2017 Hog Inlet and Dunn Sound Creek Watershed Plan

A Multi-jurisdictional Strategy to Address Fecal Coliform Bacteria Impairments in Local Shellfish Harvesting Areas.

Funded by SC DHEC through the Section 319 Non-point Source Pollution Grant Program
Developed by the Waccamaw Regional Council of Governments in partnership with Horry County, North Myrtle Beach and Horry Soil and Water Conservation District.
2017 Hog Inlet- Dunn Sound Creek Watershed Plan

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Abbreviations and Acronyms

The following is a list of abbreviations and acronyms utilized in the narrative of the Hog Inlet- Dunn Sound Creek Watershed Plan that are common terms related to water quality management in South Carolina.

ATV- All Terrain Vehicle
BMP- Best Management Practice
CCD- County Census Division
CDBG- Community Development Block Grant
CDC- Centers for Disease Control and Prevention
COG- Council of Governments
CORRI- Coastal Oyster Recycling and Restoration Initiative
CWSEC- Coastal Waccamaw Stormwater Education Consortium
FDA- United States Food and Drug Administration
GSATS- Grand Strand Area Transportation Study
HUC- Hydrologic Unit Code
LID- Low Impact Development
ml- milliliter
MPN- Most Probable Number
MS4- Municipal Separate Storm Sewer System
NPDES- National Pollutant Discharge Elimination System
NTU- Nephelometric Turbidity Unit
qPCR- Quantitative Polymerase Chain Reaction
SCDHEC- South Carolina Department of Health and Environmental Control
SCDNR- South Carolina Department of Natural Resources
SCDOT- South Carolina Department of Transportation
SCORE- South Carolina Oyster Restoration and Enhancement
SFH- Shellfish Harvesting Water
TMDL- Total Maximum Daily Load
US ACE- United States Army Corps of Engineers
US EPA- United States Environmental Protection Agency
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It has been a great honor to be the lead author of the Hog Inlet/ Dunn Sound Creek Watershed Plan. The Waccamaw Regional Council of Governments is integrally involved with regional water quality planning and management activities in Horry, Georgetown, and Williamsburg Counties. Horry County, North Myrtle Beach, and Horry Soil and Water Conservation District are among many public and private stakeholders that we partner with in our region. Several representatives from each of these jurisdictions were pivotal to initiating this project and committing their time and resources throughout the planning process. Special thanks to Kevin Blayton, Travis Dupree, and Jay Beeson from North Myrtle Beach, Sam Ward from Horry Soil and Water Conservation District, and Dave Fuss from Horry County.

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Information in the planning document came from many sources. Thanks to Mike Pearson, DHEC Shellfish Program Director, and his staff for providing monitoring data collected within Shellfish Management Area 01 as far back as 1992. The Hog Inlet Microbial Source Tracking Study, led by Coastal Carolina University- Environmental Quality Lab faculty Dr. Erin Burge and Dr. Susan Libes, was of tremendous value in assessing bacteria sources in Hog Inlet and developing recommendations for future management strategies. Additional thanks goes to Dr. Keith Walters from Coastal Carolina University who provided guidance on oyster reef ecology and gave a presentation at our initial public meeting on the Coastal Oyster Recycling and Restoration Initiative. The general public also provided insightful feedback on their concerns within the watershed at our public meetings and via the public survey.

This project has been a tremendous learning experience for all parties involved. I am confident that the collective stakeholder interest exhibited during this planning process will result in successful water quality improvement projects in the future. I look forward to remaining an integral partner as these efforts move forward.

Daniel Newquist

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The Hog Inlet- Dunn Sound Creek estuary is located in the far northeast portion of South Carolina. Hog Inlet drains directly into the Atlantic Ocean, while Dunn Sound Creek flows into Little River Inlet. The watershed is multi-jurisdictional with the majority of the land area lying within the city limits of North Myrtle Beach and the remainder in Horry County. While it is a relatively small watershed drainage area (11 total square miles), there are a variety of land use types ranging from undeveloped open space to high density residential neighborhoods. Six main catchment areas are assessed in this watershed plan, each with their own characteristics and hydrological dynamics.

Hog Inlet and Dunn Sound Creek are designated as Shellfish Harvesting Waters by SC DHEC. Both waterbodies are located within the Shellfish Program's Management Area 01. The primary water quality standard monitored by SC DHEC in Shellfish Harvesting Waters is fecal coliform bacteria. There are nine monitoring sites within Management Area 01 which are sampled on a monthly basis. The numerical standard to attain Approved harvesting status is to maintain a geometric mean of 14 Most Probable Number (MPN)/100ml and a 90th percentile of 43 MPN/100ml. The 2016 Shellfish Management Area 01 Annual Update reveals that none of the monitoring sites are meeting the standard.

To address the water quality concerns in Hog Inlet and Dunn Sound Creek, staff with Horry County, North Myrtle Beach, and Horry Soil and Water Conservation District sought the development of a watershed plan as an opportunity to analyze historical data trends, investigate the potential sources of bacteria, and to evaluate and discuss potential management options to ultimately reduce bacteria levels in the estuary. Because of the multi-jurisdictional nature of the Hog Inlet estuary, these partners solicited assistance from the Waccamaw Regional Council of Governments to facilitate the planning process.

An important step in the planning process was to assess the potential sources of bacteria entering the estuary and any transport mechanisms that exacerbate the problem. The planning team held public meetings and administered a ten question survey to solicit input from resident and business stakeholders in the community regarding their observations and concerns of water quality conditions in the estuary. Public participation was excellent throughout the planning process and very beneficial to the planning team. It was acknowledged that due to the diversity of development patterns in the watershed, each of the six catchment areas within the watershed would have varying sources of bacteria. The sanitary sewer system, pet waste, wildlife and bird populations, feral cat colonies, and septic systems were all evaluated as potential sources of bacteria. Other potential causes of the elevated bacteria levels such as land use changes, stormwater runoff, sedimentation, and boating were all discussed in the watershed plan.

As part of the data analysis portion of the plan, the partners reviewed data collected by SC DHEC at the nine monitoring sites dating back to as far as 1992. The median fecal coliform levels ranged from 7.8 MPN to 23 MPN for the entire period of record. The data does indicate that a noticeable increasing trend over the past three years of data is occurring. In the time period between February 2013 to February 2016 the median fecal coliform levels ranged from 15.5 MPN to 39.5 MPN. A scatter plot was created for each of the nine monitoring sites displaying all of the samples collected since 1992. Using Microsoft Excel trendline projections, seven of the nine sites did indicate an increasing trend in fecal coliform levels. Monitoring sites 01-07 and 01-17A were the two sites that indicated a decreasing trend in fecal coliform.

To complement the SC DHEC data analysis, the partners contracted with the Coastal Carolina University Environmental Quality Lab to perform a microbial source tracking study in Hog Inlet. The purpose of the study was to determine the animal source of origin of bacteria entering Hog Inlet. The study was designed using tracers to detect signals of human sourced bacteria. Eight sites were sampled in August and September of 2016. Samples were collected on three days with dry weather conditions and three days with wet weather conditions.
to assess the influence of storm events on bacteria levels as well as turbidity and salinity. The results indicated that currently human sourced bacteria is not a concern within Hog Inlet, but rather the bacteria entering the estuary is from non-human origin, potentially pets, birds, and wildlife. The study did confirm that bacteria levels do increase significantly after rainfall events with conditions most pronounced at monitoring sites near the shoreline. Overall the sites that were of greatest concern were at Jacks Circle Road and Sea Mountain Highway, even during dry weather periods.

Based on the findings of the DHEC data analysis and the Hog Inlet Microbial Source Tracking Study, the project team prioritized monitoring sites for future management purposes into three tiers. SC DHEC monitoring sites 01-07, 01-18, 01-06, 01-17A, and 01-17 have been designated as Tier One sites, the highest priority. Sites 01-07 and 01-18 were the most recent to meet the Approved shellfish harvesting classification standards. The hope is that with concerted management efforts, these sites have a high potential to meet the standards once again within a five year period. Monitoring site 01-06 is closest to the Jack’s Circle Road site and site 01-17 is closest to the Sea Mountain Highway site in the Microbial Source Tracking Study, both of which were identified as sites with water quality concerns. Site 01-17A should be closely monitored as it is located in close proximity to the Cherry Grove canal system, which was recently dredged in the fall and winter of 2016. SC DHEC sites 01-05 and 01-19 have been designated as Tier Two sites. Since SC DHEC sites 01-01 and 01-02 are located in the Little River Inlet drainage area, which is outside of our primary watershed focus area, they have been designated as Tier Three sites, the lowest priority.

Prior to outlining a set of future watershed management activities, the plan reviews ongoing projects and activities that watershed stakeholders are currently involved with. Activities associated with the MS4 permit, the Cherry Grove canal dredging project, pet waste campaigns, and other stormwater infrastructure projects are all highlighted. Element F outlines a total of 19 recommendations for future watershed management activities in Hog Inlet and Dunn Sound Creek. The strategies focus on a diverse range of issues and target stakeholder groups. Recommendations address proper pet waste disposal, feeding wildlife, concealing trash dumpsters, and controlling feral cat populations. Other strategies focus on BMPs that homeowners and businesses can consider implementing including rain barrels, pervious pavement installation, and maintaining a vegetated shoreline buffer. Other recommendations focused on neighborhoods relying on septic systems, sanitary sewer system maintenance, and stormwater infrastructure improvements. Another point of emphasis in the recommendations is the restoration of the oyster reef and marsh habitats within the estuary. All of the recommendations are evaluated based on the anticipated timeframe for implementation, the catchment area targeted for installation, and other barriers of implementation that need to be accounted for including project costs, partnership needs, and public acceptance.

The watershed management recommendations outlined in Element F are supplemented by chapters which focus on public outreach and education, future monitoring efforts, and potential funding sources. Each of these are critical supporting resources that are needed to ensure the long-term success of the watershed plan. Fortunately, there are excellent resources available throughout the state and within our immediate region to make strides on improving water quality. Both Horry County and North Myrtle Beach are active members of the Coastal Waccamaw Stormwater Education Consortium which focuses on public education initiatives in Georgetown and Horry Counties. The future monitoring element highlights resources available via Coastal Carolina University’s Environmental Quality Lab. Both entities were pivotal in the watershed planning process, by assisting with the facilitation of public meetings and the completion of the microbial source tracking study.

The key to the success of developing this watershed plan has been the committed partnerships between Horry County, North Myrtle Beach, Horry Soil and Water Conservation District, and concerned citizens and local business owners. Reducing bacteria loads in Hog Inlet and Dunn Sound Creek is a challenging task, requiring a multifaceted approach. All watershed stakeholders have a role to play in the implementation of this watershed plan. Therefore partnership building will continue to be paramount as projects and initiatives are pursued. This
watershed plan serves as a guide and supporting document to these partnerships with the ultimate goal of achieving the fecal coliform water quality standards in Hog Inlet and Dunn Sound Creek.
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Element A: Description of the Hog Inlet-Dunn Sound Creek Watershed

The Northeast coast of South Carolina is characterized by numerous tidal creeks, inlets, and estuaries that create unique marsh and oyster reef habitats. Hog Inlet and Dunn Sound Creek are tidally influenced estuaries just south of the Little River Inlet near the North Carolina state line. Hog Inlet drains directly into the Atlantic Ocean, while Dunn Sound Creek drains into the Little River Inlet. See Figure A-1 for a general map of the watershed and surrounding area.

Both Hog Inlet and Dunn Sound Creek comprise SC DHEC Shellfish Management Area 01. There are currently nine monitoring stations sampled monthly which determine harvesting classifications designed to protect public health. As of the SC DHEC 2015 Annual Update report, all designated shellfish habitats within Management Area 01 are Restricted or Prohibited to shellfish harvesting. Local officials from Horry County and North Myrtle Beach, along with many concerned residents, recognize the need to identify the sources of the fecal coliform impairments and develop strategies to help improve water quality in the Hog Inlet- Dunn Sound Creek area. This watershed plan is an opportunity for all stakeholders to evaluate the existing conditions in the watershed, investigate available management resources, establish water quality goals, and develop specific improvement strategies in short and long-term timeframes.

Figure A-1. Aerial view of the Hog Inlet- Dunn Sound Creek Watershed Area.

I. What is a Watershed?

In simplest terms, a watershed collects all precipitation which falls within a particular land area ultimately draining into a common waterbody outlet. Topography and the presence of water control structures are the primary determinants of the watershed boundaries for each stream, river, lake, or estuary. See Figure A-2 for a illustrated depiction of a watershed. Watersheds can be observed on small scales such as a tidal creek draining into Hog Inlet. Watersheds can also be delineated on a very large scale such as the Pee Dee River, which encompasses a network of streams extending into the Piedmont area of North Carolina and Southwestern Virginia before flowing through the coastal region of South Carolina prior to entering Winyah Bay and finally out to the Atlantic Ocean. The Hog Inlet and Dunn Sound Creek are relatively smaller watersheds encompassing an area of approximately 11 square miles. While this watershed is small, the boundaries extend into both North Myrtle Beach and Horry County, requiring multi-jurisdictional cooperation and shared responsibilities to help protect water quality in Hog Inlet and Dunn Sound Creek. There are also many land use types within the watershed, varying from highly urbanized residential/commercial properties to completely undeveloped open space. This watershed plan will focus on a neighborhood scale examining six separate catchment areas, each with distinct features. A profile of each catchment area is profiled later in Element A.
II. Purpose of the Watershed Plan

This watershed plan is the final product of a collaborative stakeholder process to assess water quality conditions in Hog Inlet and Dunn Sound Creek and determine the proper course of action for long-term improvements and protection. The planning process itself is an invaluable learning opportunity to review available water quality data in the estuary, become aware of previous and current water resource management efforts, and to engage the general public to incorporate local knowledge and perceptions on regional watershed issues.

The plan expresses the water quality goals of Horry County, North Myrtle Beach, and the community residents that live in the watershed and their commitments to ensure the long-term protection of their estuary resources. Ultimately, the plan serves as a guiding resource for future implementation activities and will be critical when seeking partnership and funding opportunities with state and federal government agencies, universities, research institutions, and non-profit organizations. This watershed plan is intended to have a time horizon of 15-20 years but should be reviewed regularly and updated as necessary by all contributing stakeholders.

III. Fecal Coliform Bacteria: Parameter of Concern

The main water quality parameter that SC DHEC monitors within designated Shellfish Harvesting Waters is fecal coliform bacteria. Though fecal coliform is generally not thought to be harmful to humans, it originates from warm-blooded animal sources, and therefore serves as an indicator of other pathogenic bacteria, protozoans, and viruses that pose public health risks. Because there are numerous species of pathogenic bacteria, testing for a single indicator organism such as fecal coliform minimizes the costs of testing for multiple parameters.

From a public health standpoint, the greatest concern associated with consuming contaminated shellfish is the transmission of waterborne diseases. The most common in the Southeast are *Giardiasis* and *Cryptosporidiosis*. The transmission of these illnesses can occur in a number of ways besides shellfish consumption including contaminated drinking water and improperly treated swimming pools. Typical symptoms of both of these diseases include dehydration, nausea, vomiting, fever, and diarrhea. The risk of exposure to these diseases is far greater when the shellfish product is
consumed raw. According to the Centers for Disease Control (CDC), in 2011 there were 16,868 reported cases of Giardia and 9,313 reported cases of Cryptosporidiosis, nationwide. In 2012, the incidents of both illnesses decreased to 15,223 reported cases of Giardia and 8,008 cases of Cryptosporidiosis. In establishing the water quality standard for Shellfish Harvesting Waters, SC DHEC utilized guidance from the US Food and Drug Administration’s (US FDA) National Shellfish Sanitation Program Model Ordinance.

IV. Long-term Water Quality Goals for Hog Inlet-Dunn Sound Creek

The watershed planning committee, with input from the general public, developed the following long-term goals for the Hog Inlet- Dunn Sound Creek watershed. While these goals are by no means exhaustive, they provide aspirational guidance for all stakeholders that will share the responsibilities for improving local water quality. Additional specific goals are outlined in several other elements of the document, particularly in Element G: Recommended Watershed Management Measures.

- Within 15-20 years, approximately 80% of all designated shellfish harvesting areas within Hog Inlet and Dunn Sound Creek will be Approved for harvesting by SC DHEC, which is the nationwide targeted goal established by the US EPA.
- Identify all common sources of bacteria entering Hog Inlet and Dunn Sound Creek so that specific management measures can be instituted to properly account for and mitigate each bacteria source at the point of origin.
- Ensure sustainable oyster reef habitats by establishing reef restoration sites and by limiting harvest to just recreational users to prevent the overharvesting of the oyster stock.
- As the Cherry Grove Beach and Little River Neck areas continue to grow, encourage sustainable development practices with a strong emphasis on protecting the natural resources within the Hog Inlet and Dunn Sound Creek watersheds.

V. Land Use Patterns

For a relatively small watershed area, approximately 11 square miles in total area, there are a number of unique and diverse landscape features including an undisturbed barrier island, high density oceanfront residential, low density rural residential, golf course communities, and commercial retail corridors. Each of these distinct land use types has a unique influence on the hydrology of the watershed. Based on EPA published mapping data there are six main catchment or drainage areas within the watershed. It is suspected that the sources of bacteria entering Hog Inlet and Dunn Sound Creek will vary across the watershed and require specific management strategies for each of these catchment areas to effectively minimize bacteria loads.

Below is a brief profile of each catchment area with a description of landscape characteristics and other notable features. Exhibit A-1 is a map providing the boundaries of each catchment area:

**Catchment Area 01 (Waties Island/Little River Inlet):**

This catchment area is located where Dunn Sound Creek drains into the Little River Inlet. It includes portions of Waties Island, a 1,105 acre undeveloped barrier island owned and managed by Coastal Carolina University. This research reserve facility is comprised of an undisturbed coastal maritime forest, tidal creeks, saltwater marshes, and sand dune complexes. The other half of this catchment area includes the most northeastern portion of Little River Neck, referred to as Tilghman Point. This area is predominately rural residential with large areas of open space with a horse stable facility and a horseback riding and ATV tour operation. SC DHEC monitoring stations 01-02, 01-05, and 01-06 are all within the drainage basin of Catchment Area 01.

*Figure A-3. Waties Island makes up a large portion of Catchment Area 01. This large undeveloped barrier island is utilized as a research facility by Coastal Carolina University*
Catchment Area 02 (Little River Neck- Marsh):

This subbasin includes the remaining portions of Waties Island, directly along the Atlantic Ocean coastline. The catchment area extends southwest to include the Myrtle Beach RV Park, a high density development with approximately 200 residential units, several which directly abut the estuary. Also within the catchment area is a small portion of the Tidewater Plantation Golf Course development. Multiple golf holes are immediately adjacent to the marsh areas of Hog Inlet. SC DHEC monitoring sites 01-19 and 01-17A are both located in close proximity to Catchment Area 02 near the Tidewater Plantation Golf Course.

Figure A-4. Catchment Area 02 consists of diverse land uses including undeveloped open space and large residential developments.

Catchment Area 03 (East Cherry Grove):

The most urbanized portion of the watershed exists within Catchment Area 03, which comprises the majority of the Cherry Grove section in North Myrtle Beach. Cherry Grove forms a peninsula bordered by the Atlantic Ocean to the east and Hog Inlet to the west. From the Hog Inlet outlet into the Atlantic Ocean to the southern extent of the watershed at 11th Ave N is approximately 3.7 miles. A notable feature within the Cherry Grove area is the network of canals that extend along each residential street, beginning at 32nd Ave North to the northern end of Cherry Grove at 63rd Ave N. These canals ultimately drain into Hog Inlet. SC DHEC monitoring sites 01-17, 01-19, 01-17A, 01-18, and 01-07 are all adjacent to Catchment Area 03.

Figure A-5. The Cherry Grove area includes a number of high rise oceanfront buildings. The adjacent residential neighborhoods include a network of canals which have silted in over time. These canals were dredged in the fall of 2016 through the spring of 2017. The dredging project will dramatically change the hydrological dynamics within the estuary with one major ecological benefit being a greater extent of daily tidal flushing through all of the channels and upstream reaches of the system.
Catchment Area 04 (Hill Street):

This catchment area is a mix of residential housing and open space immediately south of Tidewater Plantation on the east side of Little River Neck Rd and along the Sea Mountain Hwy corridor. This drainage basin consists of mostly single family residential neighborhoods intermixed with a few larger undeveloped parcels. Sea Mountain Hwy is the main east to west commercial corridor from US Hwy 17 to Ocean Blvd in Cherry Grove Beach.

![Figure A-6. Stormwater Pond in the Charleston Landing neighborhood](image)

Catchment Area 05 (Sea Mountain Highway to 11th Ave North):

Land in this subbasin drains into the southern extent of Hog Inlet at Sea Mountain Hwy. In addition to the commercial land uses along Sea Mountain Hwy, the catchment area encompasses a small portion of Cherry Grove Beach and a large section of the Surf Golf and Beach Club development.

![Figure A-7. Catchment Area 05 drains into the southern portion of the Hog Inlet estuary. The distance from the upstream portion of the watershed to the outlet point into the Atlantic Ocean is approximately 2.75 miles.](image)
Catchment Area 06 (Little River Neck-Waterway):

For the purposes of this watershed plan, the Atlantic Intracoastal Waterway forms the western extent of this catchment area. The drainage area includes Tidewater Plantation Golf Course, excluding the portion that drains through Catchment Area 02 and the Little River Neck area, as well as the portion that is within Catchment Area 01. The majority of the area consists of undeveloped open space, large timber tracts, along with residential neighborhoods including Tidewater Plantation and Riverside Dr. This area is included in our watershed focus area however, it is suspected that a large portion of this catchment area drains west into the Atlantic Intracoastal Waterway, but very well could affect SC DHEC stations 01-02 and 01-01, which are located within Shellfish Management Area 01.

VI. Soil Survey

An important step in the watershed assessment process is to inventory the underlying soils across the watershed. Soils play an important role in watershed dynamics in a number of different ways. First, soils have varying infiltration capabilities which impact the drainage patterns across a parcel and an entire subwatershed. Areas that have well-drained soils can absorb more precipitation on site, whereas poorly drained soils will pond easily and potentially runoff into nearby storm drains or ditches and ultimately into the estuary. Another important characteristic that varies between soil groups is the $k$ factor, or erosion rate, of a particular soil type. Bacteria is known to bind to sediment particles, which serve as a pathway into the estuary as long-term erosion occurs. In addition, as sedimentation builds up within the channels of the estuary over time, the tidal dynamics become altered. As tidal exchange is reduced in the upper reaches of the estuary, salinity levels also tend to decrease. Salinity is known to kill off bacteria entering the estuary. Minimizing the frequency and extent of erosion occurrences across the watershed is important to maintaining consistent tidal flushing throughout the estuary, which is critical to the ecological health of oyster reef habitats.

A complete soil inventory is also important in determining the suitability of septic systems in the watershed. If a septic system is utilized on a parcel with poorly drained soils, the system can easily malfunction and potentially become a major source of bacteria entering the estuary. A starting point to prioritizing the need for sewer connections can be an examination of the soil types on the properties that are relying on septic systems. Finally, soil types are an important consideration when siting various stormwater Best Management Practices. Some stormwater BMPs rely on specific soil infiltration rates and can also require a minimal depth to the seasonally high water table.

Appendix A includes Exhibit Appendix A-1, a map of all the soil types located in the watershed area, and Table Appendix A-1, which provides a description of each soil type highlighting the specific characteristics of the soils found in the watershed.

VII. Importance of the Estuary to the Historical Development of the Watershed

The Little River Neck, Cherry Grove, and Waties Island areas have a rich history dating back as far as 700 AD as evidenced by the numerous shell middens that have been discovered in the area. Over time, numerous factors including commercial and residential development, infrastructure improvements, weather events, and natural coastal processes have shaped the landscape and hydrology of the estuary. These changes influence water quality conditions as well as the appropriate management strategies that are suitable for the existing and future anticipated landscape characteristics of the watershed. This section provides a brief overview of some of the notable events, features, and periods of development in the history of the watershed.

Tilghman Point- The very eastern end of Little River Neck is known as Tilghman Point, named after Horace Tilghman, Sr. who purchased property in the area in the 1920s. Within his property lies several historical points of interest including...
Allston Plantation, the Randall Plantation, and Fort Randall. During the Civil War, Fort Randall was built as a Confederate battery at this site to protect Little River Inlet from invading Union forces. Today, some of the historic structures remain intact and the rest of this portion of the watershed remains primarily forested with only a few buildings present.

Waties Island- This 1,109 acre barrier island is an excellent example of an undeveloped complex of ocean frontage, fresh and saltwater marshes, tidal creeks, and upland forests. Originally it was included in a King’s Grant deeded to William Allston. It is uncertain how the property was deeded to the Waties family who owned large tracts of land in the area and helped survey the boundary line between North Carolina and South Carolina. In 1995, the owner at the time Anne Tilghman Boyce, donated the property to the Coastal Education Foundation, which was subsequently protected under a conservation easement by the Nature Conservancy. Today, Coastal Carolina University utilizes the property as a research facility to study natural coastal habitats.

Cherry Grove Beach- Originally referred to as Minor’s Island and then later Futch Island, this popular beach area was separated by Cherry Grove Inlet until it filled in around 1950. Since that time there is only one permanent tidal outlet to the Atlantic Ocean via Hog Inlet. Now the Cherry Grove area is a densely developed seasonal residential beach community, drawing many visitors to the area.

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Figure A-9. This aerial image indicates how various coastal processes have shifted the location of the ocean inlets entering the estuary.

Tropical Storm Events- As a coastal region, North Myrtle Beach and Horry County are at risk to impacts from tropical storm events and have experienced several powerful hurricanes over the past half century. Three storms that have had a direct impact on Cherry Grove Beach and Little River Neck include Hurricane Hazel in 1954, Hurricane Floyd in 1999, and Hurricane Matthew in 2016. Hurricanes can have varying ecological impacts on coastal estuary systems. They commonly produce significant amounts of rainfall, as much as 20+ inches in a 48-72 hour period in some areas. A rainfall event of that magnitude inevitably leads to significant stormwater runoff conditions within any developed areas. It often becomes necessary for SC DHEC’s Shellfish Program to close harvesting areas following major rainfall events. In the case of Hurricane Matthew in October 2016, shellfish beds remained closed to harvesting for nearly two months after the storm until oyster and clam tissue samples indicated that the product was safe to consume.
A unique characteristic of tropical storm events is the abnormally low barometric pressure readings, which provides an indication of the storm surge potential to the immediate coastline and adjacent low-lying areas. A large storm surge can result in widespread flooding as well as cause severe erosion that ultimately leads to drastic changes in the hydrology within the estuary system. Heavy rainfall and inundation from storm surge puts enormous strain on utility infrastructure systems including water and sanitary sewer. According to SC DHEC records, 124 sanitary sewer overflow occurrences were reported across the state between October 7, 2016 and October 12, 2016 following Hurricane Matthew.

Hurricane strength is generally determined by wind speed. Tropical storms with wind speeds between 74-95 mph are classified as Category 1 Hurricanes while storms with wind speeds in excess of 157 mph are categorized as a Category 5 Hurricane. Obviously, wind hazards are an additional threat to public safety and property damage. The combination of wind, rain, and storm surge can cause major ecological disturbance and severely alter the coastal landscape. A community’s capacity to prepare for these storms and adequately and promptly respond after a storm hits greatly affects their long-term social, economic, and environmental resiliency to coastal hazards such as tropical storms.

Figure A-10. Hurricane Hazel in 1954 caused significant damage to the Cherry Grove area. The picture on the left is the site of the Cherry Grove Post Office (courtesy of Ann Welborn- The Sun News). Coastal South Carolina was one of the most impacted areas in the Southeast United States during Hurricane Matthew, October 2016.

VIII. Cultural and Economic Impacts

Shellfish are a desired commodity for residents and visitors who enjoy seafood, especially people who value locally caught and harvested products. Seafood is an inherent part of the Grand Strand’s cultural identity and a distinguishing aspect of the local tourism economy. Seafood festivals and oyster roasts are annual celebrations held throughout the region. Little River alone hosts the annual Blue Crab Festival in May and the Shrimp Fest in September both drawing large crowds.

Throughout this planning process, long-time residents recalled how abundant the oyster reefs were years ago and how common shellfish harvesting was as a family activity. Residents described how fast and large the oysters would grow in the estuary as well. As you might imagine many lament that the shellfish beds are now closed and expressed a deep desire to have them reopened. A strong consensus from the public is that if the fecal coliform standard is ever attained and the shellfish beds are approved for harvesting, only small scale recreational harvesting should be permitted. The concern is that if commercial harvesting is permitted, the oyster reef stock will be depleted much faster and more extensively than from recreational harvesting alone. Ultimately residents want to ensure that the oyster reefs are protected to the extent needed so that harvesting can occur in a sustainable manner. One of the recommendations outlined in Element F is to work with the Department of Natural Resources to designate all shellfish grounds within Hog Inlet and Dunn Sound Creek as State Shellfish Grounds where only recreational harvesting is permitted.
IX. Population Trends and Future Land Use Change

The greater Cherry Grove Beach and Little River Neck portions of North Myrtle Beach and Horry County have experienced a tremendous amount of change over the past 50 years and more. A likely reality is that growth will continue over time presenting ongoing challenges in protecting water quality within the Hog Inlet- Dunn Sound Creek estuary. Below are some population data obtained from the US Census from 1970 through 2010. Also provided is a table with population projections through 2035 by the Waccamaw Regional COG based off of county level projections provided by the SC Budget and Control Board.

The level of analysis for this population data is the County Census Division (CCDs). Horry County is comprised of eight CCDs, including Little River CCD which encompasses the Hog Inlet- Dunn Sound Creek watershed. Exhibit A-3 is a reference map of the Horry County CCD and Census Designated Place boundaries. While the Little River CCD is noticeably larger than the Hog Inlet- Dunn Sound Creek watershed it is a consistent geographic boundary where population data has been collected for several decades. It serves as a good indicator of population trends that are occurring within the greater Cherry Grove Beach/Little River area. Table A-1 provides population data of the Little River CCD from 1970 to 2010. Horry County populations are also provided for comparison.

| Table A-1 Population Totals for the Little River CCD: 1970 to 2010 |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Little River CCD | 4,960            | 8,781           | 17,988          | 26,315           | 33,652           | 34,632           |
|                  | 77.0% increase  | 104.8% increase | 46.3% increase  | 27.9% increase   |
| Horry County     | 69,992          | 101,419         | 145,300         | 196,630          | 269,291          | 36.9% increase   |

Source: US Census Bureau

As the table indicates, there has been a consistent population growth within the Little River CCD over the past four decades with a pace of growth that has been greater than that of Horry County as a whole. Table A-2 provides population projections in 5-year increments through 2035.

| Table A-2 Population Projections for the Little River CCD: 2020-2035 |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Little River CCD | 46,228          | 49,975          | 53,845          | 57,754          |
| Horry County     | 316,810         | 342,536         | 367,680         | 393,160         |

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

It is expected that growth will continue within the Little River CCD and Horry County at large. Another factor that water resource managers must account for is the large number of part-time residents and seasonal vacationers. An important consideration in developing this plan is to ensure that information and long-term recommendations presented in this plan complement goals and objectives outlined in the North Myrtle Beach and Horry County Comprehensive Plans along with any other planning related study focused on the Cherry Grove Beach/Little River Neck area. Further analysis of these documents will be covered in Element F.

Despite the anticipated challenges that will undoubtedly come with the prospects of ongoing growth, the field of water resources management has made incredible advances over time as well. Fortunately, research and applied knowledge has improved our understanding of the influence of urban development on stormwater runoff rates and the negative impacts associated with elevated bacteria levels and other pollutants. State and federal regulations have evolved over time to address these concerns, a notable example being the Municipal Separate Storm Sewer System (MS4) permit program which both Horry County and North Myrtle Beach must comply with. In addition, water quality monitoring is a key management resource which water resource managers can apply when identifying and prioritizing water quality concerns. Monitoring technologies have improved to more accurately determine the source of bacteria entering the estuary leading to a better evaluation of effective management strategies to consider implementing in the watershed. Finally, stormwater management technologies have advanced tremendously, with many approaches such as Low Impact Development (LID) practices capable of mimicking the natural hydrology in an area already fully developed. A key role of this watershed plan
is to evaluate all of the varying environmental and anthropogenic factors influencing water quality conditions in Hog Inlet and Dunn Sound Creek and comprehensively apply all available resources to address each of the known water quality issues.
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Element B: Shellfish Harvesting Waters- Water Quality Standards and Regulations

This element is an overview of the water quality standards and regulations in the State of South Carolina which apply to Hog Inlet and Dunn Sound Creek. It is important to be familiar with the requirements that are in place to determine the progress that will be needed to meet the state’s water quality criteria in our local waterways. This element briefly reviews how the state designates each waterbody and what regulations are applicable to each designation. An overview of the annual reports that DHEC publishes, which summarizes the water quality monitoring data that has been collected in the Shellfish Management Area 01, is also provided.

I. Overview of South Carolina Water Quality Standards

Under the authority of the 1976 South Carolina Code of Laws, SC DHEC is tasked with instituting and enforcing regulations to assist in the implementation of the federal Clean Water Act. Regulation 61-68: Water Classifications and Standards, establishes water uses to be protected by meeting specific water quality criteria. Within Regulation 61-68 there are several general rules and standards which are applicable to all waters of the state. There are also specific standards that pertain to each water classification. Hog Inlet and Dunn Sound Creek are classified as Shellfish Harvesting Waters (SFH), which are defined as follows in the regulation:

Tidal saltwaters protected for shellfish harvesting and uses listed in Class SA and Class SB. Suitable for primary and secondary contact recreation, crabbing, and fishing. Also suitable for the survival and propagation of a balanced indigenous aquatic community of marine fauna and flora.

A full overview of the water quality standards for Shellfish Harvesting Waters is included in Appendix A. Below is an explanation of the numerical fecal coliform bacteria standards along with the corresponding shellfish harvesting classification. Under SC DHEC’s Shellfish program, the following shellfish harvesting classifications are utilized to enforce the standards set forth in Regulation 61-68. The classification guidelines were developed in coordination with the US Food and Drug Administration using the National Shellfish Sanitation Program Model Ordinance.

Approved- Areas where a sanitary survey concludes that fecal material and pathogenic microorganisms are not present in concentrations that would render shellfish unsafe for human consumption. The numeric criteria for Approved areas is as follows:

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

Note that in order to meet the Approved classification, both numeric criteria must be met.

Conditionally Approved- Areas designated with this classification are subject to temporary and predictable conditions of pollution, such as runoff resulting from a rain event. SC DHEC must adopt a management plan describing the conditions under which harvesting is allowed.
Restricted- Shellfish grounds are classified as Restricted when the water sample data exceeds the Approved standard too frequently and unpredictably to be feasibly classified as a Conditionally Approved area. SC DHEC does allow limited harvesting only for the purposes of relaying or depuration by special permit only. The following numeric water quality criteria do apply for relaying shellfish from Restricted Shellfish Areas:

- Not to exceed a geometric mean of 88 MPN/100ml
- No more than 10% of the samples collected can exceed an MPN of 260/100ml

Prohibited- SC DHEC administratively closes shellfish beds that are adjacent to facilities of potential pollution concern such as a wastewater treatment plant, industrial site, or a marina.

The next section outlines the classification trends within Hog Inlet and Dunn Sound Creek.

II. SC DHEC Shellfish Management Area 01

SC DHEC has established 25 shellfish management areas along the coast of South Carolina. Hog Inlet and Dunn Sound Creek are located within Shellfish Management Area 01. There are a total of approximately 3,289 acres of shellfish growing habitat in Area 01. Below is a breakdown of the harvesting classifications for Area 01 as of the 2016 Annual Update. Note that portions of shellfish harvesting waters are automatically classified as Prohibited in areas where marinas are located nearby. Typically, the Prohibited area is established by creating a 1,000 ft buffer surrounding the marina site. This is a precautionary measure and a permanent classification regardless of the fecal coliform measurements at nearby monitoring sites.

While DHEC does not currently allow harvesting of oysters and clams for direct marketing in any portion of Management Area 01, depuration and relaying of shellfish is allowed in Cherry Grove and Dunn Sound. Presently no commercial shellfish relay projects were permitted in the last review period.

### Table B-1 SC DHEC Shellfish Management Area 01 2016 Annual Update Classification Summary

<table>
<thead>
<tr>
<th>Prohibited Areas- 1,146 acres total</th>
<th>1. All waters of the Atlantic Intracoastal Waterway</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. All waters of Little River</td>
</tr>
<tr>
<td></td>
<td>3. All waters of Calabash Creek</td>
</tr>
<tr>
<td></td>
<td>4. All waters of Milliken Cove</td>
</tr>
<tr>
<td></td>
<td>5. All waters of Little River Inlet north of the southeastern point of Little River Neck (Tilghman Point)</td>
</tr>
<tr>
<td>Restricted Areas- 2,143 acres total</td>
<td>1. Little River Estuary seaward of Tilghman’s Point, including all portions of Dunn Sound and Hog Inlet</td>
</tr>
</tbody>
</table>

**Source:** SCDHEC, Shellfish Program. Shellfish Area 01- 2016 Annual Update

Presently there are nine monitoring sites that are sampled monthly by SC DHEC within Shellfish Management Area 01. They are listed with a location description in **Table B-2** below. A full overview of the data trends observed at these monitoring sites is provided in **Element D: Fecal Coliform Data Trends**.

### Table B-2 SCDHEC Shellfish Management Area 01, Monitoring Station Locations

<table>
<thead>
<tr>
<th>Site #</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>01-01</td>
<td>Little River Jetty</td>
</tr>
<tr>
<td>01-02</td>
<td>Mouth of Dunn Sound Creek</td>
</tr>
<tr>
<td>01-05</td>
<td>Big bend up Dunn Sound Creek</td>
</tr>
<tr>
<td>01-06</td>
<td>Bridge to Waites Island</td>
</tr>
<tr>
<td>01-07</td>
<td>Hog Inlet</td>
</tr>
<tr>
<td>01-17</td>
<td>42nd Ave- Cherry Grove</td>
</tr>
<tr>
<td>01-17A</td>
<td>53rd Ave Bridge on Canal</td>
</tr>
<tr>
<td>01-18</td>
<td>Dunn Sound at Hog Inlet</td>
</tr>
<tr>
<td>01-19</td>
<td>53rd Ave at Main Creek</td>
</tr>
</tbody>
</table>

**Source:** SCDHEC, Shellfish Program. Shellfish Area 01- 2016 Annual Update
Figure 1. Shellfish Growing Area 01
Harvest Classifications, Stations and Potential Pollution Sources

- **NPDES**
- **Marinas**
- **Shellfish Monitoring Sites**
- **Ports**

**Harvest Classification**
- Approved
- Conditionally Approved
- Restricted
- Prohibited

**Classification Updates**
- Downgraded
- Upgraded

Shellfish Annual Report 2017
Figure 1 is a map from the 2016 Annual Update- Shellfish Management Area 01 indicating the current Shellfish Harvesting Classifications and the locations of each of the nine monitoring stations which are sampled monthly.

### III. Implications of 303(d) impaired waters of the state listing

As required by the federal Clean Water Act, every two years SC DHEC publishes a list of impaired waterbodies throughout the state of South Carolina. The list identifies each of the monitoring sites that are exceeding the water quality standard for one or more pollutant criteria. The 303(d) list is a starting point for the state in acknowledging waterbodies that will require corrective action in order to improve water quality. The monitoring site will remain on the list until the water quality standard has been achieved or a Total Maximum Daily Load (TMDL) has been developed for the impaired stream. Table B-3 summarizes the monitoring sites located within the Hog Inlet- Dunn Sound Creek watershed that have been listed on the 303 (d) list from 1998 through 2014.

<table>
<thead>
<tr>
<th>Year</th>
<th>Monitoring Sites</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>Little River Southeast of Tilgham’s Point. All portions of Dunn Sound and Hog Inlet- 2,100.39 Acres</td>
<td>In 1998, impairments for Shellfish Harvesting Waters were listed by SC DHEC designated Management Area. Hog Inlet and Dunn Sound Creek were listed as a Priority One site, which means that the shellfish classification was Restricted and identified as one of the highest concerns by the State Shellfish Restoration Committee.</td>
</tr>
<tr>
<td>2000</td>
<td>Little River Estuary SE of Tilghman’s Point including all portion of Dunn Sound and Hog Inlet- 2143.2 acres.</td>
<td>The impairments were listed in the same manner as 1998. However in 2000, it is listed as a Priority Two site again based on recommendations of the Shellfish Restoration Committee.</td>
</tr>
<tr>
<td>2002</td>
<td>Little River Estuary SE of Tilghman’s Point including all portion of Dunn Sound and Hog Inlet- 2143.2 acres.</td>
<td>Same status as the 2000 listing</td>
</tr>
<tr>
<td>2004</td>
<td>01-02, 01-05, 01-06, 01-07, 01-17, 01-17A, 01-18, 01-19</td>
<td>Beginning with the 2004 303 (d) list, SC DHEC began listing the impairments within Shellfish Harvesting Waters by monitoring site versus geographically describing the area of impairment. For the 2004 303(d) listing, all of the monitoring sites within Management Area 01 were listed except for site 01-01.</td>
</tr>
<tr>
<td>2006</td>
<td>01-01, 01-02, 01-05, 01-06, 01-07, 01-17, 01-17A, 01-18, 01-19</td>
<td>In 2006, all nine of the monitoring sites within Management Area 01 were on the 303(d) list. This was also the first year that SC DHEC included a target TMDL date as part of the 303 (d) list. In 2006, the target TMDL date for these monitoring sites was 2008.</td>
</tr>
<tr>
<td>2008</td>
<td>01-01, 01-02, 01-05, 01-06, 01-07, 01-17, 01-17A, 01-18, 01-19</td>
<td>The TMDL target date for these monitoring sites was pushed back to 2011. The 303 (d) list does note that TMDL target dates are subject to change, based on the severity of pollution, designated use, the availability of site-specific information, or other factors the Department deems appropriate for scheduling TMDL development.</td>
</tr>
<tr>
<td>2010</td>
<td>01-01, 01-02, 01-05, 01-06, 01-07, 01-17, 01-17A, 01-18, 01-19</td>
<td>The TMDL target date for these monitoring sites was pushed back to 2014</td>
</tr>
<tr>
<td>2012</td>
<td>01-01, 01-02, 01-05, 01-17, 01-17A, 01-19</td>
<td>Monitoring sites 01-06, 01-07, and 01-18 were removed from the 2012 303(d) list. SC DHEC established a TMDL target date of 2015 for 01-01, 01-02, and 01-05, essentially the Dunn Sound Creek portion of Management Area 01. SC DHEC established a TMDL target date of 2018 for sites 01-17, 01-17A, and 01-19, essentially the upper portions of Cherry Grove Marsh.</td>
</tr>
<tr>
<td>2014</td>
<td>01-01, 01-02, 01-05, 01-06, 01-07, 01-17, 01-17A, 01-18, 01-19</td>
<td>All nine monitoring sites were back on the 303(d) list. The TMDL target date for both Dunn Sound Creek and Hog Inlet is now 2018.</td>
</tr>
</tbody>
</table>

Notes: For each listing period, Fecal Coliform was the cause of the impairment. The 2016 303(d) list has been drafted but was awaiting the final review and approval from the EPA at the time this watershed plan was developed.

Source: SC DHEC, Bureau of Water
A Total Maximum Daily Load is a regulatory approach to ensuring that the pollutant loads are reduced in impaired waterbodies so that the water quality standard can once again be achieved. Conceptually, a TMDL is the maximum amount of a pollutant that can enter a waterbody on a daily basis and still meet the water quality standards set forth by the state. TMDLs entail an inventory of the known sources of the pollutant and are calculated as follows:

\[
\text{TMDL} = \text{Sum of Wasteload Allocations} + \text{Sum of Load Allocations} + \text{Margin of Safety}
\]

Wasteload allocations are pollutant loadings from permitted point sources, such as industrial sites or wastewater treatment plants. There are no known point source dischargers into Hog Inlet or Dunn Sound Creek. Load allocations account for all the remaining nonpoint sources of pollution that exist in the watershed area. It is suspected that the entire pollutant loading into Hog Inlet and Dunn Sound Creek are from nonpoint sources. A margin of safety is included to account for any uncertainty when inventorying the Load and Wasteload Allocations.

Fecal coliform bacteria are the most common impairments in South Carolina, accounting for 350 of the 400 sites managed under a TMDL. It is DHEC and EPA policy that once a monitoring site is included on the state’s 303(d) list, a TMDL must be developed within a thirteen year period. It is unclear whether DHEC is going to extend the TMDL development date past 2018 as stated in the 2014 303(d) list. Therefore, it is imperative that stakeholders from Horry County and North Myrtle Beach, who will ultimately be accountable for meeting the TMDL requirements, remain proactive and fully engaged in the TMDL development process. The next element is an evaluation of potential sources of bacteria within the watershed, which may be causing the impairments at the SC DHEC monitoring stations located in Shellfish Management Area 01.