

Total Maximum Daily Load
Shem Creek Enterococcus Daily Loads for
Stations SC1, SC2, SC3, and MD-071 in
Hydrologic Unit Code
030502010707



Prepared for
SCDHEC Bureau of Water



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Abstract

Shem Creek is located within Town of Mt. Pleasant in Charleston County, South Carolina (SC). Shem Creek watershed is approximately 4.2 mi². Historically, there was one SC Department of Health and Environment (DHEC) water quality monitoring station in Shem Creek, MD-071, and was monitored from 1999-2011 for fecal coliform bacteria. Currently, there are three water quality monitoring stations, SC1, SC2, and SC3 that are monitored for enterococcus bacteria by the Charleston Waterkeeper.

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 only compared against the single sample maximum (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. All four stations have been included in the EPA approved 2016 303(d) List and draft 2018 303(d) List of Impaired Waters for exceeding the recreational water quality standard for enterococcus bacteria.

Existing conditions and percent reductions for Shem Creek were calculated using cumulative probability distributions. For stations SC1, SC2, and SC3, the percent reductions required to meet the enterococcus geometric mean water quality standard are 78.3%, 87.5%, and 96.1% respectively. Currently, there are no continuous NPDES permitted point source discharges in the watershed. There are three NPDES permitted MS4s within the watershed: Charleston County, City of Mt. Pleasant, and SC Department of Transportation. For SCDOT, existing and future NPDES MS4 permittees, compliance with terms and conditions of their NPDES permit is effective implementation of Wasteload Allocation (WLA) to the Maximum Extent Practicable (MEP) and demonstrates consistency with the assumptions and requirements of the Total Maximum Daily Load (TMDL). For existing and future NPDES construction and industrial stormwater permittees, compliance with terms and conditions of its permit is effective implementation of the WLA. Required load reductions in the Load Allocation (LA) portion of this TMDL can be implemented through voluntary measures and are eligible for Clean Water Act (CWA) §319 grants.

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

Table Ab-1. TMDLs for Shem Creek watershed. Loads are expressed as most probable number (mpn) per 100 ml.

Station	90th %tile of Existing Load (mpn/100ml)	TMDL ^{1, 2} (mpn/100ml)	WQ Target (mpn/100ml)	Margin of Safety (mpn/100ml)	WLA			LA
					Continuous Sources ³ (mpn/100ml)	Non-Continuous ^{4, 6} Sources (% Reduction)	Non-Continuous SCDOT ^{5, 6} (% Reduction)	% Reduction to Meet LA ⁶
SC1	153.4	35	33.25	1.75	See Note Below	78.3%	78.3%	78.3%
SC1	447	501	475.95	25.05	See Note Below	0%	0%	0%
SC2	266.6	35	33.25	1.75	See Note Below	87.5%	87.5%	87.5%
SC2	601.8	501	475.95	25.05	See Note Below	20.9%	20.9%	20.9%
SC3	858.7	35	33.25	1.75	See Note Below	96.1%	96.1%	96.1%
SC3	2405.7	501	475.95	25.05	See Note Below	80.2%	80.2%	80.2%

Table Notes:

1. TMDL is expressed as a concentration. If daily average tidal exchange estimates were available, this number could be converted to load in mpn/day by multiplying flow by concentration and a conversion factor.
2. SB water WQS = Geometric mean of samples shall not exceed 35 mpn/100 ml nor shall a single sample maximum exceed 501mpn/100 ml.
3. WLA is expressed as a daily maximum of 501 mpn/100 ml and a 30-day geometric mean of 35 mpn/100 ml. There are no continuous dischargers at this time. Future continuous discharges are required to meet the prescribed loading for the pollutant of concern. Loadings are developed based upon permitted flow and an allowable permitted maximum concentration of 501 mpn/100ml or 30-day geometric mean of 35 mpn/100 ml.

4. Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet percentage reduction or the existing instream standard for pollutant of concern in accordance with their NPDES Permit.
5. By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address Enterococcus, the SCDOT will comply with these TMDLs and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.
6. Percent reduction applies to existing concentration.

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1.0 Introduction

The Federal Clean Water Act (CWA) directs each state to review the quality of its waters every two years to determine if water quality standards are being met. If it is determined that the water quality is not being met, the states are to list the impaired water bodies under §303(d) of the CWA. The area of interest defined in this document includes Shem Creek in Charleston County, South Carolina (F). South Carolina Department of Health and Environmental Control (SCDHEC) station MD-071 and three stations monitored by Charleston Waterkeeper (CWK), SC1, SC2, and SC3 are considered impaired for recreational uses due to elevated *Enterococci* bacteria levels. For station location descriptions, please refer to Table 1.

A Total Maximum Daily Load (TMDL) is a written plan and analysis to determine the maximum pollutant load a waterbody can receive and still meet applicable water quality standards. The TMDL process includes estimating pollutant contributions from all sources, linking pollutant sources to their impacts on water quality, allocation of pollutant contributions to each source and establishment of control mechanisms to achieve water quality standards. All TMDLs include a wasteload 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 130.7. 2001.

1.1 Background

Shem Creek is in the Sea Islands/Coastal Marsh ecoregion of South Carolina within Charleston County. Generally, Sea Islands/Coastal Marsh ecoregions have the lowest elevations in South Carolina. Environment is highly dynamic and is affected by wind, ocean wave, and river flows. In these types of ecoregions slash pine, cabbage palmetto, red cedar, and live oaks forests are common. In the marshes saltgrass, rushes, and various cordgrasses are the dominant flora. Marshes are nursery grounds for shrimp, fish, crabs, and other species (Griffith, et al. 2002).

Between 2000 and 2010, some of the coastal counties in South Carolina, including Charleston County, has experienced rapid growth and population increases. From 2000 US Population Census to 2010 Census, Charleston County's population increased by 13% to 350,209 and total population for South Carolina increased by 15.3% to 4,625,384 (U.S. Census Bureau 2012). Based on the US Census Bureau estimates, SC population increase from 2010 to 2017 is approximately 8.6% (census.gov/quickfacts/sc). During the same

period, population of Town of Mt. Pleasant population has increased by 27.7% from 67,843 in 2010 to 86,668 in 2017 (Available at: [census.gov/quickfacts/fact/table/mountpleasanttownsouthcarolina/PST045217](https://www.census.gov/quickfacts/fact/table/mountpleasanttownsouthcarolina/PST045217)).

Genus *Enterococci* are Gram-positive cocci common in the feces of warm-blooded animals which includes humans. Starting in 1986, US Environmental Protection Agency (EPA) has recommended using *Enterococci* as the indicator organism for fecal contamination and health risk in marine waters (US EPA 1986).

Sources of bacteria are commonly diffuse or nonpoint in nature and may originate from stormwater runoff, failing septic systems, agricultural runoff, leaking sewers, wildlife, pets, birds, etc. Occasionally, the source of the pollutant is a point source, such as wastewater treatment plants, MS4s, etc.

Section §303(d) of the Federal Clean Water Act (CWA) and *Water Quality Planning and Management* Regulations (40 CFR 130.7. 2001) 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 contribution 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 (US EPA 1991).

Table 1. Water quality monitoring stations located in Shem Creek.

Monitoring Stations	Station Descriptions
MD-071	Shem Creek at bridge on US 17
SC1	Shem Creek 1 – Southwest end of floating dock at Shem Creek Park
SC2	Shem Creek 2 – End of dock at Shem Creek public boat landing
SC3	Shem Creek 3 – End of Sea Gull Drive dock (Private access)

The State of South Carolina has included four monitoring stations in Shem Creek on South Carolina's EPA approved 2016 §303(d) List and draft 2018 303(d) List of Impaired Waters (SC DHEC, 2016) for recreational uses due to exceedances of *Enterococci* bacteria. Because the sites are impaired, a TMDL must be developed for the pollutant of concern. The goal of this project will be to determine what and where the sources for *Enterococci* potentially are and calculate reductions that will meet the applicable water quality standard. All four stations covered in this TMDL document are identified and shown on Figure 1.

1.2 Watershed Description

Shem Creek TMDL watershed is in Town of Mt. Pleasant in Charleston County, South Carolina. The TMDL watershed is encompassed within 12-digit hydrologic unit code (HUC) 030502010707 which is in the larger Lower Cooper watershed.

Shem Creek watershed was delineated in collaboration with Town of Mt. Pleasant, Charleston County, South Carolina Department of Transportation (SCDOT), Charleston Waterkeeper. Initially, the watershed boundary was delineated by the department based on topography, digital elevation models (DEM), and satellite imagery. MS4s within the watershed provided various GIS layers, and these were used in refining and finalizing the watershed boundary with concurrence from all MS4s. Finalized watershed boundary has a drainage area of 4.2 mi² and is shown on Figure 1.

Shem Creek is an urban tidal stream situated to the northeast of Charleston Harbor, SC. Creek is approximately 800 feet wide at its entrance from Charleston Harbor and tapers to less than 1 foot near Von Kolnitz Road, with an average tidal range of approximately 5 feet.

Currently, there are three active stations in Shem Creek that are being monitored by Charleston Waterkeeper. Station SC1 is sampled from southwest end of floating dock at Shem Creek Park where the creek is approximately 200 feet wide and approximately 1000 feet upstream from the confluence with Charleston Harbor (Figure 2). From June 2013 to October 2018, there were 146 samples collected and analyzed from this station, where 68% of the 19 calculated geometric mean values exceeded the geometric mean WQS of 35 mpn/100 ml. During the same period, 9% of the 146 samples exceeded the single sample maximum of 501 mpn/100 ml. Sample range is 10 – 24,196 mpn/100 ml.



Figure 2. Floating dock at Shem Creek Park, vicinity of station SC1.

Station SC2 is sampled from a dock at Shem Creek boat landing, Figure 3. At this location, the creek is approximately 160 feet wide and is 4000 feet upstream of confluence with Charleston Harbor. Between July 2013 to October 2018, 145 samples were collected and analyzed. Of these, 89% of the 25 calculated geometric mean values exceeded the geometric mean WQS of 35 mpn/100 ml. During the same sampling period, 13.1% of the 145 samples exceeded the single sample maximum of 501 mpn/100 ml. Sample range is 10 – 24196 mpn/100 ml.



Figure 3. Vicinity of station SC2.

Station SC3 is sampled from a private dock upstream from Folly Road. At this location, depending on tidal stage, the creek is approximately 55 feet wide and is 2.25 miles upstream from confluence with Charleston Harbor (Figure 4). Between July 2013 and October 2018 sampling period, 146 samples were collected and analyzed from this station. Of the 146 samples collected and analyzed from SC3, 100% of the 28 exceed the geometric mean WQS of 35 mpn/100 ml, while 32.9% of the 146 samples exceeded the single sample maximum of 501 mpn/100 ml. Samples have a range of 10 – 24196 mpn/100 ml.



Figure 4. Vicinity of station SC3.

1.3 Landuse

Landuse within Shem Creek TMDL area was calculated using National Land Cover Database (NLCD) 2011 (Homer, et al. 2015). The results based on landuse characteristics are summarized on

Table 2. Figure 6 shows the NLCD 2011 landuse within Shem Creek watershed. Based on NLCD 2011, primary landuse within the TMDL area is urban (3.46 mi²) followed by woody and emergent herbaceous wetlands (0.42 mi²). Based on NLCD 2011, the Shem Creek watershed is 82.4% developed and 28.5% impervious.

Table 2. Shem Creek landuse based on NLCD 2011

Landuse	Area (mi2)	Percent of Area (%)
Open Water	0.03	0.7
Developed, Open Space	1.05	25
Developed, Low Intensity	1.51	36
Developed, Medium Intensity	0.75	17.9
Developed, High Intensity	0.15	3.6
Forest	0.27	6.4
Scrub/Shrub	0.05	1.2
Woody and Emergent Herbaceous Wetlands	0.42	10
Total	4.2 mi2	100%

1.4 Water Quality Standard

Shem Creek is classified as Class SB waters in SC Regulation 61-69 (SC DHEC 2014). Class SB waters are defined in SC Regulation 61-68 (SC DHEC 2014) as:

“Class SB are tidal saltwaters suitable for primary and secondary contact recreation, crabbing, and fishing, except harvesting of clams, mussels, or oysters for market purposes or human consumption and uses listed in Class SB. Also suitable for the survival and propagation of a balanced indigenous aquatic community of marine fauna and flora.”

Enterococci standard for Class SB waters (SC DHEC 2014):

“Not to exceed a geometric mean of 35/100 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 501/100 ml. Additionally, for beach monitoring and notification activities for CWA Section 406 only, samples shall not exceed a single sample maximum of 501/100 ml.”

2.0 Water Quality Assessment

In 1986, the USEPA documented that *E. coli* and *Enterococci* 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 and marine recreational 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, *Enterococci* and *E. coli* are more specific to sewage and fecal sources than the FC bacteria group. In light of this information, USEPA has

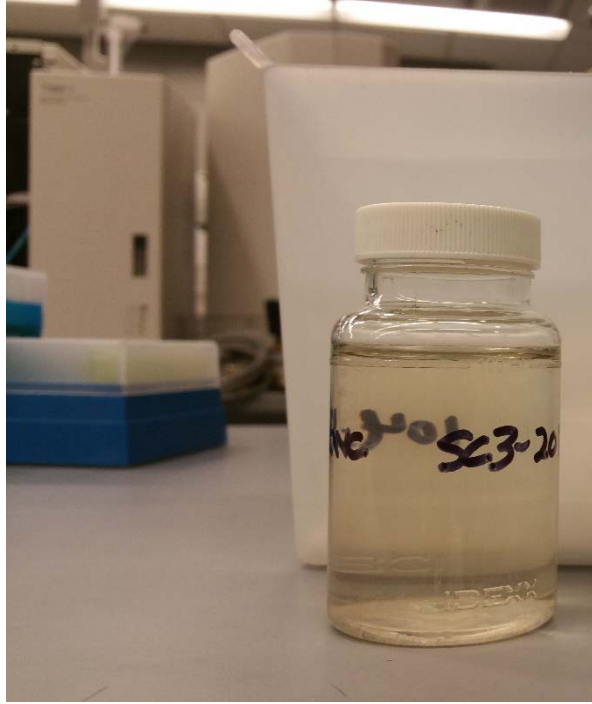
recommended the use of *E. coli* for fresh waters and *Enterococci* for marine water as the pathogen indicators.

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

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 *Enterococci* in R. 61-68. The proposed amendment was approved by the USEPA on February 28, 2013 and *Enterococci* has been promulgated in R. 61-68. *Enterococci* is the applicable water quality standard indicator for recreational use in salt waters.

Charleston Waterkeeper (CWK), based in Charleston, South Carolina is an organization whose mission is "to protect, promote, and restore the quality of Charleston's waterways..." (<http://charlestonwaterkeeper.org/>). The organization has a DHEC approved Quality Assurance Project Plan (QAPP) and has been collecting water samples since 2013. Weekly water samples are collected May through October, from approximately 15 stations from recreational marine waters around Charleston. Samples are collected from each station in pre-sterilized 120 ml bottles (Figure 5). Samples are analyzed for Enterococci according to Enterolert assay (Figure 7).

Locations sampled by the CWK include waters with heavy recreational uses such as swimming, kayaking, stand-up paddling, canoeing, etc. Shem Creek is one of the tidal streams monitored by the Waterkeeper. The Waterkeeper collects samples from three stations within Shem Creek which are identified in Figure One. Data collected by the Waterkeeper is available through their website, available at: <http://charlestonwaterkeeper.org/what-we-do/programs/water-quality-monitoring/>



Image, courtesy of Cheryl Carmack, Charleston Waterkeeper.

Figure 5. August 30, 2017 sample collected by Cheryl Carmack from station SC3.

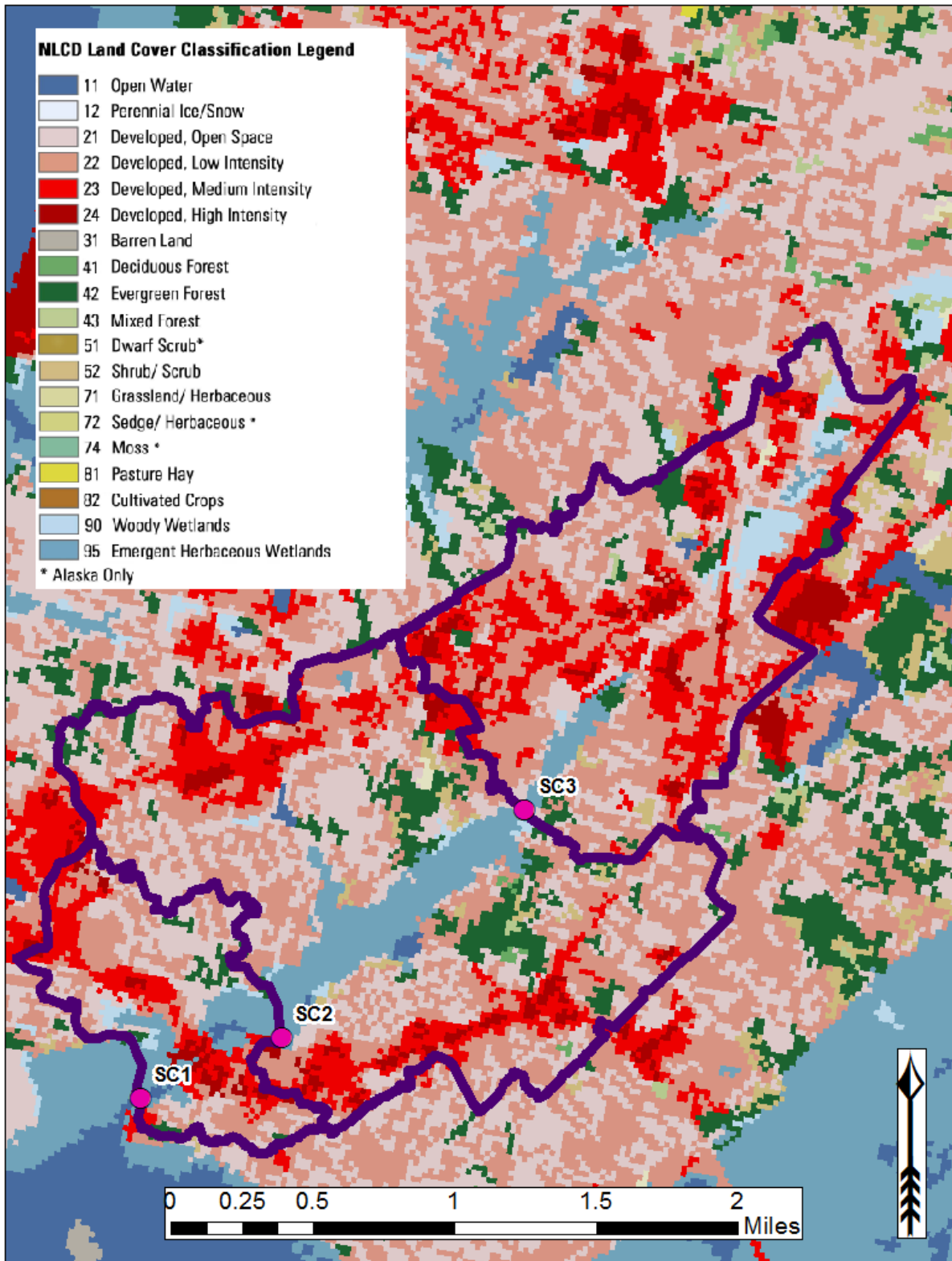
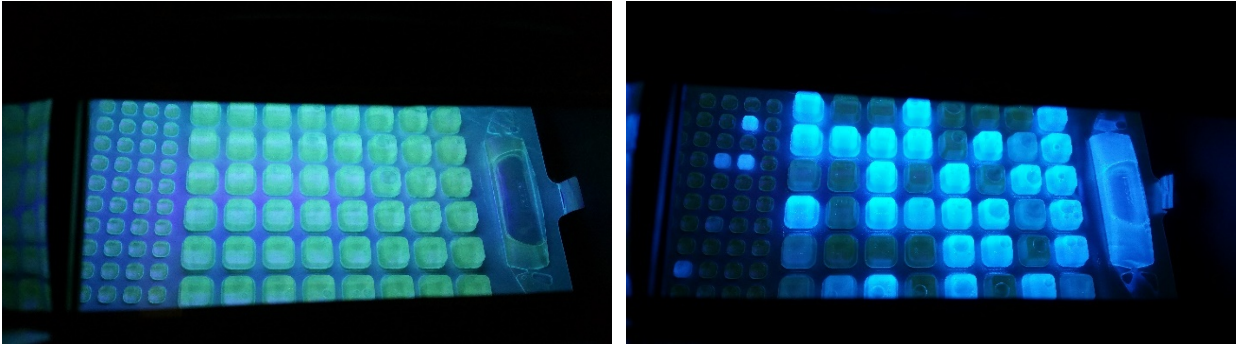


Figure 6. Landuse characteristics of Shem Creek watershed and the surrounding area.

3.0 Source Assessment

Pathogens, which are usually difficult to detect, cause disease and make full body contact recreation in lakes, streams a risk to public health. Indicators such as FC bacteria, *Enterococci*, or *E. coli* are easier to measure, have similar sources as pathogens, and persist in surface waters for a similar or longer length of time. These bacteria are not in themselves disease causing but indicate the potential presence of organisms that may result in sickness.



Image, courtesy of Cheryl Carmack, Charleston Waterkeeper.

Figure 7. Results of sample collected from SC3 on August 30, 2017 (Figure 5) is shown on the right. The analysis results indicated there were 650 mpn/100 ml *Enterococcus* in the sample. On the left is the "blank control" tray with 0 mpn/100 ml.

There are many sources of pathogen pollution in surface waters. These sources may be classified as point and nonpoint sources. Point sources are generally defined as pollutant loads discharged at a specific location from pipes, outfalls, ditches and conveyance channels from either municipal wastewater treatment plants, industrial waste treatment facilities or MS4s. Nonpoint source pollution originates from multiple sources that are unregulated over a relatively large area. Nonpoint sources can be divided in source activities related either to land or water use and include failing septic tanks, improper animal keeping practices, forestry practices, as well as urban and rural runoff. With the implementation of technology-based controls, pollution from continuous point sources, such as factories and wastewater treatment facilities, has been greatly reduced. These point sources are required by the CWA to obtain a NPDES permit. In South Carolina NPDES permits require that dischargers of sanitary wastewater must meet the state standard for *Enterococcus* at the point of discharge.

Other non-continuous point sources required to obtain NPDES permits that may be a source of pathogens include MS4s, stormwater discharges from construction sites, and stormwater discharges associated with industrial activities.

Small MS4s are authorized to require installation, implementation, and maintenance of control measures for owners and operators of construction sites or industrial activities

without an industrial stormwater general permit (SCR000000) or construction stormwater general permit (SCR100000). It is the responsibility of the MS4 to ensure stormwater discharges from these activities, through their coverage area, meet the water quality standard or percent reduction at the point of entrance to the waters of the state.

Non-continuous point sources required to obtain NPDES permits include stormwater discharges from municipal separate storm sewer systems (MS4s), industrial activities and construction sites. Each may be a source of pathogens. These sources are expected to meet the percentage reductions as prescribed in this TMDL or the existing instream standard for the pollutant(s) of concern through compliance with the terms and conditions of their permit.

3.1 Point Sources

3.1.1 Continuous Point Sources

Municipal and private sanitary wastewater treatment facilities may be sources of pathogens or *Enterococci* bacteria when not meeting limits for *Enterococci* bacteria. However, if these facilities are discharging wastewater that meets their permit limits, they are not causing or contributing to impairment provided that a daily maximum limit is being met as specified in the TMDL. If any of these facilities are not meeting their permit limits, enforcement actions/mechanisms are in place.

Currently, there are no continuous NPDES-permitted discharges to Shem Creek with an *Enterococci* effluent limit on their NPDES permit. Future NPDES dischargers in Shem Creek watershed are required to comply with the load reduction prescribed in the WLA and demonstrate consistency with the assumptions and requirements of the TMDL.

3.1.2 Non-Continuous Point Sources

Non-continuous point sources include all NPDES-permitted stormwater discharges, including current and future MS4s, construction and industrial discharges covered under permits numbered SCS and SCR and/or regulated under *South Carolina Water Pollution Control Permits: R.61-9, §122.26(b)(4),(7),(14) - (21)* (SC DHEC 2011). All regulated MS4 entities have the potential to contribute to *Enterococci* pollutant loading in the delineated drainage area used in the development of this TMDL.

The South Carolina Department of Transportation (SCDOT) is a designated MS4 within Shem Creek watershed. The SCDOT operates under NPDES MS4 Permit SCS040001 and owns and operates roads within the watershed. However, the Department recognizes that

SCDOT is not a traditional MS4 in that it does not possess statutory taxing or enforcement powers. SCDOT does not regulate landuse or zoning, issue building or development permits.

Individual landuses for the three CWK stations included in this TMDL document were calculated utilizing NLCD 2011 and a Geographic Information System (GIS) tool and are summarized in by each landuse category. Total developed landuse for SC1, SC2, and SC3 are 78.4%, 78.7%, and 87.2% of their total drainage area, respectively. Based on current GIS information available at the time of TMDL development, there are no SCDOT facilities located within these referenced watersheds.

Other than SCDOT, there are two additional permitted stormwater systems in this watershed: Charleston County (SCR031902), and Town of Mt Pleasant (SCR031906). Future permitted sanitary sewer or stormwater systems in the referenced watershed are required to comply with the load reductions prescribed in the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. See Figure 9 for stormwater outfalls and conveyances, organized by MS4.

Table 3, below, shows the total contributing areas (ac) of each MS4 within the Shem Creek TMDL watershed, which is 2700.8 ac, 4.2 mi², which is the total area of the TMDL watershed. Please see Figure 8 for a map of MS4 coverage.

Table 3. MS4s within Shem Creek TMDL watershed and their total contributing areas (ac) by station.

	Charleston County acres	Town of Mt. Pleasant acres	SC DOT acres
SC1	8.8	330.1	30.6
SC2	41.6	1214.7	114.9
SC3	41.8	796.2	122.2
Total	2700.8 ac (4.2 mi ²)		

Industrial facilities that have the potential to cause or contribute to a violation of a water quality standard are covered by the NPDES Storm Water Industrial General Permit (SCR000000). Construction activities are usually covered by the NPDES Storm Water Construction General Permit from SCDHEC (SCR100000). Where the construction has the potential to affect water quality of a water body with a TMDL, the Storm Water Pollution Prevention Plan (SWPPP) for the site must address any pollutants of concern and adhere to any waste load allocations in the TMDL. Note that there may be other stormwater

discharges not covered under permits numbered SCS and SCR that occur in the referenced watershed. These activities are not subject to the WLA portion of the TMDL.

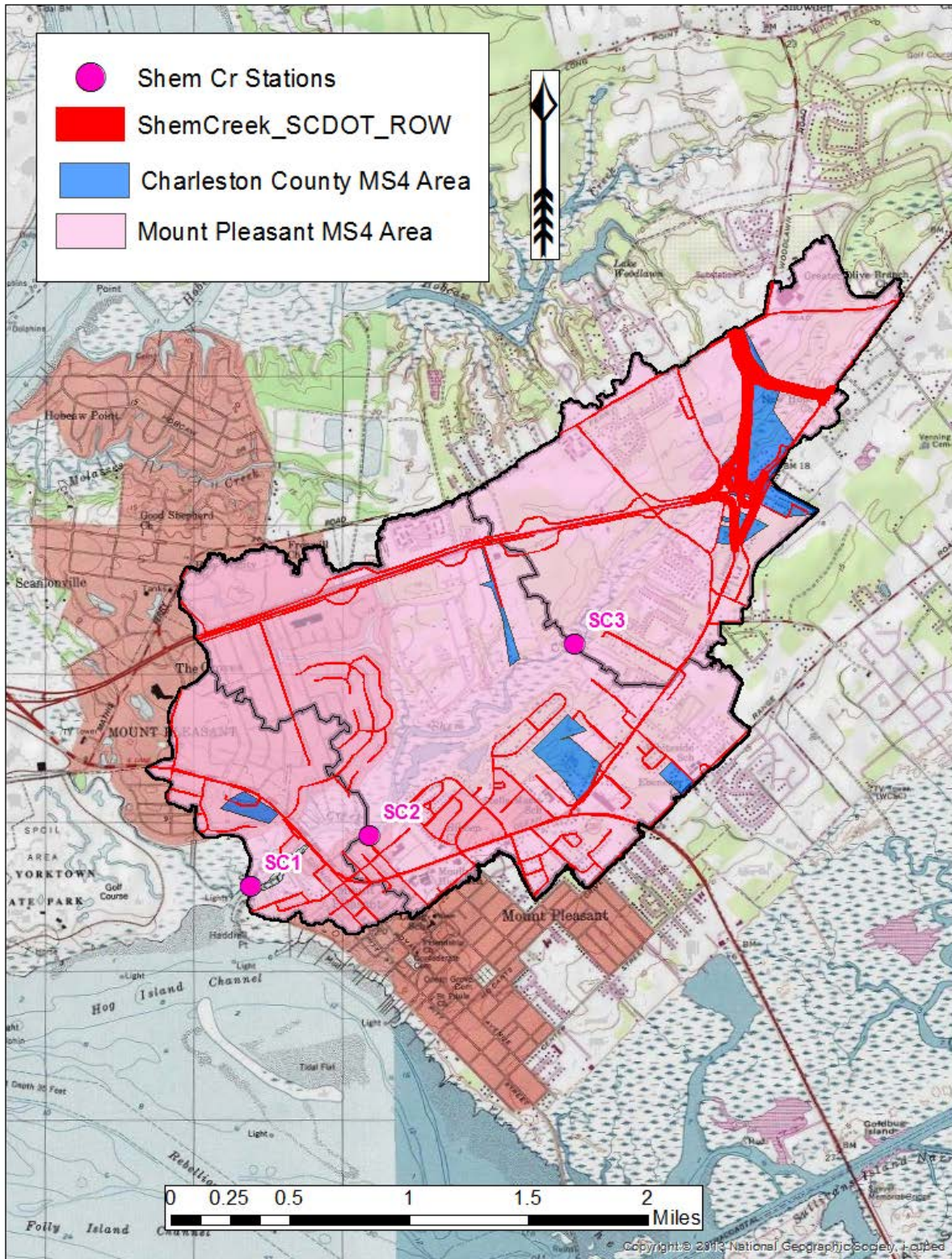


Figure 8. MS4s located within Shem Creek TMDL watershed.

Like regulated MS4s, potentially designated MS4 entities or other unregulated MS4 communities located in these watersheds may have the potential to contribute *Enterococci* bacteria in stormwater runoff. These unregulated entities are subject to the LA for the purposes of these TMDLs.

Sanitary sewer overflows to surface waters have the potential to impact water quality. These untreated sanitary discharges result in violations of the WQS. It is the responsibility of the NPDES wastewater discharger, or collection system operator for non-permitted 'collection only' systems, to ensure that releases do not occur. Unfortunately releases to surface waters from SSOs are not always preventable or reported.

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

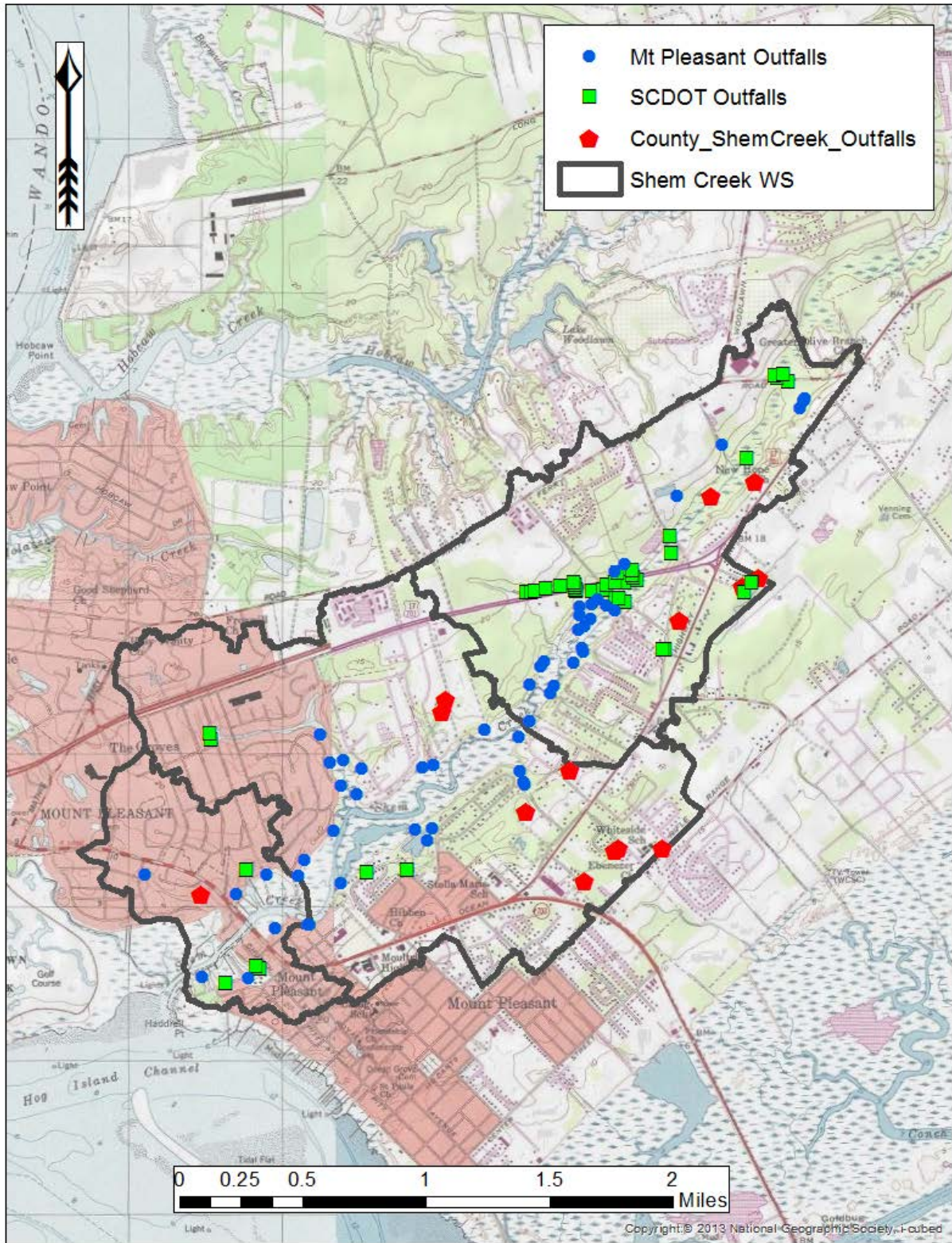


Figure 9. Stormwater outfalls of MS4s in Shem Creek watershed.

3.2 Nonpoint Sources

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

Nonpoint source pollution is a likely contributing factor to negatively impact water quality in these watersheds. 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 the permitted area) of Shem Creek watershed. Nonpoint sources located in unregulated areas are subject to the LA and not the WLA of the TMDL document.

3.2.1 Agricultural Activities

Agricultural activities that involve livestock or animal wastes are potential sources of bacterial contamination of surface waters. Fecal matter can enter the waterway via runoff from the land or by direct deposition into the stream. Owners/operators of most commercial animal growing operations are required by R. 61-43, Standards for the Permitting of Agricultural Animal Facilities, to obtain permits for the handling, storage, treatment (if necessary) and disposal of the manure, litter and dead animals generated at their facilities (SC DHEC 2002). The requirements of R. 61-43 are designed to protect water quality and there is a reasonable assurance that facilities operating in compliance with this regulation should not contribute to downstream water quality impairments. In addition to the state permit, animal operations that are considered Concentrated Animal Feeding Operations (CAFOs) are also required to have an NPDES Permit if they have a discharge to surface waters. There are no permitted CAFOs in South Carolina. Currently, there are no regulated agricultural operations within the TMDL watershed.

3.2.2 Land Application of Industrial, Domestic Sludge or Treated Wastewater

NPDES-permitted industrial and domestic wastewater treatment processes may generate solid waste bi-products, also known 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 (SC DHEC 2011), Sections 503, 504, or 505.

It is recognized that there may be operating, regulated land application sites located in Shem Creek 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 application sites can be a source of *Enterococcus* bacteria 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 Shem Creek. Direct discharges from land application sites to surface waters of the State are illegal and are subject to enforcement actions by the SCDHEC. Currently there are no NPDES permitted facilities with a land application permit of treated wastewater within Shem Creek watershed.

3.2.3 Urban and Suburban Stormwater Runoff

There are 'urban' wildlife such as resident waterfowl, squirrels, rodents, raccoons, geese and other birds, all of which can contribute to the bacteria load. Urban runoff is considered to be significant within Shem Creek TMDL watershed.

Other contributors to the *Enterococci* loading to streams, estuaries, and lakes are the household cats and dogs as well as other domesticated animals such as horses, chickens, pigs and others. One study found cat feces can contain between 3.3×10^4 to 4.1×10^7 MPN/g (wet), and dog feces between 8.4×10^6 to 1.2×10^8 MPN/g (wet) of fecal indicator bacteria (Cox, et al., 2005). U.S. Pet Ownership Statistics show 28% of households' own dogs and 23% own cats (American Veterinary Medical Association, 2014). Based on the 2010 US Population Census, there are approximately 11,101 households with a population of 20,643 within Shem Creek watershed. Based on these statistics, there are approximately 4,637 dogs and 5,065 cats within Shem Creek TMDL watersheds. American Veterinary Medical Association Pet Ownership Calculator is available at:

<https://www.avma.org/KB/Resources/Statistics/Pages/US-pet-ownership-calculator.aspx>

Similar to regulated MS4s, potentially designated MS4 entities as listed in FR 4, Appendix 7 (Federal Register 1999) or other unregulated MS4 communities located in Shem Creek watershed may have the potential to contribute bacteria in stormwater runoff.

3.2.4 Failing Septic Systems

Improperly maintained and failing septic tanks can contribute to bacterial contamination of downstream waterbodies. Untreated sewage from failing septic systems may have a potential to enter surface waters in this watershed. 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 effluent from failing septic systems.

Locations and total number of potential septic systems were estimated using various GIS layers provided by Mt. Pleasant. Based on the results of this analysis, there are approximately 76 septic tanks within Shem Creek watershed, Figure 10.

3.2.5 Wildlife

Resident, migrant and seasonal wildlife' wastes that are carried into nearby streams by runoff following rainfall or deposited directly in or adjacent to streams may be a significant source of Enterococcus in Shem Creek watershed. SCDNR's 2013 deer density study indicate there are approximately 15 to 30 deer per square mile in the vicinity of Shem Creek TMDL area (SC DNR 2013). The study estimated deer density based on suitable habitat such as forests, croplands, and pastures. Data compiled by Yagow show the fecal indicator bacteria production can be 347×10^6 mpn/deer/day, 113×10^6 mpn/raccoon/day, and $4,853 \times 10^6$ mpn/duck/day (Yagow 2001).

3.2.6 Marinas, Boating Activities and Structures

Shem Creek Marina is the only marina within the TMDL watershed. This marina does not have pumpout facilities, however, there are pumpout facilities in the vicinity. Along Shem Creek, there are numerous private docks.

There are 3 main types of marine sanitation devices (MSD) that are suitable for different kinds of marine vessels and have varying effluent treatment levels. Every vessel with an MSD installed as of January 30, 1980 must be equipped with one of the three types of MSDs (United States Code 2012). Properly-maintained MSDs should not be causing or contributing to bacteria exceedances in Shem Creek. It is prohibited under Federal law to discharge untreated sewer from vessels within navigable waters as stated in Clean Vessel Act.

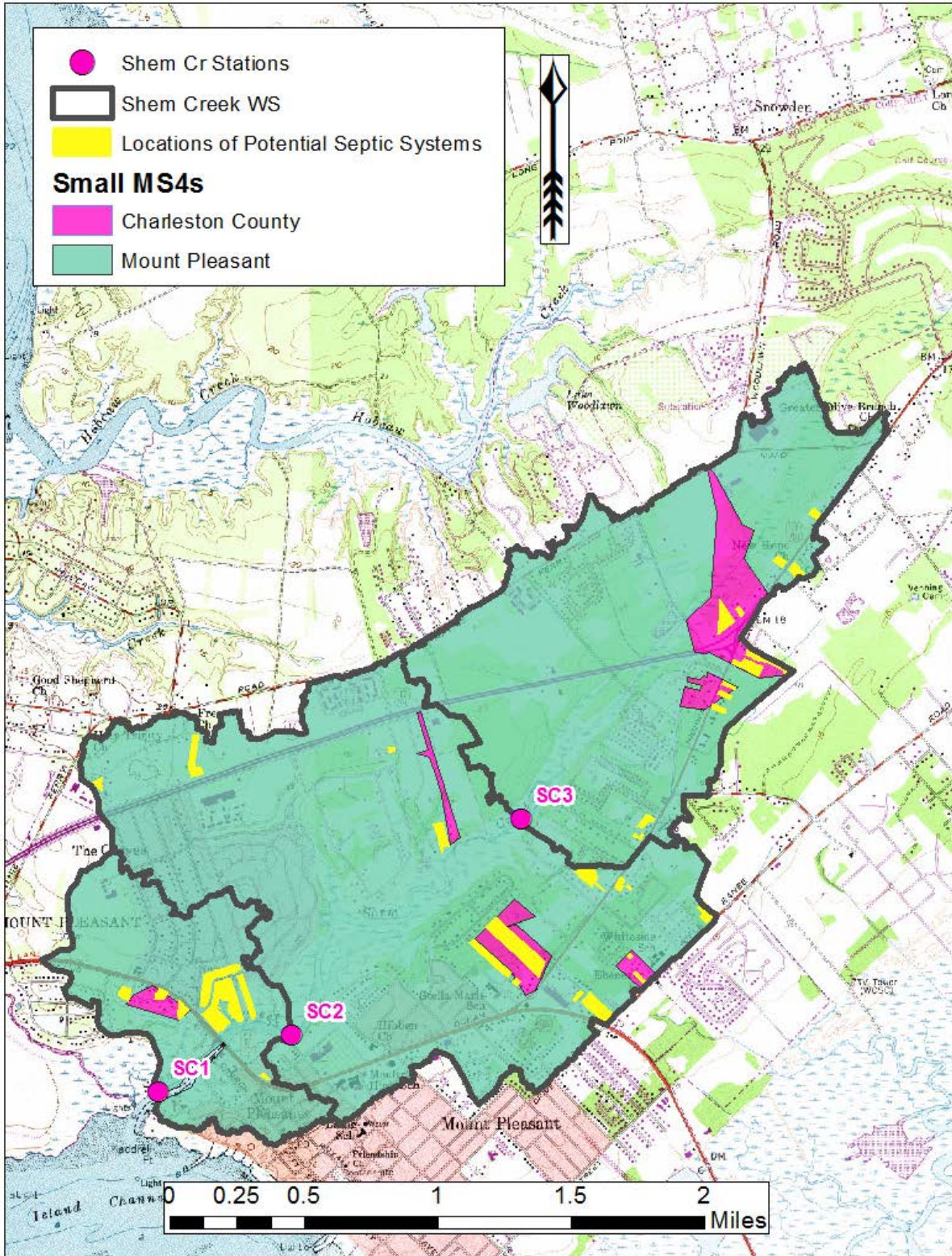


Figure 10. Locations of potential septic tanks within Shem Creek watershed.

3.2.7 Summary of Potential Sources of Bacteria in Shem Creek Watershed

There are many sources of bacteria and numerous paths of entry into the waterways. Some of these sources and pathways are:

1. Malfunctioning septic tanks
2. Pet Waste
3. Sanitary sewer overflows
4. Stormwater runoff
5. Illicit discharges

4.0 Cumulative Probability Method

Cumulative probability distributions were used to calculate existing conditions and percent reductions necessary to meet recreational saltwater water quality standard for enterococcus in the Shem Creek TMDL watershed. DHEC station MD-071 was sampled for fecal coliform from 1999 to 2011. Because enterococcus is the applicable recreational use water quality indicator and more recent enterococcus data have been collected at SC1, SC2 and SC3 in the watershed, the Department believes that the historic fecal coliform data collected at MD-071 are less representative of current conditions in the watershed. The calculated reductions for SC1, SC2 and SC3 are expected to address the current recreational use water quality standard at MD-071."

For the calculations of the cumulative probability distributions, data collected by Charleston Waterkeeper from 2013 through 2018 were used. Enterococcus results for stations SC1, SC2, and SC3 were separated into Excel spreadsheets, and were sorted by date, older to newer, from 2013 to 2018. Geometric mean of first 30-days of Enterococcus data from 2013 was calculated. Then, geometric mean of the next 30-days of data were calculated, and continued calculations for 2013. Same procedure was repeated for each station and year. An example calculation is shown on Figure 11.

After the calculations, cumulative probabilities for each station was plotted using Cumulative Probability Plot 3.0 (Tuttle, Oliver and McGinnis 2003). Log transformed geometric means are copied into the program. The program sorts the log transformed data in ascending order to determine rank and then assigns a probability plotting position using the following function:

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

where, M = rank and N = number of samples (Novotny, 2004).

In this case, the log base 10 of Enterococci is used. If the data follows a log-normal distribution, the data points on the plot will approximate a straight line (the normal distribution). This straight line is then compared to the water quality standard at the 90th percentile.

Station	2013 Date	Result	Geomean
SC2	7/10	63	Data on the left column was used to calculate geometric mean shown below
SC2	7/17	145	
SC2	7/24	179	
SC2	7/31	571	
SC2	8/7	41	
	1 st 30-day period (above)		131
SC2	8/14	50	Data on the left column was used to calculate geometric mean shown below
SC2	8/21	63	
SC2	8/28	20	
SC2	9/4	160	
SC2	9/11	300	
	2 nd 30-day period (above)		79
SC2	9/18	160	Data on the left column was used to calculate geometric mean shown below
SC2	9/25	173	
SC2	10/2	110	
SC2	10/9	63	
SC2	10/16	63	
	3 rd 30-day period (above)		104
SC2	10/23	74	Data not used
SC2	10/30	563	Data not used

Figure 11. Example of data used for calculating the Enterococcus geometric means for 2013. **Bold** indicates geometric mean is exceeding the water quality standard.

For Class SB waters in South Carolina, the TMDL target equates to a geometric mean of 35 mpn/100ml minus a 5% margin of safety (33.25 mpn/100ml) and SSM of 501 mpn/100ml minus a 5% margin of safety (476 mpn/100ml) at the 90th percentile. If the fit line crosses the 90th percentile reference line above the standard, the site is considered to not meet the standard for geometric mean and SSMs. If the line crosses below the standard reference

the site does meet the water quality standard. If the data does not meet the geometric mean, a line is drawn parallel to the original normal distribution line that intersects the standard at the 90th percentile point. Drawing the line parallel to the original distribution assumes that the coefficient of variation remains the same for the original data and the desired water quality data (Novotny, 2004). The necessary percent reduction is calculated as the difference between the distributions at the 90th percentile point:

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

Figure 12 shows the geometric mean cumulative probability graph for station SC2. Remainder of graphs can be found in Appendix A.

If sufficient approximations of tidal exchange and flow patterns were available, this method could be extended to calculate the total maximum daily *Enterococci* loading in mpn/day for locations within the watershed. Average daily tidal exchange would be multiplied by the water quality standard of 35 mpn/100ml and a conversion factor. This number would represent the maximum daily load for all waters within the delineated watershed, whether impaired or not. There is not sufficient data to calculate the loadings for each station which is a limitation of this method.

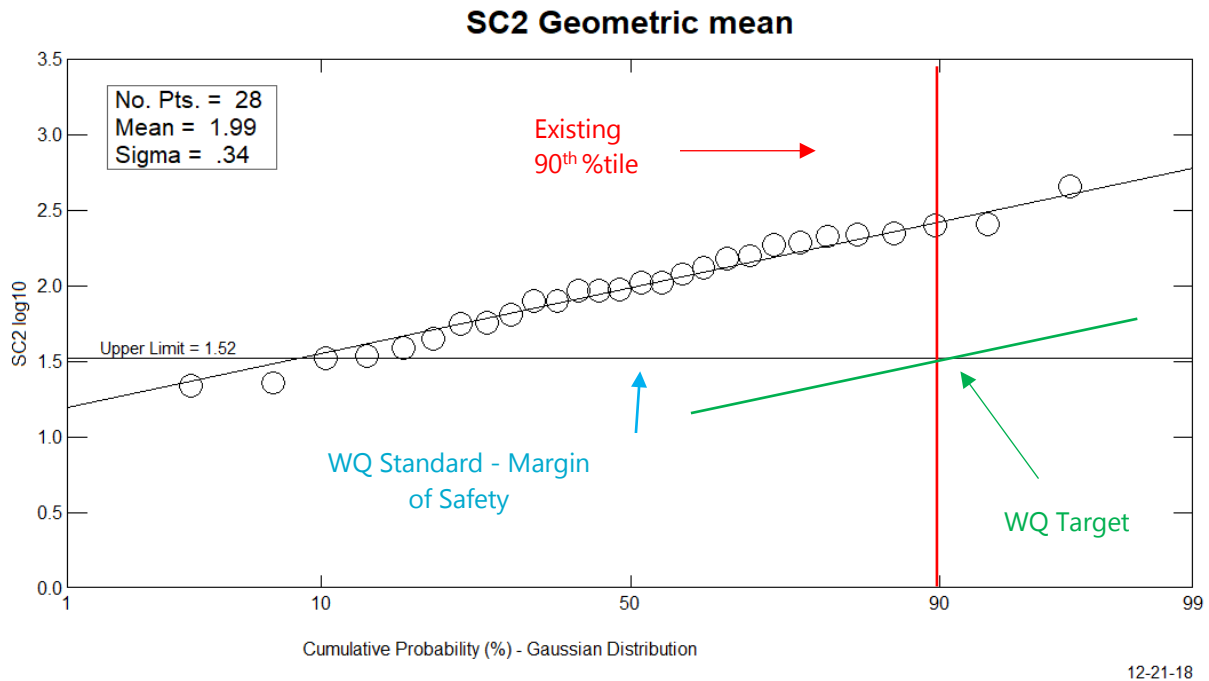


Figure 12. Cumulative probability graph for SC2.

5.0 Development of the TMDLs

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

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while still achieving compliance with WQS. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis to establish water quality-based controls.

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of number (#), colony forming units (mpn), organism counts (or resulting concentration), or MPN (Most Probable Number), in accordance with 40 CFR 130.2(l).

5.1 Applicable Water Quality Standards

Shem Creek is classified as Class SB tidal waters. In Regulation 61-68, enterococci water quality standard for SB waters is as follows: "Not to exceed a geometric mean of 35/100 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 501/100 ml. Additionally, for beach monitoring and notification activities for CWA Section 406 only, samples shall not exceed a single sample maximum of 501/100 ml".

Percent reductions applicable to stations SC1, SC2, and SC3 are summarized in Table 4 below.

As previously mentioned, Charleston Waterkeeper has been collecting weekly samples during warmer months since summer of 2013. In most cases, the department doesn't have sufficient data to calculate a geometric mean to determine if a station is meeting the geometric mean criterion. Instead, TMDLs normally only target the SSM criterion.

In the case of Shem Creek, there is enough weekly samples collected within a 30-day period to calculate geometric means. Table 5 in Section 5 includes TMDLs that address both the SSM and geometric mean criteria. Geometric mean TMDLs are higher than the percent reductions to meet the SSM TMDLs; therefore, the target percent reductions for Shem Creek stations are based on meeting the geometric mean TMDLs.

Shem Creek must meet both enterococci criteria in order to attain water quality standards. It is expected that achieving the larger of the two percent reductions, and/or meeting the recreational use criteria at the point of entering James Island Creek will result in meeting the recreational use standard.

Table 4. Single sample maximum and geometric mean reductions for stations SC1, SC2, and SC3 in Shem Creek.

	SSM % reduction	Geomean % reduction
SC1	0%	78.3%
SC2	20.9%	87.5%
SC3	80.2%	96.1%

5.2 Critical Conditions

Critical conditions are the “worst-case” environmental conditions for exceedance of water quality standards and which occur at an acceptable frequency (US EPA 1999). Due to the tidal and complex hydrologic nature of Shem Creek, it is unclear what a critical flow would be. By including all data in the calculations, inclusion of the critical condition is implicit.

5.3 Existing Conditions

Due to the tidal nature of the system, it is difficult to calculate an existing load for this system. For this reason, existing conditions are given as a concentration. Existing concentration is calculated as the concentration of *Enterococcus* at the 90th percentile point based on the normal line fit to the monitoring data. Existing concentrations for all three stations are shown on Table 5.

5.4 Wasteload Allocation

The WLA is the portion of the TMDL allocated to NPDES-permitted point sources (US EPA 1991). The wasteload summation is determined by subtracting the margin of safety and the sum of the load allocation from the total maximum daily load. Note that all illicit dischargers, including SSOs, are illegal and not covered under the WLA of this TMDL.

5.4.1 Continuous Point Sources

Shem Creek is classified as SB waters and dischargers to these waters are allowable if the Department deems appropriate. Currently, there are no continuous NPDES-permitted discharges to the affected TMDL watersheds with an *Enterococci* effluent limit on their NPDES permit. Future continuous discharges are required to meet the prescribed loading for the pollutant of concern based on permitted flow and assuming an allowable permitted daily maximum concentration of 501 mpn/100mL and monthly geomean concentration of 35 mpn/100mL.

5.4.2 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) (SC DHEC 2014). Illicit discharges, including SSOs, are not covered under any NPDES permit and are subject to compliance and enforcement mechanisms.

Table 5. TMDLs for Shem Creek watershed. Loads are expressed as colony forming units (mpn) per 100 ml.

Station	90th %tile of Existing Load (mpn/100ml)	TMDL ^{1, 2} (mpn/100ml)	WQ Target (mpn/100ml)	Margin of Safety (mpn/100ml)	WLA			LA
					Continuous Sources ³ (mpn/100ml)	Non-Continuous Sources ^{4, 6} (% Reduction)	Non-Continuous SCDOT ^{5, 6} (% Reduction)	% Reduction to Meet LA ⁶
SC1	153.4	35	33.25	1.75	See Note Below	78.3%	78.3%	78.3%
SC1	447	501	475.95	25.05	See Note Below	0%	0%	0%
SC2	266.6	35	33.25	1.75	See Note Below	87.5%	87.5%	87.5%
SC2	601.8	501	475.95	25.05	See Note Below	20.9%	20.9%	20.9%
SC3	858.7	35	33.25	1.75	See Note Below	96.1%	96.1%	96.1%
SC3	2405.7	501	475.95	25.05	See Note Below	80.2%	80.2%	80.2%

Table Notes:

1. TMDL is expressed as a concentration. If daily average tidal exchange estimates were available, this number could be converted to load in mpn/day by multiplying flow by concentration and a conversion factor.
2. SA water WQS = Samples shall not exceed 104 mpn/100 ml
3. WLA is expressed as a daily maximum of 501 mpn/100 ml and a 30-day geometric mean of 35 mpn/100 ml. There are no continuous dischargers at this time. Future continuous discharges are required to meet the prescribed loading for the pollutant of concern. Loadings are developed based upon permitted flow and an allowable permitted maximum concentration of 501 mpn/100ml or 30-day geometric mean of 35 mpn/100 ml.
4. Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction due to the uncertain

nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet percentage reduction or the existing instream standard for pollutant of concern in accordance with their NPDES Permit.

5. By implementing the best management practices that are prescribed in either the SCDOT annual SWMP or the SCDOT MS4 Permit to address Enterococcus, the SCDOT will comply with these TMDLs and its applicable WLA to the maximum extent practicable (MEP) as required by its MS4 permit.
6. Percent reduction applies to existing concentration.

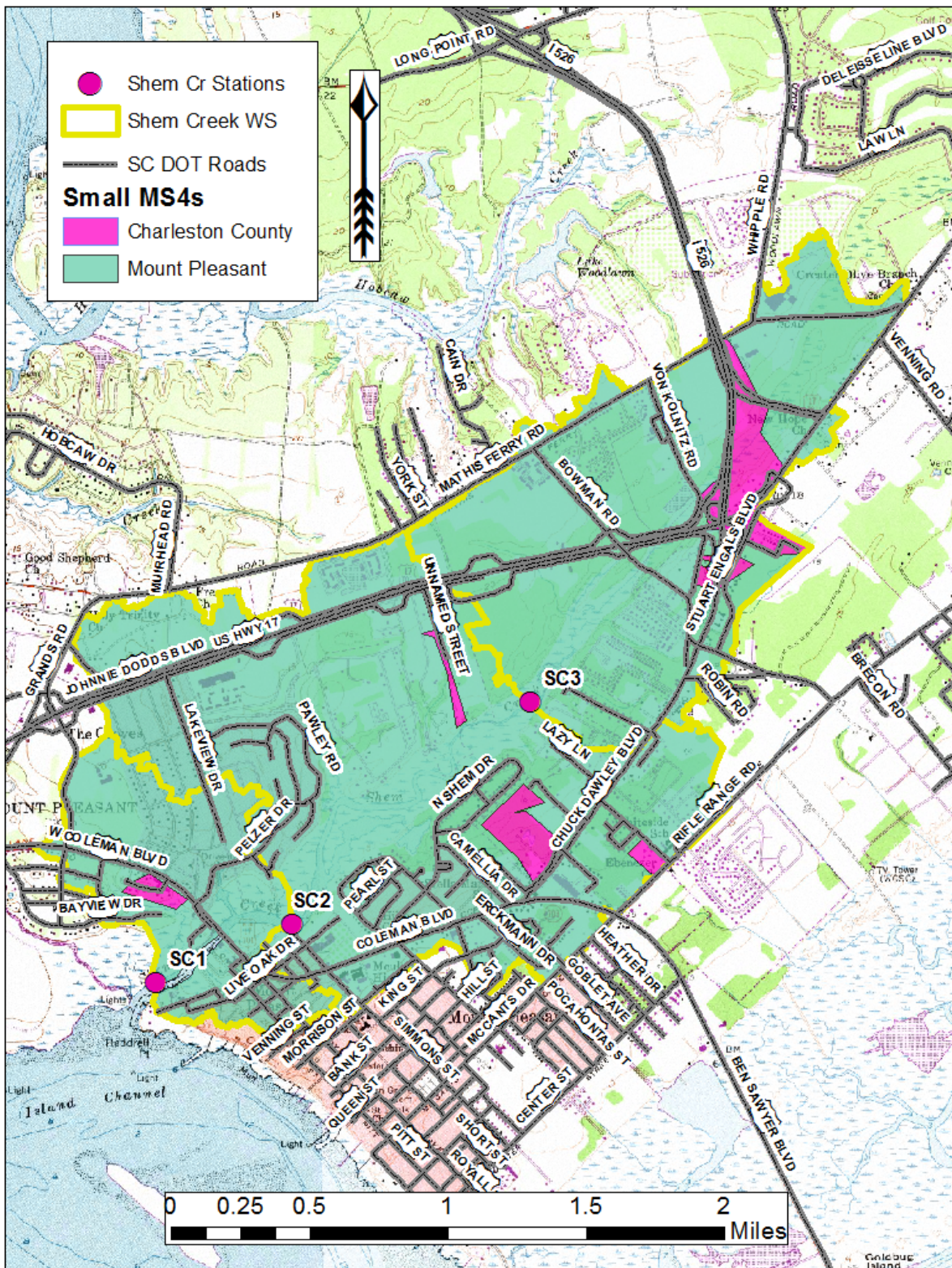


Figure 13. MS4s located within Shem Creek TMDL watershed.

All areas defined as "Urbanized Area" by the US Census are required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater. Other non-urbanized areas may be required under the NPDES Phase II Stormwater Regulations to obtain a permit for the discharge of stormwater. Based on the 2010 US Census, at the time of the TMDL development, a portion of Shem Creek watershed was classified as urbanized area.

Charleston County, SCDOT, and Town of Mount Pleasant are the designated MS4s located in the TMDL areas (Figure 13). Regulated MS4s are subject to the WLA component of this TMDL; however, there may be other unregulated MS4s located in the watershed that are subject to the LA component of this TMDL. At such time that the referenced entities or other future unregulated entities become regulated NPDES MS4 entities and subject to applicable provisions of SC Regulation 61-68, they will be required to meet load reductions prescribed in the WLA component of the TMDL. This also applies to future discharges associated with industrial and construction activities that will be subject to R61-9, §122.26(b)(4),(7),(14)-(21) (SC DHEC 2011).

Waste load allocations for stormwater discharges are expressed as a percentage reduction instead of a numeric concentration due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet the percentage reduction or the existing instream standard for the pollutant of concern. The percent reduction is based on the maximum percent reduction (critical condition) necessary to achieve target conditions. Table 5 presents the reductions needed for the impaired segments. The percent reductions in this TMDL also apply to the *Enterococci* waste load attributable to those areas of the watershed which are covered or will be covered under NPDES MS4 permits.

As appropriate information is made available to further define the pollutant contributions for the permitted MS4, an effort can be made to revise these TMDLs. This effort will be initiated as resources permit and if deemed appropriate by the Department. For the Department to revise these TMDLs the following information should be provided, including but not limited to:

- An inventory of service boundaries of the MS4 area covered in the MS4 permit provided as ArcGIS compatible shape files.
- 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.

- 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 TMDL. 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 or zoning, issue building or development permits.

5.5 Load Allocation

The Load Allocation (LA) applies to the nonpoint sources of *Enterococci* bacteria which includes unregulated processes/entities and is expressed both as a load and as a percent reduction. The LA is calculated as the difference between the target concentration under the critical condition and the point source WLA. The LA for each of the impaired stations in Shem Creek is expressed in tables as percent reduction. The Department believes that meeting the highest percent reduction or the WQS, whichever is less restrictive, will effectively protect the recreational uses of Shem Creek. Besides SCDOT, there are two other regulated NPDES permitted MS4s located in the drainage area, Town of Mount Pleasant, and Charleston County. There may be other unregulated stormwater discharges located in the watershed that are subject to LA component of this TMDL which currently are not NPDES permitted. At such time that the referenced entities, or other future unregulated entities become regulated NPDES MS4 entities and subject to applicable provisions of SC Regulation 61-68D, they will be required to meet load reduction prescribed in the WLA component of the TMDL. This also applies to future discharges associated with industrial and construction activities will be subject to R. 61-9 §122.26(b)(4),(7),(14) - (21) (SC DHEC 2011).

5.6 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 multiple years of data collected during hydrological and water quality sampling data sets. In addition, an evaluation of historic fecal coliform data collected at MD-071 from November through April demonstrated that the instream recreational use standard will be protected by TMDLs developed using enterococci data collected at SC1, SC2, and SC3 May through October.

5.7 Margin of Safety

A margin of safety (MOS) allows for an accounting of the uncertainty in the relationship between pollutant loads and receiving water quality (US EPA, 1999). Incorporation of a MOS can be done either explicitly within the TMDL calculation or implicitly by using conservative assumptions (US EPA 1991). This TMDL has an explicit 5% margin of safety. All water quality data is compared to single sample maximum of 501 mpn/100ml and a geometric mean of 35 mpn/100 ml, minus five percent margin of safety (MOS). There is also an unspecified implicit margin of safety in the percent reduction calculations derived from the cumulative probability graphs due to the assumption of independence of the data points (Novotny, 2004).

5.8 Calculation of the TMDL

A TMDL represents the loading capacity (LC) of a waterbody, which is the maximum loading a waterbody can receive without exceeding water quality standards (US EPA, 1999). The TMDL is the sum of the WLA for point sources, the LA for non-point sources and natural background, and a margin of safety (MOS). The TMDL can be represented by the equation (US EPA, 2001):

$$TMDL = LC = WLA + LA + MOS$$

The equation above results in reduction of *Enterococci* concentrations ranging from 78.3% to 96.1% in order to consistently meet the geometric mean water quality standard for *Enterococci*. Calculated TMDL reductions applicable to each station are shown on Table 5.

Based on the information available at this time, the portions of the watersheds that drains directly to a regulated MS4 and that which drains through the non-regulated MS4 has not been clearly defined. Loading from both types of sources (regulated and non-regulated) typically occur in response to rainfall events, and discharge volumes as well as recurrence intervals are largely unknown. Therefore, where applicable, the regulated MS4 is assigned the same percent reduction as the non-regulated sources in the watershed. Compliance with the MS4 permit in regard 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.

5.6. Reasonable Assurance

NPDES permits are issued for regulated dischargers, including continuous and non-continuous sources of pathogenic bacteria. In salt waters, the applicable recreation use water quality standard indicator is *Enterococcus* bacteria. Continuous discharges are required to target the *Enterococcus* water quality standard at the point of discharge. For regulated non-continuous discharges, the *Enterococcus* standard should be targeted to the maximum extent practicable. There may be other regulated activities present that could contribute to *Enterococcus* loadings in the watershed. New septic tanks, animal feeding operations (AFOs), land application of treated sludge or wastewater also require permits that reduce the potential for runoff of bacteria into waters of the State.

Other unregulated sources of *Enterococcus* loadings in the watershed may include wildlife, improper agricultural or silvicultural activities, urban and suburban runoff. These sources may be reduced through means such as best management practices, local ordinances, outreach education efforts as well as 319 grant opportunities. SCDHEC has fostered effective partnerships between other federal, state and local entities to help reduce the potential for runoff of bacteria into waters of the State. Collectively, and once implemented, these reduction mechanisms will provide reasonable assurance that the recreation use water quality standard will be attained in this watershed.

6.0 Implementation

The implementation of both point (WLA) and non-point (LA) source components of the TMDL are necessary to bring about the required reductions in *Enterococci* loading to Shem Creek in order to achieve water quality standards. Using existing authorities and mechanisms, an implementation plan providing information on how point and non-point sources of pollution are being abated or may be abated in order to meet water quality standards is provided. Sections 6.1 and 6.2 and their subsections presented below correspond with sections 3.1 and 3.2 and their subsections of the source assessment presented in the TMDL document. As the implementation strategy progresses, DHEC may continue to monitor the effectiveness of implementation measures and evaluate water quality where deemed appropriate.

Point sources are discernible, confined, and discrete conveyances of pollutants to a water body including but not limited to pipes, outfalls, channels, tunnels, conduits, man-made ditches, etc. The Clean Water Act's primary point source control program is the NPDES.

Point sources can be broken down into continuous and non-continuous point sources. Some examples of a continuous point source are domestic and industrial WWTF. Non-continuous point sources are related to stormwater and include MS4s and 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 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 component of this TMDL. The *Implementation Plan for Achieving Total Maximum Daily Load Reductions from Nonpoint Sources for the State of South Carolina* (SC DHEC, 1998) document is one example. Another key component for interested parties to control pollution and prevent water quality degradation in the watershed would be the establishment and administration of a program of Best Management Practices (BMPs). Best management practices may be defined as a practice or a combination of practices that have been determined to be the most effective, practical means used in the prevention and/or reduction of pollution.

Interested parties (local stakeholder groups, universities, local governments, etc.) may be eligible to apply for CWA §319 grants to install BMPs that will implement the LA portion of these TMDLs and reduce nonpoint source Enterococcus loadings to Shem Creek. 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 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.

SCDHEC will work with the agencies in the area to provide nonpoint source education in this watershed and the surrounding watersheds. Local sources for nonpoint source education include Charleston Counties Soil and Water Conservation Districts, local Natural Resources Conservation Service, Clemson Extension Service, South Carolina Department of Natural Resources, S.C. Sea Grant Extension Program.

The Department recognizes that adaptive management/implementation of these TMDLs might be needed to achieve the water quality standard and we are committed towards targeting the load reductions to improve water quality in Shem Creek 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 TMDL are not inclusive and are to be used only as guidance. The strategies are informational suggestions which may lead to the required load reductions being met for the referenced 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 are implemented through NPDES permits. Currently, there are no direct discharges to Shem Creek.

6.1.2 Non-Continuous Point Sources

An iterative BMP approach as defined in the general storm water NPDES MS4 permit is expected to provide significant implementation of the WLA. Discovery and removal of illicit storm drain cross connections is one important element of the storm water NPDES MS4 permit. Public nonpoint source pollution education is another. Other permit requirements for implementing WLAs in approved TMDL documents will vary across waterbodies, discharges, and pollutant(s) of concern. The allocation within a TMDL area can take many different forms – narrative, numeric, specified BMPs – and may be complimented by other special requirements such as monitoring.

The level of monitoring necessary, deployment of structural and non-structural BMPs, evaluation of BMP performance, and optimization or revisions to the existing pollutant reduction goals of the SWMP or any other plan is TMDL and watershed specific. Hence, it is expected that NPDES permit holders evaluate their existing SWMP or other plans in a manner that would effectively address implementation of this TMDL with an acceptable schedule and activities for their permit compliance.

The Department staff (permit writers, TMDL project managers, and compliance staff) is willing to assist in developing or updating the referenced plan as deemed necessary. Please see Appendix D – Evaluating the Progress of MS4 Programs which provides additional information as it relates to evaluating the effectiveness of an MS4 Permit as it related to compliance with approved TMDLs. Compliance with terms and conditions of existing and future NPDES sanitary and stormwater permits (including all construction, industrial and MS4) may effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. For SCDOT, existing and future NPDES MS4 permittees, compliance with terms and conditions of its NPDES permit is effective implementation of the WLA to the MEP. For existing and future NPDES construction and industrial stormwater permittees, compliance with terms and condition of its permit is effective implementation of the WLA. Required load reductions in the LA portion of this TMDL can be implemented through voluntary measures and are eligible for CWA §319 grants.

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

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

An informed and knowledgeable community is crucial to the success of a stormwater management plan (US EPA, 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 websites and bumper stickers.

The public can provide valuable input and assistance to a MS4 program and they may have the potential to play an active role in both development and implementation of the stormwater program where deemed appropriate. There are a variety of practices that can

involve public participation such as public meetings/citizens panels, volunteer water quality monitoring, volunteer educators, community clean-ups, citizen watch groups, and "Adopt a Storm Drain" programs which encourage individuals or groups to keep storm drains free of debris and monitor what is entering local waterways through storm drains (US EPA, 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 (US EPA, 2005). Pollutant levels from these illicit discharges have been shown in EPA studies to be high enough to significantly degrade receiving water quality and threaten aquatic, wildlife, and human health. MS4 entities may have a storm sewer system map which shows the location of all outfalls and to which waters of the US they discharge to. If not already in place, an ordinance prohibiting non-stormwater discharges into MS4 with appropriate enforcement procedures may also be developed. Entities may also have a plan for detecting and addressing non-stormwater discharges. The plan may include locating problem areas through infrared photography, finding the sources through dye testing, removal/correction of illicit connections, and documenting the actions taken to illustrate that progress is being made to eliminate illicit connections and discharges.

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

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 (US EPA, 2005). Strategies might be developed to include a combination of structural and/or non-structural BMPs. An ordinance or other regulatory mechanism may also exist requiring the implementation of post-construction runoff controls and ensuring their long term-operation and maintenance. Examples of non-structural BMPs are planning procedures and site-based BMPs

(minimization of imperviousness and maximization of open space). Structural BMPs may include but are not limited to stormwater retention/detention BMPs, infiltration BMPs (dry wells, porous pavement, etc.), and vegetative BMPs (grassy swales, filter strips, rain gardens, artificial wetlands, etc.)

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

MS4 communities are encouraged to utilize partnerships when developing and implementing a stormwater management program. Watershed associations, educational entities, and state, county, and city governments are all examples of possible partners with resources that can be shared. For additional information on partnerships contact the SCDHEC Watershed Manager for the waterbody of concern online at:

<http://www.scdhec.gov/HomeAndEnvironment/Water/Watersheds/Contacts/>

For additional information on stormwater discharges associated with MS4 entities please see the US EPA NPDES website online at:

<https://www.epa.gov/npdes/stormwater-discharges-municipal-sources> for information pertaining to the National Menu of BMPs, Urban BMP Performance Tool, Outreach Documents, etc.

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

6.2 Nonpoint Sources

6.2.1 Urban and Suburban Stormwater Runoff

In estuaries, urban runoff is considered the leading cause of impairment. Runoff from urban areas is the results of imperviousness, population and traffic density and all activities connected with urban living (Novotny, 2003). Also, estuaries are saline environments and

urban runoff, due to precipitation is fresh water. This fresh water runoff into the estuarine environments causes salinity variances, adversely effecting organisms that are adapted to high salinity. Several studies have shown that salinity fluctuations cause a decrease in biomass of organisms, change in species dominance, reduced growth and survival and other physiological stress. These studies recommend gaining control of salinity fluctuations may help improve estuarine habitats through management of freshwater runoff from urban and suburban environments (Montague & Ley 1993, Mallin et al. 2008).

Potential BMPs for residential, industrial and commercial lots with impervious surfaces for consideration but not limited to are, capturing rain by either using rain barrels or rain pillow (for single family residential units or other small buildings), or a rain water collection system, such as a cistern, for later use in landscape watering or other none potable uses. Another option would be, when appropriate, constructing rain gardens or wetlands to slow surface water runoff rates from impervious surfaces and to allow for percolation of runoff to recharge ground water. Also, using porous pavements/materials allows runoff due to precipitation percolate hence reducing the runoff rate.

6.2.2 Agricultural Runoff

Agriculture is a complex and large industry with great potential to adversely affect the environment by nonpoint source runoff (Novotny 2003). Sources of Enterococcus bacteria of nonpoint source origins to the nearby water bodies from agricultural and silvicultural activities are livestock with uncontrolled access to riparian areas, improper manure application, and concentrated or pastured animal operations, etc. Pastureland without proper erosion control measures is over grazed, or when grazing livestock are allowed to approach receiving waters are contributing to nonpoint source pollution. If these are controlled, and with additional BMPs, pollution from these lands can be minimized (Novotny 2003).

Agricultural BMPs can be vegetative, structural or management oriented. When selecting BMPs, it is prudent to keep in mind that nonpoint source related 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, Enterococcus, needs to be identified.

Fencing livestock is an effective way for confining the livestock in a certain area where BMPs are deployed; however, in certain cases it may not be sufficient for prevention of overland runoff. It may help to deploy additional BMPs such as a vegetative buffer with different growth rates behind the fence of where livestock are kept.

There are several state and federal assistance programs available to agricultural producers, and some of these are described below and electronic links for these programs are available under Section 7 of the TMDL document.

One of the programs that are available through USDA is the Environmental Quality Incentives Program (EQIP). This also is a voluntary conservation program for farmers and ranchers that promote agricultural production and environmental quality as national goals. Eligible participants receive financial and technical help from EQIP to install or implement structural and management related BMPs. Further information is available in Section 7 of this document.

It is recommended that BMPs for all existing agricultural facilities be reviewed for their effectiveness and reduction of runoff.

6.2.3 Failing Septic Systems

Age, lack of maintenance and improper use can cause septic systems to malfunction. Homeowner education about proper maintenance and repairing of their septic systems may help reduce runoff from these treatment systems. Also, encouraging homeowners to have their septic systems inspected and pumped on regular basis is another potential intervention for reducing bacterial runoff/contamination from these systems.

In addition to the resources cited in Section 7 of this document for the implementation of these TMDLs, Clemson Extension has developed a Home-A-Syst handbook that can help urban or rural homeowners reduce sources of NPS pollution from their property. This document guides homeowners through a self-assessment, including information on proper maintenance practices for septic tanks. SCDHEC also employs a nonpoint source educator who can assist with distribution of these tools as well as provide additional BMP information.

The Office of Coastal Resource Management (OCRM) has created a toolkit for homeowners and local governments which include tips for maintaining their systems. These septic system Do's and Don'ts are as follows:

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

Do's:

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

Don'ts:

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

For additional information on how septic systems work and how to properly plan a septic system, please visit the DHEC Environmental Health Onsite Wastewater page at the following link: <http://www.scdhec.gov/environment/envhealth/Septic/>

6.2.4 Wildlife and Domestic Animals

In any public places, feeding of or providing food for wild animals including deer, wild ducks, geese, swans and seagulls should be discouraged. By avoiding the feeding of birds, there will be reduced waste accumulating on impervious areas such as on roadsides, walkways, boats, docks and related structures thus helping to avoid these structures from becoming conveyors of fecal matter into the receiving waters due to run-off from precipitation or tides (US EPA, 2001).

Planting and maintaining a vegetative buffer around the residential areas will help filter pet waste that may accumulate in gardens and public walkways. Without any buffers or other BMPs, during rain events, fecal matter may be washed off to the roadside stormwater ditches. Installation of pet waste collection stations in residential neighborhoods along with dispensers of pet waste bags and bag holders for dog owners are recommended.

There are several other recommendations in Section 7 of this document along with suggestions for public outreach and education.

6.2.5 Marinas, Boating Activities and Structures

Boating related activities have potential to contribute to Enterococcus contamination through potential discharges from installed toilet (MSD) and gray water, and these discharges can contain bacteria. Improperly maintained or malfunctioning MSDs have the potential to leak or discharge untreated sewage (US EPA, January 2010). Therefore, it is important to bring attention of boating public to available pumpout facilities near Shem Creek. A map of available pumpout facilities can be found at <http://www.dnr.sc.gov/marine/vessel/pdf/coastalmaps2013.pdf>

Also, Charleston Waterkeeper provides boaters free pumpouts. For details, contact the organization: <http://charlestonwaterkeeper.org/what-we-do/programs/mobile-pumpout/>

Another important factor is outreach and education for boat and dock owners regarding the proper use and maintenance of MSDs, and impact of improper vessel discharges in Class SA waters. There are pumpout facilities located in Cooper and Ashley Rivers and within the Charleston Harbor (SC DNR, 2012).

Docks can be one of the sources as well as conveyors (as impervious surfaces) for potential bacteria contamination. Especially during the boating season, family pets can also be sources for contamination. Also fishing and shellfishing (such as crabbing) related waste can attract wildlife, especially birds and waste from these types of activities may need to be contained and disposed of properly.

7.0 Resources

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 Information for Non-Continuous Point Sources

Center for Watershed Protection. Available at: <http://www.cwp.org/>

Interlocking Concrete Pavement Institute. Available at: <http://www.icpi.org/>

Rain pillows: Rainwater Harvesting from Rooftop Catchments. Available at: <http://www.oas.org/usde/publications/Unit/oea59e/ch10.htm>

DC Greenworks Green Roofs. Available at: <http://www.dcgreenworks.org/>

Roofscapes, Inc. Taking Green Roofs to the Next Level. Available at: <http://www.roofmeadows.com/>

Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows. Natural Resources Defense Council. Available at: <http://www.nrdc.org/water/pollution/rooftops/contents.asp>

Low Impact Development Center, Inc. Sustainable Design and Water Quality Research. Available at: <http://www.lowimpactdevelopment.org/>

SCDHEC Stormwater Outreach – Resources for Phase II Stormwater. Available at: http://www.scdhec.gov/environment/water/ms4/html/other_programs.htm

7.2 General Information for Nonpoint Sources

7.2.1 Pet Waste

EPA Nonpoint Source Outreach Toolbox. Pet Care. Available at: <http://cfpub.epa.gov/npstbx/FeaturedProductsDetail.cfm?TopicID=70>

Doggie Dooley In-Ground Waste Digester Systems. Available at: http://www.drsfostersmith.com/product/prod_display.cfm?pcatid=570

7.2.2 Wildlife

Bird Deterrents:

<http://www.boatliftanddock.com/c-190-dock-bird-deterrent.aspx>

<https://www.hotfoot.com/>

http://www.birdbusters.com/bird_control_products.html

7.2.3 Septic Systems

Septic System Care. Available through Nonpoint Source Outreach Toolbox at:

<http://cfpub.epa.gov/npstbx/FeaturedProductsDetail.cfm?TopicID=70>

Clemson Extension Home*A*Syst. Available at:

<http://www.clemson.edu/psapublishing/Pages/Water/WQL21.pdf>

7.4 Outreach and Education

Nonpoint Source Runoff Pollution SCDHEC

<http://www.scdhec.gov/HomeAndEnvironment/Water/Stormwater/PreventingStormwaterPollution/>

7.5 Stormwater

Stormwater Ponds in Coastal South Carolina, Denise M. Sanger. S.C. Sea Grant Consortium (n.d.). Accessed on February 26, 2014. Available at:

<http://www.dnr.sc.gov/marine/NERR/present/stormwater/SangerStormwaterPondsSC.pdf>

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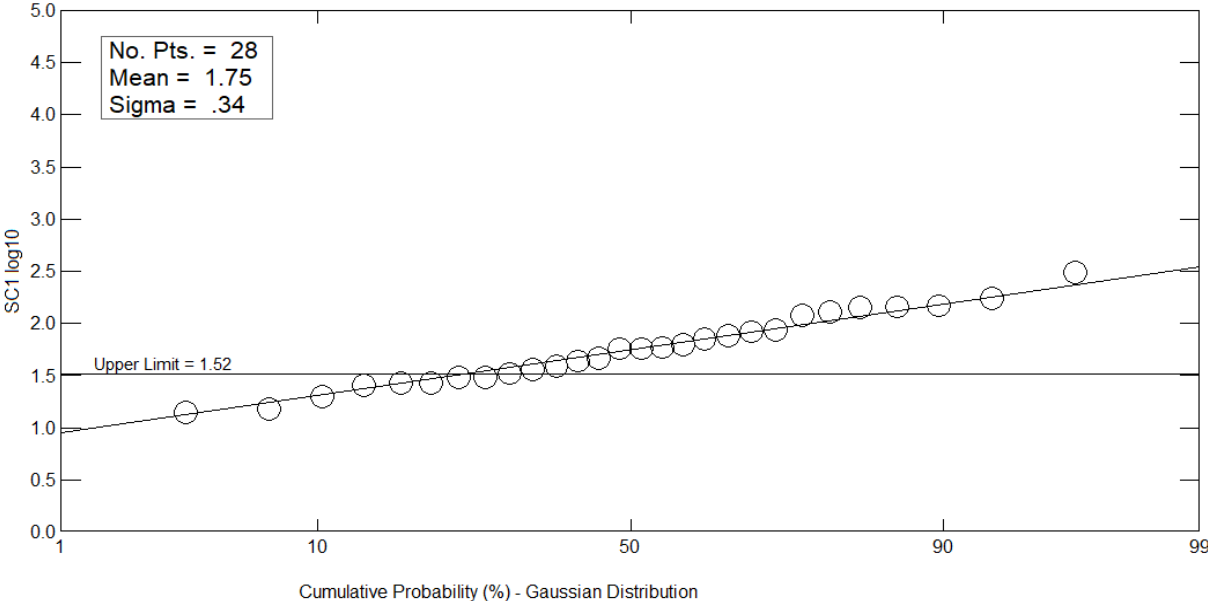
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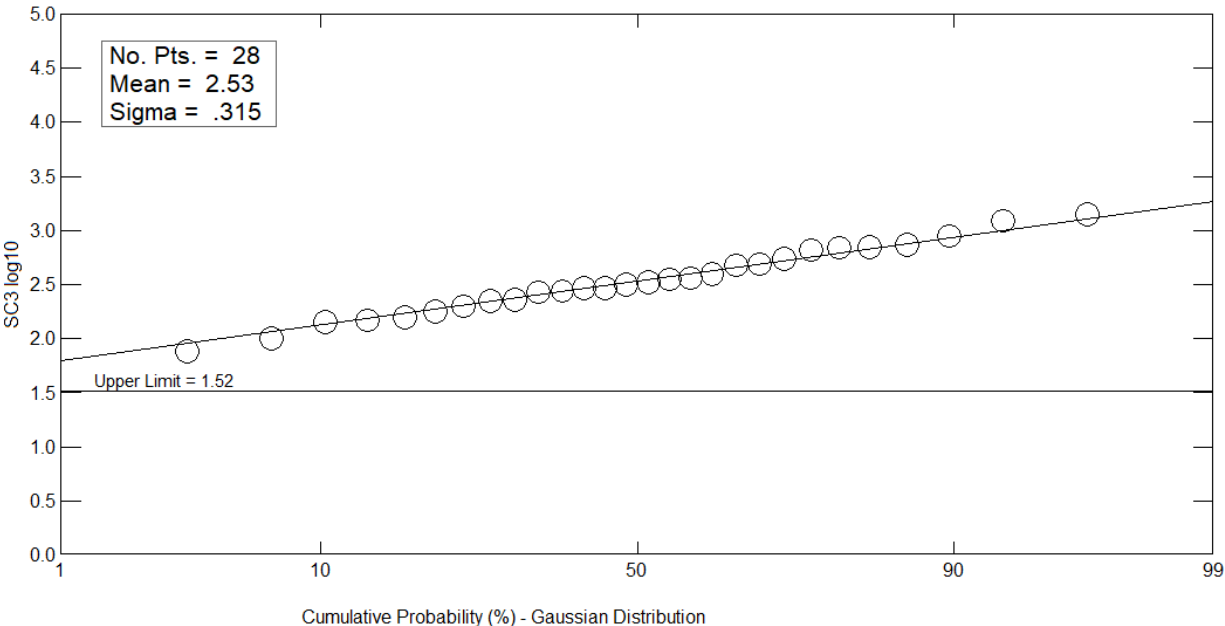
Appendix A – Cumulative Probability Graphs

SC1 Geomean



11-14-18

SC3 SSM



11-14-18

Appendix B – NLCD 2011 Individual Landuses for TMDL Stations in Shem Creek

Landuse	Area (mi2)	Percent of Area (%)
Open Water	0.03	0.7
Developed, Open Space	1.05	25
Developed, Low Intensity	1.51	36
Developed, Medium Intensity	0.75	17.9
Developed, High Intensity	0.15	3.6
Forest	0.27	6.4
Scrub/Shrub	0.05	1.2
Woody and Emergent Herbaceous Wetlands	0.42	10
Total	4.2 mi2	100%

Appendix C – Water Quality Data

SC1 Date	SC1 Results	SC2 Date	SC2 Results	SC3 Date	SC3 Results
7/10/2013	31	7/10/2013	63	7/10/2013	109
7/17/2013	158	7/17/2013	145	7/17/2013	959
7/24/2013	41	7/24/2013	179	7/24/2013	160
7/31/2013	160	7/31/2013	571	7/31/2013	689
8/7/2013	20	8/7/2013	41	8/7/2013	199
8/14/2013	50	8/14/2013	50	8/14/2013	310
8/21/2013	63	8/21/2013	63	8/21/2013	341
8/28/2013	20	8/28/2013	20	8/28/2013	430
9/4/2013	290	9/4/2013	160	9/4/2013	780
9/11/2013	140	9/11/2013	300	9/11/2013	270
9/18/2013	90	9/18/2013	160	9/18/2013	180
9/25/2013	31	9/25/2013	173	9/25/2013	75
10/2/2013	171	10/2/2013	110	10/2/2013	292
10/9/2013	10	10/9/2013	63	10/9/2013	203
10/16/2013	213	10/16/2013	63	10/16/2013	122
10/23/2013	20	10/23/2013	74	10/23/2013	262
10/30/2013	173	10/30/2013	563	10/30/2013	836
5/7/2014	41	5/7/2014	31	5/7/2014	435
5/14/2014	10	5/14/2014	20	5/14/2014	161
5/21/2014	86	5/21/2014	96	5/21/2014	933
5/28/2014	10	5/28/2014	20	5/28/2014	2046
6/4/2014	10	6/4/2014	31	6/4/2014	203
6/11/2014	41	6/11/2014	171	6/11/2014	134
6/18/2014	63	6/18/2014	10	6/18/2014	31
6/25/2014	74	6/25/2014	97	6/25/2014	173
7/2/2014	10	7/2/2014	31	7/2/2014	31
7/9/2014	20	7/9/2014	10	7/9/2014	108
7/16/2014	10	7/16/2014	31	7/16/2014	74
7/23/2014	75	7/23/2014	181	7/23/2014	529
7/30/2014	10	7/30/2014	20	7/30/2014	98
8/6/2014	30	8/6/2014	512	8/6/2014	1287
8/13/2014	63	8/13/2014	122	8/13/2014	336
8/20/2014	41	8/20/2014	41	8/20/2014	341
8/27/2014	10	8/27/2014	10	8/27/2014	10

9/3/2014	315	9/3/2014	107	9/3/2014	9804
9/10/2014	10	9/10/2014	31	9/10/2014	63
9/17/2014	1376	9/17/2014	2247	9/17/2014	2613
9/24/2014	30	9/24/2014	110	9/24/2014	624
10/1/2014	108	no data	no data	10/1/2014	744
10/8/2014	31	10/8/2014	52	10/8/2014	199
10/15/2014	9208	10/15/2014	2603	10/15/2014	12997
10/22/2014	63	10/22/2014	97	10/22/2014	145
10/29/2014	20	10/29/2014	74	10/29/2014	41
5/6/2015	10	5/6/2015	20	5/6/2015	20
5/13/2015	52	5/13/2015	41	5/13/2015	908
5/20/2015	10	5/20/2015	31	5/20/2015	52
5/27/2015	10	5/27/2015	10	5/27/2015	216
6/4/2015	10	6/4/2015	109	6/4/2015	288
6/10/2015	1076	6/10/2015	432	6/10/2015	3448
6/17/2015	10	6/17/2015	226	6/17/2015	256
6/24/2015	31	6/24/2015	122	6/24/2015	75
7/1/2015	52	7/1/2015	52	7/1/2015	3448
7/8/2015	41	7/8/2015	41	7/8/2015	226
7/15/2015	10	7/15/2015	10	7/15/2015	148
7/22/2015	10	7/22/2015	10	7/22/2015	1196
7/29/2015	41	7/29/2015	63	7/29/2015	148
8/5/2015	20	8/5/2015	31	8/5/2015	98
8/12/2015	10	8/12/2015	31	8/12/2015	119
8/19/2015	820	8/19/2015	428	8/19/2015	2613
8/26/2015	134	8/26/2015	41	8/26/2015	350
9/2/2015	10	9/2/2015	63	9/2/2015	171
9/9/2015	6867	9/9/2015	1090	9/9/2015	15531
9/16/2015	20	9/16/2015	85	9/16/2015	228
9/23/2015	253	9/23/2015	327	9/23/2015	697
9/30/2015	10	9/30/2015	31	9/30/2015	52
10/7/2015	428	10/7/2015	537	10/7/2015	934
10/14/2015	74	10/14/2015	108	10/14/2015	171
10/21/2015	295	10/21/2015	364	10/21/2015	389
10/28/2015	246	10/28/2015	146	10/28/2015	2142

05/04/2016	448	05/04/2016	328	05/04/2016	1674
05/11/2016	52	05/11/2016	148	05/11/2016	199
05/18/2016	135	05/18/2016	160	05/18/2016	2481
05/25/2016	10	05/25/2016	52	05/25/2016	30
06/01/2016	134	06/01/2016	199	06/01/2016	1017
06/08/2016	108	06/08/2016	73	06/08/2016	776
06/15/2016	10	06/15/2016	218	06/15/2016	776
06/22/2016	10	06/22/2016	10	06/22/2016	52
06/29/2016	213	06/29/2016	160	06/29/2016	437
07/06/2016	10	07/06/2016	41	07/06/2016	109
07/13/2016	10	07/13/2016	134	07/13/2016	156
07/20/2016	20	07/20/2016	97	07/20/2016	1246
07/27/2016	96	07/27/2016	109	07/27/2016	86
08/03/2016	359	08/03/2016	538	08/03/2016	14136
08/10/2016	703	08/10/2016	1354	08/10/2016	24196
08/17/2016	84	08/17/2016	359	08/17/2016	341
08/24/2016	20	08/24/2016	10	08/24/2016	52
08/31/2016	158	08/31/2016	1497	08/31/2016	5172
09/07/2016	10	09/07/2016	31	09/07/2016	74
09/14/2016	24196	09/14/2016	6488	09/14/2016	24196
09/21/2016	41	09/21/2016	158	09/21/2016	345
09/28/2016	97	09/28/2016	108	09/28/2016	262
10/12/2016	141	10/12/2016	109	10/12/2016	272
10/19/2016	20	10/19/2016	41	10/19/2016	108
10/26/2016	63	10/26/2016	75	10/26/2016	158
5/3/2017	10	5/3/2017	52	5/3/2017	397
5/10/2017	10	5/10/2017	20	5/10/2017	97
5/17/2017	10	5/17/2017	52	5/17/2017	75
5/24/2017	2282	5/24/2017	4611	5/24/2017	7701
5/31/2017	41	5/31/2017	31	5/31/2017	144
6/7/2017	2282	6/7/2017	4106	6/7/2017	10462
6/14/2017	10	6/14/2017	41	6/14/2017	84
6/21/2017	913	6/21/2017	832	6/21/2017	15531
6/28/2017	41	6/28/2017	97	6/28/2017	86
7/5/2017	41	7/5/2017	41	7/5/2017	109

7/12/2017	10	7/12/2017	747	7/12/2017	1003
7/19/2017	139	7/19/2017	109	7/19/2017	788
7/26/2017	61	7/26/2017	158	7/26/2017	383
8/2/2017	52	8/2/2017	185	8/2/2017	650
8/9/2017	51	8/9/2017	122	8/9/2017	1076
8/16/2017	63	8/16/2017	74	8/16/2017	1169
8/23/2017	10	8/23/2017	52	8/23/2017	281
8/30/2017	573	8/30/2017	836	8/30/2017	650
9/6/2017	17329	9/6/2017	24196	9/6/2017	19863
9/14/2017	459	9/14/2017	262	9/14/2017	650
9/20/2017	41	9/20/2017	30	9/20/2017	109
9/27/2017	63	9/27/2017	158	9/27/2017	51
10/4/2017	75	10/4/2017	41	10/4/2017	171
10/11/2017	20	10/11/2017	63	10/11/2017	160
10/18/2017	41	10/18/2017	52	10/18/2017	63
10/25/2017	63	10/25/2017	171	10/25/2017	171
5/2/2018	10	5/2/2018	10	5/2/2018	52
5/9/2018	52	5/9/2018	52	5/9/2018	420
5/16/2018	10	5/16/2018	10	5/16/2018	20
5/23/2018	122	5/23/2018	41	5/23/2018	683
5/30/2018	41	5/30/2018	395	5/30/2018	565
6/6/2018	10	6/6/2018	41	6/6/2018	336
6/13/2018	134	6/13/2018	139	6/13/2018	1585
6/20/2018	52	6/20/2018	617	6/20/2018	160
6/27/2018	31	6/27/2018	126	6/27/2018	266
7/2/2018	30	7/2/2018	30	7/2/2018	183
7/11/2018	84	7/11/2018	52	7/11/2018	238
7/18/2018	168	7/18/2018	408	7/18/2018	272
7/25/2018	588	7/25/2018	259	7/25/2018	1124
8/1/2018	63	8/1/2018	682	8/1/2018	161
8/8/2018	132	8/8/2018	120	8/8/2018	529
8/15/2018	10	8/15/2018	52	8/15/2018	108
8/22/2018	97	8/22/2018	30	8/22/2018	243
8/29/2018	10	8/29/2018	41	8/29/2018	74
9/5/2018	52	9/5/2018	62	9/5/2018	246

9/19/2018	75	9/19/2018	41	9/19/2018	431
9/26/2018	10	9/26/2018	30	9/26/2018	74
10/3/2018	41	10/3/2018	85	10/3/2018	393
10/12/2018	20	10/12/2018	73	10/12/2018	189
10/17/2018	20	10/17/2018	75	10/17/2018	241
10/24/2018	52	10/24/2018	52	10/24/2018	96
10/31/2018	10	10/31/2018	63	10/31/2018	156

Appendix D – Evaluating the Progress of MS4 Programs

Meeting the Goals of TMDLs and Attaining Water Quality Standards
Bureau of Water
August 2008

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

1. Calculate pollutant load reduction for each best management practice (BMP) deployed:
 - Retrofitting stormwater outlets
 - Creation of green space
 - LID activities (e.g., creation of porous pavements)
 - Creations of riparian buffers
 - Stream bank restoration
 - Scoop the poop program (how many pounds of poop were scooped/collected)
 - Street sweeping program (amount of materials collected etc.)
 - Construction & post-construction site runoff controls
2. Description & documentation of programs directed towards reducing pollutant loading
 - Document tangible efforts made to reduce impacts to urban runoff
 - Track type and number of structural BMPs installed
 - Parking lot maintenance program for pollutant load reduction
 - Identification and elimination of illicit discharges
 - Zoning changes and ordinances designed to reduce pollutant loading
 - Modeling of activities & programs for reducing pollutant reductions
3. Description & documentation of social indicators, outreach, and education programs
 - Number/Type of training & education activities conducted and survey results
 - Activities conducted to increase awareness and knowledge – residents, business owners. What changes have been made based on these efforts? Any measured behavior or knowledge changes?
 - Participation in stream and/or lake clean-up events or activities
 - Number of environmental action pledges
4. Water quality monitoring: A direct and effective way to evaluate the effectiveness of stormwater management plan activities.

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

5. Links:

- Evaluating the Effectiveness of Municipal Stormwater Programs. September 2007. EPA 833-F-07-010
- The BMP database - <http://www.bmpdatabase.org/BMPPerformance.htm> (this link is specifically to the BMP performance page, and lot more)
- EPA's STORET data warehouse - http://www.epa.gov/storet/dw_home.html
- EPA Region 5: STEPL – Spreadsheet tool for estimating pollutant loads <http://it.tetrattech-ffx.com/stepl/>
- Measurable goals guidance for Phase II Small MS4 - <http://cfpub.epa.gov/npdes/stormwater/measurablegoals/index.cfm>
- Environmental indicators for stormwater 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 (a.k.a. stacking sheds)
 - Strip cropping
 - Prescribed grazing
 - Critical Area Planting
 - Runoff Management System
 - Waste Management System

- Solids Separation Basin
- Riparian Buffers

Shem Creek Enterococcus Bacteria TMDLs Responsiveness Summary

Comments were received from the following:

Charleston County

Town of Mt Pleasant

And the following individuals:

Oliver Abar	Rob Glasser	Kathryn Matrangola
Gabriella Andrews	Darcie Goodwin	Mike McCarthy
Melissa Archer	Richards Gregory	Jerilyn McCombs
Mary Arnold	Kathy Greider	Sarah McKenna
Suzanne Auld	Tyler Grespin	Savannah McLain
Tony Beall	Bob Griffin	Sean McQuilken
Guy Beasley	Carol Gross	Alicia Mendicino
Jennifer Biondi	Kaitlyn Hackathorn	Christine Mooberry
Baker Bishop	Lisa Hakamiun	Kathryn Mundy
Kattie Boggeman	Lynday Hall	Melissa Myers
Abigail Boyer	Tyrone Hanlan	Elizabeth Nemeth
Richard Brendel	Gerald Haram	Jill Norton
Walker Brock	Meagan Harper	Sam Norton
Erica Browne	Kevin Hayes	Jim Owens
Alys Campaigne	Melissa Hayes	Dusty Parker
Maggie Carragher	Noelle Hearn	Blake Pearce
Jocelyn Chateauvert	Karen Henderson	Jessica Peragine
Brandon Clark	Franny Henty	Stephanie Ragsdale
Michael Claypoole	Kate Hewett	Emily Randisi
Carl Cole	Kimberly Imbus	Kevin Raymer
Alec Cooley	Liz Jannetta	Harriet Reavis
Austin Dandridge	Chris Jude	Sarah Romano
Sharon & Roland Day	Judith Kramer	Jason Romanosky
Laureen Deibert	Brandon Kyzar	Irene Rowe
Joe Dennig	Nathan Leach	Maureen Ryan
Kyle Draganov	Luke Levanchy	Eric Sautter
Walt Dunlap	Patricia Luck	Lisa Scharin
Nicole Fagala	Bobbie Lyon	Christian Sergent
Caroline Forgason	Deanna Maguire	Melinda Sergent
Matthew Gamble	Jennifer Mathis	Gustavo Serrano

Michael Shinall
Parker Singleton
Rob Spawar
Jeanne Sprott
Christina Stanton
Cris Sumpster
Nancy Swan
Susan Thompson
Will Tidwell
Mike Tinkey
Chris Toler
Benjamin Toy
Dana Toy

Joshua Trotta
Phil Turner
Kathleen Vanderlip
Christine von Kolnitz
Theodosia Wade
Cynde Walton
Jason Walton
J Elizabeth Way
Kris Wetzel
Ian Wheeler
Brian Wildstein
Glenn Williman
Carrie Wilson

Kathy Wilson
Mary Wofford
Elizabeth Zsolnay

Amendments:

The following additional amendments were made by the Department to the draft Shem Creek Enterococcus Bacteria TMDLs and associated appendices during the 30-day public comment period. These amendments were not made as a result of written comments received but may have been the result of an error, omission or the need for clarification.

Amendment 1 Page 4, Section 1.2:

Sentence in second paragraph was changed to "MS4s within the watershed provided various GIS layers, and these were used in refining and finalizing the watershed boundary with concurrence from all MS4s. Finalized watershed boundary has a drainage area of 4.2 mi² and is shown on Figure 1."

Amendment 2 page 22, Section 4.0 Cumulative Probability Method:

Sentences were added to first paragraph: "Because enterococcus is the applicable recreational use water quality indicator and more recent enterococcus data have been collected at SC1, SC2 and SC3 in the watershed, the Department believes that the historic fecal coliform data collected at MD-071 are less representative of current conditions in the watershed. The calculated reductions for SC1, SC2 and SC3 are expected to address the current recreational use water quality standard at MD-071."

A sentence was removed from the first paragraph: "MD-071 was located between SC1 and SC2 and calculated reductions for those stations is also applicable to MD-071."

Charleston County comments were submitted by Michele Richbourg of Thomas and Hutton

Charleston County Comment 1:

"Enterococci Units of Measure: Under Section E of SC R61-68, the Water Quality Standards for enterococci in Class SA saltwaters are given in units of MPN/100 ml. The draft TMDL for James Island Creek uses "cfu/100 ml" or "/100 ml" as units of measure for enterococci. To avoid confusion the TMDL should clearly state the units for enterococci bacteria compliance as MPN/100 ml. The TMDL should clarify when discussing historical data recorded as cfu/100 ml and provide a conversion factor where applicable."

Department's Response 1:

The comment is also applicable to the Shem Creek TMDL document. The oversight of using cfu as unit of measurement for enterococci in the draft TMDL document has been corrected and has been replaced by mpn/100ml.

Comments from Hillary Repik of the Town of Mt Pleasant

Town of Mt Pleasant Comment 1, Section 1.1, Page 3:

"Error – reference to TMDL stations link. Link or reference - has error message"

Department's Response 1:

"**Error! Reference source not found**" has been removed from the section and sentenced changed to "All four stations covered in this TMDL document are identified and shown on Figure 1".

Town of Mt Pleasant Comment 2, Sections V and 1.2, Page 6:

"Update Section 1.2 Land Use to read 1.3. Section 1.2 is already in use for prior section".

Department's Response 2:

The correction has been made.

Town of Mt Pleasant Comment 3, Figure 6, Page 10:

"Please move the Land use map up to the Land use section on page 6 so that the map and data are kept together. Please move after Table 2."

Department's Response 3:

Moving the landuse map to same page as Table 2 is not possible due to size constrains of the map and formatting.

Town of Mt Pleasant Comment 4, Table 2, Page 7:

" "Urban". Request Instead of grouping the developed area values under "urban" – please define the amounts of the other land use categories noted in the map legend. The Wando and Pudding Swamp TMDLs provided the table of separate categories and then a "total developed" – in evaluating even developed uses there are different run-off characteristic and potential contributions or benefits that are used in evaluating priority issues and solutions that would be helpful to illustrate."

Department's Response 4:

The requested change was made to Table 2.

Town of Mt Pleasant Comment 5, Section 3.0, Page 11:

“Lastfl. “MS4s may require discharge permits for industrial and construction activities under the NPDES stormwater regulations. The EPA/State requires the NPDES permit. The State issues the NPDES permits – not because of the MS4s require it. We assist the state in plan review and compliance inspections as ordered by our NPDES permits. Update to read that “The State may require...MS4s may have additional local requirements beyond NPDES requirements.”

Department’s Response 5:

Last paragraph in Section 3.0 has been replace with the following:

“Non-continuous point sources required to obtain NPDES permits include stormwater discharges from municipal separate storm sewer systems (MS4s), industrial activities and construction sites. Each may be a source of pathogens. These sources are expected to meet the percentage reductions as prescribed in this TMDL or the existing instream standard for the pollutant(s) of concern through compliance with the terms and conditions of their permit.”

Town of Mt Pleasant Comment 6, Figure 9, Page 17:

“Map of Outfalls and conveyances. The items noted as Mt. Pleasant outfalls are not all Town owned but represent the outfalls identified by the Town, within the GIS data we have assigned ownership to other MS4 operators (public and private) – if the map is to represent what the Town controls (ownership over the system) we are providing separately layers of town owned and private owned to support this map. The SCDOT and County layers can stand for their agency’s infrastructure data.”

Department’s Response 6:

Figure 9 in the draft document has been modified with new information provided by the Town of Mt Pleasant.

Town of Mt Pleasant Comment 7, Page 30:

“City of Charleston. Remove from paragraph 2 – not in this watershed”

Department’s Response 7:

Inadvertent inclusion of the City of Charleston as a designated MS4 entity has been corrected and removed from the Shem Creek draft TMDL document.

Town of Mt Pleasant Comment 8, Page 31:

“City of Charleston. Remove from last paragraph – not in this watershed”

Department’s Response 8:

Inadvertent inclusion of the City of Charleston as a designated MS4 entity has been corrected and removed from the Shem Creek draft TMDL document.

Town of Mt Pleasant Comment 9:

“Seasonal variability. The paragraph references that seasonal variability is addressed by multiple years of data however, the sampling years from CWK noted in section 5.1, are from warm months. Given this - the sampling does not truly cover seasonable variability. Since the earlier data from MD-071 was not included I do not know if this dataset showed any variability that would be noteworthy. Please update section to reflect the lack of seasonal variability of data.

Department’s Response 9:

These TMDLs for stations SC1, SC2, and SC3 do in fact take season variability into account. Astronomical seasons are defined by two solstices that fall around June 21 (summer) and December 22 (winter), and two equinoxes that fall around March 21 (spring) and September 22 (fall). Charleston Waterkeeper (CWK) typically collects water samples and analyzes them beginning of May through end of October. May through October are spring, summer, and fall seasons in South Carolina. These three seasons are also the critical seasons for recreating in or on water in South Carolina, which is how the draft TMDL document is accounting for the seasonal variability.

In addition, the Department has reviewed historical recreational use fecal coliform data collected monthly between 1999 to 2011 from station MD-071. These data were separated into two sets, May through October and November through April. This grouping allowed for an evaluation of Shem Creek data that includes the astronomical winter as well as the six month period where samples are not collected by the CWK at SC1, SC2, and SC3. From November through April 1999 to 2011, there were four exceedances of the fecal coliform SSM 400 cfu/100 ml WQS out of 68 samples (n=68), a 6% exceedance rate. During the same time frame but May through October, there were 15 exceedances of 400 cfu/100 ml WQS out of 69 samples (n=69), a 22% exceedance rate. A Summary of the 1999-2011 fecal coliform data collected at MD-071 is presented below for your information. The frequency of exceedances was higher during May-Oct, while the magnitude of the exceedances was similar. The magnitude was determined as the arithmetic average of the exceedances. Note the May-October data had two samples

reported as greater than the reporting limit of 1600 cfu/100 ml for the specific method used for analyzing the samples. The average exceedance was calculated using the reporting limit of 1600 cfu/100 ml for these samples; therefore, the average for May-October is likely higher than shown in the table. These results suggests that May-October is the critical period for bacterial levels in Shem Creek, although exceedances also occurred during the cooler months Nov-Apr. All data from 1999-current may be downloaded at the following link: <https://www.waterqualitydata.us/portal/>

Shem Creek	May-Oct	Nov-April
n	69	68
Number of Samples Exceeding WQS of 400 cfu/100 ml	15	4
Exceedance Rate	22%	6%
Average Exceedance	1047 (n=15)	1250 (n=4)

Since CWK samples for Enterococcus are collected on weekly basis, we were able to calculate monthly geometric means (35 mpn/100 ml WQS) for the three stations on Shem Creek. Using the monthly geometric means of Enterococcus data collected by CWK, percent reductions were calculated and are presented on tables Ab-1 and 5, as well as the WQ target (33.25 mpn/100 ml). Since the indicator bacteria for recreational waters was changed from fecal coliform to Enterococcus in 2013, comparison of magnitudes of fecal coliform to Enterococcus is not possible.

Because the geometric mean is generally more restrictive than SSM, we are confident that percent reductions presented in the document, which are applicable year around, will also be protective from November through April.

In order to clarify the point regarding seasonal variability in the TMDL document, the Department has inserted the following language on page 32, Section 5.6: "In addition, an evaluation of historic fecal coliform data collected at MD-071 from November through April demonstrated that the instream recreational use standard will be protected by TMDLs developed using enterococci data collected at SC1, SC2, and SC3 May through October."

The comments below were submitted by individual stakeholders or other interested parties and were deemed similar in content. The Department has grouped together these comments for a single response.

Oliver Abar:

"Dear Ms. Varlik, I am an avid fisherman and boater. I have grown up in Charleston and grown to love its waters as I get older and older. Sadly, one of the main branches of my home waters, Shem Creek, is slowly becoming more and more toxic. You can help change this, and I need your help. Please act to save this body of water that I love Thank you"

Gabriella Andrews:

"I am writing in support of cleanups for James Island and Shem Creeks. My six-year old lives to swim and shrimp in these creeks every weekend, just as I did as a child, and I find myself hesitant to allow it after learning about the bacteria levels in these areas. Charleston's unique creeks and waterways are what keep us all employed (and sane)- whether we work directly on the water, or whether we benefit from visitors coming to the city to enjoy our incredible natural resources. We owe it to the environment and to future generations to address these issues before it's too late to turn back. Thank you for reading and for all that you do."

Melissa Archer:

"I support clean water in Charleston! I will work to improve water quality through volunteering, voting, and speaking up for environmental issues!"

Suzanne Auld:

"Thank you for all your efforts for making Charleston's waters safe for our families. We are proud to be a born and raised Lowcounty family and it is our joy to teach our sons how to fish, swim, and participate in water sports in our creeks and rivers. It is imperative that our water is safe for these activities. Thank you, and God Bless."

Tony Beall:

"I support efforts to clean up the highly polluted waters mentioned above. Water quality continues to be a problem due to fecal contamination and runoff. Please use DHEC's resources to give us cleaner waterways."

Guy Beasley:

"Dear Ms. Varlik, I kayak often in the Charleston area. Shem Creek is probably my most often used access point. I love to roll my kayak, but I always check with Waterkeeper's latest testing first. I avoid going after a rain because the bacteria count is so high. Please continue the efforts to clean up Shem Creek and thank you for the steps taken so far. Thank you"

Jennifer Biondi:

"The local waterways are SO important to the beauty & safety of Charleston. Please help protect them by ensuring the cleanliness of the waterways!"

Baker Bishop:

"Dear Ms. Varlik, Thank you for your time. Please clean these Creeks up. Our waterways are too valuable a resource not to have their health and cleanliness a top priority. As an avid fisherman, it pains me to see some of these water quality results."

Kattie Boggeman:

"Please clean up Shem Creek and James Island (Ellis) Creek. We are so lucky to live in such a beautiful place, please restore it so we can enjoy every aspect of it safely. My family and I love to paddle board and it would be wonderful to have more safe places to go."

Abigail Boyer:

"I have grown up here in the low country. I love our creeks and rivers. I am a kayak guide. I take people on the water and share with them the beauty of the creeks. The community needs clean, healthy water ways to enjoy. I am in support of cleaning up our way waters!"

Richard Brendel:

"Water quality is an issue I really don't know that much about. What I do know is that I'm addicted to being in the water and it would be nice to know that it's clean. I understand that you can't just flip a switch and presto, clean water. I also understand that this is an issue that needs to be addressed from all angles so that we can learn what causes unsafe water, as well as, how to manage it. Thanks for making this a priority!"

Walker Brock:

"Shem Creek and Ellis Creek need your help. Many who recreate on those creeks do not even know how impaired the waterways they enjoy are, and the wildlife certainly does not. As an advocate for clean water in Charleston, I thank you for prioritizing clean water targets for Shem and Ellis creeks."

Erica Browne:

"This is Erica Browne, a student at Georgia State University who partook in an alternative spring break to help clean up trash in creeks and lakes in Charleston this past March. Water standards that are unsafe for swimming pose a detrimental threat to the community and the entire ecosystem. Please take this threat to our safety seriously."

Alys Campaigne:

"Dear Ms. Varlik, Hello, I am writing to express my strong support for DHEC's proposal to strengthen the health and safety standard for our creeks. I just moved after living on Shem Creek for 8 years. I still regularly enjoy kayaking, fishing and bird watching in and around the creek. We lived near the local kayak rental companies and saw the occasionally overturned novice kayaker or paddleboarder in addition to kids swimming in the creek

just for fun. The public uses these creeks for water recreation outside of boating that involves human contact with the water. Our creeks should be safe for recreational enjoyment and we rely on you to establish and enforce safety standards so that the municipalities implement meaningful plans to achieve meet them. Please move forward with a strong standard. Thank you"

Maggie Carragher:

"It's so important for our rivers and creeks to be clean, especially in these high traffic areas where thousands of people swim and boat daily. Thanks for doing the right thing."

Jocelyn Chateauvert:

"Being a parent in Charleston can be a joy with some many water activities near by. Bacteria in the water is not good for our families and the wildlife that is just trying to keep up. Please do monitor and seek punitive damages to those who pollute our waters."

Brandon Clark:

"My name is Brandon Clark and I am very excited to hear about the efforts you guys will be making for James Island Creek and Shem Creek. I love the idea of safer water for people to swim and fish in. My wife Rachel and I live on Shem Creek at the top near Bowman Rd. on Rosemead Rd. in the house she was born and raised in and we have a true love for the creek and marsh. We have seen a big change in the amount of trash and water quality over the past 30 years (since Hurricane Hugo) and have been concerned about water quality. We pick up trash along the banks regularly and even canoe in the creek to clean out trash and debris. I even have images of my canoe full of trash from the upper section of the creek. This area is the area that is typically reporting high levels of bacteria. We think a lot of that is pet waste and maybe even septic waste that makes it way to the creek as well. I would like to offer my assistance and/or, observations/ideas/opinions, if you think it will help. We know a lot of people that live along the banks of the creek and would be glad to help advocate clean water in the neighborhood. Let me know if we can help and thank you for your efforts."

Michael Claypoole:

"I urge you to continue supporting healthy ecosystems of the low country by passing bills and providing funding to clean up and protect waterways like Shem & Ellis Creeks."

Carl Cole:

"Healthy tidal creeks are an important part of our Lowcountry natural heritage. Charleston Waterkeeper has worked for several years to document that these creeks, while still largely intact, are no longer healthy. We depend on DHEC to ensure that local governments take effective measures to restore the creeks to health."

Alec Cooley:

"Dear Ms. Varlik, I'm writing to voice my support for DHEC's efforts to set cleanup targets for Shem Creek. As a resident of the Cooper Estates neighborhood that borders the creek, we spend a fair amount of time in and around it. We frequently see kids swimming at our community boat landing, and it has been a concern that tests have shown the water to be unsafe. We appreciate DHEC's efforts to address this issue. Thank you"

Austin Dandridge:

"I have lived in Charleston for over 10 years and on James Island 6 of those years. As a father, Charleston business owner, and avid water enthusiast, I want to see Shem Creek and James Island Creek safe and healthy for swimming. I fish the creeks and want my kids to be able to do the same."

Sharon & Roland Day:

"Thank you and the DHEC for setting cleanup targets for Shem Creek and James Island Ellis Creek. I know we all want to see these areas safe and healthy for swimming and water recreation. My husband and I are extremely pleased and excited that steps are being taken to ensure cleaner and healthier waterways. You have our full support. THANK YOU!"

Laureen Deibert:

"We live here in the Lowcountry because of the nearness to the water. The oceans, the creeks, the marshes all call to our hearts. It absolutely breaks my heart to hear that we do not have clean enough creeks to swim in; that we are polluting our waters to the point that our fish and fowl are also feeling the "pain". I support whatever needs to be done to help keep our waters clean, and I thank you for your testing."

Joe Dennig:

"Good Afternoon. Having lived on James Island for almost 20 years now, it's concerning to see the very high levels of bacteria being reported by Charleston Waterkeeper. Please let's set a cleanup target VERY SOON for James Island Creek as well as Shem Creek in Mt Pleasant. We love relaxing on the creek in our kayaks and paddleboards and want to see some action. Thank you for your time!"

Kyle Draganov:

"I live on James Island. I'm tired of seeing that our creek water is not safe. Please support cleaning up Ellis Creek on James Island (and Shem Creek, too)."

Walt Dunlap:

"Dear Ms. Varlik, It is imperative to maintain the health of coastal waters such as Shem Creek. The pressure on coastal ecosystems is brutal and we are losing the battle without your help. Please do what you can to aid the Charleston Waterkeeper and their efforts. Thank you"

Nicole Fagala:

"Please get these creeks clean we go in it 3 times a week!"

Caroline Forgason:

"Hoping testing and cleanup can make these creeks clean & contributing to the beauty and diversity of The Charleston area."

Matthew Gamble:

"I have been a kayak guide on Shem Creek for the last six years and the information I have learned about the consistently poor water quality in Shem and similar creeks has me more than a little concerned. In order for the creek to continue to provide the wealth of natural and economic benefits we need to make sure the water stays clean and the delicate ecosystem stays healthy. It is up to the lawmakers to listen to good science and feedback from constituents to make the best possible informed decisions. I believe we have an incredible opportunity to do this now, starting with Shem Creek and James Island creek."

Rob Glasser:

"We must take care of our estuaries and creeks"

Darcie Goodwin:

"I regularly paddle on the waters of Charleston, so clean creeks are very important to me. I want to thank you for cleaning up James Island Creek and Shem Creek. Clean, healthy waterways mean that I don't have to worry about falling in or getting water in my face."

Richards Gregory:

"I have lived on James Island Creek (Ellis Creek) for over 12 years. I'm an avid boater and I enjoy jumping off my dock and the boat into the water. I have not been able to do this for many years. The fecal bacteria levels are incredibly high. I want DHEC to make James Island Creek and Shem Creek safe for swimming again."

Kathy Greider:

"We need to make and keep all our public waterways clean. Save for our children and our fish."

Tyler Grespin:

"I'm writing in support of the Charleston Waterkeeper's mission to secure cleaner coastal waters in Charleston County. I would like to support their mission to see Shem Creek and James Island Creek safe and healthy swimming venues. As a representative of the East Cooper Land Trust, also a local environmentally conscious non-profit organization, I hope to see SCDHEC take their mission into consideration."

Bob Griffin:

"Dear Ms. Varlik, I vacation in Charleston and want to be able to kayak and paddle board in Shem Creek . Get the sewage out so I can enjoy it with my grandchildren. Thank you"

Carol Gross:

"I want James island and Shem creek safe for. Swimming"

Kaitlyn Hackathorn:

"Shem Creek and James Island Creek are the centerpieces of our community. They represent Charleston for both natives and visitors alike. I grew up swimming, kayaking, and catching seafood in these waters. Please help us to protect them. I truly believe that the history and future of our community lies in the protection of these waterways."

Lisa Hakamiun:

"I would like to see our waterways clean and safe for us and future generations. Thank you so much for what you do to keep everyone safe."

Lyndsay Hall:

"I have been a resident of the Charleston area for over 15 years - within that time Charleston Waterkeeper started testing the sites off Shem Creek and James Island Creek. Both of these sites are consistently unsafe for swimming. Having safe water, especially in South Carolina during summer, is an easy way to cool down and is a great activity for young children to enjoy. Its unfortunate that the bacterial levels continue to be unsafe - its time to act on this. Please clean these sites up!"

Tyrone Hanlan:

"I strongly believe in this push for improvement to water quality in both of these bodies of water."

Gerald Haram:

"Please act to clean up Shem and Ellis creeks. I live on Milton creek on edisto island and know the importance of fishable and swimmable water that is safe for recreation. It is the foundation of our tourist economy."

Meagan Harper:

"My name is Meaghan and I spend lots of time enjoying our beautiful Charleston waterways. It's so peaceful to look out at the water, see dolphins and other wildlife, and enjoy the tranquility it provides."

Kevin Hayes:

"As a local resident and lover of the Low Country I am asking you please help us get our water ways cleaned up and sustainable. I love to crab, fish, shrimp, swim, kayak, and spend my time on our beautiful waters. Without them being clean and safe, I can't enjoy them, nor can our future generations."

Melissa Hayes:

"I've been living in the low country all my life. I love this area and hope to never leave because of one thing alone: our community's relationship with the salt water. I can't imagine leaving these beautiful marshes and beaches. Some of the best moments of my

life include them. That being said, I'm writing to support any initiatives to make Shem Creek and James Island Creek safe for swimming so that others can enjoy our waters in the same way that I have. In addition, I think it's crucial that we care for our environment, so it can remain a resource to us for fishing, crabbing, and oystering. Please help our community by working toward cleaner, healthier waters."

Noelle Hearn:

"Dear Ms. Varlik, Every day I take out families and children on Shem Creek to paddle. It breaks my heart when I have to tell kids they cannot swim because the water is too dirty. Please help us protect our creeks so that our children can swim and play! Thank you"

Karen Henderson:

"I want to see Shem Creek and James Island Creek safe and healthy for swimming."

Franny Henty:

"Please clean up James Island and Shem Creek asap. Please inspect all septic systems in the vicinity. Furthermore please limit any development until these creeks are safe to swim again. Thank you ever so much."

Kate Hewett:

"Dear Ms. Varlik, As a resident of the Charleston area who loves our incredible water landscapes I am in support of a cleanup effort to ensure safe swimming in Shem Creek and elsewhere. Please document my support of the DHEC project. Thank you so much
Thank you"

Liz Jannetta:

"Thank for your ongoing support and efforts to keep Shem Creek and James Island Creek safe and healthy for swimming."

Chris Jude:

"My wife and I moved to Charleston in 2017 from North Carolina. At first we worried that we wouldn't have as many chances to get out doors here, until we joined a Coastal Expeditions kayaking trip on Shem Creek and into Charleston Bay. Since then we've used the rivers and waterways in the area as our recreation, and it's been great. The problem is, the pollution in these areas concerns us for swimming and what effect it may have on the wildlife that makes the low country so special. Please direct resources towards Shem Creek and James Island Creek water quality, they are vital resources to our community."

Judith Kramer:

"Thank you for the work you do to keep South Carolinians safe and healthy in our beautiful environment. Towards this end, Especially as a kayaker, I wholeheartedly support DHEC 's plan to clean up Shem Creek and James Island Creek (Ellis Creek) which will contribute to the health of all those living on, by, or in these waters."

Brandon Kyzar:

"Dear Ms. Varlik, I support initiatives to clean up Shem creek Thank you"

Nathan Leach:

"I support any effort to make Charleston's waterways safer and cleaner. The creeks around the area are a great way to cool off in the hot summer months, and it'd be a shame if we can't utilize our natural resources around us if the bacteria levels make it unsafe to do so. I've been enjoying those small pleasures for years and wouldn't want to stop now."

Luke Levanchy:

"With the majority of locals unanimously fighting for safer cleaner water availability. I urge you to strongly consider taking proper precautions to protect our waterways and estuaries. Let's show visitors why we live in such a special place."

Bobbie Lyon:

"Please take the necessary steps to make Shem Creek and Ellis Creek safe for swimming again. As an avid paddleboarder on James Island it is scary to think what I could catch in that creek were I to fall in. And on hot summer days it is a shame to not be safe to get off my board and take a dip in the creek. Our waters are all connected and left unresolved this is likely to become an expanding problem."

Deanna Maguire:

"I am passionate about Charleston waterways, and keeping them clean and safe is a priority. Swimming and fishing are my favorite activities, and just simply put, that is why we need to keep waterways clean."

Jennifer Mathis:

"Thanks for the quick response. I am not sure why it went through without a message but the essence of my email is to advocate for Charleston Waterkeeper and the work they have been doing to monitor water health. For you all to hear citizen voices supporting waterways that are clean enough to swim and fish in. Thanks for listening."

Kathryn Matrangola:

"Dear Ms. Varlik, I hope for a cleaner waterway to share with the next generations and encourage an active outdoor life! Thank you"

Mike McCarthy:

"Dear Ms. Varlik, Charleston Waterkeeper's testing revealed that Shem Creek and James Island (Ellis) Creek don't meet state water quality standards for safe swimming due to high levels of bacteria. The DHEC clean up efforts are an important step in making both creeks safe for swimming. Thank you for taking action, and making our waterways clean again. Please make an effort to make the public aware of what they can do to clean up and help maintain the cleanliness of the creeks. Thank you"

Jerilyn McCombs:

"Dear Ms. Varlik, These creeks see far too much boat traffic & perhaps runoff from businesses along the waterway. Please regulate our creeks which are home to wildlife."

Sarah McKenna:

"Dear Ms. Varlik, I am a Mt. Pleasant relative and long time creek lover. Along with countless neighbors, friends, and community members, I want to see Shem Creek and James Island Creek safe and healthy for swimming and kayaking. Being outside is critical for my mental health along with many others. Summertime just isn't the same when the water is too toxic to endure. Please help us save our waterways. Thank you."

Savannah McLain:

"Dear Ms. Varlik, We urgently need to protect our water systems. Not only for the people that swim and boat in it, but for the animals that live there and rely on it. We will not get back this ecosystem if we do not protect our water. Please help us get this water clean for future generations. Thank you"

Sean McQuilken:

"As a marine biologist who has literally spent thousands of working hours on waterways from Texas to Cape Cod I have seen firsthand the effects of water pollution. I am urging you to pass protections that would clean up Shem Creek and James Island Creek and make them safe for swimming. I personally kayak and paddleboard on Shem Creek and have friends/ family who use James Island Creek. For far too long there have been water quality issues with both of these creeks. If we pass and enforce protections for these two (and other bodies of water) they will become healthier for people and animals which will contribute beneficially to our economy as tourism is a major industry in the Charleston area. Thank you"

Alicia Mendicino:

"I am writing to let you know of my concern regarding water quality on both Shem Creek and James Island Creek. As a long time resident of Mt. Pleasant and frequent visitor to James Island, I have always appreciated the beauty of both waterways and the many activities for which they are a haven. I am an avid paddleboarder and am now reluctant to use Shem Creek due to the high level of bacteria in the water. I understand the same is true of James Island Creek. As a South Carolina resident yourself, I am sure you want all of us to be able to enjoy what nature has so abundantly provided us...clean water. I hope you will make cleaning the two waterways a priority! Thank you"

Christine Mooberry:

"Dear Ms. Varlik, I ask that you would prioritize the cleanliness and health of the local waters and environment! We love the beauty of our environment and would appreciate efforts to keep it clean and healthy! Thank you"

Kathryn Mundy:

"Dear Ms. Varlik, Thank you for helping to make James Island Creek and Shem Creek safer for me and my friends to kayak and swim in! I love living in the low country and being able to SAFELY enjoy the tidal creeks and marshes is definitely one of my favorite parts of Mount Pleasant and James Island. Thank you"

Melissa Myers:

"Dear Ms. Varlik, I want to see Shem Creek and James Island Creek safe and healthy for swimming. I'm a frequent paddler on the creeks and want to continue this. Please support clean creeks. Thank you"

Elizabeth Nemeth:

Dear Ms. Varlik, I am writing to voice my support for clean water for Shem Creek and James Island Creek and all of Charleston's tidal creeks. I live on Longbranch Creek in West Ashley and fish, crab, and shrimp the creek; you can find me on the dock wearing my Cajun Reebok's (aka white shrimp boots) most evenings. Our waters are precious- and I wholeheartedly support initiatives to set water quality standards for safe swimming and fishing. Thank you so much for your leadership in preserving the health of our waterways.

Jill Norton:

" Dear DHEC, PLEASE PROCEED IN TIMELY AND EFFECTIVE ACTIONS THAT WILL CLEAN UP THE SHEM CREEK AND ELLIS CREEK FOR THE CHARLESTON COMMUNITY OF WATER ACTIVITIES LOVERS! Thank you"

Sam Norton:

"Dear Ms. Varlik, I recently drove over Shem Creek. In the oak by the creek, a white heron. I approached it as neighbor and friend. But when the branches moved out of the way I realized it was a great white plastic bag. Down it's side were red words "Thank you, Thank you, Thank you." Soon that bag will be in the water. So let's clean it up Thank you"

Jim Owens:

"Dear Ms. Varlik, I am writing to you as a lifelong resident of Mount Pleasant who grew up on Shem Creek. In my youth, growing up in Bayview, I would take a Jon boat over to what's now known as Patriots Point, when it was a dredge spoil area collecting untold amounts of sharks teeth as a youngster. As a Council member, I have initiated a Shem Creek Task Force, Shem Creek Advisory Committee and provided financial funding resources to hire a consultant (Cranston Engineering) to provide a Shem Creek Area Management Plan to further protect the Creek from disproportionate development and provide a responsible growth management plan. I have also been very active with the DNR and USACE with negotiations concerning the Crab Bank re-nourishment plan, and initiated the single use plastics ban. I say this only to provide you with some results of what the Town is doing to protect Shem Creek and to ensure that it's enjoyed for

generations to come, but we need your help & support in making it cleaner and healthier for swimming, fishing and other recreational activities. Your work is essential to the health of the Creek and for all who enjoy the Jewel of Mount Pleasant. Thanking you in advance for your consideration."

Dusty Parker:

"Dear Ms. Varlik, I'm sure that you would agree with me that safe, clean oceans and creeks are important. I strongly support DEHC in efforts to clean our local Charleston county area creeks to meet state water quality standards for swimming, especially Shem Creek And Ellis Creek. It's not just important for today, but for future generations to enjoy. Thank you for your time and consideration."

Blake Pearce:

"Dear Ms. Varlik, Please do something about the bad water quality standards in James Island Creek and Shem Creek! Thank you very much. Thank you"

Jessica Peragine:

"Dear Ms. Varlik, As a local and environmentalist, I do my part to help better our lands and waterways and to teach others about the importance of a healthier earth. One of my current concerns is to see Shem Creek and James Island Creek safe and healthy for swimming again and to protect those living in these ecosystems above and below these waters. Many fish, sea birds, and marine mammals are affected too. Yet run-off pollution from roads after storms and waste from boats aid in the reproduction of harmful bacterias which make these waters uninhabitable for animals and unsafe for human aquatic activities. Please help all affected parties be able to safely enjoy these waters again today and for future our generations. Thank you"

Stephanie Ragsdale:

"Dear Ms. Varlik, Every body of water should be accessible for safe wading and swimming. We have to stand up before these things are no longer an option. Thank you"

Emily Randisi:

"Dear Ms. Varlik, Please help preserve Shem Creek and James Island Creek and keep them safe and healthy for swimming. As a DHEC employee, it is your professional obligation to keep the public safe from poisons they neither agreed to, nor were warned about. If there is anything people like myself can do to aid in this effort, please do your best to let us know. We support you and we have put our trust and our health in your hands. Thank you"

Kevin Raymer:

"Dear Ms. Varlik, I use Shem Creek for paddle boarding and I would like for DHEC to make these waters safe for swimming. I want my two young children to be able to enjoy the

waters of our community without fear of getting sick. Thank you for your support of clean, healthy waters! Thank you"

Harriet Reavis:

"Dear Ms. Varlik, I am President of the Marlborough Neighborhood Association on James Island, and we would like to ask for your help in making Shem Creek and Ellis Creek safer. We are counting on you to make sure our waterways are as clean as possible. Thank you"

Sarah Romano:

"Dear Ms. Varlik, I am a mother, an educator, and an avid paddle boarder. I need our local water sources to be safe for all of those reasons. Thank you"

Jason Romanosky:

"Dear Ms. Varlik, I am an avid user of Shem Creek for standup paddling and am so excited that there are more efforts planned for making this creek safe for all. I am always disheartened and nervous when I get information from the Waterkeeper that Shem is unsafe. This is one of Mount Pleasant and SC's most valuable resources, please move these efforts forward. Thank you"

Irene Rowe:

"Dear Ms. Varlik, I am concerned about the water quality of Ellis creek on James Island and Shem Creek In Mount Pleasant. Clean water is imperative. I am hopeful that you are moving to improve the water quality of these two creeks. Thank you"

Maureen Ryan:

"Dear Ms. Varlik, Please Please Please help our creeks. We need to be able to know that we will not get sick because of bacteria levels in our creeks. Please help us have clean water!!! Please! Thank you"

Eric Sautter:

"Dear Ms. Varlik, My name is Eric Sautter and I have lived less than a mile from Shem Creek all of my life. Being from the area, I've seen a lot of changes in 28 years. It is absolutely curcial to the wildlife and recreation involved around the creek to maintain a health water quality. A high amount of tourism runs through the creek especially being one of the head kayak tour guides with Nature Adventures. Personally I do my best to make sure all trash and inorganic material is removed as soon as possible but my efforts are minicule compared the continuous amount of trash and waste dumped in our creek. With the high amount of civil development and boat traffic of the area, Shem Creek needs protection from excess amount run off and pollutants spilling into our water. Members of our staff have had staph infections from the high levels of bacteria while working on the ramp or guiding tours and i'm afraid our customers and myself will contract the same skin diseases. Razor sharp oysters can als o cut through skin making infections more likely when paddling in the creek. I believe it is absolutely mandatory for everyone to do their

part and clean up after themselves but sometimes that's not enough. Please consider a larger plan to remove trash and pollutants for our future generations to enjoy the area instead of scaring them from going in the water and risking infection. Thank you"

Lisa Scharin:

"Dear Ms. Varlik, The quality and conditions of water in Shem Creek and James Island Creek are a tragedy and an absolute shame, a sin-really!!! These bodies of water are a major attraction for tourists and locals who love paddle boarding, kayaking, canoeing, bird-watching and dolphin watching. Shem Creek is also a focal point for people who want to dine on the water and enjoy the sunset, and watch people enjoy water activities while relaxing at Vickers', Reds, and the other restaurants along the creek. How horrible that the bacteria in this water is so high-it is a dangerous to swim in and I fear for those who paddle board if they fall into it! YOU should TOO!!! I also have seen enough people fishing and crabbing in this water-they should be warned and aware! This is a health issue and an issue of respect for our environment, wildlife and human rights to be able to enjoy their communities, vacations without fear of getting sick!!!! PLEASE do ALL you can to CLEAN UP these very important bodies of water-as you know-they are connected to other water sources and the ocean too! Thank you"

Christian Sergent:

"Dear Ms. Varlik, Shem creek has been a very important part of my life for as long as I can remember. From being a young child going a swimming at my friends houses on the creek, to being in high school and swimming off of the public floating dock. I now interact with the creek nearly every day working at Nature Adventures. The thought of anyone having to fear coming in contact with the water due to high bacteria levels is a truly heartbreaking thought. I think everyone should be able to experience this place that so many of us hold close to our hearts. We would appreciate your support in helping us clean the creek so very much. It would mean the world to me to be able to bring my friends out to swim again, or to have no hesitation in saying yes when someone asks me if they are able to jump off of a paddleboard into the water. Thank you"

Melinda Sergent:

"Dear Ms. Varlik, We all know that clean, healthy water is a critical concern. Please support cleaning the water of Shem Creek. My son works in that water numerous times a week. It is very worrisome that this could endanger his and others health. Thanks for your help in this very important matter. Thank you"

Michael Shinall:

"Dear Ms. Varlik, Please take the necessary actions to ensure these beautiful waters receive the care they deserve. As I'm sure you are aware, Shem Creek plays a critical role in our local economy and provides family, friends and visitors a place to relax and share

memories. Similarly, James Island Creek is home to several Charleston families where it is not unusual to find people fishing, lounging and swimming. Please take all of these aspects into consideration. Thank you for all of your help!"

Parker Singleton:

"Dear Ms. Varlik, I highly applaud and support cleaning up Shem and Ellis creek. I have frequented these beautiful tidal creeks since I was a young boy on vacation with my parents. Now I live here. The constant development troubles me that we are not prioritizing maintaining a pristine environment and that we will soon lose what took millions of years to evolve and develop. Cleanliness allows people to enjoy and appreciate the beauty of these waters and to have more reason to preserve them."

Rob Spawar:

"Dear Ms. Varlik, Thank you for your efforts to clean up our waterways. Especially JI Creek and Shem Creek where we know they need help our and our help. Thank you"

Jeanne Sprott:

"Dear Ms. Varlik, I just wanted you to know that I and my family support DHEC setting targets to clean up Shem Creek and Ellis Creek. They are important recreational resources for our wonderful state. Thank you"

Christina Stanton:

"Dear Ms. Varlik, Please work to keep our water clean. Our ecosystem is a fundamental part of our economy and our society. This is a holistic issue. You need to demonstrate your ability to lead on this front. Thank you"

Cris Sumpter:

"Dear Ms. Varlik, Please help us keep our waters in good health. I have surfed,fished,and kayaked these waters for fifty years. I also am a Creek Watcher with Waterkeepers of Charleston and do a lot of work with DNR in the SCORE program. Obviously the health of our waters is very important to me. Thank you"

Nancy Swan:

"Dear Ms. Varlik, [your message here] My two dogs both died of cancers in the same year after swimming in the creek at Two Sisters Creek off of Shem Creek ,I no longer swim in the creek because of high fecal content. Please help this situation so all citizens can enjoy this natural resource with no health issues. Thank you"

Susan Thompson:

"Dear Ms. Varlik, DHEC is setting clean up targets for both creeks. This is an important step in making both creeks, where we live safe for swimming! Please move forward with this effort. Thank you"

Will Tidwell:

"Dear Ms. Varlik, My name is Will Tidwell and I work on Shem Creek as Kayak guide and rental agent. I've witnessed firsthand the impact of someone out on the creek for the first time and seeing dolphins or the low lying Spanish moss. The importance of Shem as a historic/recreational site cannot be understated. Please help us restore our creek to its original form. Thank you"

Mike Tinkey:

"Dear Ms. Varlik, Please clean up these two popular and iconic creeks We have lived in the Old Village for 36 years and have enjoyed Shem Creek with our children, grandchildren and family. Now with the increases of uses of of the Creek it is important to protect the flora and fauna as well as the water quality for all."

Chris Toler:

"Dear Ms. Varlik, I'm writing to you today to voice my support for cleaner, healthier waterways when it comes to Ellis Creek on James Island and Shem Creek in Mt. Pleasant. As an avid waterman that fishes and paddles both of these waterways, cleaning them up is of the utmost importance to me, my family, and my neighbors. Thank you"

Benjamin Toy:

"Dear Ms. Varlik, I want clean up our creeks Thank you"

Dana Toy:

"Dear Ms. Varlik, Shem Creek is a special place to me, after all it is where I met my husband. We love taking our family here and love to paddle in this area. I would love for Shem Creek to be a place where my family doesn't have to worry about the water and can instead create lasting memories. I want to see DHEC take an active role in this popular area to make the water a place where we don't have to worry about swimming in it. Thank you"

James Trent:

"Dear Ms. Varlik, My name is James Trent and my family and I live in Mt Pleasant. Recently, my wife and I went kayaking in Shem Creek. While it was a fun experience, I couldn't help but notice the high amount of commercial activity surrounding and polluting this important shared resource. I thought about the sea turtles, dolphins, and birds we saw and how they are forced to live in waters polluted by us and don't get a say in the matter and . As our kayak trip ended, I realized that being on the water connected me to this special place and the creatures that live in it. It's an incredible community resource and one day I would like to spend time on Shem Creek with my son without fear of swimming in polluted waters. Thank you"

Joshua Trotta:

"Dear Ms. Varlik, Shem Creek has been one of my favorite places to grow up near. Swimming around the creek was my favorite pastime as a kid and I would like many more to have the same opportunity as I did. Thank you"

Phil Turner:

" Dear Ms Varlik, As a Charleston resident and someone who is out on our rivers and creeks several times a week, I strongly support the proposed mandatory testing and standards. This is essential to protecting the health of our citizens. Thank you"

Kathleen Vanderlip:

"Dear Ms. Varlik, I work for Nature Adventures and I'm a long time lover of Shem Creek and the surrounding area. As a tour guide and nature enthusiast, it's important to me that our water and environment is clean not only for visitor and locals alike but also for the natural inhabitation. It's a shame that we have to explain to people wanting to go out kayaking that the water is unsafe to swim in due to all the pollutants. The first few steps are always the hardest, but moving forward and proactively finding ways to clean an area that has so much rich history is an act of love for Charleston. Thank you"

Christine von Kolnitz:

"Dear Ms. Varlik, I live a few blocks from Shem Creek. I do not have pets that would contribute to poor water quality, I do not use fertilizers or pesticides and I capture rainwater from my roof. I know that other neighbors and businesses can do better and can be taught how to help clean up the creek. I am writing today to ask DHEC to get involved in the clean up efforts for Shem Creek and James Island Creek. These creeks contribute food, economic benefits and quality of life benefits for so many. The animals, plants and people that rely on them deserve clean water. Thank you"

Theodosia Wade:

"Dear Ms. Varlik, We are very concerned about the water quality of our creeks and rivers around James Island and the low country. As we experience more rain higher tides flooding issues increase and along with that water quality is affected. Old and or faulty Septic systems also impact our creeks along with runoff."

Cynde Walton:

"Dear Ms. Varlik, I live near Shem Creek and would love for the water quality to improve so we could take full advantage of being out on the water, enjoying the dolphins. Anything you could do to help our environment would be appreciated. I understand that you care for the lowcountry and are looking for ways to ensure the safety of the residents. Thank you"

Jason Walton:

"Dear Ms. Varlik, Hello, I am a resident of Mount Pleasant who resides close to Shem Creek. I have 3 children (14, 10, and 3). My oldest learned to fish in Shem Creek and is an active kayak fisher who used to fish in Shem Creek. My wife and 10 year old used to paddleboard in Shem Creek. They don't do any of those anymore in the Creek because of the poor water quality. Locals who still do so know that you can't go if you have cuts on your feet due to the bacteria in the Creek. I fear that my 3 year old will not be able to enjoy Shem Creek as he ages unless something is done to improve the water quality. Please help us improve the water quality in the creek that means so much to so many. Thank you"

Elizabeth Way:

"Dear Ms. Varlik, Upper Shem Creek is especially concerning to me as I work on the creek as a guide. Many homes in Shemwood are older and owned by elderly folks who are unable to afford the sewer tie-ins. They are living with old septic systems that are prone to leaking or overflowing in the creek. There must be a solution that won't force these elderly neighbors to spend a large sum to tie into the Mt. Pleasant sewer system that is just yards from their homes. Thank you"

Kris Wetzel:

"As a resident of Folly Beach and James Island, my family and I spend a lot of time at the beach and James Island Creek. Let's work together to ensure that all of our waterways stay safe and clean for everyone. Thank you so much for your service!"

Ian Wheeler:

"Dear Ms. Varlik, Our waterways are the greatest asset we South Carolinians have. Clean water is, and will increasingly be, a far more important and enticing element in attracting newcomers to S.C., and S.C.'s overall value proposition, than any politician, corporation or business entity. I want to see Shem Creek and James Island Creek safe and healthy for swimming... Not just because it's the right thing to do for our kids, but also because quality-of-life is an increasingly scarce economic resource in the U.S. If we can't do the right thing simply because it's the right thing to do, perhaps we can at least do it because the economic prosperity of South Carolina and its residents are at stake. Thank you"

Brian Wildstein:

"Dear Ms. Varlik, Please set clean water standards for our creeks. We must protect our waterways. Thank you"

Glenn Williman:

"Dear Ms. Varlik, Please set up thresholds for bacteria in Shem Creek and James Island Creek. As a boater, safe swimming water is not just nice to have, it is necessary for water recreation to prevent disease in people and pets. Thank you"

Carrie Wilson:

"Dear Ms. Varlik, Our family implores you to make every effort possible to help keep our oceans and waterways clean. It is imperative to pass laws to educate people on how to do this. Sadly people do not know unless they are taught or held by our government agencies to do so. Thank you"

Kathy Wilson:

"Dear Ms. Varlik, I feel that this issue is extremely important and cleaning up the creeks will be a win win for everyone. I currently work on Shem Creek as a kayak and paddleboard guide and feel that this is a very important issue. The water quality is very concerning especially since fishing is popular along with people swimming, and it would be great if something was done about it. Thank you"

Mary Wofford:

"Dear Ms. Varlik, I want to voice my support for DHEC's efforts to clean up James Island Creek and Shem Creek! Thank you"

Elizabeth Zsolnay:

"Dear Ms. Varlik, As waterfront Old Village residents and avid boaters We care about the lowcountry's waterways and the safety of friends and family who also recreate in them. Charleston Waterkeeper's continued testing has revealed that Shem Creek and James Island (Ellis) Creek don't meet state water quality standards for safe swimming due to high levels of bacteria. DHEC setting clean up targets for both creeks is an important step in making both creeks safe for fishing and swimming. Thank you"

Department's Response to Comments Above:

South Carolina Department of Health and Environmental Control (SCDHEC, the Department) appreciates your support, and taking the time to comment on the draft James Island Creek and/or Shem Creek Enterococcus Total Maximum Daily Load (TMDL) documents.

SCDHEC's mission is "To improve the quality of life for all South Carolinians by protecting and promoting the health of the public and the environment". To that end, various tools that are available to us are used, several of which are explained below.

One of these tools is, South Carolina Water Classifications and Standards, Regulation 61-68. These regulations were published in agreement with SC Pollution Control Act, available at: https://www.scdhec.gov/sites/default/files/media/document/R.61-68_0.pdf. These regulations establish a framework for managing and protecting the state's waterways. Classifications and standards relating to waterbodies can be found in this document. For example, James Island Creek is classified as SA recreational salt waters. Based on this classification, the water quality standard for enterococcus specifies that a geometric mean of samples taken within a 30-day period should not exceed 35 mpn/100 ml, nor should any one sample taken on a given day should not exceed 104 mpn/100 ml. Similarly, Shem Creek is classified as SB recreational salt waters. Based on this classification, the water quality standard for enterococcus specifies that a geometric mean of samples taken within a 30-day should not exceed 35 mpn/100 ml, nor should any one sample taken on a given day should not exceed 501 mpn/100 ml.

Another tool available for the Department is the §303(d) List of Impaired Water. The Department evaluates and assesses the quality of SC's waterways every two years. If the water quality standards for a classified waterbody are not met (i.e. impaired), these waters are included in the §303(d) List of Impaired Waters.

Once a waterbody is included on the §303(d) List of Impaired Waters, a total maximum daily load (TMDL) must be calculated for the pollutant of concern and documented in a TMDL document. TMDL documents also provide an inventory of potential sources of pollution, quantify total reductions that are needed to attain water quality standards and provide guidance for remediation.

The Charleston Waterkeeper (CWK) organization has been analyzing weekly bacteriological samples collected from tidally influenced creeks around the Charleston area since 2013. The CWK collects these samples from May through October (the typical recreational season in SC) and determines if the recreational use is being met in these waters. After two years of sampling by the CWK, data showed that both James Island and Shem Creek are impaired for exceeding recreational use enterococcus water quality standards.

As early as 2014, the Department began to have discussions with stakeholders regarding the potential for developing a TMDL document or an alternative restoration strategy for both creeks.

Following a presentation by Cheryl Carmack of the CWK to some of the residents of James Island Creek, the Department received a petition to develop a TMDL for James Island Creek (November 10, 2014). This petition was coordinated by Ms. Mary Edna Fraser, a resident of James Island Creek.

The CWK organization initially requested that the Department develop an alternative restoration strategy for Shem Creek watershed (October 28, 2014). Ultimately, the CWK and the permitted MS4s within the Shem Creek watershed decided that developing a TMDL document would be the more appropriate path towards restoration of recreational use in Shem Creek.

In order to calculate a scientifically defensible TMDL, additional data were needed. During the time frame from receiving the request/petition and leading to the development of the 2016 §303(d) List of Impaired Waters, the Department assigned a priority rank of "1" for both James Island Creek and Shem Creek, which meant that TMDL development was being targeted for the calendar years 2016-2018. The 2016 §303(d) List of Impaired Waters and statewide priority rankings for all impaired locations were subsequently approved by US Environmental Protection Agency (US EPA) Region 4 on June 22, 2017.

Following the commencement of the James Island Creek and Shem Creek TMDL documents on June 1, 2016, Ms. Fraser provided back ground information about James Island Creek such as its historical use for ferrying goods to and from Charleston peninsula, describing potentially problem areas around the watershed, as well as other relevant information. Other stakeholders provided local knowledge regarding both watersheds during the same time frame. As each TMDL document was drafted, the Department collaborated with the CWK and other regulated MS4s with jurisdiction in each watershed. These were the City of Charleston, Charleston County, SC Department of Transportation, the Town of James Island, and the Town of Mt Pleasant.

Pollutant sources can generally be classified as either point source or nonpoint source:

- 1) There are two types of point sources, continuous or non-continuous: Discharges from pipes owned and operated by industrial, domestic, and municipal wastewater dischargers are continuous discharges.

Point sources are permitted by the Department under National Pollutant Discharge Elimination System (NPDES) permits. If these facilities are discharging wastewater that meets their permit limits, they are not causing or contributing to impairment. If any of these facilities are not meeting their permit limits, enforcement actions/mechanisms

are in place. Currently, there are no wastewater facilities permitted to discharge treated effluent in either James Island Creek or Shem Creek.

Stormwater discharges are categorized as non-continuous, because they discharge in response to rain fall or snow melt. Depending on population size, some municipalities also have NPDES permits, called Municipal Separate Storm Sewer System (MS4) permits. Within the James Island Creek TMDL watershed, there four MS4s: The City of Charleston, Charleston County, SC Department of Transportation (state wide permit), and the Town of James Island. Within the Shem Creek TMDL watershed, there three MS4s: Charleston County, SC Department of Transportation (state wide permit), and the Town of Mt Pleasant.

- 2) Non-point source (NPS) pollution is generally a result of precipitation, deposition from air, seepage, or hydrologic modification. The cause of NPS pollution is precipitation moving over land and picking up and discharging natural or manmade pollutants to nearby waters, such as James Island Creek or Shem Creek. Several examples of NPS of pollutants can include:
 - a. Bacteria and viruses from pet poop left on the lawns, streets, or dumped into storm sewers,
 - b. Bacteria and viruses from malfunctioning septic systems,
 - c. Bacteria and viruses from wildlife poop,
 - d. Bacteria and viruses from illegal discharges of sanitary waste from boats.
 - e. Bacteria and viruses from poorly maintained marine sanitary devices,
 - f. Resuspension of bacteria containing sediment by boats, jet skis, and water skiers not abiding by "no wake zone" speed limits,
 - g. Bacteria and viruses from improperly maintained sewer lines,
 - h. Eroding stream banks,
 - i. Excessively applied lawn fertilizers, insecticides, and herbicides from backyards and gardens,
 - j. Oil, grease, antifreeze, transmission fluid, and other toxic chemicals deposited by vehicles on roads and these pollutants being carried to nearby waters as a result of rain or melting snow.

The Department believes majority of the sources contributing to enterococcus exceedances are caused by pollutants entering both James Island Creek and Shem Creek through NPS as described in #2, above.

We encourage local stakeholders to partner with organizations such as the CWK, local municipalities, sewer districts, and engage in initiatives to reduce the nonpoint sources of bacteria.

Often times, we don't realize the harmful impacts of our actions on water quality. But, the great news is these impacts can be reduced by educating ourselves and implementing these small but impactful actions. Implementing these incremental actions changes will help improve the water quality in both watersheds and help ensure that the recreational use water quality standard is being met. A few examples are given below:

- i. As pet owners, picking up after our pets, especially dogs, and removing poop from everywhere including back yards, dog parks, sidewalks, street, etc., and properly discarding the poop in the trash, or installing or building pet waste digesters in our yards.
- ii. Regularly having septic tanks inspected and repaired as needed. If feasible, connecting to the local sewer collection system.
- iii. Discouraging feeding wildlife,
- iv. Using appropriate best management practices (BMP) to discourage roosting of birds on porches, eaves, canopies, docks, dock roofs and railings, and other hard, impervious surfaces, hence reducing the amount of bird poop entering our waters.
- v. Having riparian buffer areas in our yards, especially adjacent to creeks. These vegetative areas buffer pollutants from reaching surface waters such as James Island Creek. Planting native vegetative in these buffer area reduces the watering rate, thus reducing runoff that pollute our waters.
- vi. Abiding by "no wake zone" speeds while boating, water and/or jet skiing, reduces the resuspension of bacteria containing sediments, and reduces the erosion of stream banks.
- vii. Cleaning off of crabbing/shrimping/fishing waste off of docks and disposing of such waste in the trash prevents attracting wildlife which reduces the amount of bacteria from their poop.
- viii. Making certain to close the lids of garbage bins and dumpsters to prevent wildlife, such as racoons, from accessing trash.
- ix. Properly maintaining our marine sanitation devices and refraining from dumping in our waters. Charleston Waterkeeper has a free and reliable pump out service, where they can set you up with a regular pump out schedule or on as needed basis. To get on Captain Herman Miller's schedule, please call him at 843-608-9287 (<http://charlestonwaterkeeper.org/who-we-are/team/>)

Responses to other Comments

Mary Arnold Comment 1:

"As a youth I swan in the James Island Creek. I now live off a tributary of Shem Creek. I paddle board often from my dock on Shem Creek. When paddling in Shem Creek my boards get coated in a brown film. That happens nowhere else that I paddle in the area. I sit on the end of my dock and watch the tides come and go with a top skin layer that appears to the eye to be some sort of pollutant. I have a friend that is a prone paddler that often put in at the Shem creek boat landing She became sick and was ultimately diagnosed with lead poisoning. It was opined that she contracted the disease from paddling in Shem Creek. Thus all assistance cleaning up these creeks would be greatly appreciated."

Mary Arnold Response 1:

The Shem Creek Enterococcus TMDL Document evaluates only the existing bacteria levels in Shem Creek. It is important to note that this document does not address other pollutants. Currently, there are no documented exceedances of water quality standard for lead in Shem Creek.

Incomplete Comment Submittals:

Kimberly Imbus Comment 1:

"Dear Ms. Varlik, [your message here] Thank you, [your name here]."

Kimberly Imbus Response 1:

SCDHEC attempted to reach the commenter for further clarification after receiving the initial message on 06/12/2019. The Department did not receive an additional response.

Patricia Luck Comment 1:

"Dear Ms. Varlik, [your message here] Thank you, [your name here]."

Patricia Luck Response 1:

SCDHEC attempted to reach the commenter for further clarification after receiving the initial message on 06/12/2019. The Department did not receive an additional response.

Gustavo Serrano Comment 1:

"Dear Ms. Varlik, [your message here] Thank you, [your name here] Gustavo Serrano"

Gustavo Serrano Response 1:

"DHEC: Mr. Serrano, I believe you meant to send me comments, however I have not received it (see below). If you would like to send your comments, I would encourage you to do that by 5 pm, June 14th.

Gustavo Serrano Comment 2:

"Realized that after I sent it, sorry about that..."

Gustavo Serrano Response 2:

SCDHEC attempted to reach the commenter for further clarification after receiving the initial message on 06/12/2019. The Department did not receive an additional response.