

Ecosystem Restoration

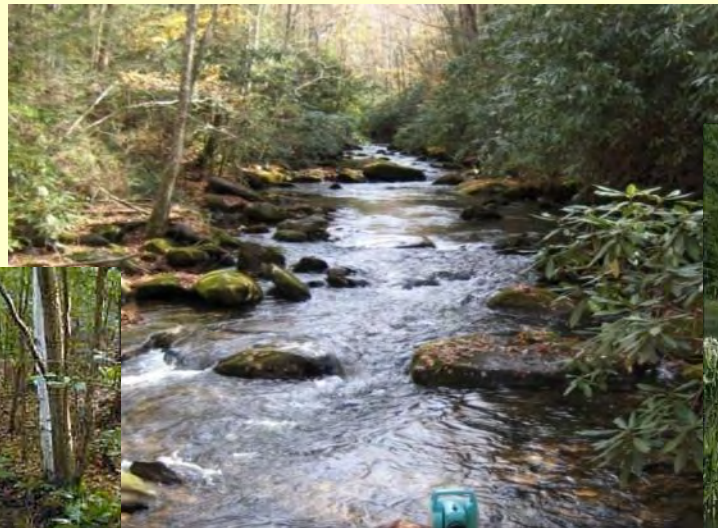
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Asheville, NC

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Aquatic Ecosystems

- Communities of organisms and their physical, chemical, and biological environments



Ecosystem Services

- *Provisioning* – food, energy, industry
- *Regulating* – climate, waste, nutrients
- *Supporting* – water quality, pest control
- *Cultural* – recreation, inspiration
- *Preserving* – species diversity



Damages to Aquatic Ecosystems

- Land use changes
- Hydromodification
- Pollution
- Invasive species
- Extreme climate



Damages to Aquatic Ecosystems



Ecosystem Restoration

- Activities that initiate or accelerate the recovery of ecosystem health, integrity, and sustainability (SER, 2004).



Survey Says: 9 out of 10 people are excited about ecosystem restoration



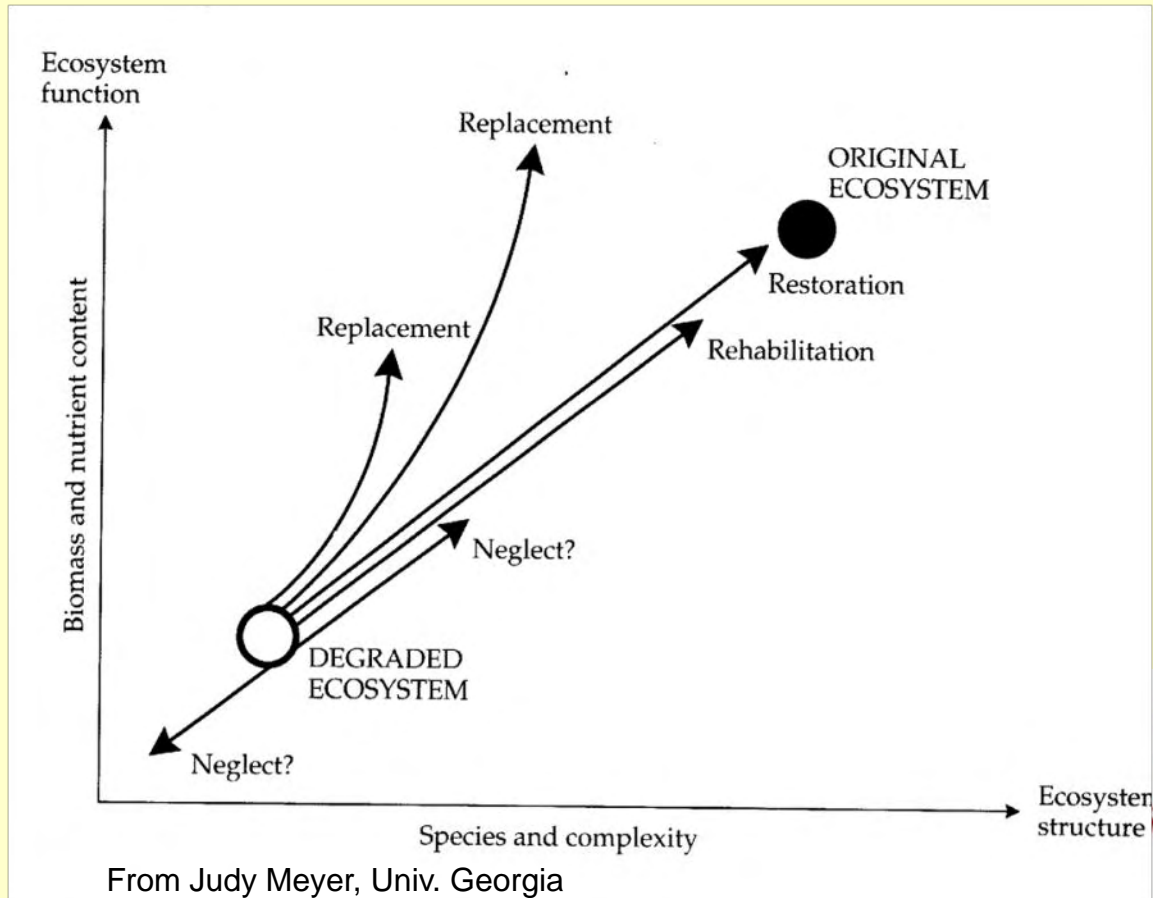
Outcomes of Ecosystem Restoration

- Habitats
- Water quality
- Natural flow regimes
- Recreation & aesthetics



Successful Ecosystem Restoration

- Returns an ecosystem to its historic trajectory or altered trajectory with improved health and integrity under current constraints



Successful Ecosystem Restoration

- Ecosystem will sustain itself structurally and functionally with resilience to normal ranges of environmental stress and disturbance



Multi-disciplinary Efforts

- Engineering
- Ecology
- Geology & soil science
- Hydrology & environmental science
- Landscape architecture
- Economics & social sciences



Ecological Engineering

- Design and management of sustainable ecosystems that integrate human activities with the natural environment



Goals of Ecological Engineering

- Restore damaged ecosystems
- Develop new sustainable ecosystems that have human and ecological values



Reference Ecosystems

- Historic data and/or comparable intact ecosystems with similar boundary conditions
- Studying and modeling to determine ranges of morphology, hydrology, soils, plants, animals, and environmental conditions



Dam Removal – Ecosystem Restoration by Removing a Disturbance

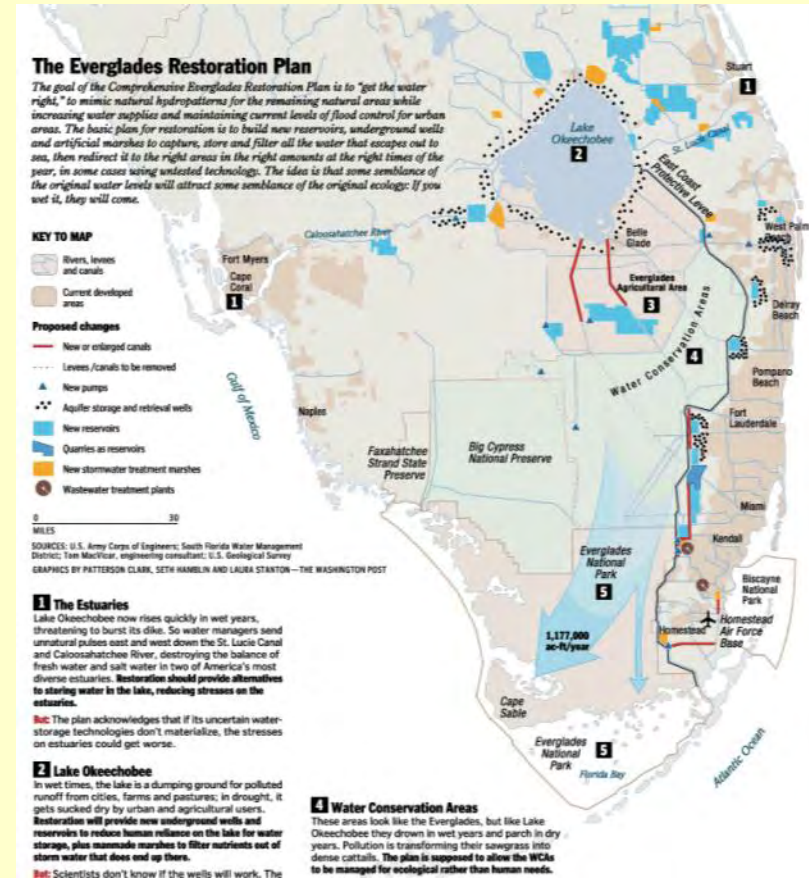
- Restore organism migration from upstream and from the floodplain
- Restore upstream and downstream habitats
- Restore species composition



Re-construction of Wetlands, Streams, & Floodplains

- Reference ecosystems used to design geomorphic, hydrologic, and environmental parameters under the current conditions

Florida Everglades Restoration



Wetland Restoration

- Disconnect drainage networks
- Plant native wetland plants
- Grade land surface to optimize structure and functions (micro-habitats)

Photos from Mike
Burchell, NCSU



Wetland Restoration – North River, NC



Photos from Mike
Burchell, NCSU

April, 2008

May, 2003



Tidal Creek Restoration – North River



Photos from Mike Burchell, NCSU

Tidal Creek Restoration – North River

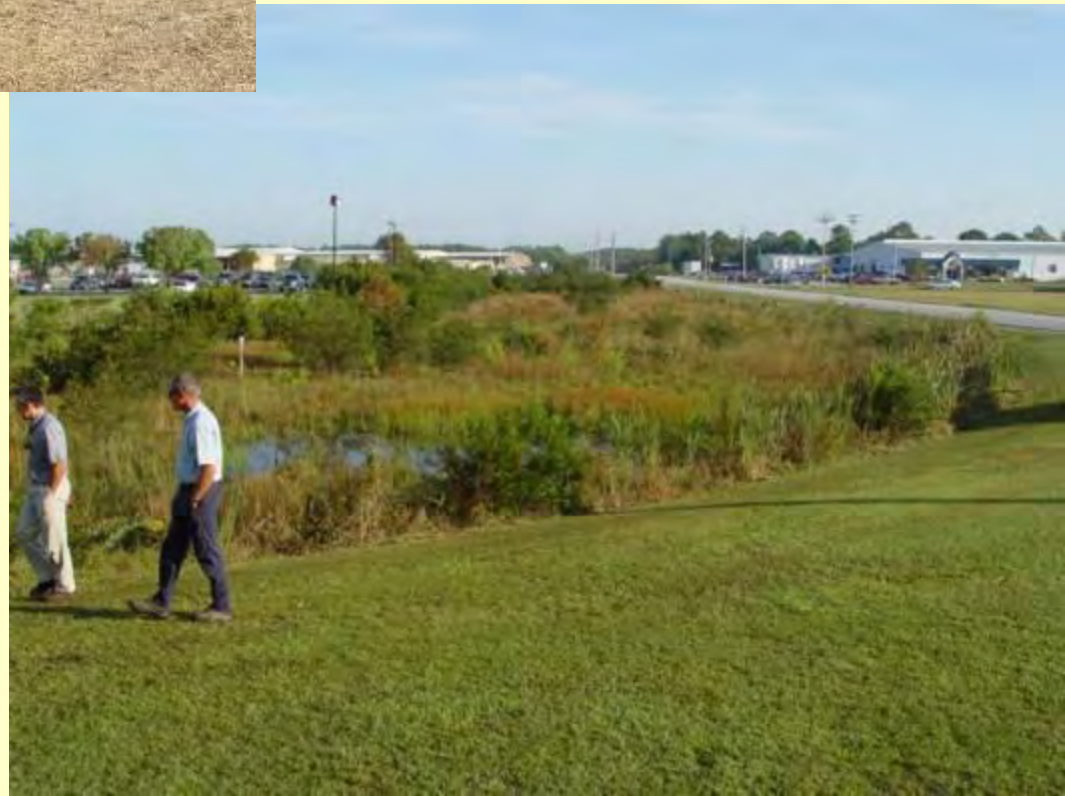


Photos from Mike
Burchell, NCSU





CCEC Wetland Carteret Co, NC



Urban Streams: Assets or Liabilities?



Liabilities

- Erosion
- Water quality
- Habitat loss
- Land loss
- Safety
- Infrastructure damage
- Flooding
- Aesthetics





Why?

- Straightening
- Dredging
- Floodplain filling
- Sedimentation
- Stormwater
- Utilities
- Culverts
- Buffer removal
- ***Disdain & neglect***



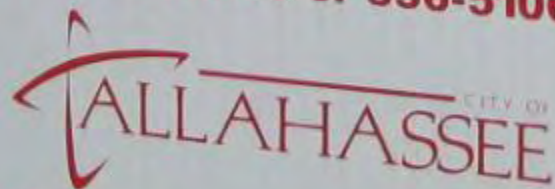




WARNING

**NO TRESPASSING!
CONTAMINATED AREA
AVOID CONTACT WITH
SOIL AND WATER**

**FOR INFORMATION
(850) 891-8850 or 556-5106**



ENVIRONMENTAL RESOURCES

Turning Liabilities into Assets

- Channel morphology & floodplain connection
- In-stream structures
- Streambank bioengineering
- Riparian buffers
- Habitat enhancements
- Stormwater management
- Stream crossings
- Monitoring & maintenance
- Public access & education



Have a plan before you start digging



Channel Morphology & Floodplain Connection

Priority 1. Raise channel to existing valley
and construct new meandering channel



2006

Town Creek Tributary

2008

Town Creek Tributary

2008



Channel Morphology & Floodplain Connection

Priority 2. Excavate lower floodplain and construct new meandering channel



2007

Cary Walnut Creek Tributary

2008

Cary Walnut Creek Tributary

2008



Channel Morphology & Floodplain Connection

Priority 2. Excavate lower floodplain and construct new meandering channel



2000

Wilmington Hewletts Creek Trib

2001

Wilmington Hewletts Creek Tributary



2003

2001



Channel Morphology & Floodplain Connection

Priority 2. Excavate lower floodplain and construct new meandering channel



2005

NCSU Rocky Branch

2007

NCSU Rocky Branch

T.S. Fay 27Aug08



T.S. Alberto 15Jun06



Channel Morphology & Floodplain Connection

Priority 3. Excavate floodplain benches and add structures to maintain straight channel



2000

NCSU Rocky Branch

2001

NCSU Rocky Branch

2008



Floodplain hazards



In-stream Structures (rocks & logs)

- Grade control
- Streambank protection
- Habitat enhancement



Newland N Toe R



Asheville Swannanoa R



Successful Structures

- Properly designed and located
- Low profile
- Constructed to withstand stress
- Excellent vegetation





Streambank Bioengineering

Integrating living woody and herbaceous materials to increase strength and structure of the soil (i.e. increase critical shear)



Newland N Toe R



NCSU Rocky Branch

Newland Kentucky Creek

Streambank Bioengineering



Fletcher Cane Creek

Streambank Bioengineering



Successful Streambank Stabilization

- Low streambanks
- Dense vegetation
- Temporary biodegradable matting
- Bioengineering in high-stress areas
- Proper channel morphology



Riparian Car-door?





Riparian Buffers

- Temporary ground covers
- Permanent grasses
- Wetland plants
- Shrubs and trees



Riparian Buffer

Vegetative zone near edge of water that protects water quality and improves habitat





www.cse.org

**NO
BUFFER
REGULATIONS**

**CSE'S WARNING:
Taxes are dangerous to your wallet.**

Citizens For a Sound Economy  1-888-JOIN-CSE www.cse.org

Temporary & Permanent Grasses



Live Stakes

(willows, dogwoods, elderberry, birch, ninebark, etc)



Transplants, Bare roots, & Containers





Purlear Creek Reach 10



Purlear Creek before restoration



Purlear Creek after restoration



2006



2004

Myrtle Beach, SC



2005



2007



Successful Vegetation

- Natives only
- Quality plants
- Installed correctly
- Watered and fertilized if needed



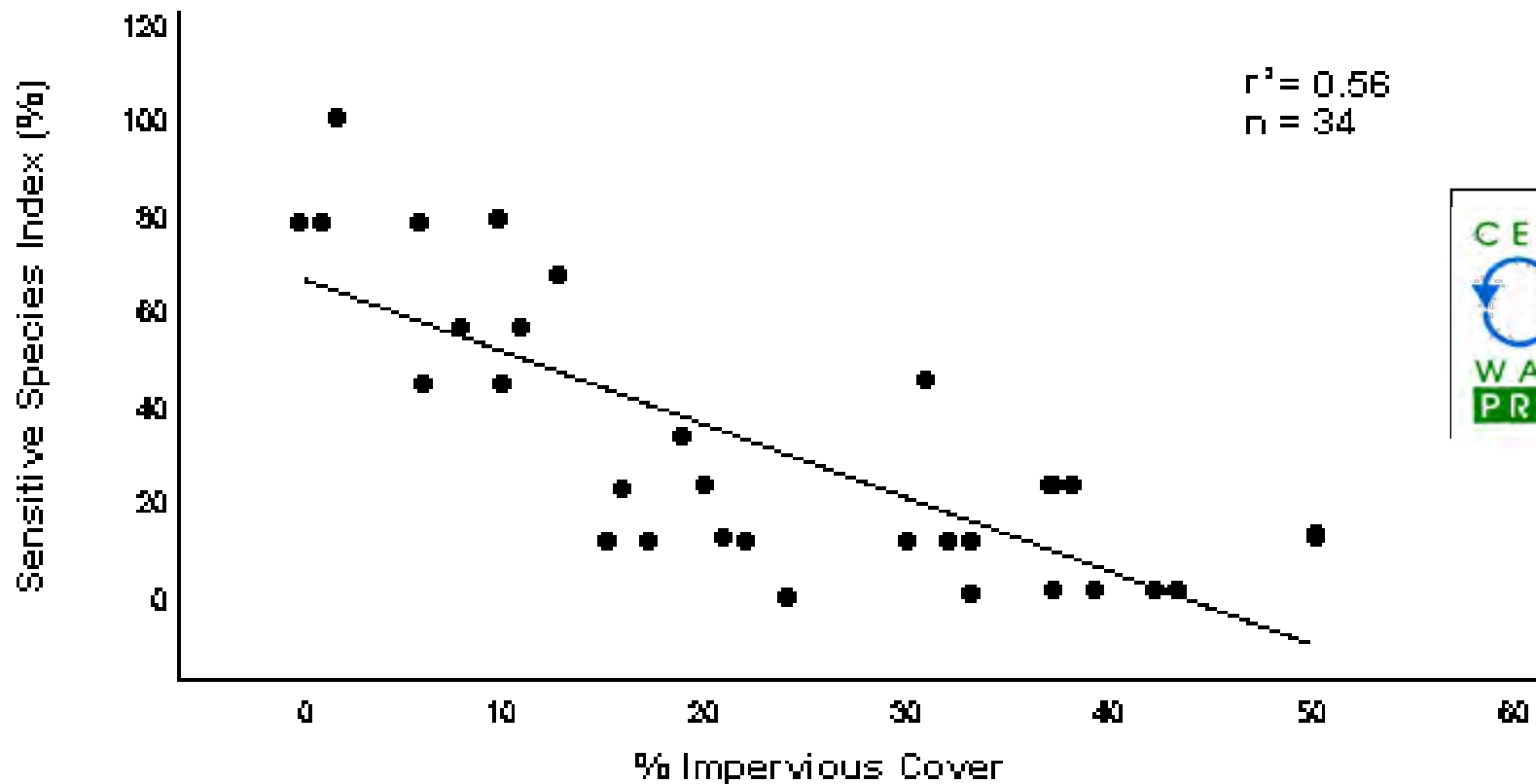
Habitat Enhancements

- Food sources
- Cover
- Scour pools
- Flow diversity



Impervious Cover Impacts on Aquatic Biota (Sensitive Species)

(Source: Maxted and Shaver, 1997)



Heron in Charlotte Sugar Creek







Stormwater Management

- Energy dissipation
- Floodplain retention
- Channel protection
- Water quality treatment



Floodplain stormwater retention and treatment



Integrating habitat with stormwater



Stream Crossings

- Aquatic organism passage
- Minimize geomorphic impacts
- Pass flood flows







Monitoring & Maintenance

- Projects are most vulnerable early
- Natural adjustments to hydrologic & habitat conditions





Big
Turd

Public Access & Education

- Greenways & paths
- Signs
- Events





Newland: Handicapped Fishing Access

Fletcher: Nature Trail with Signs





Charlotte-Mecklenburg: Little Sugar Creek

www.charmeck.org/Departments/StormWater/Projects

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Floodzone

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Water Quality

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Little Sugar Creek/Charlottetowne Ave to Baxter Street (Midtown)

Stream Restoration and Greenway Trail

Extreme makeover! Stream restoration work on this section of Little Sugar Creek is now finished. Greenway construction begins soon.



February 2008



May 2008

Contact Us
CMSWS or Water Co.
Contractors & Engineers
Easements
Forms
Lakes
Pollution Prevention
Sediment & Erosion Control
Service Requests
Storm Water Professionals



DANGER

HIDDEN 60 FT. DROP
1 MI. DOWN STREAM



Stream Enhancement & Restoration

- Channel morphology & floodplain connection
- In-stream structures
- Streambank bioengineering
- Riparian buffers
- Habitat enhancements
- Stormwater management
- Stream crossings
- Monitoring & maintenance
- Public access & education



Urban Streams: Turning Liabilities into Assets

- Build community support
- Use local media
- Take advantage of grants
- Treat streams as valuable resources
- Be a maverick!

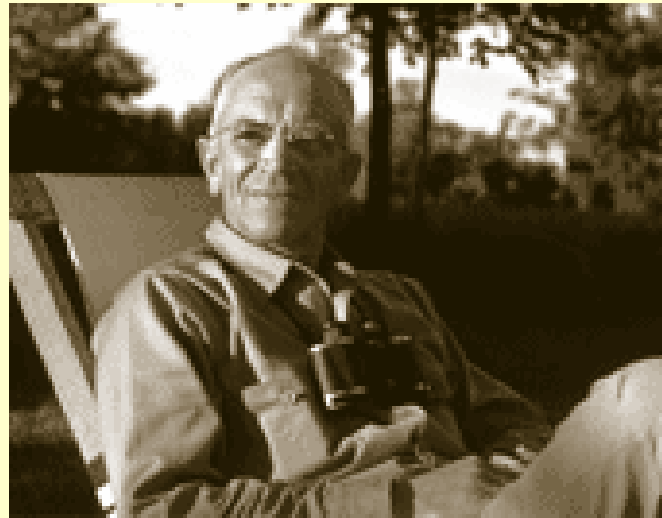


Know your Limitations



"That the situation appears hopeless should not prevent us from doing our best."

-Aldo Leopold



Thank You and Enjoy the Ride!

