Understanding and Managing Fecal Coliform in the May River Watershed Headwaters

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Project Team

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Town of Bluffton

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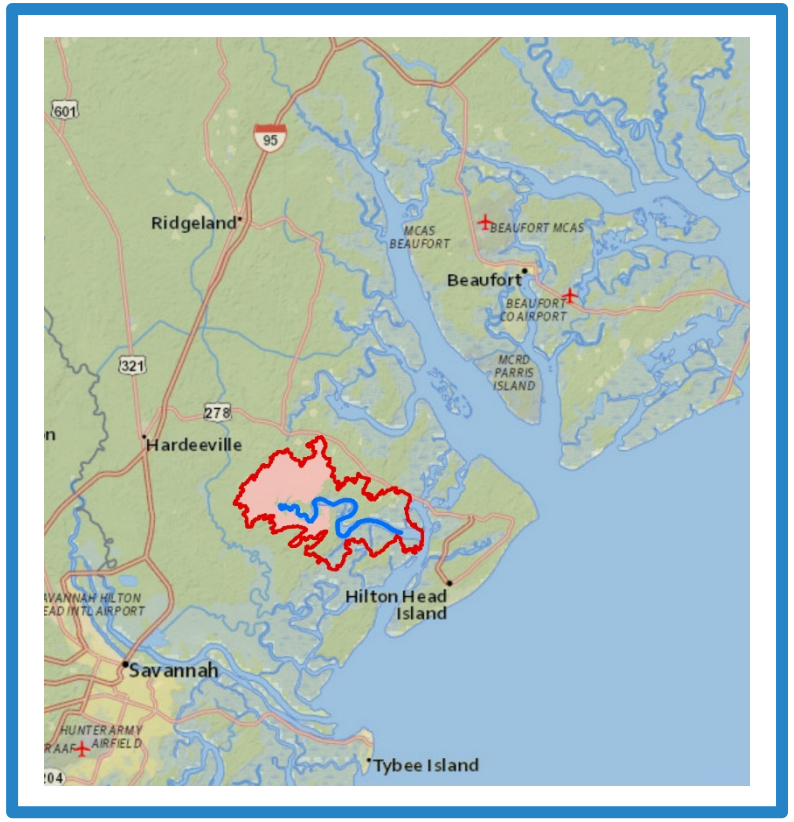
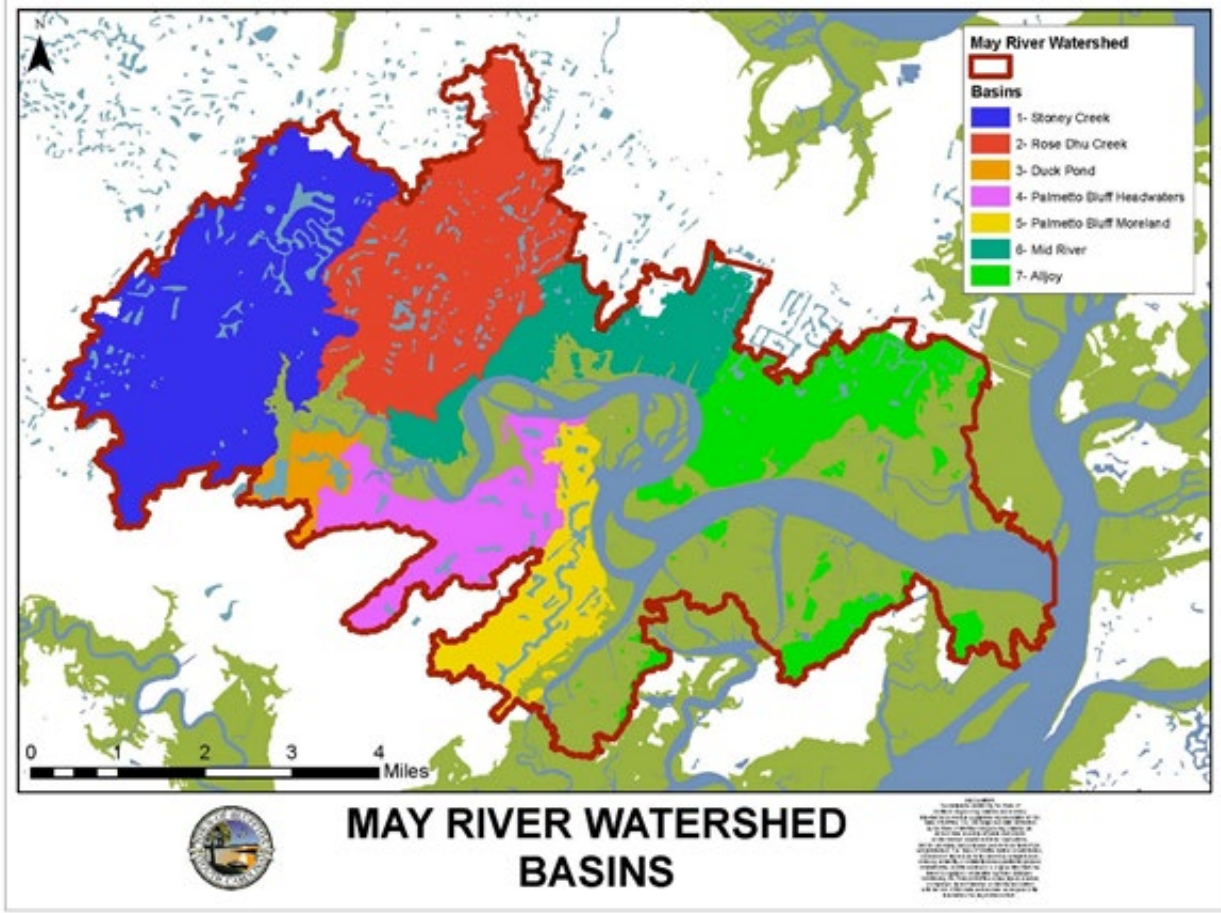
Town of Bluffton



- Located in southern coast of SC
- Named for bluff above May River
- Incorporated in 1852
  - (one-square mile)
- Currently 54 square miles
- *"Last true coastal village of the South"*

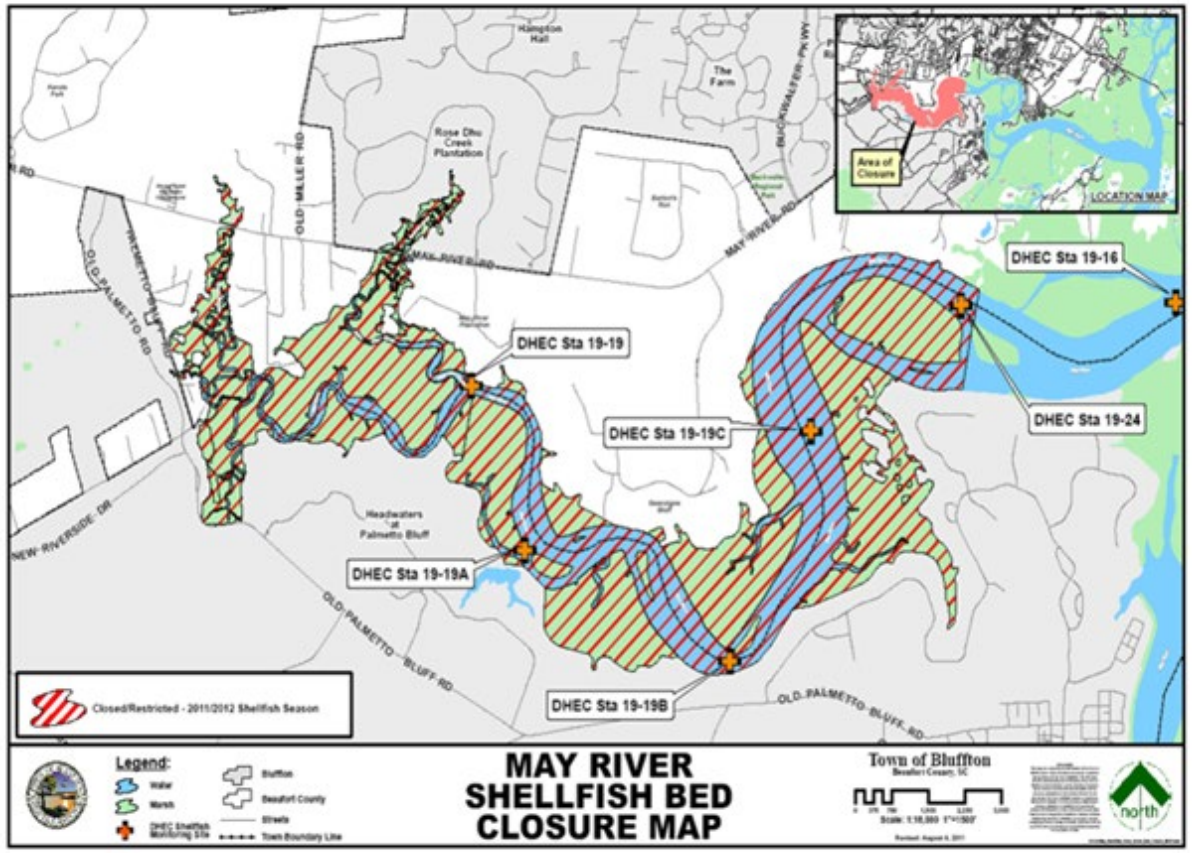
May River Watershed Overview

- Community value:
  - Historic and cultural uses
  - Aesthetics
  - Living resources
  - Economic impacts
- Outstanding Resource Water
- 13,477 acres (39% of the Town)
  - Headwaters 12,257 acres
    - **Stoney Creek** (5,480 acres)
    - **Rose Dhu Creek** (4,168 acres)
    - **Duck Pond** (683 acres)
    - **Palmetto Bluff** (1,926 acres)



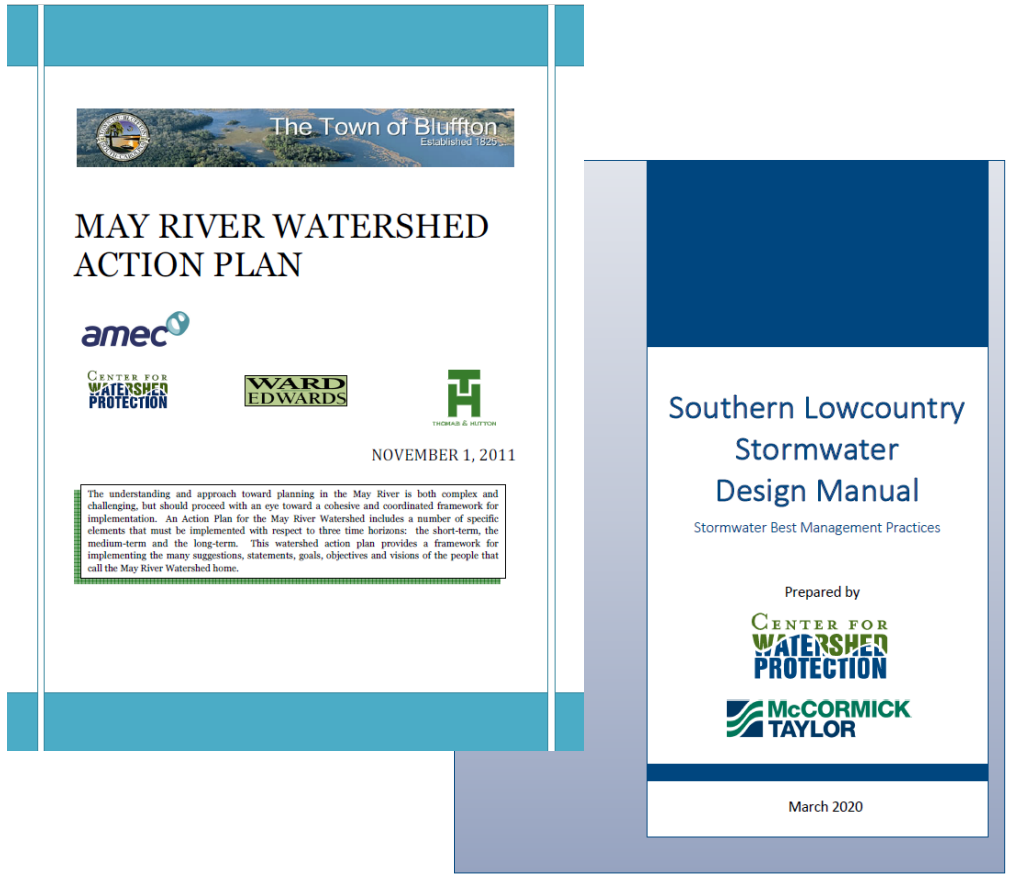
May River Watershed Development

- Rapid growth
  - Residents:
    - 1990: 794
    - 2000: 2,371
    - 2010: 12,530
    - 2019: 25,557
  - Impervious cover:
    - 2002: 5.78%
    - 2018: 15.31%
- Rise in Fecal Coliform (FC) levels
  - Water quality impairments
  - Shellfish bed closures starting in 2009



Actions to Address Water Quality

- Town of Bluffton Volume-based stormwater ordinance in 2010
- **May River Watershed Action Plan in 2011**
- Two EPA 319 Grant awards:
  - New Riverside Pond (2013)
  - Pine Ridge irrigation (2016)
- Collaborative Research to Prioritize and Model the Runoff Volume Sensitivities of Tidal Headwaters (NERRA, 2015)
  - High imperviousness, low salinity
- Historical Analysis of Water Quality, Climate Change Endpoints, and Monitoring of Natural Resources in the May River (USC-B, 2019)
  - Low salinity, higher FC
- Southern Lowcountry Stormwater Ordinance and Design Manual (2021)
  - Requirements based on HUC-12 watershed
  - Must retain 95th percentile storm on site in impaired watersheds
  - Required natural resources inventory, better site design

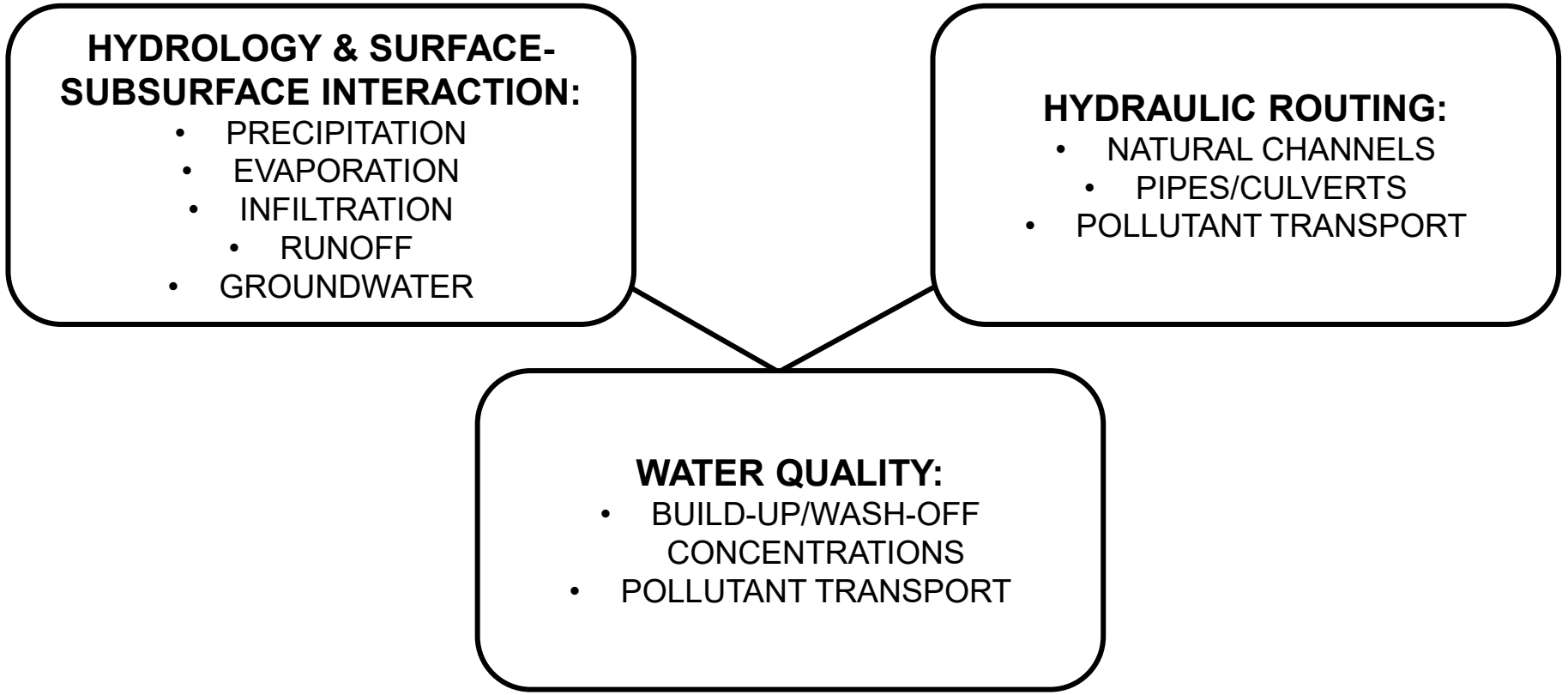


Project Overview

- Understand underlying causes of FC impairments in the May River headwaters and the extent to which development contributed to them
- Analyze changes in baseline (2002) and current (2018) conditions
- Develop XPSWMM water quality model
  - Estimates FC concentration based on land use
  - Identifies hotspots for bacteria
- Recommendations
  - Future monitoring (flow, FC, MST)
  - State of knowledge for stormwater BMPs
  - Projects
    - Septic to sewer conversion
    - Impervious surface mitigation

XPSWMM Model Development

Long-term continuous modeling for **baseline** (2000 - 2004) and **current** (2015 - 2018) time periods



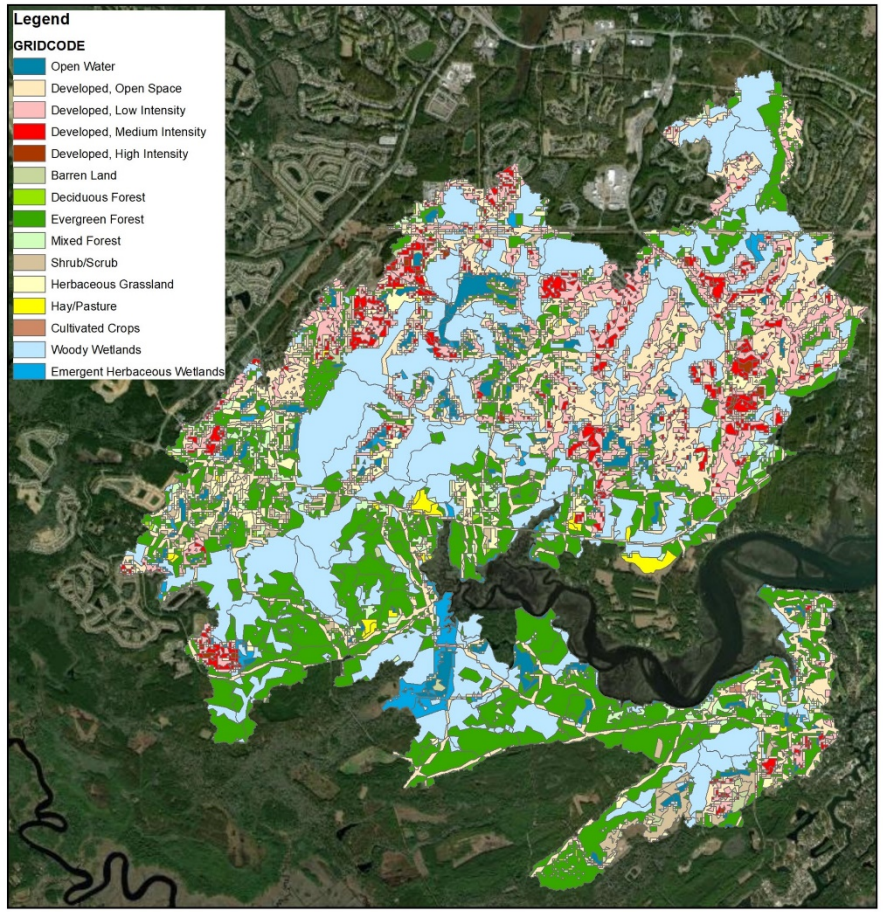
Hydrologic Setup

Precipitation: continuous precipitation time series for 2000 – 2004 and 2015 – 2018

Evaporation: calculate monthly average evaporation values using recorded meteorological data

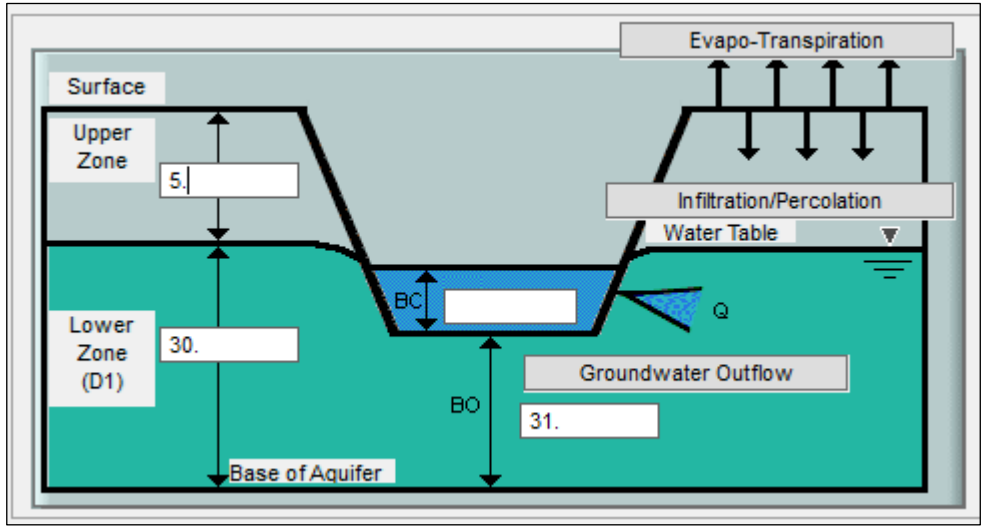
Infiltration: utilize land use and soils datasets to calculate infiltration parameters using Horton method

Runoff: utilize land use, imperviousness, and soils datasets to calculate roughness parameters for pervious and impervious areas



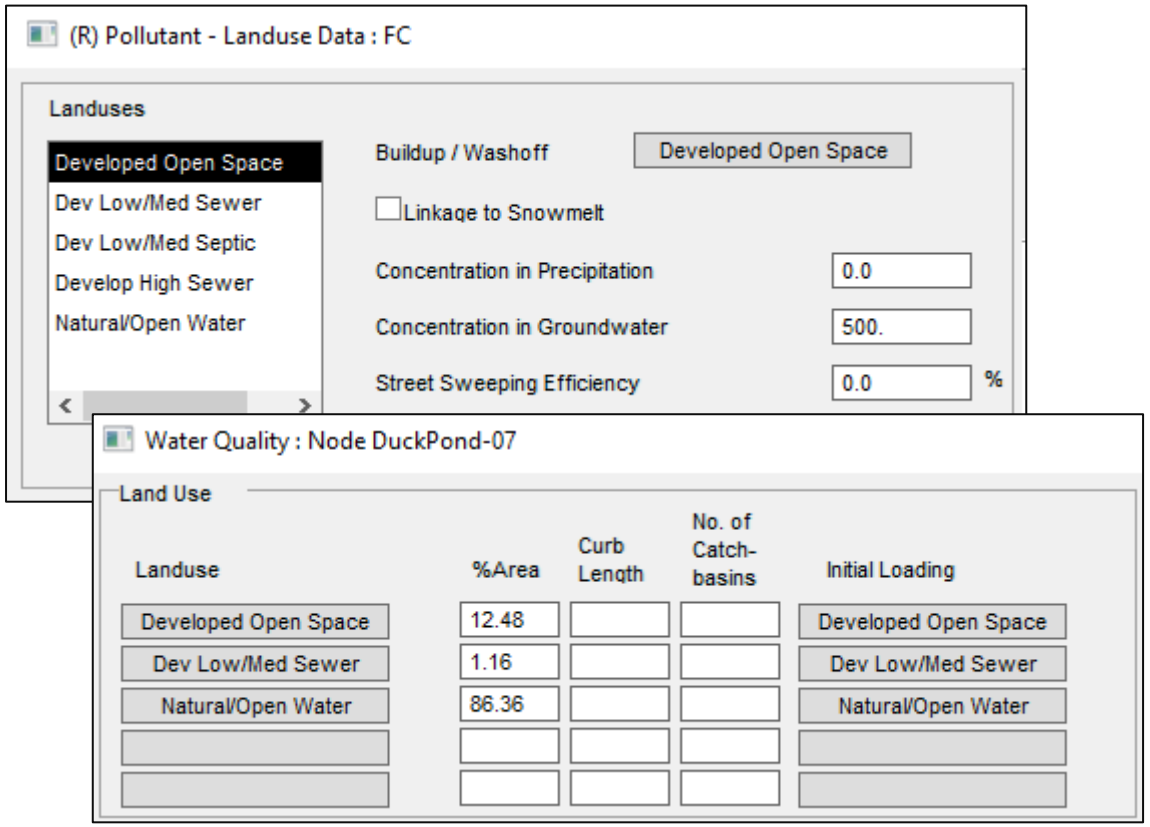
Groundwater Setup

- Define parameters related to aquifer size/thickness, evapotranspiration, infiltration, and groundwater outflow
- Drives interaction between surface runoff, infiltration, evaporation/evapotranspiration, and groundwater flow
- Contributes to dry-weather baseflow in natural channels



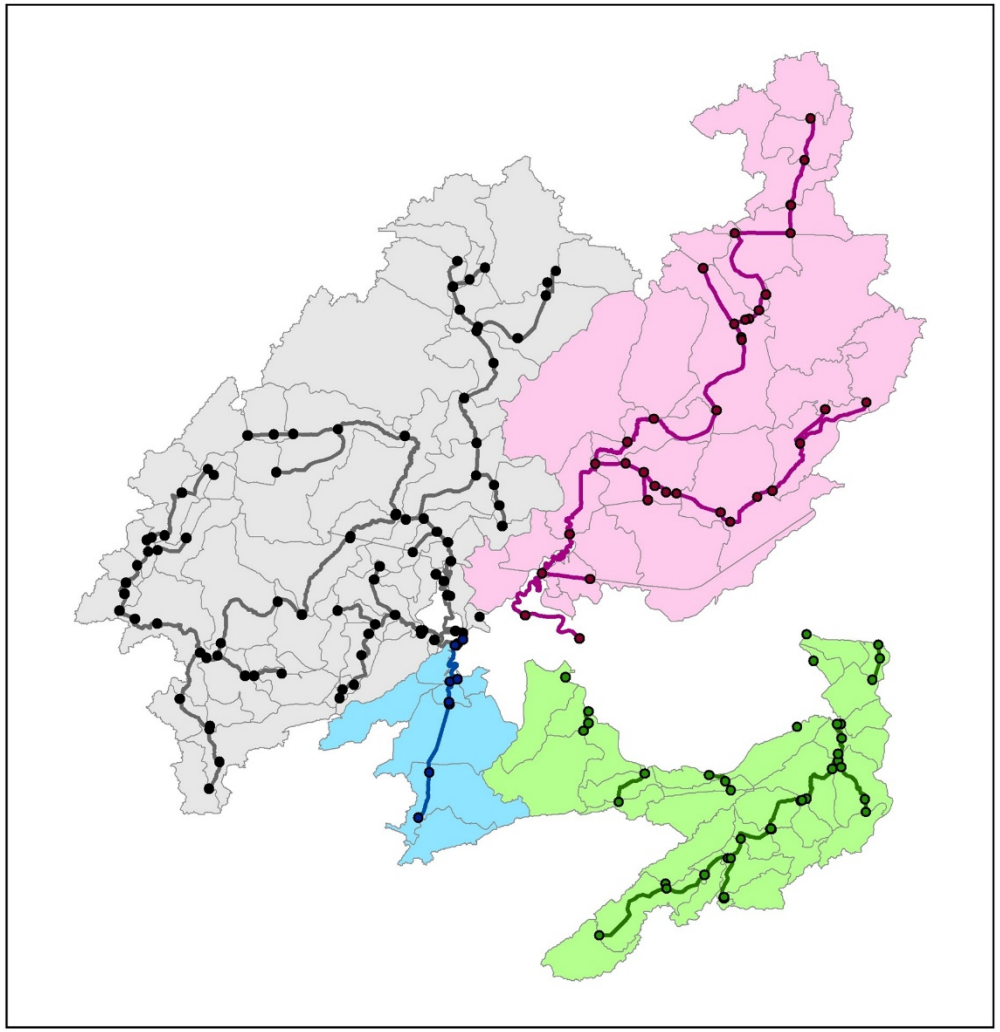
Water Quality Setup

- Build-up and wash-off approach: fecal coliform Event Mean Concentrations (EMCs) assigned based on land use and presence of septic/sewer system
- Concentrations applied to groundwater based on land use and presence of septic/sewer system
- Option to simulate pollutant decay



Hydraulic Setup

- Network of natural channels and connecting pipes/culverts
- Channel cross sections created using topography data due to lack of survey data
- Runoff (and associated pollutant concentrations) generated in hydrologic model are routed in hydraulic model



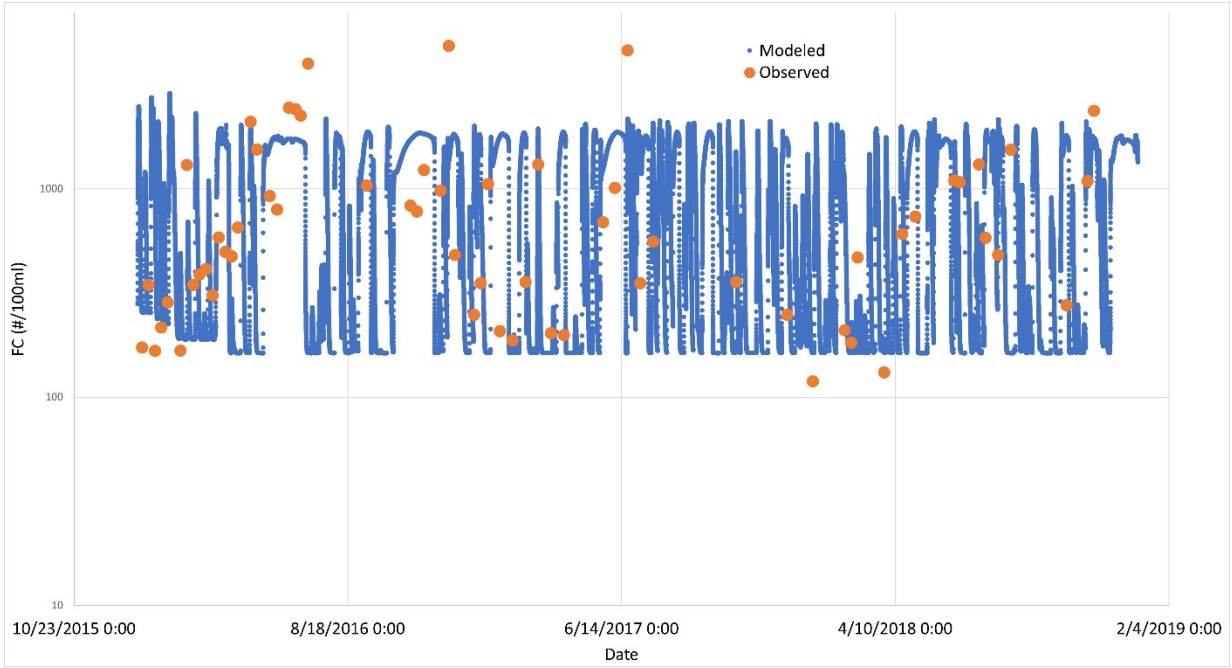
Model Calibration

FLOW

- Limited flow data available for baseline and current time periods
- Alternative validation methods used to evaluate modeled flow behavior: hydrologic water balance benchmarks and comparison to nearby USGS gages
- Evaporation and groundwater parameters adjusted during calibration

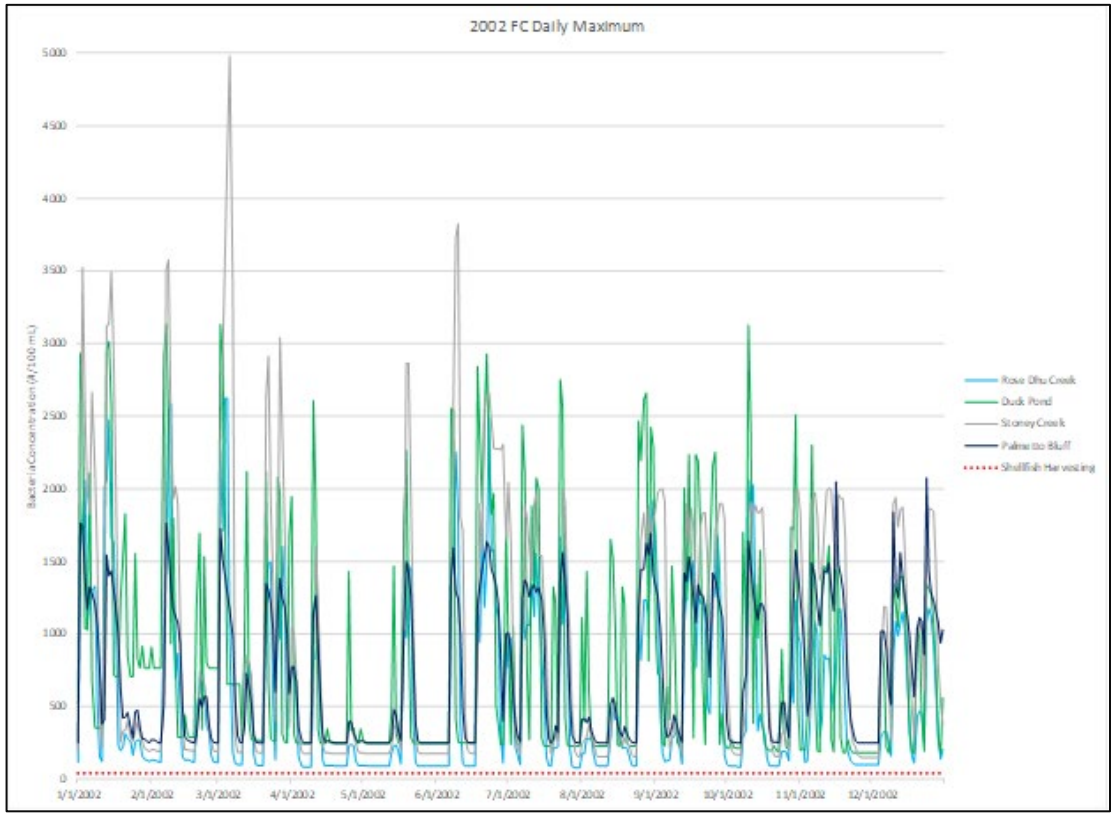
WATER QUALITY

- Recorded fecal coliform data used to calibrate the water quality portion of the model
- Fecal coliform EMCs adjusted during calibration



Water Quality Model Results

Daily Maximum FC Concentration (#/100mL)

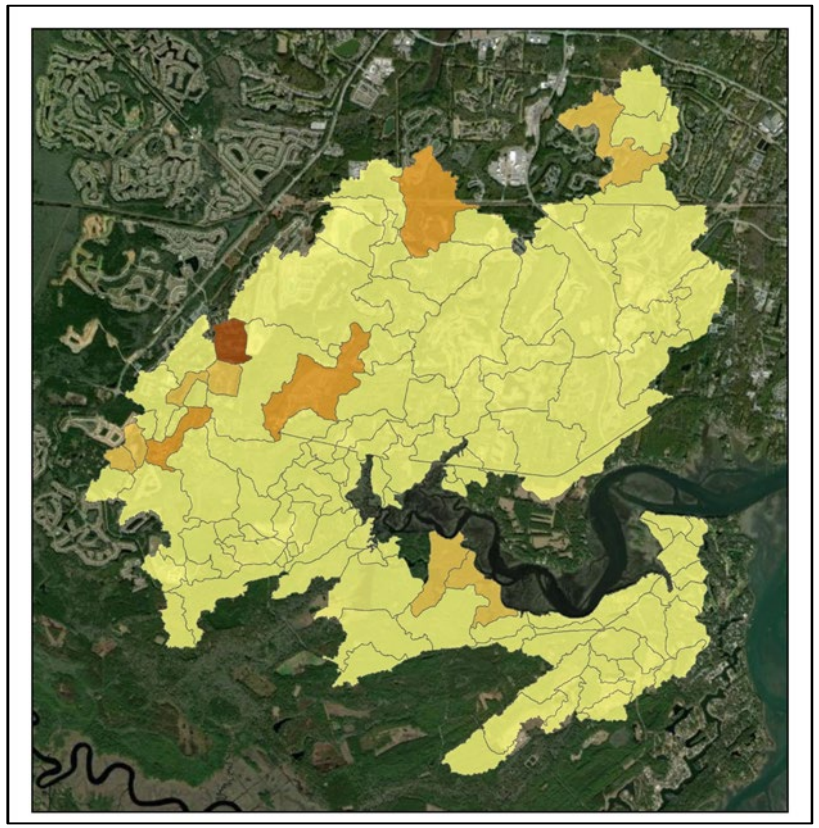


Average Daily Maximum FC Concentration (#/100mL)

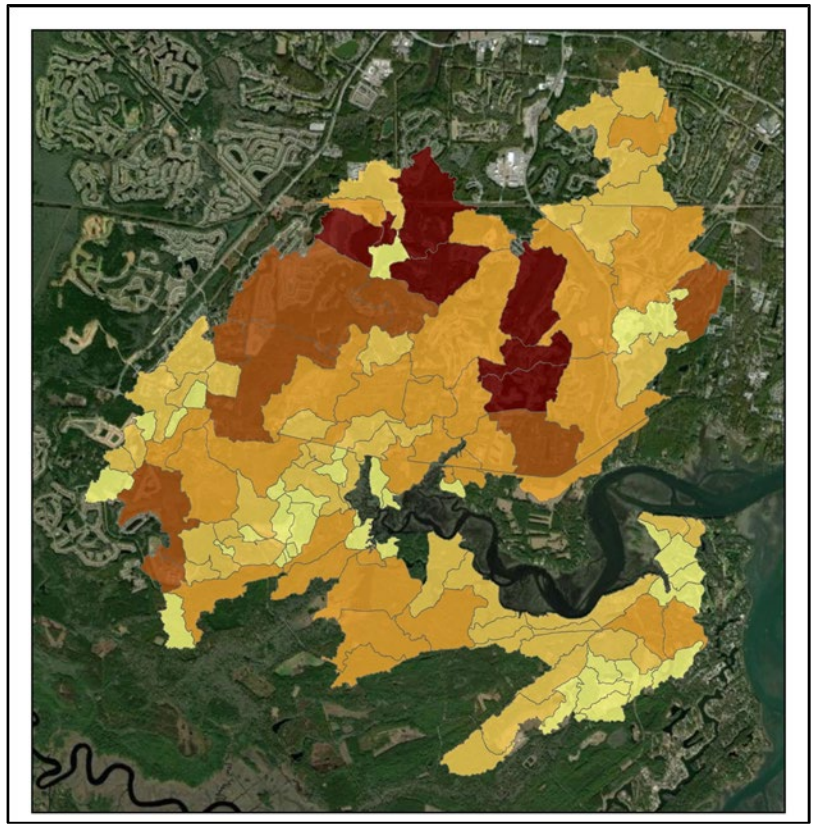
	Duck Pond	Palmetto Bluff	Rose Dhu Creek	Stoney Creek
2002 Baseline Condition	827	749	583	995
2018 Current Condition	538	687	650	932
Shellfish Harvesting Limit	43	43	43	43

Fecal Coliform Hotspots: Total Load

2002

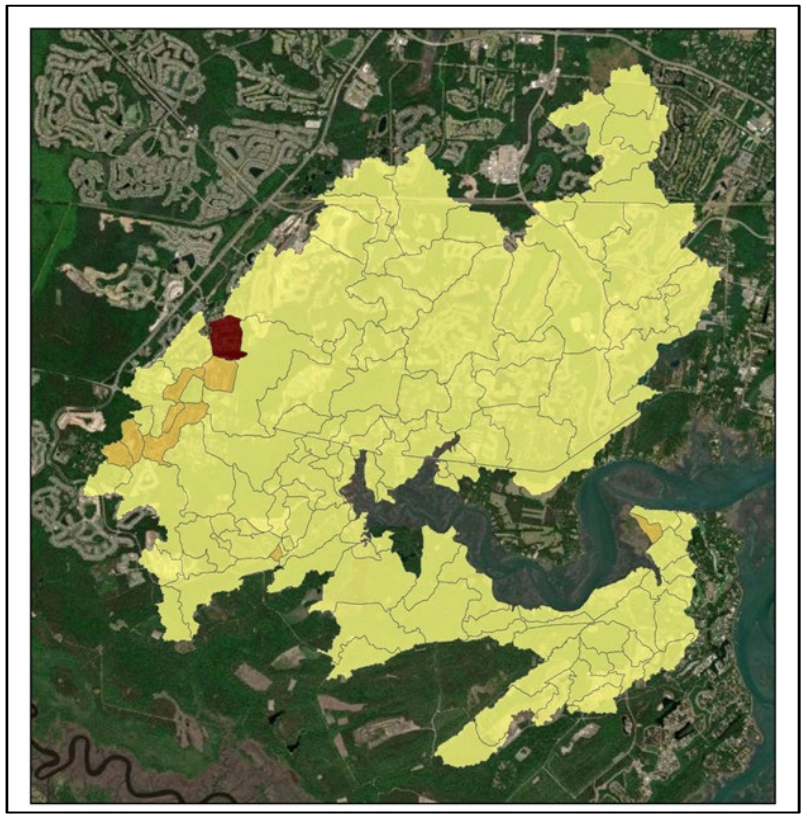


2018

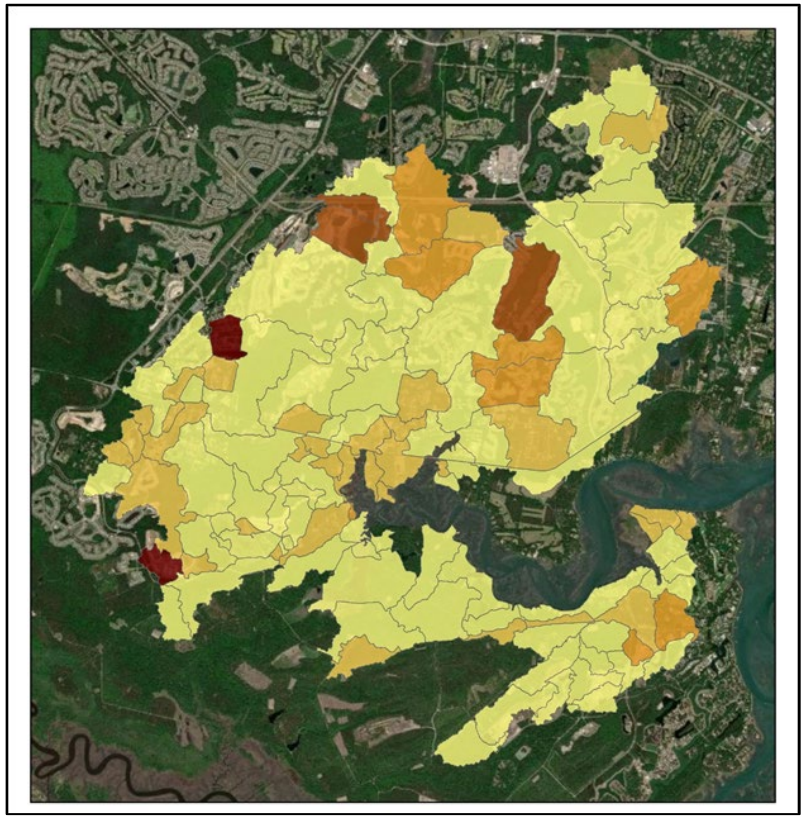


FC Hotspots: Normalized Load

2002

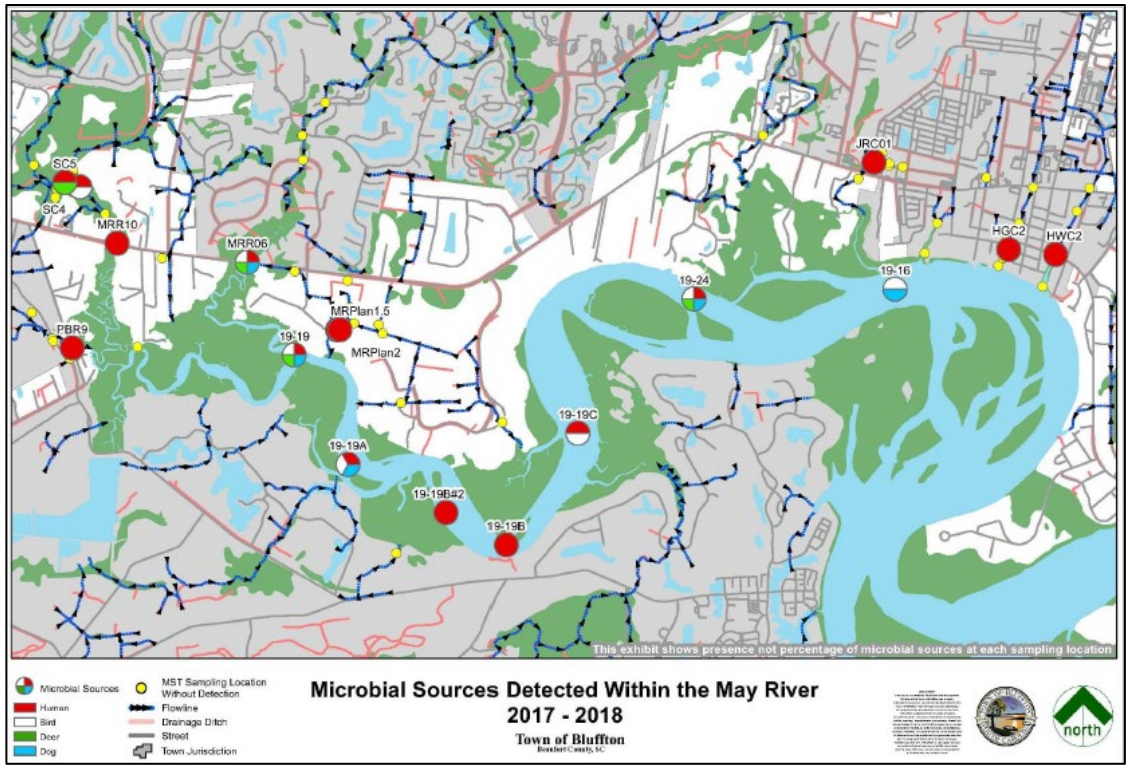


2018



Recommendations for Future Action

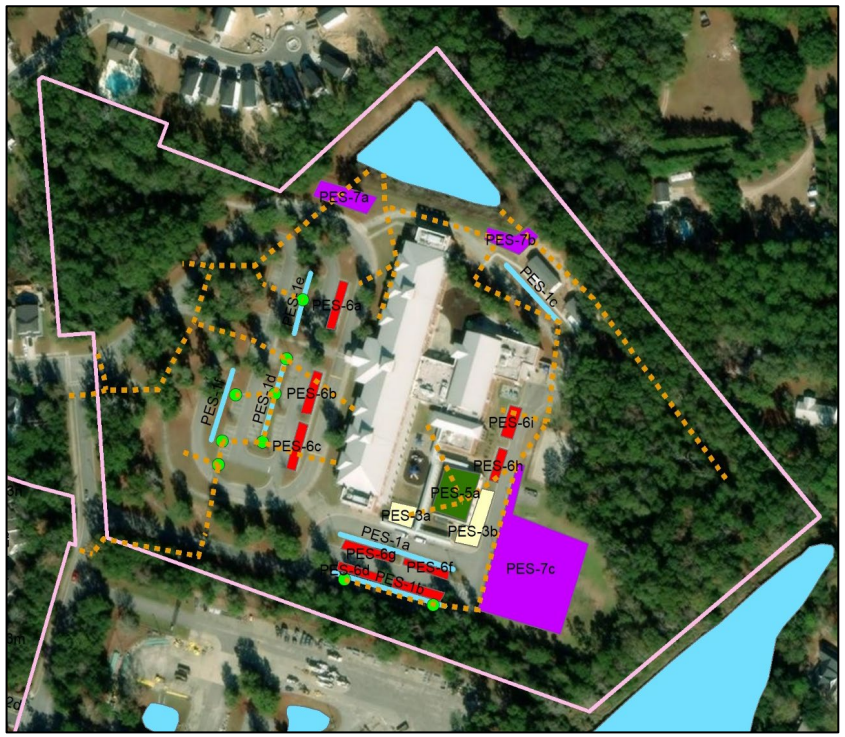
- **FIB do not correlate well with the occurrence of pathogens**
  - FIB can colonize and regrow in biofilms and sediments
- **Strategies for Assessing Problems**
  - New in-house MST
  - Simultaneous FC and flow monitoring
- **Strategies for BMPs**
  - Human sewage greatest threat
    - Septic to sewer conversion
  - Reduce stormwater volumes by infiltration techniques as first priority
    - Ponds do not promote infiltration, may contribute to persistence of FIB downstream



Project Site Selection

- **Subcatchment screening to identify potential areas**
  - Total annual load (#FC)
  - Normalized annual load (#FC/acre)
  - Total impervious Area (acres)
  - Total impervious area (% subwatershed)
- **Largest Parking Lots**
  - Schools, church, POA amenity centers, fire station, apartment complex
- **Largest Building Footprints**
  - Schools, church, recreation center, stables
- **Septic to Sewer Conversion**
  - Neighborhoods identified in separate report by Town, Beaufort County, and Beaufort-Jasper Water & Sewer Authority

Projects



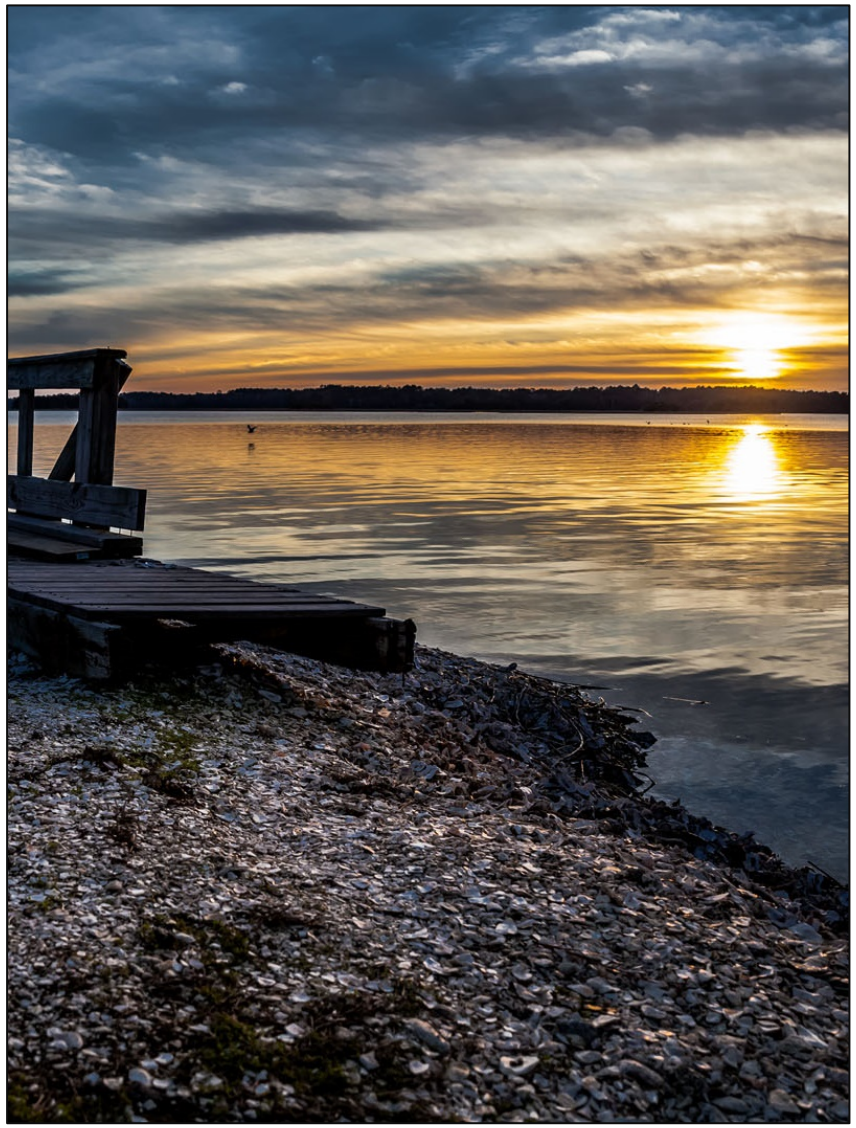
Pritchardville Elementary School

Project Type	Name
Septic to Sewer	Cahill
Septic to Sewer	Gascoigne
Septic to Sewer	Stoney Creek
Septic to Sewer	Pritchardville
Stormwater Retrofit	Bluffton Early Learning Center (BELC)
Stormwater Retrofit	Boys and Girls Club of Bluffton (BGC)
Stormwater Retrofit	Benton House (BH)
Stormwater Retrofit	Bluffton High School (BHS)
Stormwater Retrofit	Buckwalter Recreation Center (BRC)
Stormwater Retrofit	Lowcountry Community Church (LCC)
Stormwater Retrofit	McCracken Middle School/Bluffton Elementary School (MMSBES)
Stormwater Retrofit	May River High School (MRHS)
Stormwater Retrofit	One Hampton Lake Apartments (OHLA)
Stormwater Retrofit	Pritchardville Elementary School
Stormwater Retrofit	Palmetto Pointe Townes (PPT)

Project Evaluation and Ranking

Metric	Total Score	Potential Points Awarded					
Cost	20	> $10 mil = 1	$5 mil – < $10 mil = 5	$1 mil – <5 mil = 10	$500k – < $1 mil = 15	<$500k = 20	
Located in Bacteria Hotspot Subcatchment	10	Top 10 FC load = 10					
Subcatchment Imperviousness	10	> 30% = 10	20-30% = 8	10-20% = 4	< 10% = 0		
Bacteria Load Reduction (billion FC/year)	20	<1,000 = 5	1,000 to 4,999 = 10	5,000 to 9,999 = 15	>10,000 = 20		
Runoff Reduction	15	> 1,000 ac-ft = 15	500 – 1000 ac-ft = 10	< 500 ac-ft = 5			
Maintenance Burden	15	BI = 15	AN = 12	IL = 8	DALS = 4		
Landowner Cooperation	10	PUB, MIN = 10	PUB, MAJ = 8	ROAD = 5	PRIV, MIN = 4	PUB, MAJ = 2	PRIV, MAJ = 0
Permitting Burden	15	NP = 15	TP = 13	T+E = 10	T+B = 8	EIP = 5	
Acceptance/Visibility	10	HI, PUB = 10	HI, PRIV = 8	LOW = 6	HI, CI = 5		
Accessibility	10	NAI = 10	MAI = 8	MULT = 4	MJAI = 1		
TOTAL	135						

BI = minimal biannual maintenance
AN = minimal annual maintenance
IL = intensive landscaping
DALS = difficult access, intensive landscaping
PUB = public owned property
MIN = minimal impact on property
ROAD = within roadway adjoining private property
PRIV = privately owned property
MAJ = major impact on property
NP = no permits
TP = typical permits
T+E = typical plus environmental permits
T+B = typical plus building permits
EIP = environmental impacts permitting
HI = high visibility
LOW = low visibility
CI = conflict of interest/goals
NAI = no access impediments (ROW)
MAI = minor access impediments
MULT = multiple private access points
MJAI = major access impediments



In it for the Long Haul

- **Identification of data gaps**
  - Planning for model refinements/calibration at later date
- **Challenges using XPSWMM**
  - Not intuitive, user-friendly
  - Many layers of inputs
  - Hydraulic mode vs. Sanitary mode
  - Long run times
  - Difficulty incorporating BMPs in meaningful way
- **Adaptive Management**
  - Evaluate and reassess recommendations for partnerships, policies, and projects

Current Status

- **Recommendations to Improve Model Calibration**
  - Continuous flow monitoring in Stoney Creek and Rose Dhu Creek subwatersheds
    - Sontek IQ flow measurements every 15 minutes
  - Weather stations (2 Town Facilities)
    - Precipitation data every 30 minutes
  - Water Quality samples
    - Current: FC once a month at 4 stations
    - Next FY: FC 2x month
  - MST
    - MOU with USC-B
    - Looking for Human/HF183 marker at 5 SCDHEC shellfish harvesting stations
- **New Regional Stormwater Ordinance and Design Manual**
  - Final approval 9/14/21

Questions?

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