



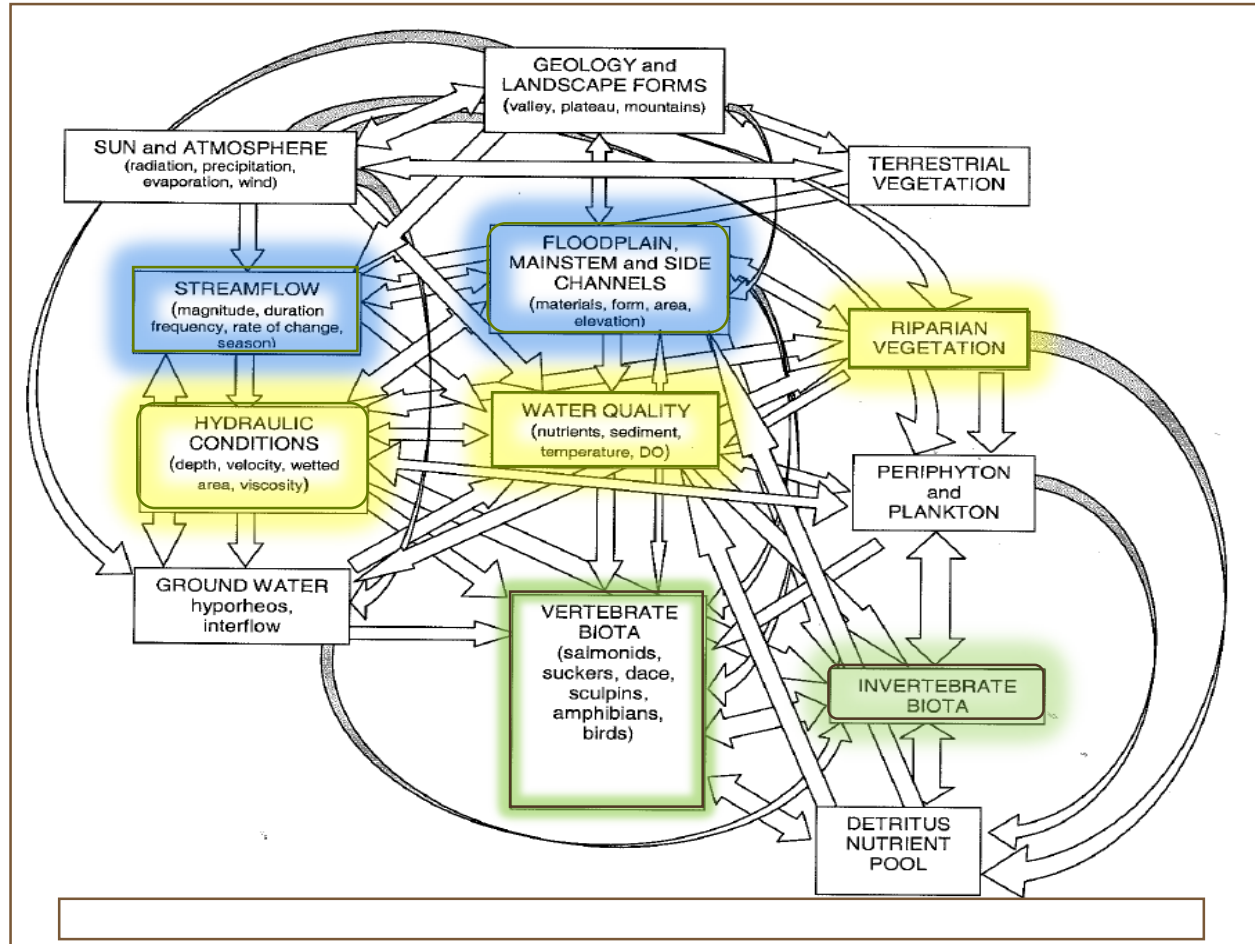
Accounting for Floodplain Function

Marjorie Wolfe, PE, CFM

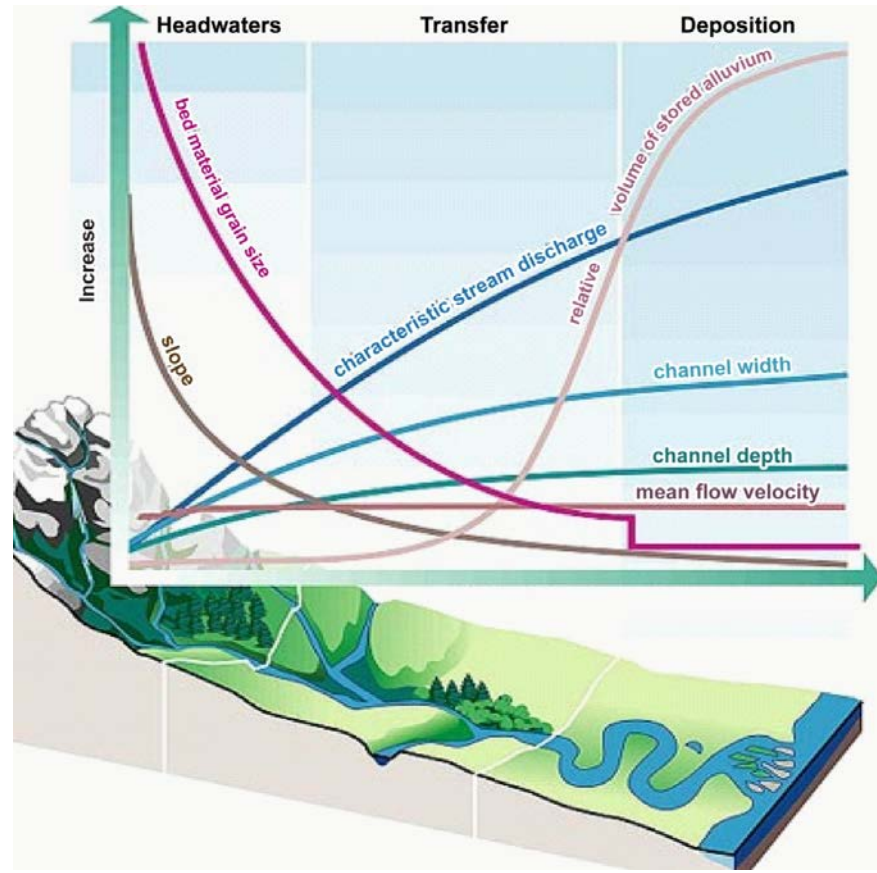


Conceptual model of elements (boxes) and processes (arrows) of the Green River ecosystem

Diagram by Chris Konrad



Natural processes depend on landscape position



Headwaters

- Infiltration
- Sediment Supply
- Spawning

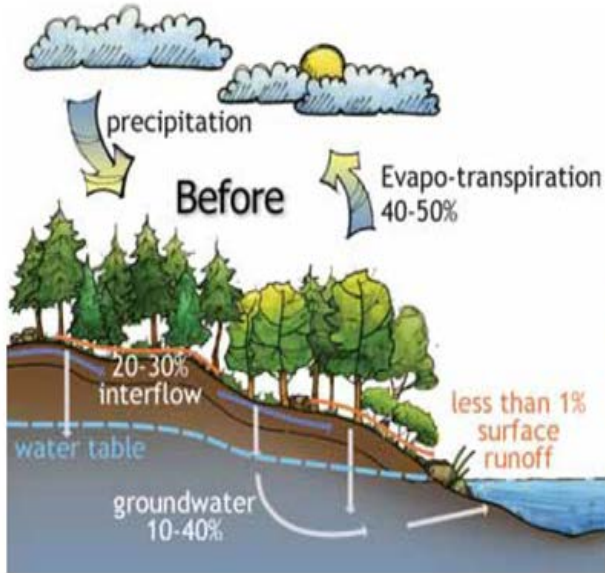
Transfer Reaches

- Storage/ Attenuation
- Agriculture
- Fish Passage, Refuge, Food Webs

Delta/ Estuary

- Storage
- Rearing
- Water Quality

Adapting to change



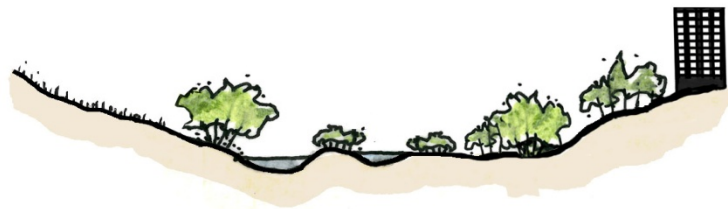
Increased Runoff



Floodplain Development



Increased Flooding
Increased Erosion
Loss of Habitat
Degraded Water Quality



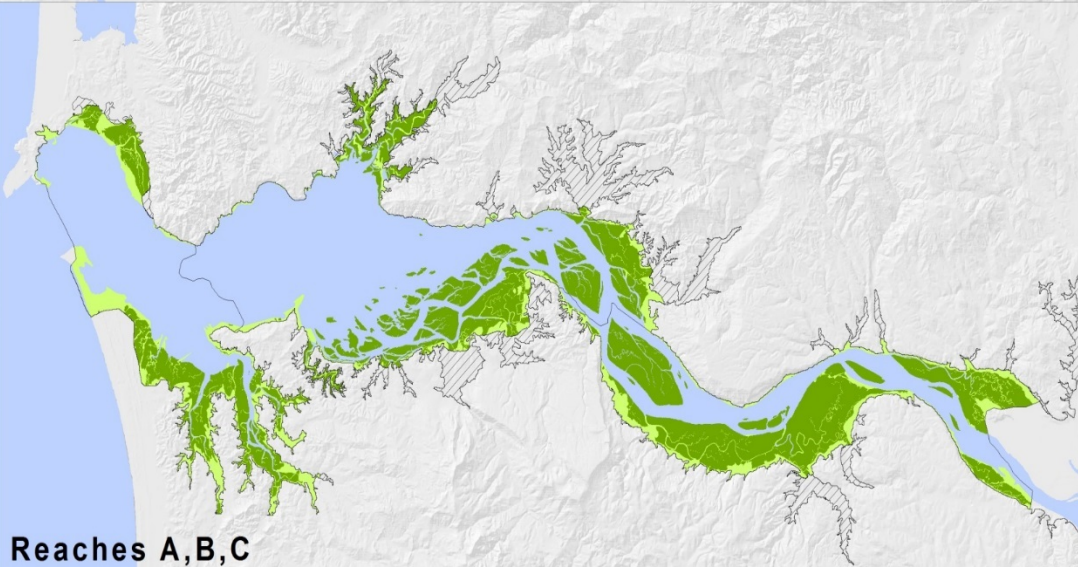
Storage
Attenuation
Habitat
Water Quality



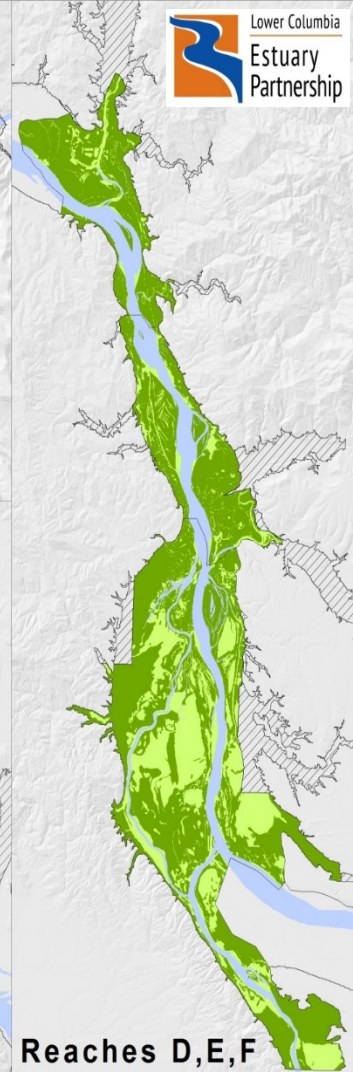
Incision
Flood Risk
Pollution

Historic Native Habitats: 224,081 acres
Historic 'Priority' Native Habitats overlay

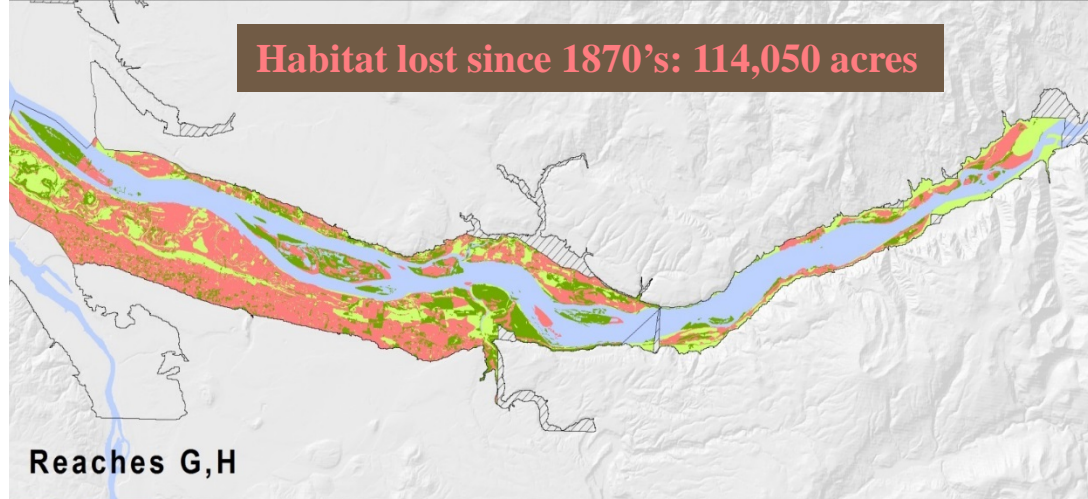
Reaches G,H



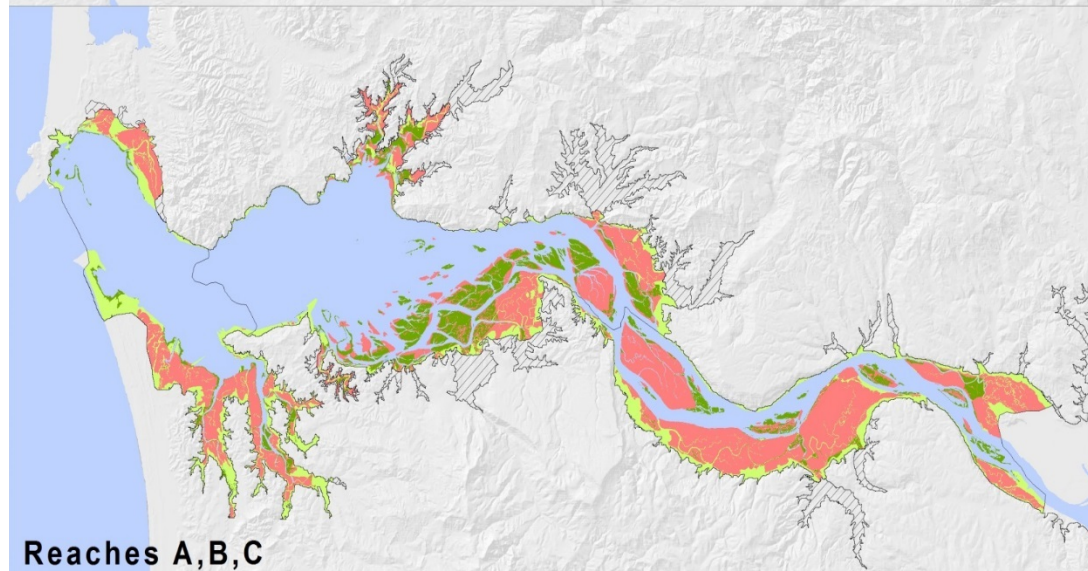
Reaches D,E,F



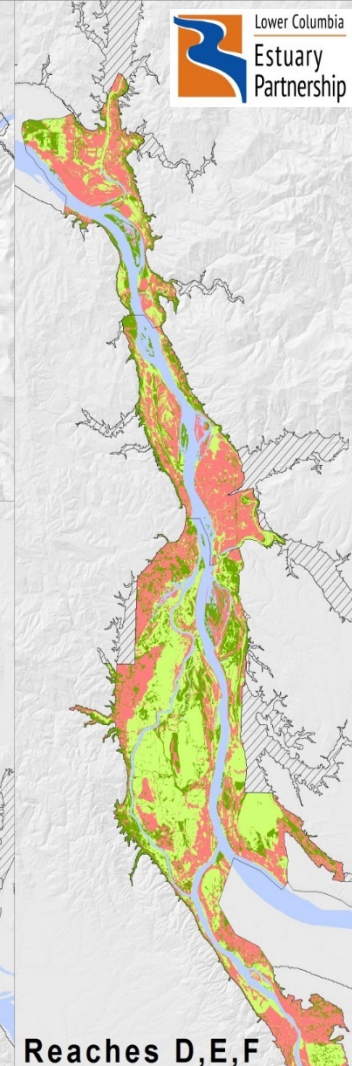
Habitat lost since 1870's: 114,050 acres



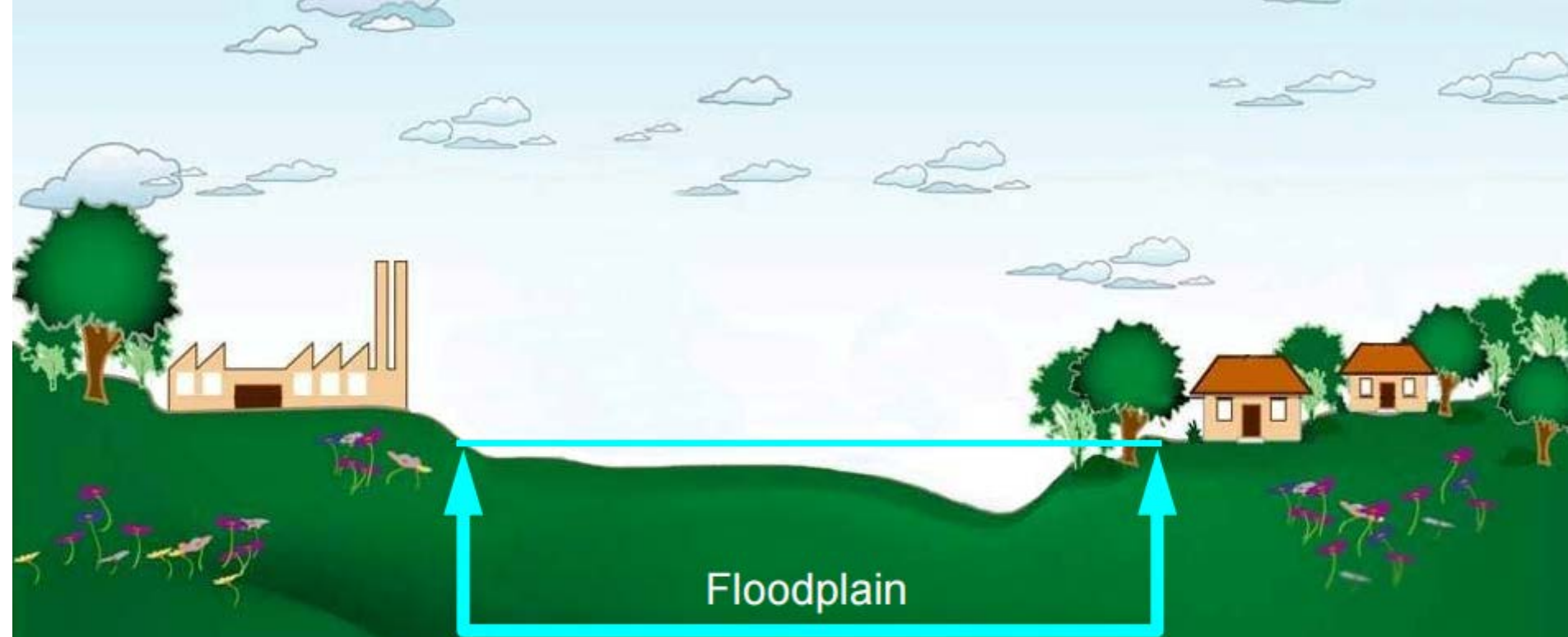
Reaches G,H



Reaches A,B,C

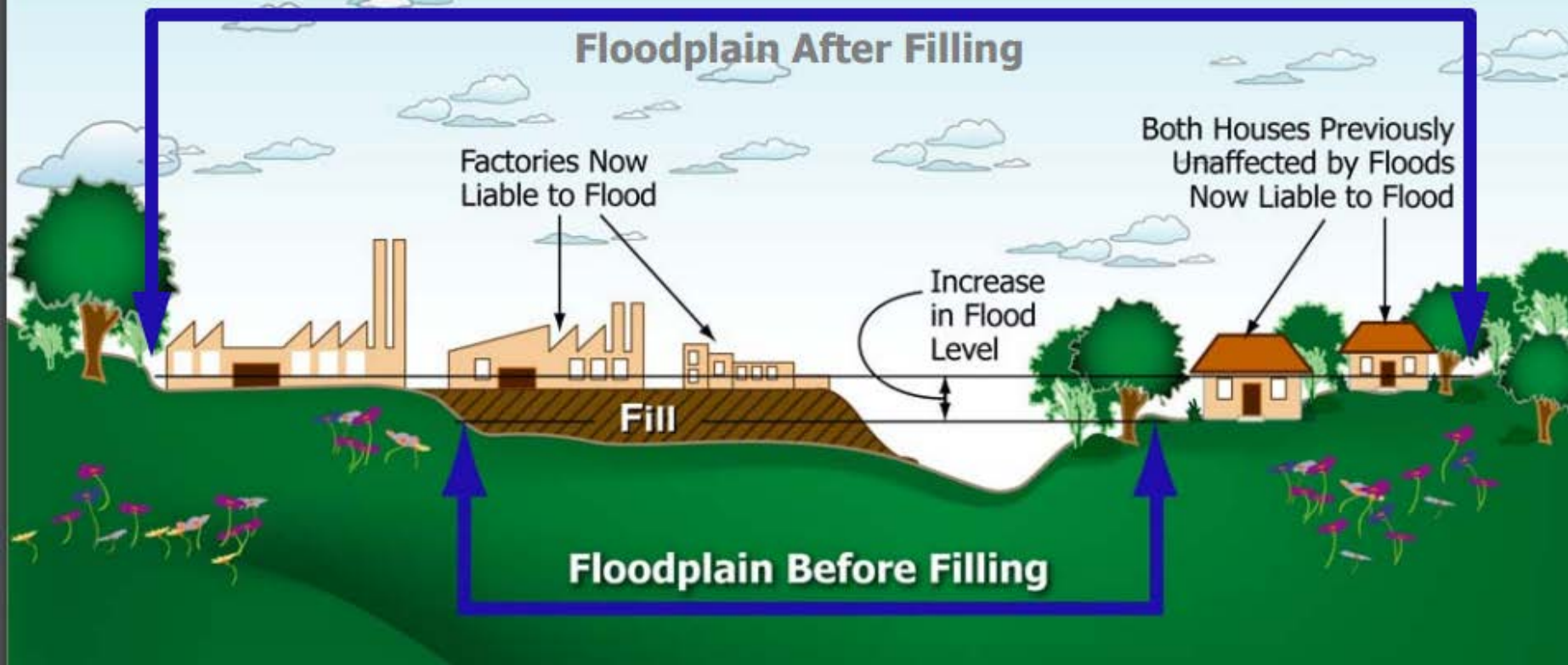


Reaches D,E,F



If you prevent floodplain fill,
you keep existing development safe.

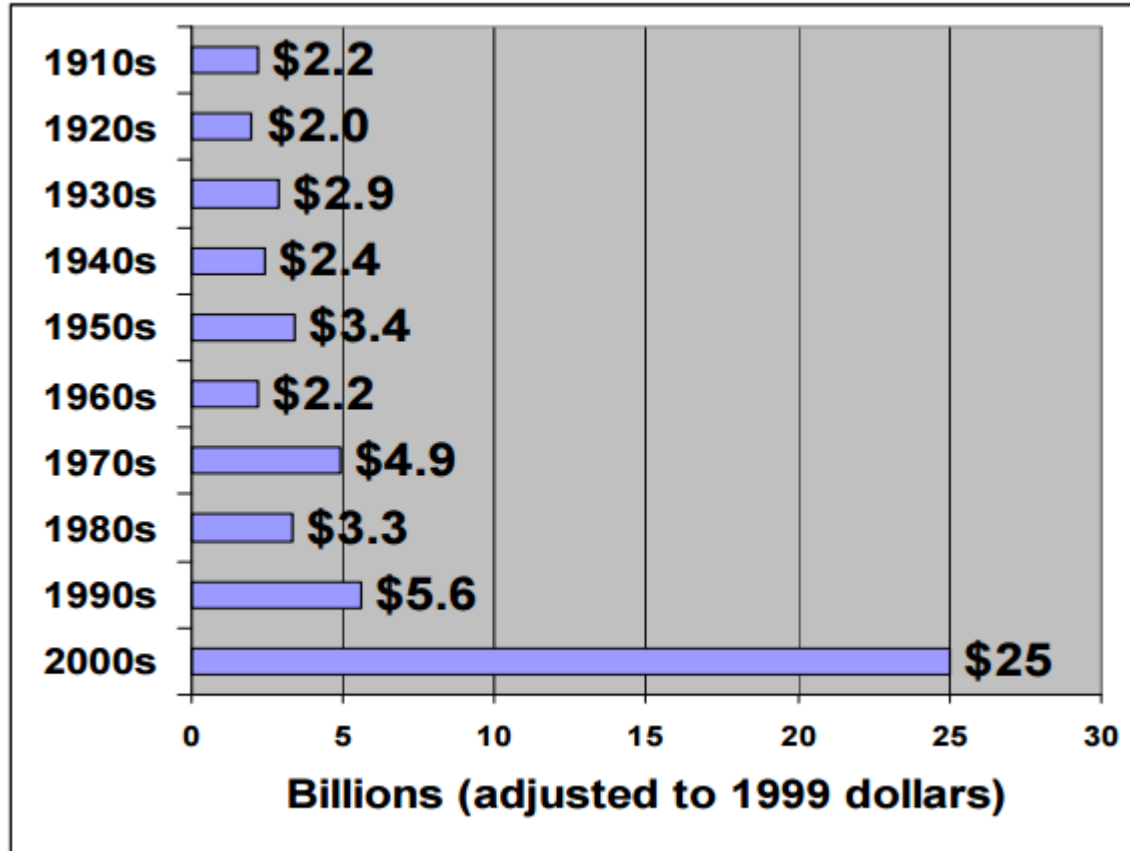
Today's Floodplain Is Not Necessarily Tomorrow's Floodplain



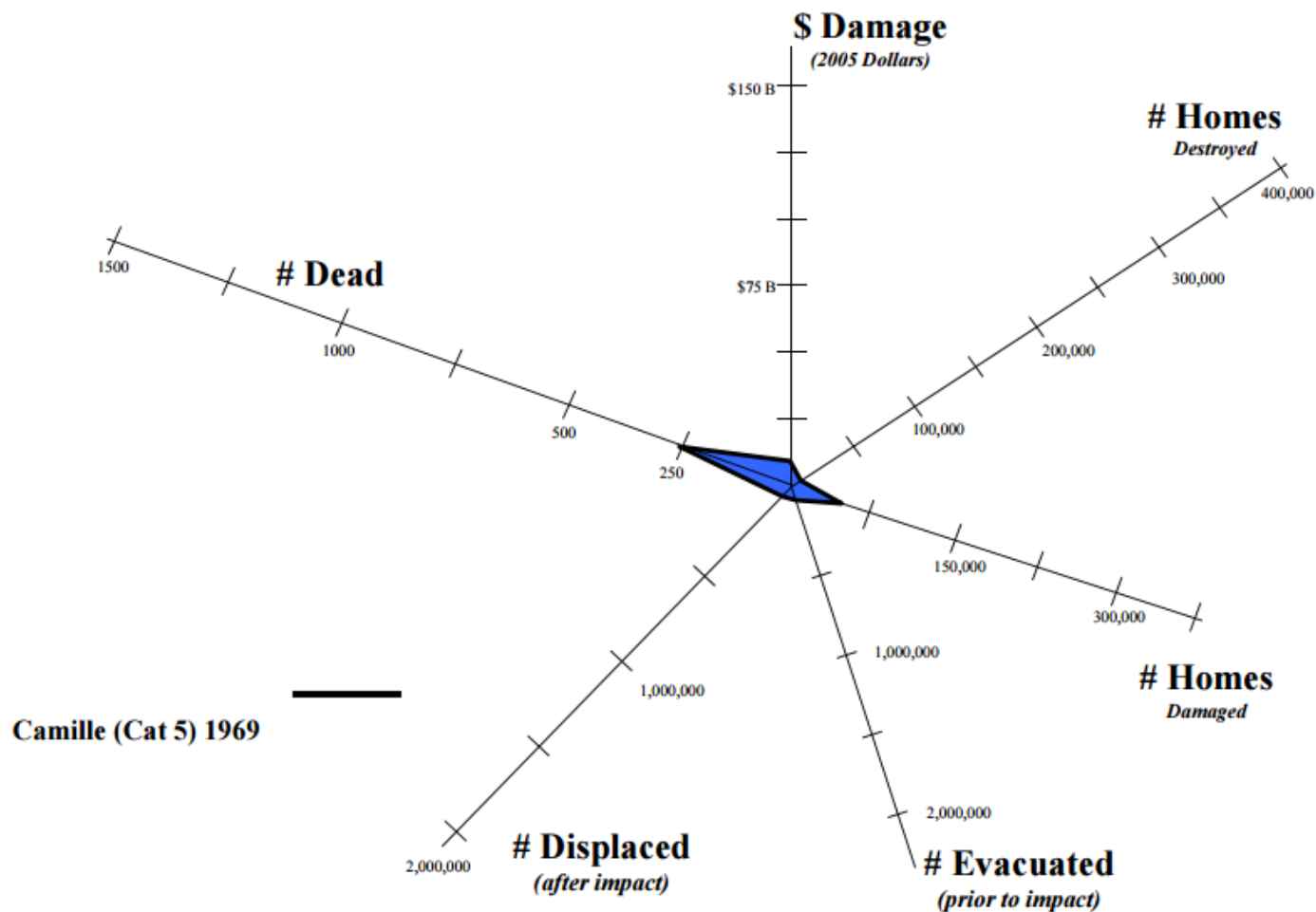
Risk = Probability x Consequence



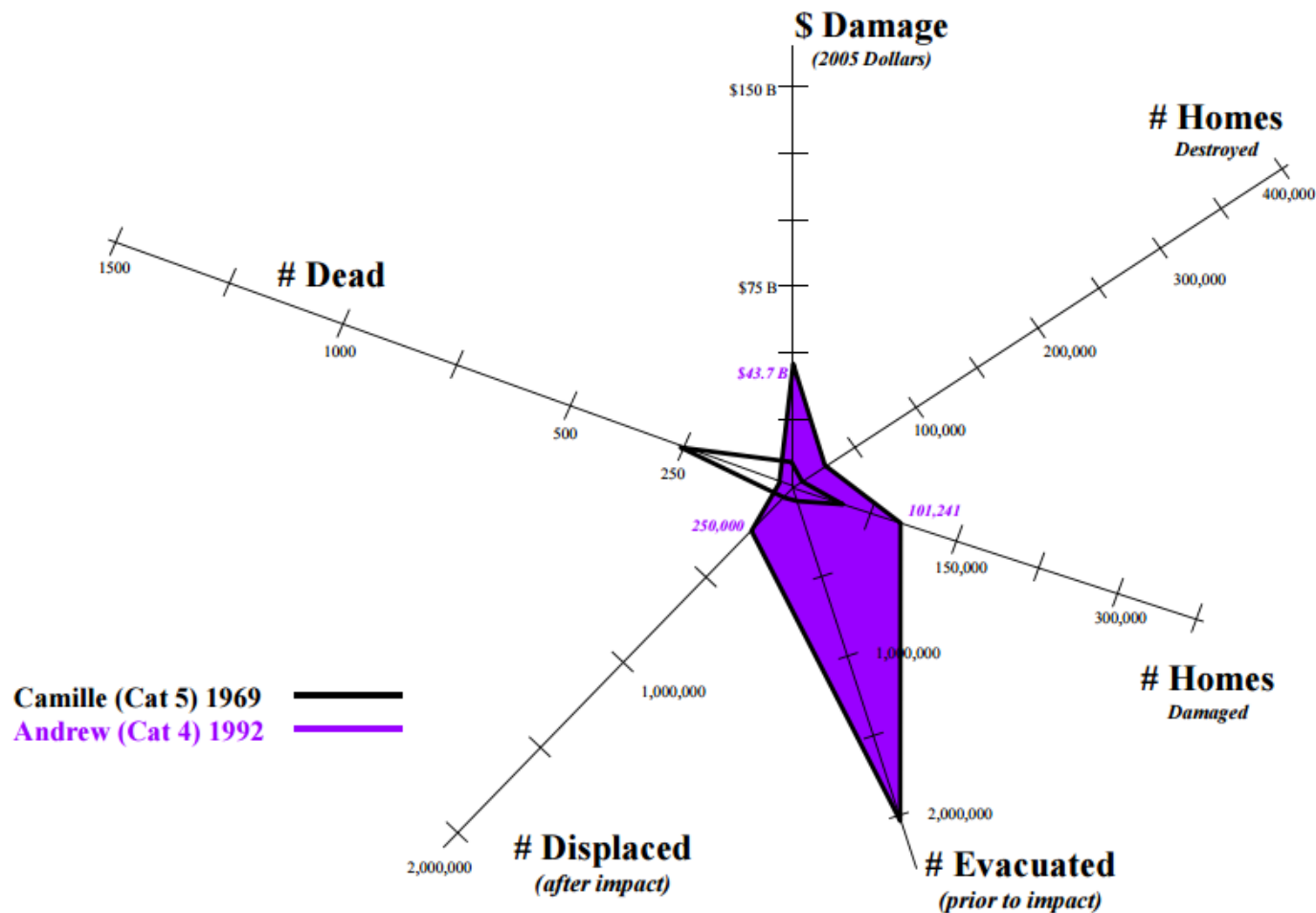
The Cost of Flooding has Dramatically Increased



Hurricane Camille

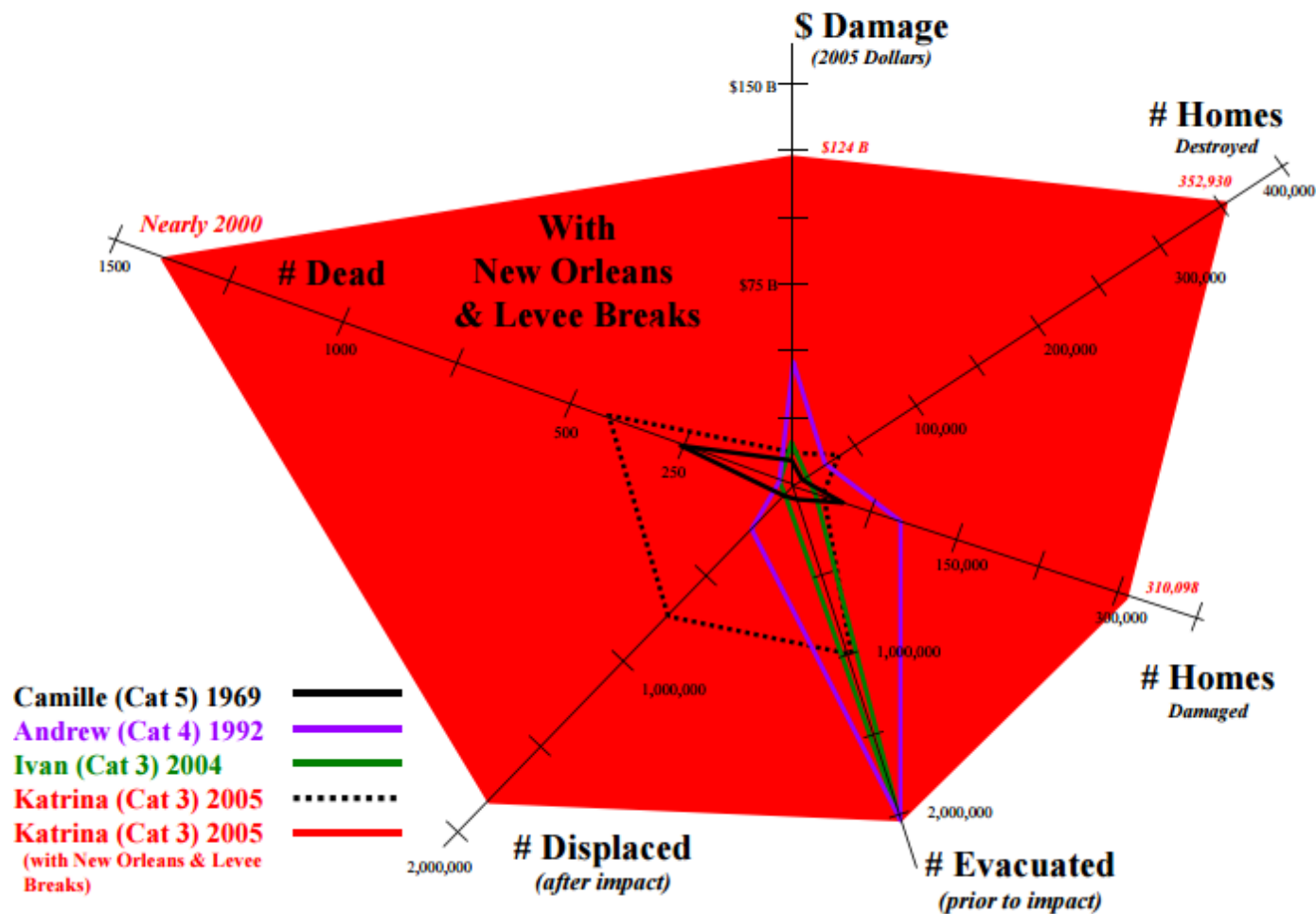


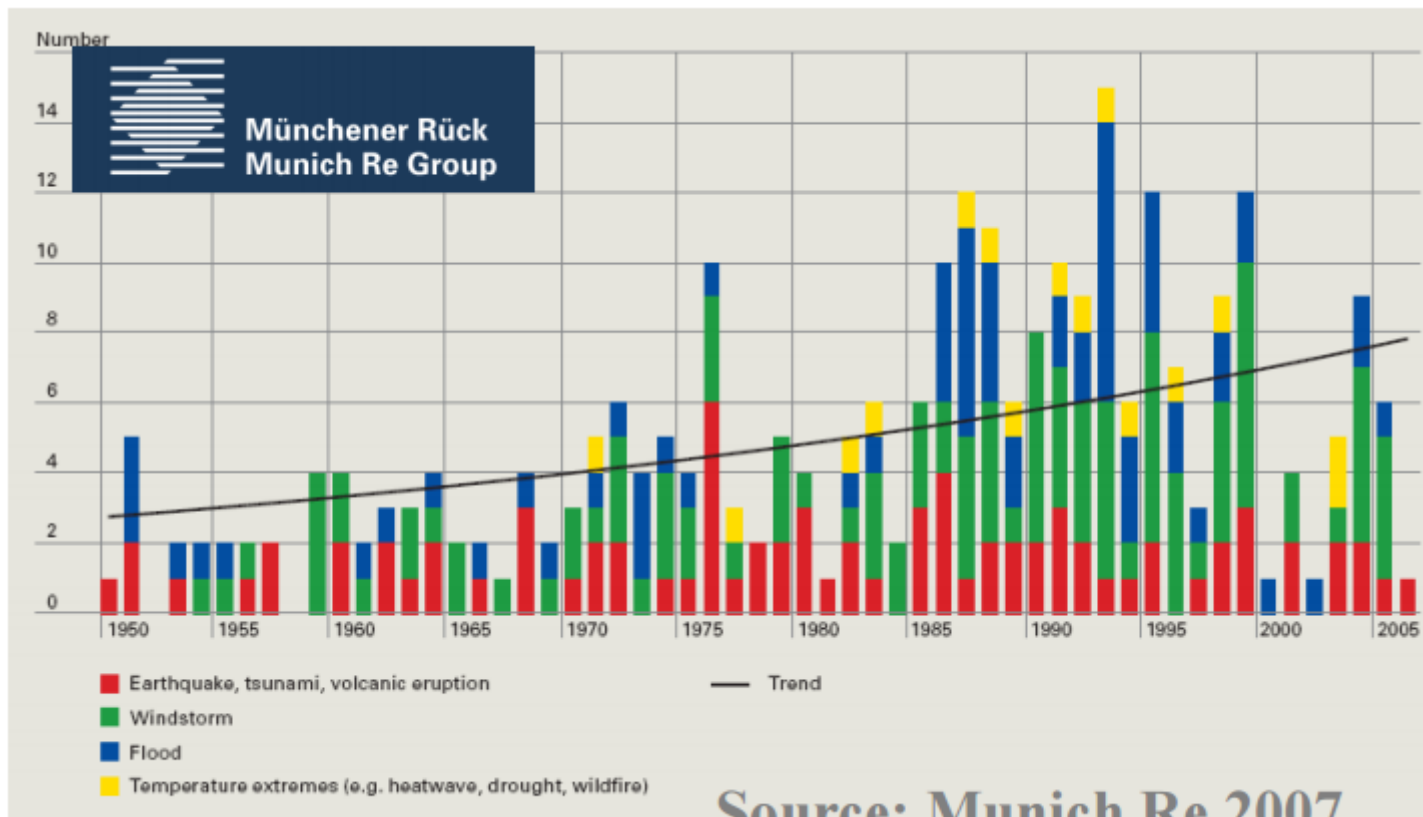
Camille and Andrew





Katrina & Rita w/o New Orleans





Courtesy of Dr. Roger Pielke Jr

Source: Munich Re 2007

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NO “Adverse Impact”

“...an approach that ensures the action of any property owner, public or private, does not adversely impact the property and rights of others” –ASFPM definition

FEMA-NMFS BiOP – Compensatory Mitigation

“no net loss or beneficial gain” of natural floodplain functions

- a. **The addition of fill**, structures, levees, and dikes, which **reduces flood storage** and fish refugia, impedes habitat forming processes, increases flow volume and velocity thereby eroding stream banks and beds, and alters peak flow timing thereby increasing risk of injury to redds, fry, and alevin;
- b. The **addition of impervious surfaces**, which reduces hyporheic function and stream recharge, increases storm water, pollutant loading, water temperature, velocity, and scour, and modifies peak and base flows;
- c. **Vegetation removal**, which reduces shade, detrital input, velocity refuge, and habitat complexity and increases storm water and erosion; and
- d. **Bank armoring**, which reduces instream habitat values and impedes habitat forming processes.



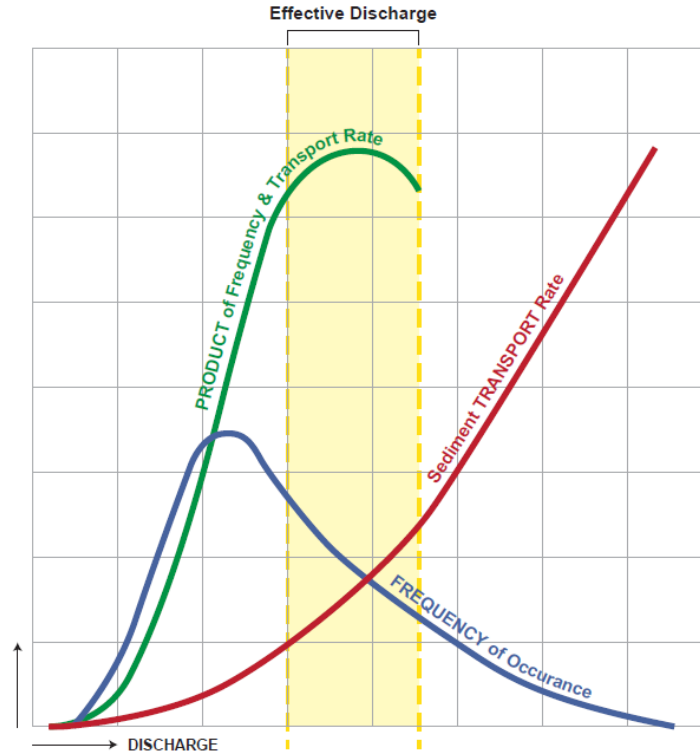
Connecting Upland and Floodplain Function

Infiltrate 1-2 inches a day AND
Protect and restore floodplains
Instead of building detention

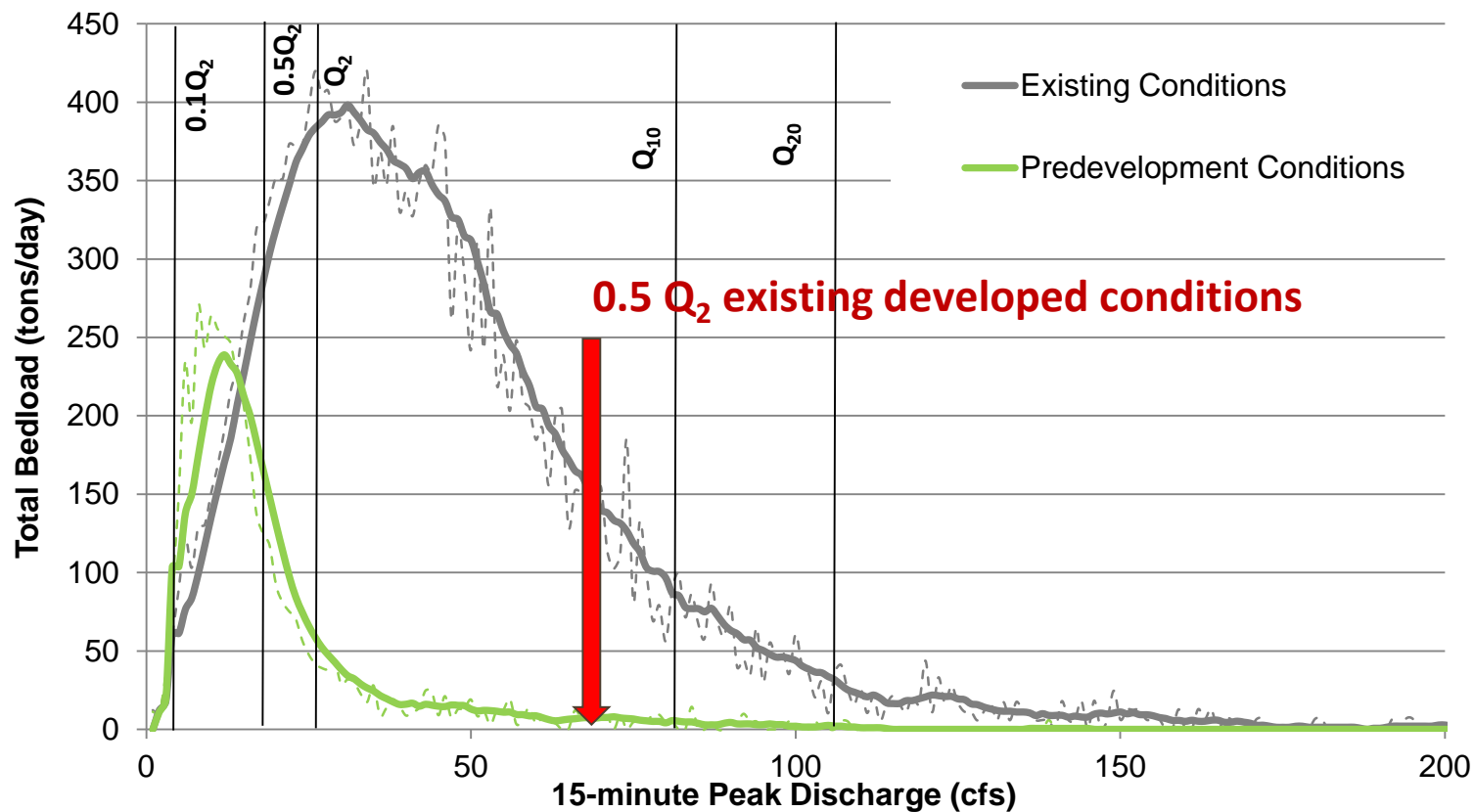
When detention ponds don't work!

- Effective flow thresholds are lower than expected
- Pre-developed condition is impervious

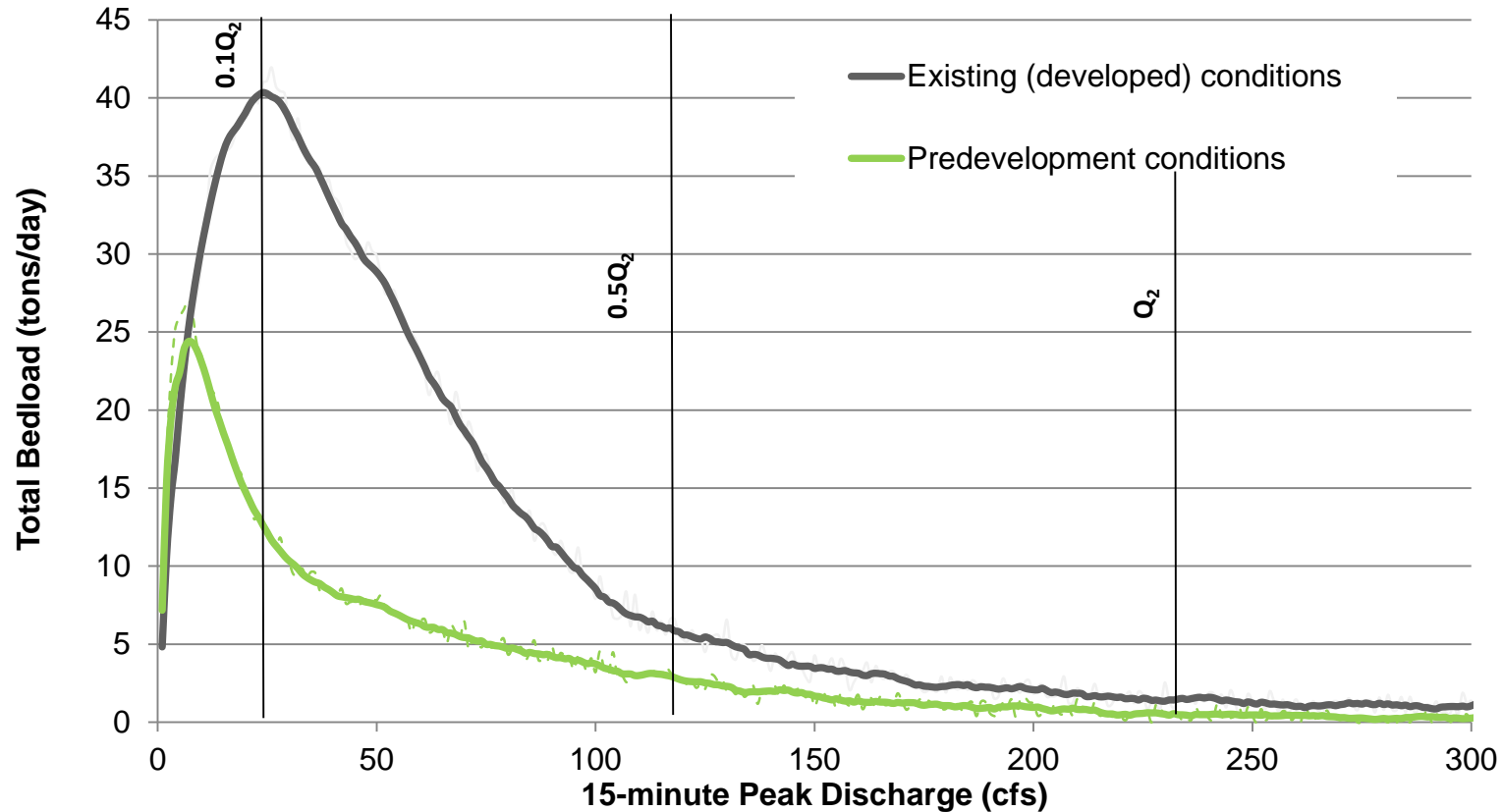
Flows most affected by urbanization are those that do the most geomorphic work



Clark Creek Effective Discharge Curves

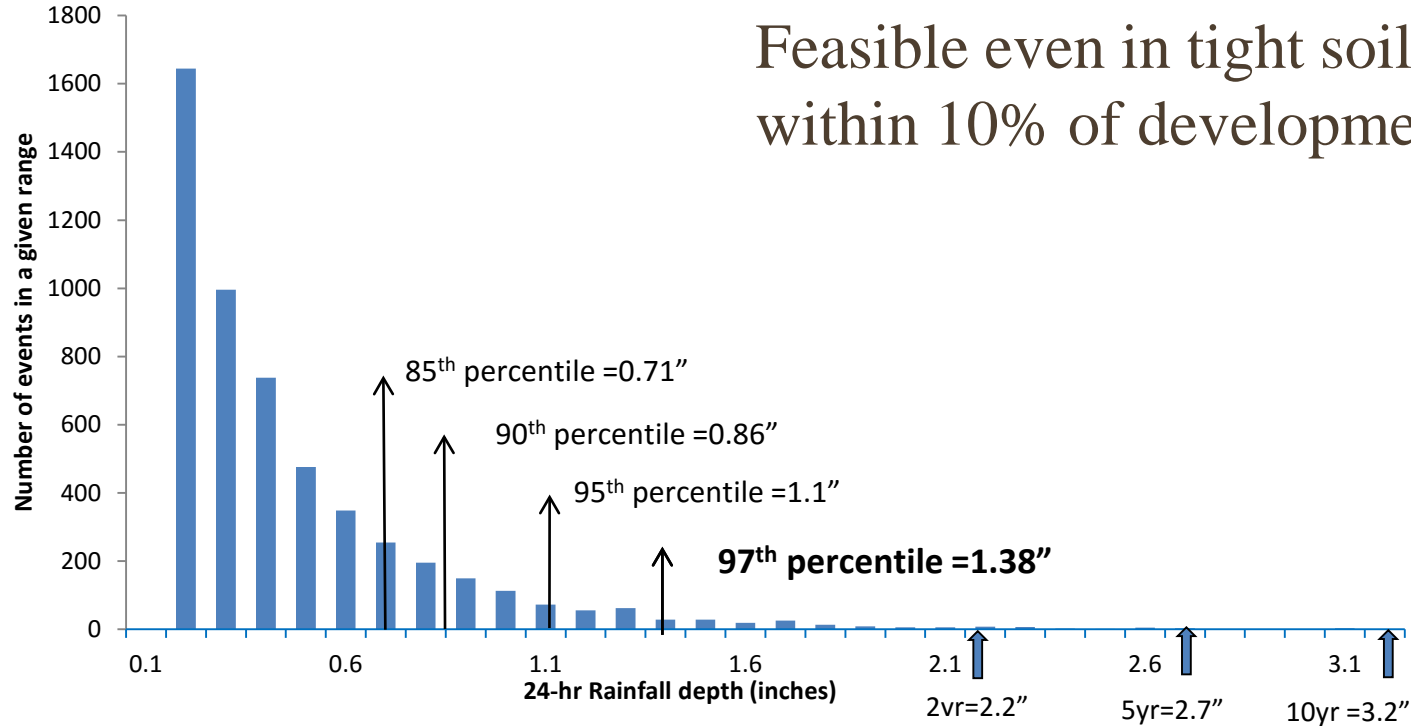


Battle Creek Effective Discharge Curves



Salem's 24 hour Percentile Storm Analysis

Feasible even in tight soils
within 10% of development area

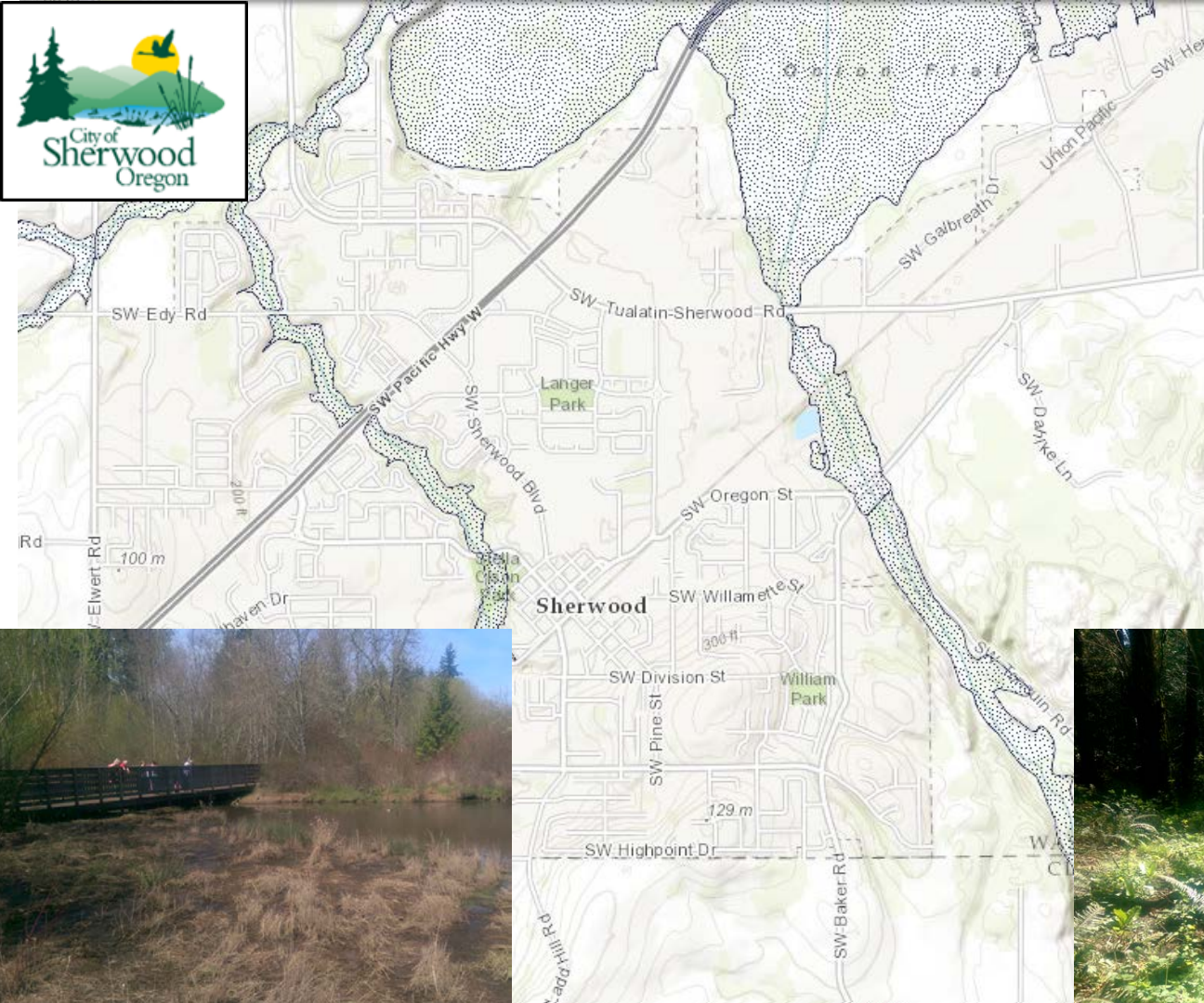


Cost Comparison for Stormwater Detention

	LID	ON SITE POND	Regional Facility
# of facilities	80	20	1
Initial Construction	\$400,000	\$500,000	\$400,000
Establishment	\$16,000	\$0	\$20,000
Annual Maintenance	\$1,600	\$30,000	\$4,000
Inspection (4 yr cycle)	\$4,000	\$3,200	\$400
\$ over 50 year	\$546,000	\$2,040,000	\$625,000

Disclaimer: These cost estimates are based on broad assumptions from various sources. Actual costs should be based on local data





Unique Topography

Active floodplain
widths up to 400ft

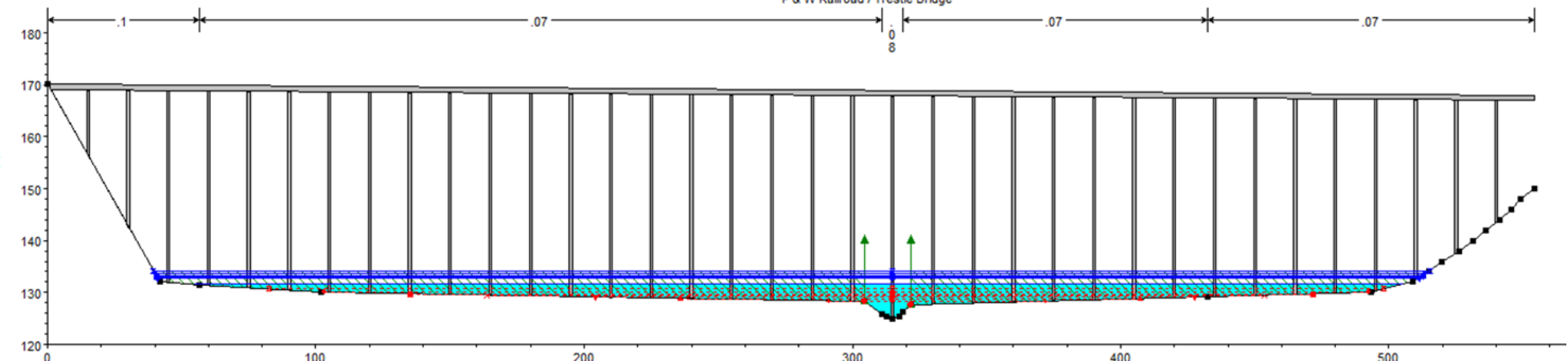
City Park Wetlands



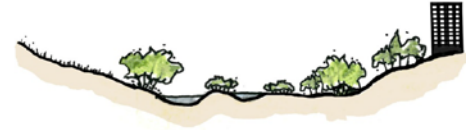


Rock Creek South - Tualatin River up to P & W Railroad / Trestle Bridge

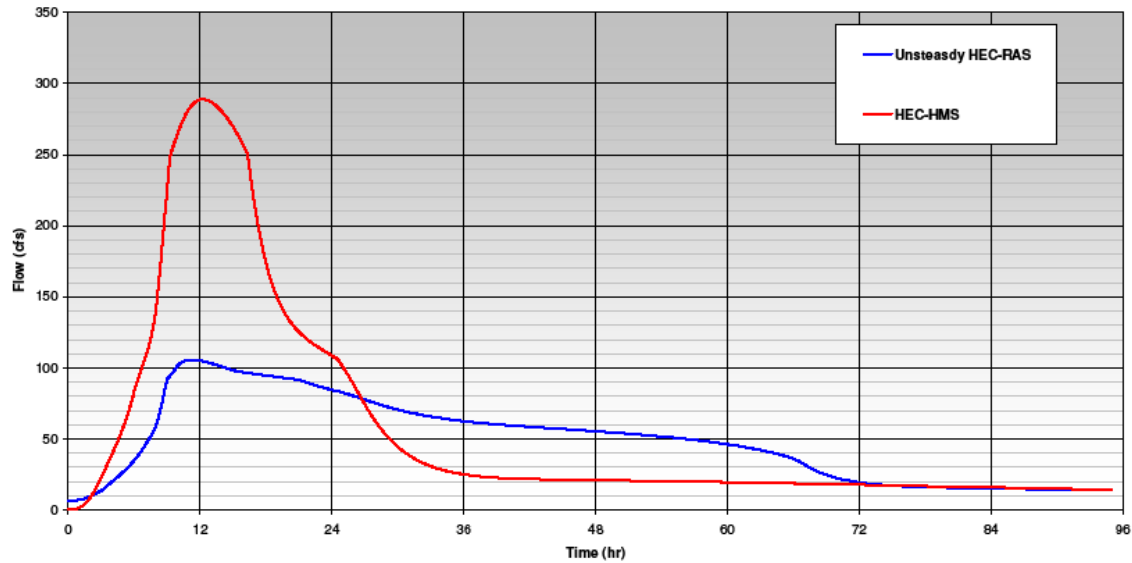
Plan: CWS FUT - Rock_South 9/15/2015



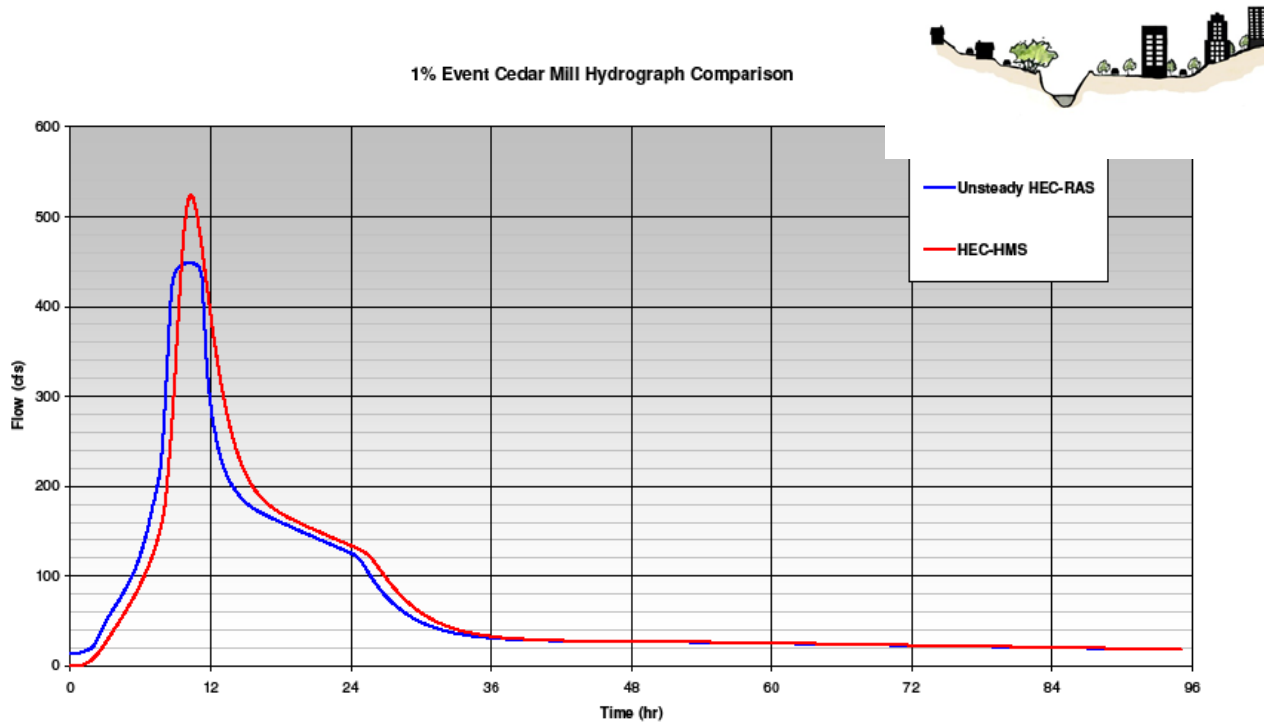
Connected Floodplain



1% Event North Johnson Hydrograph Comparison

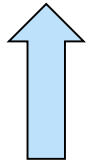


Confined Channel- limited floodplain

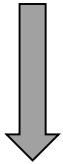


Clean Water Services Riparian Assessment

Shade Credit Program

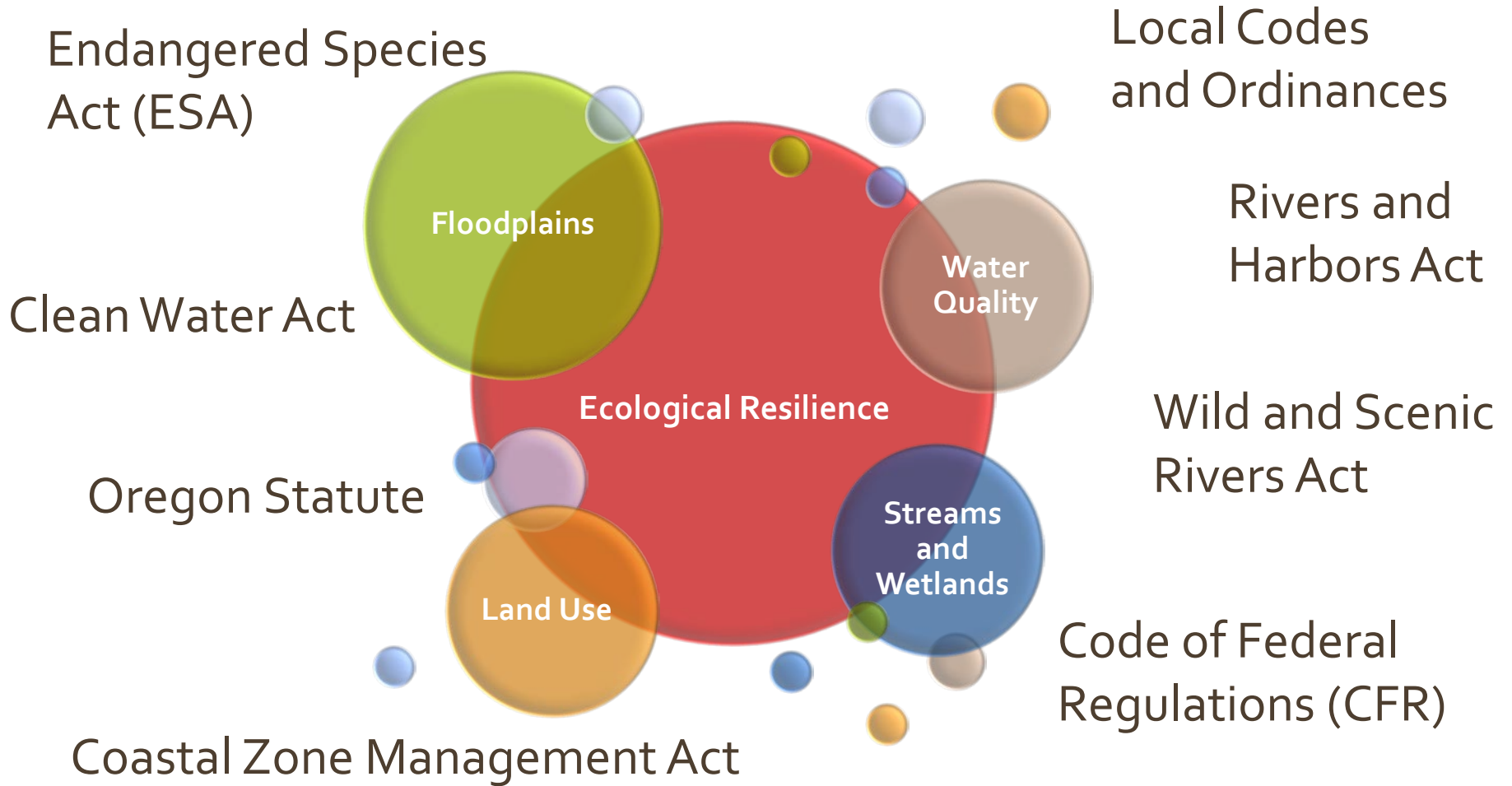


Beaver activity
Floodplain Storage
Ecological Diversity



Bank Erosion
Incision







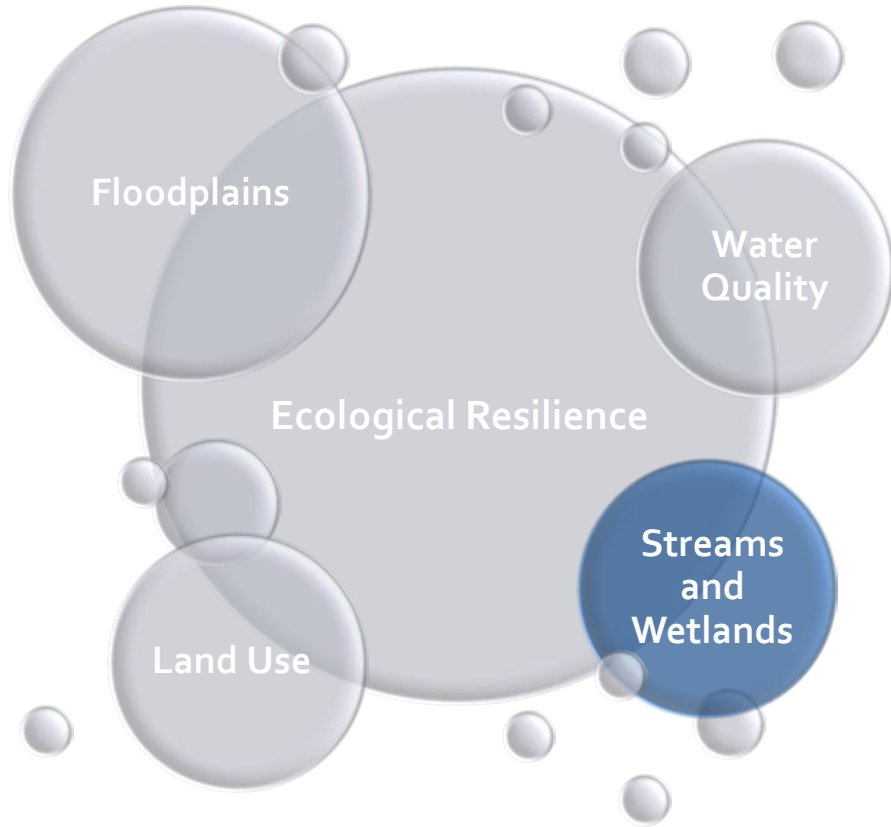
EPA/DEQ -MS₄

- Hydromodification
- Green Infrastructure/LID(A)
- Adaptive Management

Stormwater Regulations



What is the problem we are trying to solve?



USACE/DSL/NMFS/USFW

- Wetland protection/Mitigation
- Stream protection/Mitigation
- Endangered Species Act (ESA)

Habitat and Water Quality





FEMA/Local Ordinance

- Buffers
- Natural & Beneficial Functions
- ESA protections
- Flood Protection

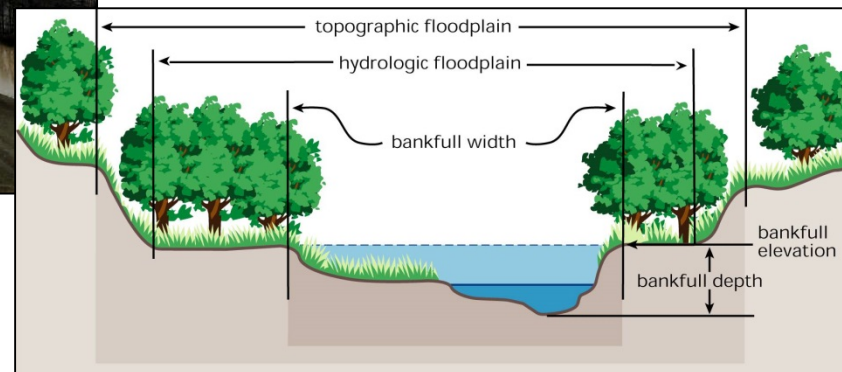


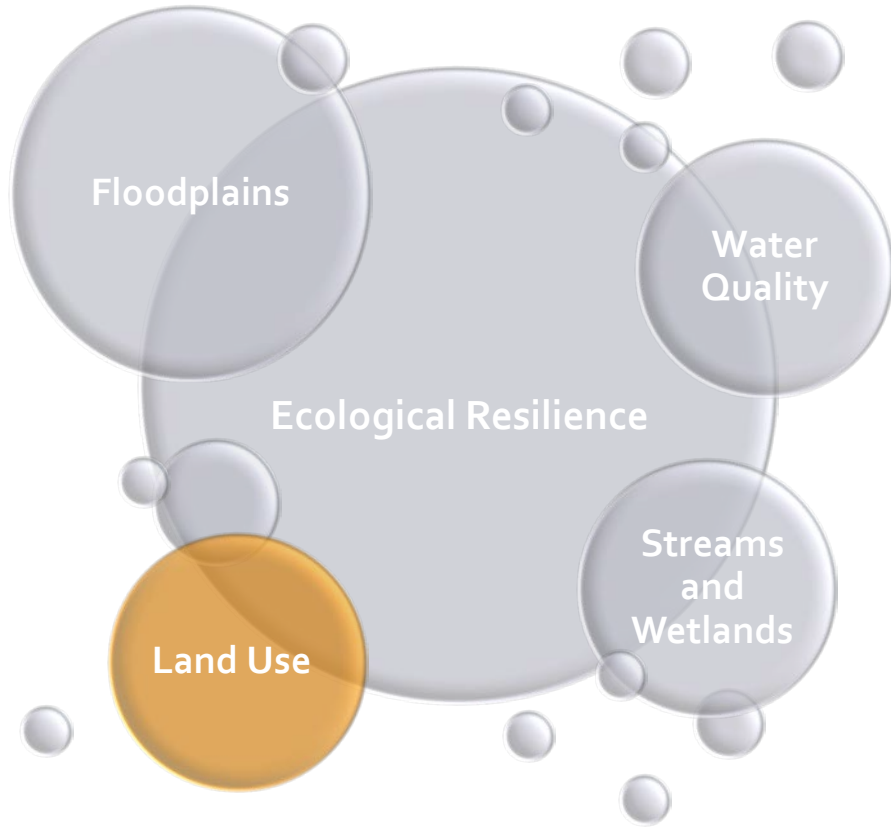
Chehalis River 2007. Photo from BergerABAM

What is the problem we are trying to solve?



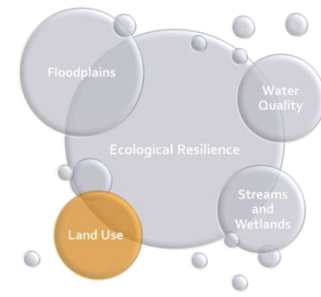
Floodplains





Local Land Use

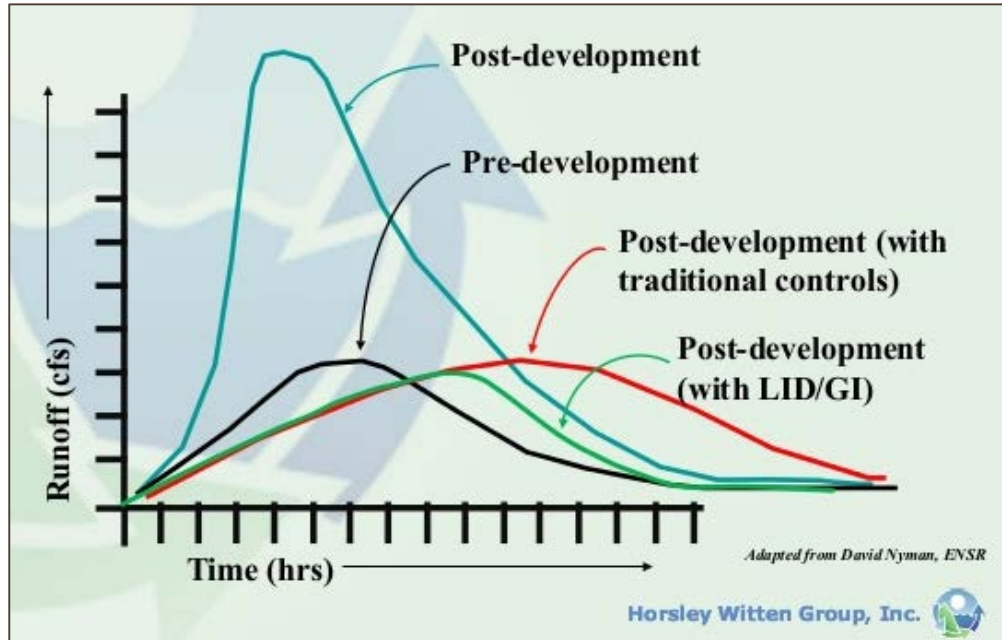
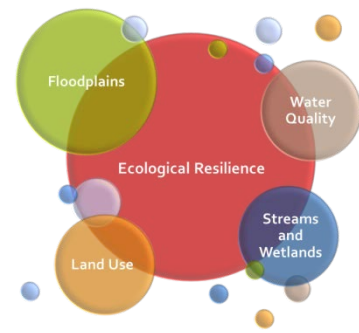
- Vegetated Corridors
- Density
- Urban Growth Boundaries



Land Use

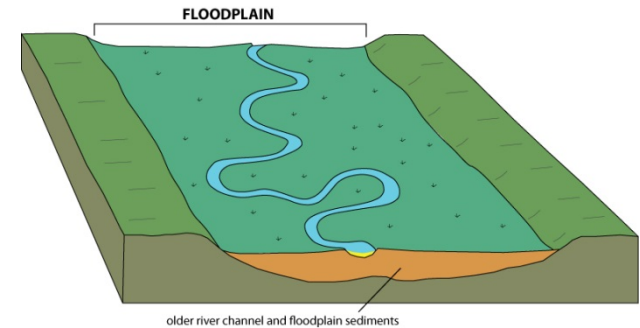


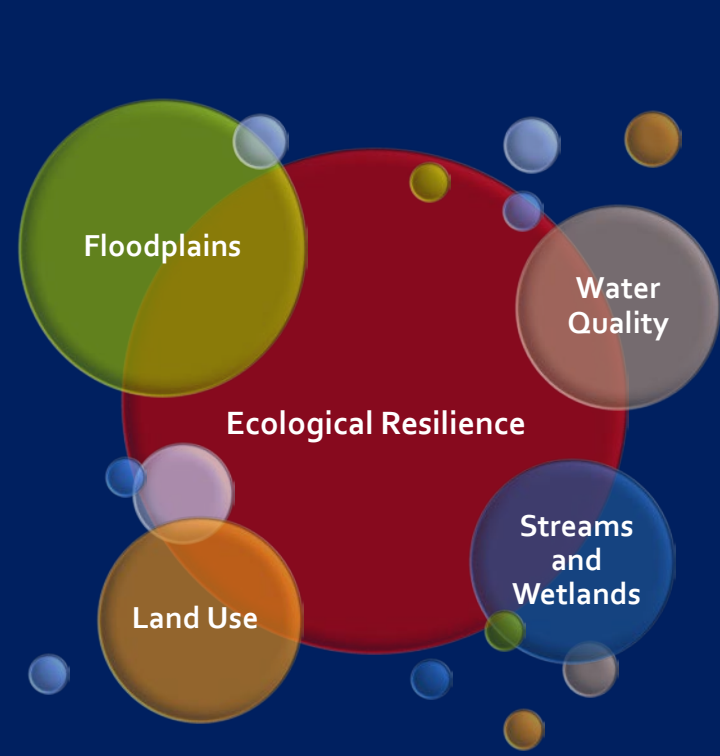
Integrated Approach



Floodplains by Design

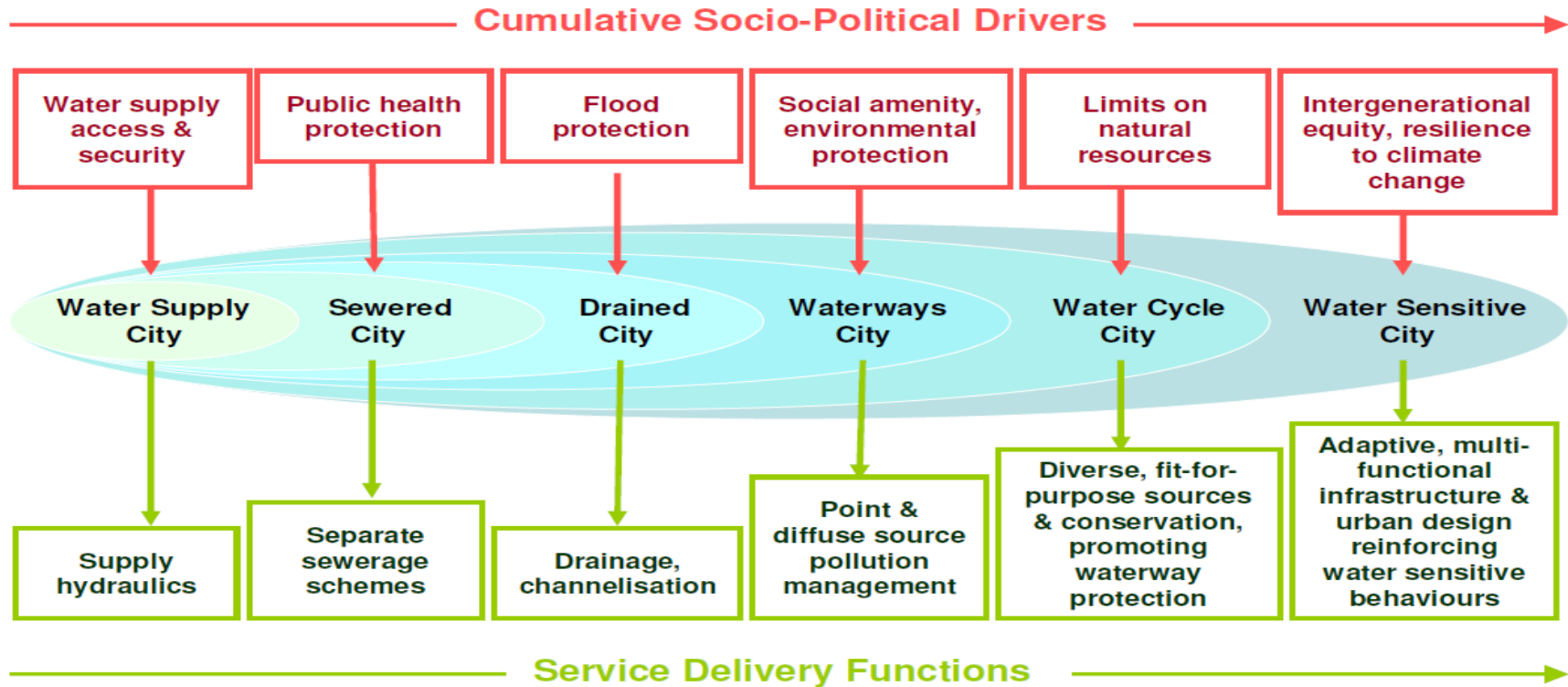
• REDUCING RISK, RESTORING RIVERS •





STRATEGIES		GOALS			
		Flow Reduction	Flow Attenuation	Coarse Sediment Supply	Stream Resiliency
Stormwater Regulations and Code	Infiltration				
	Open channel flow				
	Detention				
Floodplain and Natural Areas Regulations	Setbacks/Buffers				
	Floodplain Protection				
	Wetland protection				
	Tree protection				
Planning and Projects	Daylight piped streams				
	Stream and floodplain restoration				
	Riparian buffer restoration				
	Wetland restoration				
	Regional detention				

Changing paradigms of water management



If Walmart can do it?



Hilton Head Island, SC



Working with Nature
Partnering with People

Marjorie Wolfe, PE, CFM
Principal Engineer