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants, industrial waste treatment facilities, or regulated stormwater discharges. Point sources can also include pollutant loads contributed by tributaries to the main receiving water stream or river. Point sources can be further broken down into continuous and non-continuous.

3.1.1 Continuous Point Sources

There is an NPDES permitted continuous point source for *E. coli* is located in the approved 2005 TMDL watershed in the Hard Labor Creek (WQM Station SV-151). The Greenwood Metropolitan District's West Alexander facility is a domestic WWTP located at 225 Joe Bernat Drive near the southern boundary of the City of Greenwood in Greenwood County. The facility is authorized under the SCDHEC's NPDES Permit SC0022870 to discharge up to 2.2 MGD of treated wastewater to Hard Labor Creek. For the purposes of developing the current SCT *E. coli* TMDL document, a TMDL WLA is not being provided for this facility. The permitted flow for the facility has not changed since prior to 2005 and, consequently, the previously-prescribed WLA is still considered appropriate for FC bacteria. That loading may be converted to an equivalent loading for *E. coli*, as necessary. Note that future sections in the SCT *E. coli* TMDL document will no longer reference Greenwood Metro facility as a discharger since the facility is included in the approved 2005 TMDL Hard Labor Creek FC TMDL document.

There is one relevant continuous point source of pathogens in the SCT Watershed authorized under NPDES permit issued by the SCDHEC (Figure 5 and Table 10). The permit was reissued in 2013 and place limits on the *E. coli* discharges. The NPDES permitted continuous point source for *E. coli* is located in Reach 3 of the watershed (WQM Station SV-330). WQM Station SV-330 is also located downstream of the *E. coli* continuous point source in the approved TMDL watershed in the SCT Watershed (Figure 5). There are no NPDES permitted FC-bacteria related continuous point sources in Reaches 1 and 2 of the watershed.

The McCormick Commission of Public Works' Rocky Creek facility is a domestic WWTP located at 212 Airport Road in the Town of McCormick in McCormick County. The facility is authorized under the SCDHEC's NPDES Permit No. SC0030783 to discharge to Stevens Creek, via Rocky Creek, in Reach 3 of the SCT Watershed (Figure 5 and Table 10). Under the terms and conditions of the permit, the facility has limitations on the discharge of *E. coli,* and is authorized to discharge a monthly average of up to 3.35 MGD. The permit will expire on October 31, 2018.

For the purposes of developing these TMDLs, these continuous point sources are considered to be potential sources for both pathogen indicators. Future NPDES-permitted discharges of *E.coli* and other FC bacteria in the SCT Watershed are required to implement the WLAs and demonstrate consistency with the assumptions and requirements of the TMDLs in this document.

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/or regulated under South Carolina Water Pollution Control Permits: R61-9, §122.26(b)(4),(7),(14) - (21) (SCDHEC, 2011). All regulated MS4 entities have the potential to contribute *E. coli* and other FC bacteria pollutant loadings in the delineated drainage area used in the development of this TMDL.

The SCDOT operates the only MS4 in the three reaches of the SCT Watershed. The SCDOT is a large MS4 operator, and operates under the SCDHEC's NPDES MS4 Permit SCS040001. The SCDOT owns and operates roads within all of the SCT Watershed reaches (Figure 6 and Table 11). However, the SCDHEC recognizes that the 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.

Figure 5. NPDES Permitted *E. coli* Discharges in the Stevens Creek and Tributaries Watershed

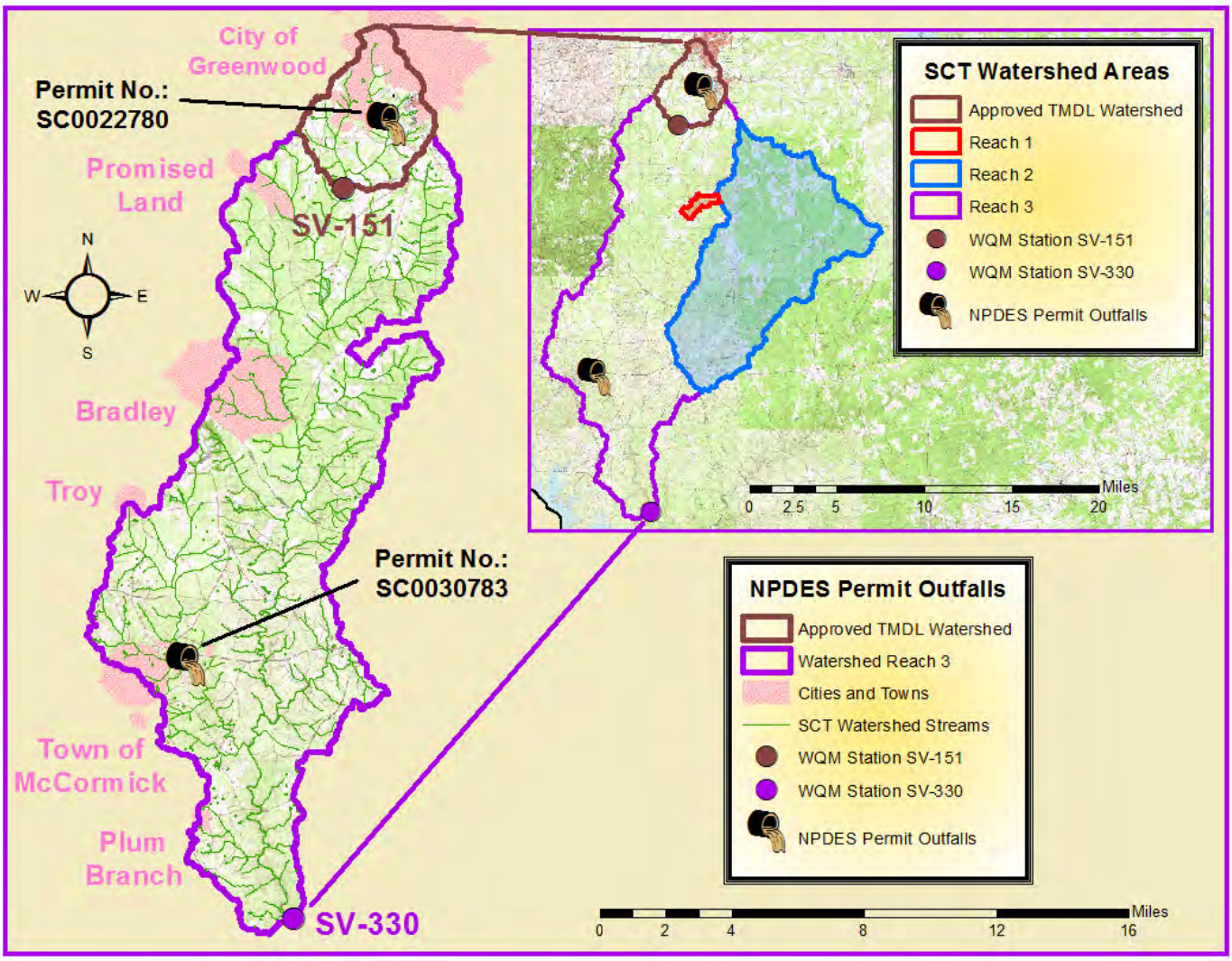


Table 10. NPDES Permitted *E. coli* Discharge in the Stevens Creek and Tributaries Watershed

Impaired Station Watershed	Permitted Facility	NPDES Permit Number	Permit Type	Permit Limitation (*E. coli* * Unit/Volume)	Permitted Flow (MGD)	Outfall Stream
SV-330	McCormick Commission of Public Works Rocky Creek WWTP	SC0030783	Major	349 MPN/mL	3.35	Stevens Creek

Current developed land use for reaches in the SCT Watershed range from 4.57% to 7.00% (Table 3). Based on current Geographic Information System (GIS) information (available at time of TMDL development) there is only one SCDOT facility located in the reaches of the SCT Watershed. The SCDOT facility is located in Reach 3 of the watershed on Airport Road (County Route S-33-53) approximately one-half mile east of the Town of McCormick in McCormick County. And, based on information provided on the SCDOT website, there are no highway rest areas in the watershed areas.

Small MS4s that discharge stormwater in urbanized areas, as designated by the U.S. Bureau of Census, are regulated under South Carolina *Water Pollution Control Permits* Regulation 122.26(b)(16) and 122.32. At the time of the development of these TMDLs, there were no regulated small MS4 discharges in the SCT Watershed.

Figure 6. SCDOT Owned and Maintained Roads in the Stevens Creek and Tributaries Watershed Reaches

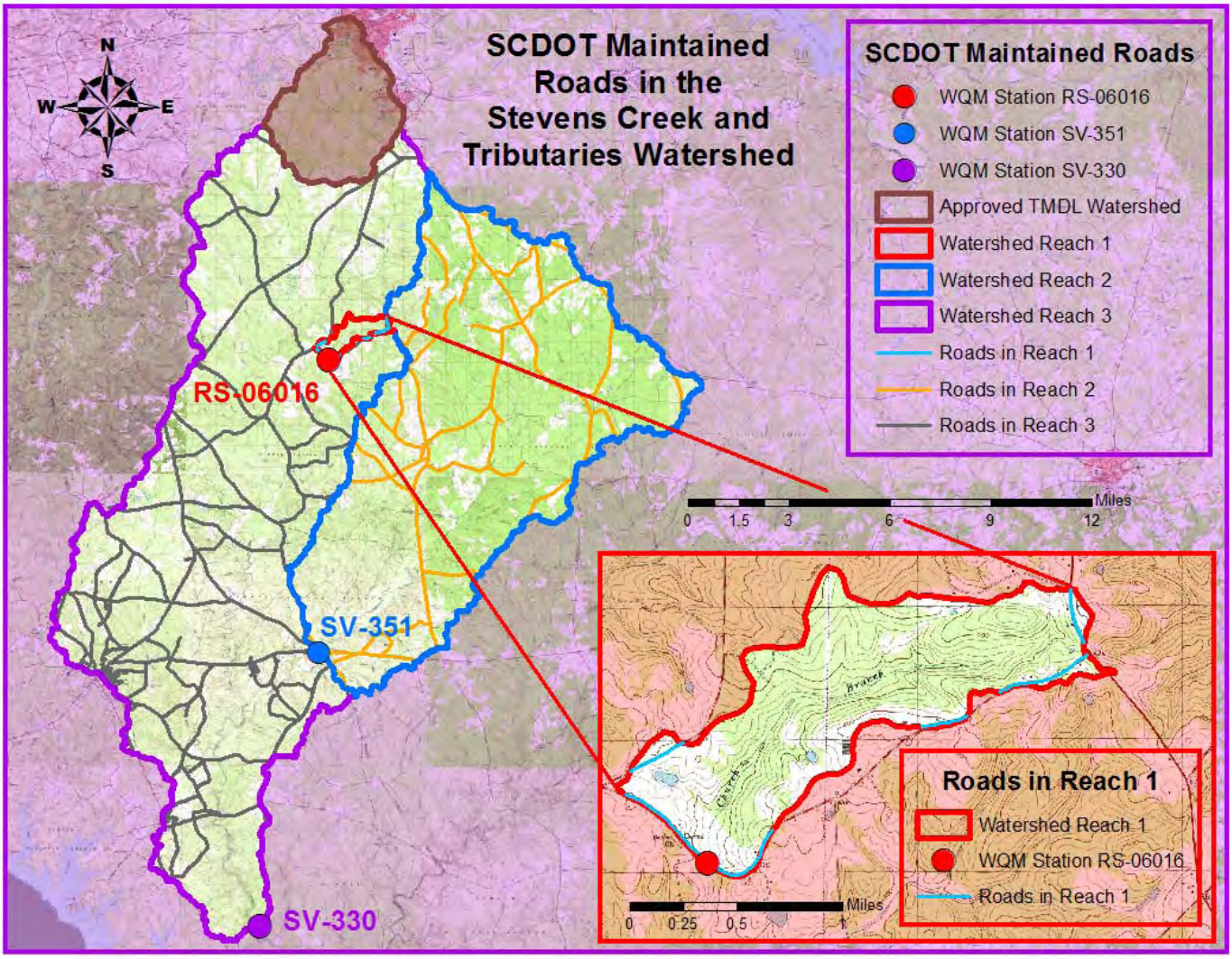


Table 11. SCDOT Maintained Road Miles in the Stevens Creek and Tributaries Watershed Reaches

Watershed Reach	Station	Road Miles
Watershed Reach 1	RS-06016	2.2
Watershed Reach 2	SV-351	83.9
Watershed Reach 3	SV-330	189.0
Total Miles in the SCT Watershed Reaches:		275.1

Other than the above-mentioned MS4 owned and/or operated storm sewer system, there are currently no permitted stormwater systems that discharge in these watersheds. Future permitted sanitary sewer or stormwater systems in the referenced watersheds will be required to comply with the load reductions prescribed in the WLA and demonstrate consistency with the assumptions and requirements of these TMDLs.

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 Stormwater Construction General Permit from the SCDHEC (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 waste load allocations in the TMDLs. Note that there may be other stormwater discharges not covered under permits numbered SCS and SCR that occur in the referenced watersheds. These activities are not subject to the WLA portion of the TMDLs.

Similar to regulated MS4s, potentially designated MS4 entities (as listed in 64 FR, 235, P.68837) or other unregulated MS4 communities located in the aforementioned watershed and surrounding watersheds may have the potential to contribute *E. coli* and other FC bacteria in stormwater runoff. These unregulated entities are subject to the LA for the purposes of this TMDL.

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. Currently, a small area of the southwestern portion of Reach 3 (WQM Station SV-330) of the SCT Watershed is serviced by the McCormick Commission of Public Works' sewer lines; and, the Greenwood Metropolitan District's sewer lines service a small area of the northern portion of the reach. However, the vast majority of Reach 3 is not served by a community collection system. No portions of Reach 1 (WQM Station RS-06016) or Reach 2 (WQM Station SV-351) of the SCT Watershed are serviced by a community collection system.

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

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

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

Pathogenic forms of *E. coli,* found in the guts of ruminant animals such as cattle, goats, sheep, deer and elk, produce toxins and are called "Shiga toxin-producing" *E. coli* or STEC. Of these ruminant animals, cattle are the major source for human illnesses. STEC infections start with ingestion of human or animal feces, contact with cattle, unpasteurized apple cider, soft cheeses made from raw milk, consumption of contaminated unpasteurized raw milk and water (CDC, n.d.).

3.2.1 Wildlife

Resident and migrant wildlife (mammals and birds) can be a significant contributor of *E. coli* and other FC bacteria. Wildlife in this area typically includes deer, squirrels, raccoons, and other mammals as well as a variety of birds. Wildlife wastes are carried into nearby streams by runoff following rainfall or deposited directly in streams. According to a study conducted by the SC Department of Natural Resources (SCDNR) in 2008, there are an estimated 30 to 45 deer per square mile in Greenwood, McCormick, and Edgefield Counties in the areas of the SCT Watershed (SCDNR 2008). The SCDNR's 2008 study estimated deer density based on suitable habitat (forests, croplands, and pastures). The FC production rate for deer has been shown to be 347×10^6 cfu/head-day in a study conducted by Yagow (1999), of which only a portion will enter the Stevens Creek and tributaries watersheds. Wildlife may contribute a significant portion of the overall *E. coli* and other FC bacteria load within the watersheds.

3.2.2 Agricultural Activities

Agricultural activities that involve livestock or animal wastes are potential sources of pathogen contamination of surface waters. Fecal matter can enter the waterway via runoff from the land or by direct deposition into the stream. Unstabilized soil directly adjacent to surface waters can contribute to pollutant loading during periods of runoff after rain events. During these events, fertilizer and wildlife wastes can be transported into the creek and carried downstream. Agricultural activities may represent a contributing source in the SCT Watershed where agricultural activities constitute a greater portion of the land use.

3.2.2.1 Agricultural Animal Facilities

Owners/operators of most commercial animal growing operations are required by South Carolina 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 the SCDHEC.

At the time of the development of these TMDLs, there were no active AFOs with regulated structures or activities in the SCT Watershed. There may be land application sites in the watershed associated with other active AFOs. 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.

3.2.2.2 Grazing Animals

Livestock, especially cattle, are frequently major contributors of FC bacteria or *E. coli* 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 or *E. coli* indirectly by runoff from pastures or directly by defecating into streams and ponds. Direct loading by cattle or other livestock to surface waters within the SCT Watershed is likely to be a contributing source of *E. coli* and other FC bacteria. However, the grazing of unconfined livestock (in pastures) is not regulated by the SCDHEC.

The United States Department of Agriculture's (USDA) National Agricultural Statistics Service reported 10,225, 1856 and 8501 cattle and calves in Greenwood, McCormick, and Edgefield Counties, respectively, in 2007 (USDA 2009). According to the 2011 NLCD, there are 38,338.05, 10,343.99, and 20,180.47 acres of pastureland in Greenwood, McCormick, and Edgefield Counties, respectively. This relates to 0.27, 0.18 and 0.41 cattle per acre of pastureland in Greenwood, McCormick, and Edgefield Counties, respectively, assuming an even distribution of cattle across pastureland in the counties. Table 12 shows the number of acres of pastureland in the SCT Watershed and, based on this acreage, an estimate of the number of cattle in the SCT Watershed. And, based on the number of cattle, the table shows an average of cfu/day of FC bacteria produced by cattle in the watershed. Based on the table, an estimated 54 cattle and calves within Reach 1 of the SCT Watershed (terminal WQM Station RS-06016) combine to produce an average of 5.40E+12 cfu/day of FC bacteria; an estimated 1515 cattle and calves within Reach 2 of the watershed (terminal WQM Station SV-351) combine to produce an average of 1.51E+14 cfu/day of FC bacteria; and, an estimated 1834 cattle and calves within Reach 3 of the watershed (terminal WQM Station SV-330) combine to produce an average of 1.83E+14 cfu/day of FC bacteria.

3.2.3 Land Application of Industrial, Domestic Sludge or Treated Wastewater

NPDES-permitted industrial and domestic wastewater treatment processes may generate solid waste bi-products, also know as sludge. In some cases, facilities may be permitted to land apply sludge at designated locations and under specific conditions. There are also some NPDES-permitted facilities authorized to land apply treated effluent at designated locations and under specific conditions. Land application permits for industrial and domestic wastewater facilities may be covered under SC Regulation

61-9, Sections 503, 504, or 505. It is recognized that there may be operating, regulated land application sites located in the SCT Watershed. If properly managed, waste is applied at a rate that ensures pollutants will be incorporated into the soil or plants and pollutants will not enter streams. Land applications sites can be a source of pathogen loadings and stream impairment if not properly managed. Similar to AFO land application sites, the permitted land application sites described in this section are not allowed to directly discharge to SCT Watershed. Direct discharges from land applications sites to surface waters of the State are illegal and are subject to enforcement actions by SCDHEC.

Table 12. Cattle FC per Day in the Stevens Creek and Tributaries Watershed Reaches

Downstream Impaired Station	County	Pasture Area (Acre) per Reach	Cattle per Reach	Cattle Fecal Coliform, cfu/day
RS-06016	Greenwood	817.30	54	5.40E+12
SV-351	Greenwood	5025.24	1340	1.34E+14
	McCormick	545.56	98	9.79E+12
	Edgefield	182.15	77	7.67E+12
SV-330	Greenwood	4964.16	1324	1.32E14
	McCormick	2841.24	510	5.10E+13

3.2.4 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.

Illicit sewer connections into storm drains result in direct discharges of sewage via the storm drainage system outfalls. Monitoring of storm drain outfalls during dry weather is needed to document the presence or absence of sewage in the drainage systems. Besides the SCDOT, there are currently no entities subject to an NPDES MS4 permit within or with impact to the SCT Watershed.

3.2.5 Failing Septic Systems

Failing, leaking or non-conforming septic systems, however, can be a major contributor of *E. coli* and other FC bacteria to the SCT Watershed. Wastes from failing septic systems enter surface waters either as direct overland flow or via groundwater. Although loading to streams from failing septic systems is likely to be a continual source, wet weather events can increase the rate of transport of pollutants from failing septic systems because of the wash-off effect from runoff and the increased rate of groundwater recharge.

3.2.5.1. Septic Systems in Reach 1 of the Stevens Creek and Tributaries Watershed (WQM Station RS-06016)

According to GIS information, there are no community sewer systems serving Reach 1 of the SCT Watershed. Based on current GIS information, 2013 USDA aerial photography of the watershed, and based on the 2010 U.S. population census, there are 13 households within the 817.30-acre reach. Therefore, assuming one septic tank per household, it is estimated that there are approximately 13 septic tanks within the reach. This translates into 0.016 septic tanks per watershed acre. At the time of the development of these TMDLs, their status in relation to function was unknown.

3.2.5.2. Septic Systems in Reach 2 of the Stevens Creek and Tributaries Watershed (WQM Station SV-351)

According to GIS information, there are no community sewer systems serving Reach 2 of the SCT Watershed. Based on current GIS information, 2013 USDA aerial photography of the watershed, and based

on the 2010 U.S. population census, there are 979 households within the 54,765.18-acre reach. Therefore, assuming one septic tank per household, it is estimated that there are approximately 979 septic tanks within the reach. This translates into 0.018 septic tanks per watershed acre. At the time of the development of these TMDLs, their status in relation to function was unknown.

3.2.5.3. Septic Systems in Reach 3 of the Stevens Creek and Tributaries Watershed (WQM Station SV-330)

According to GIS information, sewer lines for the Greenwood Metropolitan District extend into the northern portion of the 81,977.75-acre Reach 3 of the SCT Watershed; and, sewer lines for the McCormick Commission of Public Works extend into the northeastern portion of the reach. However, the vast majority of Reach 3 is not served by the Greenwood Metropolitan District's sewer system, the McCormick Commission of Public Works' sewer system, or any other community sewer system. Based on current GIS information, 2013 USDA aerial photography of the watershed, and based on the 2010 U.S. population census, there are 1759 households within the reach not served by a community sewer system. Therefore, assuming one septic tank per household, it is estimated that there are approximately 1759 septic tanks within the reach. This translates into 0.021 septic tanks per watershed acre. At the time of the development of these TMDLs, their status in relation to function was unknown.

3.2.6 Urban and Suburban Runoff

Dogs, cats, and other domesticated pets are the primary source of *E. coli* and other FC bacteria deposited on the urban landscape. There are also 'urban' wildlife, squirrels, raccoons, pigeons, and other birds, all of which contribute to the FC bacteria or *E. coli* load. Based on current GIS information, six (6) incorporated areas lie within the SCT Watershed (Figure 2). However, urban runoff is considered to be negligible within three reaches of the watershed relevant in this TMDL development project.

Besides the areas of the City of Greenwood lying within the watershed of WQM Station SV-151 with an approved TMDL for FC bacteria, the only incorporated areas in the SCT Watershed lie within the 81,977.75-acre Reach 3 of the watershed (Figure 2). According to GIS information, approximately 67.55% of the incorporated area of Promised Land (approximately 686.60 acres) lies in the north-northwestern portion of the reach. Approximately 66.58% of the incorporated area of Bradley (approximately 3304.67 acres) lies in the northwestern portion of the reach. Approximately 22.82% of the incorporated area of Troy (approximately 114.04 acres) lies in the western portion of the reach. Approximately 53.22% of the incorporated area of McCormick (approximately 1268.04 acres) lies in the west-southwestern portion of the reach. And, approximately 67.87% of the incorporated area of Plum Branch (approximately 156.09 acres) lies in the southwestern portion of the reach. There are no incorporated areas in Reach 1 or Reach 2 of the SCT Watershed. Therefore, total incorporated area in the reach (approximately 5529.44 acres) only compromises 6.75% of the reach; and, as a consequence, only compromises 3.79% of the 145,748.11-acre SCT Watershed.

Similar to regulated MS4s, potentially designated MS4 entities (as listed in FR 64, 235, p.68837) or other unregulated MS4 communities located in the SCT Watershed may have the potential to contribute pollutant loadings in stormwater runoff. Only approximately 8.32% of the entire SCT Watershed is developed, therefore there is potential for growth.

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. Two (2) United States Geological Survey (USGS) gages were used for collecting "real-time" flow data for the Stevens Creek and tributaries TMDLs, based primarily on the size of the drainage area to the downstream gage, and secondarily on the general land use in the drainage area. The USGS gage used for collecting flow data for Reach 1 of the SCT Watershed (WQM Stations RS-06016) was the Middle Tyger River gage near Gramling, SC (Gage Number: 02157470). This gage has a drainage area of 34.7 square miles, and began recording daily flows in 2002 and provides the flow data required to establish flow duration curves for this impaired station. The USGS gage used for collecting flow data for Reach 2 and Reach 3 of the watershed (WQM Stations SV-351 and SV-330) was the Rocky Creek gage at Great Falls, SC (Gage Number: 02147500). This gage has a drainage area of 194 square miles, and began recording daily flows in 1951 and provides the flow data required to establish the flow duration curve for these impaired stations.

For example, flow data for a 10-year period (January 1, 1998 to December 31, 2007) from the USGS Gramling, SC gage was used to establish flow duration curve for Reach 3 of the SCT Watershed (WQM Station SV-330). The records for this period were complete (i.e., no missing dates). The drainage area of the sampling station was delineated using USGS topographic maps using 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 gage. For example, the Gramling, SC gage records flow from 194 square miles (sq mi). The cumulative drainage area for the Reach 3 of the SCT Watershed at WQM Station SV-330 (in Stevens Creek at County Route S-33-21 in McCormick County) is approximately 227.67 sq mi, or 117.36% of the area drained at the Gramling, SC gage. Mean daily flow for the SV-330 monitoring location was assumed to be 117.36% of the daily flow at the Gramling, SC gage.

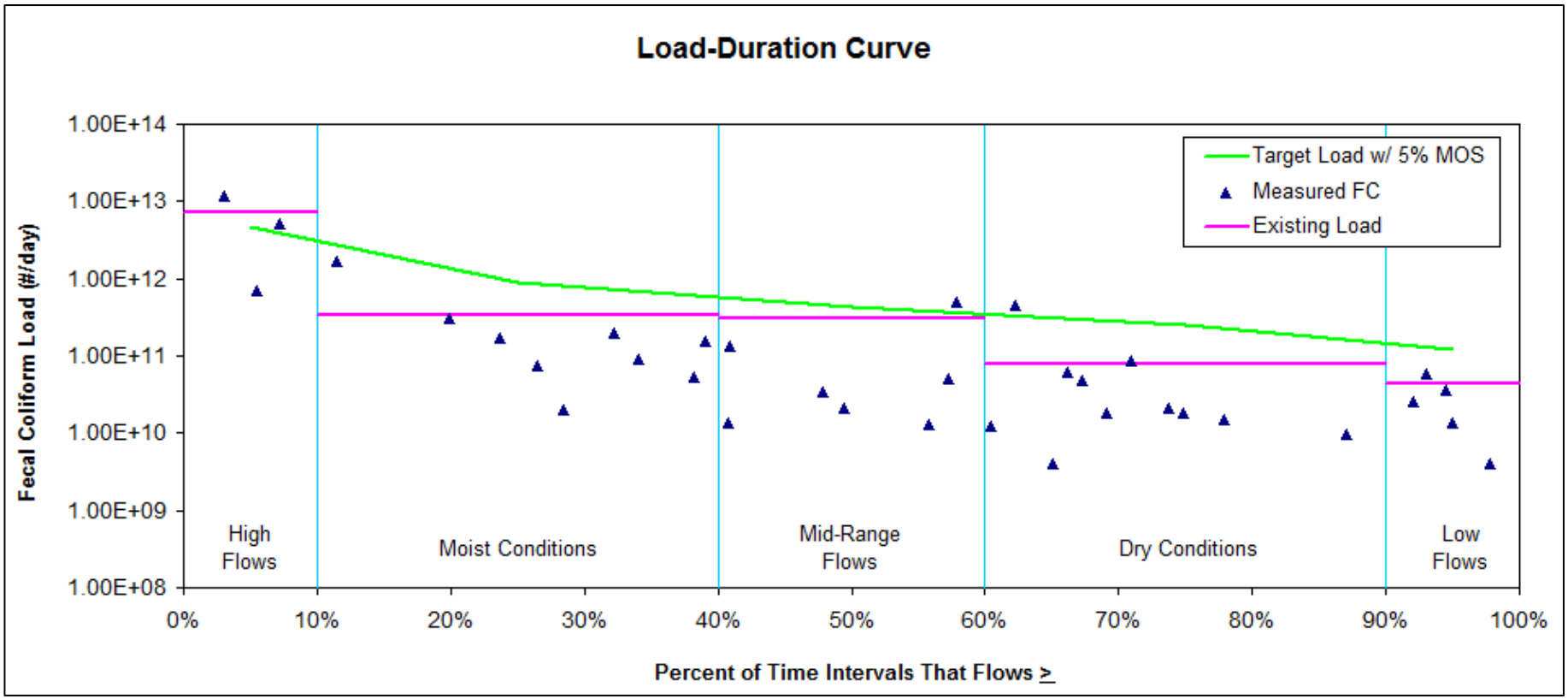
Additional adjustments were necessary in order more accurately estimate stream flow at WQM Station SV-330. The Greenwood Metropolitan District's West Alexander facility (NPDES Permit No. SC0022870) near the southern boundary of the City of Greenwood, and the McCormick Commission of Public Works' Rocky Creek facility (NPDES Permit No. SC0030783) in the Town of McCormick are two major domestic WWTPs located upstream of the water quality monitoring station. It is believed that flow contributions from these two facilities may be large enough to influence downstream flow estimates, particularly during dry conditions. To better establish existing instream conditions, long-term average facility flow data for NPDES permits SC0022870 and SC0030783 were added to the estimated time series described in the previous paragraph. Figure 2 provides an illustration of monitoring and gage locations along with a summary of drainage area statistics used to establish flows at un-gaged monitoring stations.

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. The 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 exceedences. A high number of exceedences 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.

For those WQM stations impaired due to FC (i.e., stations RS-06016, SV-351, and SV-330), target load-duration curves were created by calculating the allowable load using daily flow, former 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 former water quality criterion 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 SV-330 is presented in Figure 7 as an example. The load-duration curves for stations RS-06016 and SV-351 are presented in Appendix B.

Because SC has recently adopted a change from FC bacteria to *E. coli* bacteria as a recreational use standard in all freshwaters, this TMDL document also includes converted *E. coli* TMDLs for WQM Stations RS-06016, SV-351, and SV-330, for purposes of implementation of the current recreational use standard. For these calculations, the daily flow and a unit conversion factor were used and the water quality target was set at 332 MPN/100ml for the instantaneous criterion, which is five percent lower than the water quality

Figure 7. Load Duration Curve for Reach 3 of the Stevens Creek and Tributaries Watershed, Water Quality Monitoring Station SV-330



criteria of 349 MPN/100ml. A five percent explicit Margin of Safety (MOS) was reserved from the water quality criteria in developing target load-duration curves.

Target loads in freshwaters impaired for *E. coli* may alternatively be calculated as the ratio of *E.coli* MPN/100 ml to FC bacteria cfu/100 ml or (349/400=0.8725). This conversion is derived from an established relationship between FC bacteria and *E. coli* WQS in freshwaters determined during the SCDHEC's 2009 PIS.

At the time of TMDL development, there were no *E. coli* data available to consider for determining percent reductions necessary to meet the calculated TMDLs for WQM Stations RS-06016, SV-351, and SV-330. Therefore, all percent reductions recommended in this document for these three impaired stations are based on existing FC bacteria data. For the purposes of establishing these three TMDLs, FC bacteria percent reductions should also be representative of reductions necessary to meet the *E. coli* WQS.

For all curves, including Figure 7, 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 WQM Stations RS-06016 and SV-351, 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

For the defined flow intervals for WQM Station SV-330, existing and target loadings were calculated using the following equations.

Existing Load = (Mid-Point Flow in Each Hydrologic Category + NPDES SC0022870 Long-Term Average Discharge Monitoring Report Monthly Average Flow + NPDES SC0030783 Long-Term Average Discharge Monitoring Report Monthly Average Flow) x 90th Percentile FC Concentration x 10000

Target Load = (Mid-Point Flow in Each Hydrologic Category + NPDES SC0030783 Permitted Flow (3.35 MGD = 5.18 cfs)) x 380 (WQ criterion minus a 5% MOS) x 10000. ***Note:*** *The permitted flow of NPDES SC0022870 was not considered in calculating the target load for WQM Station SV-330, since the loading from this permit is targeted in the approved TMDL for WQM Station SV-151 in Hard Labor Creek.*

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

Instantaneous loads for each of the impaired stations were calculated. Measured FC concentrations from 1999 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 7). Only the instantaneous water quality criterion was targeted because there is insufficient data to evaluate against the 30-day geometric mean.

An existing load was determined for each hydrologic category for the TMDL calculations. For WQM Stations RS-06016 and SV-351, 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).

For WQM Station SV-330, 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 5% duration interval for the High Flows, 25% interval for Moist Conditions, 50% interval for Mid-Range, and 75% for Dry Condition) plus

the discharge monitoring report monthly average flows from NPDES permits SC0022870 and SC0030783. Due to the proportion of flow from these NPDES permit discharges to the flow from Stevens Creek, this adjustment was made to account for these discharges' large contribution to the overall stream flow in Stevens Creek.

Existing loads are plotted on the load-duration curves presented in Appendix A as well as the example for WQM Station SV-330 in Figure 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, then 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 waste load 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, in accordance with 40 CFR 130.2(l).

5.1 Critical Conditions

The critical condition is identified as the stream flow condition requiring the greatest percentage of pollutant loading reduction to meet the LA in the TMDL. Data within the High Flow and Low Flow categories are generally not used in the development of a TMDL due to their infrequency. Accordingly, the FC TMDLs for WQM Stations RS-06016 and SV-351 in the SCT Watershed were 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.' However, for WQM Station SV-330 in the SCT Watershed, no FC loading reduction was necessary to meet the LA in the TMDL based on the flow recurrence interval between 10% and 100%. Therefore, the TMDL for SV-330 was based on the flow recurrence interval between 0% and 10%. The critical conditions for the Stevens Creek and tributaries watersheds pathogen impaired segments are listed in Table 13. This data indicates that for WQM Station RS-06016, dry conditions result in larger bacteria loads and is therefore the critical condition for that station. The following flow conditions result in larger bacteria loads, and is therefore the critical conditions, for the other two WQM stations in the SCT Watershed: **a)** moist conditions for SV-351; and, **b)** high flow conditions for SV-330.

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 document. 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: cattle-in-streams, failing septic systems as well as wildlife. The existing load for WQM Stations RS-06016, SV-351, and SV-330 are provided in Appendix D.

Table 13. Percent Reduction Necessary to Achieve Target Load by Hydrologic Category

Station	Waterbody	High Flows	Moist Conditions	Mid-Range Flow	Dry Conditions	Low Flows
RS-06016	Church Branch	N/A	63	59	68	N/A
SV-351	Cuffytown Creek	N/A	51	NRN	32	N/A
SV-330	Stevens Creek	37	NRN	NRN	NRN	N/A

Highlighted cells indicate critical condition
NRN = no reduction needed. Existing load below target load
N/A = Not applicable. Not evaluated for the TMDL

5.3 Waste load Allocation

The waste load allocation (WLA) is the portion of the TMDL allocated to NPDES-permitted point sources (USEPA 1991). Note that all illicit dischargers, including SSOs, are illegal and not covered under the WLA of these TMDLs.

5.3.1 Continuous Point Sources

The relevant permitted domestic discharger discharging pathogen indicator bacteria in the SCT Watershed is the McCormick Commission of Public Works' Rocky Creek facility, which is discharging in Reach 3 (WQM Station SV-330) of the watershed (Table 14). The commission is permitted under the SCDHEC's NPDES Permit No. SC0030783 to discharge *E. coli* from the Rocky Creek facility into Stevens Creek via Rocky Creek. To determine the WLA for the district, the average permitted flow for the Rocky Creek facility was multiplied by an allowable permitted maximum concentration of 349 MPN/100mL and a unit conversion factor. The WLA for the facility, based on a permitted daily maximum of 349 MPN/100 mL, is 44.3 billion counts per day (4.43+E10 MPN/day) based on a permitted average design flow of 3.35 MGD.

Because South Carolina has recently adopted a change from FC bacteria to *E. coli* bacteria as a recreational use standard in all freshwaters, future continuous discharges are required to meet the prescribed loading for *E. coli* based on permitted flow and assuming an allowable permitted maximum concentration of 349MPN/100mL.

Table 14. Average Permitted Flow and *E. coli* WLA for the NPDES Wastewater Discharge in the Stevens Creek and Tributaries Watershed

Impaired Station Watershed	Permitted Facility	Permit Number	Permitted Flow (MGD)	WLA *E. coli* (MPN/day)
SV-330	McCormick Commission of Public Works	SC0030783	3.35	4.43E+10

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 stormwater discharges covered under permits numbered SCS & SCR and regulated under SC *Water Pollution Control Permits* Regulation 122.26(b)(14) & (15) (SCDHEC, 2010. Illicit discharges, including SSOs, are not covered under any NPDES permit and are subject to enforcement mechanisms. All areas defined as "Urbanized Area" by the US Census are required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater. At the time of the development of these TMDLs, there were no urbanized areas in the SCT Watershed. Other non-urbanized areas may be required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater.

Waste load allocations for stormwater discharges are expressed as a percentage reduction instead of a numeric loading due to the uncertain nature of stormwater discharge volumes and recurrence intervals. All current and future 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 15 presents the reduction needed for each impaired segment. The reduction percentages in these TMDLs also apply to the FC or *E. coli* waste load attributable to those areas of the watershed that are covered or will be covered under NPDES MS4 permits.

Table 15. Percent Reduction Necessary to Achieve Target Load

Station	Waterbody	% Reduction
RS-06016	Church Branch	68
SV-351	Cuffytown Creek	51
SV-330	Stevens Creek	37

Compliance by an entity with responsibility for the MS4, with the terms of its individual MS4 permit may fulfill any obligations it has towards implementing these TMDLs. As appropriate information is made available to further define the pollutant contributions for the permitted MS4, an effort can be made to revise these TMDLs. This effort will be initiated as resources permit and if deemed appropriate by the Department. For the Department to revise these TMDLs the following information should be provided, but not limited to:

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

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

5.4 Load Allocation

The Load Allocation applies to the nonpoint sources of FC and *E. coli* 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 is listed in Table 16. There may be other unregulated MS4s located in the Stevens Creek and tributaries watersheds that are subject to the LA components of these TMDLs. At such time that the referenced entities, or other future unregulated entities become regulated NPDES MS4 entities and are subject to applicable provisions of SC Regulation 61-68D, they will be required to meet load reductions prescribed in the WLA component of the TMDLs. This also applies to future discharges associated with industrial and construction activities that will be subject to SC R.61-9.122.26(b)(14) & (15) (SCDHEC, 2011).

Table 16. Total Maximum Daily Loads for the Stevens Creek and Tributaries Watersheds
Loads are expressed as FC bacteria or *E. coli* count/day

	Existing FC Load (count/day)	TMDL (count/day)		Margin of Safety (MOS) (count/day)		Waste Load Allocation (WLA)				Load Allocation (LA)		
						Continuous Source[1] (count/day)		Non-Continuous Sources[2,3] (% Reduction)	Non-Continuous SCDOT[3] (% Reduction)	Load Allocation (count/day)		% Reduction to Meet LA[3]
March 2015 Total Maximum Daily Loads												
Station	FC (CFU/day)	FC (CFU/day)	*E. coli* (MPN/day)[6]	FC (CFU/day)	*E. coli* (MPN/day)[6]	FC (CFU/day)	*E. coli* (MPN/day)[6]	(Percent)	(Percent)	FC (CFU/day)	*E. coli* (MPN/day)[6]	(Percent)
RS-06016	2.06E+10	6.86E+09	*5.98E+09*	3.43E+08	*2.99E+08*	See Note Below	See Note Below	68	0[4]	6.52E+09	*5.69E+09*	68
SV-330	7.34E+12	4.95E+12	*4.32E+12*	2.48E+11	*2.16E+11*	5.07E+10	*4.43E+10*	37	37[5]	4.65E+12	*4.06E+12*	37
March 2015 Total Maximum Daily Loads (revised from June 2005)												
Station	FC (CFU/day)	FC (CFU/day)	*E. coli* (MPN/day)[6]	FC (CFU/day)	*E. coli* (MPN/day)[6]	FC (CFU/day)	*E. coli* (MPN/day)[6]	(Percent)	(Percent)	FC (CFU/day)	*E. coli* (MPN/day)[6]	(Percent)
SV-351	6.40E+11	3.28E+11	*2.86E+11*	1.64E+10	*1.43E+10*	See Note Below	See Note Below	51	51[5]	3.12E+11	*2.72E+11*	51

Table Notes:

1. WLAs are expressed as a daily maximum. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern. For the purposes of NPDES permitting, continuous discharges may be required to meet a loading equivalent of FC bacteria, based upon permitted flow and an allowable permitted maximum FC bacteria concentration of 400 cfu/100ml, until such time that *E. coli* limits are incorporated into individual permits. *E. coli* limits will be developed based upon permitted flow and an allowable permitted maximum *E. coli* concentration of 349 MPN/100ml.
2. Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future municipal separate storm sewer system (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 FC bacteria or *E. coli.*
4. As long as the conditions within the SCDOT MS4 area remain the same the Department deems the current contributions from SCDOT negligible and no reduction of FC bacteria or *E. coli* is necessary. SCDOT must continue to comply with the provisions of its approved NPDES stormwater permit.
5. By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address fecal coliform or *E. coli,* the SCDOT will comply with these TMDLs and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.
6. Expressed as *E. coli* (MPN/day). Loadings are developed by applying a conversion factor to values calculated for FC bacteria. This conversion is derived from an established relationship between FC bacteria and *E. coli* water quality standards in freshwaters.

5.5 Seasonal Variability

Federal regulations require that TMDLs take into account the seasonal variability in watershed loading. The variability in these TMDLs is accounted for by using a 10-year hydrological and water quality sampling data set.

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, in the case of FC TMDLs, 20 cfu/100mL of the instantaneous criterion of 400 cfu/100 mL (380 cfu/100mL); and, in the case of *E. coli* TMDLs, 17 MPN/100mL of the instantaneous criterion of 349 MPN/100 mL (332 MPN/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.

A 5% MOS in freshwaters impaired for *E. coli* may be calculated as the ratio of *E.coli* MPN/100 mL to FC bacteria cfu/100 mL or 20*0.8725 = 17 MPN/100 mL of the instantaneous *E. coli* criterion of 349 MPN/100 mL (332 MPn/100 mL). This conversion is deemed appropriate by the Department and derived from an established relationship between FC bacteria and *E. coli* WQS in freshwaters determined during the 2009 PIS.

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 for the Stevens Creek and tributaries watersheds 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) minus the MOS 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.

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 16 indicates the percentage reduction or water quality standard required for each subwatershed in the Stevens Creek and tributaries watersheds (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 or *E. coli* prescribed load reductions must be targeted from all sources, including NPDES permitted and nonpoint sources.

Based on the available information at this time, the portions of the Stevens Creek and tributaries watersheds that drain directly to a regulated MS4 and that drain 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. 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.

6.0 IMPLEMENTATION

The implementation of both point (WLA) and non-point (LA) source components of the TMDLs are necessary to bring about the required reductions in FC bacteria or *E. coli* loading to the Stevens Creek and 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, the SCDHEC 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 MS4, construction activities, etc. Current and future NPDES discharges in the referenced watersheds are required to comply with the load reductions prescribed in the waste load 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 SCT 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 components of these TMDLs. 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 degradation in the SCT Watershed would be the establishment and administration of a program of BMPs. BMPs 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 portions of these TMDLs and reduce nonpoint source FC bacteria or *E. coli* loading to the Stevens Creek and tributaries. 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 but may be available for the LA component within permitted MS4 jurisdictional boundaries. Additional resources are provided in Section 7.0 of this TMDL document.

The SCDHEC will also work with the existing agencies in the area to provide nonpoint source education in the Stevens Creek and tributaries watersheds. Local sources of nonpoint source education and assistance include the Natural Resource Conservation Service (NRCS), the Barnwell, Bamberg, and Colleton 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 these TMDLs might be needed to achieve the water quality standard and we are committed towards targeting the load reductions to improve water quality in the SCT Watershed As additional data and/or information become available, it may become necessary to revise and/or modify the TMDL targets accordingly.

6.1 Implementation Strategies

The strategies presented in this document for implementation of the referenced TMDLs are not inclusive and are to be used only as guidance. The strategies are informational suggestions that may lead to the required load reductions being met for the referenced watersheds while demonstrating consistency with the assumptions and requirements of the TMDLs. 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 TMDLs. FC Loadings are developed based upon permitted flow and assume an allowable permitted maximum concentration of 400 cfu/100 mL. *E. coli* loadings are developed based upon permitted flow and an allowable permitted maximum *E. coli* concentration of 349 MPN/100 mL.

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 these TMDLs 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 C which provides additional information as it relates to evaluating the effectiveness of an MS4 Permit as it related to compliance with approved TMDLs. For the SCDOT and future NPDES MS4 permittees, compliance with terms and conditions of its NPDES permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP) and demonstrates consistency with the assumptions and requirements of the TMDLs. For existing and future NPDES construction and Industrial stormwater permittees, compliance with terms and conditions of its permit is effective implementation of the WLA. 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 acknowledges that progress with the assumptions and requirements of the TMDLs by MS4s is expected to take one or more permit iteration. Achieving the WLA reduction for the TMDLs 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 the 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 bacteria or *E. coli* loading from wildlife in areas where wildlife may be a significant contributor to the overall watershed. The SCT Watershed is 80.48 percent forest or otherwise vegetated (non-cultivated). On December 2, 16, 17, 18, and 19, 2014, the SCDHEC conducted site visits in the SCT Watershed to assess pollutant sources potentially contributing to water quality impairment in the watershed. All potential pollutant sources in the watershed found during the December 2014 site visits are identified in Tables Ap-1, Ap-2, and Ap-3 (see Appendix E). During the potential pollutant source assessment visit, the department found evidence of wild game in the SCT Watershed. During the visit, the department found wild turkeys in the woods in Reach 3 of the watershed (Figure F-1).

According to the SCDNR 2008 study, there are an estimated 30 to 45 deer per square mile in Greenwood, McCormick, and Edgefield Counties in the areas of the SCT Watershed (see Section 3.2.1 of this TMDL document) (SCDNR 2008). While the SCDHEC did not find any deer in the watershed during the December 2014 potential pollutant source assessment visit, the evidence of their presence was ample throughout the watershed in the form of deer stands (e.g., Figures F-2, F-3, and F4).

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 the SCDHEC's potential pollutant source assessment visit in December 2014, the department found waterfowl in Reach 3 of the SCT Watershed (e.g., Figures F-5, F-6, and F-7). 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, FC bacteria or *E. coli,* needs to be identified. For livestock in the referenced watersheds, 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. During

the potential pollutant source assessment visit in December 2014, the SCDHEC found several cattle pastures throughout the SCT Watershed (e.g., Figures F-8, F-9, F-10, and F-11).

During the potential pollutant source assessment visit in December 2014, the SCDHEC also found numerous hobby farms within the SCT Watershed. Horses were found in all three reaches of the watershed (e.g., Figures F-12, F-13, and F-14). Ponies were found in Reach 2 of the watershed (Figures F-15 and F-16). Donkeys were found in Reach 2 and Reach 3 of the watershed (e.g., Figures F-17, F-18, and F-19). And, goats were found in all three reaches of the watershed (e.g., Figures F-20, F-21, and F-22).

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 watersheds, many common practices exist to reduce FC bacteria or *E. coli* contributions. Unstabilized soil directly adjacent to surface waters can contribute to FC bacteria or *E. coli* 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 SCT 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 Program, Farm and Ranch Lands Protection Program, etc. You can visit the NRCS website by going to: www.sc.nrcs.usda.gov/programs/.

6.1.5 Leaking Sanitary Sewers and Illicit Discharges

Leaking sanitary sewers and illicit discharges, although illegal and subject to enforcement, may be occurring in regulated or unregulated portions of the SCT Watershed at any time. Due to the high concentration of pollutant loading that is generally associated with these discharges, their detection may provide a substantial improvement in overall water quality in the watershed. Detection methods may include, but are not limited to: dye testing, air pressure testing, static pressure testing, and infrared photography.

The 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 or *E. coli.* It is the intent of the SCDHEC to work with the MS4 entities to recognize FC bacteria or *E. coli* load reductions as they are achieved. The 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, the 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.

The 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 SCDHEC Environmental Health Onsite Wastewater page at the following link: http://www.scdhec.gov/health/envhlth/onsite_wastewater/septic_tank.htm

6.1.7 Urban Runoff

Urban runoff is surface runoff of rainwater created by urbanization outside of regulated areas which may pick up and carry pollutants to receiving waters. Pavement, compacted areas, roofs, reduced tree canopy and open space increase runoff volumes that rapidly flow into receiving waters. This increase in volume and velocity of runoff often causes stream bank erosion, channel incision and sediment deposition in stream channels. In addition, runoff from these developed areas can increase stream temperatures that along with the increase in flow rate and pollutant loads negatively affect water quality and aquatic life (USEPA 2005). This runoff can pick up FC bacteria or *E. coli* 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 the SCDHEC potential pollutant source assessment visit in December 2014, unattended dogs were found in Reach 2 and Reach 3 of the SCT Watershed (e.g., Figures F-23, F-24, and F-25).

Although the SCT Watershed is primarily rural in nature, many of the urban runoff practices discussed in this section can be applied to individual households in the watersheds. Education should be provided to individual homeowners in the referenced watersheds on the contributions to FC bacteria or *E. coli* 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: http://www.epa.gov/region1/topics/water/stormwater.html

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

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United States Environmental Protection Agency (USEPA), Region IV. 2005. Water Characterization Document, Hard Labor Creek, Fecal Coliform Bacteria. SCDHEC Technical Report Number: 019-005.

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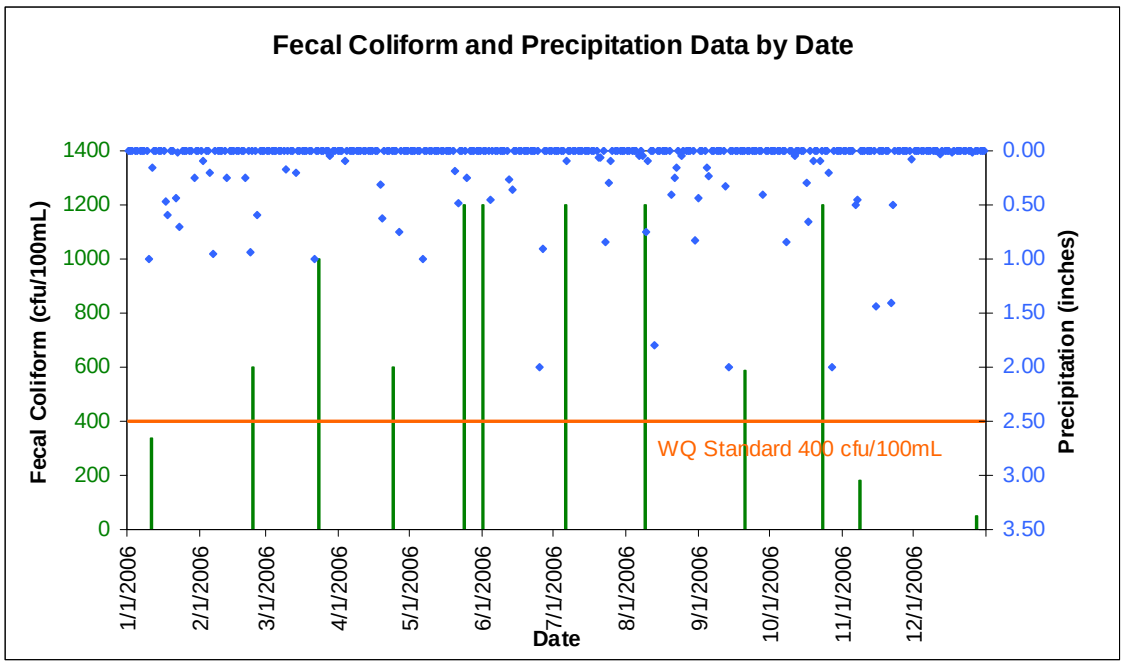
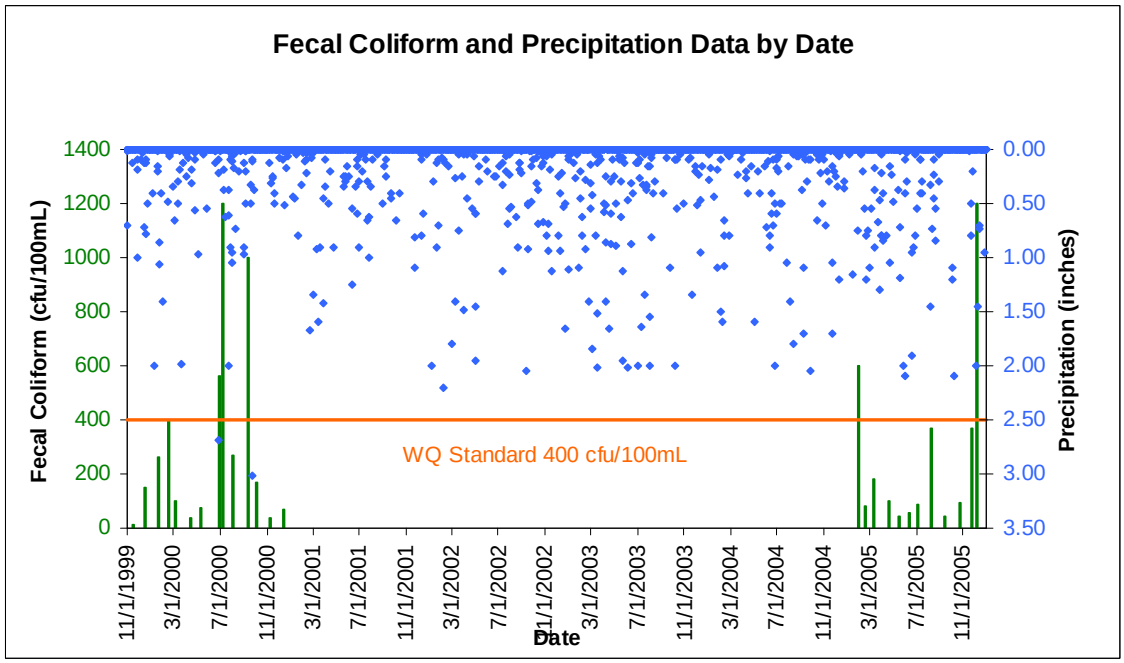
APPENDIX A
ADDITIONAL RAIN CHARTS BY STATION

Precipitation and FC Data by Date for Monitoring Station RS-06016

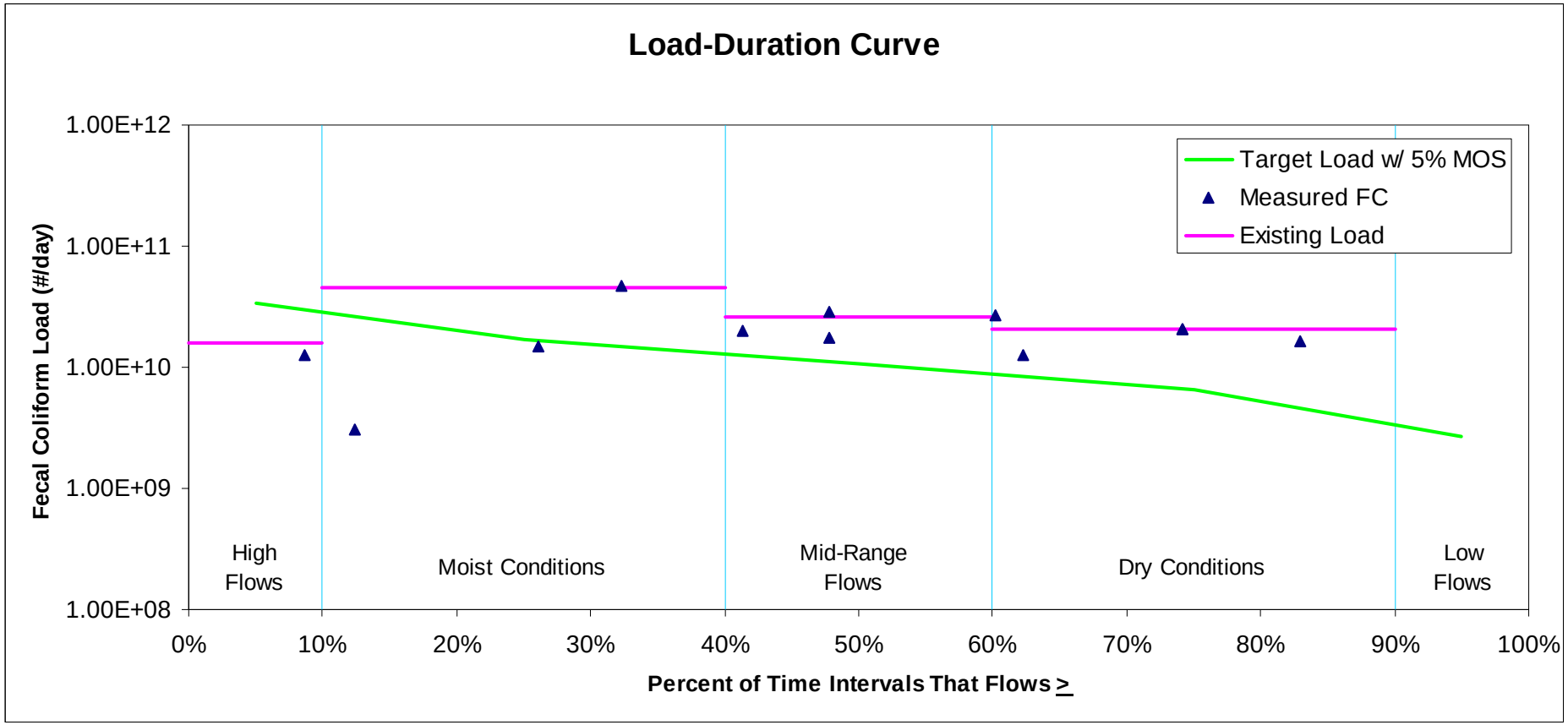


Precipitation and FC Data by Date for Monitoring Station SV-351

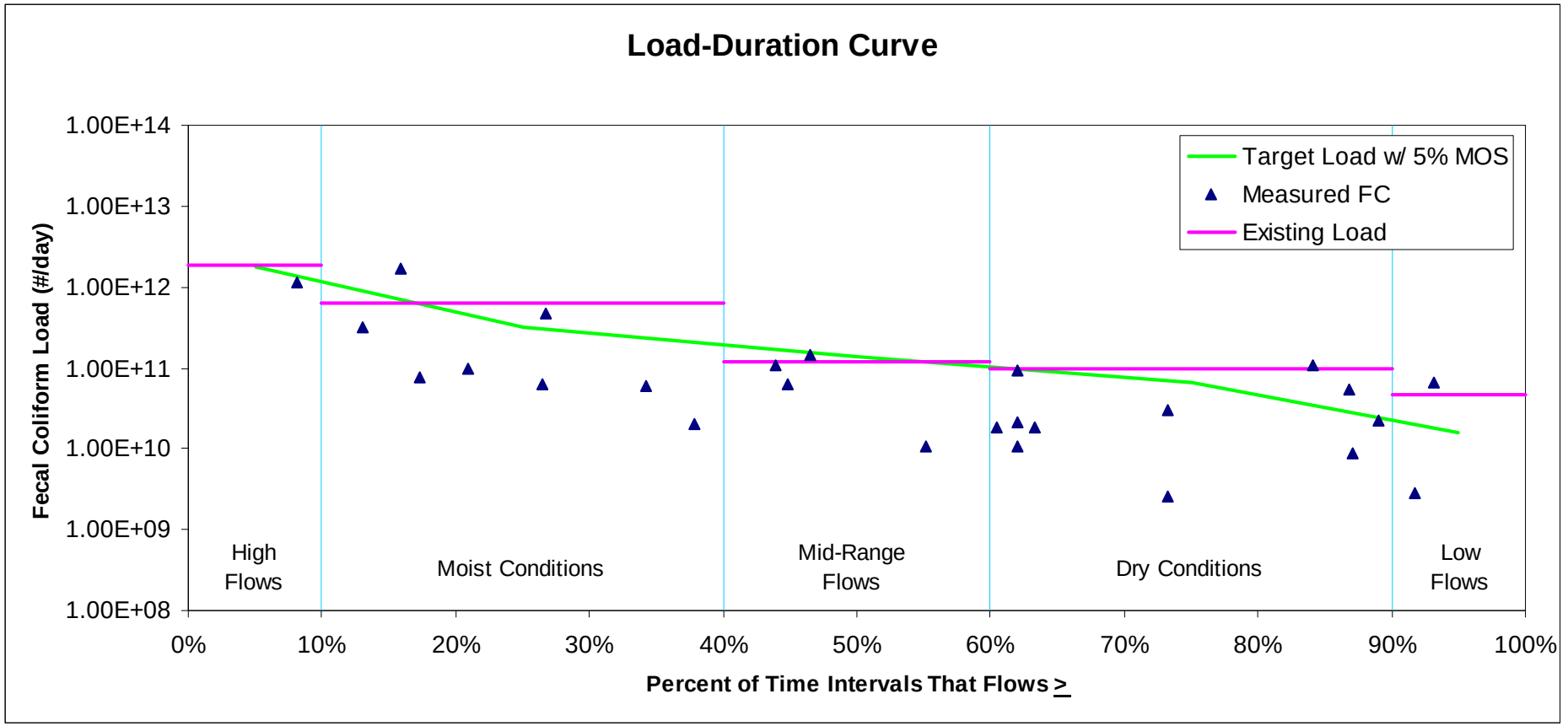


APPENDIX B
ADDITIONAL LOAD-DURATION CURVES BY STATION

Load Duration Curve for Reach 1 of the Stevens Creek and Tributaries Watershed, WQM Station RS-06016



Load Duration Curve for Reach 2 of the Stevens Creek and Tributaries Watershed, WQM Station SV-351



Appendix C

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 the 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 D
DATA TABLES

Fecal Coliform WQS Exceedence Summary for Impaired Station SV-151 by Date

Date	FC (cfu/mL)
1/13/2010	160
2/10/2010	80
3/3/2010	150
4/14/2010	190
5/12/2010	**440**
6/9/2010	**460**
7/14/2010	**3100**
8/11/2010	**840**
9/8/2010	**940**
10/13/2010	**470**
11/22/2010	**560**
12/8/2010	330

Date	FC (cfu/mL)
1/25/2011	340
2/9/2011	170
3/9/2011	300
4/13/2011	130
5/11/2011	**500**
6/8/2011	**420**
7/13/2011	**860**
8/9/2011	**780**
9/14/2011	**850**
10/12/2011	**1300**
11/9/2011	100
12/14/2011	**940**

Date	FC (cfu/mL)
1/11/2012	**580**
2/8/2012	260
3/14/2012	**440**
4/11/2012	**420**
6/27/2012	300
7/11/2012	**6100**
8/8/2012	**7400**
9/12/2012	**620**
10/10/2012	120
11/14/2012	**540**
12/12/2012	**540**

____ WQS Exceeded

E. coli WQS Exceedence Summary for Impaired Station SV-151 by Date

Date	*E. coli* (MPN/mL)
1/16/2013	**2419.60**
2/12/2013	**488.40**
3/13/2013	245.90

Date	*E. coli* (MPN/mL)
4/8/2013	272.30
5/8/2013	**488.40**
6/12/2013	**563.45**

Date	*E. coli* (MPN/mL)
7/10/2013	**1769.70**
8/14/2013	**1167.20**

____ WQS Exceeded

Fecal Coliform WQS Exceedence Summary for Impaired Station RS-06016 by Date

Date	FC (cfu/mL)
1/11/2006	340
2/23/2006	**600**
3/23/2006	**1000**
4/24/2006	**600**

Date	FC (cfu/mL)
5/24/2006	**1200**
6/1/2006	**1200**
7/6/2006	**1200**
8/9/2006	**1200**

Date	FC (cfu/mL)
9/20/2006	**590**
10/23/2006	**1200**
11/8/2006	180
12/28/2006	52

____ **WQS Exceeded**

90th Percentile FC Concentrations (#/100 mL)

Hydro Category Range	High Flow 0-10	Moist Cond. 10-40	Mid Range 40-60	Dry Flow 60-90	Low Flow 90-100	Samples
RS-06016	180	1028	920	1200	NS	12

NS = No samples

Mid Point Hydrologic Category Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-06016	3.61	1.81	1.14	0.70	0.29

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-06016	1.59E+10	4.55E+10	2.57E+10	2.06E+10	NS

NS = No samples

Target Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-06016	3.36E+10	1.68E+10	1.06E+10	6.52E+09	2.66E+09

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-06016	N/A	2.87E+10	1.51E+10	1.41E+10	N/A

% Load Reduction Necessary

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-06016	N/A	63	59	68	N/A

Fecal Coliform WQS Exceedence Summary for Impaired Station SV-351 by Date

Date	FC (cfu/mL)
11/15/1999	15
12/15/1999	150
1/20/2000	260
2/16/2000	400
3/6/2000	100
4/13/2000	40
5/10/2000	78
6/27/2000	**560**
7/5/2000	**1200**

Date	FC (cfu/mL)
8/1/2000	270
9/11/2000	**1000**
10/4/2000	170
11/8/2000	35
12/13/2000	70
1/31/2005	**600**
2/17/2005	80
3/8/2005	180
4/19/2005	97

Date	FC (cfu/mL)
5/17/2005	42
6/9/2005	58
7/5/2005	85
8/9/2005	370
9/12/2005	45
10/20/2005	94
11/22/2005	370
12/7/2005	**1200**

____ **WQS Exceeded**

90th Percentile FC Concentrations (#/100 mL)

Hydro Category Range	High Flow 0-10	Moist Cond. 10-40	Mid Range 40-60	Dry Flow 60-90	Low Flow 90-100	Samples
SV-351	400	780	337	560	1085	26

Mid Point Hydrologic Category Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-351	186.93	33.51	14.56	7.06	1.72

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-351	1.83E+12	6.40E+11	1.20E+11	9.67E+10	4.56E+10

Target Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-351	1.74E+12	3.12E+11	1.35E+11	6.56E+10	1.60E+10

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-351	N/A	3.28E+11	NRN	3.11E+10	N/A

NRN = no reduction needed. Existing load below target load.

% Load Reduction Necessary

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-351	N/A	51	NRN	32	N/A

NRN = no reduction needed. Existing load below target load.

Fecal Coliform WQS Exceedence Summary for Impaired Station SV-330 by Date

Date	FC (cfu/mL)
2/4/1999	**600**
3/1/1999	10
4/28/1999	110
5/13/1999	37
6/1/1999	6
7/7/1999	150
8/10/1999	190
9/2/1999	40
10/5/1999	100
11/9/1999	35
12/13/1999	92
1/17/2000	32

Date	FC (cfu/mL)
2/15/2000	**600**
3/15/2000	55
4/12/2000	10
5/3/2000	20
6/6/2000	32
7/5/2000	270
8/2/2000	40
9/6/2000	70
10/2/2000	75
11/1/2000	30
12/4/2000	60
1/4/2005	15

Date	FC (cfu/mL)
2/23/2005	300
3/7/2005	35
4/14/2005	62
5/31/2005	100
6/21/2005	16
7/12/2005	**600**
8/4/2005	**600**
9/12/2005	110
10/4/2005	75
11/2/2005	30
12/12/2005	110

____ WQS Exceeded

90th Percentile FC Concentrations (#/100 mL)

Hydro Category Range	High Flow 0-10	Moist Cond. 10-40	Mid Range 40-60	Dry Flow 60-90	Low Flow 90-100	Samples
SV-330	600	148	300	150	238	35

Mid Point Hydrologic Category Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-330	500.23	92.57	41.55	21.23	7.38

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-330	7.34E+12	3.35E+11	3.05E+11	7.79E+10	4.30E+10

Target Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-330	4.65E+12	8.58E+11	3.89E+11	2.04E+11	7.17E+10

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-330	2.69E+12	NRN	NRN	NRN	N/A

NRN = no reduction needed. Existing load below target load.

% Load Reduction Necessary

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-330	37	NRN	NRN	NRN	N/A

NRN = no reduction needed. Existing load below target load.

Appendix E

POTENTIAL POLLUTANT SOURCE IDENTIFICATION

Table Ap-1. Potential FC and *E. coli* Pollutant Sources in Reach 1 of Stevens Creek and tributaries Watershed (WQM Station RS-06016)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
RS-06016	Cattle	Five Notch Road	Greenwood	Central	34.04108	-82.19689	12/17/2014	Pastured cattle
RS-06016	Cattle	Reedy Creek Road	Greenwood	West	34.03649	-82.13962	12/17/2014	Cattle in pasture with stream-fed pond
RS-06016	Cattle	Dowtin Road	McCormick	Central	33.96808	-82.21267	12/18/2014	Pastured cattle with Hibbler Branch in it
RS-06016	Deer	Gold Mine Road	Greenwood	North	34.08826	-82.24683	12/16/2014	Deer stand in woods
RS-06016	Horses	Wagon Tree Lane	Greenwood	Northwest	34.13240	-82.21825	12/2/2014	Horse in pasture
RS-06016	Horses	Breezewood Road	Greenwood	East	34.06221	-82.15144	12/17/2014	Horse in pasture

Table Ap-2. Potential FC and *E. coli* Pollutant Sources in Reach 2 of Stevens Creek and tributaries Watershed (WQM Station SV-351)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
SV-351	Cattle	Breezewood Road	Greenwood	Northeast	34.05459	-82.16544	12/17/2014	Pastured cattle
SV-351	Cattle	Breezewood Road	Greenwood	Northeast	34.06019	-82.15497	12/17/2014	Pastured cattle
SV-351	Cattle	Callison Road	Greenwood	West	34.01704	-82.12197	12/17/2014	Cattle in pasture near stream
SV-351	Cattle	Callison Road	Greenwood	West	34.03073	-82.12932	12/17/2014	Pastured cattle
SV-351	Cattle	Upper Mill Road	McCormick	South	33.89332	-82.19238	12/18/2014	Cattle in pasture with stream-fed pond
SV-351	Deer	Damascus Church Road	Greenwood	North	34.04089	-82.09782	12/17/2014	Deer stand in woods
SV-351	Dogs	Mount Moriah Road	Greenwood	North	34.12633	-82.17142	12/2/2014	Unattended dogs in yard
SV-351	Dogs	Five Notch Road	Greenwood	West	34.00948	-82.15549	12/17/2014	Unattended dog in yard
SV-351	Dogs	Christain Road	McCormick	South	33.92064	-82.20220	12/18/2014	Unattended dog in yard
SV-351	Dogs	County Route S-33-138	McCormick	South	33.92306	-82.17854	12/18/2014	Unattended dog near the road
SV-351	Dogs	County Route S-33-58	McCormick	South	33.85426	-82.25625	12/19/2014	Unattended dog in yard
SV-351	Dogs	Quarles Wright Road	McCormick	South	33.91585	-82.21114	12/18/2014	Unattended dogs in yard near stream
SV-351	Donkeys	Bruce Road	Greenwood	North	34.04446	-82.06824	12/16/2014	Donkey in pasture
SV-351	Donkeys	Bradley Road	McCormick	Southwest	33.94980	-82.28573	12/18/2014	Donkeys in pasture with goats
SV-351	Horses	Bruce Road	Greenwood	North	34.04531	-82.06816	12/16/2014	Horse in pasture
SV-351	Horses	Mount Moriah Road	Greenwood	North	34.12658	-82.16974	12/2/2014	Horse in pasture
SV-351	Horses	Mount Moriah Road	Greenwood	North	34.12635	-82.17107	12/2/2014	Pastured horses
SV-351	Horses	US 178	Greenwood	Northeast	34.05580	-82.00493	12/2/2014	Pastured horses
SV-351	Horses	Beaverdam Creek Road	Greenwood	Northwest	34.07735	-82.12544	12/17/2014	Horse in pasture
SV-351	Horses	Salak Road	Greenwood	Northwest	34.14633	-82.21570	12/2/2014	Horse in pasture
SV-351	Horses	Mount Vernon Road	Greenwood	East	33.99813	-82.05294	12/16/2014	Pastured horses
SV-351	Horses	Reedy Creek Road	Greenwood	West	34.03926	-82.13958	12/17/2014	Horses in pasture with stream-fed pond
SV-351	Horses	Reedy Creek Road	Greenwood	West	34.03816	-82.13958	12/17/2014	Horse in pasture with stream-fed pond
SV-351	Horses	County Route S-33-139	McCormick	South	33.86098	-82.25510	12/19/2014	Pastured horses
SV-351	Horses	Upper Mill Road	McCormick	South	33.86845	-82.20835	12/19/2014	Horse in pasture
SV-351	Waterfowl	New Hope Road	McCormick	South	33.87330	-82.25124	12/18/2014	Geese in surface drain field
SV-351	Waterfowl	US 378	McCormick	South	33.92401	-82.19051	12/18/2014	Ducks in pasture near Bee Tree Branch

Table Ap-3. Potential FC and *E. coli* Pollutant Sources in Reach 3 of Stevens Creek and tributaries Watershed (WQM Station SV-330)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
SV-330	Cattle	Gold Mine Road	Greenwood	North	34.08788	-82.24599	12/16/2014	Pastured cattle
SV-330	Cattle	US 221	Greenwood	North	34.11152	-82.18189	12/16/2014	Pastured cattle
SV-330	Cattle	Rustville Road	Greenwood	Northeast	34.01327	-82.16579	12/17/2014	Cow in pasture
SV-330	Cattle	Salak Road	Greenwood	Northwest	34.14368	-82.20929	12/2/2014	Pastured cattle
SV-330	Cattle	SC 67	Greenwood	Northwest	34.05639	-82.13739	12/17/2014	Pastured cattle
SV-330	Cattle	Breezewood Road	Greenwood	East	34.05952	-82.15768	12/17/2014	Pastured cattle
SV-330	Cattle	Breezewood Road	Greenwood	Central	34.05487	-82.18413	12/17/2014	Pastured cattle
SV-330	Cattle	Breezewood Road	Greenwood	Southwest	34.05317	-82.18012	12/17/2014	Cattle in pasture near Church Branch
SV-330	Cattle	Rock House Road	Greenwood	Southwest	34.05741	-82.17966	12/17/2014	Pastured cattle
SV-330	Cattle	US 221	McCormick	Central	33.96644	-82.24483	12/18/2014	Pastured cattle
SV-330	Cattle	Zion Chapel Road	McCormick	Central	33.96501	-82.24157	12/18/2014	Pastured cattle
SV-330	Cattle	Zion Chapel Road	McCormick	Central	33.96623	-82.24264	12/18/2014	Cow in pasture
SV-330	Cattle	Pine Street	McCormick	Southwest	33.93113	-82.31131	12/18/2014	Pastured cattle
SV-330	Cattle	SC 28	McCormick	Southwest	33.92401	-82.31444	12/18/2014	Cattle in pasture with stream-fed pond
SV-330	Cattle	Edgefield Street	McCormick	South	33.84857	-82.25581	12/19/2014	Pastured cattle in Plum Branch
SV-330	Cattle	SC 283	McCormick	South	33.85691	-82.21324	12/19/2014	Cow in pasture with stream-fed pond
SV-330	Cattle	US 378	McCormick	South	33.92480	-82.16938	12/18/2014	Pastured cattle
SV-330	Cattle	US 378	McCormick	South	33.92398	-82.19008	12/18/2014	Cow in pasture with a pond
SV-330	Cattle	US 378	McCormick	South	33.92399	-82.19008	12/18/2014	Cattle in pasture with a pond
SV-330	Deer	SC 67	Greenwood	East	34.06601	-82.14616	12/17/2014	Deer stand in a clearing
SV-330	Deer	County Route S-33-58	McCormick	South	33.85872	-82.25097	12/18/2014	Deer stand in field
SV-330	Deer	Upper Mill Road	McCormick	South	33.91506	-82.17889	12/18/2014	Deer stand in woods near Cuffytown Creek
SV-330	Deer	Upper Mill Road	McCormick	South	33.82839	-82.20724	12/19/2014	Deer stand on edge of field
SV-330	Dogs	Bruce Road	Greenwood	North	34.04496	-82.06815	12/16/2014	Unattended dog in yard
SV-330	Dogs	Rock House Road	Greenwood	North	34.11656	-82.15676	12/2/2014	Unattended dogs in yard
SV-330	Dogs	Scotts Ferry Road	Greenwood	North	34.03054	-82.09175	12/17/2014	Unattended dog in yard
SV-330	Dogs	Griffin Street	Greenwood	Northeast	34.04579	-82.24214	12/17/2014	Unattended dogs in yard in Bradley
SV-330	Dogs	Callison Road	Greenwood	Northeast	34.04879	-82.24446	12/17/2014	Unattended dog in yard in Bradley
SV-330	Dogs	Dixie Lane Avenue	Greenwood	Northwest	34.12981	-82.23369	12/2/2014	Unattended dog in yard in Promised Land
SV-330	Dogs	Callison Road	Greenwood	West	34.03246	-82.12937	12/17/2014	Unattended dog in yard

Table Ap-3 (Continued). Potential FC and *E. coli* Pollutant Sources in Reach 3 of Stevens Creek and tributaries Watershed (WQM Station SV-330)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
SV-330	Dogs	South Calhoun Street	McCormick	Southwest	33.91371	-82.28653	12/18/2014	Unattended dogs in yard in McCormick
SV-330	Dogs	County Route S-33-58	McCormick	South	33.85311	-82.25677	12/19/2014	Unattended dog in yard in Plum Branch
SV-330	Dogs	Upper Mill Road	McCormick	South	33.93626	-82.12936	12/18/2014	Unattended dog in yard
SV-330	Dogs	Upper Mill Road	McCormick	South	33.86834	-82.20775	12/19/2014	Unattended dog in yard
SV-330	Donkeys	Rustville Road	Greenwood	West	34.00967	-82.16476	12/17/2014	Donkey in pasture with pony
SV-330	Donkeys	Dowtin Road	McCormick	Central	33.96808	-82.21267	12/18/2014	Pasture donkey with Hibbler Branch in it
SV-330	Donkeys	US 221	McCormick	Southwest	33.93167	-82.26592	12/18/2014	Pastured donkeys near Rocky Creek
SV-330	Goats	Mount Moriah Road	Greenwood	North	34.12711	-82.18054	12/2/2014	Pastured goats
SV-330	Goats	US 25	Greenwood	North	34.05525	-82.06873	12/16/2014	Pastured goats
SV-330	Goats	SC 67	Greenwood	East	34.06815	-82.14680	12/17/2014	Pastured goats
SV-330	Goats	Dowtin Road	McCormick	Central	33.97940	-82.24174	12/18/2014	Pastured goats
SV-330	Goats	Airport Road	McCormick	Southwest	33.90830	-82.26986	12/18/2014	Goats in pasture with a pond
SV-330	Goats	Bradley Road	McCormick	Southwest	33.94984	-82.28584	12/18/2014	Goats in pasture with donkeys
SV-330	Goats	County Route S-33-138	McCormick	South	33.92379	-82.17923	12/18/2014	Pastured goats next to Cuffytown Creek
SV-330	Horses	Windmill Road	Edgefield	South	33.93639	-82.12028	12/18/2014	Horse in pasture
SV-330	Horses	Bruce Road	Greenwood	North	34.04454	-82.06820	12/16/2014	Horse in pasture
SV-330	Horses	Marvin Road	Greenwood	North	34.08061	-82.08914	12/16/2014	Horse in pasture
SV-330	Horses	Whitehall Road	Greenwood	North	34.06947	-82.20081	12/17/2014	Pastured horses near Hard Labor Creek
SV-330	Horses	Breezewood Road	Greenwood	Northeast	34.05412	-82.16666	12/17/2014	Pastured horses
SV-330	Horses	Griffin Street	Greenwood	Northeast	34.04612	-82.24279	12/17/2014	Horses in pasture near Stillhouse Branch
SV-330	Horses	Callison Road	Greenwood	West	34.02535	-82.12808	12/17/2014	Horses in pasture with pond
SV-330	Horses	County Route S-33-21	McCormick	South	33.85773	-82.20896	12/19/2014	Pastured horses
SV-330	Horses	County Route S-33-58	McCormick	South	33.85704	-82.25429	12/18/2014	Horse in pasture
SV-330	Horses	Whitetown Road	McCormick	South	33.87747	-82.23770	12/18/2014	Pastured horses
SV-330	Ponies	US 25	Greenwood	North	34.05528	-82.06871	12/16/2014	Pony in pasture
SV-330	Ponies	Rustville Road	Greenwood	West	34.00967	-82.16476	12/17/2014	Pony in pasture with donkey
SV-330	Turkeys	Whitehall Road	Greenwood	North	34.06853	-82.19969	12/17/2014	Wild turkey in woods near Hard Labor Creek
SV-330	Waterfow	County Route S-33-21	McCormick	South	33.85367	-82.20698	12/19/2014	Geese in field near a stream fed pond
SV-330	Waterfow	County Route S-33-67	McCormick	South	33.87284	-82.24861	12/18/2014	Geese in stream fed pond
SV-330	Waterfow	US 378	McCormick	South	33.92402	-82.19007	12/18/2014	Ducks in pasture near a pond

Appendix F

SOURCE ASSESSMENT PICTURES

Figure F-1

Wild turkeys in the woods near Hard Labor Creek (location: 34.06853 N, -82.19969 W) on Whitehall Road in Greenwood County. Found in Reach 3 of the SCT Watershed (Date of photography: December 17, 2014).

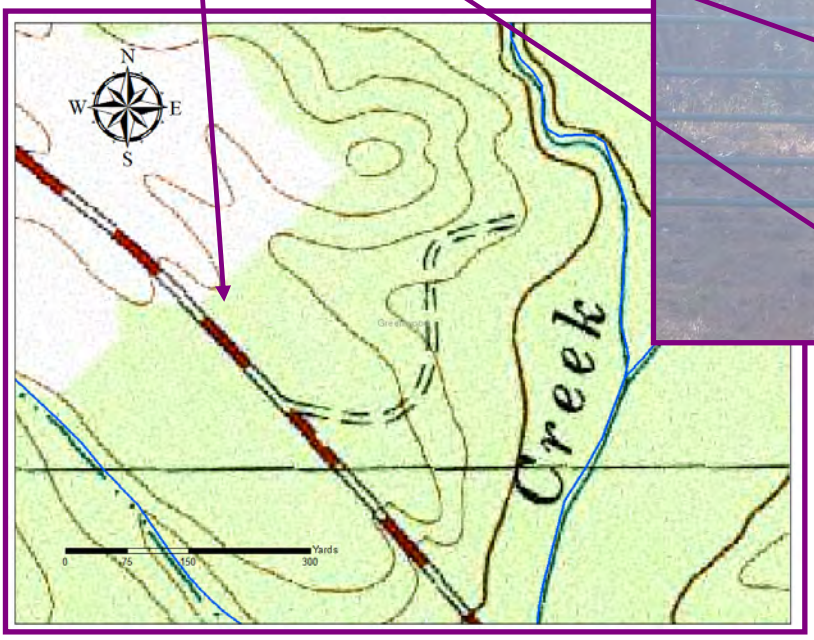


Figure F-2

Deer stand in a clearing (location: 34.06601 N, -82.14616 W) on SC Route 67 in Greenwood County. Found in Reach 1 of the SCT Watershed (Date of photography: December 17, 2014).

Figure F-3

Deer stand in the woods (location: 34.04089 N, -82.09782 W) on Damascus Church Road in Greenwood County. Found in Reach 2 of the SCT Watershed (Date of photography: December 17, 2014).

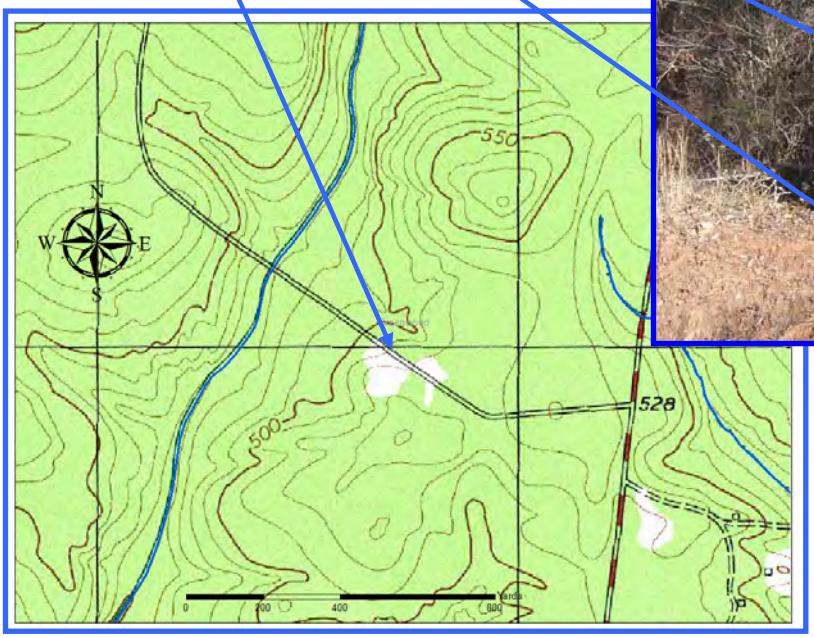


Figure F-4

Deer stand in the woods near Cuffytown Creek and Doctors Branch (location: 33.91506 N, -82.17889 W) on Upper Mill Road in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 18, 2014).

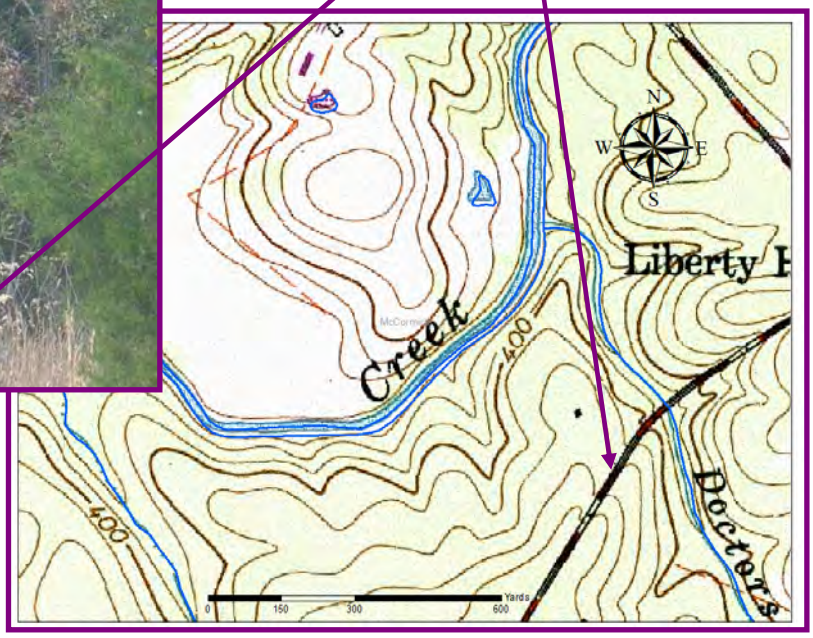


Figure F-5

Ducks in a pasture near Bee Tree Branch (location: 33.92401 N, -82.19051 W) on US Route 378 in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 18, 2014).

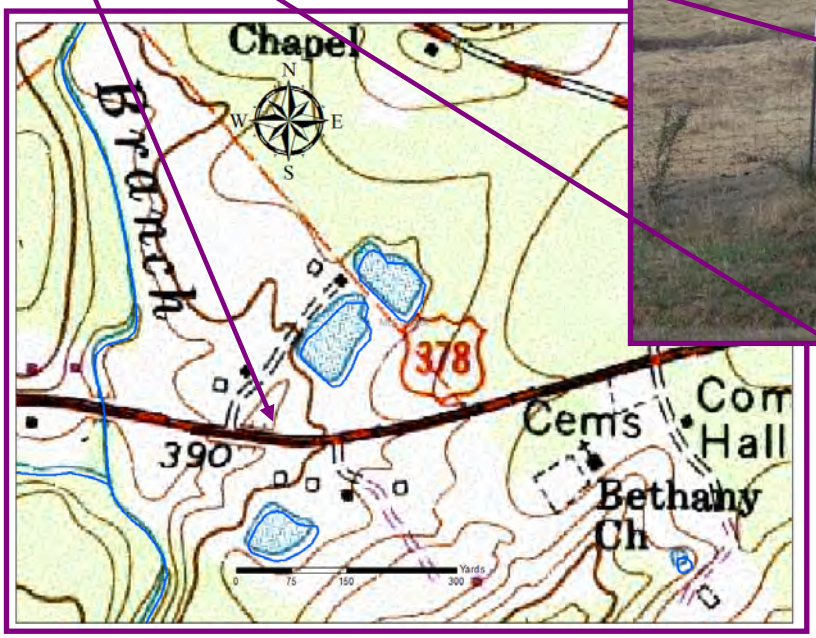


Figure F-6

Geese in a stream-fed pond (location: 33.87284 N, -82.24861 W) on County Route S-33-67 in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 18, 2014).

Figure F-7

Geese in a pasture near a stream-fed pond (location: 33.85367 N, -82.20698 W) on County Route S-33-21 in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 19, 2014).

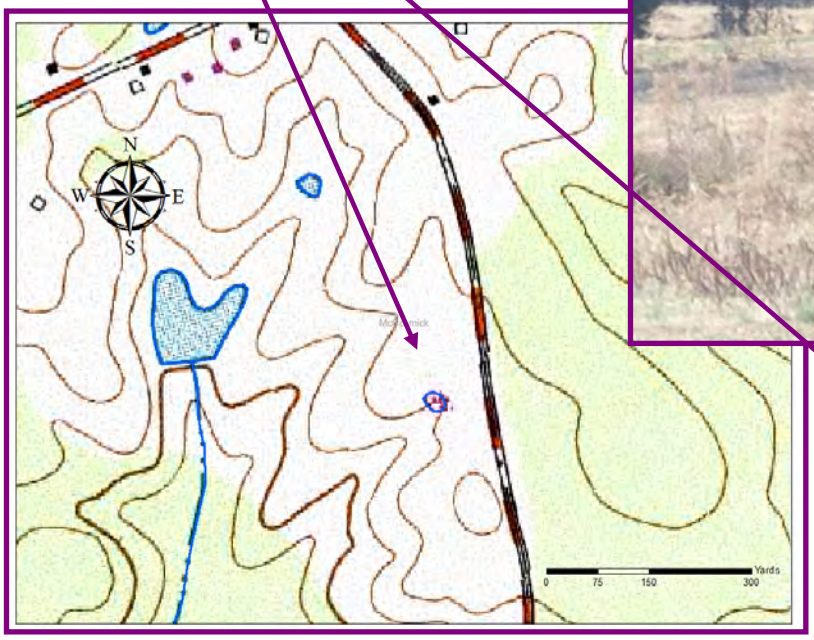


Figure F-8

Cattle in a pasture near WQM Station RS-06016 in Church Branch (location: 34.05317 N, -82.18012 W) on Breezewood Road in Greenwood County. Found in Reach 1 of the SCT Watershed (Date of photography: December 17, 2014).

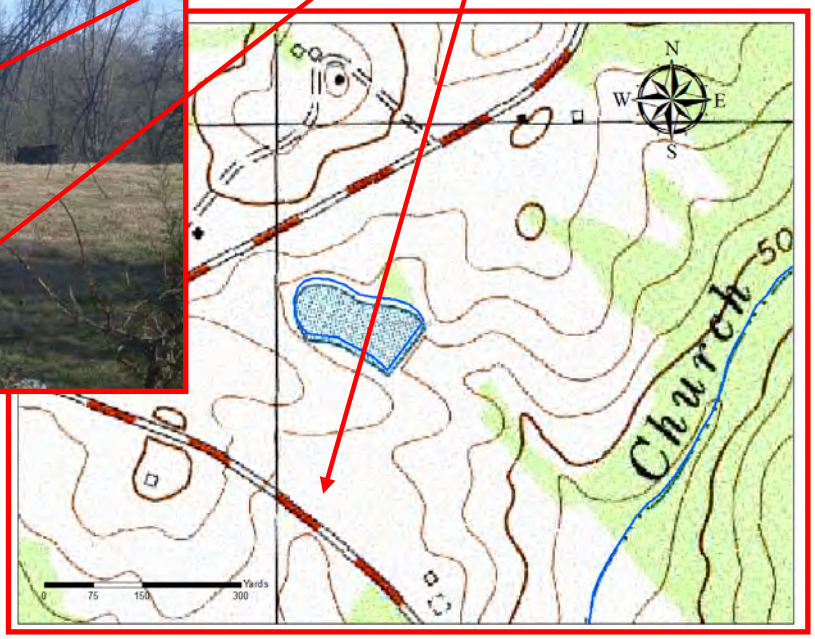


Figure F-9

Cattle in a pasture with stream-fed pond (location: 34.03649 N, -82.13962 W) on Reedy Creek Road in Greenwood County. Found in Reach 2 of the SCT Watershed (Date of photography: December 17, 2014).

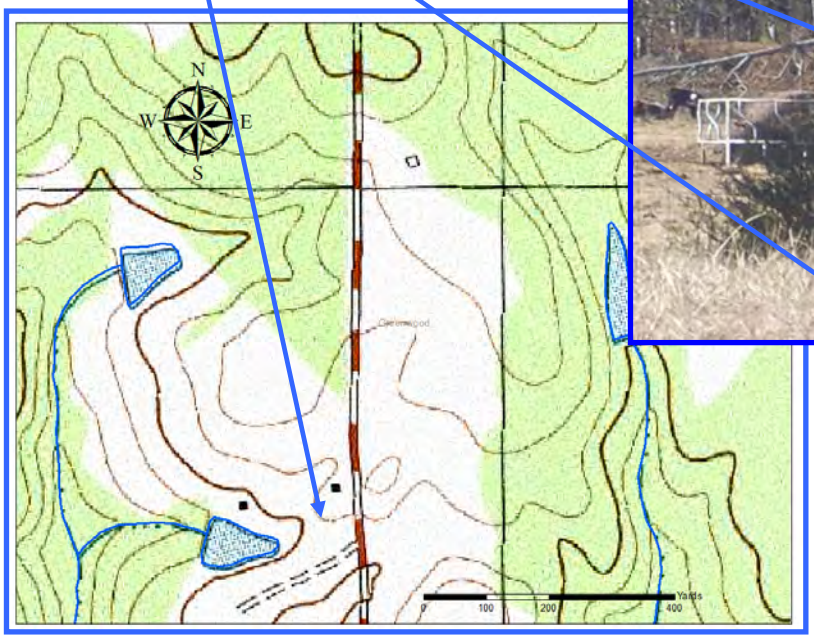


Figure F-10

Cattle in a pasture with Hibbler Branch running through it (location: 33.96808 N, -82.21267 W) on Dowtin Road in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 18, 2014).

Figure F-11

Pastured cattle in the town of Plum Branch (location: 33.84857 N, -82.25581 W) on Edgefield Street in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 19, 2014).

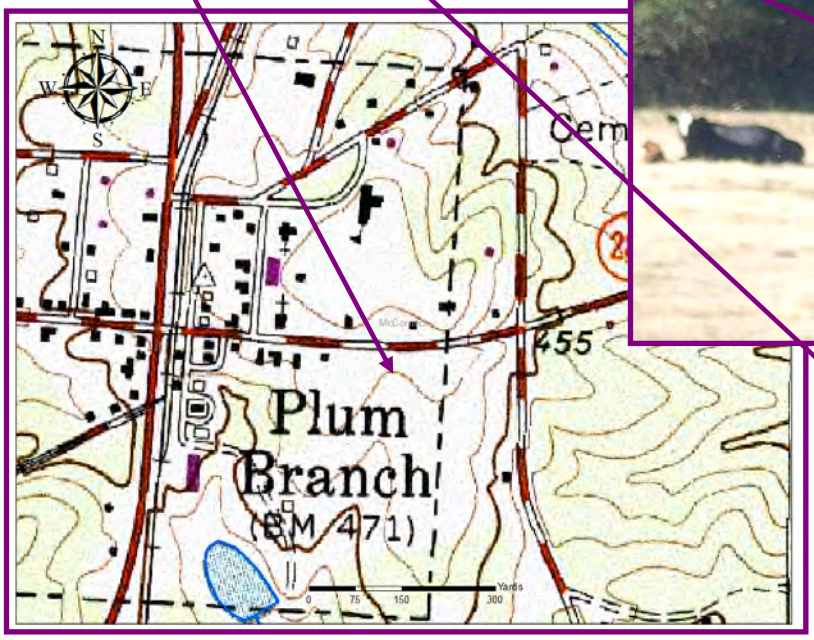


Figure F-12

Horse in a pasture (location: 34.06221 N, -82.15144 W) on Breezewood road in Greenwood County. Found in Reach 1 of the SCT Watershed (Date of photography: December 17, 2014).

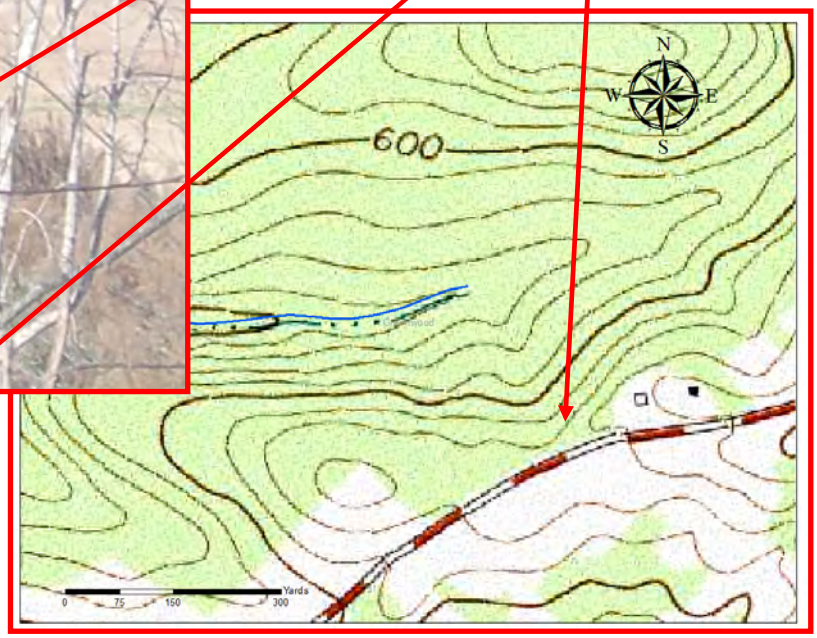


Figure F-13

Horses in a pasture with a pond (location: 34.02535 N, -82.12808 W) on Callison Road in Greenwood County. Found in Reach 2 of the SCT Watershed (Date of photography: December 17, 2014).

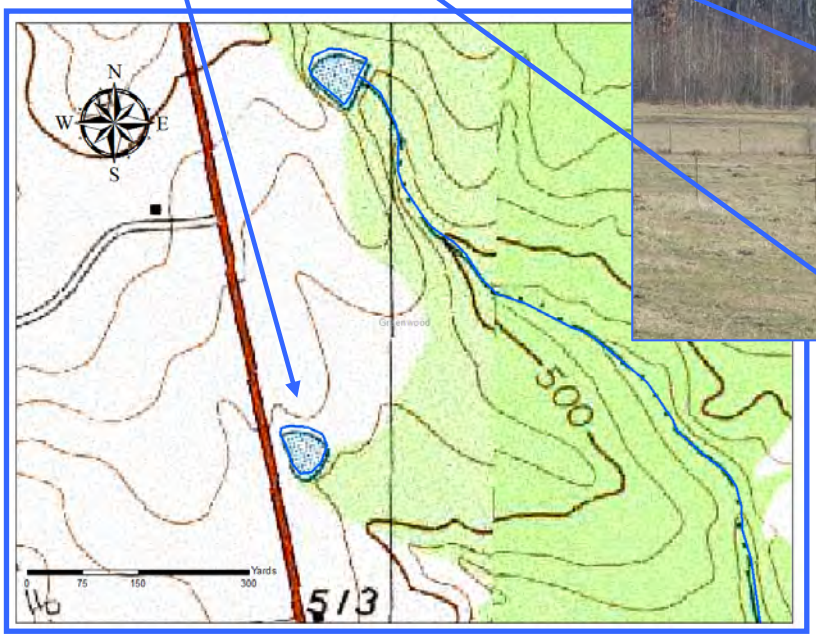


Figure F-14

Pastured horses near Hard Labor Creek (location: 34.06947 N, -82.20081 W) on Whitehall Road in Greenwood County. Found in Reach 3 of the SCT Watershed (Date of photography: December 17, 2014).

Figure F-15

Pony in a pasture (location: 34.05528 N, -82.06871 W) on US Route 25 in Greenwood County. Found in Reach 2 of the SCT Watershed (Date of photography: December 16, 2014).

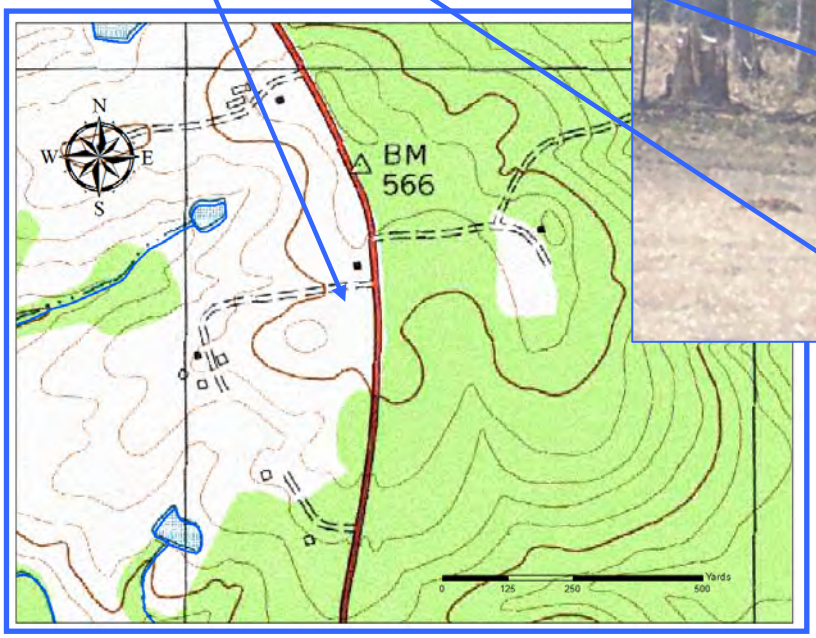


Figure F-16

Pony in a pasture with a donkey (location: 34.00967 N, -82.16476 W) on Rustville Road in Greenwood County. Found in Reach 2 of the SCT Watershed (Date of photography: December 17, 2014).

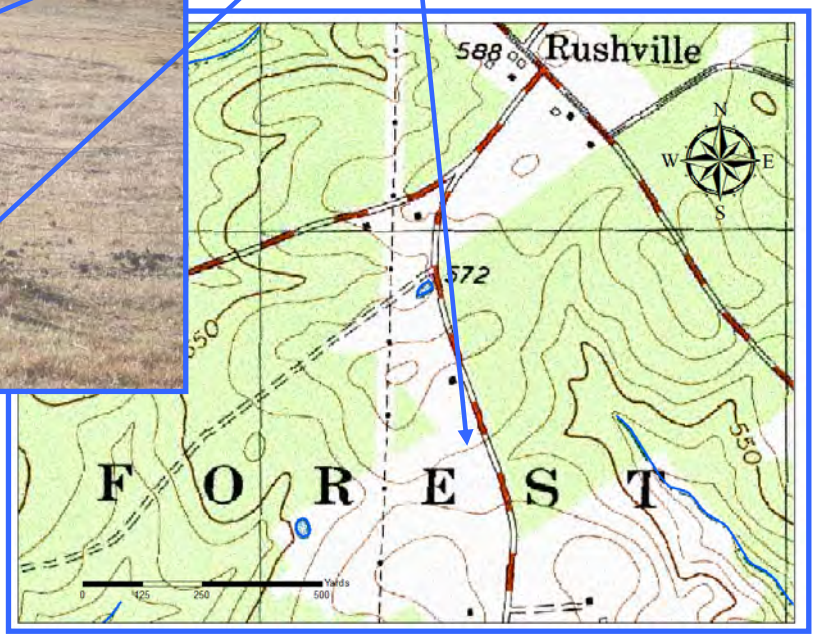


Figure F-17

Donkey in a pasture (location: 34.04446 N, -82.06824 W) on Bruce Road in Greenwood County. Found in Reach 2 of the SCT Watershed (Date of photography: December 16, 2014).

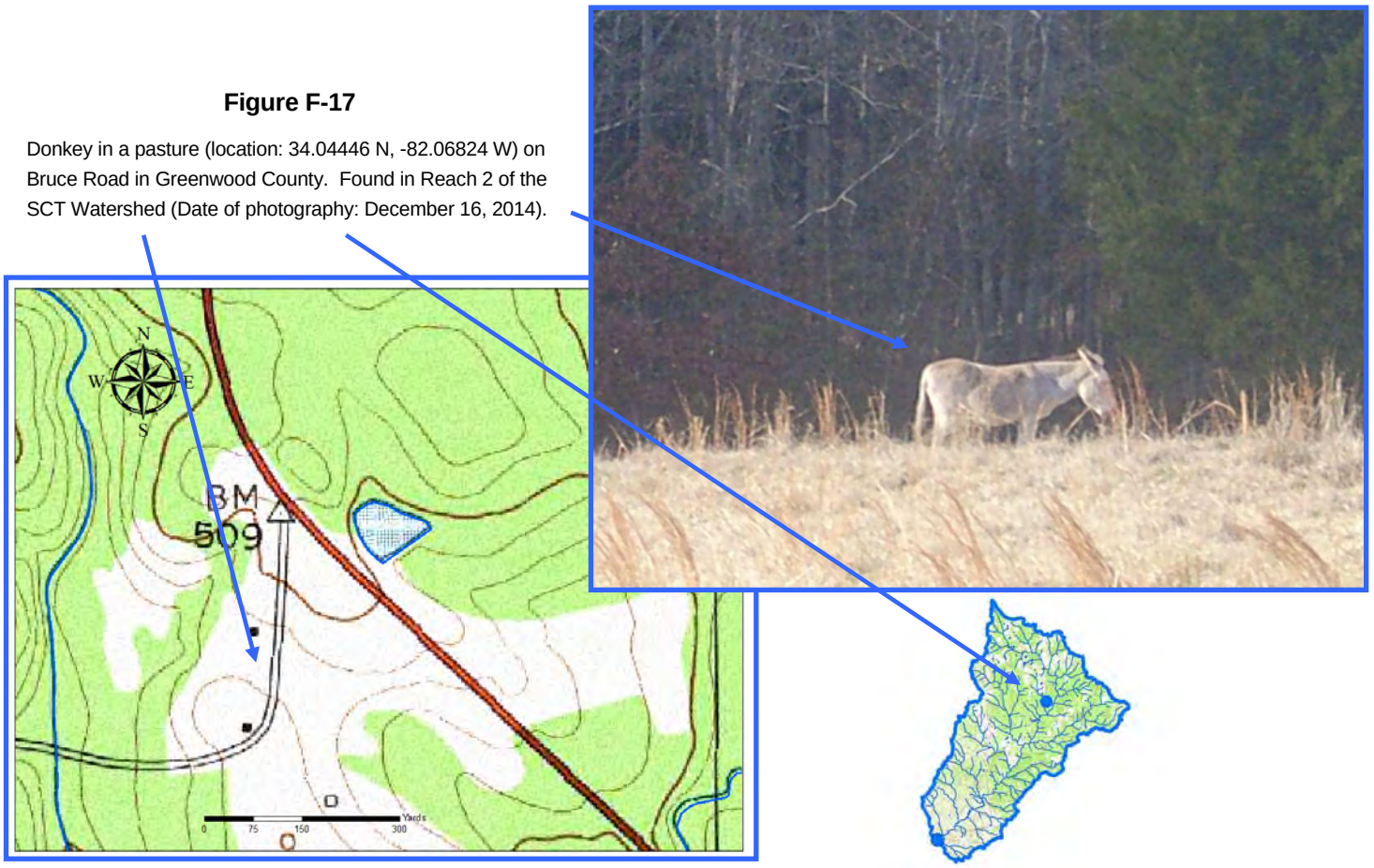


Figure F-18

Donkeys and goats in a pasture (location: 33.94980 N, -82.28573 W) on Bradley Road in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 18, 2014).

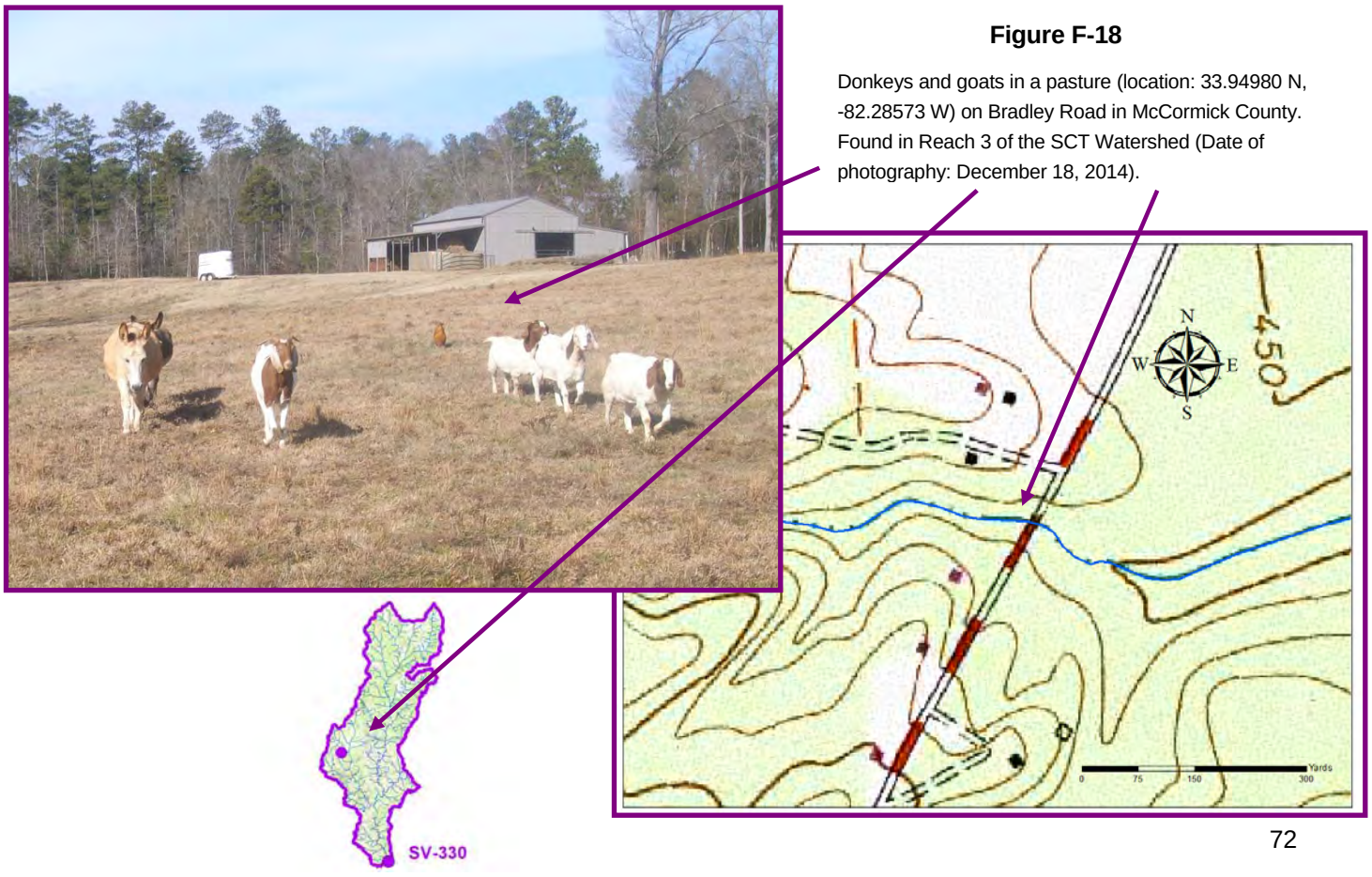
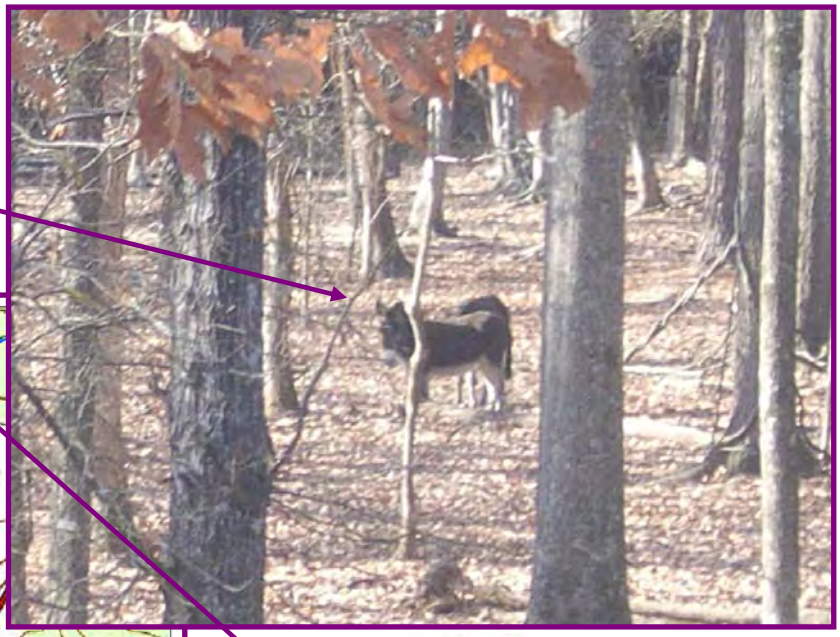


Figure F-19

Pastured donkeys near Rocky Creek (location: 33.93167 N, -82.26592 W) on US Route 221 in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 18, 2014).



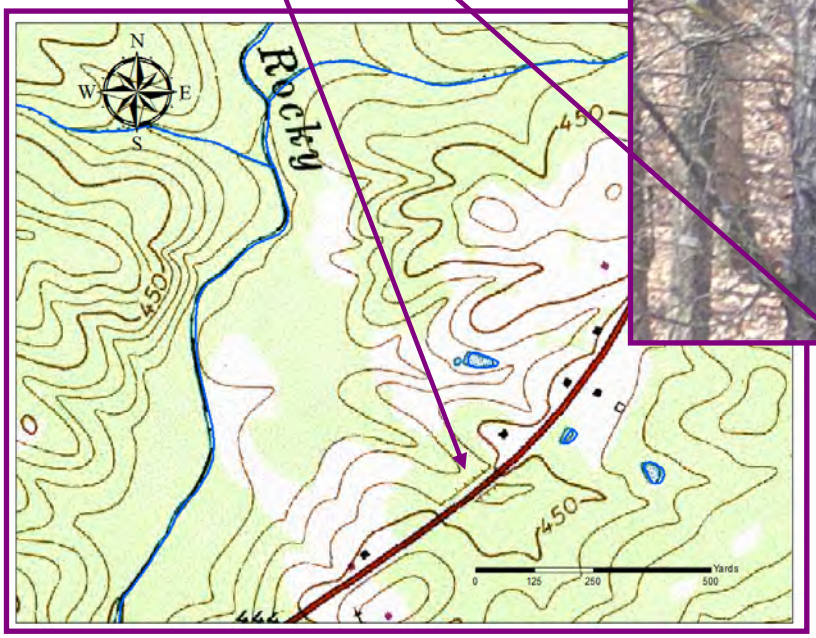


Figure F-20

Pastured goats (location: 34.06815 N, -82.14680 W) on SC Route 67 in Greenwood County. Found in Reach 1 of the SCT Watershed (Date of photography: December 17, 2014).

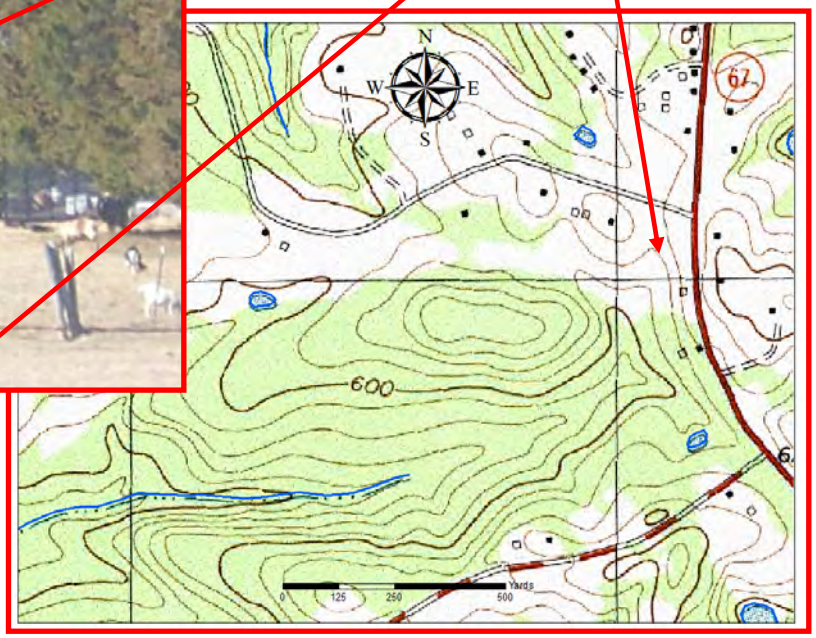


Figure F-21

Pastured goats next to Cuffytown Creek at WQM Station SV-351 (location: 33.92379 N, -82.17923 W) on County Route S-33-138 in McCormick County. Found in Reach 2 of the SCT Watershed (Date of photography: December 18, 2014).

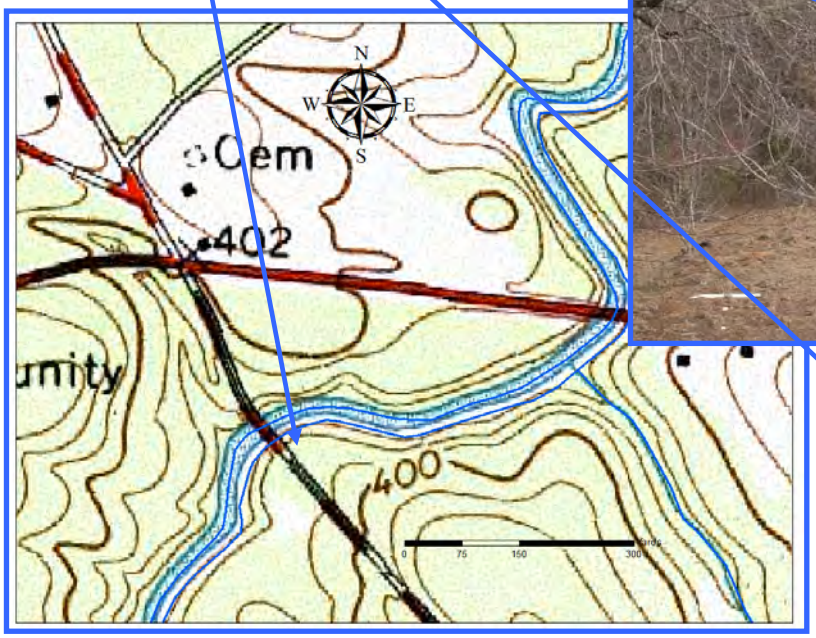


Figure F-22

Goats in a pasture with a pond (location: 33.90830 N, -82.26986 W) on Airport Road in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 18, 2014).

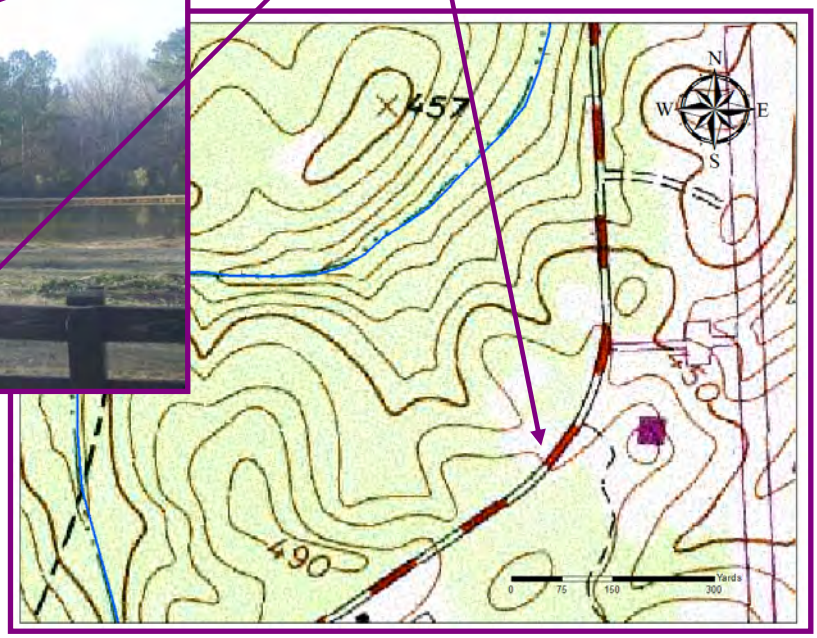


Figure F-23

Unattended dog in a yard (location: 34.03246 N, -82.12937 W) on Callison Road in Greenwood County. Found in Reach 2 of the SCT Watershed (Date of photography: December 17, 2014).

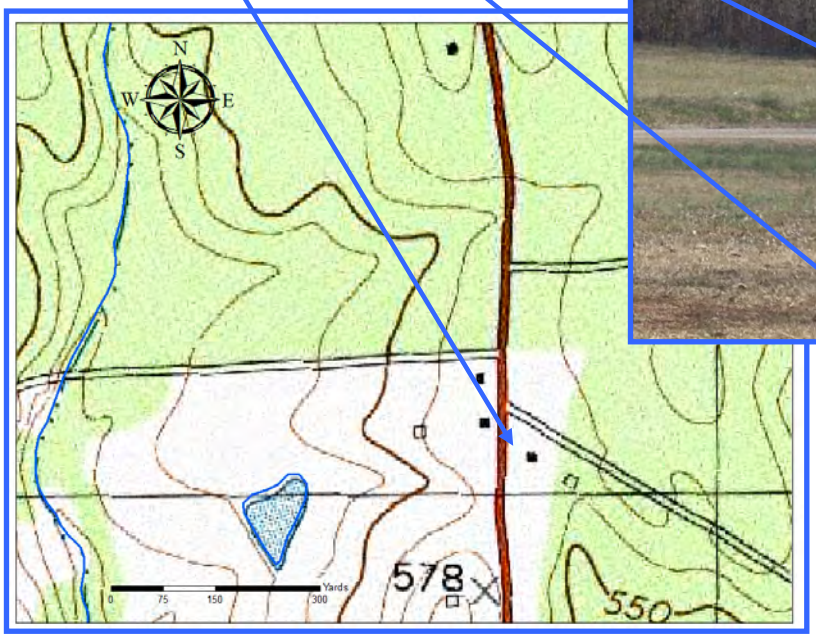


Figure F-24

Unattended dogs in a yard near a stream (location: 33.91585 N, -82.21114 W) on Quarles Wright Road in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 18, 2014).

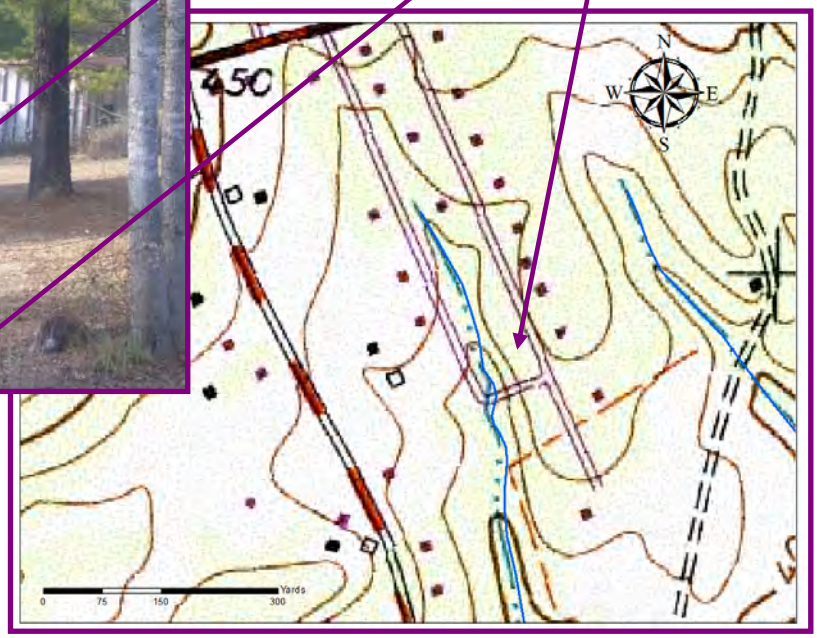


Figure F-25

Unattended dogs in a yard (location: 33.91371 N, -82.28653 W) on South Calhoun Street in McCormick in McCormick County. Found in Reach 3 of the SCT Watershed (Date of photography: December 18, 2014).