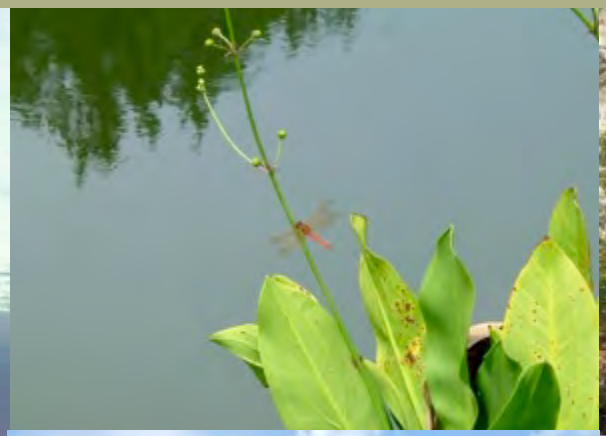
Defining Ecohydrological Function to Support Low Impact Development in Coastal South Carolina




D. R. Hitchcock, A. D. Jayakaran, T. H. Epps, and J. Palazzolo
Baruch Institute of Coastal Ecology and Forest Science, Clemson University
Tidal Creeks Summit 2013
Wilmington, NC

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Clemson Baruch Institute of Coastal Ecology and Forest Science

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Team Players

- *Dr. Tom Williams, Dr. William Conner, and Jeff Vernon* – Clemson - Baruch
- *Dr. Devendra Amatya – USFS Center for Forested Wetlands Research*
- *Dr. Tim Callahan, Dr. Vijay Vulava and Michael Griffin* - College of Charleston
- *April Turner and Samm Bruce* – S.C. Sea Grant Extension Program
- *Dr. Susan Libes and Alli Long* – Coastal Carolina University
- *Dave Fuss, Thom Roth, and Tom Garigen* – Horry County Stormwater
- *Dr. Ken Krauss* - USGS National Wetlands Research Center
- *Katie Giacalone, Kim Counts, and Guinn Garrett* – Clemson's Carolina Clear
- *Dawn White* – Clemson's EPA Center for Watershed Excellence
- *Joshua Robinson* – Robinson Engineering Inc., Charleston

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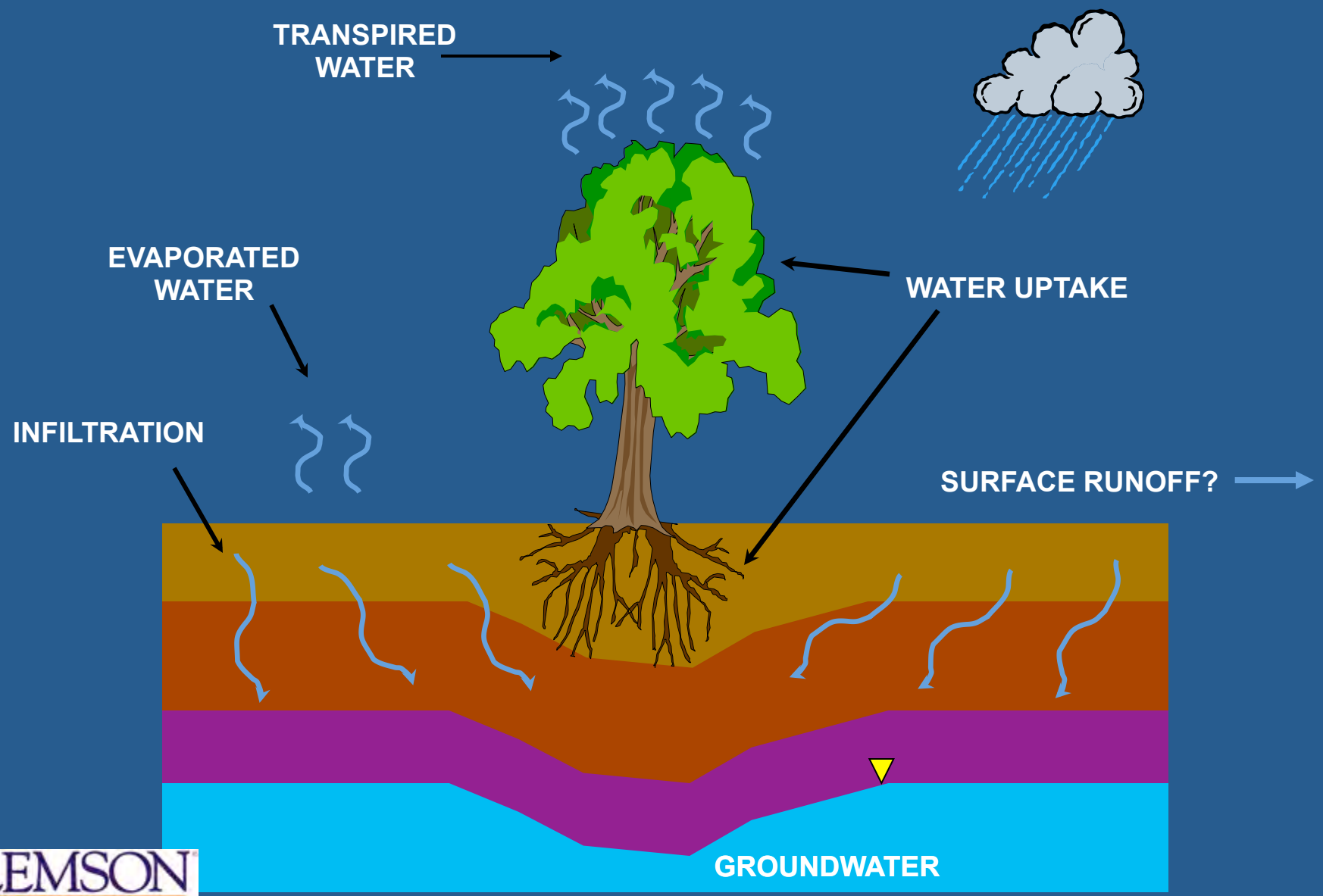
Forest Water Budget – Typical Scenario



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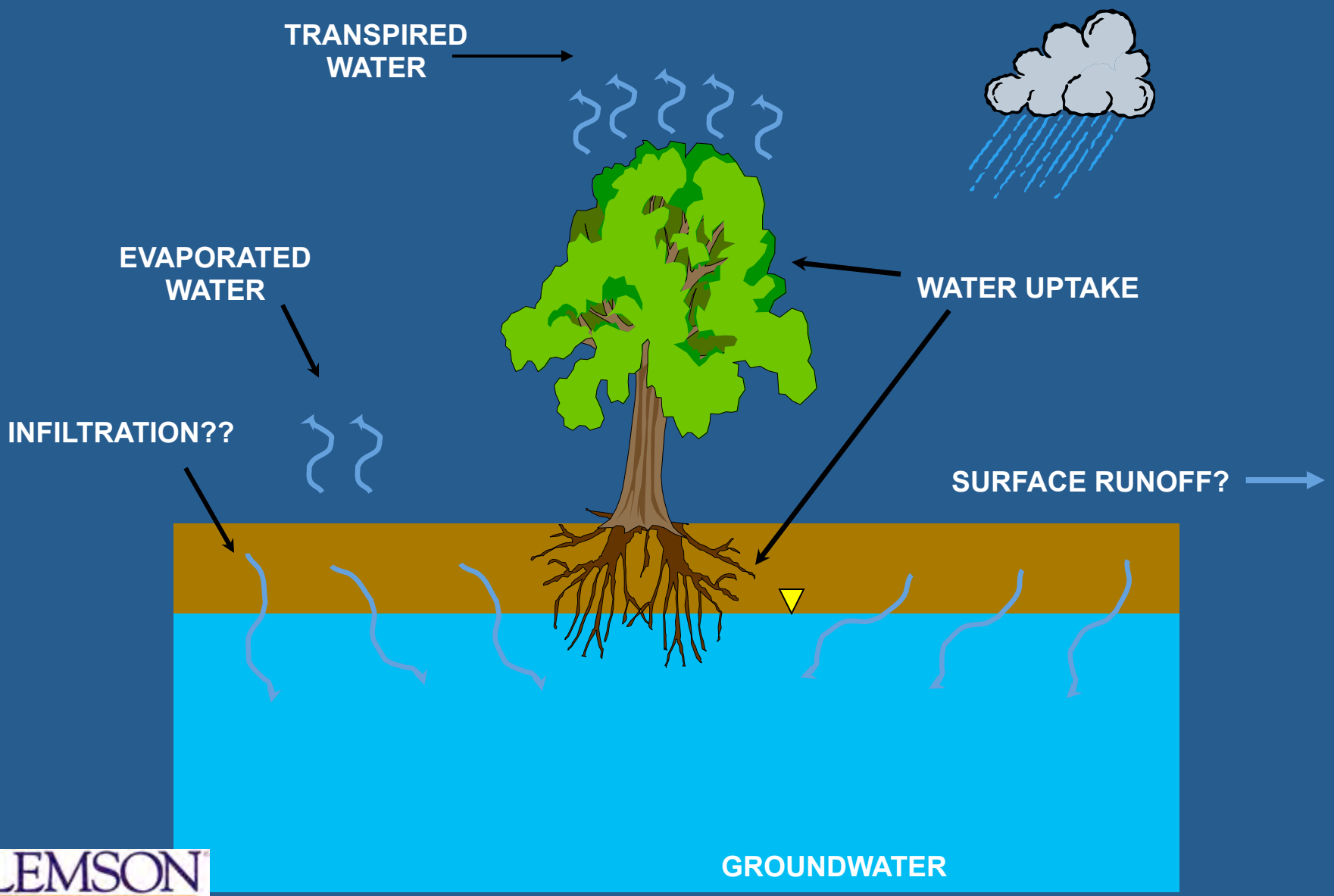
Forest Water Budget – Coastal Scenario



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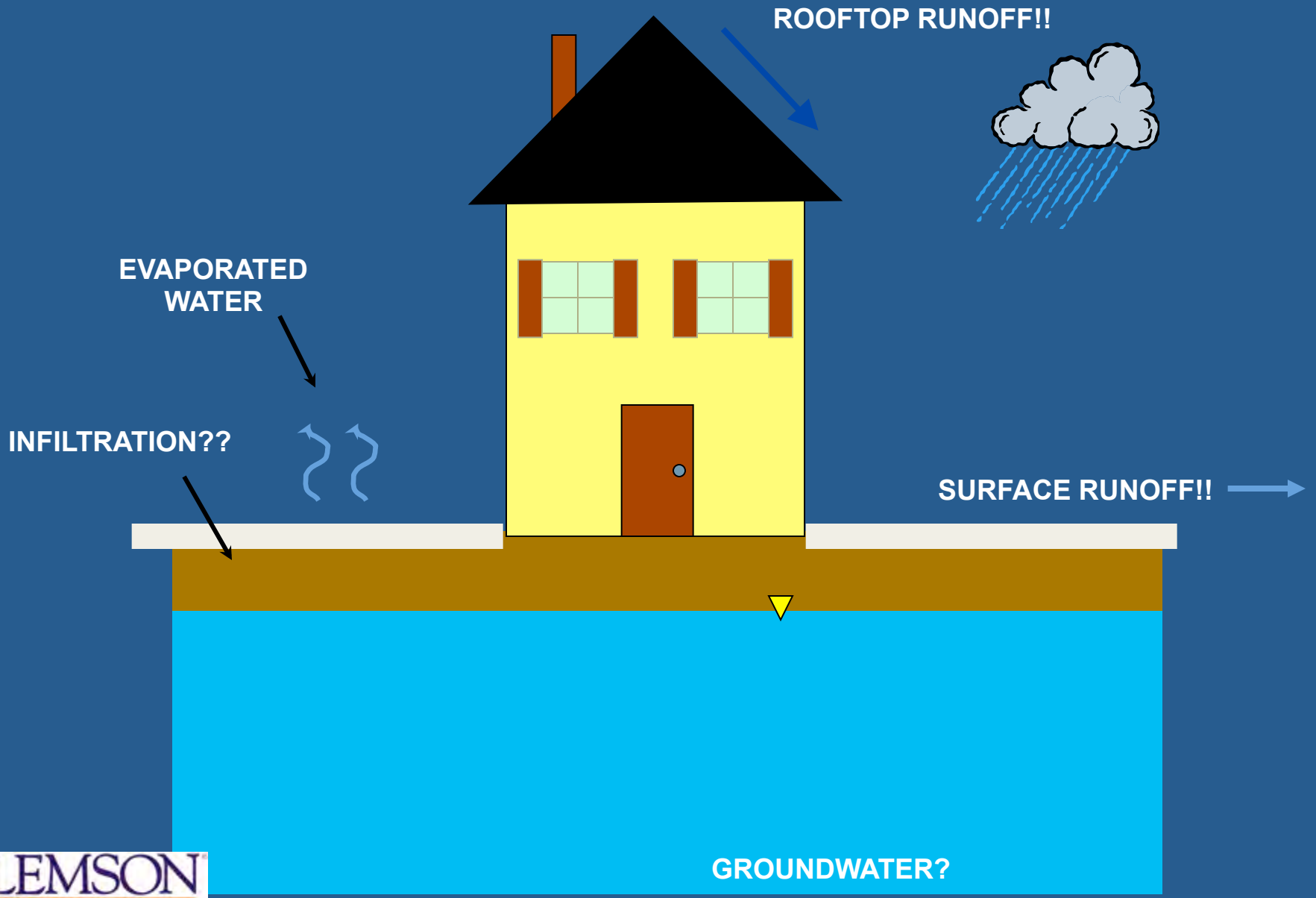
Urban Water Budget – Pavement / Rooftop Scenario



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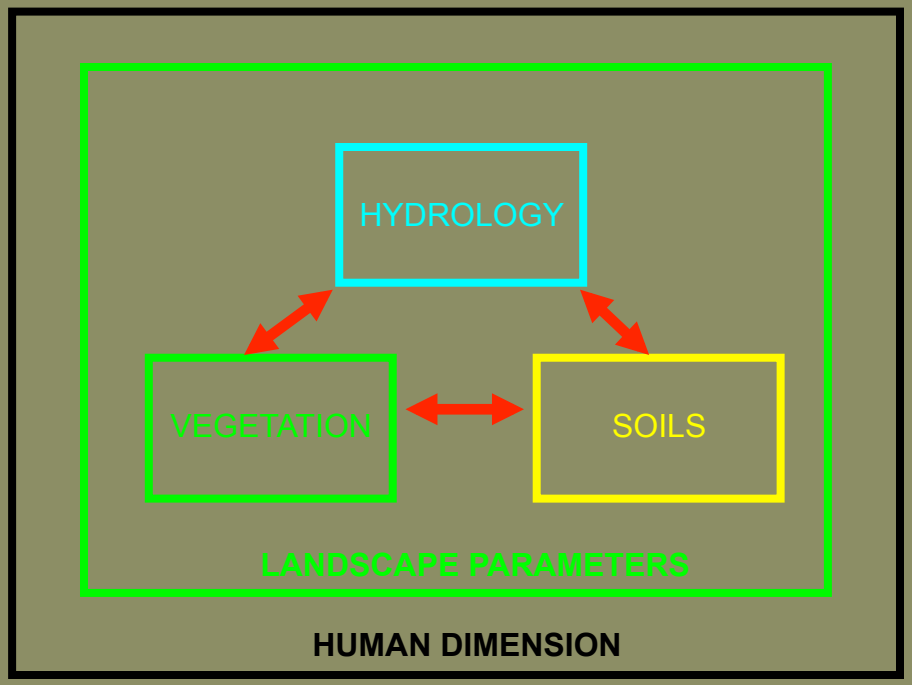
Green Infrastructure at Varying Landscape Scales

- Coastal first-order watersheds - runoff predictions
- LID selection: bioretention vs. engineered wetlands
- Online Community Resource Inventory (CRI-SC)



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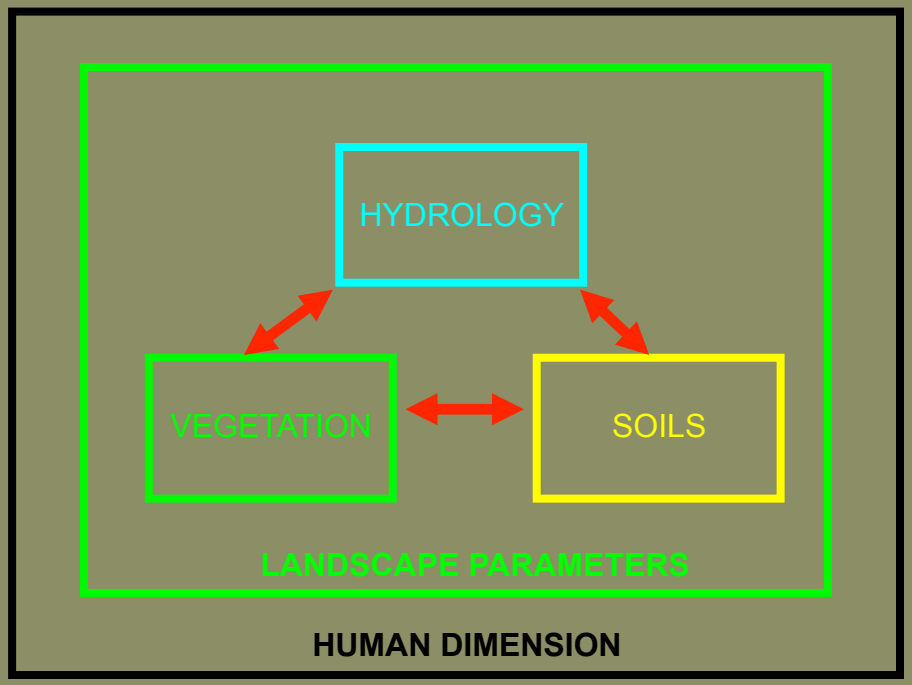

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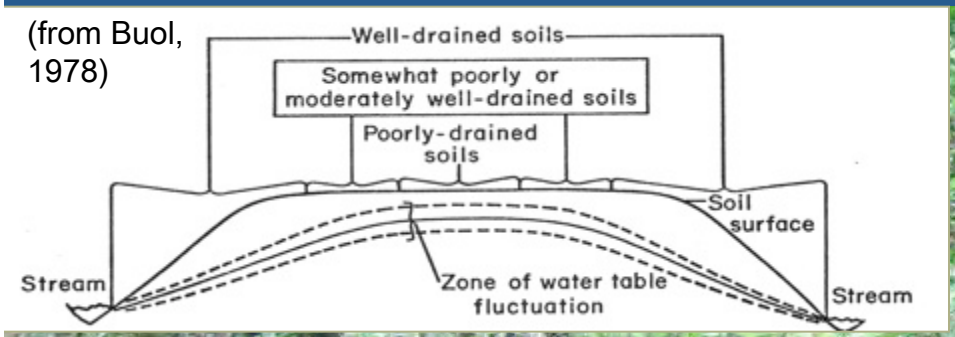
Surface and Groundwater Interaction

(from Buol, 1978)



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

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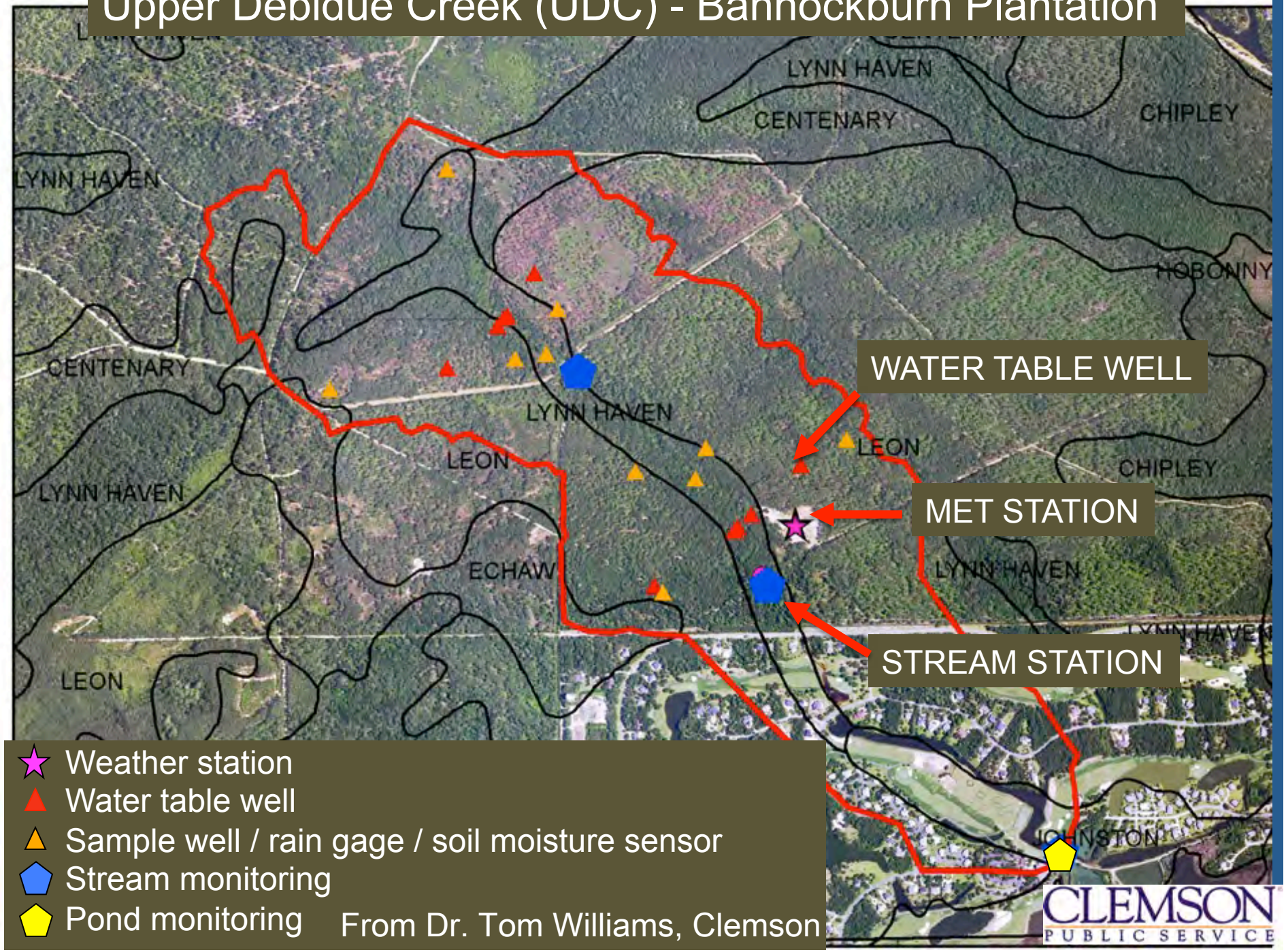
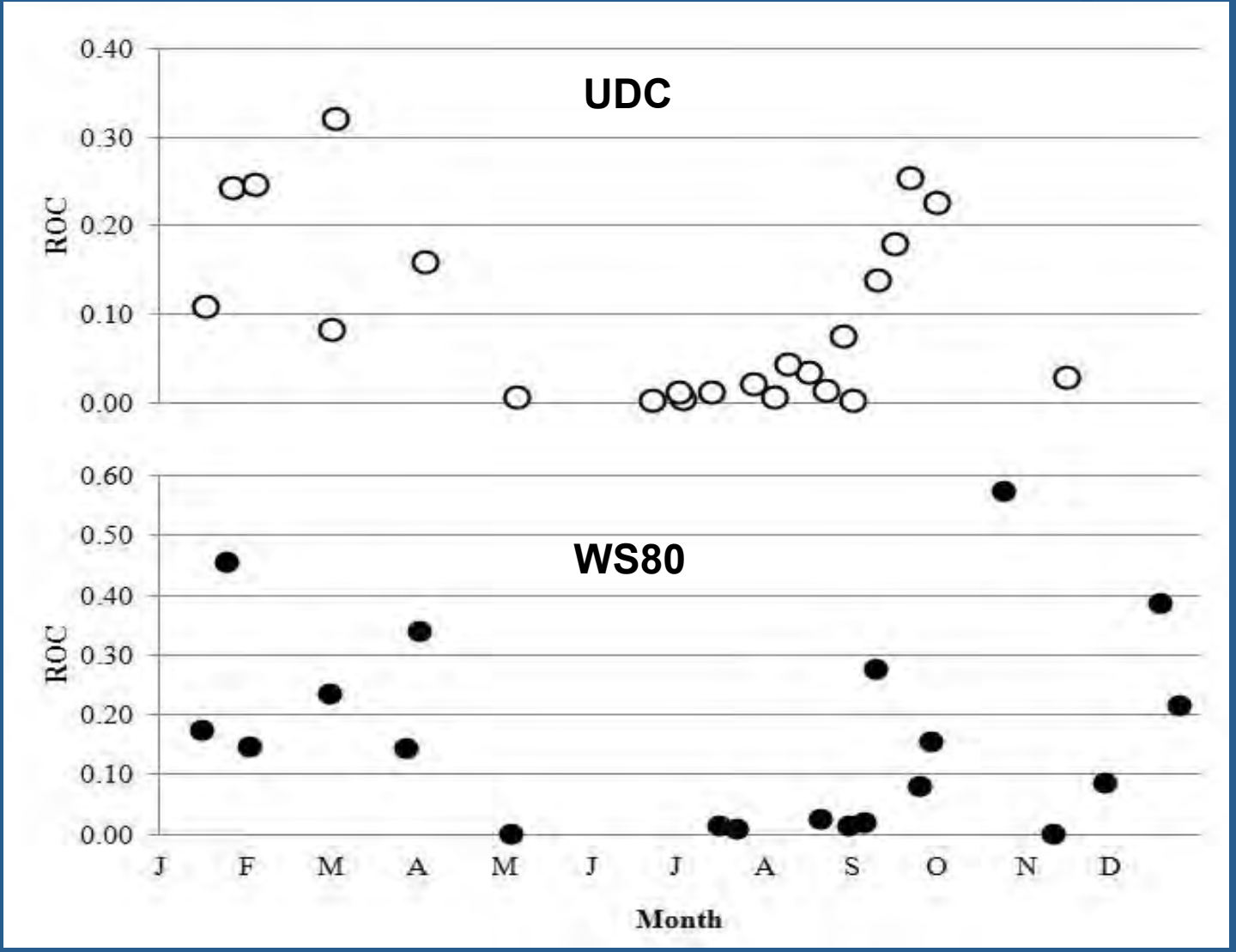
Bannockburn Plantation

Upper Debidue Creek (UDC) - Bannockburn Plantation



Seasonal Runoff Variability



Epps, T. H., D. R. Hitchcock, A. D. Jayakaran, D. R. Loflin, T. M. Williams, and D. M. Amatya, 2013. Characterization of Storm Flow Dynamics of Headwater Streams in Lower Coastal Plain South Carolina. *Journal of American Water Resources Association* 49:76-89.

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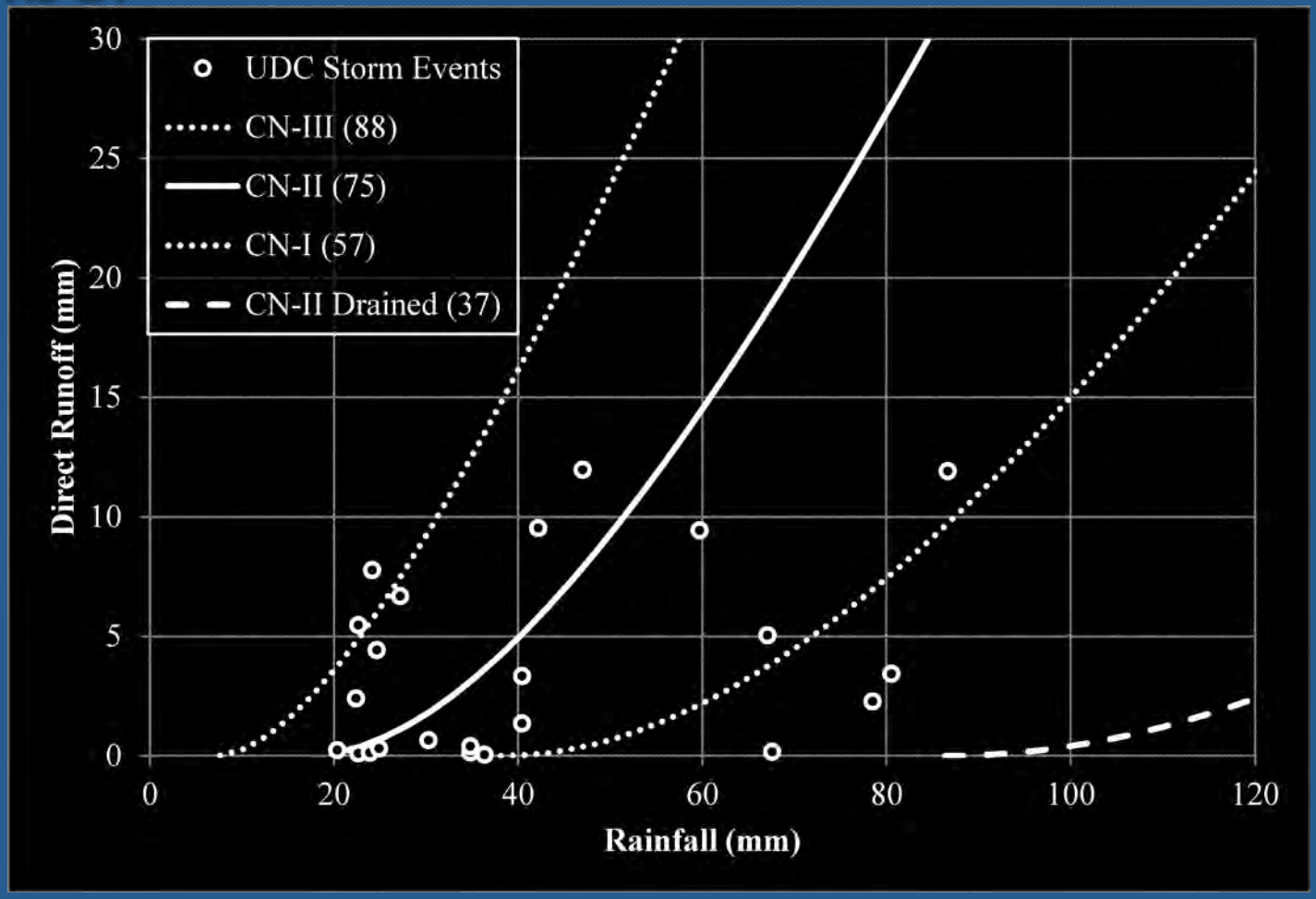
Rainfall : Runoff Relationships by Curve Number



Epps, T. H., D. R. Hitchcock, A. D. Jayakaran, D. R. Loflin, T. M. Williams, and D. M. Amatya, in press. Curve Number Derivation for Watersheds Draining Two Headwater Streams in Lower Coastal Plain South Carolina, USA. *Journal of American Water Resources Association* 49:1284-1295.

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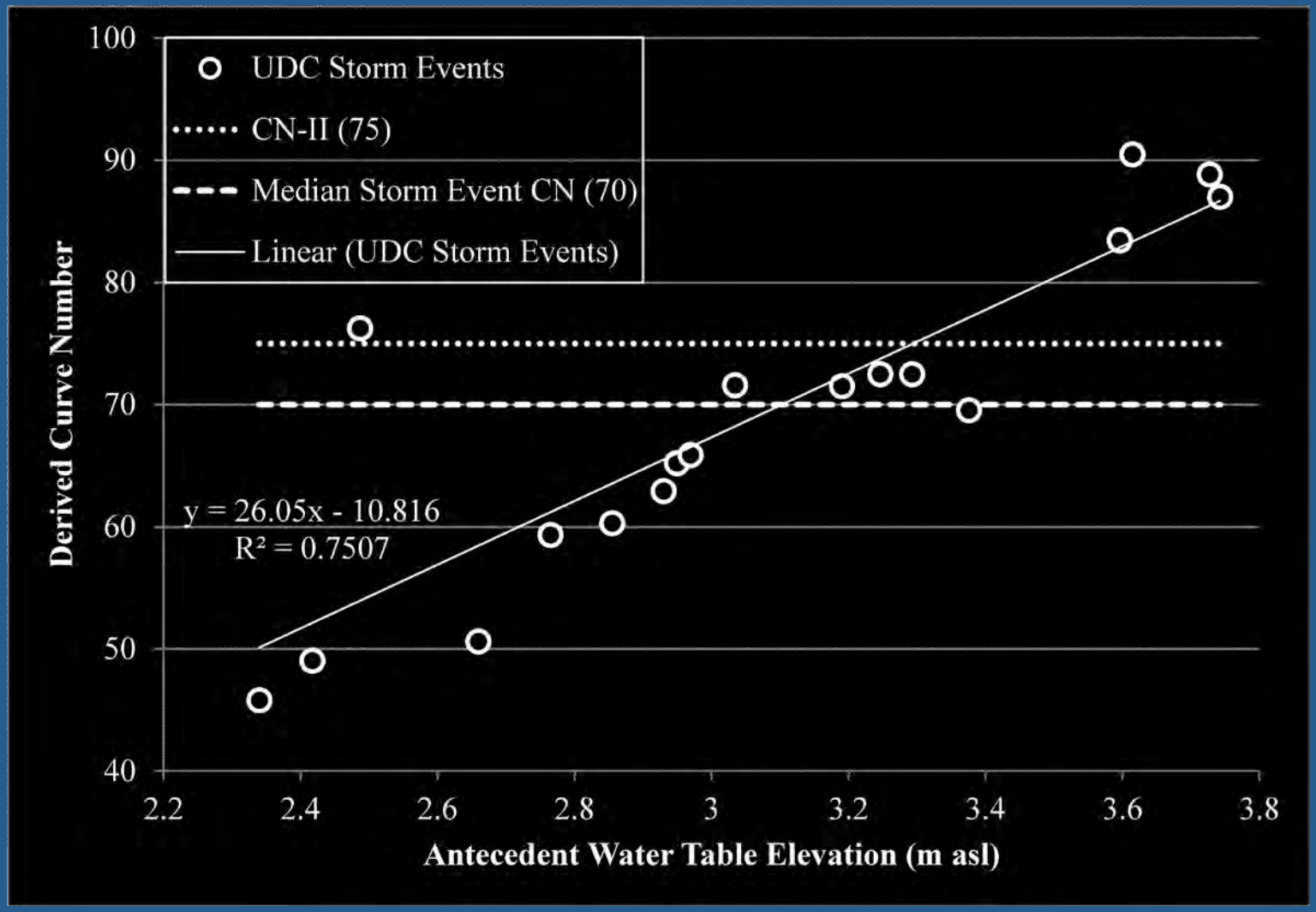
Curve Number : Water Table Relationships



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Summary of Results

- ROC ranged from 0 to 0.32 with mean = 0.10 at UDC
- ROC ranged from 0 to 0.57 with mean = 0.17 at WS80
- Derived CN's ranged from 46 to 90 with mean = 70 at UDC
- Derived CN's ranged from 42 to 89 with mean = 68 at WS80
- ROC's and CN's both seasonally variable and related to water table position (R^2 = 0.75 and 0.66, respectively)
- ROC values higher at WS80 due to argillic soil horizon, but CN value ranges and means are similar between the sites

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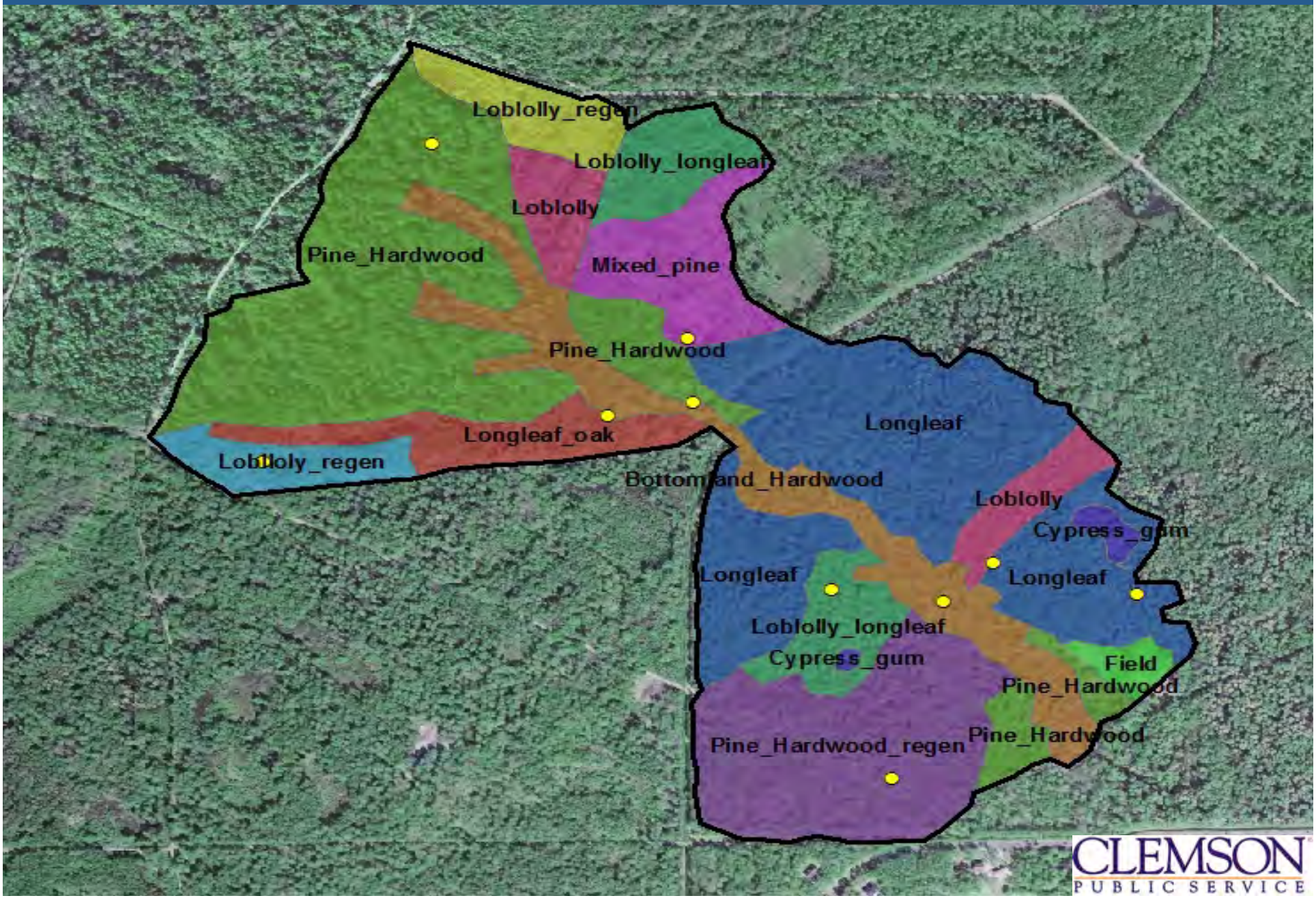
What drives the water table??

Upper Debidue Creek – Tree Survey



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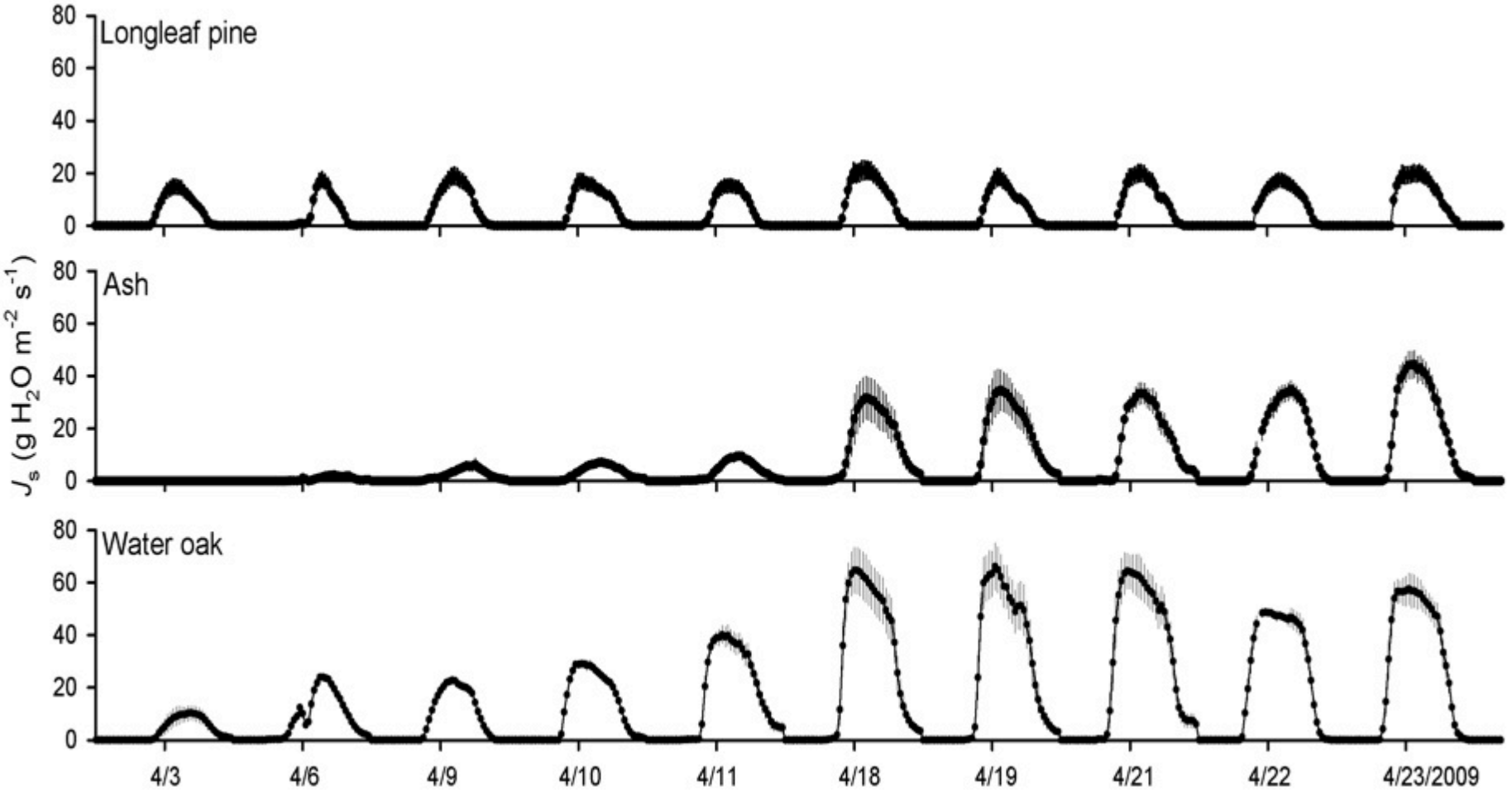
Forest Stand – Water Table Relationships



From Dr. Ken Krauss, USGS

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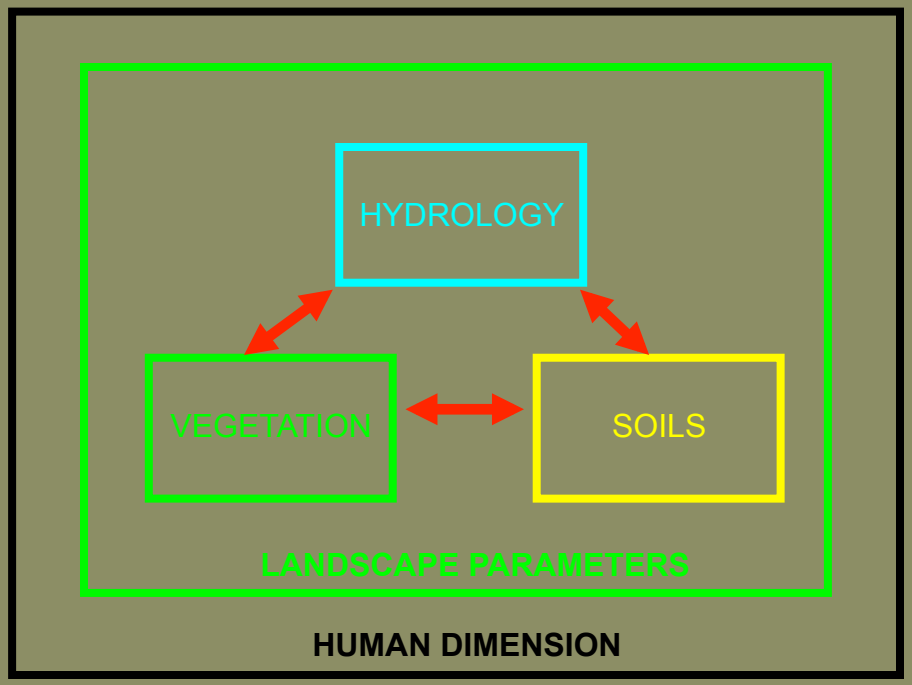

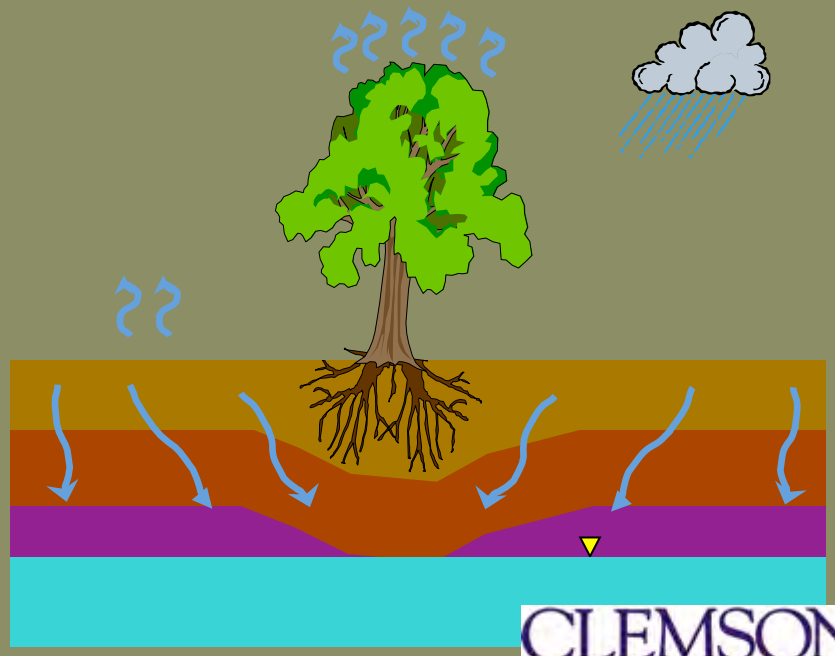

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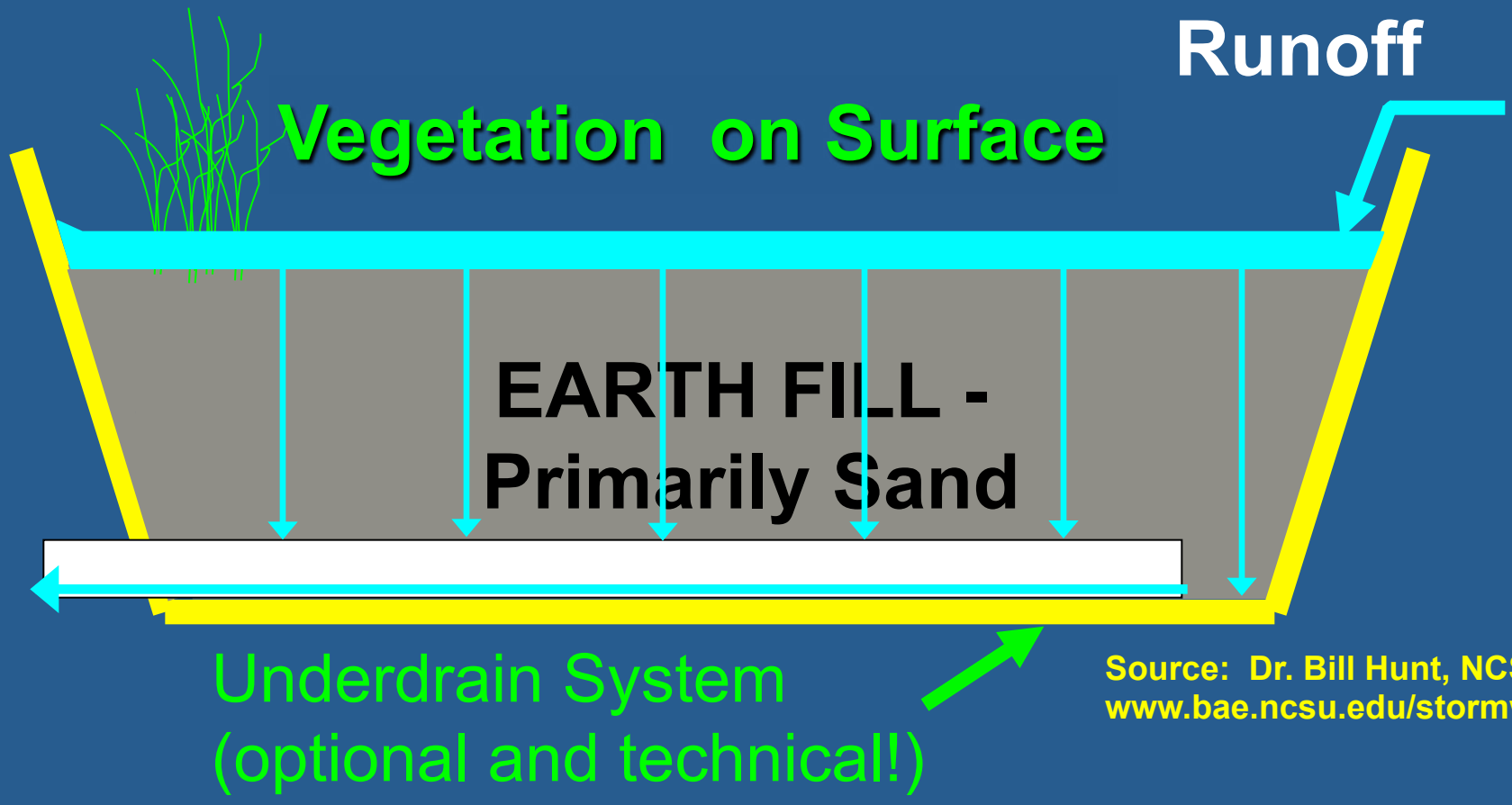
How does bioretention work?



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BEFORE…

Jan. 16, 2008

…AFTER

Sept. 25, 2009

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Is bioretention functioning as designed and intended?

We’re going to find out!!

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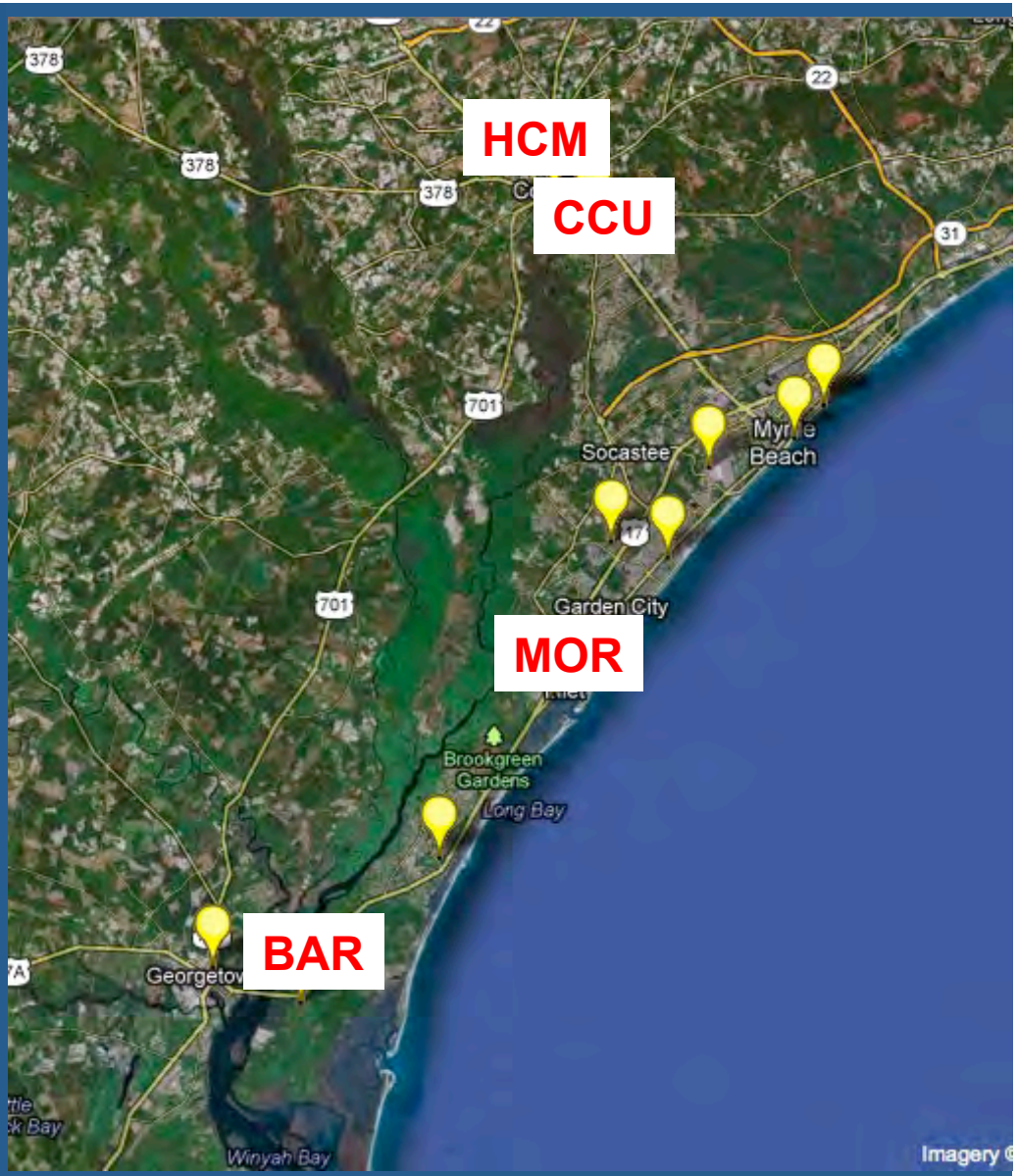
Bioretention Monitoring

- Weather parameters:
  - Rainfall
  - Barometric pressure
  - Temperature
  - Relative Humidity
  - Solar radiation
  - Potential evapotranspiration*
- Soil water parameters:
  - Soil moisture
  - Water table depth
- Surface water level and storage*
- Inflows* and infiltration*
- SW and GW sampling:
  - TSS, Nutrients, Bacteria, Carbon

(*calculated)



SC LID Atlas:
http://www.clemson.edu/public/carolinaclear/lidmap/

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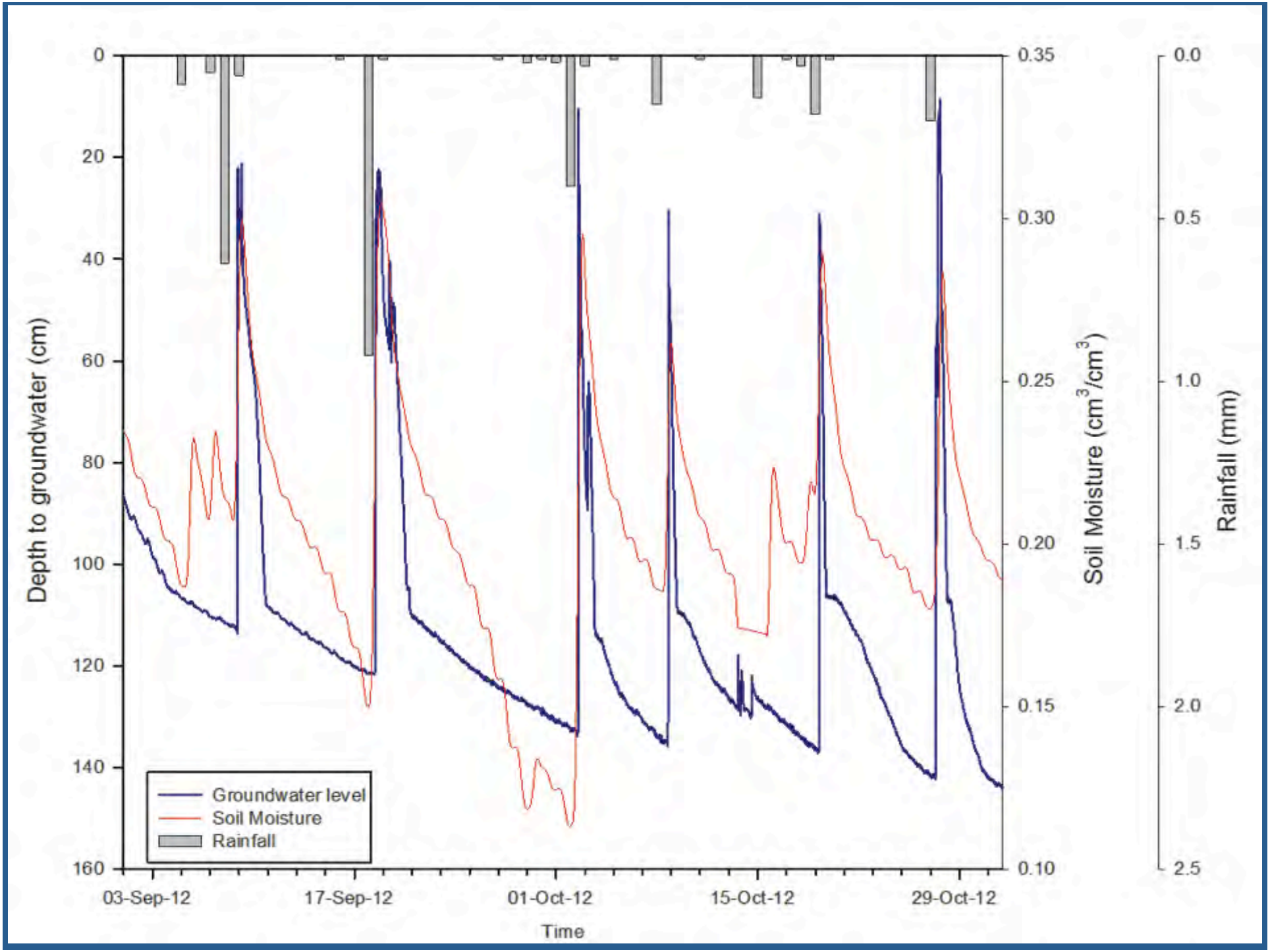
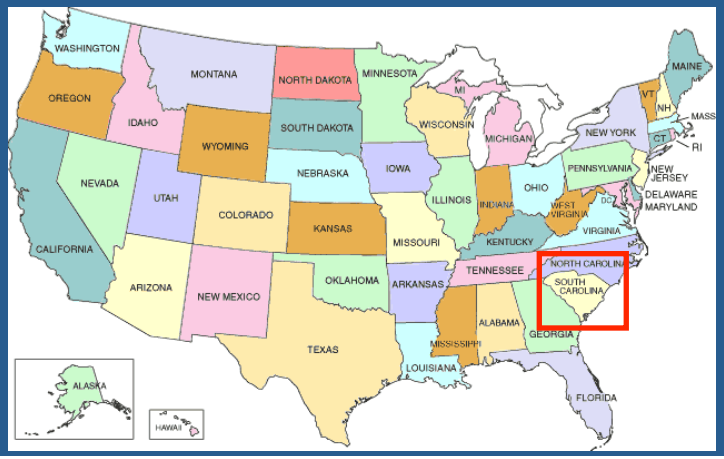

Depth to groundwater (cm)
0
20
40
60
80
100
120
140
160
Soil Moisture (cm3/cm3)
0.35
0.30
0.25
0.20
0.15
0.10
Rainfall (mm)
0.0
0.5
1.0
1.5
2.0
2.5
Groundwater level
Soil Moisture
Rainfall
03-Sep-12
17-Sep-12
01-Oct-12
15-Oct-12
29-Oct-12
Time

Coastal Wetlands Research



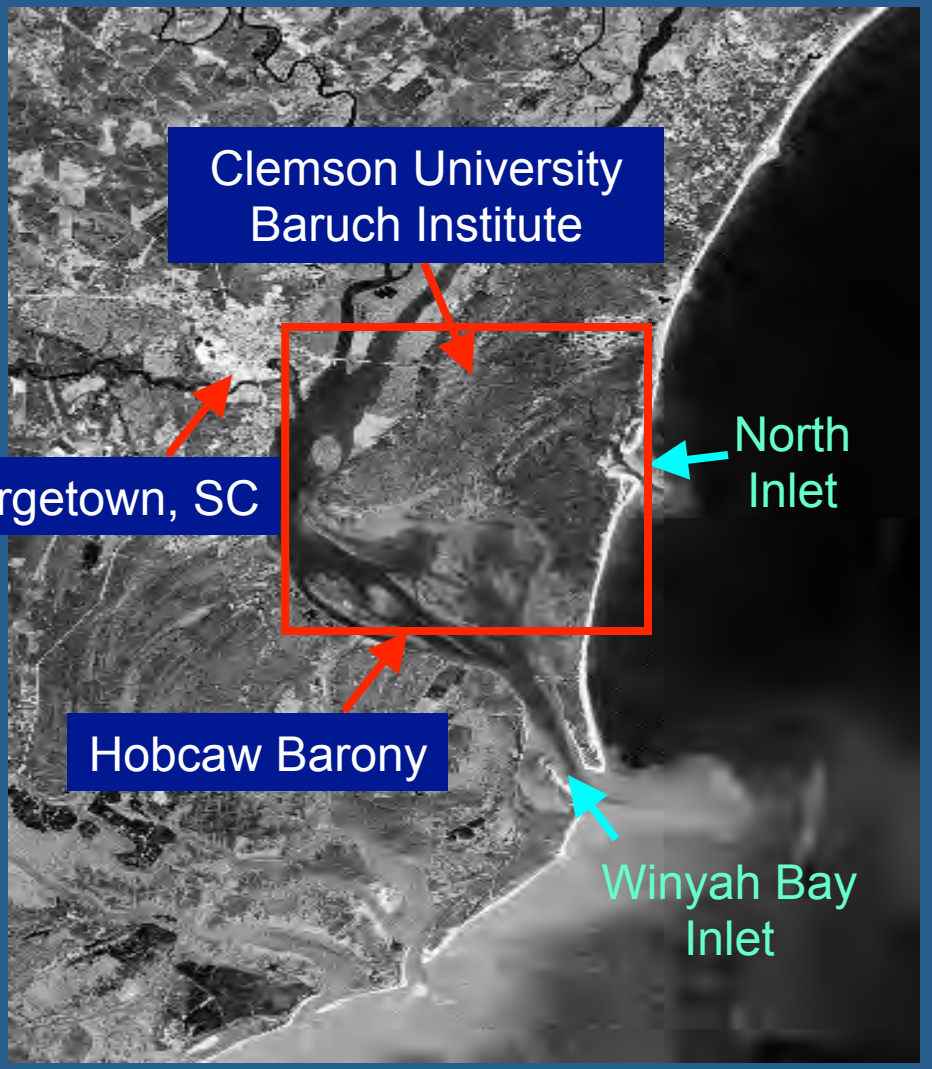


Photo: North Inlet – Winyah Bay NERR

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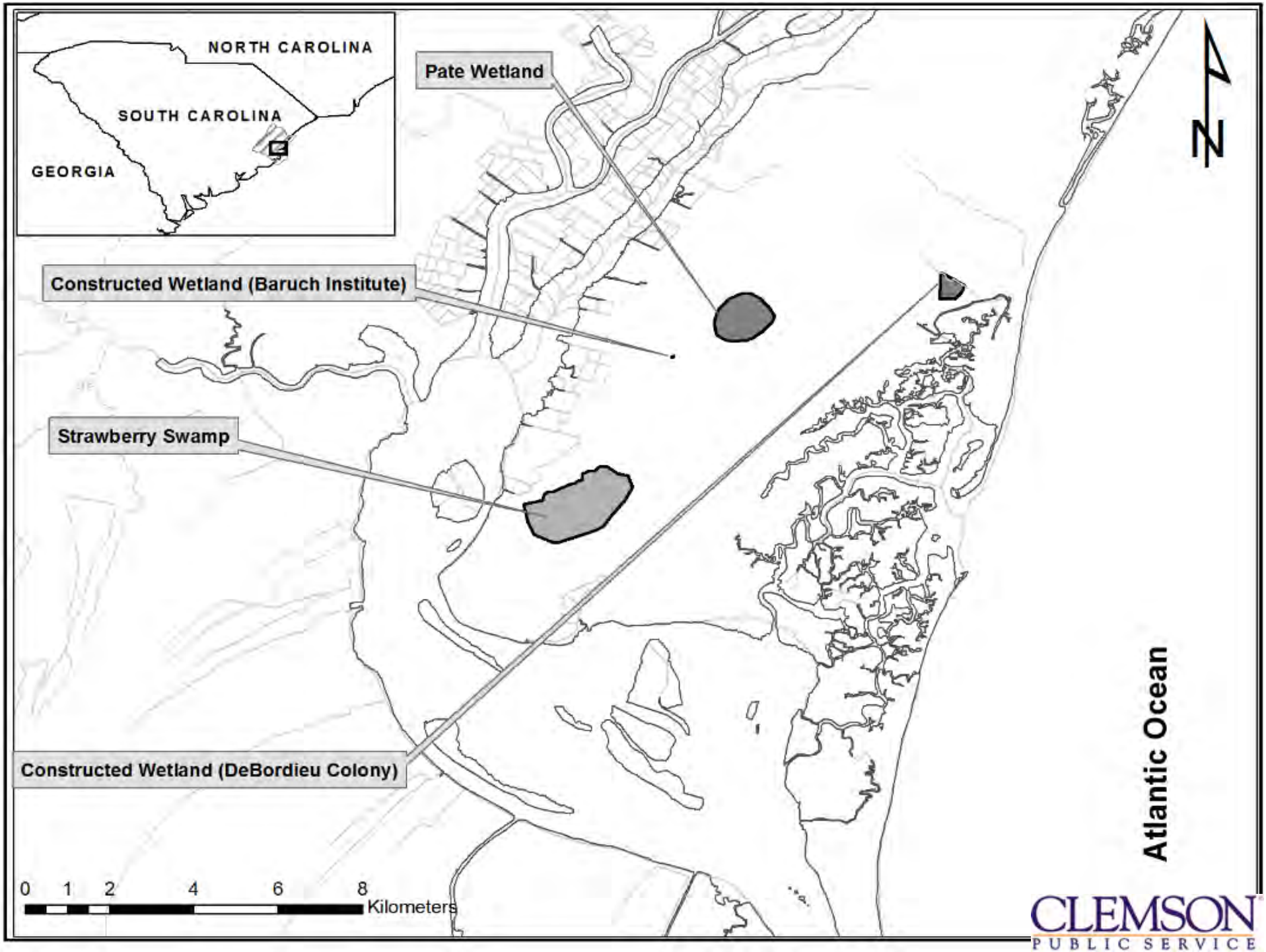
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
Pate Wetland
Constructed Wetland (Baruch Institute)
Strawberry Swamp
Constructed Wetland (DeBordieu Colony)
N
Atlantic Ocean
0 1 2 4 6 8
Kilometers
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Wetlands Monitoring

- Weather parameters:
  - Rainfall
  - Barometric pressure
  - Temperature
  - Relative Humidity
  - Solar radiation
  - Potential evapotranspiration*
- Soil water parameters:
  - Upland soil moisture
  - Water table depth
  - Specific conductance/salinity
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(*calculated)

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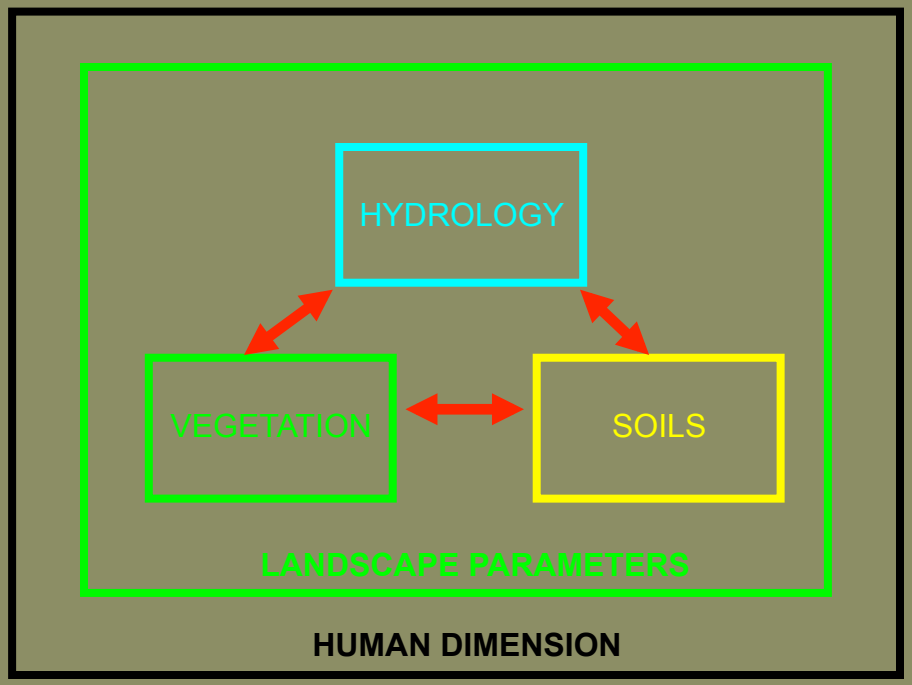

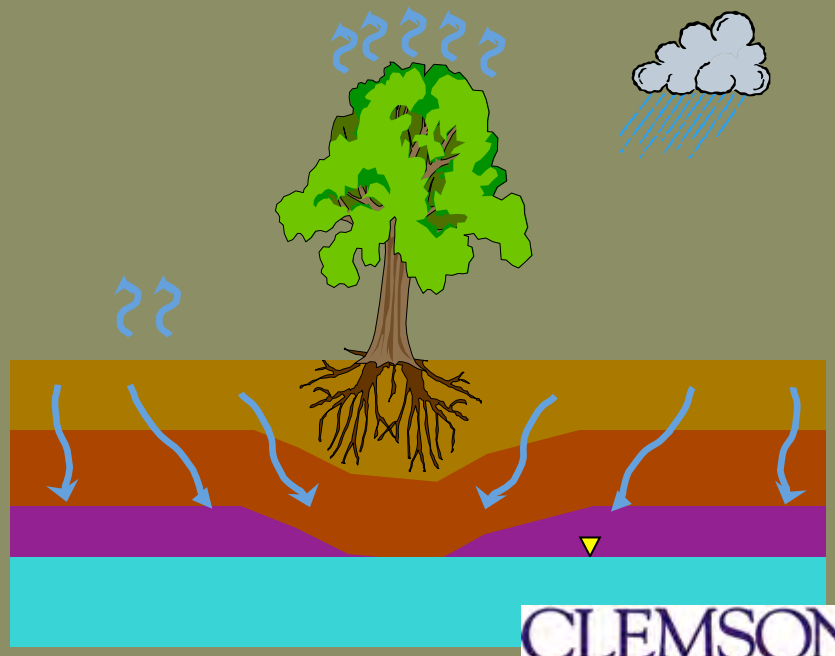

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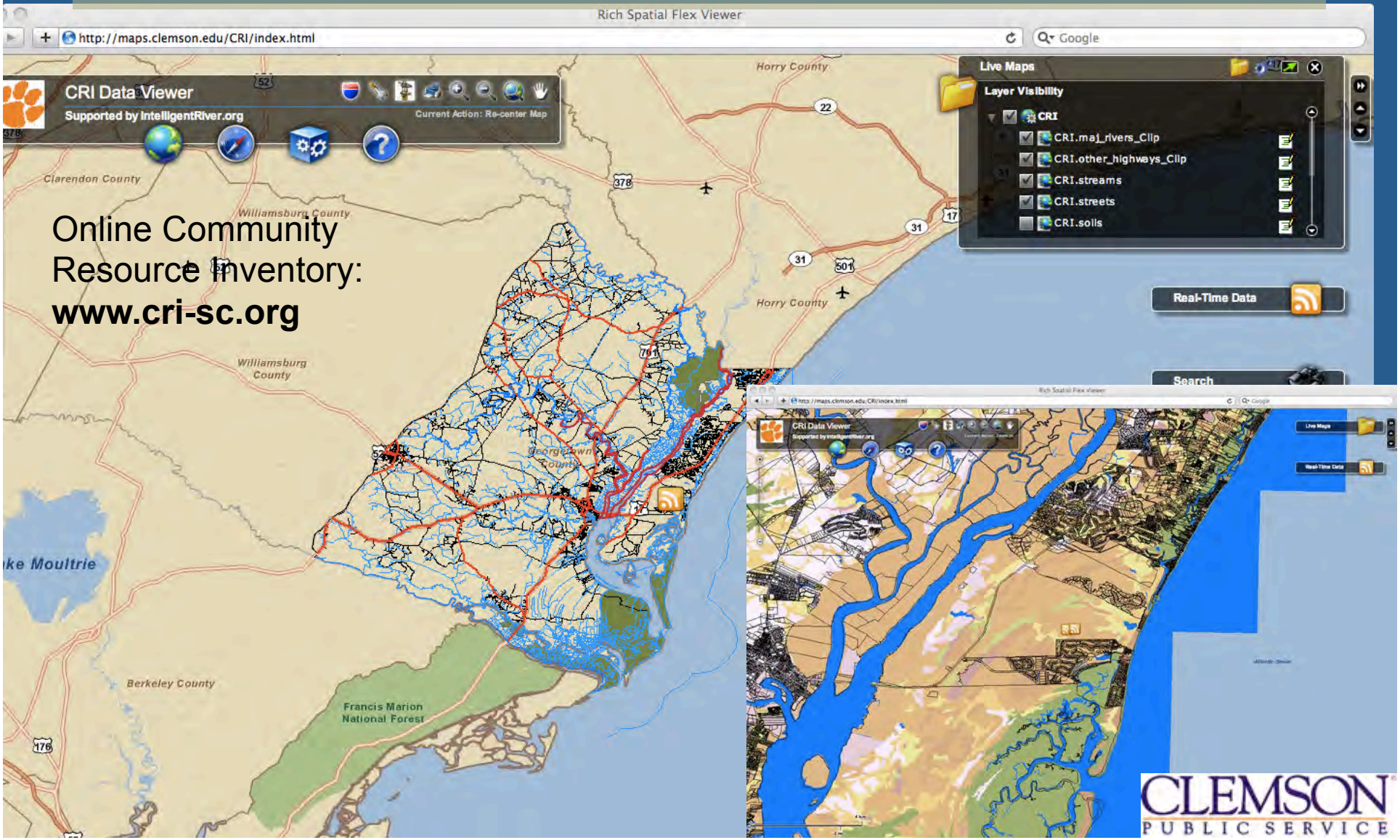
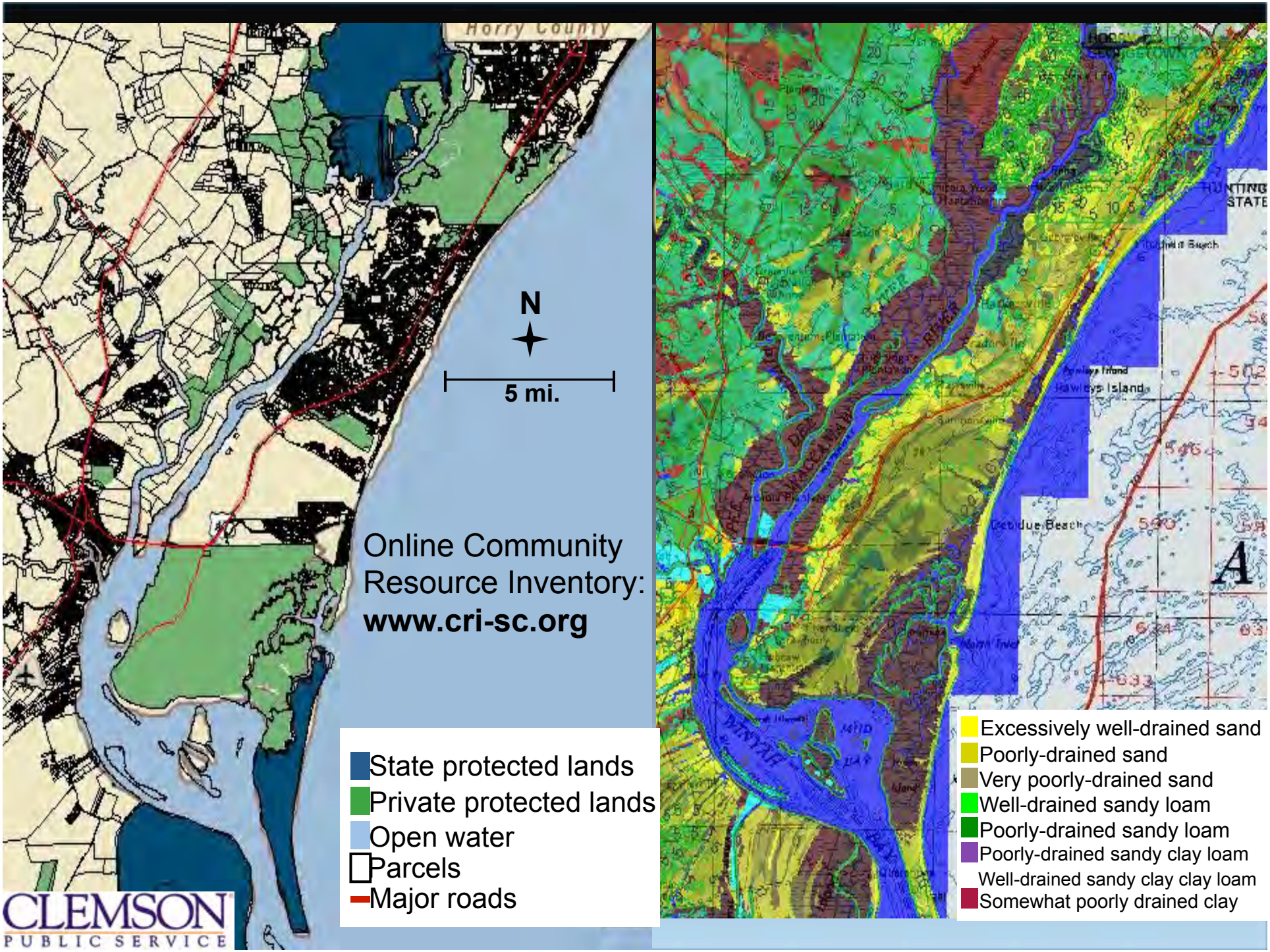
Online Community Resource Inventory (CRI) via SC Sea Grant Extension Program, SC NEMO, and the National NEMO Network




Horry County
N
5 mi.
Online Community
Resource Inventory:
www.cri-sc.org
State protected lands
Private protected lands
Open water
Parcels
Major roads
Excessively well-drained sand
Poorly-drained sand
Very poorly-drained sand
Well-drained sandy loam
Poorly-drained sandy loam
Poorly-drained sandy clay loam
Well-drained sandy clay clay loam
Somewhat poorly drained clay
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Sponsors

- ROCs/CNs work: South Carolina Sea Grant Consortium pursuant to National Oceanic and Atmospheric Administration Award No. NA06OAR4170015.
- Bioretention monitoring and education – USDA Renewable Resources Extension Act (RREA) and SC Sea Grant Consortium pursuant to National Oceanic and Atmospheric Administration Award No. NA10OAR4170073.
- Online Community Resource Inventory – CICEET funds to U.Conn. and NEMO, administered by SC Sea Grant with SC Nonpoint Education for Municipal Officials (NEMO) program.
- This work is also related to the Intelligent River™ project sponsored by Clemson Public Service Activities (PSA) and the South Carolina's EPA Center for Watershed Excellence.

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For more info, please contact me:
dhitchc@clemson.edu

Also visit:
www.clemson.edu/baruch
www.clemson.edu/baruch/rain_gardens
www.cri-sc.org

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