

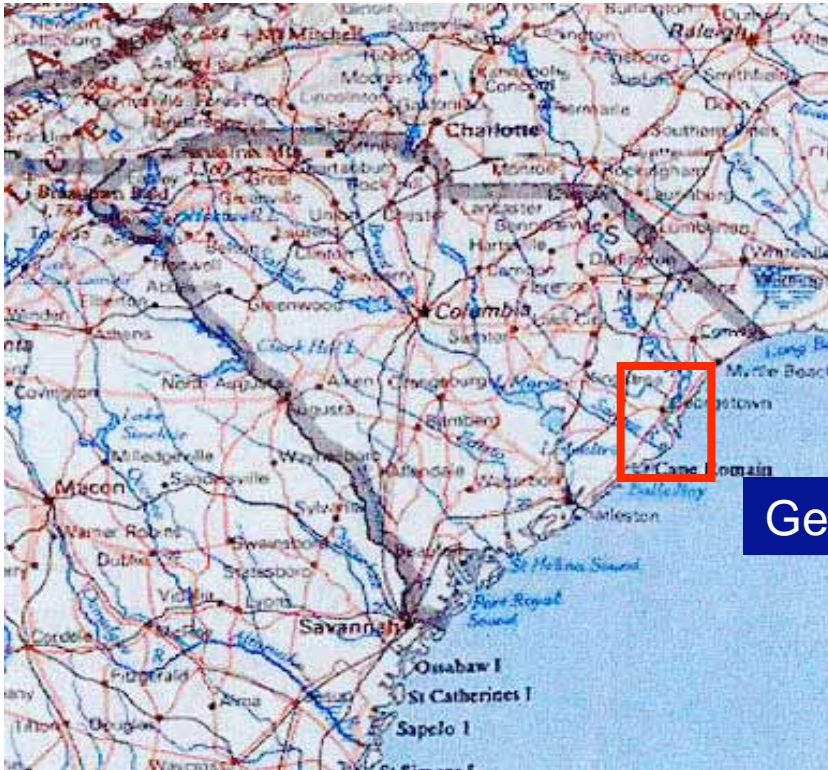
# Bringing Covert Land Use Strategies into the Spotlight: Cracking the Code for Sustainable Coastal Communities



Dan Hitchcock  
Baruch Institute, Clemson University, Georgetown, SC

NEMO U 007  
Portland, Maine – September 30, 2010

# Where are we located?



Georgetown, SC

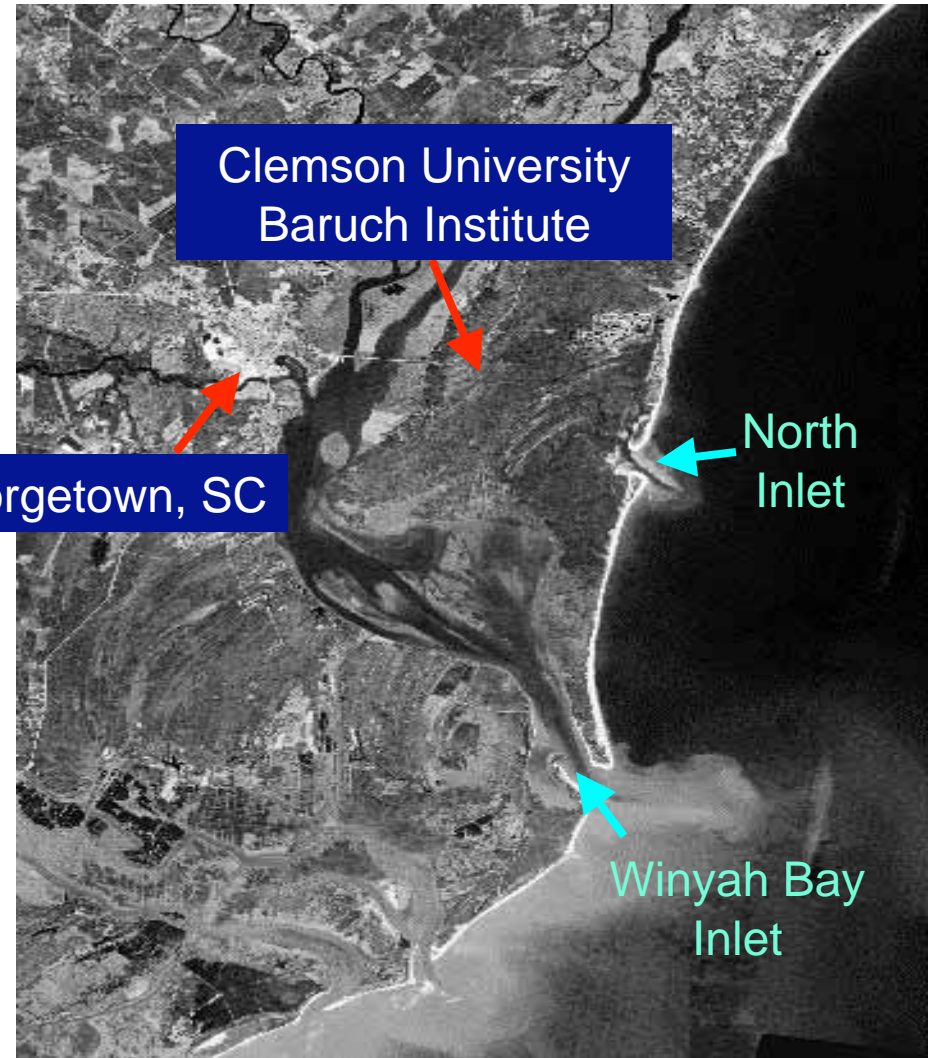
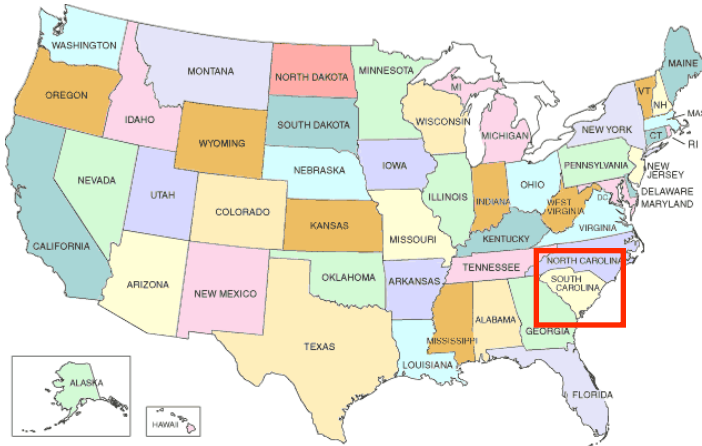


Photo: North Inlet – Winyah Bay NERR





# South Carolina's Coastal Resources





# Coastal Water Quantity and Quality

## QUANTITY:

- Flood control
- Conveyance
- Retention vs. infiltration
- Salt water intrusion
- Sea level rise / climate change

## QUALITY:

- Harmful bacteria and viruses
- Sediment and chemicals
- Nuisance algal blooms
- Low dissolved oxygen (DO)
- Fish kills
- Invasive species
- Downstream ecological health

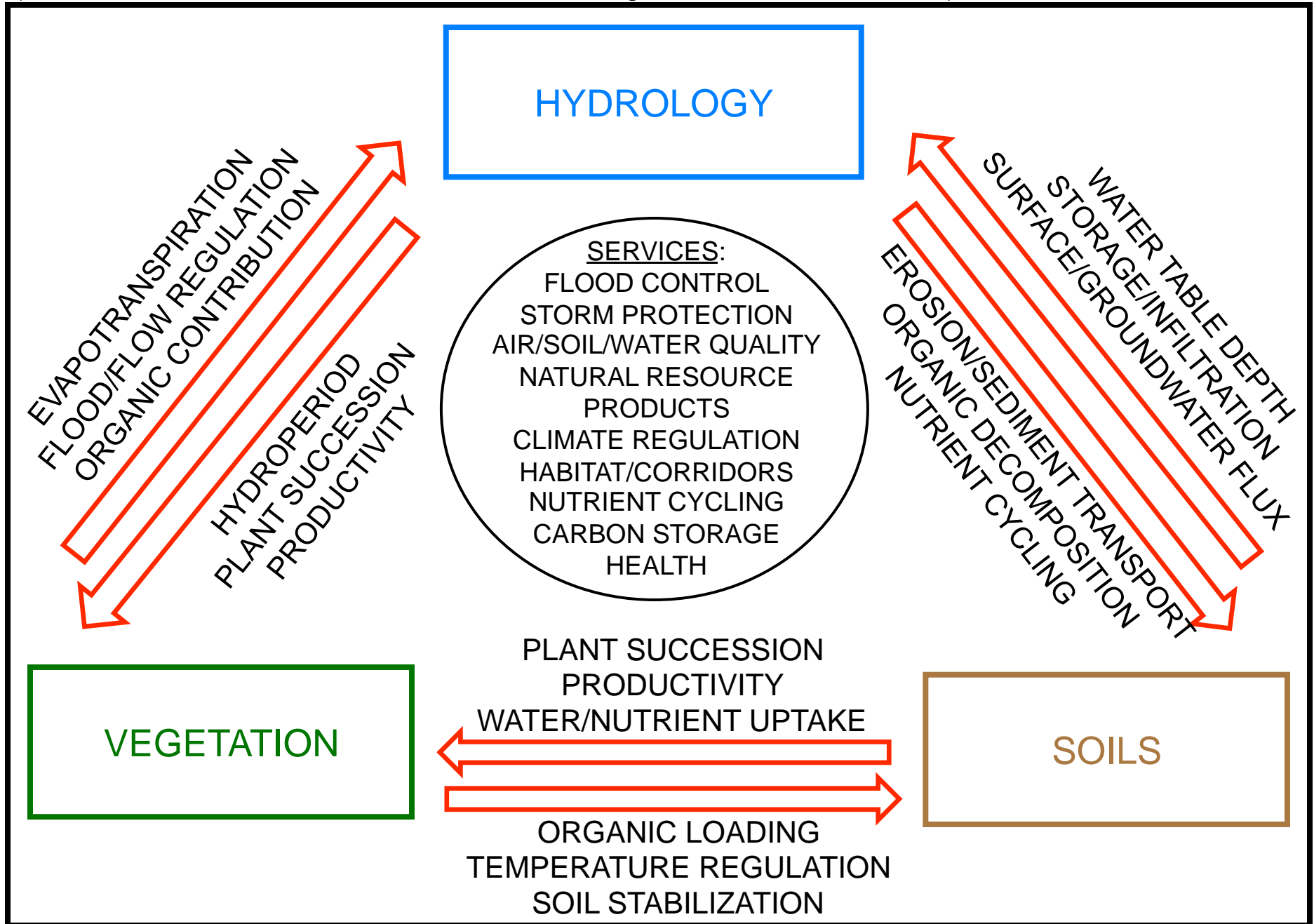




## Goals for Sustainable Land Use Change

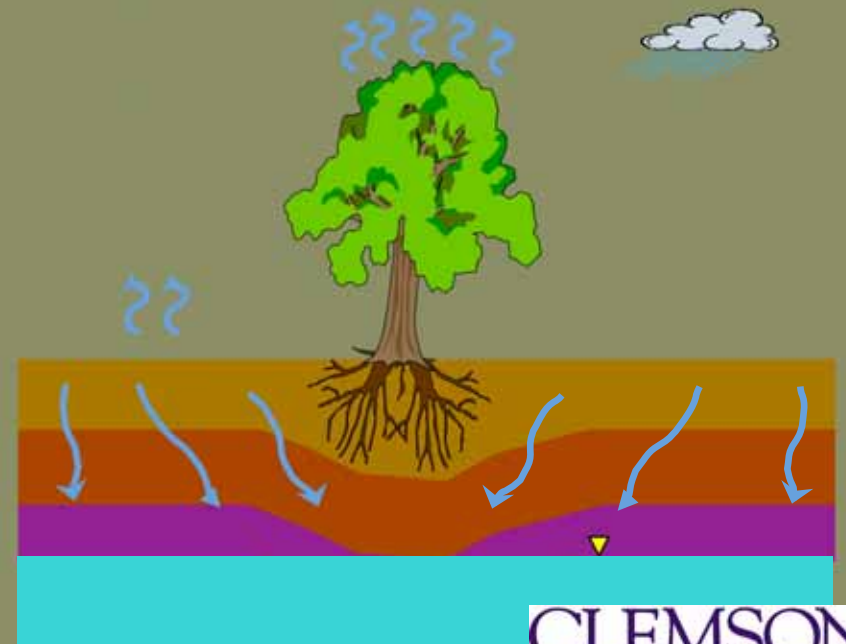
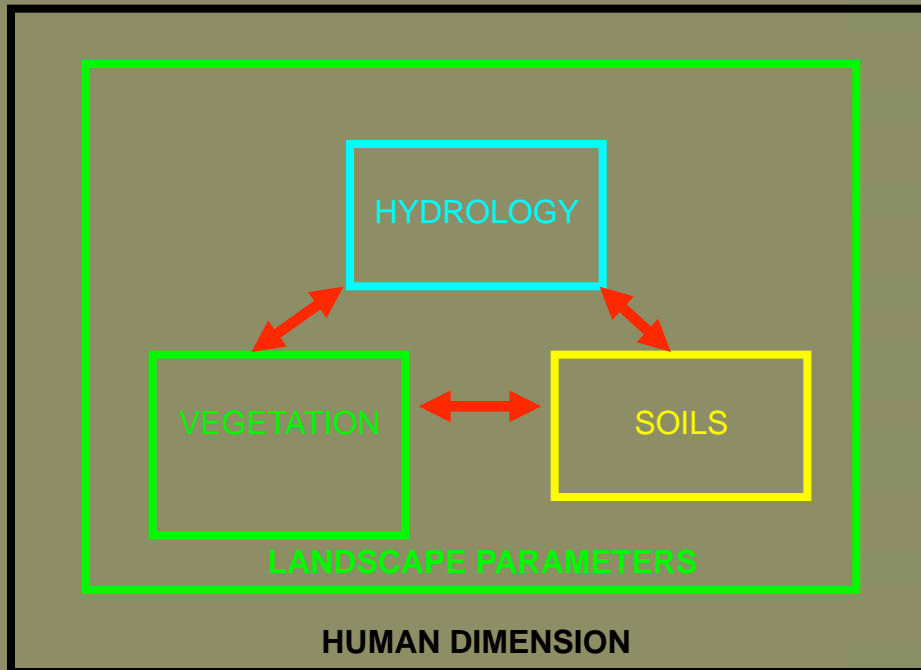
- ✓ Retain the natural landscape and hydrology
- ✓ Promote open space and habitat preservation
- ✓ Encourage riparian and floodplain protection
- ✓ Reduce and disconnect impervious surfaces
- ✓ Emphasize on-site stormwater management and water re-use

Landscape parameters, their interactive complex processes, and ecosystem services.  
(Modified from Ge Sun, Southern Global Climate Program, USDA Forest Service)



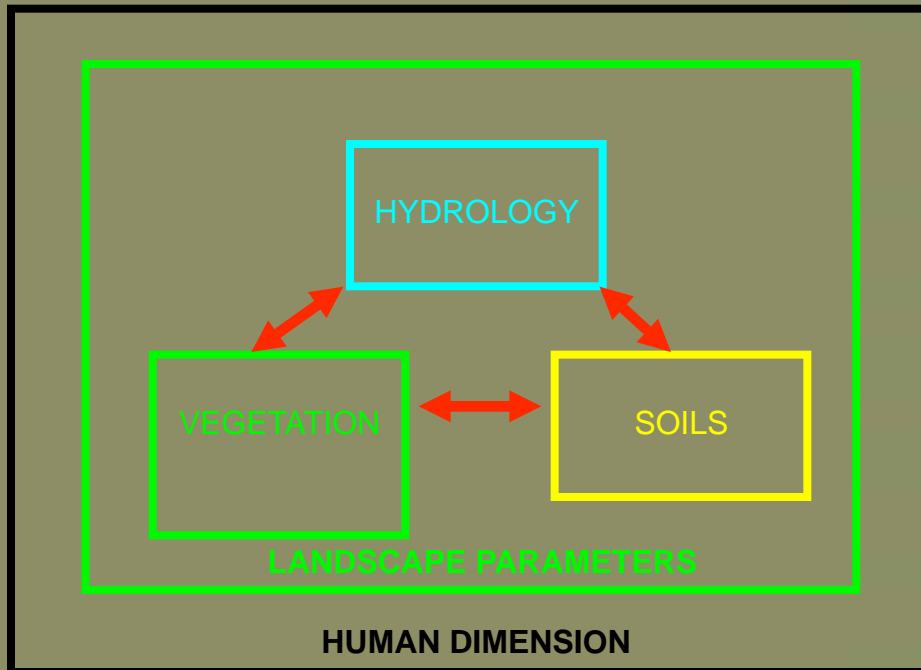
# Systems Levels for Hydrological and Ecological Assessment

- Watershed-scale
- Development land tract
- Individual management practice (BMP)



# Systems Levels for Hydrological and Ecological Assessment

- Watershed-scale
- **Development land tract**
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# Coastal Development and Land Use

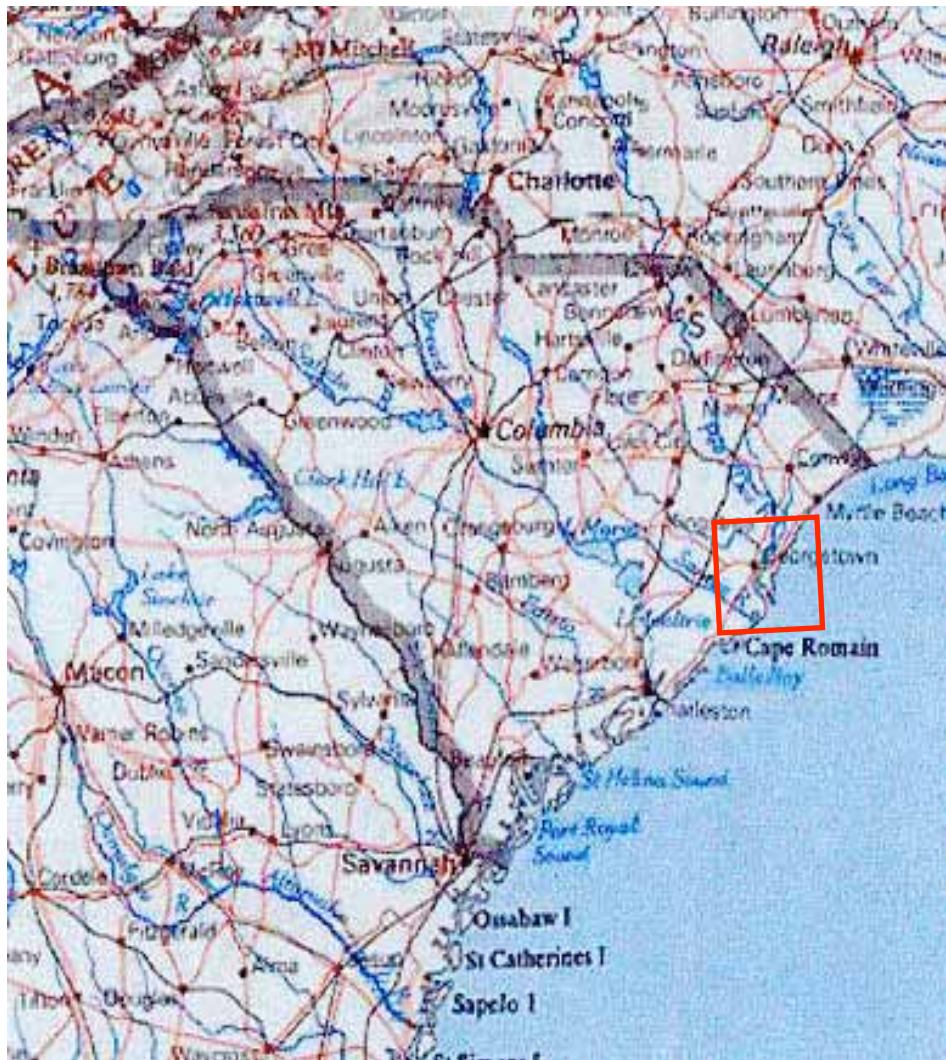


Photo: North Inlet – Winyah Bay NERR

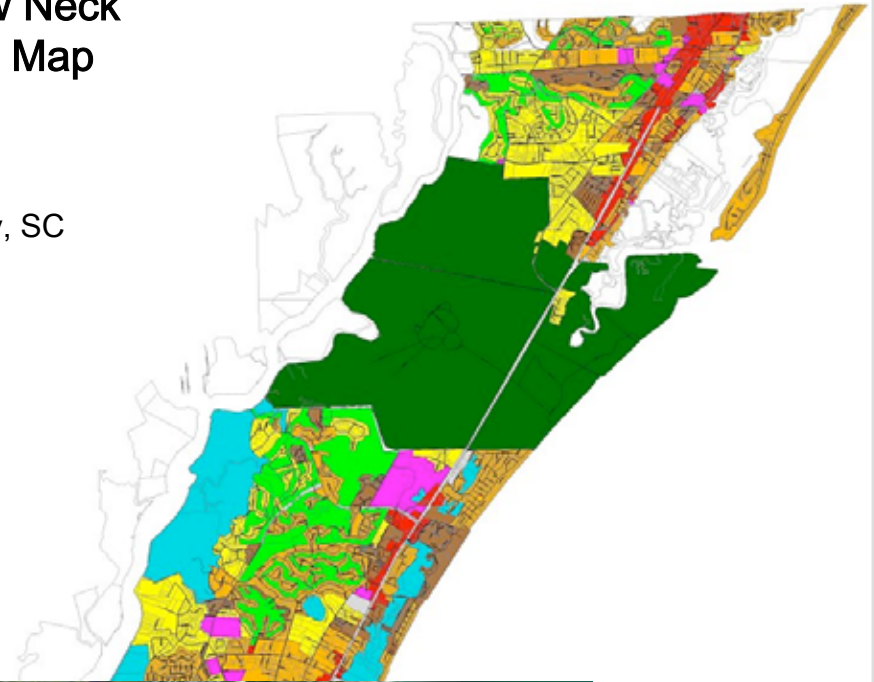
# Zoning for Future Land Uses?

- Commercial
- Conservation
- Public/Semi-public
- Private Recreational
- Public Recreational
- High Density Residential
- Low Density Residential
- Medium Density Residential

## Waccamaw Neck Land Use Map



Map courtesy of  
Georgetown County, SC



# Bannockburn Plantation



# Original Development Plan

## Arcadia East Plantation Conceptual Master Plan

Prepared for: Mandalay Ltd. Partnership

Prepared by: **Madison**



### Legend

- Wetlands
- Transitional Wetlands
- Single Family Lots
- Residential Lots
- Facilities
- Wildlife Corridor
- Canal/Artificial Center
- Assisted Living Center
- Retirement Village
- Multi-Family Apartments
- Wildlife Corridor
- Single Family Community



Proposed plan has been modified and development has been delayed...

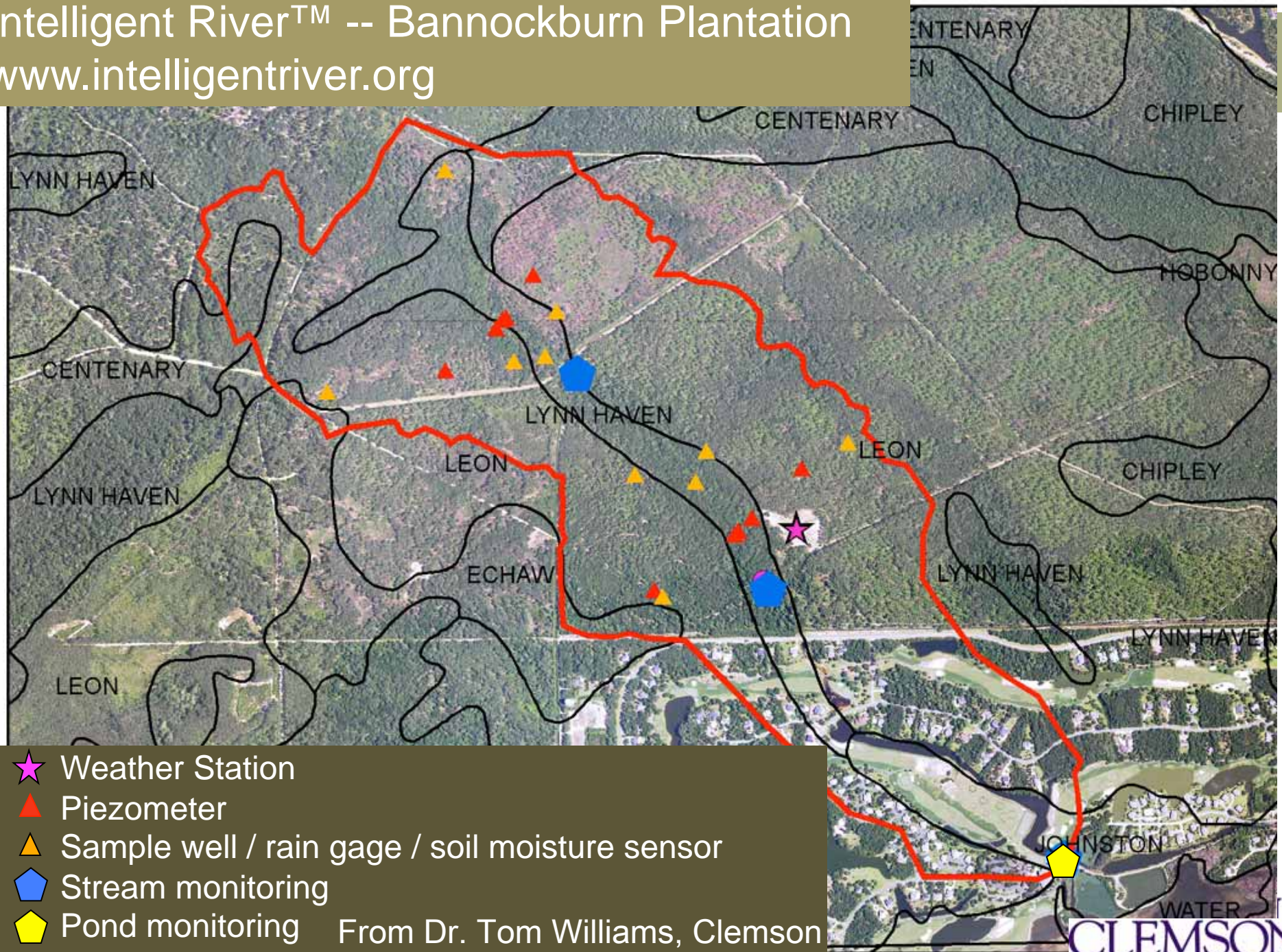


# What drives the water table??



# Intelligent River™ -- Bannockburn Plantation

[www.intelligentriver.org](http://www.intelligentriver.org)





# Monitoring Water Quantity and Quality



Weather Station Array, including Rainfall and Solar Radiation



Culvert Surface Water Levels and Flows



Stream Water Quality



Water Table Levels, Subcanopy Rain, and Piezometric Head



Surface Water Sampling



# Forest Ecology – Tree Growth and Sap Flow

Litterfall Measurements



Tree Growth - Dendrometers



Sap Flow Measurements



# Intelligent River™

## Concepts:

Sensors  
Networks  
Metadata  
Security  
Analysis  
Visualization  
Education  
Collaboration  
Data Sharing

## Infrastructure:

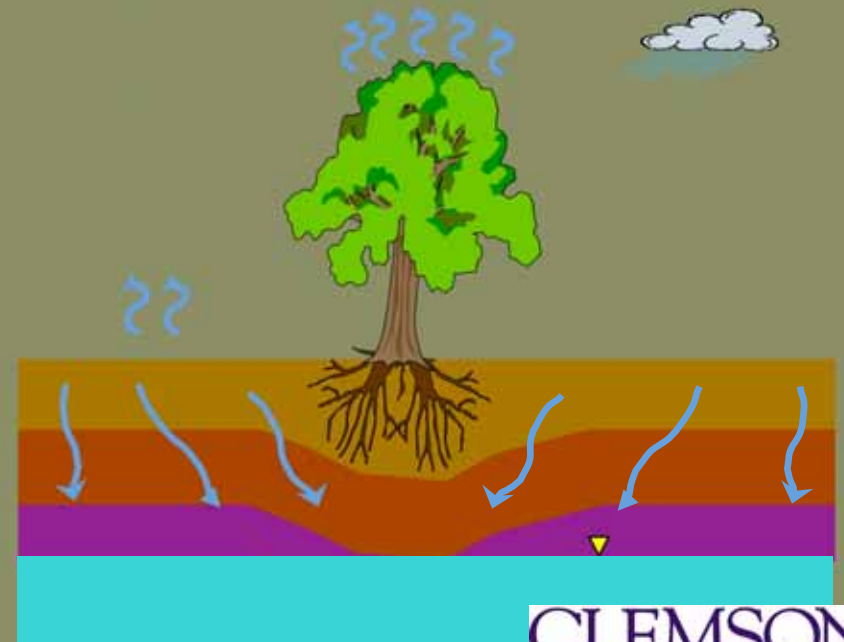
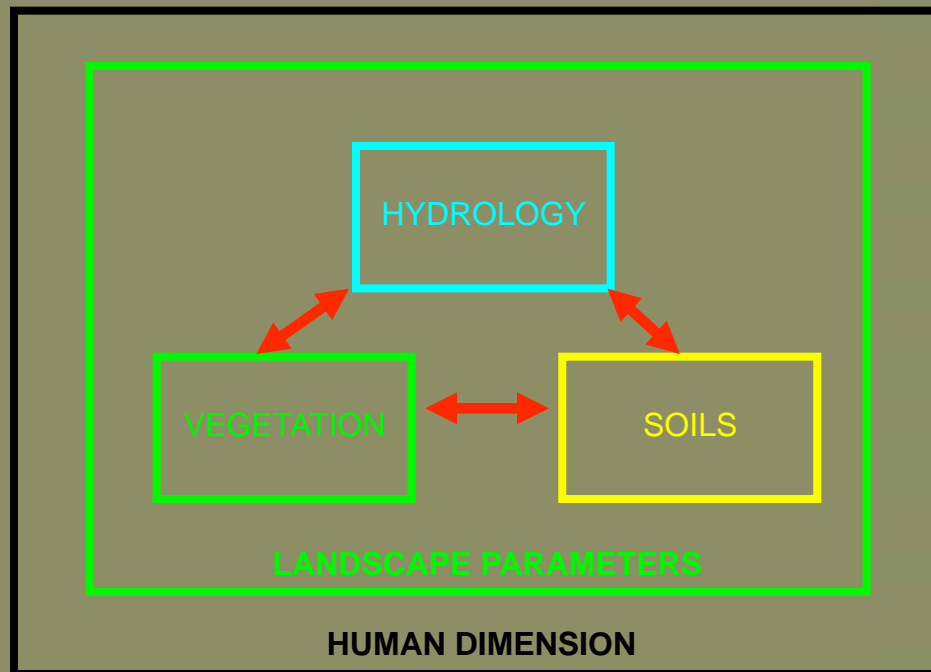
- Hardware
- Software
- Data Systems
- Website

## Deployments:

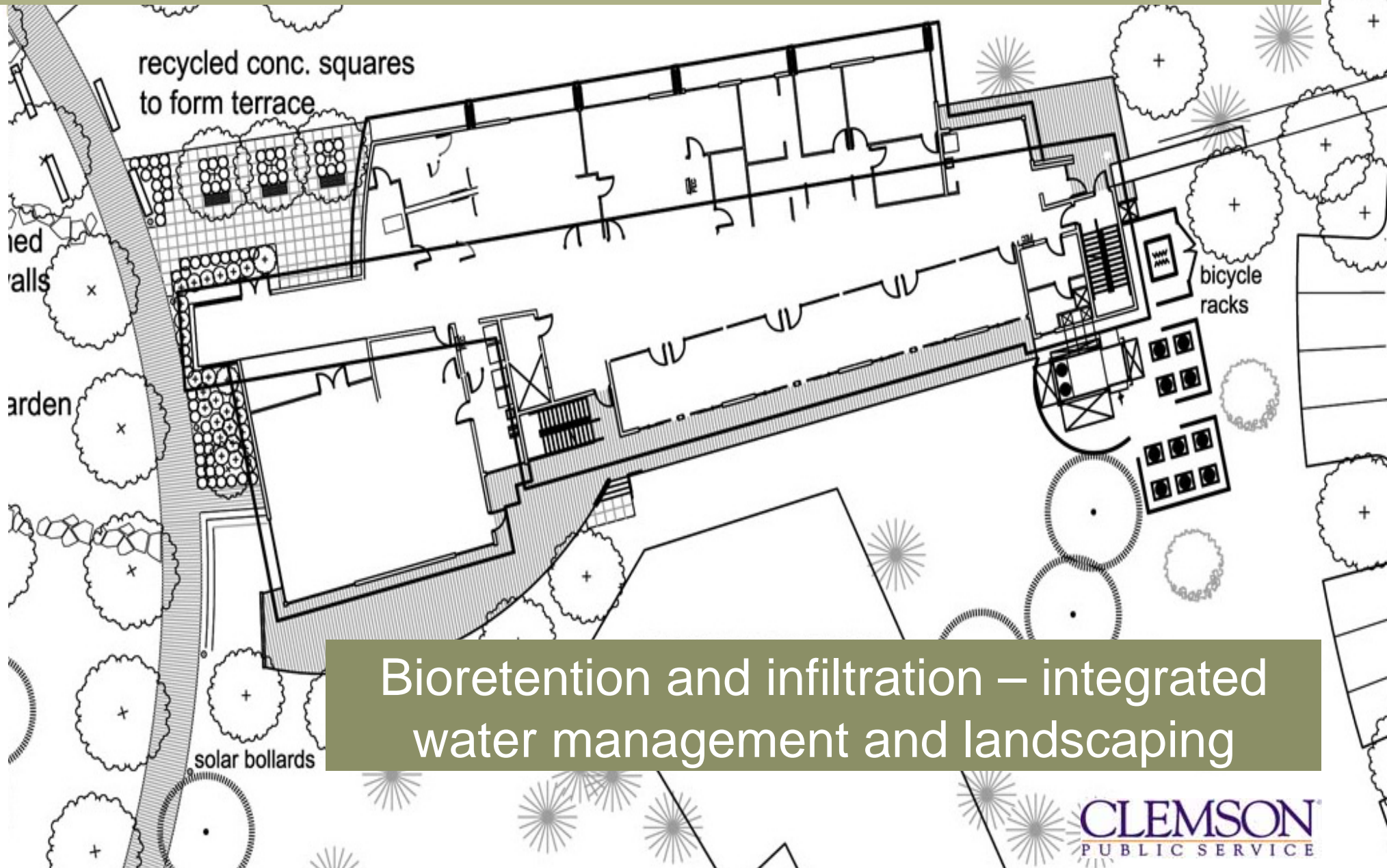
- **Bannockburn Plantation (coastal)**
- Savannah River
- Clemson Experimental Forest
- **Aiken Green Infrastructure Project**

# Systems Levels for Hydrological and Ecological Assessment

- Watershed-scale
- Development land tract
- **Individual management practice (BMP)**



# Stormwater Management at Clemson's Baruch Institute



Bioretention and infiltration – integrated water management and landscaping



## Coastal Rain Garden Demonstration Site

- Bioretention as an infiltration practice – integrated landscape
- Install equipment for real-time and continuous monitoring
- Water quantity and quality
- Demonstration for research and extension



BEFORE...

...AFTER



Jan. 16, 2008



Sept. 25, 2009

**CLEMSON**  
PUBLIC SERVICE



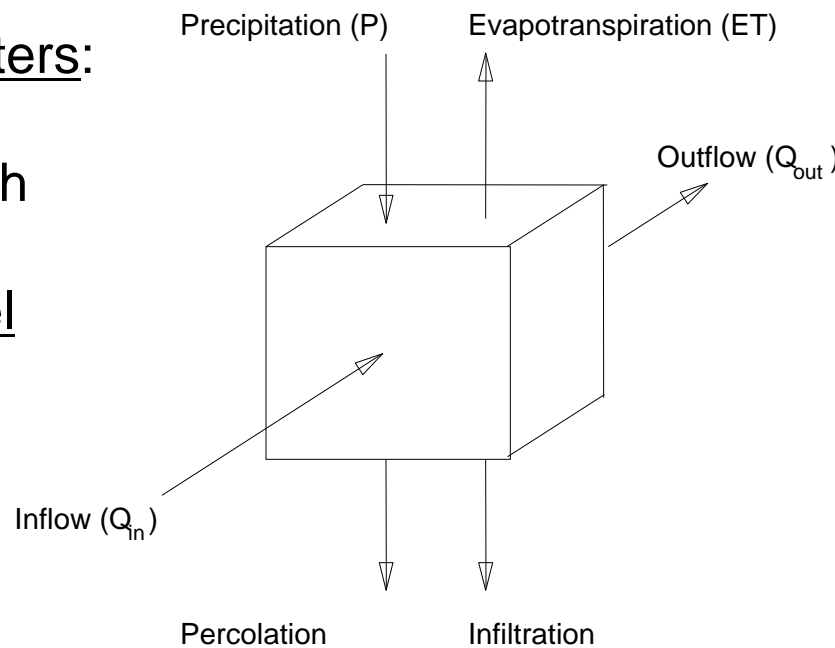
# Monitoring

- Weather parameters:
  - Rainfall
  - Barometric pressure
  - Temperature
  - Relative Humidity
  - Solar radiation
  - Potential evapotranspiration (PET)

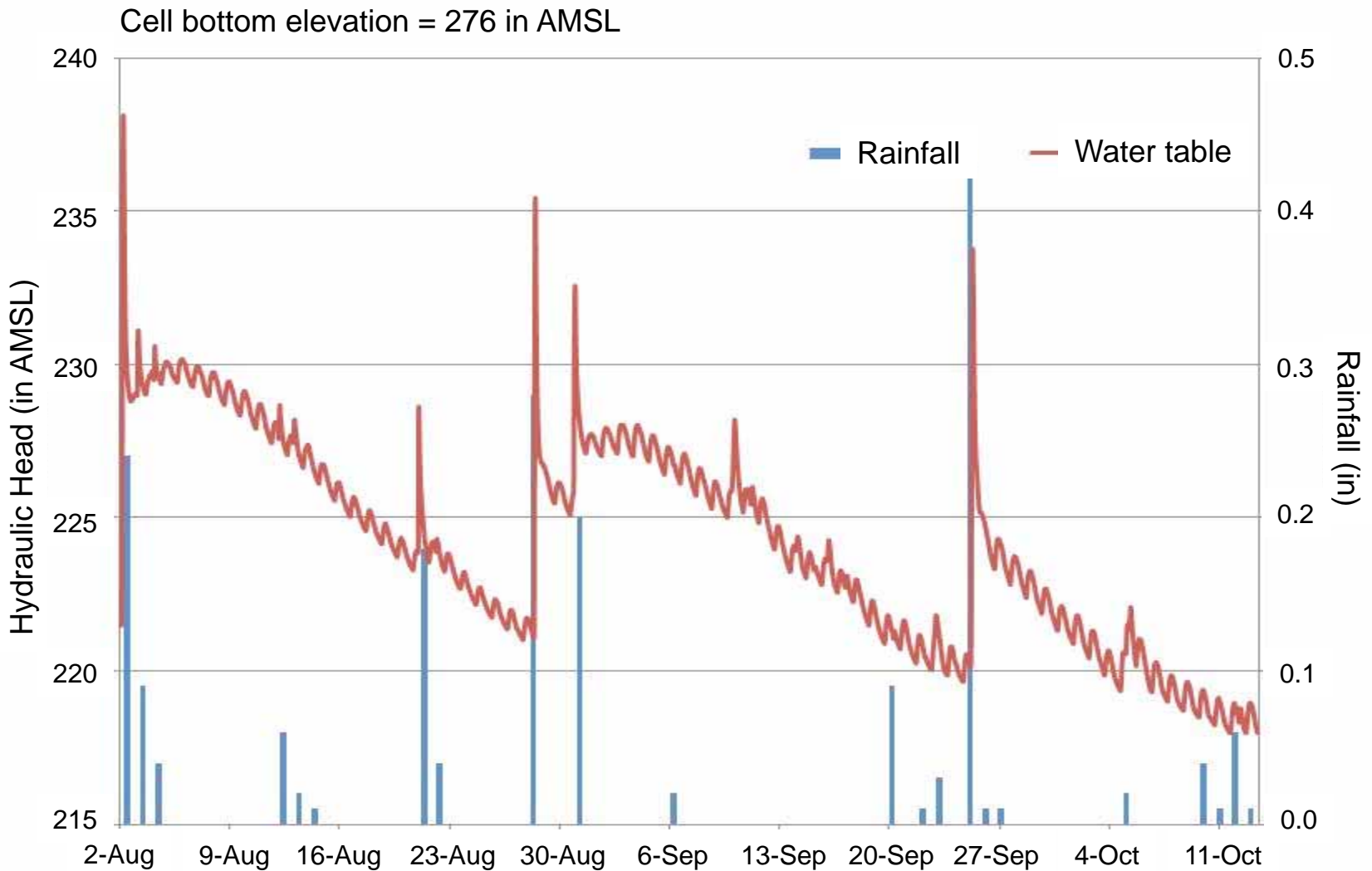
- Soil water parameters:
  - Soil moisture
  - Water table depth

- Surface water level

- Inflows/outflows

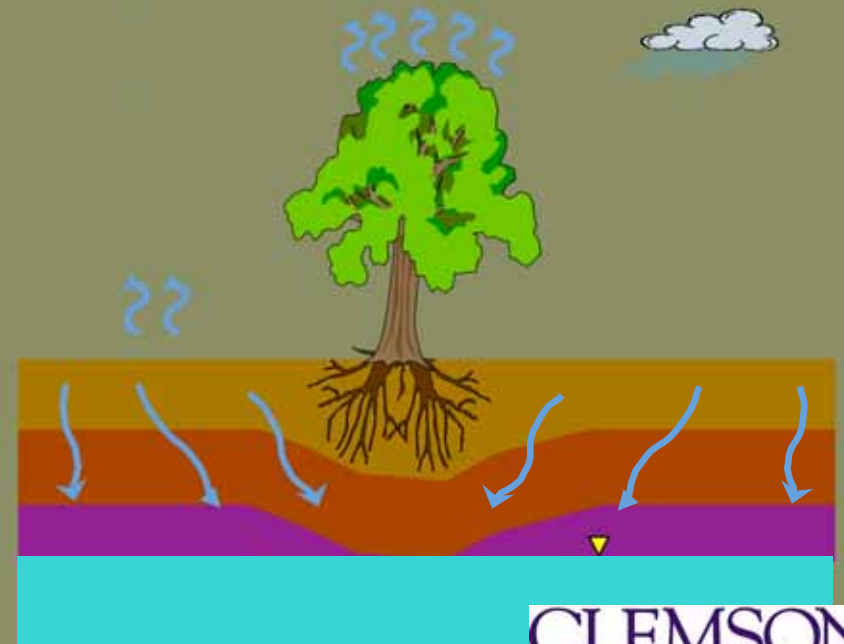
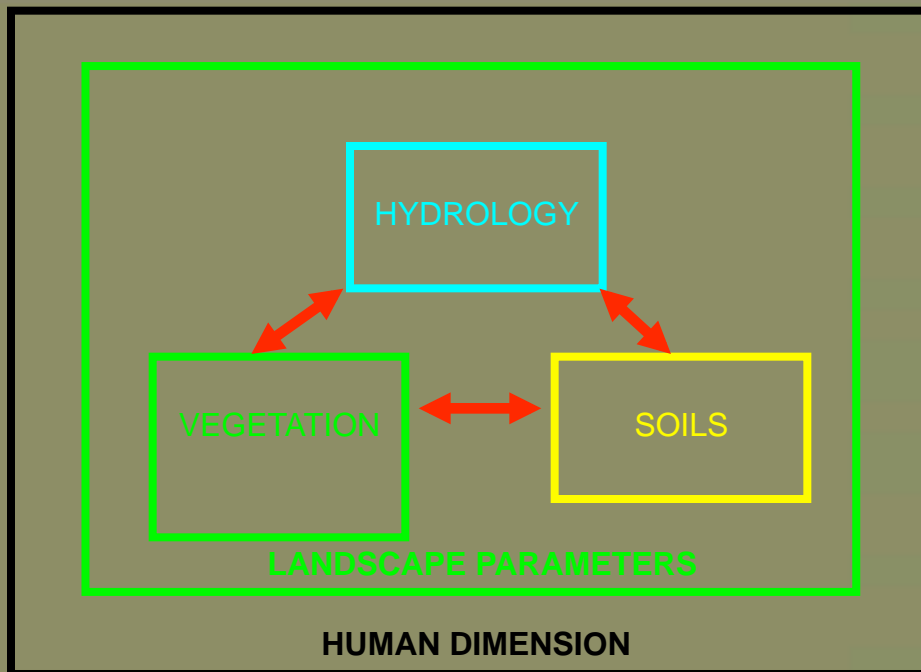


# Rain Gardens – Rainfall and Water Table



# Systems Levels for Hydrological and Ecological Assessment

- **Watershed-scale and geopolitical boundaries**
- Development land tract
- Individual management practice (BMP)

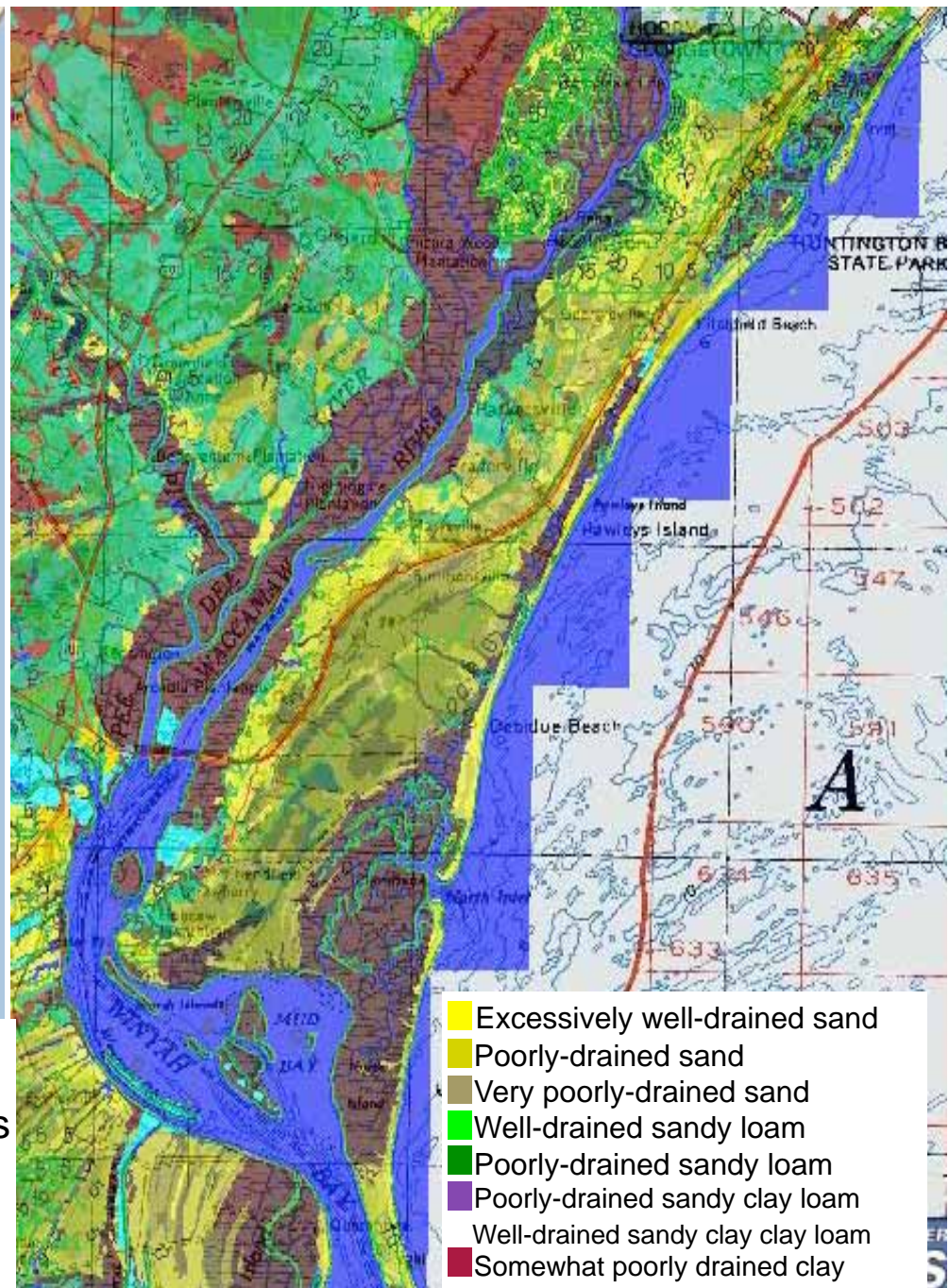
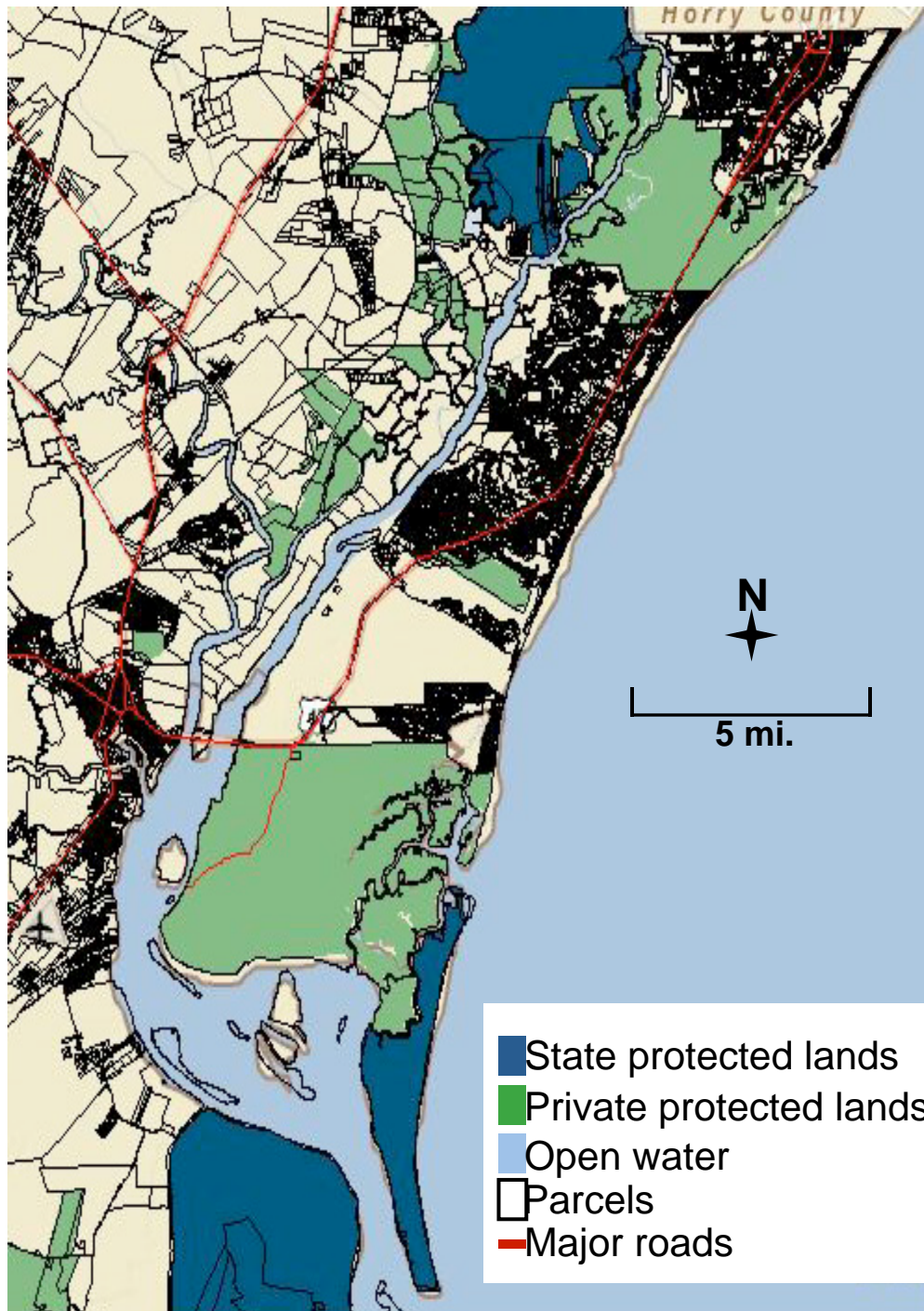






# Online Community Resource Inventory (CRI)

The image displays two overlapping screenshots of the Online Community Resource Inventory (CRI) web application. The top screenshot shows a wide view of the Charleston, South Carolina region, including Clarendon, Williamsburg, and Berkeley counties. The map features a network of red and blue lines representing community resources. A toolbar at the top left includes the CRI Data Viewer logo, supported by IntelligentRiver.org, and various navigation icons. A 'Layer Visibility' panel on the right lists several data layers: CRI, CRI.maj\_rivers\_clip, CRI.other\_highways\_clip, CRI.streams, CRI.streets, and CRI.solis. Below this panel are buttons for 'Real-Time Data' and 'Search'. The bottom screenshot provides a zoomed-in view of a specific area, showing a detailed network of blue lines (streams) and red lines (highways) overlaid on a satellite-style map. The 'CLEMSON PUBLIC SERVICE' logo is visible in the bottom right corner of the interface.





## So what's next?

- Integration of land use data with monitoring data = CRI + Intelligent River
- Continued monitoring and additional sites = Bannockburn Plantation (to be developed) and Aiken Green Infrastructure (urban retrofit)
- Delivery of outreach and education to decision-makers





## Sponsors

- Coastal watershed hydrology - South Carolina Sea Grant Consortium pursuant to National Oceanic and Atmospheric Administration Award No. NA06OAR4170015
- Baruch rain garden monitoring and education – USDA Renewable Resources Extension Act (RREA)
- Online Community Resource Inventory – CICEET funds to U.Conn. and NEMO, administered by SC Sea Grant
- This work is also related to the Intelligent River™ project sponsored by Clemson Public Service Activities (PSA) and the EPA Center for Watershed Excellence  
Web site: [www.intelligentriver.org](http://www.intelligentriver.org)

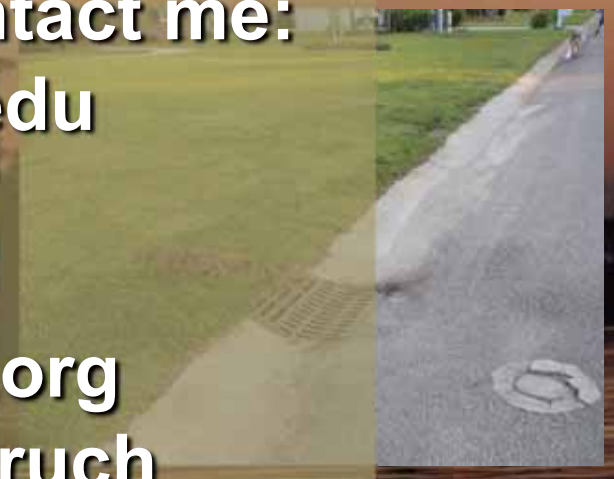


## Acknowledgements

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- *April Turner*, S.C. Sea Grant Consortium
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- *Gene Eidson* - Intelligent River project P.I., Clemson University
- *Cal Sawyer and Dawn White* – Clemson’s EPA Center for Watershed Excellence
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- *Sam Esswein*, Graduate Student, Clemson Forestry/Natural Resources
- *Lucille Vanderbilt Pate* – Bannockburn Plantation property owner



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**Also visit:  
[www.intelligentriver.org](http://www.intelligentriver.org)  
[www.clemson.edu/baruch](http://www.clemson.edu/baruch)**

