Chapter One: Introduction

Water is a critically important natural resource to the State of South Carolina and to our local communities. People depend on clean water for many of their basic daily needs. The management of local and regional water quality requires significant coordination between several entities on a local, state, and federal level. A watershed level perspective is the most effective means to evaluate local and regionwide water resource needs and to identify potential water quality issues. The Waccamaw Region Section 208 Water Quality Management Plan (Section 208 Plan) provides a framework to address specific water quality problems that exist in the regional watershed, and to develop a strategy to ensure that all local waterbodies meet and exceed water quality standards set forth by the United States Environmental Protection Agency (US EPA) and South Carolina Department of Health and Environmental Control (SC DHEC).

Clean Water Act

The Clean Water Act is the federal law that establishes the regulatory structure for managing direct point-source discharges and non-point sources of pollutants into the waters of the United States. The Clean Water Act also establishes a framework for several non-regulatory tools to help address water quality concerns on a local, state, regional, and national level. The end objective of this comprehensive legislation is to restore and maintain the overall quality of the nation's waters to ensure the "protection and propagation of fish, shellfish, and wildlife and recreation in and on the water".

One of the non-regulatory tools established in the Clean Water Act is outlined in Section 208, which calls for the development of regional areawide water quality management plans. Section 208 of the federal Clean Water Act is included in **Appendix A**. Following the enactment of the Clean Water Act in 1972, Section 208 required the Governor of each state to identify geographic areas within the state that had substantial water quality management problems as a result of urban and industrial development. The Governor then designated appropriate agencies to oversee the development and administration of Section 208 plans for established regions within their respective states. In 1975, the State of South Carolina delegated the task of developing Section 208 Plans to the Council of Governments (COGs) which are located throughout the state. The Central Midlands COG, Appalachian COG, Berkeley-Charleston-Dorchester COG, Lowcountry COG, Santee-Lynches COG and the Waccamaw Regional COG offices have all developed a Section 208 Plan for their respective regions. SC DHEC has developed a Section 208 plan for the remaining areas within the state.

Waccamaw Regional Council of Governments

The Waccamaw Regional Council of Governments administers several programs throughout the three-county region of Georgetown, Horry, and Williamsburg Counties, located in the northeast corner of South Carolina. The Waccamaw Region Section 208 Water Quality Management Plan (Section 208 Plan) is primarily focused on protecting the water quality of the surface water bodies located within this three-county region. However, watershed dynamics transcend political boundaries, requiring water quality management efforts on a larger regional scale. A watershed level planning process uses a series of cooperative, iterative steps to characterize existing conditions, identify and prioritize problems, define management objectives, develop protection or remediation strategies and implement and adopt selected actions as necessary. The watershed management approach that the US EPA has promoted establishes the following five guiding principles for dealing with water quality concerns:

- *Placed-based focus*- Activities should be managed in specific outlined geographic areas, known as management units, such as watershed boundaries or groundwater recharge areas.
- *Stakeholder involvement and partnerships*- Participation in management activities from a wide range of interests groups ensures that economic, social, and other community concerns are evaluated during the project

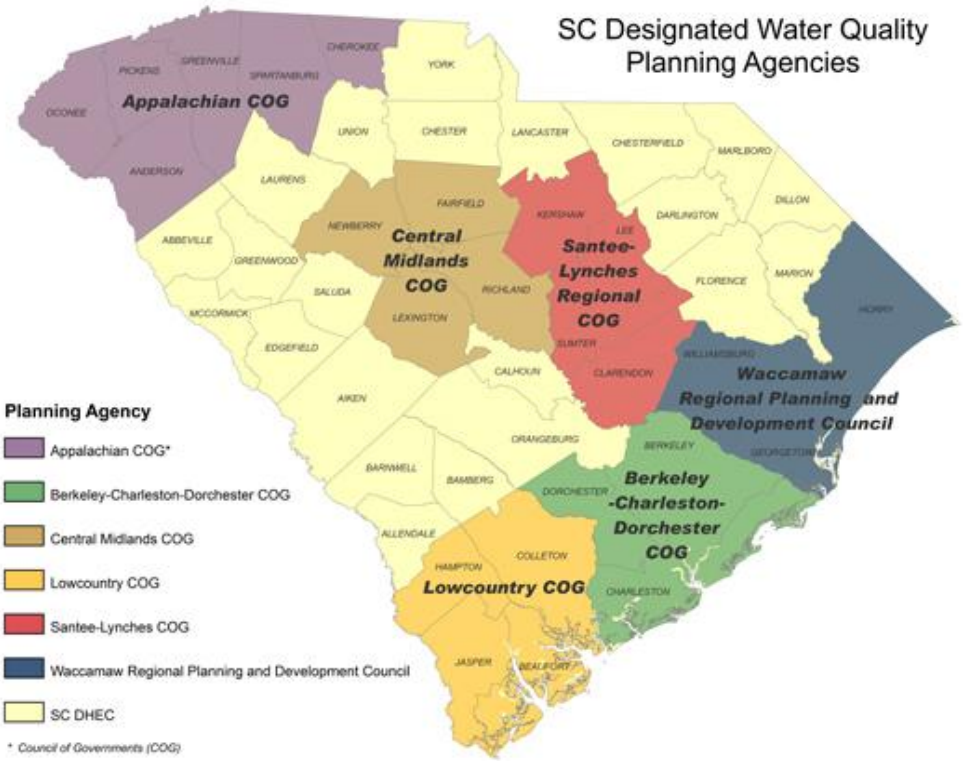
planning and implementation phase. In addition, well developed partnerships helps to ensure the long-term success of management projects.

- *Environmental goals and objectives-* Outlining concrete and specific improvement targets allows water resource managers to measure the success of watershed management projects and initiatives.
- *Problem Identification and Prioritization-* This is necessary in order to evaluate the public health risks and environmental threats of pollution concerns. Understanding the nature of the water quality concern enables water resource managers to develop a plan of action on how to direct management efforts to address water quality problems in the watershed.
- *Integration of actions-* Realizing that there is generally a finite limit to the resources available to address water quality concerns, coordination of efforts amongst all stakeholders can help identify individual responsibilities and collectively shared responsibilities to address water quality issues.

An effective water quality management plan should also integrate recommendations from other relevant planning efforts such as local government comprehensive plans. This plan assesses water quality issues throughout the entire Yadkin-Pee Dee and Santee River basins and sets forth goals and strategies to coordinate management efforts with all appropriate entities on a basin-wide scale.

The first Section 208 Plan for the Waccamaw region was adopted in 1978. Since then, the Section 208 Plan has been updated in 1981, 1986, and most recently in 1998. The opportunity to update the Section 208 Plan has been made possible by a stimulus grant authorized by the federal American Recovery and Reinvestment Act (ARRA). The Waccamaw Regional COG is a sub-recipient of a statewide grant, which has allowed for a coordinated effort to reexamine water quality issues throughout South Carolina. The Clean Water Act does not prescribe a specific mandated time cycle for designated management agencies to update their respective Section 208 Plans. This makes it critically important to take full advantage of each opportunity to review water quality findings and outline new water resource management objectives as appropriate to address current and future water quality concerns in the Waccamaw region. This Section 208 Plan is intended to have a time horizon of 15-20 years. As part of the ongoing Section 208 program, the Waccamaw Regional COG submits an annual update to SC DHEC which includes a list of Section 208 Conformance Reviews and Section 208 Plan Amendments. An objective in this plan is to expand the annual update to review other significant water quality findings and new initiatives to ensure that the Section 208 Plan remains current and relevant in the years ahead.

Below is a map that illustrates the jurisdiction of each Council of Governments office in South Carolina:



SECTION 208 PLANNING PURPOSE AND OBJECTIVES

The hydrology of a watershed system is dynamic and is constantly changing over the course of time. The watershed system is directly influenced by long-term weather patterns as well as changing land uses across the region. The Northeast region of South Carolina has undergone tremendous growth since the Waccamaw Region Section 208 Water Quality Management Plan was last revised in 1998. The local population has continued to increase at a significant pace, requiring careful attention to the region's long-term transportation, community facility, and water and sewer utility infrastructure needs.

From a regulatory perspective a stronger emphasis has been placed on stormwater permitting since the last update of the Section 208 Plan. Beginning in 1999, municipalities located within designated urbanized areas are required to obtain coverage under the National Pollutant Discharge Elimination System (NPDES) permit program. Communities that oversee Municipal Separate Storm Sewer Systems (MS4s) are now obligated to administer a stormwater management program that is focused on reducing contaminants transported to nearby surface waters via stormwater runoff. As awareness regarding water quality impacts associated with stormwater runoff and other types of non-point source pollution has increased, appropriate local and regional management strategies need to be further outlined in the Section 208 Plan.

The Section 208 Plan provides an assessment of current water quality conditions of the watersheds located in the Waccamaw region. This plan also discusses the social and economic importance of maintaining clean water to the region. New water resource management strategies are regularly emerging and innovative technologies are constantly being developed. These new approaches to water quality management are explored and appropriate recommendations are set forth to address a wide range of water quality concerns that may impact the Waccamaw region. In addition, this

plan evaluates the water quality monitoring resources needed to ensure that future water quality issues are addressed in a comprehensive and timely manner. The implementation of the Waccamaw Region Section 208 Water Quality Management Plan will require collaborative partnerships to successfully achieve the objectives outlined in this planning document. This Section 208 Plan serves as a guiding resource to fulfilling our region's obligation of meeting the expectations set forth in the federal Clean Water Act.

Figure 1.1 View of Winyah Bay from East Bay Park in Georgetown, SC

Chapter Two: Description of the Waccamaw Region Study Area

PHYSICAL SETTING AND LOCATION

The geographic boundaries of the study area for the Waccamaw Region Section 208 Water Quality Management Plan include Horry County, Georgetown County, and Williamsburg County in South Carolina. All three counties are situated in downstream portions of the Santee and Yadkin-Pee Dee River Basins. **Exhibit 2.1** provides a map of the Section 208 Plan study area. Horry County encompasses a total land area of 1,150 square miles or 736,000 acres. Horry County is a coastal county and forms a portion of the North Carolina state boundary with Brunswick County and Columbus County. Horry County is located entirely within the Yadkin-Pee Dee River Basin. Georgetown County is also a coastal county located directly south of Horry County. Georgetown County encompasses a total land area of 812.5 square miles or 520,000 acres. The Santee River forms the border between Georgetown County and Charleston County. Most of Georgetown County is located within the Yadkin-Pee Dee River Basin. The southern portions of Georgetown County are located within the Santee River Basin. Williamsburg County is located directly west of Georgetown County. It is the only county that is entirely inland in the Section 208 Plan study area. Williamsburg County encompasses a total land area of 931 square miles or 596,000 acres. Most of Williamsburg County is located within the Yadkin-Pee Dee River Basin. The southern portions of Williamsburg County are located within the Santee River Basin.

Below is a general physical and geographic description of both the Yadkin-Pee Dee River Basin and the Santee River Basin:

YADKIN-PEE DEE RIVER BASIN

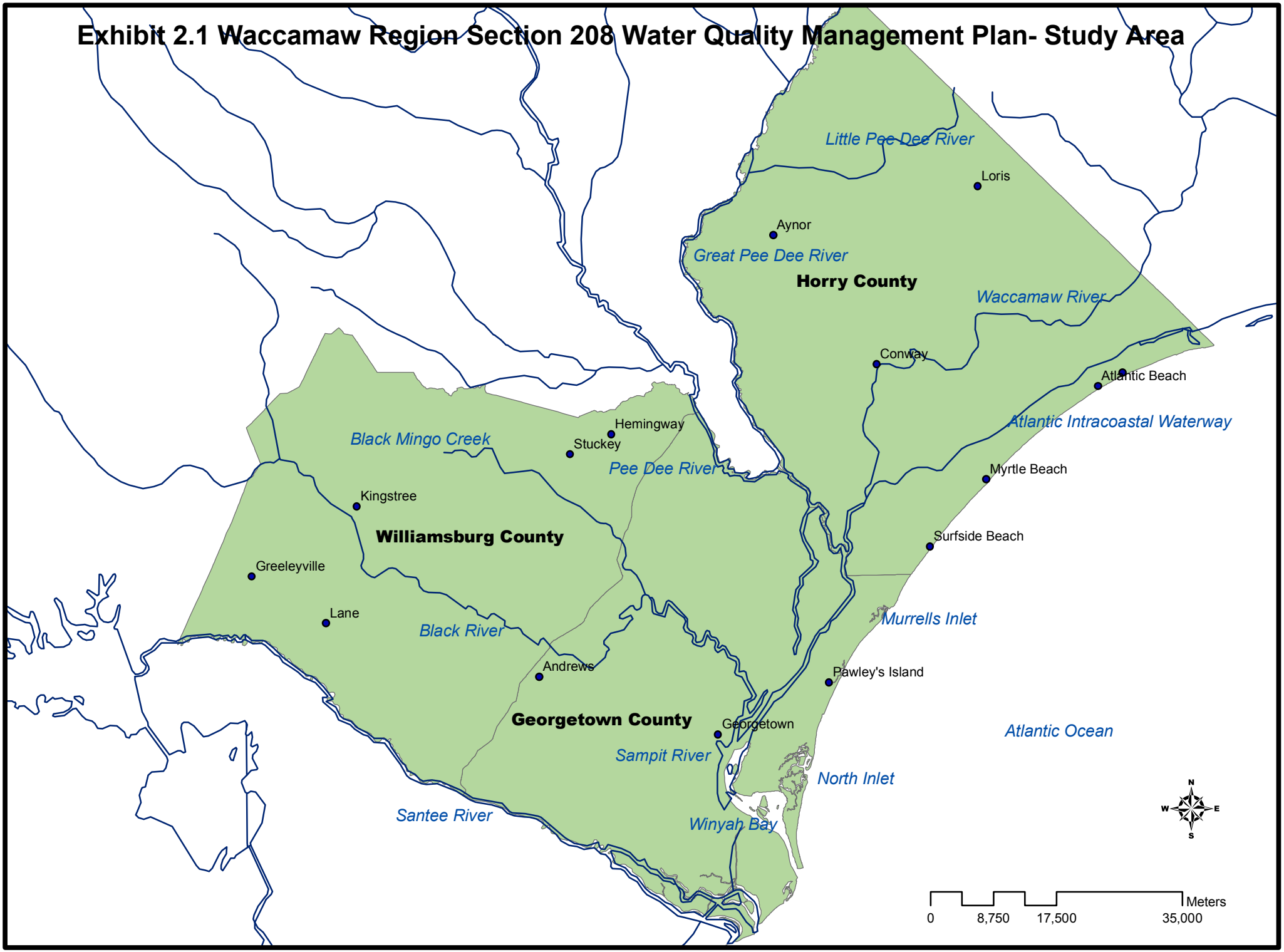
The Yadkin- Pee Dee River Basin is an extensive watershed system encompassing a total of 18,000 square miles, making it the second largest river basin on the east coast. The upstream portions of the river basin are located in the eastern section of the Blue Ridge physiographic region of North Carolina and Southwestern Virginia before flowing into the Central Piedmont region of North Carolina. The downstream portions of the basin transition into the Coastal Plain regions of North Carolina and South Carolina. The most northern reaches of the Yadkin-Pee Dee River Basin are located in the headwaters of the Ararat River watershed, a tributary of the Yadkin River, in the southern portions of Carroll and Patrick Counties in Virginia. The eastern extent of the Yadkin-Pee Dee River Basin includes the coastlines of Brunswick County, North Carolina, and Horry and Georgetown Counties in South Carolina. The major tributaries that contribute to this river basin system include the Lumber, Little Pee Dee, Lynches, Black, Waccamaw, and Uwharrie Rivers.

Within South Carolina, the Great Pee Dee River Basin traverses Marlboro, Chesterfield, Darlington, Florence, Dillon, Marion, Williamsburg, Horry, and Georgetown Counties. This portion of the Yadkin- Pee Dee River Basin includes a total of 4,669 stream miles, 10,864 acres of lake waters, and 17,676 acres of estuarine areas within 22 watersheds covering a 4,029 square mile land area. The massive Yadkin-Pee Dee River Basin ultimately drains into Winyah Bay located in Georgetown County. A more detailed description of each sub-watershed located within the Waccamaw region is provided in **Chapter Three, Watershed Assessments**.

SANTEE RIVER BASIN

The Santee River Basin encompasses a total land area of 1,280 square miles traversing parts of the Upper Coastal Plain and the Lower Coastal Plain physiographic regions of South Carolina. The Santee River is formed from the confluence of the Congaree and Wateree Rivers in the Upper Coastal Plain region of South Carolina. There are eleven separate watersheds within the river basin system including Lake Marion, Halfway Swamp Creek, Jacks Creek, Tawcaw Creek,

Exhibit 2.1 Waccamaw Region Section 208 Water Quality Management Plan- Study Area



Potato Creek, the Rediversion Canal, Wadmacon Creek, Wambaw Creek, North Santee River, South Santee River, and two hydrological units of the Santee River watershed. Within these watershed areas, there are a total of 976 stream miles, 94,668 acres of lake waters, and 5,276 acres of estuarine areas. The Santee River Basin spans across parts of Sumter, Clarendon, Calhoun, Orangeburg, Berkeley, Williamsburg, Charleston, and Georgetown Counties. A more detailed description of the sub-watersheds located within Williamsburg and Georgetown Counties is provided in **Chapter Three, Watershed Assessments.**

WACCAMAW REGION SOIL PROFILE

Soils have a significant influence on the hydrology of a watershed system. A detailed assessment of the composition of existing soils on a local site scale and a larger watershed scale is an essential aspect of water quality management. There are a number of correlations between soil systems management and water quality management. First, each type of soil has varying capabilities of eroding and migrating off the land surface into downstream surface waterbodies. Soils are naturally susceptible to erosion, however soils should be protected from unnecessary levels of erosion. Excessive soil erosion can lead to sedimentation in local rivers and streams. Sedimentation often increases the levels of turbidity in a waterbody, which can harm aquatic life habitats. Pollutants, such as animal wastes, nutrients from fertilizers, and toxic chemicals can be transported with sediment and ultimately contaminate local waterways.

Each soil type also has varying drainage capabilities. There are three soil characteristics that influence the drainage capabilities of a soil medium. The infiltration capacity is the rate at which water penetrates the soil surface. Permeability is the rate that water within the soil moves through a given volume of material. Finally, percolation is the downward movement of water through the soil. Soil types are important to identify on a site scale level of analysis in order to avoid the placement of on-site wastewater treatment systems in areas that have limited soil drainage capabilities. Larger scale land application of waste materials utilized by wastewater utility districts must also be sited in areas with suitable soil characteristics. Ongoing monitoring of both these types of wastewater treatment practices is important, as each soil type has a specific loading rate for various types of pollutants. On-site wastewater treatment systems and land application sites also have limited life spans, beyond which their ability to assimilate and treat wastewater effluent becomes diminished. A detailed profile and corresponding map displaying the types of soils commonly found within the three-county Waccamaw region is included in **Appendix E**.

WACCAMAW REGION POPULATION TRENDS

One of the fundamental steps in conducting any planning process is to evaluate population trends and projections within the planning area. An accurate assessment of population trends is invaluable to being able to meet the long-term municipal wastewater treatment service demands of local communities. Population forecasts enable sewer utility providers to construct wastewater treatment facilities at a capacity to handle current and future loading ratings. A challenging aspect of the coastal region of South Carolina is the significant number of tourists that add to the peak service demand rates in our communities, particularly in the summer months.

Table 2-1 provides historical population data at the County Census Division level for Horry, Georgetown, and Williamsburg Counties. As the table indicates, Horry County has experienced a tremendous amount of growth in the last ten years particularly along the coast and in the Conway area. Georgetown County has had more moderate growth rates since 2000, with the most substantial population increases occurring along the Waccamaw Neck. Williamsburg County has experienced a population decline since 2000. The largest population decrease occurred in the Indiantown area, while the only community within the county that had an increase in population since 2000 was the Lane CCD.

Table 2-1 Historical Population Data for the Waccamaw Region						
Horry County						
County Census Division	1970	1980	1990	2000	2010	Growth % 2000-2010
Aynor	5,634	7,190	6,786	8,909	10,052	**12.8%**
Conway	18,665	23,868	26,648	33,575	39,715	**18.3%**
Conway East	3,419	8,546	17,408	31,639	65,364	**106.6%**
Floyds Crossroads East	3,420	3,771	2,943	3,195	3,301	**3.3%**
Little River	4,960	8,781	17,833	26,315	33,652	**27.9%**
Longs	2,788	3,299	3,338	5,625	6,645	**18.1%**
Loris	9,895	11,137	11,189	13,785	15,878	**15.2%**
Myrtle Beach	21,211	34,827	57,908	73,587	94,684	**28.7%**
County Total	***69,992***	***101,419***	***144,053***	***196,630***	***269,291***	***36.9%***
Georgetown County						
County Census Division	1970	1980	1990	2000	2010	Growth % 2000-2010
Andrews	5,174	6,914	7,401	7,929	7,608	**-4.0%**
Georgetown	15,638	19,281	19,578	20,111	19,865	**-1.2%**
Plantersville	2,499	2,706	2,650	3,199	2,957	**-7.6%**
Pleasant Hill	3,059	3,518	3,553	3,994	3,592	**-10.0**
Sampit	3,977	3,519	3,440	3,918	3,913	**-0.1%**
Waccamaw	3,153	6,523	9,680	16,646	22,223	**33.5%**
County Total	***33,500***	***42,461***	***46,302***	***55,797***	***60,158***	***7.8%***
Williamsburg County						
County Census Division	1970	1980	1990	2000	2010	Growth % 2000-2010
Cades	2,703	3,126	2,769	2,681	2,409	**-10.1%**
Greeleyville	3,352	2,999	2,773	2,632	2,465	**-6.3%**
Hemingway	5,257	5,857	5,578	5,356	4,753	**-11.3%**
Indiantown	2,010	2,299	1,996	1,931	1,591	**-17.6%**
Kingstree	11,648	14,093	14,369	14,709	13,424	**-8.7%**
Lane	3,657	3,624	3,662	3,742	4,099	**9.5%**
Nesmith	3,460	3,909	3,297	3,617	3,181	**-12.1%**
Trio	2,156	2,319	2,371	2,549	2,501	**-1.9%**
County Total	***34,243***	***38,226***	***36,815***	***37,217***	***34,423***	***-7.5%***
Source: *US Census Bureau, Waccamaw Regional Council of Governments, SC Budget and Control Board*						

Table 2-2 provides twenty year population projections for each Census County Division within the Waccamaw region. Horry County is expected to continue to grow over the next twenty years. Growth is expected to occur throughout the county with the exception of the Floyds Crossroads East CCD, which is located in the northwest portion of the county. Georgetown County is also expected to experience additional population growth in the foreseeable future. Most of the county will grow at a modest rate with the exception of Sampit CCD which is expected to experience marginal growth during that time span. Meanwhile, the population in Williamsburg County is expected to remain constant on the county

level through the next two decades. Any growth that is likely to occur will be in the Kingstree, Lane, and Trio areas. The remaining portions of Williamsburg County are expected to see a population decline over the next several years.

Table 2-2 Population Projections for the Waccamaw Region

Horry County						
County Census Division	2010 Census	2015	2020	2025	2030	Projected Growth 2010-2030
Aynor	10,052	10,875	11,606	12,269	12,675	**26.1%**
Conway	39,715	44,599	47,659	50,642	53,243	**34.1%**
Conway East	65,364	50,616	56,755	62,739	68,261	**0.4%**
Floyds Crossroads East	3,301	2,992	2,974	2,926	2,763	**-16.3%**
Little River	33,652	42,526	46,882	51,290	55,842	**65.9%**
Longs	6,645	7,262	7,992	8,647	9,078	**36.7%**
Loris	15,878	16,816	17,725	18,567	19,160	**20.7%**
Myrtle Beach	94,684	115,393	125,219	135,451	146,657	**54.9%**
County Total	***269,291***	***291,080***	***316,810***	***342,530***	***367,680***	***36.5%***
Georgetown County						
County Census Division	2010 Census	2015	2020	2025	2030	Projected Growth 2010-2030
Andrews	7,608	9,280	9,606	9,965	10,413	**36.9%**
Georgetown	19,865	22,203	22,614	23,104	23,786	**19.7%**
Plantersville	2,957	3,438	3,572	3,696	3,799	**28.5%**
Pleasant Hill	3,592	4,388	4,527	4,667	4,812	**33.9%**
Sampit	3,913	3,892	3,934	3,965	3,983	**1.8%**
Waccamaw	22,223	22,930	25,397	27,783	30,086	**35.4%**
County Total	***60,158***	***66,130***	***69,650***	***73,180***	***76,880***	***27.8%***
Williamsburg County						
County Census Division	2010 Census	2015	2020	2025	2030	Projected Growth 2010-2030
Cades	2,409	2,348	2,289	2,228	2,124	**-11.8%**
Greeleyville	2,465	2,412	2,360	2,315	2,246	**-8.8%**
Hemingway	4,753	4,783	4,635	4,488	4,303	**-9.5%**
Indiantown	1,591	1,559	1,481	1,396	1,278	**-19.7%**
Kingstree	13,424	14,145	14,098	14,055	13,906	**3.6%**
Lane	4,099	4,134	4,283	4,462	4,609	**12.4%**
Nesmith	3,181	3,224	3,250	3,261	3,158	**-0.1%**
Trio	2,501	2,635	2,704	2,775	2,816	**12.6%**
County Total	***34,423***	***35,240***	***35,100***	***34,980***	***34,440***	***0.1%***

Source: *GSATS 2035 Long Range Transportation Plan, US Census Bureau, Waccamaw Regional Council of Governments, SC Budget and Control Board*

WACCAMAW REGION LAND USE PROFILE

The hydrology of a watershed is directly influenced by the urban and rural land use activities in a region. As a result of tremendous population increases and subsequent urban development patterns, the natural hydrology of the Waccamaw region has been altered significantly over the past several decades. One of the major physical changes associated with urban development is the increase in impervious surface area that covers the landscape. From a water quality management perspective, impervious surfaces can be very problematic as they are essentially a collection point for

numerous types of pollutants that accumulate from activities common to an urban setting. These impervious surfaces are typically connected to the storm drainage system which can transport this untreated polluted runoff directly to nearby waterways. This section provides information pertaining to the physical landscape changes within the Waccamaw region between 1996 and 2006, which helps gauge the rate of urban development in each county. A more detailed review of land use practices that can help minimize the potential for non-point sources of pollution is provided in **Chapter Six, Non-point Sources of Pollution** and **Chapter Eight, Economic Development.**

The National Oceanic and Atmospheric Administration (NOAA) maintains the Coastal Change Analysis Program, which is a database of land cover change for coastal counties throughout the country. This program is a useful tool that allows planners and water resource managers to make a broad assessment of land use changes and be able to identify patterns of specific concern such as the loss of wetland acreage, as an example. The program evaluates eleven separate land cover categories. The current database includes land cover changes from 1996-2006 with a long-term intention of updating the program every five years. Below is a land coverage profile for each county. Additional land use information for each watershed in the Waccamaw region is provided in **Chapter Three, Watershed Assessments.**

Table 2-3 provides land cover change trends within Horry County between 1996 and 2006.

Table 2-3 Land Cover Change in Horry County: 1996-2006

Land Cover Categories	Land Area 1996	Land Area Lost	Land Area Gained	Land Area 2006	Net Change	Percent Change
High/ Medium Intensity Developed	13.81	0.01	6.27	20.07	6.26	45.33%
Low Intensity Developed	40.74	0.56	9.60	49.78	9.04	22.19%
Open Space Developed	32.90	0.03	11.83	44.71	11.80	35.86%
Grassland	25.94	11.03	19.62	34.53	8.59	33.11%
Agriculture	223.30	2.41	3.21	224.09	0.79	0.36%
Forested	231.89	68.09	21.02	184.81	-47.08	-20.30%
Scrub/Shrub	107.02	26.27	52.38	133.13	26.11	24.40%
Woody Wetland	427.32	37.67	4.61	394.26	-33.06	-7.74%
Emergent Wetland	22.62	3.87	15.24	33.99	11.38	50.31%
Barren Land	5.93	1.31	5.74	10.36	4.43	74.81%
Open Water	123.52	0.51	2.23	125.25	1.73	1.40%

Notes: *Land area units are in square miles Source: NOAA Coastal Services Center*

Table 2-4 provides land cover change trends within Georgetown County between 1996 and 2006.

Table 2-4 Land Cover Change in Georgetown County: 1996-2006

Land Cover Categories	Land Area 1996	Land Area Lost	Land Area Gained	Land Area 2006	Net Change	Percent Change
High/ Medium Intensity Developed	2.37	0.00	0.60	2.96	0.59	25.13%
Low Intensity Developed	9.92	0.21	1.64	11.35	1.44	14.48%
Open Space Developed	8.34	0.02	1.77	10.10	1.76	21.07%
Grassland	20.46	13.75	32.56	39.27	18.81	91.94%
Agriculture	31.01	0.03	1.59	32.57	1.56	5.02%
Forested	305.66	85.68	50.31	270.30	-35.37	-11.57%
Scrub/Shrub	96.40	50.43	63.16	109.13	12.73	13.21%
Woody Wetland	233.39	14.67	4.53	223.25	-10.14	-4.35%
Emergent Wetland	99.94	3.73	10.30	106.51	6.57	6.57%
Barren Land	9.75	2.05	1.66	9.37	-0.38	-3.91%
Open Water	217.78	0.47	2.91	220.21	2.43	1.12%

Notes: *Land area units are in square miles Source: NOAA Coastal Services Center*

Table 2-5 provides land cover change trends within Williamsburg County between 1996 and 2006.

Table 2-5 Land Cover Change in Williamsburg County: 1996-2006						
Land Cover Categories	**Land Area 1996**	**Land Area Lost**	**Land Area Gained**	**Land Area 2006**	**Net Change**	**Percent Change**
High/ Medium Intensity Developed	1.29	0.00	0.18	1.47	0.18	13.77%
Low Intensity Developed	7.70	0.06	0.38	8.03	0.33	4.23%
Open Space Developed	5.02	0.01	0.29	5.30	0.28	5.65%
Grassland	29.92	20.54	26.87	36.25	6.33	21.17%
Agriculture	191.23	0.22	3.43	194.43	3.20	1.68%
Forested	264.72	63.85	30.05	230.91	-33.80	-12.77%
Scrub/Shrub	111.08	29.92	58.83	139.98	28.91	26.02%
Woody Wetland	311.22	18.24	4.58	297.56	-13.66	-4.39%
Emergent Wetland	11.27	2.32	9.39	18.34	7.07	62.74
Barren Land	0.19	0.13	0.93	0.99	0.80	420.55%
Open Water	3.29	0.03	0.39	3.65	0.37	11.11%
Notes: *Land area units are in square miles Source: NOAA Coastal Services Center*						

SIGNIFICANTLY VALUABLE NATURAL RESOURCES

The Waccamaw region is an area with an abundance of unique and diverse natural habitats. Many sites within the region have exceptional value as natural resource areas. The following is a profile of several of these sites. These examples of preserved and managed lands provide the region with tremendous environmental benefits, including water quality protection.

Waccamaw National Wildlife Refuge

The Waccamaw National Wildlife Refuge is part of a nationwide network of 550 federally managed natural habitat areas established specifically for the protection of our country's wildlife. The refuge officially became part of the national system in 1997 and was established with an initial 55,000 acre acquisition boundary. At present time, 23,000 acres are permanently protected and a land acquisition program is in place as a mechanism to work with willing landowners to purchase additional tracts. The Waccamaw National Wildlife Refuge spans across parts of Horry, Georgetown, and Marion Counties and encompasses large portions of the Waccamaw, Great Pee Dee, and Little Pee Dee River watersheds. The wildlife refuge showcases a diversity of wildlife habitats including a black water river swamp, alluvial river floodplain, forested wetlands, longleaf pine ecosystems, and tidal and managed historic ricefields. These tidal freshwater wetlands are some of the most diverse freshwater wetland systems found in North America. Additionally, refuge wetlands play a critical role in filtering storm water runoff and supplying vital drinking water resources for the greater Grand Strand region. The Waccamaw National Wildlife Refuge also has several programs and facilities that are utilized for public awareness and environmental education purposes.

North Inlet-Winyah Bay National Estuarine Research Reserve (NERR)

The North Inlet-Winyah Bay NERR site is part of a system of 27 reserve locations throughout the country designated as having unique coastal habitat characteristics. These areas are protected and utilized as long-term research sites with support from the National Oceanic and Atmospheric Administration. The North Inlet-Winyah Bay site consists of approximately 12,000 acres of coastal marsh and wetlands. North Inlet-Winyah Bay NERR has established an on-site System-Wide Monitoring Program to enhance scientific understanding of temporal and spatial dynamics of estuarine ecological processes. Findings from this monitoring program are used to improve local and national coastal zone management decisions.

Hobcaw Barony

The North Inlet-Winyah Bay NERR site is part of a larger 17,500 acre protected land parcel, Hobcaw Barony, which includes other unique coastal South Carolina habitats such as former rice fields, upland hardwood and pine forests, and nearby barrier islands. This historic site is maintained by the Baruch Foundation, which was established by former land owner Belle Baruch, and is an active research center utilized by Clemson University and the University of South Carolina.

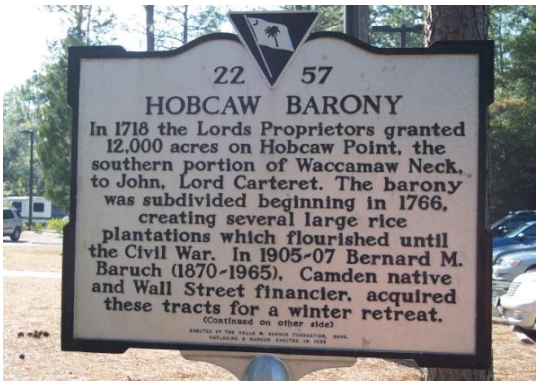


Figure 2-1 Hobcaw Barony has a rich history in the Georgetown County. Today, it is an exceptionally valuable conserved coastal habitat area.

SC Department of Natural Resources- Heritage Trust Program

The Heritage Trust Program was established in 1976 as a means to protect critical natural habitats and important cultural sites throughout the state. State enabling legislation gave the South Carolina Department of Natural Resources (SC DNR) the ability to create heritage preserve sites that would be managed and protected in perpetuity. Currently there are 70 designated Heritage Preserves throughout the state providing over 83,000 acres of protected natural habitat for local wildlife. There are four Heritage Preserves located in the Waccamaw region. Their importance in providing environmental services including, wildlife habitat areas and water quality protection, is invaluable to our region's watershed management efforts. A brief description of each Heritage Preserve is provided below.

- **Cartwheel Bay Heritage Preserve/ Wildlife Management Area:** This 568 acre site located in Horry County is one of the few remaining undisturbed Carolina Bay- longleaf pine savannah habitat complexes that are protected in the Southeast. These rare ecosystems are classified as isolated freshwater wetlands, which have unique groundwater hydrology characteristics.
- **Lewis Ocean Bay Heritage Preserve/ Wildlife Management Area:** This preserve is a 9,690 acre site in Horry County. Within the preserve there are 23 distinct Carolina Bay habitats, making it the largest undisturbed grouping of Carolina Bays in the entire state. These Carolina Bay ecosystems are classified as isolated freshwater wetlands and foster a remarkably diverse vegetative and wildlife community.
- **Tom Yawkey Wildlife Center Heritage Preserve:** This expansive management area is composed of 31 square miles of marsh, managed wetlands, longleaf pine forest, maritime forest, and other unique types of coastal habitat in Georgetown County. This pristine land area provides critical habitat for many species of plants, birds, and terrestrial wildlife.
- **Waccamaw River Heritage Preserve/ Wildlife Management Area:** This 5,347 acre site in Horry County helps protect a large undisturbed bottomland hardwood forest ecosystem within the Waccamaw River watershed. The preserve provides a significant riparian buffer corridor along the Waccamaw River enhancing the water quality benefits of the entire watershed ecosystem. The preserve provides residents and visitors several outdoor recreation opportunities and direct access to the Waccamaw River through one of seven boat landings in the area.

SC Department of Natural Resources- Scenic Rivers Program

The Scenic Rivers program was established by the South Carolina Scenic Rivers Act of 1989 and has been managed by SC DNR since its inception. The purpose of the program is to protect the "unique or outstanding scenic, recreational, geologic, botanical, fish, wildlife, historic, or cultural values" of designated river segments throughout the state. The program is structured to foster a collaborative stakeholder partnership between SC DNR and landowners, community groups, and other local entities to assess management issues within each designated Scenic River and develop conservation goals in order to ensure its long-term value to the state. A Scenic River Management Plan is drafted to

outline these goals and recommend management strategies, and a Scenic River Advisory Council is established to oversee the execution of all management initiatives. This is a great opportunity to pull together a wide range of expertise and resources to ensure that our valuable river resources are being protected and managed in a sustainable way. There are three river segments within the Waccamaw region which have been designated by SC DNR as Scenic Rivers.

- **Black River:** This important waterbody is a central feature of the natural landscape in Sumter, Williamsburg, Clarendon, and Georgetown Counties. It is a blackwater river system with an extensive area of forested swampland located in its floodplain. The Williamsburg, Clarendon, and Georgetown County Councils adopted resolutions of support for designation as a State Scenic River. In June 2001, a 75-mile segment of the Black River became South Carolina's seventh and longest State Scenic River. This scenic river segment begins at County Road #40 in Clarendon County, and extends southeast through Williamsburg County to Pea House Landing at the end of County Road #38 in Georgetown County, South Carolina.
- **Great Pee Dee River:** This prominent river is of tremendous value as a natural resource to the region. This river system has broad floodplains that in some places extend for roughly three miles in total width. The river is bordered by extensive areas of bottomland hardwood forest, making it an incredible habitat for many bird, fish, plant, and terrestrial wildlife species. In recognizing the interests of several landowners and community groups, the governor signed a bill in 2001 designating a 70 mile segment of the Great Pee Dee River as a State Scenic River. The official designation extends from the US Highway 378 bridge between Florence and Marion Counties to the US Highway 17 bridge at Winyah Bay in Georgetown County.
- **Little Pee Dee River:** This waterbody is another outstanding example of a blackwater river ecosystem in the Coastal Plain region of South Carolina. Its designation as a State Scenic River occurred in 1990. This particular segment is 14 miles in length, extending from US Highway 378 to the confluence with the Great Pee Dee River. Currently there is a single Scenic River Advisory Council for both the Great Pee Dee River and Little Pee Dee River segments.

Figure 2-2 Black River near Kingstree, SC

South Carolina Conservation Bank

In 2002, the state legislature passed the South Carolina Conservation Bank Act, which established the Land Legacy Initiative in the state. The South Carolina Conservation Bank is a program developed through this initiative with an intended purpose of identifying land areas within the state that possess uniquely valuable natural and cultural resources and providing a mechanism by which willing property owners can preserve their lands for future generations through conservation easements or by selling part of their parcels to the state.

Table 2-6 includes a list of properties in the Waccamaw region that are currently protected under a conservation easement or fee simple purchase through the South Carolina Conservation Bank. More information about the South Carolina Conservation Bank can be found online at: http://sccbank.sc.gov/

Table 2-6 South Carolina Conservation Bank- Properties in the Waccamaw Region

Name	Acreage Conserved	County
Cynthia Brown Tract	51 acres	Horry
Velma Johnson Tract	34 acres	Horry
J.M Shelley Tract	49 acres	Horry
JM and SL Shelley Tract	35 acres	Horry
JM and SL Shelley Tract	21 acres	Horry
Lacie Shelley Tract	64 acres	Horry
Robert Battle Tract	65 acres	Horry
Kyle Daniel Tract	188 acres	Georgetown
E. Hickson Tract	318 acres	Georgetown
Jones Tract/ Mt Pleasant Tr.	982 acres	Georgetown

Source: South Carolina Conservation Bank

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Chapter Three: Watershed Assessments

South Carolina DHEC oversees an ambient surface water quality monitoring program which provides critical data and information needed to complete periodic assessments of the water quality throughout the state. This monitoring program is intended to be the primary source of data used to determine if a waterbody is meeting the water quality standards for its classified use. Chemical, physical, and biological evaluations are factored into the determination of whether a waterbody is meeting the water quality standards criteria.

In its efforts to maintain good water quality and to protect the health and welfare of the general public, the State of South Carolina has established a system of classifying the uses of all of the waterbodies throughout the state. A set of water quality criteria for each of these classifications has also been developed as part of the foundation of the SC Pollution Control Act. These regulations establish antidegradation rules and serve as the basis for wastewater discharge permit limit decisions for the NPDES program. Several other activities are also affected by this regulation including the control of toxic substances, thermal dischargers, stormwater dischargers, and dredge and fill activities. **Appendix Table B-2** provides a synopsis of each of the water classifications utilized in South Carolina.

This chapter provides a general description of each watershed that traverses the Waccamaw region. A map corresponding to each watershed general profile included in this chapter is provided in **Appendix N.** Information pertaining to the waterbodies that have been included on the 2010 SC 303(d) list is provided in **Appendix D**. A detailed description of each of the Total Maximum Daily Load (TMDL) allocations that have been developed in the Waccamaw region is included in this chapter as well. Finally, a list of waterbodies that have been identified as waters of concern in the 2010 303(d) listing cycle is provided in **Appendix D**. These waterbodies will be targeted for additional water quality assessment and review prior to the issuance of the 2012 South Carolina 303(d) list.

Pee Dee Coastal Frontage Basin, Hydrological Unit: 03040208

The Pee Dee Coastal Frontage Basin is located in Horry and Georgetown Counties, and encompasses two watersheds and 358 square miles. This coastal frontage basin drains directly into the Atlantic Ocean. Of the 228,914 acres within this basin, 59.2% is water, 14.7% is urban land, 8.8% is forested wetland, 6.7% is forested land, 5.2% is nonforested wetland, 3.5% is agricultural land, 1.2% is barren land, and 0.7% is scrub/shrub land. The urban land percentage is comprised primarily of the cities of Myrtle Beach and North Myrtle Beach.

There are approximately 92 stream miles, 155 acres of lake waters, and 3,521 acres of estuarine areas located in this basin. The Little River flows back and forth across the SC/NC state line forming a portion of the Atlantic Intracoastal Waterway (AIWW) and drains to the Atlantic Ocean through the Little River Inlet. The Grand Strand beaches and their swashes all drain to the Atlantic Ocean in this watershed, as does Murrells Inlet, Pawleys Inlet, and North Inlet and each of their respective tributaries.

Figure 3-1 Tributary of the Murrells Inlet Estuary

The Table below is a general profile of the Little River, Atlantic Intracoastal Waterway, and Murrells Inlet watershed.

General Profile of the Little River/ Atlantic Intracoastal Waterway/ Murrells Inlet HUC Unit: 03040208-03		
Counties	Horry, Georgetown, Brunswick County NC.	
Watershed Size	175,584 acres	
Surface Waterbody Size	91.5 stream miles/ 148.8 acres of lake waters/ 2,365.7 acres of estuarine areas.	
Water Classifications	All streams in the watershed are classified by the state as Shellfish Harvesting Waters (SFH) with the exception of the Atlantic Intracoastal Waterway. The Atlantic Intracoastal Waterway and its tributaries from the crossing of S.C. Highway 9 to the North Carolina state line are classified Class SA (SA), and southward from the S.C. Highway 9 crossing are classified Freshwaters (FW).	
Main Waterbodies	**Little River, Atlantic Intracoastal Waterway, Murrells Inlet**	
Tributaries/ Minor Waterbodies	**South Carolina Tributaries:** Dunn Sound Creek, Dunn Sound, Sheephead Creek, Hog Inlet, House Creek, Cherry Grove Inlet, Eden Saltworks Creek, Williams Creek, Salt Flat Creek, Nixon Creek, Little River Swamp, Prices Swamp, Camp Branch Run, White Point Creek, Long Pond, Long Branch, Canepatch Swamp, Black Creek, Whale Creek, Main Creek, Woodland Creek, Parsonage Creek, Flagg Creek, Allston Creek, Oaks Creek, Oyster Cove **North Carolina Tributaries:** Mullet Creek, Calabash Creek, Milliken Cove, Horseford Creek. **Waterbodies which drain directly into Atlantic Ocean:** Singleton Swash, Bear Creek, Canpatch Swash, withers Swash, Midway Swash.	
Land Use Breakdown	**Urban Land**	**18.0%**
	Forested Land	**6.6%**
	Forested Wetland	**7.6%**
	Non-forested Wetland	**0%**
	Agricultural Land	**4.1%**
	Scrub/shrub Land	**3.6%**
	Water	**57.5%**
	Barren Land	**1.2%**
NOTES:	**Two Separate TMDLs are in place within this watershed. One is a Dissolved Oxygen TMDL along the Waccamaw River/ Atlantic Intracoastal Waterway and the second is a Fecal Coliform TMDL in Murrells Inlet. Sixteen monitoring sites within this watershed have been identified as Waters of Concern in the 2010 SC 303(d) list.**	
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

Due to its close proximity to the Atlantic Ocean and the heavily visited Grand Strand beaches, the Little River/ Atlantic Intracoastal Waterway/ Murrells Inlet is likely to continue to experience significant growth into the foreseeable future. Development trends have fluctuated due to the economic recession of the late 2000's, however one possible trend is the increase in permanent year-round residents as the coastal South Carolina region continues to become an attractive retirement destination. Additional residential and commercial development is likely as the region seeks to diversify the local economic base and attract new industries to the area. Most of this watershed has access to centralized sewer service.

Appendix Table D5 includes a list of waters in the Little River/ Atlantic Intracoastal Waterway that have been identified by SC DHEC as Waters of Concern following the 2010 water quality assessment. These waterbodies will be targeted for additional investigation prior to the next biannual release of the 303 (d) list of impaired waters.

The Table below is a general profile of the North Inlet watershed located in Georgetown County.

General Profile of the North Inlet Watershed HUC Unit: 03040208-04		
Counties	Georgetown	
Watershed Size	53,330 acres	
Surface Waterbody Size	6.6 acres of lake waters/ 1,155.2 acres of estuarine areas	
Water Classifications	Classifications provided in list of waterbodies below	
Main Waterbodies	North Inlet (ORW), Midway Inlet, Pawleys Inlet(SFH)	
Tributaries/ Minor Waterbodies	**Waterbodies classified as Outstanding Resource Waters (ORW):** Wood Creek , Double Prong Creek, Little Wood Creek, Duck Creek, Perry Creek, Bobs Garden Creek, Clambank Creek, Bread and Butter Creek, Old Man Creek, Bly Creek, Sea Creek Bay, Bass Hole Creek, Bass Hole Bay, Cooks Creek. **Waterbodies classified as Shellfish Harvesting Waters (SFH):** Cutoff Creek, Mud Creek. **Waterbodies classified as Class SB (SB):** Sawmill Creek **Other Classifications:** Jones Creek (SB, SFH, ORW), Town Creek (SA, SFH, ORW), Sixty Bass Creek (SFH,ORW), Debidue Creek(SFH,ORW).	
Land Use Breakdown	**Urban Land**	**4.2%**
	Forested Land	**7.0%**
	Forested Wetland	**12.4%**
	Nonforested Wetland	**10.7%**
	Agricultural Land	**1.5%**
	Scrub/shrub Land	**0.5%**
	Water	**62.3%**
	Barren Land	**1.4%**
NOTES:	**Fecal Coliform TMDL in place. A full overview is provided later in this chapter.**	
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

The northern portions of the North Inlet watershed near the Town of Pawleys Island is expected to experience increased population growth and continued development in the foreseeable future. Most of the Waccamaw Neck region of this watershed now has centralized sewer service available. However, there are still many areas along the Waccamaw Neck that are still reliant on septic systems. The Marysville community in particular has several residences that have experienced malfunctioning septic systems over the last few years. The southern half of this watershed is expected to experience a very limited amount of development over the next several decades, as much of this land is protected and managed by the North Inlet-Winyah Bay NERR and Hobcaw Barony.

Waccamaw River Basin, Hydrological Unit: 03040206

The Waccamaw River Basin is located in Horry and Georgetown Counties, and encompasses five watersheds and 765 square miles. Of the almost half million acres, 36.9% is forested wetland, 26.5% is agricultural land, 19.2% is forested land, 10.5% is urban land, 2.8% is scrub/shrub land, 2.2% is nonforested wetland, 1.7% is water, and 0.2% is barren land. The urban land percentage is comprised mostly of the cities of Conway, Georgetown, Myrtle Beach, and North Myrtle Beach. There are approximately 784 stream miles, 2,373 acres of lake waters, and 22,910 acres of estuarine areas in this watershed. The Waccamaw River flows across the South Carolina state line from North Carolina and accepts drainage from Kingston Lake and the Atlantic Intracoastal Waterway via Socastee Creek. The Waccamaw River then joins the Great Pee Dee River as it forms Winyah Bay and drains into the Atlantic Ocean.

The Table below is a general profile of the Juniper Swamp watershed located in Horry County.

General Profile of the Juniper Swamp Watershed HUC Unit: 03040206-05		
Counties	Horry	
Watershed Size	56,360 acres	
Surface Waterbody Size	132.1 stream miles/ 19.8 acres of lake waters	
Water Classifications	All waterbodies are classified as Freshwaters (FW)	
Main Waterbodies	Juniper Swamp	
Tributaries/ Minor Waterbodies	Tools Fork	
Land Use Breakdown	**Urban Land**	**6.5%**
	Forested Land	**13.0%**
	Forested Wetland	**31.0%**
	Non-forested Wetland	**0.6%**
	Agricultural Land	**45.7%**
	Scrub/shrub Land	**3.1%**
	Water	**0.1%**
	Barren Land	**0%**
NOTES:	**There are no portions of this watershed listed on the 2010 South Carolina 303(d) List of Impaired Waters.**	
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

The potential for growth within the Juniper Swamp watershed is limited in the foreseeable future. This watershed contains part of the City of Loris, which has experienced a stable population over the past few decades. There is water and sewer service available in the Loris area, which could potentially accommodate additional growth. The remaining portions of the watershed have been traditionally rural with mostly agricultural and silvilculture land use activity.

The Table below is a general profile of the Hydrological Unit-03040206-07 segment of the Waccamaw River watershed.

General Profile of the Waccamaw River Watershed HUC Unit: 03040206-07		
Counties	Horry	
Watershed Size	157,690 acres	
Surface Waterbody Size	335.6 stream miles/ 84.0 acres of lake waters	
Water Classifications	All waterbodies are classified as Freshwaters (FW)	
Main Waterbodies	Waccamaw River	
Tributaries/ Minor Waterbodies	Indigo Branch, Bellamy Branch, Cold Water Branch, Meetinghouse Branch, Mill Swamp, Buck Creek, Round Swamp, Sheepbridge Branch, Camp Swamp, Little Cedar Branch, Cedar Branch, Big Cedar Branch, Deep Branch, Simpson Creek, Mill Branch, Bear Branch, West Bear Branch, Neal Branch, Cowpen Swamp, Little Cowpen Swamp, Flat Bay, Floyd Bay, Big Swamp, Todo Swamp, Thoroughfare Bay, Frank Branch.	
Land Use Breakdown	**Urban Land**	**7.4%**
	Forested Land	**22.0%**
	Forested Wetland	**36.1%**
	Non-forested Wetland	**1.0%**
	Agricultural Land	**30.0%**
	Scrub/shrub Land	**3.1%**
	Water	**0.3%**
	Barren Land	**0.1%**
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

This portion of the Waccamaw River watershed is expected to experience continued growth into the foreseeable future. The highest development potential is west of North Myrtle Beach. In addition, growth is anticipated along the SC Highway 90 corridor, which connects the City of Conway to the North Myrtle Beach area. Other areas with significant growth potential include the SC Highway 9 corridor which connects the North Myrtle Beach area to western portions of Horry County.

The Table below is a general profile of the Kingston Lake watershed located in Horry County.

General Profile of the Kingston Lake Watershed HUC Unit: 03040206-08		
Counties	Horry	
Watershed Size	83,448 acres	
Surface Waterbody Size	183.8 stream miles/ 161.8 acres of lake waters	
Water Classifications	All waterbodies are classified as Freshwaters (FW)	
Main Waterbodies	Kingston Lake	
Tributaries/ Minor Waterbodies	Jacks Bay, Alligator Swamp, White Oak Swamp, Little White Oak Swamp, Cane Branch, Horsepen Branch, Huckleberry Branch, Bug Swamp, Bay Gully Branch, Bayboro Branch, Hellhole Swamp, Fox Branch, Camp Swamp, Horsepen Creek, Maple Swamp, Big Baxter Swamp, Little Baxter Swamp, Horse Creek, Cross Branch, Poplar Swamp, Booth Branch, Smith Branch, Boggy Swamp, Grier Swamp, Priver Branch, Mill Branch, Long Swamp, St. Paul Branch, Brown Swamp, Mary Branch, Crab Tree Swamp, Ned Creek, Thomspon Swamp, Oakey Swamp, Beaver Hole Swamp Altman Branch.	
Land Use Breakdown	**Urban Land**	**8.7%**
	Forested Land	**16.6%**
	Forested Wetland	**32.5%**
	Non-forested Wetland	**0.6%**
	Agricultural Land	**39.2%**
	Scrub/shrub Land	**2.2%**
	Water	**0.2%**
	Barren Land	**0%**
NOTES:	**Section 319 Grant project conducted within watershed to investigate causes of fecal coliform bacteria and dissolved oxygen impairments**	
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

The Kingston Lake watershed includes a significant portion of the City of Conway, which has been one of the fastest growing areas in the Waccamaw region over the last twenty years. Growth in Conway and the surrounding area is expected to continue over the next several years. The watershed is also accessible by several key highway corridors including US Highway 501 and US Highway 701. A large proportion of the Kingston Lake watershed is serviced by centrailized sewer and extension of service via the Grand Strand WSA Rural Sewer Program is expected to continue. The extensive floodplains associated with the Kingston Lake watershed is one of the long-term limiting factors to future growth in this part of Horry County.

Figure 3-2 provides a map of the Kingston Lake watershed in central Horry County.

Figure 3-2 Kingston Lake Watershed in Horry County, SC. New HUC watershed code for the Kingston Lake Watershed is 03040206-08 *Courtesy of Waccamaw Watershed Academy, Coastal Carolina University*

The Table below is a general profile of the Hydrological Unit-03040206-09 segment of the Waccamaw River watershed.

General Profile of the Waccamaw River Watershed HUC Unit: 03040206-09		
Counties	Horry	
Watershed Size	136,317 acres	
Surface Waterbody Size	226.2 stream miles/ 477.1 acres of lake waters	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Waccamaw River	
Tributaries/ Minor Waterbodies	Jones Big Swamp, Boggy Swamp, Horse Savannah, Watts Bay, Stanley Creek, Beaverdam Swamp, Big Swamp, Tilly Swamp, Tiger Bay, Cane Bay, Buck Bay, Long Branch, Round Swamp, Dam Swamp, Steritt Swamp, Bear Swamp, Butler Swamp, Willow Springs Branch, Busbee Lake, Pitch Lodge Lake, Cox Ferry Lake, Thorofare Creek, Wadus Lake, Gravely Gully, Halfway Swamp, Big Branch, Old Womans Lake, Big Buckskin Creek, Peachtree Lake, Socastee Swamp, Folly Swamp, Socastee Creek, Enterprise Creek.	
Land Use Breakdown	**Urban Land**	**15.5%**
	Forested Land	**19.0%**
	Forested Wetland	**44.6%**
	Non-forested Wetland	**1.5%**
	Agricultural Land	**14.8%**
	Scrub/shrub Land	**2.8%**
	Water	**1.6%**
	Barren Land	**0.2%**
NOTES:	**Dissolved Oxygen TMDL in place. A full overview is provided later in this chapter.**	
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

This section of the Waccamaw River watershed includes part of the City of Conway and several urbanized areas of Horry County on the outskirts of Myrtle Beach and North Myrtle Beach. The watershed includes highly developed areas along US Highway 501, US Highway 17 Bypass, and SC Highway 544. These areas all have grown substantially over the last twenty years and will continue to be the primary growth corridors in Horry County into the foreseeable future. Much of this area is serviced by centralized sewer.

The Table below is a general profile of the Hydrological Unit-03040206-10 segment of the Waccamaw River watershed.

General Profile of the Waccamaw River Watershed HUC Unit: 03040206-10		
Counties	Horry, Georgetown	
Watershed Size	55,596 acres	
Surface Waterbody Size	117.5 stream miles/ 581.6 acres of lake waters/ 3,493.6 acres of estuarine areas	
Water Classifications	All waterbodies classified as Freshwaters (FW), except tributaries downtstream of the confluence with Thoroughfare Creek which is classified as Class SA (SA)	
Main Waterbodies	Waccamaw River	
Tributaries/ Minor Waterbodies	Oatbed Creek, Seven Prongs, Peach Creek, Old River, Nimrod Creek, Clark Creek, Big Swamp, Old Dock Creek, Righthand Creek, Silvers Creek. Bull Creek, Prince Creek, Vaux Creek, Silver Creek, Collins Creek, Cow House Creek, Black Creek, White Creek, Sandhole Creek, Ruinsville Creek, Crane Creek, Springfield Creek, Brookgreen Creek, Pawleys Creek, Oatland Creek, Waverly Creek, Butler Creek, Schooner Creek, Caledonia Creek, Duncan Creek, Jericho Creek	
Land Use Breakdown	**Urban Land**	**13.6%**
	Forested Land	**21.6%**
	Forested Wetland	**33.3%**
	Non-forested Wetland	**11.1%**
	Agricultural Land	**6.9%**
	Scrub/shrub Land	**2.9%**
	Water	**9.6%**
	Barren Land	**1.0%**
NOTES:	**Dissolved Oxygen TMDL in place. A full overview is provided later in this chapter.**	
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

This section of the Waccamaw River watershed includes portions of the greater Surfside Beach and Murrells Inlet areas, which are popular coastal communities. These areas are expected to continue to grow over the next several years. This portion of the watershed is served by centralized sewer. The Bucksport community is the only significantly developed area west of the Waccamaw River within this portion of the watershed. The Bucksport area has not experienced significant growth over the last twenty years but has convenient access to US Highway 701 and has moderate potential for industrial development. The Bucksport area is served by centralized sewer. The remaining portions of this section of the Waccamaw River watershed are predominantly rural and are not expected to experience significant development in the foreseeable future.

Figure 3-3 Brookgreen Creek in Georgetown County

Great Pee Dee River Basin, Hydrological Units: 03040201, 03040203, 03040204, 03040207

The Great Pee Dee River Basin is located in Marlboro, Chesterfield, Darlington, Florence, Dillon, Marion, Williamsburg, Horry, and Georgetown Counties, and encompasses 22 watersheds and 4,029 square miles within South Carolina, including the Lynches River, Black River, and Waccamaw River basins. The Great Pee Dee River flows across the Sandhills region to the Upper and Lower Coastal Plain regions and into the Coastal Zone region. Of the approximately 2.5 million acres, 33.4% is agricultural land, 25.7% is forested land, 27.9% is forested wetland, 6.3% is urban land, 2.7% is scrub/shrub land, 2.6% is water, 1.2% is nonforested wetland, and 0.2% is barren land. The urban land percentage is comprised chiefly of the cities of Florence, Darlington, Bennettsville, and Dillon.

In the Great Pee Dee River Basin, there are approximately 4,669 stream miles, 10,864 acres of lake waters, and 17,676 acres of estuarine areas. The Great Pee Dee River flows across the North Carolina/South Carolina state line and accepts drainage from Thompson Creek, Crooked Creek, Cedar Creek, Three Creeks, and Black Creek. The river then accepts drainage from Jeffries Creek, Catfish Creek, the Lynches River Basin, the Little Pee Dee River, the Black River Basin and the Waccamaw River Basin before draining into Winyah Bay.

The Table below is a general profile of the Lumber River watershed.

General Profile of the Lumber River Watershed HUC Unit: 03040203-14		
Counties	Dillon, Marion, Horry	
Watershed Size	66,605 acres	
Surface Waterbody Size	101.4 stream miles/ 70.5 acres of lake waters	
Water Classifications	All waterbodies are classified as Freshwaters (FW)	
Main Waterbodies	Lumber River	
Tributaries/ Minor Waterbodies	Ashpole Swamp, Jordan Creek, Feathery Bay, Granger Pond, Gapway Swamp, Hook Branch, Boggy Branch, Pew Branch	
Land Use Breakdown	**Urban Land**	**4.2%**
	Forested Land	**15.5%**
	Forested Wetland	**38.9%**
	Non-forested Wetland	**0.6%**
	Agricultural Land	**39.4%**
	Scrub/shrub Land	**1.1%**
	Water	**0.3%**
	Barren Land	**0%**
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

Only a small portion of the Lumber River watershed is located in Horry County. The closest developed areas are Nichols in Marion County and Lake View in Dillon County. Neither of these communities are expected to experience significant growth in the foreseeable future.

The Table below is a general profile of the Lake Swamp watershed.

General Profile of the Lake Swamp Watershed HUC Unit: 03040204-06		
Counties	Horry	
Watershed Size	114,286 acres	
Surface Waterbody Size	274.1stream miles/ 169.4 acres of lake waters	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Lake Swamp	
Tributaries/ Minor Waterbodies	Mitchell Swamp, Haggins Creek, Calf Ford Branch, Skeebo Branch, Savannah Branch, Mill Branch, Seed Tick Branch, Iron Springs Swamp, Iron Springs Bay, Bobs Branch, Pinelog Branch, Long Branch, Pleasant Meadow Swamp, Gaskins Branch, Holmes Branch, Spring Branch, Big Branch, Fifth Branch, Rooty Branch, Playcard Swamp, Zeeks Branch, Pasture Branch, Chickencoop Branch, Daniel Hole Branch, Leather String Branch, Breakfast Swamp, Prince Mill Swamp, Little Mill Branch, Big Mill Branch, Limerick Branch, Honey Camp Branch, Rattlesnake Branch, Reedy Branch. Joiner Swamp, Joiner Bay, Bogue Bay, Loosing Swamp, Watery Bay, Turf Camp Bay, Mose Swamp, Horsepen Bay, Loosing Swamp, Johnny Lake.	
Land Use Breakdown	**Urban Land**	**5.9%**
	Forested Land	**11.8%**
	Forested Wetland	**33.9%**
	Non-forested Wetland	**0.5%**
	Agricultural Land	**46.9%**
	Scrub/shrub Land	**0.9%**
	Water	**0.1%**
	Barren Land	**0%**
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

The Table below is a general profile of the Brunson Swamp watershed.

General Profile of the Brunson Swamp Watershed HUC Unit: 03040204-07		
Counties	Horry	
Watershed Size	44,600 acres	
Surface Waterbody Size	83.0 stream miles/ 73.0 acres of lake waters	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Brunson Swamp	
Tributaries/ Minor Waterbodies	Chinners Swamp, Rabon Branch, Mill Branch, Savannah Creek, Big Swamp, Schoolhouse Branch, Evans Branch, Spring Swamp, Holly Hill Branch	
Land Use Breakdown	**Urban Land**	**6.0%**
	Forested Land	**17.4%**
	Forested Wetland	**30.8%**
	Nonforested Wetland	**0.6%**
	Agricultural Land	**43.9%**
	Scrub/shrub Land	**1.2%**
	Water	**0.1%**
	Barren Land	**0%**
NOTES:	**TMDL in place in the Chinners Swamp subwatershed. A detailed overview of this TMDL is provided later in this chapter.**	
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

The Lake Swamp watershed encompasses a portion of the City of Loris in western Horry County. The City of Loris has experienced only modest growth over the last twenty years. Centralized sewer service is available in Loris and the immediate surrounding area. Outside of Loris the remainder of the watershed is rural, consisting of mostly agriculture and silviculture land uses. New development is expected to be limited in the near future. The Brunson Swamp watershed is also located in western Horry County and encompasses the Town of Aynor. Development within this watershed has been relatively modest however, the Town of Aynor now has full connection to the Grand Strand WSA centralized sewer network and US Highway 501, a major roadway corridor, bisects the Brunson Swamp watershed. Both of these factors could foster future growth in this part of Horry County.

The Table below is a general profile of the Little Pee Dee River watershed.

General Profile of the Little Pee Dee River Watershed HUC Unit: 03040204-08		
Counties	Marion, Horry	
Watershed Size	217,821 acres	
Surface Waterbody Size	326.3 stream miles/ 668.8 acres of lake waters	
Water Classifications	All waterbodies classified as Outstanding Resource Waters with the exception of the following waterbodies which are classified as Freshwaters (FW): Brown Swamp, White Oak Creek, Hunting Swamp, and Palmetto Swamp along with their tributaries.	
Main Waterbodies	Little Pee Dee River	
Tributaries/ Minor Waterbodies	**Tributaries:** Cedar Creek, Cow Bog, Juniper Bay, Spring Bay, Mossy Bay, Back Swamp, Cartwheel Branch, Cartwheel Bay, Fifteenmile Bay, Jet Branch, Brown Swamp, White Oak Creek, Fowler Branch, Black Creek, Flat Bay, and Turkey Pen Swamp, Gunter Bay, Hannah Bay, Wolf Pit Bay, Mill Bay, Lake Swamp, Dawsey Swamp, Tredwell Swamp, Mill Swamp, The Falls, Back Swamp, Fox Bay, Sandy Slough, Little Reedy Creek, Cane Bay, Mill Bay, Reedy Creek, Big Sister Bay, Little Sister Bay, Reedy Creek Bay, Smith Millpond, Leggett Millpond, Sandy Slough, Cypress Creek, Marsh Creek, Alligator Run, Palmetto Swamp, Little Palmetto Swamp, Ratan Branch, Giles Bay, Singleton Creek, Dwight Creek, Red Hill Branch, Alfred Creek, Bunker Hill Creek, Church Branch, Running Branch, Brown Swamp, Brown Bay, Knotty Branch, Cooper Branch, Davis Branch, Juniper Bay, Calhoun Branch, Todd Mill Branch, Lewis Mill Branch, Alkinson Branch, Jordan Lake, Old River Lake, Hunting Swamp, Boyd Canal, Jenkins Swamp, Cedar Grove Branch, Cates Bay, Forney Branch, Brownway Branch, Big Cypress Swamp, Sarah Branch, Pawley Swamp, Russ Creek, Jiles Creek, Russ Lake **Oxbow Lakes:** Cox Lake, Newfound Lake, Gunter Lake, Johnson Big Lake, Cannon Lake, Jordan Lake, Old River Lake, Richard Lake, Sampson Lakes, Dead River.	
Land Use Breakdown	**Urban Land**	**4.1%**
	Forested Land	**16.1%**
	Forested Wetland	**45.3%**
	Nonforested Wetland	**0.8%**
	Agricultural Land	**30.3%**
	Scrub/shrub Land	**2.3%**
	Water	**1.1%**
	Barren Land	**0%**
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

This section of the Little Pee Dee River watershed traverses a very rural portion of western Horry County. The most well developed portion of this watershed is the City of Mullins in Marion County. US Highway 501 does intersect the watershed in a few locations which could lead to some limited residential and commercial growth in the future.

Figure 3-4 This segment of the Little Pee Dee River is designated as a SC Scenic River. *Photo courtesy of SC Department of Natural Resources*

The Table below is a general profile of the Sampit River watershed.

General Profile of the Sampit River Watershed HUC Unit: 03040207-01		
Counties	Georgetown	
Watershed Size	105,260 acres	
Surface Waterbody Size	166.1 stream miles/ 819.8 acres of lake waters/ 1,033.5 acres of estuarine areas.	
Water Classifications	All waterbodies classified as Freshwaters (FW), except for the Sampit River which can be classified as Class SB (SB) depending on the freshwater inflow from the neighboring rivers, Great Pee Dee River and the Waccamaw River.	
Main Waterbodies	Sampit River	
Tributaries/ Minor Waterbodies	Bond Swamp, Boety Bay, Mackey Bay, Bind Bay, Canaan Bay, Ditch Branch, Canaan Branch, Summons Swamp, Boggy Swamp, Cherryhill Swamp, Machine Branch, Britt Branch, Spring Gully, Little Kilsock Bay, Ports Creek, Canaan Branch, Pennyroyal Creek, Big Kilsock Bay, Flat Bay, Turkey Creek, Whites Creek.	
Land Use Breakdown	**Urban Land**	**5.0%**
	Forested Land	**48.4%**
	Forested Wetland	**19.8%**
	Nonforested Wetland	**3.4%**
	Agricultural Land	**12.8%**
	Scrub/shrub Land	**8.7%**
	Water	**1.6%**
	Barren Land	**0.3%**
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

The City of Georgetown is one of the oldest communities in the State of South Carolina. The Sampit River is an actively used waterway for recreational, commercial, and industrial purposes. There are several areas in Georgetown that have waterfront residential and commercial developments on the Sampit River. The Town of Andrews is connected by US Highway 521, which intersects the watershed. Although there has not been as much growth in the Sampit River watershed area over the past twenty years as in other coastal areas of within the Waccamaw region, the potential for growth in this portion of Georgetown County is significant.

Figure 3-5 The Sampit River forms Georgetown Harbor, a waterway utilized for a multitude of purposes including recreational boating and as a site for local industries.

The Table below is a general profile of the Great Pee Dee River/ Winyah Bay watershed.

General Profile of the Great Pee Dee River/ Winyah Bay Watershed HUC Unit: 03040207-02		
Counties	Marion, Florence, Williamsburg, Georgetown, Horry	
Watershed Size	259,235 acres	
Surface Waterbody Size	351.9 stream miles/ 629.6 acres of lake waters/ 16,642.3 acres of estuarine areas.	
Water Classifications	Classifications provided in list of waterbodies below	
Main Waterbodies	Great Pee Dee River and Winyah Bay	
Tributaries/ Minor Waterbodies	**Waterbodies classified as Freshwaters (FW):** Crooked Lake , Negro Lake Run, Maple Swamp, Clark Creek, Muddy Creek, Mill Creek, Soccee Swamp, Island Branch, Cedar Branch, Apple Orchard Slough, Staple Lake, Clark Creek, Jacobs Creek, Port Creek, Flat Run Swamp, Boser Swamp, Squirrel Run Bay, Pennyroyal Swamp, Bells Swamp, Tyler Creek, Larrimore Gully, Gravel Gully Branch, Jordan Lake, Jordan Creek, Dog Lake, Conch Creek, Sally Branch, Bradley Branch, Sheep Pen Branch, Bull Creek, Cowford Swamp, Horsepen Branch, Vandross Bay, Yauhannah Creek, Tupelo Bay, Pole Castle Branch, St. Pauls Branch, Cypress Creek, Chapel Creek, Little Bull Creek, Bull Creek, Cooter Creek, Joe Bay, Little Bull Creek, Thoroughfare Creek, Guendalose Creek/Bullins Creek, Squirrel Creek, Jericho Creek, Middleton Cut, Carr Creek, Little Carr Creek, Jericho Creek. **Waterbodies classified as Class SB (SB):** White Oak Bay, Kinloch Creek, Mosquito Creek, Lagoon Creek, Western Channel, Mud Bay, No Mans Friend Creek, Haulover Creek, Sign Creek, Jones Creek, Dividing Creek, Nancy Creek, Noble Slough, Cotton Patch Creek, Oyster Bay, Sawmill Creek **Waterbodies classified as Class SA (SA):** Esterville Minim Creek Canal **Waterbodies classified as Shellfish Harvesting Waters (SFH):** Little Jones Creek, Cutoff Creek **Waterbodies classified as Outstanding Resource Waters (ORW):** Boor Creek **Other Classifications:** Jones Creek (SB, SFH, ORW), Town Creek (SB, SFH, ORW)	
Land Use Breakdown:	**Urban Land**	**2.4%**
	Forested Land	**22.6%**
	Forested Wetland	**30.0%**
	Nonforested Wetland	**6.9%**
	Agricultural Land	**14.2%**
	Scrub/shrub Land	**3.2%**
	Water	**20.3%**
	Barren Land	**0.4%**
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

This watershed unit extends from the southeast portions of Williamsburg, Florence, and Marion Counties through northwest Georgetown County before entering Winyah Bay just north of the City of Georgetown. This watershed is predominately rural, with a few areas of existing development including the Town of Hemingway and the outskirts of Georgetown. The potential for future growth is primarily limited to the US Highway 701 corridor, although overall growth in this area is expected to be moderate.

Lynches River Basin, Hydrological Unit: 03040202

The Lynches River Basin is located in Lancaster, Chesterfield, Kershaw, Lee, Darlington, Sumter, Florence, and Williamsburg Counties, and encompasses 1,412.3 square miles with geographic regions that extend from the Piedmont to the Sandhills, and to the Upper and Lower Coastal Plains. The Lynches River Basin encompasses seven watersheds and 903,879 acres, of which 38.5% is agricultural land, 33.4% is forested land, 20.1% is forested wetland, 5.4% is urban land, 2.0% is scrub/shrub land, 0.3% is water, 0.2% is nonforested wetland, and 0.1% is barren land. The urban land percentage is comprised chiefly of the City of Lake City.

This predominantly rural area has approximately 1,807 stream miles and 1,310 acres of lake waters. The Lynches River originates in North Carolina and accepts drainage from the Little Lynches River, Sparrow Swamp, and Lake Swamp before draining into the Great Pee Dee River.

The Table below is a general profile of the Lake Swamp watershed.

General Profile of the Lake Swamp Watershed HUC Unit: 03040202-06		
Counties	Florence, Williamsburg	
Watershed Size	105,066 acres	
Surface Waterbody Size	152.9 stream miles/ 71.1 acres of lake waters.	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Lake Swamp	
Tributaries/ Minor Waterbodies	Twomile Branch, Cypress Branch, Sandy Run Branch, Spring Run, Camp Branch, Smith Swamp, Spring Bay, Grahams Mill Branch, Graham Branch, McNamee Swamp, Singleton Swamp, Long Branch	
Land Use Breakdown	**Urban Land**	**7.3%**
	Forested Land	**16.7%**
	Forested Wetland	**31.0%**
	Nonforested Wetland	**0.2%**
	Agricultural Land	**40.8%**
	Scrub/shrub Land	**3.8%**
	Water	**0.1%**
	Barren Land	**0%**
NOTES:	**There are no portions of this watershed listed on the 2010 South Carolina 303(d) List of Impaired Waters.**	
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

Only a very small portion of the Lake Swamp watershed extends into northern Williamsburg County, near Lake City, located in Florence County. US Highway 52 passes through the watershed and has attracted some industry seeking to locate between Florence and Charleston. The only other urbanized area within this watershed that is directly upstream of the Waccamaw region is the City of Johnsonville in Florence County. Otherwise, the Lake Swamp watershed is mostly rural with low growth potential.

Black River Basin, Hydrological Unit: 03040205

The Black River Basin is located in Kershaw, Lee, Sumter, Clarendon, Florence, Williamsburg, and Georgetown Counties, and encompasses 2,060 square miles with geographic regions extending from the Sandhills to the Upper and Lower Coastal Plains and into the Coastal Zone. The Black River Basin encompasses 18 watersheds, approximately 1.3 million acres of which 26.3% is forested land, 35.0% is agricultural land, 4.6% is scrub/shrub land, 27.1% is forested wetland, 6.1% is urban land, 0.4% is nonforested wetland, 0.1% is barren land, and 0.4% is water. The urban land percentage is comprised chiefly of the City of Sumter.

There are approximately 2,143 stream miles, 2,332 acres of lake waters, and 763 acres of estuarine areas in the Black River Basin. The Black River originates near the City of Bishopville and accepts drainage from Rocky Bluff Swamp, the Pocotaligo River, Pudding Swamp, Kingstree Swamp Canal, and Black Mingo Creek before merging with the Great Pee Dee River.

The Table below is a general profile of the Pudding Swamp watershed.

General Profile of the Pudding Swamp Watershed HUC Unit: 03040205-05		
Counties	Lee, Sumter, Clarendon, Williamsburg, Florence	
Watershed Size	119,869 acres	
Surface Waterbody Size	210.1 stream miles/ 175.8 acres of lake waters	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Pudding Swamp	
Tributaries/ Minor Waterbodies	Hope Swamp, Threemile Branch, Trustless Branch, Horse Branch, Fuller Bay, Cypress Lake, Douglas Swamp, Woods Bay, Cypress Branch, Bushy Branch, Burnt Branch, Rose Creek, Newman Branch, Cain Branch	
Land Use Breakdown	**Urban Land**	**7.9%**
	Forested Land	**15.7%**
	Forested Wetland	**28.3%**
	Nonforested Wetland	**0.3%**
	Agricultural Land	**45.8%**
	Scrub/shrub Land	**1.7%**
	Water	**0.3%**
	Barren Land	**0%**
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

Only a small section of northeast Williamsburg County is located in the downstream portions of the Pudding Swamp watershed. The only developed areas in the upstream portions of the watershed include the Town of Olanta, located in Florence County and Turbeville, located in Clarendon County. Several important roadway corridors intersect the watershed including US Highway 378, US Highway 301, and Interstate 95. The remainder of the watershed is rural, consisting primarily of agricultural and silvilculture land uses. There is no significant development expected in the downstream portions of the Pudding Swamp watershed in Williamsburg County.

The Table below is a general profile of the Hydrological Unit: 03040205-06 segment of the Black River watershed.

General Profile of the Black River Watershed HUC Unit: 03040205-06		
Counties	Lee, Sumter, Clarendon, Williamsburg	
Watershed Size	84,708 acres	
Surface Waterbody Size	190.7 stream miles/ 122.9 acres of lake waters	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Black River	
Tributaries/ Minor Waterbodies	Mill Branch, Tearcoat Branch, Davis Branch, Pen Branch, Breakfast Branch, Crow Bay, Broad Branch, Conyers Bay, and another Mill Branch.	
Land Use Breakdown	**Urban Land**	**4.1%**
	Forested Land	**23.7%**
	Forested Wetland	**34.8%**
	Nonforested Wetland	**0.3%**
	Agricultural Land	**33.4%**
	Scrub/shrub Land	**3.6%**
	Water	**0.1%**
	Barren Land	**0%**
NOTES:	**There are no portions of this watershed listed on the 2010 South Carolina 303(d) List of Impaired Waters**	
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

The Table below is a general profile of the Hydrological Unit: 03040205-07 segment of the Black River watershed.

General Profile of the Black River Watershed HUC Unit: 03040205-07		
Counties	Florence, Clarendon, Williamsburg	
Watershed Size	209,555 acres	
Surface Waterbody Size	212.1 stream miles/ 137.1 acres of lake waters	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Black River	
Tributaries/ Minor Waterbodies	Clapp Swamp, Long Branch, Bull Branch, Spring Branch, Kingstree Swamp Canal, Smiths Bay, Findley Bay, Sandy Bay, Laws Swamp, Rocky Ford Swamp, Chaney Swamp, Dickey Swamp, Mulberry Branch, Bennett Swamp, Mill Branch, Pushing Branch, Shanty Branch, Thorntree Swamp, Stony Run Branch, Boggy Swamp, McElroy Branch, Camden Swamp, Ox Swamp, Gumtree Branch	
Land Use Breakdown	**Urban Land**	**5.7%**
	Forested Land	**26.4%**
	Forested Wetland	**29.4%**
	Nonforested Wetland	**0.1%**
	Agricultural Land	**31.8%**
	Scrub/shrub Land	**6.5%**
	Water	**0.1%**
	Barren Land	**0%**
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

Only a small section of the downstream portions of the Black River HUC# 03040205-06 watershed unit traverses northeastern Williamsburg County. This section of the Black River watershed is very rural, however Interstate 95 does intersect this watershed unit for a short distance in Clarendon County. The Black River HUC# 03040205-07 watershed unit encompasses a large portion of Williamsburg County. The county seat of Kingstree is the most heavily populated area within the county and is also accessible from several highways including US Highway 52 and SC Highway SC 261. The Town of Kingstree does have a moderate growth potential as it has recently attracted new industry and has a wastewater treatment plant with enough capacity to accommodate new residential and commercial development. Other populated areas within the watershed include the Town of Greeleyville and the Town of Lane. These communities have seen little growth over the past twenty years and it is not anticipated that they will grow in the near future. The remaining portions of the watershed are largely rural, with agriculture and silviculture being the predominate land use.


Figure 3-6. View of the Black River in Williamsburg County

The Table below is a general profile of the Black Mingo Creek watershed.

General Profile of the Black Mingo Creek Watershed HUC Unit: 03040205-08		
Counties	Georgetown, Williamsburg	
Watershed Size	160,757 acres	
Surface Waterbody Size	219.6 stream miles/ 223.3acres of lake waters	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Black Mingo Creek	
Tributaries/ Minor Waterbodies	Cedar Swamp, Orr Swamp, Home Swamp, Dry Swamp, The Morass, Pine Island Bay, Parsley Swamp, Whiteoak Swamp, McKnight Swamp, Turkey Creek, Boggy Swamp, Indiantown Swamp, James Branch, Pointer Stump Branch, Wilson Lake, Gully Branch, Headless Creek, Snow Branch, Campbell Swamp, Hickory Nut Branch, Johnson Branch, Walden Branch, Poplar Hill Branch, Caney Branch, Waterman Branch, Hughs Branch, Rome Branch, Burnett Swamp, Jacks Creek, Browns Branch, Squirrel Run, Church Branch, Pittman Branch, Peters Creek, Smith Swamp, Black Steer Swamp, McGinney Creek, Cold Creek, Mingo Swamp, Schoolhouse Branch	
Land Use Breakdown	**Urban Land**	**3.9%**
	Forested Land	**29.2%**
	Forested Wetland	**30.9%**
	Nonforested Wetland	**0.2%**
	Agricultural Land	**29.1%**
	Scrub/shrub Land	**6.5%**
	Water	**0.2%**
	Barren Land	**0%**
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

The Black Mingo Creek watershed is located in a very rural portion of Williamsburg and Georgetown Counties. The largest community in the watershed is the Town of Stuckey, which is not expected to grow significantly in the foreseeable future. The remainder of the watershed is comprised mostly of agriculture and silviculture land uses.

The Table below is a general profile of the Hydrological Unit-03040205-09 segment of the Black River watershed.

General Profile of the Black River Watershed HUC Unit: 03040205-09		
Counties	Williamsburg, Georgetown	
Watershed Size	232,687 acres	
Surface Waterbody Size	354.3 stream miles/ 213.8 acres of lake waters/ 763.3 acres of estuarine areas.	
Water Classifications	All waterbodies are classified as Freshwaters (FW) upstream of the crossing of US Hwy 701. All waterbodies are classified as Class SA (SA) downstream of the US Hwy 701 crossing.	
Main Waterbodies	Black River	
Tributaries/ Minor Waterbodies	Spring Branch, Spring Gully, Jumping Gully, Thompson Swamp, Birch Creek, Dobson Branch, Dobson Bay, Gin Branch, Flat Swamp, Camp Pond Bay, Ricefield Bay, Alligator Bay, Log Branch, Johnsons Swamp, Oakridge Bay, Mill Branch, Murray Swamp, Sportsman Pond, Horse Pen Swamp, Big Dam Swamp, Roper Branch, Sleeper Branch, Cedar Patch Branch, Brightman Swamp, Lester Creek, Puncheon Creek, Indian Hut Swamp, Mill Grove Creek, Lanes Creek, Choppee Creek, Stony Run Creek, Machine Bay, Boheck Creek, Post Foot Branch, Carvers Bay, Big Branch, Millpond Branch, Carvers Bay Creek, Fardick Creek, Peters Creek, Simmons Creek, Guinea Creek, Black Swamp, Post Foot Branch, Sixmile Creek, Gapway Bay, Greens Creek, Prince Creek, Crooked Branch, Inland Branch, Cottage Creek, Longwater Bay	
Land Use Breakdown	**Urban Land**	**3.4%**
	Forested Land	**40.7%**
	Forested Wetland	**28.0%**
	Nonforested Wetland	**1.7%**
	Agricultural Land	**17.4%**
	Scrub/shrub Land	**7.5%**
	Water	**1.2%**
	Barren Land	**0.1%**
Source: *SC Department of Health and Environmental Control. 2007 Pee Dee River Basin Watershed Water Quality Assessment.*		

The HUC Unit# 03040205-09 section of the Black River watershed includes the Town of Andrews. The population of Andrews has remained steady over the last twenty to thirty years and is expected to remain stable in the near future. The watershed is intersected by US Highway 701 and US Highway 521, which could spur some areas of residential and commercial growth. The remainder of this sub-watershed is largely rural consisting primarily of agriculture and silviculture land uses.

Santee River Basin, Hydrological Unit: 03050112

The Santee River Basin encompasses eleven watersheds and 1,279 square miles. The Santee River Basin originates in the Upper Coastal Plain region of South Carolina giving way to the Lower Coastal Plain and the Coastal Zone regions. Of the nearly one million acres, 0.5% is urban land, 11.7% is agricultural land, 12.4% is scrub/shrub land, 0.5% is barren land, 42.5% is forested land, 16.1% is forested wetland, 4.6% is nonforested wetland, and 11.7% is water.

There are a total of 934.4 stream miles in the Santee River Basin, 94,664 acres of lake waters, and 5,275.6 acres of estuarine areas. The Santee River is formed from the confluence of the Congaree and Wateree Rivers and flows through Lake Marion. The river is diverted in lower Lake Marion, and either flows out of the Santee dam to eventually drain into the Atlantic Ocean via the South Santee River and the North Santee River, or is channeled along a 7.5 mile diversion

canal to fill Lake Moultrie. After flowing through the Santee dam, the Santee River is joined by the rediversion canal connecting Lake Moultrie and the lower Santee River.

The Table below is a general profile of the Santee River watershed.

General Profile of the Santee River Watershed HUC Unit: 03050112-01		
Counties	Clarendon, Williamsburg, Berkeley	
Watershed Size	120,857 acres	
Surface Waterbody Size	188.0 stream miles/ 444.6 acres of lakes	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Santee River	
Tributaries/ Minor Waterbodies	**Tributaries:** Little River, Dead River, Highland Creek, Hicks Branch, Meetinghouse Branch, Bennetts Branch, Doctors Branch, Torkiln Branch, Mill Branch, Mt. Hope Swamp, Hagan Branch, Long Branch, Junkyard Bay, Guise Bay, Little Junkyard Bay, Cypress Bay, Campbell Branch, Walnut Branch, Johns Run. **Oxbow Lakes:** Couturier Lake, Cordes Lake, Solomon Lake, Little Solomon Lake, Wood Lake, Maham Lake	
Land Use Breakdown	**Urban Land**	**0%**
	Forested Land	**45.4%**
	Forested Wetland	**28.8%**
	Non-forested Wetland	**0%**
	Agricultural Land	**14.5%**
	Scrub/shrub Land	**10.2%**
	Water	**0.7%**
	Barren Land	**0.4%**
Source: *SC Department of Health and Environmental Control. 2005 Santee River Basin Watershed Water Quality Assessment.*		

The Table below is a general profile of the South Santee River watershed.

General Profile of the South Santee River Watershed HUC Unit: 03050112-03		
Counties	Williamsburg, Berkeley, Georgetown	
Watershed Size	137,119 acres	
Surface Waterbody Size	180.9 stream miles/ 148.7 acres of lakes	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Santee River	
Tributaries/ Minor Waterbodies	Wedboo Creek, Meetinghouse Branch, Beauford Branch, Savanna Creek, Byno Creek, Wittee Lake, June Branch, Wittee Branch, Mill Creek, Ferry Lake, Dutart Creek, Echaw Creek, Bark Island Slough, Beaman Branch, Bay Branch, Pole Branch, June Pond, Put-on Branch, Buck Branch, Velvet Branch, Red Bluff Creek.	
Land Use Breakdown	**Urban Land**	**0.1%**
	Forested Land	**63.2%**
	Forested Wetland	**24.4%**
	Non-forested Wetland	**0.0%**
	Agricultural Land	**5.3%**
	Scrub/shrub Land	**5.3%**
	Water	**1.0%**
	Barren Land	**0.4%**
Source: *SC Department of Health and Environmental Control. 2005 Santee River Basin Watershed Water Quality Assessment.*		

The Table below is a general profile of the Wadmacon Creek watershed.

General Profile of the Wadmacon Creek River Watershed HUC Unit: 03050112-04		
Counties	Georgetown, Williamsburg	
Watershed Size	42,927 acres	
Surface Waterbody Size	60.7 stream miles/ 59.7 acres of lakes	
Water Classifications	All waterbodies classified as Freshwaters (FW)	
Main Waterbodies	Wadmacon Creek	
Tributaries/ Minor Waterbodies	Cedar Creek, Long Branch, Brunson Branch	
Land Use Breakdown	**Urban Land**	**0.1%**
	Forested Land	**63.9%**
	Forested Wetland	**17.7%**
	Non-forested Wetlands	**0.0%**
	Agricultural Land	**2.2%**
	Scrub/shrub Land	**9.9%**
	Water	**0.1%**
	Barren Land	**0.9%**
Source: *SC Department of Health and Environmental Control. 2005 Santee River Basin Watershed Water Quality Assessment.*		

The Table below is a general profile of the North Santee River/ South Santee River watershed

General Profile of the North Santee River/ South Santee River Watershed HUC Unit: 03050112-06		
Counties	Georgetown, Charleston	
Watershed Size	79,788 acres	
Surface Waterbody Size	68.5 stream miles/ 657.1 acres of lakes/ 5,266.9 acres of estuarine areas.	
Water Classifications	Both the North and South Santee Rivers are classified as Freshwaters (FW) from their origin to the US Highway 17 crossing, Class SA (SA) from US Highway 17 to 1000 ft. below Atlantic Intracoastal Waterway crossing, and as Outstanding Resource Waters (ORW) from 1000 ft. below the AIWW crossing to the Atlantic Ocean.	
Main Waterbodies	North Santee River, South Santee River, Atlantic Intracoastal Waterway	
Tributaries/ Minor Waterbodies	Chicken Creek, Hampton Creek, Montgomery Creek, Garfish Creek, Sixmile Creek, Pleasant Creek, Collins Creek, Fourmile Creek Canal, Alligator Creek, Sall Creek, Cedar Creek, Pole Branch, Bonny Clabber Creek, White Oak Creek, Nimin Creek, Kinloch Creek, Pleasant Meadow Creek, Bella Creek, Cork Creek, Atchison Creek, Little Duck Creek, Duck Creek, Big Duck Creek, Mosquito Creek, Beach Creek, Cane Creek, and Bird Bank Creek.	
Land Use Breakdown	**Urban Land**	**0%**
	Forested Land	**46.2%**
	Forested Wetland	**4.5%**
	Non-forested Wetlands	**36.8%**
	Agricultural Land	**0.1%**
	Scrub/shrub Land	**1.5%**
	Water	**10.6%**
	Barren Land	**0.3%**
Source: *SC Department of Health and Environmental Control. 2005 Santee River Basin Watershed Water Quality Assessment.*		

The portions of the Santee River Basin that extend into Georgetown and Williamsburg Counties are primarily rural with low growth potential. Much of the downstream sections of this watershed are conserved lands, managed as part of the Francis Marion National Forest, the Yawkey Wildlife Center Heritage Preserve, or the Santee Coastal Wildlife Management Area.

Total Maximum Daily Load Allocations

If a surface waterbody is identified as being impaired on the 303(d) list for one or more water quality parameters, the next course of action is to develop a Total Maximum Daily Load (TMDL) to address the pollutant(s) of concern. A TMDL is a management strategy that identifies all known sources of the pollutant causing the impairment, and assesses the maximum amount of that particular pollutant the impaired waterbody can assimilate and be able to meet water quality standards. When this pollutant load is quantified, an allocation process is established to determine the pollutant discharge limits for all relevant point source dischargers while accounting for all known non-point sources of the pollutant of concern. Once all appropriate control measures are implemented, the water quality is continually monitored and the waterbody is periodically evaluated to see if it is attaining the water quality standards for the pollutant of concern.

Final TMDL limits are established by accounting for Waste Load Allocations (WLA) from all known point source pollutant dischargers, Load Allocations (LA) from all known non-point sources of the pollutant of concern, and by determining a Margin of Safety (MOS) to account for uncertainties in the pollutant loadings entering the watershed.

The equation below represents each category of pollutant loadings that are accounted for in the TMDL development process:

$$\text{TMDL} = \sum \text{Wasteload Allocations} + \sum \text{Load Allocations} + \text{Margin of Safety}$$

Currently there are four TMDLs established in the Waccamaw region. TMDLs are in place in the following locations: Atlantic Intracoastal Waterway/Waccamaw River, Litchfield/Pawleys Island Estuary, Murrells Inlet Estuary, and the Chinners Swamp portion of the Pee Dee River Basin. A description of each of these TMDLs is provided below.

Waccamaw River and the Atlantic Intracoastal Water Way near Myrtle Beach, SC

In 1999, SC DHEC and the US EPA adopted a Biochemical Oxygen Demand TMDL for portions of the Atlantic Intracoastal Waterway and the Waccamaw River in Horry and Georgetown Counties. Both the Waccamaw River and the Atlantic Intracoastal Waterway are tidally influenced with relativity slow stream flow velocities. The Atlantic Intracoastal Waterway has a net northerly flow direction through the Little River Inlet in Horry County. The Waccamaw River has a predominately southerly flow direction towards Winyah Bay in Georgetown. Both of these waterbodies are classified as Freshwaters with a site specific water quality standard for dissolved oxygen (DO). The minimum DO concentration to be maintained in the Waccamaw River is 4.0mg/l. The daily average DO concentration to be maintained in the Atlantic Intracoastal Waterway is 5.0mg/l with a minimum of 4.0 mg/l. SC DHEC water quality data taken at the MD-088, MD-085, MD-127, MD-087, MD-125, MD-089, and MD-091 indicate that DO concentrations regularly fail to meet the established numeric standards during the summer months.

Table 3-1 provides a list of all current DHEC water quality monitoring stations with an approved TMDL that are located in the Waccamaw River and Atlantic Intracoastal Waterway watersheds.

Table 3-1 Monitoring Sites with an Established TMDL for Waccamaw River and Little River/ Atlantic Intracoastal Waterway							
12- Digit HUC Code	**Description**	**Station**	**County**	**Use**	**Cause**	**Use Support**	**Approval Date**
030402080301	Intracoastal waterway at PT 3 Mi N of Bridge on US 501	MD-085	Horry	AL	DO	Not Supported	07/27/99
030402080301	Intracoastal waterway Just N of Bridge on US 501	MD-087	Horry	AL	DO	Fully Supported	07/27/99
030402080301	Intracoastal waterway 1 Mi S of Bridge on US 501	MD-088	Horry	AL	DO	Not Supported	07/27/99
030402080301	Intracoastal Waterway 2 Mi S of Bridge on US 501	MD-089	Horry	AL	DO	Not Supported	07/27/99
030402080301	Intracoastal Waterway 4 Mi N of Bridge on US 501	MD-091	Horry	AL	DO	Fully Supported	07/27/99
030402080301	Intracoastal Waterway (Little River) on SC9 (US17)	MD-125	Horry	AL	DO	Not Supported	07/27/99
030402061002	Waccamaw River Near Mouth of Bull Ck at Channel Marker 50	MD-137	Horry	AL	DO	Fully Supported	07/29/99
030402061002	Waccamaw River & ICWW 1 MI below Jct at Bucksport Landing	MD-146	Horry	AL	DO	Fully Supported	07/29/99
030402060905	Waccamaw River at US 501 Bypass around Conway	MD-110	Horry	AL	DO	Fully Supported	7/27/99
030402060905	Waccamaw River at Cox's Ferry on County Rd 110	MD-111	Horry	AL	DO	Fully Supported	7/27/99
030402060906	Intracoastal Waterway at SC 544 7.5 Mi SW of Myrtle Beach	MD-127	Horry	AL	DO	Not Supported	7/27/99
030402060907	Waccamaw River at Peachtree	MD-136	Horry	AL	DO	Fully Supported	7/27/99
030402060907	Waccamaw River at Bucksville	MD-145	Horry	AL	DO	Fully Supported	7/27/99
030402060905	Waccamaw River at US 501 Bypass around Conway	MD-110	Horry	AL	DO	Fully Supported	7/27/99

Note: *Abbreviations include AL: Aquatic Life, FC: Fecal Coliform, DO: Dissolved Oxygen.*
Source: *SC Department of Health and Environmental Control, The State of South Carolina's 2010 Integrated Report. Part I: Listing of Impaired Waters.*

It is believed that the dissolved oxygen concentrations are primarily attributable to the natural conditions of this watershed and the surrounding environment. However, Antidegradation Rules outlined in the South Carolina Regulations 61-68 state that under these circumstances only a 0.1mg/l DO deficit is allowed to be attributed to point source dischargers in a river system. An inventory of all point source discharges within the watershed was completed and the entire area of concern was divided into the following four segments: Conway, Bucksport, Hagley, and North Myrtle Beach.

The critical conditions for the wasteload allocation (WLA) of this TMDL was determined using water quality data collected at USGS monitoring stations and from SC DHEC's monitoring site network over a ten year time period from 1988 to 1998. The 25th percentile of all water quality measurements was utilized as the critical condition benchmark for DO. The 75th percentile of all measurements available was utilized as the critical condition benchmark for all other water quality parameters in this river system. These in-stream measurements accounted for pollutant loadings from all sources including point source, non-point source, and conditions attributed to natural sources. The USGS incorporated this baseline data into a water quality model, known as the Branched Lagrangian Transport Model to determine appropriate wasteload allocations in the river system.

Table 3-2 below provides a summary of proposed Ultimate Oxygen Demand (UOD) limits necessary to meet the DO water quality criteria in the Waccamaw River and Intracoastal Waterway.

Table 3-2 Ultimate Oxygen Demand TMDL Permit Limits Summary for Point Source Discharges in the Waccamaw River and Atlantic Intracoastal Waterway

River Segment	Point Source Discharges	1999 Permitted Flow (MGD)	UOD (lbs/day) 1999 Permit Limit	UOD (lbs/day) Proposed TMDL Permit Limit
Conway	City of Conway	3.2	522	303lbs/day distributed amongst all dischargers
	GSWSA Central	1.2	1,351	
	Total	4.4	1,873	
Bucksport	GSWSA Bucksport	0.2	228	84lbs/day
Hagley	GSWSA Schwartz WWTP	12	7,871	8,643lbs/day distributed amongst all dischargers
	Myrtle Beach WWTP	17	13,507	
	GCWSD Murrells Inlet	1	567	
	GCWSD Pawley's Area	2.75	2,275	
	Total	32.75	24,220	
North Myrtle Beach	NMB Ocean Drive	3.4	685	1,638lbs/day distributed amongst all dischargers
	NMB Crescent Beach	2.1	743	
	GSWSA Vereen Plant	2.5	481	
	Total	8.0	1,908	

Source: *South Carolina DHEC, Total Maximum Daily Load Determination for the Waccamaw River and the Atlantic Intracoastal Water Way Near Myrtle Beach, SC. 1999.*

The complete Biological Oxygen Demand TMDL document for the Waccamaw River and Atlantic Intracoastal Waterway watersheds can be accessed at SC DHEC's website at the following link:
http://www.scdhec.gov/environment/water/tmdl/docs/tmdlwac.pdf

Fecal Coliform in Shellfish Waters of the Murrells Inlet Estuary, SC

A Fecal Coliform in Shellfish Waters TMDL for the Murrells Inlet estuary was approved by SC DHEC and US EPA in July 2005. The Murrells Inlet estuary is one of several areas along the coast of South Carolina that is suitable for the cultivation of harvestable shellfish species. Murrells Inlet is one of 25 habitat areas designated as a Shellfish Management Area in the state. The Shellfish Management Area classification number for the Murrells Inlet estuary is MA 04. There is a total of 3,108 acres of suitable shellfish habitat in management area MA 04.

The fecal coliform water quality numeric criteria that are established for Shellfish Harvesting Waters (SFH) are as follows:

- Not to exceed a Most Probable Number (MPN) geometric mean of 14/100ml
- No more than 10 percent of all samples shall exceed an MPN of 43/100ml

Water quality impairments caused by fecal coliform contamination were identified at eight SC DHEC monitoring stations, which led to the placement of these sites on the 2004 South Carolina 303(d) list of impaired waterbodies. A list of all the water quality monitoring stations that are located within the Murrells Inlet TMDL boundaries are provided in **Table 3-3** below.

Table 3-3 Monitoring Sites with an Established TMDL for Murrells Inlet Estuary HUC#:03040208-03							
12- Digit HUC Code	**Description**	**Station**	**County**	**Use**	**Cause**	**Use Support**	**Approval Date**
030402080310	Main Creek at Mickey Spillane's Home	04-02	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080310	Main Creek SE Side of the Prohibited Area Near Captain Dick's Marina	04-03B	Georgetown	SHELLFISH	FC	Fully Supported	7/19/05
030402080310	Garden City Canal E of Flagg Creek (New 01-01-2004)	04-04A	Georgetown	SHELLFISH	FC	Fully Supported	7/19/05
030402080310	Allston Creek at Weston Flat	04-06	Georgetown	SHELLFISH	FC	Fully Supported	7/19/05
030402080310	Parsonage Creek at Nance's Dock	04-08	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080310	Parsonage Creek at Chicken Farm Ditch	04-16	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080310	Parsonage Creek SW Corner of the Voyager View Marina Prohibited Zone	04-17A	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080310	Main Creek at Oyster Cove	04-23	Georgetown	SHELLFISH	FC	Fully Supported	7/19/05
030402080310	Main Creek at Flagg Creek	04-25	Georgetown	SHELLFISH	FC	Fully Supported	7/19/05
030402080310	Garden City Canal at the "Old Boat Wreck"	04-26	Horry	SHELLFISH	FC	Not Supported	7/19/05
030402080310	Main Creek, Opposite Entrance to Mt. Gilead Canal	04-27	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080310	Oyster Cove, South Branch	04-29	Georgetown	SHELLFISH	FC	Fully Supported	7/19/05
030402080310	Oyster Cove, North Branch	04-30	Georgetown	SHELLFISH	FC	Fully Supported	7/19/05
030402080310	Woodland Creek, 100 Meters East of Mainland	04-31	Georgetown	SHELLFISH	FC	Fully Supported	7/19/05

Note: *Abbreviations include FC: Fecal Coliform.*
Source: *SC Department of Health and Environmental Control, The State of South Carolina's 2010 Integrated Report. Part I: Listing of Impaired Waters.*

The estuary has a linear geography, extending 5.5 nautical miles parallel to the Atlantic Ocean and is less than 1 nautical mile wide. The average main channel depth in the estuary is 4 meters. Salinity within the estuary is generally above 30 parts per thousand (ppt), and freshwater inputs are primarily limited to direct precipitation and associated runoff from nearby areas.

It is known that surrounding land use characteristics can influence fecal coliform loadings in nearby waterbodies. As part of this TMDL, a land use assessment was completed for this 10,250 acre watershed. The watershed is characterized by the following general land use descriptions: forest (31%), open water/beach (27%), urban development (24%), wetlands (16%), and urban/recreation (2%). This TMDL study divided the estuary into eight subwatersheds utilizing the eight impaired monitoring stations as reference points. A more detailed analysis of the surrounding land use characteristics of each subwatershed is provided in **Table 3-4.**

Table 3-4: Land Use Acreage and Percentage Profile of Each Subwatershed in Murrells Inlet Estuary								
Land Use Description	**04-01**	**04-01A**	**04-27**	**04-02**	**04-26**	**04-16**	**04-08**	**04-06**
Barren	41.7 acres	2.8 acres	0.4 acres	0.8 acres	66.8 acres	0.6 acres	0.0 acres	0.6 acres
	3.9%	0.4%	0.1%	0.3%	28.4%	0.3%	0.0%	0.2%
Forest	352.9 acres	148.4 acres	63.0 acres	54.4 acres	1.4 acres	89.8 acres	66.7 acres	89.2 acres
	32.8%	23.2%	20.5%	21.9%	0.6%	39.1%	40.0%	33.6%
Open Water	17.7 acres	60.6 acres	80.0 acres	43.3 acres	63.0 acres	6.2 acres	3.0 acres	65.0 acres
	1.6%	9.5%	26.1%	17.4%	26.7%	2.7%	1.8%	24.5%
Pasture/ hay	14.3 acres	7.2 acres	2.0 acres	0.4 acres	0.8 acres	1.0 acres	0.0 acres	1.0 acres
	1.3%	1.1%	0.6%	0.2%	0.3%	0.4%	0.0%	0.4%
Urban Buildup	487.2 acres	342.8 acres	150.2 acres	137.8 acres	56.4 acres	103.7 acres	84.0 acres	91.2 acres
	45.3%	53.7%	49.1%	55.3%	24.0%	45.3%	50.5%	34.3%
Urban Grasses	59.2 acres	52.8 acres	4.4 acres	2.8 acres	2.6 acres	0.8 acres	2.4 acres	2.0 acres
	5.5%	8.3%	1.4%	1.1%	1.1%	0.3%	1.4%	0.7%
Wetlands	103.5 acres	24.2 acres	6.8 acres	9.3 acres	44.6 acres	27.4 acres	10.5 acres	16.7 acres
	9.6%	3.8%	2.2%	3.8%	18.9%	11.9%	6.3%	6.3%
Totals	1,076.5 acres	638.8 acres	306.8 acres	248.8 acres	235.6 acres	229.5 acres	166.6 acres	265.7 acres

Source: *SC DHEC, Total Maximum Daily Loads for Fecal Coliform in Shellfish Waters of the Murrell's Inlet Estuary, South Carolina (2005).*

The TMDL assessment analyzed water quality samples taken at these monitoring sites over a three year period from September 2001 to August 2004. Water quality data collected at these sites indicate that five sites exceeded both the geometric mean (14/100ml) and the no more than 10% exceedance (43/100ml) fecal coliform standards. The remaining three stations did not meet the requirements for the 10% exceedance standard. A summary of water quality measurements at the eight monitoring stations examined during this TMDL study are provided in **Table 3-5** below:

Table 3-5 Fecal Coliform Sample Data from September 2001-August 2004 at Impaired Monitoring Stations in the Murrells Inlet Estuary						
Water Quality Monitoring Station	**Number of Measurements**	**Geometric Mean**	**# of Samples above 43/100ml**	**% of Samples above 43/100ml**	**Violates Geometric Mean Standard**	**Violates 10% Exceedance Standard**
Main Creek Subwatershed (HUC: 03040207020)						
04-01	36	42.9	19	53%	YES	YES
04-01A	17	30.6	7	41%	YES	YES
04-02	45	7.5	6	13%	NO	YES
04-27	36	13.4	8	22%	NO	YES
Allston Creek Subwatershed (HUC: 03040207020)						
04-06	50	8.7	12	24%	NO	YES
Parsonage Creek Subwatershed (HUC: 03040207020)						
04-08	36	24.4	15	42%	YES	YES
04-16	35	72.7	19	54%	YES	YES
Garden City Canal Subwatershed (HUC: 03040207020)						
04-26	48	14.7	12	25%	YES	YES

Source: *SC DHEC, Total Maximum Daily Loads for Fecal Coliform in Shellfish Waters of the Murrell's Inlet Estuary, South Carolina (2005).*

The primary environmental variables examined in this study were water temperature, tidal stage, total 24-hour precipitation, and salinity levels. The strongest relationship observed was between fecal coliform levels and salinity levels. In-stream fecal coliform levels appear to be highest during times with substantial freshwater inputs and decline when salinity levels increase. This causal relationship indicates that wet weather events are a probable contributor to fecal coliform contamination conditions in the Murrells Inlet estuary. Previous research in the Murrells Inlet area suggests that the fecal coliform pollutant loadings in the estuary are mostly from non-human sources.

A pollutant source assessment was conducted to identify potential sources of fecal coliform loadings to the Murrells Inlet estuary. An inventory of point source dischargers reveals that there are no direct dischargers from wastewater treatment facilities or industrial sites into the Murrells Inlet estuary. Grand Strand Water and Sewer Authority and Georgetown County Water and Sewer District do provide centralized sewer service to residential and commercial properties within this watershed. There are a total of 54 lift stations within the study area that could cause fecal coliform loadings if they fail. However, both management agencies have emergency power sources and a notification system if a station experiences a mechanical malfuntction. Therefore, the centralized sewer system within the watershed is not believed to be a source of fecal coliform pollution.

The Murrells Inlet watershed is located in a designated MS4 NPDES stormwater permitted area. Both Georgetown County and Horry County administer a stormwater management program in their respective jurisdictions. This program is structured to reduce stormwater runoff related pollutant sources to the maximum extent practicable. The Murrells Inlet area does attract substantial boat traffic. There are several marinas within the watershed which provide septage pumpout facilities to their boating customers. Marinas are required to locate outside of an established shellfish harvesting closure zone. Many of the marinas are located in portions of the watershed that are not impaired for fecal coliform so it is doubtful that these marina facilities are significant sources of fecal coliform to the watershed system.

An analysis of potential non-point sources of pollution indicates that there are several potential sources that may contribute to elevated fecal coliform loadings to the Murrells Inlet estuary. Stormwater runoff from urban and suburban areas not covered by the existing MS4 permit is a significant problem in the watershed area. A survey of residential buildings indicate that there are approximately 119 residences adjacent to the Main Creek portion of the estuary that rely on septic systems for onsite wastewater management. Although only two were showing signs of system malfunction, there is a possibility that over time the other septic system units could cause water quality problems if they are not properly maintained. Wildlife are a potential source of fecal coliform loadings in the Murrells Inlet estuary as well. The watershed provides exceptional habitat for waterfowl and also support large populations of other wildlife species such as deer, especially in natural areas including Huntington Beach State Park and Brookgreen Gardens. Domestic pets can be sources of fecal coliform loadings if their waste is not disposed of properly. It is estimated that approximately 273 cats and 240 dogs reside in the watershed. This is an ongoing management issue that requires public awareness and adherence to local ordinances. Finally, although it is not a suspected problem in the Murrells Inlet community, there are a number of recreational boats that navigate through the estuary, therefore a potential for illegal dumping of onboard septage does exist in this watershed. A summary assessment of existing fecal coliform sources and loadings based on water quality samples collected between September 2001 and August 2004 is provided in **Table 3-6**:

Table 3-6 Estimated Daily Average Fecal Coliform Loadings to Impaired Sections of Murrells Inlet Estuary

Impaired System	Nonpoint sources	Septic Systems	Total Loading
Main Creek	1.5x10^12 (cfu/day)	1.4x10^10 (cfu/day)	1.5x10^12 (cfu/day)
Parsonage Creek/ Allston Creek	3.4x10^11 (cfu/day)	0	3.4x10^12 (cfu/day)
Garden City Canal	1.1x10^11 (cfu/day)	0	1.1x10^11 (cfu/day)

***Source**: SC DHEC, Total Maximum Daily Loads for Fecal Coliform in Shellfish Waters of the Murrell's Inlet Estuary, South Carolina (2005)*

The Critical Conditions established for the Murrells Inlet estuary TMDL were defined as periods of low tidal flows, which result in the least amount of dilution for fecal coliform entering the system. The Critical Conditions were therefore set at the 10th percentile value of the daily tidally influenced flows computed during the flow balance. **Table 3-7** provides a summary of the Wasteload Allocation, Load Allocation, and the Margin of Safety for the fecal coliform TMDL in the Murrells Inlet Estuary. For this TMDL, the Wasteload Allocation was set at zero since there are no known point source dischargers in the watershed. The Load Allocation, accounting for non-point sources, varied between the three subwatersheds delineated in the estuary. The Margin of Safety was set at 5% of existing water quality standards meaning the target water quality goals were set at 13.3cfu/mL for the geometric mean and 40.9cfu/mL for the 10% exceedance standard.

Table 3-7 TMDL Summary for the Murrells Inlet Estuary

TMDL (counts/day)	WLA (counts/day)	MS4 WLA (% Reduction)	LA (% Reduction)	Explicit MOS	% Reduction needed to meet geometric mean standard	% Reduction needed to meet 10% excceedance standard
Main Creek Subwatershed (Impaired Stations 04-01, 04-01A, 04-02, 04-27)						
3.8x10^11	N/A	80.4%	80.4%	5%	80.4%	76.5%
Parsonage Creek/ Allston Subwatershed (Impaired Stations 04-08, 04-16, 04-06)						
3.9x10^10	N/A	N/A	81.4%	5%	53.5%	81.4%
Garden City Canal Subwatershed (Impaired Station 04-26)						
4.4x10^10	N/A	N/A	71.4%	5%	0.0%	71.4%

Note: Abbreviations include: WLA- Wasteload Allocation, LA- Load Allocation, MOS- Margin of Safety, N/A- Not Applicable
Source: *SC DHEC, Total Maximum Daily Loads for Fecal Coliform in Shellfish Waters of the Murrells Inlet Estuary, South Carolina (2005)*

The complete Shellfish Waters Fecal Coliform TMDL for the Murrells Inlet estuary can be accessed via SC DHEC's website at the following link: http://www.scdhec.gov/environment/water/tmdl/docs/tmdl_murrells_fc.pdf

Fecal Coliform in Shellfish Waters of the Litchfield- Pawleys Island Estuary, SC

A Fecal Coliform in Shellfish Waters TMDL for the Litchfield- Pawleys Island estuary was approved by SC DHEC and US EPA in April 2005. The Litchfield- Pawleys Island estuary is one of several areas along the coast of South Carolina that is suitable for the cultivation of harvestable shellfish species. The Litchfield- Pawleys Island estuary is one of 25 habitat areas designated as a Shellfish Management Area in the state. The Litchfield- Pawleys Island estuary is located within Shellfish Management Area# MA 04. There is a total of 3,108 acres of suitable shellfish habitat in management area MA 04, of that 1256 acres are part of the Litchfield- Pawleys Island estuary.

The fecal coliform water quality numeric criteria that are established for Shellfish Harvesting Waters (SFH) are as follows:

- Not to exceed a Most Probable Number (MPN) geometric mean of 14/100ml
- No more than 10 percent of all samples shall exceed an MPN of 43/100ml

Water quality impairments caused by fecal coliform contamination were identified at eight SCDHEC monitoring stations, which led to the placement of these sites on the 2004 South Carolina 303(d) list of impaired waterbodies. Many stream segments within this watershed are designated as Shellfish Harvesting Waters which are now subsequently classified as Restricted to harvesting activities due to the presence of elevated levels of fecal coliform bacteria. A list of all the water quality monitoring stations that are located within the Litchfield- Pawleys Island TMDL boundary area are provided in **Table 3-8** below.

Table 3-8 Monitoring Sites with an Established TMDL for the Litchfield-Pawleys Island Estuary HUC#: 03040208-04							
12-digit HUC Code	**Description**	**Station**	**County**	**Use**	**Cause**	**Use Support**	**Approval Date**
030402080401	Clubhouse Creek at Litchfield Boulevard Bridge	04-09	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080401	Shell Avenue and Pawleys Island Creek	04-10	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080401	North Causeway Bridge at Pawleys Island Creek	04-11	Georgetown	SHELLFISH	FC	Fully Supported	7/19/05
030402080401	South Causeway Bridge at Pawleys Island Creek	04-12	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080401	Pawleys Inlet	04-13	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080401	Clubhouse Creek at Dock End of Sportsman Boulevard	04-14	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080401	Clubhouse Creek- First Bend South of Salt Marsh Cove	04-19	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080401	Pawleys Island Sound, Inlet South Boat Landing	04-21	Georgetown	SHELLFISH	FC	Not Supported	7/19/05
030402080403	Midway Inlet	04-15	Georgetown	SHELLFISH	FC	Not Supported	7/19/05

Note: *Abbreviations include FC: Fecal Coliform*
Source: *SC Department of Health and Environmental Control, The State of South Carolina's 2010 Integrated Report. Part I: Listing of Impaired Waters.*

The Litchfield- Pawleys Island estuary has a linear geography, extending 5.5 nautical miles parallel to the Atlantic Ocean and is less than 0.5 nautical mile wide. Water depths within this estuary are generally less than 2.5 meters. Salinity within the estuary is generally above 30 parts per thousand (ppt), and freshwater inputs are primarily limited to direct precipitation and associated runoff from nearby areas.

It is known that surrounding land use characteristics can influence fecal coliform loadings in nearby waterbodies. As part of this TMDL, a land use assessment was completed for this 5,250 acre watershed. Within this area, 1,256 acres are suitable habitat for shellfish production. Approximately 4,886 acres within the watershed drain through one of the eight monitoring stations listed as impaired for the fecal coliform standard. The watershed is characterized by the following general land use descriptions: forest (44%), open water/beach (23%), urban development (9%), wetlands (20%), and urban/recreation (3%).

This TMDL study divided the estuary into eight subwatersheds utilizing the eight impaired monitoring stations as reference points. A more detailed analysis of the surrounding land use characteristics of each subwatershed is provided in **Table 3-9.**

Table 3-9: Land Use Acreage and Percentage Profile of Each Subwatershed in the Litchfield-Pawleys Island Estuary								
Land Use Description	**04-09**	**04-14**	**04-19**	**04-12**	**04-11**	**04-10**	**04-21**	**04-13**
Barren	131.3 acres	19.3 acres	20.1 acres	19.7 acres	19.1 acres	28.4 acres	31.0 acres	35.6 acres
	13.0%	5.9%	5.9%	4.0%	4.1%	6.5%	5.1%	2.9%
Forest	370.6 acres	152.7 acres	93.4 acres	216.3 acres	201.0 acres	166.2 acres	242.3 acres	852.9 acres
	36.8%	46.6%	27.4%	44.5%	43.2%	37.8%	39.6%	70.7%
Open Water	80.2 acres	40.9 acres	70.7 acres	117.4 acres	91.6 acres	103.7 acres	174.2 acres	51.4acres
	7.9%	12.5%	20.8%	24.1%	19.7%	23.6%	28.6%	4.3%
Pasture/ hay	8.7 acres	0.0 acres	0.0 acres	17.5 acres	4.8 acres	3.8 acres	7.2 acres	0.2 acres
	0.9%	0.0%	0.0%	3.6%	1.0%	0.9%	1.2%	0.1%
Urban Buildup	100.5 acres	45.1 acres	29.2 acres	68.3 acres	116.0 acres	52.6 acres	15.3 acres	13.7 acres
	9.9%	13.8%	8.6%	14.0%	24.9%	12.0%	2.5%	1.1%
Urban Grasses	18.7 acres	5.4 acres	0.2 acres	0.4 acres	2.0 acres	2.2 acres	72.9 acres	27.4 acres
	1.8%	1.6%	0.1%	0.1%	0.4%	0.5%	12.0%	2.3%
Wetlands	300.3 acres	64.2 acres	126.9 acres	47.3 acres	31.4 acres	81.8 acres	66.9 acres	225.8 acres
	29.7%	19.6%	37.2%	9.7%	6.7%	18.7%	11.0%	18.7%
Totals	1,010.3 acres	327.6 acres	340.5 acres	486.9 acres	465.9 acres	438.7 acres	609.8 acres	1,207.0 acres

Source: *SC DHEC, Total Maximum Daily Loads for Fecal Coliform in Shellfish Waters of the Litchfield- Pawleys Island Estuary, South Carolina (2005).*

The TMDL assessment analyzed water quality samples were taken at these monitoring sites over a three year period from September 2001 to August 2004. Water quality data collected at these sites indicate that six sites exceeded both the geometric mean (14/100ml) and the no more than 10% exceedance (43/100ml) fecal coliform standards. The remaining two stations did not meet the requirements for the 10% exceedance standard. A summary of water quality measurements at the eight monitoring stations examined during this TMDL study are provided in **Table 3-10** below:

Table 3-10 Fecal Coliform Sample Data from September 2001-August 2004 at Impaired Monitoring Stations in the Litchfield-Pawleys Island Estuary						
Water Quality Monitoring Station	**Number of Measurements**	**Geometric Mean**	**# of Samples above 43/100ml**	**% of Samples above 43/100ml**	**Violates Geometric Mean Standard**	**Violates 10% Exceedance Standard**
Clubhouse Creek Subwatershed (HUC: 03040207040)						
04-09	36	54.3	21	58%	YES	YES
04-14	36	48.5	19	53%	YES	YES
04-19	36	43.8	15	42%	YES	YES
Pawley's Island Creek Subwatershed (HUC: 03040207040)						
04-12	36	35.5	13	36%	YES	YES
04-11	36	14.2	10	28%	YES	YES
04-10	37	22.3	15	41%	YES	YES
South Pawley's Island Subwatershed (HUC: 03040207040)						
04-21	37	17.3	12	32%	NO	YES
04-13	37	9.5	8	22%	NO	YES

Source: *SC DHEC, Total Maximum Daily Loads for Fecal Coliform in Shellfish Waters of the Litchfield- Pawleys Island Estuary, South Carolina (2005).*

The primary environmental variables examined in this study were water temperature, tidal stage, total 24-hour precipitation, and salinity levels. The strongest relationship observed was between fecal coliform levels and salinity levels. In-stream fecal coliform levels appear to be highest during times with substantial freshwater inputs and decline when salinity levels increase. This causal relationship indicates that wet weather events are a probable contributor to fecal coliform contamination occurrences in the Litchfield- Pawley's Island estuary.

A pollutant source assessment was conducted to identify potential sources of fecal coliform loadings to the Litchfield-Pawleys Island estuary. An inventory of point source dischargers reveals that there are no direct dischargers from wastewater treatment facilities or industrial sites into the Litchfield- Pawleys Island estuary. There is a NPDES-permitted land application site in the watershed at Inlet Point South Phase II (permit# ND0074616). This facility applies treated effluent to an on-site golf course and does not discharge directly to the estuary. Georgetown County Water and Sewer District provides centralized sewer service to residential and commercial properties within this watershed. There are a total of 37 lift stations within the study area that could cause fecal coliform loadings if they fail. However, Georgetown County Water and Sewer District has emergency power sources and a notification system in place if a station experiences a mechanical malfunction. Therefore, the centralized sewer system within the watershed is not believed to be a source of fecal coliform pollution.

Currently there are no permitted MS4 Stormwater NPDES jurisdictions within the Litchfield- Pawleys Island estuary watershed at this time. However, due to significant growth along the Waccamaw Neck portion of Georgetown County, it is highly probable that portions of the watershed will meet the MS4 Phase II population thresholds at some point in the future. Georgetown County administers a stormwater management program, which is structured to reduce stormwater runoff related pollutant sources to the maximum extent practicable.

An analysis of potential non-point sources of pollution indicates that there are several potential sources that may contribute to elevated fecal coliform loadings in the Litchfield- Pawleys Island estuary. Potential non-point sources include urban and suburban stormwater runoff, individual sewage treatment and disposal systems, wild and domestic animals, and boat traffic. The recent population increase has resulted in the construction of associated development including single and multi-family housing, golf courses, and commercial shopping centers. A 2001 septic system survey conducted in the Litchfield- Pawleys Island estuary indicated that the Marysville community in the Pawleys Island area had numerous malfunctioning septic systems. Although this poses a water quality concern, the Marysville community is located one mile from the estuary and there is a golf course located between the estuary and the Marysville community. Therefore, these failing septic systems are not considered a major contamination threat to the Litchfield- Pawleys Island estuary. Marine and boat related sources of fecal coliform are unlikely due to the absence of marinas within the estuary and the shallow water depth which limits traffic from larger boat vessels.

Wildlife are a significant potential source of fecal coliform loadings in the Litchfield- Pawleys Island estuary. The watershed provides exceptional habitat for shorebirds and also support large populations of other wildlife species such as deer, rabbit, raccoon, and opossum. Domestic pets can be sources of fecal coliform loadings if their waste is not disposed of properly. Based on 1997 residential population figures it is estimated that approximately 138 cats and 122 dogs reside in the watershed. This total pet population suggests that domestic pets are not a major contributor to fecal coliform loadings to the Litchfield-Pawley's Island estuary. However, as local resident populations continue to increase this will be an ongoing management issue that requires public awareness and adherence to local ordinances. Finally, although it is not a suspected problem in the Litchfield- Pawleys Island area, there are a number of recreational boats that navigate through the estuary, therefore a potential for illegal dumping of onboard septage does exist in this watershed.

A summary assessment of existing fecal coliform sources and loadings based on water quality samples collected between September 2001 and August 2004 is provided in **Table 3-11.**

Table 3-11 Estimated Daily Average Fecal Coliform Loadings to Impaired Sections of the Litchfield- Pawleys Island Estuary			
Impaired System	**Nonpoint sources**	**Septic Systems**	**Total Loading**
Clubhouse Creek	4.5x10^11 (cfu/day)	5.0x10^10 (cfu/day)	5.0x10^11 (cfu/day)
Pawley's Island Creek	3.2x10^11 (cfu/day)	2.6x10^10 (cfu/day)	3.4x10^11 (cfu/day)
South Pawley's Island	3.9x10^11 (cfu/day)	1.0x10^10 (cfu/day)	4.9x10^11 (cfu/day)
Source: *SC DHEC, Total Maximum Daily Loads for Fecal Coliform in Shellfish Waters of the Litchfield- Pawley's Island Estuary, South Carolina (2005).*			

The critical conditions established for the Litchfield- Pawleys Island estuary TMDL were defined as periods of low tidal flows, which result in the least amount of dilution for fecal coliform entering the system. The critical conditions were set at the 10th percentile value of the daily tidally influenced flows computed during the flow balance. **Table 3-12** provides a summary of the Wasteload Allocation, Load Allocation, and the Margin of Safety for the fecal coliform TMDL in the Murrells Inlet Estuary. For this TMDL, the Wasteload Allocation was set at zero since there are no point source dischargers in the watershed. The Load Allocation, accounting for non-point sources varied between the three subwatersheds delineated in the estuary and the Margin of Safety was set at 5% of existing water quality standards meaning the target water quality goals were set at 13.3cfu/mL for the geometric mean and 40.9cfu/mL for the 10% exceedance standard.

Table 3-12 TMDL Summary for the Litchfield- Pawleys Island Estuary						
TMDL (counts/day)	**WLA (counts/day)**	**MS4 WLA (% Reduction)**	**LA (% Reduction)**	**Explicit MOS**	**% Reduction needed to meet geometric mean standard**	**% Reduction needed to meet 10% excceedance standard**
Clubhouse Creek Subwatershed (Impaired Stations 04-09, 04-14, 04-15, 04-19)						
3.7x10^10	N/A	N/A	95.2%	5%	71.6%	95.2%
Pawley's Island Creek Subwatershed (Impaired Stations 04-10, 04-11, 04-12)						
3.8x10^10	N/A	N/A	94.2%	5%	40.9%	94.2%
South Pawley's Island (Impaired Station 04-13 and 04-21)						
2.4x10^10	N/A	N/A	70.0%	5%	17.9%	70.04%
Note: Abbreviations include: WLA- Wasteload Allocation, LA- Load Allocation, MOS- Margin of Safety ***Source:*** *SC DHEC, Total Maximum Daily Loads for Fecal Coliform in Shellfish Waters of the Litchfield-Pawleys Island Estuary, South Carolina. 2005*						

The complete Shellfish Waters Fecal Coliform TMDL for the Litchfield-Pawleys Island Estuary can be accessed via SC DHEC's website at the following link: http://www.scdhec.gov/environment/water/tmdl/docs/tmdl_litchfld_pawleys_fc.pdf

Fecal Coliform for Chinners Swamp of the Pee Dee River Basin, SC

In September 2005, SC DHEC and the US EPA approved a fecal coliform bacteria TMDL that covers nine separate subwatersheds within the Pee Dee River Basin in South Carolina. The TMDL was drafted in response to fecal coliform primary contact recreation use water quality standard violations at SC DHEC water quality monitoring sites within these waterbodies. These sites were previously placed on the 2004 South Carolina 303 (d) list of impaired waters. The Chinners Swamp watershed located in Horry County is included in this TMDL document. Information pertaining to the conditions set forth in this TMDL document as it relates to the Chinners Swamp watershed is outlined in the following section.

The Chinners Swamp watershed encompasses an area of 27,264 acres. This part of Horry County is primarily rural with 36 percent of the land cover being forested and 28 percent is described as wooded wetland areas. Agriculture uses are

prevalent and include 4 percent pasture land and 30 percent dedicated to row crops. Only a small fraction of the land area, roughly 2 percent, is utilized for residential or commercial land use purposes. The Town of Aynor is the most well developed area within the watershed. Chinners Swamp is a blackwater system common to the Coastal Plain in South Carolina. Chinners Swamp is part of the larger Brunson Swamp watershed system which encompasses 44,600 acres of total land area in Horry County.

Table 3-13 below provides information regarding the PD-352 monitoring site that is used to measure water quality parameters within the Chinners Swamp watershed. A total of 23 samples taken between 1998 and 2002 were used to evaluate fecal coliform impairment conditions in the Chinners Swamp watershed. Data from these samples was utilized to develop target pollutant reduction goals, which are outlined in the TMDL. Impairments within this watershed were identified based on the percentage of water samples that exceeded 400cfu/100ml. During the sampling period, 17% of the 23 samples at monitoring station PD-352 were greater than the 400cfu/100mL numeric standard, above the ten percent exceedance limit. The maximum concentration of fecal coliform at this monitoring station was 900cfu/100ml.

Table 3-13 Monitoring Sites with an Established TMDL for the Brunson Swamp Watershed HUC#: 03040204-07

12- Digit HUC Code	Description	Station	County	Use	Cause	Use Support	Approval Date
030402040701	Chinners Swamp at Gunters Island Road off S-26-99	PD-352	Horry	REC	FC	Not Supported	09/11/05

Source: *SC Department of Health and Environmental Control, The State of South Carolina's 2010 Integrated Report. Part I: Listing of Impaired Waters.*

As part of the analysis included in the Fecal Coliform TMDL for the Pee Dee River Basin, a source assessment of the pollutant of concern within each subwatershed area was conducted. This source assessment is the basis of determining Wasteload Allocations (WLAs) for point source dischargers and Load Allocations (LAs) for all identified non-point sources of pollution. A Margin of Safety (MOS) is incorporated into the analysis to account for other pollutant sources that are unknown or not easily quantifiable.

Within the Chinners Swamp watershed there are no continuous point sources of pollution such as wastewater treatment facilities or industrial dischargers. This part of Horry County is also not within the boundaries of a MS4 NPDES permitted stormwater program. Therefore this TMDL evaluation assesses non-point sources of fecal coliform bacteria that are common to areas outside of urban areas. The following section provides an overview of the suspected sources of fecal coliform bacteria in the Chinners Swamp watershed.

Wildlife: Fecal coliform bacteria are produced by humans and other warm-blooded animals such as wildlife species including deer, wild turkey, raccoons, and various other bird species. Based on a study conducted by SC Department of Natural Resources, given the land cover characteristics of the Chinners Swamp watershed there are an estimated 30-45 individual deer per square mile throughout this watershed. A typical deer produces roughly 347x10^6 cfu of fecal coliform per day. Based on the estimated deer population in the Chinners Swamp watershed, it is plausible that deer and other wildlife species are significant contributors to the fecal coliform pollutant loading in this watershed.

Livestock Management: Domestic livestock produce significant amounts of fecal coliform and if not properly managed can be a substantial source of fecal coliform pollution in our watersheds. Studies indicate that a single head of cattle produces 100 billion cfu of fecal coliform per day and pigs produce 11 billion cfu of fecal coliform per day. Many agricultural operations utilize manure products as fertilizer for land application purposes. Concentrated Animal Feeding Operations (CAFOs) are regulated under the NPDES program of the federal Clean Water Act. However, there are currently no existing permitted CAFOs within the State of South Carolina. The state maintains a list of Animal Feeding Operations (AFOs), which are permitted under the No Discharge (ND) Land Application permit system in the state.

Currently there are four permitted swine AFOs located in the Chinners Swamp watershed. Of these AFO sites, one is considered large, one is medium, and two are small operations (both of which are presently inactive). The total permitted swine capacity at these four sites is 9,240 individual animals. The total land available for waste disposal at these AFOs is 23 acres.

Cattle production is another common agriculture activity within the Chinners Swamp watershed. Statistics indicate that a typical 1,000 lbs beef cattle produces 11 tons of manure annually and a 1000 lbs dairy cow produces 15 tons of manure each year. The USDA agricultural census data indicates that there are an estimated 399 cattle managed within the watershed producing a total of 10 tons of manure daily. Another challenge to cattle management is restricting direct access to surface waters such as creeks and streams. Cattle can significantly increase fecal coliform loadings to nearby waterbodies if they are allowed access to these water sources. Two effective best management practices that can help reduce fecal coliform pollutant loadings from livestock agricultural areas are to properly dispose of animal waste and to maintain riparian buffers or install fencing adjacent to surface waterbodies on agricultural sites.

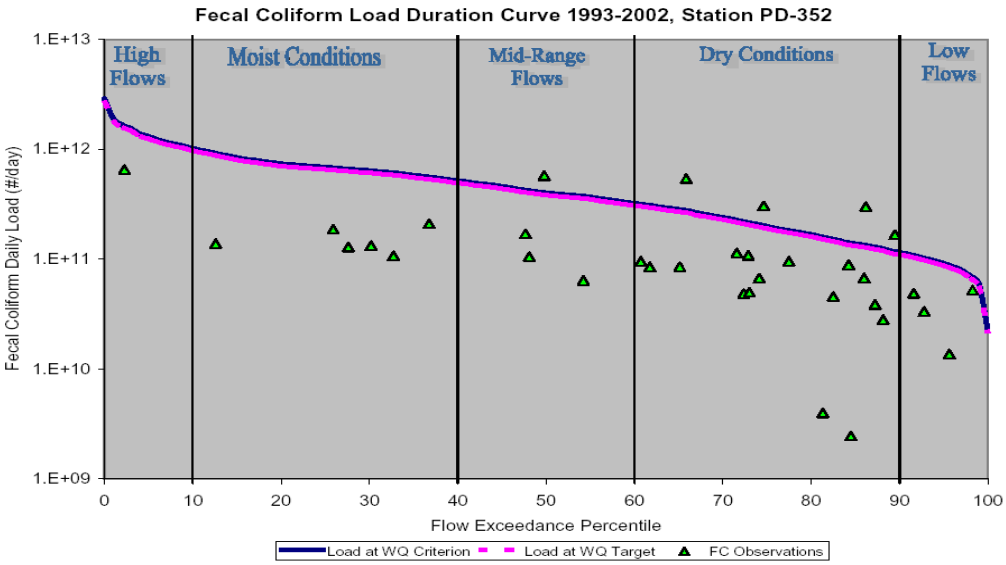
Onsite Wastewater Disposal Systems: Onsite wastewater systems such as septic tanks are commonly utilized in rural areas that are not in close proximity to a centralized sewer system. Improper maintenance of these systems can cause water quality problems by increasing fecal coliform loadings into the environment. US Census figures indicate that there are approximately 941 onsite wastewater systems located within the Chinners Swamp watershed. That equates to roughly three onsite wastewater systems per 100 acres of land area within the watershed. The US Census estimates that ten percent of all existing onsite wastewater systems are malfunctioning. A recent study conducted by SC DHEC suggested that over seven percent of septic systems installed within five years were already beginning to malfunction during high stress conditions such as above normal rainfall. Runoff from properties serviced by onsite wastewater disposal systems are a potential source of fecal coliform loadings in the Chinners Swamp watershed.

Domestic Pets: Another common contributor of non-point sources of fecal coliform pollution are from domestic pets. A typical pet produces 450 million cfu of fecal coliform per day. A widely used figure established by the American Veterinary Medical Association indicates that there is an average of 0.58 dogs and 0.66 cats per household nationally. Extrapolating that figure in Horry County, there are 76,203 dogs and 86,713 cats living in the county.

Although, domestic pets could contribute to the fecal coliform loading in Chinners Swamp, the TMDL document suggests that the biggest pollutant sources of concern within this watershed are from the swine AFOs and onsite wastewater disposal systems. Wildlife and local cattle farms are considered secondary fecal coliform sources of concern in the Chinners Swamp watershed.

TMDL Development Methodology

The fecal coliform TMDL developed for the Pee Dee River Basin utilizes a Load Duration Curve graphic technique to illustrate fecal coliform concentrations in various stream flow conditions. There is a close relationship between flow regime trends and fecal coliform loadings from both point and non-point sources of fecal coliform pollution. This methodology incorporates drainage area ratio-based flow estimates and land use and soil profile information into the water quality model. The Load Duration Curve was also used to estimate and depict nonpoint source loadings during all flow conditions. The Load Duration Curve for the Chinners Swamp watershed is shown below:



A major step in creating the wasteload and load allocations for the TMDL is identifying the hydrological critical conditions that can increase the likelihood of water quality standards violations within a watershed. The rationale is that if water quality standards are attained during instances of critical conditions such as extreme wet weather, then it is anticipated that the standards are met during other normal conditions exhibited in the watershed. The critical condition for the Chinners Swamp watershed are dry conditions as shown in the Load Duration Curve above.

There is a 5 percent margin of safety (MOS) for the normal 400cfu/ 100mL instantaneous water quality criterion established for this TMDL. Therefore the effective targeted water quality standard for the watershed is 380cfu/100mL. As mentioned before there are no distinct point sources of pollutants in this watershed, therefore the Wasteload Allocation (WLA) for this TMDL is set at zero. The existing loading at the PD-352 water quality monitoring station calculated using the 90th percentile is 3.08E+11 per day with a corresponding flow exceedance percentile of 75. This existing loading rate accounts for all known point and non-point sources of pollution in the watershed.

Table 3-14 provides a summary of all of the conditions set forth at the PD-352 water quality monitoring station in the Chinners Swamp watershed to meet the requirement outlined in the Pee Dee River Basin Fecal Coliform TMDL.

Table 3-14 TMDL Summary for the Chinners Swamp Watershed

SCDHEC WQM Station #	WLA's (cfu/day)	MS4 WLA (Percent Reduction)	LA (cfu/day or % reduction)	Margin of Safety	TMDL (cfu/day or % reduction)	Percent Reduction
PD-352	0	NA	1.90E+11	9.98E+09	2.00E+11	39%
Source: *SC DHEC, Total Maximum Daily Loads for Fecal Coliform in Pee Dee River Basin (2005)*						

The complete Fecal Coliform TMDL document for the Pee Dee River Basin can be accessed at the SC DHEC website at the following link: http://www.scdhec.gov/environment/water/tmdl/docs/tmdl_peedee_fc.pdf

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Chapter Four: Wastewater Treatment

INTRODUCTION

Wastewater treatment infrastructure is one of the most important long-term investments for all communities and regions. Wastewater treatment facilities help protect water resources by removing pollutant constituents generated by domestic, and industrial waste streams prior to the ultimate disposal to surface waterbodies or land application sites. This chapter provides an overview of the existing wastewater treatment facilities in the Waccamaw region. A summary of future wastewater treatment needs is outlined and innovative technologies and wastewater management strategies that can be applied in the Waccamaw region are explored. In addition, a list of goals and policy recommendations is included to help guide and coordinate long-term regional wastewater planning efforts.

HISTORICAL BACKGROUND

The Waccamaw Regional Council of Governments has helped to facilitate a regional wastewater treatment planning process with SC DHEC and local governments, industries, and public water utility districts since the 1970s. Water quality management strategies have changed substantially since that time due to increased population and land development, upstream water resource use activities, changes in water quality regulations, and the advance of new wastewater treatment technologies. These changes are the main reason why a periodic review and update of the region's water quality management planning efforts is essential.

The first version of the Waccamaw Region Section 208 Water Quality Management Plan laid the groundwork by identifying the main water quality issues of concern in the region, both from point and non-point sources of pollution, and the specific waterbodies that needed a direct and immediate management response. **Table 4-1** below provides a list of the waterbody segments identified as having critical water quality impairment conditions. The original Section 208 Plan provided a level of priority for each identified waterbody.

Table 4-1 1978 Waccamaw Regional 208 Areawide Water Quality Plan- Critical Water Quality Management Areas

Location	Concern	Priority Level
Myrtle Beach Urban Runoff to Ocean	Stormwater dischargers causing high Fecal Coliform levels in the surf zone.	High
AIWW from Bucksport Landing to Little River Inlet	Frequently violating Dissolved Oxygen and Fecal Coliform water quality standards.	High
AIWW from Bucksport Landing to Highway 17 Bridge	Frequently violating Dissolved Oxygen and Fecal Coliform water quality standards.	Medium
Sampit River	Point source dischargers from both industrial sites and municipal facilities.	High
Winyah Bay	Closure of shellfish harvesting areas due to bacteriological contamination.	Medium
Waccamaw River below Conway	Sensitive waterbody due to naturally low Dissolved Oxygen levels, lower pH, and high temperatures associated with extensive floodplain and adjacent swamp habitats.	Low
Black River near Kingstree	Sensitive waterbody due to naturally low Dissolved Oxygen levels, lower pH, and high temperatures associated with extensive floodplain and adjacent swamp habitats.	Low
Murrells Inlet	Closure of shellfish harvesting areas due to bacteriological contamination, likely from septic system failure. Other non-point runoff concerns include elevated heavy metal concentrations.	High

Note: Priority rankings defined as follows: **High-** Should receive current attention. **Medium-** Should receive attention within five years. **Low-** Should receive attention as funds become available after other problems have been resolved.
Source: *1978 Waccamaw Regional 208 Areawide Water Quality Plan.*

Another major accomplishment of the 1978 Waccamaw Region Section 208 Water Quality Management Plan was to designate the appropriate management agency to provide centralized wastewater treatment service to each community within Williamsburg, Georgetown, and Horry Counties. A list of each designated point source management agency can be found in **Chapter 11- Section 208 Program and Administrative Procedures.** This process also included the establishment of the Section 208 planning boundaries for each designated point source management agency. **Exhibit 11.1** is a map with the existing Section 208 planning boundaries for each designated point source management agency.

Since the initial Section 208 Plan was adopted, designated point source management agencies have progressively expanded their wastewater treatment facility capacities to meet increased centralized sewer service demand and to connect residential units utilizing onsite septic systems to the larger regional system. Each management agency has also implemented facility upgrades as necessary to meet new water quality standards and to fulfill requirements established by approved TMDLs in the Waccamaw region. Regional wastewater treatment management efforts have helped address numerous water quality concerns and have had positive impacts on the economy and the overall quality of life for residents and visitors of the Waccamaw region.

Even with the substantial previous investment and regional coordination, there are many water quality issues that still remain today. This emphasizes the reality that water quality management is an ongoing effort. A one-time investment cannot perpetually resolve all water quality concerns. The remainder of this chapter investigates current wastewater treatment methods and evaluates potential strategies that can be employed to ensure that the future water quality of the Waccamaw region is protected and maintained.

EXISTING WASTEWATER TREATMENT RESOURCES

There are numerous wastewater treatment facilities throughout the Waccamaw region. Within each county there are publicly operated wastewater utilities providing centralized sewer service to residents in each community. There are also several industries in each county that discharge treated effluent to nearby surface waters. **Insert 4A** and **Insert 4B** provides a detailed overview of each of the point source discharge facilities located in the Waccamaw region. Information provided includes the location, treatment capacity, and the receiving waterbody of the discharged effluent from each facility. A detailed summary of the effluent limits incorporated into each of the facility's NPDES point source discharge permits is also provided.

WASTEWATER TREATMENT MANAGEMENT ISSUES

The wastewater treatment system consists of several individual stages or components including the expansive sewer line collection network and associated pump stations, each process stage at the wastewater treatment facility, the final effluent disposal method, and the biosolids handling process. Each of these elements requires ongoing management to keep the entire system operating effectively. The following section examines the typical management challenges associated with meeting wastewater service demands at a reasonable cost while ensuring that the facility remains in compliance with the discharge limits set forth in each respective NPDES permit.

Insert 4A- Waccamaw Region Wastewater Treatment Facilities, General Information

Horry County NPDES Wastewater Treatment Facility- General Information

Wastewater Treatment Facility	NPDES Permit #	Location	Type of Wastewater	Receiving Waterbody	Watershed HUC Unit	Quantity (MGD)	Current Average Daily Flow Rate	Notes
AVX Corporation- Conway Plant	SC0048402	2875 Hwy 501 E Conway, SC 29526	Industrial	Socastee Swamp	03040206-09	Monitor and Report	0.023 MGD	
GSWSA/ Loris Wastewater Treatment Facility	SC0025348	Approximately 2,000 feet east of Bayboro Street, adjacent to Plesant Meadow Swamp in Horry County, South Carolina	Municipal	Pleasant Meadow Swamp	03040204-06	0.7 MGD	0.6 MGD	
GSWSA/ Schwartz/ Myrtle Beach Plant	SC0037753	Schwartz: on Freewoods Rd, approximately 1700 ft south of its intersection with Enterprise Road, Horry County, SC; Myrtle Beach: Off of Mr. Joe White Ave, approximately 3000 ft north of the intersection of Mr. Joe White Ave and Hwy 17 bypass	Municipal	Waccamaw River	Schwartz:03040206-10/ Myrtle Beach:03040208-03	Schwartz: 19.35MGD/ Myrtle Beach: 17.0 MGD (expanding to 22.4MGD)	Schwartz: 10.90 MGD Myrtle Beach: 9.29 MGD	1. Over 2.9 GPD of treated wastewater is applied to 4 separate land application sites(GSWSA Turf Farm, Island Green Golf Course, MG Golf and Yacht, Tip Top Tree Farm- ND0078921)2. This wastewater treatment facility treats 24,000 GPD of influent from one industrial site, AVX Corporation in their service area.
GSWSA/ Bucksport WWTF	SC0040886	East of Secondary Road 48 and 1/2 mile northwest of the Waccamaw River in Bucksport	Municipal	Waccamaw River	03040206-10	0.3 MGD	N/A	
GSWSA/ Conway WWTP	SC0021733	New Road, Conway,SC	Municipal	unnamed ditch to Woodland Swamp to Lake Bushy Canal to Wadus Lake to Waccamaw River	03040206-09	4.0 MGD	2.3 MGD	
GSWSA/ George R Vereen WWTP	SC0041696	approximately one mile south of the intersection of SC Highway 90 and Secondary Road 57 in the Wampee Community in Horry County, SC	Municipal	Carolina Bays Wetland System/ Atlantic Intracoastal Waterway	03040208-03	7.0 MGD	3.63 MGD	
GSWSA/ Central Wetlands WWTP	SC0039900	Jackson Bluff Road, west of SC Highway 544 southwest of Conway	Municipal	Riverine Wetlands to Waccamaw River	03040206-09	1.2 MGD Capacity/ 0.616 MGD permitted flow		Currently used as an equalization basin to pretreat and store of influent to the Schwartz WWTP
GSWSA/ Longs WWTP	SC0040878	A point 1/2 mile south of the intersection of SC Highway 9 and 905 in the Longs community in Horry County	Municipal	Waccamaw	3040206-07	0.20 MGD	N/A	
North Myrtle Beach- Crescent Beach	SC0022161	End of 27th Avenue South on Airport property in North Myrtle Beach, SC	Municipal	Atlantic Intracoastal Waterway	03040208-03	2.9 MGD	1.1 MGD	
North Myrtle Beach- Ocean Drive	SC0022152	Intersection of 2nd Avenue South and Bay Street of Hwy 17 in North Myrtle Beach, SC	Municipal	Atlantic Intracoastal Waterway	03040208-03	4.5 MGD	2.0 MGD	
AVX Corporation- Myrtle Beach Plant	SC0047953	801 17th Avenue, Myrtle Beach, SC 29577	Industrial	Withers Swash	03040208-03	Monitor and Report	0.03967 MGD	
Santee Cooper Dolphus Grainger Generating Station	SC0001104	1605 Marina Dr. Conway, SC 29526	Electric Services	Waccamaw River	03040206-09	Monitor and Report	1.425 MGD	

Williamsburg County NPDES Wastewater Treatment Facility- General Information

Wastewater Treatment Facility	NPDES Permit #	Location	Type of Wastewater	Receiving Waterbody	Watershed HUC Unit	Quantity (MGD)	Current Average Daily Flow Rate	Notes
Kingstree Wastewater Treatment Plant	SC0035971	SC Highway #527 by-pass, 0.5 miles south of US Highway #52 in the Town of Kingstree, Williamsburg County	Municipal	Black River	03040205-07	3.5 MGD	2.0132 MGD	
Town of Hemingway	SC0039934	Off of Secondary Road S-45-444, approximately 1 mile north of its intersection with S-45-34, northeast of Hemingway in Williamsburg County	Municipal	Clarks Creek to Pee Dee River	03040207-02	0.45 MGD	0.357 MGD	
Williamsburg Co/Santee River WWTF	SC0048097	US Highway 52 near Heineman, Williamsburg County, South Carolina	Municipal	Santee River	03050112-01	0.6 MGD	0.307 MGD	
Martek Biosciences- Kingstree	SC0003123	1416 N Williamsburg Hwy, Kingstree, SC	Industrial	Unamed Tributary to Broad Swamp and to Black River	03040205-07	Monitor and Report	0.143 MGD	
Town of Greeleyville	ND0077968		Municipal	Dedicated Spray Site, Santee River Watershed	03050112-01	0.036 MGD		
Milliken and Co./ Kingstree Mill	SC0023493	SC Hwy 377, Kingstree/ Williamsburg County, South Carolina	Industrial	Black River	03040205-07	Monitor and Report	0.56 MGD	

Georgetown County NPDES Wastewater Treatment Facility- General Information

Wastewater Treatment Facility	NPDES Permit #	Location	Type of Wastewater	Receiving Waterbody	Watershed HUC Unit	Quantity (MGD)	Current Average Daily Flow Rate	Notes
3V Incorporated	SC0036111	Pennyroyal Road, Georgetown County, South Carolina	Industrial	Sampit River	03040207-01	15.0 MGD	3.86 MGD	
City of Georgetown Sewage Treatment Facility	SC0040029	West Street, Georgetown, SC 29442	Municipal	Sampit River	03040207-01	12.0 MGD	3.9 MGD	Permit conditions require treated effluent to be discharged at the outgoing tide
CWS/White Creek-Lincolnshire	SC0030732	Shady Grove Lane Off Hwy 521, Georgetown, SC 29442	Municipal	Whites Creek to Sampit River	03040207-01	Monitor and Report	0.1335 MGD	
GCWSD/ Debordieu WWTP	SC0048984	Firehouse Lane Georgetown, SC 29440	Municipal	Waccamaw River	03040208-04	0.375 MGD (Nov- Feb), 0.5 MGD (Mar-Oct)	N/A	Land Application site: permit # ND0065668 must be utilized at maximum effluent storage capacity prior to discharge to Waccamaw River.
GCWSD/North Santee WWTP	SC0042439	566 Earl Road, Sampit Area in Georgetown County	Municipal	North Santee River	03050112-06	0.52 MGD	0.0284 MGD	
Georgetown County School District Pleasant Hill Elementary	SC0039101	127 Schoolhouse Road, Hemingway, SC 29554	School Facility	Bosser Swamp to Port Creek to Pee Dee River	03040207-02	0.018 MGD	0.003 MGD	
International Paper Georgetown Mill	SC0000868	700 S. Kaminski St. Georgetown, SC	Industrial	Sampit River to Winyah Bay	03040207-01	Monitor and Report	27.9 MGD	
Simpson Lumber Co. Sampit Lumber Mill	SC0046582	2701 Indian Hut Road, Georgetown, SC 29442	Industrial	Unnamed Tributary to Indian Hunt Swamp to Black River	03040205-09	Monitor and Report		
International Paper/ Santee	SC0042960	5956 Fraser St. Georgetown, SC 29440	Industrial	Unnamed Tributary to Turkey Creek to Sampit River	03040207-01	Monitor and Report		
Georgetown Steel Company, LLC	SC0001431	South Fraser Street, Georgetown, SC	Industrial	Sampit River	03040207-01	Monitor and Report	0.25 MGD (August 2008-July 2009)	
GCWSD/Murrells Inlet Wastewater Treatment Plant	SC0040959	1441 Pond Road, Murrells Inlet, SC	Municipal	Waccamaw River	03040206-10	2.0 MGD	1.015 MGD	
GCWSD/Pawleys Island Wastewater Treatment Plant	SC0039951	456 Clearwater Drive, Pawley's Island, SC 29585	Municipal	Waccamaw River	03040206-10	5.5 MGD	2.15 MGD	
Santee Cooper Winyah Generating Station	SC0022471	661 Steam Plant Dr., Georgetown, SC 29440	Industrial	Sampit River	03040207-01	Monitor and Report		
Trebol USA LLC	SC0001619	641 South Rosemary St. Andrews, SC 29510	Industrial	Black River	03040205-09	Monitor and Report	0.0858 MGD	
Inlet Point South Phase III	ND0074616	Inlet Point Drive, Pawleys Island, SC 29585	Private- Domestic	Dedicated Spray Field	03040208-04	0.014 MGD		

Insert 4B- Waccamaw Region Wastewater Treatment Facilities- NPDES Permit Discharge Limits

Horry County NPDES Wastewater Treatment Facility- Permitted Effluent Limits

Wastewater Treatment Facility	NPDES Permit #	Quantity (MGD)	BOD (lbs/day)	NH3-N (mg/L)	TSS (mg/L)	DO (mg/L)	TRC (mg/L)	pH	Fecal Coliform (#/100ml)	Other Parameters
AVX Corporation- Conway Plant	SC0048402	Monitor and Report	Monitor and Report	Monitor and Report	Monitor and Report	N/A	N/A	6.0- 8.5	N/A	**Trichloroethylene:** 0.30 mg/l monthly Avg., 0.44 mg/l daily max
GSWSA/ Lorls Wastewater Treatment Facility	SC0025348	0.7 MGD	76.0lbs monthly Avg.	1.0mg/l summer, 1.78mg/l winter monthly Avg.	45.0mg/l monthly Avg.	6.0 min at all times	0.011mg/l monthly Avg., 0.019mg/l daily max	6.0-8.5	200 monthly avg., 400 daily max	**Cadmium:** 0.002 mg/l monthly Avg., **Copper:** 0.010mg/l monthly Avg., **Lead:** 0.004 mg/l monthly Avg., **Zinc:** 0.18 mg/l monthly Avg.
GSWSA- Schwartz/ Myrtle Beach Plant	SC0037753	Schwartz: 19.6 MGD	Schwartz: 4,014.7 Summer, 5,654.5 Winter monthly Avg.	Schwartz: 15mg/l	Schwartz: 30.0 mg/l	6.0 min at all times	0.5 monthly Avg., 1.0 daily max	6.0-8.5	200 monthly avg., 400 daily max	
GSWSA/ Bucksport WWTF	SC0040886	0.2 MGD	50.0lbs monthly Avg.	20.0mg/l monthly Avg.	90.0mg/l monthly avg., 135.0mg/l daily max	6.0 min at all times	0.5 monthly Avg.	6.0-8.5	200 monthly avg., 400 daily max	
GSWSA/ Conway WWTP	SC0021733	4.0 MGD	334.0lbs monthly Avg.	2.0mg/l monthly Avg.	30.0mg/l monthly Avg.	6.0 min at all times	0.011mg/l monthly Avg., 0.019mg/l daily max	6.0-8.5	200 monthly avg., 400 daily max	**Cadmium:** 0.0029 mg/l monthly Avg., **Copper:** 0.0097 mg/l monthly Avg., **Lead:** 0.0032 mg/l monthly Avg., **Zinc:** 0.16 mg/l daily max
GSWSA/ George R Vereen WWTP	SC0041696	7.0 MGD	334.0lbs monthly Avg.	1.83mg/l summer, 2.0mg/l winter monthly Avg.	30.0mg/l monthly Avg.	6.0 min at all times	0.011mg/l monthly Avg., 0.019mg/l daily max	6.0-8.5	200 monthly avg., 400 daily max	**Cadmium:** 0.0029 mg/l monthly Avg., **Copper:** 0.0097 mg/l monthly Avg., **Lead:** 0.0032 mg/l monthly Avg., **Zinc:** 0.16 mg/l daily max
GSWSA/ Central Wetlands WWTP	SC039900	1.2 MGD Capacity/ 0.616 MGD permitted flow	300.2 lbs monthly Avg.	2.05mg/l summer, 2.09mg/l winter monthly Avg.	90.0mg/l monthly avg., 135.0mg/l daily max	6.0 min at all times	0.011mg/l monthly Avg., 0.019mg/l daily max	6.0-8.5	200 monthly avg., 400 daily max	**Cadmium:** 0.002 mg/l monthly Avg.
GSWSA/ Longs WWTP	SC0040878	0.3 MGD	50.0 lbs monthly Avg.	N/A	90.0mg/l monthly avg., 135.0mg/l daily max	4.0 min at all times	0.2mg/l monthly avg., 0.4mg/l daily max.	6.0-8.5	200 monthly avg., 400 daily max	
North Myrtle Beach- Crescent Beach	SC0022161	2.9 MGD	201lbs monthly Avg.	6.0mg/l monthly Avg.	30.0mg/l monthly Avg.	6.0 min at all times	0.234mg/l monthly Avg, 0.404mg/l daily max	6.0-8.5	200 monthly avg., 400 daily max	**Hardness (As CaCO3):** Monitor and Report. **Lead:** 0.026mg/l monthly Avg. **Phosphorus:** Monitor and Report.
North Myrtle Beach- Ocean Drive	SC0022152	4.5 MGD	311lbs monthly Avg.	2.0mg/l summer, 10.0mg/l winter monthly Avg.	30.0mg/l monthly Avg.	6.0 min at all times	0.234mg/l monthly Avg, 0.404mg/l daily max	6.0-8.5	200 monthly avg., 400 daily max	**Hardness (As CaCO3):** Monitor and Report. **Lead:** 0.026mg/l monthly Avg. **Phosphorus:** Monitor and Report.
AVX Myrtle Beach Plant	SC0047953	Monitor and Report	10mg/l monthly Avg., 20mg/l daily max	N/A	N/A	N/A	N/A	6.5-8.5	N/A	**Methylene Chloride:** 0.005mg/l monthly Avg., 0.01mg/l daily max, **1,2-CIS-Dichloroethylene:** 0.07mg/l monthly Avg., 0.14 mg/l daily max, **Vinyl Chloride:** 0.002 monthly Avg., 0.004 daily max, **Trichloroethylene:** 0.005 monthly Avg., 0.01 daily max, **1,1-Dichloroethylene:** 0.004 monthly Avg., 0.006 daily max.
Santee Cooper Dolphus Grainger Generating Station	SC0001104	Monitor and Report	N/A	N/A	30.0 mg/l monthly, 100mg/l daily max	N/A	N/A	5.0-8.5	N/A	**Winter Temperature:** 95F, **Summer Temperature:** 98F, **Oil and Grease:** 15mg/l monthly Avg., 20mg/l daily max, **Arsenic:** Monitor and Report, **Mercury:** Monitor and Report

Williamsburg County NPDES Wastewater Treatment Facility- Permitted Effluent Limits

Wastewater Treatment Facility	NPDES Permit #	Quantity (MGD)	BOD (lbs/day)	NH3-N (mg/L)	TSS (mg/L)	DO (mg/L)	TRC (mg/L)	pH	Fecal Coliform (#/100ml)	Other Parameters
Kingstree Wastewater Treatment Plant	SC0035971	3.5 MGD	876 monthly Avg.	4.55 summer-4.71 winter monthly Avg.	30 monthly Avg.	5.0 Min at all times	0.025 monthly Avg.	6.0-8.5	200 monthly Avg., 400 daily Max	**Cadmium:** 0.008 mg/l, **Copper:** 0.022mg/l, **Lead:** 0.005mg/l, **Mercury:** 0.0001mg/l
Town of Hemingway	SC0039934	0.45 MGD	169 monthly Avg.	10 summer- 26.13 winter monthly Avg.	90 monthly Avg.	5.0 Min at all times	0.1 monthly Avg.	6.0-8.5	200 monthly Avg., 400 daily Max	
Williamsburg Co/Santee RV WWTF	SC0048097	0.60 MGD	150.1 monthly Avg.	Monitor and Report	90 monthly Avg.	2.0 Min at all times	0.5 monthly Avg.	6.0-8.5	200 monthly Avg., 400 daily Max	
Martek Biosciences- Kingstree	SC0003123									
Town of Greeleyville	ND0077968	0.036 MGD	30mg/l	N/A	90 monthly Avg.	1.0 Min at all times	N/A	6.0-8.5	200 monthly Avg., 400 daily Max	
Milliken and Co./ Kingstree Mill	SC0023493	0.56 MGD	149 winter monthly Avg/ 129 summer monthly Avg	N/A	227 lbs per day	5.0 min	N/A	6.0-8.5	N/A	

Georgetown County NPDES Wastewater Treatment Facility- Permitted Effluent Limits

Wastewater Treatment Facility	NPDES Permit #	Quantity (MGD)	BOD (lbs/day)	NH3-N (mg/L)	TSS (mg/L)	DO (mg/L)	TRC (mg/L)	pH	Fecal Coliform (#/100ml)	Other Parameters
3V Incorporated	SC0036111	15.0 MGD	4.0 mg/l monthly Avg, 8.0mg/l daily max	2.0mg/l monthly Avg., 4.0 mg/l daily max	10mg/l monthly Avg. , 20 mg/L daily max	1.0 min at all times	N/A	6.5-8.5	N/A	**Temperature:** (32C monthly Avg., 35C daily max)
City of Georgetown Sewage Treatment Facility	SC0040029	12.0 MGD	1,001lbs. monthly Avg., 1502lbs daily max.	2.0mg/l monthly Avg., 3.0 mg/l daily max	30mg/l monthly Avg. 45 mg/l daily Max	6.0 min at all times	0.278 mg/l monthly Avg., 0.482 mg/l daily max	6.0-9.0	200 monthly Avg., 400 daily max	**Mercury:** Monitor and report, **Enterococci:** 35/100ml monthly avg. 501/100ml daily max
CWS/White Creek-Lincolnshire	SC0030732	Monitor and Report	6.26lbs monthly Avg., 9.38lbs daily max	4.23 mg/l monthly Avg., 6.35mg/l daily max	30mg/l monthly Avg. 45 mg/l daily Max	6.0 min at all times	0.011 mg/l monthly Avg., 0.019 mg/l daily max	6.5-8.5	200 monthly Avg., 400 daily max	**Copper:** 0.0037 mg/l monthly Avg., 0.0058 mg/l daily max **Lead:** 0.0085 mg/l monthly Avg., 0.22 mg/l daily max
GCW&SD/ Debordieu WWTP (Nov-Feb)	SC0048984	0.375 MGD	94.0lbs monthly Avg., 141lbs weekly Avg.	20.0 mg/l monthly Avg., 30 mg/l daily max	30mg/l monthly Avg. 45 mg/l daily Max	5.0 min at all times	0.5 mg/l monthly Avg., 1.0 mg/l daily max.	6.5-8.5	200 monthly Avg., 400 daily max	**Cadmium, Copper, Lead, Mercury, Zinc:** Monitor and Report
GCW&SD/ Debordieu WWTP (Mar- Oct)	SC0048984	0.5 MGD	125.0 lbs monthly Avg., 188.0lbs weekly Avg.	20.0 mg/l monthly Avg., 30 mg/l daily max	30mg/l monthly Avg. 45 mg/l daily Max	5.0 min at all times	0.5 mg/l monthly Avg., 1.0 mg/l daily max.	6.5-8.5	200 monthly Avg., 400 daily max	**Cadmium, Copper, Lead, Mercury, Zinc:** Monitor and Report
GCW&SD/North Santee WWTP	SC0042439	0.52 MGD	13.0lbsmonthly Avg., 19.5lbs weekly Avg.	N/A	90mg/l monthly Avg. 135 mg/L weekly Avg.	1.0 min at all times	0.5 mg/l monthly Avg., 1.0 mg/l daily max.	6.0-8.5	200 monthly Avg., 400 daily max	**Mercury:** Monitor and report
Georgetown County School District Pleasant Hill Elementary	SC0039101	0.018 MGD	2.0lbs monthly Avg., 3.0lbs daily max	1.13 mg/l monthly Avg., 1.69 mg/l weekly Avg.	30mg/l monthly Avg. 45 mg/l daily Max	5.0 min at all times	0.011 mg/l monthly Avg., 0.019 mg/l daily max	6.0-8.5	200 monthly Avg., 400 daily max	**Cadmium:** 0.00035 mg/l monthly Avg, 0.0019 mg/l daily max **Copper:** 0.0087 mg/l monthly Avg, 0.013 daily max, **Lead:** 0.0032 monthly Avg., **Zinc:** 0.16 monthly Avg.
International Paper Georgetown Mill	SC0000868	Monitor and Report	19,150lbs. winter, 8,900lbs. summer monthly Avg.; 38300lbs winter, 1500lbs, summer daily max	Monitor and Report	54,400 lbs/day monthly Avg., 101,000 lbs daily max	N/A	N/A	6.0-9.0	N/A	**Temperature:** 34C monthly Avg., 36C daily max. **AOX:** Monitor and Report. **2,3,7,8-Tetrachloro-dibenzo p-dioxin:** 27.0 pg/l daily max. **Mercury:** Monitor and Report. **Copper:** 14.9 lbs/day daily max. **Chloroform:** Monitor and Report.
Simpson Lumber Co Sampit Lumber Mill	SC0046582	Monitor and Report	24mg/l monthly Avg, 48 mg/l daily max	2.0 mg/l monthly Avg.	55mg/l monthly Avg., 110 mg/l daily max	5.0 min at all times	N/A	6.0-8.5	N/A	**Temperature:** 90F, **Oil and Grease:** 10 mg/l monthly Avg., 15 mg/l daily max.
International Paper/ Santee	SC0042960	Monitor and Report	N/A	N/A	60mg/l daily max	N/A	N/A	6.5-8.5	N/A	**Manganese, Iron:** Monitor and Report
Georgetown Steel Company, LLC	SC0001431	Monitor and Report	Monitor and Report	Monitor and Report	400 lbs/day monthly Avg., 650 lbs daily max.	N/A	N/A	6.0-9.0	N/A	**Temperature:** 35C winter, 38C summer daily max. **Oil and Grease:** 153 lbs/day monthly Avg., 270 lbs daily max, **Lead:** 0.79 mg/l monthly Avg., 2.14 mg/l daily max. **Zinc:** 1.18 mg/l monthly Avg., 3.21 mg/l daily max. **Hexachlorobenzene:** 0.637 ug/l monthly Avg., 0.921 ug/l daily max.
GCWSD/Murrells Inlet Wastewater Treatment Plant	SC0040959	2.0 MGD	167lbs. monthly Avg.	2.0 mg/l monthly Avg.	30 mg/l monthly Avg.	6.0 min at all times	0.5 mg/l monthly Avg., 1.0 mg/l daily max.	6.0-8.5	200 monthly Avg./ 400 daily max	
GCWSD/ Pawleys Island Wastewater Treatment Plant	SC0039951	5.5 MGD	1000lbs. monthly Avg.	14.5 mg/l summer, 20.0 mg/l winter monthly Avg.	30 mg/l monthly Avg.	6.0 min at all times	0.5 mg/l monthly Avg., 1.0 mg/l daily max.	6.0-8.5	200 monthly Avg./ 400 daily max	
Santee Cooper Winyah Generating Station	SC0022471	Monitor and Report	N/A	N/A	19.5mg/l monthly Avg. 59.9mg/l daily max	N/A	7.5 ug/l monthly Avg., 13.0 ug/l daily max	6.5-8.5	N/A	**Temperature:** 93F, **Selenium:** 71ug/l monthly Avg., 290ug/l daily max, **Nickel:** 8.3ug/l monthly Avg., 75.0ug/l daily max, **Thallium:** 6.3ug/l monthly Avg., 9.2ug/l daily max, **Copper:** 3.7ug/l monthly Avg., 5.8 ug/l daily max, **Manganese:** 100ug/l monthly Avg., 146ug/l daily max.
Trebol USA LLC	SC0001619	Monitor and Report	9.4lbs monthly Avg., 18.8lbs daily max	1.78mg/l monthly Avg., 3.56mg/L daily max	33.8 lbs monthly Avg., 62.8 lbs daily max	6.0 min at all times	N/A	Monitor and Report	N/A	**Temperature:** 90F, **Cadmium, Copper, Iron, Nickel, Zinc:** Monitor and Report
Inlet Point South Phase III	ND0074616	0.014 MGD	45 mg/L	N/A	90 mg/L	2.0 mg/L	N/A	6.0-9.0	200 monthly Avg/ 400 daily max	

Wastewater Collection System Maintenance

In terms of geographic scope, maintaining the collection system is one of the single most challenging aspects of operating a wastewater treatment system. As sewer infrastructure systems age, they can become prone to inflow and infiltration (I/I) problems. Inflow and infiltration is the introduction of groundwater and/or stormwater into the sewer collection system. As I/I volumes increase, the intended design capacity of the sewer lines, pump stations, and treatment facilities becomes diminished. The potential for I/I problems is pronounced in coastal South Carolina, as much of the region has a relatively high groundwater table, especially in the winter and spring months. Another major cause of I/I is the penetration of tree roots into the collection system. Sanitary sewers provide great sources of nutrients for tree root growth, which can result in broken or clogged pipes.

The ultimate cause of concern with high I/I rates is the potential for sanitary sewer overflow (SSO) events. Sanitary sewer overflow events caused by a blocked sewer line can lead to the backup of raw sewage into residential plumbing systems, creating serious public health risks. During significant wet weather events, sewer systems prone to I/I can also cause environmental problems if raw untreated sewage escapes the collection system and enters a nearby waterbody.

Figure 4-1 Example of a Sanitary Sewer Overflow
Courtesy of SC DHEC

Reducing instances of SSO events requires a thorough and comprehensive preventative maintenance plan. One mechanism for minimizing I/I problems and preventing SSO events is to implement a Capacity, Management, Operations, and Maintenance (CMOM) program for each sewer system. A CMOM program is designed to provide a flexible and comprehensive framework to more effectively manage and operate the sewer collection system. The CMOM program provides a means for utilities to establish concrete management goals and establishes a protocol for monitoring progress towards achieving each of the outlined goals. Besides an evaluation of the physical assets of the utility, a thorough CMOM program evaluates a range of considerations including budgeting, the organizational structure and personnel needs of the agency, internal and external communications procedures, interlocal service agreement policies, employee training and safety resource needs. Below is a brief description of some of the critical aspects of a typical CMOM program.

- ***Inspections:*** There are several different types of inspection methods including physical inspection of manholes, smoke testing, dye-water testing, internal pipe evaluation using closed circuit video apparatus, and right of way/ easement general inspection. Together these methods allow managers to detect pipe blockages and leakages, sources of I/I, and the location of unauthorized sewer connections. The main objectives of conducting a collection system inspection are to:
    - Evaluate the physical condition of each of the components of the sewer system.
    - Identify the location and types of defects that may be entry points of inflow and infiltration into the sewer system. It is critical to estimate to the extent possible the volume of I/I entering the collection system.
    - Utilize this inspection information and data to help systematically correct sewer system defects.

- ***Maintenance and Rehabilitation:*** The fundamental objective of instituting a regular maintenance and rehabilitation program is to extend the longevity of the existing wastewater collection system. A maintenance and rehabilitation program responds to the system needs identified during the inspection process. General maintenance activities include the periodic cleaning of all sewers and associated appurtenances such as manholes, pump stations, etc. A rehabilitation program requires more long-term planning and entails the development of a repair schedule based on a priority list of projects and a corresponding budget that meets the current and future maintenance needs of the wastewater collection system. It is also important to select the type of rehabilitation to be performed for each project. New technologies such as pipe bursting and sliplining have enabled utilities to repair and replace sewer lines without having to excavate a trench to access the existing sewer line.

- ***Capacity Certification:*** The purpose of a capacity certification program is to ensure that the proper size sewer pipe is installed to accommodate the anticipated wastewater flows that will be collected within an identified service area. Having an effective tracking mechanism which can measure current wastewater flows and accounts for I/I volumes is essential for making decisions regarding any capacity limitations that might prevent the existing collection system from being able to handle new contributing flows to the wastewater treatment system. As the population of the Waccamaw region continues to grow, this aspect of wastewater collection system maintenance and planning will become increasingly important. Several communities in the Waccamaw region are encouraging more dense development and infill redevelopment patterns which will require increased conveyance capacity within the wastewater treatment collection system.

- ***Sanitary Sewer Overflow Emergency Response Program:*** Even in well maintained wastewater collection systems, there is always a possibility of a SSO event. Some SSO events attributed to vandalism or extreme rainfall events are beyond the control of the sewer utility provider. To minimize the public health and environmental impacts during SSO events, it is important to have an adequate response protocol in place to correct the problem and follow all applicable public notification procedures. These procedures include the investigation of the cause of the SSO, the total volume of the system overflow, an assessment of the affected area including any overflows into surface waterbodies, and a determination of whether to restrict public access to the SSO site.

  On a state level, SC DHEC initiated a public notification program in 2008 to report all Sanitary Sewer Overflow events that exceed 5,000 gallons. The state legislature has recently considered making this a mandatory public notification requirement. A list of SSO events that have occurred in the previous six months is available through SC DHEC's website at: http://www.scdhec.gov/environment/water/sso-psf_display.aspx

Investing in a comprehensive collection system inspection and rehabilitation program is a proactive way to prevent SSO events. The financial benefits of implementing this type of a program include savings from reduced emergency repair overtime and construction costs and a reduced likelihood of facing penalties as a result of regulatory non-compliance.

Fats, Oils, and Grease Management

One of the most costly management challenges of operating a wastewater collection system is cleaning and repairing sewer lines that become clogged due to the accumulation of fats, oils, and grease (FOGs) in the sanitary sewer system. These waste products enter the collection system via residential customers pouring kitchen grease into their sink drains and from commercial restaurant establishments with inadequate grease interception mechanisms. Serious FOG accumulation problems can result in SSO events leading to potentially detrimental public health and environmental impacts. A core element of a FOG management strategy is enhancing public awareness about the proper disposal method of kitchen grease byproducts. In addition, while most sewer utility providers require the installation of grease

traps or interceptors in commercial restaurant facilities, it is imperative that these grease traps be properly maintained. Poorly functioning grease traps can cause undesirable FOG constituents to enter the wastewater collection system.

Another emerging FOG management strategy is to foster an economic incentive to separate the grease collected and recycle it into a reusable byproduct such as soaps or biodiesel. Increasingly, there are new grease rendering service provider companies throughout the state. Typically, they collect grease at area restaurants and convert it to biofuel or another type of reusable byproduct. Some communities provide recognition to local restaurants who participate in this type of recycling program.

Biosolids Disposal

In addition to wastewater effluent, the solids separated during the wastewater treatment process need to be adequately treated prior to final disposal. Biosolids are rich in nutrients and also contain some metals. Therefore they need to be properly handled to minimize impacts to the natural environment. The bacterial content in biosolids byproducts can also pose a threat to public health. Careful measures are taken to reduce pathogen levels prior to final disposal of biosolid waste residuals. Common disposal methods for treated biosolids include disposal to an approved landfill site, diversion to a permitted land application site, incineration of dried biosolids, and recycling the biosolids into a reusable compost byproduct. Depending on the design of the wastewater treatment facility, biosolids management can either be a daily or weekly operational task or in the case of a lagoon type system, biosolids are dredged from the facility and disposed of on a periodic basis, ranging from one to ten years depending on the facility.

Figure 4-2 Land application sites can be permitted to accept biosolids material

Biosolid residuals are classified as either Class A or Class B biosolids depending on the level of treatment and the control measures utilized to reduce pathogen levels. Class A biosolids are treated via composting, pasteurization, heat drying, or by increasing the alkalinity in the biosolids mixture. These techniques reduce pathogen levels to a point that is deemed not to pose any risk of infectious disease transmission through direct contact with the residual material. Class A biosolids can meet additional environmental quality criteria, which would allow the biosolids to be marketed and distributed as a fertilizer product to commercial users and even the general public. Class B biosolids are typically treated via aerobic digestion, anaerobic digestion, air drying, or lime stabilization. These processes effectively reduce the level of pathogens, however final disposal of Class B biosolids are limited to landfill disposal or restricted land application uses.

In addition to reducing pathogen levels in biosolid residuals, wastewater treatment operators must also meet requirements to reduce the attraction of vectors such as insects and rodents. The need for vector reduction measures is more pronounced in Class B biosolids due to the higher levels of pathogen content in the biosolids material. Common methods for reducing vector attraction in biosolids is by either incorporating the biosolids into the soil during land application processes or by elevating the pH levels in the biosolids material. Minimizing moisture levels of stored biosolids is important in maintaining stable pathogen levels in the biosolids material.

Industrial Wastewater Pretreatment Programs

Through the NPDES permit program, industrial facilities also must comply with water quality standards prior to the ultimate discharge of industrial process wastewater into surface waterbodies. Some industrial facilities have onsite wastewater treatment facilities and therefore must meet the effluent discharge limits outlined under their individual NPDES permits. Many other industrial sites rely on the wastewater treatment services provided by the local publicly owned treatment works (POTW). Under these circumstances, agreements between the industrial facility and the

wastewater utility district are outlined within an established industrial pretreatment program. Generally, an industrial facility must institute on-site control measures to minimize the level of pollutants that need to be treated at the POTW.

An industrial pretreatment program is designed to support wastewater utility district service efforts by establishing standards and criteria so that the industrial effluent does not disrupt the operations of the treatment facility. Some types of industrial wastewater can cause disruptions within the treatment system, which can potentially result in the discharge of untreated effluent into local waterways. Pass through is a discharge that exits the POTW into surface waters at concentrations or in quantities that cause a violation of requirements outlined in the facility's NPDES permit. Interference is a discharge that causes operational problems at the treatment plant, also resulting in NPDES permit violations. A pretreatment program enables utility districts to accommodate industrial users while providing safeguards to ensure that they are meeting their own NPDES permit requirements and are fulfilling other operational responsibilities within their service region.

Industrial wastewater pretreatment programs incorporate three levels or categories of standards, which apply to each industrial user depending on their industrial classification and the characteristics of their discharge effluent. The following section provides an overview of each type of standard that is implemented as part of an industrial pretreatment program.

1. Prohibited discharge standards that are mandatory for all industrial users.

- Discharges containing pollutants that create a fire or explosion hazard at the POTW, including waste streams with a closed-cup flashpoint of less than 140 °F (60 °C).
- Discharges containing pollutants causing corrosive structural damage to the treatment plant, but in no case discharges with a pH lower than 5.0, unless the facility is specifically designed to accommodate such discharges.
- Discharges containing pollutants in amounts causing obstruction to the flow in the POTW resulting in interference.
- Discharges of any pollutants released at a flow rate or concentration that will cause interference at the POTW.
- Discharges of effluent at temperatures that will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the treatment plant exceeds 104 °F (40 °C) unless SC DHEC, at the utility district's request, approves alternative temperature limits.
- Discharges of petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through.
- Discharges that result in the presence of toxic gases, vapors, or fumes within the wastewater treatment facility in a quantity that could cause acute worker health and safety problems.
- Discharges of trucked or hauled pollutants, except at discharge points designated by the wastewater treatment service provider.

2. Categorical pretreatment standards

Direct Industrial Dischargers. These sites must comply with effluent limitation guidelines, which are national standards developed by the US EPA on an industry-by-industry basis and implemented through the NPDES permit program. They are intended to represent the greatest pollutant reductions economically achievable for an industry. US EPA analyzes the characteristics of the effluent that is commonly discharged by each industry and then identifies the best available technology that is economically achievable for that industry. Requirements established in the effluent limitations guidelines are based on the performance of that technology.

Indirect Industrial Dischargers. This type of industrial facility discharges wastewaters to a POTW and are regulated through categorical standards based on its industrial classification. Pretreatment standards differ

depending on whether the industrial facility is an existing or new discharge source. Standards for new sources are usually more stringent, because a new industrial site should be able to pursue the installation of the best available demonstrated technology to reduce pollutant concentrations and loads that need to be treated by the POTW.

Table 4-2 provides a list of industries subject to specific categorical pretreatment standards prior to final treatment and discharge at a POTW. A full description of each of the specific requirements within the categorical pretreatment standards can be found in the *Federal Register* under **40 CFR Parts 405-471**.

Table 4-2 Categorical Pretreatment Standards for Indirect Industrial Dischargers	
Aluminum Forming	*Nonferrous Metals Forming and Metal Powders*
Battery Manufacturing	*Nonferrous Metals Manufacturing*
Carbon Black Manufacturing	*Oil and Gas Extraction*
Centralized Waste Treatment	*Organic Chemicals, Plastics, and Synthetic Fibers*
Coil Coating	*Paint Formulating*
Concentrated Animal Feeding Operations (CAFO)	*Paving and Roofing Materials (Tars and Asphalt)*
Copper Forming	*Pesticide Chemicals*
Electrical and Electronic Components	*Petroleum Refining*
Electroplating	*Pharmaceutical Manufacturing*
Fertilizer Manufacturing	*Porcelain Enameling*
Glass Manufacturing	*Pulp, Paper, and Paperboard*
Grain Mills	*Rubber Manufacturing*
Ink Formulating	*Soap and Detergent Manufacturing*
Inorganic Chemicals Manufacturing	*Steam Electric Power Generating*
Iron and Steel Manufacturing	*Timber Products Processing*
Leather Tanning and Finishing	*Transportation Equipment Cleaning*
Metal Finishing	*Waste Combusters*
Metal Molding and Casting	
Source: *US EPA- Introduction to the National Pretreatment Program, June 2011*	

3. **Local limits.** Many wastewater utility providers elect to establish local limits to address the industrial pretreatment needs that are specific to their treatment facilities. Local limits are developed for pollutants that could cause interference, pass through, sludge contamination, or worker health and safety problems if received by the POTW at excessive concentrations or quantities. Below is a list of steps and considerations a utility provider should make when assessing the need to institute local limits as part of their industrial pretreatment program.

   - Conduct a survey to identify all industrial users that might be subject to the pretreatment program.
   - Determine the characteristics and volume of flows contributed to the POTW by each of these industries.
   - Assess which pollutants discharged by each of these industrial sites have a reasonable potential for pass through, interference, or sludge contamination.
   - Determine contributions from other sources, such as residential and commercial customers, to determine the maximum allowable headworks loading (MAHL) from industrial sources. Implement a system to ensure that MAHLs will not be exceeded.
   - Unique circumstances that might require the institution of case-by-case discharge limits.
   - Incorporate standards that promote the utilization of best management practices at industrial sites.
   - Any other prohibitions that have been adopted through local municipal ordinances.

It is important to note that while the inspections, reporting, and other administration tasks of industrial pretreatment programs are generally the responsibility of municipal governments or water utility districts, the program must be

approved by the state. The Water Facilities Permitting Division within the Bureau of Water at SC DHEC is in charge of overseeing local industrial pretreatment programs in South Carolina. The requirements adopted by each wastewater utility provider are incorporated into each facility's NPDES permit. The six minimum elements that must be included in the pretreatment program are:

1. The legal authority to administer and enforce a pretreatment program.
2. Procedures to ensure compliance with the requirements of the pretreatment program.
3. Funding sufficient to administer the program.
4. Local limits on industrial users.
5. An enforcement response plan that outlines how the utility district will investigate and respond to instances of industrial noncompliance.
6. A list of all significant industrial users serviced by the POTW.

As communities throughout the region pursue opportunities to attract new industries, wastewater treatment infrastructure will be a critical determinant in being able to provide the essential services that most industries will need. Administering a comprehensive industrial pretreatment program provides the foundation for future economic development opportunities in the Waccamaw region.

For more information about industrial pretreatment programs in the State of South Carolina visit SC DHEC's website at: http://www.scdhec.gov/environment/water/pretreatpage.htm

Contaminants of Emerging Concern

Recently, water resource managers have become increasingly concerned about the presence of a wide range of contaminants, such as pharmaceuticals, detergents, natural and synthetic hormones, and other chemicals in the aquatic environment. It is believed that many of these contaminants enter the municipal waste stream from bathing, laundry, human waste, and improper disposal of pharmaceutical products through the sanitary sewer system. Two possible serious impacts associated with these contaminants are public health risks associated with the presence of these compounds in local drinking water supplies and the impacts on native fish species in the Waccamaw region.

Presently, most contaminants of emerging concern are not typically regulated or monitored as part of the state's ambient water quality monitoring program. The federal government has begun to conduct several research projects to advance our knowledge on the potential impacts of these contaminants. The research findings of this important water quality issue will likely have significant implications on future water quality management efforts, perhaps including the adoption of new limits on municipal drinking water treatment and wastewater treatment permitting programs.

The United States Geological Survey has been one of the leading federal research entities investigating the ecological impacts of contaminants of emerging concern. A recent USGS study published in 2009 entitled *Widespread Occurrence of Intersex Bass found in U.S. Rivers* produced some important findings related to the impacts of endocrine disrupting compounds on aquatic life. The research was conducted at river sites across the United States, including the Pee Dee River in South Carolina. Researchers collected samples from sixteen fish species to assess the prevalence of intersex characteristics among fish populations in streambodies throughout the country. On a national level, intersex characteristics, such as the presence of immature female eggs in the testes of male fish, were most commonly found in smallmouth bass and largemouth bass. The Pee Dee River site in Bucksport, SC had the highest occurrence of intersex fish in largemouth bass at 91% of all samples collected. Researchers indicate that the correlations between the incidence of intersex characteristics in fish species and the presence of known endocrine disrupting compounds were very sporadic. They concluded that the manifestation of intersex traits varied by location and that it was unlikely that occurrences were due to a single definitive source or human activity. This study raised serious concerns about the impacts of contaminants of emerging concern, and also revealed the need for much further study and research.

The USGS Toxic Substances Hydrology Program has initiated the Emerging Contaminants Project to conduct similar research projects to investigate potential implications of this challenging water quality issue. Research is conducted in several specific focus areas that each aim to assist in the development of appropriate management responses to mitigate potential problems associated with this class of contaminants. An overview of each research area within this program is provided below.

1. ***Analytical methods*** The importance of water quality monitoring is strongly emphasized throughout this plan with a particular focus included in **Chapter Nine, Water Quality Monitoring.** To date, one of the difficulties of having a complete understanding of potential problems attributed to contaminants of emerging concern is a lack of analytical tools to measure the amount of each contaminant present in the environment. Several contaminants of emerging concern can only be detected at trace levels, requiring specialized equipment and a precise monitoring protocol. This research division seeks to advance the analytical capabilities of measuring this class of contaminants in the environment.

2. ***Environmental occurrence*** Field research projects are conducted to determine the location and level of occurrence of various contaminants. Some contaminants might impact groundwater resources, while others could have more detrimental impacts in stream habitats. This research allows water quality managers to pinpoint more specifically where mitigation efforts should be prioritized.

3. ***Sources and source pathways*** Preventing harmful contaminants from entering the environment requires thorough investigation into all the possible sources of each pollutant of concern. Suspected sources of contaminants of emerging concern that are regularly studied by the USGS include wastewater treatment plants, biosolids land application sites, onsite wastewater treatment systems, landfill leachate, and concentrated animal feeding operations. Typical research projects related to pollutant source and source pathways aim to identify and quantify the groups of contaminants that are associated with major pollutant sources and the pathways through which these sources contribute contaminants to the natural environment.

4. ***Transport and fate*** This area of research focuses on understanding the ultimate fate of each contaminant once it is released from its original source into the natural environment. Several factors including biological, chemical, and hydrological processes can influence the level of persistence in the environment or the rate of biological degradation of each contaminant of concern.

5. ***Ecologic effects*** Ultimately the main research objective is to determine whether each contaminant of concern is capable of causing detrimental impacts to the natural environment or poses significant risks to human health. Research is needed to understand the potential effects of both acute and long-term exposure to each group of contaminants. Knowing the ecologic and public health effects of each contaminant allows water resource managers to dedicate and prioritize specific resources to mitigate problems associated with known harmful contaminants.

Each of these specific research efforts has helped to expand our knowledge and understanding about this important area of water quality management. As a whole, each research area is integrated to enable water resource managers to develop the most effective strategy to address all potential issues related to contaminants of emerging concern. It is important for water resource managers in the Waccamaw region, in particular representatives from identified contaminant sources such as wastewater treatment facilities, landfills, land application sites, and concentrated animal feeding operations, to be actively engaged in emerging contaminant research and policy development. Public education and awareness on the proper disposal of sources of these contaminants such as pharmaceuticals and personal care products also needs to be an integral aspect in management efforts to address this water quality issue. Several communities throughout the Wacccamaw region are beginning to organize outreach initiatives such as establishing drop off locations and times to collect and safely dispose unused pharmaceuticals.

More information about the USGS Toxic Substances Hydrology Program can be found online at: http://toxics.usgs.gov/regional/emc/index.html

WASTEWATER TREATMENT MANAGEMENT OPPORTUNITIES

New advancements in wastewater treatment technologies are constantly emerging and becoming increasingly more applicable to a larger number of wastewater treatment facilities throughout the country. As a result, it is likely that there will be many new opportunities to improve the treatment capabilities and energy efficiencies at most wastewater treatment facilities in the Waccamaw region. New wastewater reuse alternatives and biosolids byproducts are also being regularly developed as well, providing several innovative wastewater management strategies to consider implementing in the Waccamaw region. This section discusses some of these opportunities and profiles a few existing programs and technologies that have been developed to help address future wastewater treatment needs and challenges.

US EPA's Sustainable Infrastructure Initiative. This program aims to facilitate the application of innovative water infrastructure technologies and best management practices to ensure that long-term infrastructure needs are adequately being met in communities throughout the United States. As existing water infrastructure facilities are being replaced, rehabilitated, expanded, or upgraded, the US EPA encourages communities to institute sustainable practices that use water efficiently and protect water quality health**.** Under this initiative, US EPA promotes Four Pillars of Sustainable Infrastructure, which are described below.

1. ***Better Management of Water and Wastewater Utilities.*** This aspect of wastewater utility sustainability entails taking a broad look at the facility operations, service provision, and general management of the utility. There are numerous approaches to managing each of these areas, and new practices are being developed regularly to improve the overall efficiency of wastewater treatment systems. Increased access to information resources through the US EPA and other professional organizations has enabled local utilities to learn about initiatives and technologies being utilized throughout the country.

2. ***Rates that Reflect the Full Cost Pricing of Services.*** Drinking water provision and wastewater treatment service entail significant capital and operational costs. Water and wastewater utility pricing should be structured so that the consumer pays the appropriate proportion of costs incurred to finance these services. Pricing is a useful way to encourage the end consumer to place an economic value on water resources and make individual efforts to conserve water. There are several benefits of full cost pricing in addition to meeting the operating expenses of the wastewater utility. Conserving water places less demand on water and wastewater facilities thereby reducing the overall energy costs associated with each respective treatment process.

   There are multiple approaches to developing a pricing scheme that reflects the level of water use relative to the costs of providing the utility services. Below is a brief description of common rate structures.

   - **Increasing block rates.** Increasing block rates or tiered pricing reduces water use by increasing the per-unit charges for water as the amount of water used increases. The first block is charged at a base rate, and subsequent blocks are charged at higher rates.
   - **Time of day pricing.** Higher prices are charged during a utility's peak demand periods. Public awareness of peak demand periods should be heightened regardless of whether pricing is structured based on a time of day approach.
   - **Water surcharges.** A higher rate is imposed for excessive water use. Traditionally, many utilities offered volume discounts for customers, meaning that the more water used, the less per unit of volume charged for the service. This type of pricing mechanism has been proven to discourage water conservation and should be repealed if possible.
   - **Seasonal rates.** Prices are structured based on the historical seasonal water demands, with higher prices usually occurring in the summer months.

3. ***Efficient Water Use***. As water infrastructure ages, leaks within the system can begin to occur more regularly. The US EPA estimates that nationwide 14% of all treated potable water is lost due to leaks and other system

inefficiencies. This approach to sustainable water infrastructure emphasizes the need to implement mechanisms and initiatives that help utilities prevent unnecessary water loss and improve overall water use efficiency. Water use efficiency and conservation helps to minimize the costs associated with treating drinking water and subsequently wastewater. As demands for drinking water increase due to population growth pressures, water efficiency and conservation measures can offset the need for new water supplies and withdrawals.

A comprehensive water efficiency use program must incorporate both supply side and demand side measures. An initial supply side management step in addressing water use efficiency is to detect and account for leaks within the distribution system. This assessment provides the baseline information needed to prioritize service line repair projects in the annual operating budget. Another worthwhile exercise is to develop a water conservation plan for the utility. This is a valuable asset management activity that can help extend the life of water and wastewater infrastructure systems by proactively addressing maintenance needs and reducing operating costs. An additional incentive to developing a water conservation plan is that they are an eligibility requirement for several types of federal loan and grant programs. Water utility providers can also structure water rate pricing so that consumers are encouraged to conserve water. Water conservation efforts on the demand side of water servicing, include the use of water efficient household appliances and products. Public education and awareness regarding the importance of water conservation is also an essential aspect of demand side water use efficiency. Resources to address demand side water conservation challenges are available through US EPA's WaterSense program. More information about the WaterSense program can be found online at: http://www.epa.gov/watersense/index.html

4. ***Watershed Approaches to Protection*** As with other aspects of water quality management, evaluating wastewater infrastructure's role in addressing water quality issues needs to be conducted on a regional watershed level. The main focus is on making sound infrastructure and growth decisions within the context of how water flows through a watershed. This aspect of sustainable infrastructure requires cooperation between multiple agencies to maximize available resources. Specific water utility management strategies that can be implemented to address watershed level concerns include interlocal service agreements between utility districts and local governments, source water protection programs, watershed-based permitting including water quality trading programs, and smart growth principles including land use policies aimed at protecting water resources.

More information about US EPA's Sustainable Water Infrastructure Program can be found online at**:**
http://water.epa.gov/infrastructure/sustain/

Energy Efficiency

Providing wastewater treatment service is an energy intensive process entailing an expansive infrastructure system with multiple components including the collection lines, pump stations, and the treatment plant. Wastewater treatment facilities operate on a continuous basis, therefore even small improvements in energy efficiency can reduce energy costs significantly. As energy rates have fluctuated unpredictably over the past several years, facility managers are seeking economical investments in equipment upgrades, or new operation techniques to minimize energy demand and reduce overall wastewater treatment service costs.

It is estimated that drinking water and wastewater systems account for approximately three to four percent of energy use in the United States. On a local level, drinking water and wastewater plants are typically the largest energy consumers of municipal governments, accounting for thirty to forty percent of total energy consumed. On a positive note, studies estimate that at most drinking water and wastewater treatment plants there are many readily achievable strategies that can reduce total energy use by up to thirty percent. This level of energy use reduction can result in significant financial returns within a short payback period.

To begin the process of implementing an energy reduction strategy, it is important for wastewater service providers to conduct a full-scale energy audit at their facilities. This assessment is the starting point for identifying potential energy

savings opportunities at each facility. From there, facility operators can establish an energy benchmarking plan to progressively implement the recommendations noted in the facility energy audit.

The US EPA's Sustainable Infrastructure Initiative is a central resource to learn more about energy efficiency strategies that are being practiced throughout the country. The following section highlights a wide range of management strategies and technologies that are specifically designed to improve wastewater treatment plant energy efficiencies. More information about this program can be found online at: http://water.epa.gov/infrastructure/sustain/energyefficiency.cfm

Variable Frequency Drives: This technology application can be used as part of the wastewater treatment plant's pumping system. They are designed to adjust motor output speeds to the current wastewater volume thus reducing the need to run pump motors at full power on a continual basis.

Freshwater Consumption Reduction: A number of operation and maintenance activities at wastewater treatment facilities, such as compressor cooler water, tank and belt press washdown, etc. require an onsite potable water source. Using recycled final effluent as a water source for these activities reduces the need for freshwater, which is energy intensive to treat and supply.

Optimize Flow with Controls: Installing flow control technology that can address a variation of low and peak design flows can reduce energy use in a treatment facility. One approach is to have smaller pumps operate for longer times, which conveys flows more consistently than larger pumps which are designed for peak flows.

Manage for Seasonal/ Tourist Peaks: The Waccamaw region experiences a significant increase in water and wastewater utility service demand during the summer tourism season. By using a flexible system design, certain stages of the treatment process such as the aeration system can be reduced during off-peak flow periods. Due to permit restrictions, this management practice is generally only feasible for treatment facilities that have separate and redundant treatment trains. Typically, NPDES discharge permits restrict wastewater treatment operators from taking offline individual components of a single unit wastewater treatment system.

Flexible Sequencing of Basin Use: This management strategy makes use of smaller basins while anticipating the need to place additional basins online as projected flows increase over time. In practice, operating a treatment system near its design capacity is more energy efficient than operating a system with larger size basins that are far below design capacity. Implementing this strategy can be as simple as adding an interior wall to partition an existing tank.

Ultraviolet (UV) Disinfection Options: Many wastewater utility providers are beginning to upgrade their facilities to utilize ultraviolet disinfection instead of chlorination disinfection systems. Ultraviolet systems can be configured in several ways, by adjusting the use of bulbs and setting controls based on flow and transmissivity.

Optimize Aeration System: There are several approaches to achieving energy reduction savings by optimizing the aeration system. Fine bubble aeration, dissolved oxygen monitoring and control, and variable capacity blowers are all applications that can be used to improve aeration efficiencies. Integration of all three applications together can increase efficiencies even further. Savings can also be realized in other phases of the treatment process including biosolids processing.

Figure 4-3 Ultraviolet systems have become a common method of final effluent disinfection.

Biosolids Processing Options: Biosolids management can be an energy intensive process due to the extensive aeration and mixing that is required to control volatile solids and reduce vector attraction. The use of fine bubble diffusers

and variable air-flow rate blowers along with a combination of mixing strategies can help reduce the amount of energy used during the biosolids management process.

WASTEWATER TREATMENT MANAGEMENT GOALS AND POLICY RECOMMENDATIONS

The following section provides a list of goals and policy recommendations to help address the current and future wastewater treatment needs in the Waccamaw region. The intent of these goals is to pursue wastewater treatment strategies that achieve the highest level of treatment possible at a reasonable cost to the general public. Another major goal outlined is to improve energy efficiency in wastewater treatment plant operations and to pursue opportunities for wastewater reuse and the beneficial reuse of biosolids. In addition, an ongoing goal is to serve as many residential and industrial customers as possible and continue to pursue collaborative ways to integrate each community's wastewater infrastructure system into a larger regional framework. All of the following goals may apply to designated point-source management agencies differently depending on the priority of needs for each individual facility.

Goal One: Ensure that the long-term domestic and industrial wastewater treatment service needs are adequately met in the Waccamaw region. ***Recommendations include:***

- Regularly review full-time and seasonal population trends in the Waccamaw region to ensure peak wastewater treatment flows are well within treatment facility capacity limits.
- Encourage each designated point source management agency to collaborate with each other in order to provide the highest level of service throughout the Waccamaw region. In the past, interlocal service agreements have been an effective way to provide critical service coverage between point source management agencies.
- Investigate the use of innovative treatment technologies that reduce pollutant loads to surface waterbodies thereby increasing the assimilative capacity to meet future wastewater treatment service demand.

Goal Two: Extend the centralized sewer system where practical to areas with known septic system problems. ***Recommendations include:***

- Update centralized sewer service maps at least once every five years to determine areas that still rely on septic systems to meet their wastewater treatment needs.
- Enhance coordination between the wastewater treatment providers, county governments, county health departments, and SC DHEC to ensure that existing septic systems are being properly maintained and to implement a strategy to address future septic system problems in an effective and timely manner.
- Utilize regulations and incentives, as appropriate, to encourage homeowners relying on septic systems to connect to the centralized sewer system.

Goal Three: Actively implement strategies to improve the energy efficiency for each wastewater treatment facility and associated collection system in the Waccamaw region. ***Recommendations include:***

- As the wastewater treatment system becomes more regionalized, invest in energy efficient technologies such as variable-frequency drives to offset the increased energy demand associated with the need to pump larger volumes of influent for longer distances.
- Pursue a US Department of Energy wastewater treatment facility audit assessment through the Save Energy Now program. More information can be found online at: http://www1.eere.energy.gov/industry/saveenergynow/

- Utilize ENERGY STAR's Portfolio Manager as a tool to establish an energy benchmarking plan for each wastewater treatment facility. This web-based program allows operators to track energy consumption and identify opportunities for energy use improvements. This program also has a performance rating system that allows operators to compare their facilities with others around the country. More information can be found online at: http://www.energystar.gov/index.cfm?c=evaluate_performanc.bus_portfoliomanager
- Develop public awareness initiatives to promote the conservation and efficient use of water. The less water that is used and ultimately returned to the wastestream, the less energy that is required to meet systemwide treatment demands.
- Assist water and wastewater utility providers to develop a water conservation plan for each of their respective jurisdictions.
- Evaluate the feasibility of developing full-cost pricing structures that reflect the variable levels of water use and the associated expenses incurred to provide water and wastewater utility service. Considerations should be made based on water use trends typical to the Waccamaw region, including seasonal variations due to tourist population, climate, etc.

Goal Four: Evaluate problems associated with inflow/infiltration in each POTW collection system in the Waccamaw region and minimize the occurrences of sanitary sewer overflow events in the region. ***Recommendations include:***

- Utilize US EPA's Sanitary Sewer Overflow Analysis and Planning Toolbox to perform a rainfall derived infiltration and inflow assessment for each sewershed in the Waccamaw Region. This analysis can help designated point-source agencies determine the quantity and source of I/I problems within the sewer network. This enables wastewater utility managers to prioritize specific areas within their sewer line network for sewer rehabilitation or implement other targeted I/I mitigation measures. More information can be found online at: http://www.epa.gov/nrmrl/wswrd/wq/models/ssoap/
- Develop and maintain a comprehensive sanitary sewer CMOM (capacity, management, operations, and maintenance) program for each of the designated point source management agencies in the Waccamaw region.
- Encourage each designated point source agency to fully participate in SC DHEC's sanitary sewer overflow event public notification program.

Goal Five: Develop innovative and cost efficient ways to dispose biosolids from wastewater treatment processes safely and with minimal impacts to the natural environment ***Recommendations include:***

- Assess the feasibility of upgrading wastewater treatment facilities that currently produce Class B biosolids to advanced technologies capable of producing Class A biosolids. Also assess the feasibility of establishing regional biosolids handling facilities, to increase the economies of scale to meet the biosolids disposal needs for several facilities concurrently.
- Enhance public awareness about biosolids byproducts that are available for home landscaping purposes. Strive to expand market for biosolids byproducts as an economically feasible approach to biosolids disposal.
- Participate in initiatives such as the National Biosolids Partnership which serves as a clearinghouse and information resource on effective biosolids management practices. More information can be found online at: http://www.wef.org/biosolids

Goal Six: Work with local governments to develop utility concurrency policies which would provide incentives for new development to be served by the existing wastewater treatment collection system. This type of policy should be aimed to encourage infill development and increase urban densities in and near downtown areas. ***Recommendations include:***

- Identify areas within each community that are targeted for infill or high density development and determine whether the existing collection system has the available capacity to meet long-term service needs.
- Assess the benefits and feasibility of instituting a capacity certification program in designated areas targeted for infill development or high density development.

Goal Seven: Develop and expand initiatives to prevent FOG byproducts from entering the sanitary sewer system. ***Recommendations include:***

- Conduct a thorough assessment of issues related to improper FOG byproduct disposal in the sanitary sewer and stormwater collection system in our region. The assessment should include a market evaluation of potential end users of reusable FOG byproducts within the area.
- Provide training workshops to stormwater managers, wastewater treatment providers, and local restaurant owners regarding issues related to FOG byproduct disposal. Workshops should focus on any initiative that may be developed to improve the enforcement of illicit discharge of FOG byproducts, expand grease rendering programming, enhance public awareness, etc.
- Review municipal sewer use ordinances and assess the need to incorporate regulations pertaining to the installation and maintenance of grease interceptors at local restaurant establishments and other known sources of FOG disposal.
- Increase awareness among area restaurants about grease rendering services in the State of South Carolina. Expand public recognition initiatives to restaurants that participate in grease byproduct recycling programs.
- Enhance public awareness efforts about proper grease disposal through mechanisms such as wastewater utility websites, periodic monthly bill inserts, etc.

Goal Eight: Continue to advance local knowledge about the potential impacts of the presence of contaminants of emerging concern in the aquatic environment. Develop appropriate management strategies to address this water quality issue based on detailed scientific understanding of the public health and environmental impacts attributed to contaminants of emerging concern in the Waccamaw region. ***Recommendations include:***

- Utilize new analytical methods to detect contaminants of emerging concern in the local environment and in waste streams as they are developed.
- Actively review management recommendations provided by the USGS and other agencies/institutions based on findings from their ongoing research projects and evaluate their relevance and applicability to the Waccamaw region.
- Develop public awareness initiatives that explains the problems associated with improper disposal of pharmaceuticals and other household products.

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Chapter Five: Septic System Management

INTRODUCTION

A common method of treating wastewater is the utilization of on-site wastewater treatment systems, including residential septic tanks. Traditionally, these types of systems have been installed in rural areas, where access to the centralized sewer system is not readily available. Although these systems provide alternatives to large scale public wastewater treatment facilities, there are several management issues including the suitability of installing on-site wastewater treatment systems in certain locations and the typical long-term maintenance needs of these types of systems. This chapter focuses on the use of on-site wastewater treatment systems in the Waccamaw region. Concerns related to public health and environmental issues are assessed. Comprehensive management strategies related to on-site wastewater treatment systems are outlined and a set of policy recommendations is provided.

PUBLIC HEALTH AND ENVIRONMENTAL CONCERNS

Wastewater has a number of harmful constituents that can adversely affect human health and cause environmental contamination and degradation if not properly treated. The most prevalent human health concern associated with domestic wastewater is the presence of pathogenic bacteria. Exposure to pathogenic bacteria can cause minor intestinal illnesses such as diarrhea, as well as other waterborne diseases such as *Giardiasis* and *Cryptosporidiosis. S*eptic system failures can result in the contamination of nearby groundwater sources, which can be a pathway for human exposure if groundwater supplies are utilized as the local drinking water supply. Direct physical contact is another means of transmitting disease-causing microorganisms. Failing septic systems can lead to direct exposure to elevated levels of pathogenic bacteria, posing similar risks of contracting water-borne diseases. In addition, several stream segments within the Waccamaw region are listed as impaired due to non-attainment of the fecal coliform standard. A probable source of many of these impairments is from failing septic systems. Watershed assessments, such as Total Maximum Daily Loads for fecal coliform, must include an investigation of whether failing septic systems may be a possible cause of these impairments.

As a coastal area, the Waccamaw region faces added environmental threats caused by failing septic systems. Coastal areas typically have a shallow water table which makes it highly restrictive to use septic systems as a wastewater treatment practice. South Carolina state law requires a minimum 6-inch distance between the seasonal high water table and the bottom of the septic system drainfield. The Waccamaw region is also characterized by the presence of sandy soils, which in some circumstances allows wastewater to infiltrate through the soil substrate without being fully treated. Our local coastal inlets are critical habitat for shellfish harvesting areas, such as oysters. As filter feeders, shellfish can become contaminated by the presence of pathogenic bacteria. Failing septic systems can be a source of pathogenic bacteria due to non-point runoff into nearby shellfish habitat areas. Malfunctioning septic systems also release excessive amounts of nitrates and phosphates into the environment, degrading the water quality of nearby streams and rivers. These nutrients can cause algal blooms resulting in dissolved oxygen deficits leading to the loss of habitat for aquatic life.

In determining the suitability of installing an on-site wastewater treatment system, several considerations must be made. First, the on-site soil type is an important limiting factor. Each soil type has varying capabilities of filtration and percolation. **Appendix E** describes the soil types and characteristics that are present in the Waccamaw region and provides a survey map for each county. The tables provided in **Appendix E** also include general guidance on the suitability of each soil type for siting septic systems. In addition, the depth of the water table is a common constraint for the placement of septic systems. Physiographically, the Waccamaw region is located in the Coastal Plain region of the

southeastern United States. This area is known for having shallow depths to the groundwater table. The water table in this region also varies seasonally, requiring site design criteria to be specified for the zone of saturation.

FUTURE SEPTIC SYSTEM MANAGEMENT NEEDS

To prevent or reduce the environmental and public health impacts associated with septic systems, multiple management strategies must be implemented. Most importantly, installing septic systems in areas that are not suitable for on-site waste disposal systems should be avoided. This requires an on-site assessment of the soil conditions, water table levels, and the presence of nearby sensitive natural resources. Septic system functionality is highly dependent on the site conditions, therefore following an approach that prohibits septic system installation in poorly suited areas can prevent costly problems in the future. Another important management strategy is to ensure that homeowners relying on a septic system are aware of how these systems work and the regular maintenance that needs to be performed in order to keep the system functioning properly. Finally, remediation of failing septic systems is sometimes the only remaining option in areas that have chronic incidences of septic system problems. Planning the extension of centralized sewer to serve these communities is an ongoing task in the Waccamaw region. This section provides more detail on each of these approaches to septic system management.

Homeowner Awareness and Education

Properly maintaining a septic system is an extremely important homeowner responsibility for residents relying on this type of on-site waste management system. Prospective rural property owners need to do their due diligence in evaluating land parcels on which they plan to build residential dwelling units. SC DHEC can perform a site evaluation that delineates all required septic system setbacks including:

- Buildings- 5 feet
- Property lines- 5 feet
- Private well- 75 feet (changed from 50ft in Jan 2009. Existing sites can maintain this setback distance)
- Public well- 100 feet
- Surface waters- 75 feet
- Drainage ditch- 25 feet (changed from 50ft in Jan 2009. Existing sites can maintain this setback distance)

The site evaluation can also identify other site conditions that would make the installation of a residential septic system unfeasible, including the presence of wetlands, poor surface drainage, and flooding frequency of nearby streams and rivers. It is important to recognize areas that are not suitable for the placement of septic systems. This will minimize future public health and environmental concerns and avoid long-term homeowner costs associated with managing these types of systems.

Many homeowners who occupy previously owned property do not know precisely where the septic system is located on their property. This information is essential in order to conduct routine homeowner assessments and to minimize activities requiring heavy equipment on or near the septic system and drainfield. This may cause physical damage or reduce the functionality of the on-site system. SC DHEC maintains permit records for septic systems of residences that were built within the last twenty years. A licensed professional septic system inspector can also identify the location of the septic system on private properties.

The best course of action to ensure the long-term functionality of a septic system is to routinely inspect the septic system every two years and have the system pumped out every three to five years. Also, the proper use of household water can minimize overloading and stress on the system. Water conservation devices such as low-flow toilets, faucets, and

showerheads can ensure that the amount of wastewater flowing through the septic system and drainfield does not approach or exceed the design capacity of the on-site system. Extra care should be taken to avoid the disposal of trash, food waste such as coffee grinds and grease, and household chemical products through the septic system. This can impact the physical and biological integrity of the on-site waste management unit. Regular care can prevent unforeseen septic system failures and backups. Finally, homeowners should be aware that maintaining their onsite septic system is their legal responsibility. Residents who live nearby can file a complaint if excessive odor or other public health concerns can be linked to a failed septic system. SC DHEC can issue a notice of violation and pursue legal action to correct the problem.

SC DHEC- Priority List of Environmentally Distressed Communities

SC DHEC's Bureau of Environmental Health maintains a statewide assessment of communities that are in need of sewer facilities. Surveys are conducted to determine whether existing on-site septic systems are adequately functioning. The survey consists of several criteria that are applied to a formula that is based on the percentage of residential dwellings within the assessed community that are experiencing on-site wastewater management issues. The survey findings are utilized to develop a priority list of communities that are considered environmentally distressed. Several communities within the Waccamaw region are included on SC DHEC's Priority List of Environmentally Distressed Communities.

Ongoing efforts by the local water and sewer utility providers have led to significant progress in addressing the sewer needs of communities located in the Waccamaw region. Many communities that were listed in the June 22, 1999 Sewer Needs Ranking list have been removed due to the extension of central sewer lines to service these areas. Communities that have been delisted as Environmentally Distressed Communities are included in **Table 5-1.**

Table 5-1: Communities Removed from the Priority List of Environmentally Distressed Communities since 1999.

Community	County
Choppee	Georgetown
Pennyroyal Rd.	Georgetown
Bennettown	Horry
Cedar Branch	Horry
Cochrantown	Horry
Pennyroyal Village	Horry
Woodland	Georgetown
Rock Bluff	Williamsburg
Watson's Riverside	Horry
Aynor	Horry

Source: *SC DHEC, 2010 Priority List of Environmentally Distressed Communities for Sewer Needs.*

Table 5-2 includes the most recent updated Priority List of Environmentally Distressed Communities for Sewer Needs issued by SC DHEC on June 28, 2010.

Table 5-2 SC DHEC Priority List of Environmentally Distressed Communities for Sewer Needs				
Ranking	Community	County	# Dwellings Surveyed	Index Per Dwelling
2	Annie Village	Georgetown	51	3.69
3	Greeleyville	Williamsburg	222	3.55
5	Lane	Williamsburg	228	3.31
6	Plantersville	Georgetown	128	3.23
10	Sandridge	Williamsburg	56	3.14
11	Beulah Road	Williamsburg	54	3.06
13	Sandy Island	Georgetown	25	2.96
14	Muddy Creek	Williamsburg	23	2.96
17	St. Paul's	Georgetown	278	2.86
18	Rock Bluff	Williamsburg	20	2.8
21	Brunson Crossroad	Williamsburg	173	2.77
23	Gausetown	Williamsburg	317	2.7
24	Nesmith- Morrisville	Williamsburg	574	2.67
25	Brooksville	Horry	83	2.65
26	Little River Road	Horry	45	2.62
27	Andrews	Georgetown	50	2.58
28	Shaw Corner	Williamsburg	36	2.58
29	Hebron	Williamsburg	125	2.57
31	Bloomingvale	Williamsburg	456	2.51
32	Red Road	Williamsburg	118	2.5
35	Intracoastal Waterway	Horry	18	2.44
37	Allentown	Horry	134	2.28
38	Trio	Williamsburg	315	2.25
40	White Oak	Williamsburg	117	2.21
46	St. Lawrence	Williamsburg	370	2.07
48	Poplar	Horry	565	1.99
50	Pawley's Island SC	Georgetown	299	1.99
54	South Williamsburg	Williamsburg	392	1.95
61	Sampit	Georgetown	273	1.75
69	Flagpatch	Horry	109	1.6
79	Sandridge	Horry	80	1.3
83	Briarcliffe	Horry	62	1.13
Source: *SC DHEC, 2010 Priority List of Environmentally Distressed Communities for Sewer Needs*				

It is apparent that community sewer service needs will be a prevalent concern for the foreseeable future in the Waccamaw region. The periodic community sewer need surveys are important for establishing the initial determination of areas that are vulnerable to public health and environmental problems due to poorly functioning on-site wastewater systems. Communication is vital so that homeowners are aware of the risks associated with on-site wastewater disposal problems. A process can then begin to explore the most effective and economically feasible wastewater treatment alternative for each affected community. Funding mechanisms can then be pursued to initiate necessary capital improvement projects and homeowner awareness initiatives.

SEPTIC SYSTEM GOALS AND RECOMMENDATIONS

The following section provides a list of goals and corresponding recommendations with respect to managing existing and future septic system issues in the Waccamaw region. Some of these goals highlight the public outreach needs to ensure that homeowners are aware of their responsibilities to manage their septic systems. Other goals provide guidance on

direct management responses needed to address community sewer needs in areas that have identified septic system problems. The remaining recommendations emphasize the need to coordinate management efforts and to promote effective communication between all relevant parties, including individual homeowners.

Goal One: Extend the centralized sewer system where practical to areas with known septic system problems. ***Recommendations include:***

- Update centralized sewer service maps at least once every five years to determine areas that still rely on septic systems to meet their wastewater treatment needs.
- Utilize regulations and incentives, as appropriate, to encourage homeowners relying on septic systems to connect to the centralized sewer system.

Goal Two: Improve coordination between SC DHEC, county health departments, water and sewer utility providers, local governments, and homeowners to prevent incidences of septic system failure and to pursue appropriate alternatives for communities that become designated as Environmentally Distressed Communities on the SC DHEC Priority List of Sewer Needs. ***Recommendations include:***

- Develop a long-term funding mechanism to assist homeowners with the expense of connecting to the centralized sewer system. Potential funding sources could include the USDA Rural Development Home Repair Loan and Grant program or the Community Development Block Grant program.
- Develop a specific and comprehensive mitigation protocol for communities that become designated as Environmentally Distressed or as Imminent Health Hazard areas.
- Improve the recordkeeping of septic system permits to make them more accessible to homeowners seeking to know the installation and maintenance history of their septic systems and to watershed managers trying to account for septic system problems in their communities.
- Be sure that communities relying on septic systems that are not currently on SC DHEC's Environmentally Distressed community list are regularly surveyed. This allows homeowners, county governments, and sewer utility providers the opportunity to identify and address septic system problems in a timely manner instead of waiting until problems escalate and require more urgent action.
- Encourage relevant agencies, to develop permitting criteria that prohibits installation of new septic systems within a certain distance of waterbodies and shellfish harvesting areas identified on the South Carolina 303(d) list of impaired waters.
- Consider adopting provisions within local zoning and development regulations that prevents the use of septic systems in areas not suitable for privately owned and operated on-site wastewater treatment systems.

Goal Three: Strategically target homeowner awareness efforts for residents of communities that rely heavily on septic systems for on-site wastewater treatment. ***Recommendations include:***

- Widely distribute literature containing information about the proper maintenance of septic systems, common indicators that the system could be failing, and the environmental consequences associated with malfunctioning septic systems.
- Utilize multiple outlets to relay septic system management information including pamphlets, educational presentations, and on-site public workshops.
- Consider mailing reminders to homeowners to encourage them to have their septic system pumped out and/or inspected on a regular basis.
- Make homeowners aware when a sewer line extension becomes available and inform them of the costs and procedures necessary to connect to the centralized sewer system.

Goal Four: Encourage local communities to develop and enforce septic system and sewer use ordinances to reduce public health and environmental problems associated with septic systems. ***Recommendations include:***

- Require homeowners to tie into central sewer when service becomes available.
- Require all new septic system installations to be designed with an access manhole or port system to improve inspection capabilities.
- Require inspections of septic systems prior to the sale of real estate. Ensure that the inspector has appropriate SC DHEC professional licenses and certifications.
- Incorporate septic system capacity criteria based on the size of the residential structure.
- Provide detailed definitions to establish clear guidance on what constitutes a *failing septic system* and a septic system that is in *good operating condition*.
- Include enforcement provisions that require homeowners to repair or replace septic systems that are determined to be failing.

Goal Five: Develop programs to provide incentives to install water conservation devices on faucets, toilets, and showerheads, focusing outreach efforts to target homeowners that rely on septic systems.

Goal Six: Incorporate regular assessments of septic system failures as part of an overall water quality monitoring program in the Waccamaw region. This will improve watershed management efforts to address fecal coliform 303 (d) impairments in the Waccamaw region. ***Recommendations include:***

- Prioritize areas that have an established TMDL boundary for fecal coliform and have suspected septic system problems.
- Investigate instances of illicit discharges from failing septic systems into nearby ditches or storm drains.

Chapter Six: Nonpoint Source Pollution

INTRODUCTION

A comprehensive water quality management plan must include a full assessment of non-point sources of pollution that may be entering the surface water or groundwater systems within a watershed. There are many inherent challenges to identifying all sources of non-point source pollution and developing a strategy to minimize their impacts on our water resources. Non-point sources of pollution typically cannot be traced back to a single definitive pollutant source location. The pollutant load can accumulate over a large geographic area and enter the waterway through multiple pathways versus a single discharge pipe or outfall from a point source location (i.e. at a wastewater treatment plant or an industrial site).

Each watershed has its own set of non-point source pollution concerns, based on a wide range of factors including land use, population growth, and the context of the natural environment itself. The first objective of this chapter is to identify the sources of known non-point sources of pollution that exist in the Waccamaw region. Upon analyzing the difficulties of controlling non-point sources of pollution in the Waccamaw region, this chapter describes several management strategies that can be implemented to reduce non-point source pollutant loads. This plan also outlines specific water quality goals and policy recommendations to provide long-term guidance on how management entities within the Waccamaw region can help to minimize the harmful impacts of non-point sources of pollution.

NON-POINT SOURCE POLLUTION ISSUES AND CHALLENGES

The Waccamaw region has a wide range of land uses including agriculture, silviculture, industrial, low density rural residential, and high density urban commercial and residential areas. Each of these land use types has varying potentials of contributing non-point sources of pollutants to the natural environment, requiring specific management strategies to prevent or minimize pollution impacts. As the population of the region continues to grow, the natural and urban landscape will certainly change as well. One of the most important objectives of managing non-point source pollution is to account for these changes in land use and development patterns. Watershed managers can then target resources and efforts towards addressing specific non-point source pollution concerns in our watershed based on the identified needs.

Below is a description of several non-point source pollution issues common in the Waccamaw region.

Agricultural Runoff

Agriculture is a prominent land use in the Waccamaw region. Activities associated with agriculture can have tremendous ecological impacts on our waterbodies. Several notable reports, including US EPA's annual *National Water Quality Inventory* briefing to Congress, mention agricultural runoff as being the greatest cause of water quality impairments of all pollution sources, both from point source dischargers and non-point sources. Depending on the specific activity of a farm site, agricultural lands can be a source of pathogenic bacteria from livestock, sedimentation from the cultivation of crops, excessive nutrients from the use of fertilizers, and chemicals from the application of pesticides.

Table 6-1 provides a general profile of the agricultural land use and activities in the Waccamaw region. The trends in agricultural land use differ between each county. Horry County has experienced the largest decrease in available farmland between 2002 and 2007. However, all three counties experienced a noticeable increase in the amount of total harvested cropland.

Table 6-1 Agricultural Land Use Information				
	Total Land in Farms	Average Size of Farm	Total Harvested Cropland	Total Woodland
Horry County	**2002-** 188,311 **2007-** 163,622	**2002-** 191 **2007-** 179	**2002-** 69,974 **2007-** 74,739	**2002-** 69,952 **2007-** 50,035
Georgetown County	**2002-** 54,691 **2007-** 57,647	**2002-** 242 **2007-** 229	**2002-** 8,695 **2007-** 11,156	**2002-** 30,914 **2007-** 31,157
Williamsburg County	**2002-** 205,904 **2007-** 209,402	**2002-** 170 **2007**- 174	**2002-** 61,855 **2007-** 75, 890	**2002-** 88,937 **2007-** 91,674
Notes: *Land units are measured in acres.* ***Source:*** *2007 Census of Agriculture- County Data. USDA, National Agricultural Statistics Service*				

Table 6-2 provides information on livestock production in the Waccamaw region. The primary non-point source pollution concern with livestock agricultural facilities is the runoff of untreated animal waste, which is loaded with high concentrations of nutrients and pathogenic bacteria, into nearby streams and rivers. Livestock agricultural areas are also prone to erosion due to the ongoing disturbance of ground cover by livestock. Watershed managers can encourage landowners to implement various best management practices to mitigate these problems. Proper fencing can be utilized to control direct livestock access to surface waterbodies. In addition, maintaining adequate riparian buffers adjacent to livestock areas can significantly reduce the amount of polluted runoff that can enter our streams.

Figure 6-1. This farm site utilizes wire fencing and a riparian buffer to protect nearby streams from livestock access and polluted agricultural runoff. *Photo courtesy of USDA Natural Resources Conservation Service*

At present, Concentrated Animal Feeding Operations (CAFOs) are regulated under a general NPDES "no discharge" permit in the state of South Carolina. Permit holders are required to build waste storage lagoons with a capacity sufficient to retain the volume of manure generated at the facility during the time between land applications, the normal rainfall that occurs between land applications, and the rainfall generated from the calculated twenty five year, twenty four hour storm event. Permitted facilities must also develop an animal facility management plan which outlines the land area and chosen crop used for manure application purposes. Facility managers must follow the agronomic land application rates for each viable crop grown on-site. As an outreach and education strategy, CAFO facility operators must also receive certification through Clemson University's Confined Animal Manure Managers Program.

A copy of the South Carolina NPDES General Permit for "No- Discharge" Concentrated Animal Feeding Operations can be accessed online at: http://www.scdhec.gov/environment/water/docs/g800000.pdf The Bureau of Water Agricultural Program at SC DHEC is in charge of administering this permit program. Information about the Agricultural Program at SC DHEC can be found online at: http://www.scdhec.gov/environment/water/agcafo.htm

Table 6-2 Agricultural Livestock Data					
	Farms with Cattle	Total Inventory of Cattle	Farms with Pigs	Total Inventory of Pigs	Farms with Poultry
Horry County	**2002-** 272 **2007-** 228	**2002-** 8,425 **2007-**10,446	**2002-** 30 **2007-** 30	**2002-** 43,900 **2007-** 42,079	**2002-** 58 **2007-** 70
Georgetown County	**2002-** 75 **2007-** 55	**2002-** 1,373 **2007-** 1,144	**2002-** 22 **2007-** 7	**2002-** 8,187 **2007-** (D)	**2002-** 22 **2007-** 7
Williamsburg County	**2002-** 131 **2007-** 135	**2002-** 4,868 **2007-** 4,682	**2002-** 45 **2007-** 25	**2002-** 11,503 **2007-** (D)	**2002-** 36 **2007-** 36
Notes: *Abbreviations- (D)- Withheld to avoid disclosing data for individual farmers*					
Source: *2007 Census of Agriculture- County Data. USDA, National Agricultural Statistics Service*					

Table 6-3 provides information on the application of manure, fertilizers, and chemicals used to control pests on agricultural lands in the Waccamaw region. These land management practices are essential to the production capabilities of many farm sites in the State of South Carolina. However, excessive or poorly timed application of these chemicals can result in contaminated runoff problems in local streams and rivers. Excessive irrigation can cause erosion, and transport nutrients, pesticides, and heavy metals. Excessive irrigation has also been known to cause the buildup of selenium, which can adversely affect waterfowl reproduction. Efficient irrigation water use can minimize potential water quality concerns related to this aspect of cropland management.

Figure 6-2. Farmer applying nitrogen-based fertilizer to cropland. It is generally much more effective to apply fertilizers in smaller amounts more frequently than applying them all at once. This also reduces the amount of nitrogen from entering groundwater or surface water system. ***Photo courtesy of USDA Natural Resources Conservation Service.***

Farmers also apply nutrients in the form of manure, sludge, and fertilizers to enhance crop production. If not applied at appropriate agronomic rates and only during suitable weather conditions, nutrients can easily run off of agricultural land areas and enter nearby waterbodies. Elevated nutrient loads can cause harmful algal blooms resulting in the loss of aquatic habitats and the degradation of recreational areas. Developing a nutrient management plan that establishes the amount and frequency of nutrient application is an effective way to ensure desired crop yields in a cost efficient manner while minimizing nutrient pollution risks.

Another common chemical application on agricultural lands is the use of pesticides. Pesticides can pose serious environmental threats by harming fish and wildlife and contaminating food sources. It is highly recommended that all pesticide users implement Integrated Pest Management strategies to reduce the offsite migration of pesticides and minimize exposure of these chemicals to humans and wildlife. Specific management techniques should be utilized based on the soil characteristics, pest history, and climate conditions of a particular site. In order to provide further water quality protection from pesticide use, SC DHEC has recently begun to administer the NPDES General Permit for Discharges from the Application of Pesticides. The permit incorporates various Integrated Pest Management principles specific to each of the classes of pests that are commonly treated in the State of South Carolina. A copy of the permit can be accessed online at: http://www.scdhec.gov/environment/water/docs/npdes_permit.pdf More information about the pesticide application and the status of this permit issuance can be found at SC DHEC's Bureau of Water website at http://www.scdhec.gov/environment/water/npdes_pesticide.htm

Table 6-3 Chemical Application Data for Agricultural Lands							
	Acres of Irrigated Land	Acres Treated with Commercial Fertilizer, Lime and Soil Conditioners	Acres Treated with Manure	Acres Treated with Chemicals Used to Control Insects	Acres Treated with Chemicals Used to Control Weeds, Grass or Brush	Acres Treated with Chemicals Used to Control Nematodes	Acres Treated with Chemicals Used to Control Diseases in Crops and Orchards
Horry County	**2002-** 741 **2007-** 1,316	**2002-** 78,475 **2007-** 75,791	**2002-** 2,263 **2007-** 1,233	**2002-** 34,886 **2007-** 34,043	**2002-** 46,927 **2007-** 46,146	**2002-** 11,317 **2007-** 11,571	**2002-** 6,900 **2007-** 3,490
Georgetown County	**2002-** 1,325 **2007-** 710	**2002-** 8,658 **2007-** 7,925	**2002-** 215 **2007-** (D)	**2002-** 4,189 **2007-** 6,741	**2002-** 5,244 **2007-** 6,327	**2002-** 405 **2007-** 1,248	**2002-** 310 **2007-** (D)
Williamsburg County	**2002-** 758 **2007-** 913	**2002-** 60,032 **2007-** 73,927	**2002-** 2,440 **2007-** 3,194	**2002-** 36,214 **2007-** 41,979	**2002-** 38,818 **2007-** 45,719	**2002-** 15,680 **2007-** 15,944	**2002-** 2,521 **2007-** 17,913
Notes: *Land units are measured in acres. Abbreviations- (D)- Withheld to avoid disclosing data for individual farmers* ***Source:*** *2007 Census of Agriculture- County Data. USDA, National Agricultural Statistics Service*							

As the tables above indicate, our use of agricultural lands changes regularly and is influenced by weather patterns, economic trends, innovative agricultural management practices and technologies, along with many other factors. It is helpful to understand these factors and work with agricultural landowners to maintain viable local agricultural opportunities, while protecting the health of our land and water resources.

The United States Department of Agriculture oversees several conservation and stewardship programs through the Natural Resources Conservation Service aimed at engaging farmers in initiatives to minimize water quality impacts associated with agricultural activities. Programs vary significantly and include long-term regionwide conservation plan development, individual property assessment, and direct technical assistance to implement recommended management practices. Additional information about the programs and services offered by the Natural Resources Conservation Service can be found on their website at: http://www.nrcs.usda.gov/

Forestry Activities

Due to favorable soil and climate conditions, South Carolina historically has been a productive silviculture region in the eastern United States. In fact, it is estimated that a total of 66% of South Carolina's entire land area is comprised of timberland (SC *DHEC Pee Dee Basin Watershed Water Quality Assessment*). The South Carolina Forestry Commission oversees forestry related activities throughout the state. The commission divides the management of state forest lands into six operational units. The three-county Waccamaw region is part of the six-county Black River Unit.

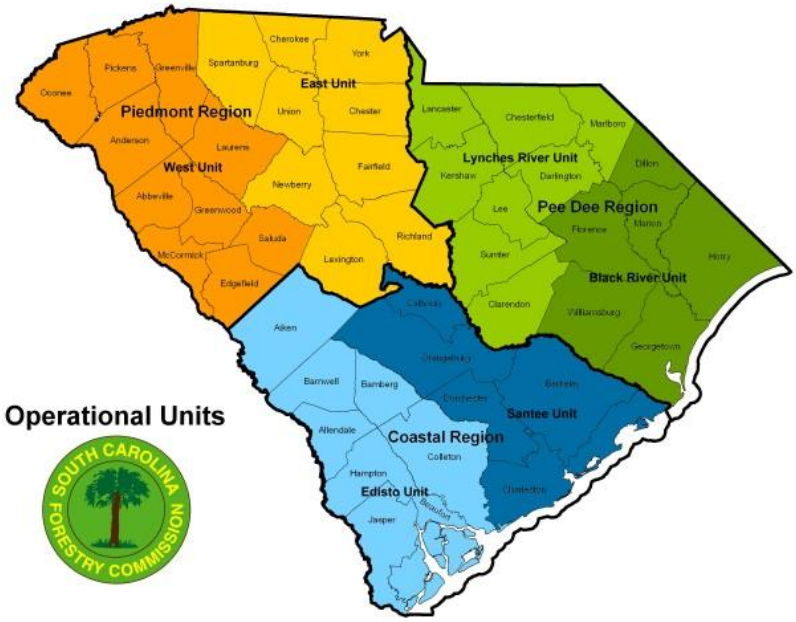

Figure 6-3- SC Forestry Commission Statewide Operational Units

Intensive land based activities, such as silviculture, need to be properly managed in order to minimize impacts to our watershed resources. The biggest pollution concern related to silviculture activities is the disturbance of soils, which can lead to increased sedimentation in adjacent waterways. Timber extraction requires the construction of access roads, which disrupts the ground surface and exposes loose soil. In addition, tree harvesting exposes soil to erosion, increasing the potential for sedimentation. Foresters often use fertilizers and pesticides in the regular management of their forest lands. These chemicals along with oil and grease residues from heavy construction and harvesting equipment have a high propensity for binding to sediment particles and then often get transported to nearby surface waters via soil erosion.

Serious environmental impacts can occur when forestry activities encroach too closely to streams and lakes. Removal of vegetation in what is termed the "Streamside Management Zone" is likely to cause direct soil erosion into the waterway due to its close proximity to the stream's shoreline. Land disturbance in this area can destabilize the streambank, further exacerbating the magnitude of the erosion problem. Trees are a vital component of a healthy natural stream ecosystem. Trees provide shade which helps to reduce the temperature of the waterbody. Cooler water temperatures help to maintain an adequate level of dissolved oxygen in the waterbody, which is vital to aquatic species survival. Sedimentation can lead to detrimental physical modifications of aquatic habitat areas. Fish often utilize streambank areas and tree roots for shelter and as spawning areas.

The key to minimizing forestry impacts is to develop a comprehensive pre-harvest site management plan, which strategically locates the development of forest access roads, identifies the proper streamside management zones, outlines parameters for all forestry activities in various weather conditions, and establishes a post-harvest restoration strategy. For all on-site activities, best management practices should be followed as prescribed by the South Carolina State Forestry Commission. Some of the primary considerations when creating a management plan is to conduct an assessment of the local seasonal weather conditions, an inventory of soil types, the location of all surface waterbodies, and a topographical survey, which accounts for slope variations in the surrounding terrain. Although several activities related to agriculture and forestry are exempt from provisions under the federal Clean Water Act, the US EPA has encouraged states to develop volunteer forestry certification programs, which train professional foresters about sustainable forestry practices. The South Carolina Forestry Commission has developed a Best Management Practice Courtesy Exam program for foresters in South Carolina. Since its inception, BMP compliance has steadily increased and currently it is estimated that BMP compliance is achieved at 98.6% of all timber harvesting operation sites throughout the state. In addition, foresters have important responsibilities in assisting watershed managers implement practices to comply with pollutant loads established in Total Maximum Daily Loads. Even if timber harvesting areas are not the suspected source of impairment, forestry management can be an effective approach to establishing riparian buffers to minimize non-point source pollution runoff on a larger watershed scale.

In addition to the management of rural timberland areas, the South Carolina Forestry Commission also oversees an Urban and Community Forestry Program. The commission recognizes the multiple benefits of urban tree landscapes including reduced stormwater runoff, enhanced groundwater recharge capabilities, and decreased soil erosion and stream sedimentation. To promote and encourage the establishment of a well managed urban tree program, the South Carolina Forestry Commission issues community forestry grants throughout the state. The South Carolina Forestry Commission also partners with the National Arbor Day Foundation, the US Conference of Mayors, the National League of Cities, and the US Forest Service in sponsoring the Tree City USA program, which encourages local governments to establish a community tree commission or designate a municipal department to oversee tree protection. The program also requires participating communities to adopt tree care ordinances, and to dedicate a regular funding source to manage the local

community forestry program. Currently, Myrtle Beach, North Myrtle Beach, Surfside Beach, Georgetown, and Conway are all participating in the Tree City USA program.

One of the key goals stated in the Forestry Commission's strategic plan is to "enhance water quality protection by increasing awareness and compliance with South Carolina Best Management Practices for Forestry". This goal is to be achieved through the facilitation of several training programs and by building partnerships with public and private entities. The agency's strategic plan also focuses on the need for continued collaboration with local governments and to raise awareness amongst the general public, policy decision makers, and other key community leaders about the value of our state's forestry resources and the need to protect these resources into the future. There are many opportunities to increase collaboration with the SC Forestry Commission and local forestry industry stakeholders to continue to benefit from our forestry resources while protecting the landscape so that water quality problems associated with silviculture activities can be prevented.

More information about the South Carolina Forestry Commission can be found at: http://www.state.sc.us/forest/

Stormwater runoff

An ongoing challenge in reducing non-point sources of pollution is being able to effectively manage stormwater runoff from urbanized areas within our watersheds. An inherent characteristic of urban development is the substantial land coverage of impervious surfaces associated with roadways, parking lots, and buildings. As the Waccamaw region grows and continues to become an attractive location for both permanent residents and seasonal visitors, urban development will likely continue well into the future. Historically most of the urbanized areas in our region has been concentrated along the beachfront Grand Strand communities and in the county seats of Conway, Kingstree, and Georgetown. Growth pressures have expanded residential and commercial development well past the Atlantic Intracoastal Waterway into new areas such as Carolina Forest and elsewhere. This physical alteration of the natural landscape has changed the hydrological dynamic of our watershed system, both on a local scale and on a regional scale. Stormwater runoff rates typically peak sooner and at larger quantities in developed land areas in comparison to undeveloped land areas, creating additional environmental stressors on local waterways. **Chapter Two, Description of the Waccamaw Region Study Area**, provides an assessment of land cover change in each county between 1996 and 2006. A land use summary is also provided in the general profile for each sub-watershed in **Chapter Three, Watershed Assessments.**

Figure 6-4. A typical storm sewer collects runoff from surrounding impervious surfaces such as roadways which is then transported untreated into a nearby waterway. ***Photo Courtesy of Clemson University's Carolina Clear Program***

There are many stormwater runoff pollutants of concern that have the potential to have significant impacts on the water quality of our streams and rivers. The source of these pollutants is generally dependent on the land use activities occurring within the watershed. Contaminants commonly transported by stormwater runoff include sediments, metals, nutrients, bacteria, hydrocarbons, and other toxic pollutants. In addition, aquatic habitats can be degraded due to the presence of oxygen-demanding substances and from elevated surface water temperatures. Reducing these pollution threats requires both site scale and watershed scale structural and non structural management practices. Given the complexity and scope of this water quality issue, stormwater management requires a comprehensive framework supported by the efforts of multiple stakeholders.

Although specific stormwater management strategies will often vary depending on the pollutant of concern and the watershed characteristics, there are some common overall objectives of stormwater management. One of the primary objectives is to minimize the amount of impervious land coverage and to disconnect existing impervious areas within the watershed. A second objective is to implement development practices and watershed management strategies to promote stormwater retention or infiltration in the targeted watershed. Another key objective is to ensure that known sources of pollutants are not exposed to stormwater runoff, where practical. Finally, an additional objective is to institute measures that help remove pollutants before stormwater runoff enters natural waterbodies.

Two main approaches to managing stormwater runoff are through the implementation of structural and non-structural practices. Non-structural practices are designed to reduce pollutant loads or manage polluted runoff at its source. This can be accomplished via regulatory controls such as municipal codes and ordinances. Much of the focus of non-structural management strategies focuses on land use practices. Sensitive areas within a watershed can be safeguarded from harmful development by designating it within a protective zoning district or by pursuing other means such as a conservation easement. Public awareness initiatives are a vital aspect of non-structural stormwater management efforts as well. Individuals have a significant role in minimizing stormwater pollution sources, even by just altering some very simple activities such as car maintenance, fertilizer and pesticide application, and pet waste disposal.

Structural management practices involve engineered designed control mechanisms which can alter the flow rates and other characteristics of stormwater runoff from an individual site or on a larger neighborhood scale. Several types of engineered systems such as catch basin filtration devices are now readily available. These units can be easily retrofitted into new or existing structures. In addition to providing effective filtration of solid pollutants such as debris and sediment, they can be configured to also help remove metals, nutrients, bacteria, hydrocarbons, and other harmful pollutants.

It is important to be mindful that non-structural and structural stormwater management practices are both necessary in achieving stormwater management objectives and ought to complement each other to achieve desired water quality improvements. One of the emerging trends in stormwater management is the advance of green infrastructure and Low Impact Development (LID) strategies. These stormwater management opportunities are discussed in further detail later in this chapter.

Industrial Stormwater

At many industrial sites, routine activities such as material storing and handling, equipment maintenance and cleaning, and other industrial processes are often exposed to wet weather. Controlling stormwater runoff pollution sources at industrial facilities is critically important in ensuring that the water quality in nearby streams and rivers is protected. Since 1990, the US EPA has overseen permitting efforts to regulate stormwater discharges. SC DHEC regulates 29 different industrial sectors under the NPDES General Permit for Storm Water Discharges Associated with Industrial Activities (Except for Construction). One of the primary requirements to obtain coverage under the permit is to develop a Stormwater Pollution Prevention Plan which includes an assessment of all potential sources of stormwater runoff pollution and a description of the control measures, such as site specific best management practices, maintenance procedures, inspection, and employee training, that will be implemented at the facility.

Figure 6-5. Example of an industrial site that is properly covering raw material stockpiles. ***Photo courtesy of Tetra Tech, Inc.***

The US EPA provides a comprehensive fact sheet for each regulated industrial sector, which explains the pollutants of concern, suggested best management strategies, and additional reference material pertaining to that particular industrial sector. These industrial stormwater fact sheets can be accessed online at:
http://cfpub.epa.gov/npdes/stormwater/swsectors.cfm

Table 6-4 provides a complete list of each of these regulated industrial sectors. **Appendix H** provides a list of all the facilities in the Waccamaw region that are regulated under this permit program. A copy of the NPDES General Permit for Storm Water Discharges Associated with Industrial Activities (Except Construction) can be accessed online at: http://www.scdhec.gov/environment/water/docs/SCR000000.pdf This permit is administered by the Industrial Stormwater Permitting and Compliance Division at SC DHEC Bureau of Water. Additional information can be found at SC DHEC's website at: http://www.scdhec.gov/environment/water/swnindustact.htm

Table 6-4 Industrial Sectors Regulated under NPDES Stormwater Permit for Industrial Activities	
Timber Products	*Scrap Recycling and Waste Recycling*
Paper and Allied Products Manufacturing	*Steam Electric Generating Facilities*
Chemical and Allied Products Manufacturing and Refining	*Land Transportation and Warehousing*
Asphalt Paving and Roofing Materials and Lubricant Manufacturing	*Water Transportation*
Glass, Clay, Cement, Concrete, and Gypsum Product	*Ship and Boat Building and Repair Yards*
Primary Metals	*Air Transportation Facilities*
Metal Mining (Ore Mining and Dressing)	*Treatment Works*
Coal Mines and Coal Mining-Related	*Food and Kindred Products*
Mineral Mining and Dressing	*Textile Mills, Apparel, and Other Fabric Products*
Hazardous Waste Treatment, Storage, or Disposal	*Furniture and Fixtures*
Landfills, Land Application Sites, and Open Dumps	*Printing and Publishing*
Automobile Salvage Yards	*Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries*
Leather Tanning and Finishing	*Fabricated Metal Products*
Transportation Equipment, Industrial or Commercial Machinery	*Electronic and Electrical Equipment and Components, Photographic and Optical Goods.*
Source: *SC NPDES General Permit for Storm Water Discharges Associated with Industrial Activities (Except Construction)*	

Discharges Associated with Non-metal Mineral Mining Facilities.

Mining activities entail various processes which involve the discharge of water from a facility site. SC DHEC recently renewed the NPDES General Permit for Discharges Associated with Non-metal Mineral Mining Facilities in September, 2010. The types of facilities covered by this permit include operations consisting of the mining of sand, gravel, clay, fill dirt, kaolin, vermiculite, and dimension stone. The permit focuses on the discharge of groundwater dewatering, stormwater, mine process wastewater, mine equipment wash water, and dredge water from a permitted facility.

A list of entities covered by this permit program within the Waccamaw region is provided in **Appendix I**. The permit can be accessed online at http://www.scdhec.gov/environment/water/docs/scg730000.pdf

Marinas and Boating

As a coastal area with an extensive network of inland rivers, there are numerous opportunities for recreational boating and a sufficient number of marina facilities to meet this demand throughout the Waccamaw region. Marina facilities exist in Georgetown, Murrells Inlet, Pawleys Island, Litchfield Beach, Myrtle Beach, North Myrtle Beach, Little River, and Conway. Many residents also own their own private docks along many of the waterways throughout the Waccamaw region. Public landing access points are also common throughout the region. Due to the direct proximity to our waterways, marine operations can cause significant water quality impacts if these sites and associated activities are not properly managed.

SC DHEC-Office of Ocean and Coastal Resource Management (SC DHEC-OCRM) in partnership with the South Carolina Marine Association has developed the Clean Marina Program as a recognition and outreach program to encourage marina owners to utilize best management practices in the operation of their facilities. Local marinas that are currently participating in the South Carolina Clean Marina Program include Osprey Marina in Myrtle Beach and Reserve Harbor Marina in Litchfield Beach. A program guidebook was recently developed that explains the purpose and the participation requirements of the program. The guidebook also provides a comprehensive list of activities and best management practices to minimize boat-related pollution activities in the state's waterways. Suggested management practices address concerns related to boat storage, fueling, mechanical repairs, painting, cleaning, and general facility maintenance. The guidebook is an excellent resource for individual boaters as well to learn about new ideas and various alternatives to maintain their boats in as environmentally conscious way as possible.

The 2010 South Carolina Clean Marina Guidebook can be accessed at the following website: http://www.scdhec.gov/administration/library/CR-006968.pdf

One of the major facility needs of most recreational boaters is access to a septage pumpout station. It is critically important to enforce regulations pertaining to illicit discharge of onboard septage into restricted waterways. Through the federal Clean Vessel Act, the United States Fish and Wildlife Service administers a grant program established to expand the number of available septage pumpout stations throughout the nation's waterways. This program intends to support the recreational boating industry while protecting the environmental health of local waterways. An assessment of septage pumpout station needs in the Waccamaw region should be conducted in order to evaluate the benefits of pursuing this grant opportunity. More information about the Clean Vessel Act program can be found on the United States Fish and Wildlife Service website at: http://wsfrprograms.fws.gov/Subpages/GrantPrograms/CVA/CVA.htm

NON-POINT SOURCE POLLUTION MANAGEMENT PROGRAMS

National Pollutant Discharge Elimination System (NPDES) Permit Program for Stormwater Management

The National Pollutant Discharge Elimination System (NPDES) permit program was expanded in 1990 to include Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4s). This relatively new permit program is intended to reduce the pollutant load that is commonly transported through our nation's stormwater systems and discharged without treatment into our local waterways. The permit program was instituted in two phases; the first phase addresses larger urban areas throughout the United States and the second phase addresses smaller yet significantly urbanized areas around the country. Several municipalities and densely populated unincorporated communities along the coastal portions of Horry and Georgetown Counties meet the population thresholds that require them to obtain coverage under the Phase II NPDES General Permit for Storm Water Discharges from Regulated Small Municipal Separate Storm Sewer Systems (SMS4).

Table 6-5 below is a list of NPDES Phase II Small Regulated MS4 Jurisdictions of the Myrtle Beach Urbanized Area including Forestbrook, Garden City, Little River, Murrells Inlet, Red Hill and Socastee Census-Designated Places (CDPs). **Figure 6.6** is a map illustrating the boundaries of the MS4 jurisdictions within the Myrtle Beach Urbanized Area.

Table 6-5 NPDES Phase II Small Regulated MS4 Jurisdictions in the Waccamaw Region	
Atlantic Beach	*North Myrtle Beach*
Briarcliffe Acres	*Surfside Beach*
Conway	*Georgetown County*
Myrtle Beach	*Horry County*

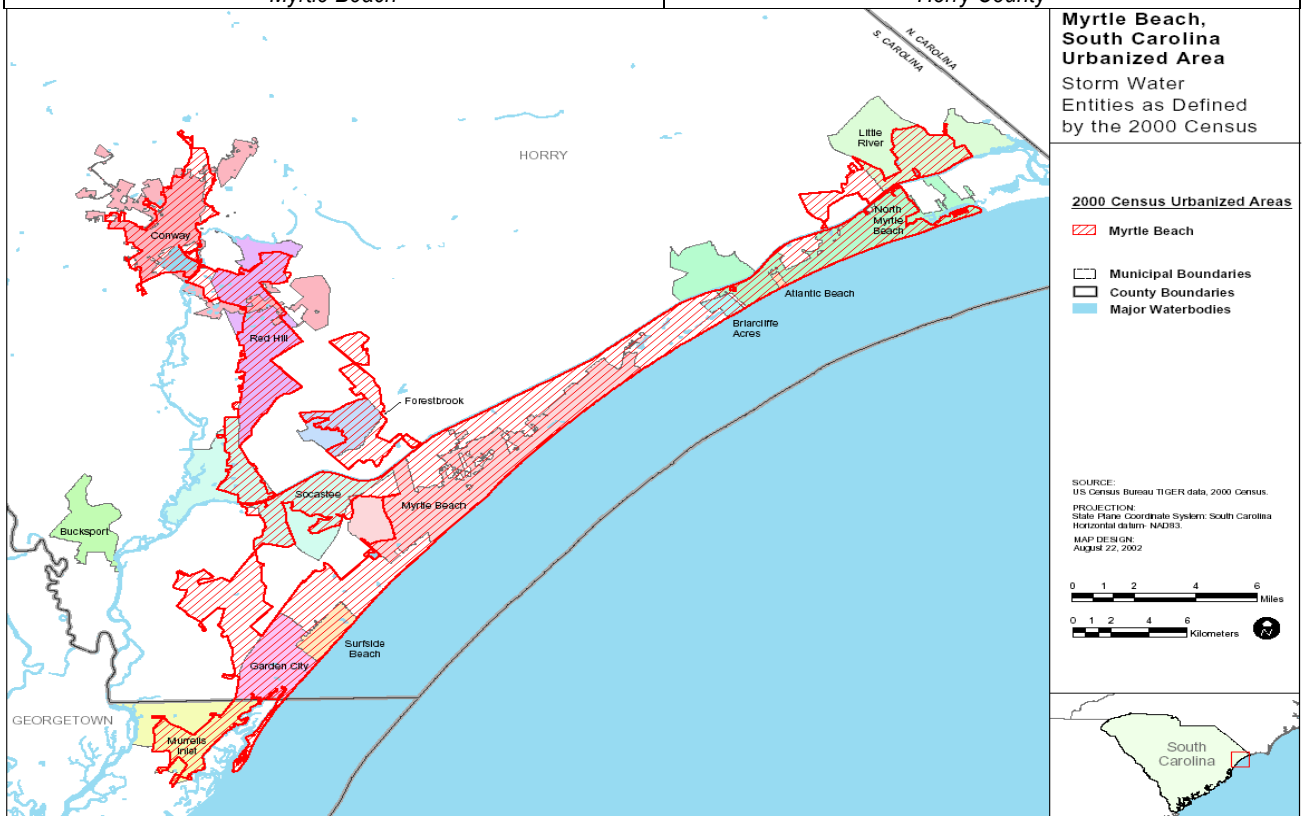

Figure 6-6 NPDES Phase II SMS4 permit boundaries as of the 2000 Census enumeration

SC DHEC is the agency authorized to issue NPDES permits for stormwater discharges. They have structured the MS4 permit as a general permit with the same conditions in place for all of the regulated small MS4s throughout the state. There are six main elements known as "minimum control measures" that make up the central requirements of the permit. As part of the permit application process, each MS4 must submit a list of appropriate BMPs and measurable goals for each minimum control measure. The six minimum control measures are explained below.

Figure 6-7 Waccamaw region MS4 communities have instituted a storm drain marking program as a means to increase public awareness about polluted runoff issues and to engage citizens in stormwater management activities. *Image courtesy of the Coastal Waccamaw Stormwater Education Consortium*

- **Public Education and Outreach on Stormwater Impacts:** Requires permittees to implement a comprehensive stormwater education and outreach program in their communities. The program must define outreach objectives for at least three community-wide stormwater issues based on the identified pollutants of concern. Outreach messaging must target at least three residential issues and three industrial/ commercial issues. Based on the chosen outreach issues, the permittee must develop appropriate educational materials, such as signage, printed materials, radio and television advertisements, and website information.
- **Public Participation/ Involvement:** This minimum control measure is intended to encourage the public to participate in the development and implementation of the MS4 community's Stormwater Management Plan. Permitted MS4 communities are

encouraged to consider the creation of a representative citizen group to assist in the Stormwater Management Plan development process. Permittees must also facilitate opportunities such as stream cleanups, storm drain marking, and water quality monitoring to directly engage the general public in the Stormwater Management Plan activities.

- **Illicit Discharge Detection and Elimination:** This control measure establishes the basis for MS4 communities to institute local ordinances and regulations to help eliminate non-stormwater discharges into the stormwater system. Stormwater management ordinances provide the MS4 community with the legal authority to detect, investigate, and enforce prohibited illicit discharges within the MS4 community. The US EPA is one of many informational sources with model ordinances and guidance on how to develop a stormwater management ordinance. For information on model ordinance language visit US EPA's website at http://www.epa.gov/owow/NPS/ordinance/stormwater.htm

  This control measure also requires permittees to update their community's storm sewer map providing details on the location of each stormwater outfall, and the priority areas within the system that have a high likelihood of illicit discharges. Finally this control measure outlines the field screening and monitoring procedures for detecting illicit discharges to the storm drain system.

- **Construction Site Stormwater Runoff Control:** This permit requirement specifically deals with water quality impacts related to construction activities. Under this control measure, permittees must administer a program to ensure that property owners who engage in construction activities select and install stormwater control measures which comply with the South Carolina NPDES General Permit for Stormwater Discharges from Construction Activities and the South Carolina Stormwater Management and Sediment Reduction Regulations 72-300, along with any other applicable local regulations. Among the requirements includes the submission of a stormwater management/erosion and sediment reduction plan, commonly referred to as a Stormwater Pollution Prevention Plan prior to the disturbance of any land.

Figure 6-8 This storm drain inlet protection device helps to prevent sediment that may runoff an active construction site from entering the storm drain system. ***Photo courtesy of US EPA.***

- **Post-Construction Stormwater Management in New Development:** Under this minimum control measure MS4 communities are required to implement a program to control stormwater discharges from private and public new development and redeveloped sites that disturb at least one acre of total land area. Permittees must institute development design standards that promote the infiltration, evapotranspiration, or reuse of on-site rainfall and can demonstrate effective runoff reduction and pollutant removal necessary to maintain predevelopment hydrological conditions and to protect water quality to the maximum extent practicable.

- **Pollution Prevention/ Good Housekeeping for Municipal Operations:** This final minimum control measure is intended for MS4 communities to take a holistic approach to achieving the ultimate goal of preventing or reducing pollutant runoff due to their own municipal operations as part of the community's Stormwater Management Plan. The MS4 community must identify and map all municipally-owned and operated facilities and all associated stormwater controls. The permittee must specifically identify high priority facilities and implement good housekeeping procedures to ensure proper stormwater pollution controls are in place.

US EPA provides guidance on potential best management practices that can be implemented to fulfill the requirements of each of the six minimum control measures outlined in the NPDES General Permit for Storm Water Discharges from Regulated Small Municipal Separate Storm Sewer Systems (SMS4). The National Menu of Stormwater Best Management Practices can be accessed online at http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

It is important to note that the NPDES permit for designated Phase II Small MS4s is due for renewal in 2011. Local governments need to be alert to possible changes to the jurisdictional coverage boundaries outlined in the permit. This program is administered by the Municipal Separate Storm Sewer System permitting division within the Bureau of Water at SC DHEC. Additional information about this permitting division can be found at SC DHEC's website at: http://www.scdhec.gov/environment/water/swnsms4.htm

The existing NPDES General Permit for Storm Water Discharges from Regulated Small Municipal Separate Storm Sewer Systems (SMS4) can be accessed online at: http://www.scdhec.gov/environment/water/docs/scs000000.pdf

The NPDES Stormwater Discharge General Permit Program was in the early development phase at the time the last Waccamaw Region Section 208 Plan update was adopted. Our region's water quality management efforts have benefited tremendously from the implementation of the NPDES MS4 permit program. Looking forward, the Waccamaw Region Section 208 Plan will integrate the goals and strategies that have been developed through our local stormwater management programs. One of the intentions of this Section 208 Plan update is to support these stormwater management efforts on a regional level and help coordinate activities amongst both point-source and non-point source designated water quality management entities within the Waccamaw region.

SC NPDES General Permit for Stormwater Dischargers from Large and Small Construction Activities

SC DHEC administers a general permit to regulate stormwater discharges that enter surface waters from construction site activities. Allowable stormwater discharges primarily consist of stormwater associated with the construction activity and discharges from support activities such as equipment and material storage areas, concrete and asphalt batch plants, and excavated material disposal areas. Other allowable non-stormwater discharges associated with construction activities include discharges from fire hydrants, vehicle and equipment non-detergent washwater, landscape irrigation, water used to control dust, and building exterior washwater.

As part of the permit application procedures, a Stormwater Pollution Prevention Plan (SWPPP) must be submitted which identifies all potential sources of pollution that may affect the quality of stormwater discharged from the construction site and a description of pollution reduction practices that will be implemented at the construction site. The SWPPP must also include information about the type of development site (i.e. residential housing, shopping mall, etc), a description of the sequence and scope of all planned major disturbance activities, and an estimate of the total land area that will likely be disturbed or impacted. In addition, a construction site map must be submitted which indicates the stormwater flow characteristics, areas of soil disturbance, location of surface waters and wetlands, and all on-site stormwater controls.

Construction activity stormwater discharges containing pollutants of concern within an established Total Maximum Daily Load boundary are not allowed unless specific control measures are incorporated into the permit holder's SWPPP. All applicable wasteload allocation requirements for the TMDL are in effect for all permit holders. Where applicable, requirements under the US Army Corps of Engineers' 404 permit program, which regulates the discharge of dredged or fill material to surface waters or wetlands, must be fulfilled prior to being granted coverage under the Construction General Permit.

A copy of the SC NPDES General Permit for Stormwater Discharges from Large and Small Construction Activities can be accessed online at: http://www.scdhec.gov/environment/water/docs/finalcgp.pdf

Clemson University Certified Erosion Prevention and Sediment Control Inspector Program (CEPSCI)

The Clemson University CEPSCI educational outreach program was developed to help address water quality problems associated with land disturbing activities in South Carolina. The program is designed to train individuals about the proper design, installation, maintenance, and inspection of appropriate erosion prevention and sediment control practices. The program organizes one-day workshops which introduce attendees to the latest practices in erosion control techniques and provides an overview of all pertinent state laws and regulations. Training also consists of assistance with conducting a site review to develop environmentally sensitive grading and drainage plans, and the selection of suitable best management practices. The program also has a certification component which includes the successful completion of a certification exam. At the end of the program, qualified participants become a SC Certified Erosion Prevention and Sediment Control Inspector.

For more information about Clemson University's CEPSCI program visit the following website:
http://www.clemson.edu/public/cepsci/index.html

Clemson University Certified Stormwater Plan Reviewer Program (CSPR)

An additional public service program offered by Clemson University is the Certified Stormwater Plan Reviewer program. Participants are trained on the proper review of stormwater and sediment control plans for development sites to determine if a proposal submittal meets all pertinent regulatory requirements. The program is organized as a two-day workshop culminating in an exam. Upon satisfactory completion of the program, participants become a SC Certified Stormwater Plan Reviewer, which is valid for five years. The workshop covers topics including innovative techniques and best management practices in stormwater and sediment control; stormwater management requirements; plan submittal, review, and approval process; plan review checklists; and common submittal deficiencies.

For more information about Clemson University's CSPR program visit the following website:
http://www.clemson.edu/t3s/cspr/index.htm

SC Department of Transportation (SC DOT) Stormwater Management Program (PERMIT # SCS 040001)

The South Carolina Department of Transportation has been classified as a large MS4 management entity under the NPDES permit program. This provides the agency permit coverage to discharge stormwater via SC DOT owned and maintained stormwater sewer facilities in accordance with conditions outlined in the issued permit. SC DOT is also required to comply with the SC NPDES General Permit for Stormwater Dischargers from Large and Small Construction Activities, which regulates stormwater runoff from construction project sites. In addition, the agency has obtained coverage under the SC NPDES General Permit for Storm Water Discharges Associated with Industrial Activities (Except Construction) for each of the agency's county maintenance facilities throughout the state. Because SC DOT maintains a large percentage of the arterial highways and local community streets throughout the Waccamaw region, their stormwater management efforts are critical to the long-term protection of our local water resources. It is important for our local governments and water resource managers to work closely with SC DOT so that future local transportation improvement projects can be designed to incorporate storrmwater management practices that will protect local waterways.

A copy of SC DOT's Large MS4 NPDES permit can be accessed online at:
http://www.epa.gov/npdescan/SCS040001FP.pdf

Further information about the SC DOT Stormwater Program can be found on their website at:
http://www.scdot.org/ms4/default.shtml

NON-POINT SOURCE POLLUTION MANAGEMENT OPPORTUNITIES

As awareness and knowledge about the impacts of non-point source pollution continue to advance, new management strategies are regularly being explored and developed. This section examines green infrastructure, which has been a common stormwater management approach supported by the US EPA and several partnering agencies and organizations. This section provides a general overview of green infrastructure applications and their anticipated social, environmental, and economic benefits. This section also discusses challenges to implementing green infrastructure practices and provides guidance on ways to pursue green infrastructure opportunities in our local communities.

Green Infrastructure can be described as an interconnected network of managed landscapes and conserved natural areas that function on a site scale and on a community-wide scale. Green infrastructure projects are strategically designed to mimic natural hydrologic conditions and to reduce the amount of polluted runoff in urban areas and surrounding watersheds. Depending on the design of each green infrastructure project, additional benefits include decreased stormwater infrastructure costs, reduced energy consumption, urban heat island mitigation, improved air quality, increased property values, enhanced wildlife habitats, and enhanced community outdoor recreation opportunities. Below is a general description of several types of green infrastructure on a site scale, neighborhood scale, and on a larger watershed scale.

Site Scale Applications

- ***Green Roofs*** reduce the impervious properties of typical rooftops, by partially or completely covering the building rooftop surface with suitable vegetative material and a sufficient growing medium. The purpose of a green roof is to intercept rainfall on the building's site and to minimize the volume of stormwater runoff that leaves a site. Ultimately the rainwater is released back into the atmosphere via evapotranspiration.

Figure 6-9 Example of plant and drainage material used in a typical green roof. ***Photo courtesy of US EPA***

- ***Rain Harvesting*** is the practice of capturing and storing rainwater for eventual reuse, most commonly for landscape irrigation purposes. Rain harvesting reduces the amount of stormwater that leaves the site. Rainwater is typically collected from rooftops in large cisterns or rain barrels. Rain harvesting provides property owners with an immediately available irrigation water source. The community benefits are substantial as the demands for irrigation water supplies can be significantly reduced.

- ***Downspout Disconnection*** is an inexpensive yet effective green infrastructure stormwater management practice. The purpose of disconnecting downspouts is to direct rooftop runoff away from ground-level impervious surfaces such as driveways and streets. This simple practice can significantly reduce the amount of runoff that enters the municipal stormwater system. If properly designed, downspouts can provide an excellent irrigation source for home lawns and gardens. Some municipalities throughout the country have instituted ordinances that require property owners to disconnect their downspouts.

- ***Permeable Pavements*** are road construction materials consisting of fewer fine particles, which provide more material void space enabling stormwater to infiltrate into the ground surface more easily. In terms of community-wide coverage, parking lots, roadways, and driveways account for one of the most extensive components of

impervious surface areas in our watersheds. Permeable pavements are an innovative way to reduce stormwater volumes and runoff rates.

- ***Planter Boxes, Rain Gardens, and Vegetated Swales*** are a diverse group of green infrastructure approaches that incorporate native landscaping to capture stormwater runoff from nearby impervious areas. These landscaping techniques enhance property aesthetics while improving water quality and in the case of vegetated swales and rain gardens to promote groundwater infiltration.

Figure 6-10 Example of a rain barrel used for residential irrigation purposes.
Photo Courtesy of US EPA.

Figure 6-11 This type of paver system allows water to infiltrate into the ground surface below.
Photo courtesy of US EPA

Neighborhood Scale Applications

- ***Green Streets*** involve a holistic approach to incorporating stormwater best management practices into the existing urban landscape along roadway corridors. Since roadways are one of the largest components of publicly owned space within local communities, this offers local governments one of the best opportunities to invest in green infrastructure practices. Individual design elements include street trees, permeable pavements, and infiltration and bioretention practices. Each roadway has unique implementation challenges and opportunities requiring corridor specific planning and design. Despite the varying design functions and appearance, the overall objectives of green streets are generally the same and include source control of stormwater runoff, limiting the conveyance of harmful pollutants, and restoring pre-development hydrologic characteristics.

- ***Pocket Wetlands*** are engineered systems designed to control stormwater volume and facilitate pollutant removal. Generally, pocket wetlands have less biodiversity than natural wetlands but still require a base flow to support the aquatic vegetation present. Pollutant removal in these systems occurs through the settling of larger solids and course organic material, microbial breakdown of pollutants, and also by uptake in the aquatic vegetation.

- ***Tree Planting*** provides numerous environmental and social benefits for local communities. With respect to stormwater management, trees are capable of intercepting rainfall which reduces the quantity and the rate at which rainfall reaches the ground surface. Trees are also very beneficial in reducing erosion rates by stabilizing

the soil substrate and holding soil in place. Trees also enhance the abilities of the soil to absorb stormwater and recharge the groundwater system. As mentioned earlier in this chapter, many communities in the Waccamaw region participate in the Tree City USA program co-sponsored by the South Carolina Forestry Commission. Maintaining an urban forestry program helps to enhance property values and community aesthetics while providing numerous benefits for local residents and wildlife.

Watershed Scale Applications

- ***Riparian Buffers*** are vegetated areas between stream shorelines and adjacent upland areas providing enhanced water quality protection for our river systems. Vegetative buffers provide similar water quality protection benefits around wetland areas as well. Having a sufficient vegetated buffer between surface waterbodies and actively utilized land areas has shown to be an effective means of reducing nutrient and pathogenic bacteria loads to our waterways. The vegetative materials help to stablilize stream banks, therefore minimizing the potential for soil erosion. Forested buffers also increase the shade along the shoreline providing additional benefits by keeping the surface water temperatures cooler, thereby improving the habitat for aquatic species. The effectiveness of a riparian buffer is often dependent on maintaining an adequate width of vegetated area. The general recommendation is to establish a vegetative buffer of at least 50 feet from the stream shoreline, where practicable. Vegetated buffers can provide similar benefits when they are established along roadway drainage ditches and residential and commercial detention/retention ponds, but should be limited to small shrubs and plants so that access to maintain the channels is not impeded.

Figure 6-12 Example of a green street. Beneficial features include a mature tree canopy and a vegetated curb extension which not only reduces the total area of impervious surface, but also collects and stores stormwater runoff from the roadway. ***Photo courtesy of US EPA.***

Figure 6-13 Pocket wetlands can be designed to provide valuable outdoor amenities within a community. ***Photo courtesy of US EPA***

Green Infrastructure Implementation Guidance

Fostering the utilization of green infrastructure stormwater management practices entails a long-term strategy which must focus on municipal infrastructure investments, public awareness, and the use of regulatory and incentive based mechanisms. The US EPA created the *Water Quality Scorecard: Incorporating Green Infrastructure Practices at the Municipal, Neighborhood, and Site Scales* as a reference document to assist local governments with developing strategies to implement green infrastructure practices in their communities. This section highlights a broad array of strategies to develop a holistic green infrastructure network on a local and watershed scale. A copy of the *Water Quality Scorecard: Incorporating Green Infrastructure Practices at the Municipal, Neighborhood, and Site Scales* can be accessed online at: http://www.epa.gov/smartgrowth/pdf/2009_1208_wq_scorecard.pdf

Objective #1: *Protect natural resources (including trees) and open space.*

This objective aims to protect significant tracts of critical lands and wildlife habitat. These land areas provide tremendous water quality benefits on a regional watershed scale by increasing infiltration and groundwater recharge, minimizing the impacts of erosion, and by protecting drinking water supplies. This objective also recognizes mature trees as an invaluable natural resource asset which help to reduce stormwater runoff rates and improve stormwater quality.

Implementation Tools and Policies

- Identify and map critical natural resource areas such as drinking water source areas, wetland areas, etc.
- Conduct periodic inventory surveys of tress on public lands and street right of ways to identify maintenance and planting needs as part of a local urban forestry program.
- Develop goals and objectives in the natural resources element of the comprehensive plan to call for the preservation of critical natural resource areas.
- Develop a community open space and parks plan.
- Establish a dedicated source of funding for open space acquisition through impact fees or local sales tax.
- Develop conservation subdivision ordinances to ensure that critical open space is protected on new development tracts.
- Revise land development regulations to include riparian buffer requirements of fifty feet, or to the greatest extent practicable, from all wetlands and streams.
- Provide open space credit for developers who incorporate green roofs into the building site design.
- Establish tree removal permit programs and require tree replacement provisions for trees that are removed during construction activities.
- Establish reduced setbacks or increased building density incentives for developers who exceed minimum tree preservation requirements.
- Adopt tree preservation credits as an alternative to meeting stormwater management requirements.

Objective #2: *Promote efficient, compact development patterns and infill.*

This objective promotes the reuse of existing developed land so that natural greenfield sites do not become developed unnecessarily. By minimizing the amount of total land that becomes developed within a community, there is a corresponding reduction in the amount of impervious surfaces within a watershed. This objective also encourages development on greenfield sites to be limited to areas that can be serviced by existing infrastructure such as water and sewer. Continued growth and economic development objectives can be achieved by promoting the development of mixed use districts. These types of development patterns typically decrease the amount of impervious surfaces by minimizing the need and demand for parking spaces.

Implementation Tools and Policies

- Develop an inventory of all brownfield and grayfield sites and provide redevelopment incentives such as density bonuses and expedited permit review.
- Establish higher density zoning districts in areas that have adequate water and sewer infrastructure capacity.
- Target vacant and underutilized lands as retrofit areas for the incorporation of green infrastructure practices.
- Adopt a transfer of development rights program to provide incentives for landowners to preserve valuable rural areas.
- Reduce impact fees for infill development based on less demand for new infrastructure.

- Develop concurrency ordinances which only allow development in areas where infrastructure such as centralized water and sewer service already exist.
- Identify areas in local comprehensive plans that may be suitable to higher density mixed-use districts.
- Review existing zoning ordinances and remove any existing barriers to mixed-use development in targeted districts within the community.
- Limit the use of auto-oriented services such as commercial drive-throughs in mixed use zoning districts.

Objective #3: *Design complete, smart streets that reduce overall imperviousness.*

Appropriate street design and transportation demand management strategies can be pursued within urban settings to meet the transportation needs of multiple users such as walkers, motorists, bicyclists and public transportation passengers. In turn, if effectively implemented, the total impervious surface area within a watershed can be significantly reduced by utilizing strategic green infrastructure practices to protect the water quality of runoff generated from streets, sidewalks, and parking lots.

Implementation Tools and Policies

- Encourage the expansion of alternative modes of transportation on a local and regional level in local comprehensive plans and transportation plans.
- Encourage the use of context-sensitive design transportation corridors in local comprehensive plans. Context-sensitive design can be used to narrow road widths and to identify key natural features such as mature trees along transportation corridors, thereby enhancing roadway aesthetics and providing stormwater management benefits.
- Identify street corridors within the street network that could be narrowed from 12-13 feet to 10-11 feet per travel lane. Work with SC DOT to accomplish this objective for roadways that are owned and maintained by the state.
- Eliminate the use of curb and gutter stormwater management systems within the roadway network where practical and replace them with green infrastructure elements such as roadside bioswales.
- Include green infrastructure feasibility and cost assessments in all new transportation improvement projects.
- Secure funding for green infrastructure improvements through state and federal transportation enhancement grant programs.
- Incorporate green infrastructure pilot projects as part of the local government's capital improvements plan for public facility and transportation improvement projects.
- Adopt regulations that require a minimum percentage of all parking lots, sidewalks, and roadways to be constructed with pervious pavement materials.

Objective #4: *Encourage the efficient provision of parking.*

This objective focuses on specific stormwater management issues related to parking facilities. The objective aims to utilize structural approaches such as the utilization of pervious pavement materials in parking lot areas and non-structural approaches such as reducing the minimum parking space provision for businesses and residential developments.

Implementation Tools and Policies

- Require the installation of bicycle amenities in exchange for a reduction in required vehicular parking spaces, especially in areas such as mixed-use districts.

- Allow flexibility in parking space requirements by permitting on-street parking and shared parking to count towards total requirements.
- Allow developers within certain districts to make in-lieu payments for parking. Collected fees can be dedicated to the investment of public parking areas within the community.
- Adopt parking lot landscaping provisions such as the preservation of existing trees, minimum interior landscaped island areas, and the utilization of specific plant species to meet landscaping requirements.
- Reduce total parking lot area by providing additional compact car spaces and reduce drive aisle widths as mechanisms to reduce the total parking lot impervious surface area.
- Require use of green infrastructure practices such as tree planting, rain gardens, and bioswales, to control the amount of stormwater runoff leaving parking lot sites.
- Reduce parking requirements for developers in mixed-use zoning districts and other areas served by multiple modes of transportation to reflect the decreased use in automobiles.

Objective #5: *Adopt Green Infrastructure stormwater management provisions.*

Green infrastructure has proven to be an effective approach to managing stormwater runoff and in ensuring the protection of water quality in our rivers and streams. In addition, green infrastructure can in many instances be more cost effective than traditional stormwater infrastructure practices. Green infrastructure can also provide numerous other community benefits such as enhanced community aesthetics, reduced heat island effects, and a secondary source of non-potable water to meet landscaping irrigation needs. This objective promotes the need to enhance public awareness of the benefits of green infrastructure and provides guidance on how local governments can encourage the use of these practices within their communities.

Implementation Tools and Policies

- Develop public education and workshop activities to provide property owners information about the benefits of green infrastructure, the various applications of green infrastructure, and the maintenance requirements of each selected green infrastructure practice.
- In local comprehensive plans, identify areas within the community that could be targeted for green infrastructure retrofit projects.
- Credit green infrastructure practices towards meeting minimum requirements for stormwater runoff controls.
- Reduce stormwater utility fees for developments that incorporate green infrastructure practices.
- Provide expedited permit review for developments that incorporate green infrastructure practices.
- Incorporate routine inspection provisions for all approved green infrastructure projects to ensure that property owners are properly maintaining each project site.
- Institute a recognition program to highlight green infrastructure projects that are implemented in the local community. This would provide models and examples showcasing the benefits of green infrastructure and to encourage the expanded use of these stormwater management strategies.
- Develop a concise maintenance plan for green infrastructure projects so that maintenance responsibilities and timelines are clearly outlined.

Local Case Studies

Clemson's Carolina Clear program has developed and maintained an online Low Impact Development atlas, which highlights stormwater best management practices that have been implemented in the state of South Carolina. This tool enables stormwater managers, planners, and developers to share specific information about LID projects to serve as models for addressing community stormwater and growth management issues. The types of LID practices which are

showcased in the atlas include bioswales, bioretention rain gardens, rain harvesting projects, stormwater wetlands, green roofs, permeable pavements, and water conservation projects.

The South Carolina Low Impact Development Atlas is integrated into a national database sponsored by the Nonpoint Education for Municipal Officials network. Communities within the Waccamaw region have actively participated in this project and have submitted a total of 24 projects into the database as of 2011. **Table 6-6** provides a list of the projects currently included in the South Carolina Low Impact Development Atlas. The South Carolina Low Impact Development Atlas can be viewed at: http://www.clemson.edu/public/carolinaclear/lidmap/

Table 6-6 South Carolina Low Impact Development Atlas

Site	Location	Type of LID Application	Date of Installation
Georgetown High School	2500 Anthuan Maybank Drive, Georgetown, SC 29440	Bioretention/ Rain Garden	2008
Georgetown Chamber of Commerce	1001 Front Street. Georgetown, SC 29440	Permeable Pavement	2005
Clemson Baruch	1 Hobcaw Road. Georgetown, SC 29440	Bioretention/ Rain Garden	2009
Hobcaw Barony	22 Hobcaw Road. Georgetown, SC 29440	Permeable Pavement	2007
Oyster Landing- North Inlet Winyah Bay NERR	Georgetown, SC 29440	Erosion Control	2007
Ricefields Residential Development	Pawleys Island, SC 29585	Stormwater Wetlands	2000
Waccamaw Elementary School	1364 Waverly Road, Pawleys Island, SC 29585	Bioretention/ Rain Garden	2010
Brookgreen Gardens	1931 Brookgreen Drive. Murrells Inlet, SC 29576	Permeable Pavement	N/A
Murrells Inlet Bike Path	Murrells Inlet, SC 29576	Permeable Pavement- 300 ft section	2008
Burgess Elementary School	9645 Scipio Lane, Myrtle Beach, SC 29588	Bioretention/ Rain Garden	2008
Moss Park	Myrtle Beach, SC 29588	Stormwater Wetlands	2005
Yaupon Park	Surfside Beach, SC 29575	Permeable Pavement	2009
Magnolia Lake	14th Avenue N. Surfside Beach, SC 29575	Vegetated Shoreline Stabilization	2008
Fire Station #14	1170 Howard Parkway, Myrtle Beach, SC 29577	Bioretention/ Rain Garden	2009
Myrtle Beach Train Depot	851 Broadway Street. Myrtle Beach, SC 29578	Bioretention/ Rain Garden	N/A
Socastee High School	4900 Socastee Boulevard. Myrtle Beach, SC 29588	Bioretention/ Rain Garden	2008
Habitat Park	Cabana Street and Pine Tree Lane, Briarcliffe Acres, SC 29572	Native vegetation landscaping	N/A
Habitat Park	Cabana Street Briarcliffe Acres, SC 29572.	Bog Garden/ Riparian Buffer	2010
Coastal Carolina University- Center for Marine and Wetlands Studies	1270 Atlantic Avenue Conway, SC 29526	Bioretention/ Rain Garden	2006
Waccamaw Elementary School	251 Claridy Road. Conway, SC 29526	Bioretention/ Rain Garden	2010
Horry County Administration Building	1301 Second Avenue Conway, SC 29526	Bioretention/ Rain Garden	2010
Conway High School	1605 Horry Street Conway, SC 29528	Bioretention/ Rain Garden	2008

Note: *Current as of May 2011*
Source: *South Carolina Low Impact Development Atlas, Carolina Clear- Clemson University*

Funding Opportunities

Section 319 Non-point Source Management Program

The 1987 amendments to the federal Clean Water Act established the Section 319 Nonpoint Source Management Program in the United States. The aim of this program is to grant funding opportunities to state and local government agencies to provide technical, educational, training, and project implementation assistance to address non-point source pollution problems. Grant awards cover up to 60% of the total project costs, with the remaining 40% being covered by the grant applicant. SC DHEC gives highest priority to projects that are implemented in a watershed with an approved TMDL. Section 319 grant projects are also intended to address non-point source pollution outside of existing designated MS4 permit boundaries.

Section 319 grants have been utilized to implement non-point source management projects in the Waccamaw region in the past. Between 1999-2003 Coastal Carolina University engaged in a non-point source management project in the Kingston Lake and Crabtree Canal Watersheds in Horry County. The aim of the project was to identify and mitigate fecal coliform and low dissolved oxygen problems attributable to non-point sources of pollution. The project included the retrofit of an existing detention pond into a more natural pond/wetland system. Significant monitoring and educational components were also included as part of the scope of this project. This project successfully reduced fecal coliform bacteria and Total Suspended Solid loads to Kingston Lake and was one project in an ongoing effort to address long-term water quality concerns in the Waccamaw River watershed. Watershed stakeholders still actively promote public awareness of watershed management needs through the Kingston Lake Environmental Awareness Network (KLEAN). More information about their efforts can be found online at: http://www.coastal.edu/wwa/klean/

The Kingston Lake Section 319 grant project serves as a great example of how to address problems associated with non-point sources of pollution in the Waccamaw region. There are waterbodies with existing TMDLs within the Waccamaw region that may be eligible for Section 319 grant support. This would provide great benefits to our region's water quality management efforts by providing a focused approach at addressing specific known threats of non-point source pollution.

South Carolina Clean Water State Revolving Fund

The South Carolina Clean Water State Revolving Fund (SFR) was established and authorized via the 1987 amendments to the federal Clean Water Act. The aim of the fund is to assist project sponsors with the financing of Publicly Owned Treatment Works and non-point source management activities. The SC DHEC office in conjunction with the State Budget and Control Board Office of Local Governments processes and issues loans to fund eligible projects.

South Carolina utilizes a Priority Ranking System to evaluate eligible projects. Recently the state has decided to evaluate capital projects for municipal wastewater treatment facilities and non-point source pollution prevention projects on an equal basis, allowing the Clean Water State Revolving Fund program to focus on water quality issues as comprehensively as possible. In fiscal year 2009, only four of the forty-two projects listed on the SRF Intended Use Plan were non-point source pollution related projects. It is important for non-point source management entities to be aware of this potential funding source as they implement projects to address stormwater runoff issues in their communities. The State of South Carolina was a recipient of American Recovery and Reinvestment Act stimulus funding. $40,148,200 was passed onto the Clean Water State Revolving Fund. One of the main objectives of the ARRA funding is to promote and encourage "green infrastructure" projects. 20% of all ARRA funding, approximately $8,000,000, will be dedicated to green infrastructure projects. This is a great incentive to promote and encourage the implementation of innovative non-point source water quality management strategies within our local communities.

For general information about the SC Clean Water State Revolving Fund visit the SC DHEC website at: http://www.scdhec.gov/environment/water/srf.htm For more information about green infrastructure funding opportunities through the SC Clean Water State Revolving Fund and eligibility requirements refer to the following weblink: http://www.scdhec.gov/environment/water/docs/srf_gpr.pdf

US Army Corps of Engineers- Planning Assistance to States Program. Through the Water Resources Development Act, the US Army Corps of Engineers awards grants to states and local governments for the purpose of developing comprehensive plans for the utilization and conservation of water and related land resources.

More information about this grant opportunity can be found online at:
http://www.sac.usace.army.mil/?action=programs.support

US EPA Wetlands Program Development Grants. This grant program is designed to foster the acceleration of research, training, demonstrations, and studies relating to the causes, prevention, and elimination of water pollution. The program has three established priority areas including developing a comprehensive monitoring and assessment program, improving the effectiveness of compensatory mitigation, and refining the protection of vulnerable wetlands and aquatic resources.

Additional information about this grant opportunity can be found online at US EPA's website at:
http://water.epa.gov/grants_funding/wetlands/grantguidelines/index.cfm

SC DHEC-OCRM, Capacity Building Grant for Local Governments. One of the many responsibilities of SC DHEC-OCRM is to coordinate activities to address non-point source pollution water quality issues in coastal areas through the Federal Coastal Nonpoint Program. One of the ways SC DHEC-OCRM supports efforts to address coastal non-point source issues is through the Capacity Building Grant for Local Governments.

Additional information on programs administered by SC DHEC- OCRM to address water quality issues in coastal waters can be found online at: http://www.scdhec.gov/environment/ocrm/water_quality.htm

The programs mentioned in this section have led to the implementation of many successful water quality management projects in the Waccamaw region. It is only a partial list of all the available funding sources focused on water quality management. A current and regularly updated list of grant programs administered through various federal agencies can be found online at www.grants.gov

NON-POINT SOURCE POLLUTION MANAGEMENT GOALS AND RECOMMENDATIONS

The following section provides a list of goals and corresponding recommendations with respect to non-point source pollution management efforts in the Waccamaw region. As discussed throughout this chapter, non-point sources of pollution can have tremendous impacts on the water quality of our local beaches, estuaries, streams, and rivers. Management efforts must be directed at several potential pollution sources within our watersheds in both urban and rural areas. These goals reflect the range of activities and land uses that must be addressed as part of a comprehensive non-point source pollution management framework. Many of these goals focus on emerging stormwater management strategies, such as green infrastructure. In addition, several recommendations highlight the need to coordinate efforts amongst all relevant stakeholders to develop both structural and non-structural solutions to manage stormwater runoff and other types of non-point source pollution.

Goal One: Government entities will lead the effort to address non-point source pollution as a serious water quality issue in the Waccamaw region by implementing projects and management strategies to minimize impacts associated with non-point source pollution. ***Recommendations include:***

- Pursue projects and initiatives that support the goals outlined in SC DHEC's South Carolina Non-point Source Management Plan. This document can be accessed online at: http://www.scdhec.gov/environment/water/docs/nps.pdf
- Encourage close collaboration between point-source and non-point source management agencies to ensure that regional water quality issues are being addressed thoroughly and comprehensively.
- Pursue all available funding opportunities to address non-point source related problems as part of Total Maximum Daily Load projects within the Waccammaw region. Section 319 grant funding should be pursued in areas outside of the MS4 boundaries that are covered within the boundaries of a TMDL in the Waccamaw region.
- Ensure that all available structural stormwater filtration devices are evaluated when considering stormwater construction projects.
- All MS4 jurisdictions, including SC DOT, are responsible for maintaining the roadways throughout the Waccamaw region. Strive to implement innovative stormwater best management practices in all scheduled roadway maintenance and improvement projects, where appropriate. Establishing vegetated buffers along roadway drainage ditches is one example of a practice that can be implemented along linear infrastructure corridors such as roadways.
- Continue to share knowledge with nearby communities on the effectiveness of various non-point source pollution management techniques that have been utilized in the region. In particular, take advantage of the findings from projects conducted by local research institutions including Coastal Carolina University, North Inlet-Winyah Bay NERR, and the Belle W. Baruch Foundation.
- Direct a specific focus on incorporating stormwater best management practices into linear projects such as utility installation and roadway corridor improvement projects.
- Ensure that water quality monitoring remains an integral investigative watershed management tool in identifying non-point source pollution problems in the Waccamaw region.

Goal Two: Facilitate the implementation of innovative stormwater management practices such as green infrastructure and Low Impact Development. Local governments should make the case that green infrastructure and Low Impact Development is a viable economical alternative to traditional stormwater management practices. ***Recommendations include:***

- Strive to implement Low Impact Development best management practices at community facilities, where appropriate, within each of the local jurisdictions in the Waccamaw region. Utilize these sites as public demonstration sites for proper design and implementation criteria.
- Pursue the development of a coastal Low Impact Development manual that assists stormwater managers and local decision makers in implementing stormwater management strategies that help to minimize water quality impacts commonly associated with urban development and increased impervious surfaces. A Low Impact Development manual should include engineering schematics that are suitable to coastal environmental conditions unique to the South Carolina coast.
- Revise local ordinances to allow and encourage the use of innovative best management practices and designs consistent with green infrastructure and Low Impact Development principles.

- Continue to encourage local stormwater managers to contribute Low Impact Development and green infrastructure projects to Clemson's Carolina Clear SC Low Impact Development Atlas program.
- Determine and implement a viable mechanism to ensure that green infrastructure projects that are constructed or established at a development site are protected indefinitely. Develop enforcement procedures designed to ensure that credited green infrastructure projects are properly maintained on a routine basis.
- Revise stormwater utility fee structures to provide discounts to property owners who incorporate green infrastructure practices into existing and new developments.
- Consider providing development incentives such as expedited permit review, permit and impact fee reductions, and floor/ area ratio density bonuses, for property owners who incorporate green infrastructure strategies into their site designs.
- Create tax incentives for installing Low Impact Development practices on residential and commercial properties.
- Encourage homeowners to use rain barrels by selling them at a reduced cost and offering installation assistance.
- Encourage homeowners to participate in initiatives such as Clemson's Carolina Yard and Neighborhood program, which focuses on the use of native landscaping and the efficient use of water, pesticides, and fertilizers to minimize impacts on local water resources. More information about this program can be found online at: http://www.clemson.edu/extension/natural_resources/water/carolina_yards/
- In partnership with planning staff at local governments, develop a list of areas to target for the establishment and maintenance of riparian buffers on a regional level.
- Continue to provide educational workshops and technical assistance to engineers, developers, and homeowners on LID and green infrastructure design and maintenance guidance.

Goal Three: Identify and actively address water quality issues associated with forestry related activities in the Waccamaw region. ***Recommendations include:***

- Promote and expand forestry management training programs such as the Best Management Practice Courtesy Exam program offered by the South Carolina Forestry Commission. Encourage local forestry professionals to continue to implement the South Carolina Forestry Commission best management practices at harvesting sites in the Waccamaw region.
- Utilize information gathered by the South Carolina Forestry Commission best management practices monitoring program to assess the level of compliance of forestry related BMPs and to direct appropriate education and outreach resources to ensure that BMPs are being implemented.
- Partner with timber harvesting site owners to assess the feasibility of preserving key forested areas to provide critical riparian buffer areas to address watershed level water quality impairment issues.
- Encourage local forestry landowners to participate in volunteer forestry certification programs such as the Sustainable Forestry Initiative Program and the Forest Stewardship Council.
- Encourage local communities to continue to participate in the Tree City USA program and other urban forestry initiatives sponsored by the South Carolina Forestry Commission.

Goal Four: Continue to work with local farmers and relevant management agencies such as the United States Department of Agriculture to identify and address all agricultural non-point source pollution concerns. ***Recommendations include:***

- Continue to monitor trends within agricultural based industries in the Waccamaw region by regularly reviewing land cover data and data published by the USDA Ag Census.

- Identify potential non-point source pollution management projects at local agriculture sites that may be eligible for Section 319 grant funding. Historically, agricultural runoff projects, such as riparian buffer establishment, have accounted for nearly forty percent of all Section 319 grant fund awards.
- Work with local farmers to pursue opportunities to participate in conservation and stewardship initiatives administered by the USDA Natural Resources Conservation Service.

Goal Five: Actively address non-point source pollution problems associated with boating and marine related activities.
Recommendations include:

- Partner with SCDHEC-OCRM and the South Carolina Marine Association to encourage local marinas to participate in the SC Clean Marina Program and institute measures to reduce non-point sources of pollution from their marine activities and operations.
- Identify popular recreational boating areas that are in need of boat septage pumpout stations and pursue funding sources such as the Clean Vessel Act Grant program to install them at appropriate marinas throughout the Waccamaw region.

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