

# Tidal Creek Ecosystems: Sentinel Habitats for Assessing the Consequences of Rapid Coastal Development

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# Objectives

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- Demonstrate that tidal creek networks are **sentinel ecosystems** that provide early warning of the consequences of uncontrolled development on the Coastal Zone.
- Utilize traditional and new technologies to evaluate ecosystem condition, animal health, and potential threats to public health and welfare.



# Characteristics of Sentinel Habitats

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- Important structural components (e.g., habitat builders).
- Key functional roles (e.g., nursery habitat, materials cycling).
- High exposure and sensitive to stressors of interest
- Response patterns to stressors understood (i.e., baseline information exists)



# Charleston Urban Growth - Allen & Lu



Tidal creeks are conduits of non-point source runoff and are being converted to ditches



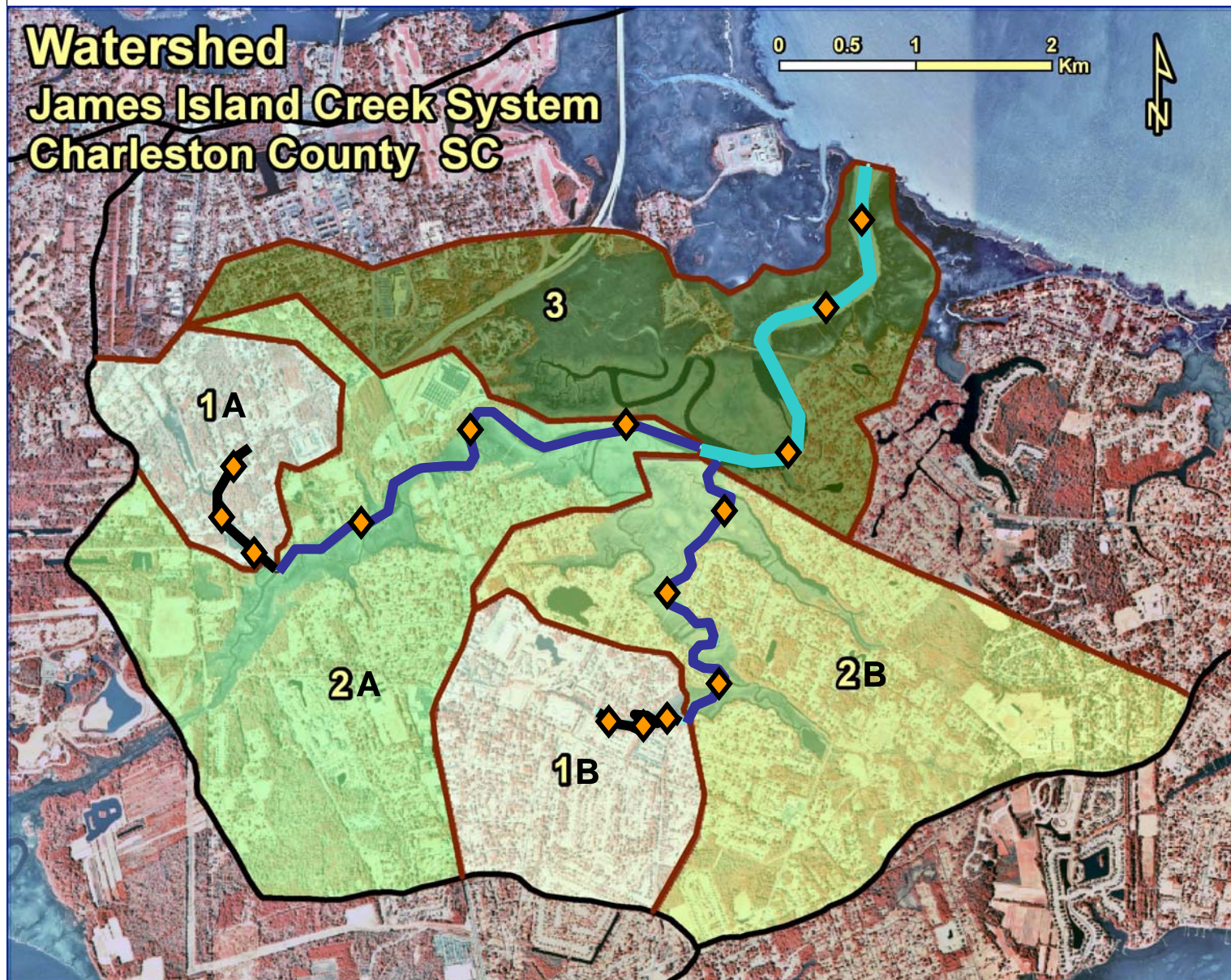


# Tidal Creeks Sampled





# Creek Gradient



## Creek Lengths

1A - 850 m

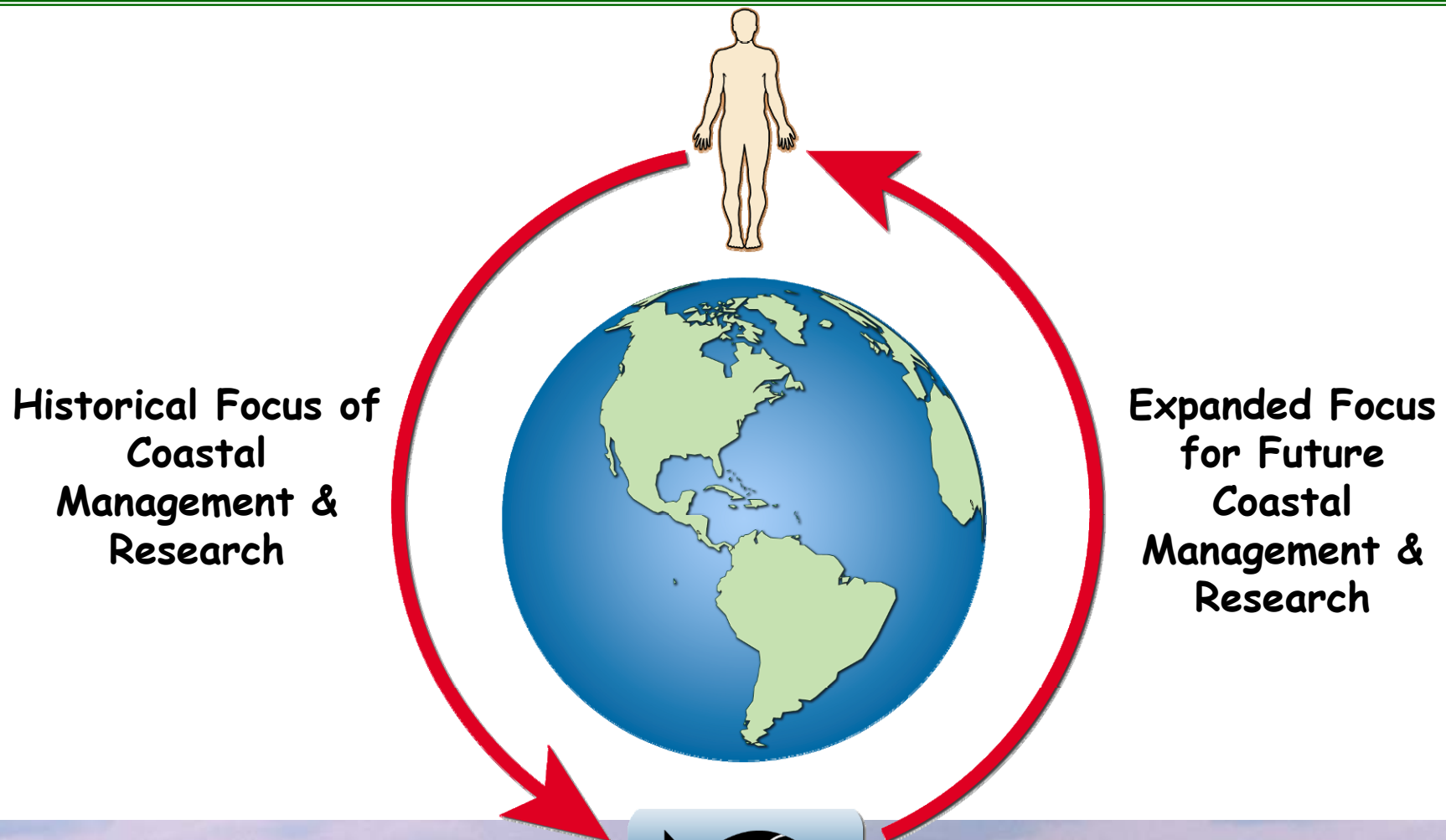
1B - 850 m

2A - 6400 m

2B - 4600 m

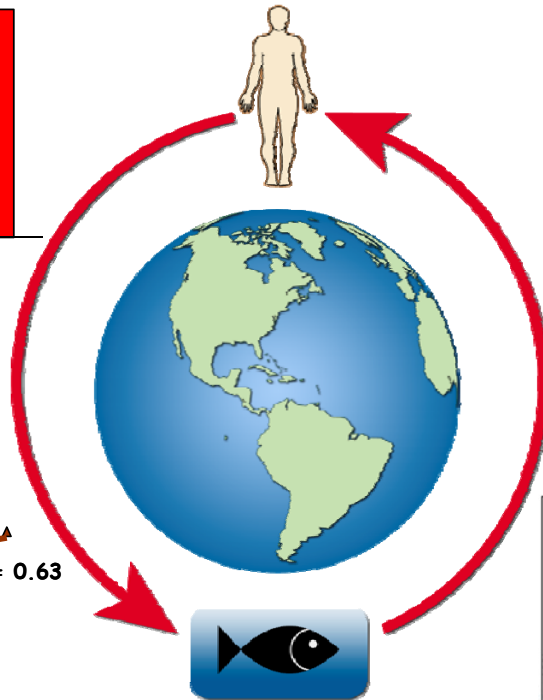
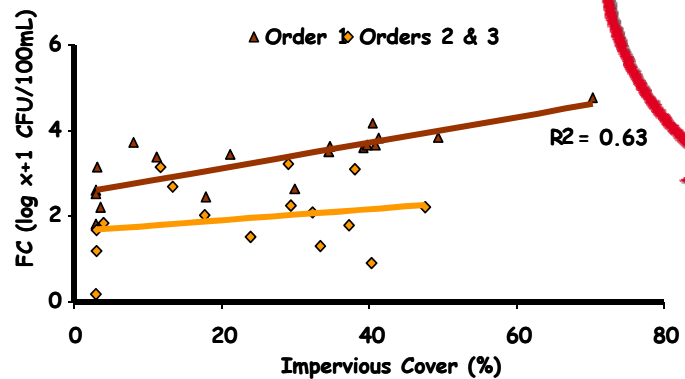
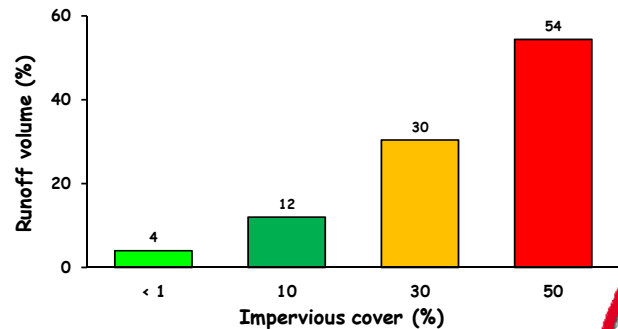
3 - 5800 m

# Humans and Coastal Management



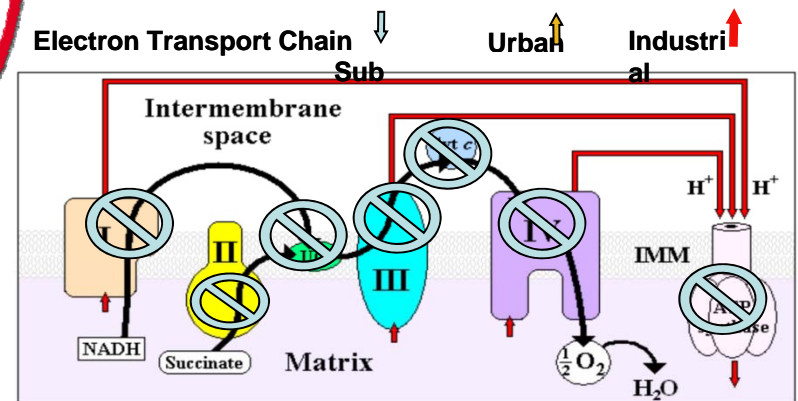


# Humans and Coastal Management



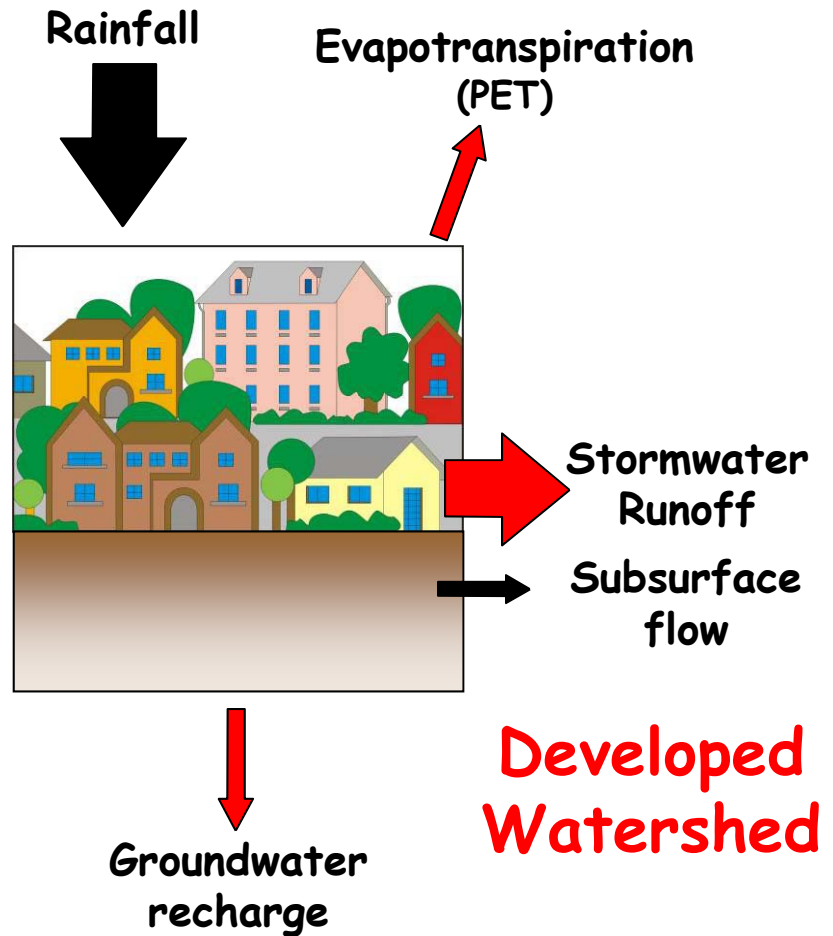
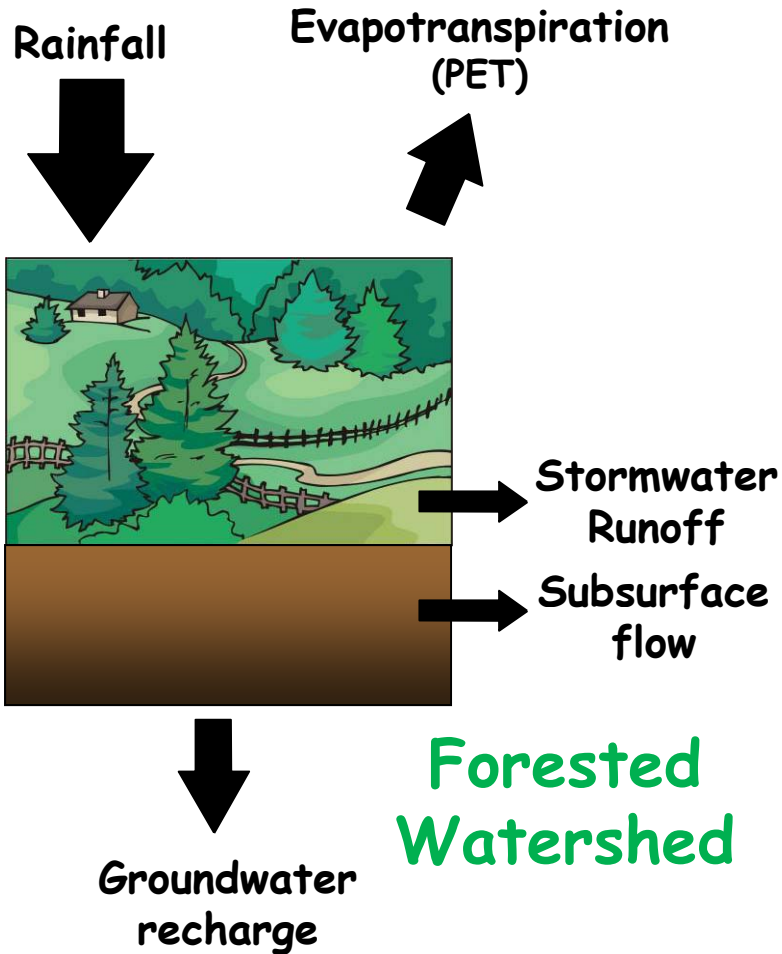
Utilizing Residential Property Attributes in a Hedonic Valuation of Tidal Creek Health

DO	• 1 mg/L increase alters prices by \$0
NO <sub>2</sub> +NO <sub>3</sub>	• 1 µg/L increase alters prices by -\$4,478.51
Depth	• 1 m increase alters prices by \$18,713.79
TSS	• 1 mg/L increase alters prices by -\$319.89
Turbidity	• 1 NTU increase alters prices by \$799.73





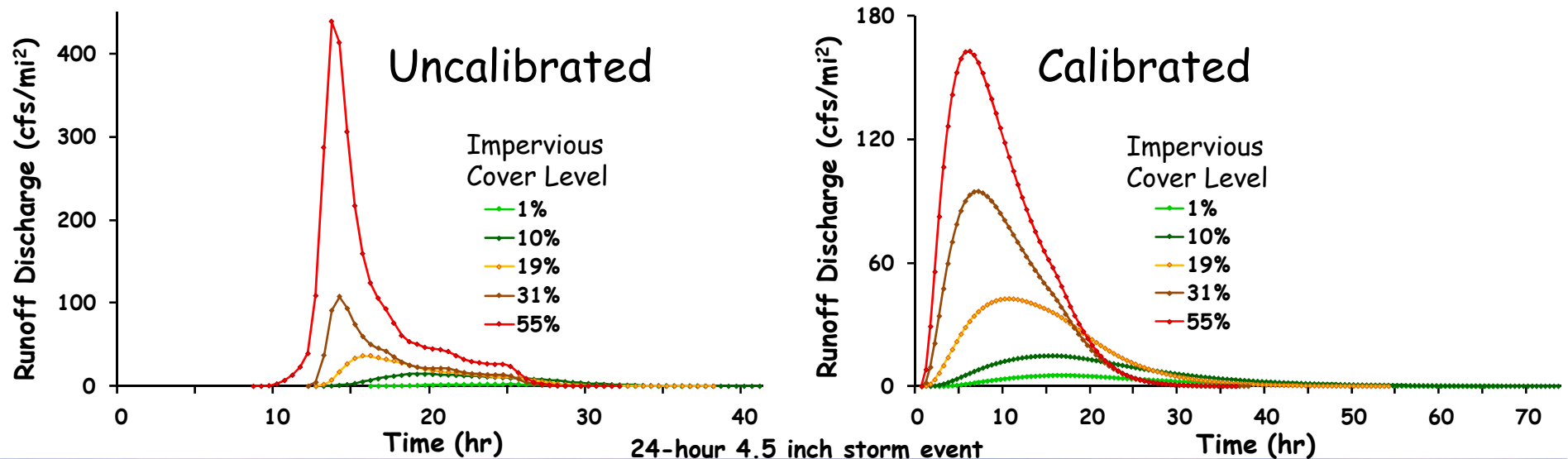
# Water Budgets



# Stormwater runoff model - calibration

## Calibrations to USDA model to reflect southeast coastal geomorphology

1. Rainfall temporal distribution (NOAA Atlas 2004)
2. Initial abstraction to storage ratio (Hawkins et al. 2002; Lim et al. 2006)
3. CN for developed classes (Lim et al. 2006)
4. Peak rate factor (Sheridan et al. 2002; USDA, NRCS 2007)
5. Sheet flow travel time equation (Zomorodi 2005)



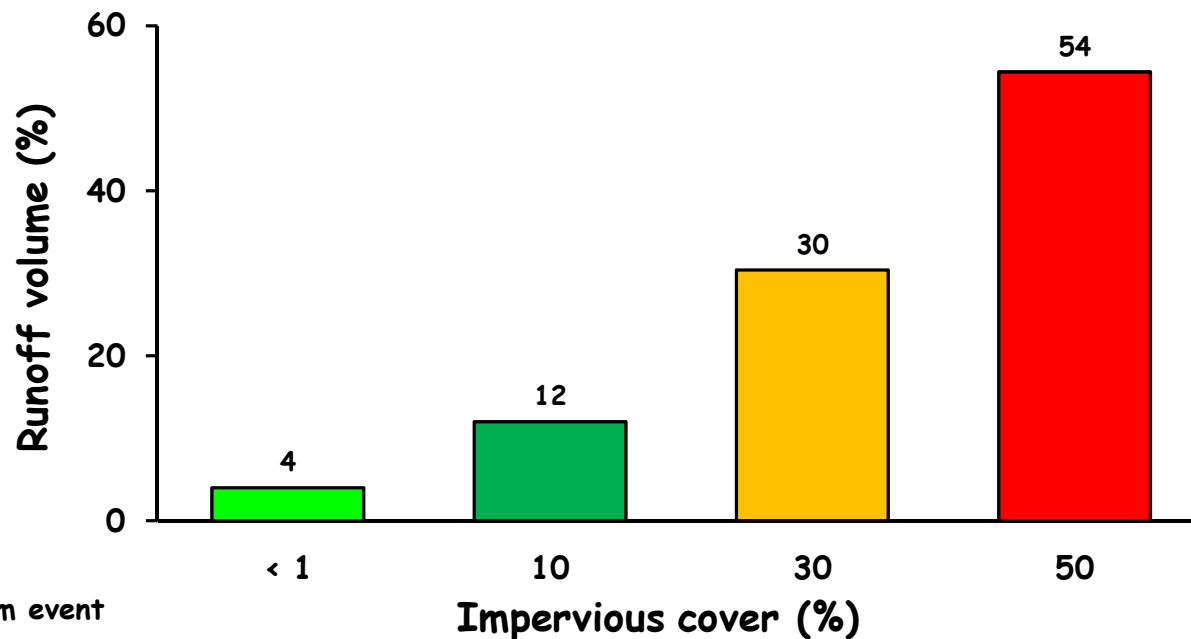
# Stormwater runoff model - prediction

## Urbanization alters watershed hydrography

Stormwater runoff from Village Creek watershed

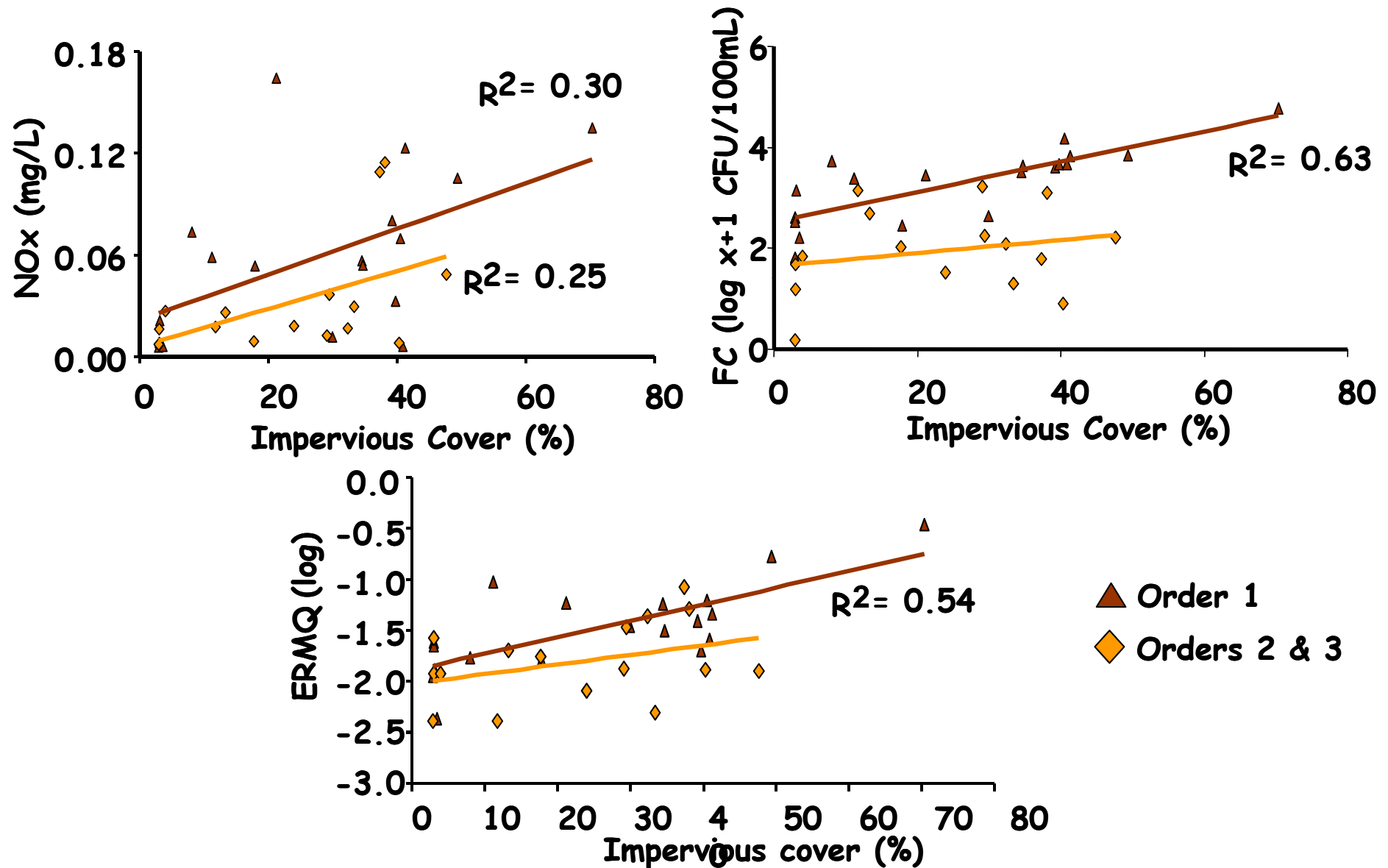
--at current development level of <1% impervious cover

-- at predicted development levels of 10%, 30%, and 50% impervious cover

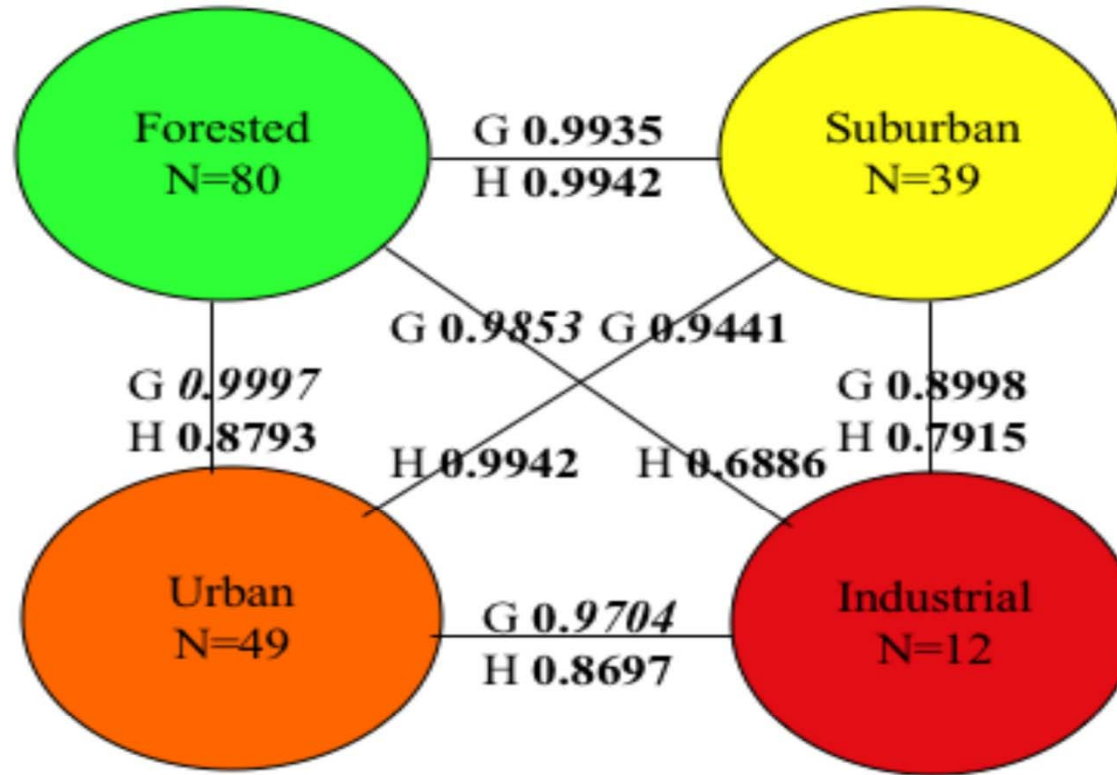




# Exposure vs Impervious Cover



# Area Under ROC curves for Creek Type

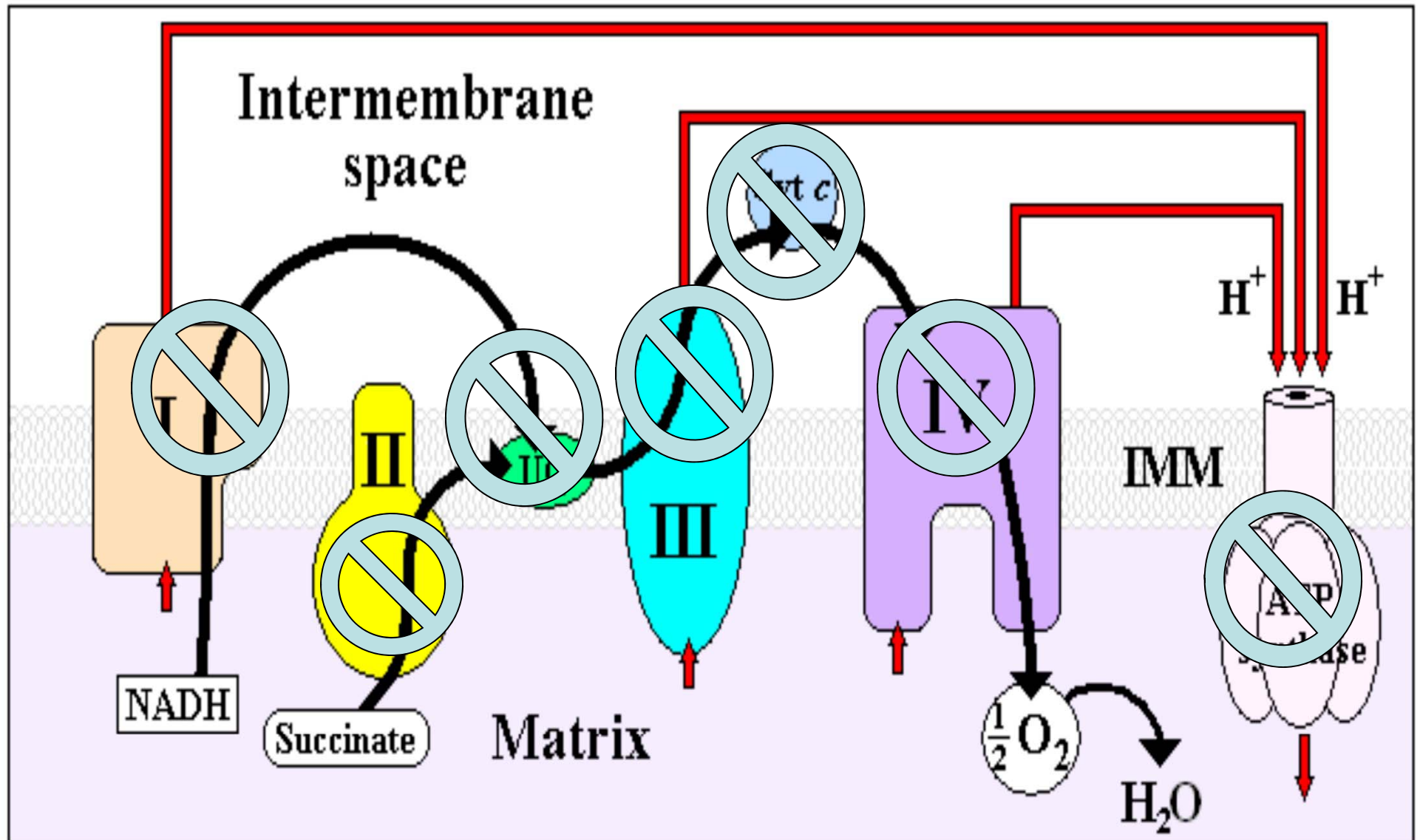


Electron Transport Chain

Sub ↓

Urban ↑

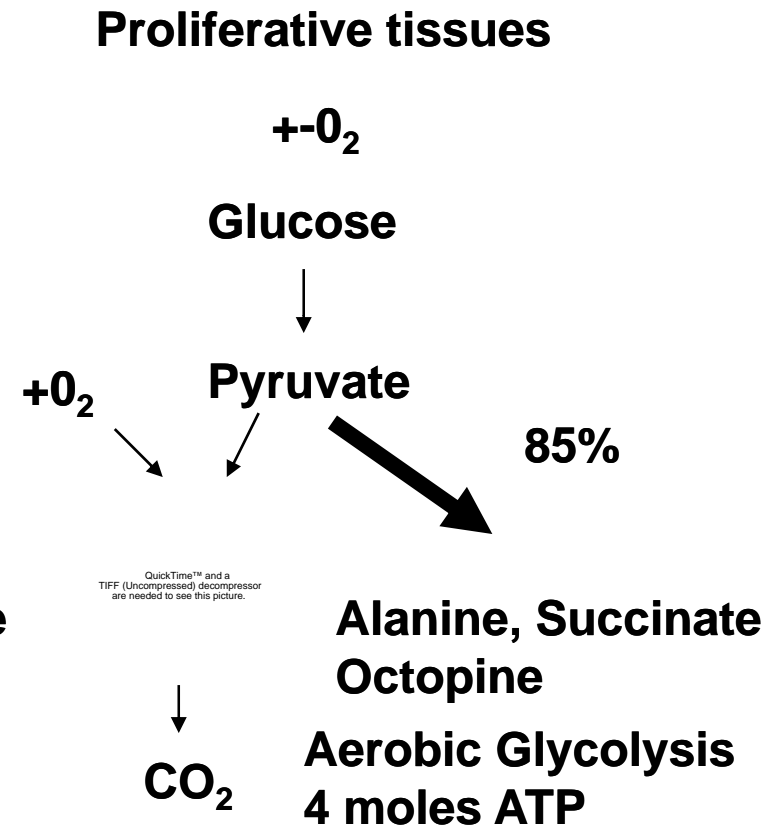
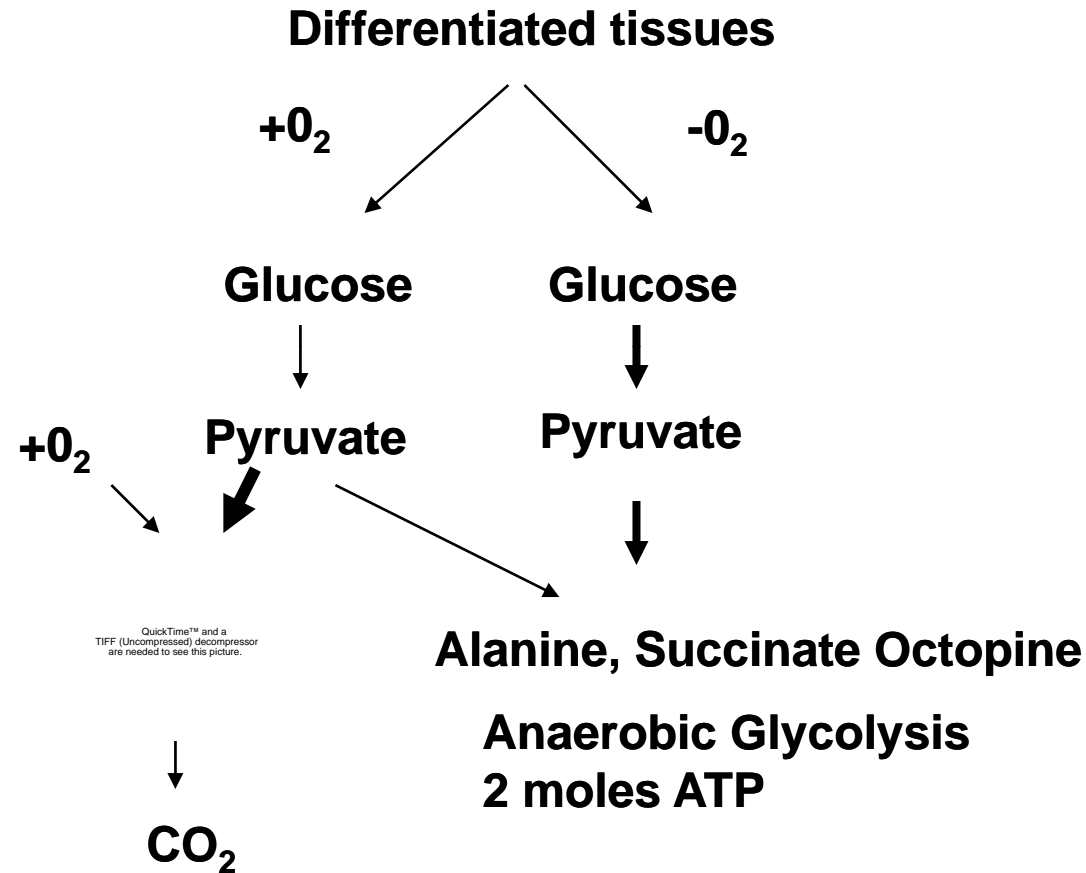
Industrial ↑





# Maintenance

# Growth



**Oxidative Phosphorylation 36 moles ATP**

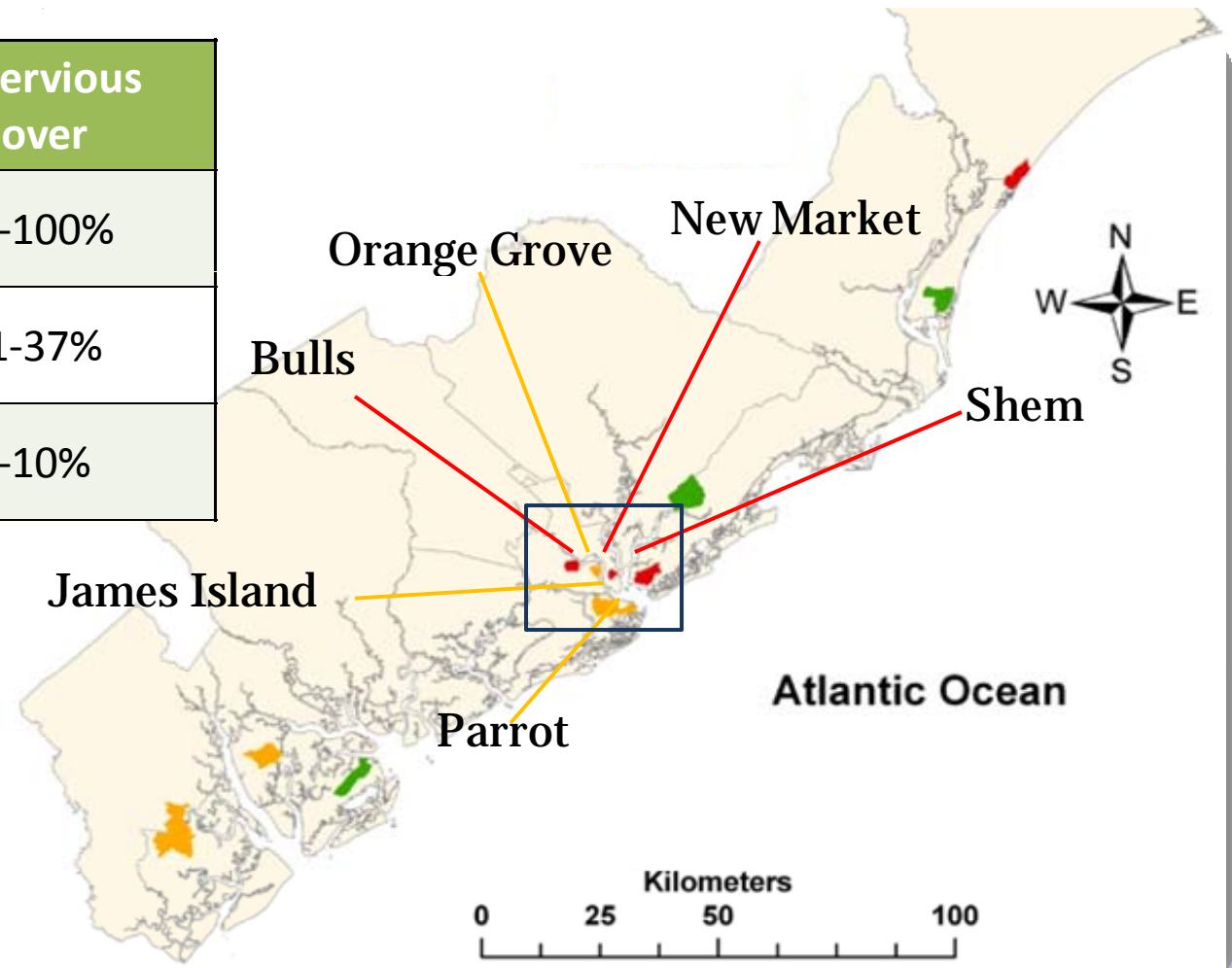
QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

Hollings Marine Laboratory  
promoting coastal community health

# Does a relationship exist between the health of a tidal creek and the property values of the homes within in the creek's watershed?

Development Category	Impervious Cover
URBAN	38-100%
SUBURBAN	11-37%
FORESTED	0-10%

Charleston County, SC

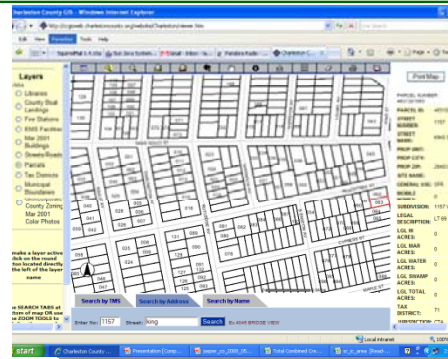


# Utilizing Residential Property Attributes in a Hedonic Valuation of Tidal Creek Health

Geographic Area	Population	Household Income	Total Area	Water Area	Land Area	Population Density	Household Income
Charleston County	304,400	34,100	1,100.0	410.0	690.0	276.7	83.0
Census Tract 501	2,700	1,400	0.80	0.30	0.50	3,375.0	168.0

## Community Data

- Median Household Income
- Commute Times of Population



## Housing Structural Data

- Year of Sale
- Finished Area

Structural Factors (S)

Neighborhood Factors (N)

Environmental Factors (E)

Property Price ( $P_h$ )



## Water Quality Data

- Average Depth
- Average Dissolved Oxygen
- Average Turbidity
- Average NO2 and NO3
- Total Suspended Solids

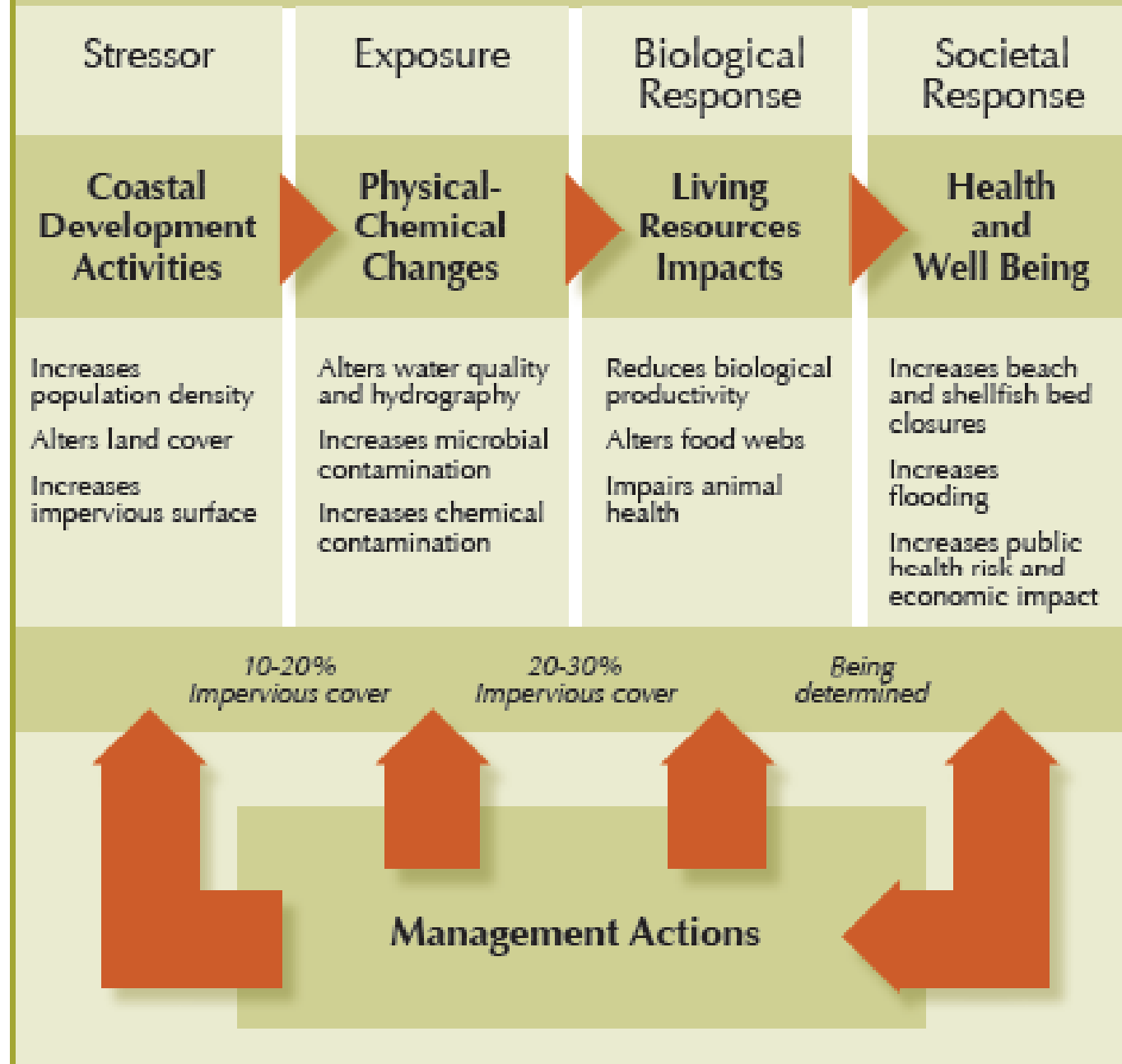
$$P_h = P_h(S, N, E)$$



# Utilizing Residential Property Attributes in a Hedonic Valuation of Tidal Creek Health

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## Conceptual Model of Tidal Creek Watershed Linkages



# Tidal Creek Sentinel Habitats

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- Important structural connection to land
- Strongest relationships in the headwater areas
- Many functional roles
  - refuge and nursery
  - pollution & materials processing
- Relationships exist between coastal development and the environmental quality of tidal creeks and resulting human health and welfare impacts
- Knowledge exists to forecast responses





# Tidal Creeks as Sentinel Habitats

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Tidal creeks are  
the zone of first impact—  
the proverbial  
“canary in the mine”—  
for coastal ecosystems.

# Next Steps

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- Develop potential to forecast or predict potential impacts from various levels of development and changes in climate
- Expand results to *Gulf of Mexico* region and other areas



# Tidal Creek Habitats

Sentinels of Coastal Health



[http://www.scseagrant.org/pdf\\_files/tidal\\_creeks\\_booklet.pdf](http://www.scseagrant.org/pdf_files/tidal_creeks_booklet.pdf)

 HH  
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