Total Maximum Daily Load Document
Turkey Creek and Tributaries
Stations: RS-08068 and SV-352
(Hydrologic Unit Codes: 030601070201, 030601070202, 030601070203, 030601070204, 030601070205, 030601070206, 030601070207, 030601070208,)
Escherichia coli Bacteria,
Indicator for Pathogens

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Prepared for:

Bureau of Water

D H E C

PROMOTE PROTECT PROSPER

Technical Document Number 0406-17

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Photographs on Title Page

Photograph in the foreground: proximity of the South Carolina Department of Health and Environmental Control's (SCDHEC) Water Quality Monitoring Station SV-352 in Turkey Creek at Key Road on the county line for Edgefield and McCormick Counties, SC (date of photography: February 25, 2016). Photograph in the background: proximity of the SCDHEC's Water Quality Monitoring Station RS-08068 in Sleepy Creek at Faulkner Mountain Road in Edgefield County, SC (date of photography: February 18, 2016).

Abstract

§303(d) of the federal *Clean Water Act (CWA)* and the U.S. Environmental Protection Agency's (USEPA) *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-352 and RS-08068, in Turkey Creek and Sleepy Creek, a tributary to Turkey Creek, located in Edgefield County, SC. These two (2) WQM stations were included on the State's final 2012 §303(d) list as impaired due to excessive fecal FC bacteria. Because SC adopted a change from FC bacteria to *Escherichia coli (E. coli)* bacteria as a recreational use standard in all freshwaters, these two (2) WQM stations were included on the State's final 2014 §303(d) list as impaired due to *E. coli.* Accordingly, these two (2) WQM stations 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. Furthermore, these two (2) FC bacteria TMDLs were converted to *E. coli* bacteria TMDLs for purposes of implementation of the current *E. coli* WQS. At least thirteen (13) percent of the samples collected between November 1999 and December 2012 at these two (2) impaired WQM stations exceeded the WQSs.

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 moist or dry depending on which condition demonstrated the highest load reductions necessary to meet WQSs. In order to achieve the target load for the Turkey Creek and tributaries, the following reductions in the existing loads at the respective stations will be necessary: **a)** up to 8% at RS-08068; and, **b)** up to 27% at SV-352. 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 considered 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 considered 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 WQS and the Department is committed towards targeting the load reductions to improve water quality in the Turkey 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 Turkey 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]
Station	FC (cfu/day)	FC (cfu/day)	*E. coli* (MPN/day)[6]	FC (cfu/day)	*E. coli* (MPN/day)[5]	FC (cfu/day)	*E. coli* (MPN/day)[5]	(Percent)	(Percent)	FC (cfu/day)	*E. coli* (MPN/day)[5]	(Percent)
RS-08068	1.09E+11	1.06E+11	*9.21E+10*	5.28E+09	*4.61E+09*	See Note Below	*See Note Below*	8	0[4]	1.00E+11	*8.75E+10*	8
SV-352	1.18E+12	8.98E+11	*7.83E+11*	4.49E+10	*3.92E+10*	See Note Below	*See Note Below*	27	0[4]	8.53E+11	*7.44E+11*	27

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 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. 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* WQSs in freshwaters.

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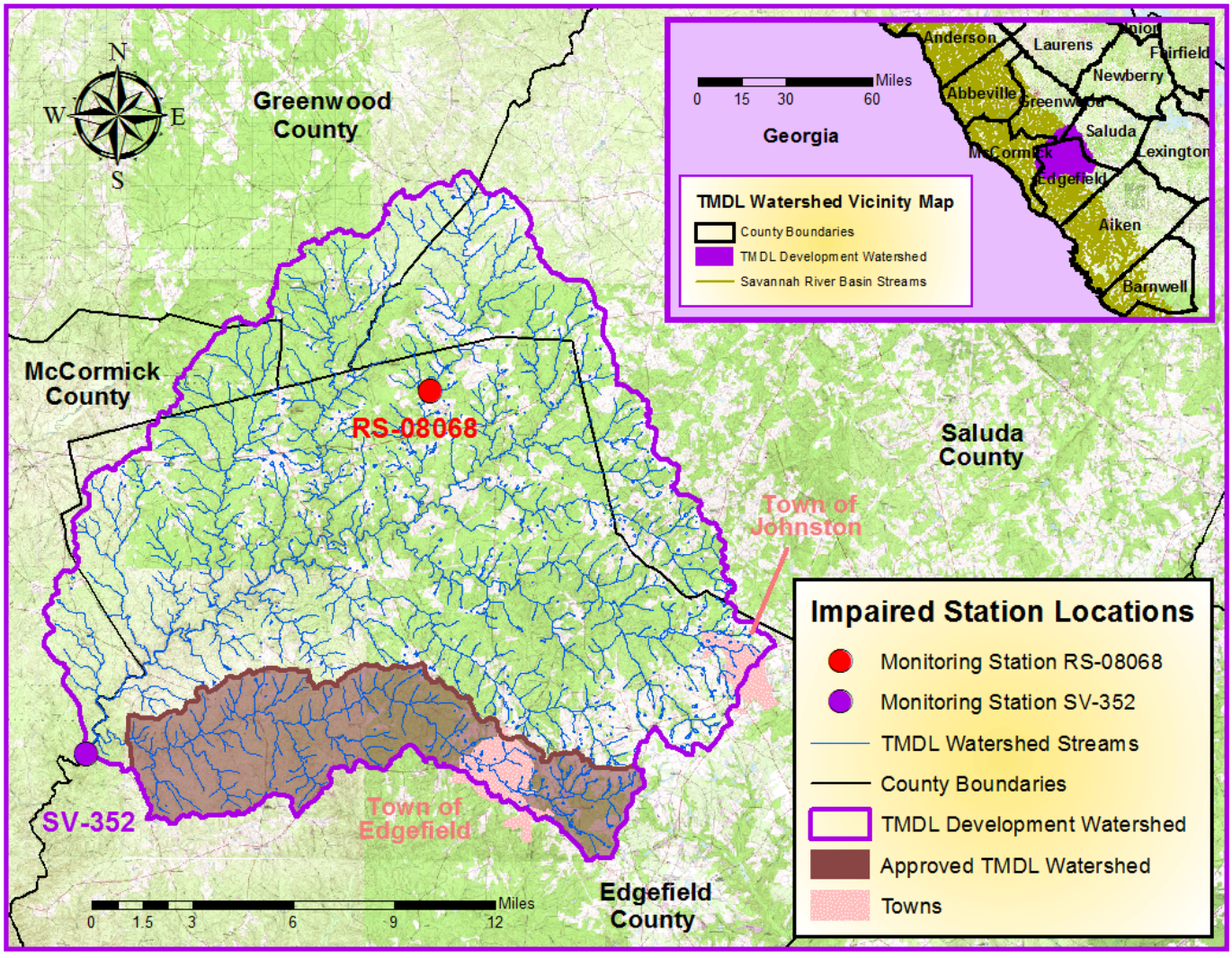
1.0 Introduction

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 (WQSs) are being met. If it is determined that the WQS 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)** Turkey Creek (determined by water quality monitoring results from Water Quality Monitoring (WQM) Station SV-352 in Edgefield County to be impaired); and, **b)** Sleepy Creek, a tributary to Turkey Creek, (determined by results from WQM Station RS-08068 in Edgefield County to be impaired). Because SC adopted a change from FC bacteria to *Escherichia coli (E. coli)* bacteria as a recreational use standard in all freshwaters, these two (2) WQM stations were included on the State's final 2014 §303(d) list as impaired due to *E. coli.* These two WQM stations are identified in Figure 1 and Table 1.

Figure 1. Location of Water Quality Monitoring Stations RS-08068 and SV-352 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 WQSs. 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 WQSs (US EPA, 1999).

Table 1. Turkey Creek and Tributaries Watersheds FC Impaired Waters

Waterbody	Station Number	Description
Sleepy Creek	RS-08068	Sleepy Creek at County Route S-24-375 in Edgefield County
Turkey Creek	SV-352	Turkey Creek at County Route S-33-227/S-19-68 in Edgefield 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).

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-08068 in Sleepy Creek in Edgefield County and WQM Station SV-352 in Turkey Creek in Edgefield County, two (2) WQM stations the SCDHEC placed on South Carolina's final 2012 §303(d) list for impairment due to FC bacteria exceedances. Because SC adopted a change from FC bacteria to *E. coli* bacteria as a recreational use standard in all freshwaters, these two (2) WQM stations were included on the State's final 2014 §303(d) list as impaired due to *E. coli.* Accordingly, this TMDL document also includes converted *E. coli* TMDLs for WQM stations RS-08068 and SV-352, for purposes of implementation of the current recreational use standard.

1.2 Watershed Descriptions

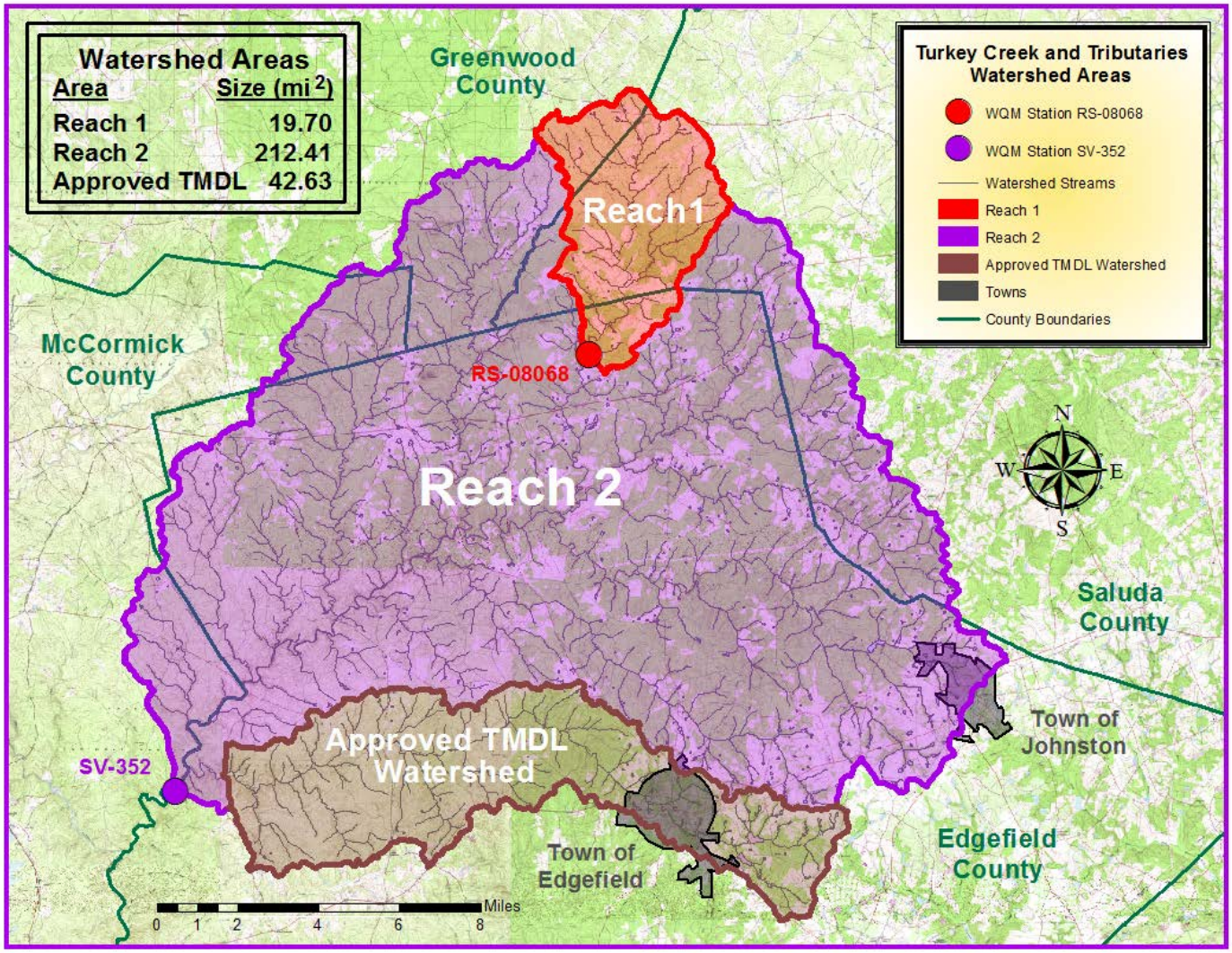
The watersheds for the two (2) aforementioned WQM stations were placed on South Carolina's final 2014 §303(d) list for impairment due to *E. coli* are addressed in this TMDL document. In addition to the watersheds for the two (2) aforementioned WQM stations, the watershed for WQM Station SV-353 in Beaverdam Creek in Edgefield County is addressed. On December 23, 2013, the U.S. Environmental Protection Agency (USEPA) approved an *E. coli* TMDL that was developed internally by the SCDHEC for WQM Station SV-353 (SCDHEC Technical Report No.: 0107-14) (SCDHEC, 2013). The watershed for SV-353 is described in Section 1.3.1 of this TMDL document. All three watersheds are hydrologically connected. Drainage from all three watersheds ultimately flows through WQM Station SV-352. Collectively, the three (3) watersheds are referred to as the Turkey Creek and Tributaries (TCT) Watershed in this TMDL document.

The entire TCT Watershed is 274.73 mi^2 (175,874.04 acres) in size, is located in Edgefield, Greenwood, McCormick, and Saluda Counties in South Carolina, and lies in the Piedmont and Southeastern Plains ecoregions of the State. The general stream flow direction in the TCT Watershed is in the southwestern direction. The upper northern part of the watershed is located primarily in the western portion of Saluda County, and in the southern part of Greenwood County approximately eight (8) miles west of the Town of Saluda. The central to southern part of the watershed is located in primarily in Edgefield County, and

includes the towns of Johnston and Edgefield and the watershed for the TMDL developed for Beaverdam Creek.

The two (2) WQM station watersheds in the TCT Watershed for which TMDLs are developed in this TMDL document are addressed as separate distinct reaches in the TCT Watershed. The two (2) reaches are: **a)** Reach 1 - the watershed draining through WQM Station RS-08068 in Sleepy Creek; and, **b)** Reach 2 - the watershed draining through WQM Station SV-352 in Turkey Creek. The reaches of the TCT Watershed, and the approved TMDL watershed in Beaverdam Creek, are shown in Figure 2.

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

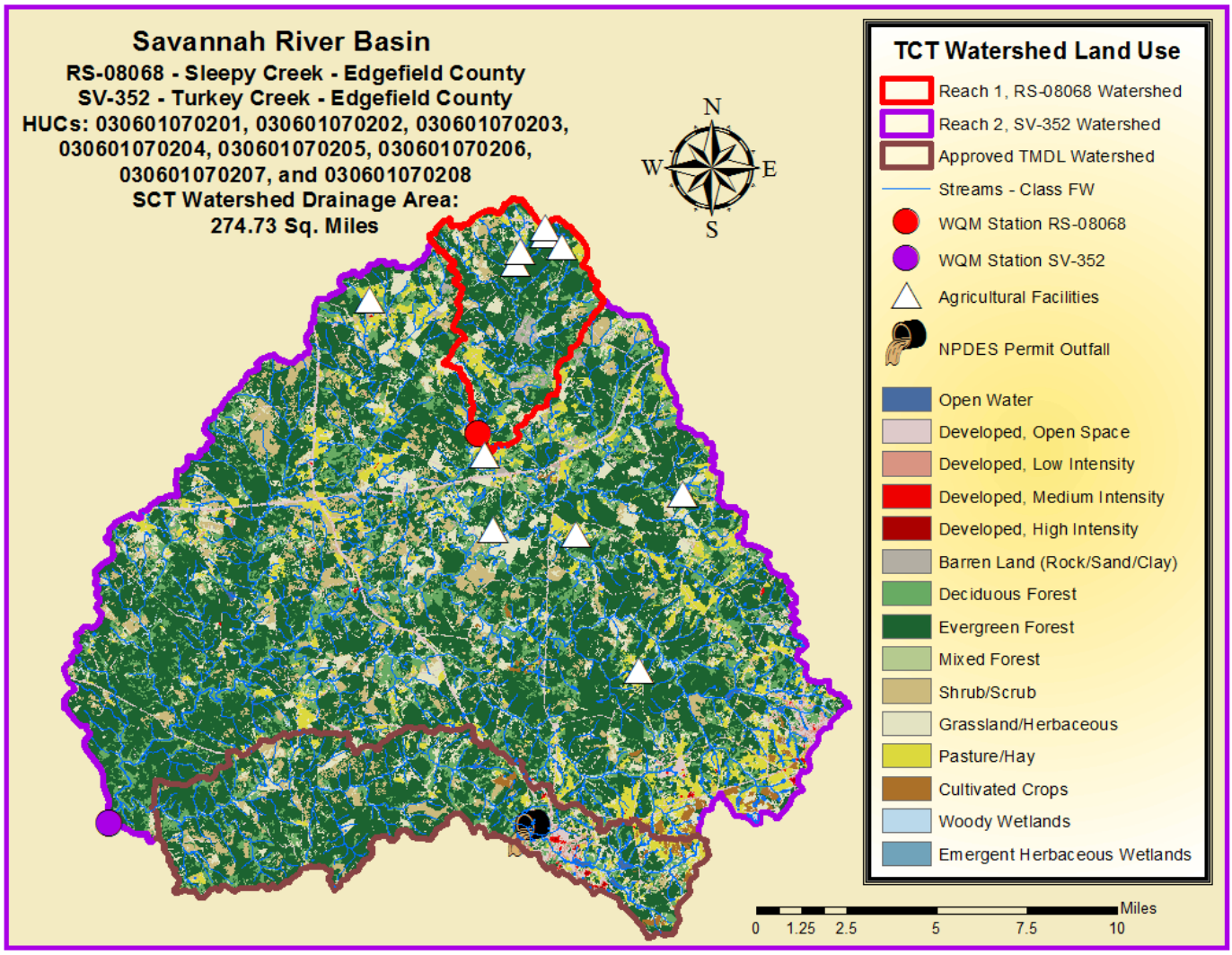


Land use within the entire TCT Watershed is predominately Evergreen Forest (50.63%), and Deciduous Forest (17.26%) (Figure 3a). Following are detailed descriptions for the two (2) reaches in the TCT Watershed.

1.2.1 Reach 1 of the TCT Watershed; Terminal WQM Station RS-08068

Reach 1 of the TCT Watershed covers a drainage area of 19.70 mi^2 (12,644.29 acres) in size. The reach drains into Sleepy Creek and its tributaries from the headwaters of Sleepy Creek in the vicinity of the Saluda and Greenwood County borders, approximately 9 miles west-northwest of the Town of Saluda in Saluda County, in a general southern fashion to impaired WQM Station RS-08068 in Sleepy Creek at County Route S-24-375 in the northern portion of Edgefield County (Figure 2). The reach lies in the Piedmont ecoregion of the State. Land use within Reach 1 of the TCT Watershed is predominately Evergreen Forest (52.88%), and Deciduous Forest (15.05%) (Figure 3b, Table 2a). Developed lands (residential, commercial, industrial, or open urban space) only comprise 4.50% of the reach (Table 3). At the time of development of these TMDLs, there were five (5) active animal feeding operations in the reach (Figure 3b).

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



According to GIS information, there are approximately 50 miles of streams within Reach 1 of the TCT Watershed. The streams are all classified as freshwater (FW). From WQM Station RS-08068, Sleepy Creek flows for approximately 5.7 stream miles to Little Stevens Creek approximately 6.8 miles north north-west of the Town of Edgefield in Edgefield County.

1.2.2 Reach 2 of the TCT Watershed; Terminal WQM Station SV-352

Reach 2 of the TCT Watershed covers a drainage area of 212.41 mi^2 (135,975.00 acres) in size. The reach drains into Turkey Creek and its tributaries from Reach 1 of the watershed and the western border of Saluda County approximately 4.8 miles southwest of the Town of Saluda, in a general southwestern fashion to impaired station SV-352 in Turkey Creek at County Route S-33-227/S-19-68, approximately 11.0 miles west of the Town of Edgefield in Edgefield County (Figure 2). The reach lies in the Piedmont and Southeastern Plains ecoregions of the State.

Land use within Reach 2 of the TCT Watershed is predominately Evergreen Forest (50.07%), and Deciduous Forest (17.64%) (Figure 3c, Table 2b). Developed lands (residential, commercial, industrial, or open urban space) only comprise 4.54% of the reach (Table 3). At the time of the development of these TMDLs, there were six (6) active animal feeding operations in the reach (Figure 3c).

According to GIS information, there are approximately 561 miles of streams within Reach 2 of the TCT Watershed. The streams are all classified as FW. From WQM Station SV-352 flows for approximately 3.6 stream miles to Stevens Creek on the border of Edgefield and McCormick Counties approximately 12.3 miles west of the Town of Edgefield.

Figure 3b. Land Use Diagram for Reach 1 in the Turkey Creek and Tributaries Watershed

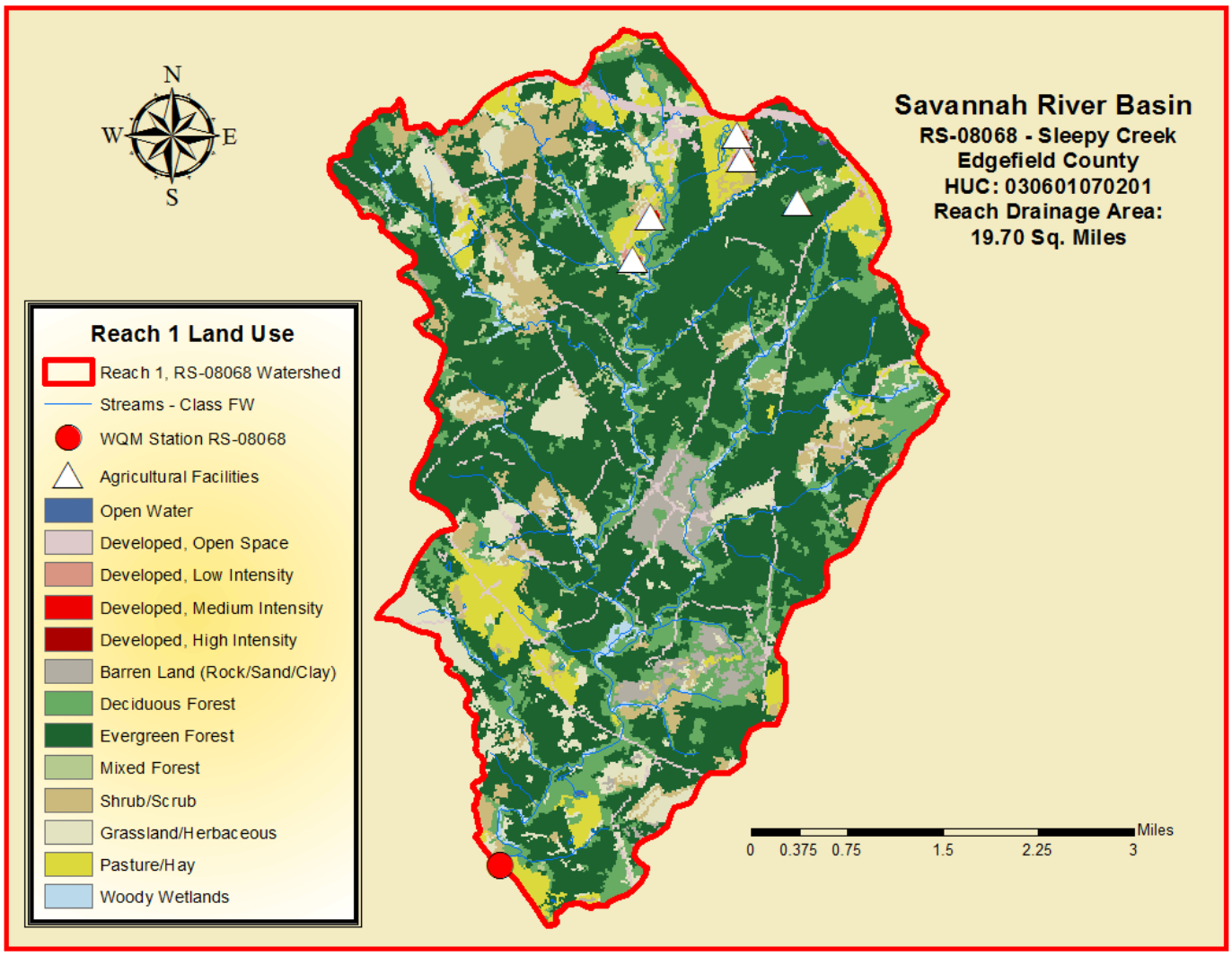


Table 2a. Turkey Creek and Tributaries Watershed: Land Use in Reach 1 (WQM Station RS-08068)
(Derived from National Land Cover Database (NLCD) 2011)

Description	Area (Acres)	Area (Mile^2)	Percent
Evergreen Forest	6669.37	10.42	52.88%
Deciduous Forest	1898.58	2.97	15.05%
Grassland/Herbaceous	1117.31	1.75	8.86%
Pasture/Hay	847.99	1.32	6.72%
Shrub/Scrub	847.32	1.32	6.72%
Developed, Open Space	524.18	0.82	4.16%
Barren Land (Rock/Sand/Clay)	314.91	0.49	2.50%
Woody Wetlands	185.25	0.29	1.47%
Mixed Forest	157.45	0.25	1.25%
Developed, Low Intensity	16.23	0.03	0.13%
Developed, High Intensity	15.79	0.02	0.13%
Developed, Medium Intensity	10.90	0.02	0.09%
Open Water	6.00	0.01	0.05%
Totals	**12,611.29**	**19.70**	**100.00%**

Table 3. Developed Areas from Reach to Reach in the Turkey 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 the headwaters of Sleepy Creek in the vicinity of the Greenwood and Saluda County borders, approximately 9 miles west-northwest of the Town of Saluda, to impaired station RS-08068 in Sleepy Creek at County Route S-24-375 in the northern portion of Edgefield County.	19.70	0.89	4.50%
2	From Reach 1 of the TCT Watershed and the western border of Saluda County, approximately 4.8 miles southwest of the Town of Saluda, to impaired station SV-352 in Turkey Creek at County Route S-33-227/S-19-68, approximately 11.0 miles west of the Town of Edgefield in Edgefield County.	274.73	9.64	4.54%
All	*Total for All Reaches	294.43	10.53	3.58%

*The total area does not include the area of the approved TMDL watershed for WQM Station SV-353.

Figure 3c. Land Use Diagram for Reach 2 in Turkey Creek and Tributaries Watershed

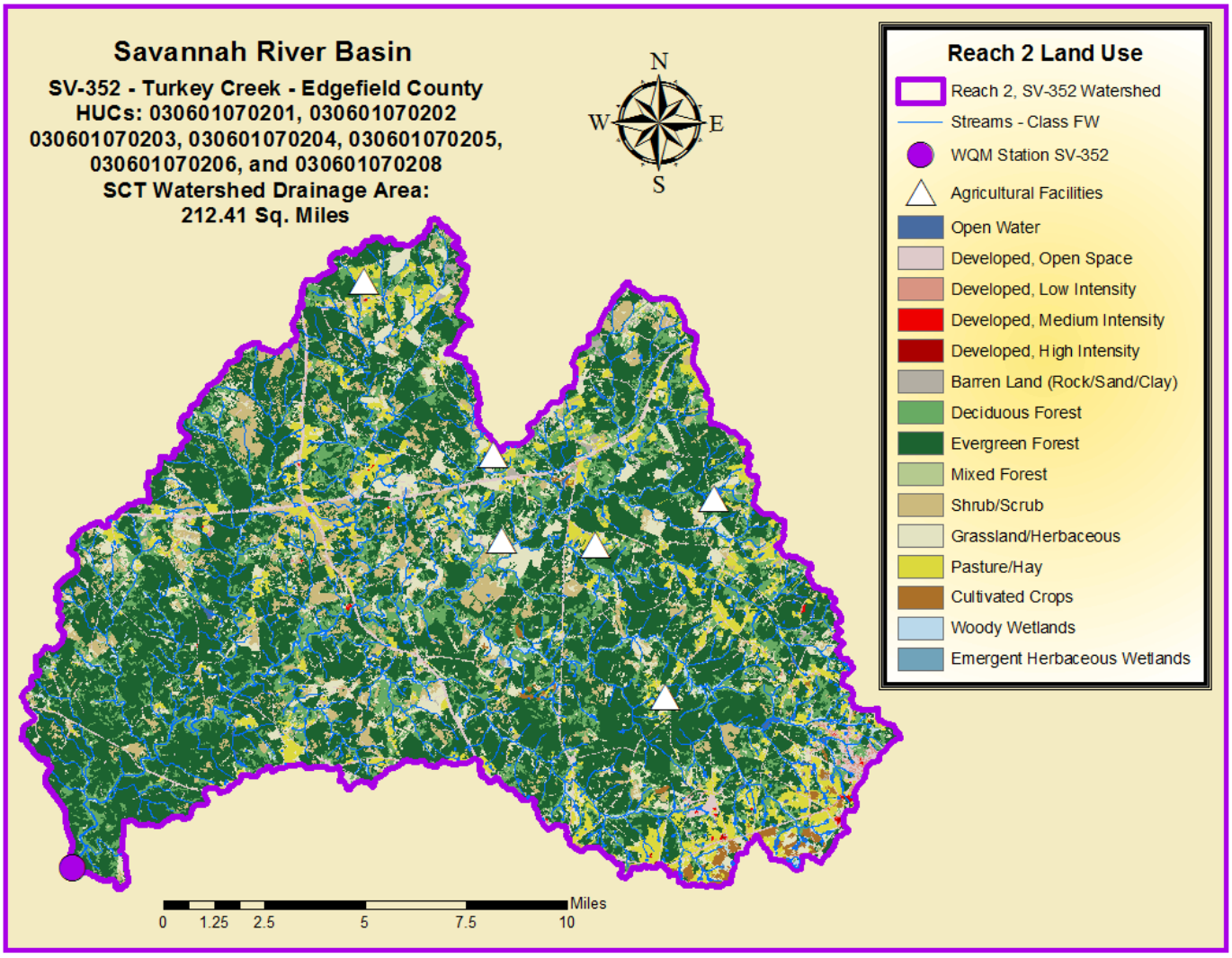


Table 2b. Turkey Creek and Tributaries Watershed: Land Use in Reach 2 (WQM Station SV-352) (Derived from National Land Cover Database (NLCD) 2011)

Description	Area (Acres)	Area (Mile^2)	Percent
Evergreen Forest	68,080.13	106.35	50.07%
Deciduous Forest	23,987.19	37.47	17.64%
Grassland/Herbaceous	12,398.46	19.37	9.12%
Shrub/Scrub	9677.92	15.12	7.12%
Pasture/Hay	9471.31	14.80	6.97%
Developed, Open Space	5467.78	8.54	4.02%
Woody Wetlands	2596.89	4.06	1.91%
Mixed Forest	1434.00	2.24	1.05%
Cultivated Crops	810.85	1.27	0.60%
Barren Land (Rock/Sand/Clay)	691.20	1.08	0.51%
Open Water	606.02	0.95	0.45%
Developed, Low Intensity	542.64	0.85	0.40%
Developed, Medium Intensity	124.76	0.19	0.09%
Emergent Herbaceous Wetlands	48.48	0.08	0.04%
Developed, High Intensity	37.36	0.06	0.03%
Totals	**135,975.00**	**212.41**	**100.00%**

1.3 Existing Total Maximum Daily Load for Beaverdam Creek

1.3.1 Watershed Description for the Beaverdam Creek TMDL Watershed

The watershed for WQM Station SV-353 covers a drainage area of 42.63 mi^2 (27,287.74 acres) in size that drains into Beaverdam Creek and its tributaries from the headwaters of Beaverdam Creek approximately 2.7 miles east of the Town of Edgefield in Edgefield County, in a general western fashion to WQM Station SV-353 in Beaverdam Creek at Forest Service Road 621 off County Route S-19-68, approximately 10.0 miles west of the Town of Edgefield in Edgefield County (Figure 2). The northern border of the watershed joins the southern border of Reach 2 in the TCT Watershed (terminal WQM Station SV-352).

The watershed for WQM Station SV-353 lies in the Piedmont and Southeastern Plains ecoregions of the State. According to the 2011 NLCD, land use within the watershed is predominately Evergreen Forest (52.36%), and Deciduous (16.36%) (Figure 3a). According to GIS information, there are approximately 123 miles of streams within the watershed. The streams are all classified as FW. Flows within the watershed for WQM Station SV-353 in the TCT Watershed penultimately flow through WQM Station SV-353, and ultimately flow through WQM Station SV-352.

1.3.2 2013 TMDL Development for Beaverdam Creek (Terminal WQM Station SV-353)

The SCDHEC placed WQM Station SV-353 in Beaverdam Creek in Edgefield County on the State's 2012 §303(d) list due to excessive fecal FC bacteria. Also during 2012, the SCDHEC adopted a change of its pathogen indicator from FC bacteria to *E. coli* bacteria. The change in pathogen indicator bacteria was adopted after the SCDHEC designed a Pathogen Indicator Study (PIS) and conducted the study during 2009 to determine which pathogen indicator bacteria was better suited in South Carolina as the recreational use WQS in fresh waters. The new WQS was approved by EPA on February 28, 2013. Therefore, starting with the effective date of February 28, 2013, *E. coli* bacteria was the new pathogen indicator for recreational use in freshwaters (also see Section 2.0 of this TMDL document).

Accordingly, on December 23, 2013, the USEPA approved an *E. coli* bacteria TMDL for WQM Station SV-353, that was developed internally by the SCDHEC using E. *coli* bacteria data collected from January 5, 2009 to December 29, 2009 during the PIS (SCDHEC Technical Report No.: 0107-14) (SCDHEC, 2013). Table 4 summarizes the sampling data supporting the USEPA approved 2013 TMDL for WQM Station SV-353.

Table 4. *E. coli* Bacteria Observed at WQM Station SV-353 (2009-2009)[1]

Station	Waterbody	Number of Samples	Maximum Concentration MPN/100 mL	Number of Samples >349/100 mL	% Samples Exceed WQS
SV-353	Beaverdam Creek	52	2452.4	9	17%

[1]Source: South Carolina Department of Health and Environmental Control (SCDHEC). 2013

The 2013 *E. coli* bacteria TMDL for WQM Station SV-353 in Beaverdam Creek identified moist conditions as the critical conditions, i.e., the stream flow conditions requiring the greatest percentage of *E. coli* bacteria loading reduction to meet the LA in the TMDL. A 24% reduction was established to meet the LA. The 2013 TMDL for WQM Station SV-353 also established an *E. coli* bacteria WLA for the Edgefield County Water and Sewer Authority's Brook Street facility, a domestic wastewater treatment facility (WWTF) discharging into Beaverdam Creek (authorized under the SCDHEC's NPDES Permit No. SC0025330). Extreme high and low flow conditions were not evaluated during the 2013 TMDL. Table 5 gives the components of the 2013 *E. coli* bacteria TMDL.

Table 5. Total Maximum Daily Load for Beaverdam Creek, September 2013[1]

Station	Existing *E. coli* Load (MPN/day)[2]	TMDL (MPN/day)	Margin of Safety (MOS) (MPN/day)	Waste Load Allocation (WLA) (MPN/day)[3]	Load Allocation (LA) (MPN/day)	Reduction To Meet LA (Percent)	Reduction to Meet LA (MPN/day)	Critical Condition
SV-353	1.76+11	1.50E+11	7.32E+09	9.60E+09	1.33E+11	24	4.30E+10	Moist

[1]Source: SCDHEC. 2013.
[2]Existing *E. coli* bacteria Load (MPN/day) at the time of TMDL development in September 2013.
[3]*E. coli* bacteria discharges authorized under the SCDHEC's NPDES Permit No. SC0025330, issued for the Edgefield County Water and Sewer Authority's Brook Street WWTP .

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 municipal separate storm sewer system (MS4) jurisdictional boundaries. According to the SCDHEC's Nonpoint Source Coordinator, as of the time of the development of these TMDLs, no *CWA* §319 grants had been awarded for activities in the watershed for WQM Station SV-353.

1.4 Water Quality Standard

The impaired stream segments of the Turkey Creek and tributary basins are designated as Class 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 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 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 WQS in fresh waters, the SCDHEC designed a 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 WQS 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 were 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 two (2) monitoring locations within the watersheds described earlier in this document. The two (2) monitoring sites (WQM Stations RS-08068 and SV-352) were included in the State's

final 2012 §303(d) list due to excessive fecal FC bacteria. Because of the aforementioned WQS change from FC bacteria to *E. coli* bacteria, these two (2) stations were then listed on the final 2014 §303(d) list as impaired due to *E. coli.* For recreational use, if greater than 10% of the monthly geometric mean of available data collected during an assessment period exceeds the criterion, the station is included on South Carolina's §303(d) list. If there are not an adequate number of monthly samples to calculate a geometric mean, then the available sample results are compared against the SSM criterion. If greater than 10% of these samples exceed this criterion then the station is included on South Carolina's §303(d) list due to recreational use. 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 parameter of concern. As discussed previously, this TMDL document addresses the development of FC bacteria TMDLs for two of these two (2) impaired WQM stations in the TCT Watershed (i.e., WQM stations RS-08068 and SV-352) based on FC bacteria samples. This TMDL document also addresses the conversion of these two FC bacteria TMDLs to *E. coli* bacteria TMDLs for purposes of the current *E. coli* WQS. Table 6 provides a summary of number of FC bacteria samples collected, number of exceedences and exceedence percentages.

Table 6. FC Bacteria WQS Exceedence Summary for Impaired Stations (1999-2012)

Station	Waterbody	Number of Samples	Number of Samples >400/100mL	% Samples Exceed WQS
RS-08068	Sleepy Creek	10	3	30%
SV-352	Turkey Creek	133	17	13%

Figure 4 illustrates precipitation and FC by data and date for WQM Station SV-352. The graph and Table 7 show that there is a weak positive relationship between the amount of precipitation and the temporal FC exceedences of WQSs (r = 0.256). The graphs for precipitation and FC by data and date for WQM Station RS-08068 is shown in Appendix A. The relationship between the amount of precipitation and the temporal FC exceedences of WQSs for WQM Station RS-08068 is undefined since the amount of rain did not change during the sampling period.

Figure 4. Precipitation and FC Data by Date for Water Quality Monitoring Station SV-352

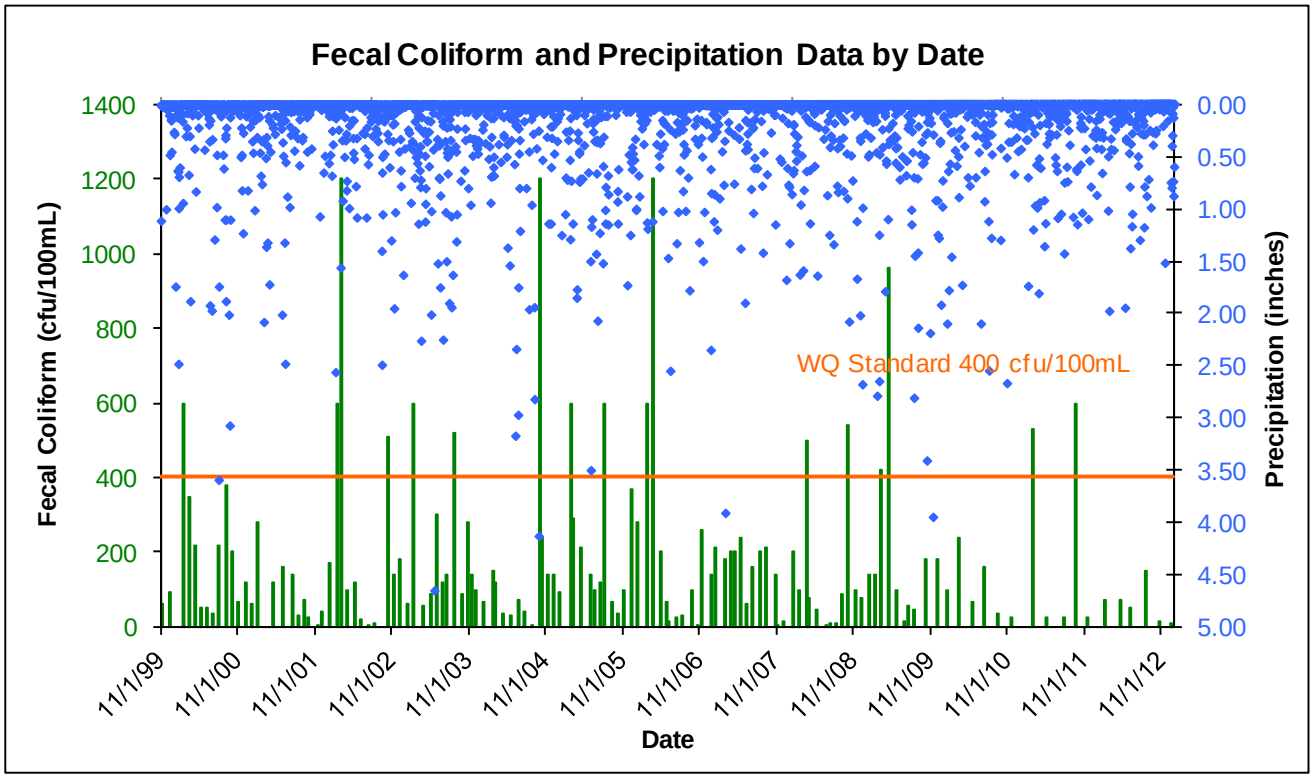


Table 7. Correlations Between Rainfall and FC in the Turkey Creek and Tributaries Watershed

Station	Waterbody	Correlation Coefficient (r)	Coefficient of Determination (r^2)
RS-08068	Sleepy Creek	0.256	0.065
SV-352	Turkey Creek	U[1]	U[1]

[1]Undefined: The term is undefined since the amount of rainfall did not change during the sampling period.

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

The SCDHEC 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* was 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.

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 WWTFs, 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 WWTFs may occasionally be sources of pathogens. However, if these facilities are discharging wastewater that meets their permit limits, then these facilities 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 WQS as prescribed in Section 5 of this TMDL document and required in their MS4 permits, then these entities should not be causing or contributing to an instream pathogen impairment.

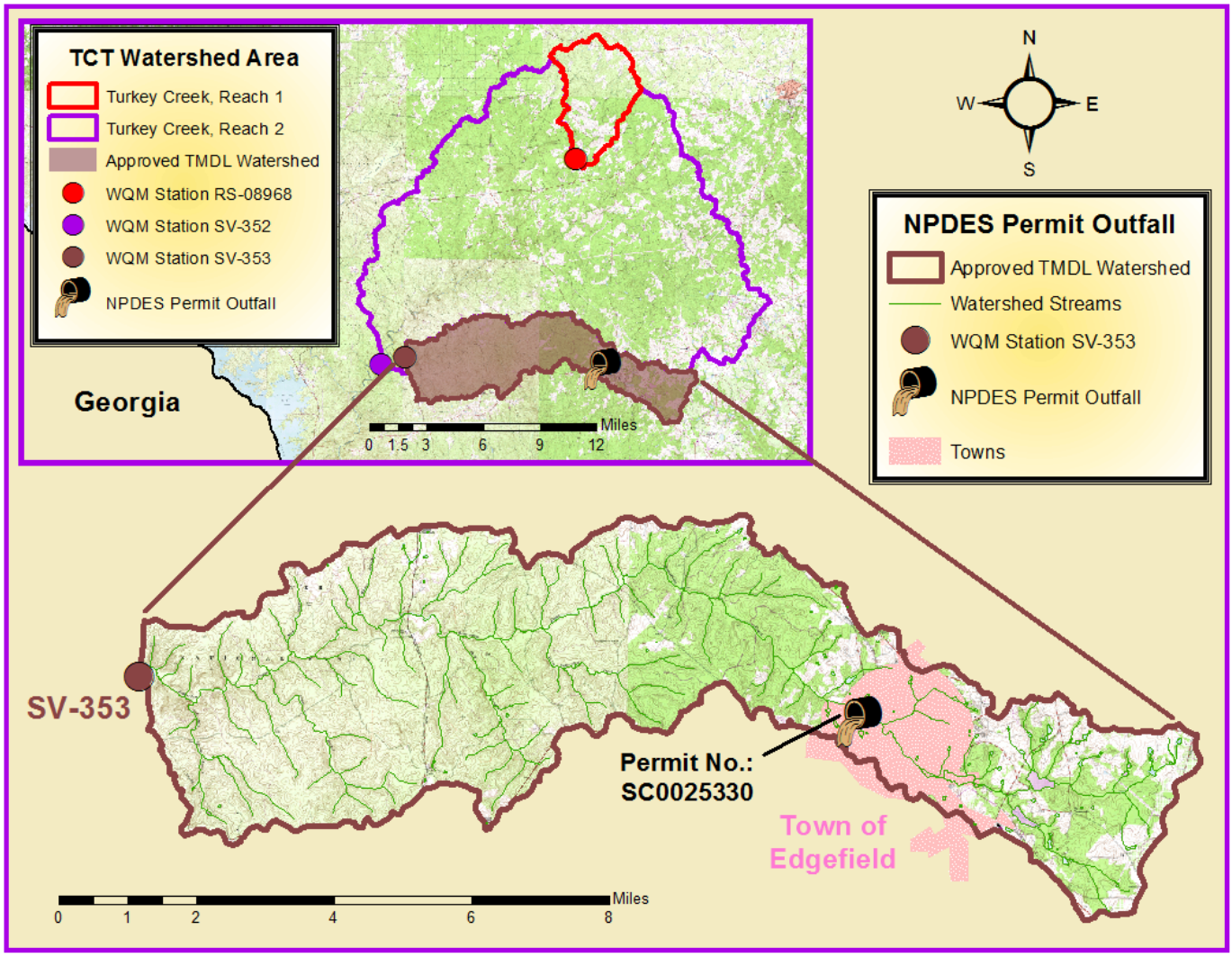
3.1 Point Sources

Point sources are defined as pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal WWTFs, 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 one (1) NPDES permitted continuous point source in the TCT Watershed authorized to discharge *E. coli* bacteria. The point source is located in the approved 2013 TMDL watershed in the Beaverdam Creek (WQM Station SV-353). The point source is the Edgefield County Water and Sewer Authority's Brook Street facility, a domestic WWTP located at the corner of Brooks and Bauskett Streets in the western portion of the Town of Edgefield in Edgefield County (Figure 5 and Table 8). The facility is authorized under the SCDHEC's NPDES Permit SC0025330 to discharge up to 0.725 MGD of treated wastewater to Beaverdam Creek. For the purposes of developing the current TCT *E. coli* TMDL document, a TMDL WLA is not being provided for this facility. The permitted flow for the facility has not changed since March 1, 2013 and, consequently, the previously-prescribed WLA is still considered appropriate for *E. coli* bacteria. Note that future sections in this TCT *E. coli* TMDL document will no longer reference the Brook Street facility as a discharger of *E. coli* bacteria since the facility is included in the approved 2013 Beaverdam Creek *E. coli* bacteria TMDL document.

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



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

Table 8. NPDES Permitted *E. coli* Discharge in the Turkey Creek and Tributaries Watershed

Impaired Station Watershed	Permitted Facility	NPDES Permit Number	Permit Type	Permit Limitation (*E. coli* x Unit/Volume)	Permitted Flow (MGD)	Outfall Stream
SV-353	Edgefield County Water and Sewer Authority's Brook Street WWTP	SC0025330	Minor	349 MPN/mL	0.725	Beaverdam Creek

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 these TMDLs.

There are two (2) regulated MS4s in the TCT Watershed: **a)** The South Carolina Department of Transportation (SCDOT); and, **b)** Edgefield County. The SCDOT is the only large MS4 in the watershed. There are no medium MS4s in the watershed. The other MS4, Edgefield County, is a small MS4. The SCDOT operates under the SCDHEC's NPDES MS4 Permit SCS040001 and owns and operates roads within all of the watersheds in the TCT Watershed (Figure 6 and Table 9). However, the Department recognizes that SCDOT is not a traditional MS4 in that it does not possess statutory taxing or has enforcement powers. SCDOT does not regulate land use or zoning, issue building or development permits.

Current developed land use for the TCT Watershed reaches range from 4.50% to 4.54% (Table 3). Based on GIS information, the SCDOT has a facility in the Approved TMDL Watershed (terminal WQM Station SV-353), located on US 25 approximately 0.25 miles north of the Town of Edgefield in Edgefield County. There are no other SCDOT facilities in the TCT Watershed. And, based on the SCDOT website, there are no highway rest areas in the watershed.

Small MS4s that discharge stormwater in urbanized areas, as designated by the U.S. Bureau of Census, are regulated under SC *Water Pollution Control Permits* Regulation 122.26(b)(16) and 122.32. Urbanized areas in the TCT Watershed are shown in Figure 7. Edgefield County, a small MS4, discharges stormwater in urbanized areas in Reaches 2 of the TCT Watershed, and discharges stormwater in the Approved TMDL Watershed (terminal WQM Station SV-353) (Figure 7). However, at the time of development of the TMDLs addressed in this TMDL development document (i.e., terminal WQM Stations RS-08068 and SV-352), the county had not obtained coverage under an NPDES permit from the SCDHEC for stormwater discharges from small MS4s. Thus, Edgefield County will be subject to the LA component of the TMDL until such time the small MS4 obtains NPDES permit coverage.

Other than the above mentioned MS4 owned and/or operated storm sewer systems, there are currently no permitted stormwater systems that discharge into the TCT Watershed. 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 the TMDLs in the TMDL development document.

Industrial facilities that have the potential to cause or contribute to a violation of a WQS are covered by the NPDES Storm Water Industrial General Permit (SCR000000). Construction activities are usually covered by the NPDES Storm Water Construction General Permit from 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 WLAs 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.

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

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

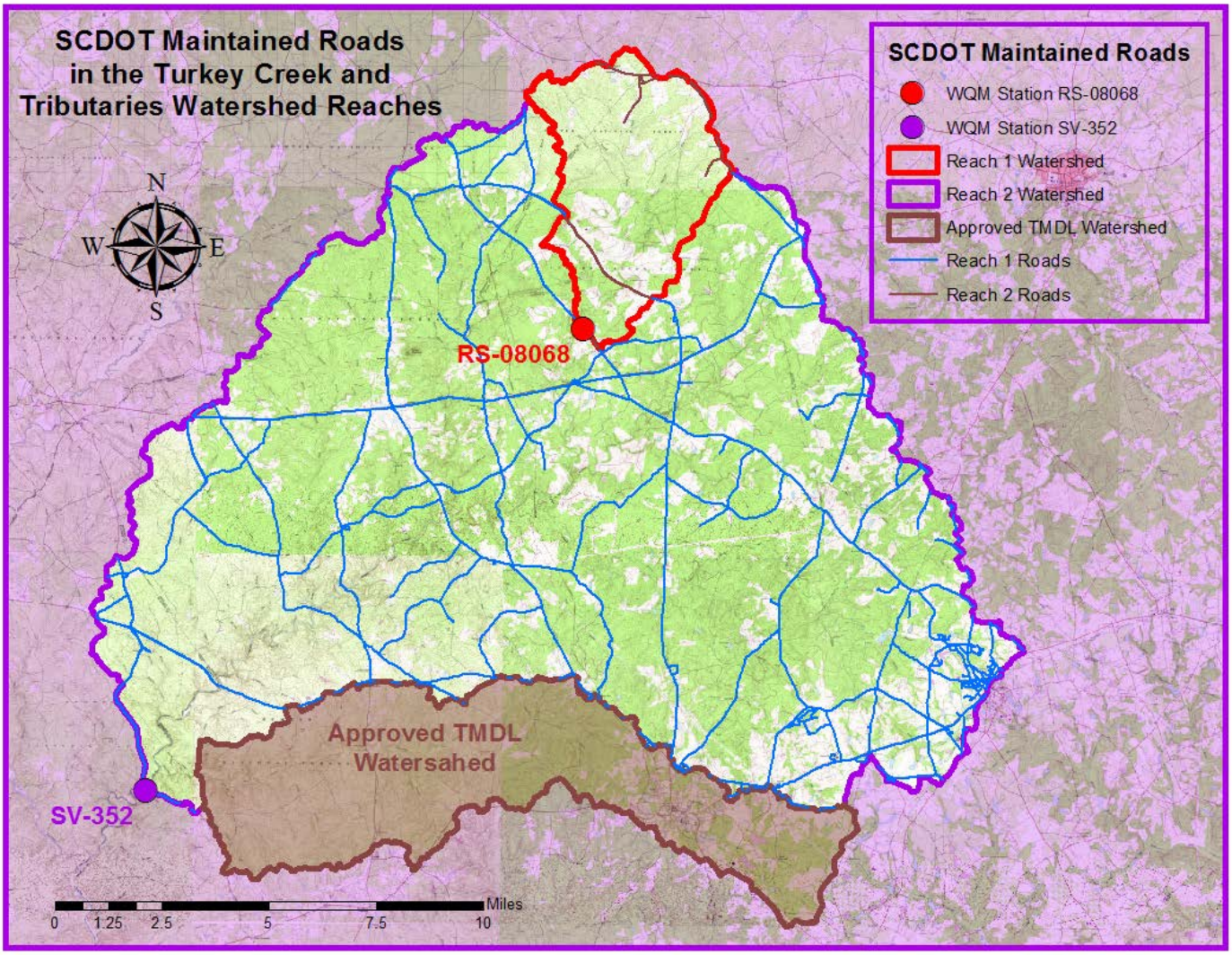


Table 9. SCDOT Maintained Road Miles in the Turkey Creek and Tributaries Watershed Reaches

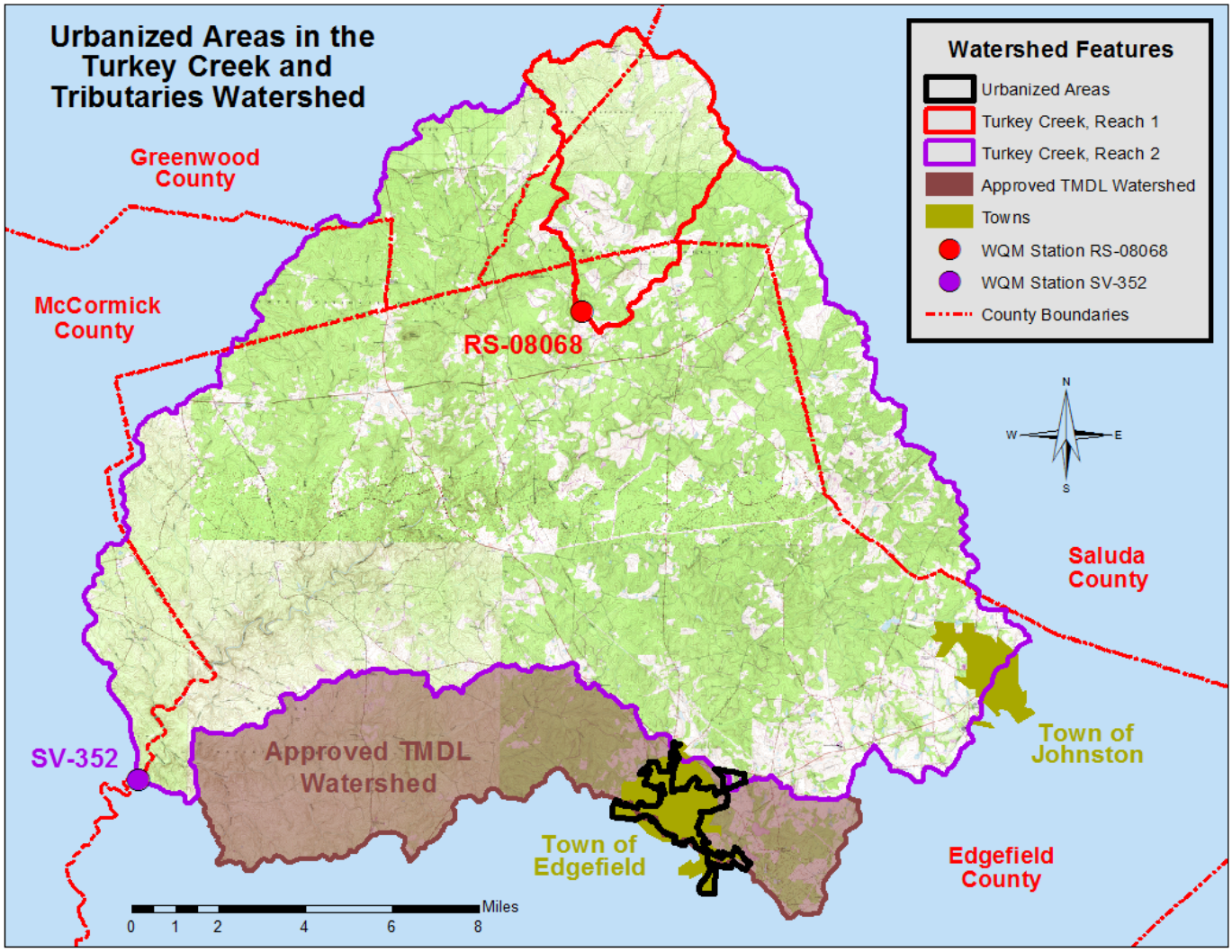
Watershed Reach	Station	Road Miles
Watershed Reach 1	RS-08068	10.5
Watershed Reach 2	SV-352	257.6
Total Miles in the TCT Watershed Reaches:		268.1

wastewater discharger, or sewer 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.

According to GIS information, community sewer collection systems are located in Reach 2 of the TCT Watershed. The Edgefield County Water and Sewer Authority, the Town of Johnston, and a small community sewer collection system approximately one (1) mile north-northwest of Strom Thurmond High School in Edgefield County serve a 7.88 mi^2 (5040.15 acres) area at the southeastern border of the reach. This represents only 3.71% of the 212.41 mi^2 reach being served by a sewer 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

Figure 7. Urbanized Areas in the Turkey Creek and Tributaries Watershed as Designated by the U.S. Bureau of Census



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 Turkey Creek and tributaries watersheds. Nonpoint sources located in unregulated areas are subject to the 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 Edgefield, Greenwood, McCormick, and Saluda Counties, in the areas of the TCT 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 x 10^6 cfu/head-day in a study conducted by Yagow (1999), of which only a portion will enter the Turkey 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 TCT 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, the Department has 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 eleven (11) active AFOs with regulated structures or activities in the TCT Watershed (Figure 3a, and Table 10). These facilities consist of nine (9) poultry facilities and two (2) dairy facilities. Five (5) of the AFOs are located in Reach 1 of the TCT Watershed (terminal WQM station RS-08068) (Figures 3a and 3b); and, six (6) of the AFOs are located in Reach 2 of the watershed (terminal WQM station SV-352) (Figures 3a and 3c). The nine (9) poultry operations are regulated according to Section 122.23 of SC Regulation 61-9, *Water Pollution Control Permits*. There may also be land application sites associated with these facilities. 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 (including *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 TCT 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 5144, 7479, 2465 and 19,716 cattle and calves in Edgefield, Greenwood, McCormick, and Saluda Counties, respectively, in 2012 (USDA 2014). According to the 2011 National Land Cover Database (NLCD), there are 20,180.47, 38,338.05, 10,343.99 and 56,249.88 acres of pastureland in Edgefield, Greenwood, McCormick, and Saluda Counties, respectively. This relates to 0.25, 0.20, 0.24 and 0.35 cattle per acre of pastureland in Edgefield, Greenwood, McCormick, and Saluda Counties, respectively, assuming an even

Table 10. Active Animal Feeding Operations with Regulated Structures or Activities Within the Turkey Creek and Tributaries Watershed

Downstream Impaired Station	AFO Permit	Facility	Type of Livestock	Number of Permitted Animals
RS-08068	ND0081248	JWM Poultry Farm	Poultry (Broilers)	96,000
RS-08068	ND0084174	Oak Hill Farm	Poultry (Broilers)	109,600
RS-08068	ND0084182	Ridlehoover Broiler Farm	Poultry (Broilers)	109,600
RS-08068	ND0088498	Watkins Poultry Farm	Poultry (Broilers)	468,000
RS-08068	ND0080586	Wayne McDowel Broiler Facility	Poultry (Broilers)	96,000
SV-352	ND0086801	BW Poultry Farm	Poultry (Broilers)	264,000
SV-352	ND0083208	Duane Faust Broiler Facility	Poultry (Broilers)	114,769
SV-352	ND0076431	Hammond Dairy	Dairy	100
SV-352	ND0078565	Hickory Hill Farm	Dairy	250
SV-352	ND0082783	High View Broiler Farm	Poultry (Broilers)	217,888
SV-352	ND0008486	Johnson Brothers Poultry	Poultry (Broilers)	132,000

distribution of cattle across pastureland in the counties. Table 11 shows the number of acres of pastureland in Reaches 1 and 2 of the TCT Watershed and, based on this acreage, an estimate of the number of cattle in those reaches. And, based on the number of cattle, the table shows an average of cfu/day of FC bacteria produced by cattle in those reaches. Based on the table, following is the average FC bacteria produced per day by the estimated total cattle and calves within each reach: **a)** 2.59E+13 cfu/day by an estimated 259 cattle and calves in Reach 1 of the TCT Watershed (terminal WQM Station RS-08068); and, **b)** 2.51E+14 cfu/day by an estimated 2511 cattle and calves in Reach 2 of the TCT Watershed (terminal WQM Station SV-352).

Table 11. Cattle FC per Day in the Turkey Creek and Tributaries Watershed Reaches

Downstream Impaired Station	County	Pasture Area (Acre) per Reach	Cattle per Reach	Cattle Fecal Coliform, cfu/day
RS-08068	Edgefield	145.25	37	3.70E+12
	Greenwood	151.70	30	2.96E+12
	Saluda	549.41	193	1.93E+13
SV-352	Edgefield	6923.99	1765	1.76E14
	Greenwood	967.89	189	1.89E13
	McCormick	75.39	18	1.80E12
	Saluda	1538.34	539	5.39E+13

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 TCT 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 TCT Watershed. Direct discharges from land applications sites to surface waters of the State are illegal and are subject to enforcement actions by SCDHEC.

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 TCT Watershed.

3.2.5 Failing Septic Systems

Failing, leaking or non-conforming septic systems can be a major contributor of *E. coli* and other FC bacteria to the TCT 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 Turkey Creek and Tributaries Watershed (WQM Station RS-08068)

According to GIS information, there are no community sewer systems serving Reach 1 of the TCT Watershed. Based on current GIS information, 2015 USDA aerial photography of the reach, and based on the 2010 U.S. population census, there are 87 households within the 12,611.29-acre reach. Therefore, assuming one (1) septic tank per household, it is estimated that there are approximately 87 septic tanks within the reach. This translates into 0.007 septic tanks per reach 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 Turkey Creek and Tributaries Watershed (WQM Station SV-352)

According to GIS information, sewer lines for the Edgefield County Water and Sewer Authority, The Town of Johnston, and a small community sewer collection system approximately one (1) mile north-northwest of Strom Thurmond High School in Edgefield County extend into a small area (i.e., 5040.15 acres) at the southeastern border of the 135,975.00-acre Reach 1 of the TCT Watershed. However, the vast majority of Reach 1 (approximately 96%) is not served by the aforementioned community sewer systems, or any other community sewer system. Based on GIS information, 2015 USDA aerial photography of the watershed, and based on the 2010 U.S. population census, there are 1328 households within the reach not served by a community sewer system. Therefore, assuming one (1) septic tank per household, it is estimated that there are approximately 1328 septic tanks within the reach. This translates into 0.010 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 (including *E. coli*) load. Based on current GIS information, two (2) incorporated areas lie within the TCT Watershed (Figure 2). However, urban runoff is considered to be negligible within the two reaches of the watershed relevant in this TMDL development project.

The vast majority of the incorporated area of the Town of Edgefield lies within the approved TMDL watershed (WQM Station SV-353) in the TCT Watershed. However, according to GIS information, only 2.43% of the incorporated area of the Town of Edgefield (i.e., 66.83 acres) lies in the southern portion of Reach 1 of the watershed. And, according to GIS information, 59.30% of the incorporated area of the Town of Johnston (i.e., 975.13 acres) lies in the southeastern portion of the Reach 1 of the watershed. There are no incorporated areas in Reach 2 of the watershed. Therefore, total incorporated areas within Reach 1 of

the watershed (i.e., 1041.96 acres), one of the two reaches of the watershed relevant in this TMDL development project, only compromises 0.77% of the 135,975.00-acre reach.

Similar to regulated MS4s, potentially designated MS4 entities (as listed in FR 64, 235, p.68837) or other unregulated MS4 communities located in the TCT Watershed may have the potential to contribute pollutant loadings in stormwater runoff. Only 4.75% of the entire TCT 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 Turkey 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 TCT Watershed (WQM Stations RS-08068) 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 of the watershed (WQM Station SV-352) 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 12-year period (January 1, 1999 to December 31, 2012) from the USGS Great Falls, SC gage was used to establish flow duration curve for Reach 2 of the TCT Watershed (WQM Station SV-352). 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 Great Falls, SC gage records flow from 194 square miles (sq mi). The cumulative drainage area for the Reach 2 of the TCT Watershed at WQM Station SV-352 (in Turkey Creek at County Route S-33-227/S-19-68 in Edgefield County) is 274.73 sq mi, or 141.61% of the area drained at the Great Falls, SC gage. Mean daily flow for the SV-352 monitoring location was assumed to be 141.61% of the daily flow at the Great Falls, SC gage.

However, additional adjustments were necessary in order more accurately estimate stream flow at WQM Station SV-352. The Edgefield County Water and Sewer Authority's Brook Street facility (NPDES Permit No. SC0025330) at the corner of Brooks and Bauskett Streets in the western portion of the Town of Edgefield in Edgefield County (Figure 5 and Table 8) is a minor domestic WWTP located upstream of the WQM station. It is believed that flow contributions from this facility may be large enough to influence downstream flow estimates, particularly during dry conditions. The long-term average facility flow data for Brook Street facility is greater than 5% of the estimated low flow conditions at WQM Station SV-352. Therefore, in order to better establish existing instream conditions, monthly average facility flow data for NPDES permit SC0025330 were added to the estimated daily flows 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 (5) 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-08068 and SV-352), 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 (5) percent lower than the former water quality criterion of 400 cfu/100ml. A five (5) percent explicit MOS was reserved from the water quality criteria in developing target load-duration curves. The load-duration curve for station SV-352 is presented in Figure 8 as an example. The load-duration curve for station RS-08068 is 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-08068 and SV-352, 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 (5) percent lower than the current water quality criteria of 349 MPN/100ml. A five (5) percent explicit 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-08068 and SV-352. Therefore, all percent reductions recommended in this document for these two impaired stations are based on existing FC bacteria data. For the purposes of establishing these two TMDLs, FC bacteria percent reductions should also be representative of reductions necessary to meet the *E. coli* WQS.

For both curves, including Figure 8, 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). For the defined flow intervals for WQM Station RS-08068, existing and target loadings were calculated using the following equations.

Existing Load (cfu/day) = Mid-Point Flow in Each Hydrologic Category (ft^3/s) x 90^{th} Percentile FC Concentration (cfu/100 ml) x Conversion Factor (24465758.4)

Target Load (cfu/day) = Mid-Point Flow in Each Hydrologic Category (ft^3/s) x 380 (WQ criterion minus a 5% MOS) (cfu/100 ml) x Conversion Factor (24465758.4)

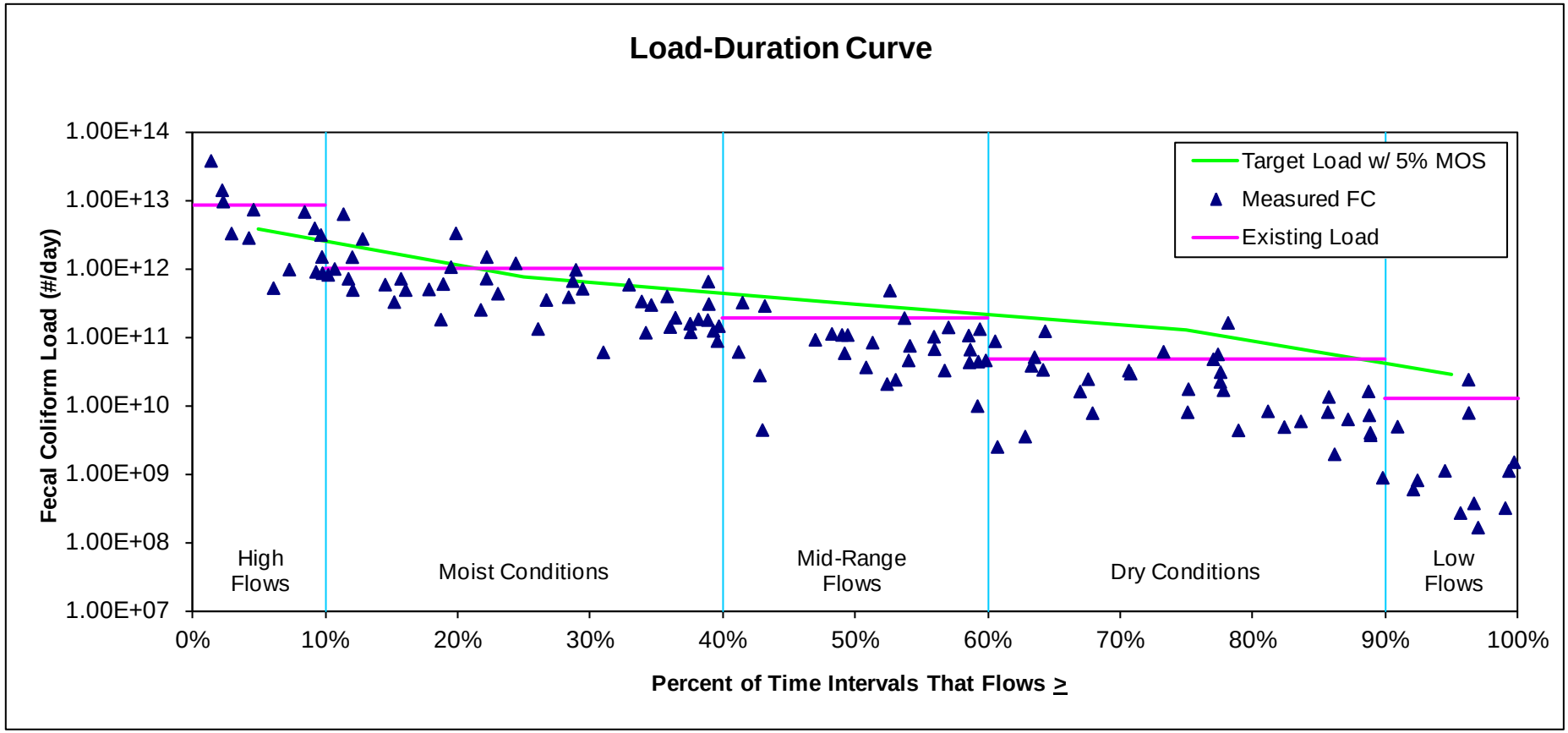
Percent Reduction = (Existing Load – Target Load) / Existing Load

For the defined flow intervals for WQM Station SV-352, existing and target loadings were calculated using the following equations.

As previously mentioned, adjustments to the estimated instream flow were made to more accurately account for the presence of an upstream NPDES discharge. For determining existing instream conditions, NPDES 0025330 long-term average discharge monitoring report data were added to the estimated instream time series described in Section 4.0, paragraph three of this document. For determining the target load, the NPDES design flow was added to the estimated instream flow time series.

Existing Load (cfu/day) = DMR adjusted Mid-Point Flow in Each Hydrologic Category (ft3/s) x 90th Percentile FC Concentration (cfu/100 ml) x Conversion Factor (24465758.4)

Figure 8. Load Duration Curve for Reach 2 of the Turkey Creek and Tributaries Watershed, Water Quality Monitoring Station SV-352



Target Load (cfu/day) = Design Flow adjusted Mid-Point Flow in Each Hydrologic Category (ft3/s) x 380 (WQ criterion minus a 5% MOS) (cfu/100 ml) x Conversion Factor (24465758.4). ***Note:*** *The design flow of NPDES SC0025330 (0.725 MGD = 1.12 cfs) was considered for instream flow in calculating the target load, or the LA (where the LA = TMDL - WLA - MOS), for WQM Station SV-352.* ***However,*** *the WLA portion of the TMDL for WQM Station SV-352 is considered to be zero, since the WLA for NPDES SC0025330 is targeted in the approved TMDL for WQM Station SV-352 in Turkey 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 2012 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 8). 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-08068, 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-352, due to the proportion of flow from the upstream NPDES permit SC0025330 discharge to the flow from Turkey Creek, an adjustment was made to the overall flow time-series (January 1, 1999 to December 31, 2012) to account for this discharge's contribution to the overall stream flow in Turkey Creek. The subsequent DMR adjusted time-series was used to determine the existing load for each hydrologic category for the TMDL calculations where the 90th percentile of measured FC concentrations within each hydrologic category were multiplied by the adjusted 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).

Existing loads are plotted on the load-duration curve presented in Appendix A as well as the example for WQM Station SV-352 in Figure 8. These values were compared to the target load (which includes an explicit 5% MOS) at each hydrologic category midpoint to determine the percent load reduction necessary to achieve compliance with the WQS. This TMDL assumes that if the highest percent reduction is achieved, then the WQS will be attained under all flow conditions.

5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

A TMDL for a given pollutant and water body is comprised of the sum of individual WLAs for point sources, and LAs for both nonpoint sources and natural background levels. In addition, the TMDL must include a 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 TMDLs for the two (2) WQM stations in the TCT 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.' The critical conditions for the TCT Watershed pathogen impaired segments are listed in Table 12. This data indicates that for WQM Station RS-08068, dry conditions result in larger bacteria loads and is therefore the critical condition for that station. For WQM Station SV-352, moist conditions result in larger bacteria loads and is therefore the critical condition for that station.

Table 12. Percent Reduction Necessary to Achieve Target Load by Hydrologic Category

Station	Waterbody	High Flows	Moist Conditions	Mid-Range Flow	Dry Conditions	Low Flows
RS-08068	Sleepy Creek	N/A	NRN	NRN	8	N/A
SV-352	Turkey Creek	N/A	27	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

5.2 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-08068 and SV-352 are provided in Appendix D.

5.3 Waste Load Allocation

The 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

At the time of the development of these TMDLs, there were no continuous point sources within the two reaches of the TCT Watershed relevant in this TMDL development project. 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.

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. Figure 7 shows the urbanized areas in the TCT Watershed. Other non-urbanized areas may be required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater.

WLAs 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 13 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 13. Percent Reduction Necessary to Achieve Target Load

Station	Waterbody	% Reduction
RS-08068	Sleepy Creek	8
SV-352	Turkey Creek	27

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 LA applies to the nonpoint sources of *E. coli* and other FC bacteria and is expressed both as a load and as a percent reduction. The LA is calculated as the difference between the target load under the critical condition and the point source WLA. The LA is listed in Table 14. There may be other unregulated MS4s located in the Turkey 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, these entities 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).

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 MOS may be explicit and/or implicit. The explicit MOS 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/100 mL of the instantaneous criterion of 349 MPN/100 mL (332 MPN/100mL).

Table 14. Total Maximum Daily Loads for the Turkey 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]
Station	FC (cfu/day)	FC (cfu/day)	*E. coli* (MPN/day)[6]	FC (cfu/day)	*E. coli* (MPN/day)[5]	FC (cfu/day)	*E. coli* (MPN/day)[5]	(Percent)	(Percent)	FC (cfu/day)	*E. coli* (MPN/day)[5]	(Percent)
RS-08068	1.09E+11	1.06E+11	*9.21E+10*	5.28E+09	*4.61E+09*	See Note Below	*See Note Below*	8	0[4]	1.00E+11	*8.75E+10*	8
SV-352	1.18E+12	8.98E+11	*7.83E+11*	4.49E+10	*3.92E+10*	See Note Below	*See Note Below*	27	0[4]	8.53E+11	*7.44E+11*	27

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 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. 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* WQSs in freshwaters.

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(I). Only the instantaneous water quality criterion was targeted for the Turkey 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 14 indicates the percentage reduction or WQS required for each subwatershed in the TCT Watershed. Note that all future regulated NPDES-permitted stormwater discharges will also be required to meet the prescribed percentage reductions, or the WQS. 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 Turkey 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 (i.e., WLA) and non-point (i.e., LA) source components of the TMDLs are necessary to bring about the required reductions in FC bacteria or *E. coli* loading to the Turkey Creek and tributaries in order to achieve WQSs. 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 WQSs 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 *CWA's* primary point source control program is the NPDES. Point sources can be broken down into continuous and non-continuous point sources. Some examples of a continuous point source are 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 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 TCT Watershed are subject to the 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 TCT 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 Turkey 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 TCT Watershed. 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 SCDNR.

The Department recognizes that **adaptive management/implementation** of these TMDLs might be needed to achieve the WQS and the Department is committed towards targeting the load reductions to improve water quality in the TCT 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 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, existing and future NPDES MS4 permittees, compliance with terms and conditions of its NPDES permit is considered 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 considered 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 TCT Watershed is 92.28 percent forest or otherwise vegetated (non-cultivated). On February 18, 25 and 29, 2016, and March 3, 2016 the SCDHEC conducted site visits in Reach 1 and Reach 2 of the TCT Watershed to assess *E. coli* and other FC bacteria pollutant sources potentially contributing to water quality impairment in the watershed. During the February and March 2016 site visits, the SCDHEC found potential pollutant sources in both reaches of the watershed; however, due to a GPS camera malfunction, the locations of those potential pollutant sources in Reach 1 of the watershed could not be fixed. The locations of potential pollutant sources in Reach 2 of the watershed that could be fixed are identified in Table Ap-1 (see Appendix E). During the potential pollutant source assessment visit, the department found evidence of wild game in the TCT Watershed. During the visit, the department found wild turkeys in the woods in Reach 1 of the watershed (Figure F-1).

According to the SCDNR 2008 study, there are an estimated 30 to 45 deer per square mile in Edgefield, Greenwood, McCormick, and Saluda Counties in the areas of the TCT Watershed (see Section 3.2.1 of this TMDL document) (SCDNR 2008). In addition to finding live deer in Reach 1 of the TCT Watershed during the February and March 2016 potential pollutant source assessment visit (Figure F-2), the SCDHEC also found ample evidence of their presence throughout both reaches of the watershed in the form of deer stands (e.g., Figures F-3, F-4, and F-5).

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 February and March 2016 potential pollutant source assessment visit in the TCT Watershed, the department found ducks (e.g., Figures F-6 and F-7) and geese (e.g., Figure F-8) in Reach 1 of the watershed. 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 February and March 2016 potential pollutant source assessment visit in the TCT Watershed, the SCDHEC found several cattle pastures throughout both reaches of the watershed (e.g., Figures F-9, F-10, F-11, F-12, and F-13).

During the February and March 2016 potential pollutant source assessment visit in the TCT Watershed, the SCDHEC also found numerous hobby farms within the TCT Watershed. Horses were found in both reaches of the watershed (e.g., Figures F-14, F-15, F-16, and F-17). Donkeys were found in Reach 1 of the watershed (e.g., Figure F-18). Goats were found in Reach 1 of the watershed (e.g., Figures F-19, F-20, and F-21). And, chickens were found in Reach 1 of the watershed (e.g., Figure 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 TCT 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 TCT 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 February and March 2016 potential pollutant source assessment visit in the TCT Watershed, the SCDHEC found unattended dogs in Reach 1 of the TCT Watershed (e.g., Figures F-23, F-24, F-25, and F-26).

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

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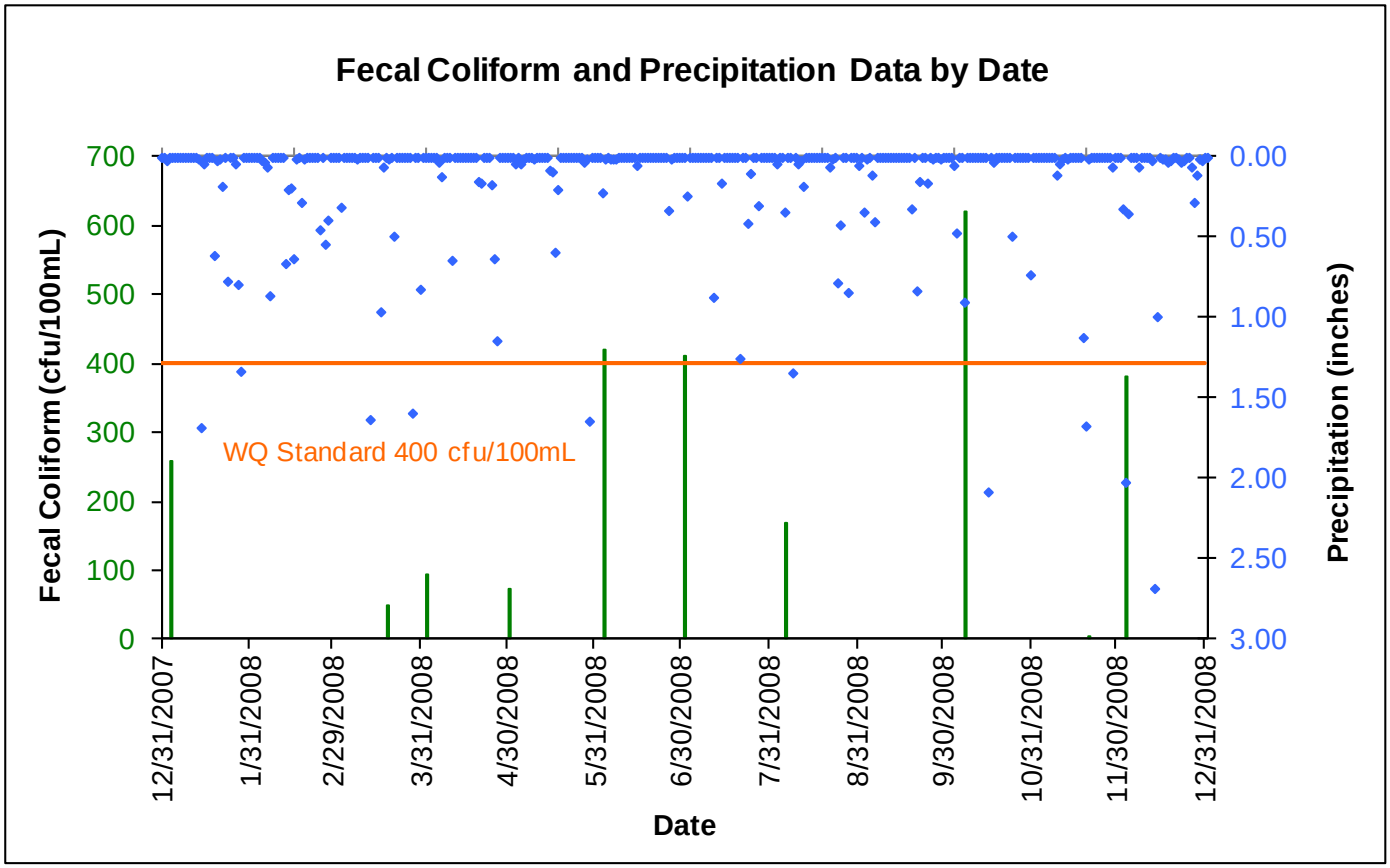
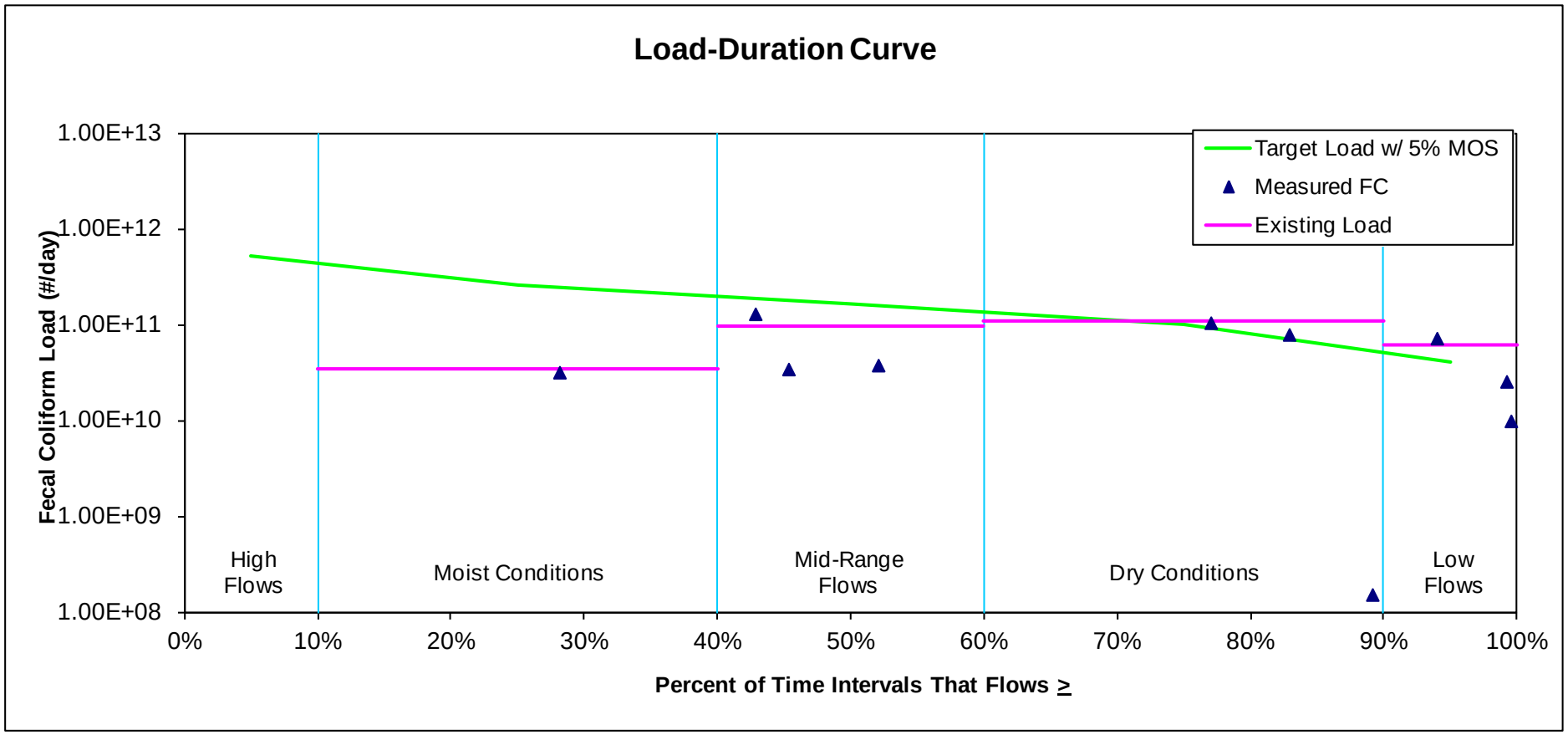
APPENDIX A
ADDITIONAL RAIN CHARTS BY STATION

Precipitation and FC Data by Date for Monitoring Station RS-08068



APPENDIX B
ADDITIONAL LOAD-DURATION CURVES BY STATION

Load Duration Curve for Reach 1 of the Turkey Creek and Tributaries Watershed, WQM Station RS-08068



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 RS-08068 by Date

Date	FC (cfu/mL)
1/3/2008	260
3/19/2008	50
4/2/2008	94
5/1/2008	73

Date	FC (cfu/mL)
6/3/2008	**420**
7/1/2008	**410**
8/6/2008	170
10/8/2008	**620**

Date	FC (cfu/mL)
11/20/2008	1
12/3/2008	380

____ **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-08068	NS	50	227	412	578	10

NS = No samples

Mid Point Hydrologic Instream Category (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-08068	55.64	27.82	17.60	10.79	4.41

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-08068	NS	3.40E+10	9.77E+10	1.09E+11	6.23E+10

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-08068	5.17E+11	2.59E+11	1.64E+11	1.00E+11	4.10E+10

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
RS-08068	N/A	NRN	NRN	8.44E+09	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)
RS-08068	N/A	NRN	NRN	8	N/A

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

Fecal Coliform WQS Exceedence Summary for Impaired Station SV-352 by Date

Date	FC (cfu/mL)
11/9/1999	60
12/13/1999	92
2/15/2000	**600**
3/15/2000	350
4/12/2000	220
5/3/2000	52
6/6/2000	50
7/5/2000	35
8/2/2000	220
9/6/2000	380
10/2/2000	200
11/1/2000	65
12/4/2000	120
1/4/2001	60
2/1/2001	280
4/18/2001	120
6/4/2001	160
7/16/2001	140
8/15/2001	32
9/11/2001	72
10/1/2001	26
11/14/2001	4
12/4/2001	42
1/8/2002	170

Date	FC (cfu/mL)
2/12/2002	**600**
3/5/2002	**1200**
4/4/2002	100
5/8/2002	120
6/6/2002	20
7/10/2002	6
8/8/2002	12
10/15/2002	**510**
11/7/2002	140
12/10/2002	180
1/15/2003	62
2/11/2003	**600**
3/26/2003	55
4/29/2003	88
5/28/2003	300
6/30/2003	120
7/16/2003	140
8/18/2003	**520**
9/24/2003	90
10/30/2003	280
11/12/2003	140
12/3/2003	100
1/5/2004	65
2/19/2004	150

Date	FC (cfu/mL)
3/4/2004	120
4/6/2004	35
5/12/2004	30
6/22/2004	70
7/22/2004	40
8/23/2004	6
9/28/2004	**1200**
10/7/2004	240
11/3/2004	140
12/1/2004	140
1/4/2005	95
2/23/2005	**600**
3/7/2005	290
4/14/2005	210
5/31/2005	140
6/21/2005	100
7/12/2005	120
8/4/2005	**600**
9/12/2005	67
10/4/2005	37
11/2/2005	100
12/12/2005	370
1/11/2006	280
2/23/2006	**600**

___ WQS Exceeded

Fecal Coliform WQS Exceedence Summary for Impaired Station SV-352 by Date (Continued)

Date	FC (cfu/mL)
3/23/2006	**1200**
4/24/2006	200
5/24/2006	67
6/1/2006	15
7/6/2006	25
8/9/2006	31
9/20/2006	98
10/23/2006	4
11/8/2006	260
12/28/2006	140
1/16/2007	210
2/26/2007	180
3/22/2007	200
4/12/2007	200
5/15/2007	240
6/12/2007	62
7/10/2007	160
8/14/2007	200
9/11/2007	210
10/24/2007	140
11/7/2007	5

Date	FC (cfu/mL)
12/5/2007	16
1/15/2008	200
2/13/2008	100
3/18/2008	**500**
4/3/2008	77
5/6/2008	45
6/24/2008	5
7/10/2008	7
8/7/2008	7
9/3/2008	87
10/1/2008	**540**
11/4/2008	100
12/8/2008	77
1/6/2009	140
2/3/2009	140
3/3/2009	**420**
4/15/2009	**960**
5/19/2009	100
6/30/2009	15
7/14/2009	55
8/11/2009	45

Date	FC (cfu/mL)
10/7/2009	180
12/2/2009	180
1/12/2010	100
3/16/2010	240
5/13/2010	65
7/14/2010	160
9/15/2010	37
11/16/2010	23
3/2/2011	**530**
5/4/2011	25
7/20/2011	23
9/13/2011	**600**
11/15/2011	25
2/7/2012	71
4/17/2012	70
6/5/2012	50
8/15/2012	150
10/17/2012	15
12/12/2012	10

____ 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-352	852	527	244	157	209	133

Mid Point Hydrologic Instream Category Including Long Term Average DMR Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-352	460.63	91.16	35.91	14.45	2.78

Mid Point Hydrologic Instream Category Including Facility Design Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-352	461.37	91.75	36.53	15.28	3.53

Existing Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-352	9.60E+12	1.18E+12	2.14E+11	5.55E+10	1.42E+10

Target Load (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-352	4.92E+12	8.53E+11	3.40E+11	1.42E+11	3.28E+10

Load Reduction Necessary (#/day)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-352	N/A	3.17 E+11	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-352	N/A	27	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 Turkey Creek and Tributaries Watershed (WQM Station SV-352)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
SV-352	Cattle	US 378	Edgefield	North	33.93574	-81.96029	2/25/2016	Cattle in pasture near a pond
SV-352	Cattle	US 378	Edgefield	North	33.93574	-81.96027	2/25/2016	Cattle in pasture near a pond
SV-352	Cattle	Long Cane Road	Edgefield	Northeast	33.91615	-81.91846	2/29/2016	Pastured cattle
SV-352	Cattle	Long Cane Road	Edgefield	Northeast	33.89837	-81.87774	2/29/2016	Pastured cattle
SV-352	Cattle	McKendree Drive	Edgefield	Northeast	33.95003	-81.92981	2/18/2016	Pastured cattle
SV-352	Cattle	Odell Adams Road	Edgefield	Northeast	33.96119	-81.93183	2/18/2016	Cattle in pasture with a stream-fed pond
SV-352	Cattle	Odell Adams Road	Edgefield	Northeast	33.96235	-81.93223	2/18/2016	Cattle in pasture with a stream-fed pond
SV-352	Cattle	SC 430	Edgefield	Northeast	33.91528	-81.93261	2/29/2016	Pastured cattle
SV-352	Cattle	US 378	Edgefield	Northeast	33.96964	-81.89443	2/25/2016	Cattle with donkey in pasture with a pond
SV-352	Cattle	US 378	Edgefield	Northeast	33.96969	-81.89451	2/25/2016	Pastured cattle
SV-352	Cattle	US 378	Edgefield	Northeast	33.95420	-81.90262	2/25/2016	Pastured cattle near Stevens Creek
SV-352	Cattle	US 378	Edgefield	Northeast	33.95235	-81.90474	2/25/2016	Pastured cattle near Stevens Creek
SV-352	Cattle	US 378	Edgefield	Northeast	33.94253	-81.92689	2/25/2016	Cattle in pasture near a pond
SV-352	Cattle	Timmerman Road	Edgefield	Central	33.89939	-82.02643	2/25/2016	Cattle in pasture near a pond
SV-352	Cattle	US 25	Edgefield	Central	33.87487	-82.00885	2/25/2016	Cattle in pasture with a stream-fed pond
SV-352	Cattle	US 378	Edgefield	West	33.92100	-82.10940	2/25/2016	Cow in pasture with horse and donkey
SV-352	Cattle	Bouknight Road	Edgefield	Southeast	33.80176	-81.84275	2/29/2016	Cattle in pasture with a stream-fed pond
SV-352	Cattle	Bouknight Road	Edgefield	Southeast	33.80110	-81.84133	2/29/2016	Pastured cattle
SV-352	Cattle	Center Springs Road	Edgefield	Southeast	33.85092	-81.88749	2/29/2016	Pastured cattle
SV-352	Cattle	Country Club Road	Edgefield	Southeast	33.80123	-81.89090	2/29/2016	Cattle in pasture with a stream-fed pond
SV-352	Cattle	Country Club Road	Edgefield	Southeast	33.81087	-81.88867	2/29/2016	Cattle in pasture with a stream-fed pond
SV-352	Cattle	Country Club Road	Edgefield	Southeast	33.82404	-81.86946	2/29/2016	Pastured cattle
SV-352	Cattle	Lanier Road	Edgefield	Southeast	33.82613	-81.82683	2/29/2016	Pastured cattle
SV-352	Cattle	Lanier Road	Edgefield	Southeast	33.83668	-81.82624	2/29/2016	Pastured cattle
SV-352	Cattle	Old Chappell Ferry Road	Edgefield	Southeast	33.86825	-81.88166	2/29/2016	Pastured cattle
SV-352	Cattle	Old Chappell Ferry Road	Edgefield	Southeast	33.85255	-81.88708	2/29/2016	Pastured cattle
SV-352	Cattle	SC 430	Edgefield	Southeast	33.79856	-81.89751	2/29/2016	Cattle in pasture with a stream-fed pond
SV-352	Cattle	SC 430	Edgefield	Southeast	33.80398	-81.89971	2/29/2016	Cattle in pasture with a stream-fed pond
SV-352	Cattle	Two Mile Drive	Edgefield	Southeast	33.79123	-81.87821	2/29/2016	Pastured cattle

Table Ap-1 (continued). Potential FC and *E. coli* Pollutant Sources in Reach 1 of Turkey Creek and Tributaries Watershed (WQM Station SV-352)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
SV-352	Cattle	Two Mile Drive	Edgefield	Southeast	33.79018	-81.86931	2/29/2016	Cattle in pasture with a stream-fed pond
SV-352	Cattle	West D Herlong Road	Edgefield	Southeast	33.80091	-81.83735	2/29/2016	Pastured cattle
SV-352	Cattle	Guy Williams Road	Edgefield	Southwest	33.84812	-82.06786	2/25/2016	Cattle in pasture near a pond
SV-352	Cattle	Hamilton Road	Greenwood	North	34.01094	-81.99043	2/18/2016	Cattle in pasture near a pond
SV-352	Cattle	Hamilton Road	Greenwood	North	33.99658	-81.99256	2/18/2016	Cattle in pasture near a pond
SV-352	Cattle	Kirksey Pitts Road	Greenwood	North	33.99996	-82.01801	2/18/2016	Cattle in pasture near a pond
SV-352	Cattle	Kirksey Pitts Road	Greenwood	North	33.99909	-82.01766	2/18/2016	Pastured cattle
SV-352	Cattle	Mount Creek Road	Greenwood	North	33.99956	-81.99326	2/18/2016	Pastured cattle
SV-352	Cattle	Mount Creek Road	Greenwood	North	34.00119	-82.00309	2/18/2016	Pastured cattle
SV-352	Cattle	US 25	Greenwood	North	33.97477	-82.04554	2/25/2016	Cow in pasture
SV-352	Cattle	Faulkner Mountain Road	Saluda	North	33.97796	-81.99001	2/18/2016	Pastured cattle
SV-352	Cattle	Faulkner Mountain Road	Saluda	North	33.97890	-81.99081	2/18/2016	Pastured cattle
SV-352	Cattle	Fruit Hill Road	Saluda	Northeast	33.97637	-81.87693	3/3/2016	Pastured cattle
SV-352	Cattle	Fruit Hill Road	Saluda	Northeast	33.97360	-81.87595	3/3/2016	Pastured cattle
SV-352	Cattle	Fruit Hill Road	Saluda	Northeast	33.97189	-81.87507	3/3/2016	Pastured cattle
SV-352	Cattle	Jay Road	Saluda	Northeast	33.97104	-81.87515	3/3/2016	Pastured cattle
SV-352	Cattle	Jay Road	Saluda	Northeast	33.97009	-81.87801	3/3/2016	Cattle in pasture near a pond
SV-352	Cattle	May Road	Saluda	Northeast	33.98807	-81.88438	2/18/2016	Cattle in pasture near a pond
SV-352	Cattle	Old Edgefield Road	Saluda	Northeast	33.91427	-81.86101	3/3/2016	Pastured cattle
SV-352	Cattle	County Route S-41-190	Saluda	Southeast	33.89757	-81.82653	3/3/2016	Pastured cattle
SV-352	Cattle	Long Cane Road	Saluda	Southeast	33.88813	-81.86573	2/29/2016	Pastured cattle
SV-352	Chickens	US 378	Edgefield	North	33.93551	-81.96224	2/25/2016	Chickens in a pen
SV-352	Chickens	US 378	Edgefield	West	33.92094	-82.10611	2/25/2016	Chickens in pasture with horse and goats
SV-352	Chickens	Ridge Road	Edgefield	Southeast	33.85268	-81.82590	3/3/2016	Chicken in pen an unattended dog in yard
SV-352	Chickens	Hamilton Road	Greenwood	North	34.01004	-81.99009	2/18/2016	Chickens in a pen
SV-352	Deer	US 378	Edgefield	North	33.93514	-81.96506	2/25/2016	Deer stand in field near Sleepy Creek
SV-352	Deer	Elmwood Road	Edgefield	Northeast	33.90540	-81.93608	2/29/2016	Deer stand in woods
SV-352	Deer	Elmwood Road	Edgefield	Northeast	33.90478	-81.93695	2/29/2016	Deer stand in woods
SV-352	Deer	Elmwood Road	Edgefield	Northeast	33.89973	-81.94275	2/29/2016	Deer stand in power line right-of-way

Table Ap-1 (continued). Potential FC and *E. coli* Pollutant Sources in Reach 1 of Turkey Creek and Tributaries Watershed (WQM Station SV-352)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
SV-352	Deer	SC 430	Edgefield	Northeast	33.93596	-81.92894	2/29/2016	Deer stand on edge of field
SV-352	Deer	Elmwood Road	Edgefield	Central	33.87650	-81.96993	2/29/2016	Deer stand in field
SV-352	Deer	Elmwood Road	Edgefield	Central	33.87431	-81.97068	2/29/2016	Deer stand in power line right-of-way
SV-352	Deer	Log Creek Road	Edgefield	Central	33.86882	-81.97044	2/29/2016	Deer stand in woods
SV-352	Deer	Center Springs Road	Edgefield	Southeast	33.84542	-81.89479	2/29/2016	Deer stand in a clearing
SV-352	Deer	Center Springs Road	Edgefield	Southeast	33.83028	-81.90423	2/29/2016	Deer stand on edge of field
SV-352	Deer	Cottonwood Lane	Edgefield	Southeast	33.84941	-81.82164	3/3/2016	Deer near street in the Town of Johnston
SV-352	Deer	Log Creek Road	Edgefield	Southeast	33.84240	-81.95482	2/29/2016	Deer stand in power line right-of-way
SV-352	Deer	Ridge Road	Edgefield	Southeast	33.85859	-81.82447	3/3/2016	Deer stand on edge of field
SV-352	Deer	Slide Hill Road	Edgefield	Southeast	33.83453	-81.81821	2/29/2016	Deer stand in power line right-of-way
SV-352	Deer	Weaver Road	Edgefield	Southeast	33.84606	-81.84168	2/29/2016	Deer stand at edge of woods
SV-352	Deer	Guy Williams Road	Edgefield	Southwest	33.84811	-82.06556	2/25/2016	Deer stand in woods
SV-352	Deer	SC 283	Edgefield	Southwest	33.82361	-82.08124	2/25/2016	Deer stand in woods
SV-352	Deer	SC 283	Edgefield	Southwest	33.83392	-82.02026	2/25/2016	Deer stand in woods
SV-352	Deer	Key Road	McCormick	Southwest	33.86505	-82.15403	2/25/2016	Deer stand in field
SV-352	Deer	Key Road	McCormick	Southwest	33.86505	-82.15404	2/25/2016	Deer stand in woods
SV-352	Deer	Blue Bird Hill Road	Saluda	Northeast	33.96083	-81.87846	3/3/2016	Deer stand in power line right-of-way
SV-352	Deer	Running Wild Road	Saluda	Northeast	33.98468	-81.89582	2/18/2016	Deer stand in woods
SV-352	Deer	Running Wild Road	Saluda	Northeast	33.98321	-81.89318	2/18/2016	Deer stand in woods
SV-352	Deer	US 378	Saluda	Northeast	33.98146	-81.88347	2/18/2016	Deer stand in power line right-of-way
SV-352	Deer	County Route S-41-190	Saluda	Southeast	33.88331	-81.83093	3/3/2016	Deer stand in woods
SV-352	Deer	Rocky Creek Road	Saluda	Southeast	33.89504	-81.84724	3/3/2016	Deer stand on edge of field
SV-352	Dogs	Dorn Road	Edgefield	North	33.93203	-82.00013	2/25/2016	Unattended dog in yard
SV-352	Dogs	Bland Baptist Road	Edgefield	Southeast	33.82174	-81.82711	2/29/2016	Unattended dogs in yard
SV-352	Dogs	Cottonwood Lane	Edgefield	Southeast	33.84742	-81.82015	3/3/2016	Chained dog in yard
SV-352	Dogs	Cottonwood Lane	Edgefield	Southeast	33.84932	-81.82049	3/3/2016	Unattended dog in yard
SV-352	Dogs	Mobley Street	Edgefield	Southeast	33.83174	-81.80717	2/29/2016	Unattended dogs in yard
SV-352	Dogs	Ridge Road	Edgefield	Southeast	33.85268	-81.82590	3/3/2016	Unattended dog in yard and chicken in pen
SV-352	Dogs	Sandra Drive	Edgefield	Southeast	33.84454	-81.81742	3/3/2016	Unattended dogs in yard in the Town of Johnston

Table Ap-1 (continued). Potential FC and *E. coli* Pollutant Sources in Reach 1 of Turkey Creek and Tributaries Watershed (WQM Station SV-352)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
SV-352	Dogs	Woodridge Road	Edgefield	Southeast	33.82228	-81.87689	2/29/2016	Unattended dog in yard
SV-352	Dogs	Hamilton Road	Greenwood	North	34.01025	-81.99016	2/18/2016	Unattended dog near road near Talbert Branch
SV-352	Dogs	Faulkner Mountain Road	Saluda	North	33.97849	-81.99050	2/18/2016	Unattended dog near road
SV-352	Dogs	Round Up Road	Saluda	Northeast	33.91303	-81.84221	3/3/2016	Unattended dogs in pasture
SV-352	Dogs	Round Up Road	Saluda	Northeast	33.90994	-81.86238	3/3/2016	Unattended dog in yard
SV-352	Dogs	County Route S-41-190	Saluda	Southeast	33.89225	-81.82928	3/3/2016	Unattended dog in yard
SV-352	Dogs	Rocky Creek Road	Saluda	Southeast	33.89860	-81.84157	3/3/2016	Unattended dog in yard
SV-352	Dogs	Rocky Creek Road	Saluda	Southeast	33.89677	-81.84481	3/3/2016	Unattended dog in yard
SV-352	Donkeys	Hamilton Road	Greenwood	North	34.00999	-81.99006	2/18/2016	Pastured donkeys near Talbert Branch
SV-352	Donkeys	US 378	Edgefield	Northeast	33.96964	-81.89443	2/25/2016	Donkey with cattle in pasture with a pond
SV-352	Donkeys	US 378	Edgefield	West	33.92100	-82.10940	2/25/2016	Donkey in pasture with cow and horse
SV-352	Ducks	SC 430	Edgefield	Southeast	33.83264	-81.92896	2/29/2016	Ducks in a stream-fed pond
SV-352	Ducks	North Martintown Road	Edgefield	Southwest	33.83361	-82.05352	2/25/2016	Ducks in a pond
SV-352	Ducks	Hamilton Road	Greenwood	North	33.99682	-81.99235	2/18/2016	Ducks near a pond
SV-352	Ducks	Fruit Hill Road	Saluda	Northeast	33.99421	-81.88265	2/18/2016	Duck in a pond
SV-352	Ducks	Jay Road	Saluda	Northeast	33.96943	-81.87901	3/3/2016	Ducks in a pond
SV-352	Geese	Jake Bryan Road	Edgefield	Central	33.87121	-82.01272	2/25/2016	Geese near a stream-fed pond
SV-352	Geese	SC 283	Edgefield	Southwest	33.83217	-82.05303	2/25/2016	Geese in a pond
SV-352	Goats	Dorn Road	Edgefield	North	33.92990	-81.99915	2/25/2016	Pastured goats
SV-352	Goats	US 378	Edgefield	West	33.92094	-82.10611	2/25/2016	Goats in pasture with horse and chickens
SV-352	Goats	Highwater Road	Edgefield	Southeast	33.86870	-81.94091	2/29/2016	Goat and horse in pasture
SV-352	Goats	Roland Avenue	Edgefield	Southeast	33.83875	-81.79787	2/29/2016	Pastured goats in the Town of Johnston
SV-352	Goats	SC 430	Edgefield	Southeast	33.82943	-81.92820	2/29/2016	Pastured goats
SV-352	Goats	Hamilton Road	Greenwood	North	34.01019	-81.99014	2/18/2016	Goats in a pen near Talbert Branch
SV-352	Horses	US 25	Edgefield	North	33.94704	-82.04722	2/25/2016	Horse in pasture with a stream-fed pond
SV-352	Horses	Gold Mine Road	Edgefield	Northeast	33.95792	-81.93077	2/18/2016	Horse in pasture with a stream-fed pond
SV-352	Horses	Long Cane Road	Edgefield	Northeast	33.90203	-81.88153	2/29/2016	Pastured horses
SV-352	Horses	Ouzts Road	Edgefield	Northeast	33.89371	-81.91146	2/29/2016	Horses in pasture with a pond
SV-352	Horses	US 378	Edgefield	Northeast	33.96213	-81.89833	2/25/2016	Horse in pasture near Stevens Creek

Table Ap-1 (continued). Potential FC and *E. coli* Pollutant Sources in Reach 1 of Turkey Creek and Tributaries Watershed (WQM Station SV-352)

Reach Station	Source	Vicinity of Road/Street	County	Location in Watershed	Latitude	Longitude	Date Observed	Source Notes
SV-352	Horses	US 378	Edgefield	West	33.92094	-82.10611	2/25/2016	Horse in pasture with goats and chickens
SV-352	Horses	US 378	Edgefield	West	33.92100	-82.10940	2/25/2016	Horse in pasture with cow and donkey
SV-352	Horses	Highwater Road	Edgefield	Southeast	33.86870	-81.94091	2/29/2016	Horse and goat in pasture
SV-352	Horses	Lanier Road	Edgefield	Southeast	33.84024	-81.82487	2/29/2016	Pastured horses
SV-352	Horses	SC 430	Edgefield	Southeast	33.81046	-81.92994	2/29/2016	Pastured horses
SV-352	Horses	SC 430	Edgefield	Southeast	33.82470	-81.92849	2/29/2016	Pastured horses
SV-352	Horses	Gilgal Road	Edgefield	Southwest	33.86784	-82.09064	2/25/2016	Horses in pasture with a stream-fed pond
SV-352	Horses	Kirksey Pitts Road	Greenwood	North	33.98744	-82.00399	2/18/2016	Pastured horse near Talbert Branch
SV-352	Horses	Fruit Hill Road	Saluda	Northeast	33.98974	-81.88180	2/18/2016	Horse in a pasture
SV-352	Horses	Fruit Hill Road	Saluda	Northeast	33.97324	-81.87578	3/3/2016	Pastured horses
SV-352	Horses	Round Up Road	Saluda	Northeast	33.91274	-81.84334	3/3/2016	Pastured horses
SV-352	Horses	County Route S-41-190	Saluda	Southeast	33.88747	-81.83135	3/3/2016	Pastured horses
SV-352	Turkeys	Old Chappell Ferry Road	Edgefield	Southeast	33.86946	-81.88013	2/29/2016	Wild turkeys in woods near Turkey Creek

Appendix F

SOURCE ASSESSMENT PICTURES

Figure F-1

Wild turkeys in woods near Turkey Creek (location: 33.86946 N, -81.88013 W) on Old Chappell Ferry Road in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 29, 2016).

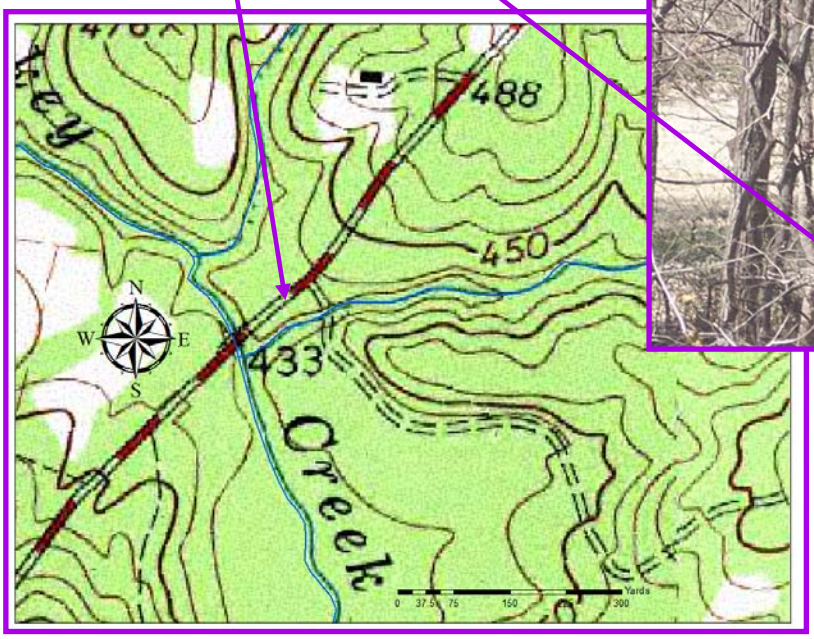


Figure F-2

Deer by street (location: 33.84941 N, -81.82164 W) on Cottonwood Lane in the Town of Johnston in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: March 3, 2016).

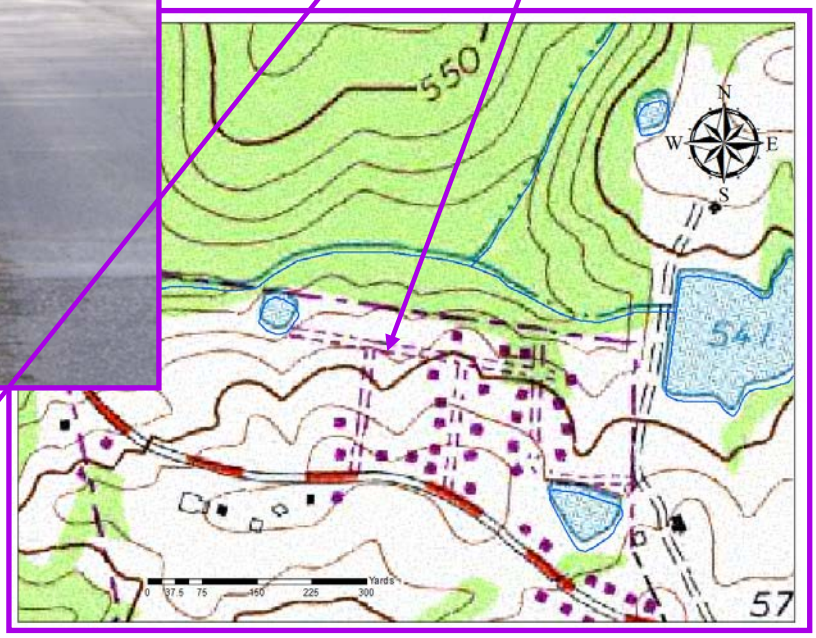
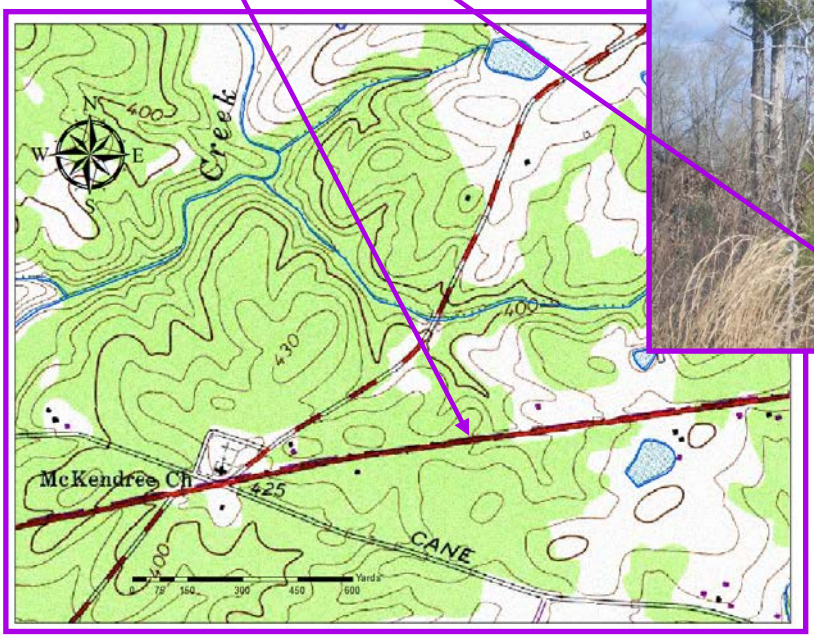


Figure F-3

Deer stand in field near Sleepy Creek (location: 33.93514 N, -81.96506 W) on US 378 in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 25, 2016).



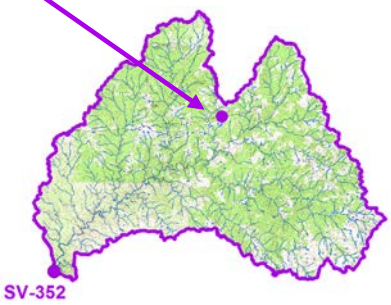


Figure F-4

Deer stand in woods (location: 33.90540 N, -81.93608 W) on Elmwood Road in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 29, 2016).

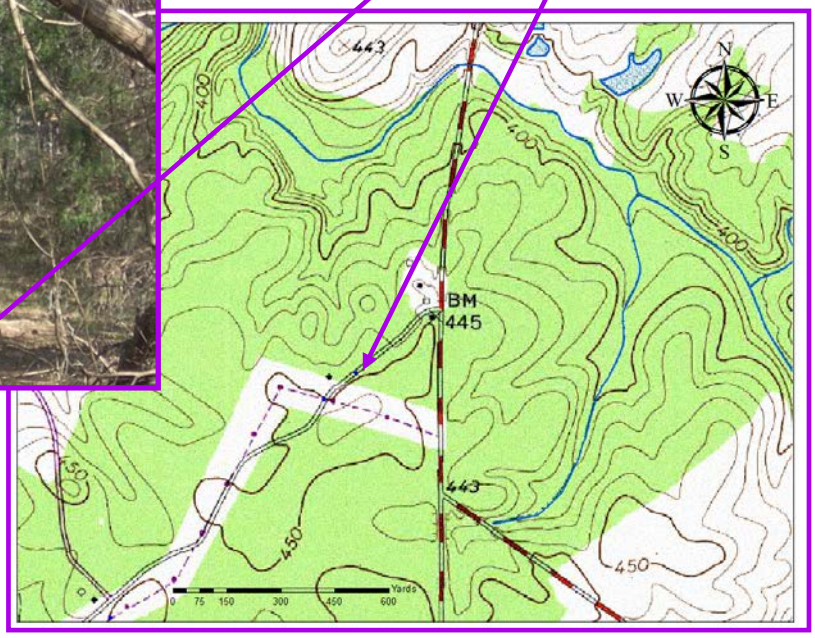
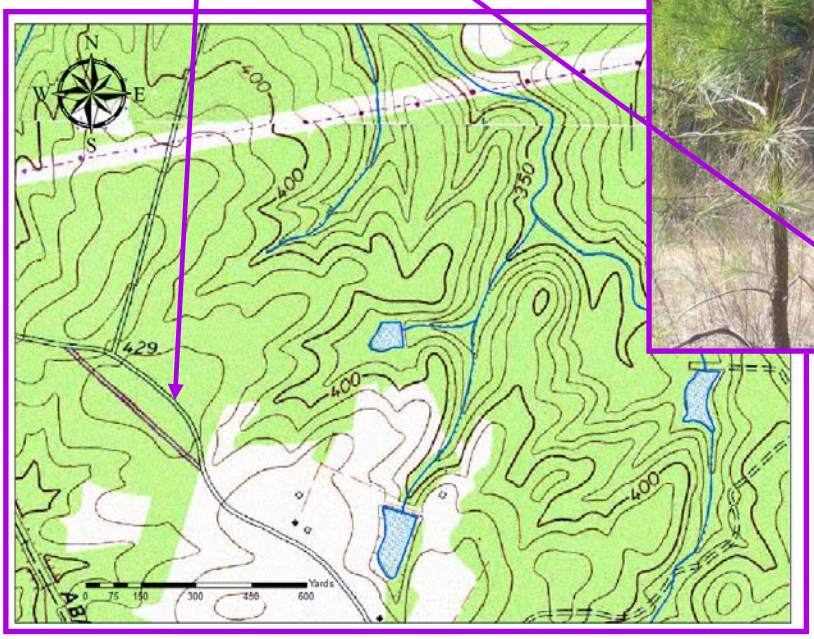


Figure F-5

Deer stand in woods (location: 33.86882 N, -81.97044 W) on Log Creek Road in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 29, 2016).



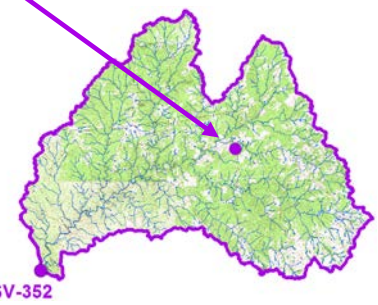
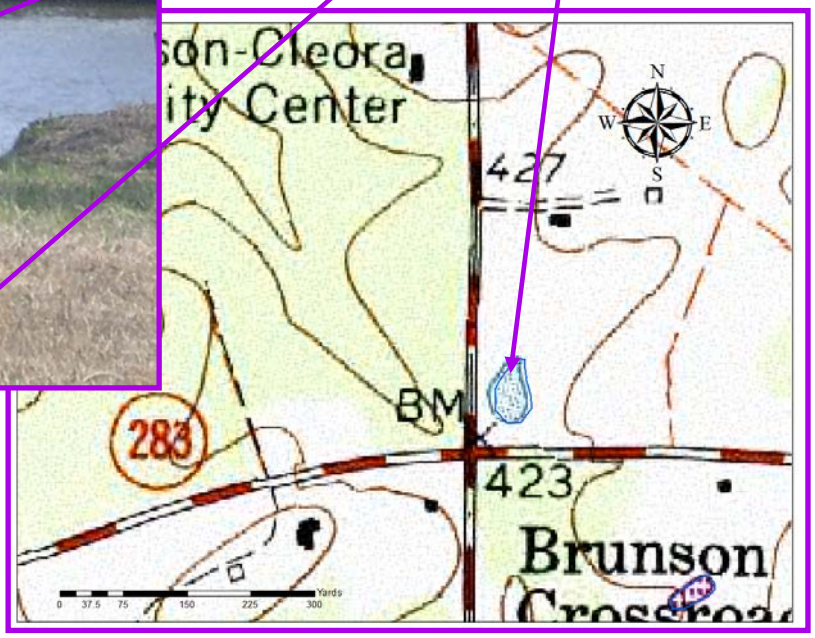


Figure F-6

Ducks in a pond (location: 33.83361 N, -82.05352 W) on North Martintown Road in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 25, 2016).



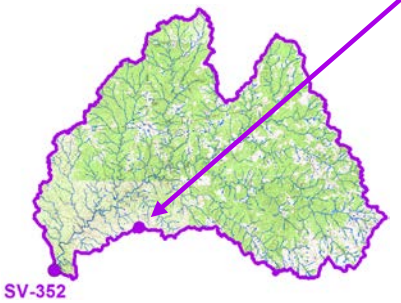


Figure F-7

Ducks in a pond (location: 33.96934 N, -81.87901 W) on Jay Road in Saluda County. Found in Reach 1 of the TCT Watershed (Date of photography: March 3, 2016).

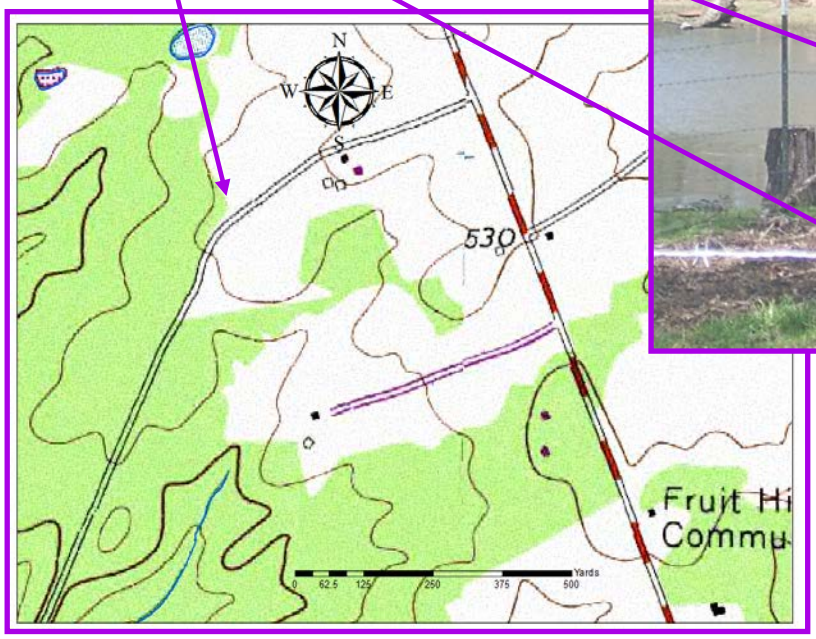
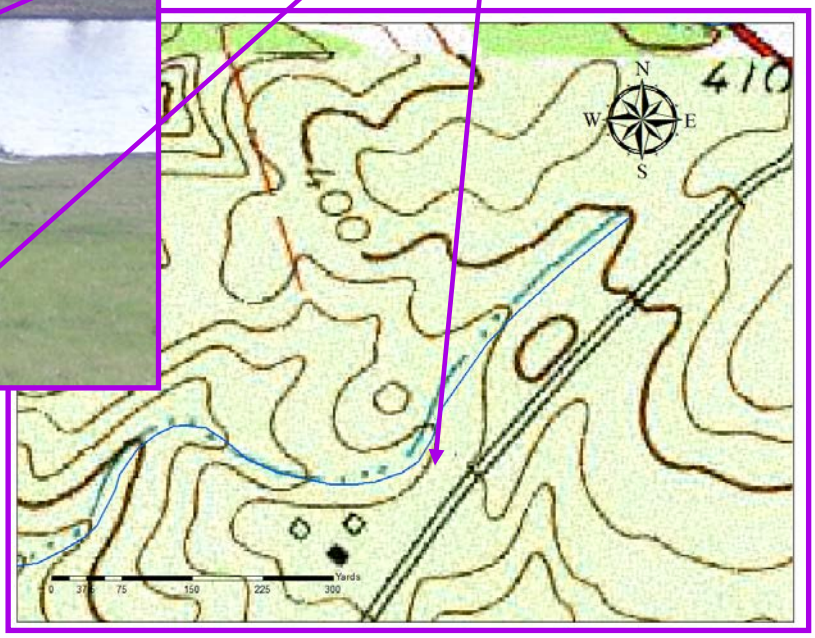


Figure F-8

Geese near a stream-fed pond (location: 33.87121 N, -82.01272 W) on Jake Bryan Road in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 21, 2016).



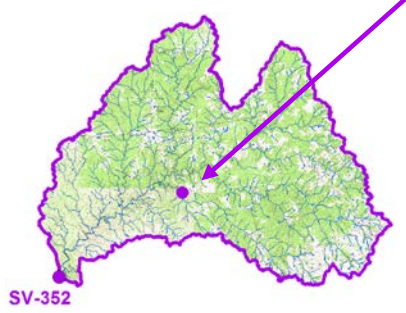


Figure F-9

Pastured cattle near Stevens Creek (location: 33.95420 N, -81.90262 W) on US 378 in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 25, 2016).

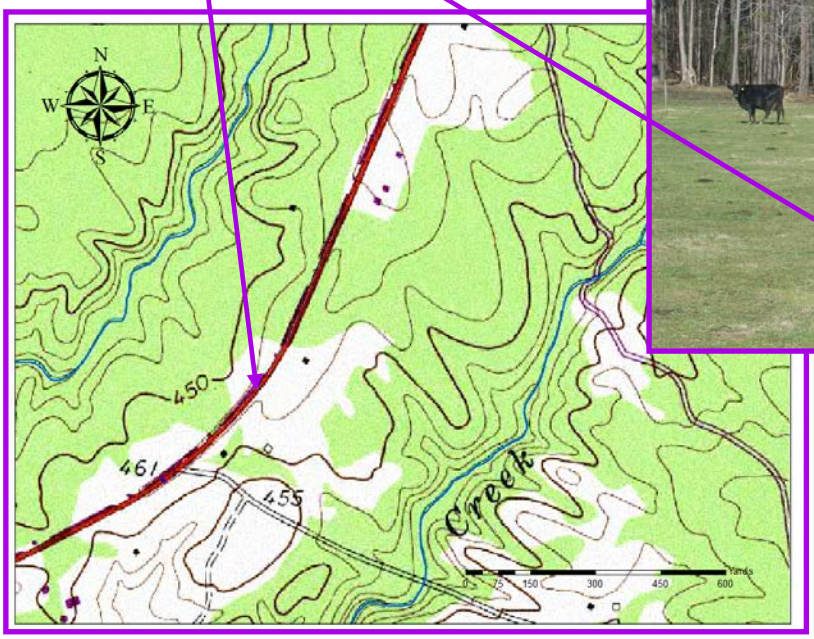


Figure F-10

Cattle in pasture with a stream-fed pond (location: 33.80398 N, -81.89971 W) on SC 430 in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 29, 2016).

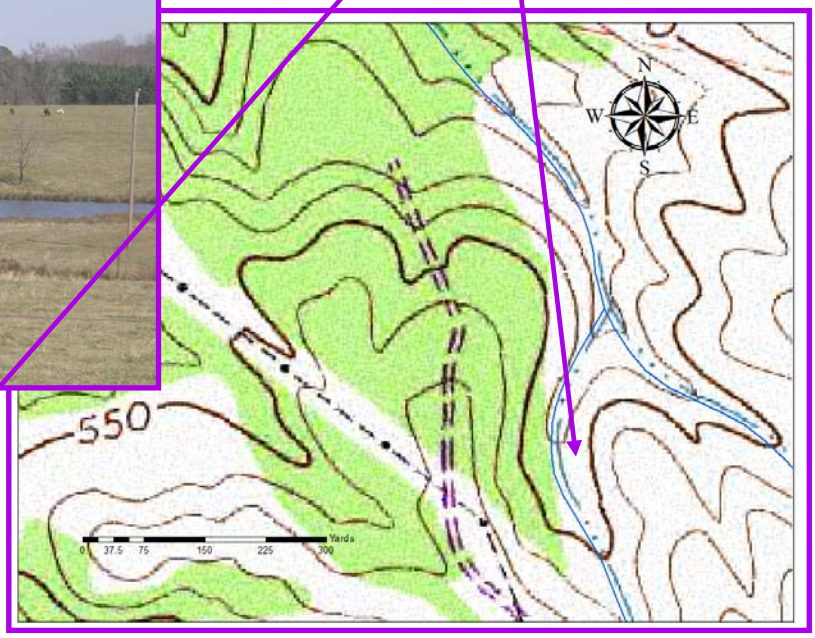
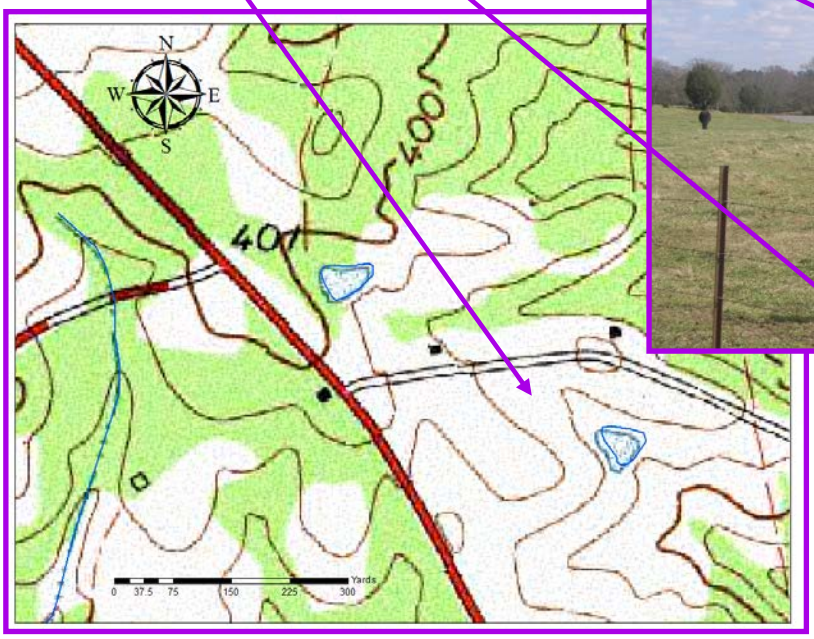


Figure F-11

Cattle in pasture near a pond (location: 33.89939 N, -82.02643 W) on Timmerman Road in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 25, 2016).



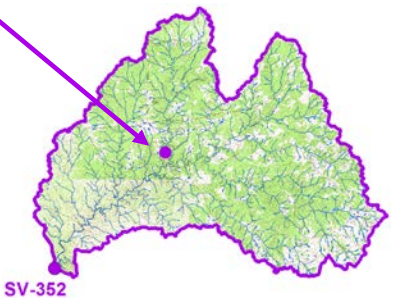


Figure F-12

Cattle in pasture with a stream-fed pond (location: 33.80176 N, -81.84275 W) on Bouknight Road in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 29, 2016).

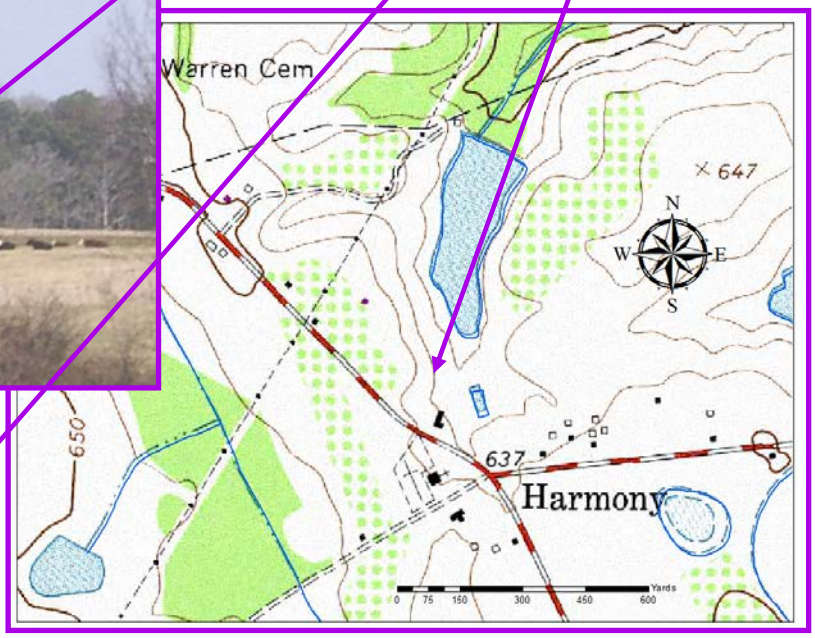


Figure F-13

Cattle in pasture near a pond (location: 33.93574 N, -81.96027 W) on US 378 in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 25, 2016).

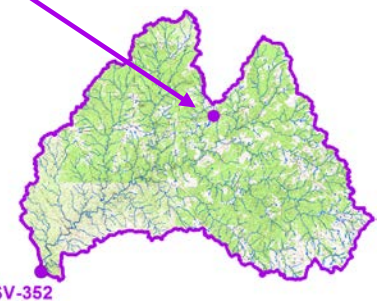
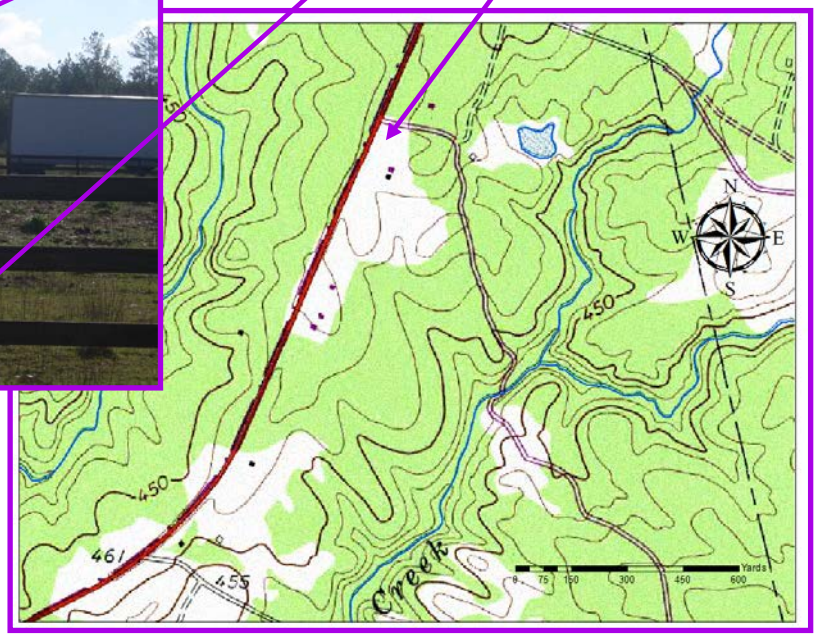


Figure F-14

Horse in pasture near Stevens Creek (location: 33.96213 N, -81.89833 W) on US 378 in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 25, 2016).



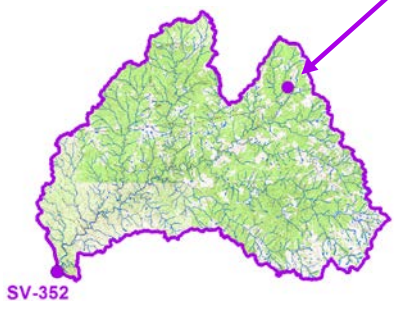
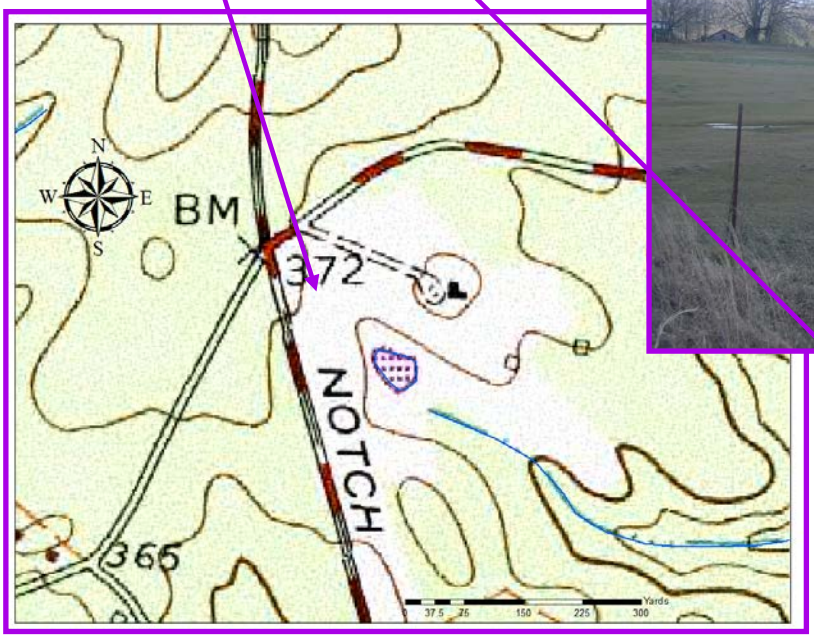


Figure F-15

Horses in pasture with a stream-fed pond (location: 33.86784 N, -82.09064 W) on Gilgal Road in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 25, 2016).



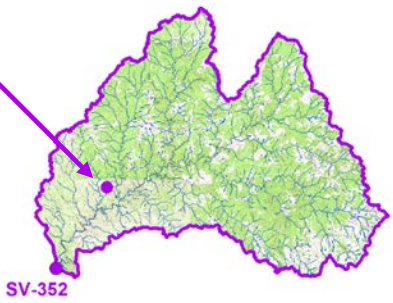


Figure F-16

Pastured horses (location: 33.88747 N, -81.83135 W) on County Route S-41-190 Road in Saluda County. Found in Reach 1 of the TCT Watershed (Date of photography: March 3, 2016).

Figure F-17

Pastured horses (location: 33.97324 N, -81.87578 W) on Fruit Hill Road in Saluda County. Found in Reach 1 of the TCT Watershed (Date of photography: March 3, 2016).

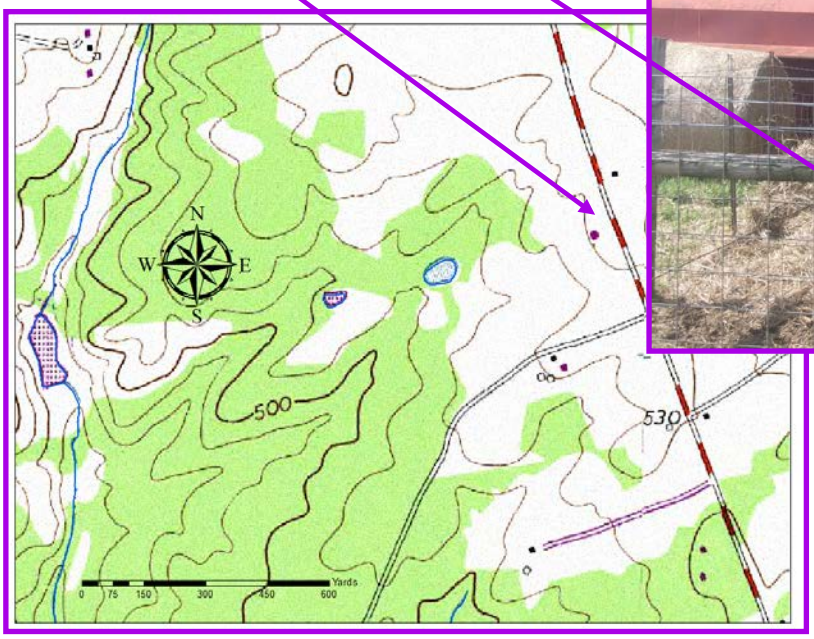


Figure F-18

Pastured donkeys near Talbert Branch (location: 34.00999 N, -81.00996 W) on Hamilton Road in Greenwood County. Found in Reach 1 of the TCT Watershed (Date of photography: February 18, 2016).

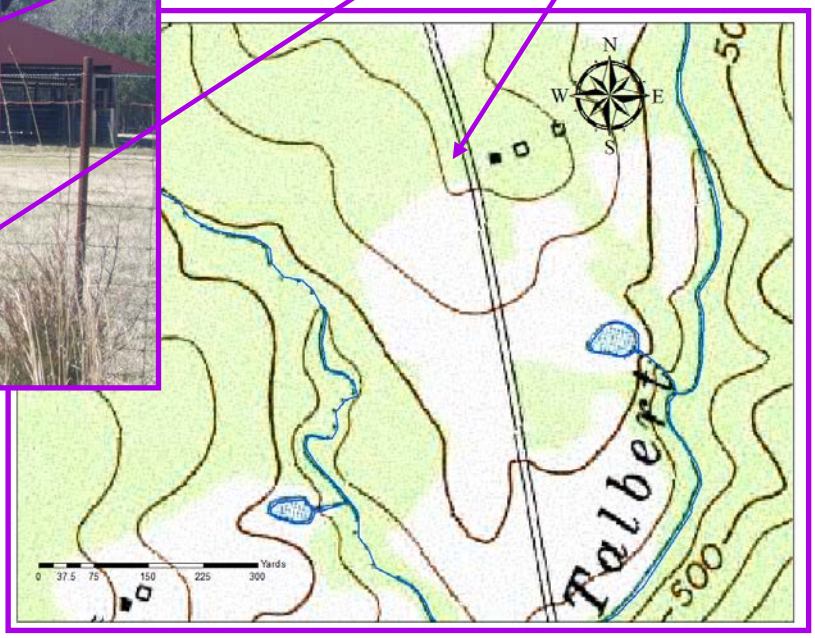
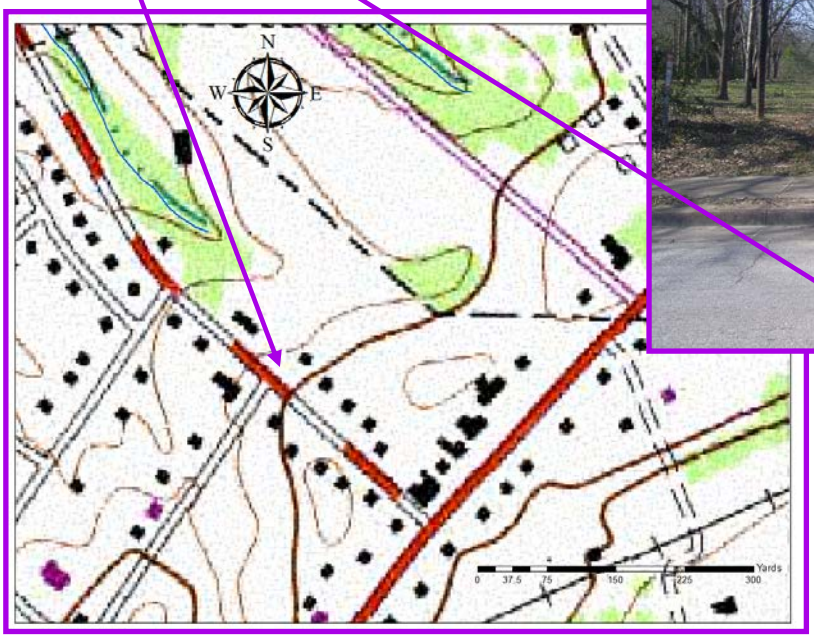


Figure F-19

Pastured goats in the Town of Johnston (location: 33.83875 N, -81.79787 W) on Roland Avenue in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 29, 2016).



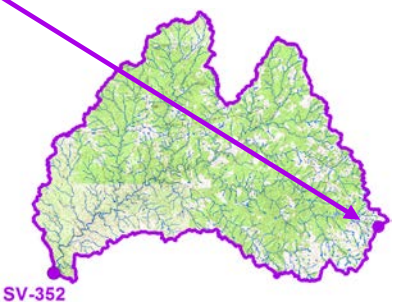


Figure F-20

Goats in a pen near Talbert Branch (location: 31.01019 N, -81.99014 W) on Hamilton Road in Greenwood County. Found in Reach 1 of the TCT Watershed (Date of photography: February 18, 2016).

Figure F-21

Pastured goats (location: 33.82943 N, -81.92820 W) on SC 430 in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 29, 2016).

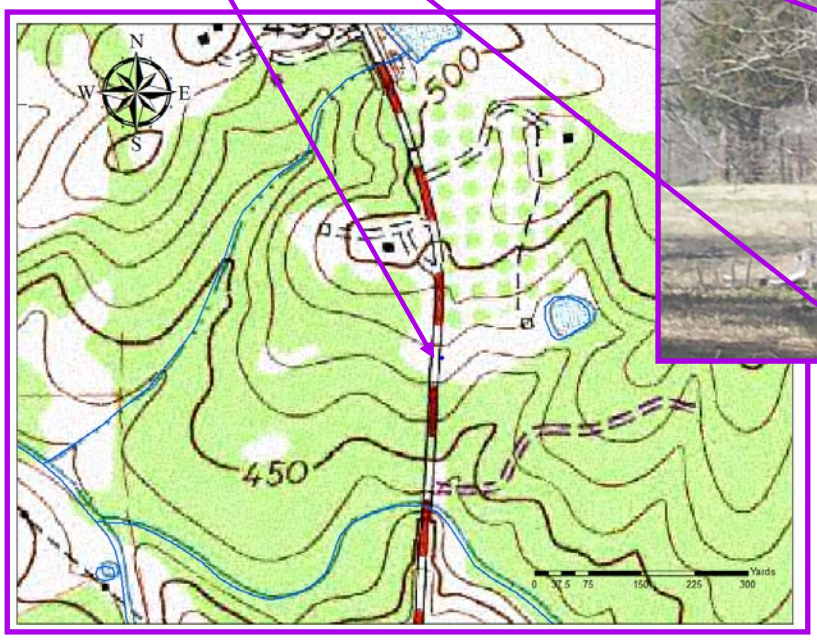


Figure F-22

Chickens in a pen (location: 33.93551 N, -81.96224 W) on US 378 in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: February 25, 2016).

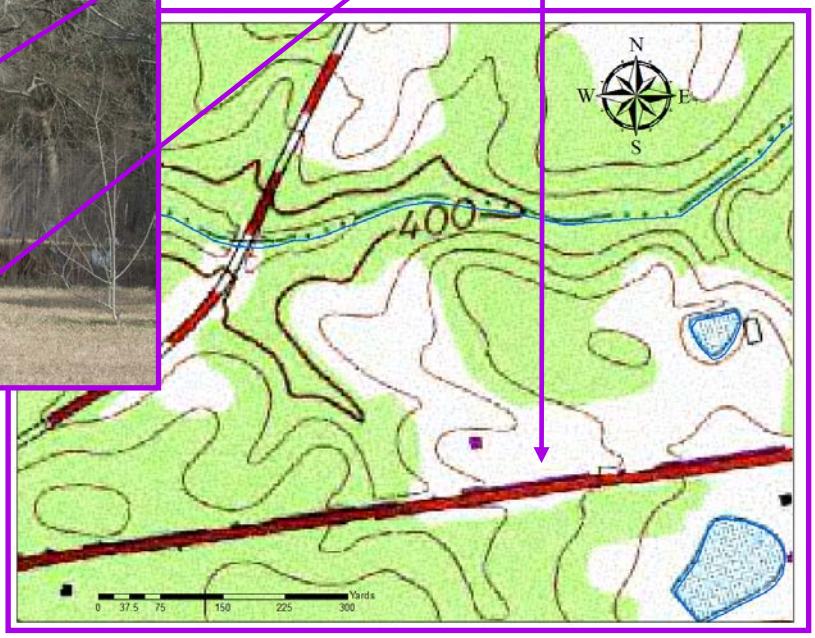


Figure F-23

Unattended dogs in yard (location: 33.84454 N, -81.81742 W) on Sandra Street in the Town of Johnston in Edgefield County. Found in Reach 1 of the TCT Watershed (Date of photography: March 3, 2016).

Figure F-24

Unattended dog near Hamilton Road (location: 34.01025 N, -81.99016 W) near Talbert Branch in Greenwood County. Found in Reach 1 of the TCT Watershed (Date of photography: February 18, 2016).

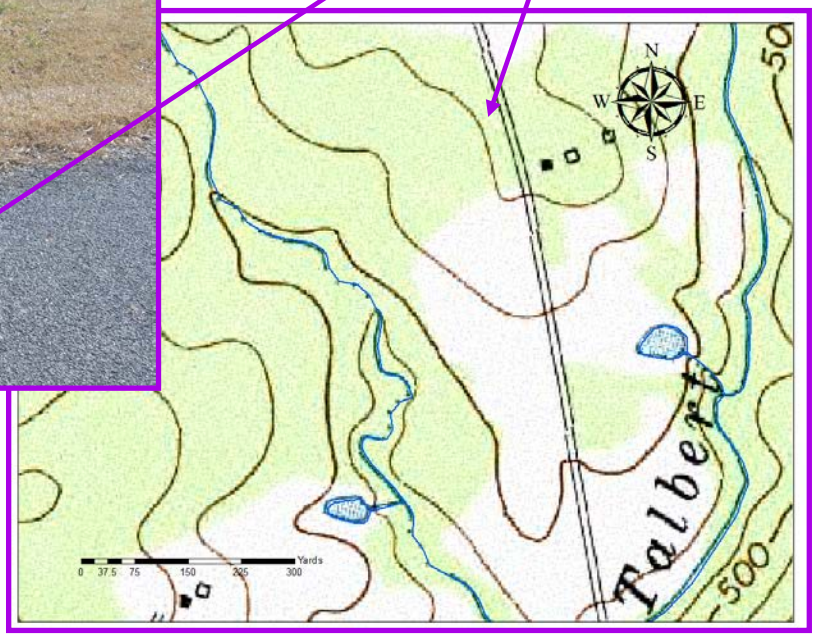


Figure F-25

Unattended dog in yard (location: 33.89860 N, -81.84157 W) on Rocky Creek Road in Saluda County. Found in Reach 1 of the TCT Watershed (Date of photography: March 3, 2016).

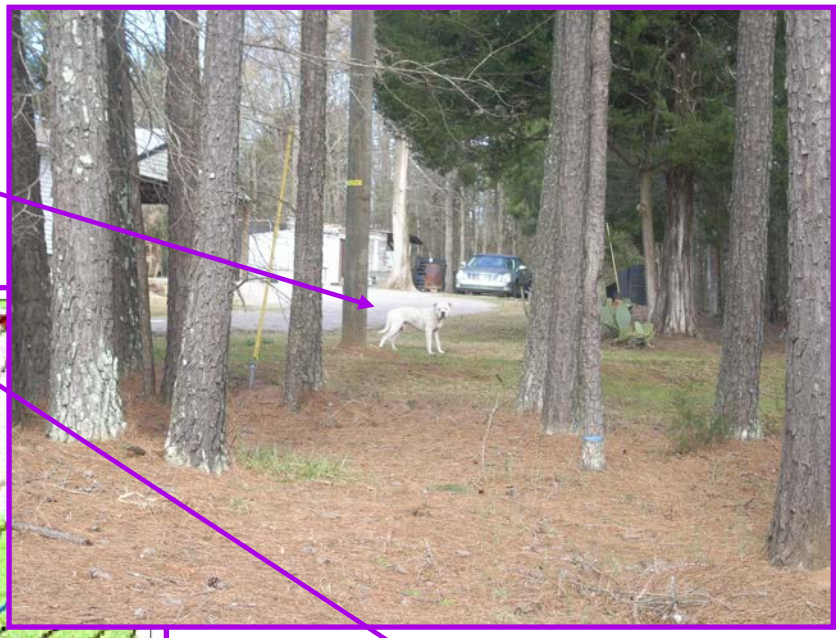


Figure F-26

Unattended dogs in pasture (location: 33.91303 N, -81.84221 W) on Round Up Road in Saluda County. Found in Reach 1 of the TCT Watershed (Date of photography: March 3, 2016).

Amendments to *Turkey Creek and Tributaries E. coli TMDL Document* (and associated appendices)

The following amendments were made by the Department to the referenced document and associated appendices after the 30-day public comment period. These amendments were not made as a result of written comments received during the public comment period but were the result of additional review of the document after initial submittal to the USEPA, Region 4 for final approval on February 10, 2017.

Amendment 1:

Page iv, Table Ab-1 and Page 25, Table 14: The Load Allocation (LA) for RS-08068 was incorrectly provided as 1.00e9 CFU/day. The Document has been updated to include the correct LA as 1.00e11 CFU/day in each table.

Amendment 2:

Page 19, Section 4.0, paragraph 4: The following sentence has been added: "The long-term average facility flow data for Brook Street facility is greater than 5% of the estimated low flow conditions at WQM Station SV-352".

Amendment 3:

Page 19 through 22, Section 4.0, after paragraph 10: Appropriate units were added to the equations provided for calculating existing and targeted loads. The conversion factor was changed from 10000 to the appropriate conversion factor of 24465758.4, given the units provided in the equations. Clarification regarding target load calculations was also provided. In addition, the following paragraph was added to this section in reference to SV-352:

"As previously mentioned, adjustments to the estimated instream flow were made to more accurately account for the presence of an upstream NPDES discharge. For determining existing instream conditions, NPDES 0025330 long-term average discharge monitoring report data were added to the estimated instream time series described in Section 4.0, paragraph three of this document. For determining the target load, the NPDES design flow was added to the estimated instream flow time series".

Amendment 4:

Page 22, Section 4.0, second to last paragraph: Additional language was added to this paragraph in order to clarify the rationale for adjusting instream flow at existing conditions. "For WQM Station SV-352, due to the proportion of flow from the upstream NPDES permit SC0025330 discharge to the flow from Turkey Creek, an adjustment was made to the overall flow time-series (January 1, 1999 to December 31, 2012) to account for this discharge's contribution to the overall stream flow in Turkey Creek. The subsequent DMR adjusted time-series was used to determine the existing load for each hydrologic category for the TMDL calculations where the 90^{th} percentile of measured FC concentrations within each hydrologic category were multiplied by the adjusted 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)".

Amendment 5:

Page 49: The heading for this page has been changed to "Fecal Coliform WQS Exceedence Summary for Impaired Station RS-08068 by Date". Site SV-353 was incorrectly identified as the water quality monitoring site.

Amendment 6:

Page 48-52, Appendix D: Incorrect values were included by hydrologic category in the Target Load Tables for sites RS-08068 and SV-352. The values were initially included as the Target Load + a 5% MOS. The Target Load Tables have been updated to include the correct target loads by hydrologic category.

Amendment 7:

Page 48-52, Appendix D: The following two tables were added pertaining to site SV-352 in order to clarify mid-point hydrologic category used for calculations in the document. Due to the proportion of flow from the upstream NPDES permit SC0025330 discharge to the flow from Turkey Creek, an adjustment was made to the overall flow time-series (January 1, 1999 to December 31, 2012) to account for this discharge's large contribution to the overall stream flow in Turkey Creek.

Mid Point Hydrologic Instream Category Including Long Term Average DMR Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-352	460.63	91.16	35.91	14.45	2.78

Mid Point Hydrologic Instream Category Including Facility Design Flow (cfs)

Hydro Categ (Mid-Point)	High Flow (5)	Moist Cond. (25)	Mid Range (50)	Dry (75)	Low Flow (95)
SV-352	461.37	91.75	36.53	15.28	3.53