COUNTY COUNCIL OF BEAUFORT COUNTY

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AGENDA
NATURAL RESOURCES COMMITTEE

Monday, October 5, 2015
3:00 p.m.
Executive Conference Room
Administration Building
Beaufort County Government Robert Smalls Complex
100 Ribaut Road, Beaufort

Committee Members:
Brian Flewelling, Chairman
Alice Howard, Vice Chairman
Gerald Dawson
Steve Fobes
William McBride
Jerry Stewart
Roberts "Tabor" Vaux

Staff Support:
Tony Criscitiello, Planning Director
Ed Hughes, Assessor
Eric Larson, Division Director
Environmental Engineering
Dan Morgan, Division Director
Mapping & Applications

1. CALL TO ORDER – 3:00 P.M.

2. PRESENTATION / VOLUME SENSITIVITY STUDY (THE SALINITY STUDY)
South Carolina Department of Natural Resources (presentation) (report)

3. LADY'S ISLAND ZONING MAP AMENDMENT FOR R200 015 000 0165 0000, R200 015 000 0169 0000, R200 015 000 0721 0000, R200 015 000 0820 0000, R200 015 000 0866 0000, R200 015 000 0867 0000, R200 015 000 0868 0000, R200 015 000 0869 0000, R200 015 000 0870 0000, R200 015 000 0871 0000, R200 015 000 0872 0000, R200 015 000 0873 0000, R200 015 000 0874 0000, R200 015 000 0875 0000 (14 PARCELS TOTALING 9.5 ACRES, SOUTH SIDE OF SEA ISLAND PARKWAY BETWEEN LADY'S ISLAND COMMONS AND YOUMANS ROAD) FROM T3-HC (HAMLET CENTER) TO T4-HCO (HAMLET CENTER OPEN); APPLICANT: COUNTY PLANNING STAFF (staff report) (property owner notification)

4. LADY'S ISLAND ZONING MAP AMENDMENT FOR R200 015 000 111G 0000, R200 015 000 0114 0000, R200 015 000 114B 0000, R200 015 000 114C 0000, R200 015 000 114D 0000, AND R200 015 000 0638 0000 – NORTH OF SEA ISLAND PARKWAY; R200 018 00A 0147 0000, R200 018 00A 0148 0000, R200 018 00A 0149 0000, R200 018 00A 0150 0000, R200 018 00A 0161 0000, R200 018 00A 0162 0000, R200 018 00A 0163 0000, R200 018 00A 0192 0000, R200 018 00A 0193 0000, AND R200 018 00A 0248 0000 – SOUTH OF SEA ISLAND PARKWAY (16 PARCELS TOTALING 19 ACRES, NORTH AND SOUTH SEA ISLAND PARKWAY BETWEEN GAY DRIVE AND DOW ROAD) FROM T3-N (NEIGHBORHOOD) AND T3-HN (HAMLET NEIGHBORHOOD) TO T4-NC (NEIGHBORHOOD CENTER) AND T4-HCO (HAMLET CENTER OPEN); APPLICANT: COUNTY PLANNING STAFF
(staff report) (property owner notification)

5. TEXT AMENDMENTS TO ARTICLES 2, 3, 4, 5, 6, 7, AND 10 OF THE COMMUNITY DEVELOPMENT CODE AS A RESULT OF THE SIX-MONTH REVIEW OF THE NEWLY ADOPTED CODE; APPLICANT: COUNTY PLANNING STAFF
(staff report) (text amendments)

6. ADJOURNMENT

Beaufort County Volume Sensitive Waters Study

Beaufort County Stormwater Utility Board

September 30, 2015

Beaufort County

- Water quality impairments in the County
- Strong stormwater standards with requirement to meet <u>volume limits,</u> also controls pollutants
- NPDES Phase II MS4 Permitting
- Stormwater Management Plan being revised
- The county is faced with managing stormwater to maintain the health of the waterways in the face of coastal growth.

Objectives

1. Delineate the spatial extent (within) of stormwater impact on major tidal waters.
2. Identify which watersheds (across) are more volume sensitive.
3. Project impacts on volume control.

Load = Volume * Concentration

Methods

- Five study creeks
- Install rain gauges in each watershed
- Measure salinity and depth down-stream from headwaters
- Evaluate magnitude of salinity change as function of rainfall
- Identify location of "critical volume-sensitive waters" - within and across
- Model stormwater runoff to assess BMPs and changing rainfall patterns

May River

Watershed Advisory Committee Members

- Don Smith
- Andy Kinghorn
- Eric Larson
- Danny Polk
- Kim Jones
- Al Segars
- Al Stokes
- Russell Berry
- Alan Warren
- Chris Marsh
- Reed Armstrong
- Dan Ahern
- Bob Gross

Precipitation Impact on Estuarine Waters

Within Watersheds

Across Watersheds

Volume Impacts (contaminants)

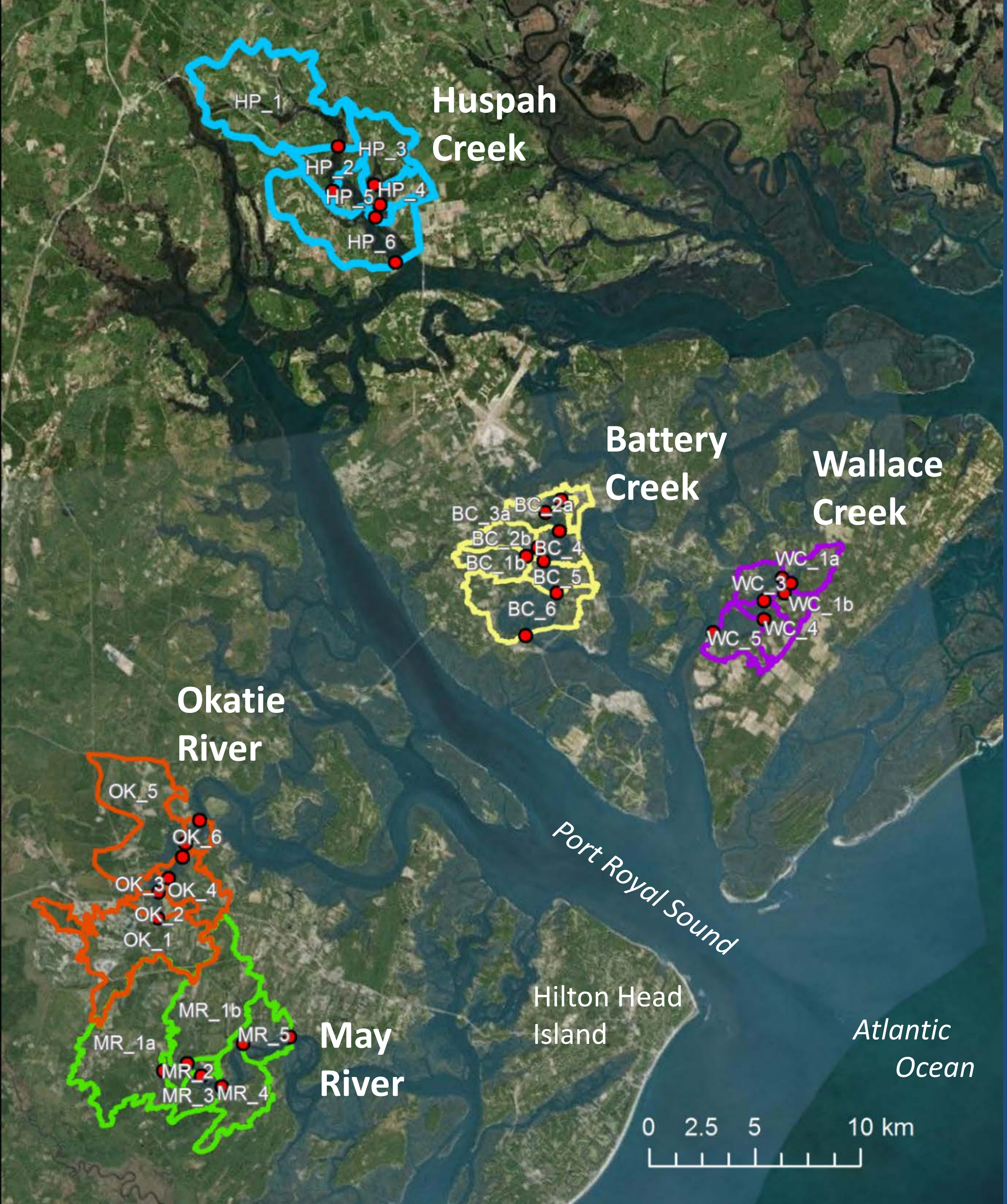
Impacts on Organisms

Data Collection

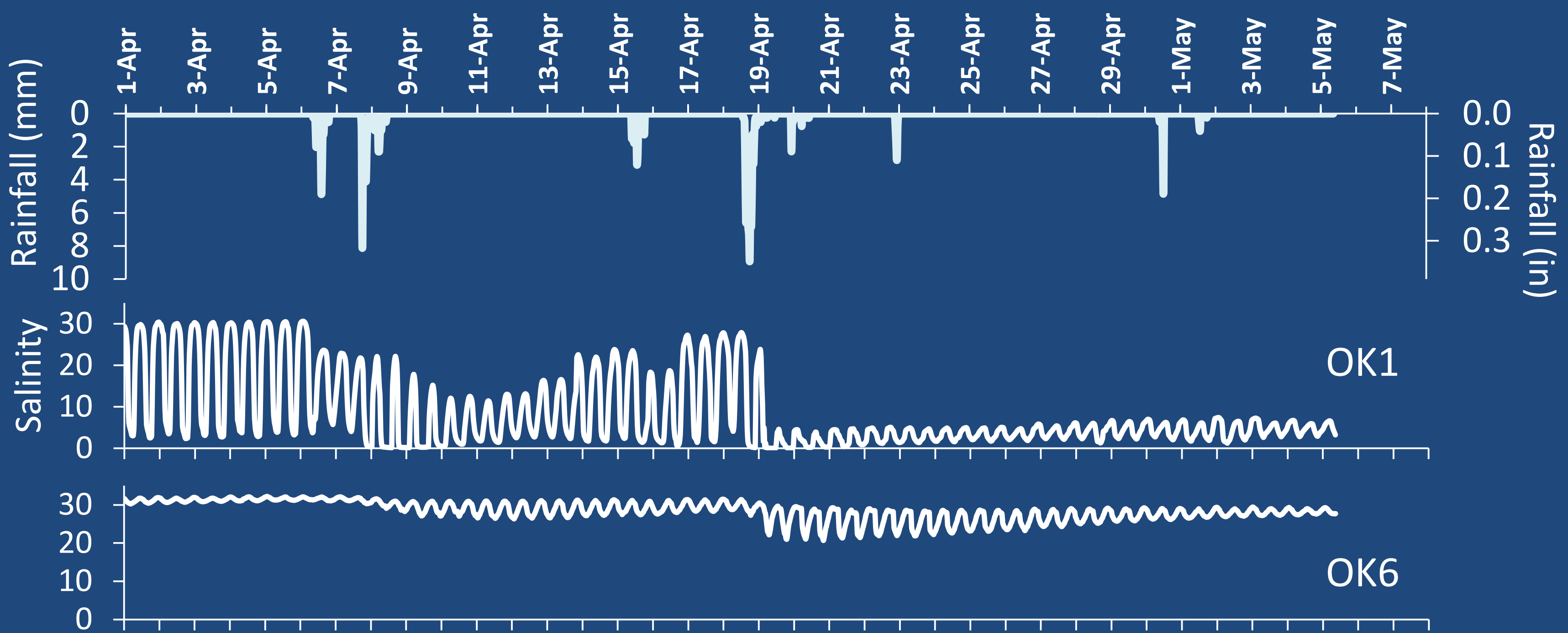
Salinity Drop

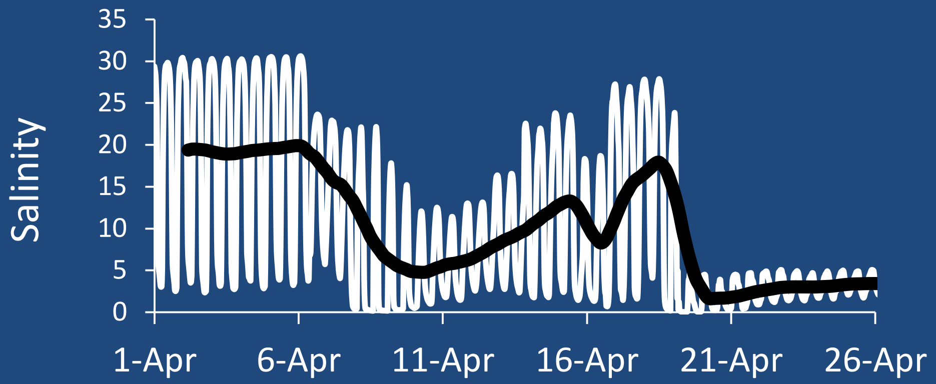
Predictive Models

Within Watersheds

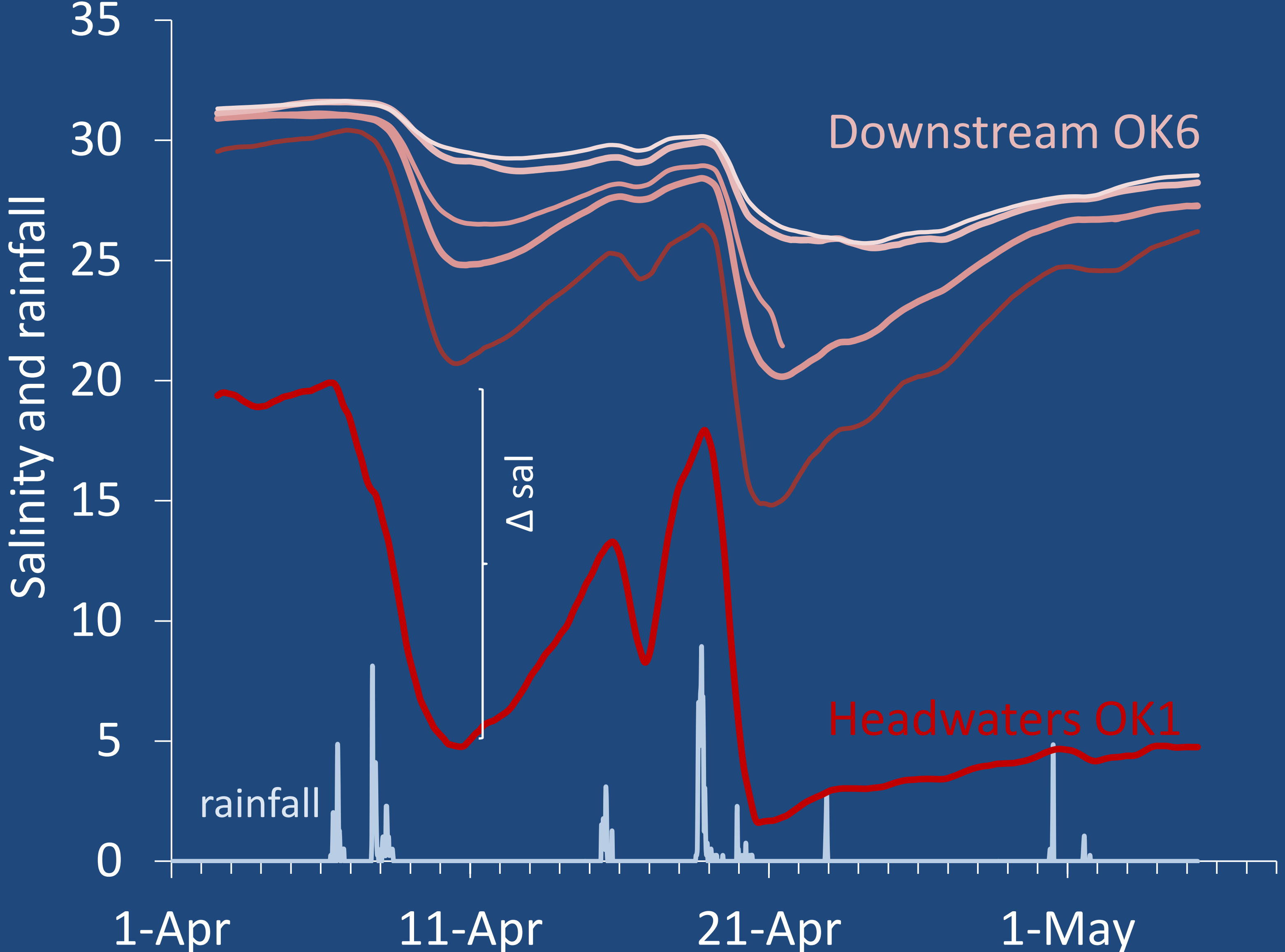


Data Preparation

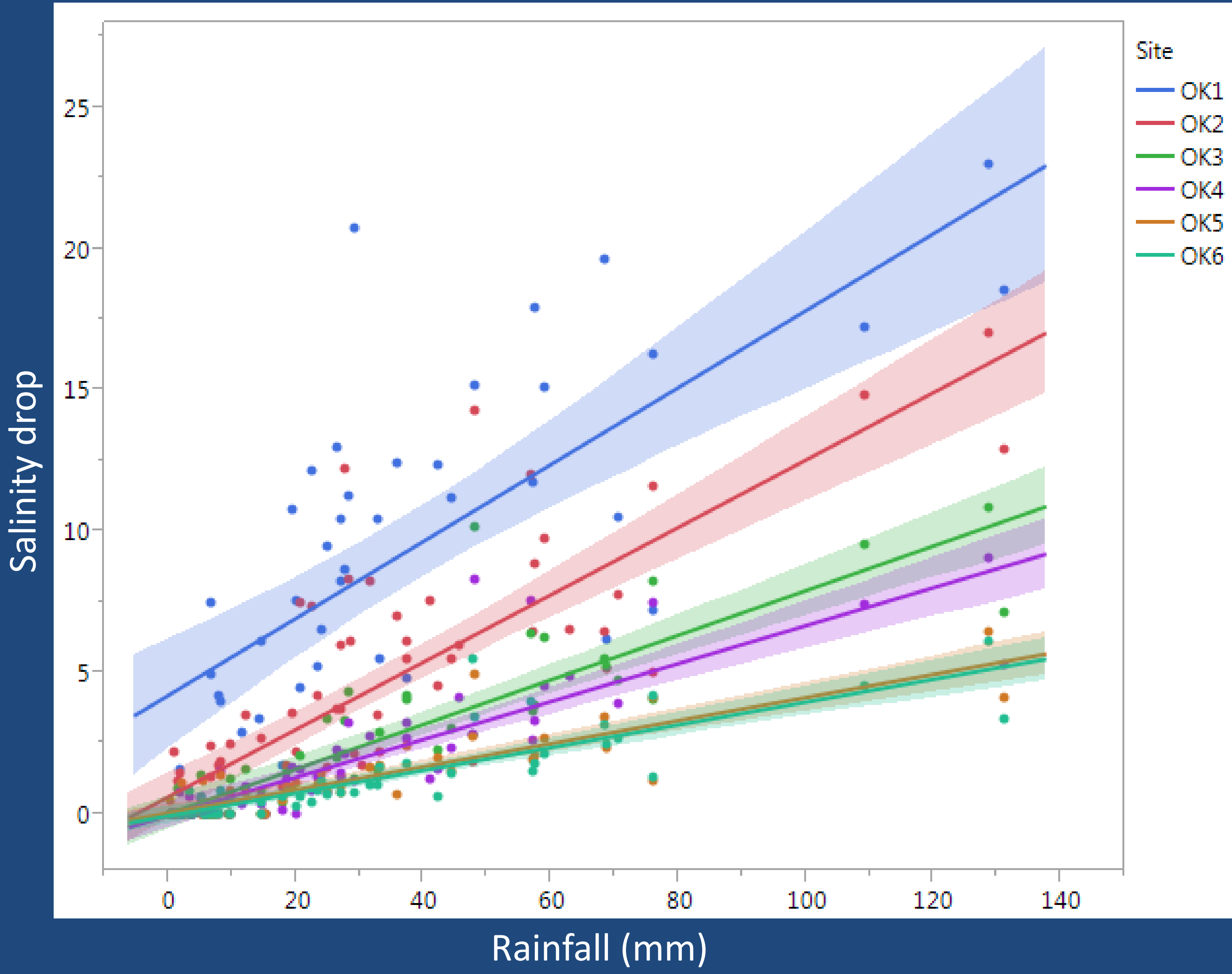




Okatie River



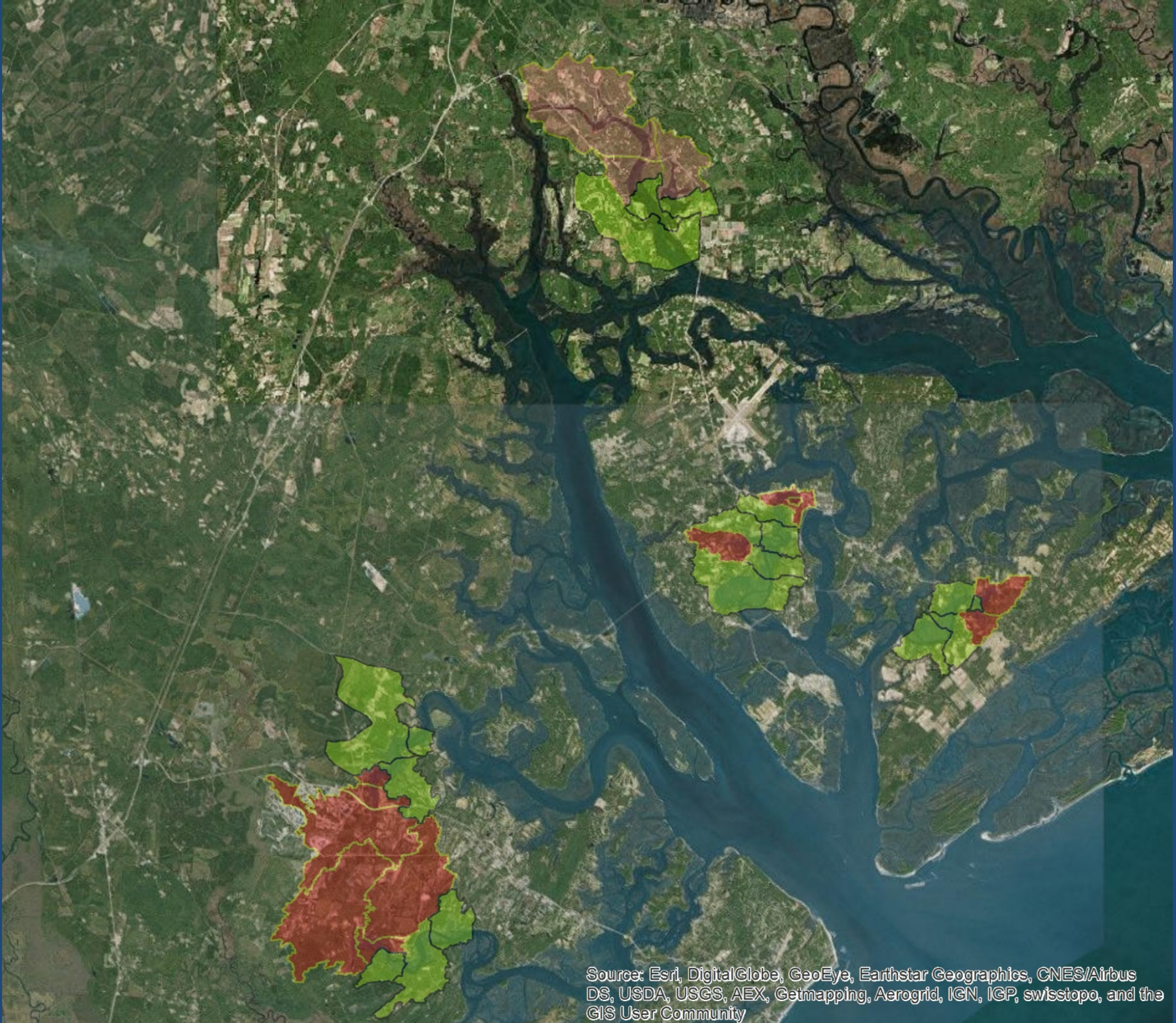
Okatie River



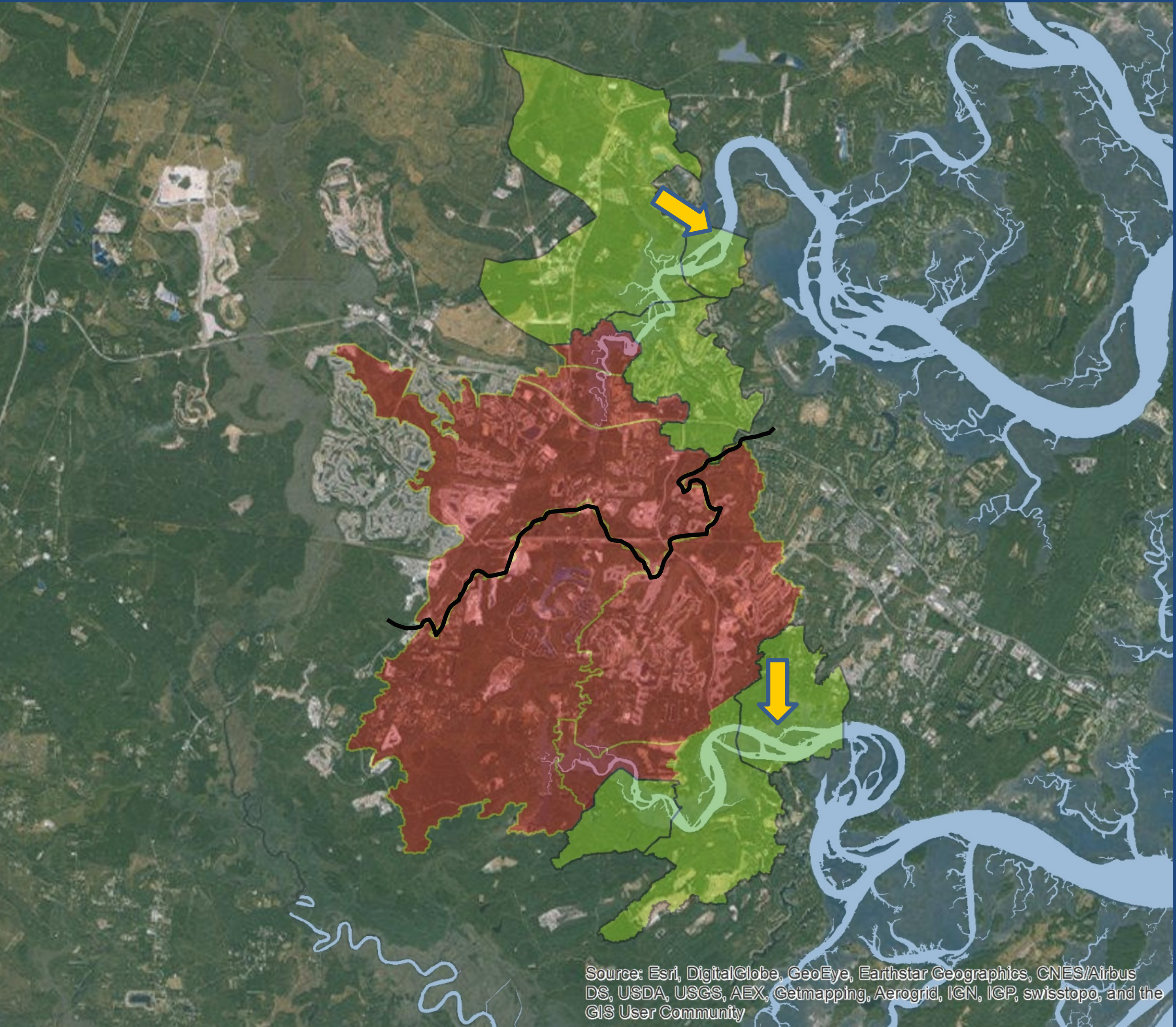
Within Watersheds Model

Salinity Drop/mm rainfall related to

- Imperviousness (developed/soils)
- Freshwater wetlands
- Estuarine wetlands
- Creek width


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Okatie and May Rivers



Large watersheds

Restricted

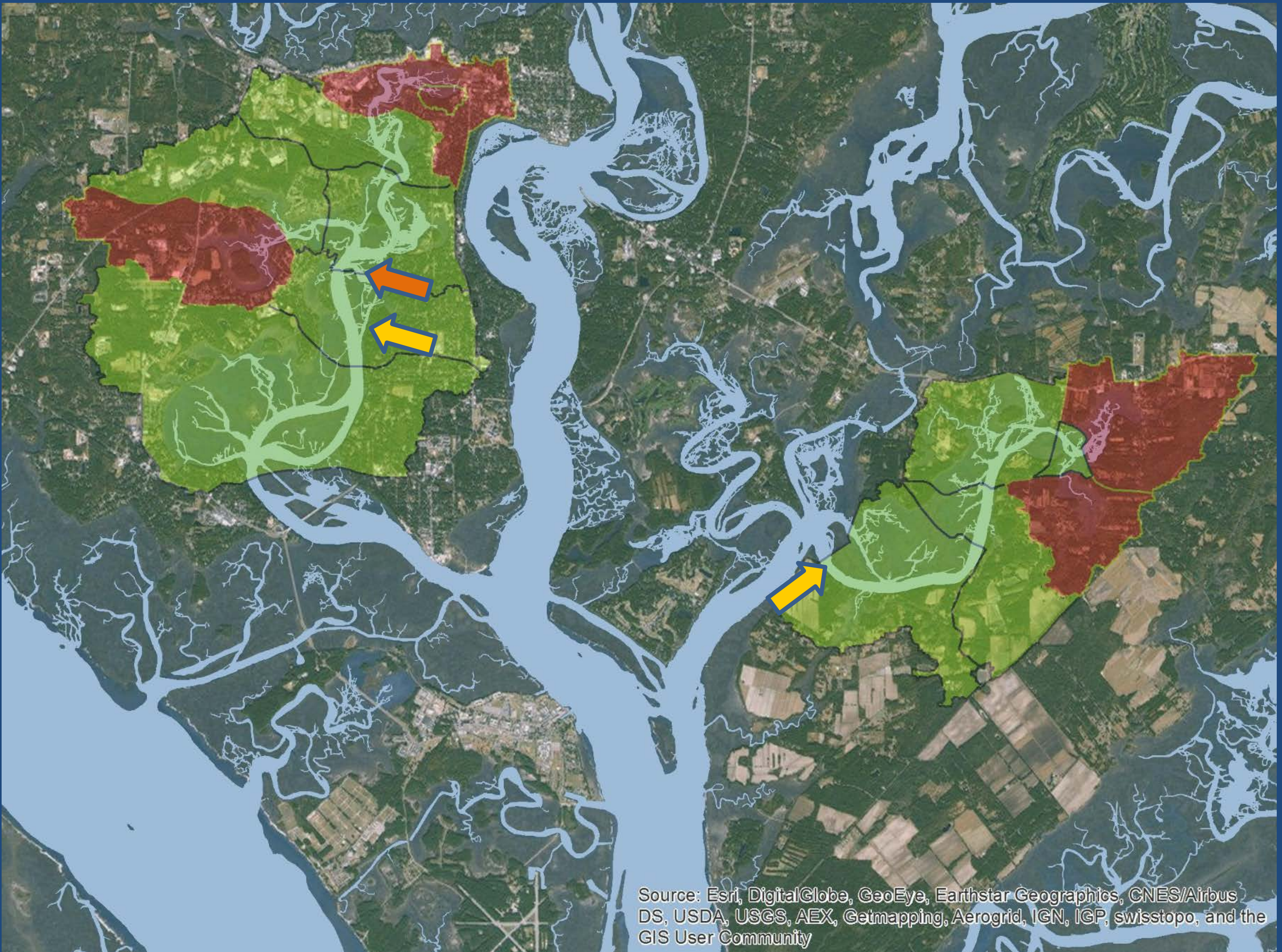
Impervious soils

Suburban

Restricted

Prohibited

Battery and Wallace Creeks



Small watersheds

Restricted/ Prohibited

Pervious soils

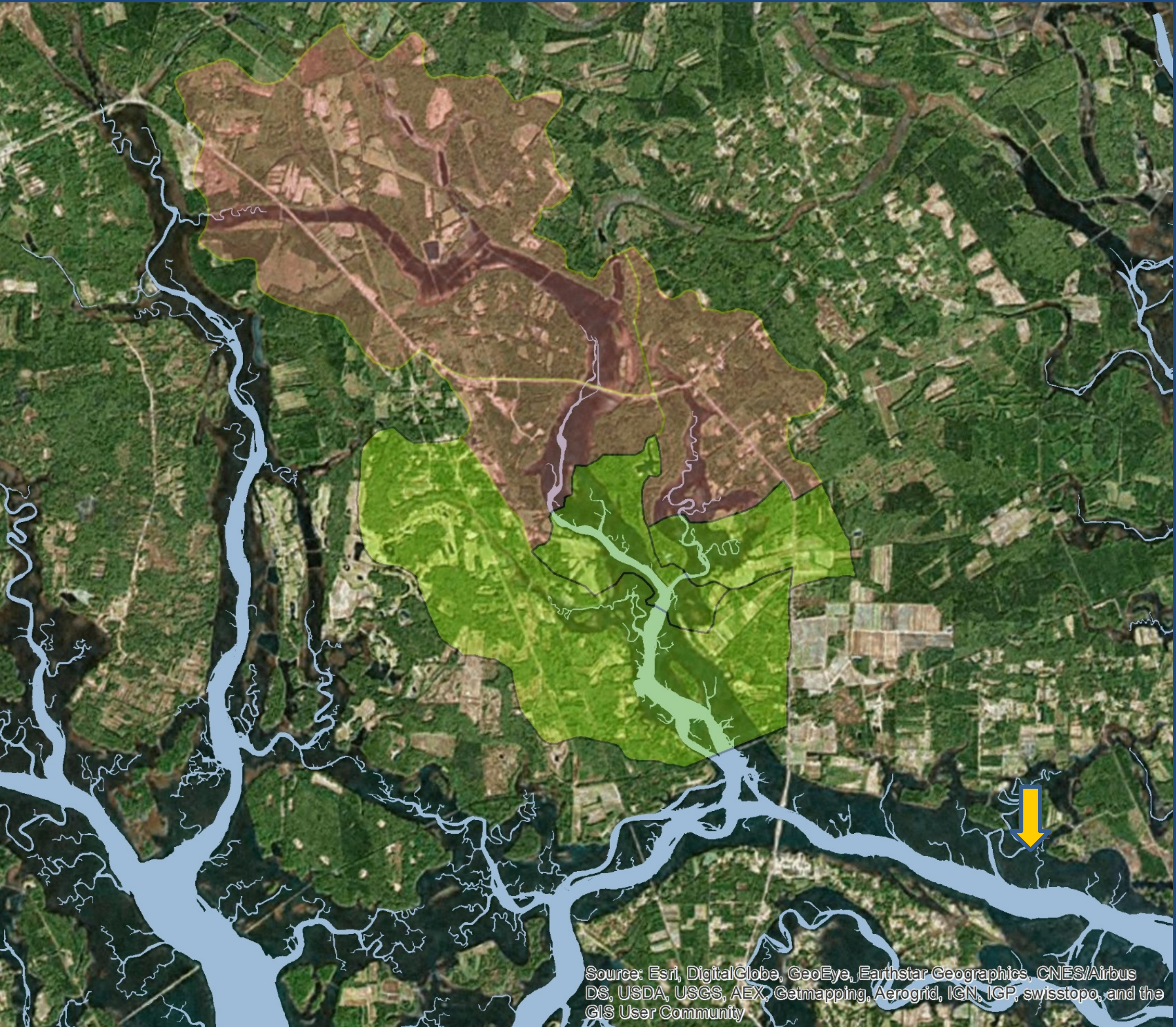
Suburban

Forested

Restricted

Prohibited

Huspah Creek



Large watershed

Restricted

Impervious soils

Forested/ Agriculture

Restricted

Prohibited

Precipitation Impact on Estuarine Waters

Within Watersheds

Across Watersheds

Volume Impacts (contaminants)

Impacts on Organisms

Volume Impacts (contaminants)

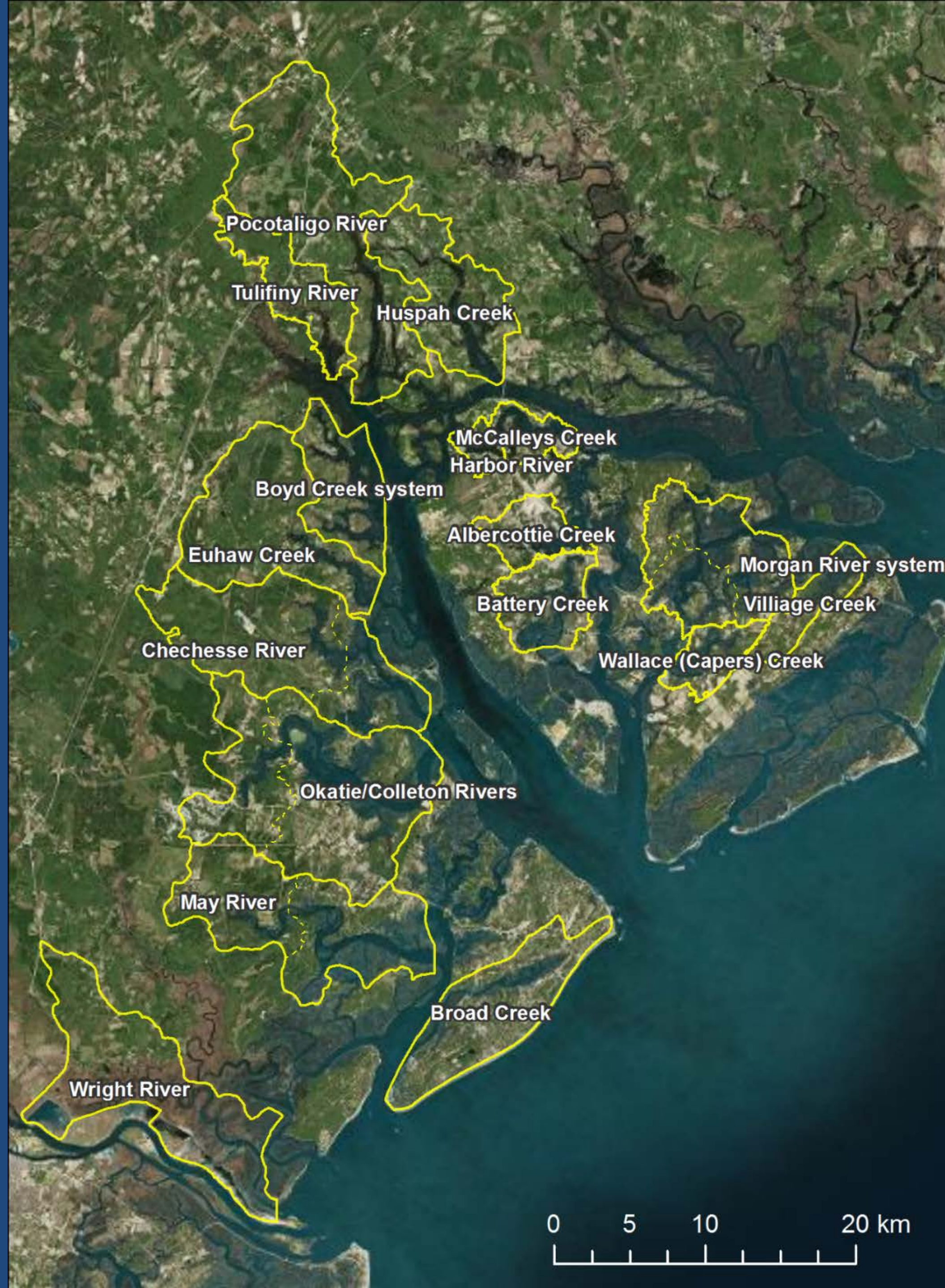
Data Collection

Watershed Assessment

Salinity Drop

Predictive Models of Sensitivity

Predictive Models


Pocotaligo River
Tulifiny River
Huspah Creek
McCalleys Creek
Harbor River
Boyd Creek system
Albercottie Creek
Euhaw Creek
Morgan River system
Battery Creek
Villiage Creek
Chechesse River
Wallace (Capers) Creek
Okatie/Colleton Rivers
May River
Broad Creek
Wright River
0
5
10
20 km

Across Watershed Modeling

Modeling salinity drop/mm rainfall:

Model 1:
slope = % estuarine wetlands

Model 2:
slope = % estuarine wetlands
% very poorly drained soils

Model 3:
slope = % estuarine wetlands
% freshwater wetlands
% very poorly drained soils

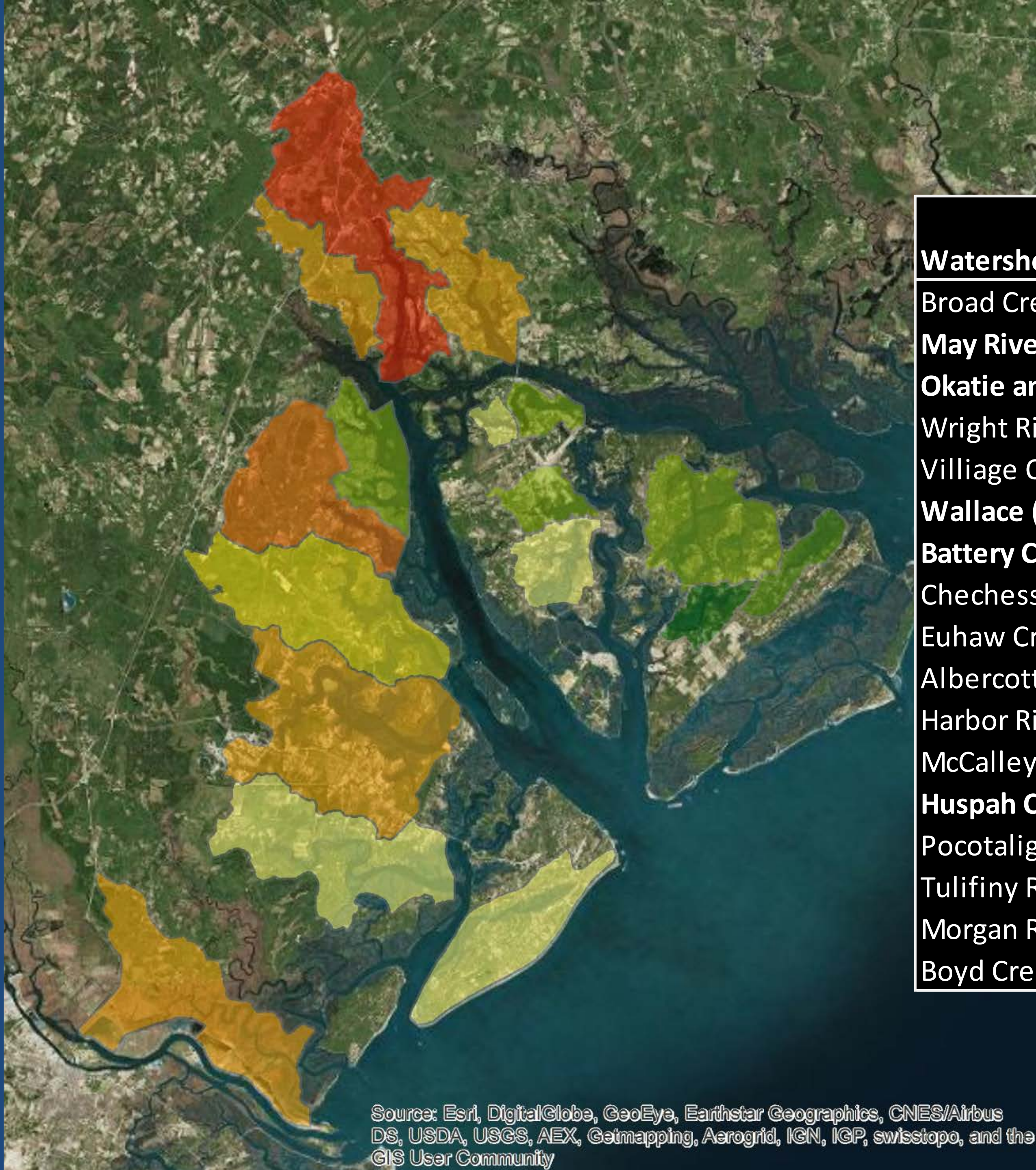
Modeling *average* salinity drop:

Model 1:
avg drop = watershed area

Model 2:
avg drop = watershed area
% very poorly drained soils

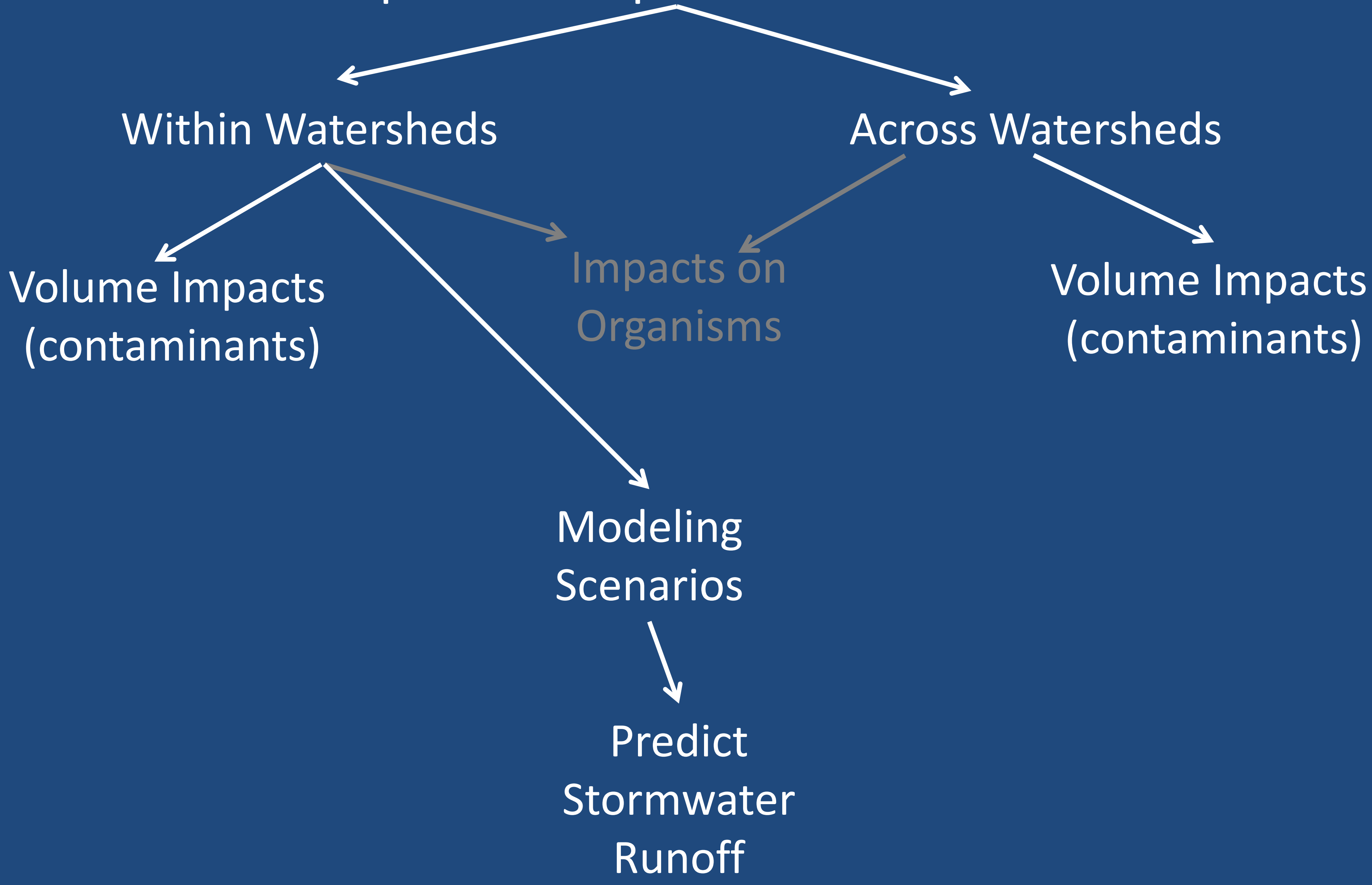
Model 3:
avg drop = watershed area
% very poorly drained soils
water body width at mouth

Top 25% and bottom 25% from each given 1 or -1 points respectively

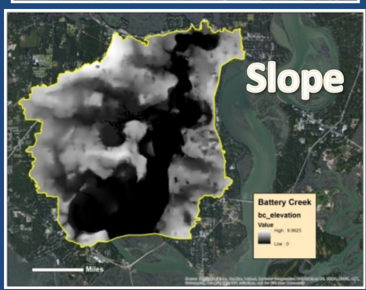


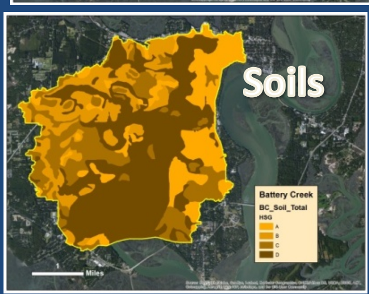
Watershed	Combined 25% rank score
Broad Creek	0
May River	**0**
Okatie and Colleton Rivers	**3**
Wright River	3
Villiage Creek	-5
Wallace (Capers) Creek	**-6**
Battery Creek	**0**
Chechesse River	2
Euhaw Creek	4
Albercottie Creek	-3
Harbor River	0
McCalleys Creek	-3
Huspah Creek	**3**
Pocotaligo River	5
Tulifiny River	3
Morgan River system	-3
Boyd Creek system	-3

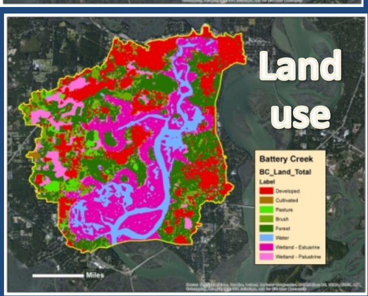
Precipitation Impact on Estuarine Waters



SWARM – Stormwater Runoff Modeling System



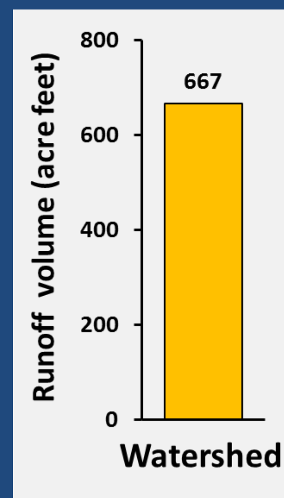




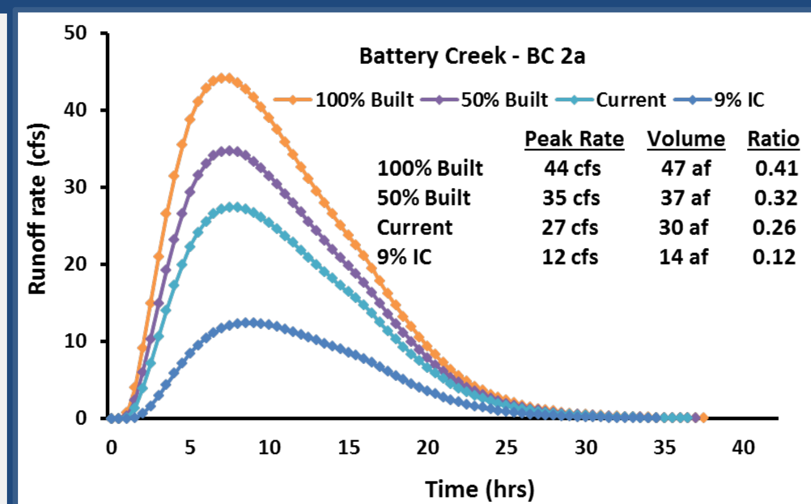
Inputs

Outputs

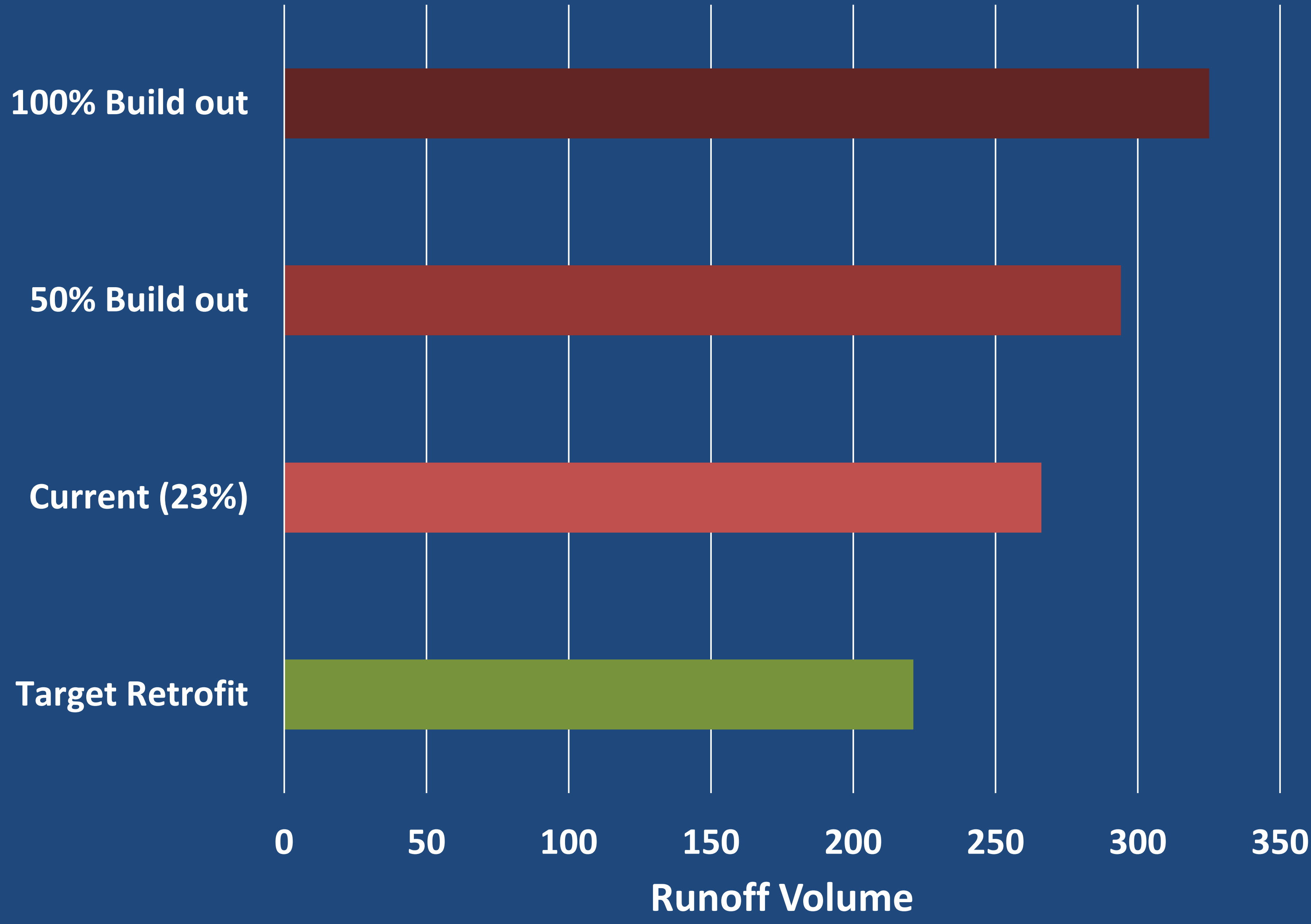
Amount



Rate & Time



SWARM – Okatie Example



Precipitation Impact on Estuarine Waters

Within Watersheds

Across Watersheds

Impacts on Organisms

Impacts on Estuarine Animals

- Marine zooplankton (rotifers and copepods) – change from ~30 to 15 ppt.
- Oysters spat - minimum 6 ppt for larvae to settle and metamorphose into spat.
- Blue crab larvae - minimum 20 ppt salt.
- Spotted sea trout spawn - levels above 20 ppt.
- Brown shrimp post larvae (<day 13) - < 25 ppt causing mortality.

Summary

- Sensitivity within system is correlated to (but not necessarily caused by)
  - Greater % Imperviousness
  - Greater proportion of % freshwater wetlands
  - Less proportion of % estuarine wetlands
  - Smaller creek width
- Sensitivity across systems is correlated to (but not necessarily caused by)
  - Greater proportion of freshwater wetlands
  - Larger size
  - Greater proportion of poorly draining soils
  - Less % estuarine wetlands
- Watersheds west and north of Port Royal Sound are more likely to contain sensitive headwaters than to the east; however, all are sensitive in their headwaters.
- Runoff modeling can be used to understand potential changes within a watershed.

What Does It Mean?

- Potential for impacts to living resources.
- Current on-site volume control is important
- Can predict potential volume changes with development and changing rainfall
- Ability to understand differences within watersheds based on physical characteristics
- Data available to inform management decisions
- Limited resources can be targeted to appropriate types of BMPs and policy, for example
  - Battery Creek – concentration important
  - Okatie Creek – volume (and concentration) important

NATIONAL ESTUARINE
RESEARCH RESERVE SYSTEM
SCIENCE COLLABORATIVE

Collaborative Research to Prioritize and Model the Runoff Volume Sensitivities of Tidal Headwaters

A Final Report Submitted to the

National Estuarine Research Reserve System Science Collaborative 08/13/2015

Project Start Date: September 1, 2013
Project Completion Date: June 30, 2015

Project Coordinator: Dr. Denise Sanger
Applied Science Lead: Dr. Denise Sanger
Collaboration Lead: April Turner

Submitted by: A. Tweel, D. Sanger, A. Blair, E. Montie, A. Turner, J. Leffler

Name: Denise Sanger
NERR: ACE Basin
Email: sangerd@dnr.sc.gov
Phone: 843-953-9074

This project was funded by a grant from NOAA/National Estuarine Research Reserve Science Collaborative, NOAA Grant Number NA09NOS4190153.

UNIVERSITY of NEW HAMPSHIRE

Abstract

Non-point source pollution from stormwater runoff associated with large-scale land use changes threatens the integrity of ecologically and economically valuable estuarine ecosystems. Beaufort County, SC implemented volume-based stormwater regulations on the rationale that if volume discharge is controlled, contaminant loading will also be controlled. The County seeks to identify which of their tidal creeks and what portions of the creeks are most sensitive to stormwater runoff.

Through an ongoing collaborative process with county staff and officials as well concerned citizens, four watersheds, with a fifth added for validation, of critical interest were instrumented with rain gauges and salinity sensor arrays to monitor the movement of freshwater down these systems from volume "sensitive" headwaters to volume "insensitive" downstream waters. A total of 32 sites were monitored with 791 salinity responses to rain events captured. The change in salinity was measured as the primary indicator of the volume of stormwater entering the estuarine ecosystem. Salinity was filtered using a 13.5 and 25 hour moving average to remove the tidal fluctuations observed in estuarine systems in South Carolina, thereby allowing us to isolate the stormwater impacts from tidal effects. Statistical analyses were conducted on the salinity data, rainfall, and various watershed parameters to develop predictive models. A watersheds study was conducted across all Beaufort County major watersheds to scale up the findings of this study. Stormwater runoff was also modeled with the Stormwater Runoff Modeling System (SWARM) to estimate the expected runoff based on watershed area, land cover, soils, and slope. SWARM was used to project impacts of climate change and engineered stormwater retrofits on tidal creeks.

Four major outcomes resulted from this project. First, a strong working relationship has been forged with the range of relevant Intended Users including the establishment of a Watershed Advisory Committee that has helped drive data collection, analysis, synthesis, and translation. Second, correlations between rainfall amount and salinity drop were developed in order to define volume sensitive areas, and locations within each system have been designated as more volume sensitive. Third, a ranking of all Beaufort County watersheds as either more or less volume sensitive has been made based on a range of different analyses. Fourth, best management practices (BMP) and climate change scenarios were developed for the six volume sensitive watersheds; the scenarios will enhance understanding of impacts of future conditions in Beaufort County. This information will permit Beaufort County to focus policy and stormwater management actions on the portions within a tidal creek as well as which creeks are more sensitive to stormwater inputs.

Management Problem and Context

Non-point source pollution from stormwater runoff associated with rapid coastal human population growth and large-scale land use changes threaten the integrity of ecologically and economically valuable estuarine ecosystems worldwide. Climate change is expected to exacerbate these stormwater problems (Karl et al. 2009). A portion of the ACE Basin lies within Beaufort County, South Carolina, a community very concerned about the threat of stormwater degrading its estuarine environments, a challenge that figures prominently in its Comprehensive

Plan, local media, and government affairs (Van Dolah et al. 2000, Island Packet 2001, Beaufort County 2007, Pollack and Walker Szivak 2007, Town of Bluffton 2008). This concern is also cited as a priority for the ACE Basin NERR in its 2011-2016 Management Plan and its Coastal Training Program (CTP) Strategic Plan (Maier 2010, Walker 2010). The Reserve has been actively involved with Beaufort County in addressing stormwater issues through its CTP and Stewardship activities. Beaufort County's rapid growth (83% between 1990 and 2006 and an additional 70% increase expected through 2025) makes it particularly susceptible to environmental degradation from stormwater runoff (Beaufort County 2007). The local population is particularly concerned that, in addition to runoff transporting biological and chemical contaminants, the "flashiness" of salinity changes due to stormwater influx of freshwater may negatively affect larval recruitment and survival of shellfish, crustaceans, and fish in the marshes. The health of these fishery resources is of the highest priority for local residents and rapid salinity changes are considered locally to be as much a problem as contaminants or nutrient enrichment (Barber 2008, Town of Bluffton 2008).

The County has modified its stormwater requirements to include water quantity control (runoff volume) within their Best Management Practices (BMP) manual in addition to water quality (Ahern et al. 2012). The County's rationale is that reducing the runoff of stormwater into estuaries results in fewer bacterial, nutrient, and chemical contaminants as well as less rapid salinity changes (J.R. McFee, County Engineering and Infrastructure Director, personal communication). Beaufort County has implemented some of the toughest regulations in the country, which may serve as a model for coastal communities nationally. Within specifically identified "volume sensitive" watersheds they may require that all stormwater be retained on site through a variety of Low Impact Development (LID) approaches.

Three barriers have been identified by the Intended User group which invited us to partner with them. First, a significant barrier to implementing Beaufort County's volume control plan is the lack of scientific data necessary to identify those watersheds and portions of creeks which are more sensitive to stormwater runoff. Beaufort County's stormwater standards have been contentious at times considering the financial impact to developers and property owners. Secondly, the Beaufort County recognized that it lacked the internal capacity to conduct the necessary studies. Early in 2012, the County approached the South Carolina Department of Natural Resources (SCDNR), the ACE Basin NERR, and the University of South Carolina at Beaufort (USCB) with a request to help it identify specific volume sensitive waters, based upon scientifically rigorous data, so that appropriate regulations could be applied to those areas. A five-year cooperative Memorandum of Understanding (MOU) between Beaufort County, SCDNR, USCB, and the Town of Bluffton was developed and approved by County Council with a commitment of funds to begin the process of both identifying these watersheds and assessing whether the observed salinity fluctuations (flashiness) in tidal creeks negatively affect key fishery resources. The level at which these funds were allocated represented a third significant barrier, in that it would take at least five years to obtain the desired data. This constraint on funding meant that only one or two creek systems per year could be assessed with minimal data collection. It would also mean that these critical, user-prioritized watersheds would be monitored in different years, making volume sensitivity assessments challenging. This collaborative project provides Beaufort County with the data they need in order to address policy in a timely manner.

The data will be available for incorporation into their next Stormwater Management Plan (2016-2026).

The immediate Intended Users impacted by this problem are the Beaufort County Council elected officials, the Council-appointed Stormwater Management Utility Board (SWMUB) who represent each legal jurisdiction of the County including Town of Bluffton, and the Beaufort County Stormwater Management Division professional staff, all of whom are charged with managing stormwater within Beaufort County. In addition, we established and worked throughout the project with a Watershed Advisory Committee (WAC). The WAC was comprised of SWMUB members, Beaufort County stormwater staff, and various others involved in water quality or natural resource conservation in Beaufort County. All of these entities are insistent on strong scientific justification for any major changes to stormwater policies. Coastal municipalities throughout South Carolina and the Southeast are all faced with similar challenges and are watching Beaufort County's experience with implementing strict volume control ordinances.

The barriers listed above were used to formulate, along with input from the Intended User Group, the following project questions answered by this project:

1. *Can the major watersheds in the County be prioritized based on the extent and severity of volume sensitive waters?* Working in partnership with the WAC, SCDNR and USCB monitored rainfall and salinity responses in the drainages of five watersheds of critical interest to Beaufort County. The resulting profiles have helped define how these waters respond seasonally and tidally to rain events and the extent of the impact downstream until it is attenuated. These profiles will permit Beaufort County to rank its watersheds in terms of volume sensitive areas and to focus policy and regulatory decisions on those locations that are most critical. The concurrent acquisition of data across several watersheds during the study period addresses the three barriers cited above.

2. *How will these critical volume sensitive waters respond to implementation of volume control BMPs and to possible climate change scenarios?* A partnering scientist at the National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science (NOAA-NCCOS) Hollings Marine Laboratory (HML) has incorporated the rainfall and relevant landscape data into a stormwater runoff model called SWARM for projecting expected changes in stormwater runoff due to changing BMPs and precipitation patterns (Blair et al. 2014a, 2014b). This model has been developed specifically for the soils and topography found in coastal South Carolina. The results provide Beaufort County officials and professional staff with projections of the effect the implementation of different stormwater management policies will have on the identified volume sensitive watersheds. The model also evaluates the impacts on these watersheds of altered precipitation patterns projected by various climate change scenarios. While not necessarily required to address the three identified barriers, this component is welcomed by the Intended Users as a tool to help them evaluate possible engineered retrofits for priority watersheds. This management community has indicated an interest in designing stormwater management policies that are robust to possible future climate alterations.

The specific collaborative objectives, as defined in the proposal, were to:

1. Ensure that the publically appointed members of the Stormwater Management Utility Board thoroughly understand the research they have previously endorsed, are well informed as the project progresses, and are likely to embrace the results of the studies.
2. Engage the engineers and professional staff of the County and SWMUB for advice and assistance in additional watershed selection, specific site locations, interpretation of results, site-specific modeling modifications, synthesis of results, and translation of results for the Intended User community charged with policy development.
3. Enable community groups that routinely work with elected officials and professional staff on local environmental issues to understand and disseminate the results and analyses generated by this project.

The applied science objectives, as defined in the proposal, were to:

1. Assess the relationship between rainfall and salinity range throughout the length of tidal creeks in Beaufort County-selected watersheds in order to define what size water bodies and which particular watersheds are most volume sensitive.
2. Project the potential impacts that implementation of volume control BMPs and changing precipitation patterns might have on salinity range in priority watersheds.

Outcomes, Methods and Data

Outcomes

This study has been successful in achieving our objectives, although we have modified them in some cases based on the collaborative process. For example, the SWMUB representatives worked with us to develop a Watershed Advisory Committee (WAC) to ensure that we worked directly with all three stakeholder groups in one venue instead of engaging the groups separately as identified in our original proposal. In addition, we have also achieved additional outcomes based on questions raised by the WAC as new data were collected. For example, we did not originally plan to continue monitoring beyond a one year time period; however, the WAC suggested we try to obtain additional larger size events. The following text provides a summary of our major outcomes followed by the methods, data, and an overall project summary of the findings.

The first major outcome for the project was the establishment of a strong working relationship between the research team, Beaufort County staff, SWMUB members, environmental groups, state agency staff, and scientists. Based on feedback from these individuals, we established the WAC to help drive the project data collection, analysis, synthesis, and translation. Through a series of four facilitated and interactive workshops as well as email contact, the strength of the project was increased. This also helped to ensure that the information collected has utility for Beaufort County. The WAC understands the limitations of the data and the potential use of the information, and have asked us to present the results to the SWMUB and Beaufort County Council's Natural Resource Committee. Over the next two months, we will first present the information associated with this final report to the WAC who will help us outline the critical information that will be most useful to the SWMUB and Natural Resource Committee.

The second major outcome for this project was the development of strong relationships between rainfall and salinity drop throughout the length of each study tidal creek and across the study creeks in WAC-selected watersheds in order to define areas where waters would be deemed more volume sensitive. This was achieved through monitoring salinity and rainfall down the length of each system via a network of 26 salinity-logging datasondes. There were six sondes deployed in each of the Okatie River, May River, and Wallace Creek watersheds, and eight placed in the bifurcated Battery Creek watershed. Each watershed was also outfitted with a weather station that included a rain gauge. The portions of each creek identified as sensitive were, inclusive of their upstream components, OK3, MR2, WC1a and WC1b, and BC2a and BC1b. The headwaters of Huspah Creek, HP2, also appeared to be very sensitive, but more data are needed to confirm this. When comparing the sensitive headwater portions across watersheds, the order of sensitivity (most to least) was found to be Huspah Creek, Okatie River, May River, Battery Creek, and Wallace Creek. The sensitivity appeared to be related to coverage of freshwater wetlands (positive), creek width (negative), coverage of estuarine wetlands (negative), and imperviousness (positive).

The third major outcome was the identification of all seventeen watersheds in Beaufort County as more or less volume sensitive. This was conducted based on the findings of the data collected and analyzed to date as well as on a watershed level assessment of the major watersheds in Beaufort County. Based on this landscape analysis, the larger coastal watersheds west and northwest of Port Royal Sound were found to be more sensitive and the small coastal watersheds east of Port Royal Sound were found to be generally less sensitive. All creeks are sensitive down to some point along their length; however, this analysis provides a perspective on which watersheds are expected to be more sensitive over more of their length. We had not originally proposed to conduct this analysis; however, we wanted to provide a broader context and better understand the potential types of watersheds in the County. Beaufort County can use this information to identify priority watersheds for consideration of stronger stormwater management requirements and in the identification of systems that warrant additional protection.

The fourth major outcome was the best management practices (BMPs) and climate change scenarios for each of the study watersheds. Beaufort County identified this as a critical component to the project. In particular, they want the scientific evidence to help decide where limited resources should be placed for mitigating the impacts from current development levels but also to understand what they might expect in the future. Ultimately, they want to keep the quality of life in Beaufort County, which for them includes healthy coastal waters and abundant natural resources.

Methods Leading to above Outcomes

Collaboration

Upon learning of funding for this project, we met with Dan Ahern (retired Beaufort County Stormwater Manager), Kim Jones (Town of Bluffton Stormwater Manager and SWMUB member), and Andy Kinghorn (SWMUB member) to discuss the proposed collaboration approach. It was decided that we would present to the SWMUB and discuss development of a technical committee. We presented the proposed project and establishment of the technical committee to the SWMUB on August 7, 2013. The SWMUB was interested in the findings of the project, and we discussed who should participate on the technical committee. This led to the establishment of the Watershed Advisory Committee (WAC) with representation from SWMUB, stormwater management professionals, natural resource or water quality managers, and active citizens. It was also requested we give a presentation to be delivered to the Beaufort County Council's Natural Resource Committee, which was conducted at their next scheduled meeting. This presentation was televised and has been shown several times on the county public affairs station.

The Watershed Advisory Committee (WAC) was established in September 2013 with the following members currently participating.

Beaufort County Watershed Advisory Committee – Stormwater Volume Sensitivities	
Dan Ahern	Retired Manager, Beaufort County Stormwater Utility
Reed Armstrong	Project Manager, South Coast Office, SC Coastal Conservation League
Russell Berry	Director, SCDHEC Environmental Quality Control Region 8
Bob Gross	Owner, Beaufort Group, LLC
Kim Jones	Director, Stormwater Management Division, Town of Bluffton
Andy Kinghorn	Member, Beaufort County Stormwater Management Utility Board
Eric Larson	Manager/Engineer, Beaufort County Stormwater Utility
Chris Marsh	Director, The LowCountry Institute
Danny Polk	Stormwater Inspector, Beaufort County Stormwater Utility
Kevin Pitts	Special Projects Manager, Beaufort County Stormwater Utility
Al Segars	Stewardship Coordinator, ACE Basin NERR
Don Smith	Chair-Beaufort County Stormwater Management Utility Board
Al Stokes	Manager, Waddell Mariculture Center
Alan Warren	Program Director, Environmental Health, USCB
ex-officio:	
Anne Blair	Project Scientist, NOAA- Hollings Marine Laboratory
John Leffler	Project Administrator, ACE Basin NERR Research Coordinator
Eric Montie	Faculty, Biology Dept., University of South Carolina – Beaufort
Robert O'Quinn, IV	Field Biologist, South Carolina Department of Natural Resources
Denise Sanger	Science Lead, South Carolina Department of Natural Resources
April Turner	Collaboration Lead, South Carolina Sea Grant Consortium
Andrew Tweel	Project Scientist, South Carolina Department of Natural Resources

Engagement of the WAC was primarily through three workshops with a fourth workshop scheduled for September 10, 2015. The first workshop was held on September 25, 2013. The focus of this workshop was largely to engage the WAC to obtain advice and assistance with the proposed study design, specifically, to identify appropriate watersheds to study, specific sites within those watersheds, and to begin discussing the modeling component and how it may benefit the study. One additional goal of this project was to ensure that the collaborative group, both the researchers and WAC, understood the project goals, and how the information generated by the project would ultimately be used. There was a thorough discussion of the project's goals, plans, and methodologies. Some of the watersheds to be studied were specified in the collaborative research MOU that pre-dated the NERRS Science Collaborative funding and were identified in the proposal. The Committee nominated and discussed additional watersheds for inclusion. SCDNR staff then surveyed and evaluated the nominated watersheds. These findings with pros and cons for each system were reported to the WAC in November via email. The WAC members considered those results and then voted on the watersheds, finally selecting two additional tidal systems, Wallace Creek and Huspah Creek for inclusion in the study. It was decided that Wallace Creek would be instrumented first with Huspah Creek being monitored if resources were available.

The second workshop was held after a significant amount of salinity data had been collected and analyzed, so that the preliminary results could be discussed, and any adjustments to methods or sites could be made. This workshop was held on September 8, 2014. Some early findings were presented, and the WAC was eager to discuss their implications and how to proceed. This process was very helpful in ensuring the development of a useful product for the group. The objectives of the September 8, 2014 workshop were to engage the WAC in facilitated discussions so that its members had a good understanding of the planned analytical approaches to the empirical data and of the structure and assumptions of the SWARM model. We also wanted to obtain advice regarding specific watershed delineation questions and site-specific modeling modifications. These discussions were designed such that the WAC members would begin to develop confidence in both the empirical analyses and the SWARM modeling approach to the extent that they would feel comfortable in making decisions based on the eventual results. A primary objective of this workshop was to get approval from the WAC of the analytical approaches to the empirical data and of the modeling methodology. This approval was forthcoming and permitted the team to move ahead with the analyses throughout the fall. In addition, the WAC raised questions about such considerations as seasonal influence and antecedent rainfall, which led to rethinking and modifying some of the empirical analyses to take these factors into account.

A third workshop was held on February 2, 2015 after a nearly a full year of data had been collected for the four main study watersheds, and considerable data analysis had been conducted. At this point there was enough data to begin the discussion about what areas could be considered volume sensitive, and where those boundaries might be delineated. With this WAC workshop, our strategy was to transfer more of the responsibility for data interpretation to the WAC with the expectation that its members would begin to accept ownership of the empirical and modeling results. The research team presented a series of representative graphs that summarized empirical and modeling results. The research team was very careful not to interpret the graphs, but just to explain how to read them. The WAC then divided into two teams and moved to separate rooms. Everyone was given three packets of graphs that related to 1) background information, 2) empirical results, and 3) modeling results, as well as a series of questions. Over the course of 90 minutes the two teams followed the questions, studied the graphs, and answered the questions to the best of their ability. Project scientists were with each team to answer specific methodological questions, but refused to interpret the graphical results with the hope that this would force the WAC members to think deeply about the results and to incorporate them into their own understanding. The teams then reconvened and, through a facilitated discussion, compared their results. Our hope was that the two groups would reach similar conclusions, and that we could identify areas where these conclusions differ. These differences then became the focus of the follow up discussion- What information do we still need? Do we need to bring in additional datasets or variables? How confident are we in these results? At the end of the workshop, the two groups rejoined and discussion addressed these and other questions. The members of the WAC asked for further monitoring to capture additional large rain events, as well as some additional analyses such as rate of change of estuarine salinity as a result of stormwater influx. We evaluated using a rate of change metric with little success in increasing the modeling performance. They also suggested that some of the monitoring sondes be withdrawn from certain locations and try to continue monitoring for large rain events. This proved very helpful to the project researchers, who followed up the workshop with a 3.5 hour meeting to consider and address all suggestions and observations developed through the WAC workshop.

We are planning an additional WAC meeting for September 10, 2015. The goal of this meeting will be to discuss this report (including the additional analyses they requested) to ensure that they can take the lead in interpretation, and to focus the discussion primarily on how they will use the results to develop new policies regarding stormwater management in the County. In addition, a second goal is to discuss how to best present the research findings and conclusions to the SWMUB and Natural Resource Committee. We believe the input received from the WAC will allow us to insure the information is translated and conveyed such that it can be used by decision makers and elected officials. We are scheduled to present to the SWMUB on September 30, 2015 and the Natural Resource Committee on October 1, 2015.

Applied Science

The geography of Beaufort County, South Carolina, is characterized by broad expanses of wetlands (43% of coastal watersheds), gently sloping topography (< 0.5 m/km in some areas), a large tidal range (2.3-2.6 m), and a dominance of soil types classified as poorly draining. In the past several decades, Beaufort County has experienced rapid population growth and the associated conversion of upland habitats to impervious surfaces, and this growth is expected to continue (Figure 1).

A variety of tidal creeks drain the upland habitats and developed areas. Excessive runoff from the proliferation of impervious surfaces has raised concern over the health of these tidal creeks. Newer housing developments have included stormwater ponds in their design as an attempt to mitigate this increase in runoff by retaining stormwater and allowing infiltration to groundwater and slower release to downstream systems.

Due to the low gradient and high tidal exchange, many of the creek systems are intertwined with watershed boundaries that are difficult to define. However, we were able to define 17 watersheds that originate near or within Beaufort County (i.e., not fed by riverine flows from beyond the coastal zone) (Figure 2). We focused on these low-lying coastal headwaters to study the varying responses to stormwater runoff and identify sensitivity thresholds.

The average size of these watersheds was 85 km^2, and five watersheds were selected to use for this volume sensitivity study. Beaufort County and the WAC-selected watersheds that were a priority area for mitigative measures and reasonably representative of other watersheds in the county, but that also represented a range of variables to help identify the dominant characteristics related to volume sensitivity. These systems were initially the Okatie River, May River, Battery Creek, and Wallace Creek, with Huspah Creek added later (Figure 3). Land use, soil types, and other geophysical characteristics of these watersheds are discussed in greater detail in the watershed study as part of this project.

In total, 26 salinity-logging datasondes were deployed in four priority watersheds of varying size, development proportions, and marine influence for at least a year to assess the variability in salinity response to stormwater input. An additional two months of data have been collected at a fifth watershed (Huspah Creek) with six datasondes, and this monitoring is ongoing with funding support from Beaufort County. Each watershed was also outfitted with a data logging rain gauge.

Sampling sites in each creek system were established from the headwaters to a downstream location that extended into what was expected to be volume "insensitive" waters. The downstream location was identified based on previously collected data provided by the South Carolina Department of Health and Environmental Control (SCDHEC) such as shellfish bed harvesting classification change (e.g., restricted to open), an indication that the system is no longer volume sensitive (Figure 4). There were six sondes deployed in each of the Okatie River, May River, and Wallace Creek watersheds, eight placed in the bifurcated Battery Creek watershed, and later six sondes placed in Huspah (Figure 3). Figure 5 shows an example of the rainfall and salinity data collected from OK1 (headwater site) and OK6 (most downstream site).

At each site, a HydroLab MS5 salinity/temperature/depth data logger was installed near the bottom of the water column to ensure that they remain submerged even during the lowest spring tides. Data sondes took measurements at 30 minute intervals. The water quality dataloggers followed QA/QC procedures similar to those employed by the NERR System-wide Monitoring Program (SWMP) to ensure the instrumentation functioned properly in the field and that all units and parameters were within the manufacturer's recommendations (Small et al. 2010). Rain gauges were installed at a central location in each watershed, and it was assumed that this rainfall would represent rainfall for the entire watershed.

Our primary metric of volume sensitivity was the drop in salinity following a rain event (Figure 6). Although we tested and discussed other metrics, this proved to be the most useful. Measurements of time from rain event to maximum salinity drop often took several days and were confounded by additional rain events. We removed the tidal signal prior to analysis by applying the Palmetto Filter, a nested 13.5 h moving window average (MWA) and a 25 h MWA developed by Paul Conrads (USGS, 4/22/2008, personal communication), because we were interested in characterizing the salinity changes over a longer time period than a single tidal cycle (Figure 6). The salinity drop was then measured in response to each rain event using the filtered data (Figure 7).

We defined a 'rain event' as occurring on a day (or days) with consecutive rainfall. It was necessary to condense the half-hourly rain data into a larger unit of time because salinity drops occurred over a period of days in many cases. If rain data were analyzed at a finer resolution, it would be impossible to attribute a salinity drop to a rainfall amount. In this regard, compressing rainfall into a timescale of days, rather than hourly increments, was most appropriate given that the salinity drops also occurred over a number of days. Accordingly, consecutive days experiencing rainfall were counted as one event, with a full day of no rainfall being necessary to end an event.

Once the salinity drops for each rain event were quantified, these two variables were entered into regression models for each site with rain as the independent variable and salinity drop as the dependent variable. These relationships were tested for significance, and their slopes were studied in greater detail, with higher slopes indicating a greater salinity response, or more sensitivity, for a given rainfall event. These slopes were then used to compare between watersheds and identify differences in volume sensitivity.

These subwatershed slopes were also used to look for factors that could help explain differences in salinity drops. A number of additional watershed characteristics, such as land cover classes and watershed size, were explored using stepwise multiple polynomial regression. Variables expressing curvilinear relationships to the slope were entered as such in the model.

To further explore these salinity-rainfall relationships, a study was conducted to investigate characteristics of watersheds originating in or near Beaufort County (Figure 3). US Geological Survey (USGS) Hydrologic Unit Code (HUC)-12 watersheds served as our basis for identifying the major creek/river systems. A variety of land use/land cover, soil type, and geophysical data were collected for each watershed using ArcGIS 10. These were then compared between all of the watersheds to identify how the study watersheds compare to other watersheds not included in this study. Multiple regression was used to quantify these relationships, and to draw inferences about the sensitivity of other watersheds in Beaufort County based on similarities and differences to the five watersheds with known sensitivities.

The Stormwater Runoff Modeling System (SWARM) was used to model runoff for each of the study watersheds and sub-watersheds. SWARM is based on the long-established and widely-used runoff curve number and unit hydrograph methods of the US Department of Agriculture, National Resource Conservation Service (USDA, NRCS), and has been calibrated for the low-gradient topography of the Southeast coastal plain. The modeling system integrates land use, soil type, area, elevation, and precipitation amount and distribution to calculate runoff volume and runoff rate over time for individual storm events (Figure 8). Detailed descriptions of SWARM methods and applications are available in two publications by Blair and colleagues (2014a, 2014b).

The watersheds varied greatly in characteristics that affect runoff modeling such as area, level and type of development, and soil types. Because the watersheds differ greatly in area, our modeling provided both actual runoff volumes and rates as well as normalized results in order to remove effects of area. We used the actual output to investigate impacts of various drivers of runoff within each watershed and the normalized output to compare those impacts among the watersheds.

We modeled runoff for two different synthetic rainfalls: 1.95 inches, which is the 95th percentile 24-hour rain for the region and 4.5 inches, which is the 24-hour 2-year storm event for the general area. For the hydrographs, we also can use actual rainfall amounts and distribution recorded by rain gauges in each of the watershed.

We developed regression equations for each watershed by calculating volume from rainfalls of 0.5 inch to 5 inches using 0.5 inch intervals (Table 1). For each site watershed, these equations can predict runoff for any rainfall amount, and we used them to predict runoff for each of the rainfall amounts connected to specific drops in salinity in order to then use the predicted volumes as regressors and the salinity drop values as the response variables.

Because SWARM output showed statistical significance in predicting salinity changes, we selected the 6 subwatersheds designated as critically sensitive to stormwater runoff and used SWARM to model their responses to the implementation of a volume-control BMP scenario, two buildout scenarios, and two climate change scenarios.

For the BMP scenario, the objective was to set the watershed hydrology to one of low development. We modeled runoff using the 95th percentile rain amount of 1.95 inches and adjusted land-use categories in each watershed to reflect a development level of 9% impervious cover. Ten percent impervious cover is considered to be the threshold for stream/creek quality degradation (Schueler 1994, Holland et al. 2004, Sanger et al. 2015). The modeled volume at 9% impervious cover serves as the target for volume reduction required for current levels of development. Additionally, we adjusted land-use categories in each watershed to reflect two higher levels of development: 50% Build Out and 100% Build Out. Fifty percent Build Out is projecting additional watershed development for half of dry land not yet developed. One hundred percent Build Out projects additional watershed development for all dry land not yet developed. The difference between the low development volume and the volumes for the 3 higher development levels shows the amount of volume reduction required for each watershed to return to a low-development hydrology.

For the climate change scenarios, we based our modeling on general predictions of increasing frequency and intensity of heavy storms (Gutowski et al. 2008). Already from 1958 to 2012, the heaviest storm precipitation increased by 27% in the southeast US (Melillo et al. 2014). We compare watershed runoff using average antecedent runoff condition (ARC) to runoff from two different climate scenarios: Climate 1 and Climate 2. Both climate scenarios include a 15% increase in precipitation. Climate 1 uses semi-wet ARC and Climate 2 uses wet ARC. ARC comprises “rainfall intensity and duration, total rainfall, soil moisture conditions, cover density, state of growth, and temperature” (USDA NRCS 2004) and has a strong impact on both volume and rate of runoff.

Data Leading to Above Outcomes

Review of existing and new rainfall data

Rainfall during 2014 and 2015 compares well to rainfall data collected by Ashepoo-Combahee-Edisto Basin National Estuarine Research Reserve (ACE Basin NERR) meteorological station (station ID: ACXS1) on both monthly and annual timescales. The typical peak in rainfall occurs in the summer months, as weather patterns are dominated by late afternoon air mass thunderstorms associated with heating of the land surface (Figure 9A). Winter and spring monthly precipitation is about half that of summer patterns, but generally occurs associated with frontal systems that result in a more homogenous distribution of rainfall. April 2014 resulted in a very large rain total (221 mm) which is over three times the long term (2001-2014) average of 65 mm. Summer 2014 precipitation, which usually peaks in August, peaked in September instead, and was again above average. To date, 2015 has been a fairly average precipitation year, staying near 1 standard error (S.E) from the long-term average. On an annual basis, 2014 was the wettest year since 2001, when data collection began, for the ACE Basin NERR station (Figure 9B).

In addition to producing the most precipitation, August also experienced the shortest average time between rain events—3 days (Figure 9C). November had the least frequent rain events, averaging 7.8 days between events. Another interpretation of this data is that rain events in August were more likely to occur on wetter soils than those in November, not accounting for differences in evaporation or other seasonal effects.

Rain data collected for this study reflect the same seasonal trends as the ACE Basin NERR station. However, on a per-event basis, there tended to be fewer, larger events occurring in the fall and winter months (Figure 10A). There was good agreement between the study watershed gauges, and this agreement was stronger for the larger frontal events than the summer-pattern rain events. The vast majority of rain events captured were less than 10 mm total, with exponential decay towards the larger events (Figure 10B). The average rain event was 34 mm (1.3 in), and the maximum observed was 131 mm (5.2 in).

Coliform data

We reviewed fecal coliform data collected in Beaufort County by the SCDHEC. There was high interannual variability (Figure 11A), as well as high spatial variability. Exceedances, defined as counts in excess of 40.9 cfu/100 ml, were computed on an annual and monthly basis. On average, nearly 4% of samples collected exceed this threshold, and there was no clear relationship to precipitation totals on an annual basis; however, there may be stronger relationships if investigated at a finer temporal resolution. November data indicated the highest exceedances, and January through March were the lowest (Figure 11B). There may be a sampling bias, and we did not have the necessary information to correct for this.

For the four main study watersheds, we summarized coliform data relative to our study subwatersheds. The headwater portions of these systems generally experienced much higher coliform counts than samples collected farther downstream in the same systems (Figure 12). No headwater trend was observed in Wallace Creek, which only contains two sites compared to the nine and ten sites of the other watersheds. Wallace Creek is also the least developed of the study watersheds, and among the least developed in the County.

Salinity data

Nearly 750,000 salinity readings were collected across five watersheds comprised of 32 subwatersheds, capturing 791 salinity responses to rain events over the course of the project. These sites exhibited wide variation in almost every attribute we considered, including soil type, land-use characteristics, and geophysical setting. The average salinity for all data collected was 27.3 psu, with individual site averages ranging from 14.2 (OK1) to 32.3 (WC5).

The average rain-induced drop in tidally-filtered salinity was 2.8, with a maximum observed drop of 23 psu in the Okatie River headwater site (OK1) following a 4 day rain event in November 2014 that resulted in 128 mm of precipitation. Figure 13 shows an April 18, 2015 rain event that dropped similar amounts of rain for the primary four systems.

In terms of volume sensitivity (i.e., the response of a receiving body to an input of stormwater), we found the drop in salinity to be most informative (Figure 14). Average salinity drops for each site are shown in Figure 15. Specifically, we compared the rainfall total to the observed drop in salinity for each of the 791 site-events, and formed regression relationships for each of the 32 subwatersheds. These relationships are shown in Figures 16 through 20. Summary statistics for these regressions are shown in Table 2. The slope of these relationships (unless stated otherwise, 'slope' refers to this relationship) proved to be a useful metric for volume sensitivities—higher slopes corresponded to a greater drop in salinity for a given rain event. The greatest slope, a drop of 0.14 psu per mm rainfall, was initially observed in the headwaters of the Okatie River. Towards the end of the study, when Huspah Creek was instrumented in June 2015, much higher salinity drops were observed (slope = 0.27), suggesting even greater sensitivity to volume inputs. There were, however, only 5 events observed in the Huspah Creek headwaters versus 41 events for the Okatie River headwaters, and this relationship may change as more data are collected.

A comparison of these slopes and their standard errors is shown in Figure 21. Least squares means differences (LSD) were used to look for thresholds and significant differences in subwatershed responses to volume inputs. These LSD t-tests are presented in Table 2. It was clear early in the study that the Okatie River and May River headwater sites were quite different from Battery Creek and Wallace Creek in terms of salinity response to rain events, with slopes approximately double that of the other two creek headwaters.

The time to achieve minimum salinity following a rain event was also measured. From this we calculated the salinity drop over time of this trend (salinity drop per unit time). However, these relationships were much noisier and were not helpful in assessing volume sensitivity for these watersheds during this study period. These results are not presented.

Predictive model

The rainfall-salinity drop relationship slopes were used to compare among subwatersheds and explore a variety of land cover and geophysical characteristics that may help explain the observed sensitivity differences. A scatterplot matrix of these relationships is shown in Figure 22. Additional variables were explored, but are not shown, such as coverage of specific soil types (e.g., "poorly drained"), forested upland area, or developed land use. Huspah Creek sites, with much fewer data to support the slope relationships, are shown in grey. These sites were quite different in terms of width, distance to bay, estuarine wetland coverage, and provided a good opportunity to test previous observations and relationships.

A multiple polynomial regression was used to quantify the relationship between a subset of these independent variables and the slopes identified from the regressions of rainfall and salinity drop for each of the subwatersheds. The three lower Huspah Creek sites were excluded due to poor relationships between rainfall and salinity drop, which may be attributable to low sample size. Battery Creek 1a was also excluded due to its very small size (10% of the next closest subwatershed) that was discerned when watershed boundaries were reanalyzed using LiDAR elevation data rather than boundaries derived using more conventional means.

As can be seen in the scatterplots, some of these relationships to slope were non-linear (Figure 22). These were fit accordingly in the multiple regression. The results of this regression are shown in Figure 23 and Table 3 ($r^2 = 0.95$, $F_{(6, 21)} = 70.64$, p = <0.0001). The percent cover of freshwater wetlands (excluding water) exhibited the strongest relationship to slope, followed by creek width and estuarine wetland coverage. Percent imperviousness (a combined metric of soil and development-related imperviousness) was also significantly inversely correlated to slope. Residuals from this model followed a normal distribution (Shapiro-Wilk: p = 0.45). The root mean square error from this predictive model is 0.016 psu per mm rain.

Watershed study

Valuable comparisons were made between our 5 study watersheds and 12 other nearby watersheds (Figure 2). A wide variety of data pertaining to these watersheds were collected, including land use and land cover characteristics (Table 4), soil classifications and coverages (Table 5), and additional geophysical parameters (Table 6). These tables are color-coded to help depict variability and common attributes between the watersheds.

Broad Creek, Battery Creek, and Albergottie Creek were the three most developed watersheds. Not surprisingly, the larger watersheds toward the head of the estuary were comprised of the largest coverage of freshwater wetlands. The watersheds monitored for volume sensitivity (in bold) represent a wide range of variability for nearly all of these parameters. The addition of Huspah Creek to the monitoring database provided an even greater coverage of this variability, especially due to its low abundance of estuarine wetland and corresponding high coverage of freshwater wetland. As noted earlier, Huspah Creek also exhibited a much higher slope than any of the watersheds studied prior to its introduction.

Stepwise multiple regression was used to identify parameters best correlated to the slope values. We also included average salinity drop (the average of the observed drops for all rain events) in this analysis. Due to the low sample size (n = 5 watersheds), we tested several models ranging from simple univariate to the maximum possible given the sample size, a multiple regression of three independent variables. The results of these models are presented in Tables 7 and 8. Because the very high correlations ($r^2 = 0.999$) may be overfit due to the low sample size, we present an array of tests of increasing complexity (and increasing potential for type I error).

Variability in slopes was best explained by an inverse relationship to the coverage of estuarine wetlands (Table 7). The second most explanatory variable was a positive correlation to the coverage of soils classified as ‘very poorly drained.’ The full model also included freshwater wetland coverage.

Variability in average salinity drop was somewhat different, with area (km^2) explaining much of the variability—the larger watersheds (Okatie and May Rivers, as well as Huspah later on) tended to contain the most sensitive headwaters (Table 8). The addition of coverage of poorly drained soils further improved this model. The full model also identified creek width at mouth as a helpful independent variable. Predicted slopes and average salinity drops are shown in Table 9.

We used this suite of models to estimate headwater sensitivity of the 12 coastal watersheds not monitored for salinity sensitivity in this study. To synthesize these model results, such that the result is not dependent on a single model, but rather consistency between varied models that utilize different parameters, we selected the top (most sensitive) and bottom (least sensitive) 25% from each model. We then assigned a total score to each of the watersheds, with a value of 3, for instance, corresponding to that watershed appearing in the top 25% for 3 of the 6 models. A value of -6, for instance, would mean that all six models predicted sensitivity in the bottom 25%.

According to this classification scheme, 7 of the 17 watersheds were modeled to have sensitive headwaters. Scores within these categories, however, do not necessarily indicate more sensitivity, but rather more model confidence in the prediction. These included, in decreasing order: the Pocotaligo River (5), Euhaw Creek (4), Okatie River (3), Wright River (3), Huspah Creek (3), Tulifiny River (3), and Chechesse River (2). Six watersheds were identified as least likely to be sensitive, and these were, in order: Wallace Creek (-6), Village Creek (-5), Albergottie Creek (-3), McCalleys Creek (-3), Morgan River system (-3), and Boyd Creek system (-3). Actual estimates of sensitivity would best be determined from individual models and these are presented in Table 9.

Stormwater runoff modeling results

Table 10 provides details for major watershed characteristics related to modeling runoff. Two of the major drivers of stormwater runoff are development level and soil type. Development changes the hydrology of a watershed by creating surfaces impermeable to rain, thus causing more rainfall to be converted to runoff. Soils range from those pervious to rainfall to ones that rainfall cannot penetrate. Two watersheds in Battery Creek had the highest percentage of developed land use – BC2a with 57% and BC3a with 47%. The lowest percentage of developed land use was in Wallace Creek where the six watersheds range from 1% to 7%. The most impervious soils were found in the Okatie River with all six watersheds at 90% to 92%. May River was next with an impervious soil range of 72% to 78% for the six watersheds followed by Wallace Creek with a range of 60% to 70%. Battery Creek had the lowest proportion of impervious soils with a range of 27% to 61%. Watersheds absorb an initial amount of rainfall before runoff begins, and that amount is referred to as the initial abstraction (I_a). For the four major watersheds, the I_a ranged from 0.19 inches to 0.35 inches. Okatie River watersheds had the lowest range owing to the combination of high development and impervious soils – 0.19 inches to 0.21 inches. Wallace Creek watersheds had the highest range owing to low development and soils around 65% impervious – 0.26 inches to 0.35 inches.

We modeled runoff for all of the watersheds based on a 4.5 inch 24-hour rain event (Figures 24 and 25). Volume increased with progression from the headwaters to the final watershed outlet for each of the four main waterways as expected since each subsequent watershed had greater area than the preceding ones. Runoff for the two smaller waterways, Wallace Creek at 1944 hectares (ha) and Battery Creek at 3,229 ha, totaled 762 acre feet (af) and 1,332 af, respectively. (An acre-foot, af, is the volume of water required to cover an acre at a depth of one foot.) Runoff for the two larger systems, Okatie River at 4,859 ha and May River at 6,093 ha, totaled 2,222 af and 2,509 af, respectively.

When runoff is shown as a percentage of the rainfall that was converted to runoff, the results showed similarity for the Okatie River and Wallace Creek subwatersheds. MR1b was higher than the other May River watersheds and was also the most highly developed. BC2a was the highest of the Battery Creek watersheds and was also the most highly developed.

We constructed hydrographs for the watersheds in each of the four waterways to show runoff rate over time. As with the modeled volume, rate and time increased with progression from the headwaters to the final watershed outlet. For the Battery Creek hydrographs, the peak rate ranged from 9 cubic feet per second (cfs) and 102 cfs at the two headwater watersheds to 757 cfs at the final outlet (Figure 25). When the hydrographs were normalized to show cfs per square mile in order to remove the effect of area, BC2a had the highest peak rate followed by BC1a and then BC3a.

To project the potential impacts that implementation of volume-control BMPs and changing precipitation patterns from climate change might have on runoff volume in priority watersheds, we conducted a series of scenarios using SWARM. SWARM scenarios included: (1) pre-development scenarios to understand what volume reduction would be required in the developed watersheds to reach pre-development levels (< 9% impervious cover); (2) future development scenarios to understand the increase in volume associated with increased development levels; and (3) two climate change scenarios to understand how the predicted future weather (i.e., increased rainfall and wetter soils for periods of time) will change the runoff volume for the study watersheds.

For the BMP scenario of identifying the volume reduction amount required to match a low development (9% impervious cover) hydrology for a 95th percentile rain of 1.95 inches, three of the six volume sensitive watersheds were already below the low development level and were not considered (Table 11). For the others, BC2a needed to reduce volume from 30 af to 14 af, OK3 from 266 af to 221 af, and MR2 from 408 af to 398. BC2a had the greatest relative change.

Modeling impacts of additional development in each watershed showed the greatest relative changes for the lower developed watersheds of WC1a, WC1b, and BC1b (Table 11). At the 50% Build Out, runoff volume increased by 46%, 35%, 44%. At the 100% Build Out, volumes increased by 112%, 82%, 104%. For the higher developed watersheds of BC2a, OK3, and MR2, relative increases were lower: 23%, 11%, 20% for the 50% Build Out; 57%, 22%, 45% for the 100% Build Out. Volume increases for the larger watersheds, OK3 and MR2, were an order of magnitude greater than for the smaller ones. For all of the watersheds, the two development scenarios result in an increase in the targeted volume reduction required to achieve a 9% impervious cover hydrology.

We constructed hydrographs for the most developed small (BC2a) and large (OK3) watersheds to investigate the impact of development on the rate of runoff (Figure 26). To retrofit the watersheds to the lower development hydrology, for BC2a, the peak rate would need to decrease from 27 cfs to 12 cfs for the 1.95 inch rain and from 122 cfs to 73 cfs for the 4.5 inch rain. For OK3, the peak rate would need to decrease from 115 cfs to 97 cfs for the 1.95 inch rain and from 472 cfs to 423 cfs for the 4.5 inch rain. OK3 rates were much higher than BC2a because of the watershed's larger area – 2,296 ha compared to 288 ha; however, the relative change in rates was much greater for the smaller watershed, which could be partially explained by its more pervious soils.

The climate scenarios applied to the modeling of a 1.95 inch rain resulted in remarkably large increases in runoff volume (roughly double) for all watersheds (Table 12). For the Climate 1 scenario of a 15% increase in rainfall and a change from average to semi-wet antecedent runoff conditions, volume increases were greatest in the less developed watersheds (WC1a, WC1b, BC1b) at 108%, 106%, 107%. In the more developed watersheds (BC2a, OK3, MR2), volumes increased by 83%, 77%, 88%. For the Climate 2 scenario which included a 15% increase in rain and a change from average to wet antecedent runoff conditions, volume increases were generally double those of the Climate 1 scenario. For less developed WC1a, WC1b, BC1b, volumes increased by 223%, 212%, 222%, respectively. For more developed BC2a, OK3, MR2, the increases were 157%, 143%, 172%, respectively.

As with the BMP and development scenarios, we constructed hydrographs for the most developed small (BC2a) and large (OK3) watersheds to investigate the impact of climate on the rate of runoff (Figure 27). For BC2a at the 1.95 inch rain, the peak rate increased 93% (from 27 cfs to 52 cfs) for Climate 1 and 178% (to 75 cfs) for Climate 2. For the 4.5 inch rain, the peak rate increased 57% (from 122 cfs to 191 cfs) for Climate 1 and 95% (to 238 cfs) for Climate 2. OK3 rates were much higher than BC2a because of the watershed's larger area – 2,296 ha compared to 288 ha. For the 1.95 inch rain, the peak rate increased by 78% (from 115 cfs to 205 cfs) for Climate 1 and by 144% (to 281 cfs) for Climate 2. For the 4.5 inch rain, the peak rate increased by 49% (from 472 cfs to 705 cfs) for Climate 1 and by 78% (to 839 cfs) for Climate 2.

Data Summary and Context

The two primary study years, 2014 and 2015, proved to be good examples for studying the effects of storms. From a stormwater perspective, 2014 experienced higher than average precipitation, which provided a large number of rain events to follow as the stormwater pulse travels through each system. To date, 2015 was more reflective of an average rainfall year for this area. Together, these two years have provided a good variety of events to study.

We collected nearly 750,000 salinity readings across five watersheds, capturing nearly 800 salinity responses to rain events over the course of the project. For each rain event, we measured the salinity drop that occurred at each site. By compiling a large database of these rain events, and the response in the tidal creeks, we were able to identify areas that were volume sensitive. The most volume sensitive areas experienced the greatest salinity drop for a given rain event, and we were able to establish relationships between rainfall amount and projected salinity drop, and thus identify salinity sensitivity thresholds within each watershed.

Using feedback generated at one of our WAC workshops, we were able to delineate volume sensitive cut-points in each of the four main study watersheds. These were largely based on the slopes of the relationships between rainfall and salinity. Because each watershed responded quite differently to rain inputs, and with some watersheds being much more variable than others, there was no set threshold for what we defined as "sensitive," rather we identified salinity sensitivity thresholds based on a holistic assessment of all sites in each system. With a majority of agreement from the WAC, we identified watersheds as "sensitive," with the caveat that some of the choice in location was limited by the spatial resolution of the deployment zones—i.e., we cannot feasibly instrument every portion of a system. These watersheds were, inclusive of their upstream components, OK3, MR2, WC1a and WC1b, and BC2a and BC1b. We erred on the side of inclusion, rather than exclusion, in that if a site was transitional it was included as sensitive. For instance, the two most headwater sites in the May River, MR1a and MR1b, exhibited high sensitivity (mean slope = 0.125), yet the next site after the confluence of these two branches exhibited moderate sensitivity (slope = 0.060). Therefore, there was likely continued sensitivity beyond the first two sites, and so we included the watershed downstream, MR2. The mean of the slopes of all cut points was 0.060 psu/mm rainfall, which may serve as a general guideline based on the watersheds studied and rain events captured to date. A more objective classification of the slope breakpoints for each watershed is the least squares differences test. These results were very similar. The main distinction was that Wallace Creek, the least sensitive and least developed watershed, did not contain large enough differences in salinity drop to be statistically significant between the headwaters and downstream portions. This was likely due to the low levels of development and more pervious soils.

Expansion of the salinity monitoring into Huspah Creek proved to be worthwhile, in that it tested much of what we knew, and expanded the range of site types in the study to include more brackish salinities. Based on early results (5 rain events) salinity drops in Huspah Creek were more than twice those of the Okatie River headwaters for the same amount of rainfall.

Once we had identified volume sensitive portions of the study watersheds, we began to look for factors correlated to this sensitivity and also to model how these watersheds might respond to implementation of volume control BMPs or changing precipitation patterns associated with climate change. We used a statistical model to look for variables most closely associated with volume sensitivity. The most significant variable correlated to volume sensitivity was percent coverage of freshwater wetlands. Areas with higher percent coverage of freshwater wetlands were more likely to be volume sensitive. Two variables were inversely correlated to volume sensitivity: creek width and coverage of estuarine wetlands (salt marsh), and so volume sensitivity decreased with increases of these metrics. This was not surprising, as estuarine wetland coverage and creek widths increase toward the downstream section of these watersheds.

Imperviousness, a combined metric we developed to account for both soil type and land-use categories, was also significantly positively correlated to volume sensitivity. We used this prediction formula to estimate changes in slope that might occur in response to changes in imperviousness. This metric weighs development that occurs on pervious soil greater than development occurring on an already impervious soil surface. We estimated the change in slope in response to an increase in 10% of the total imperviousness score for all five headwater sites, presented as *current slope (predicted slope)*: Okatie River 1: 0.13 (0.16), May River 1a: 0.12 (0.15), Battery Creek 2a: 0.06 (0.08), Wallace Creek 1a: 0.06 (0.07), Huspah Creek 1: 0.27 (0.31). A 10% increase in imperviousness would result from 10% of the remaining undeveloped upland of a pervious soil type being developed as C-CAP development class high, medium, or low intensity.

To provide a broader context for our research, we investigated other coastal watersheds within Beaufort County, and quantified a variety of land cover, soil type, and geomorphological characteristics at a coarser spatial scale than the detailed subwatershed comparisons made above. This provided an opportunity to compare our study watersheds to other watersheds we did not study, and to make inferences about their potential headwater sensitivities. This statistical modeling identified a number of variables related to volume sensitivity, and some of these varied between models. There was high covariability between these variables, and so we let stepwise regression identify the greatest correlations.

Of the 17 watersheds studied here, the models identified 7 that were likely to contain volume sensitive headwaters. In general, these tended to be in the west and northwest of Port Royal Sound, which are also the larger coastal watersheds in this area: Pocotaligo River, Euhaw Creek, Okatie River, Wright River, Huspah Creek, Tulifiny River and Chechesse River. Watersheds identified as least likely to contain sensitive headwaters were, in general, smaller and concentrated on the eastern side of Port Royal Sound. These watersheds were Wallace Creek, Village Creek, Albergottie Creek, McCalleys Creek, the Morgan River System, and the Boyd Creek System. With the exception of the Wright River and the Boyd Creek System, these are all located on the Sea Islands in the vicinity of Beaufort. The absence of the May River and Battery Creek from these lists indicates that they did not appear in the top 25% of sensitive or insensitive for any of the models. The WAC did, however, identify sensitive areas within both of these watersheds.

SWARM provided modeled runoff volume for all of the study watersheds in each of the four creek systems. This provides basic data on the percent of development, percent of impervious soils, and amount of rainfall required in order for runoff to occur under average conditions. It also provides the actual runoff modeling which allows for comparison between the watersheds of each creek system. In addition, the normalization of the runoff (both volume and rate over time) by area allows comparison among all of the watersheds, with charts and hydrographs enabling identification of any anomalies to investigate further. A regression equation for each watershed was developed to allow Beaufort County to predict the runoff volume based on any selected rainfall amount.

To project the potential impacts that implementation of volume control BMPs and changing precipitation patterns from climate change might have on runoff volume in priority watersheds, we conducted a series of scenarios using SWARM. The six headwater watersheds designated as critically sensitive to stormwater runoff were used for modeling the responses to implementation of mitigation measures in the two more-developed watersheds scenario, two volume-control BMP scenarios, and two climate change scenarios.

For the BMP scenarios, the first objective was to set the watershed hydrology to one of low development. Three of the six watersheds had levels of development lower than the targeted level (9% impervious cover). With the three more-developed watersheds, volume reduction amounts required to reach the targeted amount were calculated. The volume reduction for Battery Creek to achieve 9% impervious cover would require a 53% reduction, in comparison to the May River and Okatie River which only required a 2% and 17% reduction, respectively.

Volume reduction amounts were calculated for two higher development scenarios for all six watersheds. Volume increases for the larger watersheds, OK3 and MR2, were an order of magnitude greater than for the smaller ones. Using the current development level and the two higher levels will allow Beaufort County to have an understanding of what stormwater runoff volume changes are likely as development continues.

For the climate scenarios, we based our modeling on general predictions of increasing frequency and intensity of heavy storms. Both scenarios used an increase in rainfall, and each scenario included a wetter antecedent runoff condition. In general, the runoff volume doubled or tripled within each system for the two scenarios.

Our stormwater runoff modeling provides Beaufort County with information and insights concerning runoff in the study areas and how it will be impacted by additional development and by climate change. There is also the potential to apply SWARM to other creek systems both to calculate runoff and to predict salinity changes. However, as with all modeling, SWARM output should be viewed as an approximation of actual runoff. SWARM's validations indicate that the major drivers of runoff are captured well in the modeling system, but the results are best viewed as representative of runoff for a given rain event.

Going Forward

Although we have collected data in five watersheds in Beaufort County, there is still much that is unknown with regard to volume sensitivity. This is evidenced by our recent data collection in the Huspah Creek watershed, which varied considerably from the other watersheds studied. Had we used a regression model built on the four primary study watersheds, the large salinity drops observed in Huspah would have been grossly underpredicted. This realization confirmed that there were still a number of unknowns. We would continue to study these salinity responses, but we would use the watershed study database to identify areas where little is known with regard to volume sensitivity. Additional data collected in these relatively unstudied watersheds could then be used to validate or test the models presented here. We will discuss this with the WAC at our next meeting.

The original proposal also included a series of bioassays to assess the impact of these salinity drops on various biota of concern. Due the complexity and resources needed to complete these types of studies, this was withdrawn from the proposal. It is, however, still of interest to us and the WAC. Given additional resources we would pursue a targeted series of bioassays designed to assess the effects of stormwater runoff on estuarine organism health and survival.

Retrospective

Challenges

Overall, the project has been successful. As with other research projects, there were some challenges. The design, acquisition, and deployment process proceeded slower than anticipated. Although the official start date for the NERRS Science Collaborative grant was September 1, 2013, until the necessary forms were signed by all parties and the account was set up, it was October 22nd before we were permitted to bid out the equipment, and early December before our partner, the University of South Carolina-Beaufort received its subcontract. As a result, the sondes and rain gauges that had to be purchased did not arrive until December. By borrowing existing equipment we were able to completely outfit the Okatie River watershed and to use other sondes to survey the tidal dynamics in other watersheds. Considerable effort was made to contact dock owners in each waterway, explain the purpose and requirements of the monitoring work, and securing their cooperation in deploying monitoring sondes or weather stations from their docks. By the end of February 2014, the Okatie River, May River, Battery Creek, and Wallace Creek were fully instrumented, and we were prepared to deploy in a fifth watershed.

In Huspah Creek, technical problems with datasondes delayed full deployment until the four priority watersheds could be studied for at least one year. We experienced some significant instrumentation malfunction problems during the initial deployments, particularly in Huspah Creek starting in May 2014. Datasondes were not recording correctly, and some of these malfunctions required the instruments to be sent back for repairs. We therefore made the decision to withdraw from Huspah Creek temporarily to ensure that we had enough sondes in reserve to compensate for any malfunctions in the other watersheds.

Intended User Impact on Applied Science

Intended User collaboration was an integral component of this project and contributed greatly to its success. To ensure that our analysis was as relevant and useful as possible, we actively engaged the WAC at several points along the way, via a series of interactive workshops. This group consisted of 15 individuals representing Beaufort County stormwater staff, SWMUB members, environmental groups, state agency staff, and scientists. We presented our most recent findings and gathered group feedback as to how to proceed. Therefore, the modeling, analyses, and results were strongly driven by the interests and needs of this group. This proved an invaluable resource, as the scientific process became adaptive to the information needs of the user groups. The end result, hopefully, is that by maximizing the utility of the results to Beaufort County, local stormwater managers can make the most informed decisions.

We will continue to work with the WAC beyond the ending of this grant, in accordance with our five-year Agreement. We are planning an additional WAC meeting on September 10, 2015. The goal of this meeting will be to discuss this report (including the additional analyses they requested) to ensure that they can take the lead in interpretation, and to focus the discussion primarily on how they will use the results to develop new policies regarding stormwater management in the County. In addition, a second goal is to discuss how to best present the research findings and conclusions to the SWMUB and Natural Resource Committee. We believe the input received from the WAC will allow us to insure the information is translated and conveyed such that it can be used by decision makers and elected officials. We are scheduled to present to the SWMUB on September 30, 2015 and the Natural Resource Committee on October 1, 2015.

Budget and Resources Assessment

The budget was generally sufficient to conduct the study as proposed. We were successful at collecting over a year of data for each of the four primary study systems. A portion of the success can be attributed to the purchase of the Hydrolab datasondes at a discounted price. The project has sparked a number of additional avenues to follow which we will try and accomplish with other funding sources.

What We Know Now

There were a number of bumps in the road for this project including slow purchasing due to agency software upgrades, and the inability to test the modeling system to specific sites in Beaufort County. The slow purchasing and grant establishment were out of our control. The collection of flow data for model testing was not as successful as we originally proposed. The overall time it took to collect and process the salinity data resulted in less time to measure flow at appropriate sites (i.e., locations with no overbank flow). However, SWARM modeling has been validated prior to this study using data from other estuarine tidal creeks in South Carolina. We are currently working with Beaufort County to collect paired data in the Okatie River. The County purchased a similar instrument and we will continue to work with them to collect data at sites of interest.

Sharing Your Work with the Reserves and NOAA

This ACE Basin NERR project has applicability to many of the other coastal Reserves. We are submitting an abstract to present a poster at the 2015 NERR annual meeting to share the findings of the study with the Reserve system. We collaborated with a NOAA scientist, Anne Blair, who we hope will also provide avenues to share the information with other NOAA offices.

Anything Else?

We have been very fortunate to conduct this work with NERR Science Collaborative funding. It allowed us to provide Beaufort County with a more robust scientific dataset to use in their management decisions.

We shared the study findings through the following oral or poster presentations.

Sanger, D., J. Leffler, E. Montie, A. Blair, A. Turner, J. Brunson, G. Riekerk, and K. Pitts. Determining Volume Sensitive Waters in Beaufort County, SC Tidal Creeks. Presented at the Southeastern Estuarine Research Society annual meeting, February 13-15, 2014, Savannah, GA.

Pitts, K., D. Sanger, J. Leffler, J. Brunson, G. Riekerk, R. O'Quinn IV, E. Montie, A. Blair, and A. Turner. Determining Volume Sensitive Waters in Beaufort County, SC Tidal Creeks. Presented at the First Annual Marine Resources Division Conference, March 25-26, 2014, Charleston, SC.

Pirhalla, D., A. Blair, C. Currin, K. Holderied, E. Turner, D. Kidwell. "Impacts of Climate-related Threshold Events - Current NCCOS Research". Presented at the Climate Thresholds Workshop at Hollings Marine Laboratory August 18, 2014, Charleston, SC.

Sanger, D., J. Leffler, A. Blair, A. Tweel, and E. Montie, "Prioritizing Volume Sensitive Tidal Creek Watersheds in Beaufort County, SC". Presentation at 9th Annual Southeast Regional Stormwater Conference, October 8-10, 2014, Charleston, SC.

Tweel, A., D. Sanger, J. Leffler, E. Montie, and A. Blair, "Volume Sensitive Waters in Tidal Creeks of Beaufort County, SC". Presentation at the South Carolina Water Resources Conference, October 15-16, 2014, Columbia, SC.

Tweel, A., D. Sanger, A. Blair, and J. Leffler. "Determining Volume Sensitive Waters in Beaufort County, SC Tidal Creeks". Poster at the National Estuarine Research Reserve System Annual Meeting, November 17-21, 2014, Shepherdstown, WV.

Tweel, A., D. Sanger, A. Blair, and J. Leffler. "Determining Volume Sensitive Waters in Beaufort County, SC Tidal Creeks". Presentation at the Fifth Interagency Conference on Research in the Watersheds, March 2-5, 2015, Charleston, SC.

Tweel, A. "Determining Volume-sensitive Waters in Beaufort County Tidal Creeks". Presented at the Marine Resources Division Conference, March 18-19, 2015, Charleston, SC. Technical audience. 100 attendees.

Blair, A., D. Sanger, and S. Lovelace. "Stormwater Runoff in Watersheds: A System for Predicting Impacts of Development and Climate Change". Presentation at the Fifth Interagency Conference on Research in the Watersheds, March 2-5, 2015, Charleston, SC.

Leffler, J. "Determining Volume Sensitive Waters in Beaufort County, SC Tidal Creeks". Poster at the Fort Johnson Poster Session for Senator Sheldon Whitehouse, April 22, 2014, Charleston, SC.

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Appendix A. Figures and Tables

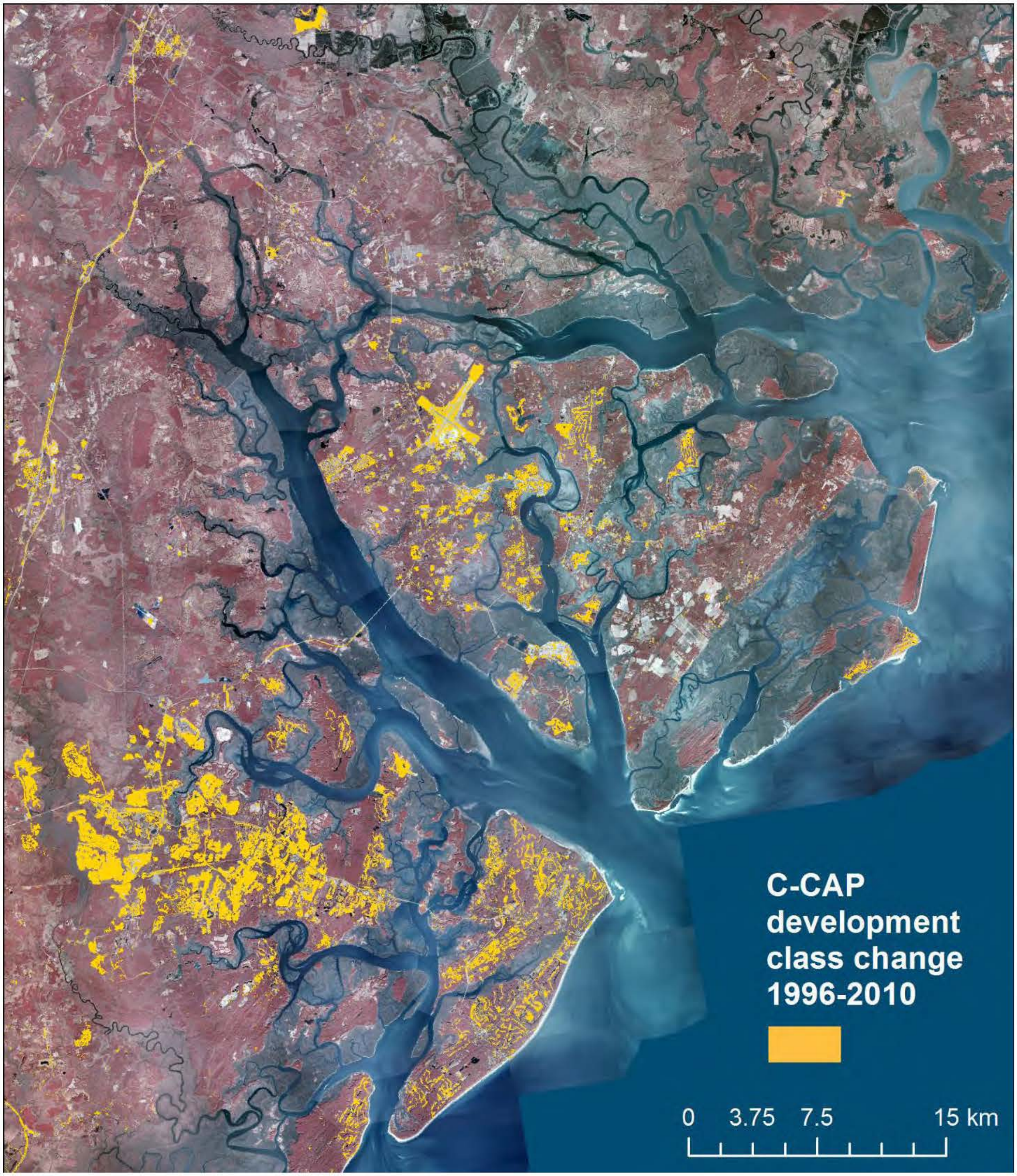


Figure 1. NOAA Coastal Change Analysis Program (C-CAP) change analysis for 1996 to 2010 in the Beaufort County area. Areas shown in yellow changed land use category from undeveloped to developed, or from a less developed category to a more developed category. Base layer is SCDNR NAPP IR 2010 image.

Figure 2. Watershed boundaries used in watershed study (yellow lines), based on USGS HUC-12 boundaries. Headwater portions of the largest watersheds were also analyzed separately (dashed lines). Base layer is USDA NAIP 2013 image.

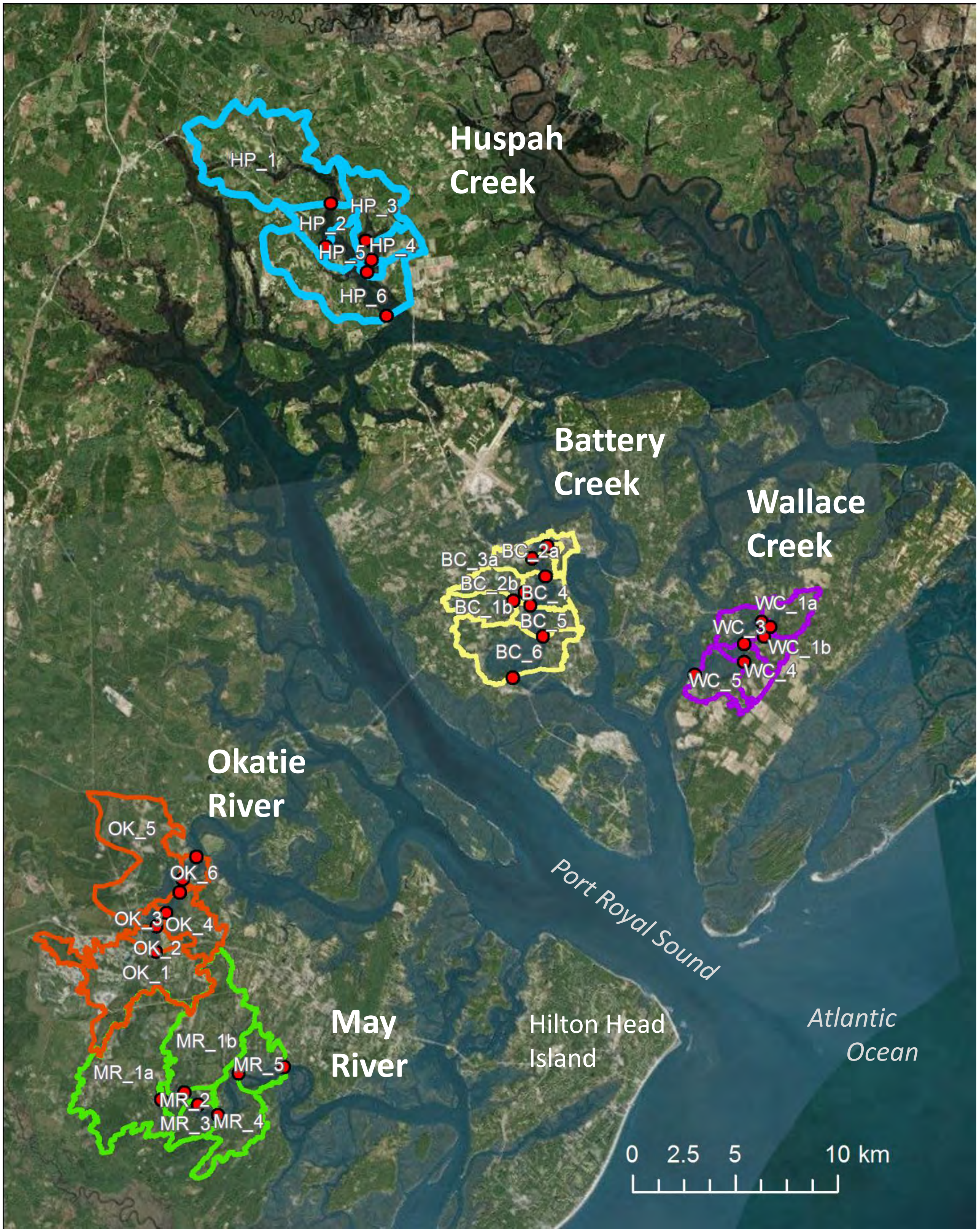


Figure 3. Aerial map of Beaufort County depicting study watersheds for Okatie River (orange), May River (green), Battery Creek (yellow), Wallace Creek (purple), and Huspah Creek (blue). Labels indicate subwatersheds and datalogger locations. WC is Wallace Creek, BC is Battery Creek, OK is Okatie River, MR is May River, HP is Huspah Creek. Base layer is USDA NAIP 2013 image.

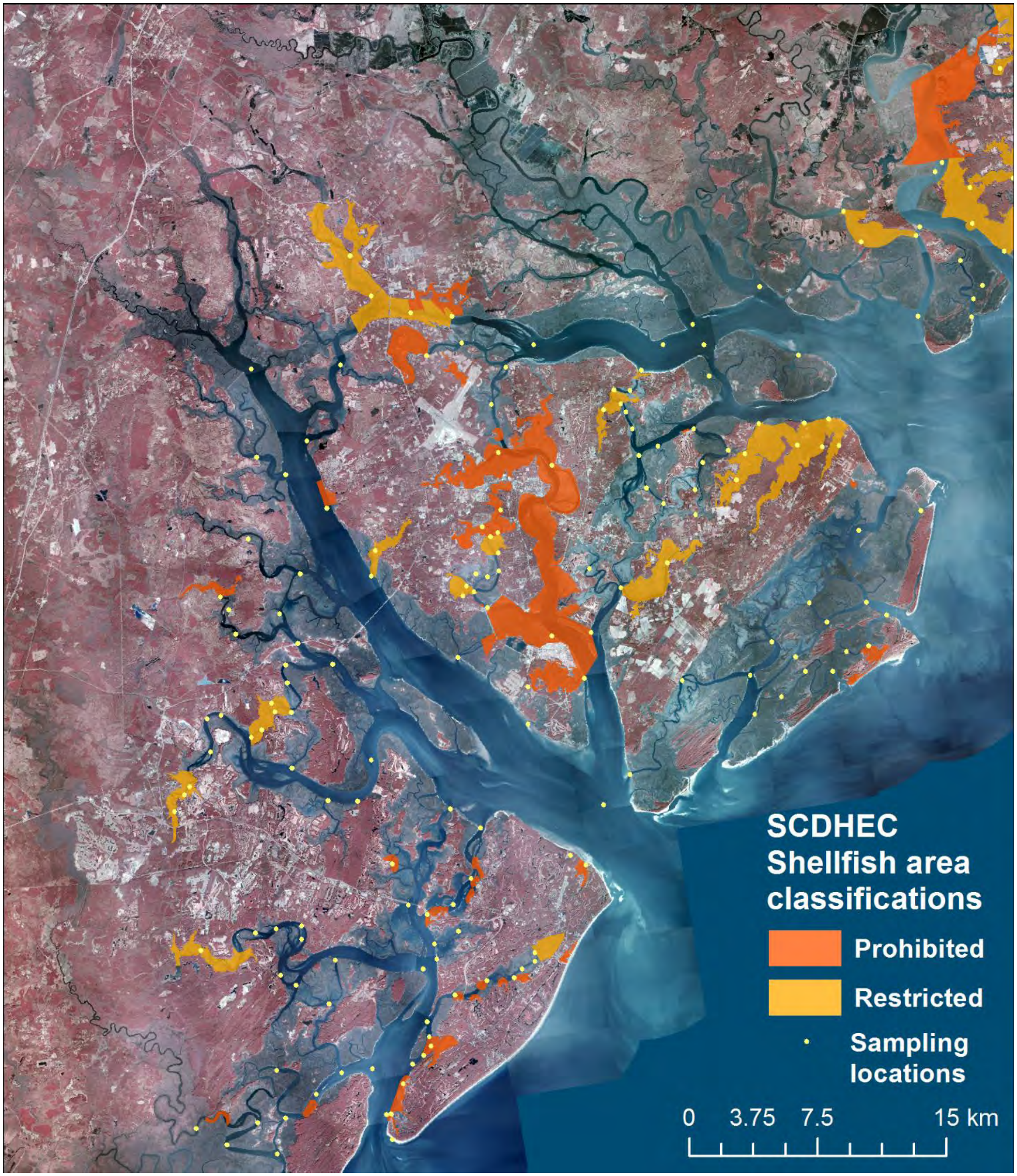


Figure 4. South Carolina Department of Health and Environmental Control (SCDHEC) shellfish zone classifications and water quality sampling locations. Headwater portions of tidal creeks are often classified as restricted or prohibited. Base layer is SCDNR NAPP IR 2010 image.

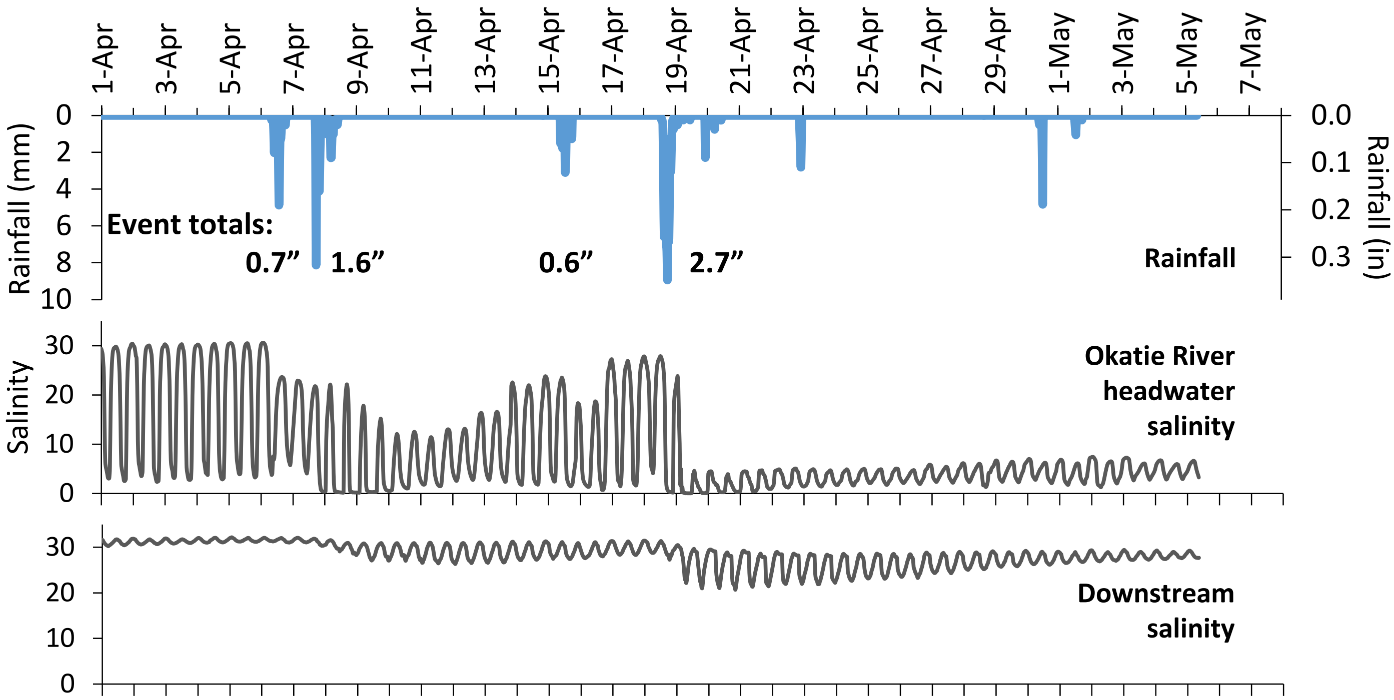


Figure 5. Example data collected from the Okatie River from April 1 to May 8, 2014. Salinity varies over the course of the two tidal cycles per day and ranges were much greater and much more influenced by rain events in the tidal creek headwaters (OK1) compared to farther downstream (OK6).

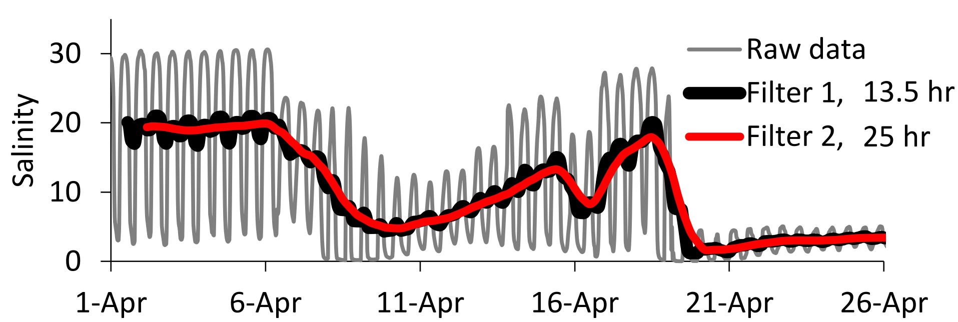


Figure 6. An example of salinity data filtered to isolate stormwater impacts from tidal effects.

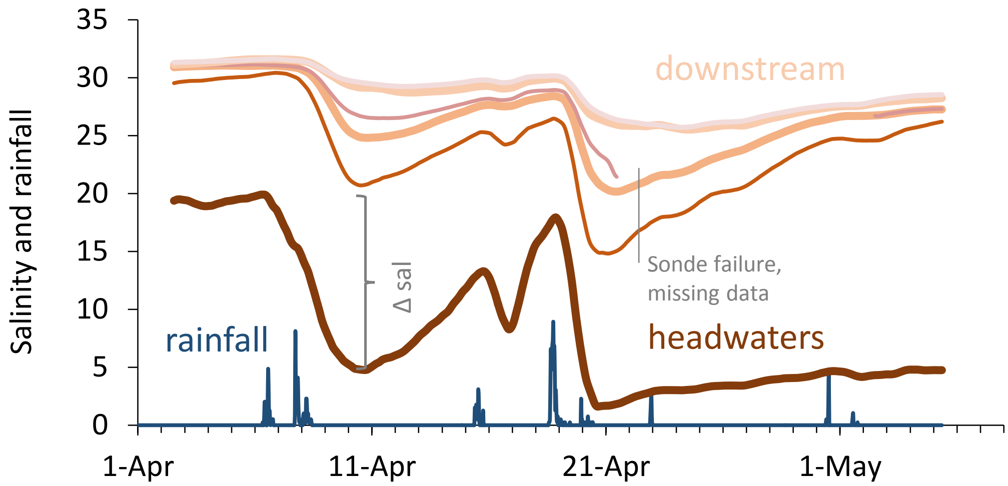


Figure 7. An example of filtered salinity data for all six Okatie River sites from two primary rain events in spring 2014. Darker colors represent more headwater sites, salinity response is dampened as the freshwater signal progresses downstream. An example of a salinity drop is brackted as Δ sal for the first rain event.

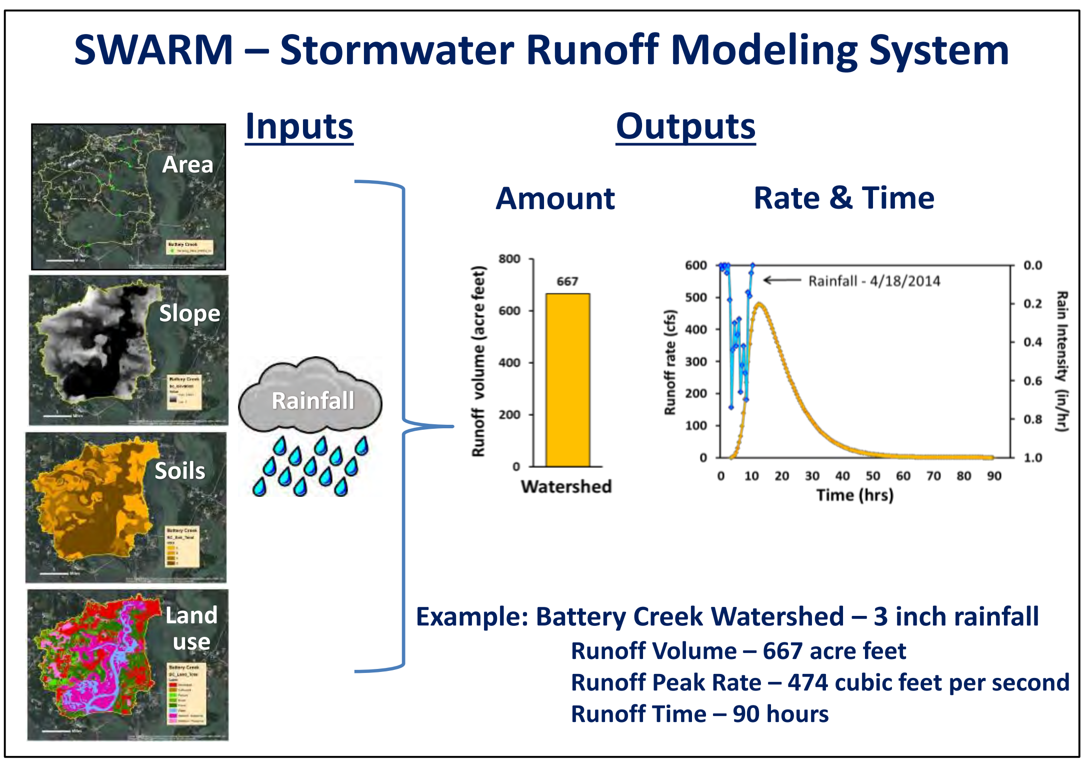


Figure 8. Diagram of general elements of SWARM. Model inputs are shown on the left. Model outputs are shown in the center and right. Specific input and output data are provided at the lower right.

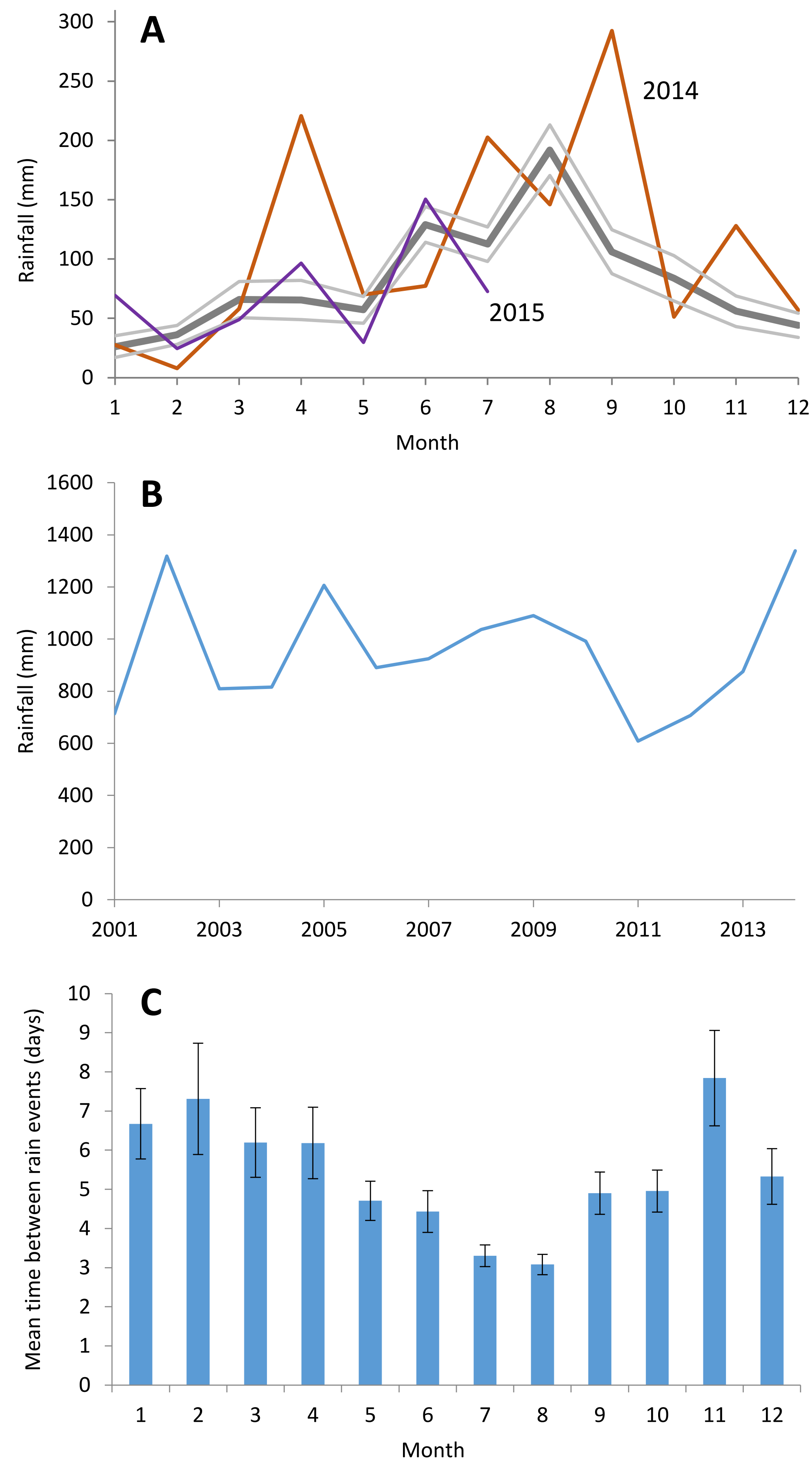


Figure 9. Summary of ACE Basin NERR meteorological data collected at Bennett's Point, South Carolina. **(A)** Mean monthly precipitation (± 1 S.E.) 2001-2014, overlain with study years 2014 and 2015. **(B)** Annual rainfall totals. **(C)** Average number of days (± 1 S.E.) between rain events for all years, by month.

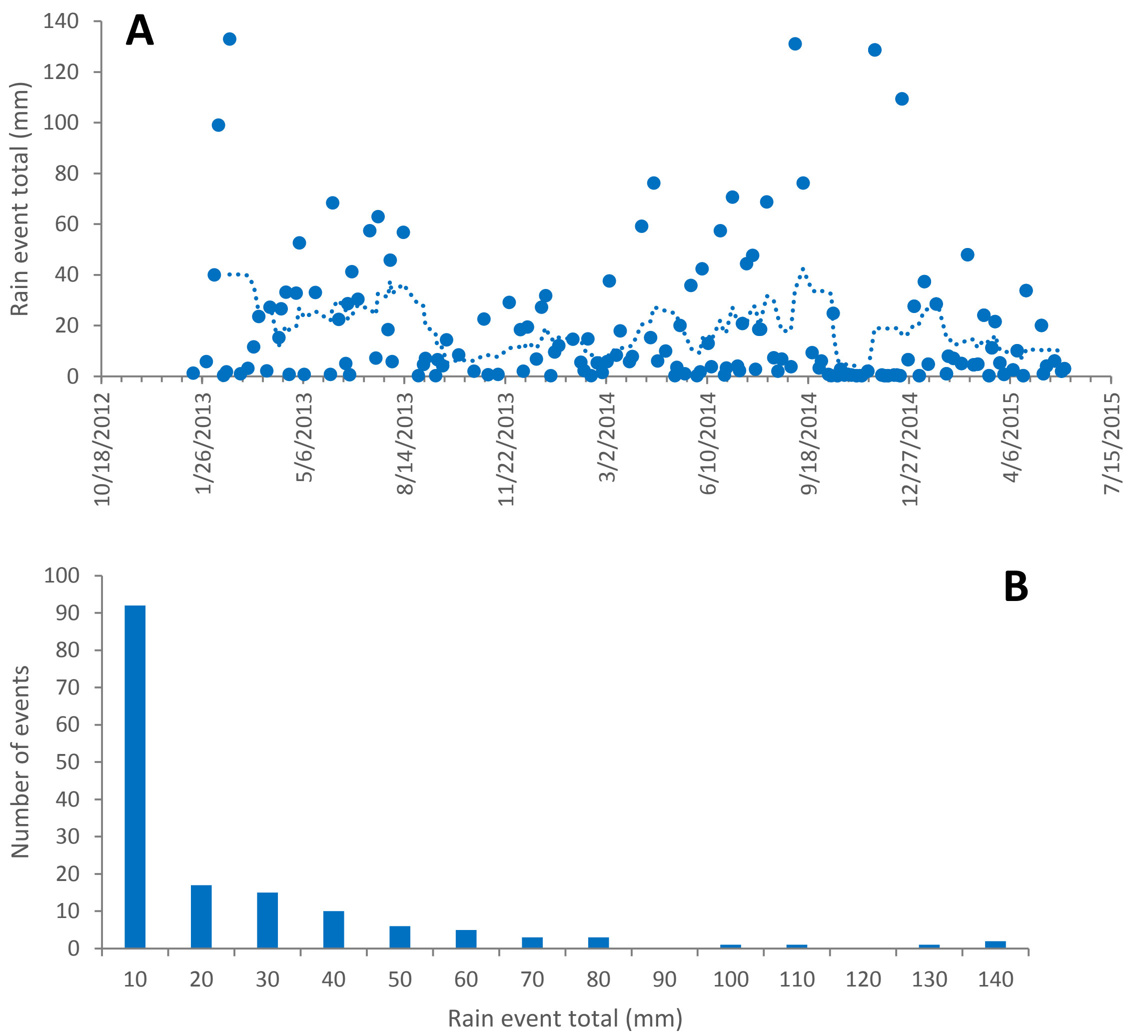


Figure 10. Summary of meteorological data collected for this study. Only data for Okatie River gauge is shown, other sites exhibit similar patterns. **(A)** Rain event totals over the course of the study, and the moving average shows periods of higher and lower rainfall. **(B)** Histogram of rain event totals by 10 mm bin.

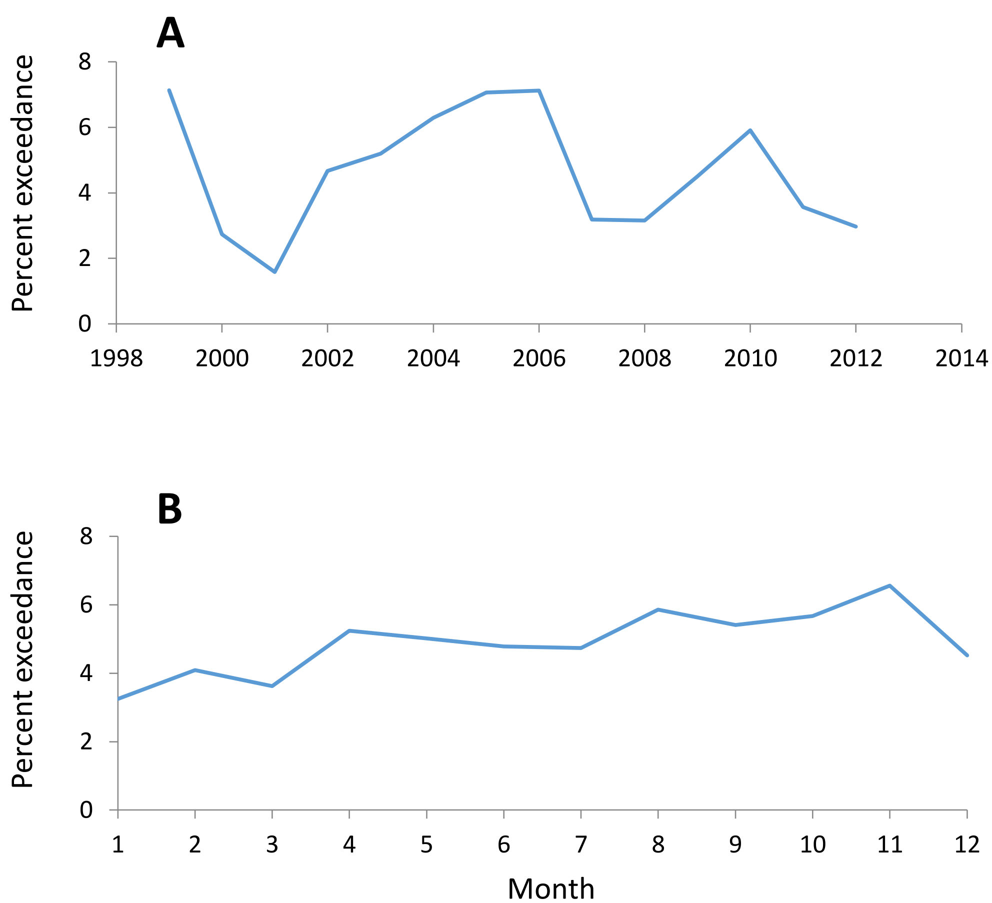


Figure 11. Summaries of SCDHEC fecal coliform water quality sample results by year **(A)** and month **(B)** for all available sample data collected in Beaufort County, South Carolina. Exceedance criteria is defined as greater than 40.9 cells/100 ml.

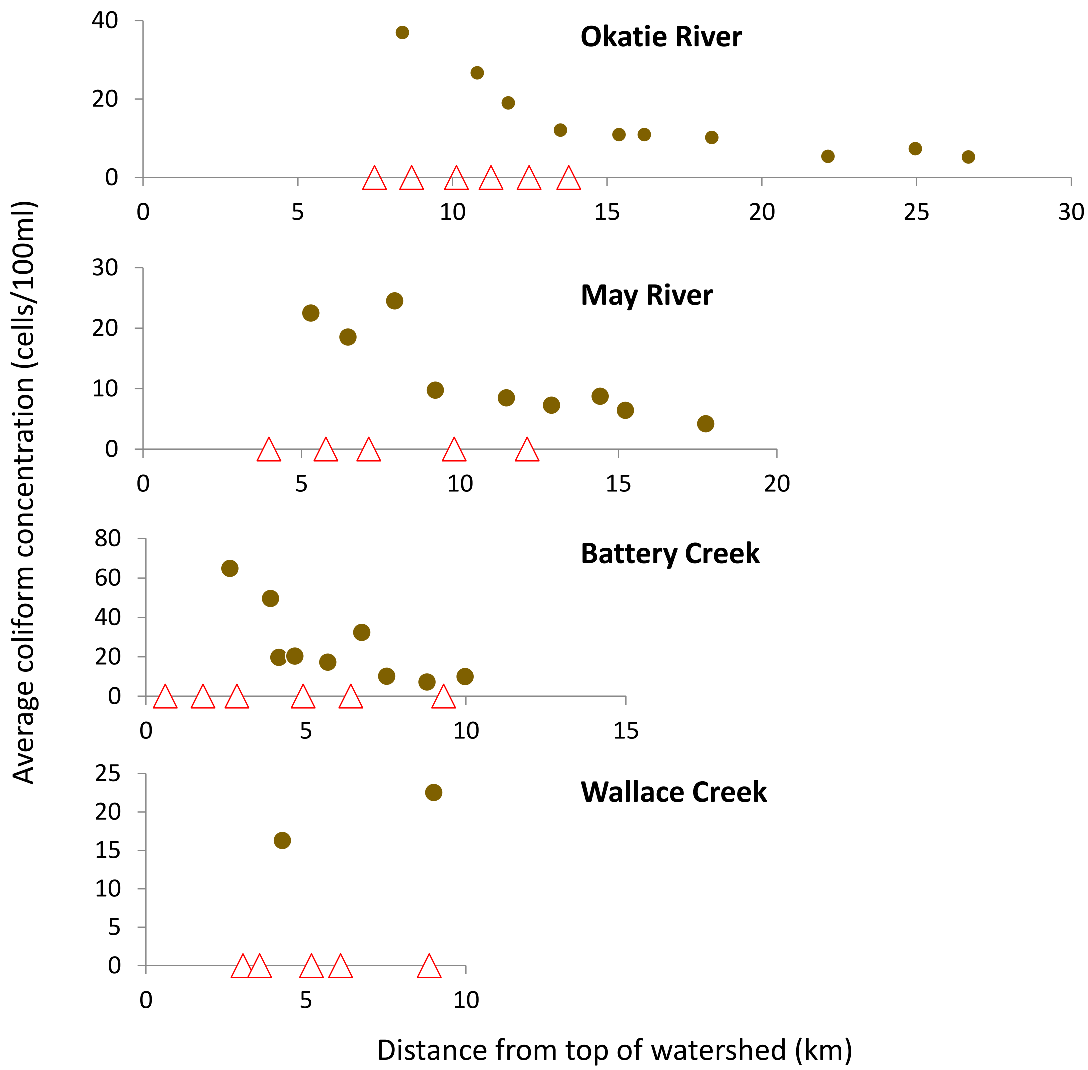
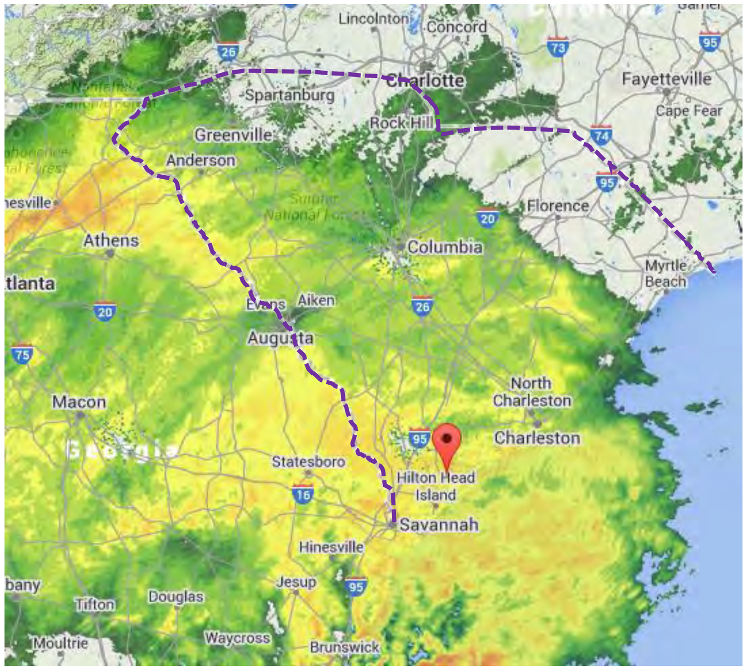


Figure 12. Summaries of SCDHEC fecal coliform water quality sample results by location within the study systems (brown) for all available data. Our study sites down the length of each creek are shown as red triangles. Note differing y-axis scales.



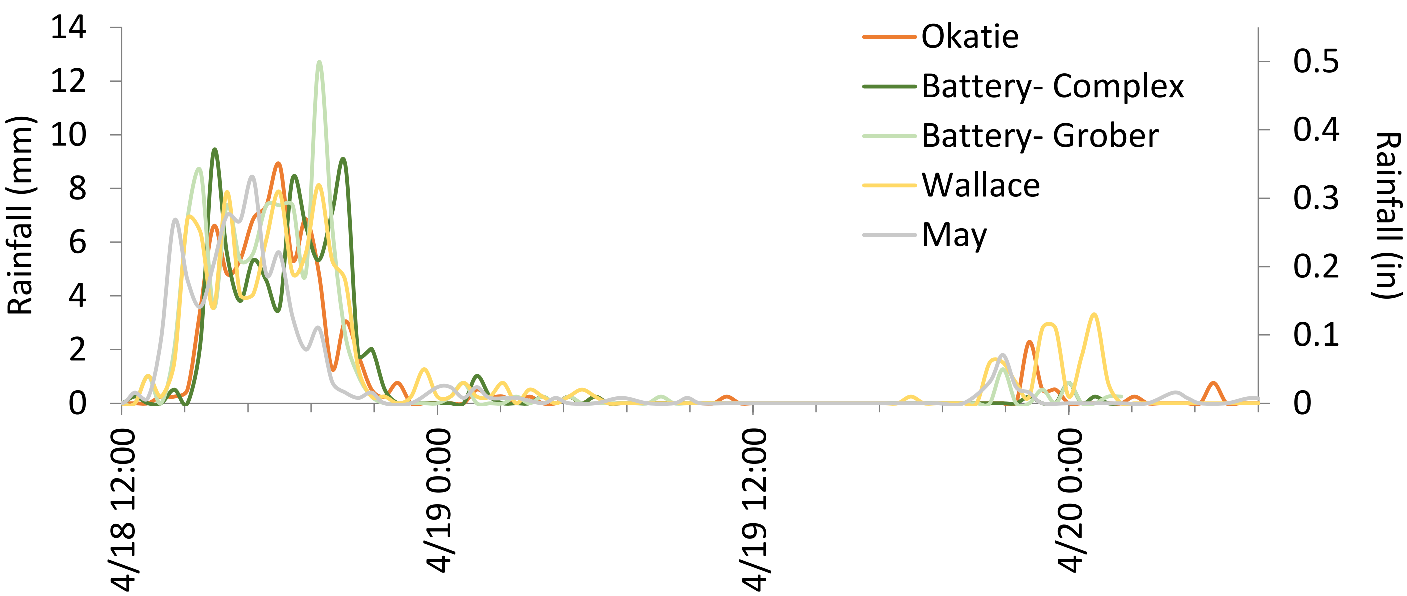


Figure 13. An example of a large rain event on April 18, 2014, showing similarities and differences between the five study rain gauges. This large rain event yielded similar rain totals and timing for all study watersheds, and was used as a case study to learn about salinity response in greater detail.

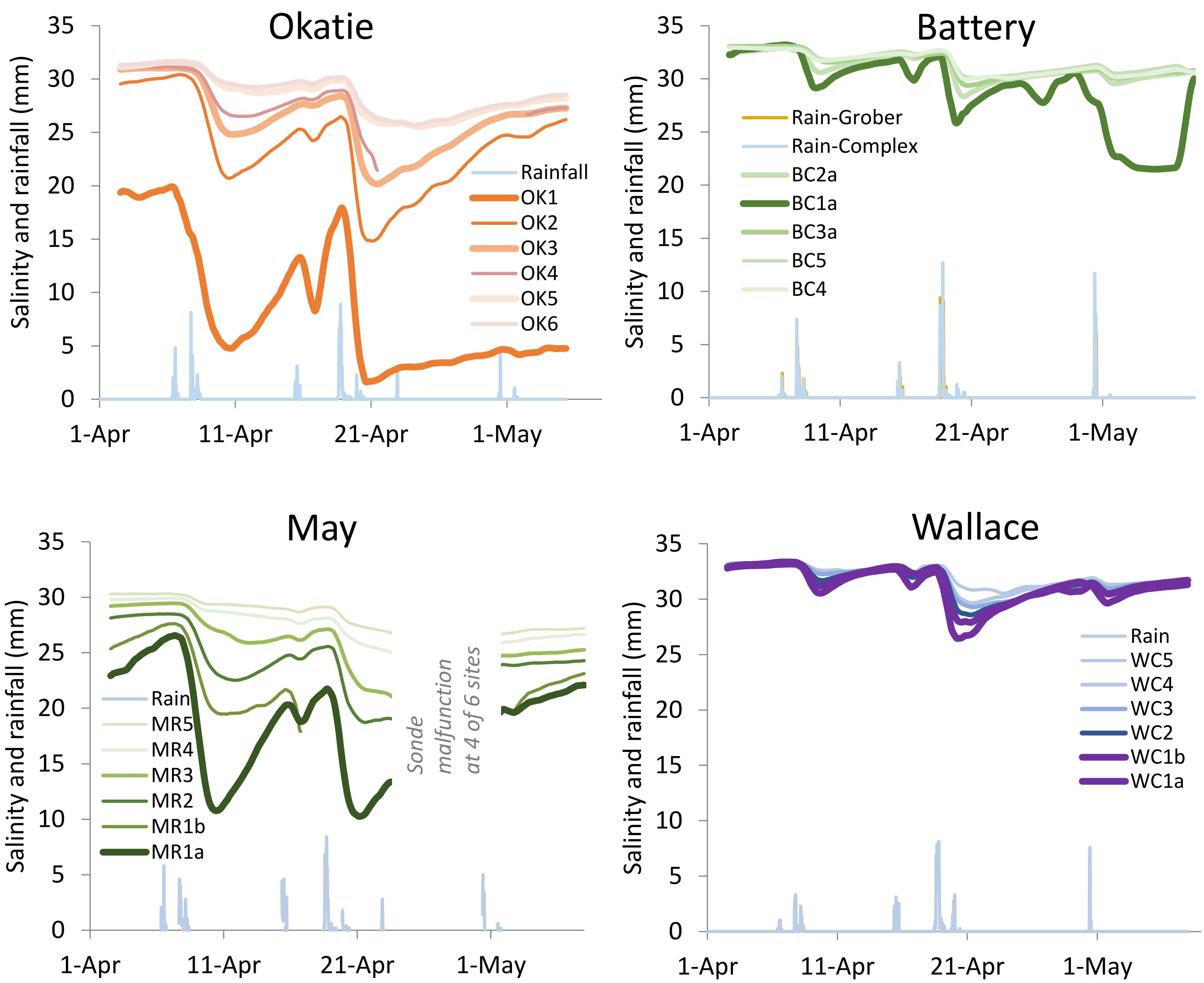


Figure 14. Examples of filtered salinity data for the four main study watersheds from two primary rain events in spring 2014. Darker colors represent more headwater sites, salinity response was dampened as the freshwater signal progressed downstream. The Okatie River and May River watersheds exhibited much larger salinity drops than Battery Creek and Wallace Creek watersheds for the same rain events.

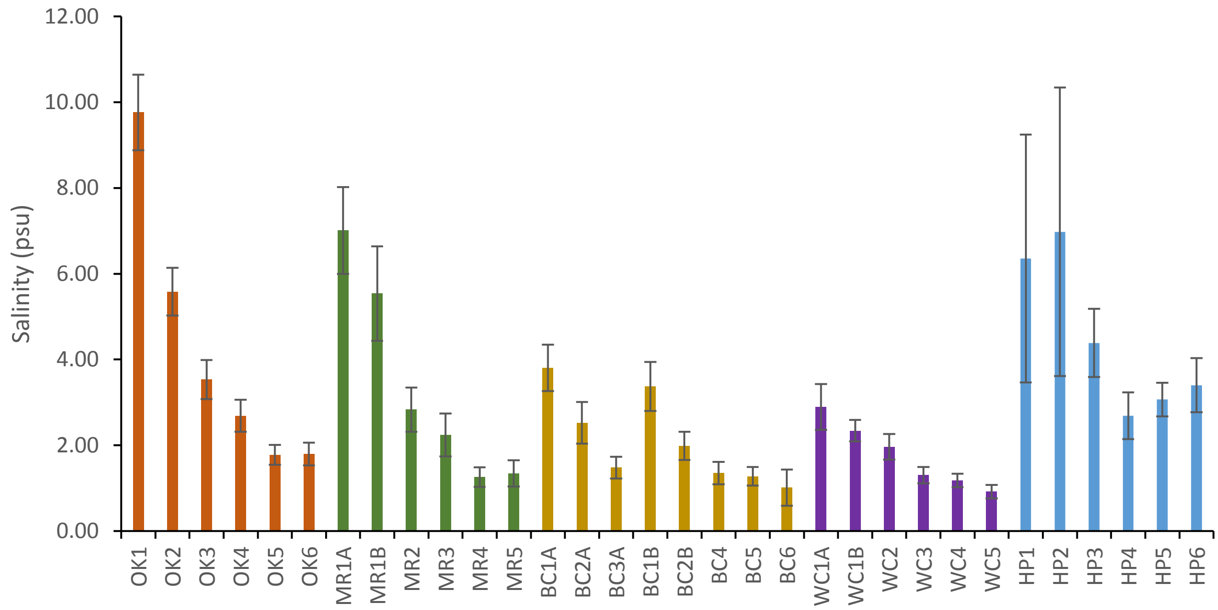


Figure 15. Average salinity drop observed at each site. Error bars represent one standard error. Average was computed across all rain events.

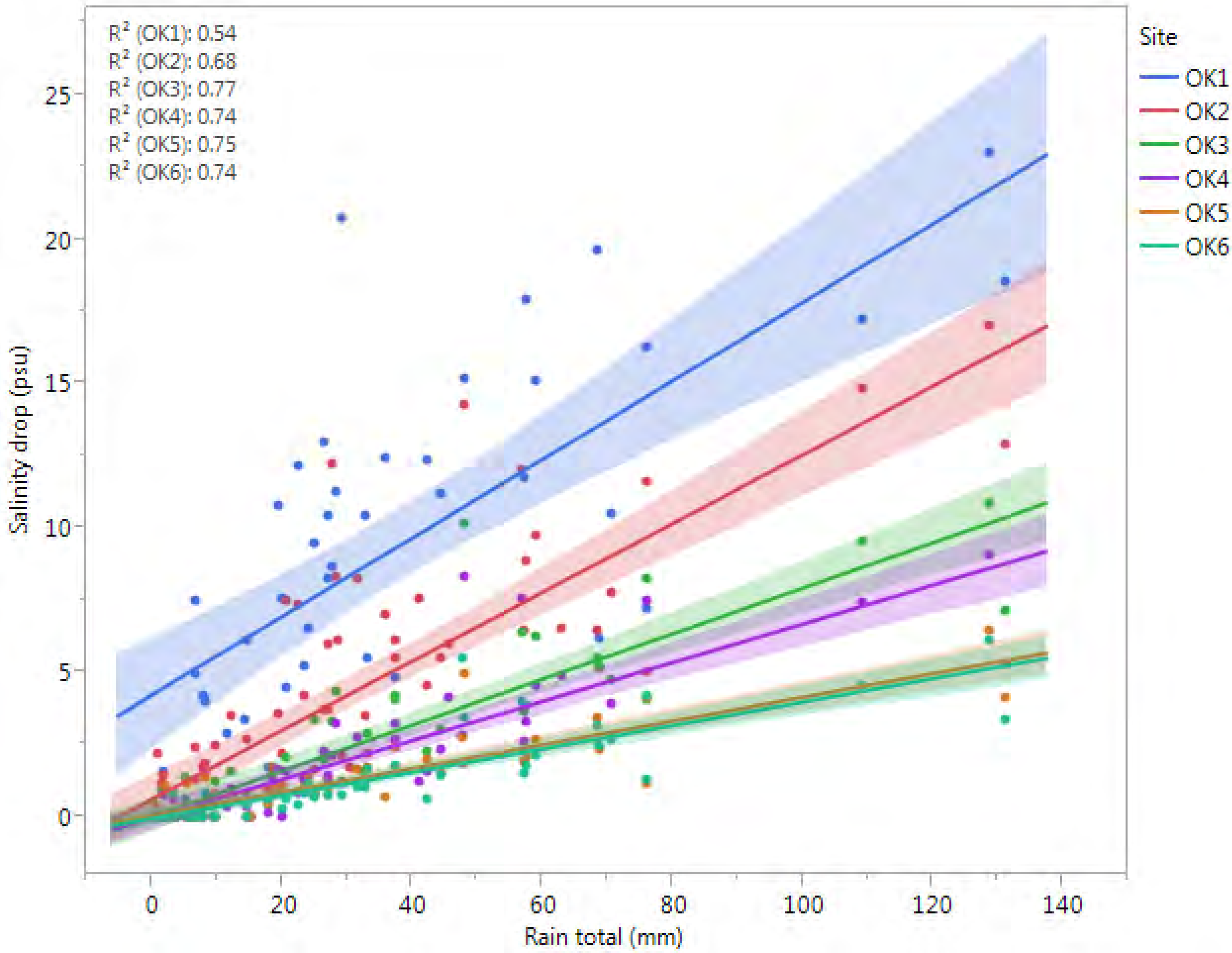


Figure 16. Relationship between rainfall total and salinity drop for the study sites in the Okatie River. The R^2 is provided for each site.

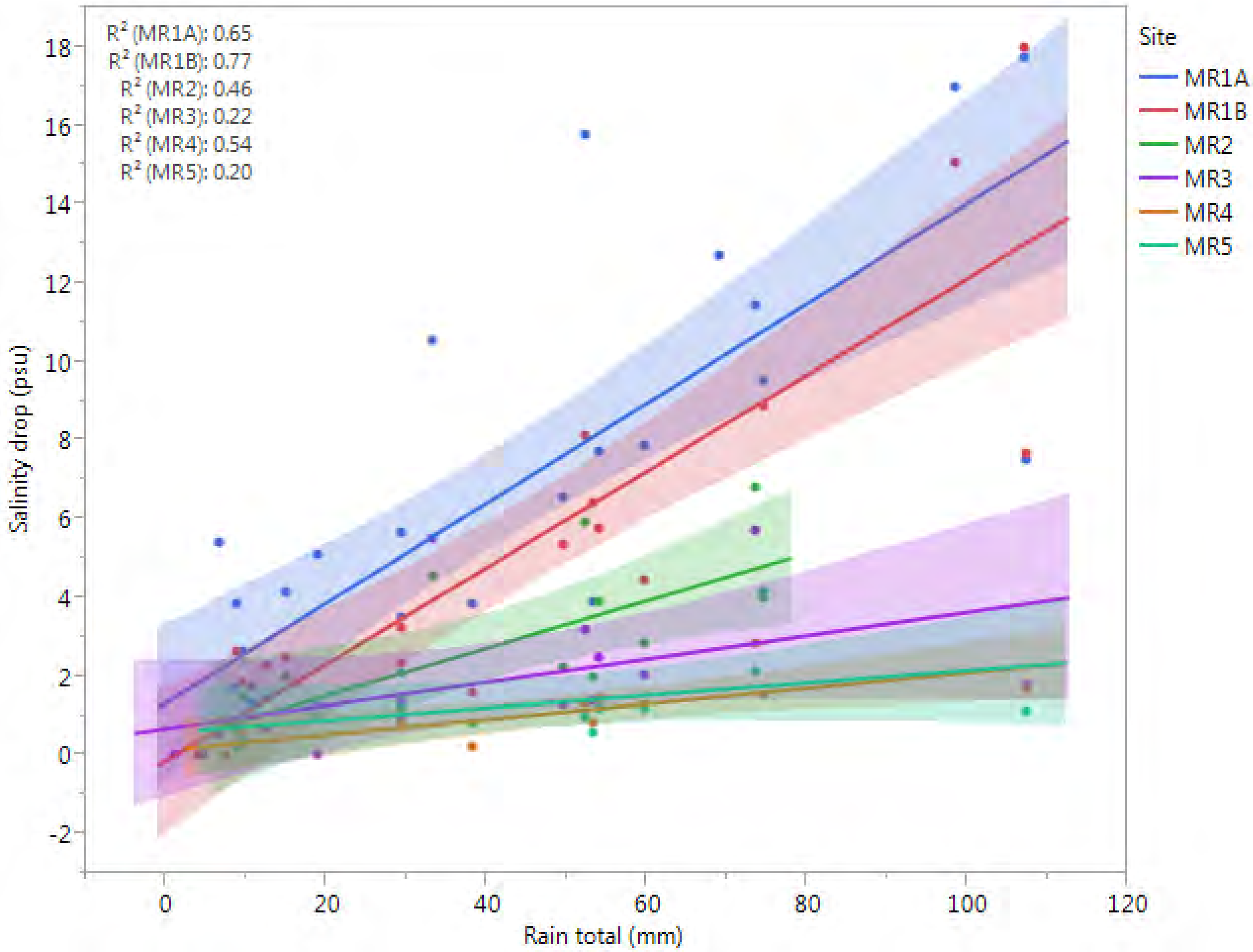


Figure 17. Relationship between rainfall total and salinity drop for the study sites in the May River. The R^2 is provided for each site.

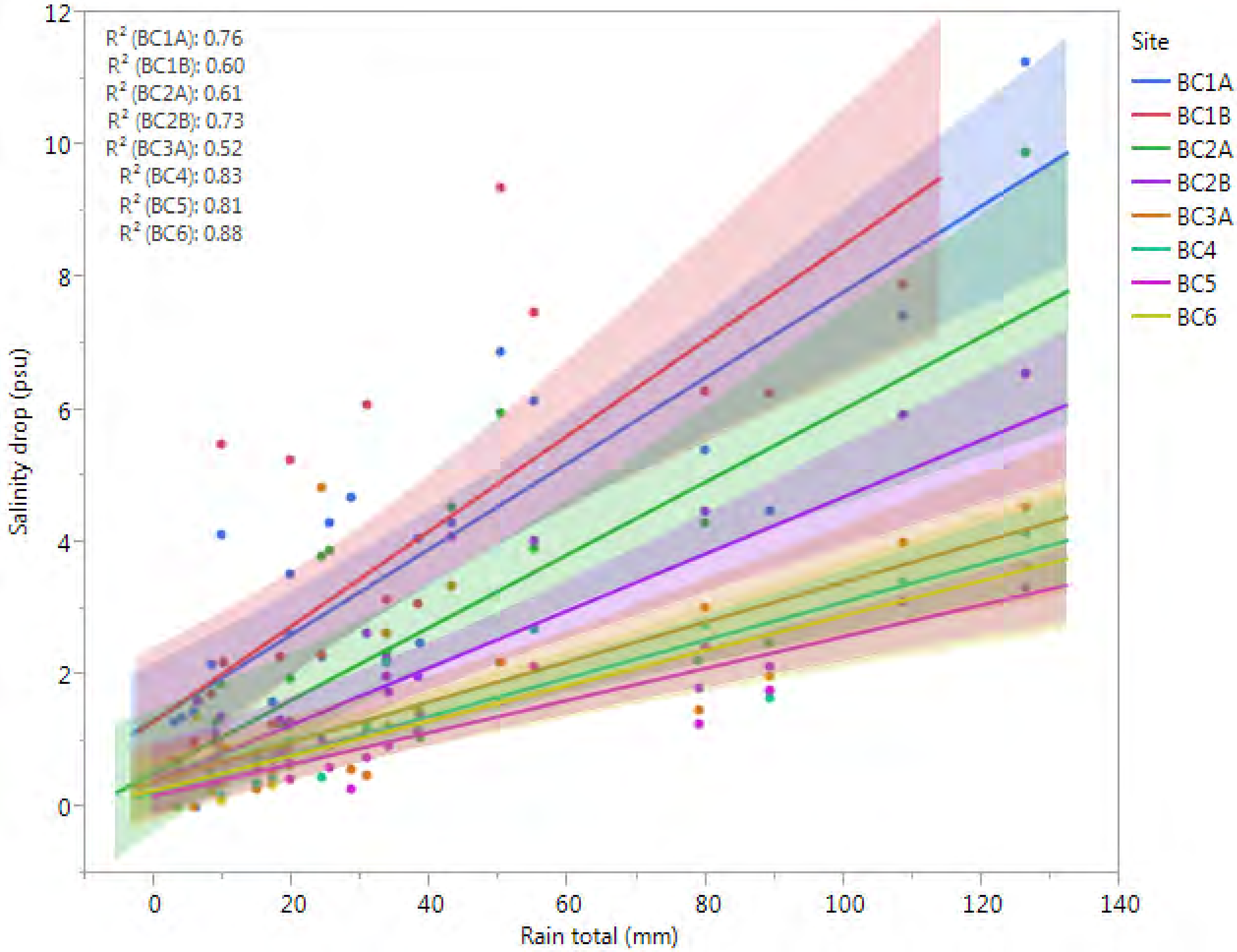


Figure 18. Relationship between rainfall total and salinity drop for the study sites in Battery Creek. The R^2 is provided for each site.

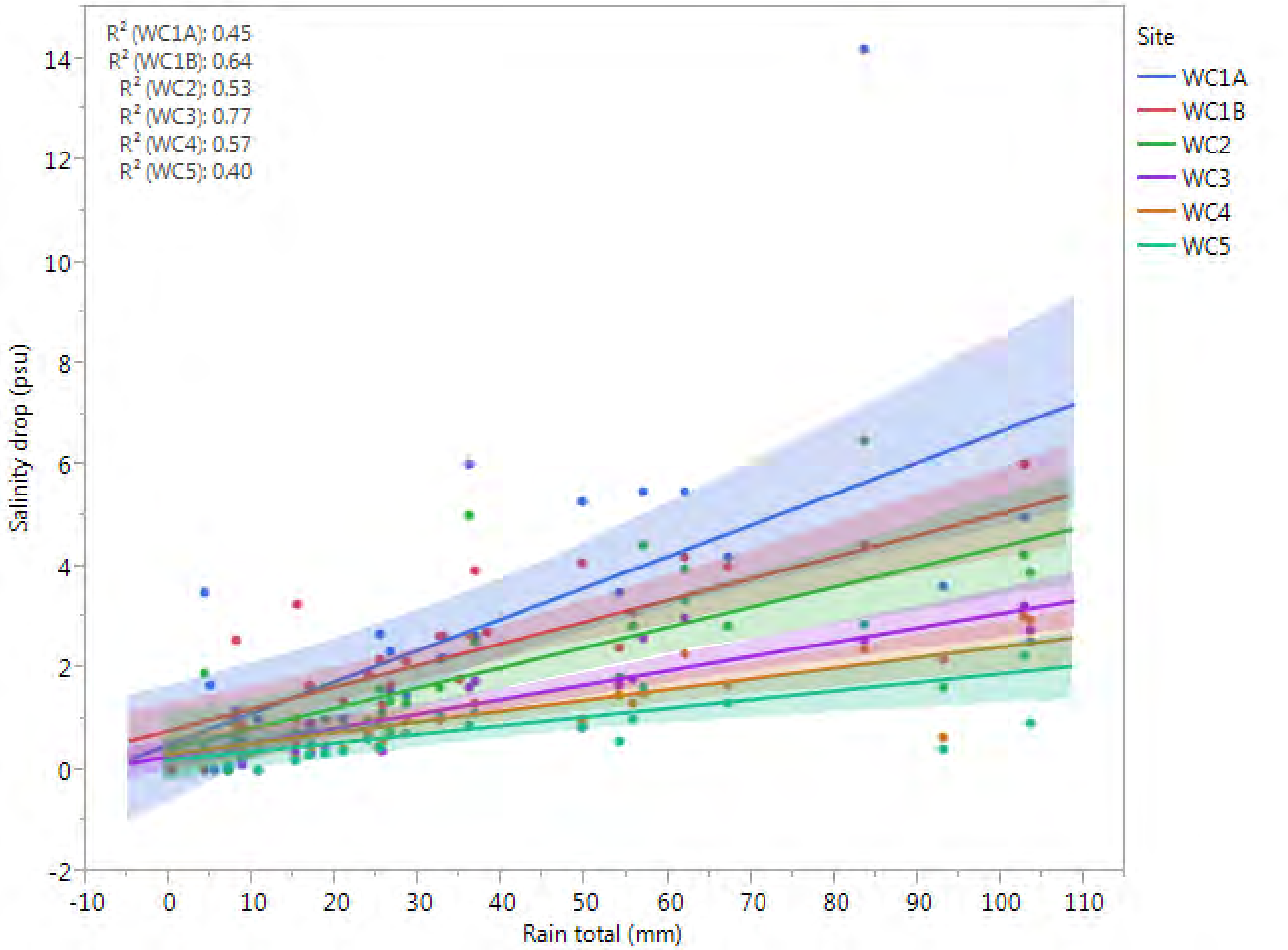


Figure 19. Relationship between rainfall total and salinity drop for the study sites in Wallace Creek. The R^2 is provided for each site.

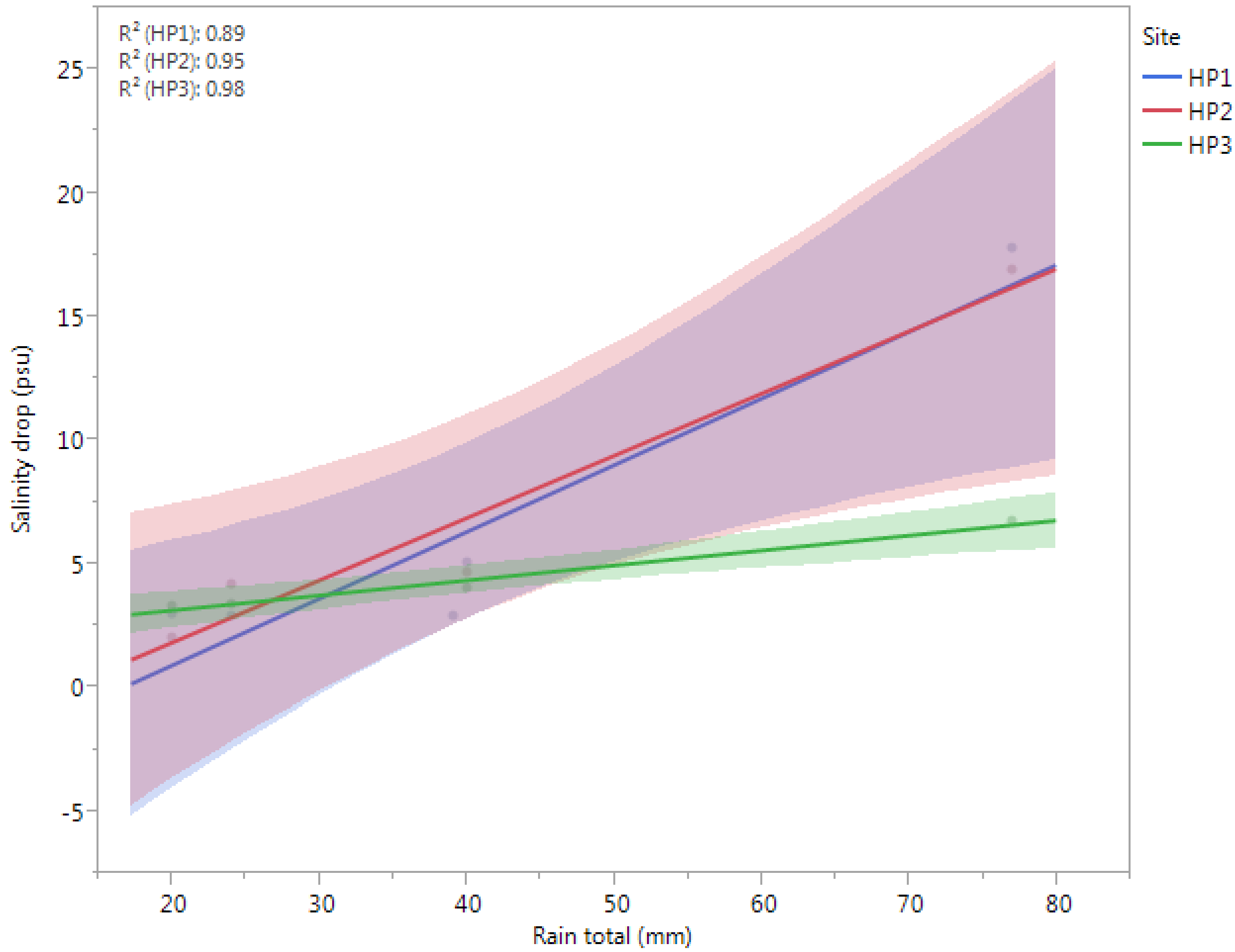


Figure 20. Relationship between rainfall total and salinity drop for the study sites in Huspah Creek. The R^2 is provided for each site. Sites HP4, HP5, and HP6 are not shown due to high p values ($p > 0.2$).

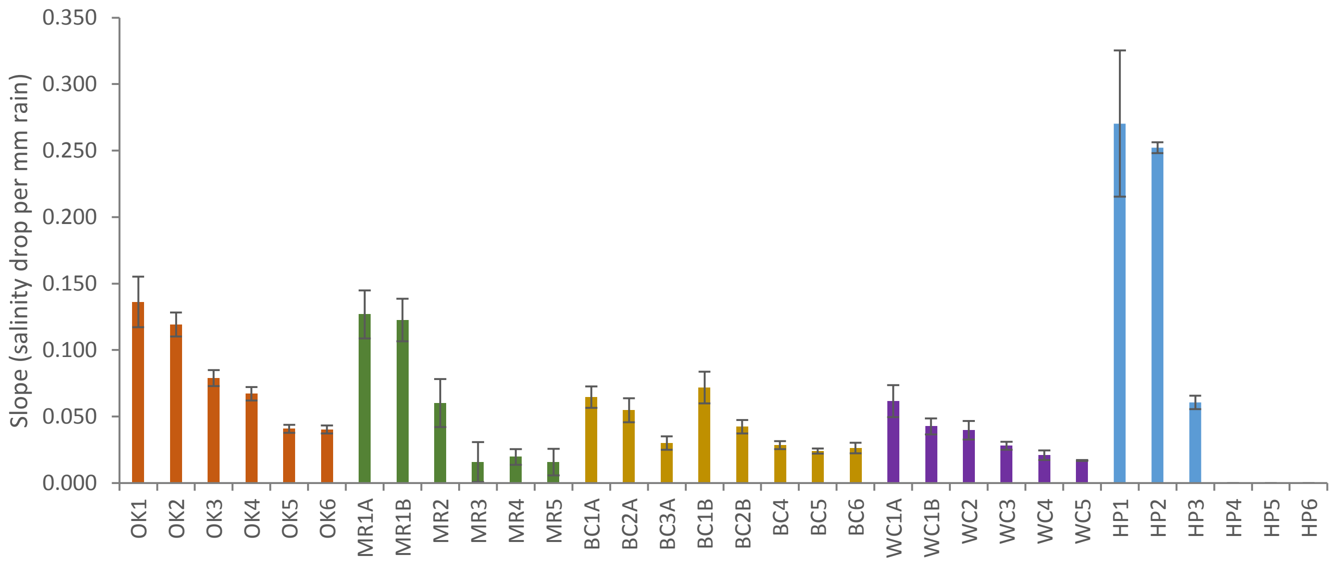


Figure 21. Slopes of equations for regressions of rain total (x) vs salinity drop (y). Huspah 4, 5, and 6 were not significant and are not shown ($p > 0.2$). All other regressions were significant except for May River 3 and 5 ($p < 0.05$).

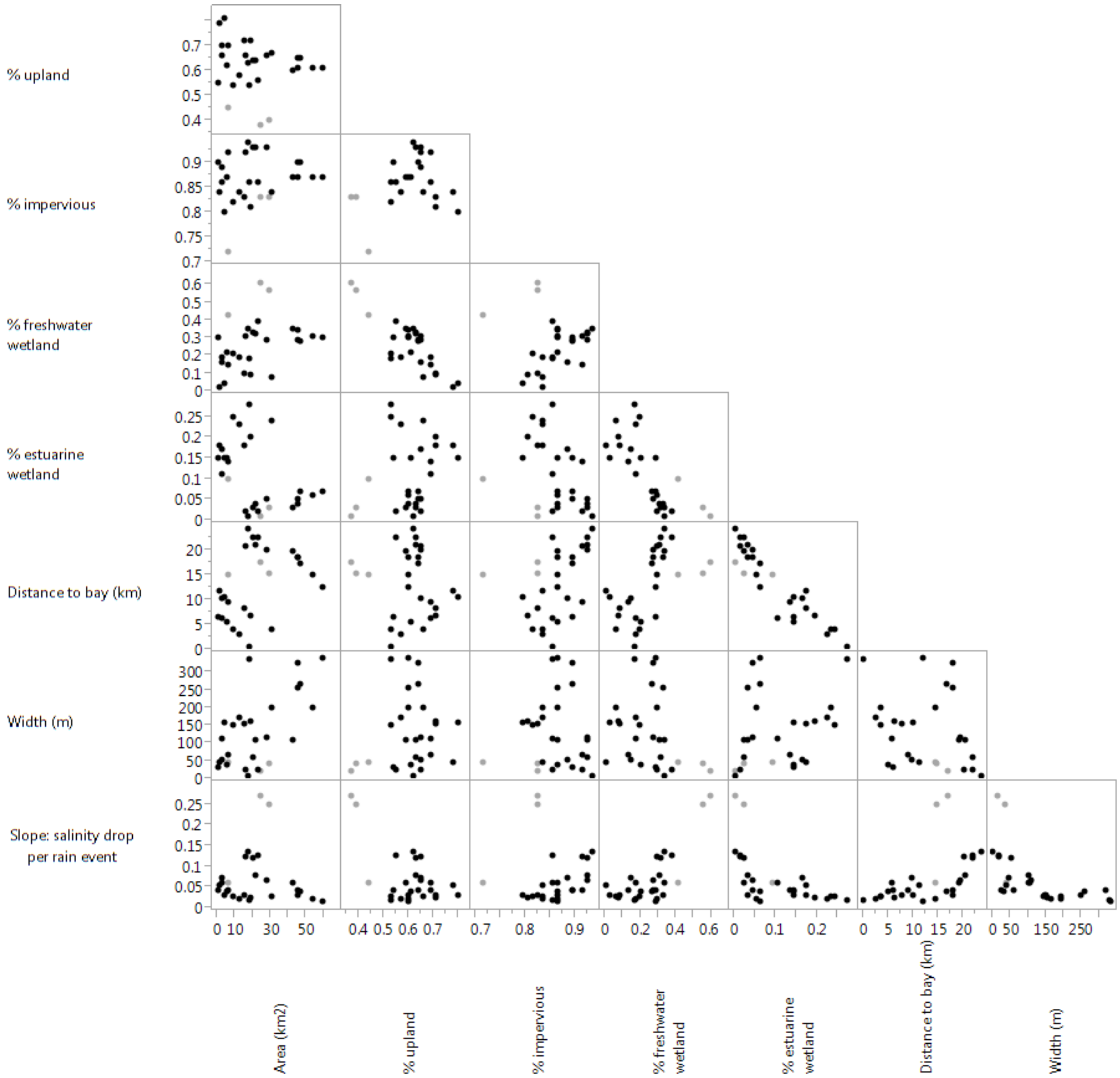
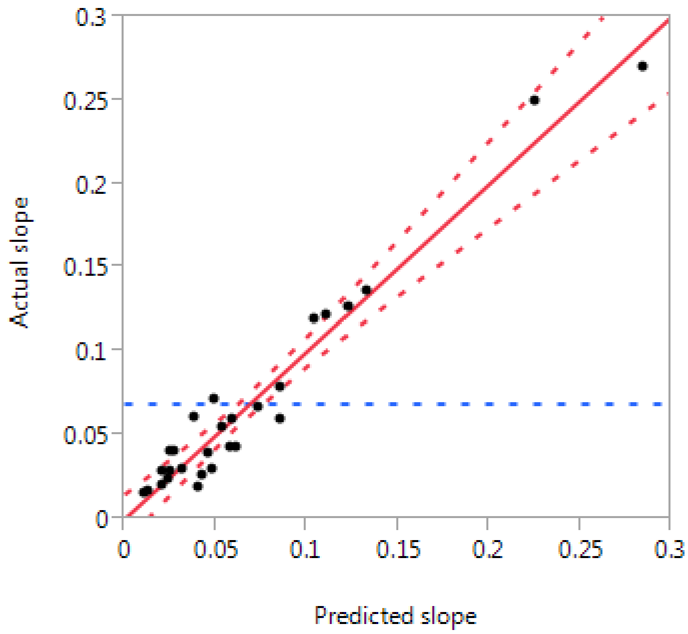


Figure 22. Scatterplot matrix of select variables used in the multivariate analysis. Huspah Creek headwater sites (HP1, HP2, HP3) appear in grey and were included in the analysis. The downstream sites exhibited no significant relationship, likely due to sparse data (max n=5 for Huspah). Variables suggesting curvilinear relationships (e.g., % saltwater wetland) were tested as such in the regression analysis.



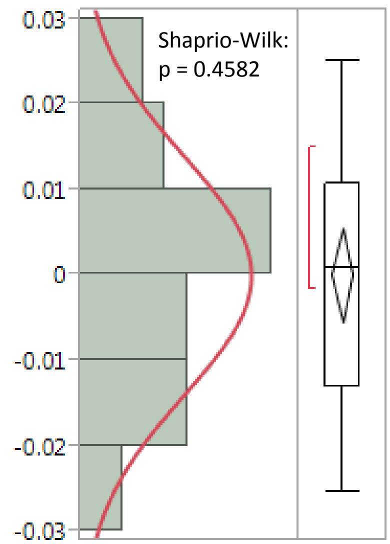


Figure 23. Model performance and normality test of residuals for best regression model to predict slope (salinity drop per mm rainfall) in study subwatersheds for each site.

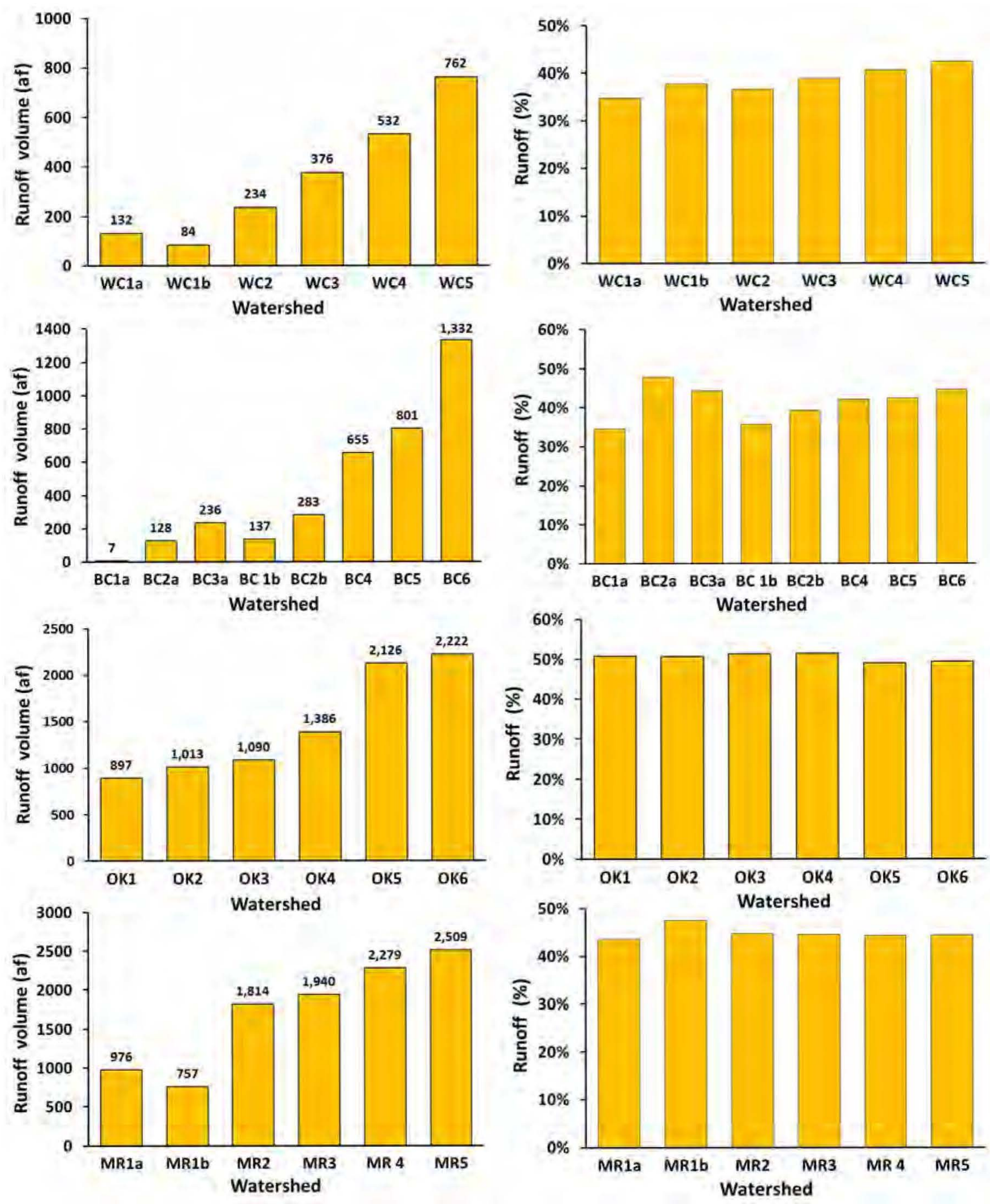
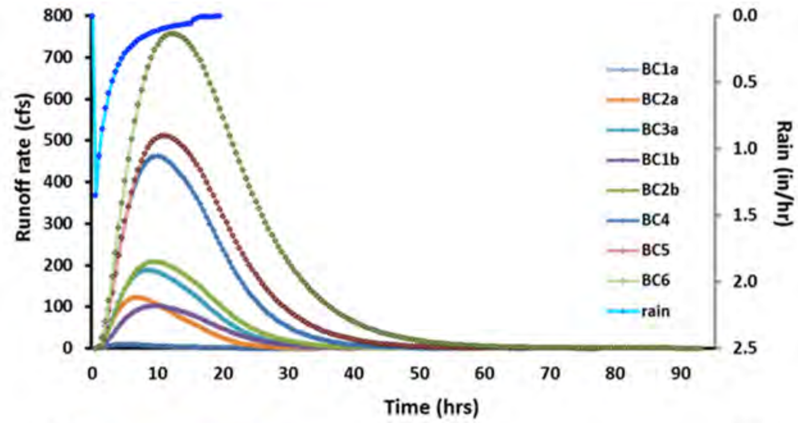


Figure 24. Runoff modeled using a 4.5 inch rain event for each of the 4 primary creek systems. Charts on the left side show output in actual volume (af is acre feet). Charts on the right side show output as a percentage of the rainfall that was converted to runoff (which removes the variance caused by area differences).



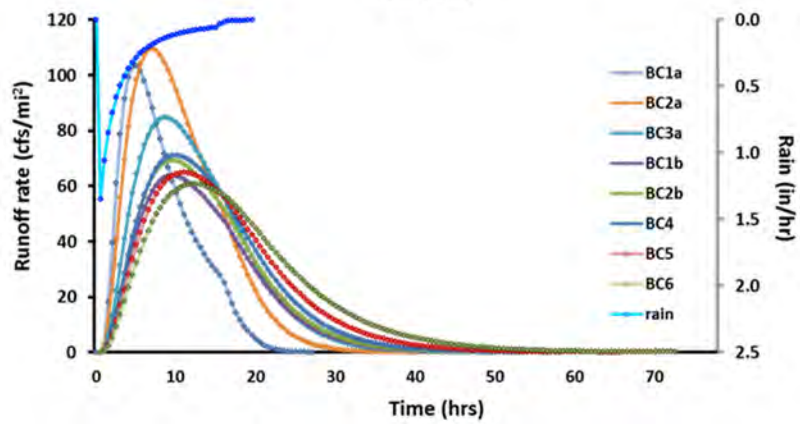


Figure 25. Hydrographs for a design 4.5 inch 24-hour rain event in each Battery Creek watershed for each site. The x-axis shows runoff time, the primary y axis shows runoff rate, and the secondary y-axis rain intensity in inches per hour. The upper chart shows the actual modeled rate in cubic feet per second (cfs). The lower chart shows a normalized rate of cfs per watershed square mile in order to remove the effect of different watershed areas. The space under each curve represents the volume of runoff.

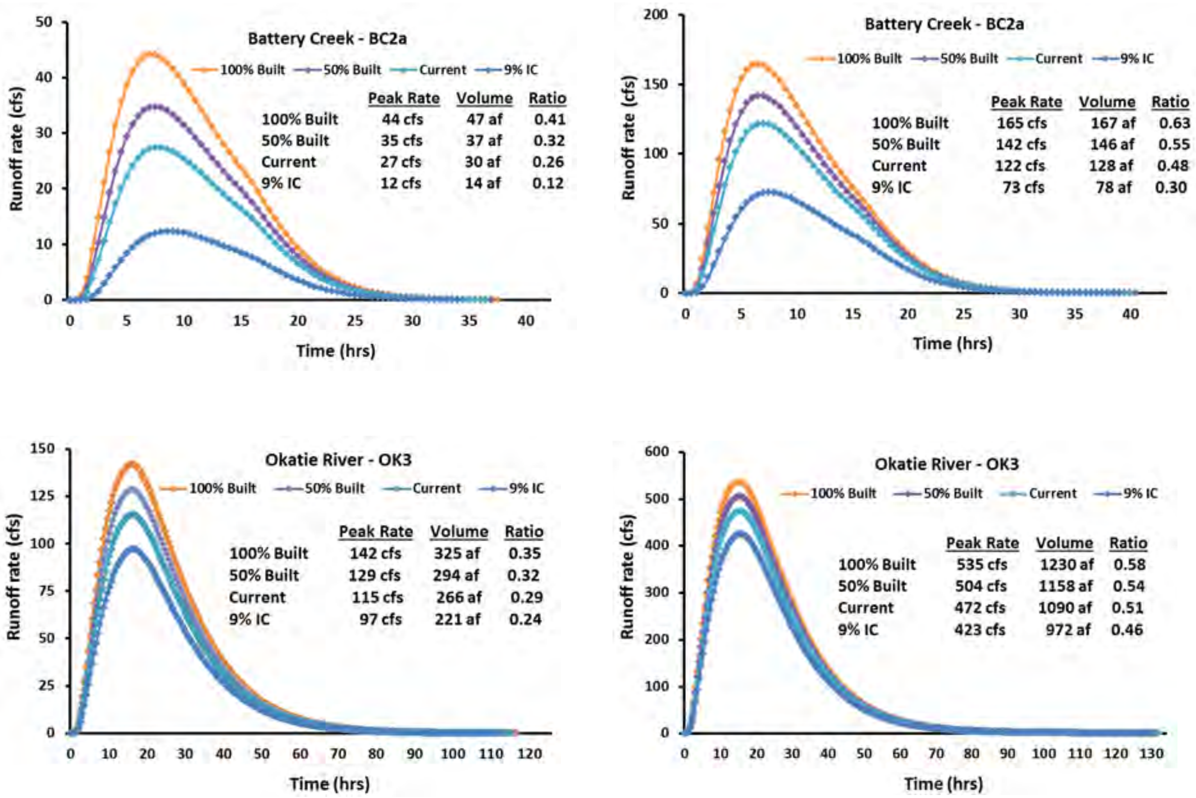


Figure 26. Development scenarios for two of the volume sensitive watersheds: BC2a (top) and OK3 (bottom). The x axis shows runoff time, and the y axis shows runoff rate. The charts on the left are modeled on a 1.95 inch 24-hour rain (95th percentile rain); the charts on the right are based on a 4.5 inch 24-hour rain (2-year storm). 100% Built is projecting additional watershed development for all of dry land not yet developed. 50% Built projects development for 50% of dry land not yet developed. Current is present watershed development. 9% IC is the percent of impervious cover reflecting the threshold of measurable environmental degradation from development. cfs is cubic feet per second, af is acre feet, hrs is hours. Peak rate is the maximum cfs for the modeled runoff. Ratio is proportion of rainfall converted to runoff. The area under each curve represents the volume of runoff.

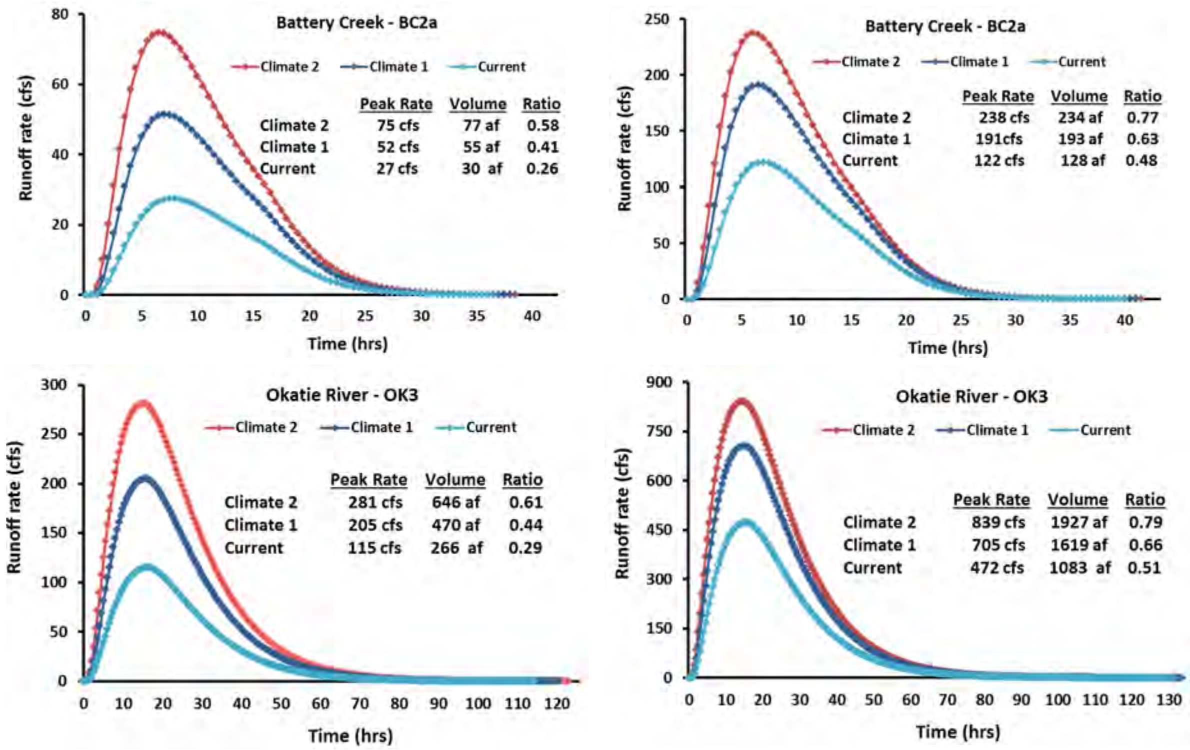


Figure 27. Climate scenarios for two of the volume sensitive watersheds: BC2a (top) and OK3 (bottom). The x axis shows runoff time, and the y axis shows runoff rate. The charts on the left are modeled on a 1.95 inch 24-hour rain (95^{th} percentile rain); the charts on the right are based on a 4.5 inch 24-hour rain (2-year storm). Current scenario uses average antecedent runoff conditions (ARC), Climate 1 scenario uses semi-wet ARC, and Climate 2 scenario uses wet ARC. Both rainfalls are increased by 15% for the climate scenarios. cfs is cubic feet per second, af is acre feet, hrs is hours. Peak rate is the maximum cfs for the modeled runoff. Ratio is proportion of rainfall converted to runoff. The area under each curve represents the volume of runoff.

Table 1. Linear regression equations to predict runoff volume in each watershed at current development levels and with average runoff conditions. Y is runoff (acre feet), and x is rainfall amount (mm). WC is Wallace Creek, BC is Battery Creek, OK is Okatie River, MR is May River.

Watershed	Regression Equation - Volume	r^2
WC1a	$y = 0.0082 x^2 + .2678 x - 6.4477$	0.999
WC1b	$y = 0.0049 x^2 + .2107 x - 4.4992$	0.999
WC2	$y = 0.014 x^2 + .5466 x - 12.144$	0.999
WC3	$y = 0.0215 x^2 + 1.0054 x - 20.695$	0.999
WC4	$y = .0293 x^2 + 1.5625 x - 30.544$	0.999
WC5	$y = 0.0404 x^2 + 2.4311 x - 45.44$	0.999
BC1a	$y = 0.0005 x^2 + 0.0149 x - 0.3621$	0.999
BC2a	$y = 0.006 x^2 + 0.5041 x - 8.3966$	0.999
BC3a	$y = 0.012 x^2 + 0.8198 x - 14.63$	0.999
BC1b	$y = 0.0084 x^2 + 0.2978 x - 6.8798$	0.999
BC2b	$y = 0.016 x^2 + 0.7748 x - 15.739$	0.999
BC4	$y = 0.0349 x^2 + 2.0668 x - 38.851$	0.999
BC5	$y = 0.0425 x^2 + 2.5546 x - 47.755$	0.999
BC6	$y = 0.0672 x^2 + 4.6579 x - 82.831$	0.999
OK1	$y = 0.0391 x^2 + 3.8871 x - 61.48$	0.999
OK2	$y = 0.0443 x^2 + 4.3728 x - 69.403$	0.999
OK3	$y = 0.047 x^2 + 4.797 x - 75.302$	0.999
OK4	$y = 0.0595 x^2 + 6.1264 x - 95.86$	0.999
OK5	$y = 0.0967 x^2 + 8.7356 x - 142.38$	0.999
OK6	$y = 0.1003 x^2 + 9.2319 x - 149.58$	0.999
MR1a	$y = 0.0504x^2 + 3.2746x - 59.547$	0.999
MR1b	$y = 0.0357x^2 + 2.9555x - 49.536$	0.999
MR2	$y = 0.0911x^2 + 6.3921x - 113.2$	0.999
MR3	$y = 0.0979x^2 + 6.7922x - 120.72$	0.999
MR4	$y = 0.1157x^2 + 7.8925x - 141.11$	0.999
MR5	$y = 0.1268x^2 + 8.752x - 155.86$	0.999

Table 2. Salinity drop summary data and regression results for all subwatersheds monitored. Regressions compared rainfall total (mm) to observed salinity drop. Additional variables were studied, but rainfall total exhibited the greatest correlation to salinity drop.

	Salinity drop summary data				Regression: Rain total vs. salinity drop				Salinity drop:rain total
Site	Number Events	Avg. Salinity Drop	St. Dev.	St. Err.	p value	r^2	Slope	St. Err. Slope	LSD t-test
OK1	41	9.76	5.64	0.88	<0.0001	0.54	0.136	0.019	A
OK2	52	5.58	4.00	0.55	<0.0001	0.68	0.119	0.009	B
OK3	38	3.53	2.80	0.45	<0.0001	0.77	0.079	0.006	C
OK4	41	2.69	2.38	0.37	<0.0001	0.74	0.067	0.005	C
OK5	35	1.78	1.37	0.23	<0.0001	0.75	0.041	0.003	C
OK6	35	1.80	1.56	0.26	<0.0001	0.74	0.040	0.003	C
MR1A	24	7.01	4.96	1.01	<0.0001	0.65	0.127	0.018	A
MR1B	18	5.54	4.67	1.10	<0.0001	0.77	0.123	0.016	B
MR2	14	2.83	1.93	0.51	0.0077	0.46	0.060	0.018	BC
MR3	12	2.24	1.74	0.50	0.08	0.22	0.016	0.015	C
MR4	10	1.26	0.73	0.23	0.0099	0.54	0.020	0.006	C
MR5	12	1.34	1.05	0.30	0.147	0.20	0.016	0.010	C
BC1A	22	3.81	2.53	0.54	<0.0001	0.76	0.065	0.008	A
BC2A	22	2.52	2.28	0.49	<0.0001	0.61	0.055	0.009	B
BC3A	28	1.48	1.34	0.25	<0.0001	0.52	0.030	0.005	C
BC1B	23	3.37	2.73	0.57	<0.0001	0.60	0.072	0.012	A
BC2B	26	1.99	1.68	0.33	<0.0001	0.73	0.042	0.005	BC
BC4	19	1.35	1.14	0.26	<0.0001	0.83	0.029	0.003	C
BC5	19	1.28	0.94	0.22	<0.0001	0.81	0.024	0.002	C
BC6	8	1.01	1.20	0.42	0.0006	0.88	0.026	0.004	[1]
WC1A	28	2.90	2.83	0.53	<0.0001	0.45	0.062	0.012	AB
WC1B	29	2.34	1.35	0.25	<0.0001	0.64	0.043	0.006	AB
WC2	29	1.97	1.60	0.30	<0.0001	0.53	0.040	0.007	AB
WC3	24	1.31	0.93	0.19	<0.0001	0.77	0.028	0.003	A
WC4	27	1.18	0.81	0.16	<0.0001	0.57	0.021	0.004	AB
WC5	26	0.92	0.80	0.16	0.0004	0.40	0.017	0.000	B
HP1	5	6.36	6.46	2.89	0.0165	0.89	0.270	0.055	[1]
HP2	4	6.98	6.74	3.37	0.0273	0.95	0.252	0.004	[1]
HP3	4	4.39	1.59	0.79	0.0088	0.98	0.061	0.005	[1]
HP4	4	2.69	1.10	0.55	0.20	-	-	-	
HP5	3	3.07	0.68	0.39	0.75	-	-	-	
HP6	5	3.40	1.41	0.63	0.21	-	-	-	

[1] Too few events for meaningful comparison

Table 3. Model results and parameters for best regression model.

Slope = -0.0002*width – 0.29634*(% est. wet.) + 2.19439 * (% est. wet.)^2 + 0.04187*(% fr. wet.) + 1.45627*(% fr. wet.)^2 + 0.28130*(% imperviousness)

Summary		Model parameters	Estimate	t ratio	p
r^2	0.95	Intercept	-0.16248	-2.62	0.0161
RMSE	0.016	Width	-0.00020	-5.83	<0.0001
Mean	0.069	% estuarine wetlands	-0.29634	-4.12	0.0005
n	28	(% estuarine wetlands)^2	2.19439	3.47	0.0023
$F_{(6,21)}$	70.64	% freshwater wetlands	0.04187	1.01	0.3236
p	<0.0001	(% freshwater wetlands)^2	1.45627	8.70	<0.0001
		% imperviousness	0.28130	3.81	0.0010

Table 4. Summary of land use and land cover attributes for watersheds originating in or near Beaufort County, South Carolina. Bolded sections represent watersheds that were the primary focus of this study. Headwater sections are shown for select large watersheds. Color gradient depicts range from high (red) to low (green) values for each category.

	Land use and land cover % coverages				
Watershed	**Upland developed**	**Upland forest**	**Freshwater wetland**	**Estuarine wetland**	**Water**
Broad Creek	21.5	40.3	7.5	14.6	9.4
May River	9.8	29.0	17.7	20.3	15.7
May River (headwaters)	**11.4**	**34.0**	**29.6**	**5.4**	**4.5**
Okatie and Colleton Rivers	16.4	27.3	16.3	16.5	12.4
Okatie River (headwaters)	**18.7**	**25.8**	**26.8**	**6.3**	**4.5**
Wright River	0.6	12.1	32.4	40.2	5.6
Village Creek	1.2	43.6	17.3	25.2	4.9
Wallace (Capers) Creek	**2.1**	**32.6**	**16.7**	**26.1**	**7.3**
Battery Creek	**21.7**	**32.1**	**7.3**	**21.1**	**12.0**
Chechesse River	1.1	36.5	32.1	16.8	8.3
Chechesse River (headwaters)	0.7	41.5	42.9	6.1	2.5
Euhaw Creek	0.5	39.3	43.1	6.0	3.6
Albergottie Creek	22.9	25.1	15.2	17.7	5.1
Harbor River	2.9	40.7	16.6	13.1	14.0
McCalleys Creek	4.2	19.7	19.0	21.4	21.3
Huspah Creek	**1.6**	**27.1**	**40.9**	**6.9**	**11.2**
Pocotaligo River	2.2	39.7	34.8	7.2	5.4
Tulifiny River	0.9	30.4	47.2	9.6	4.4
Morgan River system	4.5	25.8	11.9	36.6	15.2
Morgan River (headwaters)	5.7	20.1	12.9	40.9	17.9
Boyd Creek system	0.3	32.4	17.2	28.1	17.7
AVERAGE	7.2	31.2	24.1	18.4	9.7

Table 5. Summary of soil classification attributes for watersheds originating in or near Beaufort County, South Carolina. Bolded sections represent watersheds that were the primary focus of this study. Headwater sections are shown for select large watersheds. Color gradient depicts range from high (red) to low (green) values for each category.

	Soil classification % coverages				
Watershed	**Somewhat poor**	**Poor**	**Very poor**	**Poor and very poor**	**All poor categories**
Broad Creek	18.8	22.7	19.7	42.4	61.2
May River	25.5	16.8	31.3	48.0	73.6
May River (headwaters)	**10.2**	**2.7**	**24.5**	**27.2**	**37.4**
Okatie and Colleton Rivers	19.8	25.5	26.0	51.5	71.2
Okatie River (headwaters)	**13.5**	**2.4**	**39.0**	**41.4**	**54.9**
Wright River	7.1	11.3	67.5	78.7	85.8
Village Creek	28.9	12.9	33.0	46.0	74.8
Wallace (Capers) Creek	**36.5**	**5.6**	**36.6**	**42.2**	**78.7**
Battery Creek	**30.6**	**8.5**	**28.1**	**36.6**	**67.2**
Chechesse River	7.0	33.3	30.4	63.7	70.7
Chechesse River (headwaters)	25.7	1.7	43.3	45.0	70.6
Euhaw Creek	17.5	25.6	25.9	51.5	69.0
Albergottie Creek	22.6	17.6	25.7	43.3	66.0
Harbor River	8.2	27.2	22.9	50.1	58.3
McCalleys Creek	13.3	13.4	33.7	47.1	60.4
Huspah Creek	**14.3**	**36.3**	**22.7**	**59.0**	**73.3**
Pocotaligo River	16.3	30.1	20.9	51.0	67.3
Tulifiny River	13.3	25.4	31.4	56.9	70.2
Morgan River system	15.3	11.4	42.9	54.3	69.6
Morgan River (headwaters)	8.5	16.9	10.8	27.7	36.2
Boyd Creek system	10.7	18.3	38.6	56.9	67.7
AVERAGE	17.3	17.4	31.2	48.6	65.9

Table 6. Summary of geophysical attributes for watersheds originating in or near Beaufort County, South Carolina. Bolded sections represent watersheds that were the primary focus of this study. Headwater sections are shown for select large watersheds. Color gradient depicts range from high (red) to low (green) values for each category.

	Geophysical characteristics						
Watershed	**Area (km^2)**	**Width at mouth (m)**	**Perimeter (km)**	**Depth at mouth (m)**	**Elevation range (m)**	**Mean elevation (m)**	**Mean salinity (psu)**
Broad Creek	68	268	44	-6	13	2	29
May River	103	615	60	-11	26	4	30
May River (headwaters)	**79**	**230**	**46**	**-4**	**47**	**4**	**30**
Okatie and Colleton Rivers	151	687	68	-11	22	4	31
Okatie River (headwaters)	**49**	**273**	**68**	**-3**	**26**	**5**	**30**
Wright River	108	317	69	-4	16	2	24
Village Creek	21	137	25	-4	11	3	27
Wallace (Capers) Creek	**19**	**109**	**31**	**-5**	**15**	**2**	**32**
Battery Creek	**32**	**132**	**33**	**-9**	**13**	**3**	**31**
Chechesse River	113	629	57	-9	47	3	30
Chechesse River (headwaters)	56	235	73	-4	24	6	26
Euhaw Creek	88	212	48	-5	32	6	31
Albergottie Creek	22	252	35	-2	17	5	32
Harbor River	8	69	17	-4	16	5	30
McCalleys Creek	16	214	26	-2	16	2	31
Huspah Creek	**63**	**306**	**46**	**-3**	**18**	4	25
Pocotaligo River	128	197	80	-1	20	4	22
Tulifiny River	39	176	53	-1	20	5	14
Morgan River system	73	514	54	-7	13	2	30
Morgan River (headwaters)	24	319	33	-8	12	1	25
Boyd Creek system	42	403	33	-6	13	2	29
AVERAGE	62	300	48	-5	21	4	28

Table 7. Series of models used to investigate relationship between slope (salinity drop per mm rainfall) and various watershed-scale variables. Due to the low sample size, the risk of overfitting increases as the number of model variables increases.

y = slope of salinity drop per rainfall mm

Summary		Model parameters	Estimate	t ratio	p
r^2	0.9422	Intercept	0.3432	10.58	0.0018
RMSE	0.024	% estuarine wetlands	-0.0117	-6.99	0.0060
Mean	0.129				
n	5				
$F_{(1, 3)}$	48.9				
p	0.006				

Summary		Model parameters	Estimate	t ratio	p
r^2	0.9918	Intercept	0.1958	4.35	0.0491
RMSE	0.011	% estuarine wetlands	-0.0178	-9.42	0.0111
Mean	0.129	% very poorly drained soils	0.0088	3.47	0.0740
n	5				
$F_{(2, 2)}$	120.45				
p	0.0082				

Summary		Model parameters	Estimate	t ratio	p
r^2	0.999	Intercept	0.1520	14.73	0.0431
RMSE	0.002	% freshwater wetlands	-0.0066	-7.45	0.0849
Mean	0.129	% estuarine wetlands	-0.0414	-12.95	0.0491
n	5	% very poorly drained soils	0.0028	10.45	0.0608
$F_{(3,1)}$	2289				
p	0.0154				

Table 8. Series of models used to investigate relationship between headwater salinity drop (averaged for all events studied) and various watershed-scale variables. Due to the low sample size, the risk of overfitting increases as the number of model variables increases.

y = average salinity drop for all events

Summary		Model parameters	Estimate	t ratio	p
r^2	0.922	Intercept	2.0125	2.73	0.0717
RMSE	0.904	Area (km^2)	0.0500	5.98	0.0094
Mean	5.694				
n	5				
$F_{(1, 3)}$	35.78				
p	0.0094				

Summary		Model parameters	Estimate	t ratio	p
r^2	0.984	Intercept	1.3901	3.00	0.0953
RMSE	0.4986	% poorly drained soils	0.0650	2.80	0.1073
Mean	5.694	Area (km^2)	0.4209	7.78	0.0161
n	5				
$F_{(2, 2)}$	62.67				
p	0.0157				

Summary		Model parameters	Estimate	t ratio	p
r^2	0.999	Intercept	1.5250	37.70	0.0169
RMSE	0.043	% poorly drained soils	0.0590	29.20	0.0218
Mean	5.694	Area (km^2)	0.0708	39.33	0.0162
n	5	Width at mouth (m)	-0.0058	-16.50	0.0385
$F_{(3,1)}$	5798				
p	0.0097				

Table 9. Model results for full three-variable models predicting headwater sensitivity as measured by slope (salinity drop per mm rainfall) and average salinity drop. All six models were tested, and the results were scored into top 25% (most sensitive) and bottom 25% (least sensitive). The total score across all models is the combined rank score. A score of -6, for instance, indicates that the bottom 25% was predicted in all 6 models, whereas a score of 3 indicates that the watershed was in the top 25% for 3 of the 6 models.

	Statistical modeling results						
Watershed	**Observed slope**	**Model estimate slope**	**% error**	**Observed average drop**	**Model estimate drop**	**% error**	**Combined 25% rank score**
Broad Creek		0.830			6.114		0
May River	**0.125**	**0.125**	**0.000**	**6.250**	**6.245**	**-0.081**	**0**
Okatie and Colleton Rivers	**0.136**	**0.134**	**-1.471**	**9.760**	**9.778**	**0.185**	**3**
Wright River		0.281			8.012		3
Village Creek		0.000			2.981		-5
Wallace (Capers) Creek	**0.050**	**0.050**	**0.000**	**2.600**	**2.604**	**0.161**	**-6**
Battery Creek	**0.065**	**0.066**	**1.538**	**3.500**	**3.550**	**1.425**	**0**
Chechesse River		0.148			7.851		2
Euhaw Creek		0.388			8.040		4
Albercottie Creek		0.083			2.671		-3
Harbor River		0.180			3.317		0
McCalleys Creek		0.142			2.196		-3
Huspah Creek	**0.270**	**0.270**	**0.000**	**6.360**	**6.357**	**-0.052**	**3**
Pocotaligo River		0.245			11.217		5
Tulifiny River		0.376			4.747		3
Morgan River system		0.000			4.384		-3
Boyd Creek system		0.023			3.277		-3

Table 10. Watershed characteristics related to stormwater runoff modeling. Dev. is Development shown as percentage of watershed area, IC is Impervious Cover, and CN is Curve Number - the higher the values the greater the runoff; I_a is Initial Abstraction and reflects the amount of rain needed for runoff to begin; HSG is Hydrologic Soil Group, and C and D are the most impervious of the soil groups.

Watershed	Area		Dev.	IC	CN		I_a (in)	HSG
	Ac	Ha		%	0.20	0.05	($CN_{0.05}$)	C+D
WC1a	1,013	410	7%	3	70.5	59.2	0.34	60%
WC1b	596	241	1%	1	72.5	61.9	0.31	70%
WC2	1,707	691	4%	2	71.8	60.9	0.32	64%
WC3	2,585	1,046	4%	2	73.2	62.8	0.30	63%
WC4	3,498	1,416	3%	2	74.3	64.3	0.28	66%
WC5	4,804	1,944	2%	1	75.3	65.8	0.26	69%
BC1a	58	23	13%	5	70.4	59.0	0.35	39%
BC2a	712	288	57%	30	78.4	70.1	0.21	27%
BC3a	1,419	574	47%	24	76.5	67.4	0.24	40%
BC1b	1,023	414	16%	8	71.1	60.0	0.33	50%
BC2b	1,924	779	25%	14	73.5	63.2	0.29	52%
BC4	4,151	1,680	30%	17	75.2	65.6	0.26	48%
BC5	5,050	2,044	30%	16	75.3	65.8	0.26	50%
BC6	7,979	3,229	24%	13	76.6	67.6	0.24	61%
OK1	4,713	1,907	44%	26	80.0	71.9	0.20	90%
OK2	5,339	2,161	42%	24	79.9	71.8	0.20	91%
OK3	5,673	2,296	40%	23	80.2	72.5	0.19	91%
OK4	7,189	2,909	41%	21	80.3	72.7	0.19	91%
OK5	11,565	4,680	33%	17	79.1	70.5	0.21	92%
OK6	12,008	4,859	32%	17	79.3	70.8	0.21	92%
MR1a	5,984	2,422	15%	8	76.0	66.7	0.25	78%
MR1b	4,253	1,721	40%	20	78.3	69.9	0.22	72%
MR2	10,819	4,378	24%	13	76.7	67.7	0.24	74%
MR3	11,616	4,701	22%	12	76.6	67.6	0.24	74%
MR4	13,732	5,557	20%	10	76.5	67.4	0.24	74%
MR5	15,056	6,093	19%	10	76.6	67.5	0.24	74%

Table 11. BMP and development scenarios for the subwatersheds in each system identified as more volume sensitive. IC is Impervious Cover, Dev. Is Developed, and CN is Curve Number – the higher the values the greater the runoff; I_a is Initial Abstraction and reflects the amount of rain needed for runoff to begin; af is acre feet; and Ratio is proportion of rainfall converted to runoff. Target Retrofit is the development level at which minimum degradation to water quality occurs. 50% Build Out is projecting additional watershed development for half of all dry land not yet developed. 100% Build Out projects for all of dry land not yet developed. Target Volume Reduction is volume of runoff required to be reduced in order to reach Target Retrofit scenario.

Watershed & Area (ha)	Development Scenario	IC	Dev.	CN 0.20	CN 0.05	I_a (in) ($CN_{0.05}$)	Runoff - 1.95" rain Volume (af)	Runoff - 1.95" rain Ratio	Target Volume Reduction (af)
WC1a	Current Development	3%	7%	71	59	0.34	26	0.16	–
410	Target Retrofit	9%	27%	74	65	0.27	33	0.20	–
	50% Build Out	16%	38%	77	68	0.24	38	0.23	5
	100% Build Out	29%	69%	83	76	0.16	55	0.34	22
WC1b	Current Development	1%	1%	72	62	0.31	17	0.18	–
241	Target Retrofit	9%	21%	76	66	0.25	21	0.22	–
	50% Build Out	18%	28%	77	68	0.23	23	0.24	2
	100% Build Out	35%	55%	82	75	0.17	31	0.32	10
BC2a	Current Development	30%	57%	78	70	0.21	30	0.26	16
288	Target Retrofit	9%	30%	67	54	0.42	14	0.12	–
	50% Build Out	35%	66%	82	75	0.16	37	0.32	23
	100% Build Out	40%	74%	86	81	0.12	47	0.41	33
BC1b	Current Development	8%	16%	71	60	0.33	27	0.16	–
414	9% Impervious Cover	9%	25%	73	62	0.30	30	0.18	–
	50% Build Out	20%	41%	77	68	0.24	39	0.23	9
	100% Build Out	32%	66%	83	76	0.16	55	0.33	25
OK3	Current Development	23%	40%	80	73	0.19	266	0.29	45
2,296	Target Retrofit	9%	25%	77	69	0.23	221	0.24	–
	50% Build Out	30%	51%	82	75	0.17	294	0.32	73
	100% Build Out	36%	63%	83	77	0.15	325	0.35	104
MR2	Current Development	13%	24%	77	68	0.24	408	0.23	10
4,378	Target Retrofit	9%	24%	76	67	0.24	398	0.23	–
	50% Build Out	23%	42%	80	72	0.19	491	0.28	93
	100% Build Out	33%	61%	83	76	0.16	592	0.34	194

Table 12. Climate scenarios for the watersheds identified as the most volume sensitive. CN is Curve Number – the higher the value the greater the runoff; I_a is Initial Abstraction and reflects the amount of rain needed for runoff to begin; af is acre feet and Ratio is proportion of rainfall converted to runoff. Current Conditions reflects average antecedent runoff conditions and 1.95 inch rain. Both Climate Scenarios increase rainfall by 15%. Climate 1 reflects semi-wet runoff conditions, and Climate 2 reflects wet runoff conditions.

Watershed & Area (ha)	Climate Scenario	CN 0.20	CN 0.05	I_a (in) ($CN_{0.05}$)	Runoff - 1.95" rain Volume (af)	Runoff - 1.95" rain Ratio
WC1a	Current Conditions	71	59	0.34	26	0.16
410	Climate 1	78	70	0.22	54	0.29
	Climate 2	86	81	0.12	84	0.44
WC1b	Current Conditions	72	62	0.31	17	0.18
241	Climate 1	80	72	0.20	35	0.31
	Climate 2	87	82	0.11	53	0.48
BC2a	Current Conditions	78	70	0.21	30	0.26
288	Climate 1	84	79	0.14	55	0.41
	Climate 2	90	87	0.07	77	0.58
BC1b	Current Conditions	71	60	0.33	27	0.16
414	Climate 1	79	70	0.21	56	0.29
	Climate 2	86	81	0.12	87	0.45
OK3	Current Conditions	80	73	0.19	266	0.29
2,296	Climate 1	86	81	0.12	470	0.44
	Climate 2	91	89	0.06	646	0.61
MR2	Current Conditions	77	68	0.24	408	0.23
4,378	Climate 1	83	77	0.15	769	0.38
	Climate 2	89	86	0.08	1108	0.55

MEMORANDUM

TO: Natural Resources Committee of Beaufort County Council

FROM: Anthony Criscitiello, Planning Director

DATE: September 9, 2015

SUBJECT: **Lady's Island Map Amendments on Sea Island Parkway, between Lady's Island Commons and Youmans Road, from T4-HC (Hamlet Center) to T4-HCO (Hamlet Center Open)**

PLANNING COMMISSION RECOMMENDATION (an excerpt from draft minutes of its September 2, 2015, meeting):

Mr. Robert Merchant noted that the map amendments were to mirror the district formerly known as Lady's Island Community Preservation District. He mentioned the workshop where the Planning staff met with the community who recommended zoning and uses. The original intent was to have the most intense zoning along Sea Island Parkway. Mr. Merchant noted that property owners Mr. Merritt Patterson and Mr. Paul Trask asked that the area be brought under the same district. The Lady's Island Community Preservation Committee recommended approval of the map amendments.

Discussion by Commissioners included the rationale for including the separate property (R200 015 000 0169 0000) and not including the triangular property (R200 015 000 0168 0000 – see map on page 3) for consistency, the rationale for the split zoning of the shopping center *(staff indicated that the consultants did not take into account of the property on the ground)*, and querying the location of the former theater.

Public Comment: None received.

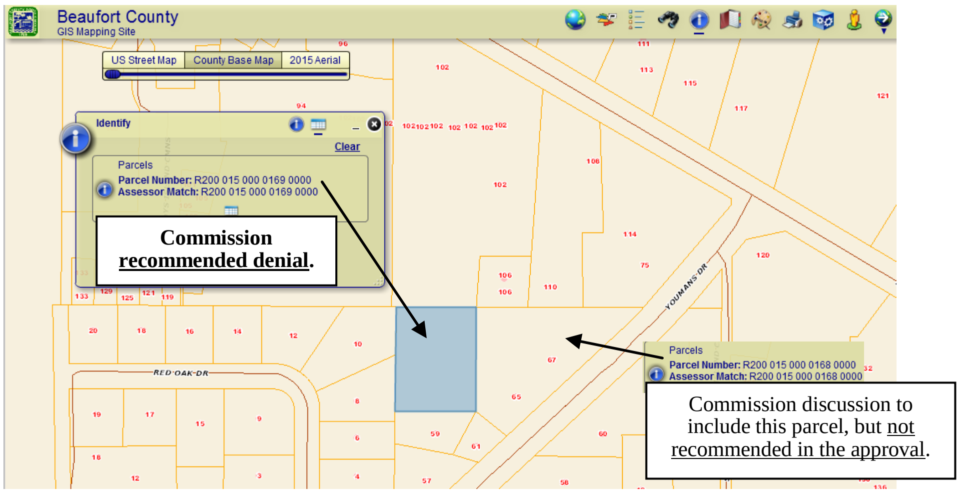
Further discussion by Commissioners including opposing the rezoning, concern for encroachment into the adjoining residential area, wanting to rezone the triangle parcel (R200 015 000 0168 0000), querying the current and proposed uses allowed, noting the current non-conforming shopping center and theater becoming conforming with the proposed zoning and possibly increasing in size if desired, noting no objections received from the public regarding the map amendments, partially agreeing with the map amendment with the exclusion of "square" parcel (R200 015 000 0169 0000), concern with higher zoning abutting residential neighborhood, concern with accessibility to the "square" parcel (R200 015 000 0169 0000), querying reconsidering the map amendments at next month's meeting or deleting the "square" parcel (R200 015 000 0169 0000) from the consideration, and querying the access to the square parcel (R200 015 000 0169 0000) from the shopping center.

Motion: Ms. Chmelik made the motion, and Ms. Davis seconded the motion, **to recommend:**

- **approval to County Council on the Lady's Island Zoning Map Amendments for R200 015 000 0165 0000, R200 015 000 0721 0000, R200 015 000 0820 0000, R200 015 000 0866 0000, R200 015 000 0867 0000, R200 015 000 0868 0000, R200 015 000 0869 0000, R200 015 000 0870 0000, R200 015 000 0871 0000, R200 015 000 0872 0000, R200 015 000 0873 0000, R200 015 000 0874 0000, and R200 015 000 0875 0000 (13 parcels south side of Sea Island Parkway between Lady's Island Commons and Youmans Road) from T4-HC (Hamlet Center) to T4-HCO (Hamlet Center Open); AND**

- **denial to County Council on the Lady's Island Zoning Map Amendment for R200 015 000 0169 0000 (1 parcel) from T4-HC (Hamlet Center) to T4-HCO (Hamlet Center Open).** (see map below)

No further discussion occurred. The motion **carried (FOR: Chmelik, Davis, Fireall, Riley, Stewart, and Walsnovich; OPPOSED: Semmler and Johnston; ABSENT: Brown).**



STAFF REPORT:

A. BACKGROUND:

Case No.	ZMA-2015-05
Applicant/Owner:	Beaufort County
Property Location:	Located on Lady's Island on the south side of Sea Island Parkway between Lady's Island Commons and Youmans Road
District/Map/Parcel:	R200 015 000 0165 0000, R200 015 000 0169 0000, R200 015 000 0721 0000, R200 015 000 0820 0000, R200 015 000 0866 0000, R200 015 000 0867 0000, R200 015 000 0868 0000, R200 015 000 0869 0000, R200 015 000 0870 0000, R200 015 000 0871 0000, R200 015 000 0872 0000, R200 015 000 0873 0000, R200 015 000 0874 0000, R200 015 000 0875 0000
Property Size:	9.5 acres
Future Land Use Designation:	Community Commercial
Current Zoning District:	T4 Hamlet Center
Proposed Zoning District:	T4 Hamlet Center Open

B. SUMMARY OF REQUEST:

As part of the development of the Beaufort County Community Development Code (CDC), the County changed the zoning of the business district of Lady's Island. The original zoning designation of properties along Sea Island Parkway was "Lady's Island Village Center" which allowed for a wide range of commercial land uses and pedestrian friendly development with buildings addressing the street. For this reason, as the County was developing its new code, this portion of Lady's Island was determined to be a good location to apply the transect zones to continue the goals of promoting pedestrian friendly development. The transect zones were mapped during a charrette held in December 2011 and refined by the Lady's Island Community Preservation Committee.

The original intention of the delineation of the districts was to taper off the intensity of the zoning as development moved back from Sea Island Parkway. Therefore, the zoning along US 21 at the Lady's Island Shopping Center is T4 Hamlet Center Open with the interior lots zoned T4 Hamlet Center. T4HC is more restrictive and limits retail and office uses to 3,500 square feet. However, the property owner brought to the attention of the Planning Department that the Lady’s Island Shopping Center buildings crossed parcel boundaries, rendering the shopping center split zoned. Since it is the intention of the owner to eventually redevelop the shopping center, the owner did not want to be encumbered by the split zoning and the restrictions placed by T4 Hamlet Center. After further analysis, it was also determined that the building occupied by Seaside Vineyard (formerly Lady’s Island Cinema) would be restricted by the T4 Hamlet Center zoning if it ever were to be converted to a retail or office use because of the size restriction. The Planning Department brought this map issue to the attention of the Lady's Island Community Preservation Committee that recommended the following map change (see attached map).

C. ANALYSIS: Section 7.3.40 of the Community Development Code states that a zoning map amendment may be approved if the proposed amendment:

1. ***Is consistent with and furthers the goals and policies of the Comprehensive Plan and the purposes of this Development Code.***

The area proposed to be rezoned is designated as Community Commercial in the Comprehensive Plan which calls for land uses that typically serve nearby residential areas, such as a shopping district anchored by a grocery store. The Comprehensive Plan also promotes infill development and redevelopment within the context of its future land use plan. Since it is the intention of the property owner to redevelop the site as a cohesive master planned commercial development, having consistent zoning across parcel boundaries would greatly facilitate this endeavor.

2. Is not in conflict with any provision of this Development Code, or the Code of Ordinances.

The proposed zoning change will ensure that development in this area will be consistent with other parcels along Sea Island Parkway on Lady’s Island.

3. Addresses a demonstrated community need.

Not applicable

4. Is required by changing conditions.

Not applicable

5. Is compatible with existing and proposed uses surrounding the land subject to the application, and is the appropriate zone and uses for the land.

The T4 Hamlet Center Open district allows for larger retail and office uses and would accommodate the existing buildings that exceed 3,500 square feet including the shopping center building (33,200 sf) and the Seaside Vineyard building (10,400 sf).

6. ***Would not adversely impact nearby lands.***

   The site currently has commercial, office and institutional uses compatible with the types of uses and intensity of the proposed T4 Hamlet Center Open zoning.

7. ***Would result in a logical and orderly development pattern.***

   The proposed zoning would achieve consistent zoning across the Lady's Island Commons and Lady's Island Shopping Center properties. It would also provide a logical continuation of the commercial zoning along Sea Island Parkway.

8. ***Would not result in adverse impacts on the natural environment – including, but not limited to, water, air, noise, storm water management, wildlife, vegetation, wetlands, and the natural functioning of the environment.***

   Because of the existing commercial development on the site, the proposed T4 Hamlet Center Open zoning is not determined to have any adverse impacts on the natural environment.

9. ***Would result in development that is adequately served by public facilities (e.g. streets, potable water, sewerage, storm water management, solid waste collection and disposal, schools, parks, police, and fire and emergency facilities)***

   The site has adequate public facilities.

D. STAFF RECOMMENDATION:

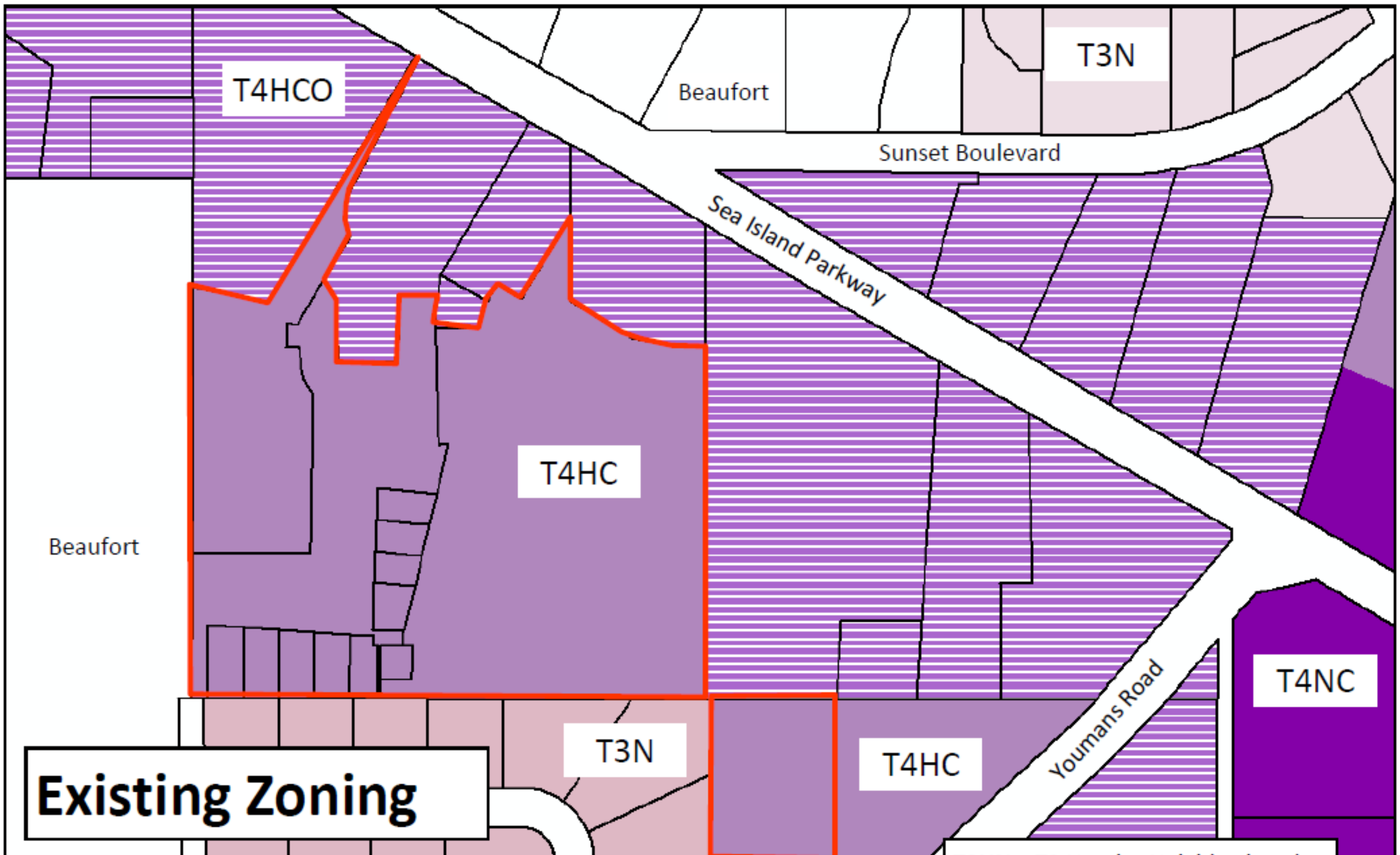
After review of the guidelines set forth in Section 7.3.40 of the Community Development Code, staff recommends correcting the official zoning map from T4 Hamlet Center to T4 Hamlet Center Open.

E. METROPOLITAN PLANNING COMMISSION DRAFT MINUTES SUMMARY AND RECOMMENDATION:

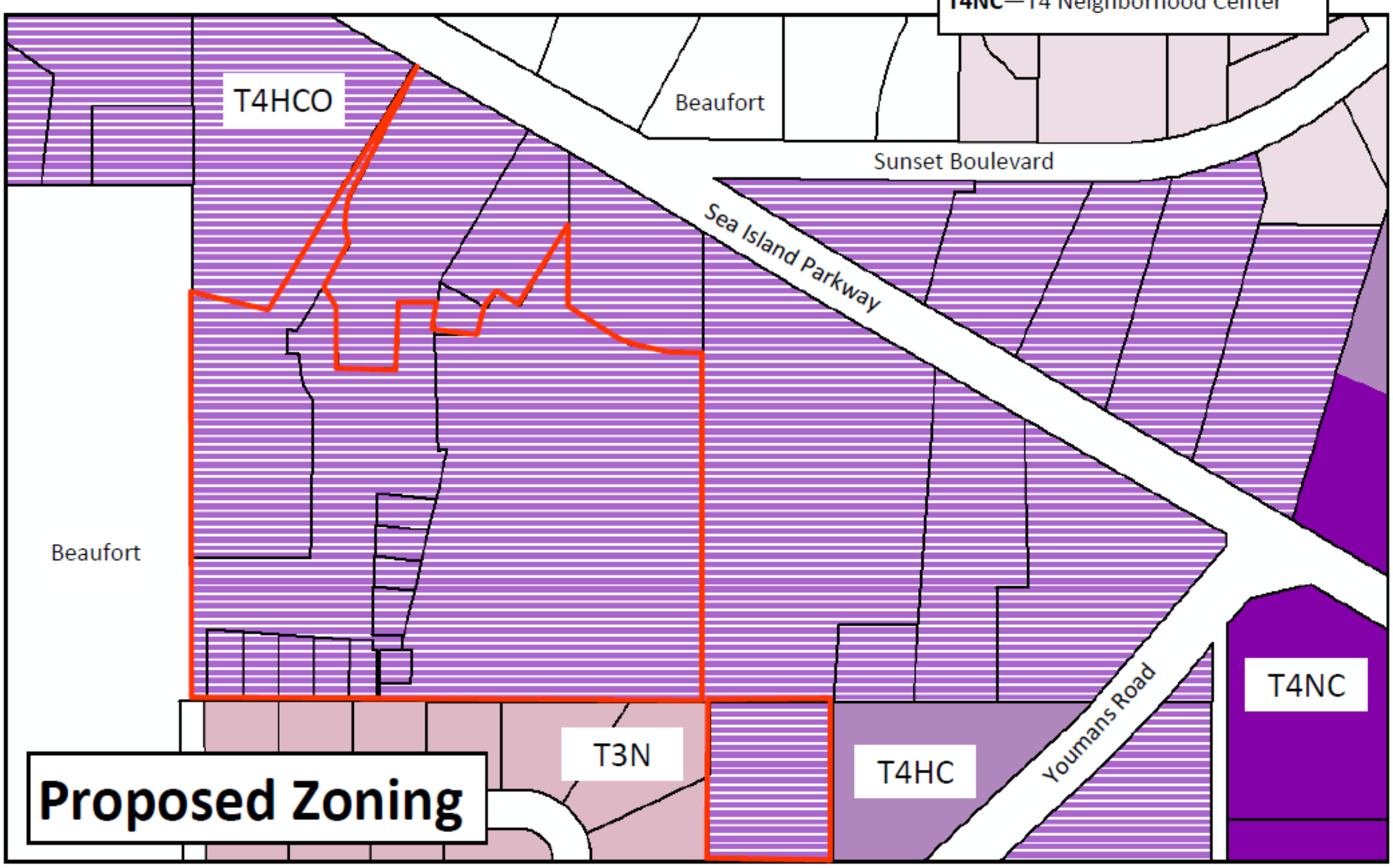
The Commission met on August 17, 2015. Rob Merchant, Beaufort County Long-range Planner, summarized the proposed zoning map change to the Metropolitan Planning Commission. One person from the public spoke. Loretta Grant asked about Youman's Road and if that part would include the community center off of Red Oak. Mr. Merchant said no, those properties are not included. Commissioner Harris asked if there was anything more intense zoning "up toward the bridge." Mr. Merchant said the most intense zoning is at the intersection of Sam's Point Road and Sea Island Parkway, and "as you go towards the bridge, it tapers." He added that there are some city properties there, too. Commissioner Semmler moved to correct the official zoning map from T4-HC to T4-HCO. Commissioner Johnson seconded the motion. The motion passed unanimously.

F. ATTACHMENTS:

- Existing and Proposed Zoning Map (ZDSO)
- Property Owners Notified of Map Amendment
- Notification Letter (copy)



T3HN—T3 Hamlet Neighborhood
T3N—T3 Neighborhood
T4HC—T4 Hamlet Center
T4HCO—T4 Hamlet Center Open
T4NC—T4 Neighborhood Center



PROPERTY OWNERS NOTIFIED OF LADY'S ISLAND MAP AMENDMENT OF 14 PARCELS

near Sea Island Parkway between Lady's Island Commons Youmans Road, from T4-HC (Hamlet Center) to T4-HCO (Hamlet Center Open)

PIN_	Owner1	MailingAdd	City	State	ZIP
R200 15 751	AMERICAN CAPITAL RESOURCES COMPANY	108 CLEARVIEW DRIVE	MC MINNVILLE	TN	37110-1615
R200 15 173,175	BAKER ROBERT J (BISHOP OF CHARLESTON	119 BROAD STREET	CHARLESTON	SC	29401
R123 15 155	BEAUFORT COUNTY SCHOOL DIST	POST OFFICE DRAWER 309	BEAUFORT	SC	29901
R200 15 165B,820	BEAUFORT JASPER WATER & SEWER AUTHORITY	6 SNAKE ROAD	OKATIE	SC	29909-3937
R123 15 915	BEAUFORT SENIOR LIVING PROPERTIES LL	1124 PARK WEST BLVD #101	MOUNT PLEASANT	SC	29466-7158
R123 15 178A	BISHOP OF CHARLESTON	POST OFFICE BOX 818	CHARLESTON	SC	29401
R200 16 051	BROWN WILLIE MAE	10 RED OAK DRIVE	BEAUFORT	SC	29907
R200 15 163B	CAROLINA LAND AND LEASE LLC	POST OFFICE BOX 856	WALTERBORO	SC	29488
R200 15 177	CARTER DENISE M / JESSICA K	54 YOUMANS DRIVE	BEAUFORT	SC	29902
R200 15 133	CHANDLER FRANKLIN THOMAS	101 SEA ISLAND PKWY	BEAUFORT	SC	29907
R123 15 790,791,792,793	COASTALSTATES BANK	POST OFFICE BOX 4800	HILTON HEAD ISLAND	SC	29938
R200 15 167	COLE CK PORTFOLIO VI LLC % CIRCLE K	POST OFFICE BOX 52085	PHOENIX	AZ	85072
R200 15 874	COMMUNITY DEVELOPMENT CORP OF BEAUFORT	2009 BAY STREET	BEAUFORT	SC	29902
R123 15 798	CROUT PROPERTIES LLC	422 COVE VIEW PT	COLUMBIA	SC	29212
R200 16 050	CUPPIA JEROME CHESTER	8 RED OAK DRIVE	BEAUFORT	SC	29907
R200 16 062	CUYLER MISHAW T	1 RED OAK ROAD	BEAUFORT	SC	29907
R123 15 921	DE TREVILLE ROBERT ELLIS / KAREN	POST OFFICE BOX 942	BEAUFORT	SC	29901
R123 15 138	DETREVILLE B ELLIS TRUSTEE B ELLI	POST OFFICE BOX 942	BEAUFORT	SC	29901
R200 15 132	DOCK HOLIDAY OF BEAUFORT LLC	109 SEA ISLAND PKWY	LADYS ISLAND	SC	29907
R200 15 173A	DUMAC COMPANY INC (THE)	1044 WHARF INDIGO PL	MOUNT PLEASANT	SC	29464
R200 15 173C	DUMAC COMPANY INC (THE)	186 SEVEN FARMS DRIVE F394	DANIEL ISLAND	SC	29492
R200 15 717	EZELL SYLVESTER THERESA K	POST OFFICE BOX 1521	BEAUFORT	SC	29907
R200 15 870	FACTORY CREEK LANDING GROUP LLC	2009 BAY STREET	BEAUFORT	SC	29902
R123 15 139,800	FALCON MORTGAGE GROUP LP	307 W 7TH STREET	FORT WORTH	TX	76201
R200 16 057	GILBERT GREGGORY L / CATIA	301 WIMBEE LANDING ROAD	SEABROOK	SC	29940
R200 16 060	GOODWATER SHURLEEN D	9 RED OAK DRIVE	BEAUFORT	SC	29907
R200 16 055	GRANT LORETTA E	18 RED OAK DRIVE	BEAUFORT	SC	29901
R123 15 137,903,904	HAMILTON VILLAGE LLC	325 FALLEN OAK DRIVE	COLUMBIA	SC	29229
R200 15 173B	HARRIS MARY	56-A YOUMANS DRIVE	BEAUFORT	SC	29907
R200 15 185	HARVEY JOHN G CANDACE O	15 TUSCARORA DRIVE	BEAUFORT	SC	29907
R200 15 172	HERNANDEZ DIONISIO / ALBA LUZ DIAZ	57 YOUMANS DRIVE	BEAUFORT	SC	29907
R200 16 059	HOLLOWAY SINGLETON RENEE C	15 RED OAK DRIVE	BEAUFORT	SC	29907
R200 15 178	JENKINS FRED FORD NATHANIEL BROWN V	33 F AND B ROAD	BEAUFORT	SC	29907

PROPERTY OWNERS NOTIFIED OF LADY'S ISLAND MAP AMENDMENT OF 14 PARCELS

near Sea Island Parkway between Lady's Island Commons Youmans Road, from T4-HC (Hamlet Center) to T4-HCO (Hamlet Center Open)

R200 15 172A	JENKINS LACARRA	325 AMBROSE RUN APT 206	BEAUFORT	SC	29906
R200 15 168	JENKINS MARION HRS OF C/0 ROSE MARIE	65 YOUMANS DRIVE	BEAUFORT	SC	29907-1462
R200 15 151	KENT THERON JAIMIE (LIFE EST) ALEXA	70 SEA ISLAND PARKWAY	BEAUFORT	SC	29907
R200 15 875	LADY'S ISLAND COMMONS PROPERTY OWNER	POST OFFICE DRAWER 4160	BEAUFORT	SC	29903-4160
R200 15 152	LANASA CAROLINE C / LYNETTE C	1009 COTTON PLANTATION DRIVE	STOCKBRIDGE	GA	30281
R200 15 174	LAWRENCE ANTHONY	POST OFFICE BOX 2352	BEAUFORT	SC	29907
R200 16 61	LINNEN MARY D	POST OFFICE BOX 1954	BEAUFORT	SC	29907
R200 15 872	MAZZANNA REVOCABLE TRUST AGREEMENT	51 HIDDEN COVE POINT	PROSPERITY	SC	29127-9087
R200 15 869	MCDOUGALL J OLIN II SHAWN SALYER J	POST OFFICE BOX 1336	BEAUFORT	SC	29901
R200 15 180	MIDDLETON WILLIE D MARVIN J	50 YOUMANS DRIVE	BEAUFORT	SC	29907
R200 15 182	MIDDLETON WILLIE DEE	50 YOUMANS DRIVE	BEAUFORT	SC	29907
R200 15 174A	MITCHELL SYRAUS ANNIE MAE	12 SANGSTER ROAD	BEAUFORT	SC	29907
R200 16 56	MYERS A D GLORIA E	20 RED OAK DRIVE	BEAUFORT	SC	29907
R200 15 130	NATSCO INC (D/B/A GUYS & DOLLS)	111 SEA ISLAND PKWY	BEAUFORT	SC	29907
R200 16 53	NAVY FEDERAL CREDIT UNION	820 FOLLIN LANE	VIENNA	VA	22180
R200 15 873	NEAL'S CONSTRUCTION LLC	69 ROBERT SMALLS PKWY STE 2E	BEAUFORT	SC	29906
R123 15 799	OAKKLAND HOLDING LLC	900 QUAIL DRIVE	WALTERBORO	SC	29488
R200 15 868	PASAI LLC	POST OFFICE BOX 88	PORT ROYAL	SC	29935
R200 16 52	PATTERSON J ALLAN THREE P'S PARTNERS	2732 DEPOT ROAD	BEAUFORT	SC	29907
R200 15 176/R200 16 49	PIZZO MARY E	45 SHORTS LANDING ROAD	BEAUFORT	SC	29907
R200 15 185A	R & K HEAPE PROPERTIES LLC	3 SUNSET BLUFF	BEAUFORT	SC	29907
R200 16 47	RHODAN GEORGE	2 RED OAK DRIVE	BEAUFORT	SC	29907
R123 15 905	SHAKY POND LLC	6821 OAKMONT DRIVE	BEAUFORT	SC	29906
R200 16 54	SIMMONS ANGELINE %LAVERN SIMMONS LES	16 RED OAK DRIVE	BEAUFORT	SC	29907
R200 15 171	SINGLETON CHARLES D	1107 WASHINGTON STREET	BEAUFORT	SC	29907
R200 15 871	SIS HOLDINGS LLC	POST OFFICE BOX 2450	BEAUFORT	SC	29901
R200 15 163C	SMITH JAMES A	7632 JOE ALLEN DRIVE	BEAUFORT	SC	29906-9752
R200 15 166	TAYLOR DELORES M	21 MERIDIAN ROAD	BEAUFORT	SC	29907-1402
R123 15 631	THOMPSON DAVID B MOST REV (THE DIOCE	119 BROAD STREET	CHARLESTON	SC	29401
R200 15 163, 165, 165A, 169, 648	THREE P'S PARTNERSHIP	2732 DEPOT ROAD	BEAUFORT	SC	29907
R200 15 721,866,867	TRASK DEVELOPMENT CO LLC	POST OFFICE BOX 4160	BURTON	SC	29903
R200 16 048	ULMER GEORGE L MARVELLE L	2207 WEST SALEM	BEAUFORT	SC	29907
R200 16 58	WISE JIMMY LEE JR NELSON ALBERT C V	29 BROWN ROAD	YEMASSEE	SC	29945

COUNTY COUNCIL OF BEAUFORT COUNTY
BEAUFORT COUNTY PLANNING DIVISION
Multi-Government Center • 100 Ribaut Road, Room 115
Post Office Drawer 1228, Beaufort SC 29901-1228
Phone: (843) 255-2140 • FAX: (843) 255-9432

August 25, 2015

RE: <u>REVISED</u> Notice of Public Meetings to Consider a Lady's Island Map Amendment for Fourteen* (14) Parcels (see attached map), near Sea Island Parkway, between Lady's Island Commons and Youmans Road, from T4-HC (Hamlet Center) to T4-HCO (Hamlet Center Open); Applicant: Beaufort County Planning Staff

Dear Property Owner:

In accordance with the Beaufort County Zoning & Development Standards Ordinance, Section 106-402, a public hearing is required by the Beaufort County Planning Commission and the Beaufort County Council before a map amendment/rezoning proposal can be adopted. You are invited to attend the following meetings and public hearings to provide comments on the subject proposed map amendments in your neighborhood. A map of the properties is on the back of this letter.

1. The **Beaufort County Planning Commission** (public hearing): **<u>THURSDAY, September 3, 2015,</u> at 6:00 p.m.** in the County Council Chambers, located on the first floor of the Beaufort County Administration Building, 100 Ribaut Road, Beaufort, SC.
2. The **Natural Resources Committee** of the County Council: **<u>Monday, October 5, 2015,</u> at 2:00 p.m.** in the Executive Conference Room, located on the first floor of the Beaufort County Administration Building, 100 Ribaut Road, Beaufort, SC.
3. **Beaufort County Council** usually meets second and fourth Mondays at 5:00 p.m. in the County Council Chambers of the Beaufort County Administration Building, 100 Ribaut Road, Beaufort, SC. County Council must meet three times prior to making a final decision on this case. Please contact the County Planning Department for specific dates, times, and locations.

Documents related to the proposed amendment are available for public inspection between 8:00 a.m. and 5:00 p.m., Monday through Friday, in the Beaufort County Planning Department office located in Room 115 of the Beaufort County Administration Building. If you have any questions regarding this case, please contact the Planning Department at (843) 255-2140.

Sincerely,

Tony Criscitiello

Anthony J. Criscitiello
Planning Director

Attachment: Map on back of letter

<u>*Properties Affected by Map Amendment:</u>
<u>R200 015 000 0165 0000</u>
<u>R200 015 000 0169 0000</u>
<u>R200 015 000 0721 0000</u>
<u>R200 015 000 0820 0000</u>
<u>R200 015 000 0866 0000</u>
<u>R200 015 000 0867 0000</u>
<u>R200 015 000 0868 0000</u>
<u>R200 015 000 0869 0000</u>
<u>R200 015 000 0870 0000</u>
<u>R200 015 000 0871 0000</u>
<u>R200 015 000 0872 0000</u>
<u>R200 015 000 0873 0000</u>
<u>R200 015 000 0874 0000</u>
<u>R200 015 000 0875 0000</u>

MEMORANDUM

TO: Natural Resources Committee of Beaufort County Council

FROM: Anthony Criscitiello, Planning Director

DATE: September 9, 2015

SUBJECT: **Lady's Island Zoning Map Amendments for 16 Parcels north and south of Sea Island Parkway between Gay Drive and Dow Road**

PLANNING COMMISSION RECOMMENDATION (an excerpt from draft minutes of its September 2, 2015, meeting):

Mr. Merchant noted that the map amendments are to correct commercial uses that were rendered non-conforming by the Code. The Lady's Island Community Preservation Committee recommended rezoning north of Sea Island Parkway as T4-NC (Neighborhood Center) and south of Sea Island Parkway as T4-HCO (Hamlet Center Open). The southern parcels are smaller and less intense zoning makes sense. The entire area was known as the Lady's Island Village Center in the Zoning and Development Standards Ordinance (ZDSO). The northern side of Sea Island Parkway includes the Lady's Island Middle School.

Discussion by Commissioners included the lots along the marsh where a larger building could be placed if the current building is destroyed by natural disaster *(staff indicated that various obstacles, including setbacks, may prevent developing these lots beyond the existing building size).*

Public Comment: None received.

Motion: Mr. Marque Fireall made the motion, and Mr. Ed Riley seconded the motion, **to recommend approval to County Council on the Lady's Island zoning map amendments for R200 015 000 111G 0000, R200 015 000 0114 0000, R200 015 000 114B 0000, R200 015 000 114C 0000, R200 015 000 114D 0000, and R200 015 000 0638 0000 – north of Sea Island Parkway; AND R200 018 00A 0147 0000, R200 018 00A 0148 0000, R200 018 00A 0149 0000, R200 018 00A 0150 0000, R200 018 00A 0161 0000, R200 018 00A 0162 0000, R200 018 00A 0163 0000, R200 018 00A 0192 0000, R200 018 00A 0193 0000, and R200 018 00A 0248 0000 – south of Sea Island Parkway (16 parcels totaling 19 acres, north and south of Sea Island Parkway between Gay Drive and Dow Road) from T3-N (Neighborhood) and T3-HN (Hamlet Neighborhood) to T4-NC (Neighborhood Center) for those lots north of Sea Island Road and T4-HCO (Hamlet Center Open) for those lots south of Sea Island Road, as recommended by the Planning staff.** No further discussion occurred. The motion **carried (FOR: Chmelik, Davis, Fireall, Johnston, Riley, Semmler, Stewart, and Walsnovich; ABSENT: Brown).**

STAFF REPORT:

A. BACKGROUND:

Case No.	ZMA-2015-04
Applicant/Owner:	Beaufort County
Property Location:	**Located on Lady's Island** north and south of Sea Island Parkway (US 21) between Gay Drive and Dow Road (see map)
District/Map/Parcel:	

Properties Affected by Map Amendment:

North of Sea Island Parkway:	**South of Sea Island Parkway:**
R200 015 000 111G 0000	R200 018 00A 0147 0000
R200 015 000 0114 0000	R200 018 00A 0148 0000
R200 015 000 114B 0000	R200 018 00A 0149 0000
R200 015 000 114C 0000	R200 018 00A 0150 0000
R200 015 000 114D 0000	R200 018 00A 0161 0000
R200 015 000 0638 0000	R200 018 00A 0162 0000
	R200 018 00A 0163 0000
	R200 018 00A 0192 0000
	R200 018 00A 0193 0000
	R200 018 00A 0248 0000

Property Size:	19 acres
Future Land Use Designation:	Community Commercial
Current Zoning District:	T3 Hamlet Neighborhood and T3 Neighborhood
Proposed Zoning District:	T4 Hamlet Center Open and T4 Neighborhood Center

B. SUMMARY OF REQUEST:

As part of the development of the Beaufort County Community Development Code (CDC), the County changed the zoning of the business district of Lady's Island. The original zoning designation of properties along Sea Island Parkway was "Lady's Island Village Center" which allowed for a wide range of commercial land uses and pedestrian friendly development with buildings addressing the street. For this reason, as the County was developing its new code, this portion of Lady's Island was determined to be a good location to apply the transect zones to continue the goals of promoting pedestrian friendly development. The transect zones were mapped during a charrette held in December 2011 and refined by the Lady's Island Community Preservation Committee.

The original intention of the delineation of the districts was to taper off the intensity of the zoning on both sides Sea Island Parkway as it approached the marshes of Little Capers Creek east of Lady's island Middle School. However, the Planning Department was approached by a property owner who had commercial zoning under the former zoning ordinance, but was now restricted to primarily residential uses with T3 Hamlet Neighborhood in the new code. In addition, several existing businesses in the area were rendered non-conforming including Mother Earth Nursery, Island Flooring, and Tidewatch. This was brought to the attention of the Lady's Island Community Preservation Committee and they recommended revising the zoning to ensure that all of the property owners who were originally zoned Lady's Island Village Center will have a compatible commercial zoning district in the new code (T4 Hamlet Center Open and T4 Neighborhood Center).

C. ANALYSIS: Section 7.3.40 of the Community Development Code states that a zoning map amendment may be approved if the proposed amendment:

1. ***Is consistent with and furthers the goals and policies of the Comprehensive Plan and the purposes of this Development Code.***

   The area proposed to be rezoned is designated as Community Commercial in the Comprehensive Plan which calls for land uses that typically serve nearby residential areas, such as a shopping district anchored by a grocery store. Commercial development within the growth boundaries of northern Beaufort County is also encouraged to be mixed use which would be restricted with the current T3 Neighborhood and T3 Hamlet Neighborhood Zoning. In addition, the Plan calls for the promotion of appropriate infill development and redevelopment within the context of the future land use plan. With the development of a new Walmart at Airport Junction looming, the parcels along Sea Island Parkway between Sams Point Road and the proposed Walmart are good candidates for infill development which may be discouraged with the current T3 zonings.

2. ***Is not in conflict with any provision of this Development Code, or the Code of Ordinances.***

   The proposed zoning change will ensure that development in this area will be consistent with other parcels along Sea Island Parkway on Lady's Island.

3. ***Addresses a demonstrated community need.***

   Not applicable.

4. ***Is required by changing conditions.***

   With the proposed Walmart at Airport Junction located ½ mile east of the rezoning, there will likely be greater demand for commercial development in this area.

5. ***Is compatible with existing and proposed uses surrounding the land subject to the application, and is the appropriate zone and uses for the land.***

   The proposed T4 Hamlet Center Open and T4 Neighborhood Center districts are applied to other commercial properties on Sea Island Parkway on Lady's Island. From 2000 to 2014, the properties were zoned Lady's Island Village Center which is consistent with the proposed T4 zoning districts.

6. ***Would not adversely impact nearby lands.***

   There are existing non-conforming commercial uses scattered in the area proposed to be rezoned including Mother Earth Nursery, Island Carpet and Flooring, and Tidewatch.

7. ***Would result in a logical and orderly development pattern.***

   The proposed zoning is a logical continuation of the commercial zoning along Sea Island Parkway.

8. ***Would not result in adverse impacts on the natural environment – including, but not limited to, water, air, noise, storm water management, wildlife, vegetation, wetlands, and the natural functioning of the environment.***

   The site is buffered from the marsh on the north side of Sea Island Parkway by School District property (Lady's Island Middle). On the south side, there is one property east of Dow Road that fronts the marsh. This parcel has an existing 2,500 square foot commercial building that is severely limited in its redevelopment potential given the non-conforming nature of the site.

9. ***Would result in development that is adequately served by public facilities (e.g. streets, potable water, sewerage, storm water management, solid waste collection and disposal, schools, parks, police, and fire and emergency facilities)***

   The site has adequate public facilities.

D. STAFF RECOMMENDATION:

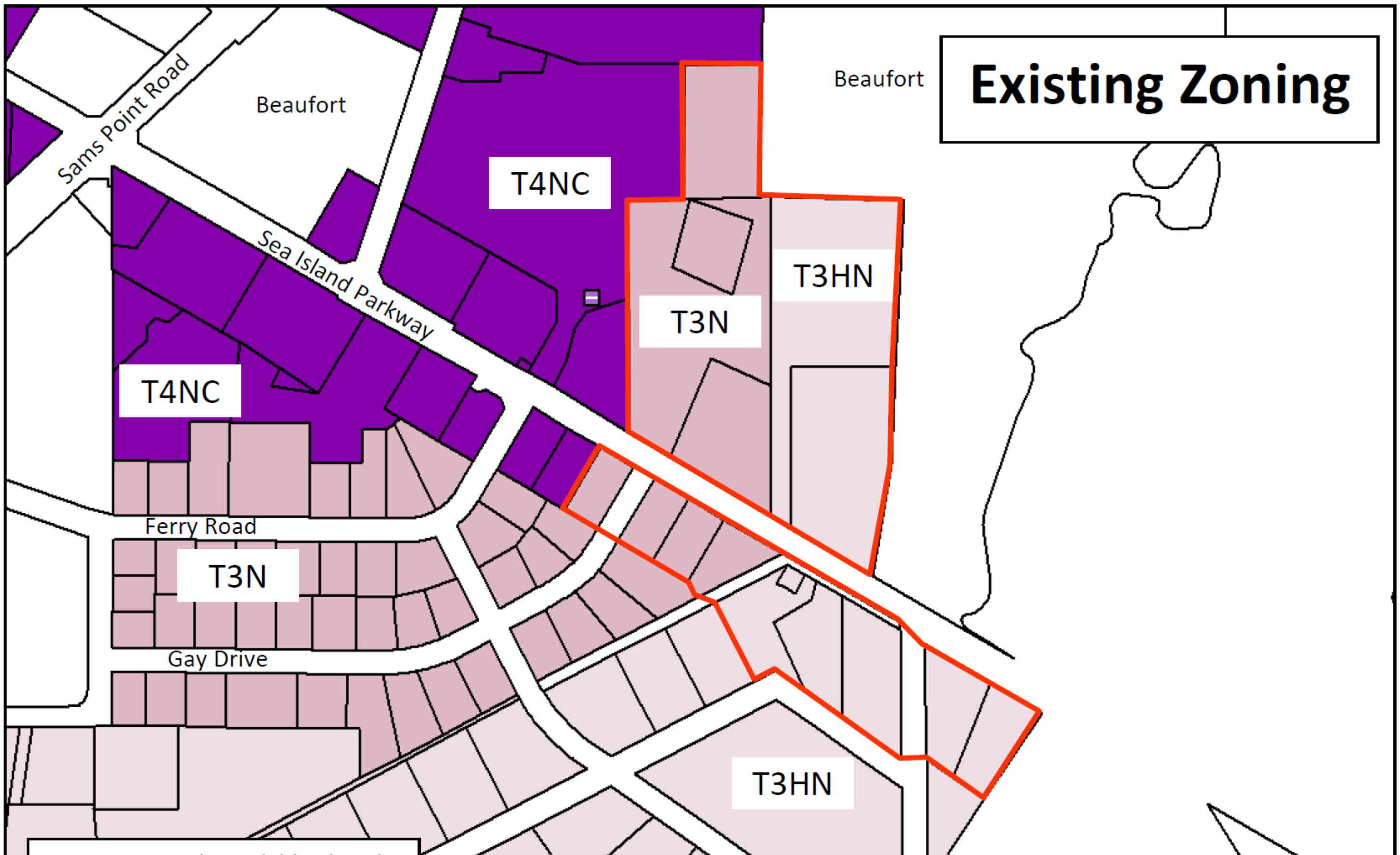
After review of the guidelines set forth in Section 7.3.40 of the Community Development Code, staff recommends correcting the official zoning map from T3 Hamlet Neighborhood and T3 Neighborhood to T4 Hamlet Center Open and T4 Neighborhood Center.

E. METROPOLITAN PLANNING COMMISSION DRAFT MINUTES SUMMARY AND RECOMMENDATION:

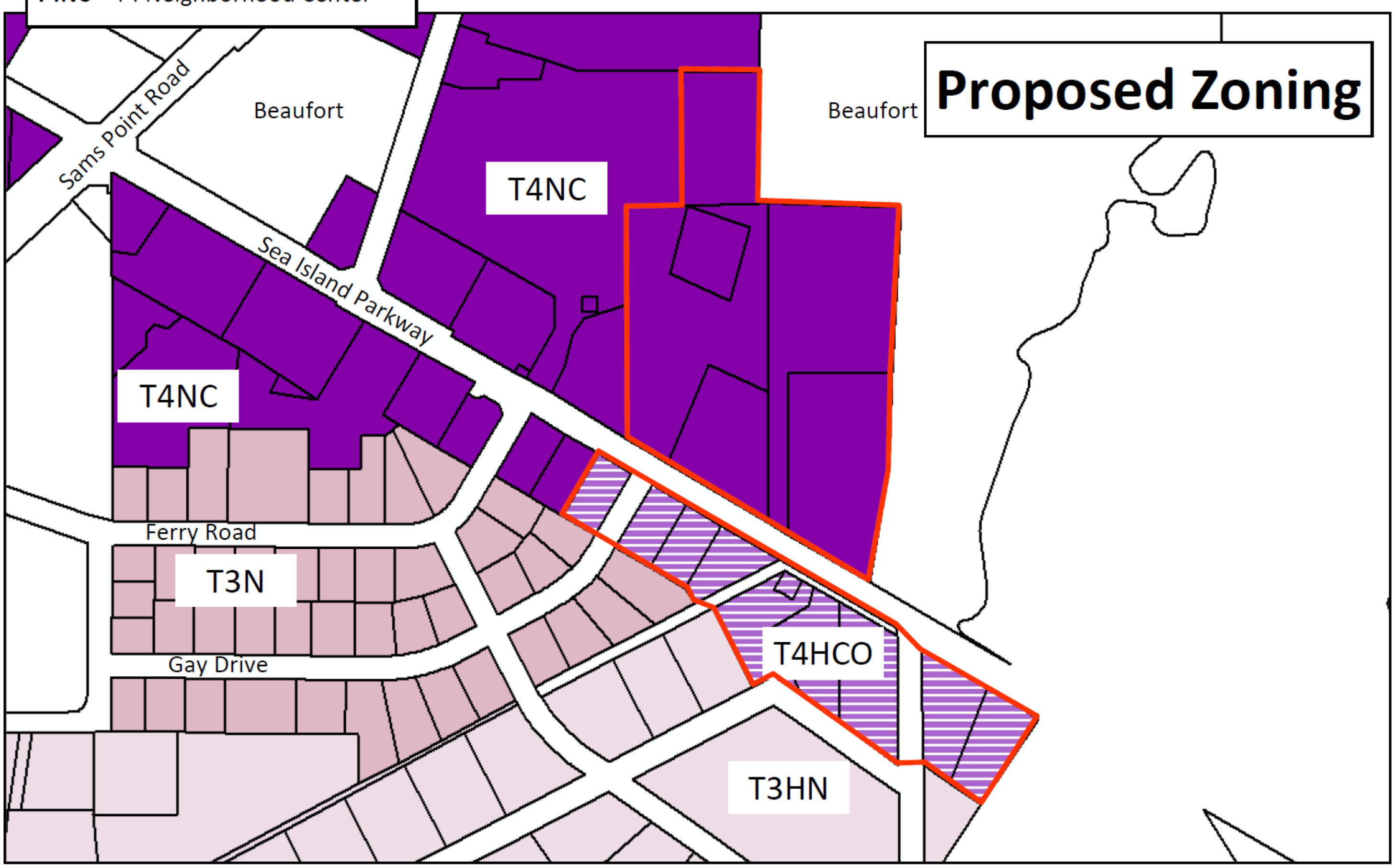
The Commission met on August 17, 2015. Rob Merchant, Beaufort County Long-Range Planner, summarized the proposed zoning map change to the Metropolitan Planning Commission. One person from the public spoke. Selmer Robert Holmquist said he had heard Mr. Merchant say he'd talked to people, but he is here in reference to his own property and to his church. He indicated the section that the church owns and said, "Nobody's talked to us." He asked Mr. Merchant if someone has applied to put a business there. He showed some heirs' property and marshland that is within this area. Mr. Merchant said it's the county's opinion that they are making it consistent with the zoning that's been there for the last 15 years. They are bringing it back in line with what the zoning was historically. They are not doing it in response to any particular application. They have received no petitions for projects. This will only bring it more in line with the zoning policy, not "change the land use policy in that area that would result in anything that couldn't have located there already." Commissioner Johnson made a motion to recommend the change in the zoning map from T3-Neighborhood and T3-Hamlet Neighborhood to T4-Neighborhood Center and T4-Hamlet Center Open. Commissioner Harris seconded the motion. The motion passed unanimously.

E. ATTACHMENTS:

- Existing and Proposed Zoning Map (ZDSO)
- Property Owners Notified
- Notification Letter (copy)



T3HN—T3 Hamlet Neighborhood
T3N—T3 Neighborhood
T4HC—T4 Hamlet Center
T4HCO—T4 Hamlet Center Open
T4NC—T4 Neighborhood Center



PROPERTY OWNERS NOTIFIED OF MAP AMENDMENT FOR 16 PARCELS ON LADY'S ISLAND, between Gay Drive and Dow Road, to T4-NC (Neighborhood Center) for north of Sea Island Parkway; and T4-HCO (Hamlet Center Open) for south of Sea Island Parkway

PIN_	Owner1	MailingAdd	City	State	ZIP
R200 15 505	AHUMADA VICTOR	7 ROBIN DRIVE	BEAUFORT	SC	29907
R200 18 108	AMSLER THOMAS W	1143 OTTER CIRCLE	BEAUFORT	SC	29902
R200 15 638	BARKER ASSOCIATES	808 BROOME LANE NORTH	BEAUFORT	SC	29902
R200 18 147	BEAUFORT COUNTY	POST OFFICE DRAWER 1228	BEAUFORT	SC	29901
R200 15 284-286, R123 15 110	BEAUFORT COUNTY SCHOOL DIST	POST OFFICE DRAWER 309	BEAUFORT	SC	29901
R200 15 661; R200 18 2	BEAUFORT JASPER WATER AUTHORITY	6 SNAKE ROAD	OKATIE	SC	29909
R200 18 148 & 149	BLALOCK TIMOTHY P	7 CHICKADEE LANE	BEAUFORT	SC	29907
R200 18 153	BODISON ANNIE PEARL	1086 BODISON MEMORIAL DRI\	ROUND O	SC	29474
R200 18 122	BRYANT WILBERT J LYNN C	9 FERRY DRIVE	LADYS ISLAND	SC	29907
R200 15 194F	CSRH ENTERPRISES LP	130 SPANISH POINT DRIVE	BEAUFORT	SC	29902
R200 18 192	FARRIOR DAVID P DAUBERT BARBARA J	1 HERMITAGE POINTE	BEAUFORT	SC	29907
R200 18 126	FAW JOHN E / PATRICIA T	14002 GREENCROFT LANE	COCKEYSVILLE	MD	21030
R123 18 483	FLEMING ANDERSON GROUP LTD P/S	POST OFFICE BOX 189	PORT ROYAL	SC	29935
R200 15 114B	GODOWNS FRANCES T	64 ALUMNI ROAD	BEAUFORT	SC	29907
R200 18 51	GRAVE YARD ISRAELITE CEMETERY OF L I	29 ISRALITE CHURCH ROAD	BEAUFORT	SC	29907
R200 15 107A, 111, 111A, 111D-G, 115, 275, 277, 279, 280, 281, 282, 503, 729	GRAY HOLDING LIMITED P/S	22 SAMS POINT ROAD	BEAUFORT	SC	29907
R200 18 163	GREENWALT TRISTAN	1 BOYDS LANDING	OKATIE	SC	29909
R200 18 145	HENDERSON CLINT C	530 ROOKERY LANE	SAINT HELENA ISLAND	SC	29920
R200 18 124	HOLMQUIST S R JANET O'QUINN	1 SALICORNIA DRIVE	BEAUFORT	SC	29907
R200 18 154	HOLSOPPLE WAYNE PATRICIA I	5 FERRY DRIVE	BEAUFORT	SC	29907
R200 15 114 & 114C	HORTON JAMES E JR	197 SEA ISLAND PARKWAY	BEAUFORT	SC	29907
R200 18 157	HUDSON MILTON JOSEPH DEBRA C	POST OFFICE BOX 705	BEAUFORT	SC	29907
R200 18 675	INLET FARM LLC	8 FLYCATCHER LANE	BEAUFORT	SC	29902
R200 18 143	KERR GARRY R MARIA AMALIA	4 CAPWING DRIVE	BURTON	SC	29902
R200 18 125	KNOLES TIMOTHY L LORRAINE K BURLEY	12 GAY DRIVE	LADY'S ISLAND	SC	29907
R200 18 107	LAZER LLC	22 SAMS POINT ROAD	BEAUFORT	SC	29907
R200 18 109	LEMIEUX DANIEL G PAMELA G	6 FERRY DRIVE	BEAUFORT	SC	29907
R200 18 193 & 194	MARSHALL JAMES L	POST OFFICE BOX 3035	CROSSVILLE	TN	38557
R200 18 123	MCCRACKEN WILLIAM C JR MCCRACKEN MAR	POST OFFICE BOX 276	PORT ROYAL	SC	29935
R200 18 158-160, 168	MEADOWBROOK BAPTIST CHURCH	POST OFFICE BOX 118	LADYS ISLAND	SC	29907
R200 18 158-160, 168	MEADOWBROOK BAPTIST CHURCH	12 LUPO DRIVE	BEAUFORT	SC	29907
R200 15 114D	MOTHER EARTH LANDSCAPING INC	199 SEA ISLAND PARKWAY	BEAUFORT	SC	29907

PROPERTY OWNERS NOTIFIED OF MAP AMENDMENT FOR 16 PARCELS ON LADY'S ISLAND, between Gay Drive and Dow Road, to T4-NC (Neighborhood Center) for north of Sea Island Parkway; and T4-HCO (Hamlet Center Open) for south of Sea Island Parkway

R200 18 156	NEWTON LINDA L WAYNE S MICHAEL E FAY	3151 DATURA ROAD	VENICE	FL	34293
R200 18 155	NGUYEN SON THANH	8 GAY DRIVE	BEAUFORT	SC	29907
R200 18 142	PHAM RICHARD / NGUYEN ANH	4961 LAKE PALMETTO LANE	NORTH CHARLESTON	SC	29418
R200 15 315	PIZZO MARY E	45 SHORTS LANDING ROAD	BEAUFORT	SC	29907
R200 18 146	RAHTJEN KATHLEEN H	3 GAY DRIVE	BEAUFORT	SC	29907
R200 18 760	RIVER CITY DEVELOPERS LLC	1857 RIBAUT ROAD	PORT ROYAL	SC	29935
R200 15 312	RODRIGUEZ PATRICIA OROZCO	3 KATY CIRCLE	BEAUFORT	SC	29907
R200 18A 150-152	RUSHTON SUSAN Y / EMORY W	2700 FORT SCOTT DRIVE	ARLINGTON	VA	22202
R200 18 141	SENG STEVEN D SHAWN K D	POST OFFICE BOX 4158	BURTON	SC	29903
R200 15 316	SMALLS ROSA MAE A/K/A MCDONALD ROSA	ST RTE 5 BOX 69E	BEAUFORT	SC	29907
R200 15 115A	SOUTH CAROLINA BANK & TRUST NA ATTN:	POST OFFICE BOX 1287	ORANGEBURG	SC	29116
R200 18 144	STEPHENS DAVID W / VERONICA M	7 GAY DRIVE	BEAUFORT	SC	29907
R200 18 182	TARRANCE GREGG N	304 COTTAGE FARM DRIVE	BEAUFORT	SC	29907
R200 18 161-162	TIDEWATCH OWNERS ASSOCIATION INC	POST OFFICE BOX 1600	SAINT HELENA ISLAND	SC	29920
R200 15 313	TRASK E CHANDLER	162 COOSAW CLUB DRIVE	BEAUFORT	SC	29907
R200 18 110	VELICH KATHY N LOUIS JAMES	8 FERRY DRIVE	BEAUFORT	SC	29907
R200 15 283	WELLS ROBERT ALLEN SARAH ALICE	28 ROBIN DRIVE (LOT 9)	BEAUFORT	SC	29907
R200 15 318	WISE JOYCE A	27 ROBIN DRIVE	BEAUFORT	SC	29907
R200 18 171, 180-181, 221	YOAKUM DAVID W / PATRICIA P	3 LUPO DRIVE	BEAUFORT	SC	29907

COUNTY COUNCIL OF BEAUFORT COUNTY
BEAUFORT COUNTY PLANNING DIVISION
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August 25, 2015

RE: <u>REVISED</u> Notice of Public Meetings to Consider a Lady's Island Map Amendment for Sixteen* (16) Parcels (see attached map), north and south of Sea Island Parkway, between Gay Drive and Dow Road, from T3-N (Neighborhood) and T3-HN (Hamlet Neighborhood) to:

- **T4-NC (Neighborhood Center) for north of Sea Island Parkway; and**
- **T4-HCO (Hamlet Center Open) for south of Sea Island Parkway.**

Applicant: Beaufort County Planning Staff

Dear Property Owner:

In accordance with the Beaufort County Zoning & Development Standards Ordinance, Section 106-402, a public hearing is required by the Beaufort County Planning Commission and the Beaufort County Council before a map amendment/rezoning proposal can be adopted. You are invited to attend the following meetings and public hearings to provide comments on the subject proposed map amendments in your neighborhood. A map of the properties is on the back of this letter.

1. The **Beaufort County Planning Commission** (public hearing): **THURSDAY, September 3, 2015, at 6:00 p.m.** in the County Council Chambers, located on the first floor of the Beaufort County Administration Building, 100 Ribaut Road, Beaufort, SC.
2. The **Natural Resources Committee** of the County Council: **Monday, October 5, 2015, at 2:00 p.m.** in the Executive Conference Room, located on the first floor of the Beaufort County Administration Building, 100 Ribaut Road, Beaufort, SC.
3. **Beaufort County Council** usually meets second and fourth Mondays at 5:00 p.m. in the County Council Chambers of the Beaufort County Administration Building, 100 Ribaut Road, Beaufort, SC. County Council must meet three times prior to making a final decision on this case. Please contact the County Planning Department for specific dates, times, and locations.

Documents related to the proposed amendment are available for public inspection between 8:00 a.m. and 5:00 p.m., Monday through Friday, in the Beaufort County Planning Department office located in Room 115 of the Beaufort County Administration Building. If you have any questions regarding this case, please contact the Planning Department at (843) 255-2140.

Sincerely,

Tony Criscitiello

Anthony J. Criscitiello
Planning Director

Attachment: Map on back of letter

***Properties Affected by Map Amendment:**

North of Sea Island Parkway:	South of Sea Island Parkway:
R200 015 000 111G 0000	R200 018 00A 0147 0000
R200 015 000 0114 0000	R200 018 00A 0148 0000
R200 015 000 114B 0000	R200 018 00A 0149 0000
R200 015 000 114C 0000	R200 018 00A 0150 0000
R200 015 000 114D 0000	R200 018 00A 0161 0000
R200 015 000 0638 0000	R200 018 00A 0162 0000
	R200 018 00A 0163 0000
	R200 018 00A 0192 0000
	R200 018 00A 0193 0000
	R200 018 00A 0248 0000

MEMORANDUM

To: **Natural Resources Committee** of Beaufort County Council

From: Anthony J. Criscitiello, Planning & Development Director

Date: September 28, 2015

Subject: Proposed Amendments to the Articles 2, 3, 4, 5, 6, 7, and 10 of the Community Development Code as a Result of the Six-Month Review of the Newly Adopted Code

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Excerpt of PLANNING COMMISSION RECOMMENDATION from its September 3, 2015, draft meeting minutes:

Mr. Semmler explained that the Commission had been reviewing the text amendments during their special monthly meetings, along with the 2010 Comprehensive Plan. Commission comments and recommended changes have been available at the Planning office, and the Commission has reviewed the proposed changes finalized by staff. Mr. Semmler noted that the Commission would discuss specific areas, if further clarification was needed.

Mr. Merchant noted that at the adoption of the Code, Council added the condition for a 6-month and a 1-year review of the Code. The reviews would give staff the opportunity to apply and enforce the Code and thereby learn what works or needs adjustment. He briefed the Commission on the major areas of amendments.

Discussion by the Commission included clarifying the tapering of transect zones in community plans, and clarifying what the staff needs from the Planning Commission regarding these changes.

Public Comment: None received.

Motion: Ms. Carolyn Davis made a motion, and Mr. Marque Fireall seconded the motion, **to recommend to County Council approval of all the text amendments to the Community Development Code, as recommended by staff**. The motion **carried** (FOR: Chmelik, Davis, Fireall, Johnston, Riley, Semmler, Stewart, and Walsnovich; ABSENT: Brown).

MEMORANDUM

TO: Beaufort County Planning Commission

FROM: Tony Criscitiello, Planning Director T.C.

DATE: August 25, 2015

SUBJECT: 6-Month Review of Community Development Code – Proposed Text Amendments

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When County Council adopted the Community Development Code (CDC) on December 8, 2014, the motion included a 6 month and 1 year evaluation of the code as a condition of approval. Since the adoption of the CDC, staff has learned of both minor and major corrections that should be made to the ordinance based on application and enforcement of the Code. A summary of these changes were presented to the Natural Resources Committee meeting on June 1, 2015 as part of the 6-month review of the code. At that time, the Committee approved the summary and directed staff to bring any necessary amendments forward.

To help navigate through this list of amendments, they have been categorized with the major changes first and minor fixes at the end of the document. The amendments are divided into the following categories:

- **Transect Zone Amendments:** These include amendments to transect zones and related provisions, such as the Traditional Community Plan, which promote mixed-use walkable communities. Since the transect zones are a prominent feature in the new Code, it is in the County's best interest to insure that the districts are utilized and do not present unnecessary barriers to development.
- **Sign Amendments:** These are changes to the sign requirements in Division 5.6.
- **Use Amendments:** These are amendments to the Use Table (Section 3.1.60), the Land Use Definition Table (Section 3.1.70), and Specific To Use standards (Division 4.1).
- **Corrections, Clarifications, and provisions from the ZDSO:** These are minor amendments that do not change the substance of the code. They include mistakes found in the code, such as incorrect building setbacks, or references to provisions that were removed from the code (e.g. Plat Vacation). They also include clarifications, which are changes to wording that aid in the understanding of the requirements. Finally, some of the changes being brought forward were provisions that were in the former ZDSO and did not make it into the final draft of the CDC.

Transect Zone Amendments

1. **Allowing Mobile Homes to be replaced without meeting Building Type and Public Frontage Standards:** This series of amendments is proposed to address an issue that has occurred in the enforcement of the Community Development Code. Some of the transect zones have Building Type and Public Frontage standards for single family dwellings that are difficult to meet for standard mobile homes. This has come up several times in the Alljoy/Brighton Beach Community, Land's End and Shell Point. In order to prevent placing undue burden on property owners who are simply replacing an older mobile home with a newer unit, staff recommends the following amendment in T2 Rural Neighborhood Open (3.2.50), T2 Rural Center (3.2.60), T3 Hamlet Neighborhood (3.2.80), T3 Neighborhood (3.2.90), T4 Hamlet Center (3.2.100), and T4 Neighborhood Center (3.2.110). See sample table below from T2 Rural Neighborhood Open for the proposed amendment that will appear in the above sections.

A. Purpose

The Rural Neighborhood (T2RN) Zone protects the residential character of existing communities and neighborhoods in the rural area. The district is intended to minimize non-conforming lots and provide owners of small clustered rural lots flexibility in the use of their land. The districts are established by identifying areas with five contiguous lots of five or fewer acres. It permits subdivision of existing lots to a maximum of 1.2 units to one acre gross density, with DHEC approval, for wastewater treatment. The district is not intended to promote tract development or to encourage rezoning.

The T2 Rural Neighborhood (T2RN) Zone implements the Comprehensive Plan goals of preserving the rural character of portions of Beaufort County.

B. Subzones

T2 Rural Neighborhood Open

The T2 Rural Neighborhood Open (T2RNO) Subzone provides rural residential areas with limited retail and service uses in the scale and character of the T2RN zone.

C. Allowed Building Types

Building Type	Specific Regulations
Carriage House	5.1.40
Estate House	5.1.50
Village House	5.1.60
Miscellaneous	
Building Type Standards only apply to T2 Rural Neighborhood Open	
Existing manufactured homes that are being replaced with another manufactured home that does not exceed the size and/or setbacks of the existing unit are exempt from Building Type (Division 5.1) and Private Frontage (Division 5.2) Standards.	

2. **Facilitating Side-Parking in the T4 Transect Zones:** The T4 Hamlet Center, T4 Hamlet Center Open, and T4 Village Center Transect Zones are mixed use districts that promote pedestrian friendly development that is in close proximity to the street and sidewalk. Many of the areas of Beaufort County (e.g. Shell Point, Lady's Island, Corners Community) that are zoned with these districts are in the process of transitioning from auto-oriented to pedestrian-friendly communities. During this transition, many businesses will resist having parking at the rear of the building when a majority of customers will access the business from the highway and want to park in front of the business. A good compromise is to allow parking at the side of the building with the entrance at the front corner. This orients the building both toward the sidewalk and the parking lot accommodating both modes of transportation. The rigid requirements in the T4 districts for the percentage of building façade within the façade zone, and the parking setbacks make it difficult to impossible to have parking at the side of the building. Therefore, staff proposes to allow a wall or decorative fence that screens side parking to count toward a percentage of the façade zone. Staff also recommends reducing the parking lot setback to align parking with the front façade of the building minus 5 feet to allow a fence or wall with landscaping (see tables on pages 4 and 5).

3. **Making Allowances for Larger Buildings in the T4 Zones:** T4 Hamlet Center Open and T4 Village Center allow buildings of a size up to 50,000 square feet. T4 Neighborhood Center has no limit on the square footage of retail or service uses. However, there are other standards that make it difficult to site larger buildings in the T4 districts. Both districts have a maximum lot size and width

that is too small to accommodate larger buildings. In addition, the Building Types assigned to the T4 districts also limit the size of buildings. Therefore staff recommends the following amendments to accommodate the larger buildings that are already permitted in these districts:

a. Providing for an exemption from the maximum lot sizes in the T4 Districts for larger buildings;
b. Providing an exemption from the maximum building footprint width for larger buildings;
c. Adding the Industrial/Agricultural building type to the T4 Districts; and
d. Allowing for an exemption for larger buildings from the building size and massing requirements for the Industrial/Agricultural building type.

The tables below show the amendments required to allow side parking and to accommodate larger buildings in the T4 districts:

Section 3.2.100.C Amended to allow Industrial/Agricultural Building Type in T4HC, T4 HCO, and T4 VC

A. Purpose

The Hamlet Center (T4HC) Zone is intended to integrate appropriate, medium-density residential building types, such as duplexes, townhouses, small courtyard housing, and mansion apartments in an environment conducive to walking and bicycling.

The T4 Hamlet Center is appropriate for more rural areas, implementing the Comprehensive Plan goals of creating areas of medium intensity residential in portions of Beaufort County, the City of Beaufort and Town of Port Royal.

B. Sub-Zones

T4HC-O (Open)

The intent of the T4HC-O Sub-Zone is to provide neighborhoods with a broader amount of retail and service uses in the scale and character of the T4HC zone.

T4VC (Village Center – St. Helena)

The Village Center (T4VC) Zone provides a tailored set of land uses for St. Helena Island.

C. Allowed Building Types

Building Type	Specific Regulations
Carriage House	5.1.40
Village House[1]	5.1.60
Small Lot House	5.1.70
Cottage Court	5.1.80
Duplex	5.1.90
Townhouse	5.1.100
Mansion Apartment	5.1.110
Apartment House	5.1.120
Industrial/Agricultural	5.1.140

Notes

[1]The use of this building type is limited to non-residential uses

Section 3.2.100.D Amended to accommodate decorative fences and walls screening parking to count toward façade within façade zone requirement. Section 3.2.100.D also amended to exempt large buildings from maximum lot size requirements. Section 3.2.100.E amended to exempt large buildings from maximum building footprint width requirements.

D. Building Placement		
Setback (Distance from ROW/Property Line		
Front	10' min., 25' max.	A
Side Street	10' min., 20' max.	B
Side:		
Side, Main Building	5' min.	C
Side, Ancillary Building	5' min.	
Rear	5' min.	D
Façade within Façade Zone[1]		
Front	75%	
Side Street	50%	
Notes		
[1]A Parking Lot Perimeter Strip (Section 5.8.80.C) utilizing a decorative fence or wall can substitute up to 50% of the required façade within the façade zone.		
Lot Size (37,500 SF Maximum)		
Width	150 ft. max.	E
Depth	250 ft. max.	F
Miscellaneous		
Where existing adjacent buildings are in front of the regulated BTL or front setback, the building may be set to align with the façade of the front-most immediately adjacent property.		
Maximum lot size does not apply to Recreation, Education, Safety, Public Assembly uses, and buildings with a footprint exceeding 10,000 square feet.		

E. Building Form		
Building Height		
Main Building	2.5 stories max.	G
Ancillary Building	2 stories max.	
Ground Floor Finish Level:[1]		H
Residential	18" min.	
Commercial (T4HC-O)	6" max.	
Ground Floor Ceiling:		I
Commercial (T4HC-O)	10' min.	
Upper Floor(s) Ceiling	8' min.	J
Ground Floor lobbies and Common areas in multi-unit buildings may have a 0" to 6" ground floor finish level.		
Within 25' of the rear property line, buildings may not be more than a half-story taller than the allowed height of adjacent buildings.		
Footprint		
Width: Main Building	100' max.[2]	
All upper floors may have a primary entrance along the front. Loading docks, overhead doors, and other service entries may not be located on street-facing façades.		
Notes		
[1]Buildings located in a flood hazard zone will be required to be built above base flood elevation in accordance with Beaufort County Building Codes.		
[2]Buildings with a footprint exceeding 15,000 square feet are exempt from the maximum building width requirement.		

Section 3.2.100.G Amended to reduce parking lot setback to 5 feet behind the front façade line.

F. Encroachments and Frontage Types		
Encroachments		
Front	12' max.	L
Side Street	12' max.	M
Side	3' max.	N
Rear	3' max.	O
Encroachments are not allowed across a side or rear property line, or across a curb.		
See Division 5.2 (Private Frontage Standards) for further refinement of the allowed encroachments for frontage elements.		

Allowed Frontage Types	
Common Yard	Forecourt
Porch: Projecting	Dooryard
Porch: Engaged	Porch: Side Yard
Stoop	Shopfront[1]
Terrace[1]	

[1] Allowed in T4HC-O Sub-Zone only.

G. Parking		
Required Spaces: Residential Uses		
Single-family detached	2 per unit	
Single family attached/ duplex	2 per unit	
Multi-family units	1.25 per unit	
Accessory dwelling unit	1 per unit	
Community residence	1 per bedroom	
Required Spaces: Service or Retail Uses		
Retail, Offices, Services	1 per 300 GSF	
Restaurant, Café, Coffee Shop	1 per 150 GSF	
Drive-through Facility	Add 5 stacking spaces per drive-through	
Gas Station/Fuel Sales	1 per pump plus requirement for retail	
Lodging: Bed and breakfast	2 spaces plus 1 per guest room	
Lodging: Inn/hotel	1 per room	
Required Spaces: Industrial Uses		
Light manufacturing, processing and packaging	1 per 500 GSF	
Warehousing/Distribution	1 per 2,000 GSF	
For parking requirements other uses see Table 5.5.40.B (Parking Space Requirements).		
Location (Setback from Property Line)		
Front	~~40' min.~~ 5' behind front façade of main building	P
Side Street	~~15' min.~~ 5' behind side façade of main building	Q
Side	0' min.	R
Rear	5' min.	S
Miscellaneous		
Parking Driveway Width		T
40 spaces or less	14' max.	
Greater than 40 spaces	18' max.	

Section 3.2.110.B amended to allow Industrial/Agricultural Building Type in T4NC.

A. Purpose

The Neighborhood Center (T4NC) Zone is intended to integrate vibrant main-street commercial and retail environments into neighborhoods, providing access to day-to-day amenities within walking distance, creating potential for a transit stop, and serving as a focal point for the neighborhood.

The T4 Neighborhood Center Zone implements the Comprehensive Plan goals of creating areas of higher intensity residential and commercial uses in Beaufort County, the City of Beaufort and Town of Port Royal.

B. Allowed Building Types

Building Type	Specific Regulations
Carriage House	5.1.40
Small Lot House	5.1.70
Cottage Court	5.1.80
Duplex	5.1.90
Townhouse	5.1.100
Mansion Apartment	5.1.110
Apartment House	5.1.120
Main Street Mixed Use	5.1.130
Industrial/Agricultural	5.1.140

Section 3.2.110.D amended to exempt large buildings from maximum lot size requirements in T4NC.

C. Building Placement		
Setback (Distance from ROW/Property Line		
Front	0' min., 15' max.	A
Side Street	0' min., 10' max	B
Side:		C
Main Building	3' min., 6' max.	
Ancillary Building	0' or 3' min.	
Rear	3' min.	D
Façade within Façade Zone:		
Front	75%	
Side Street	50%	
Lot Size (62,500 SF Maximum)		
Width	250' max.	E
Depth	250' max.	F
Miscellaneous		
Where existing adjacent buildings are in front of the regulated BTL or front setback, the building may be set to align with the facade of the front-most immediately adjacent property.		
No planting strips are allowed between sidewalk and building.		
Maximum lot size does not apply to Recreation, Education, Safety, Public Assembly uses, and buildings with a footprint exceeding 20,000 square feet.		

D. Building Form		
Building Height		
Main Building	2 stories min.,[1] 4 stories max.	G
Ancillary Building	2 stories max.	
Ground Floor Finish Level[2]		H
Residential	18" min.	
Commercial	6" max.	
Ground Floor Ceiling:		I
Commercial	10' min.	
Upper Floor(s) Ceiling	8' min.	J
Ground Floor lobbies and common areas in multi-unit buildings may have a 0" to 6" ground floor finish level.		
Within 25' of the rear property line, buildings may not be more than a half-story taller than the allowed height of adjacent buildings.		
Footprint		
Width: Main Building	250' max.	
Miscellaneous		
Distance Between Entries, to Upper Floor(s)	80'	
All upper floors must have a primary entrance along the front.		
Loading docks, overhead doors, and other service entries may not be located on street-facing facades.		
Notes		
[1]On Lady's Island, one-story buildings are permitted; multi-story buildings are recommended		
[2]Buildings located in a flood hazard zone will be required to be built above base flood elevation in accordance with Beaufort County Building Codes.		

Section 5.1.140.C amended to exempt larger buildings from the maximum dimensions for the Industrial/Agricultural building type.

B. Lot		
Lot Size		
Width	100 ft	A
Depth	200 ft	B
C. Building Size and Massing		
Height		
Per building form standards based on zone.		
Main Body[1]		
Width	100 ft. max.	C
Depth	150 ft. max.	D
Notes		
[1]Buildings with a footprint exceeding 15,000 square feet may exceed main body maximum width and depth requirements provided that the building meets the standards in Division 5.3 (Architectural Standards and Guidelines) and the site planning standards of Division 2.6 (Commercial Oriented Communities).		

D. Allowed Frontages		
Porch: Projecting	Porch: Engaged	
Gallery	Arcade	
The porch, gallery, or arcade, shall extend along at least 75% of either the length or width of the building.		E
E. Pedestrian Access		
Main Entrance Location	Front or Side	F
F. Vehicle Access and Parking		
Parking may be accessed from the alley, side street, or front.		
Parking drives and access may be shared on adjacent lots.		
G. Private Open Space		
No private open space requirement.		

4. **Traditional Community Plans: Allowing Greater Flexibility in the Choice of Transect Zones:** The Traditional Community Plan (Division 2.3) is a good tool for promoting the development of mixed use walkable communities. In order to promote the use of the TCP, staff recommends having greater flexibility with the Neighborhood-Scale TCP which currently requires the assignment of three transect zones for a development as small as 40 acres. Staff recommends making the following amendment to Table 2.3.60.B to reduce the number of required transect zones for the Neighborhood-Scale TCP from 3 to 2:

Table 2.3.60.B Required Allocation Mix of Transect Zones		
Transect Zone	**Percentage of Land Assigned to Zone**	
Infill-Scale TCP		
T3 Edge (T3E)	No min.	25% max.
T3 Hamlet Neighborhood (T3HN)	25% min.	70% max.
T3 Neighborhood (T3N)	25% min.	50% max.
Neighborhood-Scale TCP		
T2 Rural (T2R)	No min.	50% max.
T3 Edge (T3E)	No min.	25% max.
T3 Hamlet Neighborhood (T3HN)	25% No min.	40% max.
T3 Neighborhood (T3N)	25% 60% min.	50% 90% max.
T4 Hamlet Center (T4HC)	10% min.	40% max.
Commercial Redevelopment TCP		
For Areas Zoned C4		
T3 Neighborhood (T3N)	No min.	100% max.
T4 Hamlet Center Open (T4HCO)	No min.	100% max.
For Areas Zoned C5		
T4 Hamlet Center Open (T4HCO)	No min.	100% max.
T4 Neighborhood Center(T4NC)	No min.	100% max.

5. **Place Type Overlay Zone: Greater Flexibility for Village Place Type (3.4.80.E):** The following amendment is proposed to allow greater flexibility of the allocation of transect zones in the Village Place Type provided that the regulating plan meets the objectives of the division and is the product of a multi-day charrette involving stakeholders and the public. The amended language reads as follows:

   "**E. Allocation of Transect Zones:** Applications for a comprehensive amendment under the provisions of the Place Type Overlay (PTO) Zone shall assign and map transect zones to each pedestrian shed according to the percentages allocated in the Table 3.4.80.E. The Director may ~~approve a variance for~~ modulate up to 15% for the transect zone allocation within Table 3.4.80.E as long as the proposed regulating plan meets the objectives of this Division. Modulations greater than 15% of the transect zone allocation may be permitted for the Village Place Type, provided that the regulating plan meets the objectives of this Division and is the product of a multi-day charrette involving all affected stakeholders and the public."

Sign Amendments

The following amendments are proposed for Division 5.6. The most common form of sign in auto-oriented areas is the freestanding sign which includes pole signs and monument signs designed to be seen from the highway by passing motorists. When the Community Development Code was adopted, Table 5.6.40.A allowed freestanding signs in each of the conventional zones, but none of the transect zones. The original purpose of prohibiting freestanding signs in T4 was that the T4 zones were meant to create pedestrian oriented development. With buildings set at a close distance from the street, wall signs and projecting signs are easily visible from the street and are conducive to a pedestrian environment. However, this created a hardship for buildings that were unable to be sited close to the highway. Staff responded with an amendment allowing for freestanding signs in T4 when the building was sited 30 feet or greater from the front property line. After further analysis, staff has determined that neighboring jurisdictions permit freestanding signs in areas zoned for pedestrian friendly development. Therefore, staff is bringing forward the following amendment that would allow freestanding signs in T4, but at a scale that is more pedestrian-friendly, but still visible from the street. In addition, freestanding signs were prohibited in T2 districts in the Community Development Code. Staff believes that this was a mistake and is bringing forward as a correction to permit them in the T2 districts.

Table 5.6.40.A amended to allow for freestanding signs as permitted in T2 districts and as a conditional use in T4 districts:

Free Standing Signs: Free standing signs encompass a variety of signs that are not attached to a building and have an integral support structure. Three varieties include: Freestanding, Monument and Pole.

T1 T2 T3 T4
C3 C4 C5 S1

5.6.120

Section 5.6.120.B amended to provide conditions for freestanding signs in T4 districts:

A. Description

Freestanding Signs encompass a variety of signs that are not attached to a building and have an integral support structure. Freestanding varieties include Monument and Pole Signs.

A Pole Sign, usually double-faced, mounted on a single or pair of round poles, square tubes, or other fabricated members without any type of secondary support.

A Monument Sign stands directly on the ground or ground level foundation and is often used to mark a place of significance or the entrance to a location.

B. Standards

Size

Signable Area	T4	All Other Districts
Single Tenant	24 SF max.	40 SF max.
Multiple Tenant with one highway frontage	32 SF max.	80 SF max.
Multiple Tenant with two or more highway frontages	32 SF per frontage	80 SF per frontage

Location

Signs per Highway Frontage:		
Single Tenant	1 max.	
Multiple Tenant	1 max. [1,2]	
Height	10' max.	A
Width	15' max.	B
Distance from ground to the base of the sign	4' max.	
Setback within Corridor Overlay District	10' min.	

[1]Individual tenants may not have a Freestanding Sign.

[2]Frontages greater than 500 feet may include one additional freestanding sign not to exceed 80 SF in area and with a total allowable sign area not exceeding the maximum allowable sign area for the multiple tenant center.

Miscellaneous

~~Freestanding signs are permitted in T 4 zones in cases where the principal structure is located greater than 30 feet from the front property line.~~

Changeable copy signs are allowed for gasoline price signs, houses of worship, schools, directory signs listing more than one tenant, and signs advertising restaurant food specials, films and live entertainment which change on a regular basis.

Use Amendments

1. **Add Residential Storage Facility as a conditional use in T4 Hamlet Center Open and T4 Neighborhood Center.** The Community Development Code currently does not permit Residential Storage Facilities in any of the T4 districts. This was originally done because the T4 districts are meant to encourage pedestrian friendly development. However, two areas of the County (Shell Point and Lady's Island) have T4 districts for the entirety of their commercial districts. With this particular use in high demand, especially in areas with small residential lots, staff is recommending adding residential storage facility as a conditional use in T4.

17. Residential Storage Facility	--	--	--	--	--	--	--	--	--	--	--	--	C	C	--	C	C	C
18. Vehicle Services: Minor Maintenance and Repair	--	--	--	--	--	C	--	--	--	--	--	C	C	C	--	C	C	--
19. Vehicle Services: Major Maintenance and Repair	--	--	--	--	--	C	--	--	--	--	--	--	C	C	--	C	C	C
Land Use Type	T1 N	T2R	T2 RL	T2 RN	T2 RNO	T2 RC	T3E	T3 HN	T3 N	T3 NO	T4 HC	T4 VC	T4 HCO	T4 NC	C3	C4	C5	SI

"P" indicates a Use that is Permitted By Right.
"C" indicates a Use that is Permitted with Conditions.
"S" indicates a Use that is Permitted as a Special Use.
"TCP" indicates a Use that is permitted only as part of a Traditional Community Plan under the requirements in Division 2.3
"--" indicates a Use that is not permitted.

The following amendments are recommended to Section 4.1.220 for residential storage facility in T4. Provide an additional subsection "E" to address this use in T4 Hamlet Center Open:

"E. Residential Storage Facilities in T4 Hamlet Center Open and T4 Neighborhood Center: Residential storage facilities shall be sited so that storage buildings are located in the interior of the block and do not face a street. The site shall incorporate outparcels to screen and separate the storage buildings from the street. The leasing office and/or security quarters may face and address the street."

2. **Revising the Definition of Lodging:Inn:** Regulating the short-term rental (i.e., less than 30 days) of single-family homes as a commercial lodging use requires that the homes be renovated to commercial building code standards per the County Building Official. For this reason, staff recommends that the short-term rental of single-family homes be deleted from the definition of "Lodging: Inn." Staff will be developing separate standards for this use for the Planning Commission's future consideration. Revise Table 3.1.70 as follows:

OFFICES AND SERVICES	
This category is intended to encompass activities, without outdoor storage needs, that are primarily oriented towards office and service functions.	
Land Use Type	**Definition**
9. Lodging: Inn	A building or group of buildings used as a commercial lodging establishment having up to 24 guest rooms providing lodging accommodations to the general public. ~~This includes the use of any dwelling unit for lodging accommodations on a daily or weekly rate to the general public.~~

2.7.40.C: Family Compound Standards (Clarification). Edit as follows:

C. **Property May Be Subdivided.** Family compounds shall be developed and the dwelling units built, or the family compound property may be subdivided and conveyed by the landowner to a family member to build a dwelling unit. Family compounds that are subdivided are limited to the maximum number of units without clustering shown in Table 2.7.40.A.

2.7.40.D: Family Compound Standards (from ZDSO). Add a new subsection that reads as follows:

5. Family Compound Design. Family compounds that are subdivided shall be accompanied by covenants and cross easements, or similar restrictions and reservations, guaranteeing essential infrastructure and 50 feet of vehicular access for each lot.

2.9.80.C: Minimum Construction Specifications for Unpaved Roads (Clarification). Edit item 2 as follows:

2. Minor subdivisions, as long as no more than four lots will be served by the proposed road, and rear lanes (see Table 2.9.90.E) may utilize a stabilized aggregate road, in accordance with the standards in this section.

2.9.80.C: Minimum Construction Specifications for Unpaved Roads (Correction). Delete item 6.

6. ~~The road shall consist of a 20-foot roadway with four-foot shoulders and roadside ditches.~~

2.9.9.F: Public Frontage Standards (Correction). Amend table to allow public frontage type "HW-RD-ST" which allows open swales in the T3 and C3 districts with approval by the director.

Table 2.9.90.F Public Frontage Standards

This table assembles prescriptions and dimensions for the public frontage elements - curbs, walkways, and planters - relative to specific thoroughfare types within transect zones. The Assembly row assembles all of the elements for the various thoroughfare types.

Transect Zone	T1 T2 T3 T4 / C3 C4 C5 S1	T1 T2 T3 T4 / C3 C4 C5 S1	T1 T2 T3 T4 / C3 C4 C5 S1	T1 T2 T3 T4 / C3 C4 C5 S1
Public Frontage Type*	**HW-RD-ST**	**RD & ST**	**ST-DR-AV**	**ST-DR-AV-BV**
Assembly: The principal variables are the type and dimension of curbs, walkways, planters and landscape.				
Total Width	13' – 22'	13' – 22'	10' – 17'	12' – 16'
Curb: The detailing of the edge of the vehicular pavement, incorporating drainage.				
Type	Rural (Open Swale)	Rolled Curb (Valley Gutter)	Raised Curb	Raised Curb
Radius	25'	10' – 30'	5' – 20'	5' – 20'

3.2.30.B T1 (Natural Preserve) Building Placement (from ZDSO). Amend table to establish a minimum lot width of 150 feet for this district (see Table below)

B. Building Placement		
Setback (Distance from ROW/Property Line)		
Front	50' min.	A
Side Street	50' min.	B
Side:		
Side, Main Building	50' min.	C
Side, Ancillary Building	20' min.	
Rear	100' min.	D
Lot Size (One Acre Minimum)		
Width	~~n/a~~ 150' min.	E
Depth	n/a	F
Miscellaneous		
Where existing adjacent buildings are in front of the regulated BTL or front setback, the building may be set to align with the façade of the front-most immediately adjacent property.		

3.2.30.C: T2R (Rural) Building Placement (from ZDSO). Amend table to change side setbacks for residential uses from 50 feet to 18 feet to match what was in the ZDSO for the Rural district. Change site setbacks for ancillary uses from 20 feet to 10 feet. Establish a minimum lot width for Rural of 100 feet (see Table below).

C. Building Placement		
Setback (Distance from ROW/Property Line		
Front	50' min.	A
Side Street	50' min.	B
Side		
Side, Main Building	~~50'~~ 18' min.	C
Side, Ancillary Building	~~20'~~ 10' min.	
Rear	50' min.	D
Lot Size (Half Acre Minimum)		
Width	~~n/a~~ 100' min	E
Depth	n/a	F
Miscellaneous		
Where existing adjacent buildings are in front of the regulated BTL or front setback, the building may be set to align with the facade of the front-most immediately adjacent property.		

3.2.80.C: T3HN (Hamlet Neighborhood)Building Placement: (Correction): Remove maximum side yard setback for main buildings (see table below).

C. Building Placement		
Setback (Distance from ROW/Property Line)		
Front	25' min., 35' max.	A
Side Street	15' min, 25'max.	B
Side:		
Side, Main Building	10' min, ~~15'max.~~	C
Side, Ancillary Building	5' min.	
Rear	15' min.	D
Lot Size (7,500 SF Minimum)		
Width	65' min.	E
Depth	100' min.	F
Miscellaneous		
Where existing adjacent buildings are in front of the regulated BTL or front setback, the building may be set to align with the façade of the front-most immediately adjacent property.		

3.2.110.C: T4NC (Neighborhood Center)Building Placement: (Correction): Remove maximum side yard setback for main buildings and ancillary buildings (see table below).

C. Building Placement		
Setback (Distance from ROW/Property Line		
Front	0' min., 15' max.	A
Side Street	0' min., 10' max	B
Side:		C
Main Building	3' min.~~, 6' max.~~	
Ancillary Building	0' ~~or 3'~~ min.	
Rear	5' min.	D
Façade within Façade Zone:		
Front	75%	
Side Street	50%	
Lot Size (62,500 SF Maximum)		
Width	250' max.	E
Depth	250' max.	F

3.4.30.D: MCAS Airport Overlay – Noise Reduction Requirement: (Correction). Amend note #2 to read as follows:

> "Because manufactured homes are constructed to federal standards that may not meet the standards listed above for noise attenuation, all permit applications for the placement of manufactured homes within ~~a~~ noise zone 2a, 2b, or 3 shall be accompanied by the following disclosure statement:"

3.4.30.E: MCAS Airport Overlay – Notification: (Correction). Amend subsection 2 to read as follows:

> "All prospective renters signing a commercial or residential lease shall be notified by the property owner through a written provision contained in the lease agreement if the leased property is located within the ~~ZO~~ MCAS-AO Zone."

4.1.120.C: General Retail: Specific to S1 District. [from ZDSO] This amendment to the ZDSO was approved by County Council in 2014 and is being recommended by staff to be carried over to the Community Development Code. Amend subsection C to read as follows:

"1. Access shall be from the development's internal streets.

2. The use shall not have direct access to arterial or collector streets.

3. General retail establishments may reuse developed sites that have been unoccupied by a light industrial business for more than two years provided the following standards are met:

   a. Adequate parking in compliance with Division 5.5 (Off-Street Parking) shall be provided;
   b. The site shall be located within 1,000 feet of an arterial road, and traffic impacts as measured by trips per day shall not exceed by more than 10% the traffic impact of the former permitted use on the site;
   c. The proposed use shall meet the Land Use Compatibility Recommendations of the United States Navy for the Accident Potential Zones (APZs) or Noise Zones, if the site is within such a zone; and
   d. No outside sales for an adaptive reuse shall be permitted with the APZs or Noise Zones, if the site is within such a zone.
   e. Structural additions shall not increase the existing floor space by more than 15%; if more than a 15% increase is proposed, the application will be treated as a special use."

4.2.20.E General Standards and Limitations: Standards for Freestanding Accessory Buildings/Structures: (Clarification) Amend subsection 1(2) to read as follows:

> " Except in T1, T2R, and T2RL zones, all river, marsh, and ocean waterfront lots, and water/marine-oriented facilities, no accessory structure shall project beyond the front building line of the principal structure."

4.2.200.I: Private Fish Ponds: Fencing: (Correction) Delete subsection "I. Fencing"

5.3.20.2: Architectural Standards and Guidelines: Applicability: (Clarification) Amend subsection A(2) to read as follows:

> "The ~~T2RNO, T2RC, T3E, T3HN, T3HN, T3N, and T3NO~~ T2 and T3 Zones with the exception of agricultural, single-family and two-family residential uses."

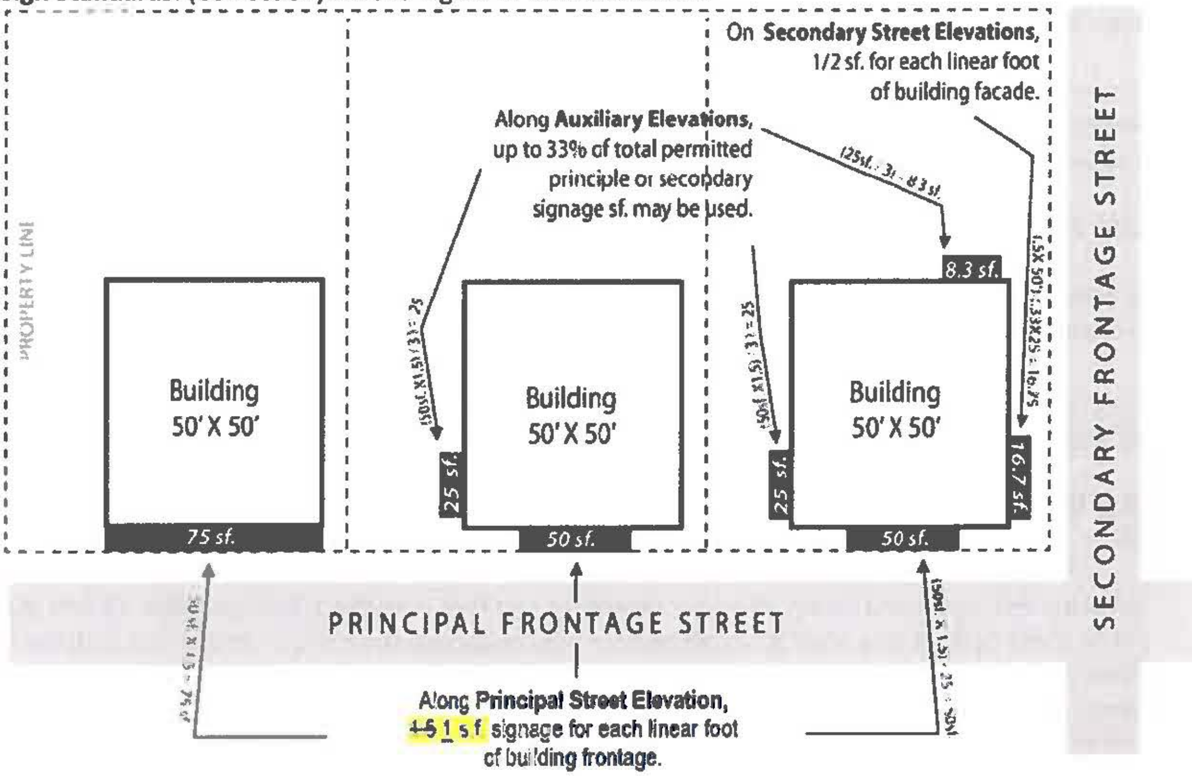
5.4.60.D: Design and Appearance: Landscape Screening: (Correction) Amend subsection to read as follows:

> "All chain link fences and fences and walls exceeding four feet in height, if located within 15 feet of a public street right-of-way, shall be supplemented with landscape screening in accordance with the following standards, to soften the visual impact of the fence. These standards shall not apply to fences in the S Zone or single-family dwellings in the ~~CS~~ C3 Zone, unless they are located within 15 feet of the right-of-way of an arterial or collector street."

5.6.30.F: General Sign Requirements: Sign Height Measurement: (Clarification) Amend Subsection F(2) to read as follows:

> "Sign height is measured as the vertical distance from the average elevation between the highest point and the lowest point of finished grade at the base of a sign to the top of the sign. Refer to sections 5.6.80 – 5.6.190 for height measurements by type of sign."

5.6.40.B: Permanent Sign Types for Buildings, Businesses and Communities: Figure 5.6.40.B Aggregate Sign Standards: (Correction) Amend Figure to read as follows:



5.7.50: Illumination of Outdoor Sports Fields and Performance Areas: (from ZDSO) Add the following subsections:

"C. **Height of Fixtures.** Light fixtures shall not exceed a height of 80 feet.

D. **Buffers Adjacent to Residential Properties.** A landscaped buffer yard sufficient to prevent light and glare spillover to adjacent residential properties may be required by the Director."

5.8.20.B Landscaping, Buffers, and Screening Standards: Applicability: Exemptions: (Clarification) Amend as follows:

1. **"Within Transect Zones:** Single-family residential and duplexes on individual lots are exempt from the requirements of this section within T1 Natural Preserve, T2 Rural, T2 Rural Neighborhood, T2 Rural Neighborhood Open, T2 Rural Center, T3 Edge, T3 Hamlet Neighborhood, and T3 Neighborhood.
2. **Within Conventional Zones and Community Preservation Districts:** Single-family residential and duplexes on individual lots are exempt."

5.8.30.B: General Landscape Design Applicable to All Zones: Existing Landscape Preservation: (Clarification) Amend subsection 2 to read as follows:

~~"Trees 8 inches DBH and larger, and all dogwoods (*Cornus spp.*), reduds (*Cercis canadensis*), and magnolias (*Magnolia spp.*) four inches DBH and larger may not~~ No vegetation may be removed from required buffers without approval of a re-vegetation plan unless dead, diseased, or listed as an invasive species in Table 5.11.100.C. of this ordinance."

5.8.50.B: Thoroughfare Buffer: Applicability: (Clarification) Amend subsection "B" to read as follows:

" A thoroughfare buffer is required along all collector and arterial roads within all conventional zones, community preservation districts, T2 Rural, T2 Rural Low, and T2 Rural Neighborhood."

5.9.20: Neighborhood Compatibility Standards: Applicability: (Correction) Amend subsection as follows:

"Except where exempted in accordance with Section 5.9.30 (Exemptions), these neighborhood compatibility standards apply to all institutional, commercial, light industrial, mixed-use, townhouse, and multi-family development in the conventional, community preservation, T1, and T2 zones located on land abutting one side or across a street or alley with two or fewer lanes from existing single-family detached residential development."

5.11.20.A: Resource Protection Standards: General: Applicability: (Clarification) amend subsection to read as follows:

" These resource protection standards apply to all ~~development~~ property in the unincorporated County, unless expressly stated otherwise in this Division."

5.11.60.A: River Buffer: River Buffer Setbacks: (Correction) Amend Table 5.11.60.A as follows:

Table 5.11.60.A: River Buffer Setbacks

District	River Buffer	Single Family/ Duplex Setback	Other Residential Buildings and Nonresidential Buildings Setback	Parking Lots and Drives Setback	Septic Tank/ Tile Field Setback	Agriculture/ Golf Course Setback
T1 and T2	50 feet	60 feet	100 feet	100 feet	100 feet	150 feet
Conventional & CP Districts; PUDs	50 feet	60 feet	100 feet	100 feet	100 feet	150 feet
T3 Edge	40 feet	50 feet	75 feet	100 feet	100 feet[1]	150 feet
T3	25 feet	35 feet	35 feet	100 feet	100 feet[1]	150 feet
T4	20 feet	30 feet	30 feet	50 feet	100 feet[1]	150 feet

[1]Or as approved by SCDHEC

5.11.60.C: River Buffer: Uses Allowed Between Building Setback and River Buffer: (Clarification) Amend subsection C(1) to read as follows:

"Residential – playgrounds, fire pits, outdoor furniture, pervious hardscapes, uncovered decks, pools, etc."

5.11.60.F: River Buffer: Buffer Disturbance (Clarification) Amend Subsection (2) to read as follows:

"Removal of Trees: Except for invasive species; see Section 5.11.100.G (Removal of Invasive Tree Species), removal of any tree within a river buffer shall require a tree removal permit; see section 7.2.50 (Tree Removal Permit). Removal of trees shall require plant back inch for inch (DBH) of trees removed, except in those instances in which a tree is dead, hollow, or has another condition that poses a hazard to people or structures on the property or adjoining property as determined in writing by a certified arborist. In those cases, the tree shall be replaced with one 2.5 inch minimum caliper tree. If all tree inches cannot be planted back on site due to site constraints, the remaining tree inches shall be subject to a general county reforestation fee; see Section 5.11.100.D.3 (Reforestation Fee)."

5.11.60.K: River Buffer: Private Trails (Clarification) Amend Subsection to read as follows:

K. **~~Private~~ Trails.** ~~Private~~ Trails shall be permitted to cross the river buffer at reasonable intervals for access to the water. Horizontal trails through the river buffer, such as walking paths and bikeways, will be allowed with the following requirements:

1. Such trails shall be designed and constructed in a manner that does not result in them becoming channels for stormwater, that does not result in erosion, or that does not damage surrounding vegetation.
2. The County may require trails to be of boardwalk construction, pervious paving systems, or stepping stones if needed to ensure meeting the objectives of the buffer, and for long term maintenance of the trail.
3. The trails shall be no more than 5 feet wide.
4. Such trails will be accessible to the public or residents of a private community.

5.11.100.D: Tree Protection: Tree Removal: (Clarification) Add a new subsection (3) to read as follows.

" **3. Penalty for Removing Trees Prior to Permitting.** If trees are cut down prior to a development receiving all necessary permits from the County, the County shall not issue a permit to allow the development to occur within two years of the tree removal, unless the property owner provides mitigation for the trees removed. Mitigation shall involve the replanting of trees a minimum of 2.5 caliper inches with a total caliper equal to 1.25 times that of the DBH of the trees removed." [Note: renumber **Reforestation Fee** to subsection 4.]

5.11.100.F: Tree Removal on Developed Properties: Single-Family Residential Lots: (Clarification) Amend Subsection (1)(b) as follows:

"**b. Tree Removal Permit Standards:** A tree removal permit will be issued to remove a grand tree from a residential lot if the tree is dead, diseased, hollow, or has another condition that poses a hazard to people or structures on the lot or adjoining lot as determined by a certified arborist. Upon removal, the tree shall be replaced with one 2.5 inch minimum caliper tree of the same species."

5.11.110: Allowed Activities in Resource Protection Area: (Correction) Amend Table 5.11.110.A as follows:

Table 5.11.110.A: Activities in Resource Protection Areas							
	Activities						
	Water Dependent Uses	Trails	Bikeway	Picnic Area	Public Road/ <u>Essential Access</u>	Water Sewer Line	Additional Standards
Tidal Wetlands	C	--	--	--	--	--	Sec. 5.11.30
Non-Tidal Wetlands	-	C	C	--	S	S	Sec. 5.11.40
Beach-Dunes	-	C	--	--	--	--	Sec. 5.11.50
River Buffer	C	C	C	--	S	S	Sec. 5.11.60
Endangered Species Habitat	-	C	--	--	--	S	Sec. 5.11.70
Forests	--	C	C	--	--	--	Sec. 5.11.90

C = Conditional S = Special Use -- = Not Permitted

6.1.60.B: Subdivision and Land Development: Easements: (Clarification) Amend Subsection as follows:

"Width: Utility easements shall be a minimum of ten feet wide. Easements that fall on shared side or rear lot lines shall be divided equally, requiring five feet from each lot. <u>Access easements shall meet the standards of Division 2.9 (Thoroughfare Standards) for a comparable roadway.</u>"

Section 7.2.20.A: Procedures: Zoning Permit: Purpose: (Clarification) Amend Subsection as follows:

"Purpose: The purpose of a Zoning Permit is to ensure that proposed development <u>and/or new land uses</u> compl~~ies~~<u>y</u> with all the requirements of this Development Code and ha~~s~~<u>ve</u> any required permits for access, potable water, sewer, and any other permits required under the Code of Ordinances <u>and/or state or federal law</u> prior to issuance of a Building Permit <u>or Business License</u>."

Section 7.2.30.A Modulation Permit: Allowable Modulations (Correction): Amend Table 7.2.30.A as follows:

Table 7.2.30.A: Allowable Modulations		
Modulation	**Required Findings**	**Maximum Modulation**
Community Scale		
Block Face and Perimeter Length. See Section 2.2.40.A.2.	Natural resources limit the ability to create an interconnected network of streets and blocks.	20 percent
Dead-End Streets and Cul-de-Sacs See Section 2.2.30.E (Dead-End Streets and Cul-de-Sacs).	Existing site specific environmental feature(s) requires protection and/or preservation, and no alternative block structure is practicable.	Allowed
Building Placement		
Setbacks: A decrease of the minimum required setback areas (e.g., side, street side, and rear) for structures. See Article 3 (Specific to Zones).	Existing development on adjacent parcels on the same block face is less than the required setback; and The modulation will allow the proposed development to blend in with the adjacent development.	3 feet or 20 percent, whichever is greater. For lots of record created before 1999, no less than 10-ft side and rear setbacks to make lot buildable.[1]
Setbacks: Additions. Allowing any new addition to an existing structure to be located up to the furthest point of setback encroachment, subject to Fire Code regulations. See Article 3 (Specific to Zones).	New addition does not increase the non-conformity; and Addition to or new garage is not within 15 feet of a public right-of-way.	Up to existing encroachment[1]
Build-to-Line: Front or Side. A relaxation of the specified build-to-line. See Article 3 (Specific to Zones).	Existing development on adjacent parcels on the same block face is set back less than the required setback; and The modulation will allow the proposed development to blend in with the adjacent development.	5 feet
Build-to-Line: Defined by an Existing Building. A relaxation of the specified build-to-line, defined by the building façade, for sites located within Transect Zones. See Article 3 (Specific to Zones).	Modulation will allow the proposed development to blend with the existing adjacent development.	10 percent
Facade within façade zone in Transect Zones. A relaxation of the specified front façade requirements for sites located within Transect Zones. See Article 3 (Specific to Zones).	Modulation will allow the proposed development to blend in with the adjacent development.	10 percent
Parcel dimensions (e.g., ~~area,~~ depth~~,~~ or width). A decrease in the minimum required parcel ~~area,~~ parcel depth~~,~~ or parcel width. See Article 3 (Specific to Zones).	An existing parcel can be developed following the intent of the zone; or The size of a new parcel is limited by natural resources.	10 percent

7.4.50.A: Public Hearing Scheduling and Notice: Required Public Hearings: (Correction) Amend Table 7.4.50.A as follows:

Table 7.4.50.A: Required Public Hearings			
Development Application or Approval	Advisory or Decision-Making Bodies		
	County Council	Planning Commission	Zoning Board of Appeals (ZBOA)
Comprehensive Plan Amendment	X	X	
Text Amendment	X	X	
Zone Map Amendment	X	X	
Special Use Permit			X
Variance Permit			X
~~Plat Vacation~~	~~X~~		
Street Renaming		X	
Appeal to Planning Commission		X	
Appeal to Zoning Board of Appeals			X
Development Agreements	X		

7.4.130.B: Expiration of Development Approval: Exceptions: (Correction) Amend subsection to read as follows:

"**Exceptions:** Zoning map amendments, ~~plat vacations,~~ and street ~~naming and~~ renaming, shall be exempt from the standard in Subsection 7.4.130.A, above."

7.5.60.A: Department of Community Development and Director: Powers and Duties of Director: (Correction) Delete subsection 3(b)(6) as follows:

~~(6) Plat Vacations. See Section 7.2.70.L (Plat Vacation)~~. [renumber remaining subsection].

7.5.70: Administrative Bodies and Staff: Development Review Responsibilities: (Correction) Amend Table 7.5.70.A as follows:

Table 7.5.70.A: Summary Table of Development Review Responsibilities

D = Decision R = Recommendation A = Appeal < > = Public Hearing

Procedures	Director	Design Review Board (DB)	Historic Preservation Review Board (HPRB)	Zoning Board of appeals (ZBOA)	Planning Commission	County Council
Application Specific Review Procedures						
Zoning Permit	D	--	--	<A>	--	--
Modulation Permit	D	--	--	<A>	--	--
Sign Permit	D	--	--	<A>	--	--
Tree Removal Permit	D	--	--	<A>	--	--
Land Development Plan (Minor and Major)	D	--	--	--	<A>	--
Subdivision Plat (Minor and Major)	D	--	--	--	<A>	--
Traditional Community Plan (TCP)	D	--	--	--	<A>	--
~~Plat Vacation~~	~~R~~	~~--~~	~~--~~	~~--~~	~~--~~	~~<D>~~
Street Renaming[1]	R	--	--	--	<D>	--
Certificate of Design Compliance	R	D	--	--	--	--
Certificate of Appropriateness	R	--	D	--	--	--
Special Use Permit	R	--	--	<D>	--	--
Variance Permit	R	--	--	<D>	--	--

10.1.160 : P Definitions: Amend definition for Passive Recreation as follows (direction from Natural Resources Committee)

"**Passive Recreation.** Recreation requiring little or no physical exertion focusing on the enjoyment of one's natural surroundings. In determining appropriate recreational uses of passive parks, the promotion and development of resource-based activities such as fishing, camping, hunting, boating, gardening, bicycling, nature studies, horse-back riding, visiting historic sites, hiking, etc., shall be the predominate measure for passive park utilization. ~~However, use-based activities such as target shooting or archery shall not be prohibited on passive park properties when site designs indicate compatibility of the proposed use with natural or cultural resources.~~"