EDISTO ISLAND WATERSHED-BASED PLAN

A community-driven watershed-based plan addressing water quality across Edisto Island and the Town of Edisto Beach.

Prepared by Clemson Extension for Submission to SCDHEC
December 2022

COOPERATIVE EXTENSION
College of Agriculture, Forestry and Life Sciences

ACE Basin
National Estuarine Research Reserve

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Acronyms & Abbreviations

BMP	Best Management Practice
CRS	Community Rating System
CTP	Coastal Training Program
CWA	Clean Water Act
EIOLT	Edisto Island Open Land Trust
EIW	Edisto Island Watershed
EPA	Environmental Protection Agency
OCRM	SCDHEC Office of Ocean and Coastal Resource Management
NERR	National Estuarine Research Reserve
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
STEPL	Spreadsheet Tool for Estimating Pollutant Loads
TMDL	Total Maximum Daily Load
GIS	Geographic Information System
LID	Low Impact Development
MST	Microbial Source Tracking
WBP	Watershed-Based Plan

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Executive Summary

Clemson Extension and partners, including the South Carolina Department of Natural Resources, the ACE Basin National Estuarine Research Reserve, the South Carolina Sea Grant Consortium, and the Edisto Island Open Land Trust, developed this watershed-based plan (WBP) to address bacteria and turbidity impairments in three HUC-12 watersheds in the Lowcountry of South Carolina. The three watersheds include Store Creek (HUC 030502060307), the South Edisto River-Atlantic Intracoastal Waterway (HUC 030502060308), and the Dawho River-North Edisto River (HUC 030502060405), which encompass the entirety of Edisto Island and the Town of Edisto Beach. Referred to in this watershed-based plan as the Edisto Island Watershed, this watershed has been classified as an Outstanding Resource Waters and has abundant shellfish resources. Many of these shellfish beds are currently closed to harvest due to elevated bacteria levels.

Nineteen water quality monitoring stations across the watershed are classified as impaired for bacteria, eleven monitoring stations are classified as impaired for sediment, and two monitoring stations have been assigned total maximum daily loads for bacteria. This watershed-based plan outlines a case for the primary sources of pollution causing these impairments and identifies key areas to target for protection and management. The plan includes recommendations for best management practices to implement across the watershed and associated calculations of existing pollution loads and potential load reductions. Potential funding opportunities are identified, and outreach and education strategies are outlined.

Reducing existing levels of water pollution may seem daunting, but there are several success stories across South Carolina where recommendations from a watershed-based plan were implemented and resulted in the removal of an impairment. Using this watershed-based plan as a guide, and treating it as a living document that can be updated and modified over time, increases the likelihood of restoring water quality across the Edisto Island Watershed and preserving the ability of the community to enjoy and benefit from a healthy ecosystem.

Chapter 1.
Introduction

Overview of Watershed-Based Planning Process

Clemson Extension and partners, including the South Carolina Department of Natural Resources, the ACE Basin National Estuarine Research Reserve, the South Carolina Sea Grant Consortium, and the Edisto Island Open Land Trust, worked with the Edisto community to create a Watershed-Based Plan (WBP) to address pollution in the Store Creek watershed, the South Edisto River-Atlantic Intracoastal Waterway watershed, and the Dawho River-North Edisto River watershed, hereby referred to as the Edisto Island Watershed (EIW).

What is a Watershed-Based Plan?

A watershed is the area of land that contributes runoff to a lake, river, stream, wetland, estuary, or bay. If water pollution becomes a concern in a watershed, a WBP provides a roadmap for managing efforts to restore water quality in impaired waterbodies, and to protect the overall health of the watershed. WBPs help communities to address pollution by identifying pollution sources and recommending voluntary management measures to reduce or eliminate those sources.

Six steps of watershed-based planning:

1. Build partnerships
2. Characterize the watershed
3. Finalize goals and identify solutions
4. Design implementation program
5. Implement watershed-based plan
6. Measure progress and make adjustments

Once a WBP is finalized, local governments and community organizations within the watershed are eligible to apply for funding assistance through sources such as the Clean Water Act Section 319 Grant. This 319 funding, administered through the South Carolina Department of Health and Environmental Control (SCDHEC), can be used to install voluntary best management practices on private and public land, produce outreach material, conduct workshops, and other activities identified in the approved WBP.

> *"Watershed planning helps address water quality problems in a holistic manner by fully assessing the potential contributing causes and sources of pollution, then prioritizing restoration and protection strategies to address these problems." (EPA Quick Guide to Developing Watershed Plans)*

Why do Edisto Island and Edisto Beach need a Watershed-Based Plan?

The waterways on and around Edisto Island are affected by pollution from a variety of sources. There are currently 32 locations in the area that are listed as impaired for one or more pollutants, including fecal coliform bacteria (16), enterococcus bacteria (3), turbidity (11), dissolved oxygen (3), ammonia (1), and copper (1). For the purposes of this WBP, we focused on addressing bacteria (fecal coliform and enterococcus) and turbidity pollution in the watershed. Creating a community driven WBP for the area is a first step towards reducing pollution, improving water quality, and protecting water use for the Edisto community. But creating a WBP is only the first step; implementing recommendations requires community support and collaboration, so the team worked closely with community leaders and sought input from residents at each stage of the plan development.

Building Partnerships

There were many organizations already active, engaged, and concerned about local water quality around Edisto Island, and others whose livelihoods are or could be affected by poor water quality across the watershed. We first established an advisory board consisting of members representing a variety of community interests, to guide plan development.

We also surveyed both the advisory board and the broader community to gauge awareness and concerns about local water quality, to identify areas of particular concern, and to help define our larger goals and objectives for the watershed-based plan. Our advisory board members assisted with distributing the survey throughout the community (both online and hard-copy options), and we received 376 completed surveys (approximately 13% of the entire population of the Edisto Beach and Edisto Island). A detailed description of the survey and results can be found in Chapter 8, and Appendices A and B.

While there was a range of perspectives and understanding of the water quality challenges in the EIW, responses consistently reflected a common desire to protect Edisto's natural resources, including the waterways and aquatic habitats that make this such a special place. A key part of the desire to protect and conserve Edisto's natural resources is a desire to protect local shellfish beds, and to reopen those recreational and commercial beds that have been closed to harvest due to high bacteria levels. Reflecting this feedback from the community, the major goal of this watershed-based plan is to **reduce bacteria and turbidity impairments across the watershed**, and to eventually **reopen shellfish beds to harvest**.

This plan lays out a roadmap and a timeline towards removing impairments and improving local water quality, but an added challenge is the increasing pressure of climate change. As the Edisto Island/Edisto Beach community works towards reducing pollutant sources, it is also necessary to consider the future implications of potential increases in storm frequency and severity, sea level rise, and flooding events, which can all affect bacteria and turbidity levels in local waterways. Recommendations contained within the plan were made through a climate adaptation lens that acknowledged the highest risk areas across the watershed.

Chapter 2.
Watershed Description

The Edisto Island Watershed (EIW)

The area of focus for this EIW WBP is comprised of three HUC-12 watersheds: Store Creek, South Edisto River-Atlantic Intracoastal Waterway, and Dawho River-North Edisto River (Table 1). These three watersheds were selected to include the entirety of Edisto Island (population 2,301) and the Town of Edisto Beach (population 582).

Table 1: Edisto Island Watershed Characteristics

Watershed	HUC-12 Code	Total Acreage
South Edisto River-Atlantic Intracoastal	030502060308	33,054
Store Creek	030502060307	16,097
Dawho River-North Edisto River	030502060405	37,179

Located at the downstream end of the Edisto River Basin, the EIW is a coastal watershed comprised of a sea island (Edisto Island, Charleston County) and a barrier island (Town of Edisto Beach, Colleton County), with an interconnected network of rivers, tidal creeks, and the Atlantic Ocean (Figure 1). Waterways are tidally influenced, with main tributaries including Bailey Creek, Milton Creek, Store Creek, and Fishing Creek. The tributaries converge to form St. Pierre Creek which empties to the Edisto River near the Town of Edisto Beach. In total, the Town of Edisto Beach and Edisto Island have approximately 12 miles of beaches facing the Atlantic Ocean. All waterways within the watershed are designated as Outstanding Resource Waters. The entire watershed is within the Critical Area Boundary, a designation assigned to tidal and coastal waterways and associated landmass by the SC Department of Health and Environmental Control's Office of Ocean and Coastal Resource Management.

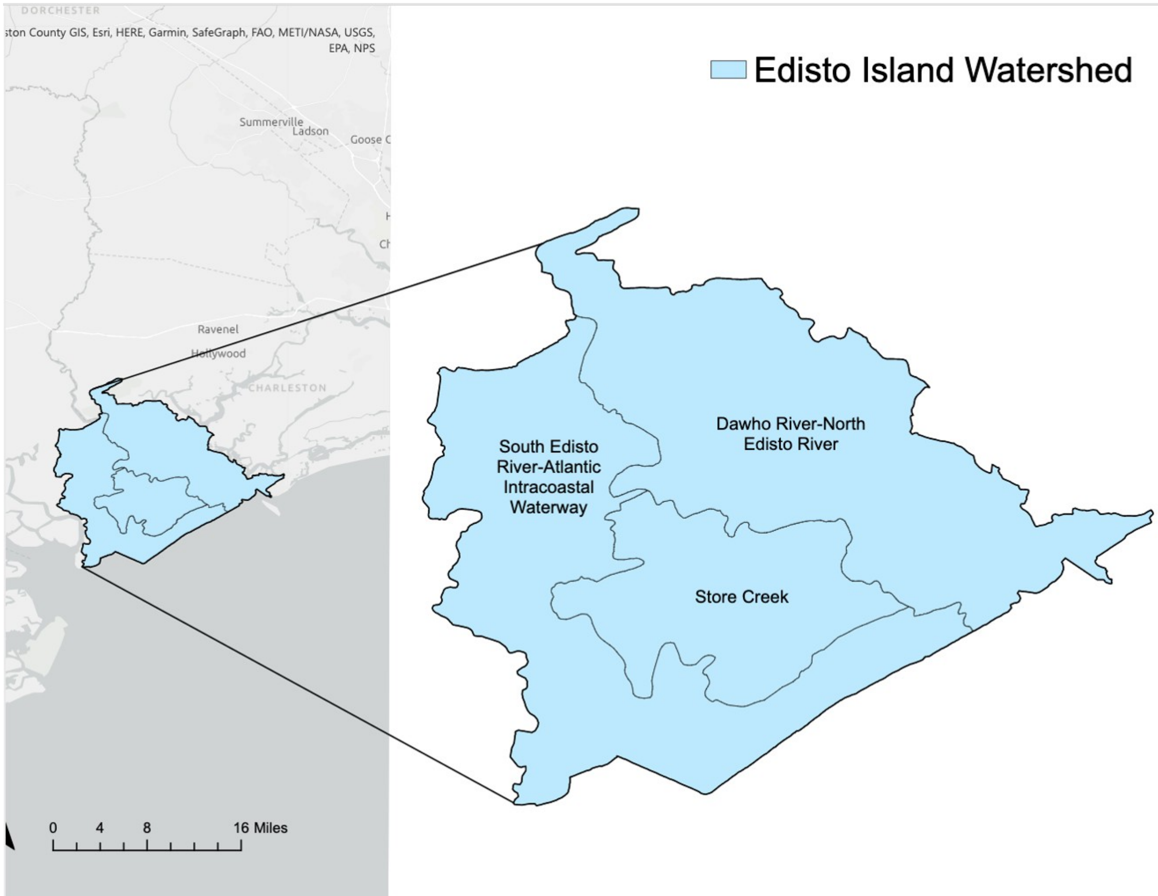


Figure 1: Map of the Edisto Island Watershed, focus area for the watershed-based plan

The Edisto River, which forks into a north and south branch on either side of Edisto Island, is one of the longest free-flowing blackwater rivers in North America. The lower part of the Edisto River Basin joins with the Ashepoo and Combahee River Basins to create the Ashepoo Combahee Edisto Basin, commonly referred to as ACE Basin, an estuary of national significance. Much of the ACE Basin has been preserved and protected through public and private partnerships.

The Town of Edisto Beach, a six-mile-long barrier island made up of approximately 25% salt marsh, is a beachfront community with a small population of full-time residents. Edisto Beach experiences a seasonal influx of tourists and includes a portion of the 1,200-acre Edisto Beach State Park, which hosts both cabins and campsites.

History and Culture

Edisto Island is named for the Native American people, the Edisto, who were the first inhabitants of the area. Archaeological excavations of a rapidly eroding oyster shell mound, known as Spanish Mount, indicate that oysters were a significant part of the diet of the Edisto people (Figure 2). After European colonization, enslaved Africans were forcibly brought to the Sea Islands in the 18th and 19th centuries to labor in the rice, indigo, and sea island cotton industries. Cotton production thrived for several centuries on the island until the boll weevil arrived in the early 1920s. Agricultural production then shifted to row crops, such as cabbage, potatoes, and tomatoes, and livestock. Today, small fruits and vegetables, such as tomatoes, are more commonly grown. (Puckette C, 1978; Connor A & Beardsley S, 1998; Wapole, 2016).

Figure 2: View of the eroding oyster shell midden, Spanish Mount, from Scott Creek

Both residents and visitors alike appreciate the natural beauty of the watershed and the many ecosystem services it provides. There is a strong community ethic to preserve and protect local waterways so they can be enjoyed for both consumptive (e.g., shellfish and finfish harvest) and non-consumptive (e.g. water-based recreation, scenic viewshed, wildlife viewing) uses. Commercial shellfish harvesting is a historically important resource to the Lowcountry of South Carolina, and the waterways in and around Edisto Island are managed through SC Department of Natural Resources (DNR) for both commercial and recreational harvest. Today, many of the commercial and recreational beds are closed to harvest due to (fecal) bacteria impairments.

Climate and Precipitation

Edisto Island, like much of the Lowcountry, is known for its warm climate. The EIW boundary lies within both Charleston and Colleton counties. Annual precipitation for Charleston County is 49.89 inches, and 45.43 inches for Colleton County. Climate for the watershed area includes a mean annual temperature average of 67°F (SC State Climatology Office, 2010).

Watershed Characterization

Geology and Hydrology

Edisto Island, like many of the sea islands along the South Carolina coast, is considered part of the coastal marsh ecoregion, an area characterized by estuary, marsh, and beach systems and local geology has been influenced by Edisto's proximity to influences from ocean and river processes (Griffith et al. 2002). Edisto Island is comprised of Pleistocene-age fluvial sands, muds deposited behind former barrier islands, and barrier island beach sands. Edisto Beach is formed from more recent Halocene-age fluvial and marine deposited sands and clay deposits. Where development has occurred on Edisto Beach, characterized by more dense development than Edisto Island, these geologic deposits may be overlain by fill material (Doar, 2003).

The waterways across the watershed are tidally influenced, ranging from salt water on the ocean side of Edisto Beach, to brackish moving up the South Edisto River and throughout the tidal creeks crossing Edisto Island. The freshwater/saltwater dividing line across coastal South Carolina generally follows Highway 17 and is inland of the EIW (Figure 3).

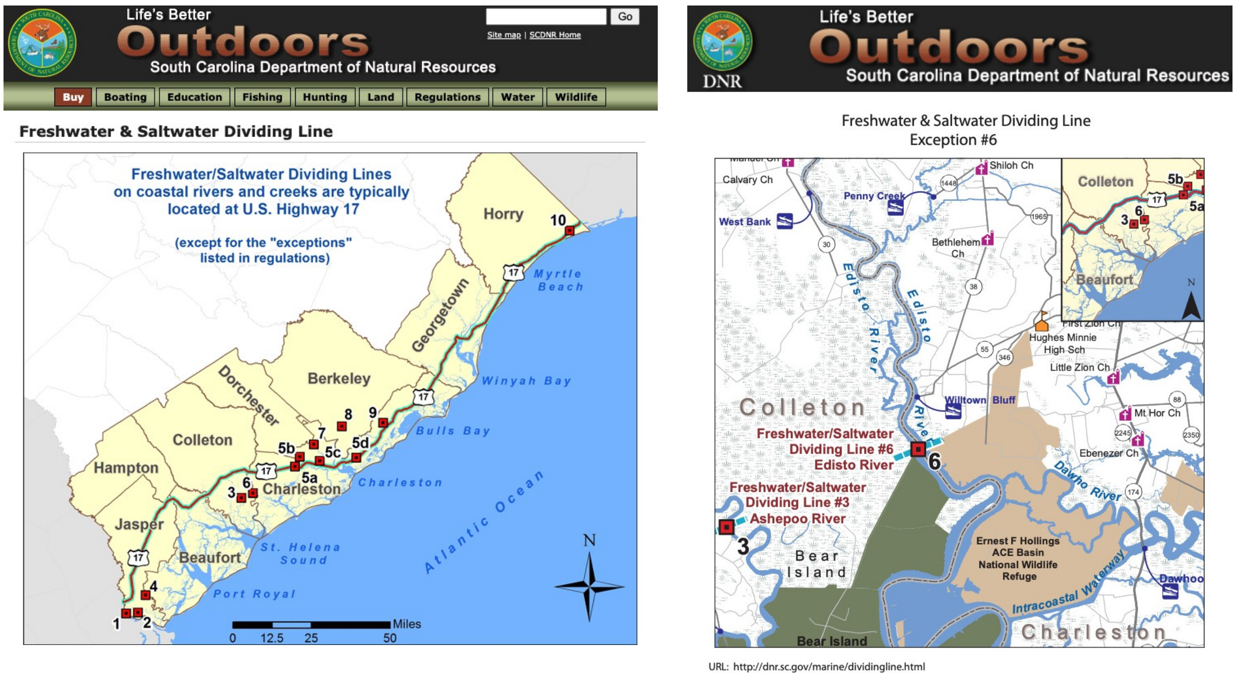


Figure 3: Freshwater/saltwater dividing line across coastal South Carolina generally follows Highway 17 (SC DNR, 2021)

Due to tidal influences on the Edisto River and the small brackish streams across the island, flow is difficult to measure or estimate in the watershed. The US Geological Survey (USGS) maintains a stream gage at the Edisto River in Givhans, South Carolina, approximately 26 miles northwest of Edisto Island and the project area, and beyond the extent of tidal influence on flow (Figure 4). Historically, this gage has been used by SC Department of Natural Resources as a proxy to estimate discharge and load for the South Edisto River in the study area (Sanger et al. 2020).

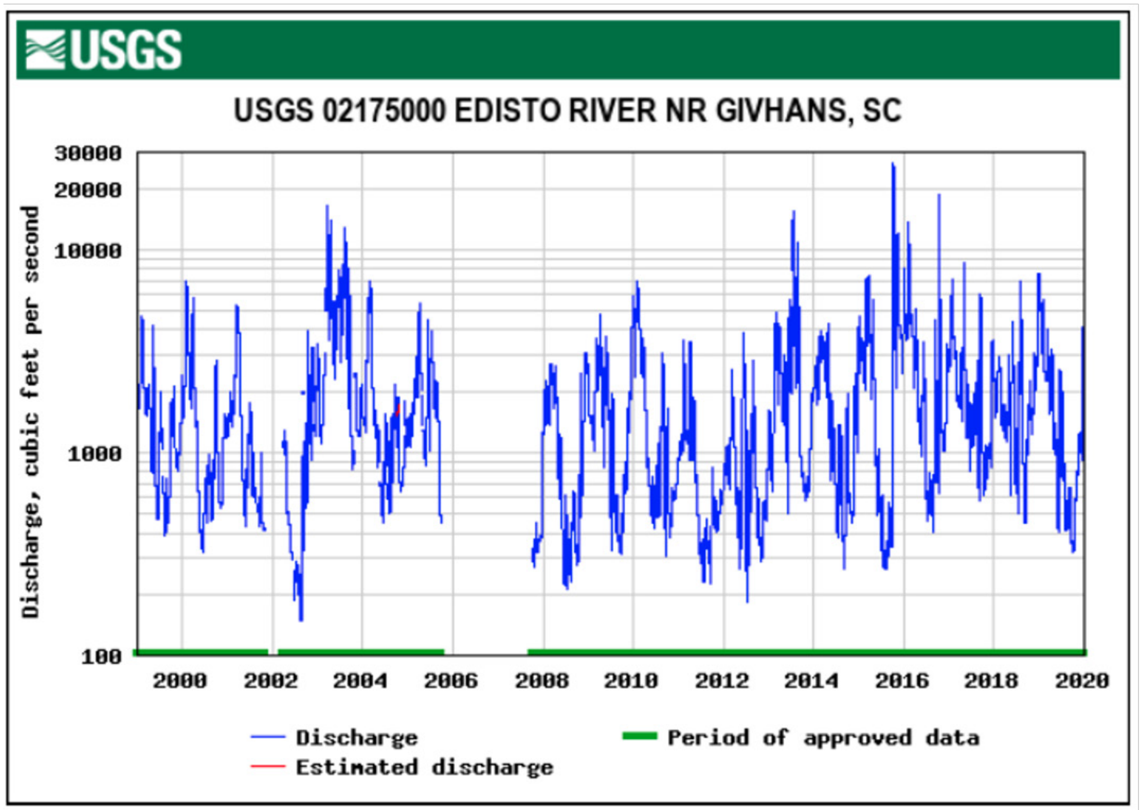


Figure 4: Daily observed discharge at Givhans Ferry on the Edisto River north of Edisto Island. Data to create the hydrograph were downloaded from the National Water Information System (USGS, 2020)

Soils

Much of Edisto Island and Edisto Beach are classified as tidal marsh (23%). Major soil types outside of the tidal marsh include the Capers formation, a silty, clay loam with poor drainage often found closely associated with tidal marsh systems and comprising approximately 10% of the total area, and several poorly drained to well drained loamy sands, including the Wagram, Seabrook, and Kiawah formations together comprising 15% of the land area (Figure 5) (NRCS, 2020).

A large majority, roughly 85%, of soils in the study area are classified as somewhat poorly drained, to poorly or very poorly drained (Figure 6) (NRCS, 2020). The presence of these poorly drained soils over much of the landscape suggests that, during storm events, much of the rainfall volume may be converted to runoff, particularly during the dormant season of plant growth. Edisto's characteristically shallow water table and low topography results in widespread ponding in low areas, rather than high velocity runoff, playing a role in pollutant transport to nearby waterways.

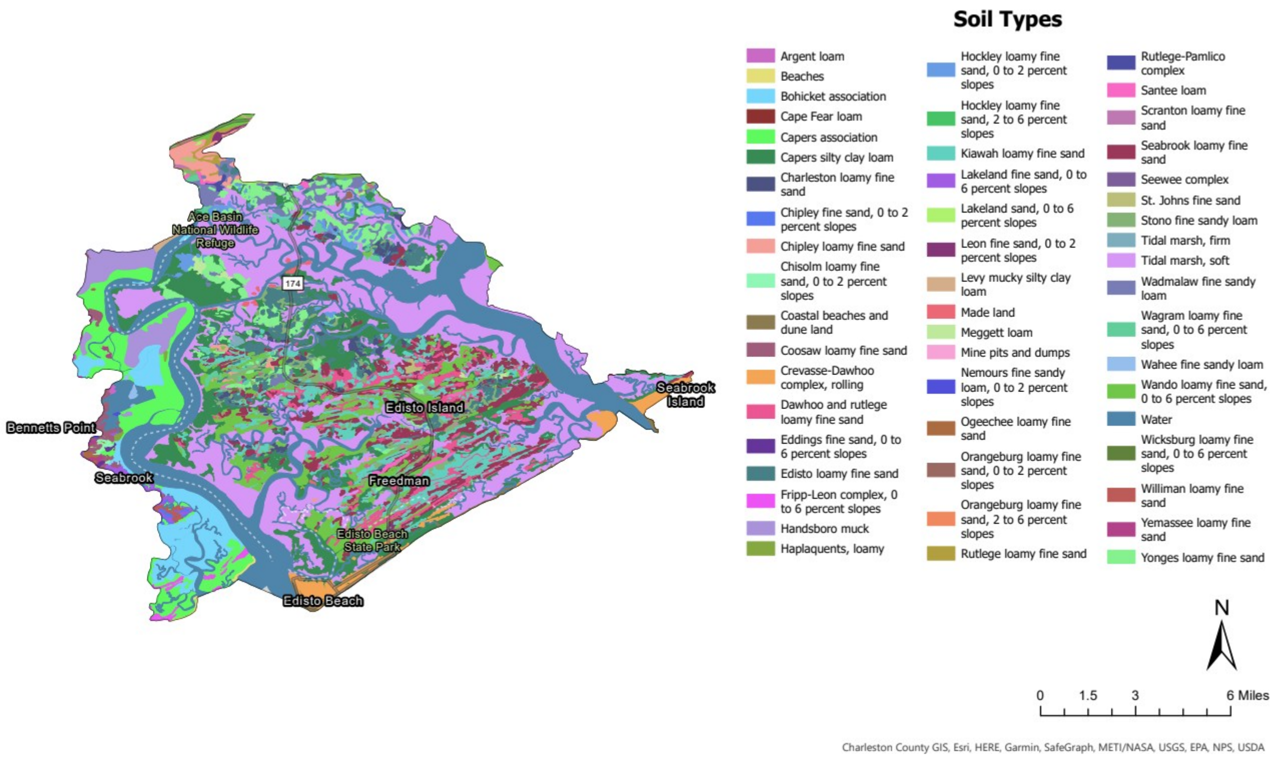


Figure 5: Description of soil types across the Edisto Island Watershed (data from the NRCS dataset)

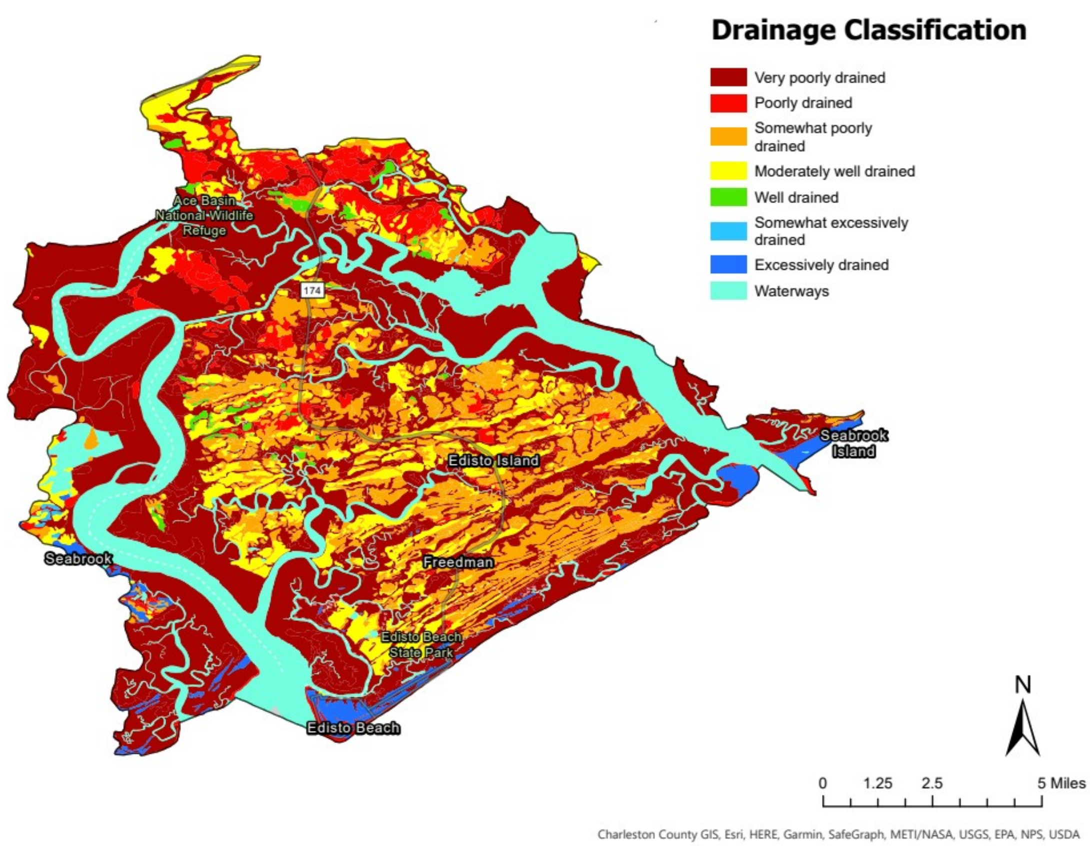


Figure 6: Drainage class of soils across the Edisto Island Watershed

K-Factor Value Used for Examining Erosion Potential

The impacts of human-linked activities on erosion are well documented, as well as their potential for impacts to turbidity concerns in receiving waterways. A soil's K-factor values can be used to examine the susceptibility of soils on Edisto Island and Edisto Beach to soil loss due to erosion, which in turn has implications on potential sedimentation in receiving waterways. K-factor values for soil types will range from 0.02 to 0.64, a high K-value indicates higher susceptibility to erosion. Soils with large volumes of organic matter and high permeability are less erodible, while soils with a high silt content are more erodible, and thus have a higher K-value (Ward and Trimble, 2004). Additional factors influencing K-factor values include topography, land use and management, and others.

Traditionally, in agriculture, soils recognized to have high K-values could benefit from the use of additional best management practices, like strip cropping, to limit erosion loss due to cultivation and livestock. For soils described by the Natural Resources Conservation Service (NRCS) Soil Survey, the median K-factor value (0.17) for soils on Edisto Island indicates that it has low susceptibility to erosion (Figure 7). While erosion can still occur with landscape alteration due to development, forestry, or agriculture, with implementation of basic best management practices the risk of sediment from land-based sources may be managed to reduce sediment load in waterways.

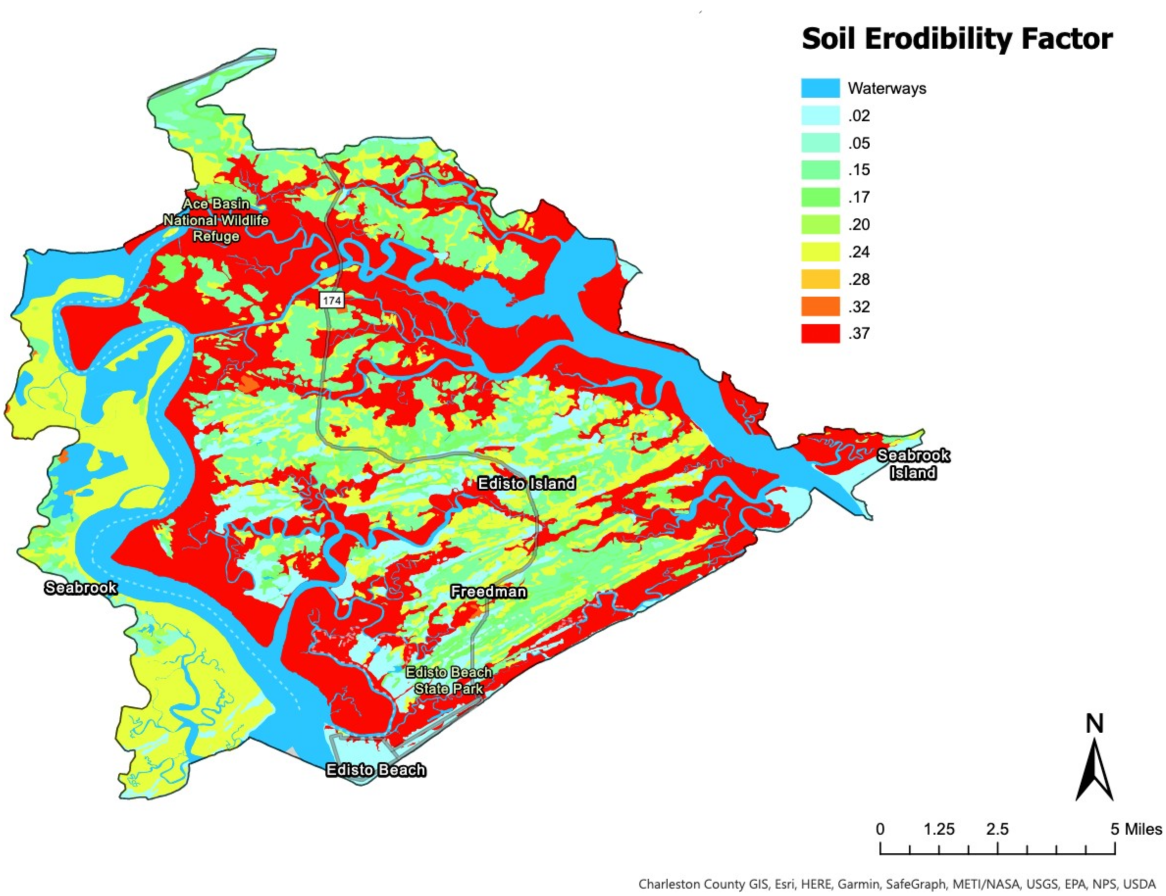


Figure 7: Erodibility of soils (K-factor) across the Edisto Island Watershed

Land Cover

Land cover across Edisto Island is mostly rural with low density residential and agricultural land uses predominant. Land cover classifications across the watershed includes emergent herbaceous wetlands, evergreen forests, woody wetlands, scrub/shrub, cultivated crops, pasture/hay, mixed forest, grassland, deciduous forest, and open water, in addition to developed land (open space, low intensity, medium intensity, and high intensity) and barren land (Figure 8).

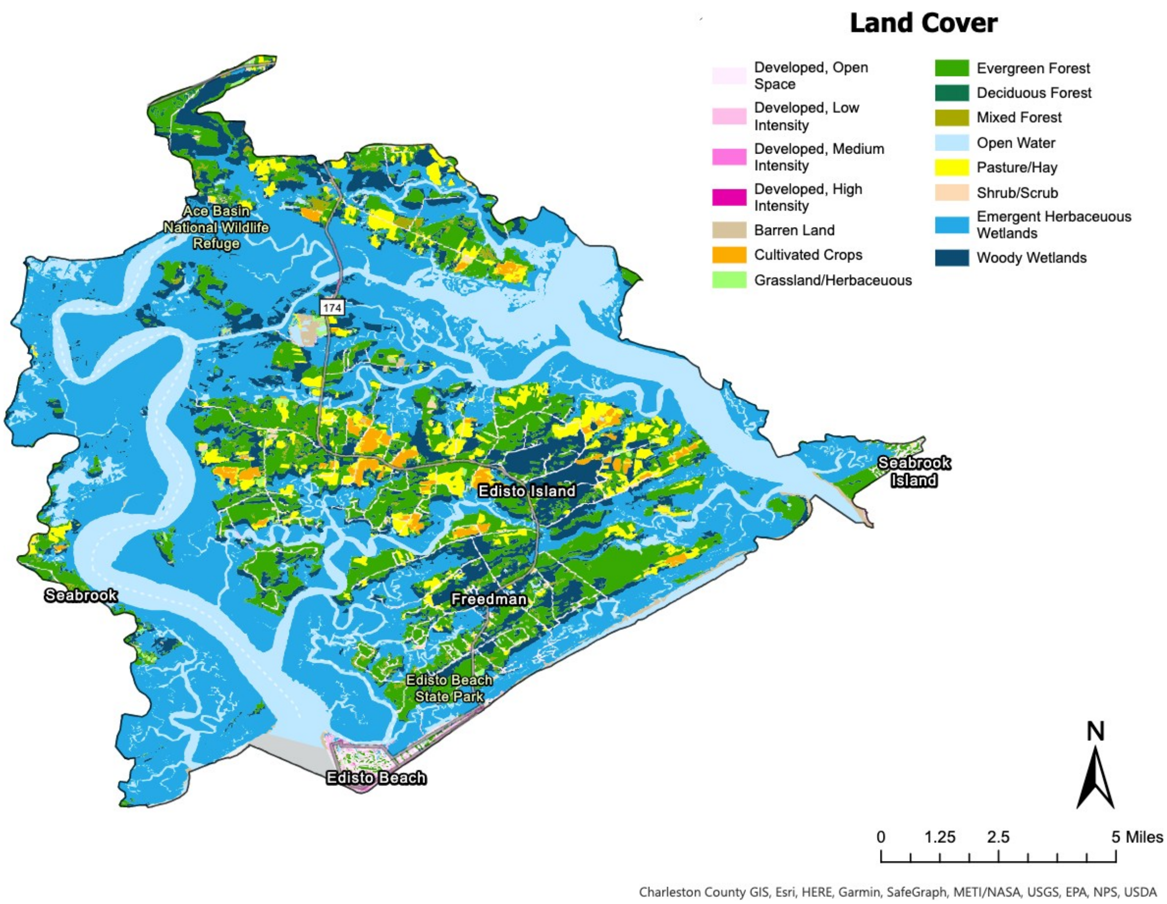


Figure 8: Map of land cover classifications across the Edisto Island Watershed

Wetlands are the predominant land cover class across the watershed, accounting for 65% of the entire watershed. The next largest cover type across the watershed is forested lands (18%), followed by cropland, pastures, developed land, and impervious cover (Table 2). Figure 9 displays the specific land cover percentages for each individual HUC-12 watershed.

Table 2: Breakdown of land cover classifications across the Edisto Island Watershed (Data from the National Land Cover 2016 Dataset)

	Dawhoo River - North Edisto	Store Creek	South Edisto-Atl Intracoastal
Wetlands	65%	53%	77%
Forest	16%	27%	11%
Cropland	7%	8%	2%
Pasture	4%	1%	0%
Developed	1%	2%	3%
Impervious	0%	0%	1%

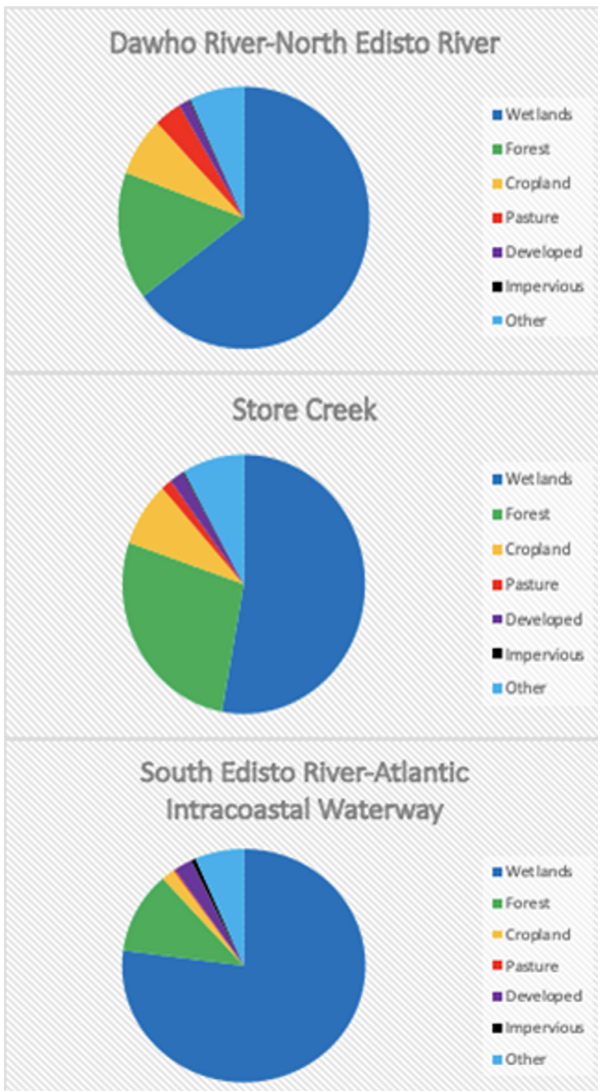


Figure 9: Breakdown of land cover classifications by sub-watershed within the Edisto Island Watershed

Elevation and Flooding

As a low-lying sea island and barrier island, coastal flooding is a concern for both Edisto Island and Edisto Beach, respectively. Despite a relatively flat topography, there are elevation changes across the EIW, as seen in a LIDAR map of the watershed (Figure 10). While much of the initial development of these areas occurred on the highest ground, over time development has spread into lower lying areas that are considered at elevated risk of flooding. Areas along creeks and wetlands are more prone to flooding during extreme high tides, and flooding levels can be exacerbated by wind and rainfall (Figure 11).

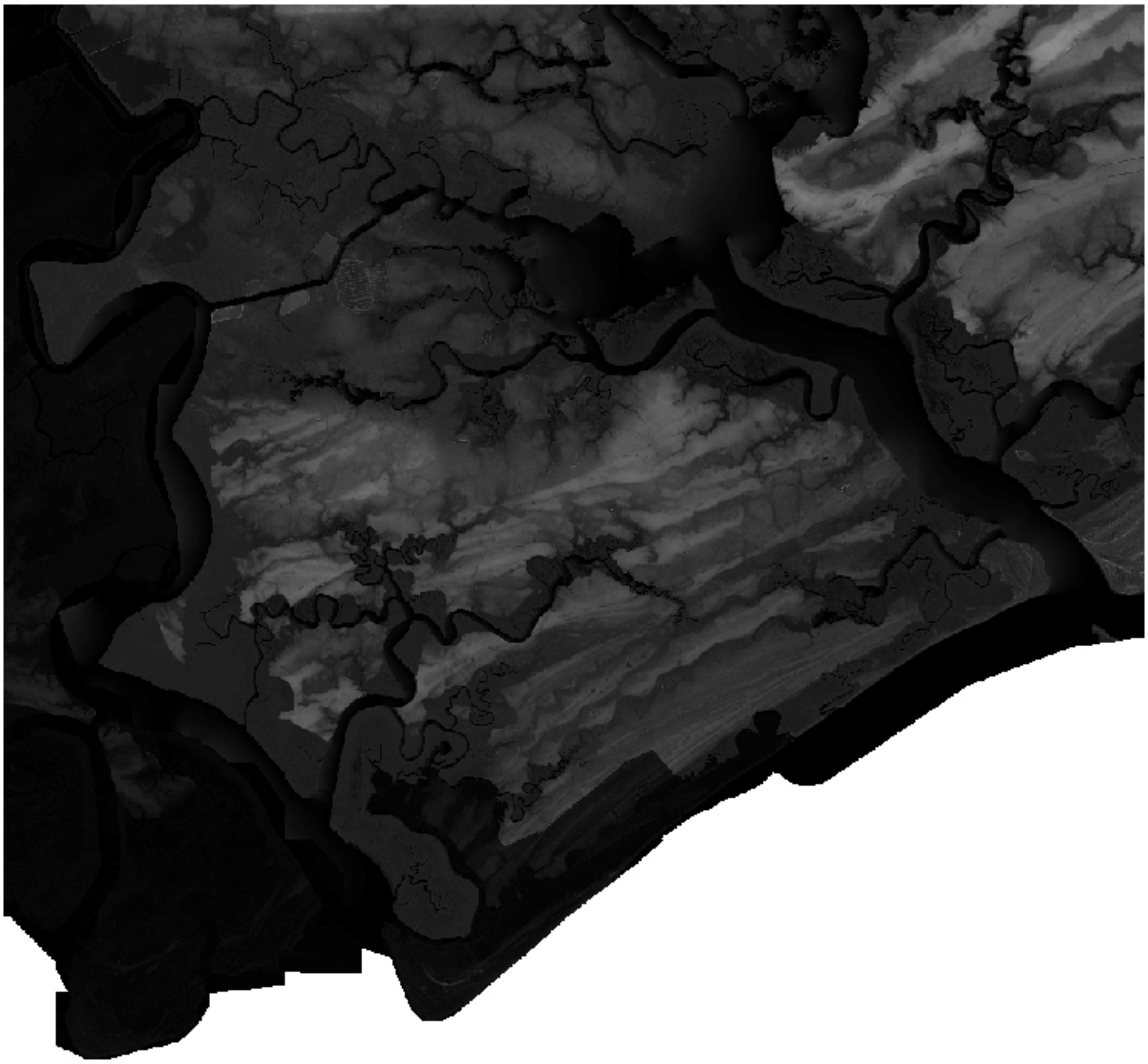


Figure 10: LIDAR map of the Edisto Island Watershed (provided by Nick Wallover, SCDNR)

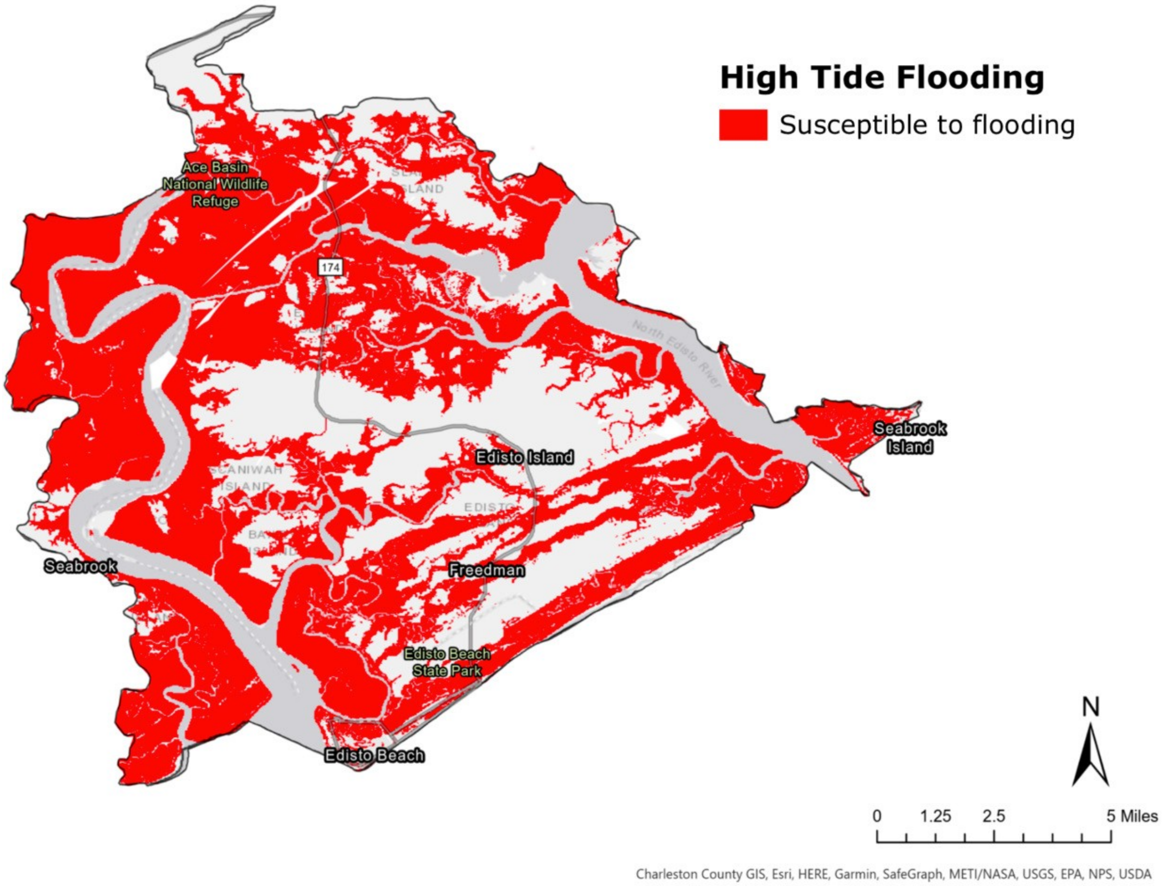
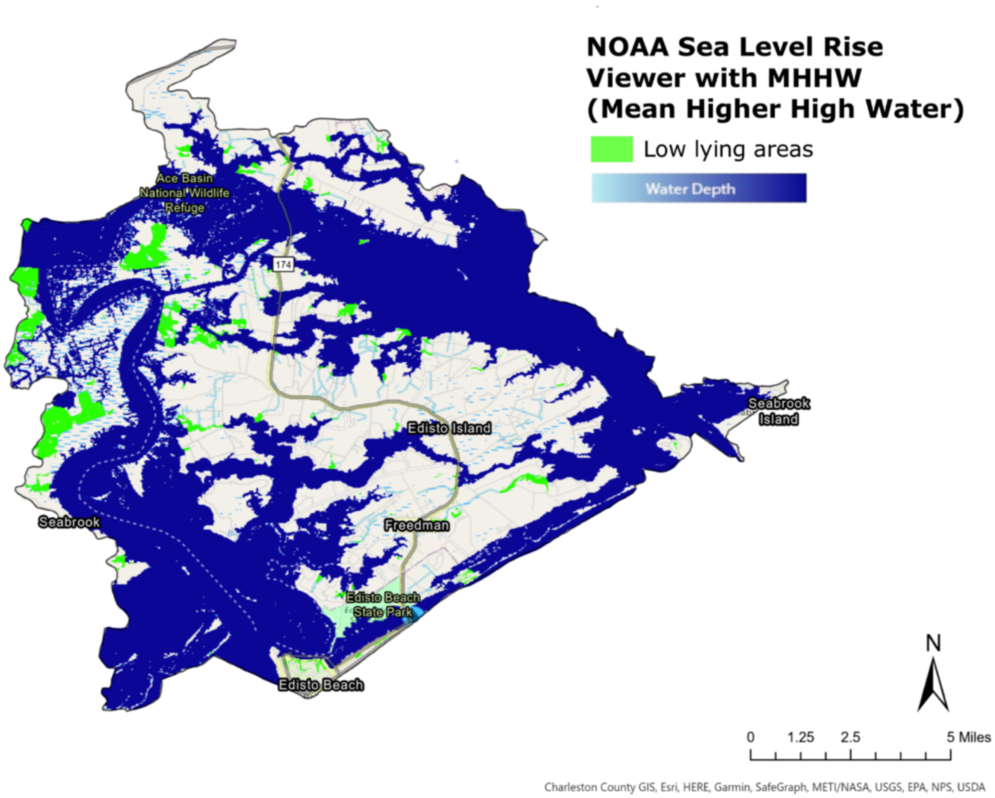


Figure 11: Map illustrating low-lying coastal areas prone to flooding during extreme high tides (NOAA Coastal Flood Exposure Mapper, 2021)

Considering sea level rise predictions due to climate change is an important part of protecting future water quality. Many of these low-lying areas that occasionally flood now may flood more regularly, or be underwater entirely, with even small increases in sea level (Figure 12). These areas may need to be considered as priorities for conservation; protecting natural buffers along waterways will create zones for marsh migration, enabling marshes to expand inland, keeping pace with sea level rise. Zoning can help to limit certain new land uses in these vulnerable areas to prevent future sources of pollution, such as septic system drainfields that can flood and transmit raw sewage to waterways.

Projections for sea level rise in nearby Charleston Harbor are estimated at two to three feet over the next 50 years (City of Charleston's Flooding & Sea Level Rise Strategy, 2019). Even at the conservative end of this range, significant areas along creeks and rivers will potentially become inundated, compared to current mean higher high water (Figure 12).

A)



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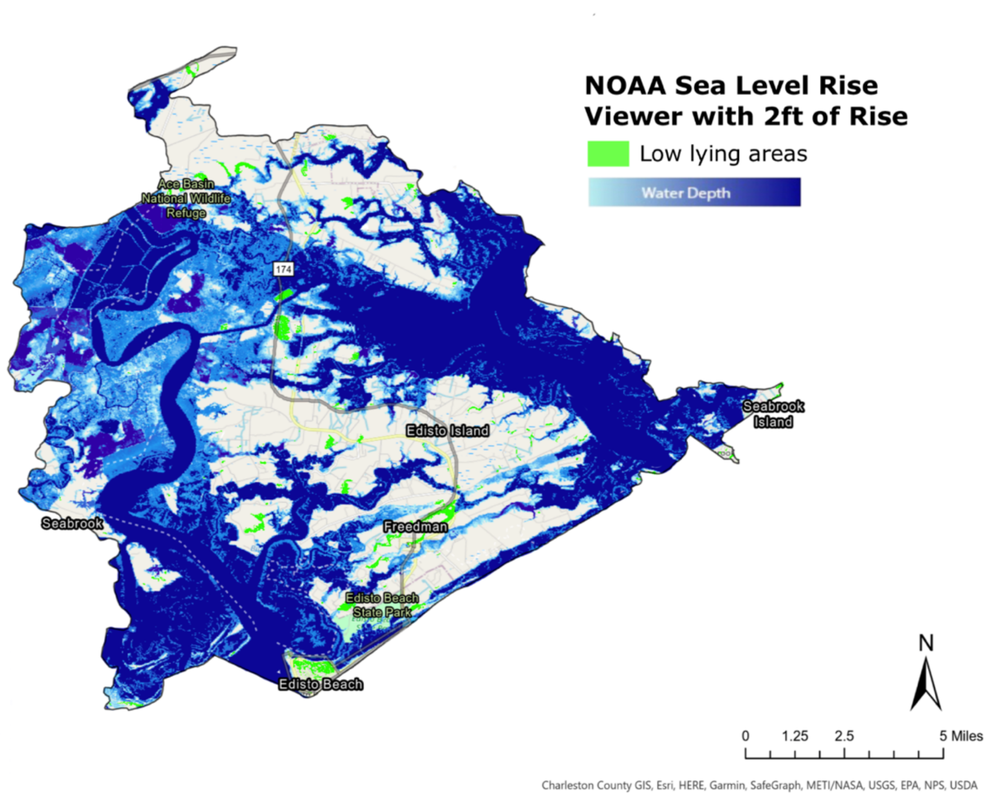


Figure 12: NOAA Sea Level Rise viewer depicting a) current MHHW (top) and b) a predicted sea level rise of two feet (bottom)

When sea level rises, wetlands can often migrate landward. This process of wetland migration can be thwarted when the adjacent land contains infrastructure such as bulkheads, roads, or houses that block a potential migration corridor. The wetland potential map (Figure 13) indicates areas throughout the watershed that are not currently mapped as wetlands or development, but conditions (including soil characteristics, elevation, hydrographical extents, and satellite imagery) may represent the likelihood of wetland conditions or potential. These areas of high wetland potential, indicated as a dark pink color on the map, are notable as locations that could be targeted for conservation, wetlands mitigation, or restoration.

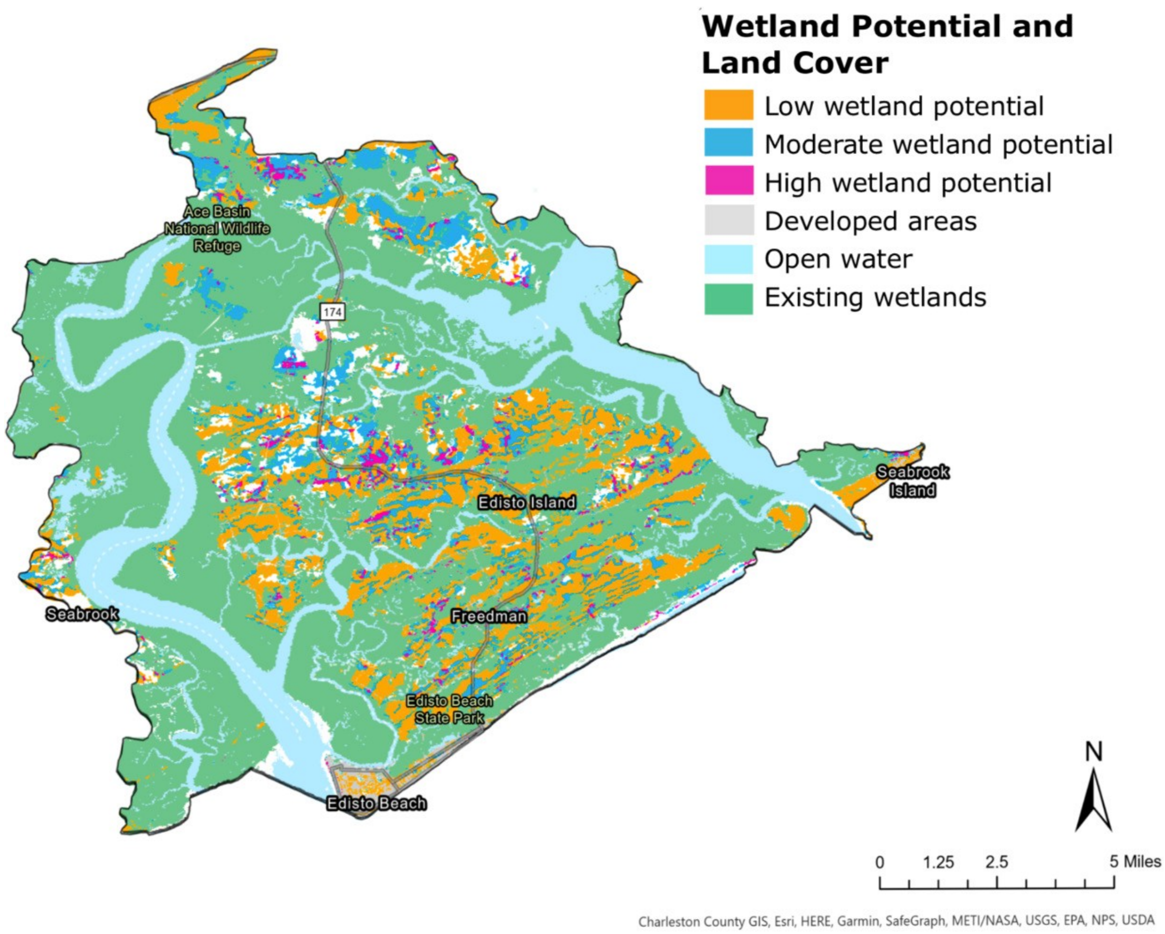
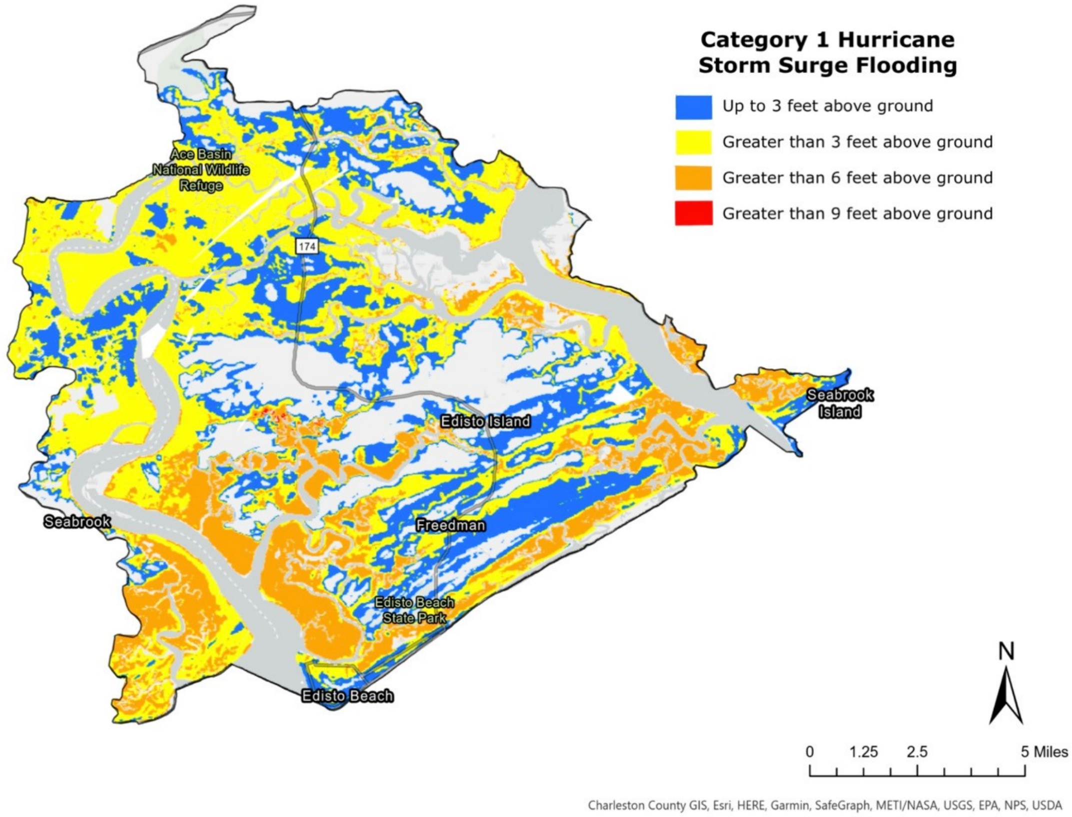


Figure 13: Map of wetland potential for areas not currently mapped as wetlands or development (NOAA Coastal Flood Exposure Mapper, 2021)

In addition to sea level rise, climate change can also give rise to larger and more frequent storms. Figure 14 illustrates potential inundation scenarios to the EIW from Category 1, 2, and 3 hurricanes.

A)



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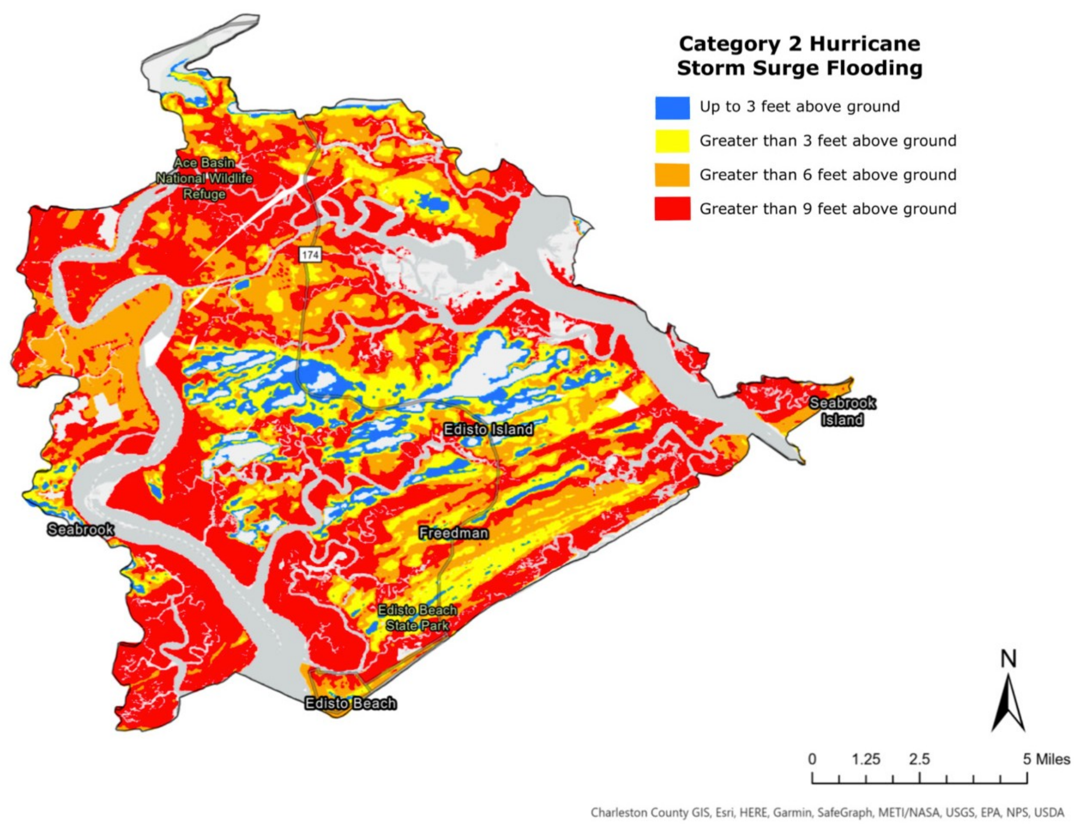

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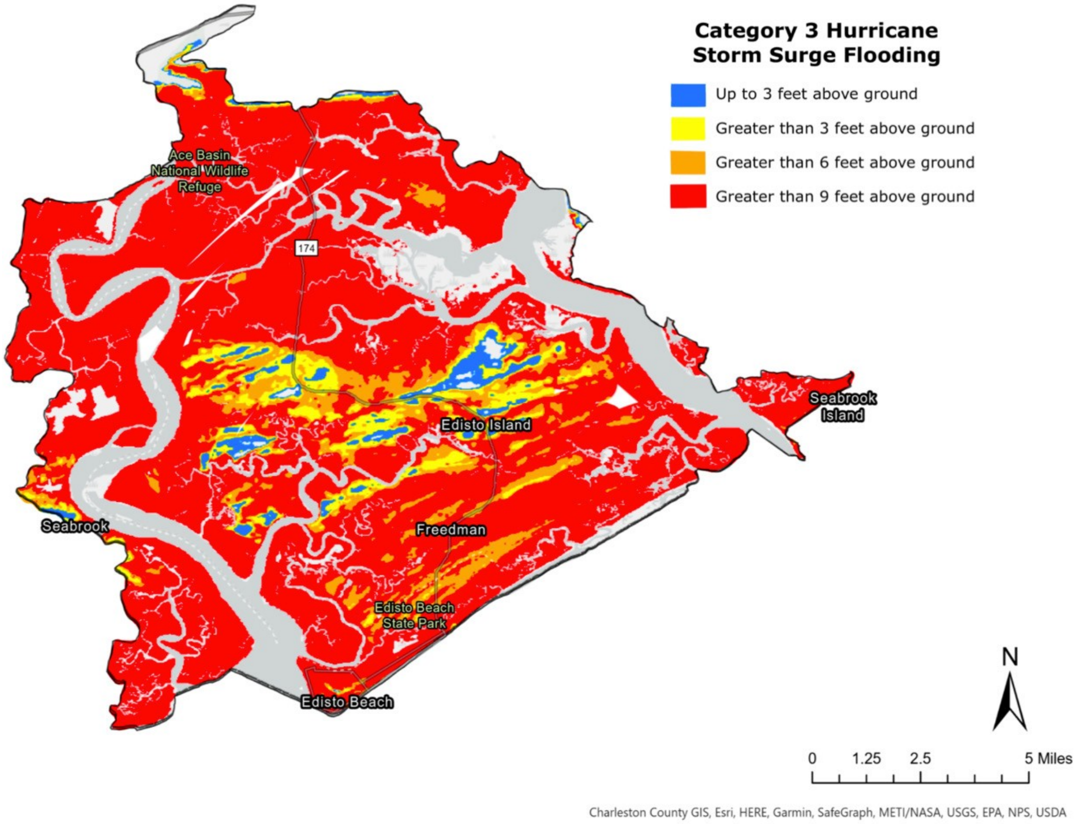

Figure 14: Storm surge maps showing inundation scenarios created by the National Hurricane Center using the SLOSH model. Maps display depth of storm surge inundation in water depth above ground for a) category 1, b) category 2, and c) category 3 hurricanes (NOAA Coastal Flood Exposure Mapper, 2021)

Development

Urban sprawl/development is an escalating threat to water quality in coastal South Carolina. Edisto Island has largely been spared by this development pattern locally, through a combination of geography, geomorphology, and zoning requirements. For example, the most common (by acreage) zoning district on Edisto Island is AG-10 (one dwelling unit per ten acres). There is also a substantial area within the AGR zoning district (one dwelling unit per acre). Locally, the Edisto Island Open Land Trust (EIOLT) actively works to preserve the rural character of Edisto through land preservation and the use of conservation easements (Figure 15). Roughly 3,070 acres are held in 37 conservation easements by the EIOLT, but the total acreage of conserved land across the watershed is closer to 25,000 acres. Approximately 47% of Edisto Island's high ground and marsh are permanently conserved through the efforts of EIOLT and other conservation partners.

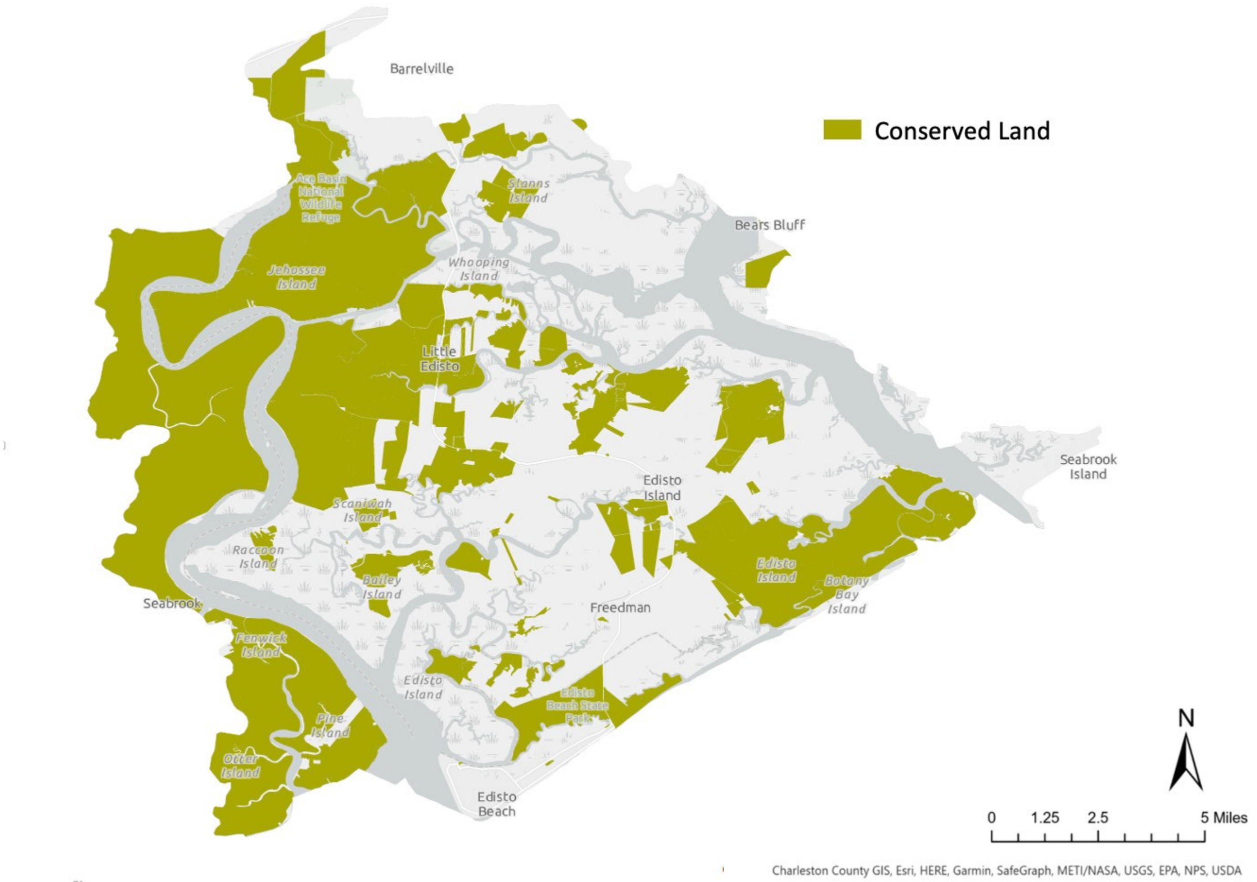

Figure 15: Conserved land on Edisto Island (Data provided by Tom Austin, EIOLT)

The southernmost portion of the Edisto Island Watershed is within Colleton County and includes the Town of Edisto Beach. Zoning regulations on Edisto Beach allow for four dwelling units per acre. Proposed future land use for this portion of the watershed, as indicated by the Colleton County Comprehensive Plan (Figure 16), includes Coastal Preservation, Village Residential, and Village Center. As seen in the plan, the Colleton County portion of the watershed, excluding Edisto Beach, is currently zoned as a combination of Rural Development 1, Rural Development 2, Resource Conservation 1, and Planned Development District. The proposed future uses will likely increase the amount of development and impervious surfaces within the watershed, highlighting the need to mitigate any additional stormwater runoff to prevent increased pollution loading rates.

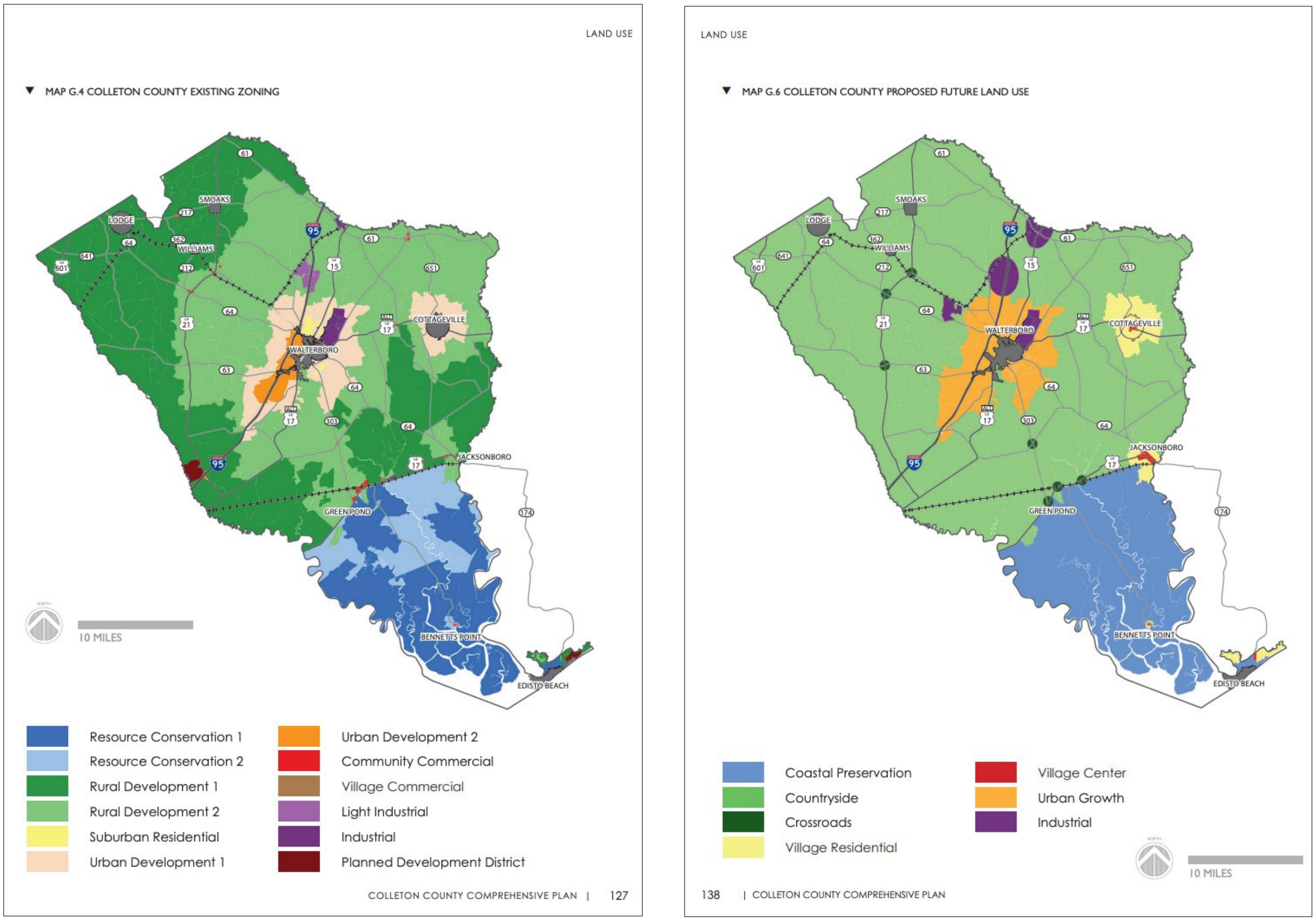

Figure 16: Existing zoning and proposed future land use for Colleton County, including Edisto Beach (Colleton County Comprehensive Plan, adopted Jan 2020)

Land Cover Change

Aerial photos can be useful for visualizing land cover change and patterns of development over time; Figure 17 shows the increase in development over the last 35 years within a portion of the watershed. Maps from the National Land Cover Dataset synthesizing data from 2001-2016 indicate changes to forest cover for Edisto Island (Figure 18) and Edisto Beach (Figure 19), and impervious cover for Edisto Beach (Figure 20). These maps show that Edisto Island experienced a net gain in forest cover during this period, which is consistent with feedback we heard from our advisory committee about an overall decrease in the occurrence of timber harvesting and agricultural production on the Island. Edisto Beach had a net loss in forest and a net gain in developed/impervious cover during this period.

Figure 17: Aerial photos from 1985 and 2020 show patterns of development of the last 35 years (photos captured from Google Earth)

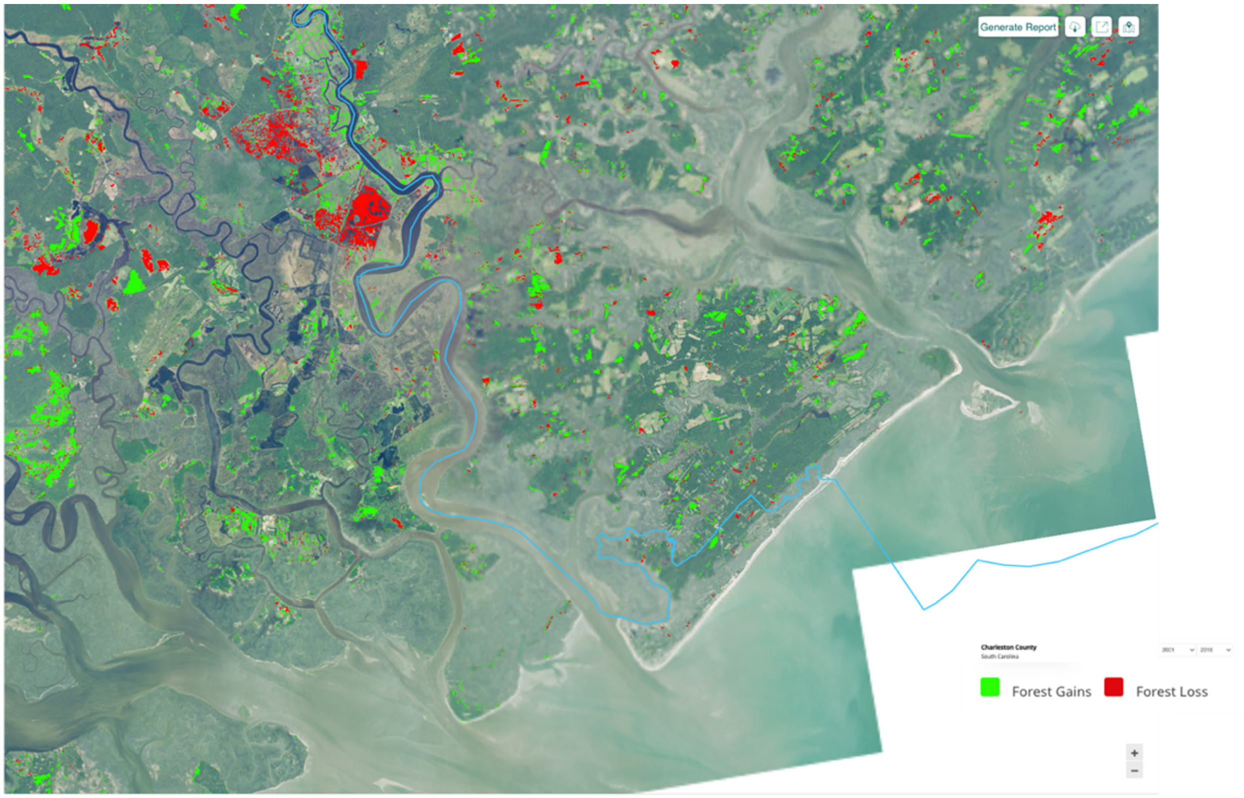

Figure 18: Change in forest cover on Edisto Island between 2001-2016 (map obtained from National Land Cover Database, mrlc.gov/eva)

Figure 19: Change in forest cover on Edisto Beach between 2001-2016 (map obtained from National Land Cover Database, mrlc.gov/eva)

Figure 20: Change in developed (impervious) cover on Edisto Beach between 2001-2016 (map obtained from National Land Cover Database, mrlc.gov/eva)

Stormwater

While only 2% of the watershed is classified as developed, existing development generates stormwater runoff which must be managed to prevent nuisance flooding and associated impacts. The Town of Edisto Beach is the most intensively developed area within the watershed (62% of the Town is developed, including developed open space, low, medium, and high intensity development), and we estimate that 49% of Edisto Beach is impervious (Figure 21).

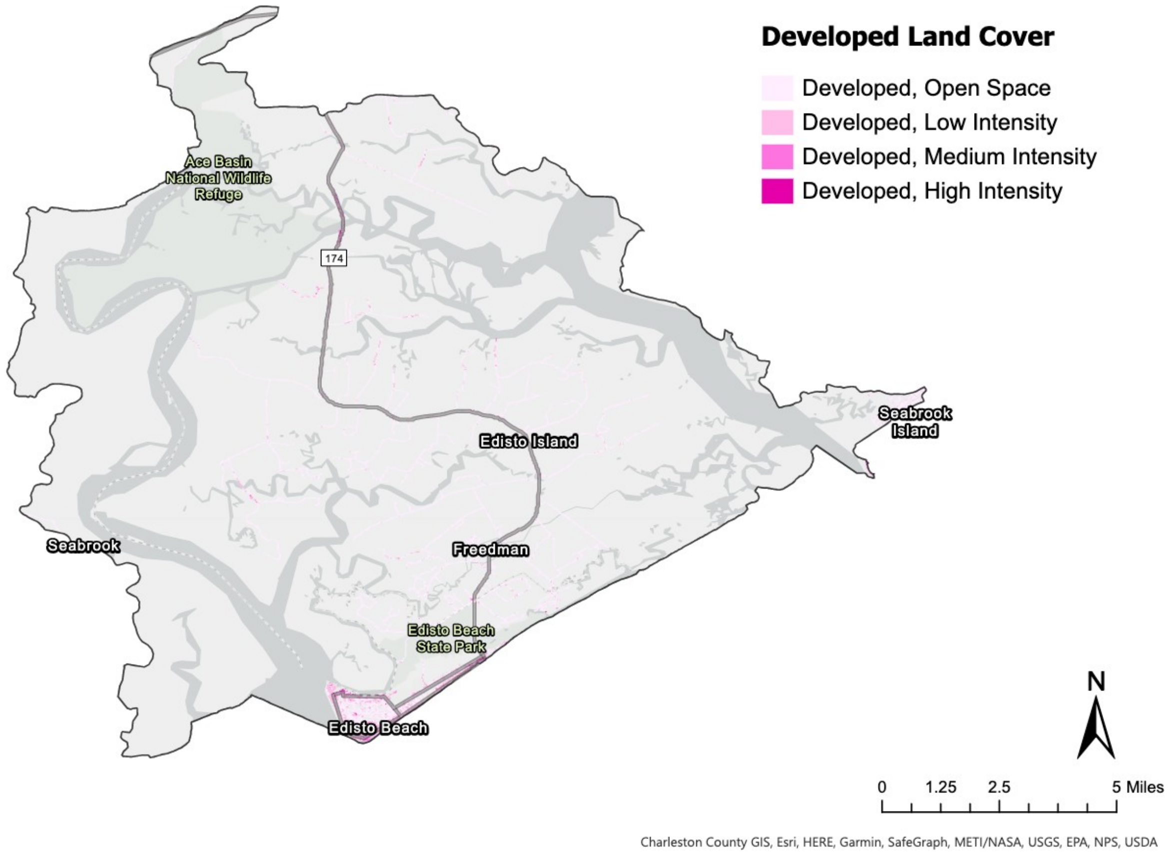

Figure 21: Developed areas across the Edisto Island Watershed

Stormwater on Edisto Beach is managed through a combination of wet detention ponds, catch basins, drainage ditches, and underground pipes (Figure 22; Figure 23). This traditional stormwater strategy is designed to move water off the landscape as quickly as possible, and generally prioritizes runoff over infiltration. Moving towards a stormwater strategy that focuses on treating water onsite will help to reduce erosion and pollution transport into nearby waterbodies. However, this may be a challenge considering ongoing sea level rise and a shallow water table significantly reducing infiltration capacity. Temporary storage, such as rain barrels/cisterns, and better management of existing stormwater ponds for water quality treatment may be more practical solutions.

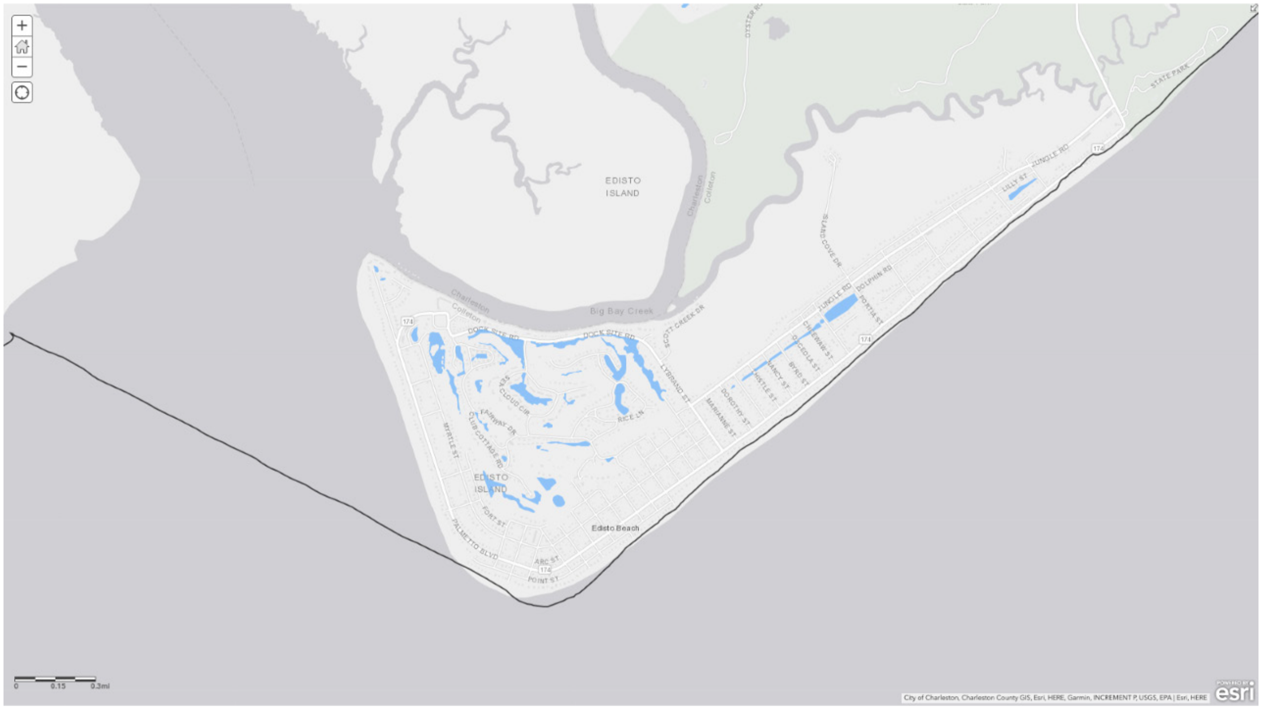

Figure 22: Location of stormwater ponds on Edisto Beach (map used with permission of SC Sea Grant Consortium)

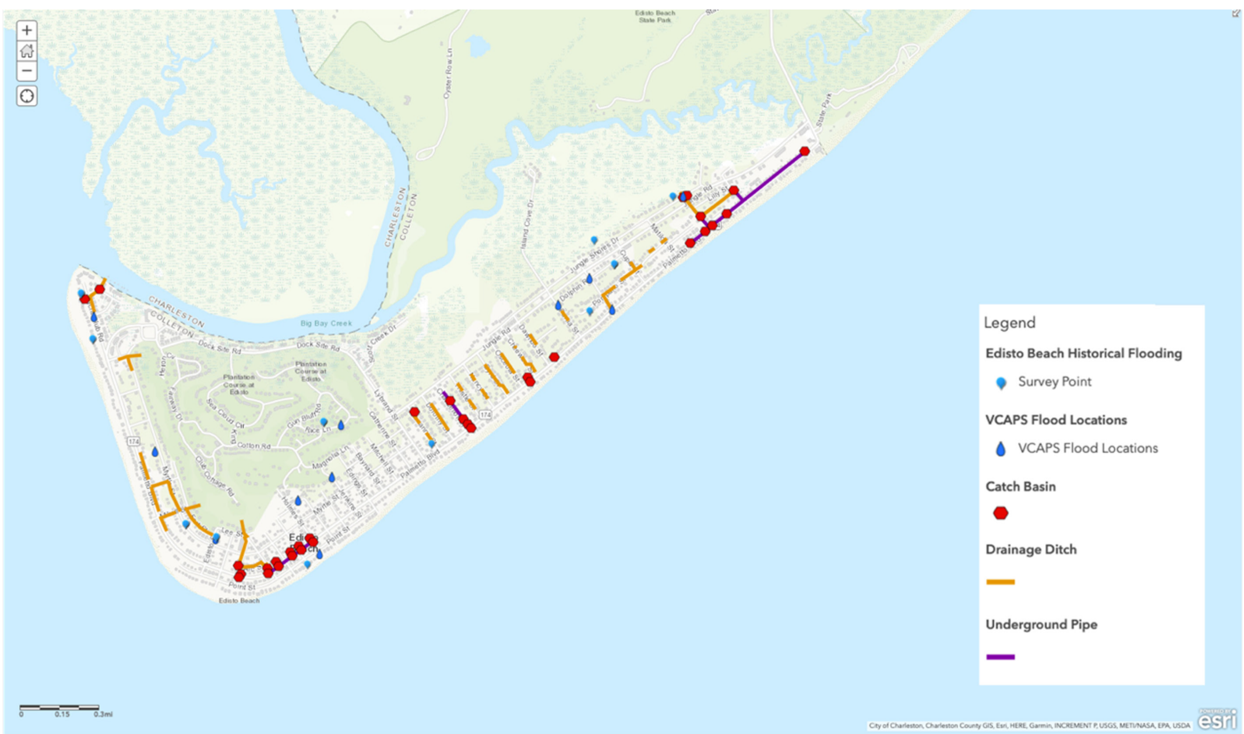

Figure 23: Mapped stormwater infrastructure across the Town of Edisto Beach (data provided by the Town of Edisto Beach, map created by Landon Knapp, South Carolina Sea Grant Consortium)

Across Edisto Island, stormwater is primarily managed through a combination of wet detention ponds, drainage easements, stormwater channels, stormwater pipes, and canals (Figure 24)

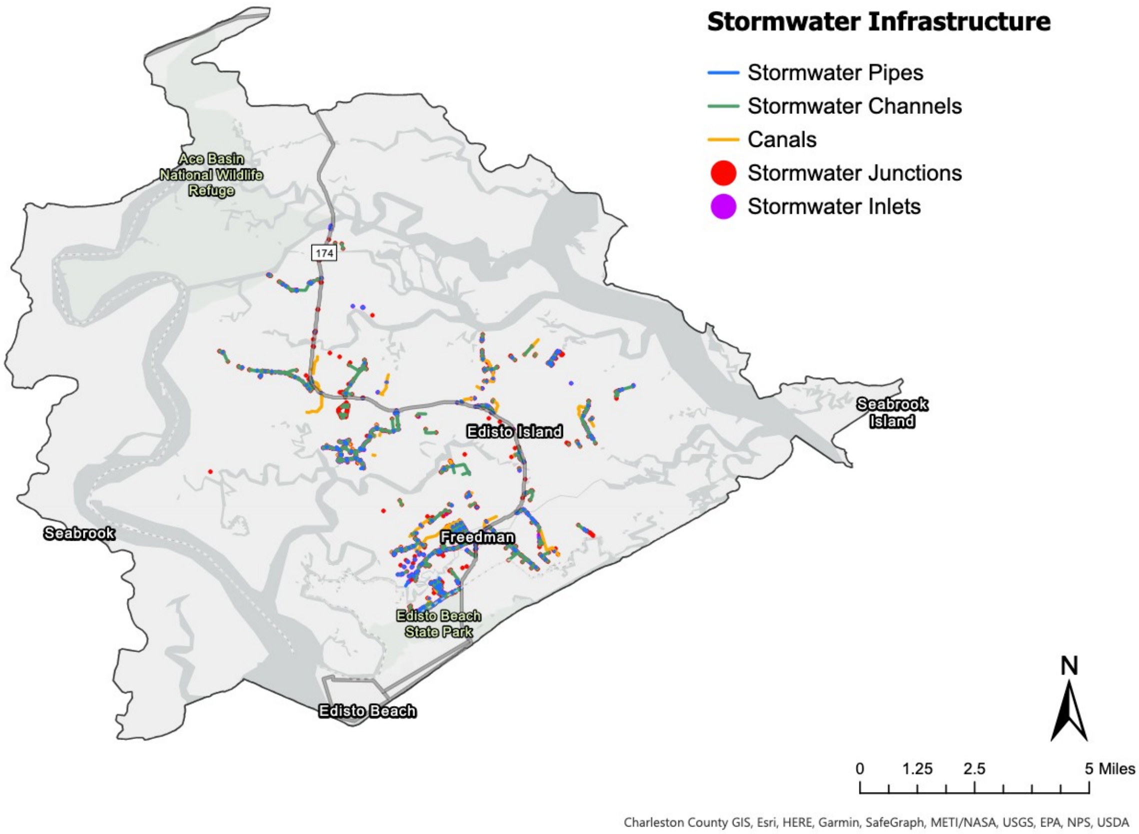

Figure 24: Stormwater infrastructure across Edisto Island (data provided by Charleston County Stormwater Department)

These stormwater features are highly visible across Edisto Island, including the large outfall at Crisp Road, and the network of roadside ditches. Many of these roadside ditches are vegetated, which likely helps with sediment retention and pollution reduction. However, conversations with residents indicate that ditch maintenance by Charleston County generally involves removing both plants and sediment to increase volume capacity, leaving behind bare soil.

There are four SCDHEC regulated permits for NPDES discharges within the watershed.
The first one is classified as industrial and is for a sand mine located near the confluence of the North Edisto River and Legare Creek. The second one is classified as domestic, located near Jeremy Creek at Edisto Beach. The third one is classified as municipal, and is the wastewater treatment plant on Edisto Beach, located just south of the Plantation Golf Course. The fourth one is classified as municipal and is the Town of Edisto Beach's Reverse Osmosis Water Treatment Plant.

There are four nationwide permits, all on Edisto Island, located near Sand Creek, Steamboat Creek, Store Creek, and between Bailey Creek and St. Pierre Creek. These are for minor activities that may result in discharges into waters of the United States but not considered a significant source of identified impairments.

Drinking Water

There are a total of 19 public water supply wells across the watershed, 3 on Edisto Beach and 16 on Edisto Island (Figure 25). On Edisto Beach there are 2,419 total water taps connected to the Town's municipal water system; 2,247 of these are residential, 57 are commercial, 75 are for irrigation, and 40 are classified as "other."

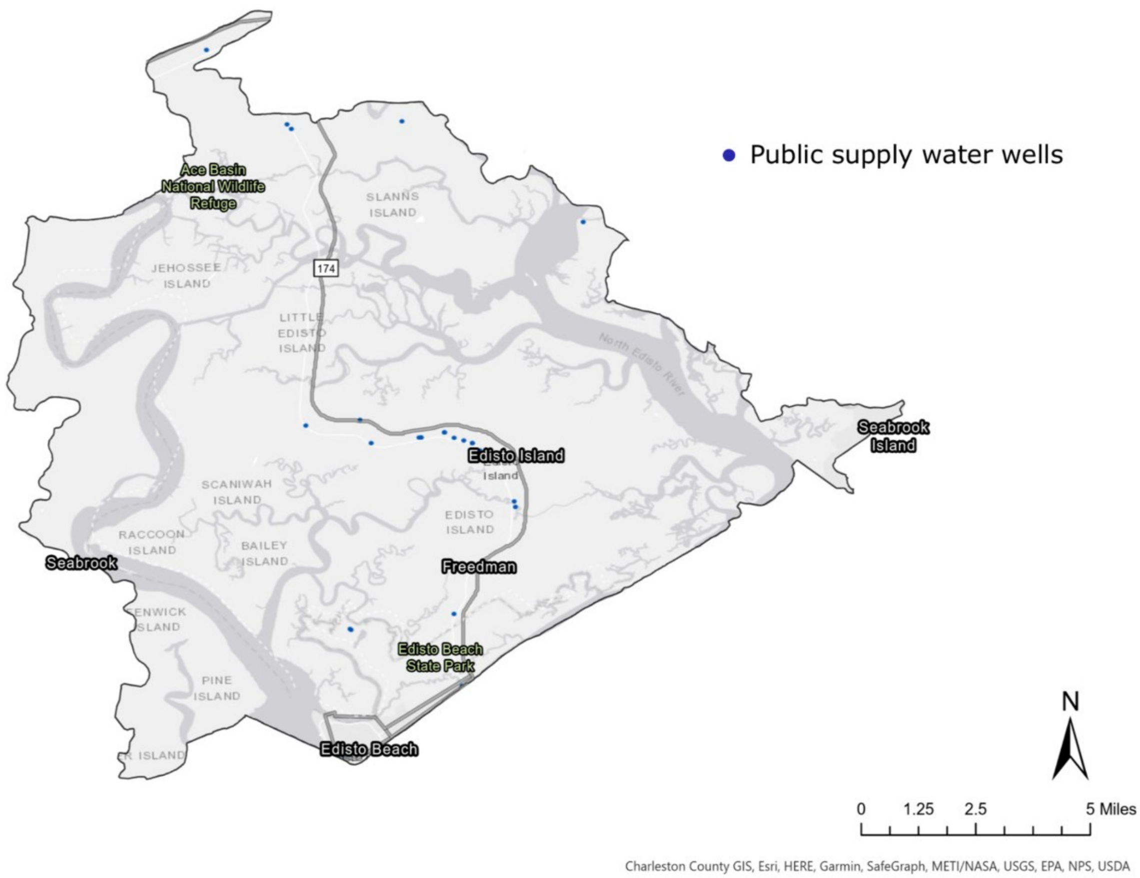

Figure 25: Public water supply wells within the watershed (SCDHEC, 2019)

Wastewater and Septic Systems

Wastewater treatment on Edisto Island is primarily achieved through on-site wastewater treatment systems, also known as septic systems or septic tanks. According to GIS data provided by Charleston County, there are 864 septic systems mapped across the Charleston County portion of Edisto Island (Figure 26). This is likely an underestimation because the number of mapped parcels with building footprints (2,552) is about three times the number of mapped septic systems (864). Not all these building footprints indicate residences; they could indicate a barn, a shed, a garage, or similar. However, a review of the maps indicated some known houses with septic systems were not included on the septic layer, so the true number is somewhere between 864 and 2,552. We overlayed the septic system map with the building footprints map (Figure 27) and aerial imagery and determined that there are likely another 553 septic systems across Edisto Island that are not currently mapped.

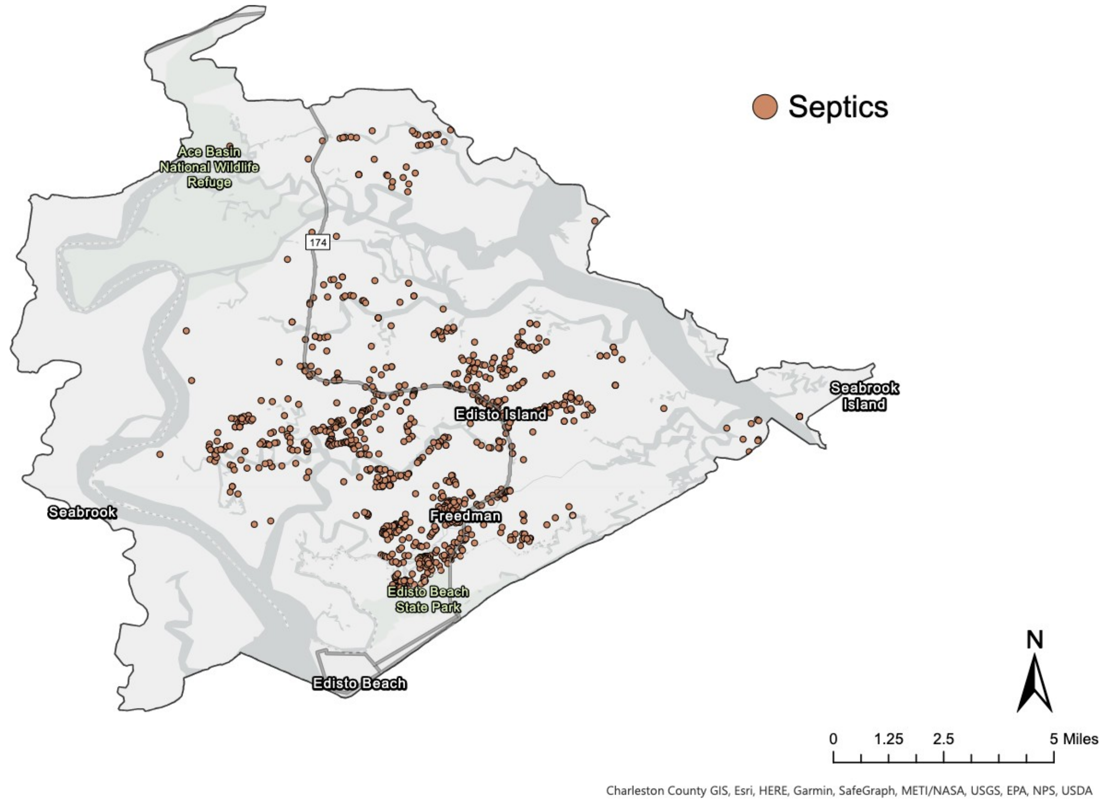

Figure 26: Septic system locations (data for Edisto Beach/Colleton County not available)

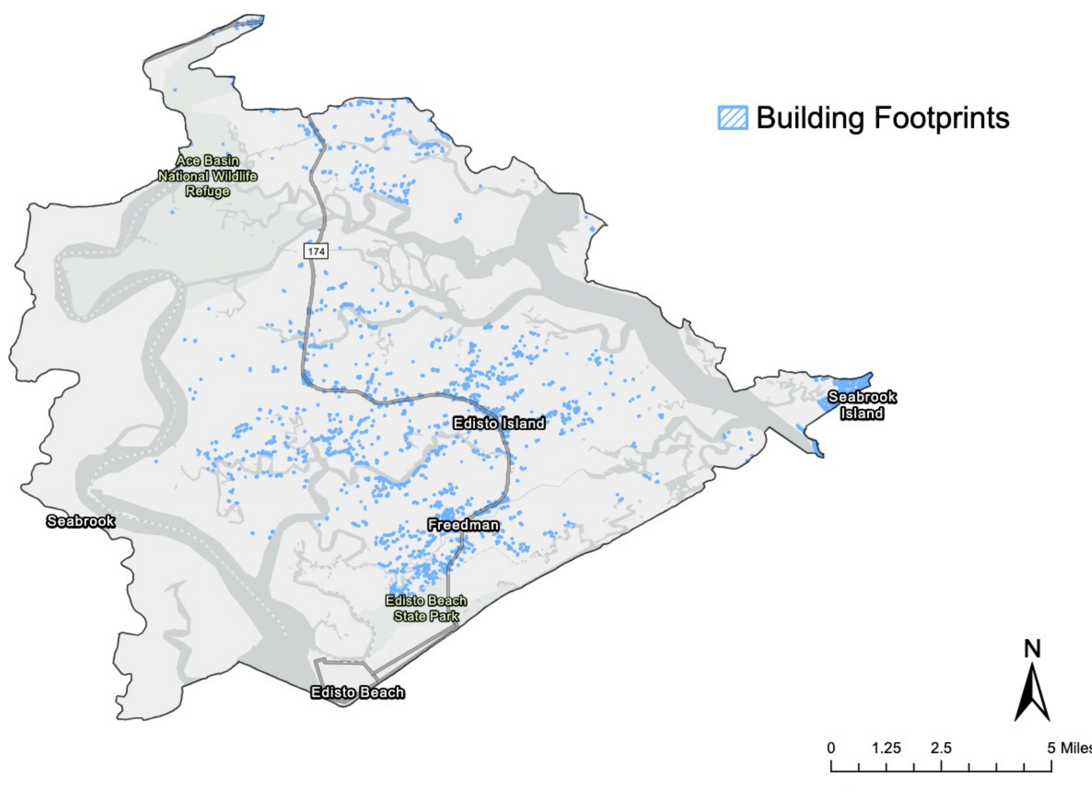

Figure 27: Building parcels across Edisto Island (data for Edisto Beach/Colleton County not available)

Edisto Beach has a municipal wastewater treatment plant that serves 1,074 connections (1,017 residential and 57 commercial). The remaining 1,230 properties are served by individual on-site wastewater treatment systems (septic systems). Data was provided by the Town of Edisto Beach, but no accompanying GIS data was available. There have been no recent reported sanitary sewer overflows over 500 gallons from the Edisto Beach wastewater treatment plant.

Agriculture

Among the general categories of pollution sources, agriculture ranks as the number one cause of stream and lake impairments nationwide. This is largely due to the production of animal wastes, which contain bacteria, nutrient losses from fertilizers, which can cause turbidity and dissolved oxygen issues in adjacent and downstream water bodies, and sediment loss from fields which can increase turbidity in receiving waterways. However, while there is livestock production present within the Edisto Island watershed, none of the operations are large enough to require a permit.

SCDHEC does not monitor for nutrients within estuarine waters. Nutrient-driven algal blooms may play a role in decreased water clarity and increased turbidity in the waterways. Most of the turbidity impairments across the watershed are in the South Edisto River.

The parcels across Edisto containing livestock are shown in Figure 28. Point counts of livestock indicate the total cattle population is less than 200 animals (McMaster, 2008). Discussions with residents and results of the survey suggest that cattle are known to enter the stream in certain locations, which could be a direct source of bacteria, and a cause of turbidity, in those waterways. At least one of the impaired sites (monitoring station 12B-47) is near an area where cattle are adjacent to the stream.

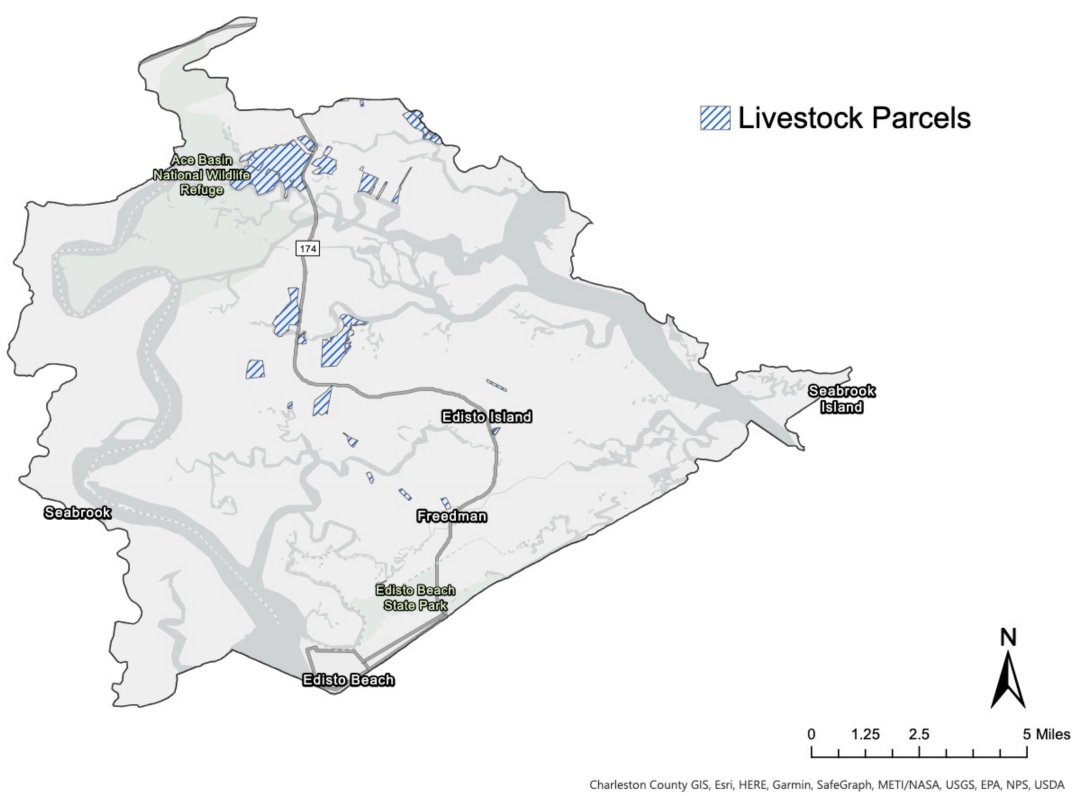

Figure 28: Livestock parcels across Edisto Island (data from McMaster, 2008)

Cultivated crop production is another type of agriculture that can potentially act as a source of nutrients, sediment, and bacteria resulting from land application of fertilizers, including manure. As seen in Figure 29, there is not an extensive amount of agricultural production across the watershed, and conversations with local experts indicate that land once used for traditional agricultural food production has been lost due to farmer attrition and is now fallow or converted to wildlife plots. Some local farmers do their own on-site composting of manure, while others pay to have it hauled off-site.

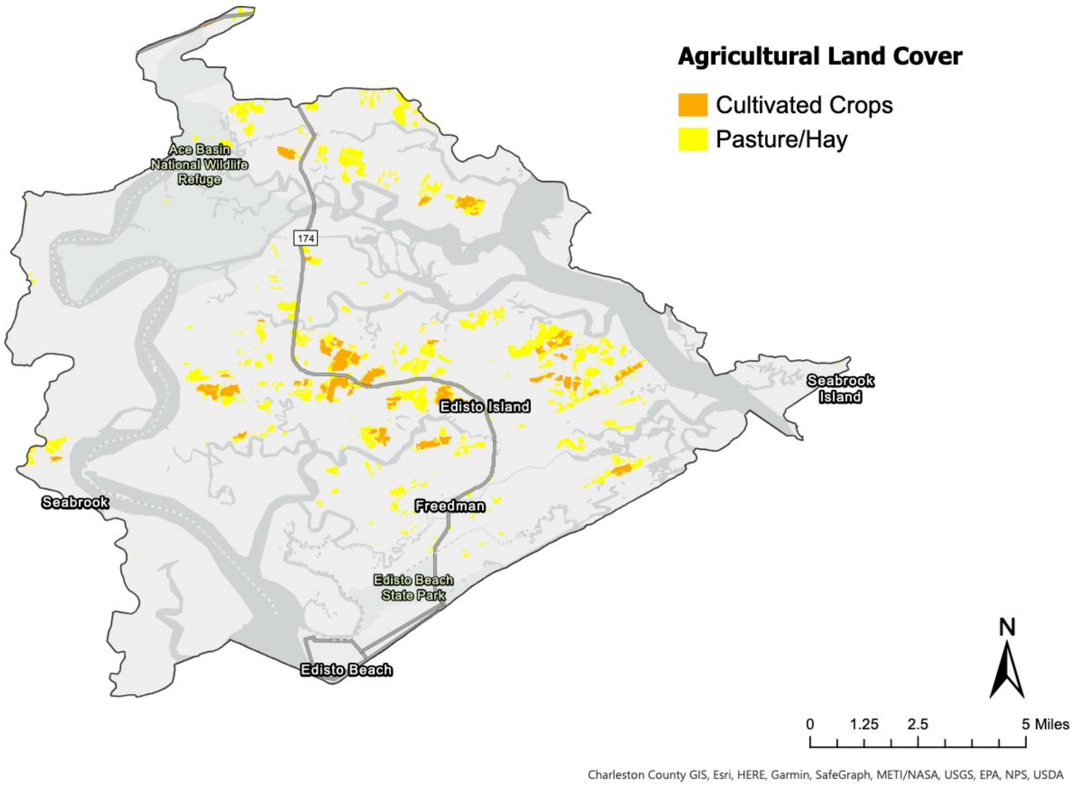

Figure 29: Agricultural land cover (cultivated crops, pasture/hay) across the Edisto Island Watershed

Forestry

Forests are the second most common land cover type, by acre, within the watershed, with wetlands being the first (Figure 30). The Store Creek Watershed has the highest forest cover (27%), followed by the Dawho River-North Edisto Watershed (16%), and the South Edisto-Atlantic Intracoastal Watershed (11%).

It was difficult to obtain data on forest management activities within the watershed. Conversations with our advisory board and additional experts indicated that pine forest management may be on the decline, in favor of an increase in management of forests for wildlife. There does not appear to be a lot of land still actively managed for timber, although some timber harvesting still occurs. In general, local experts mentioned that Edisto's remote location makes it a less desirable place to target for timber harvest due to the cost and time involved with hauling timber offsite. Concern exists among residents about the use of prescribed burns as a forest management strategy, particularly those that burn right up to the marsh edge, which may contribute to erosion and turbidity issues in the waterway. The use of vegetated buffers, sited between potential sources of pollution (such as agricultural land or impervious areas) and waterways, is an important best management practice (BMP) to consider for reducing polluted runoff from non-forested areas. In many cases this could involve protecting existing buffers, but in some areas may require a replanting effort.

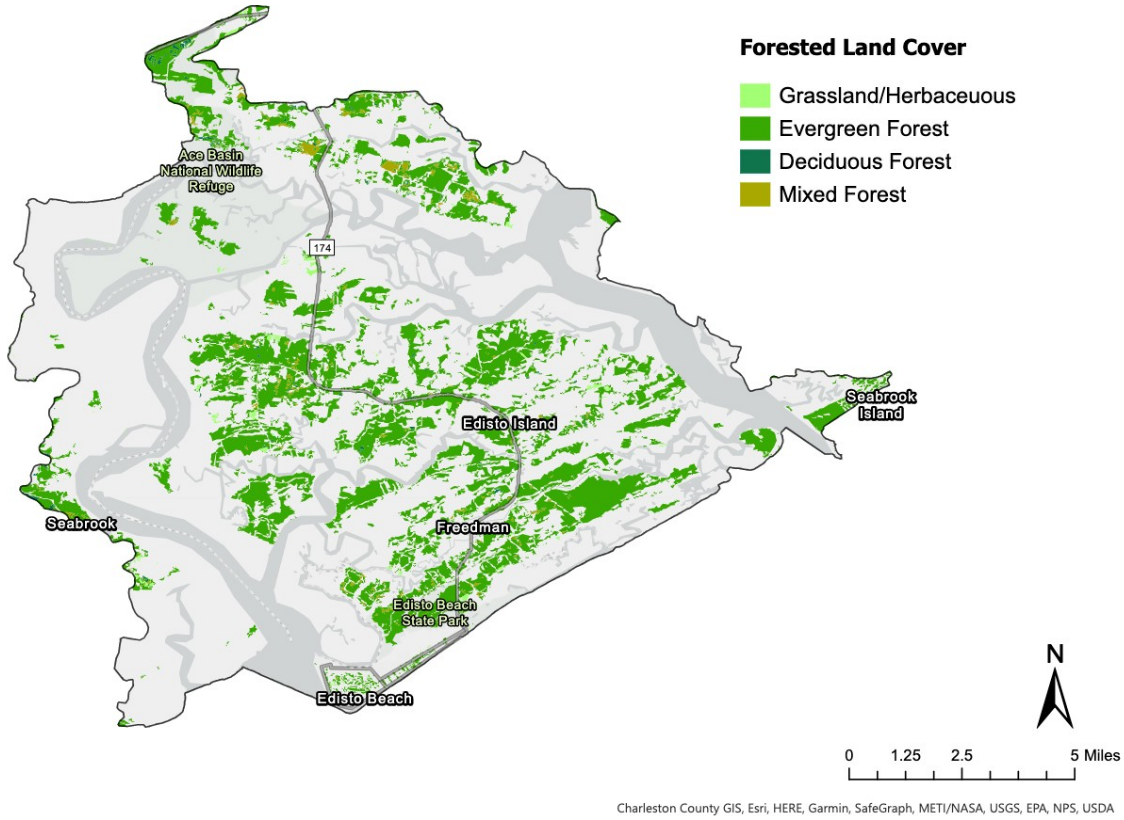

Figure 30: Forested land cover across the Edisto Island Watershed

Shellfish

Shellfish, including oysters, clams, and mussels, are abundant in the waterways around Edisto Island (Figure 31). SCDHEC's Shellfish Monitoring Program routinely monitors shellfish areas across the coast to ensure that both shellfish and the areas they are harvested from meet health and environmental quality standards (SCDHEC Shellfish Monitoring Program website, 2022). Monitoring results determine whether shellfish beds are rated as approved, conditional, or restricted for harvest. Sites across the EIW have been monitored monthly since the 1990s. The samples measure a variety of parameters, including bacteria. High levels of bacteria in the water pose a human health threat for those who consume shellfish, so ongoing monitoring establishes areas that are considered safe to harvest oysters for consumption and those that are not. Many of the shellfish areas around the EIW are currently classified as either restricted or prohibited (Figure 32).

Target water quality standard for shellfish harvesting (fecal coliform) is a daily maximum concentration of 43 colonies/100 milliliters (mL) or a monthly average of 14 colonies/100 mL. 10% of samples collected must exceed that maximum to become designated as impaired. The daily maximum used for the EIW is lower than in some other areas of the state because the waters in and around Edisto Island are classified as outstanding resource waters, and the designated use includes shellfish harvesting/consumption. As a result of ongoing monitoring efforts, nineteen sites across the watershed have been classified as impaired for fecal coliform or enterococcus bacteria, and eleven for turbidity. Two sites have Total Maximum Daily Load (TMDL) designations for fecal coliform bacteria.

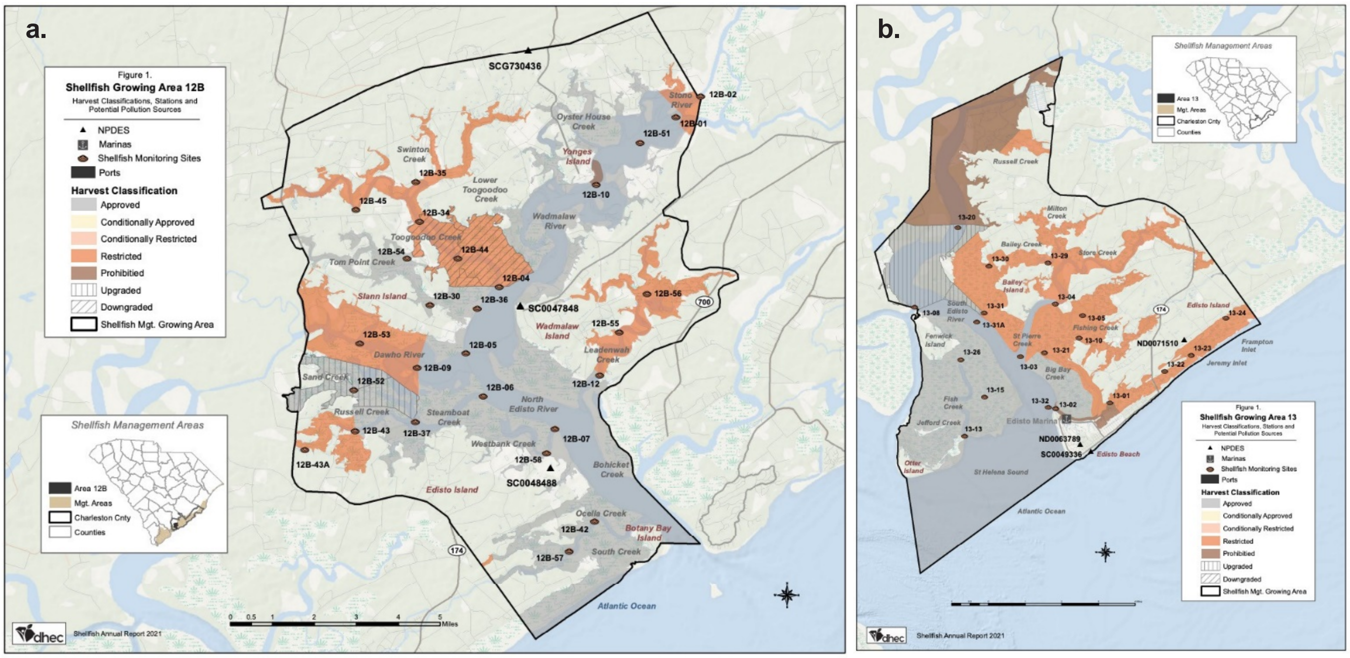

Figure 31: Shellfish Growing Areas a) 12B and b) 13, encompassing the Edisto Island Watershed (maps from SCDHEC, 2022)

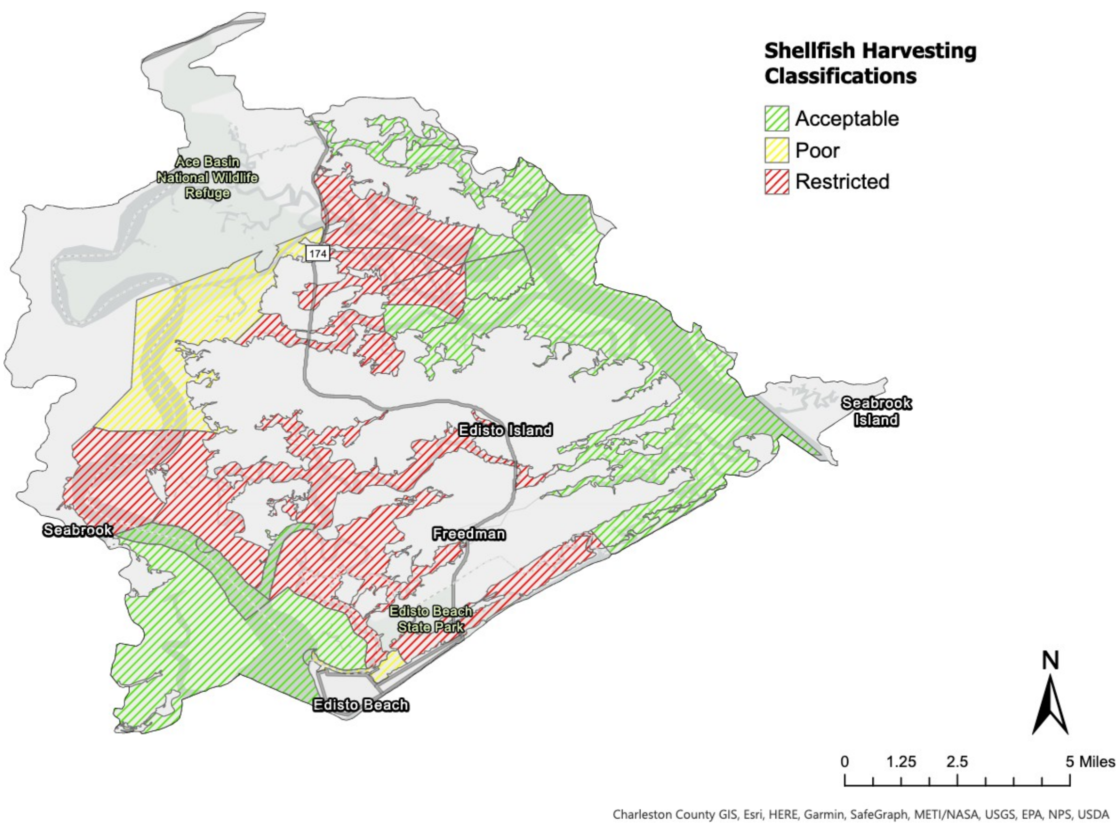

Figure 32: Classification of shellfish harvest zones within the Edisto Island Watershed (data provided by the SCDHEC Shellfish Monitoring Program)

Wildlife and Domestic Animals

Many residents cite the abundance of wildlife as one of the things they love about living on Edisto. However, dense or overpopulations of some wildlife, or improperly managed domestic animal waste, can be a source of bacteria to waterways. The watershed supports a variety of species, including white-tailed deer, raccoons, wading birds, and migratory waterfowl (SCDHEC, 2021), as well as marine mammals. There is also an active shorebird nesting area on Deveaux Bank, located at the mouth of the North Edisto River, which houses the largest pelican rookery in the state. Residents also report owning dogs, horses, goats, and chickens.

Both Edisto Island and Edisto Beach have areas of high habitat value for white-tailed deer (Figure 33). Across the EIW, deer densities range from a high of more than 45/mi^2 along the South Edisto River to a low of 15-30/mi^2 across other parts of the watershed. The Town of Edisto Beach conducts point counts for the number of deer present, and a primary concern is people feeding deer and other wildlife.

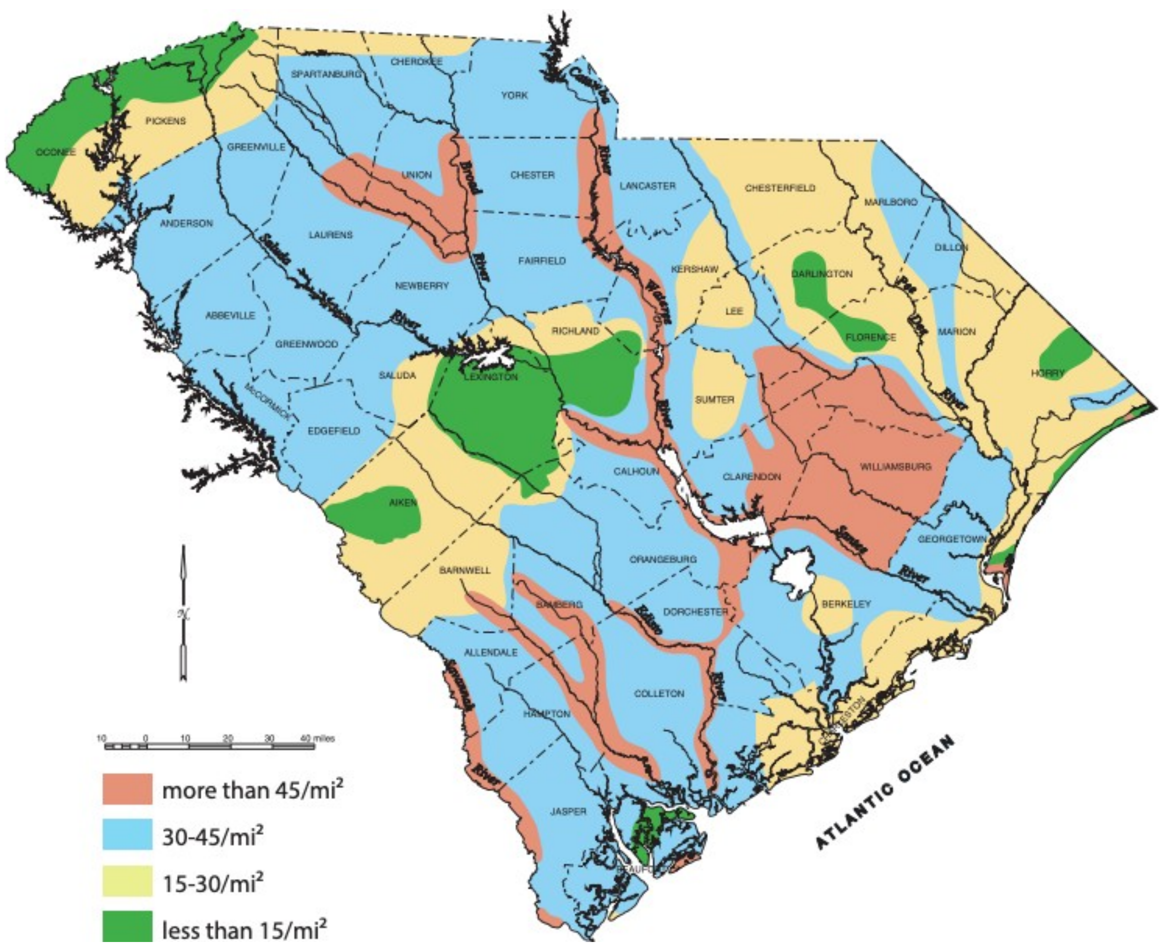

Figure 33: South Carolina deer density map (SCDNR, 2013)

Water Access and Use

Both commercial and recreational boating, and other water-based activities such as kayaking and paddle boarding are popular across the watershed. Many of the houses on Edisto Island are built along waterways and have private dock access. There are three public boat ramps on Edisto Island: Dawho Landing at the Intracoastal Waterway, Steamboat Landing at Steamboat Creek, and Live Oak Landing on Big Bay Creek (Figure 34). Additionally, there is a public marina on Edisto Beach, located in Big Bay Creek near the confluence of the South Fork of the Edisto River (Figure 34). Feedback from residents suggests a noticeable increase in boat traffic across local waterways over the last few years. This could be contributing to streambank erosion and introduction of sediment into waterways, increasing turbidity. While there are some designated “no wake zones” across the Island, there seems to be little enforcement, thus, little compliance.

In addition to turbidity, boats can also be a direct source of bacterial pollution to waterways. Human waste collected on board should be disposed of at a designated pump out station, but availability may be limited. SCDHEC requires pump out stations at marinas and at community docks longer than 250 linear feet. While SCDNR’s map of coastal pump out stations indicates one at the Edisto Marina (https://www.dnr.sc.gov/cleanvessel/pdf/coastalArea1.pdf), a pump out facility is not currently operational. It is unclear if there are any community docks within the watershed that meet those length requirements for sewage disposal, but our advisory board was not aware of any other community-operated pump out stations. Therefore, a follow up effort to determine if there are any community docks that meet the pump out requirements is recommended.

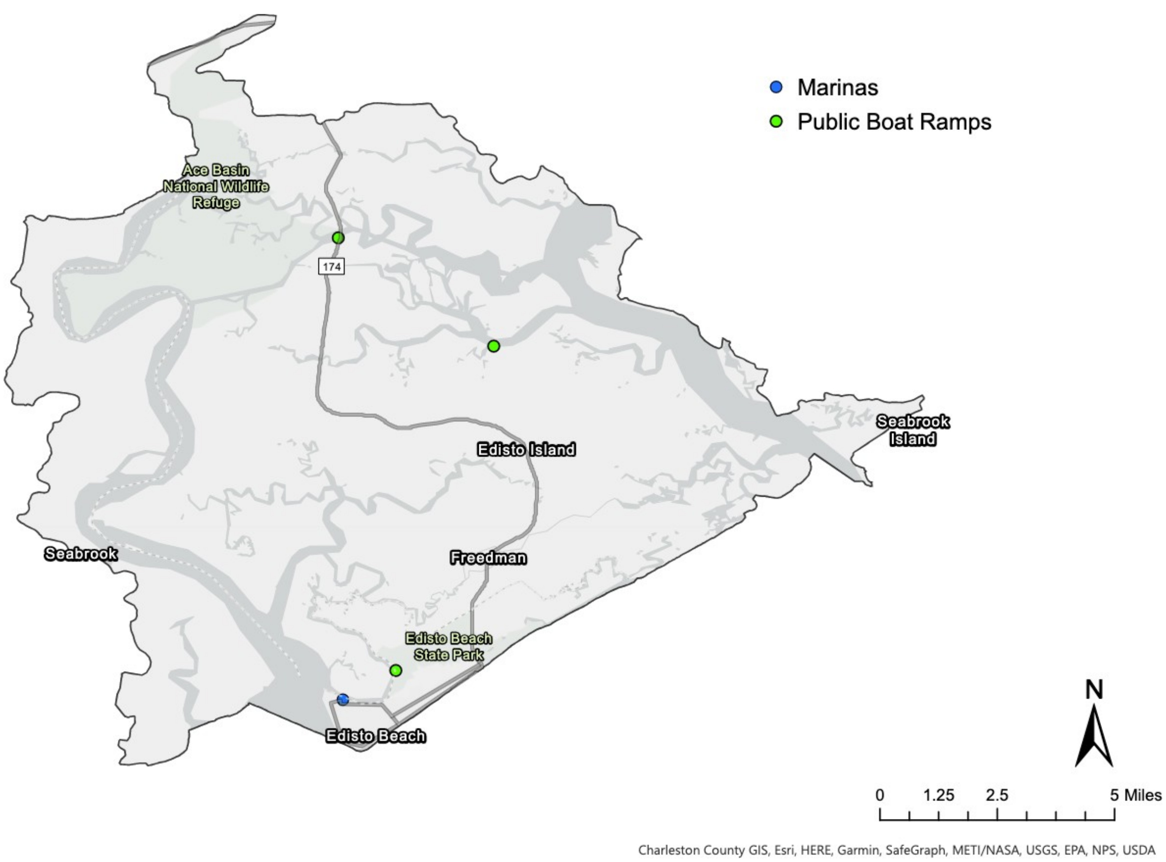

Figure 34: Location of public-access boat ramps and the Edisto Marina

Chapter 3
Water Quality Standards & Regulations

Regulations

SCDHEC monitors surface waters across the state to characterize water quality, determine if water quality standards are being met, and identify areas that need attention. Ultimately, SCDHEC strives to maintain both state and federal water quality standards as directed by the Clean Water Act and the SC Pollution Control Act (SCDHEC website, 2022). Water bodies that do not meet set water quality standards (Table 3) are designated as impaired and placed on the 303(d) list (Table 4). A TMDL is developed for impaired sites within two to thirteen years to limit pollutant discharges.

Impaired waterways: A waterbody is impaired if it does not attain the water quality criteria associated with its designated use(s), as defined by SCDHEC. Uses include recreation, fishing and harvesting shellfish, navigation, drinking water supply, and agriculture.

Total Maximum Daily Load: A TMDL is the calculation of the maximum amount of a pollutant that can enter a waterbody on a daily basis and still meet water quality standards. When applied to a waterbody, a TMDL determines a pollutant reduction target and allocates load reductions necessary to the source(s) of the pollutant.

Table 3: Quality standards for shellfish harvesting waters (S.C. Code Sections 48-1-10 et seq.)

	Quality Standards for Shellfish Harvesting Waters
Impairment	Standards
Fecal coliform	Not to exceed an MPN fecal coliform geometric mean of 14/100 ml; nor shall the samples exceed an MPN of 43/100 ml
Enterococci	Not to exceed a geometric mean of 35/100 ml based on at least four samples collected from a given sampling site over a 30 day period; nor shall a single sample maximum exceed 104/100 ml. Additionally, for beach monitoring and notification activities for CWA Section 406 only, samples shall not exceed a single sample maximum of 104/100 ml
Dissolved oxygen	Daily average not less than 5.0 mg/l with a low of 4 mg/l.
Turbidity	Not to exceed 25 (NTUs) provided existing uses are maintained.

Water Quality Monitoring

Water quality monitoring is conducted across the EIW at varying intervals by several agencies. Figure 35 details all monitoring stations across the watershed, including those currently monitored and sites monitored in the past. SCDHEC regularly monitors numerous sites on a monthly basis as part of the Shellfish Management Program (going back to 1999) and through their ambient surface water monitoring. SCDNR regularly monitors both through the ACE Basin National Estuarine Research Reserve and the SCECAP program (in partnership with SCDHEC). For the purposes of this management plan, we focus on turbidity and bacteria (fecal coliform, enterococcus) impairments as this is the predominant pollution type in EIW waterways.

Water quality data collected by these agencies has informed the list of impaired stations across the watershed (Figure 36). The list of impaired sites across the three HUC-12 watersheds was developed using both the SCDHEC Water Quality Portal and the SCDHEC Watershed Atlas. The EIW has nineteen designated impairments for bacteria, eleven designated impairments for turbidity, and two designated TMDLs for bacteria (Table 4).

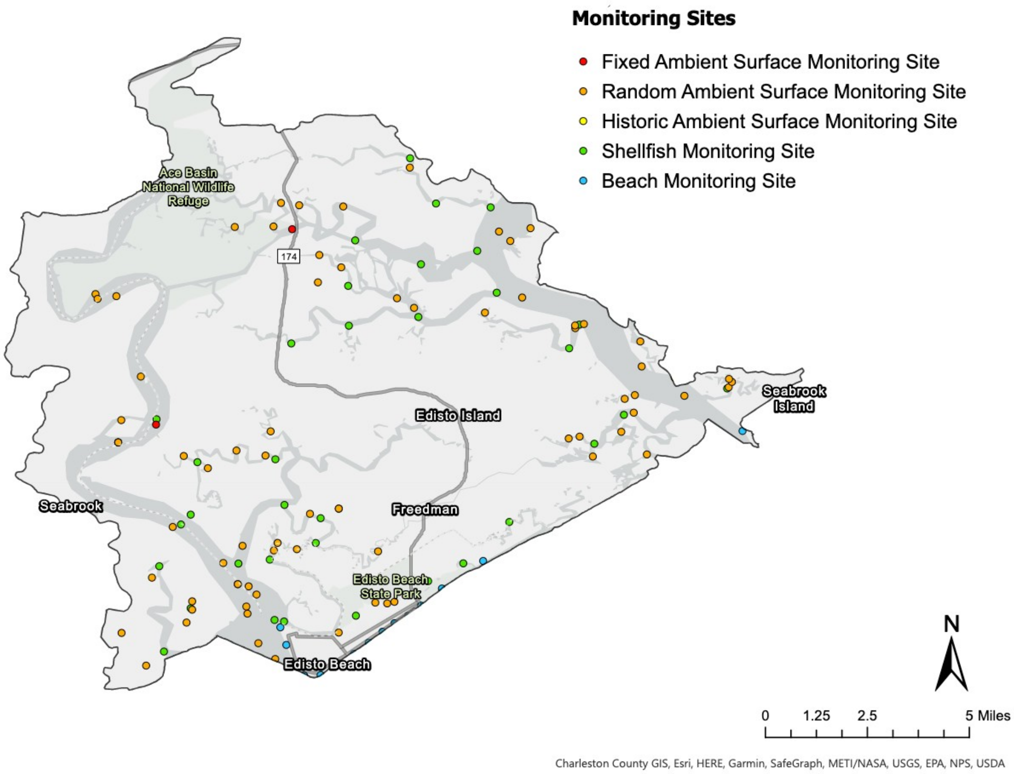

Figure 35: Location of monitoring stations across the watershed

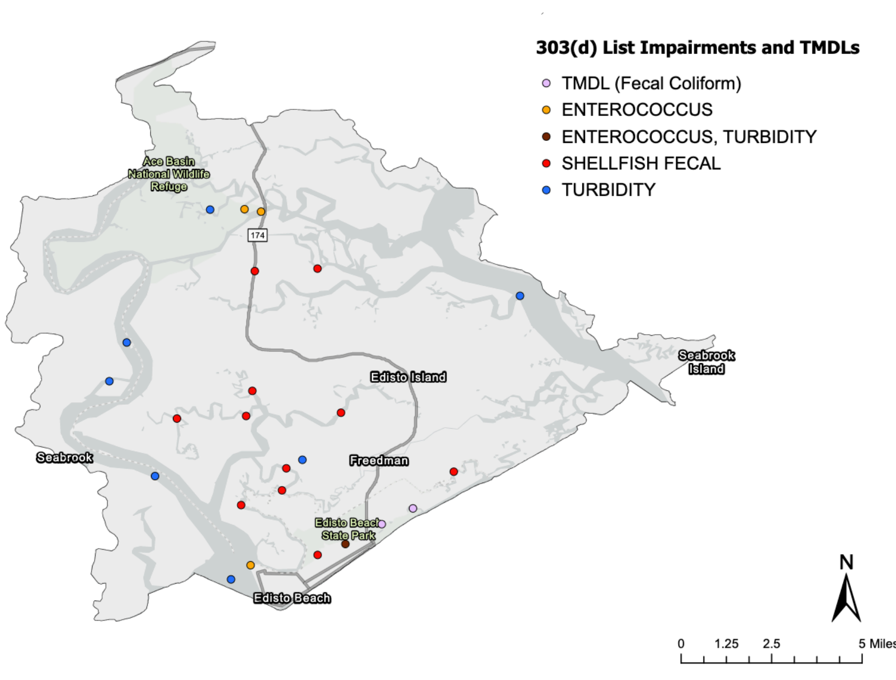

Figure 36: Designated impaired sites on the 303d list across the watershed (several sites have multiple impairments)

Table 4: Summary of impaired and TMDL stations for bacteria and turbidity across the Edisto Island Watershed (Source: SCDHEC Watershed Atlas)

HUC-12	Watershed Name	Station	Use	Impairment
030502060307	Store Creek	13-04	Shellfish	Fecal Coliform
030502060307	Store Creek	13-05	Shellfish	Fecal Coliform
030502060307	Store Creek	13-07	Shellfish	Fecal Coliform
030502060307	Store Creek	13-10	Shellfish	Fecal Coliform
030502060307	Store Creek	13-28	Shellfish	Fecal Coliform
030502060307	Store Creek	13-29	Shellfish	Fecal Coliform
030502060307	Store Creek	13-30	Shellfish	Fecal Coliform
030502060307	Store Creek	RT-11016	AL	Turbidity
030502060308	South Edisto River-AIW	13-01	Shellfish	Fecal Coliform
030502060308	South Edisto River-AIW	13-20	Shellfish	Fecal Coliform
030502060308	South Edisto River-AIW	13-21	Shellfish	Fecal Coliform
030502060308	South Edisto River-AIW	13-22*	Shellfish	Fecal Coliform
030502060308	South Edisto River-AIW	13-23*	Shellfish	Fecal Coliform
030502060308	South Edisto River-AIW	13-24	Shellfish	Fecal Coliform
030502060308	South Edisto River-AIW	MD-260	AL	Turbidity
030502060308	South Edisto River-AIW	RO-01123	AL	Turbidity
030502060308	South Edisto River-AIW	RO-08355	AL	Turbidity
030502060308	South Edisto River-AIW	RO-12320	AL	Turbidity
030502060308	South Edisto River-AIW	RO-12323	AL	Turbidity
030502060308	South Edisto River-AIW	RT-12023	AL	Turbidity
030502060308	South Edisto River-AIW	RT-13057	AL	Turbidity
030502060308	South Edisto River-AIW	RT-13057	REC	Enterococcus
030502060405	Dawho River-North Edisto River	12B-43A	Shellfish	Fecal Coliform
030502060405	Dawho River-North Edisto River	12B-47	Shellfish	Fecal Coliform
030502060405	Dawho River-North Edisto River	12B-50	Shellfish	Fecal Coliform
030502060405	Dawho River-North Edisto River	12B-53	Shellfish	Fecal Coliform
030502060405	Dawho River-North Edisto River	12B-54	Shellfish	Fecal Coliform
030502060405	Dawho River-North Edisto River	MD-120	REC	Enterococcus
030502060405	Dawho River-North Edisto River	RO-08343	AL	Turbidity
030502060405	Dawho River-North Edisto River	RT-01665	AL	Turbidity
030502060405	Dawho River-North Edisto River	RT-02005	AL	Turbidity
030502060405	Dawho River-North Edisto River	RT-07055	REC	Enterococcus

** denotes TMDL; AL = Aquatic Life, REC = Recreation, AIW = Atlantic Intracoastal Waterway*

Bacteria

Fecal coliform bacteria are used as the indicator organism for fecal contamination in shellfish waters, and Enterococci are used as the indicator organism for fecal contamination in marine recreational waters. The EIW includes both fecal coliform and enterococcus impairments, depending on whether impaired sites were being monitored for shellfish or recreation as the designated use.

The target water quality standard for fecal coliform in shellfish harvesting waters is a daily maximum concentration of 43 colonies/100mL, or a monthly average of 14 colonies/100mL. Ten percent of samples collected must exceed these standards in order to be classified as impaired. This means that for the bacteria-impaired sites within the Edisto Island Watershed, bacteria levels exceed the standard often enough that they cannot maintain their designated use. The graph in Figure 37 illustrates how the concentrations of fecal coliform bacteria fluctuated over time at monitoring station 13-05 in the Store Creek watershed.

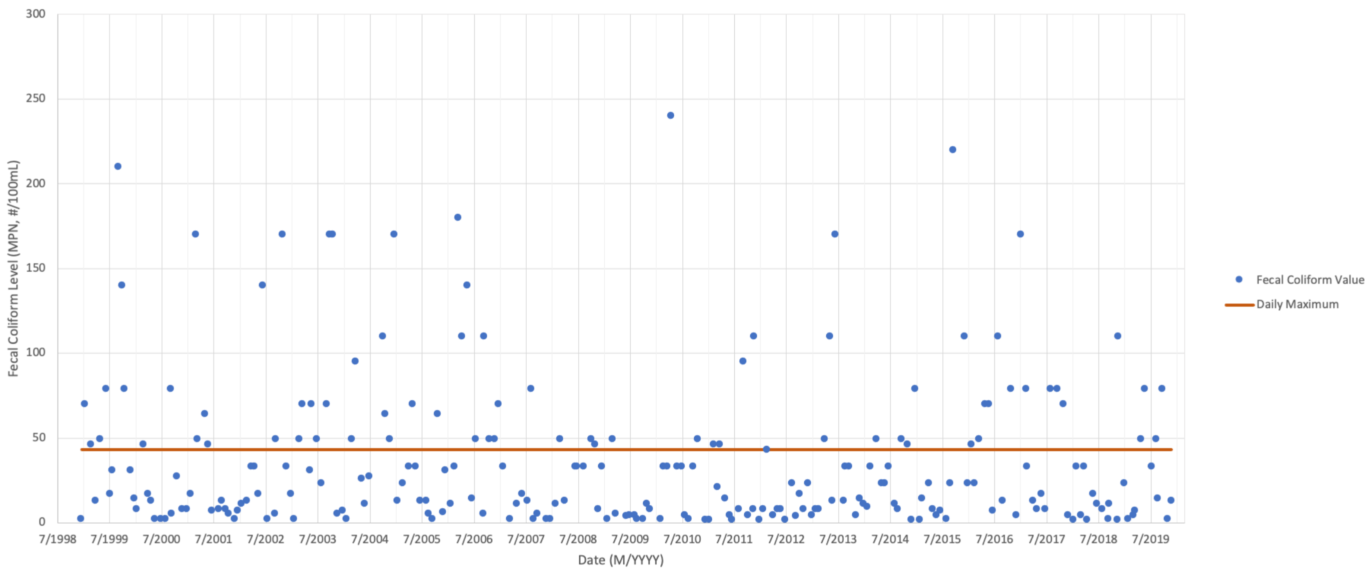

Figure 37: Monthly sampling events for monitoring station 13-05 showing the fluctuations in fecal coliform levels over time (concentration of fecal coliform measured as most probable number per 100 milliliters of water (MPN/100mL)

The target water quality standard for enterococcus in recreational salt water is a daily maximum of 104 MPN per 100 mL, or a monthly average of 35 MPN per 100 mL. The graph in Figure 38 illustrates how the concentrations of enterococci bacteria fluctuated over time at monitoring station MD-120 in the Dawho River-North Edisto River watershed.

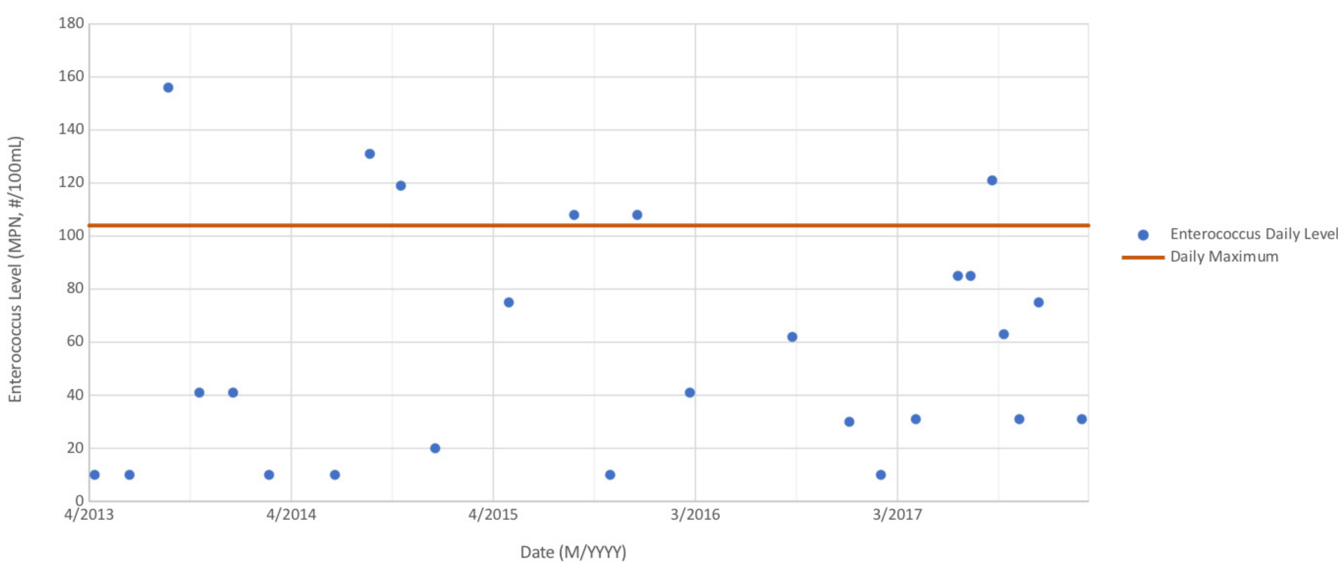

Figure 38: Bi-monthly sampling events for monitoring station MD-120 showing the fluctuations in enterococcus levels over time (concentration of enterococcus measured as most probable number per 100 milliliters of water (MPN/100mL)

The target water quality standard for turbidity in shellfish harvesting waters is a daily maximum concentration of 25 Nephelometric Turbidity Units (NTUs). 10% of samples collected must exceed these standards in order to be classified as impaired. This means that for the turbidity-impaired sites within the Edisto Island Watershed, turbidity levels exceed the standard often enough that they cannot maintain their designated use. Turbidity sampling across the Edisto Island Watershed is not as consistent as bacteria sampling. In fact, impairment designations for all turbidity-impaired sites were based on a one-year regime of monthly sampling. Two samples exceeding the daily maximum would be enough to result in a listing on the 303(d) list. The graph in Figure 39 illustrates how the turbidity levels fluctuated over time at monitoring station RO-12320 in the South Edisto-Atlantic Intracoastal Waterway Watershed.

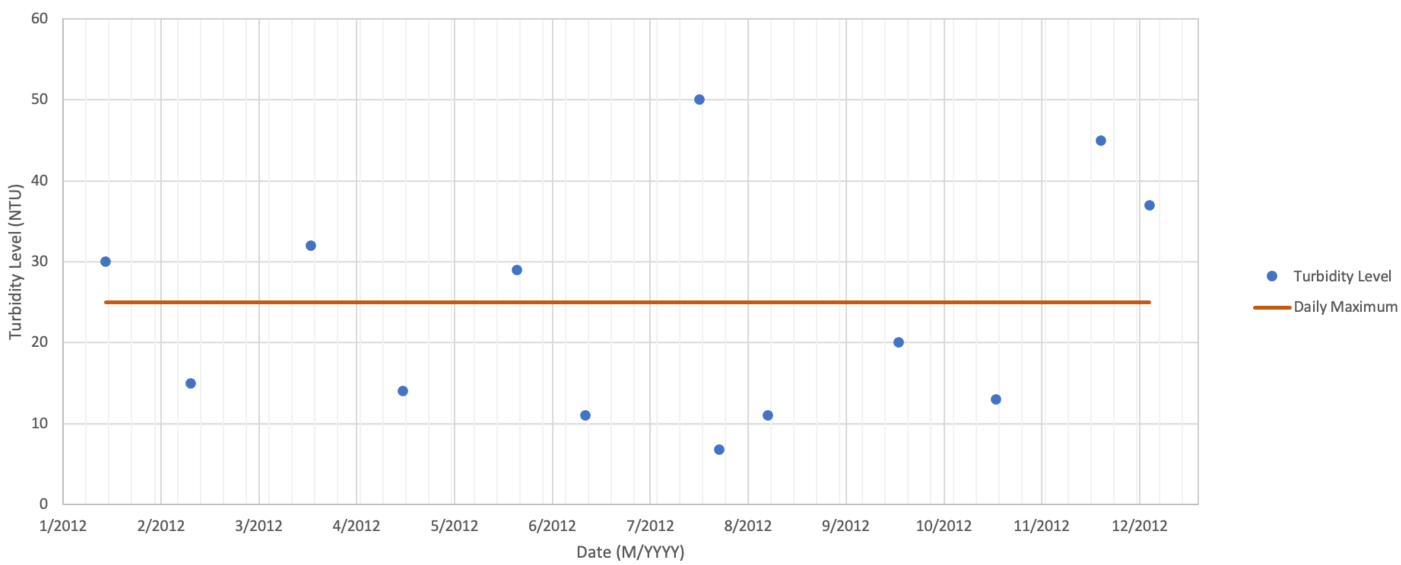

Figure 39: Monthly sampling events for monitoring station RO-12320 showing the fluctuations in turbidity levels over time

Chapter 4
Evaluation Of Pollution Sources & Pathways

Pollutants of Concern

The primary pollutant of concern across these watersheds is bacteria, indicated by measurements of fecal-associated bacteria, specifically enterococcus and fecal coliform bacteria (Table 4). Elevated levels of these fecal bacteria serve as a proxy for other associated pathogens in the water that can pose a human health risk, particularly when consuming shellfish (such as oysters) harvested from high-risk areas. As a result, elevated levels of fecal bacteria in local waterways have resulted in the closure of shellfish beds, which poses an impediment to local traditions and way of life and can create an economic hardship for those who generate income from shellfish harvest or who depend on shellfish as a source of protein. Recreational and commercial harvest of shellfish and other seafood is a cultural tradition in the watershed practiced by residents and visitors alike. Elevated levels of bacteria can also make it unsafe to swim and other recreational uses of the water, particularly following heavy rains.

The secondary pollutant of concern across these watersheds is sediment, derived from upland or stream bank erosion (Table 4). Sediment in the water column increases turbidity and reduces water clarity. Sedimentation in navigable waterways is often associated with additional pollutants such as chemicals and heavy metals which can attach to soil particles. When sediment clouds the water, less light can penetrate, which can affect aquatic plants and animals that live in the water. Edisto's tourism-based economy is dependent on clean water. Activities like swimming, kayaking, charter fishing, and eating local seafood are primary draws for visitors, and these activities support the livelihood for many area residents. All of these can be affected by water quality pollution, and excess sediment deposition in waterways used for navigation can be a costly fix for local communities.

As land-use change alters habitats and contributes pollution to downstream waterways, waterway health surrounding Edisto Island and the Town of Edisto Beach are impacted by both upstream and local activities. However, because bacteria and turbidity impairments are not present on the lower section of the Edisto River just before it reaches the EIW, it is apparent that the impairments are being driven by local pollution sources within the watershed.

Stormwater runoff serves as the main conduit transporting pollution from land to water. During dry periods, pollution accumulates on impervious surfaces such as roofs, driveways, roads, sidewalks, and even compacted turfgrass lawns. When it rains, stormwater runoff flowing across the land sweeps up pollution and carries it downstream. Stormwater infrastructure, such as ditches, pipes, and storm drains are designed to move water off the landscape as quickly as possible, which limits opportunities to treat water quality onsite and to reduce both runoff volume and velocity. Flooding, from stormwater runoff or extreme high tides and storms, can exacerbate pollution issues, especially during and immediately following rain events.

While conducting our watershed analysis, we were limited to analyzing existing data; fortunately, sufficient data exists to identify probable sources of bacteria and causes of turbidity across the watershed. However, to confirm sources with a higher degree of certainty, **we recommend follow up microbial source tracking studies**. While monitoring for fecal bacteria is effective at identifying presence/absence of bacteria in waterways, it does not identify which species is the source of the fecal bacteria. Microbial source tracking involves analyzing a bacteria sample in a laboratory to determine the type of original host (e.g., avian, ruminant, canine, human). We did not have funding to conduct microbial source tracking studies as part of the watershed planning process but encourage future efforts to update this document when additional data is available.

We also recommend additional monitoring for nutrients or chlorophyll A to determine whether the turbidity impairments are purely driven by sediment load, or if algae in the water are also driving turbidity. For this plan, based on available data, we assumed that sediment in waterways is the major driver of turbidity impairments. However, discussions with several SCDNR scientists indicated that turbidity levels across the watershed, particularly at the impaired sites in the South Edisto River, may reflect healthy sediment loads that are integral to maintaining a healthy salt marsh ecosystem, and this should be explored further.

Sources of Pollution

The main goal of the watershed-based plan is to reduce the number of bacteria and turbidity impairments across the Edisto Island Watershed so that waterways meet state water quality standards, and shellfish areas can be reopened to recreational and commercial harvest.

To achieve this goal, it was first necessary to identify causes and sources of pollution, and then to quantify loads from the identifiable sources. Potential sources of pollution across the watershed were identified via a combination of community surveys and participatory mapping exercises, literature reviews of existing TMDLs and microbial source tracking study reports, synthesis of existing water quality data, creation of GIS map layers, and windshield and boat surveys.

Our assessment of the watershed identified the most probable sources of **bacteria** pollution as:

1. Failing or poorly functioning septic systems
2. Discharges of untreated or partially treated wastewater from boats
3. Waste from livestock, dogs, and wildlife
4. Stormwater discharges from detention ponds and ditches

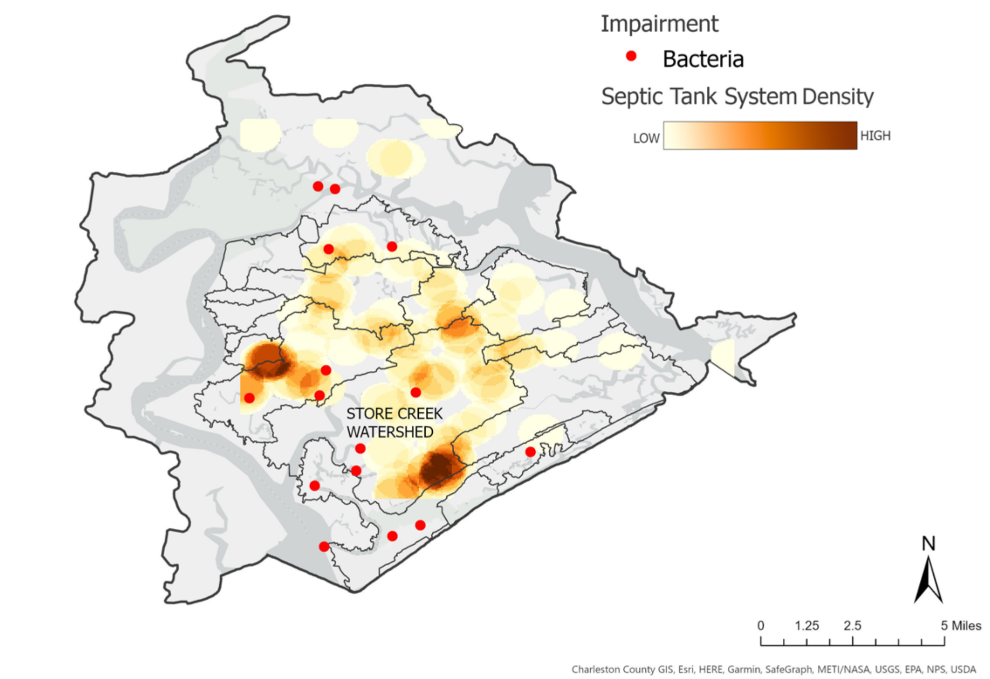

Figure 40: Density map of septic systems across Edisto Island that pre-date the start of the current onsite wastewater permitting program, and location of bacteria impairments (GIS map contributed by Nick Wallover, SCDNR)

Given the age, density, and proximity of septic systems to waterways, poorly functioning or managed septic systems are considered a significant source of bacteria to the watershed. The area of primary concern is the Store Creek watershed, where higher densities of older septic systems along waterbodies are aligned with six of the bacteria-impaired stations (Figure 40). Figure 41 identifies an attempt to further delineate the drainage basins within the three watersheds, but tidal flushing across the entire system limits a clearer understanding of the connection between upland drainage and location of impairments (i.e., an impaired monitoring station in the waterway can be both “upstream” and “downstream” at different points throughout the tidal cycle).

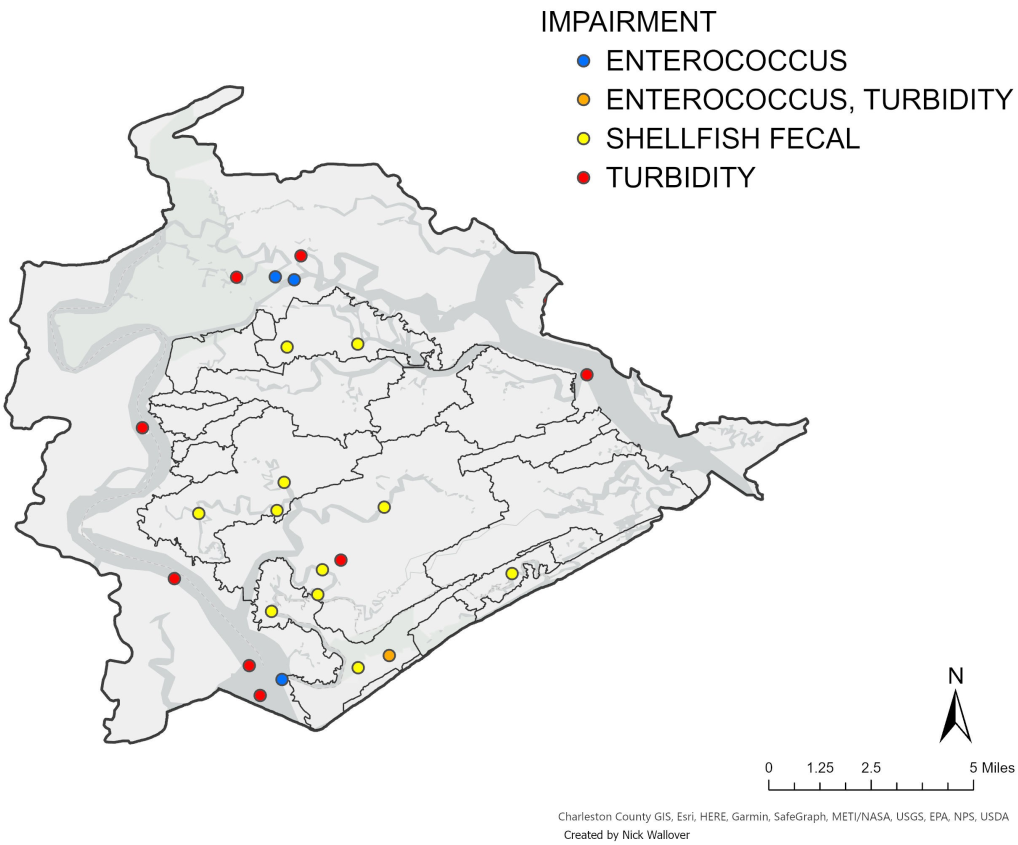

Figure 41: Delineated drainage areas for major creeks across the watershed with impairments labelled (GIS map contributed by Nick Wallover, SCDNR)

The South Edisto-Atlantic Intercoastal watershed is also a priority area of concern for bacteria, with six bacteria-impaired stations and a marina near the outlet of Big Bay Creek that lacks a functional pump out station installed.

It is important to note that human sources of bacteria (such as from failing septic systems and waste discharged from boats directly into waterways) are more harmful to humans than bacteria from animal sources. Solutions should prioritize addressing pollution from these human-derived sources if financial resources are limited.

Livestock are also a probable source of bacteria where they have direct access to waterways and are regularly observed in creeks. Community feedback identified the key locations where cattle have direct access to waterways; these include the northern part of the Store Creek Watershed, and the western part of the Dawho River-North Edisto River Watershed.

There is not sufficient data to determine whether waterfowl concentrated in marsh impoundments (primarily located throughout the South Edisto River-Atlantic Intracoastal Waterway Watershed), which are usually drained in spring as a management strategy, are a source of bacteria to the watershed. Birds and dogs were identified as the primary sources of bacteria at monitoring sites LC-081 and LC-082 (both near the mouth of Big Bay Creek, Figure 42) as part of a microbial source tracking study conducted in 2016-2017 (Ek et al. 2021). This indicates that dog waste and bird waste (such as from Canada Geese and associated waste around stormwater ponds) are of concern, particularly in the lower part of the South Edisto River-Atlantic Intracoastal Waterway watershed that is influenced by Edisto Island. However, local knowledge indicated that the golf course on Edisto Island may have used chicken manure as fertilizer for a brief period around that same sampling timeframe, which could have biased the results. Bacteria contributions from dogs and wildlife on Edisto Beach could be delivered to Big Bay Creek from stormwater outfalls along Jungle Road and Dock Side Road. Human sources of bacteria were also present, likely derived from poorly functioning septic systems across Edisto Beach and from boats using the Edisto Marina, which does not have a pump out station (as of August 2022).

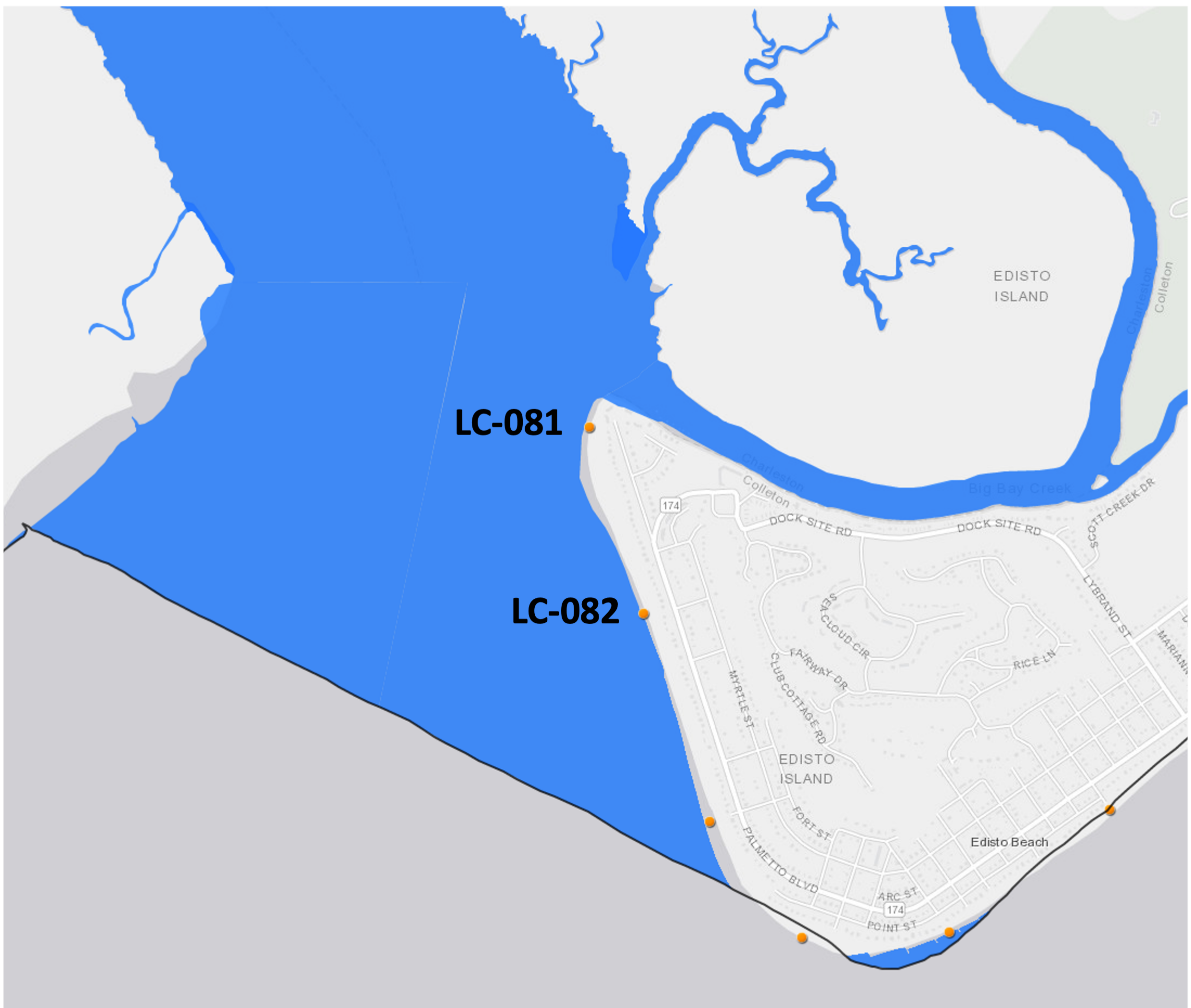

Figure 42: Monitoring stations LC-081 and LC-082 were used in the microbial source tracking study conducted by Ek et al. (2021)

Water quality monitoring stations 13-22 and 13-23 (Figure 43) were both listed on the 2004 303(d) list as impaired for shellfish use support due to exceedances of the fecal coliform standard. In 2010, a TMDL was approved for Jeremy Inlet and Scott Creek (Hydrologic Unit Code 030502060308), encompassing impaired stations 13-23 and 13-22, and outlining the percent reductions needed to reach water quality targets for bacteria. To reach water quality targets at these sites, station 13-22 needs a 70% reduction in bacteria load, and station 13-23 needs a 66% reduction in bacteria load (Table 5). As of September 2021, both stations were still exceeding the fecal coliform standard. The delineated watershed consists of of approximately 1.24 square miles of shellfish growing area habitat, and is in Colleton County (SCDHEC, 2010).

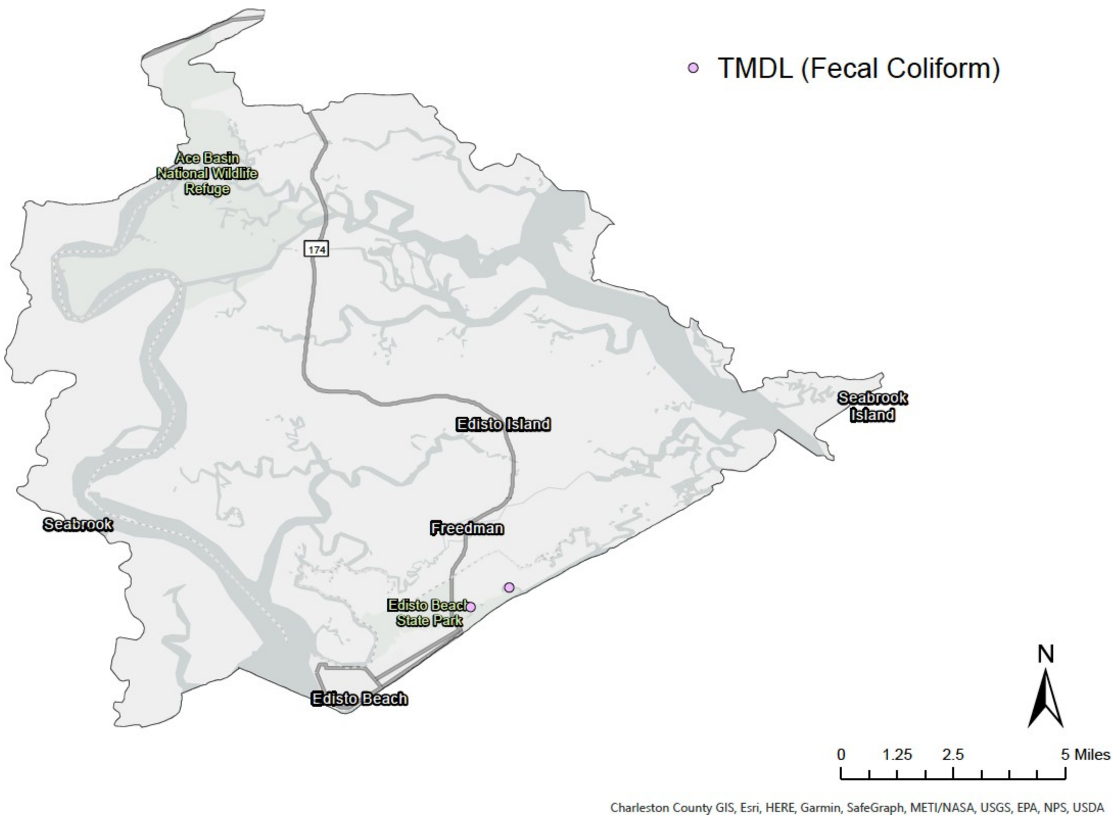

Figure 43: Monitoring stations 13-22 and 13-23, shown in pink on the map, are the locations of the two TMDLs for the South Edisto-Atlantic Intracoastal Waterway watershed

Table 5: Total Maximum Daily Load for the Jeremy Inlet TMDL Watershed. Loads are expressed as colony forming units (cfu) per day (Table and table notes from SCDHEC, 2010)

Station ID	90th %tile of Existing Load (cfu/100ml)	TMDL[1,2] (cfu/100ml)	WQ Target (cfu/100ml)	Margin of Safety (MOS) (cfu/100ml)	WLA			LA
					Continuous Sources[3] (cfu/100ml)	Non-Continuous Sources[4,6] (% Reduction)	Non-Continuous SCDOT[5,6] (% Reduction)	% Reduction to Meet Load Allocation[6]
13-22	137	43	40.9	2.1	N/A	70%	0%	70%
13-23	121	43	40.9	2.1	N/A	66%	0%	66%

Table Notes: 1. TMDL is expressed as a concentration. If daily average tidal exchange estimates were available, this number could be converted to load in cfu/day by multiplying flow by concentration and a conversion factor. 2. Shellfish WQS = No more than 10% of the samples shall exceed 43cfu/100 ml. 3. WLA is expressed as a daily maximum; N/A=not applicable. Existing and future continuous discharges are required to meet the prescribed loading for the pollutant of concern. Loadings were developed based upon permitted flow and an allowable permitted maximum concentration of 43cfu/100ml. 4. Percent reduction applies to all NPDES-permitted stormwater discharges, including current and future MS4, construction and industrial discharges covered under permits numbered SCS & SCR. Stormwater discharges are expressed as a percentage reduction due to the uncertain nature of stormwater discharge volumes and recurrence intervals. Stormwater discharges are required to meet percentage reduction or the existing instream standard for pollutant of concern. 5. As long as the conditions within the SCDOT MS4 area remain the same the Department deems the current contributions from SCDOT negligible, and no reduction of FC bacteria is necessary. SCDOT must continue to comply with the provisions of its approved NPDES stormwater permit. 6. Percent reduction applies to existing concentration. *WQ indicates water quality, WLA indicates wasteload allocations (point sources), LA indicates load allocation (non-point sources)

The TMDL suggests that the potential bacteria sources for these two impairments are wildlife, agricultural activities, leaky sanitary sewers, and illicit discharges, failing septic systems, and urban runoff (SCDHEC, 2010). This is consistent with the sources we have identified across the rest of the watershed.

Our assessment of the watershed identified the most probable sources of **turbidity** as:

1. Streambank erosion
2. Construction and other land clearing
3. Cropland and pasture erosion
4. Stormwater pond bank erosion
5. Roads
6. Urban runoff
7. Excess nutrients

According to Van Dolah et al. (2002), SC's estuarine waters are naturally higher in turbidity than many other states. This same study indicated that turbidity levels in tidal creeks may be higher than in more open water habitats, due to shallow depths and current-driven resuspension of bottom sediments (Van Dolah et al. 2002). Additionally, excess nutrients in waterways can stimulate algal blooms, which can also increase the turbidity of water.

Across the EIW, the highest number of turbidity impairments occur in the main channel of the South Edisto River, where erosion of banks does not visually appear to be significant along much of the channel and upstream monitoring stations draining into the EIW have no identified turbidity impairments. This could indicate that the turbidity levels in the South Edisto are being driven by biological and not mineral (i.e., sediment) sources, but insufficient chlorophyll a sampling data exists to determine if this is the case.

Additional research is needed to disentangle the contributions of biological vs. mineral sources as drivers of turbidity, and if the current turbidity levels are impacting marine life.

The impact of boat wake on shoreline erosion is likely more pronounced in the EIW's narrower channels, and increased boat traffic could be contributing to sediment-driven turbidity. Signs of streambank erosion can be seen more commonly throughout the various tidal creeks across the watershed (Figure 44), and the tidal creeks also tend to be the receiving water bodies for much of the stormwater runoff generated across the watershed. Runoff from developed areas can cause erosion at the shoreline, both from overland flow and at discharge points from stormwater infrastructure.

Figure 44: Erosion of marsh platform visible in Fishing Creek (photo: Katie Luciano, SCDNR)

Much of the property on Edisto Island is waterfront property. All the parcels shown in green on Figure 45, more than 48,000 acres in all, are located less than 100 feet from a waterway. These properties range in land use from residential, to forested, to agricultural. Some are under conservation easements, and some are not. These properties will be a critical area of focus for addressing turbidity because their close proximity to waterways increases the likelihood that pollution, particularly sediment resulting from erosion, will affect water quality.

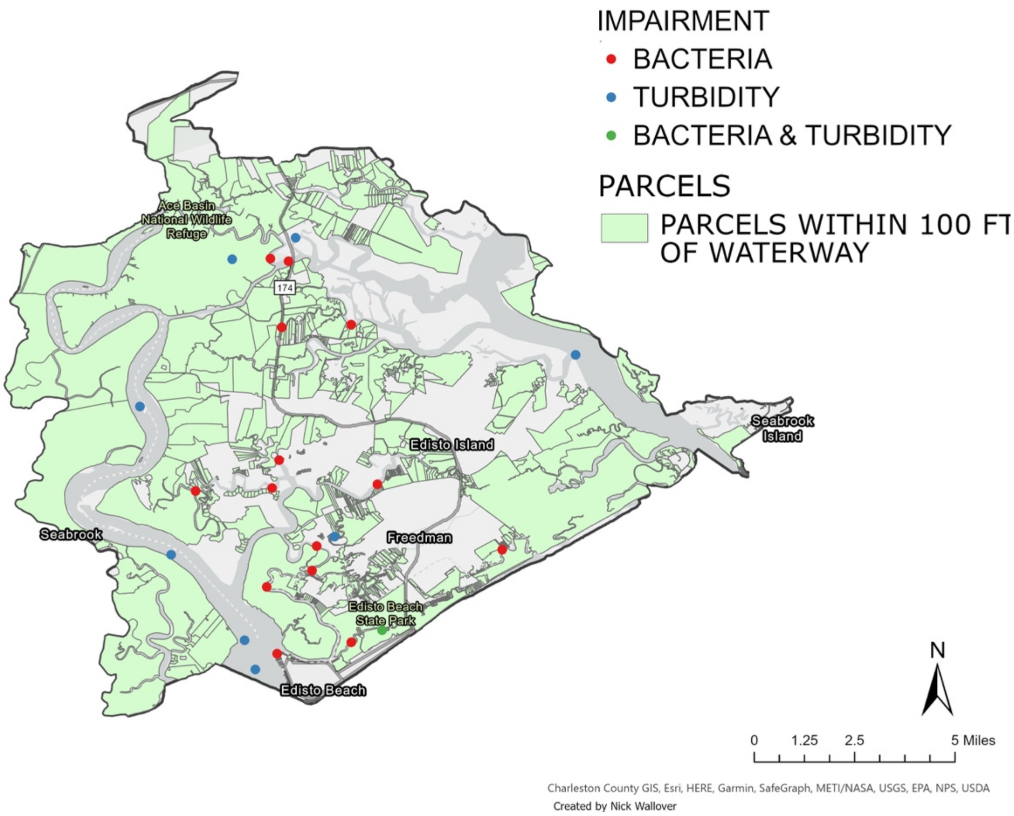

Figure 45: Parcels within 100 ft. of a waterway on Edisto Island indicated in green

There are a significant number of unpaved roads across Edisto Island (Figure 46). While many of these roads are buffered by ditches and adjacent vegetation, ongoing ditch clearing as a management measure removes stabilizing vegetation and increases the likelihood of erosion. As such, the network of roadside ditches and stormwater channels could serve as a conduit for sediment to reach waterways during heavy rainfall events.

Figure 46: Dirt road on Edisto Island, typical of those seen in less intensely developed areas of the watershed (photo: A. Scaroni)

A sediment retention model of the watershed created using InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs model) (Figure 47) predicts where sediment would be exported from, if all areas within the watershed were converted to bare soil/no cover (Clay, unpublished data). Areas in red are more likely to contribute sediment to waterways under conditions of bare soil/no cover (although much of the red areas are saltmarsh that will not be converted to other uses). This indicates that the type of land cover (e.g., forest, crops) across the watershed impacts sediment export or retention. Thus, land conversion, such as vegetation removal on the landscape, could contribute to increased turbidity levels in waterways if not managed with appropriate BMPs. Land cover practices that prevent erosion, such as forest conservation easements and buffers, help to retain sediment on site and prevent turbidity issues downstream.

Stormwater ponds, particularly those on Edisto Beach, serve as a settling basin for pollutants such as sediment and associated nutrients. As ponds fill in with sediment over time, they begin to lose storage capacity, and can also become saturated with nutrients such as phosphorus. Water exported from stormwater ponds is transported directly into nearby waterways, so poorly functioning stormwater ponds could be serving as sources of sediment to impaired waterways, particularly stations at the mouth of the South Edisto River.

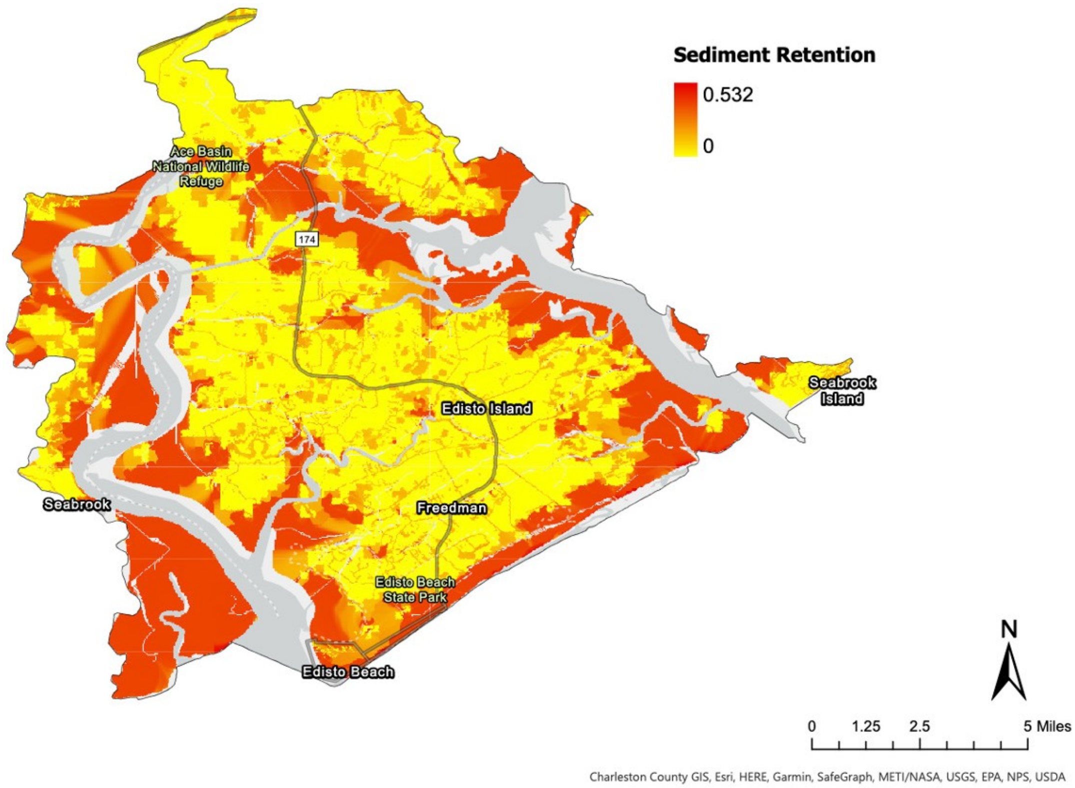

Figure 47: Sediment retention model of the Edisto Island Watershed developed using the InVEST model (Clay, unpublished data)

Data Gaps

Watershed-based plans are often developed using existing data, and in some watersheds this information is limited. In this case, we have a great deal of information about water quality and land use on Edisto Island and Edisto Beach, but there are several gaps in our understanding. Future efforts should monitor nutrients and/or chlorophyll a to determine whether nutrients and associated algae blooms are contributing to the turbidity impairment. Additional studies should use microbial source tracking to definitively identify the primary source of bacteria at each impaired site throughout the EIW. Mapping of the septic systems on Edisto Beach (the Colleton County portion of the watershed) would be helpful to customize septic recommendations for Edisto Beach and identify priority locations for management efforts, and septic mapping for Edisto Island should be updated as our work identified nearly 600 potential septic sites that are not included on existing maps.

Chapter 5
Watershed Management Strategies

Best Management Practices

Best management practices (BMPs) are solutions or acceptable practices that can be implemented throughout the landscape to help protect water quality. BMPs can take different shapes and are commonly separated into two categories – structural and nonstructural. Structural BMPs are installed on-the-ground and are used to significantly and measurably reduce pollutant loads before they reach nearby waterways. Nonstructural BMPs focus on educational strategies or campaigns. These are not as site-specific as structural BMPs and can be implemented across a community. Further information on educational campaigns recommended for this watershed will be covered in Chapter 8 of this plan.

BMPs selected for the Edisto Island Watershed are those that target the main impairments found throughout the watershed area: bacteria and turbidity. Other water quality issues, such as nutrient enrichment, could also be improved (either directly or indirectly) from the implementation of many of these recommendations. Below is a list of recommended BMPs for the EIW, categorized by land cover and the target pollutants.

Agriculture

Cattle exclusion fencing near waterways – Bacteria, Sediment, Nutrients

Cattle exclusion fencing is a practice used to control access. Restricting livestock from direct access to a waterway reduces direct input of bacteria, protects vegetative buffers, and reduces erosion along the shoreline from livestock entering the waterway.

Based on windshield surveys, discussions with stakeholders, and mapping tools, we estimated areas where livestock parcels would benefit from BMPs like exclusion fencing, alternate sources of water, and buffers. Figure 48 shows all livestock parcels on Edisto Island within 1,000 feet of a waterway, and we recommend prioritizing these parcels for the installation of exclusion fencing, if not already present. It is unclear how many farmers have already adopted this practice.

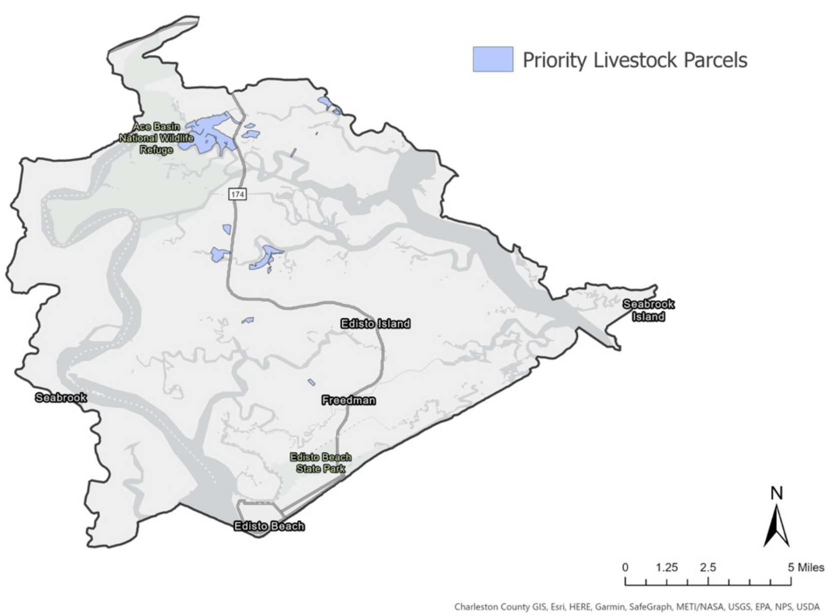

Figure 48: Livestock parcels within 1000 feet of a waterway

Alternate watering sources – Bacteria, Nutrients
This practice is commonly paired with exclusion fencing and involves installation of alternate watering sources for livestock. When livestock have direct access to an alternate water source, they will not have to depend on waterways for supply anymore. This adds another protective measure for keeping livestock, and their waste, out of adjacent waterways. We recommend alternate watering sources for livestock on all livestock parcels across the watershed, whether combined with exclusion fencing or not, to discourage livestock from entering waterways. It is unclear how many farmers have already adopted this practice.

Riparian Buffer – Sediment, Nutrients
Riparian buffers are areas of vegetation planted along a waterway. The planted vegetation filters out pollutants, stabilizes soil on site, and provides habitat for wildlife. Exclusion fencing can keep livestock out of buffer areas, preventing grazing and trampling of riparian vegetation. A well-maintained buffer can minimize erosion and keep both nutrients and sediment out of waterways. Figure 48 indicates the parcels where livestock fields may be adjacent to waterways. We recommend riparian buffers be installed, or maintained if existing, between these livestock fields and adjacent waterways to reduce erosion and sediment delivery to the creeks.

Field borders/filter strips – Sediment, Nutrients
These practices include areas of planted vegetation surrounding fields of crops, pasture, and wildlife food plots. Filter strips are typically established in environmentally sensitive areas that need to be protected from pollutants and sediment. Field borders are established strips of permanent vegetation found along the edge or around the perimeter of a field. Both practices can be used to support or in addition to other buffer practices within or between fields.

Cover crops – Sediment, Nutrients
Cover crops are planted grasses, legumes, and forbs that are used for seasonal vegetative cover. This practice is used in fields that are occasionally left bare, to instead establish vegetation year-round. Benefits of this practice include reduced erosion, increased soil organic matter, improved soil moisture, and reduced soil compaction. It is unclear how many farmers currently plant cover crops on Edisto Island. We recommend the use of cover crops (instead of letting the field go fallow) on fields that will not be planted as a cash crop that growing season.

Nutrient Management – Sediment, Nutrients
Nutrient management consists of managing the proper rate, timing, source, and placement of plant nutrients and soil amendments. When executed properly this practice can improve plant health and reduce excess nutrients entering nearby waterways. We recommend nutrient management as a best management practice across the watershed, but particularly on fields that drain to water bodies with turbidity impairments.

Agricultural Conservation Easements – Bacteria, Sediment, Nutrients
NRCS Agricultural Conservation Easement Program (ACEP) aims at protecting the agricultural viability of eligible land by limiting nonagricultural uses that negatively impact agricultural uses. This is done by protecting, restoring, and enhancing eligible grazing lands and wetlands. See “Forestry Easement” discussion for recommended parcels to prioritize for easements.

Forestry

Stream Management Zones (SMZ) – Bacteria, Sediment, Nutrients

Streamside Management Zones are put in place as a buffer alongside a waterway, to provide a source of protection for the natural environment in the stream (or creek). These zones are critical areas where pollutants could be introduced into a nearby waterway through runoff. This BMP is used to filter out pollutants such as sediment, fertilizers, pesticides, and bacteria; stabilize shorelines helping prevent erosion; and provide habitat for wildlife. Streamside Management Zones are recommended adjacent to any silviculture areas across the watershed.

Road Construction – Sediment, Nutrients

Proper road construction and design is essential to reduce the amount of sediment entering nearby waterways. Proper practices that should be considered with this BMP include placing roads in proper areas, making sure culverts are installed properly, utilizing water turnouts where needed, and using vegetation to help stabilize any exposed soil.

Timber Harvesting – Sediment, Nutrients

Timber harvesting best management practices include protecting sensitive areas, planning for regeneration, and looking beyond the harvest site for potential impacts to the environment. When implemented these practices can help to reduce sediment and nutrients entering waterways due to timber harvesting. While timber harvesting is not widespread on Edisto Island, it is practiced on private land and the South Carolina Forestry Commission can help landowners identify appropriate management measures before, during, and after harvest.

Forestry Easements – Bacteria, Sediment, Nutrients

Forested lands can be voluntarily and permanently protected from development through a conservation easement. The encouragement of natural areas will help reduce nutrients and sediment that could otherwise enter our waterways through construction and development.

We used GIS to prioritize areas that we recommend targeting for future conservation easements (Figure 49). Priority land was identified as that which met the following criteria:

- is not already in a conservation easement
- over 10 acres
- classified by somewhat poorly drained, poorly drained, or very poorly drained soil

This drainage classification for soil types was selected because these parcels would have an increased likelihood of runoff and as a result, a higher risk of pollution export from a variety of residential or commercial activities. For example, if septic was installed on these parcels, there may be a higher likelihood of septic failure due to poor soil conditions and increased risk of bacteria pollution to waterways.

Based on the criteria, approximately 21,000 acres of land were identified across the watershed. Conserving these areas and protecting them from development prevents a future source of pollutant loading to waterways. For more information about conservation easements within the Edisto Watershed, contact the Edisto Island Open Land Trust.

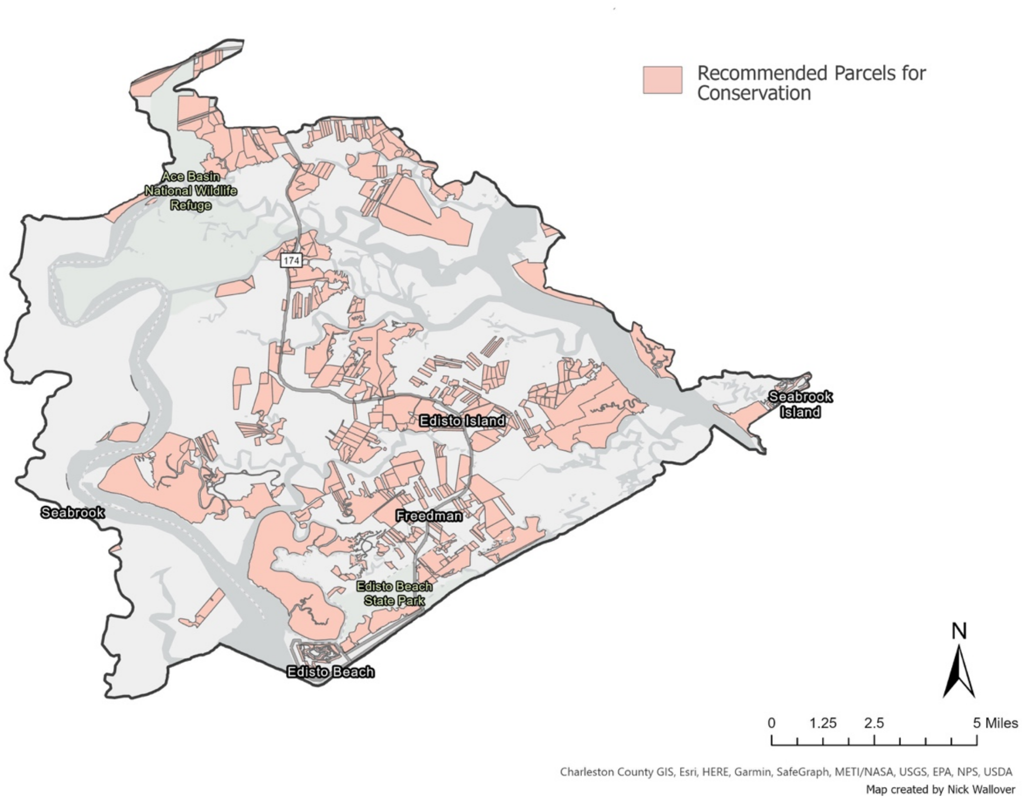

Figure 49: Recommended priority areas for conservation easements to prevent future sediment and bacteria loads

Integrated Pest Management – Sediment, Nutrients

Integrated Pest Management (IPM) is a comprehensive approach used to address unwanted pest problems. This is done by using mechanical, biological, or chemical control options, or a combination of the three to yield results. By using a combination of approaches to target unwanted pests, you are helping to reduce negative impacts on the environment which can result when relying on or overusing a single method. IPM can be used across multiple land cover types including agriculture, forestry, and residential.

Residential

Conservation Easements – Bacteria, Sediment, Nutrients

Homeowners can use conservation easements as a tool to help preserve their property's conservation values and protect it from further development, ensuring its beauty and ecosystem services for future generations. This is a legal agreement between a landowner and a land trust or other nonprofit conservation organization. For more information about conservation easements within the Edisto Watershed, contact the Edisto Island Open Land Trust. See "Forestry Easement" discussion for recommended parcels to prioritize for easements.

Low Impact Development – Bacteria, Sediment, Nutrients

Low Impact Development (LID) uses practices that mimic natural processes to promote water infiltration on site, thus decreasing the amount of stormwater runoff. Common practices include, but are not limited to, rainwater harvesting, rain gardens, bioretention cells, bioswales, and permeable pavement. These practices are site specific structural BMPs that reduce pollutants in developed areas. Encouraging residents to install rain barrels can help to reduce the initial load on the stormwater system during rain events. Parking lots adjacent to waterways with eroding banks can be retrofitted with pervious materials that infiltrate water on site. Planted stormwater features such as rain gardens or bioretention cells can be installed between impervious areas and waterways (including stormwater ponds) to reduce sediment, nutrients, and bacteria from runoff. Use of LID practices is recommended for Edisto Beach, in particular, due to the higher density of development as compared to the rest of the watershed. Infiltration practices will work best in well-drained soils, while vegetated buffers are recommended for poorly drained soils. These practices are effective at the lot scale, so targeting town properties for BMP installations is a recommended starting point. Follow up outreach efforts can encourage or incentivize residents to install practices on their properties as well.

Additional priority areas of focus include undeveloped land, not under a conservation easement, with well-drained soils, that is likely to be developed in the future (Figure 50). Development at these locations should encourage LID designs to promote storage and infiltration of runoff on-site, versus conveying downstream. Examples of BMPs to target include pervious parking areas, bioretention cells and rain gardens, rainwater harvesting systems, shoreline buffers, and conversion of turfgrass to conservation landscaping with native plants. These types of practices can reduce the volume of runoff moving into nearby waterways and reduce associated pollution as well. These priority focus areas are well suited for LID techniques to be incorporated into new construction and retrofitted into existing developments.

Figure 50 shows that much of the land with high development potential on well drained soils (indicated in orange) is clustered across the Store Creek watershed. Identifying the importance of these areas to water quality poses opportunities for strengthening zoning in new developments or redevelopment, and incentivizing onsite management of runoff in these areas to reduce impacts on Store Creek.

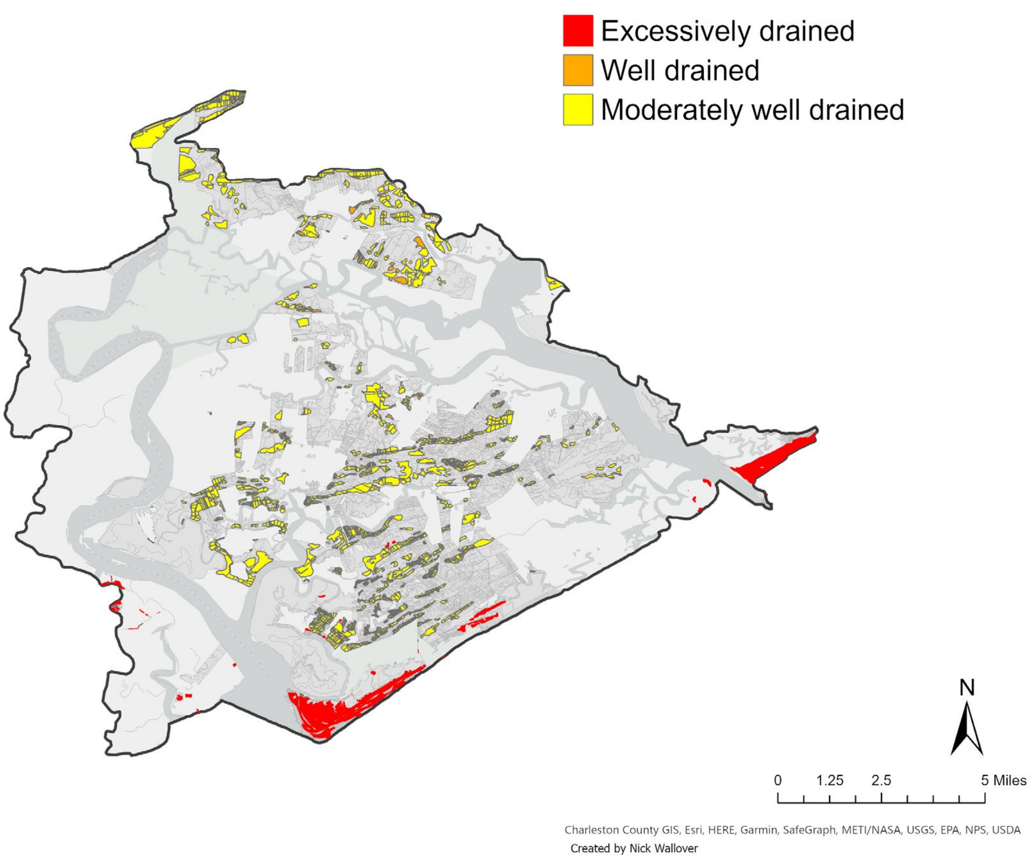

Figure 50: Land with high potential for development, identified as parcels not under a conservation easement, on well-drained soils, are key areas to target for low impact designs

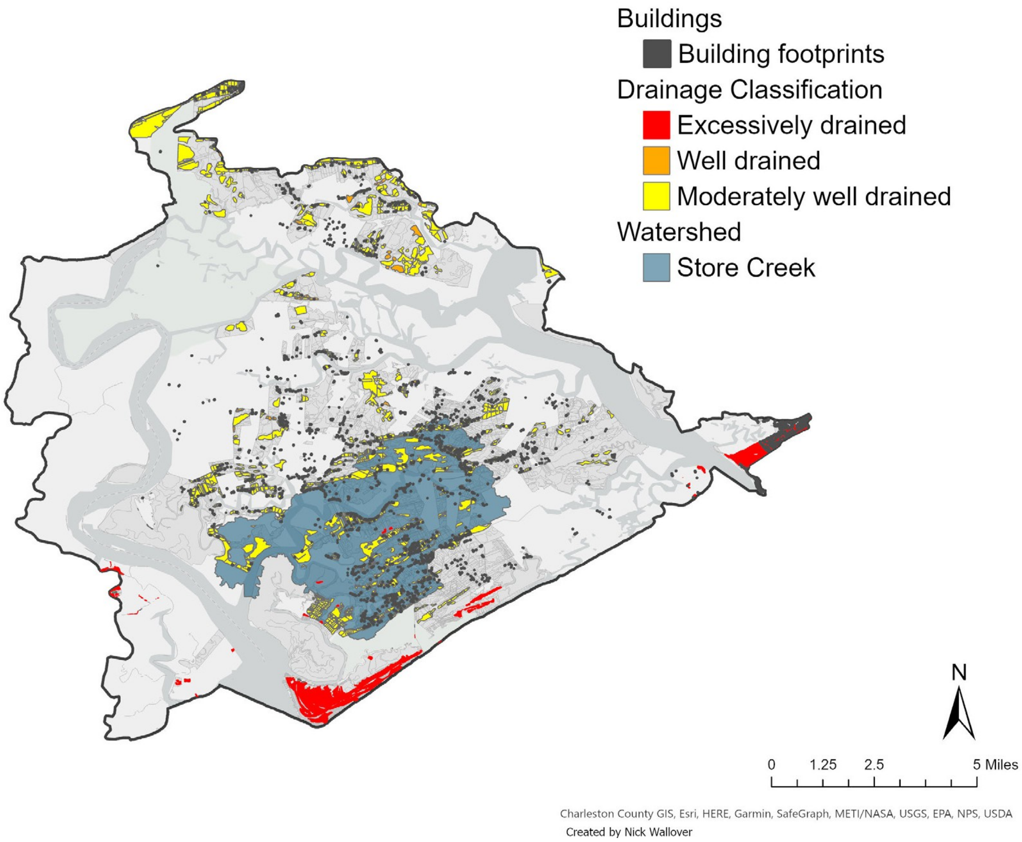

Figure 51: Land with high potential for development, layered with building footprints and local drainage areas

Previous work from Dr. Dhanuska Wijesinghe (2018) identified the most suitable areas for bioretention and stormwater wetlands across the Charleston County portion of the watershed. These locations (indicated in pink on Figures 52, 53) can be used to prioritize site selection when LID practices are needed to receive and manage runoff from impervious areas.

Students in Dr. Nandan Shetty's Hydrology and Hydraulics class at the Citadel identified several locations across the watershed that could benefit from LID practices and designed them to treat a 1-inch storm. These projects include:

1) A series of four rain gardens at the farmer's market parking lot on Dockside Rd, Edisto Beach.
2) A permeable pavement installation within a section of the Food Lion (fomerly BiLo) parking lot adjacent to McConkey's.
3) A rain garden streetscape project on the first block of Palmetto Boulevard on Edisto Beach.
4) A permeable pavement installation at the entrance of a lumber facility on Edisto Island.

More information on each practice can be found in Appendix C.

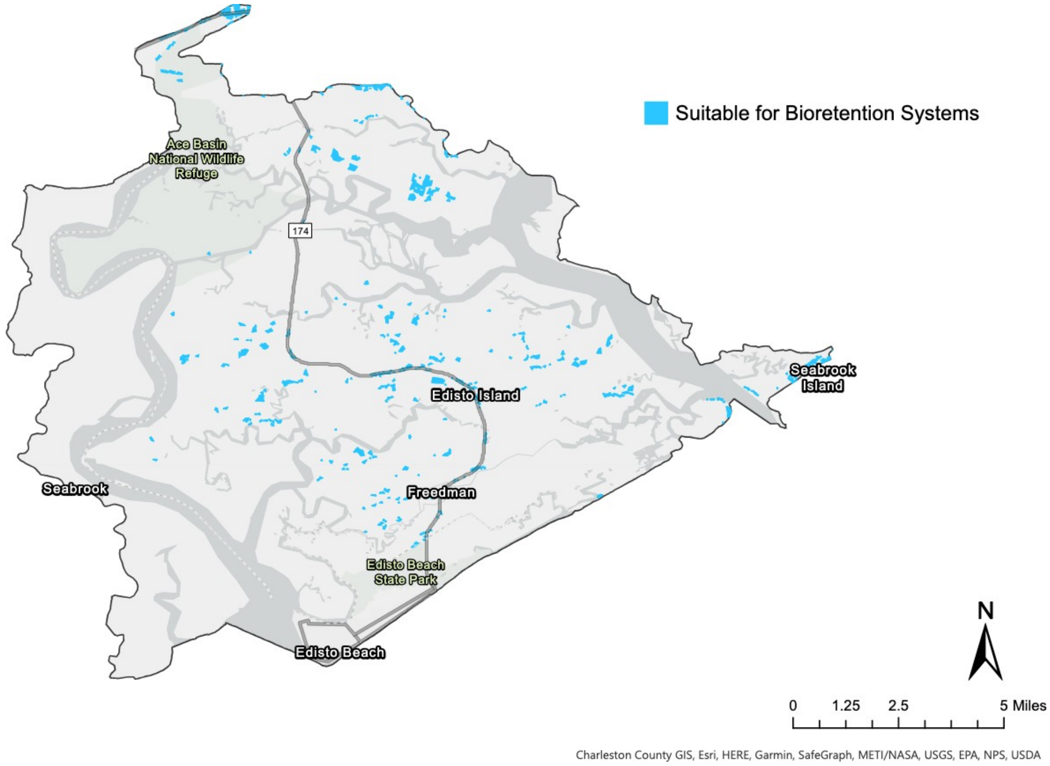

Figure 52: Suitable areas for bioretention systems across the Charleston County portion of the watershed (data from Wijesinghe, 2018)

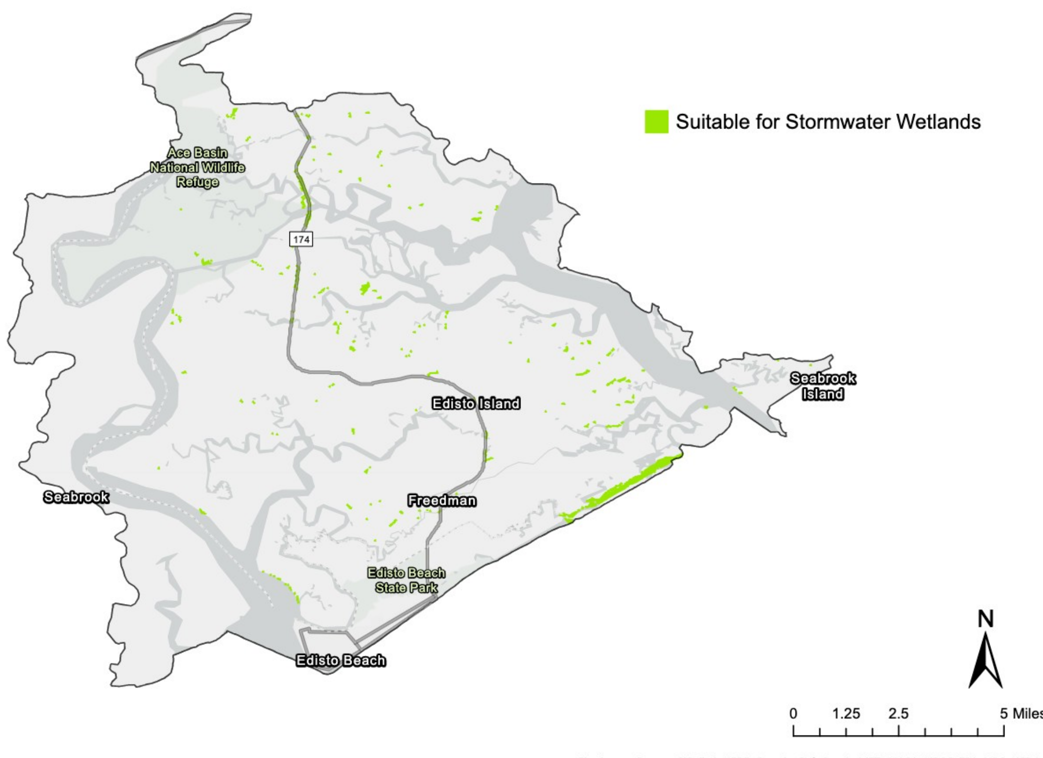

Figure 53: Suitable areas for stormwater wetlands across the Charleston County portion of the watershed (data from Wijesinghe, 2018)

Pet Waste Stations with Proper Signage – Bacteria, Nutrients

Dog waste is a common source of bacteria, making proper disposal an important BMP. Pet waste stations with proper signage are one common solution. These can be highly effective when placed in public areas with high foot traffic. Pet waste stations do exist at beach entrances and at several parks around Edisto Beach. However, signage discussing the effect of pet waste on water quality can be more motivating than signs that do not provide a justification (Figure 54). Also, an overall increase in garbage cans at parks and along common walking routes make it more convenient to pick up and dispose of pet waste, potentially motivating responsible behavior. Garbage cans observed on Edisto Beach in June 2021 were blue, which could be commonly confused with recycle bins (Figure 55). Making garbage cans easier to identify could help with proper disposal of pet waste.

Figure 54: A pet waste station on Edisto Beach lacking descriptive signage (photo: A. Scaroni)

Figure 55: A blue garbage can on Edisto Beach (photo: A. Scaroni)

Shoreline buffers – Bacteria, Sediment, Nutrients

Shoreline buffer are areas of natural, native vegetation along a waterway. The vegetation helps to stabilize soils, helping to prevent erosion and sediment from entering the water. They also help to filter out any pollutants, such as bacteria or excess nutrients, that would otherwise cause further impairment to local waterways.

Figure 56: Erosion occurring on a residential shoreline with no buffer (photo: A. Scaroni)

Shorelines without established vegetative buffers are more susceptible to erosion and undercutting and sloughing of banks (Figure 56). Turfgrass is commonly used on lawns across the watershed; with its shallow root system and intolerance to saturated soils, turfgrass does a poor job of stabilizing banks and holding the soil in place. Furthermore, turfgrass lacks tolerance to brackish conditions of Edisto waterways. We recommend the use of deep-rooted, salt-tolerant, native vegetation planted as buffers along shorelines, particularly on parcels that are known to have erodible soils within 100 feet of a creek (Figure 57).

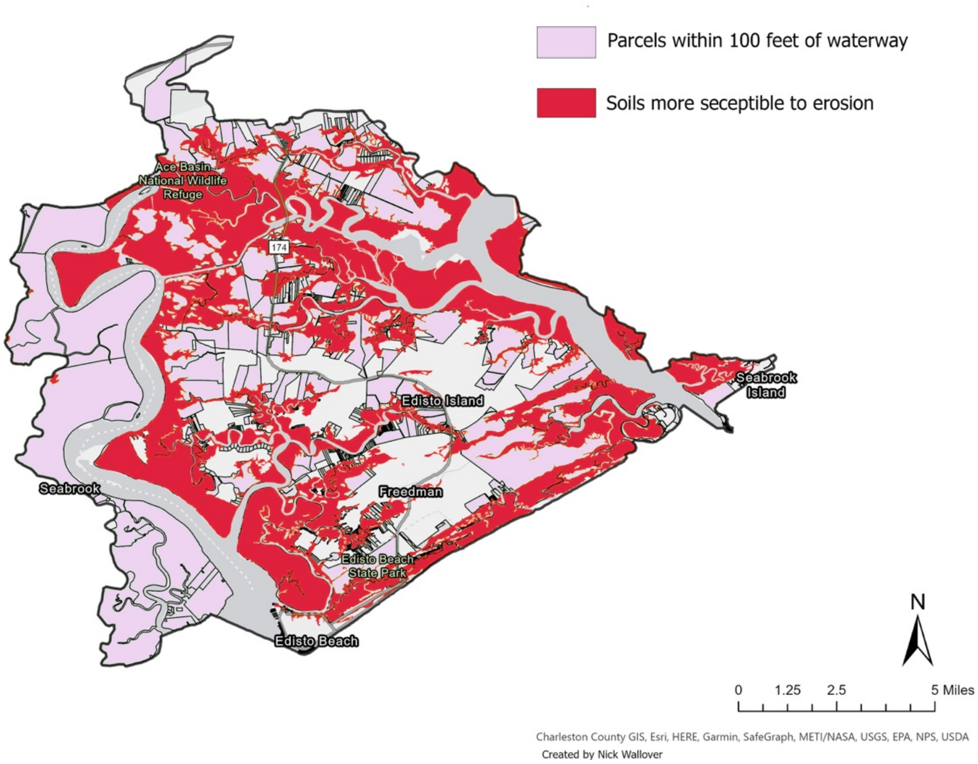

Figure 57: Parcels within 100 ft. of a creek with soils more susceptible to erosion

Septic system repair and replacement – Bacteria, Nutrients
Another common source of bacteria is from leaking or failing septic systems. Septic systems are used to treat household waste onsite and are often not thought of until problems arise. In some cases, total system replacements or retrofits are recommended to help reduce this bacteria pollution. This could be based on system age, improper placement/system design, or inadequate soil conditions.

Septic systems are designed to treat wastewater for bacteria and nutrients onsite, through a combination of settling, biogeochemical processes, and filtration in the soil. A properly sited, maintained, and functioning septic system should not release bacteria and nutrients to receiving water bodies. Prior to 1987, the SCDHEC regulations on septic system permits only required a percolation test, while the permit revision in 1987 includes consideration for groundwater levels. Thus, the functioning of some aging septic systems installed prior to 1987 may be influenced by poor site conditions (Figure 58).

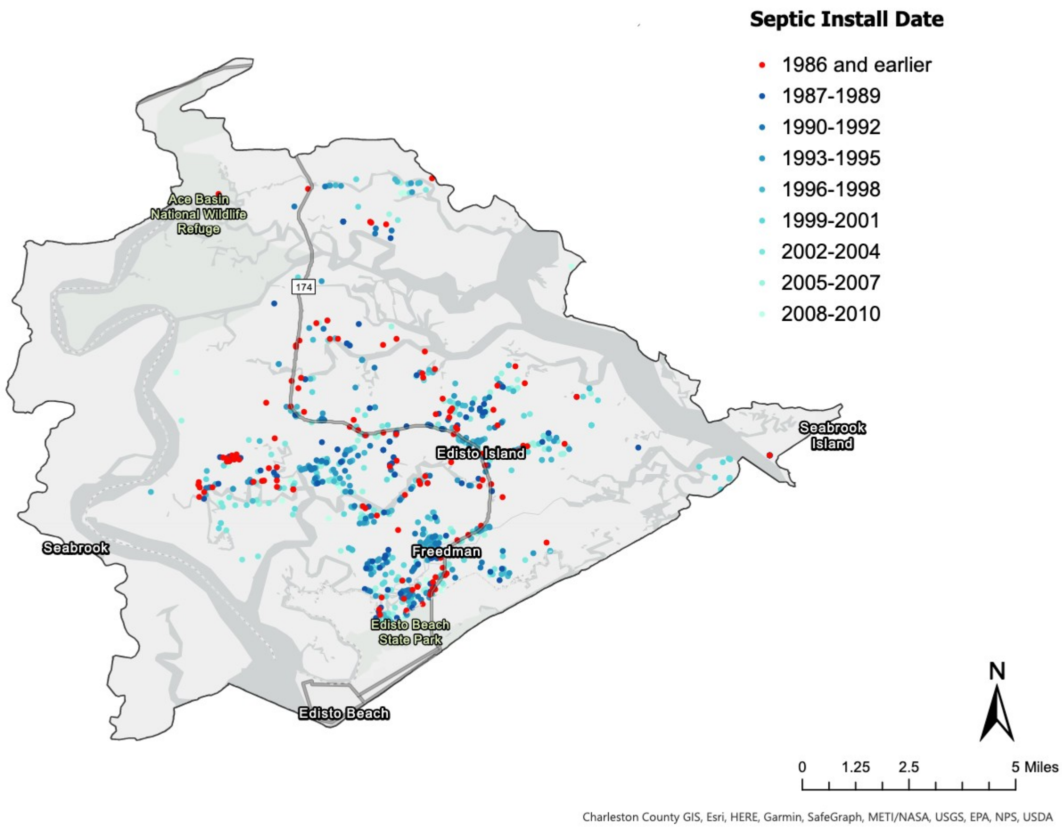

Figure 58: Install date of Septic system locations (mapped in Charleston County portion of watershed only due to availability of data)

Additionally, we compared the locations of the mapped septic systems on Edisto Island to flood zone mapping information provided by the SC Sea Grant Consortium. This highlights vulnerable locations on the island where septic tanks could be compromised during flood events. As illustrated by this map (Figure 59), which depicts flood zones in colored shading, not only is a large majority of Edisto Island in the flood zone, but so are its septic tanks. Zone AE, shown in green, is considered the 1% flood, sometimes referred to as a 100-year flood (Table 6). This area has a 1% annual chance of flooding a year. Zone VE, shown in purple, also is a 1% annual chance flood event, with additional storm related hazards (like wave action). Approximately 48% of Edisto's septic tanks are in Zone AE or VE.

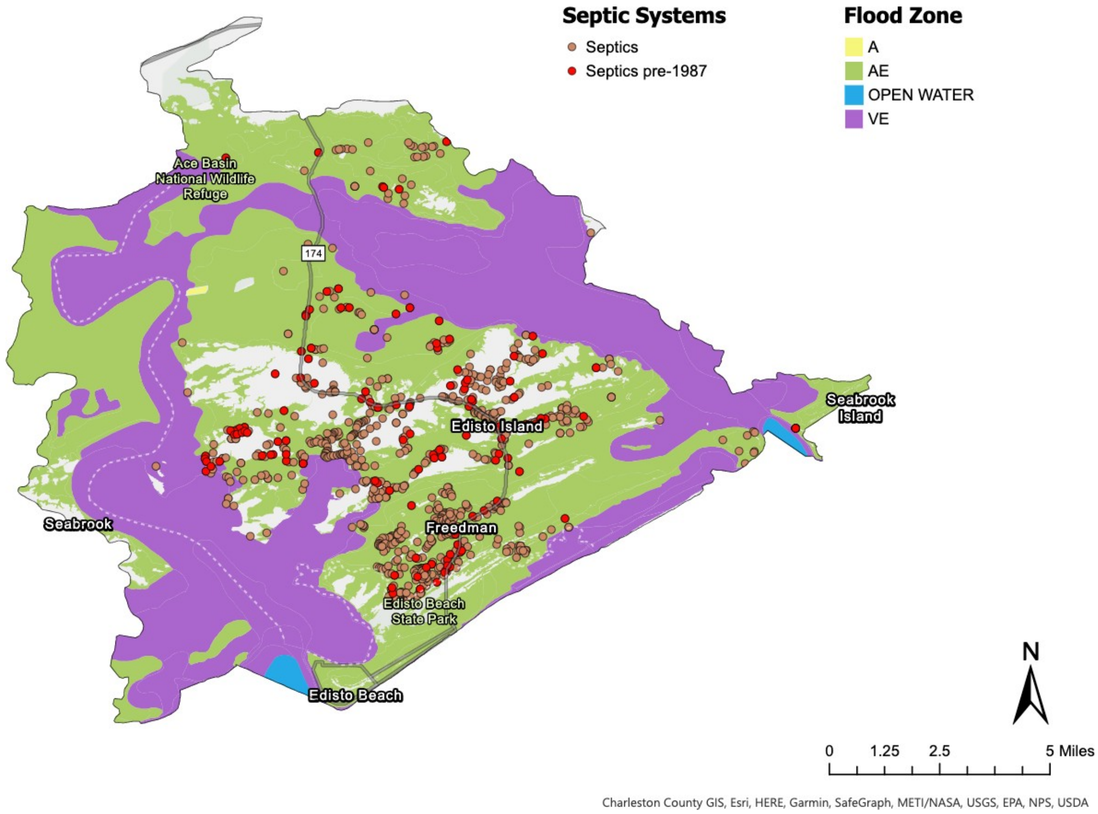

Figure 59: Septic Tank Systems located in the flood zone across Edisto Island

Table 6: Description of flood zone designations

FLOOD ZONES	
VE	High risk, base flood elevations determined, coastal flood zone with velocity hazard (waves)
AE	High risk, base flood elevations determined
A	High risk, no base flood elevations determined
X	Low risk, <0.2% chance of flood
0.2 PCT	Low risk, 0.2 % chance of flood
Open water	-

In terms of prioritization, density of septic tank systems across Edisto Island help to identify where septic clusters exist. These density maps indicate three clusters of septic tanks in the St. Pierre and Store Creek watersheds, shown in purple on this map (Figure 60). Store Creek also has the highest number of bacteria impairments. This is helpful in identifying where septic retrofits and replacements may be most effective. We recommend targeting older septic systems for replacement that are clustered along creeks, located near existing bacteria impairments, in the flood zone, with poorly draining soils. The Store Creek Watershed has the highest density of septic systems of the three watersheds encompassing Edisto Island and Edisto Beach, and should be a priority, along with any individual systems across the watershed that are known to have failed.

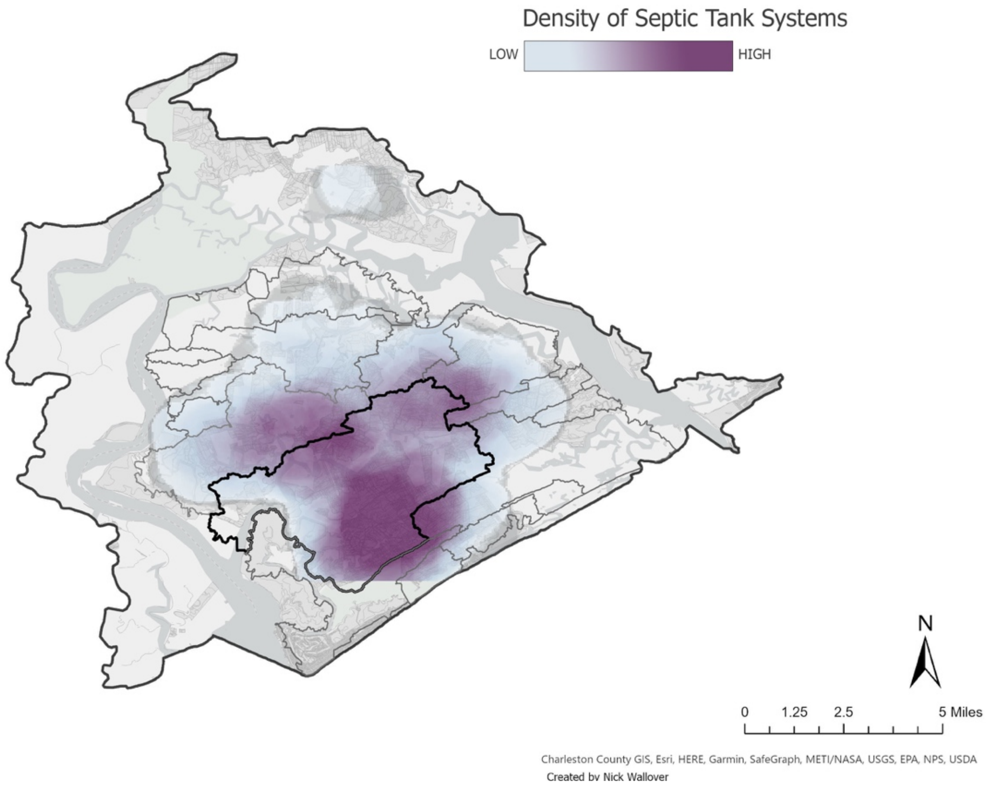

Figure 60: Septic tank system hot spots across Edisto Island

The septic systems on Edisto Beach are not mapped, so recommendations for retrofits and replacement should follow similar guidelines as above. Aging septic systems, septic systems installed on poor site conditions, and those with a history of failure should be prioritized first. Septic systems on the ocean side of Edisto Beach are more likely to be uncovered during strong storms, as has happened in the past (e.g., Hurricane Matthew). Considering susceptibility of tanks should help to inform the type of system chosen.

Septic maintenance – Bacteria, Nutrients
Oftentimes proper maintenance of septic systems can help prevent small problems from becoming system failures. Proper maintenance includes routine inspections by septic professionals and proper use of the septic system. SCDHEC recommends that septic systems are inspected once every two years and pumped out when necessary. Pretreatment may benefit septic systems with a history of infrequent maintenance, but this is not a requirement.

The project team interviewed an active septic maintenance company in the area to identify common issues, reasons for failures, and geography of concentrated failures, should these exist. According to the company owner's experiences over many decades, the most significant factor in failures on Edisto Island and Edisto Beach is lack of maintenance, and this is not limited to any specific geography or development across the watershed. Results from our survey of 376 residents at the beginning of the watershed planning process indicated that only 44% of residents had their septic system maintained regularly (at least once every three years), 37% had it inspected rarely (more than three years between inspections), and 13% never had their tank inspected. This is important because improperly functioning and poorly maintained septic systems are most likely to release bacteria and nutrients to waterways. Septic maintenance as an outreach strategy is discussed further in Chapter 8.

Encourage planting native plants – Sediment, Nutrients
The use of native plants can be implemented throughout the landscape to help stabilize bare soils, filter any unwanted pollutants, and provide habitat for wildlife and pollinators. These are plants that are native to the area and are better suited for local soil types, weather conditions, and water demands. We recommend choosing native plants over nonnative plants whenever possible and feasible. Use of native plants as an outreach strategy is discussed further in Chapter 8.

Soil testing – Sediment, Nutrients
Soil testing is a management tool commonly used to determine current nutrient levels in the soil. This allows landowners to make better decisions related to fertilizer and lime applications. Soil testing can be used in many situations including on a residential scale, for row crops, or for wildlife plots. Through prescriptive recommendations, landowners can apply what is needed for the land use type and cover, reducing the chance of excess nutrients reaching nearby waterways. Soil samples can be submitted to a local Clemson Extension office for analysis and recommendations. Use of soil testing as an outreach strategy is discussed further in Chapter 8.

Stormwater Pond Management – Bacteria, Sediment, Nutrients
There are currently a number of stormwater ponds located across the EIW, particularly on Edisto Beach. When managed properly, stormwater ponds are used to help capture stormwater runoff and treat pollutants onsite. Proper maintenance and management of these systems is essential to ensure they are functioning correctly. Management tools include shoreline buffers, aquatic weed control, aeration, analysis of water quality conditions, and dredging. In addition, where possible, it is recommended that stormwater pond owners work with a licensed engineer to incorporate appropriately sized pretreatment systems (i.e. - forebay) into pond design.

Some of the ponds on Edisto Island lack vegetated buffers and are landscaped with mowed turfgrass to the water's edge. Turfgrass in general has very shallow root systems, which leaves the soil at the water line susceptible to erosion. Planting vegetation and native plants with deeper root systems aids in stabilizing pond banks and preventing the undercutting and sloughing seen in Figure 61. Shoreline vegetation, as seen in Figure 62, also helps to slow runoff, filter pollutants, and can even deter Canada Geese, which are a common source of fecal bacteria to ponds.

Figure 61: Undercutting of bank observed in a stormwater pond on Edisto Beach without a vegetated buffer between the pond and impervious parking area (photo: A. Scaroni)

Figure 62: Stormwater pond in the Town of Edisto Beach with a vegetated buffer (photo: A. Scaroni)

Upland management practices are also an important part of protecting the health and function of stormwater ponds. Clemson Extension hosts a variety of resources to assist with upland and pond management, including a Master Pond Manager course, a pond management website, and regular webinars. In partnership with SC Sea Grant and SCDNR ACE Basin NERR, Clemson Extension also hosts a Healthy Pond Series for pond owners and biennial stormwater pond conferences. Stormwater pond management as an outreach strategy is discussed further in Chapter 8.

Education/outreach – Bacteria, Sediment, Nutrients
Educational outreach campaigns are an effective way to spread messages throughout a community related to specific topics with a desired adoption by the public. These can be accomplished through signage, consistent messaging, bill stuffers, workshops/classes, booths at community events, and more. Educational topics suitable for the EIW include septic outreach, pet waste disposal, reducing stormwater runoff, pond management, use of native plants, and responsible boating practices. These will be discussed further in Chapter 8.

Educational Signage – Bacteria, Sediment, Nutrients
Educational signage can be one way to deliver messaging to a community on environmental issues and desired behaviors. Examples include pet waste disposal signs at pet waste stations, “Do not feed wildlife” signs to help discourage this practice, “now entering” waterway/watershed signage, No Wake Zones, and boat pump out information. By incorporating educational signage into an outreach campaign, communities can be informed about proper practices to help reduce pollutant loads to nearby waterways. These will be discussed further in Chapter 8.

Wildlife

Reduce populations of nuisance wildlife – Bacteria, Nutrients

Large populations of nuisance wildlife like feral hogs, raccoons, coyotes, and residential geese have the potential to contribute to bacteria levels in waterways. By better managing their populations, wildlife can coexist with residents in a way that is not potentially harmful to them and the environment. Other wildlife, such as waterfowl, can be kept away from docks and lawns near surface waters using deterrents (e.g., plastic owls, scarecrows). Wildlife plots adjacent to waterways should maintain existing buffers, or incorporate new buffers, between the edge of the plot and the waterway to intercept runoff.

Discourage feeding of waterfowl and wildlife (feeding ordinances)– Sediment, Nutrients

One management tool used to help control wildlife and waterfowl populations in public areas or more dense residential areas, like Edisto Beach, is through wildlife feeding ordinances. This helps to discourage residents and visitors from feeding wildlife, which can cause wildlife to become overly friendly and encourages them to frequent heavily trafficked areas. Trash can also be an unintentional source of food for wildlife. Securing trash cans with well-fitting lids, securing all food at campsites, and keeping dumpster lids closed can all help to prevent scavenging by wildlife.

In terms of nuisance wildlife, conversations with residents indicated that feeding of wildlife by humans is an issue that needs to be addressed. The presence of nuisance wildlife is often visible near water, e.g., racoon scat on docks, deer, geese waste on pond banks (Figure 63).

Figure 63: Several types of wildlife scat observed near ponds (photo: A. Scaroni)

Figure 64: A "don't feed the wildlife" sign on Edisto Beach, and a sign that could be used in areas where Canada Geese congregate (photo: A. Scaroni)

Displaying "do not feed wildlife" signage at locations where humans are likely to encounter animals can serve as a prompt to limit harmful behaviors (Figure 64).

Buffers zones at the edge of wildlife plots – Bacteria, Sediment, Nutrients
Wildlife food plots are one way that landowners can manage their land and are planted to encourage feeding of certain desirable wildlife species. If these areas are overused or highly trafficked by wildlife, it can contribute to bacteria and sediment loads to nearby waterways. By incorporating buffer zones of native plants around these food plots, soil is better protected, and pollutants are filtered from runoff. We do not have accurate data on where wildlife plots are located around the watershed.

Within Waterbodies
Pump out stations – Bacteria, Nutrients
Sewage from boats can be properly disposed of at pump out stations. These can be located at marinas or public docks. By using pump out stations, overboard discharge of vessel sewage is reduced which, in turn, reduces direct bacteria and nutrients discharge to waterways. According to SCDHEC, pump out stations are required at marinas and at any community dock longer than 250 linear feet. The Edisto Marina has 72 wet slips providing berthing to vessels 20 to 50 feet in length (Figure 65). A functional pump out station at the Edisto Marina will ensure that any waste from transient boats docking at the marina is not discharged directly into waterways. There are a few docks longer than 250 linear feet throughout the watershed. It is unclear if these docks function as community docks; if so, pump out stations should be installed in these locations as well.

Figure 65: Edisto Marina (image from Google Maps)

Living shorelines – Bacteria, Sediment, Nutrients

Living shorelines are used to help stabilize shorelines along tidal waters by using native vegetation and other natural structures like oyster shell (Figure 66). These natural structures promote the health and growth of the native ecosystem, helping reduce sediment from entering waterways. Several living shorelines have been installed by SCDNR throughout the watershed; one in Big Bay creek has seen oyster growth and growth of marsh grass behind the reef over a three-year period. These practices may be useful for eroding areas of marsh throughout the watershed, particularly in areas where erosion is linked to boat traffic and wake. The installed reef can reduce wave energy, lessening erosive forces and enabling new marsh growth. Sites considered for potential living shoreline installations should be identified through The Nature Conservancy's Living Shorelines app to determine if the site is appropriate: https://maps.coastalresilience.org/southcarolina/living-shorelines/. Additional site considerations can be found on the South Carolina Living Shorelines page: https://www.clemson.edu/extension/living-shorelines/selecting-shoreline/property.html. Living shorelines are a great alternative to traditional hardened shoreline structures, like bulkheads. FEMA's Community Rating System (CRS) now recognizes the benefits of nature-based solutions to flooding; living shorelines can earn points under the CRS, which can help to reduce the cost of flood insurance for a community.

Figure 66: Living shoreline installation in Big Bay Creek (photo: SCDNR, 2019)

No Wake Zones – Sediment

When boaters speed through sensitive areas, their wake can negatively affect water quality, causing increased wave action. This can hinder shorelines and increase erosion. No wake zones are one tool that can be used to help promote reduced speeds for boaters (Figure 67). By slowing down in smaller or heavily trafficked channels, lives and shorelines are protected. Increased signage at marinas and boat landings can help promote this practice, as well as signs throughout the channels with high visibility.

Figure 67: A small, faded "idle speed no wake" sign in the channel along Big Bay creek (photo: A. Scaroni)

Climate Change Adaptations

These recommendations were developed based on the current state of the watershed, with consideration for how the effects of climate change could impact the effectiveness of a variety of BMPs. For example, while **infiltration practices** can help to address flooding in the short term, over the long term these practices will be less effective as water tables rise and coastal flooding increases. As a result, our recommendations for **low-impact development** practices on Edisto Beach prioritize rainwater harvesting and runoff reduction over infiltration practices where possible. This includes a focus on stormwater pond management to better handle increasing water volumes, and also to treat water quality from stormwater runoff.

Both sea level rise and increased rainfall leading to an increase in flooding are potential consequences of climate change. **Conservation easements** can be used to preserve open space, and wetlands, which can help to manage the effects of flooding. Wetlands also act as carbon and nutrient sinks, sequestering carbon that would otherwise end up in the atmosphere. Our recommendations for conservation easements took flood risk and soil drainage class into account to prioritize areas that will reduce future development in high-risk areas. This strategy will also preserve corridors for wetlands to migrate landward to keep pace with sea level rise.

Septic systems go hand in hand with future development on Edisto Island and parts of Edisto Beach, so recommendations for conservation easements also prioritize areas that would appeal to developers (including well drained soils and proximity to waterways) to protect water quality from future flood risk. Our **septic maintenance and replacement** recommendations also factor in the future risk to septic system function, particularly for systems in the flood zone, with poorly draining soils, clustered along creeks, from sea level rise and rising water tables.

Rising sea levels and increased rainfall resulting from climate change can accelerate coastal erosion. **Shoreline buffers and living shorelines** can help to stabilize shorelines, reducing erosion and protecting infrastructure, such as homes and septic systems, on adjacent land. Our recommendations prioritized these practices on shorelines with erodible soils, and those subject to the impacts of heavy boat traffic. Similarly, **riparian buffers** can stabilize land areas, reducing erosion that could be exacerbated by heavy rains. Additionally, all three of these practices can aid in climate change mitigation via the capacity for storage of carbon in the soil and plants, and also through removal of carbon dioxide from the atmosphere via photosynthesis.

Summary of Key BMP Recommendations

Table 7 summarizes the key BMPs described in Chapter 5 and recommends site characteristics for prioritizing locations that will best achieve pollutant load reductions under current and future scenarios.

Table 7: Summary of key BMP recommendations

BMP Category	Summary of Recommendations
Agriculture	Targeted outreach efforts to owners of parcels adjacent to waterways (within 1,000 ft), and those that drain directly to waterways with an impairment.
Forestry	Targeted outreach efforts to properties over 10 acres, with poorly drained soils, that are not already in a conservation easement.
Land Protection	Targeted outreach efforts to properties over 10 acres, with poorly drained soils, that are not already in a conservation easement.
Septic Repairs/Replacements	Priority 1 - Store Creek watershed, initial focus on older systems, and those with a history of failure. Priority 2 - Systems in a flood zone on poorly drainings soils. Priority 3 - Systems clustered along creeks (hot spots), and those located near impairments.
Low Impact Development	Priority 1 - Properties on Edisto Beach, initial focus on retrofits: high density developed areas, and town properties, followed by outreach to residents. Priority 2 - Store Creek Watershed, initial focus on new construction: undeveloped land, not under a conservation easement, with well drained soils.
Wildlife Ordinances and Deterrents	Targed outreach efforts in dense residential areas, and to waterfront property owners.
Shoreline Buffers	Targeted installations on parcels with highly erodible soils within 100 ft. of a waterway.
Living Shorelines	Targeted installations in sensitive areas, with eroding marsh, and heavy boat traffic. Pair with Shoreline buffers when possible.

All BMPs will require maintenance to remain effective over time. The SCDHEC BMP manual (available online) should be consulted for specific maintenance recommendations before design or installation of any BMP recommended in this plan.

Chapter 6
Pollutant Loads & Load Reductions

After we identified recommended BMPs for the EIW, the next step was to quantify loads from the identified sources. Once existing pollutant loads are quantified, we can compare those numbers to the load reduction potential for the BMPs recommended in Chapter 5. Due to the tidal nature of the watershed, it is difficult to accurately calculate existing loads for the system. Here we provide our best estimates, while acknowledging there is likely a significant margin of error. Notably, tidal flushing may reduce bacteria loads due to dilution during high tides, so peak levels discharged from the watershed may be higher than what monitoring data suggest.

Bacteria Loading Estimates

The potential sources of bacteria we identified across the watershed include waste from failing septic systems, livestock (e.g., beef cattle, swine, sheep, horses, turkey, goat, mules, chicken), domestic animals (e.g., dogs), wildlife (e.g., deer, racoons, waterfowl, and other birds), and discharge from recreational boats.

Load calculations and load reduction calculations for bacteria, below, are both calculated using fecal coliform as the indicator species for bacteria. While there are several enterococcus impairments across the watershed, we are assuming here that a reduction of fecal coliform equals a similar percent reduction of enterococcus.

Septic Systems and Pet Waste

Septic Systems

Given the age and density of septic systems across the watershed (Figures 58, 60), we assume that the primary source of bacteria can be attributed to failing septic systems, due to both inadequate design for soil conditions and lack of maintenance. This could be confirmed through future microbial source tracking efforts (see Chapter 11 for further discussion of microbial source tracking).

Because EPA's STEPL tool does not calculate bacteria loads or load reductions, we used the Center for Watershed Protection's Watershed Treatment Model (WTM) to calculate surface water loading (a combined estimate of septic load plus pet waste load, because on its own the estimated pet waste load is negligible compared to the magnitude of the estimated septic load) and demonstrate the potential load reductions with septic tank maintenance or upgrades to septic systems in the watershed (Tetra Tech, 2011). We had to make several assumptions to fit our data into this model, so potential loading calculations will be an underestimation of the true load but demonstrate potential reductions from the largest assumed source of bacteria to waterways. First, we input the watershed area as 39,249 acres, annual rainfall as 50 inches (from the nearest weather station at Givhans Ferry), and an estimated stream length of 232 miles. Land use areas were entered as seen below (Table 8).

Table 8: Area of watershed categorized by land use

PRIMARY SOURCES - Land Use							
	Annual Loading Rates (Calculated) - User can override this using the optional cells to the right.						
Land Use		Area	TN	TP	TSS	FC	Runoff
Category	Detailed Description		(lb/acre)	(lb/acre)	(lbs/acre)	(# billion/acre)	(inches/year)
Residential	LDR (<1du/acre)	480	6.08	0.90	141.95	264.05	
Residential	MDR (1-4 du/acre)	115	7.54	1.11	175.85	327.11	
Residential	HDR (>4 du/acre)	6.4	9.47	1.40	221.05	411.19	
Residential	Multifamily	0	11.25	1.66	262.48	488.27	
Commercial	Commercial	0	15.77	1.65	322.89	684.46	
Roadway	Roadway	2048	18.69	2.03	1088.63	740.51	
Industrial	Industrial	0	13.31	1.51	489.93	551.33	
Forest	Forest	14726	2.50	0.20	100.00	12.00	
Rural	Rural	4594	4.60	0.70	100.00	39.00	
Open Water	Open Water	17280	12.80	0.50	155.00	0.00	
Active Construction	Active Construction	0	5.09	1.02	3457.80	0.00	
Total	Total Acres	39249					

Soils were divided into hydrologic soil groups A, B, C, D by percentage of the total. When determining the soil fraction percentages for the hydrologic soil groups (A, B, C, D), we assigned any “combo” soil (A/D, for example) as the lower draining category (ex: A/D was designated as D).

Depth to groundwater was obtained using the “depth to water table” layer from the NRCS dataset. We classified 90% of the watershed at less than three feet depth to groundwater, and 10% between three and five feet.

There are 3,168 dwelling units mapped across the watershed, 66% of which are unsewered, and 22% that are less than 100 feet from a waterway. Without additional data, we assumed that 100% of the septic systems are conventional systems.

With that information, and an estimated 25% failure rate, the WTM estimated the following current bacteria load attributed to current septic systems and maintenance regime (Table 9).

Table 9: Output of the Center for Watershed Protection’s Watershed Treatment Model for bacteria

Summary Table					
	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
Surface Water Loads					
Uncontrolled Load from Primary Sources	321,246.4	19,528.5	6,929,678.8	2,039,443.0	9,991.1
Uncontrolled Load from Secondary Sources	280,556.4	271,308.7	6,810,460.4	480,025.4	0.0
Load Reduction from Existing Practices	-694.9	-980.4	0.0	0.0	0.0
Existing Surface Water Load	**602,497.7**	**291,817.6**	**13,740,139.2**	**2,519,468.4**	**9,991.1**
Existing Load - Storm	**562,426.7**	**288,119.7**	**13,472,957.5**	**2,039,443.0**	**9,991.1**
Existing Load - Nonstorm	**40,071.0**	**3,697.8**	**267,181.7**	**480,025.4**	
Load Reduction from Future Practices	1,491.0	248.5	9,939.9	54,331.2	0.0
Surface Load with Future Practices in Place	**601,006.7**	**291,569.1**	**13,730,199.3**	**2,465,137.2**	**9,991.1**
Surface Load Change From Existing (%)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Surface Load with Future Practices - Storm	**562,426.7**	**288,119.7**	**13,472,957.5**	**2,039,443.0**	**9,991.1**
Surface Load with Future Practices - Nonstorm	**38,580.0**	**3,449.3**	**257,241.8**	**425,694.2**	
Load from New Development	0.0	0.0	0.0	0.0	0.0
Total Surface Load Including New Development	**601,006.7**	**291,569.1**	**13,730,199.3**	**2,465,137.2**	**9,991.1**
Surface Load Change From Existing (%)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Surface Load Including New Development - Storm	**562,426.7**	**288,119.7**	**13,472,957.5**	**2,039,443.0**	**6,810.5**
Surface Load Including New Development - Non-Storm	**38,580.0**	**3,449.3**	**257,241.8**	**425,694.2**	**3,180.6**
Groundwater Loads with Existing Practices in Place	**82,110.2**	**5,040.9**	**0.0**	**6,467.0**	**0.0**
Total Storm Load	**562,426.7**	**288,119.7**	**13,472,957.5**	**2,039,443.0**	**6,810.5**
Total Non-Storm Load	**38,580.0**	**3,449.3**	**257,241.8**	**425,694.2**	**3,180.6**
Groundwater Loads					
Urban Land	43,186.9	3,103.7	0.0	0.0	0.0
Septic Systems	40,683.1	2,024.7	0.0	6,759.4	0.0
Total Groundwater Load	**83,870.0**	**5,128.5**	**0.0**	**6,759.4**	**0.0**

We then identified future practices (BMPs) that could be implemented across the watershed to reduce bacteria loading. The BMPs applicable to the WTM data are septic education, repair, and upgrades. Septic repair refers to repairs of existing septic systems, and septic upgrades refers to replacement of a conventional septic system with a more efficient version. Input to the model (Table 10) included:

- Implementing a septic education campaign that reaches 50% of the population and motivates 20% of those reached to change their behavior.
- Implementing a septic repair initiative that reaches 20% of the population and motivates 10% of those reached to repair their system.
- Implementing a septic upgrade initiative that reaches 20% of the population and incentivizes 10% of those reached to upgrade their system.

Greater adoption of these practices would result in a higher load reduction; however, these percentage estimates used in the model were selected to be realistic regarding the number of people that could be reached through potential funding sources dedicated to septic inspection, maintenance, and upgrades.

Table 10: Inputs to the Watershed Treatment Model for Septic System Education, Repair, and Upgrades

Several options are available to reduce the pollutant load associated with On-Site Sewage Disposal Systems. The four practices to the left and below this box represent different techniques that either improve septic system performance or reduce the number of septic systems in the landscape.

OSDS Education	
Program? (Y/N)	Yes
Awareness of Message (Percent of Population)	50%
Percent willing to change behavior	20%

OSDS Repair	
Program? (y/n)	Yes
Percent Inspected	20%
Percent Willing to Repair	10%

OSDS Upgrade	
Program? (y/n)	Yes
Percent Inspected	20%
Percent Willing to Upgrade	10%
Upgrade System?	1.Conventional

In total, the calculated existing surface water fecal coliform load from septic systems and pet waste is **2.52x10^15 bacteria/year**. The runoff volume from stormwater is 9,991 acre-feet/year. The estimated fecal coliform load reduction from the addition of the above-described BMPs is **5.43x10^13 bacteria/year**.

Pet Waste

We used our estimate of surface water bacteria loading (a combined estimate of septic load plus pet waste load) from the WTM to demonstrate the potential load reductions from implementing pet waste education campaigns across the watershed. We had to make several assumptions to fit our data into this model but were able to use results of our community surveys to refine some of the estimates to better reflect the Edisto Island Watershed (Table 11). First, we input the number of households as 3,168, and the model assumes that 40% of households have a dog. The model also assumes that 65% of the fecal coliform in pet waste die off before reaching a waterway. Our local survey indicates that 55% of pet owners already pick up after their dog, so a pet waste education campaign needs to target the remaining 45% of the total households (1,426) that do not usually pick up pet waste. A previous statewide survey conducted by Clemson Extension's Carolina Clear program (Scaroni et al., 2021) indicated that 81% of residents statewide always or usually pick up after their dogs; therefore, our goal for awareness of message for our target audience is 58% (827 households), which would bring the total number on Edisto of people who always or usually pick up after their dogs to 81%, in line with the statewide estimate.

Table 11: Inputs to the Watershed Treatment Model for Pet Waste Education

Pet Waste Education		
		Baseline Conditions
Program? (Y/N)	Yes	No
Number of households	1426	3168
Awareness of Message (Percent of Population)	58.00%	55%

In total, the calculated existing surface water fecal coliform load from septic systems and pet waste is **2.52x10^15** bacteria/year. If we assume a 58% success rate from an outreach campaign focused on picking up and properly disposing of pet waste, the estimated fecal coliform load reduction is **2.32x10^12 bacteria/year**.

Livestock

Cattle

Livestock, particularly those with access to waterways, are another source of bacteria to watersheds. There are approximately 189 cattle across the watershed. Using the standard estimate of 1.97x10^11 bacteria/year for each cow (Metcalf and Eddy, 1991), the calculated surface water fecal coliform load from cattle is **3.72x10^13 bacteria/year**. If we assume a 50% success rate from an outreach campaign focused on cattle exclusion fencing and alternative water sources, the estimated fecal coliform load reduction is **1.86x10^13 bacteria/year** (Table 12).

Table 12: Estimates of load and load reductions for cattle

Standard bacteria loading per cattle/year	success rate of outreach	# cattle in watershed	Total possible reductions for cattle
1.97E+11	0.5	189	1.86E+13

Horses

There are roughly 104 horses across the watershed. Using the standard estimate of 4.20x10^8 bacteria/year for each horse (ASAE, 1998), the calculated surface water fecal coliform load from horses is **4.37x10^10 bacteria/year**. If we assume a 50% success rate from an outreach campaign focused on exclusion fencing and alternative water sources, the estimated fecal coliform load reduction is **2.18x10^10 bacteria/year** (Table 13).

Table 13: Estimates of load and load reduction for horses

Standard bacteria loading per horse/year	success rate of outreach	# horses in watershed	Total possible reductions for horses
4.20E+08	0.5	104	2.18E+10

Sediment Loading Estimates

The potential sources of sediment we identified across the watershed include agriculture (cropland and pasture erosion), shoreline erosion in creeks and ponds, construction, roads, and urban runoff. We used the USEPA STEPL tool to estimate the total sediment load for the watershed, and the potential load reductions based on a series of recommended BMPs (Tetra Tech, 2011). Using data supplied to the tool by the Givhans Ferry weather station, we input an annual rainfall of 50 in., with an average rain event of 0.78 in., and 100 rain days per year. We also input the acreage of urban (2,649 acres, a combination of single-family residential, commercial, and transportation classifications), cropland (1,100 acres), pasture (3,494 acres, included grassland area under this land cover category), and forest land cover (14,726 acres), and the number of estimated agricultural animals across the watershed (McMaster, 2008, and EPA, 2011) (Tables 14-15). We selected soil hydrologic group C (lower infiltration potential) as the average soil group across the watershed.

Table 14: Land use area and precipitation inputs to STEPL

1. Input watershed land use area (ac) and precipitation (in)								
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total
W1	2649	1100	3494	14726	0	0	0-24%	21969

Table 15: Agricultural animal inputs to STEPL

2. Input agricultural animals										
Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pastureland
W1	189	0	6	15	104	3	512	16	0	0

The tool is not able to account for natural and accelerated erosion of shorelines and dirt roads, and construction sites throughout the watershed. Thus, our calculated sediment load will likely underestimate the actual sediment load, although it does account for what we assume to be the largest potential sources of sediment to waterways.

Agriculture

We identified future practices (BMPs) that could be implemented across the watershed to reduce sediment loads derived from agricultural land cover. The BMPs applicable to the STEPL tool are focused on cropland and pastureland. Input to the model included:

- Cropland – Grass buffer (35 ft. wide, applied to 100%), cover crop 1 (group A commodity) cover crop 2 (group A traditional normal planting time), and nutrient management (2 – determined rate).
- Pastureland – Livestock exclusion fencing, alternative water supply, grass buffer (min. 35 ft. wide, applied to 75%), forest buffer (min. 35 ft. wide, applied to 25%)

Table 16: Total watershed load output from STEPL

1. Total load by subwatershed(s)				
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	t/year
W1	114994.4	21016.2	369102.2	1805.2

Table 17: Total watershed load (with BMPs implemented) output from STEPL

N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	E. coli Load (with BMP)
lb/year	lb/year	lb/year	t/year	Billion MPN/ye
114994.4	21016.2	369102.2	1674.0	0.0

Table 18: Total watershed load (with BMPs implemented) by land use output from STEPL

2. Total load by land uses (with BMP)					
Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	E. coli Load (Billion MPN/yr)
Urban	55224.70	9143.76	177540.48	1364.81	0.00
Cropland	7512.28	1364.94	15732.45	246.02	0.00
Pastureland	33754.02	2678.09	109109.70	147.72	0.00
Forest	5533.36	2749.50	13758.70	46.69	0.00
Feedlots	0.00	0.00	0.00	0.00	0.00

According to the STEPL run solver, **the current total sediment load in the watershed, based on land cover, is 1,805.2 tons/year** (Table 16). If the cropland and pastureland BMPs listed above are implemented across the watershed, **the total sediment load in the watershed, with BMPs, is 1,674 tons/year** (Table 17), with urban land use as the largest source (Table 18, Figure 68). This is a **reduction of 131 tons/year** or 7% of the total sediment load. However, the total sediment load from just cropland and pastureland is 394 tons/year, so a 131 tons/year reduction based on the implementation of cropland and pastureland BMPs is a 33% reduction across those land uses. Because there is no TMDL for turbidity already established for the watershed, the load reduction needed to meet the water quality standard is unknown.

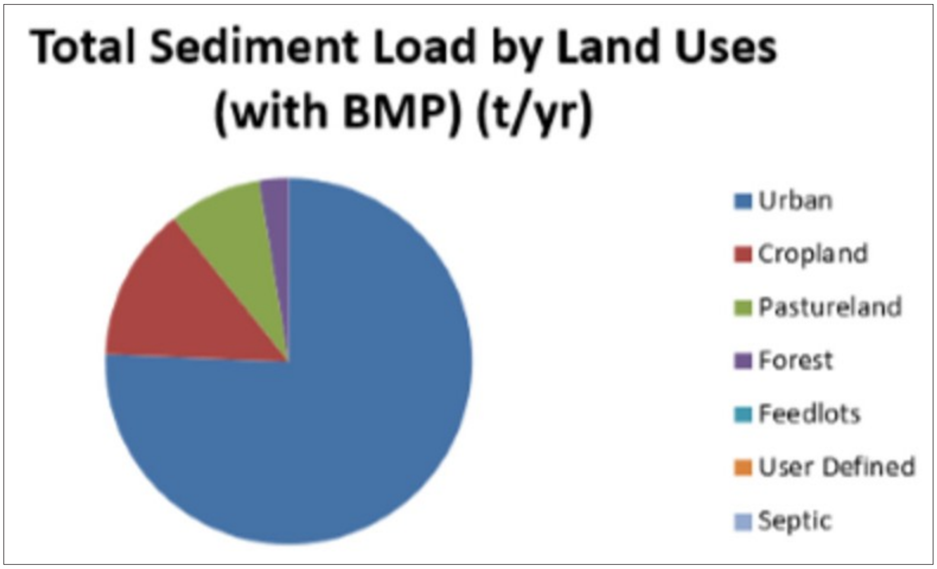

Figure 68: Total watershed load by land use output from STEPL

Notably, the largest source of sediment across the watershed (based on the parameters of the tool, which didn't include wetland and shoreline erosion) is urban land uses, including roads, followed by cropland, pastureland, and forest. Many of our recommended BMPs in Chapter 5 that target urban/residential land uses focus on behavior changes that limit runoff and erosion. These are not easily quantifiable as load reductions, but BMPs such as increasing use of LID practices, increasing use of native plants, and maintaining shoreline buffers will all contribute to sediment load reductions from urban areas.

Urban Development

Urban runoff is also a source of sediment pollution to local waterways and needs to be run separately in STEPL using the Urban BMP Tool (Tetra Tech, 2011). Urban runoff is primarily a concern on Edisto Beach, where most of the commercial and high-density development exists within the watershed. Therefore, we limited potential load reduction calculations using a suite of Low Impact Development BMPs to Edisto Beach for this watershed plan. The Urban BMPs applied in STEPL included:

- Weekly street sweeping
- Water quality inlets
- Cisterns
- Porous pavement
- Bioretention
- Rain barrels

The land use classifications used to inform the BMP drainage areas in the STEPL tool can be seen in Figure 69.

Figure 69: Land use classifications for the Town of Edisto Beach

Street sweeping is a BMP that removes sediment from roadways before it can be washed into the storm drainage system. To determine the BMP drainage area for street sweeping, we used the total available area of highways and main roads within the Town of Edisto Beach (42.6 acres). If 100% of these roads are swept on a weekly basis, a total of 8,512 lb/yr, or **4.3 tons of sediment load will be reduced annually**.

Water quality inlets are used to remove sediment from stormwater runoff in catch basins before it flows to waterways. To determine the BMP drainage area for water quality inlets, we used the total available area of highways and main roads within the Town of Edisto Beach (42.6 acres). If water quality inlets are installed such that 10% of the drainage area is filtered through the water quality inlets (4.26 acres), a total of 1,968 lb/yr, or approximately **1 ton of sediment load will be reduced annually**. This load reduction could be increased by the installation of additional inlets to treat a larger percentage of the drainage basin, particularly along Jungle Road, Dockside Road, and Palmetto Boulevard.

Porous pavement is an alternative to conventional pavement that allows water to infiltrate, reducing the volume of runoff from the pavement system. To determine the BMP drainage area for porous pavement, we used the total commercial area within the Town of Edisto Beach (4.6 acres) and applied 50% of it (2.3 acres) to drain to porous pavement areas. This would result in **0.4 tons (771 lbs) of sediment load being reduced annually**. It would also result in **879,145 gallons of water being kept out of the stormwater drainage system** annually. The area of porous pavement needed to treat this 2.3-acre drainage area is only 0.05 acres, which is the equivalent of roughly 13 parking spaces. Additional sediment and volume reduction can be achieved if a larger percentage of the drainage area is captured with a larger area of porous pavement installed. Porous pavement would be helpful in locations where hard surfaces generally collect water, such as the parking lot across from the farmer's market stand.

Bioretention cells are another BMP that can help with sediment removal and infiltration in commercial areas. Similar to rain gardens, bioretention cells are vegetated basins with engineered soils designed to infiltrate water. These could be applied in commercial areas, such as adjacent to parking lots or as overflow locations for rain barrels and cisterns. To determine the BMP drainage area for bioretention cells, we used the total commercial area within the Town of Edisto Beach (4.6 acres) and applied 50% of it (2.3 acres) to drain to bioretention areas. This would result in **879,145 gallons of water being kept out of the stormwater drainage system** annually. The area of bioretention cells needed to treat this 2.3-acre drainage area is only 0.032 acres, or 1,393 sq. ft. Additional volume reduction can be achieved if a larger percentage of the drainage area is captured with a larger area of bioretention cells installed. Bioretention cells would be helpful where they could drain hard surfaces, such as in the median of Palmetto Boulevard.

Bioretention cells can also be used in residential areas, where they are more commonly referred to as rain gardens, and often receive runoff from a downspout. STEPL only allows the bioretention classification but differentiates between commercial vs. residential land uses. Here, we will refer to bioretention as rain gardens when applied to residential areas. To determine the BMP drainage area for rain gardens, we used the total area of building footprints within the Town of Edisto Beach (89.5 acres), and applied 20% of it (17.79 acres) to drain to rain gardens. This would result in **242,894 gallons of water being kept out of the stormwater drainage system** annually. The area of rain gardens needed to treat this 17.89-acre drainage area is only 0.25 acres, or 10,890 sq. ft. Additional volume reduction can be achieved if a larger percentage of the drainage area is captured with a larger area of rain gardens installed. Rain gardens would be helpful if they were installed on private properties and were used to capture rainfall running off rooftops and driveways.

Cisterns and rain barrels are tanks for collecting rainwater. While they come in many sizes, STEPL considers a cistern to be 100 gallons and a rain barrel to be 60 gallons. Cisterns are more likely to be used in commercial development, and rain barrels are more likely to be used for residences. To determine the BMP drainage area for cisterns and rain barrels, we used the total area of building footprints (since cisterns and rain barrels collect water from rooftops) within the Town of Edisto Beach (89.5 acres). If 20% of the drainage area (17.89 acres) sets up cisterns or rain barrels, or a combination of both, **242,894 gallons of water would be kept out of the stormwater drainage system** and stored for reuse (Table 19). This would require either 1,518 cisterns or 4,048 rain barrels (or some combination of both). Rainwater harvesting can also be used in conjunction with rain gardens, so that the overflow from the tanks can be captured by the rain garden.

Table 19: Pollutant load (lb/yr) and volume reductions (gal/yr) for the Town of Edisto Beach

Land Use Type	BMP	Load Reduction (lb/yr)			Captured Volume
		N	P	TSS	(gal/yr)
Transportation	Weekly Street Sweeping	0	11	8,512	0
	Water Quality Inlets	21.3	1.6	1,968	0
Commerical/high density	Porous Pavement	19.4	1.5	771	879,145
	Bioretention	9.8	1.9	0	879,145
Single family/low/medium density	Rain Garden	29.7	10.2	0	2,415,205
Building Footprints	Rain Barrel	1.4	0.3	63	2,415,205
	Cistern	1.4	0.3	63	2,415,205
		83	**26.8**	**11,377**	**9,003,905**

LID practices can also remove and treat bacteria present in stormwater runoff, however neither the STEPL tool nor the WTM tool allow for those calculations.

Conservation Easements

Additionally, we used the Michigan Tool for Conservation Easements (Michigan DEQ, 1999) to calculate the potential sediment load that could be prevented from reaching waterways in the future if unprotected forested land or wetlands that could convert into residential developments were put into conservation easements.

Based on the criteria identified in Figure 70, we prioritized 21,164 acres to consider for potential conservation easements. This prioritization focused on parcels not already under a conservation easement, larger parcels (i.e. - over 10 acres in size), and parcels characterized by poorly or very poorly drained soils. Some of the land included in this priority map includes land already owned by either the South Carolina or the United States government (primarily tidal wetlands). Because these lands could still be sold and eventually developed or disturbed, we kept them in the priority map as a conservation easement could be used to protect them in perpetuity. If these acres were converted into residential developments, they would be dependent on septic systems, since Edisto Island does not have a wastewater treatment plant, which, if not properly sited or maintained, could also increase bacteria loading to the watershed.

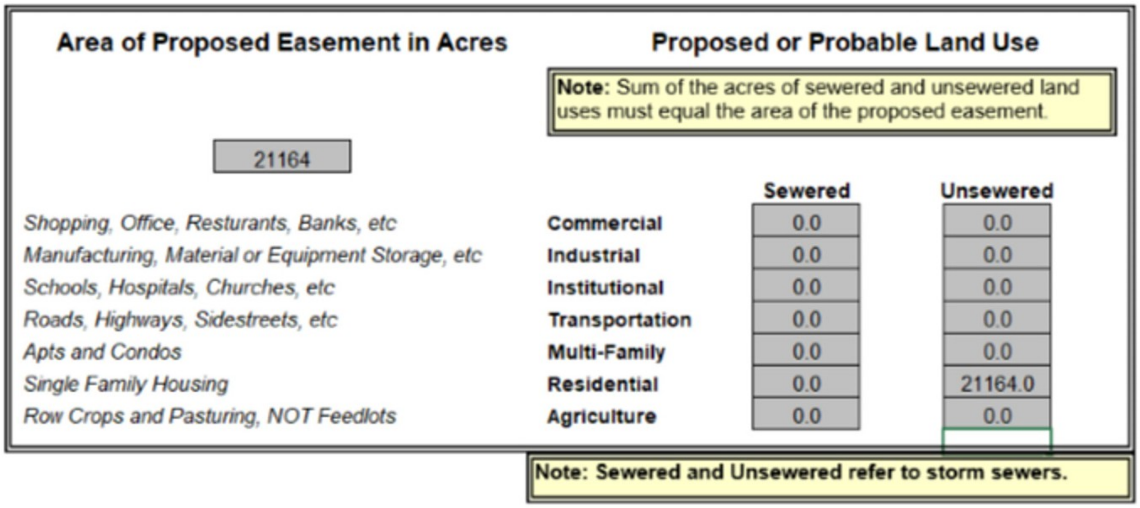

Figure 70: Area of proposed easement output of the Michigan Tool for Conservation Easements

We ran the model to estimate the expected pollutant load from converting the existing land cover for those 21,164 acres into residential development and compared it to the load reduction if those acres were protected from development under a conservation easement (Table 20). We would **expect an additional load of 1,629 tons/yr of total suspended solids (TSS) in waterways** if development were to occur on this land. If this land was instead protected with a conservation easement, we would **expect a load prevention of 1,417 tons/yr of TSS** that would otherwise reach waterways and contribute to turbidity.

Table 20: Pollutant load of potential residential development vs. load prevention of conservation easement across same area (output of the Michigan Tool for Conservation Easements)

	Load of proposed use (lb/yr)	Load Reduction with Easement (lb/yr)	Load Reduction with Easement (tons/yr)
TSS	3,259,256	2,835,976	1417

Chapter 7
Estimated Costs and Potential Financial and Technical Assistance

There are a variety of funding sources, both grant opportunities and low-interest loans, that can be explored for funding the various projects recommended in this plan. The following list is not exhaustive but includes many of the most relevant options for funding water quality improvement projects.

Possible sources of funding for septic repairs and replacements include:

Healthy Harbors Fund administered by the Coastal Community Foundation in Charleston, SC. This funding opportunity is available for coastal projects in the greater Charleston area (including Charleston County) that benefit water quality. Eligibility is limited to small non-profits. The Edisto Island Open Land Trust is eligible, and could seek funding for septic inspections, maintenance, and replacement.

The Charleston County Community Development HUD funding is available for septic replacements for septic systems within the Charleston County portion of the watershed (Edisto Island). Individual septic owners can apply.

EPA Clean Water Act Section 319 Grants for Implementation Projects administered by SCDHEC. Projects that are designed to achieve measurable water quality improvements by reducing nonpoint source contributions are eligible. This funding opportunity could be used to fund septic system replacements.

Possible sources of funding for marina pump-out stations include:

The Clean Vessel Act is a source of funding, administered by SC DNR, that can help marinas to install pump-out stations (covers up to 75% of the cost).

Possible sources of funding for living shorelines include:

The SC Office of Resilience's Revolving Loan Fund Program provides low-interest loans, of which up to 25% can be converted into a grant not requiring repayment for projects that implement beneficial flood mitigation practices. Eligible projects include buying out land for the purpose of removing hardened shoreline structures and installing living shoreline structures or removing hardened shoreline structures and installing living shoreline structures on land purchased using another funding source so long as a portion of the land used in either case contained coastal wetlands.

Possible sources of funding for installation of agricultural and forestry BMPs, installation of LID practices, and outreach campaigns include:

EPA Clean Water Act Section 319 Grants for Implementation Projects administered by SCDHEC. Projects that are designed to achieve measurable water quality improvements by reducing nonpoint source contributions are eligible. This funding opportunity could be used to install agricultural BMPs such as cattle exclusion fencing, alternative water sources, and buffers; fund the purchase of land for conservation easements; and implement LID practices such as impervious cover removal, bioretention, and rain gardens.

USDA Environmental Quality Incentives Program (EQIP) grants provide agricultural producers and forest managers with financial resources and one-on-one help to plan and implement conservation practices, such as cover crops and filter strips.

NRCS Regional Conservation Partnership Program (RCCP) grants, with minimum budgets of $250,000 focus on engaging with producers and landowners to implement conservation practices, systems, and approaches on or for the benefit of agricultural and non-industrial private forest lands. Relevant priority resource concerns for our area include both water quality degradation and inadequate habitat for fish, wildlife, and invertebrates, both of which could address bacteria issues and shellfish bed closures on Edisto.

USDA Wetland Reserve Enhancement Partnership is part of the Agricultural Conservation Easement Program (ACEP), a Farm Bill conservation program. WREP provides technical and financial assistance to help conservation partners protect and restore critical wetlands on agricultural lands. Local governments and NGOs work with private landowners who voluntarily enroll eligible land into easements to protect, restore, and enhance wetlands on their properties. The Edisto Island Open Land Trust and Charleston County are eligible and could seek funding for additional easements on high-priority locations within the watershed.

NFWF Five Star and Urban Waters Restoration Grant Program annually gathers water quality and source water protection plan proposals for the Five Star and Urban Waters Restoration grant program. Eligible applicants include non-profit 501(c) organizations, state government agencies, local governments, municipal governments, Indian tribes, and educational institutions. Awards range from $20,000 to $50,000, and relevant priorities include restoration, environmental education, outreach, and training. This could be used to support local projects such as riparian buffer restoration and living shorelines installations.

EPA Environmental Education Grants support environmental education projects that promote environmental awareness and stewardship and help provide people with the skills to take responsible actions to protect the environment. This grant program provides financial support for projects that design, demonstrate, and/or disseminate environmental education practices, methods, or techniques. This funding opportunity could be used to fund the development and implementation of outreach campaigns on topics such as pet waste, septic maintenance, use of native plants, and LID practices for the home landscape. Clemson Extension and others are eligible, and could seek funding for the development of education programs specifically designed for the Edisto Island Watershed.

EPA Environmental Justice Small Grants Program to support community-driven projects designed to engage, educate, and empower underserved communities to better understand and address local environmental and public health issues. This grant program has previously funded water quality and sampling projects, and stormwater and green infrastructure projects, and could be used to fund the development and implementation of outreach campaigns on septic maintenance, with additional sampling to conduct microbial source tracking to definitively identify bacteria sources. The Edisto Island Open Land Trust and other small non-profits are eligible, and could seek funding for septic inspections, maintenance, and replacement.

Cost estimates for the suite of BMPs recommended in this plan are included in Table 21.

Table 21: Estimated cost of recommended BMPs

Residential	
BMP	***Estimated Cost***
Conservation Easement	*Varies*
Permeable Pavement	$10 per square foot
Rain barrels	$120/each
Cisterns	$1500/each
Water Quality Inlets (vaults)	$2,000-$8,000
Rain Gardens	$500 per small garden
Pet Waste Stations	$225 per station
Pet Waste Bags	$60/2,000
Shoreline Buffers	$5-10/linear foot
Septic System Repair/Replacement	$10,000
Septic System Maintenance	$300/pump out
Native Plant Outreach	*Varies*
Soil Testing	$6/sample
Education and Outreach	Varies
Stormwater Pond Management	*Varies*
Educational Signage	$150/sign
Within Waterbodies	
BMP	***Estimated Cost Per Unit***
Pump out Station	$30,000
Living Shoreline	$50 - $150/linear foot
No-Wake Zone	$250
Wildlife	
BMP	***Estimated Cost Per Unit***
Reduce Populations of Nuisance Wildlife	$320-$460/trap
Discourage Feeding of Wildlife	$150/sign
Buffer Zones at Wildlife Plot Edges	$168/acre
Agriculture	
BMP	***Estimated Cost Per Unit***
Cattle Exclusion Fencing	$3.50/ft
Riparian Buffer	$390/acre
Field Border/Filter Strips	$168/acre
Agricultural Conservation Easements	*Varies*
Nutrient Management	$19/acre/year
Cover Crops	$37/acre
Alternate Watering Source	$1067 each
Grass Buffer	$338/acre/year

Chapter 8
Public Outreach & Education

Watershed-based planning is a community-driven effort to identify sources of water pollution and develop solutions. People who live in the watershed and those who use the waterways, whether for fun, for work, for feeding their family, or even for cultural and spiritual practices, benefit from clean water. That is why it is crucial to involve the community in creating a watershed-based plan. Everyone with a stake in the watershed should have a voice in the creation of the plan. How has the river changed over time? Which areas should be restored first? Which solutions are preferred? Stakeholder input is key to creating a vision for the watershed that works for everybody in the community.

At the initial stages of plan development, we surveyed 376 residents to gather information on how Edisto residents use and value local waterways, and to identify local water quality concerns and potential water pollution sources. An online survey link was emailed out on local listservs, the link was advertised on postcards distributed at popular community spaces, and hard copies were made available for pickup and drop-off at the EIOLT office. The postcard advertising the program and the survey questions are included in appendices A and B, respectively. The feedback from residents helped in the overall watershed assessment, but it also helps to inform an education and outreach strategy tailored to the needs of the watershed. As a non-structural best management practice, education can help to change behavior that may be contributing to water quality problems.

Survey results:

Of the survey respondents, 39% lived on Edisto Island, 33% lived within the Town of Edisto Beach, and 28% either owned property or regularly vacationed at Edisto Island or Edisto Beach.

Nearly 70% frequently or occasionally eat fish that they catch in local water bodies. 78% eat locally harvested shellfish, and 30% harvest shellfish themselves for consumption.

Residents are concerned about pollution in Edisto's waterways, primarily from bacteria, litter, engine oil, sediment, and nutrients. Other pollution concerns included saltwater intrusion, microplastics, general stormwater runoff, pool discharge, herbicides (particularly defoliants), and marine debris. Nearly 90% of respondents are concerned that shellfish are affected by bacteria and sediment pollution (the two primary water quality impairments across the watershed). Despite these concerns, most respondents (64%) rarely or never let worry over water pollution prevent them from enjoying Edisto waterways.

When we asked residents to identify the primary source of bacteria pollution in Edisto waterways, answers included septic systems (39%), illicit discharges (25%), pet waste (12%), livestock (10%), and wildlife (7%). Individual responses also pointed to boats discharging waste, renters during tourist season overloading septic systems, leaks from the Town of Hollywood's wastewater treatment plant, and toilets unlawfully installed underneath elevated houses.

When we asked residents to identify the primary source of sediment pollution in Edisto waterways, answers included construction/development (43%), residential lawn-care practices (25%), agriculture (20%), and forestry activities (5%). Individual responses also pointed to tides and boat wakes, the causeway road and bridges, and natural erosion.

The majority of respondents (75%) have a septic tank on their property and are not connected to a municipal sewer system. The remaining 25% said they do not have a septic system or were unsure. Of the residents with septic systems, 26% reported having their tank inspected regularly (every 1-3 years), 22% rarely had it inspected, and 11% said they never had it inspected (or were unsure).

Dog ownership is estimated at 52%, but only 55% of dog owners said they always picked up after their dogs, and 16% rarely or never pick up. Only 4% of residents own livestock (horses, goats, donkeys, or chickens).

Residents are affected differently when it comes to flooding on their property. Only 3% experience flooding on their property more than twice a month, and 39% never experience flooding. However, 37% of residents experience flooding once or twice a year, and 13% deal with it every few months.

Write-in answers to some of the survey questions also indicated that residents were unclear that the water quality was regularly monitored across the watershed and were unaware that the data is publicly available.

Lastly, we asked residents what they love most about Edisto, and there were some very common themes in their responses (Figure 71). Nature, quiet, beauty, natural, wildlife, waterways, and beaches were the most common responses, highlighting the existing conservation ethic across the watershed. This indicates that lack of knowledge about how to protect waterways may be a key barrier to reducing pollution-generating behaviors. This is positive news for the development of outreach campaigns; if the community already knows "why" they want to protect waterways, messaging only needs to focus on the "how."

Figure 71: Word cloud depicting survey responses to the question "What do you love most about Edisto?"

Pollution sources that are generated or exacerbated by human behavior (e.g., not removing pet waste, ignoring no-wake zones, neglecting septic maintenance, etc.) are often best addressed through outreach and education campaigns to inform, motivate, and remove barriers to behavior change. Based on our survey results, community discussions, and feedback from experts, we provide the following outreach recommendations to address bacteria and turbidity.

Outreach Recommendations

Bacteria

Septic Awareness & Maintenance

- Goal: Regular inspection and maintenance (pump outs) of septic systems
- Target audience: Septic owners
- Current behavior: Survey results indicate many residents do not regularly inspect and maintain their septic systems (some never do)
- Target behaviors: regular "health checkups" of septic system every 1-2 years; pump outs every 3-5 (or as needed); proper use of system to maintain performance and reduce costs.
- Outreach strategies: Presentations and tabling at community events, distribute informational materials (e.g., Clemson Extension septic education packets) to homeowners, rental companies, and realtors (Figure 72), provide a list of septic companies that service Edisto Island and Edisto Beach, explore local maintenance ordinances, provide financial incentives for free or reduced-cost inspections and pump-outs for those in priority areas.
- Messages: Emphasize connection to waterways, cost savings from routine maintenance prevents bigger issues in the future, improper use/maintenance can lead to sewage backups in your residence, highlight SCDHEC rules, regulations, and recommendations.
- Possible funding opportunities: Healthy Harbors fund, Section 319 grant funds, Charleston County Community Development HUD funding

Figure 72: Example of a septic magnet included in Clemson Extension's septic maintenance packets

Septic Replacement

- Goal: Full replacement of failing septic systems in priority areas
- Target audience: Septic owners with aging, failing septic systems
- Current behavior: Many residents have poorly functioning septic systems, and those systems need to be replaced.
- Target behavior: Sign up to be considered for full septic replacement.
- Outreach strategies: Presentations and tabling at community events, mailings to homeowners, provide financial incentives for full septic replacements in priority areas.
- Messages: Raise awareness of funding opportunities for septic replacement, information about lifespan of septic, how to know it is time to replace, emphasize connection to waterways, risks of failure.
- Potential funding opportunities: Healthy Harbors fund, Section 319 grant funds, Charleston County Community Development HUD funding for septic replacements (Figure 73)

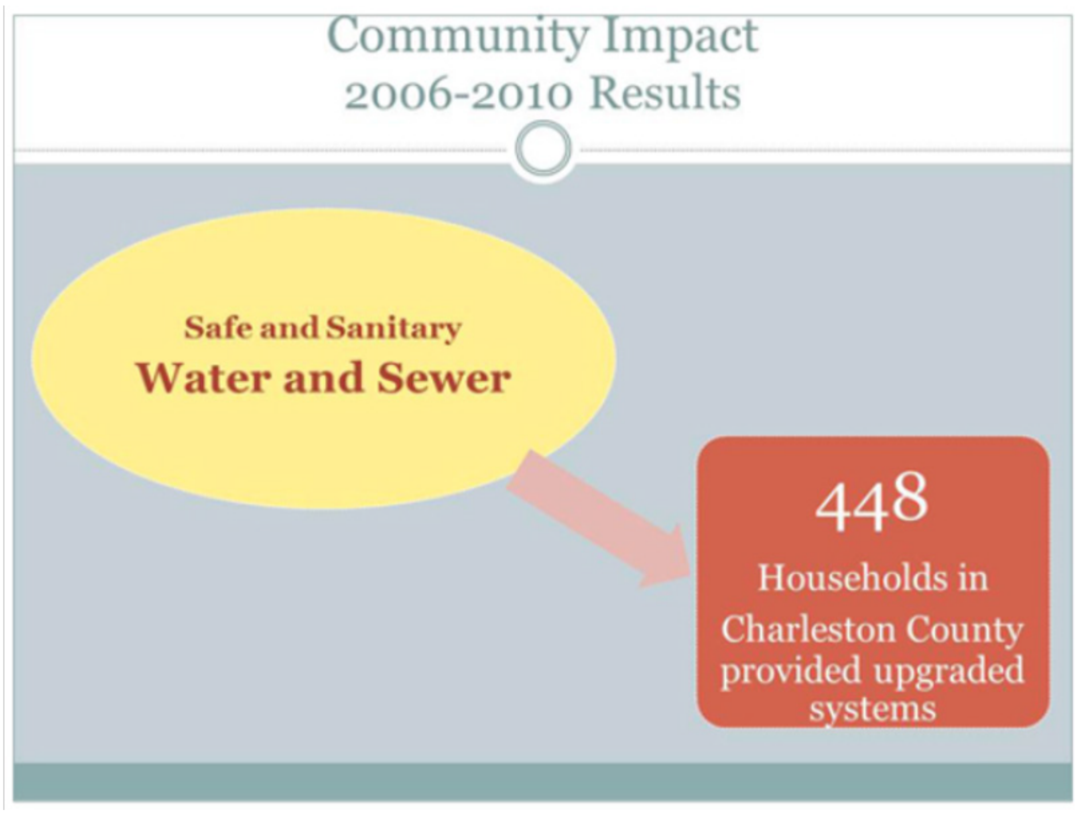

Figure 73: Charleston County Community Development department uses federal grant funding to pay for upgrades to eligible septic systems for low and moderate income residents in Charleston County (https://www.charlestoncounty.org/departments/community-development/water-septic.php)

Boat waste disposal

- Goal: Responsible disposal of human waste from boats
- Target audience: Boaters (both locals and visitors)
- Current behavior: It is unclear what current behaviors are, but there are no pump out stations in the area, so it is assumed that some boaters are improperly disposing of waste in waterways.
- Target behavior: Dispose of boat waste at a pump out station or an onboard bucket system with disposable bags.
- Outreach strategies: Clean Marina program for Edisto Marina (Figure 74), signage at boat landings and community docks, bucket system for local boaters, installation of pump out stations at community docks.
- Messages: Human waste dumped out of boats contributes harmful bacteria to local waterways.
- Potential funding opportunities: Clean Vessel program

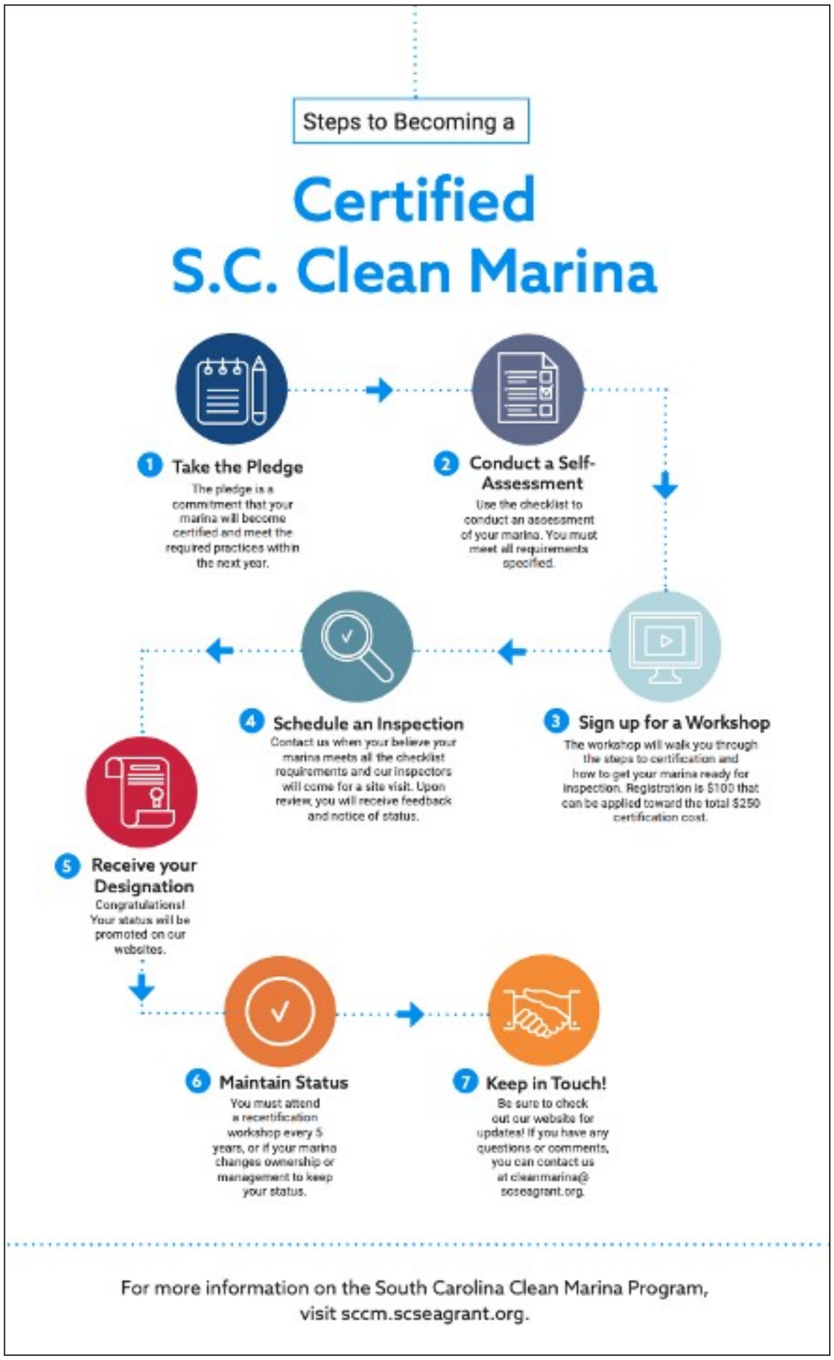

Figure 74: Steps to becoming a certified SC Clean Marina (from www.sccm.scseagrant.org)

Feeding Wildlife

- Goal: Reduce feeding of wildlife for entertainment in residential areas and campgrounds
- Target audience: Residents and visitors
- Current behavior: Both intentional feeding (e.g., throwing bread to geese) and inadvertent feeding (e.g., littering food waste, improperly storing food at campsites that ends up being consumed by wildlife) occurs across the watershed.
- Target behavior: Passive wildlife viewing.
- Outreach strategies: Educational signage, infographics, create slogans as prompts, feeding ordinances, partnerships with SCDNR, SC Wildlife Society.
- Messages: Feeding wildlife is bad for their health, their behavior (negative human/wildlife interactions), and water quality.
- Potential funding opportunities: Clemson Extension and SCDNR for existing resources (Figure 75).

Figure 75: Example of a Clemson Extension sign to discourage feeding of geese

Pet Waste

- Goal: Reduce the amount of pet waste (i.e. dog poop) left on the ground.
- Target audience: Dog owners, including both residents and visitors
- Current behavior: Roughly half of dog owners are not picking up their pet's waste.
- Target behavior: Pick up pet waste and properly dispose of it in the trash.
- Outreach strategies: Add educational signage to existing pet waste stations, additional pet waste stations and trash cans in hot spots, swap out blue garbage cans that resemble recycling bins, tabling events that distribute pledge cards, pet waste bag dispensers and dog bandanas, pet waste ordinances that extend beyond the beach, enforcement of ordinance on the beach during peak seasons.
- Messages: Be prepared, always bring a bag, and properly dispose of waste in the trash every time. Pet waste on the ground contributes harmful bacteria to local waterways.
- Funding opportunities: Clemson Extension's Carolina Clear program for existing resources Figure 76).

Figure 76: A dog wearing a pick up pet waste bandana received when their owner signed a pledge to pick up pet waste (Photo credit: Clemson Carolina Clear)

Sediment

Stormwater runoff-Conservation

- Goal: Increase land area in conservation easements to offset impacts of future development (and associated runoff).
- Target audience: Landowners in priority areas.
- Current behavior: Land is not currently under conservation easement.
- Target behavior: Landowner puts a conservation easement on their property.
- Outreach strategies: Targeted landowner discussions with Edisto Island Open Land Trust, Lowcountry Land Trust, Center for Heirs Property Preservation.
- Messages: Conservation easements can protect the watershed from future impacts of development.
- Funding opportunities: Section 319 grant funds can be used to purchase conservation easements.

Stormwater runoff-LID

- Goal: Low Impact Development practices are prioritized in future development.
- Target audience: Charleston County, Colleton County, Town of Edisto Beach Landowners, design engineers, and developers.
- Current behavior: Low Impact Development is not the default development style for residential buildings across the watershed.
- Target behavior: Landowners request LID designs for new development, design engineers and developers incorporate LID into plans, County/Town requires or incentivizes LID practices fo future development.
- Outreach strategies: LID trainings for Charleston County/Town of Edisto Beach/Colleton County staff and council, Clemson's Beyond the Silt Fence training for construction industry, shared examples of technical guidance/incentives from other regional/coastal communities, outreach to property owners with conservation easements.
- Messages: Low Impact Development practices paired with future development can reduce impacts to water quality and maintain pre-development hydrology.
- Funding opportunities: Existing resources and trainings available from Clemson Extension, SCDNR ACE Basin NERR Coastal Training Program, SC Sea Grant.

Stormwater Pond Management

- Goal: Better management of stormwater ponds for water quality
- Target audience: Pond owners, golf course, landscaping companies, adjacent landowners
- Current behavior: Lack of understanding about appropriate maintenance for stormwater ponds driving water quality issues.
- Target behavior: Perform annual inspections of stormwater pond.
- Outreach strategies: Expand marketing and offerings of existing resources on Edisto, (such as Clemson/SC SG/DNR's Healthy Pond Series), stormwater pond workshops focused specifically on Edisto Beach, educational signage installed around ponds.
- Messages: A healthy stormwater pond can protect water quality in local waterways.
- Funding opportunities: Existing resources and trainings available from Clemson Extension, SCDNR ACE Basin NERR Coastal Training Program, SC Sea Grant.

Lawn care for waterfront properties/upland management

- Goal: Proper planting practices to benefit water quality.
- Target audience: Waterfront property owners
- Current behavior: Lack of buffers along shoreline, use of non-native plants in landscaping, mowing turfgrass to water line.
- Target behavior: Waterfront property owners get their soil tested and follow recommendations, incorporate the use of native plants on their property, create or enhance buffers along shorelines.
- Outreach strategies: Buffer workshops, Clemson Extension Carolina Yards course offering for Edisto, tabling at community events with soil sample collection drives (Master Gardeners), handouts on the Carolina Yards Native Plant database, native plant sales.
- Messages: Watershed friendly landscaping incorporates the right plant in the right place, healthy shoreline buffers protect your property from erosion and protect water quality in adjacent waterways.
- Funding opportunities: Existing resources and trainings available from Clemson Extension, SCDNR ACE Basin NERR Coastal Training Program, SC Sea Grant, partnerships with the SC Native Plant Society, local native plant nurseries.

Living Shorelines

- Goal: Increased adoption of living shorelines
- Target audience: Waterfront property owners with eroding marsh who are identified as a feasible site for a living shoreline.
- Current behavior: Hardened shorelines are commonly used to combat marsh erosion on private property, in other locations no interventions are performed to protect eroding marsh.
- Target behavior: Install living shorelines where feasible.
- Outreach strategies: Living shorelines workshops, training courses, volunteer restoration events, TNC living shorelines app, tabling at community events with information on the SCDHEC living shorelines permit and educational website (Figure 77).
- Messages: New SCDHEC living shorelines permit offers an alternative to hardened shorelines to reduce erosion; living shorelines protect water quality, sequester carbon, and provide habitat.
- Funding opportunities: Existing resources and trainings available from Clemson Extension, SCDNR, SCDHEC, The Nature Conservancy.

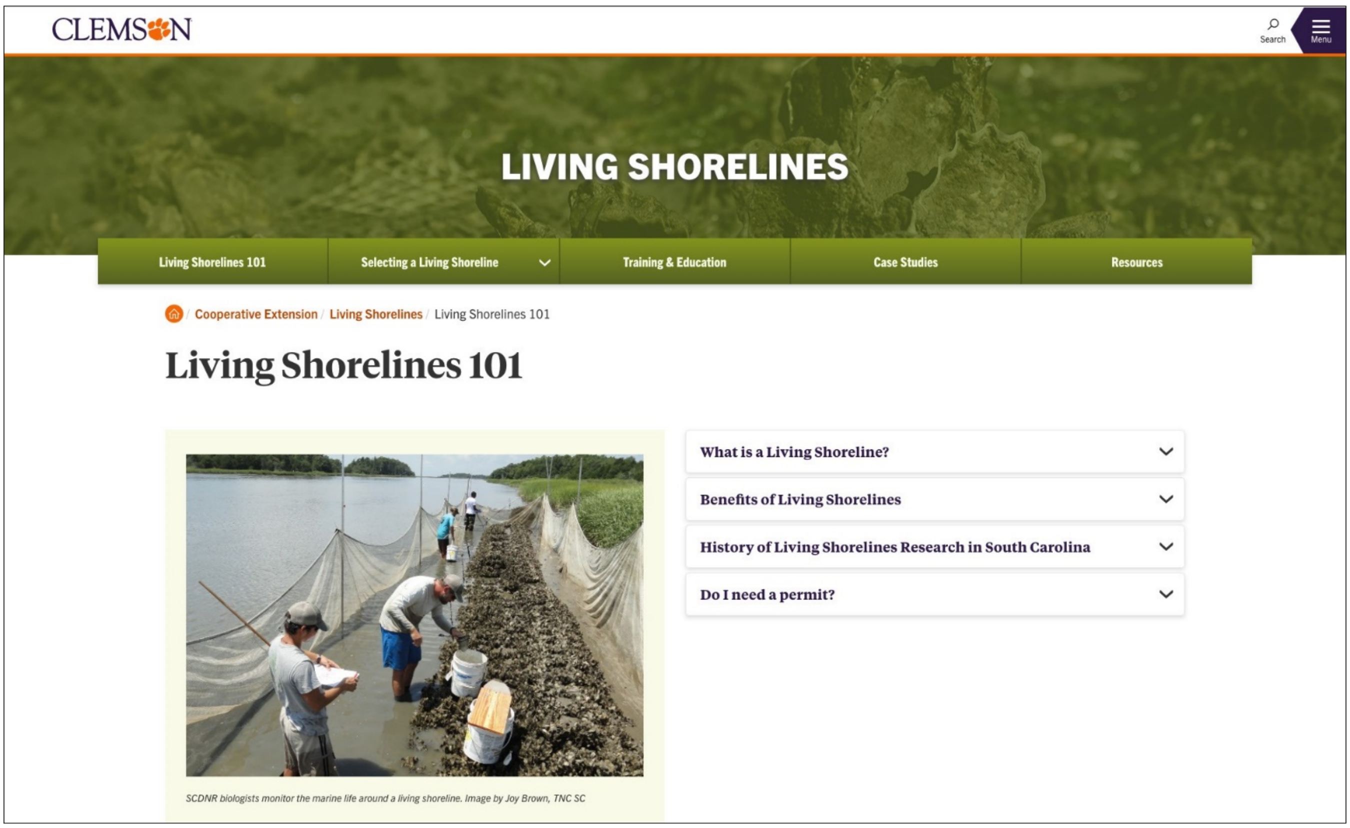

Figure 77: Screenshot of SCDHEC (and partners) living shorelines informational website

Responsible boating behavior

- Goal: Boaters abide by no wake zones and control their speed in areas where creeks are experiencing significant erosion.
- Target audience: Boaters, both residential boat owners and visitors who rent boats.
- Current behavior: No wake zones are commonly ignored.
- Target behavior: Slow down and obey signage for no wake zones, and additionally for informal no wake zones (such as within a certain distance of a swimmer or dock, rapidly eroding creek banks).
- Outreach strategies: Educational signs/materials at marina, boat ramps, community docks, and tackle/bait shops explaining no wake zones and boating etiquette, tabling at community events using existing SCDNR boater safety outreach materials, replacement of old non-descript no wake signs with clearer versions.
- Messages: Obeying no wake zones protects shorelines, water quality, and humans and wildlife (e.g., turtles, dolphins) that use our waterways.
- Funding opportunities: Existing resources and materials available from SCDNR.

General watershed awareness

- Goal: Residents and visitors are aware of the water quality issues throughout the watershed and can identify the three distinct watersheds encompassing Edisto Island and the Town of Edisto Beach.
- Target audience: Residents and visitors to the watershed.
- Current behavior: Some residents are unaware of the water quality issues that have resulted in shellfish bed closures. Many residents are unaware that the waterways are regularly monitored by SCDHEC and SCDNR, or where to find that water quality data.
- Outreach strategies: Educational materials, tabling at community events, website, raising awareness of local water quality monitoring, the watershed plan, local workshops, SC Adopt-a-Stream trainings, “now entering” watershed signs (Figure 78).
- Messages: Edisto has some water quality challenges that can be addressed and resolved through a community-wide effort.
- Funding opportunities: Section 319 grant funds, existing materials and resources from SCDHEC, Clemson Extension, SCDNR ACE Basin NERR Coastal Training Program, SC Sea Grant.

Figure 78: Example of a Clemson Extension “Now entering...watershed” sign that has been approved by SCDOT and can be printed and installed at watershed boundaries

Chapter 9
Long-term Water Quality Monitoring Needs

Long term water quality monitoring across the EIW is primarily conducted by the SCDHEC Shellfish Management Program, with additional ongoing monitoring conducted by the SCDNR. There are sufficient monitoring sites across the watershed (Figure 35); however, they are not all monitored with the same frequency and for the same parameters. The bacteria impairments were set based on monthly monitoring data that stretches back as far as the late 1990s, while turbidity impairments were set with one year's worth of monthly monitoring data. These turbidity impairments should be monitored again to determine if the conditions have changed or if the impairment designation is still appropriate. Additionally, nutrient monitoring is needed to determine whether the turbidity impairments are driven by sediment or algal growth fueled by excess nutrients.

A broader microbial source tracking study is needed to confirm the sources of bacteria across the watershed. Recommended sites for sampling are indicated in Figure 79, and were selected based on ease of access, proximity to existing impairments, and relevant land-based sources of pollution. Commercial labs offer microbial source tracking, as does Clemson's Center for Watershed Excellence in partnership with the Clemson University Molecular Plant Pathogen Detection Lab, and potentially Dr. Tye Pettay's lab at the University of South Carolina Beaufort County.

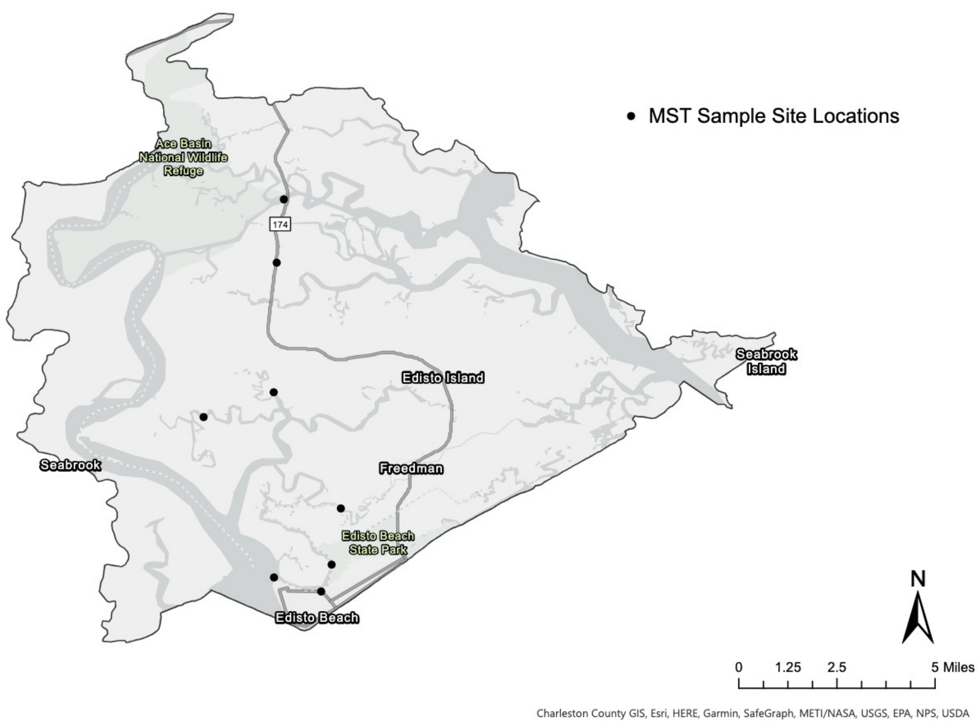

Figure 79: Recommended locations to sample for microbial source tracking analysis

The South Carolina Adopt-a-Stream program, a community science collaboration between Clemson's Center for Watershed Excellence and SCDHEC, could be a valuable tool in expanding capacity for detecting major changes or new issues related to water quality. Clemson Extension and SCDNR have already offered training on Edisto for interested volunteers, and there is currently an enthusiastic group of local volunteers monitoring basic water quality parameters.

Discussions with community members throughout the development of this watershed-based plan indicated that many locals were unaware of the extensive monitoring effort and long-term data record for the Edisto Island Watershed. Outreach and education efforts led by SCDHEC and SCDNR would be helpful to familiarize the community with historic and current water quality conditions. This watershed-based plan itself can also be used to inform conversations on the health of the EIW.

Chapter 10
Evaluation

Evaluation metrics can be used to measure the progress of the watershed-based plan implementation, and to assess if goals are being achieved. While some of the plan's goals are more difficult to measure than others (e.g., behavior change), it is important to regularly assess progress to understand what is working, and what goals and strategies may need to be adjusted. Suggested evaluation criteria for priority best management practices are listed below.

WATER QUALITY METRICS

Increase in water quality monitoring parameters measured

- Number of sites monitored for nutrients
- Number of sites included in microbial source tracking study

Increase in water quality monitoring

- Number of water quality monitoring stations actively monitored
- Number of SC Adopt-a-Stream volunteers
- Number of SC Adopt-a-Stream sites monitored

Demonstrated water quality improvement

- Percentage of samples meeting water quality standards
- Removal of impairments
- Updated ordinance on addressing riparian buffers on residential property

BEHAVIOR CHANGE METRICS

Surveys conducted after educational campaigns are implemented [see Chapter 8 and Appendix B for survey conducted before educational campaigns implemented].

- Increase in general watershed awareness
- Increase in septic inspections and pump outs
- Increase in stormwater BMP adoption on residential property
- Increase number of residents indicating they pick up pet waste

BEST MANAGEMENT PRACTICE INSTALLATION

Increase in best management practices installed

- Number of new pet waste stations installed
- Number of pet waste bags used per year
- Number of septic replacements
- Total acres of land placed under conservation easement
- Linear feet of cattle exclusion fencing installed
- Number of alternate water sources installed
- Number of buffer strips established on residential and agricultural land
- Total acres of cover crops planted
- Linear feet of living shoreline installed
- Number of demonstration sites established
- Number of pump out stations installed

- Number of no-wake zone signs installed
- Miles of streets included in active street sweeping maintenance plan
- Number of water quality inlets established
- Number of rain barrels installed
- Number of cisterns installed
- Total square footage of permeable pavement
- Total square footage of rain gardens

Results of regular evaluations can be used to adjust the goals and strategies of this living document, as needed.

Chapter 11
Implementation Schedule & Milestones

Implementation of watershed-based plans often depends on incremental efforts, conducted as time and resources allow, to meet plan goals. The implementation schedule and milestones (Table 22) laid out for this plan divides recommendations into priority and supplemental actions. Action items are categorized by type of best management practice with milestones, recommended timeline for implementation, and potential partners. Potential lead or partner suggestions indicate those whom it may be advantageous to involve; appearance in this column does not signify an existing commitment to implementation. Goals and milestones may need to change over time. See Chapter 7 for funding suggestions for individual BMPs.

Table 22: Implementation Schedule and Milestones

Implementation Schedule and Milestones

Prioritization	Action Items		Year					Potential Lead or Partners
	Recommended BMP	Milestones	1	2	3	4	5	
Priority Actions	Secure Funding for Plan Implementation	Identify and apply for funding (see Chapter 7) for individual BMPs	X	X	X	X	X	Partners will depend on specific BMP to be implemented
		Collaborate with relevant partners	X	X	X	X	X	
	Land Conservation	Identify priority parcels	X	X				Edisto Island Open Land Trust, other regional land trusts
		Increase land acreage in conservation easement on priority parcels		X	X	X	X	
	Septic Tank Repair or Replacement	Send targeted mailings to septic owners in priority areas	X					Charleston County, Town of Edisto Beach, Colleton County, Charleston County Soil and Water Conservation District, Edisto Land Trust, Clemson Extension
		Conduct septic management outreach to septic owners through distribution of educational materials, workshops, and presentations	X	X	X			
		Replace 50% of all failing septic systems on Edisto Island			X	X	X	
	Livestock BMPs	Prioritize livestock parcels where BMPs are needed	X	X				Natural Resource Conservation Service, Charleston Soil and Water Conservation District, Clemson Extension
		Conduct outreach to relevant landowners	X	X				
		Install exclusion fencing on two priority livestock parcels that intersect waterways			X	X	X	
		Provide alternate water sources on two priority livestock parcels that intersect waterways			X	X	X	
	Pet Waste Management	Conduct outreach to residents and tourists on proper pet waste disposal	X					Town of Edisto Beach, Clemson Extension, Community sponsors
		Identify locations for stations	X					
		Install four new pet waste stations and associated signage on Edisto Beach		X				
	Agricultural BMPs	Identify high-visibility agriculture parcel for buffer enhancement	X					Clemson Extension, NRCS, Charleston County S&W, Private land owners
		Implement buffer project on high-visibility agricultural parcel			X	X		
		Host field day workshop for growers on soil health best practices					X	
	Stormwater BMPs	Work with local government to enhance riparian buffer ordinances on residential property	X	X				Charleston County, Town of Edisto Beach, Edisto Beach Community Association, Colleton County
		Identify high-visibility proper for buffer installation		X				
		Install one demonstation riparian buffer planting at high-visibility community property			X	X		
		Host educational field day for demonstration site					X	
	Marina Waste Management	Install pumpout station or pumpout boat service at community marina	X					Private marina, SC Department of Natural Resources, SC Sea Grant Consortium
	In Public Waterways BMPs	Upgrade signage at No-Wake Zones for increased visibility		X	X			SC Department of Natural Resources, Charleston County, Colleton County

Table 22: Implementation Schedule and Milestones (cont.)

Implementation Schedule and Milestones

Prioritization	Action Items: Recommended BMP	Action Items: Milestones	Year 1	Year 2	Year 3	Year 4	Year 5	Potential Lead or Partners
Supplemental Actions*	Stormwater BMPs	Host a rain barrel and cistern sale; pair with workshop on installation and maintenance best practices	■	■				Town of Edisto Beach, Clemson Extension, Colleton County, SC Department of Transportion
		Purchase a street sweeping truck for weekly use on Edisto Beach				■	■	
		Install water quality vaults along Palmetto Boulevard and Jungle Road on Edisto Beach			■	■	■	
		Host a rain garden workshop and establish a high-visiblity demonstration site at a public property		■				
		Increase use of permeable pavement in parking spaces at commercial properties			■	■	■	
	In Public Waterways BMPs	Install one living shoreline project at high-visiblity waterway location		■				SC Department of Natural Resources, Clemson Extension, SC State Park Service
	Watershed Awareness Outreach	Install watershed crossing signs		■				Charleston County, Colleton County, SC Department of Transportation
	Stormwater Pond BMPs	Establish stormwater pond buffers where needed on ponds on Edisto Beach			■	■		Private pond owners, Town of Edisto Beach, Colleton County, Clemson Extension

**as funding and resources allow*

Chapter 12
Conclusion

Achieving water quality goals can feel like a monumental task; however, with this watershed-based plan as a guide, the Edisto Island Watershed has the potential to reduce the number of impairments and reopen shellfish beds to harvest, thereby improving waterway health and protecting the health of the community. Similar successes have already been documented across the SC coast following the implementation of watershed-based plans targeting bacteria.

This plan has outlined a series of structural and non-structural practices that, if implemented, can benefit water quality across the Edisto Island Watershed. While it may not be feasible to implement every best management practice recommended within this plan, watershed-based planning is an iterative process and taking steps to implement priority recommendations, either individually or in combination, will make a difference. Recommendations focus broadly on addressing pollution sources from agriculture, forestry, development, septic systems, wildlife, and erosion within tidal creeks and rivers. Further research is recommended to better quantify the contribution from individual sources, but recommendations were included to address all potential sources identified within the watershed.

The Edisto Island Watershed is a special place with a long history of appreciating and caring for its natural resources. Many of the water quality challenges are ones that will require the support and participation of the entire community to address. Fortunately, every resident and visitor to Edisto can play a role in limiting pollution and improving water quality. Non-structural practices, like education and outreach, will be of particular importance moving forward, to ensure residents and visitors to the watershed understand how their behavior could adversely impact water quality. Structural practices, like replacing failing septic tanks, may be eligible for grant funding to provide the financial resources needed for improvement.

This watershed-based plan is just the first step in a longer process to address pollution sources and implement solutions. With a watershed-based plan now in place, the Edisto community and many engaged and supportive partners can move forward together to restore a healthy Edisto Island Watershed for all.

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Appendix A: Community Survey postcards

Appendix B: Community Survey Questions

1. Where do you live?
   Edisto Island
   Town of Edisto Beach
   Other [comment box, with subtext: if other, what is your connection to Edisto Island and/or the Town of Edisto Beach?]

2. What do you like best about Edisto Island/Town of Edisto Beach?
   [open ended]

3. Do you live on a waterway? If so, which one? (name or location)

4. How often do you participate in the following activities in local waterways?
   [Kayaking, canoeing, or paddle boarding], boating, fishing, harvesting oysters, visiting beaches, swimming [LIST AND RANK EACH ACTIVITY SEPARATELY]
   Frequently
   Often
   Sometimes
   Rarely
   Never

5. If you fish, how often do you eat your catch?
   ALWAYS
   SOMETIMES
   RARELY
   NEVER
   I DON'T FISH

6. Do you eat locally harvested oysters?
   Yes
   No
   Other [comment box]

7. Do you harvest local oysters yourself for consumption?
   Yes
   No
   Other (If other, provide further explanation)

8. What types of pollution are you concerned with related to local waterways? (check as many as you are concerned about.)
   Bacteria
   Soil from erosion
   Nutrients
   Litter
   Oil from boats
   Other [comment box]

9. To what extent has concern over water quality prevented you from fully enjoying your local waterways?
   - ALWAYS
   - SOMETIMES
   - RARELY
   - NEVER
   - [comment box]

10. How concerned are you that oysters, clams, and mussels, can be affected by bacteria from failing septic systems, wildlife and pets, and other sources of pollution like sediment?
    - Very concerned
    - Somewhat concerned
    - Not very concerned
    - Not at all concerned
    - [comment box]

11. What do you think is the primary source of that bacteria pollution? (check all that apply)
    - Pets
    - Livestock
    - Wildlife
    - Septic systems
    - Illicit Discharge
    - Other [FILL IN THE BLANK]

12. What do you think is the primary source of that sediment pollution? (check all that apply)
    - Development
    - Forestry activities
    - Agriculture
    - Other [comment box]

13. Where do you think pollution is entering local waterways?
    - [comment box]

14. Do you have an operating septic tank on the property where you live?
    - Yes
    - No
    - Unsure

15. How many times has your septic tank been inspected in the past three years?
    - (enter number of times)

16. Is there a dog in your household?
    - Yes
    - No
    - Sometimes

17. How often do you pickup, bag, and dispose of your dog's poop?
    - Always
    - Sometimes
    - Only when we are on a walk
    - Rarely
    - Never

18. Do you own livestock (horses, goats, donkeys, chickens etc.)?
    - Yes
    - No
    - Unsure

19. What would you like to see done to improve local water quality?
    - [comment box]

20. How often does flooding impact your roads?
    - More than twice a month
    - Once or twice a month
    - Every few months
    - Once or twice a year, none

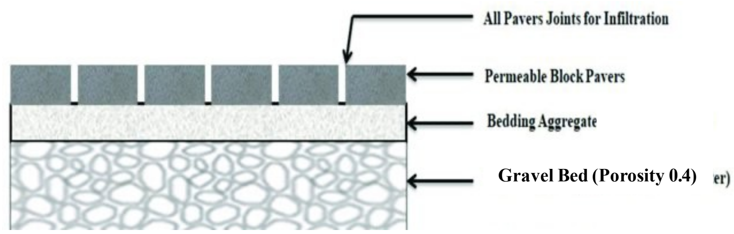
Appendix C: BMPs designed by Dr. Nandan Shetty's engineering students in a Hydrology and Hydraulics course at the Citadel

Designs include:

- A permeable pavement installation at the entrance of a lumber facility on Edisto Island.
- A raingarden streetscape project on the first block of Palmetto Boulevard on Edisto Beach.
- A permeable pavement installation within a section of the Food Lion (formerly BiLo) parking lot adjacent to McConkey's.
- A series of 4 rain gardens at the farmer's market parking lot on Dockside Rd, Edisto Beach.

Jen Copps and Alicia Brewington

The Site is located at 796 State Highway 174 at a lumber storage facility on Edisto Island, SC. The purpose of this design is to aid in the development of a watershed-based plan (WBP) that will be submitted to the South Carolina Department of Health and Environmental Control (SCDHEC). The goal of this design is to propose the installation of permeable pavement at this facility to address surface water pollutants that may impact source water in the form of runoff. The facility is surrounded by wetlands and bound by Highway 174, runoff in this area can be impacted by the facility itself and traffic from the highway. The permeable pavement may be installed in the facilities parking lot to minimize runoff from these areas. The size of the drainage area is 120' x 18' x 2.64' and designed for 1 inch of rainfall.



$$WWWWWW = \frac{PP * AA *}{12}$$

$$WWW = \frac{(1") * (28750\ ffff") * (0.95)}{12} = 2276\ cf$$

$$V_{\#\$\%\&'()} = AA * nn * dd$$

$$\#\$\%\&'() = (2160\ fff^{'}) * (0.4) * (2.64\ ffff) = 2281\ ff^{+}$$

FIRST BLOCK OF PALMETTO BLVD. EDISTO BEACH, SC

The first block of Palmetto Blvd on Edisto Beach is notorious for flooding every time we have a heavy rain. This is one of the low points of the area, resulting in constant ponding in the roadway. We have previously proposed a system of catch basins and storm drainage to be collected in a retention pond located at Edisto State Park. As an alternate method or in addition to catch basins to control ponding in the first block, we propose a Streetscape project with a Rain Garden down the center of the street. This would create a boulevard. It would be planted with pink muhly grass and sable palmetto trees. The rain gardens would be lower than the road pavement and allow water in, retaining most of it. In a rain over one inch, some runoff will overflow the rain gardens. This is when the catch basins would take over. They are designed for a 10-year storm. This streetscape project can be funded by a matching T100 DOT grant. The town of Edisto Beach would be required to fund 50% of the project. These funds could be obtained from the Town Hospitality Tax.

The rain garden median would be 4 ft wide and 1100 feet long. It will stop at the second beach access. Below are the calculations for the size requirements based on this first block of Palmetto Blvd.

Catchment Area Characteristics		Rain Garden Design			
Design Precip	0.9 in	Area Rain Garden	4365 SF	road length	1163
Rv	0.95	Vol Soil Media	1309.5 CF	road width	50
Area	58150 SF	Vol Drainage Layer	1746 CF	road area	58150
Water Qv	4143.1875 CF	Water Qv	4146.75 CF		

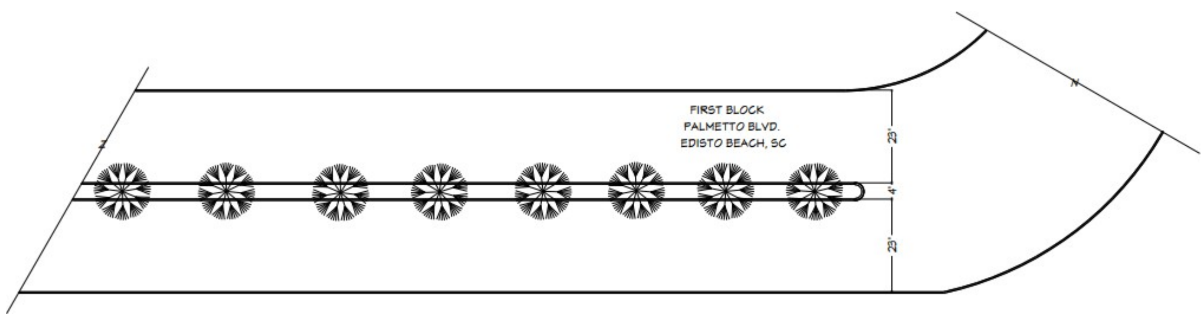


Figure 1: Plan view of rain garden

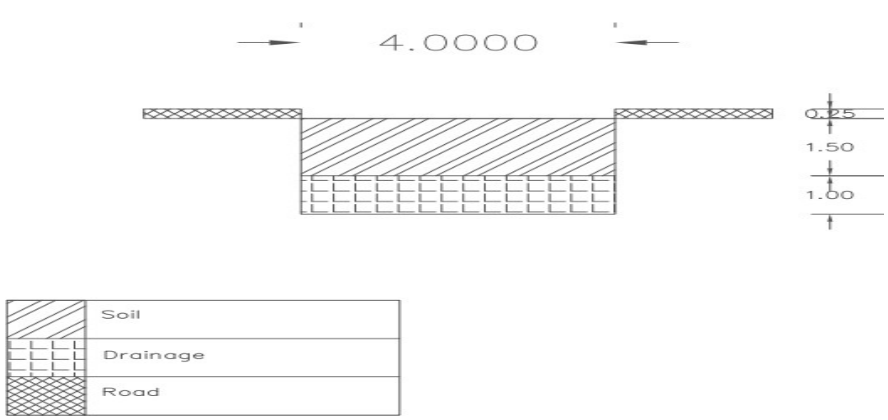


Figure 2: cross section view of rain garden

Submitted by Gerald Meetze, Ezekiel Durand, Sebastian Burton-Austrom

William Metts

CIVL 321 – Edisto Watershed Project

The permeable pavement section is located in a low area of the Edisto Beach Bi-Lo parking lot. The lot is at the beach entrance located at the corner of highway 174 and Jungle rd. A pavement section area of 5,000 sf was chosen with a drainage area of 10,000 sf. The pavement section was then designed to hold 1 inch of direct rainfall. The storage area is also connected to a nearby drainage basin where runoff exits the section. The overall dimensions of the section are 100ftx50ftx4.75in.

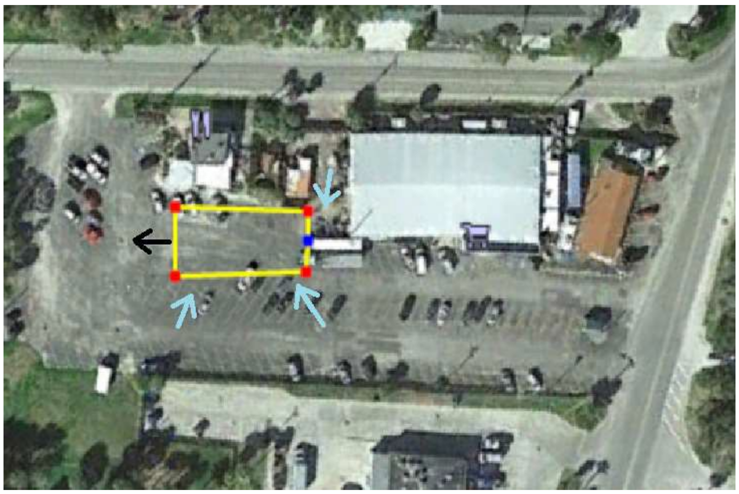


Figure 1: Plan Drawing

Figure 2: Section Drawing

Assumptions:

Drain Area = 10,000 ft^2

Storage Area: 5,000 ft^2

Water Quality Volume

$$WQ_v = \frac{(P)(R_v)A}{12} = \frac{(1)(.95)10{,}000}{12} = 791.67\ ft^3$$

Storage Volume

$$SV = A_p \cdot n \cdot dt$$

$$WQ_v = 5{,}000(.4) \cdot dt$$

$$791.67 = 5{,}000(.4)dt$$

$$dt = .3958\ ft \approx 4.75\ \text{inches}$$

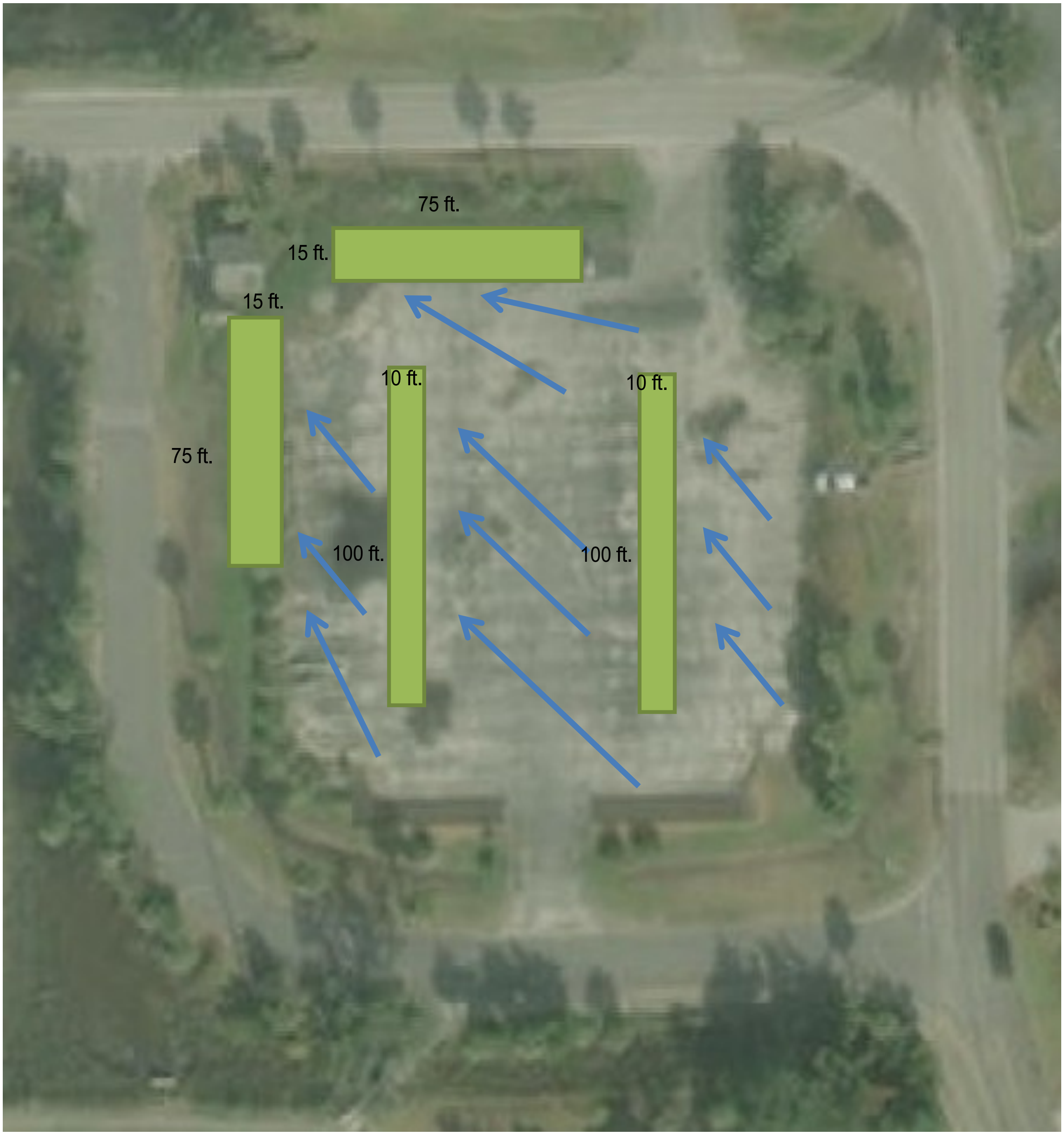
$SV = WQ_v$ ∴ Storage Area can hold 1" of direct rain fall

Figure 3: Hand Calculations

Daniel Stone, Noah Helms, Christopher Dennis, Collier Summers

Watershed Project Part 3

Our drainage area is a parking lot in between a corner and another branch of Docksite Rd. on the western peninsula of Edisto Island. The size of the area is 0.72 acres. We will be constructing a system of four rain gardens focused toward the upper left corner of the parking lot, which is the lowest point, to receive stormwater runoff. Since the drainage area is so large, the two rain gardens within the



parking lot will pick some of the runoff from the highest points, and the gardens in the corner will receive the remaining bulk of the runoff. The required water quality volume for a one-inch storm for the drainage area is 2483 cubic feet, and the combined volume of the designed rain gardens is 2762 cubic feet, so that the garden stores a one inch storm from the parking lot.

P (in) =	1
I (%) =	100
Rv =	0.95
Drainage Area (ft^2) =	31363
WQv (ft^3) =	2482.904
Area of RGs (ft^2) =	4250
Depression depth (ft) =	0.25
Depression Storage Volume (ft^3)	1062.5

	Depth (ft)	Porosity	Storage Volume (ft^3)
Soil Media	1	0.2	850
Drainage Layer	0.5	0.4	850
		Total Volume =	2762.5