Integrating Stormwater Quantity and Quality Requirements using the Runoff Reduction Method

Beaufort County, South Carolina

SESWA Fall 2015 Conference

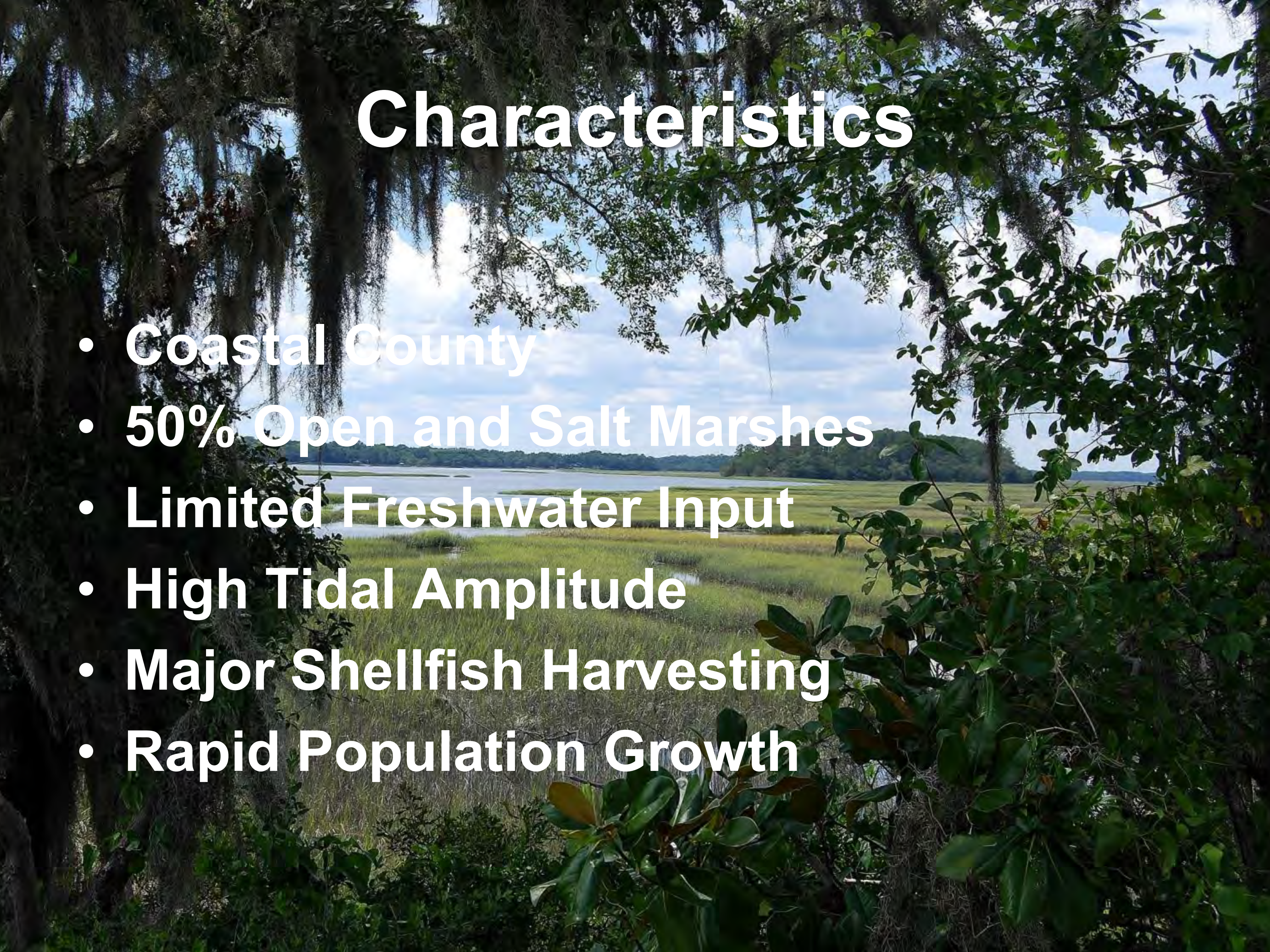
October 14 - 16, 2015

Eric W Larson, PE, CPSWQ, AICP, CFM

An update of an original White Paper by

Dan Ahern, PE, Bob Klink PE, and

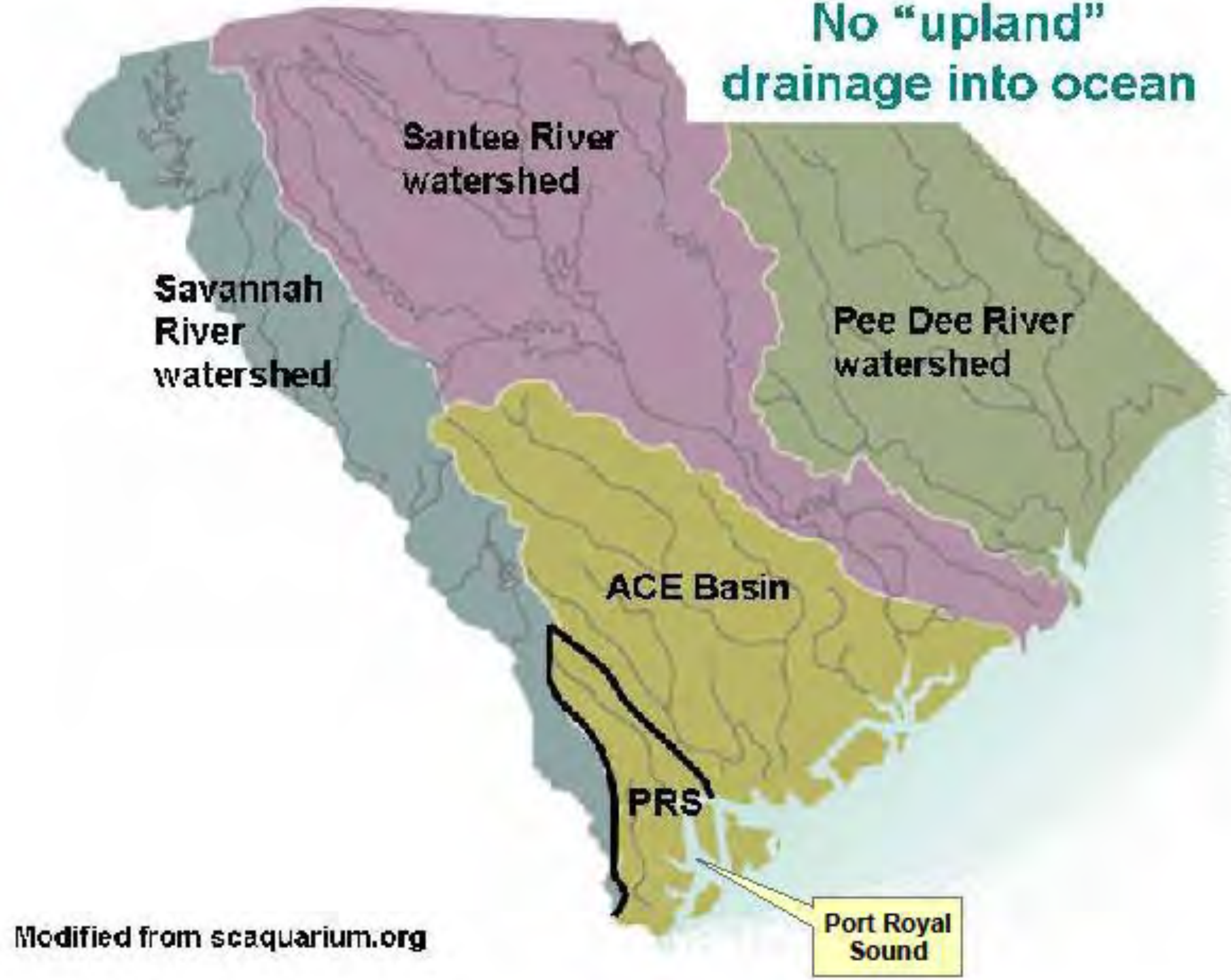
Richard Wagner, PE



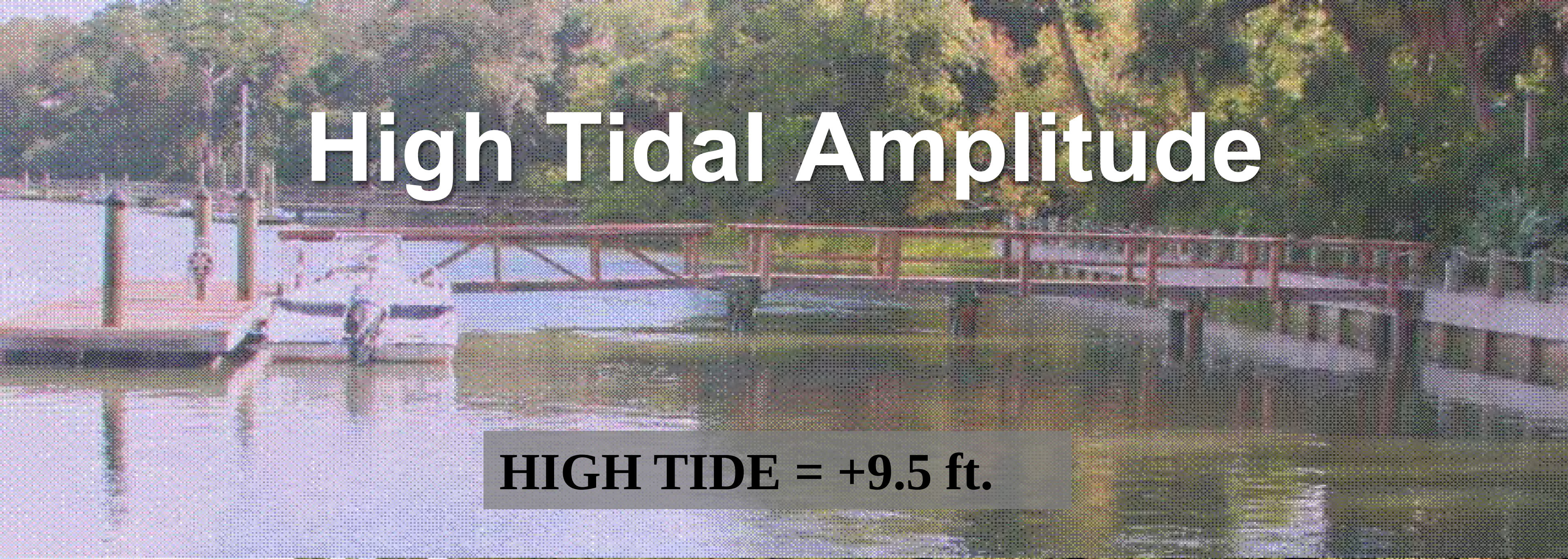
Characteristics

- Coastal County
- 50% Open and Salt Marshes
- Limited Freshwater Input
- High Tidal Amplitude
- Major Shellfish Harvesting
- Rapid Population Growth

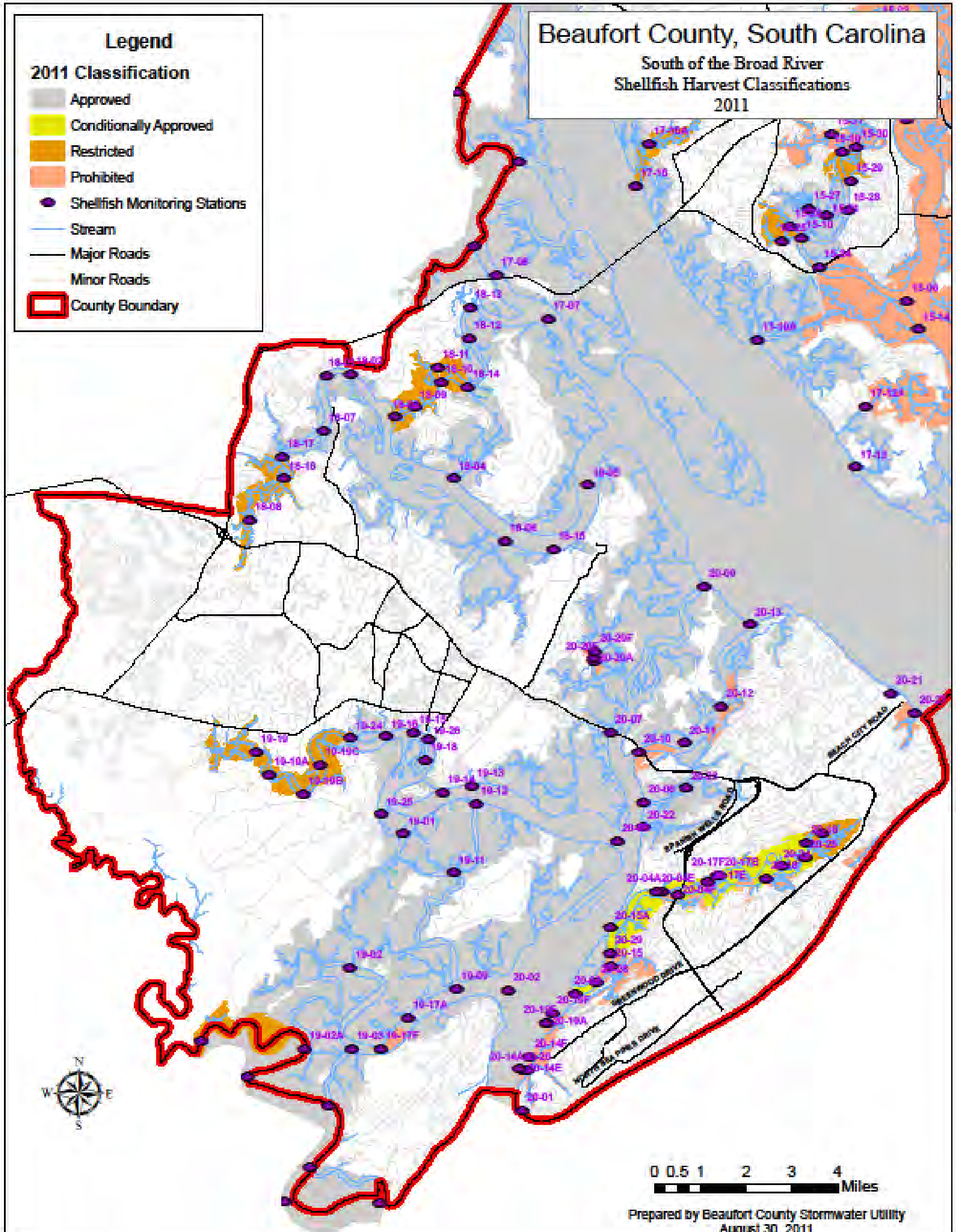
No “upland” drainage into ocean



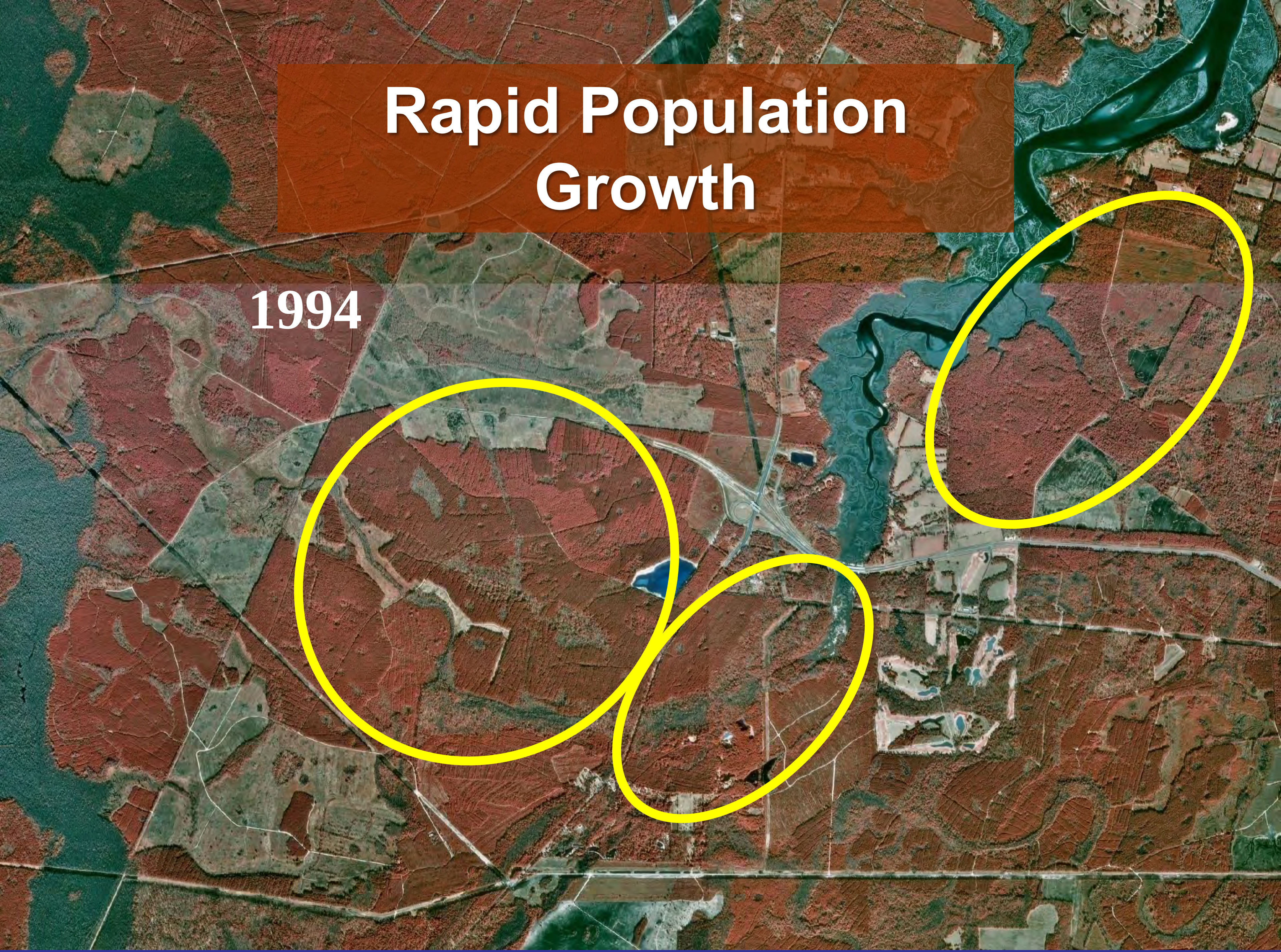
High Tidal Amplitude

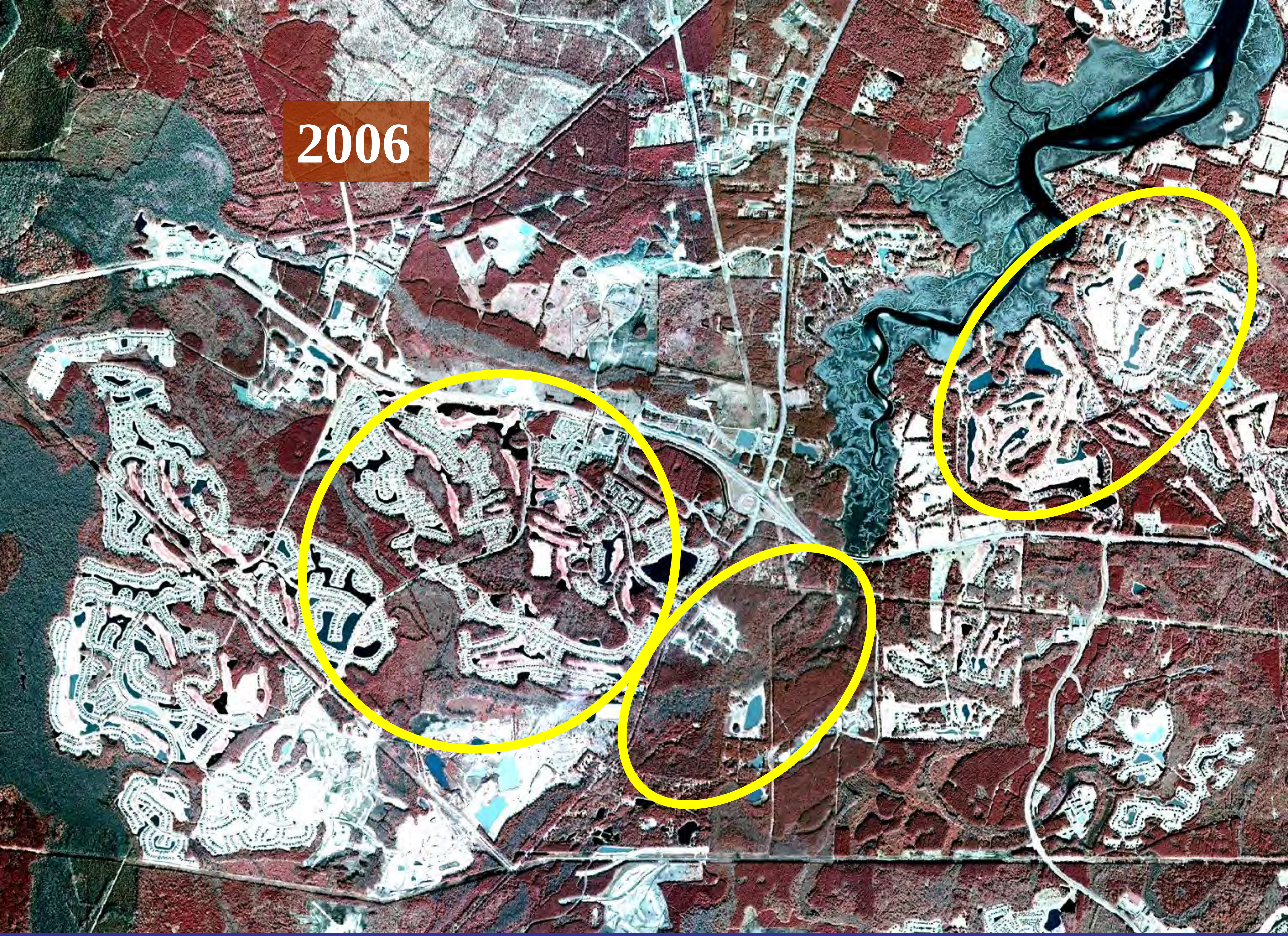


Shellfish Harvesting



Rapid Population Growth




2006

Impacts of Development on Runoff

- New Development adds Impervious Surface
- Impervious Surface causes
  - An increase in rate of runoff
  - Pollutants are carried to receiving waters
  - An increase in total volume of runoff

History of Stormwater Controls

- 1994 – Flooding leads to Peak Controls
- 1995 – Closing of Broad Creek in HHI leads to Clean Water Task Force
- 1998 – Adoption of First Water Quality requirements – First BMP Manual
- 1998-2009 – No closure of Shellfish Harvesting Areas- SW Plan - 2006
- 2009 – May River closure leads to Runoff Volume Controls

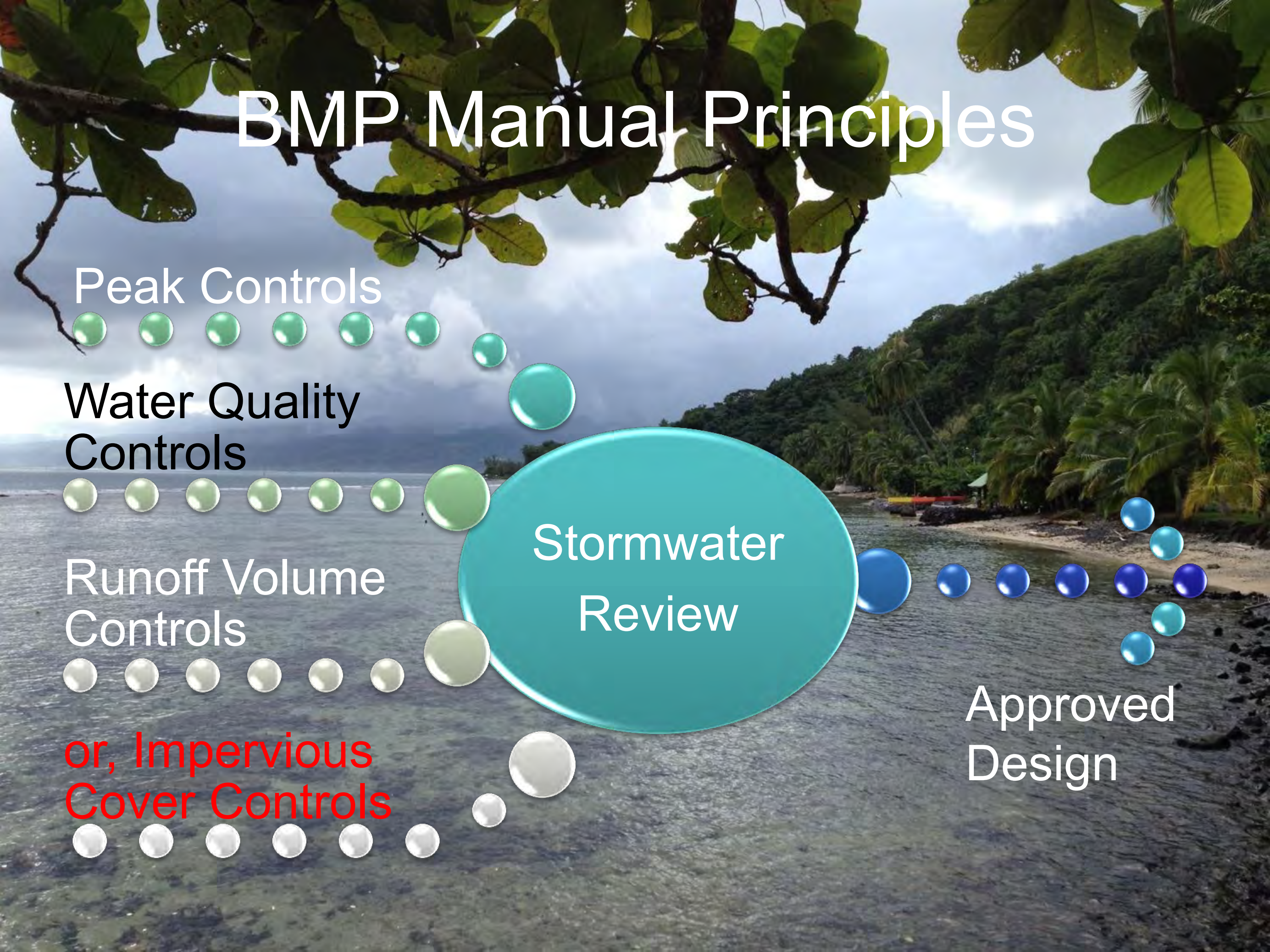
Local Studies

- Rose Dhu Watershed – Bacteria
- New River Wet Detention Pond – Bacteria
- Salinity Studies -Fresh Water inputs

The Regulations

(d) To the maximum extent technically feasible, **no development or redevelopment shall cause post-development stormwater rates, quality or volume to increase above predevelopment levels** or to cause an adverse increase in the surface runoff reaching adjacent or surrounding property or receiving waters. Surface runoff rate and volume shall be dissipated by detention or retention on the development parcel, percolation into the soil, evaporation, transpiration, reuse or by transport by natural or manmade drainageway or conduit (protected by legal easement) to a county-approved point of discharge.

BMP Manual Principles



Equivalent/Effective Impervious Cover (EIC)

- Metric that measures how effectively impervious surface runoff is reduced relative to pre-development pervious surface runoff
- 1998 –Adopts Antidegradation Goal on 10% Impervious Surface for Phosphorus
- 2003 - Adopts 5% goal for Bacteria
- 2009 – Adopts 10% goal for Nitrogen
- 2010 – Volume control of 95th percentile rainfall event is equivalent to 10 % EIC

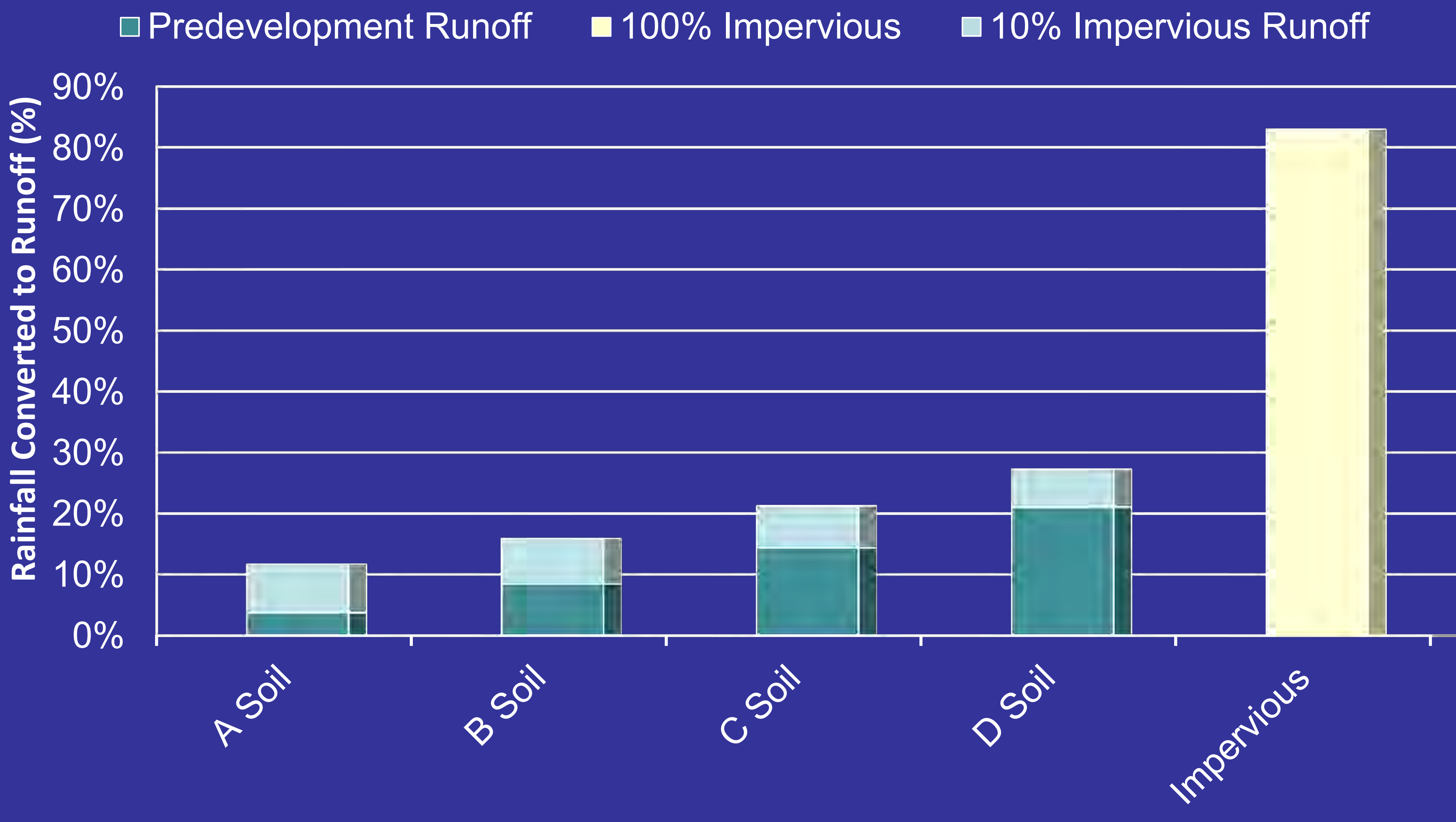
Volume Control Requirements

- Required Volume controls
  - Control runoff for 95 percentile storm event (1.95 inch)
- Implementation
  - Step 1 New Developments - October 2009
  - Step 2 On-lot Controls – June 2010
    - Individual lot controls to 95^{th} percentile
    - Can be exempted if development meets Step 1 requirements

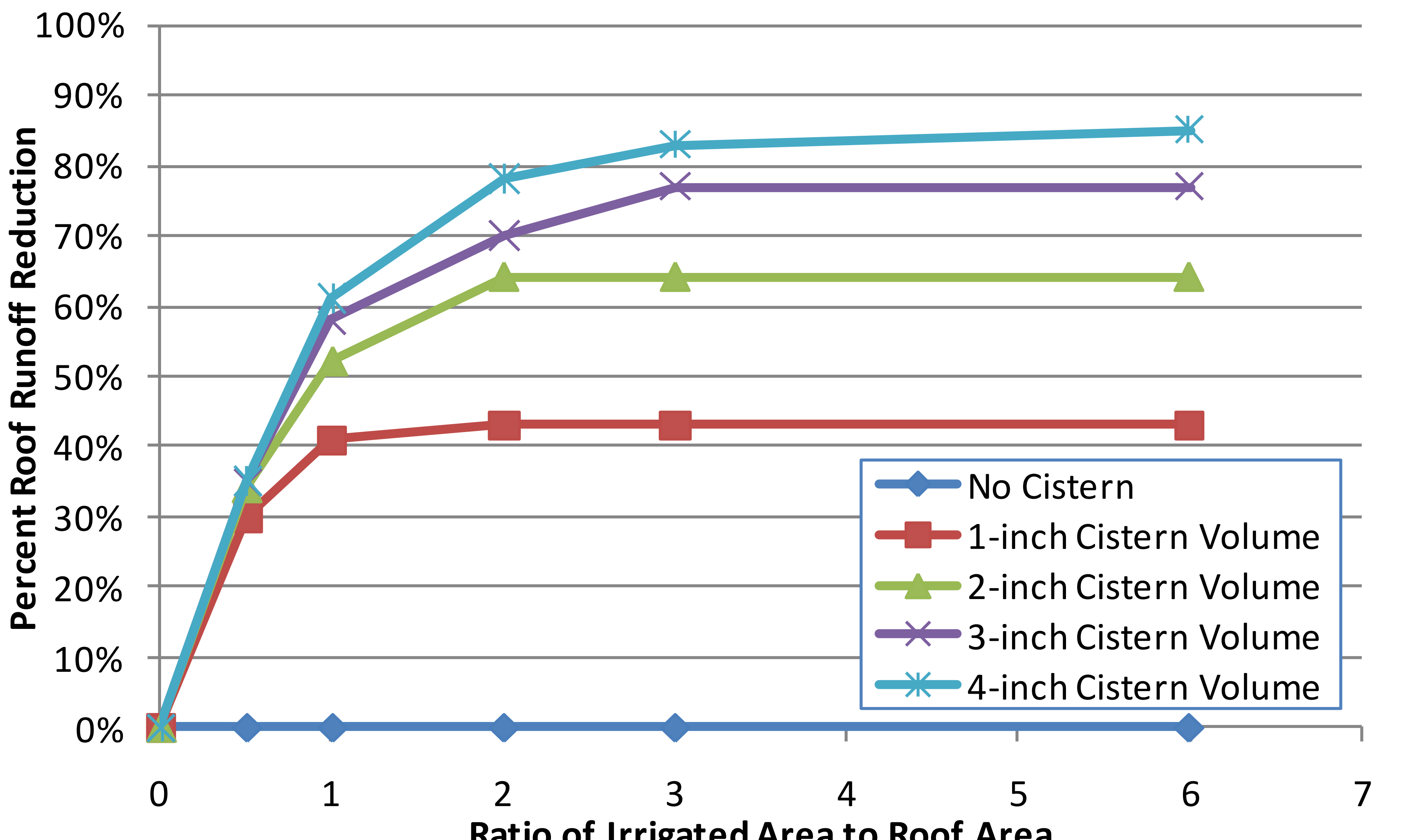
Integrating BMP Practice Runoff Reductions to EIC

- Integration Factors
  - Soil Type
  - Size of BMP
- Generate EIC for practice selected
- EIC reflects annual average Impact
- Annual average Impact can be related to WQ Control calculations

Impervious Surface and Annual Runoff



Capture for Reuse
BMP Size Factor



EIC for Reuse with A Soils

Soil Group A					
Ratio Of	Effective Imperviousness for Various Combinations of				
Irrigated	Irrigated Area to Impervious Area Ratio and Captured Volume				
Area To	Captured Volume (inches)				
Impervious Area	0	1	2	3	4
0	**100%**	100%	100%	100%	100%
0.5	100%	69%	65%	64%	63%
1	100%	57%	46%	40%	36%
2	100%	55%	34%	24%	19%
3	100%	55%	33%	20%	13%
6	100%	55%	33%	19%	**11%**

EIC of Reuse with D Soils

Soil Group D					
Ratio Of	Effective Imperviousness for Various Combinations of				
Irrigated	Irrigated Area to Impervious Area Ratio and Captured Volume				
Area To	Captured Volume (inches)				
Impervious Area	0	1	2	3	4
0	100%	100%	100%	100%	100%
0.5	100%	62%	57%	56%	56%
1	100%	48%	34%	27%	23%
2	100%	46%	19%	8%	1%
3	100%	46%	18%	2%	-6%
6	100%	46%	18%	2%	**-8%**

Step 2 Requirements

- Required On-Lot Volume controls
  - Control runoff for 1.95 inch storm event
  - Options
    - BMP Manual – requires formal review
    - On-lot Volume worksheet – no technical review
  - Encourages Impervious Surface reduction to reduce size of volume practices
  - Options for staff variance if lot becomes unbuildable
  - Can be exempted if development complies

On-Lot Volume Worksheet

- Not only Method – but does not require technical review – field verification
- Uses three practices in series
  - Storage and Reuse
  - Disconnected Imperviousness
  - Raingardens
- Irrigation decisions impact practice requirements

Program Input - Homeowner

- Impervious Area
  - Rooftop
  - Other
- Total Lot Size
- Soil Type
- Irrigation Decision
- BMP Implementation Data

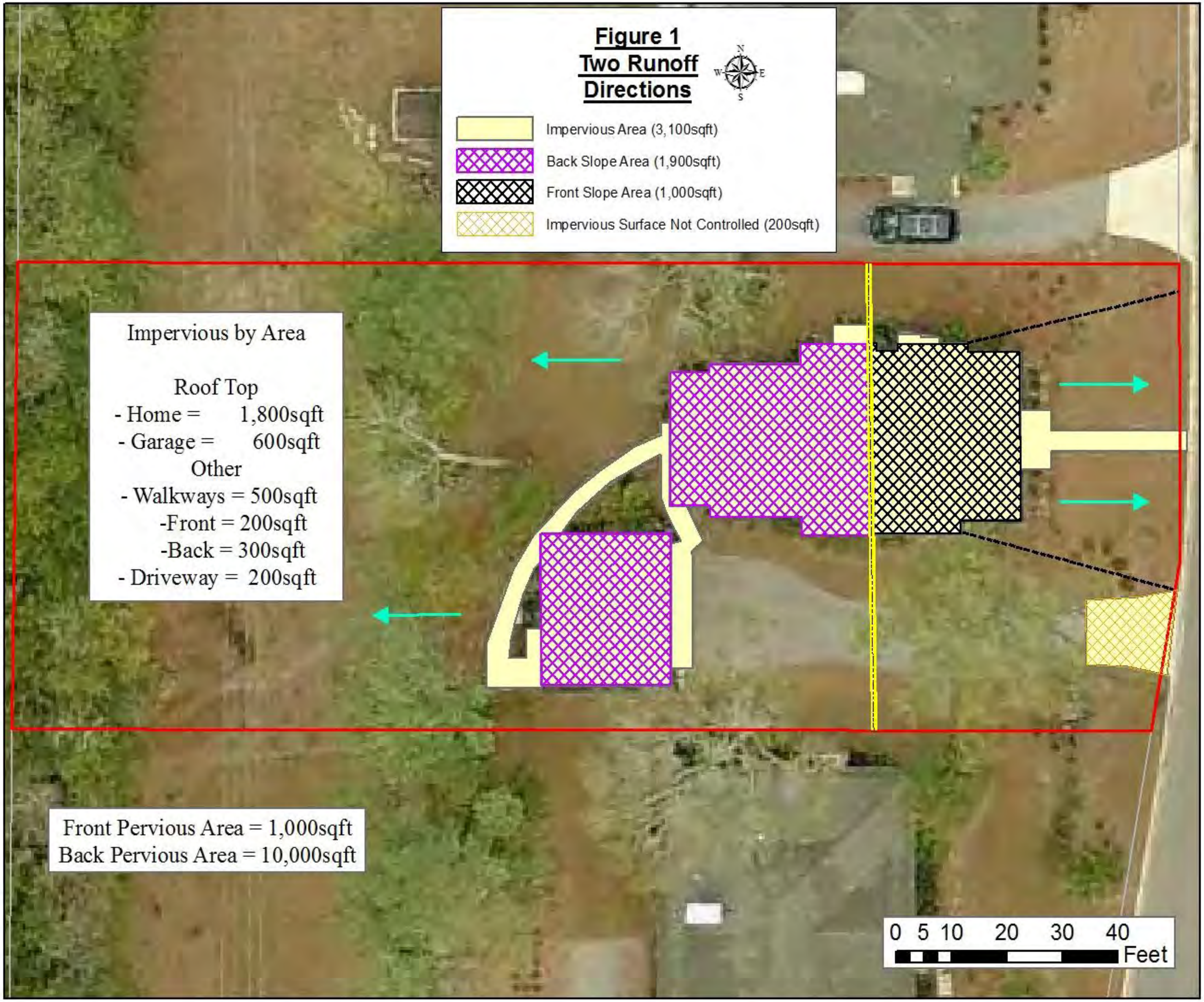


Figure 1
Two Runoff Directions
N
W
E
S
Impervious Area (3,100sqft)
Back Slope Area (1,900sqft)
Front Slope Area (1,000sqft)
Impervious Surface Not Controlled (200sqft)
Impervious by Area
Roof Top
- Home = 1,800sqft
- Garage = 600sqft
Other
- Walkways = 500sqft
-Front = 200sqft
-Back = 300sqft
- Driveway = 200sqft
Front Pervious Area = 1,000sqft
Back Pervious Area = 10,000sqft
0 5 10 20 30 40
Feet

Go Back - Print this page

Projected Web Based Zoning Permit Attachment

Date: 3/6/2011

Builder/Homeowner Input

Address	**Figure 1 Solution 1 Street**
Parcel Number	**R120**
Home/Rooftop	**2400 Square Feet**
Other Impervious	**700 Square Feet**
Total Lot Size	**16000 Square Feet**
Soil Type	**Sandy**
Area to be Irrigated	**5000 Square Feet**

Excess Stormwater from Homeowner Input = 3565

Program Approved Practices

Storage and Reuse

Practice	Number	Size	Quantity
Rainbarrel	2	70	140
Cisterns	2	400	800

Disconnected Impervious Area

Practice	Impervious	Runoff Area	Quantity
First Runoff Direction	300	1000	336
Second Runoff Direction	1780	10000	1993.6

Raingarden

Size **36.7** Square Feet

Excess Stormwater controlled from practices = 3565 Gallons

What's next?

- While we have successfully created design standards to integrate water quantity and quality through site design and BMP construction, we haven't been as proactive with implementation
- What's the solution? MS4


Questions?
www.bcgov.net

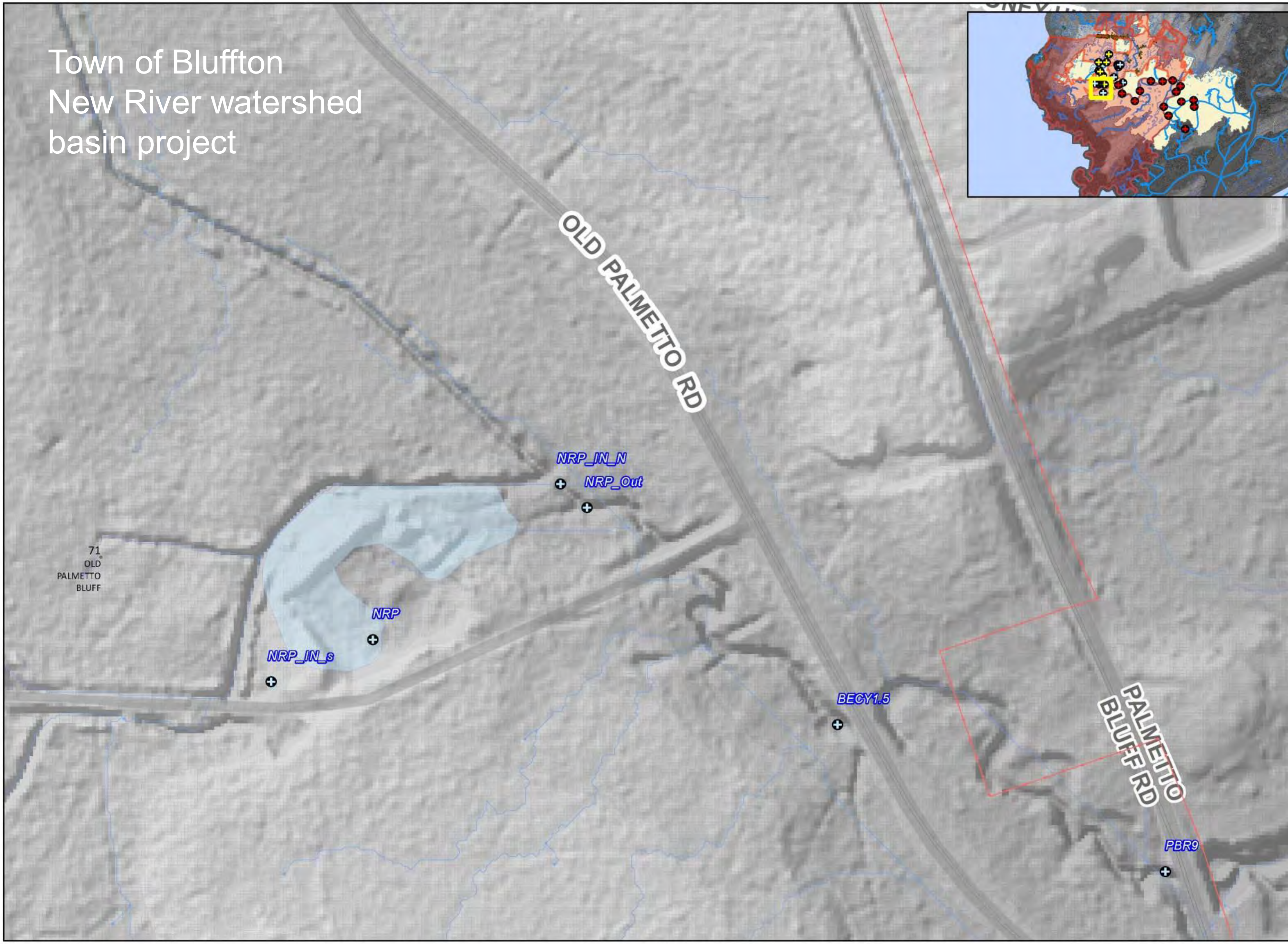
Additional Information

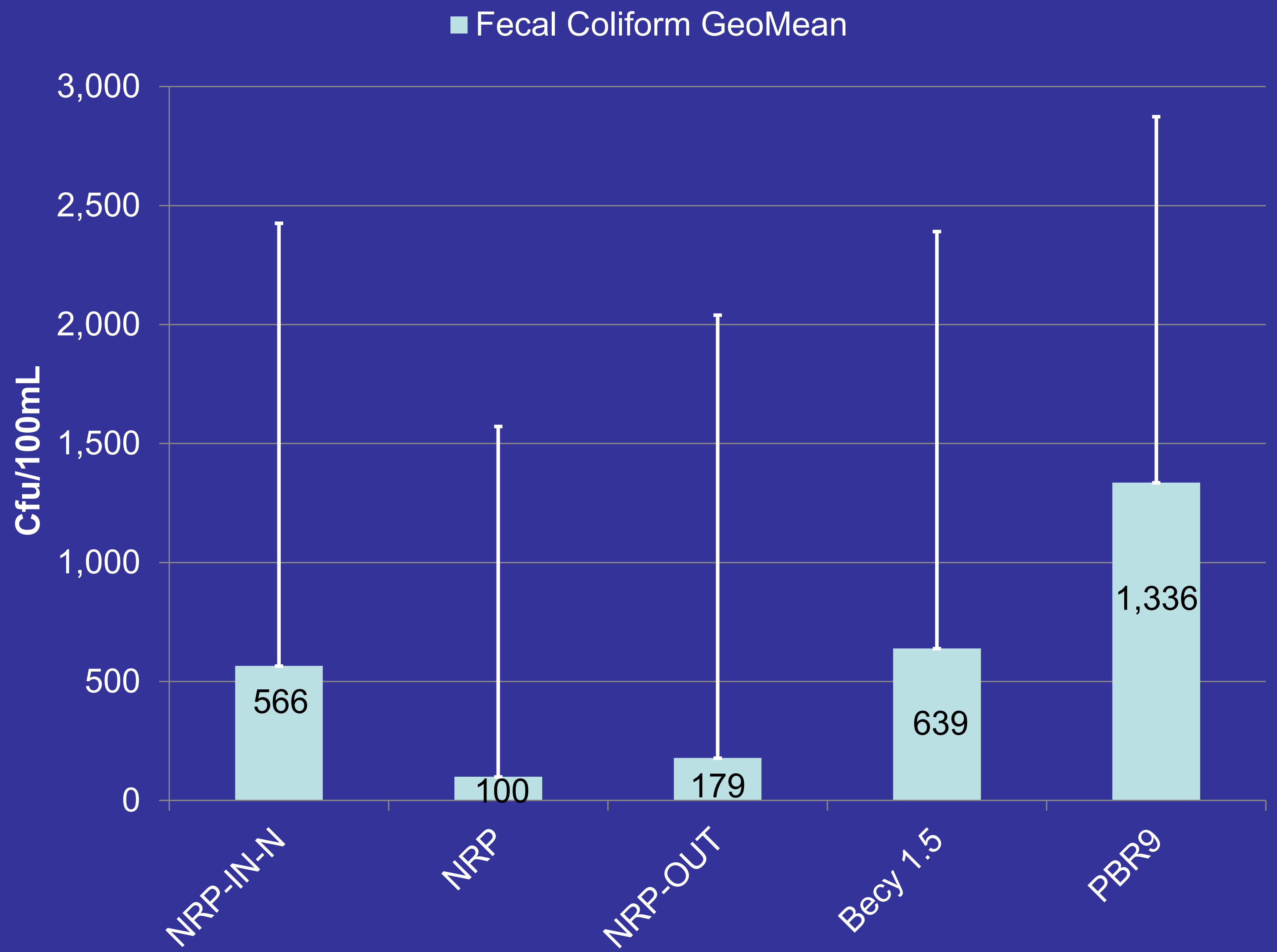

North Carolina
Raleigh
South Carolina
Columbia
Atlanta
Georgia
Atlantic Ocean
Beaufort, SC
Tallahassee
Florida
N
W
E
S
0
30
60
120
180
240
Miles


HH-4
HH-5
Watershed
HH-2
HH-3
HH-6
MRR6
19-19
May River

Sampling Station Fecal Data

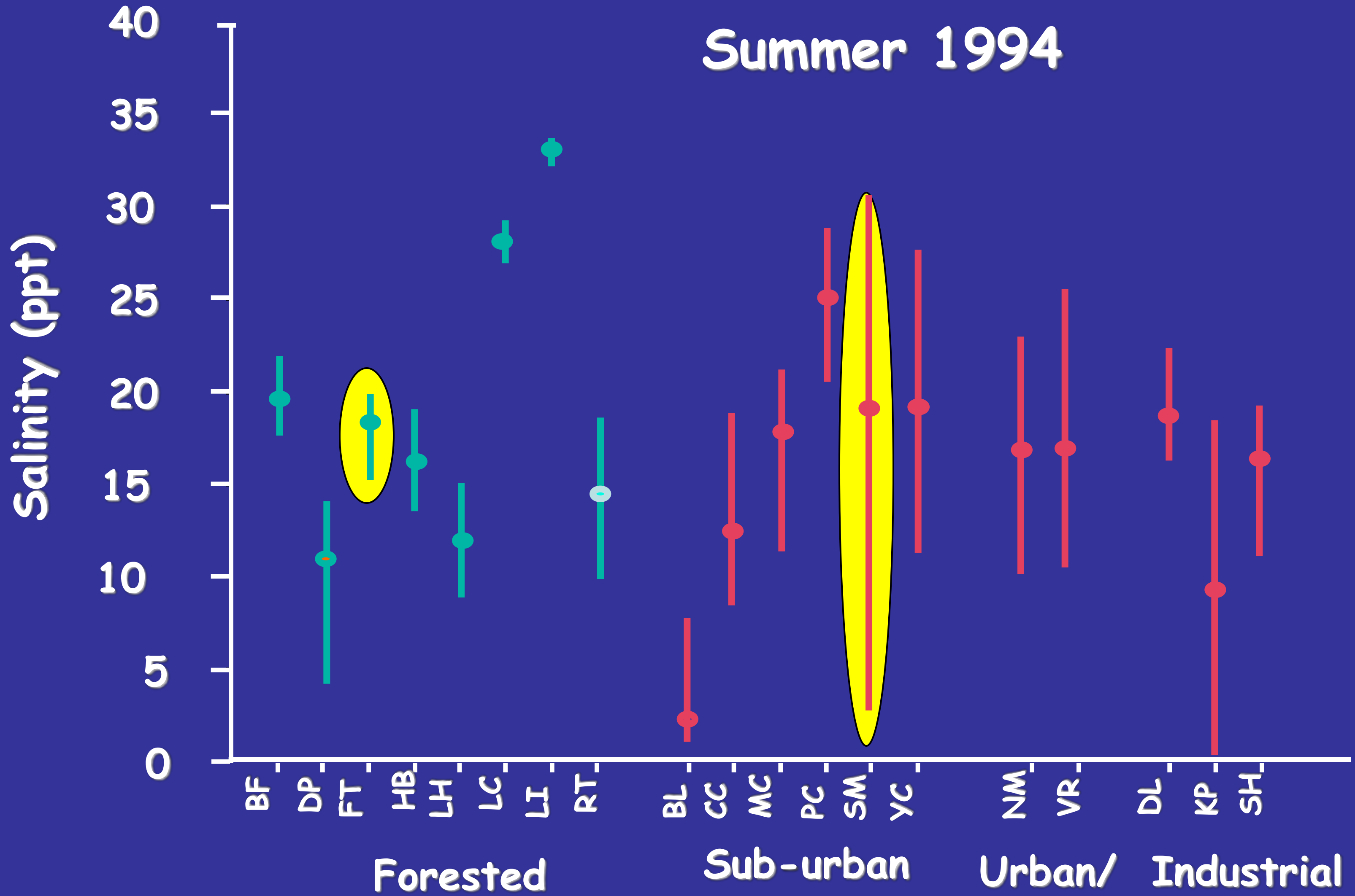
Station Date	January 6, 2011	January 12, 2011	January 19, 2011	January 26, 2011
HH4	N/A	N/A	N/A	770
HH5	**N/A**	**N/A**	**N/A**	**866**
HH2	6	11	3	14
HH3	**7**	**5**	**4**	**6**
HH6	**4,082**	**1,072**	**1,245**	**582**
MRR6	41	1,226	25	1,120


Town of Bluffton
New River watershed
basin project
OLD PALMETTO RD
PALMETTO BLUFF RD
NRP_IN_N
NRP_Out
NRP
NRP_IN_s
BECY1.5
PBR9
71
OLD
PALMETTO
BLUFF

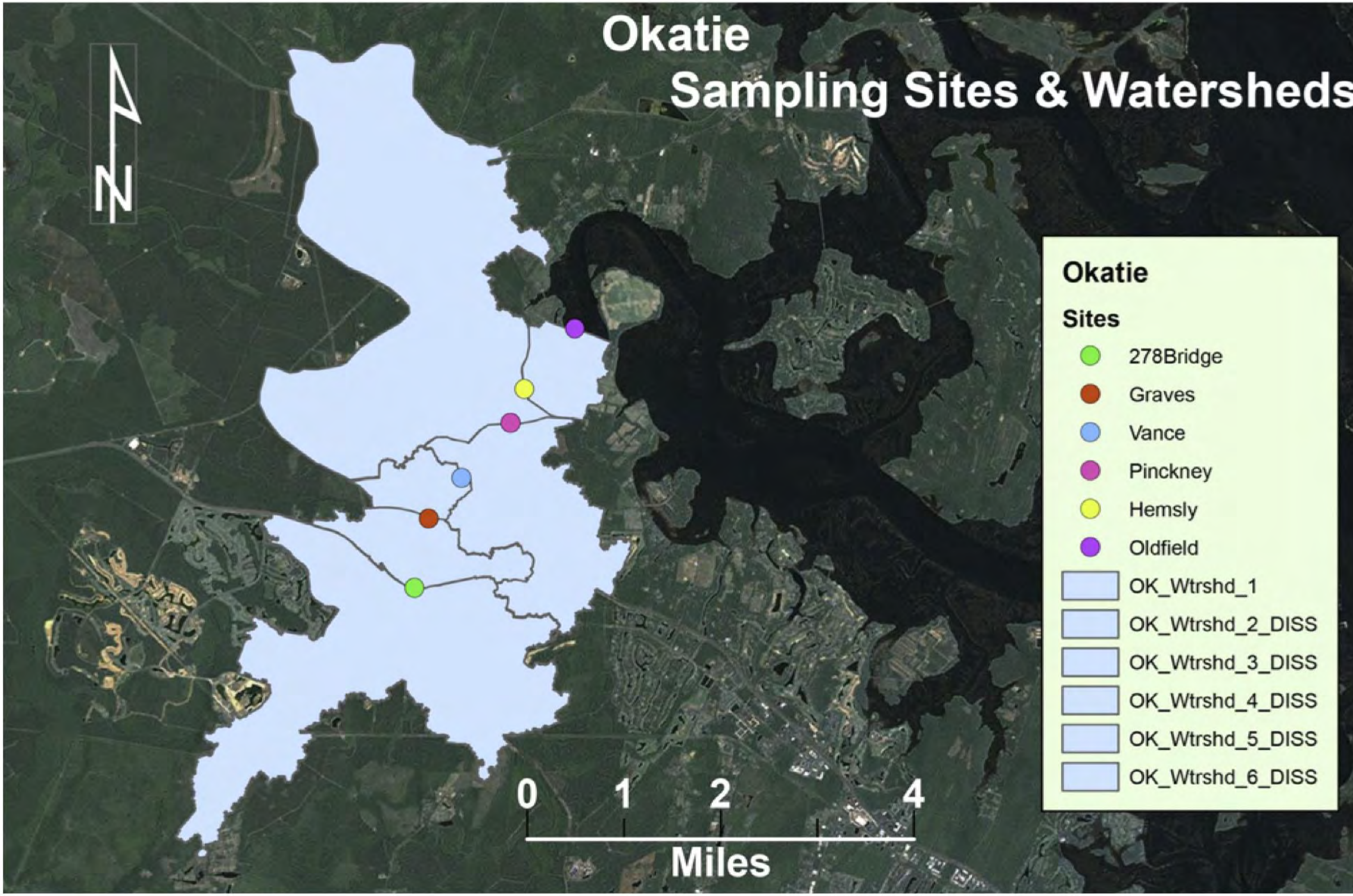


Fecal Coliform GeoMean
Cfu/100mL
3,000
2,500
2,000
1,500
1,000
500
0
566
100
179
639
1,336
NRP-IN-N
NRP
NRP-OUT
Becy 1.5
PBR9

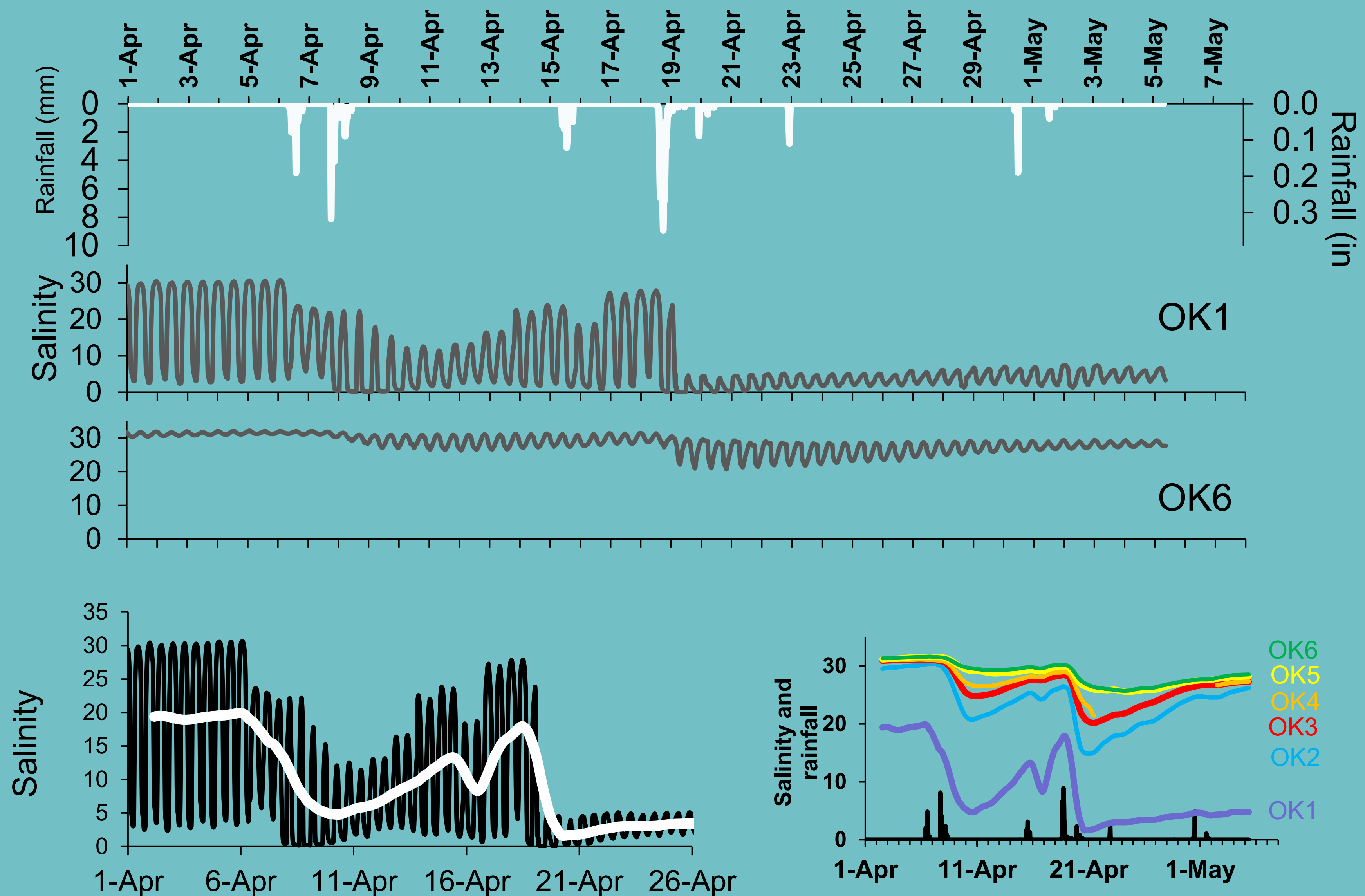
Salinity Distributions



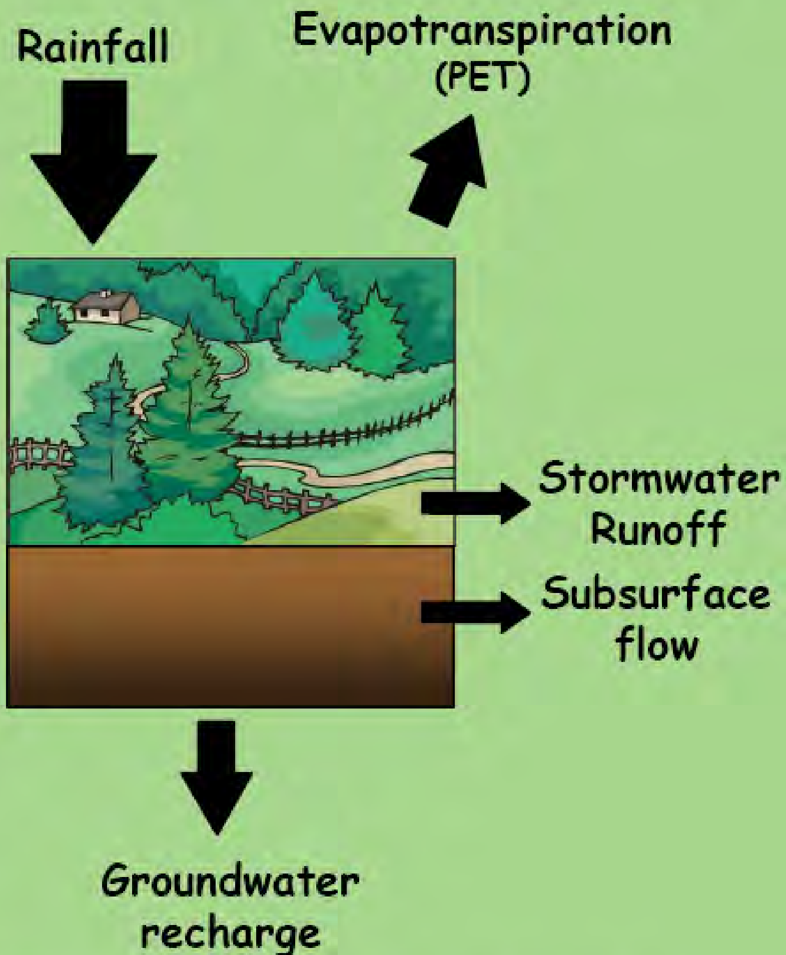
Okatie River Salinity Impacts



Okatie River Salinity Impacts

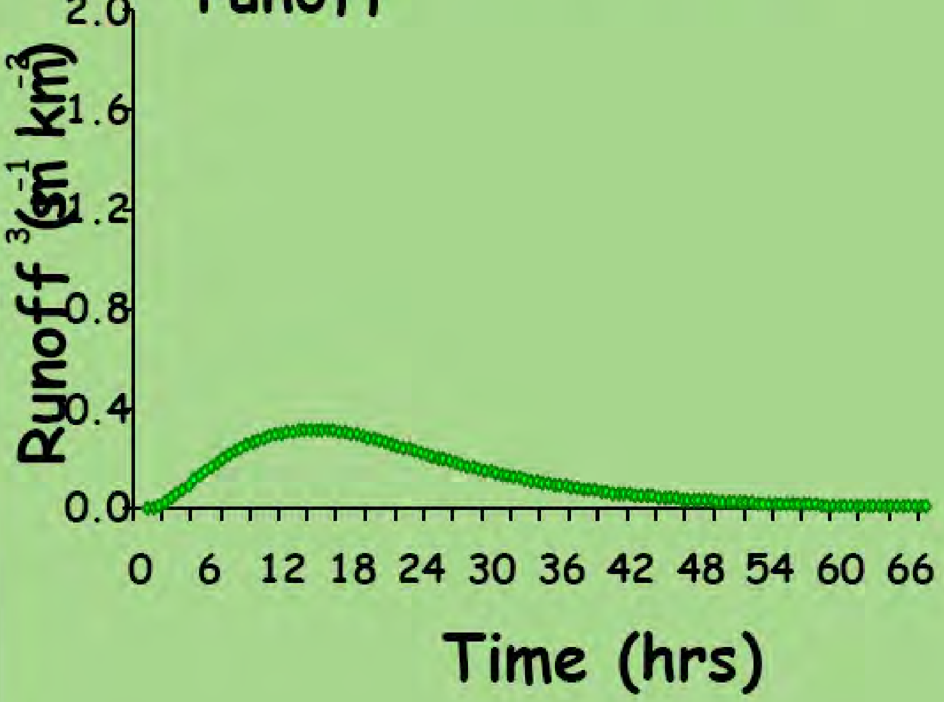


Water Budgets: Forested Watershed

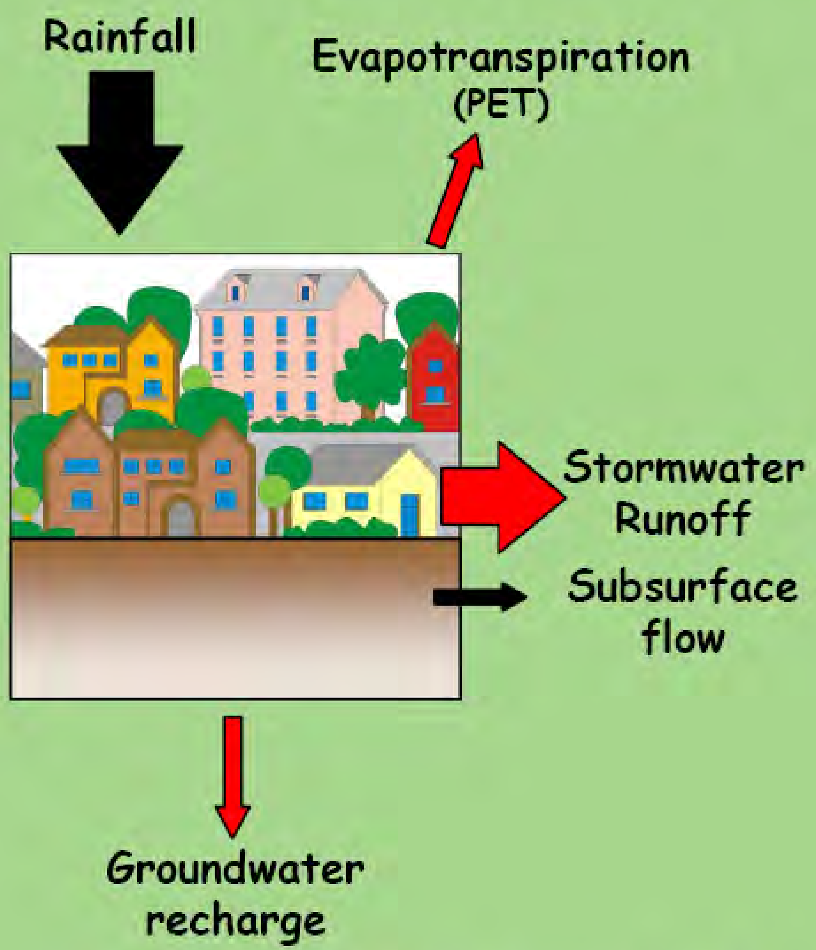


Forested Watershed

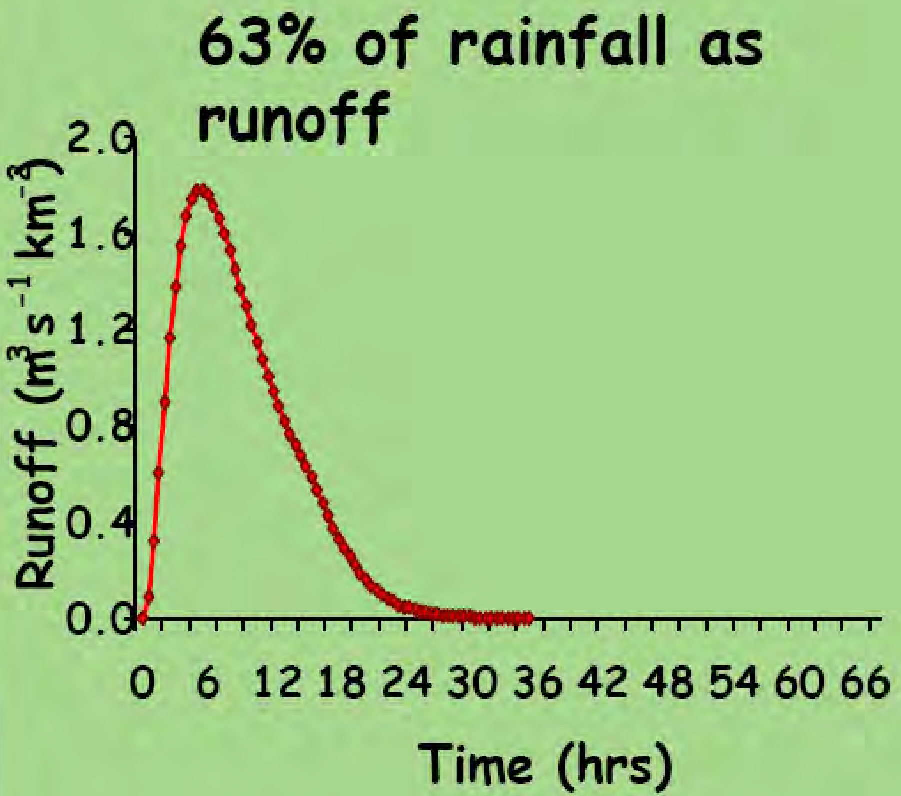
16% of rainfall as runoff



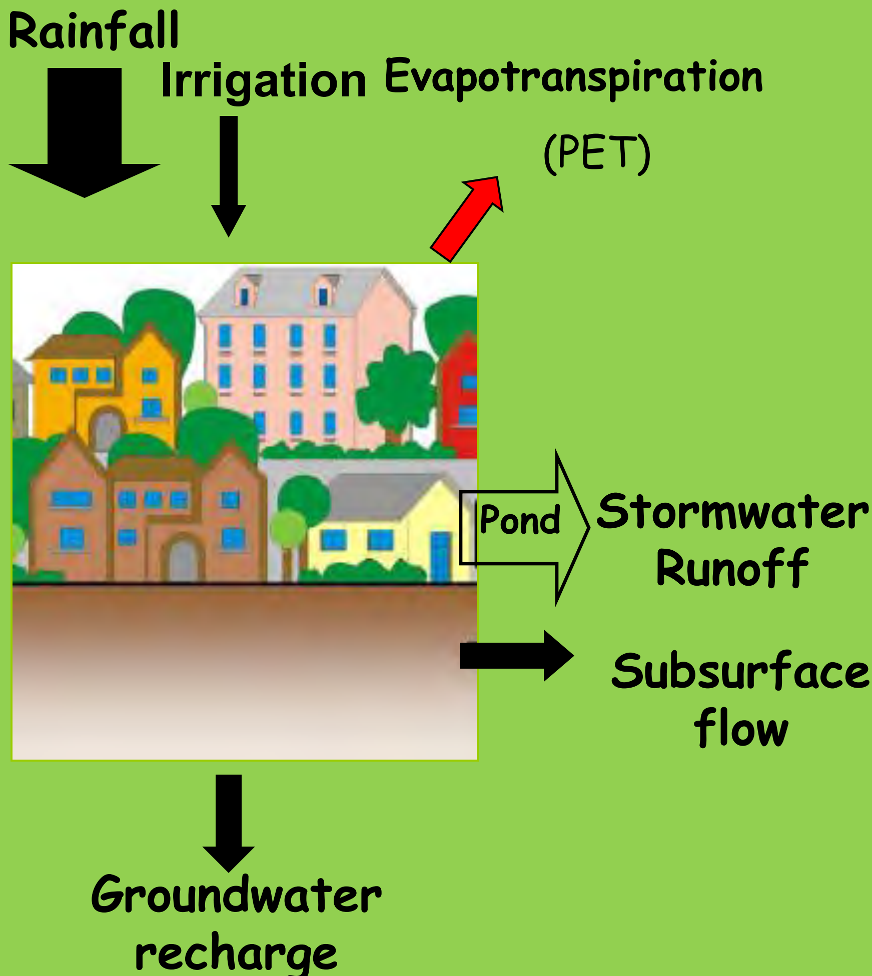
Water Budgets: Developed Watershed



Developed Watershed



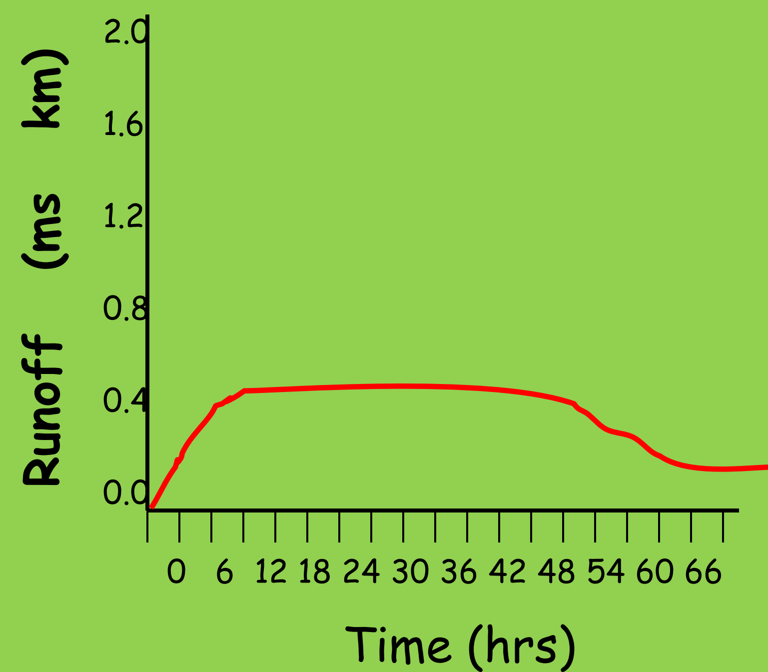
Water Budgets: Developed Watershed With Stormwater Controls



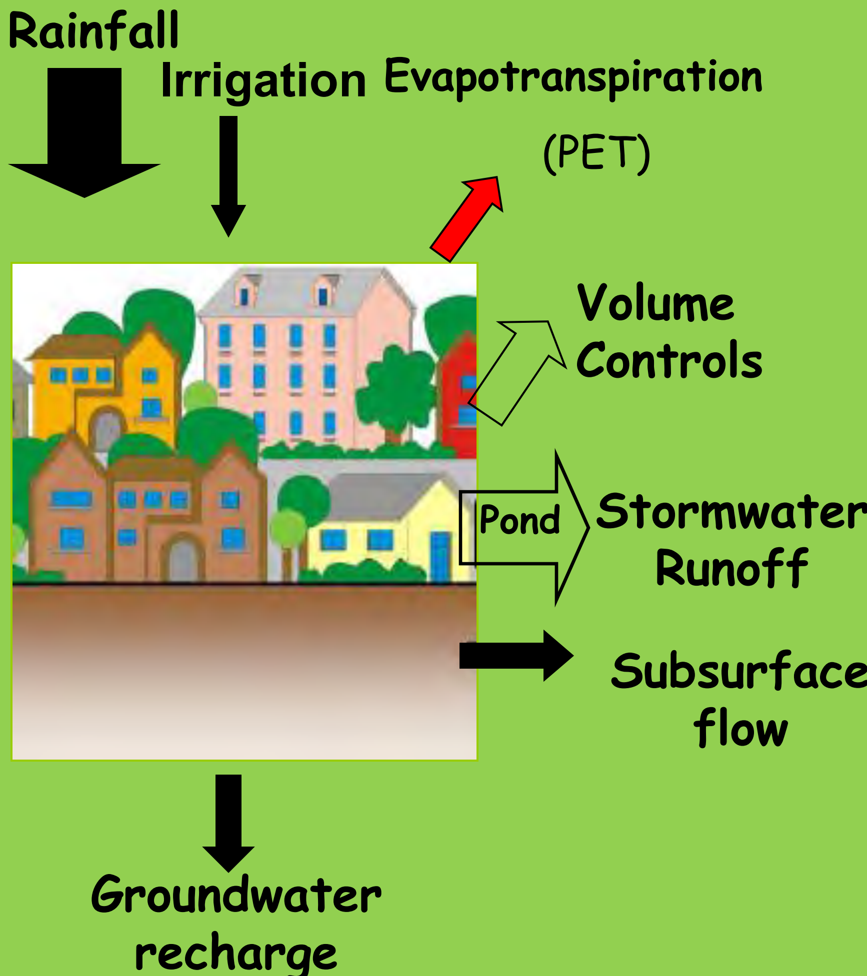
Developed Watershed

Peak same as Forested Watershed

Volume of Stormwater is Four Times Forested Watershed



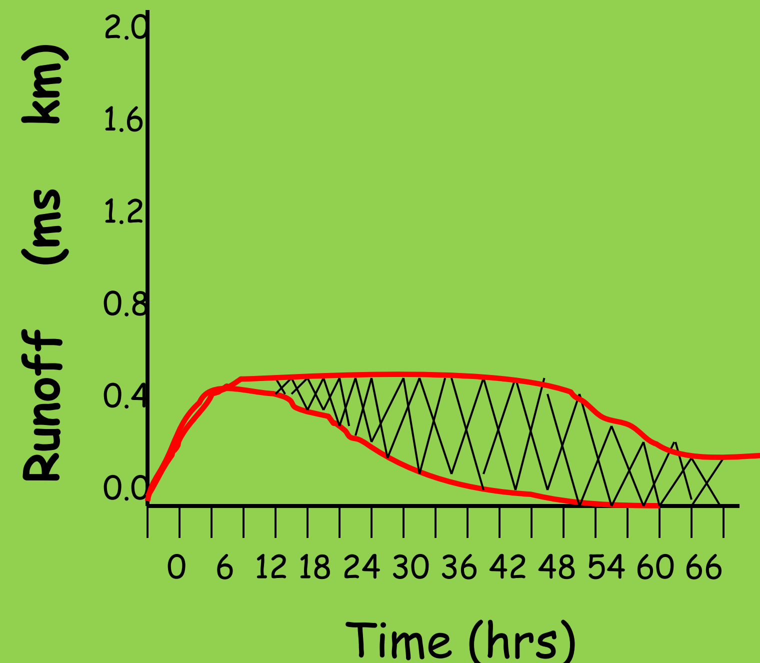
Water Budgets: Developed Watershed With Stormwater Volume Controls



Developed Watershed

Peak same as Forested Watershed

Volume of Stormwater is Similar to Forested Watershed



Case Study
Del Webb’s Sun City

- Study focused on water inputs into a built environment and natural environment and compare runoff volumes
- The developed watershed contained water inputs from rainfall and irrigation
- Evaluated losses from evapotranspiration and groundwater recharge & runoff impacts to pond storage and downstream volumes

Case Study Conclusions

- Developed watersheds can contribute up to 50% more runoff
- Use of effluent or potable water sources for irrigation added on average another 20% to annual rainfall
- Better management of stormwater ponds was needed
- Alternate means to reuse or dispose of runoff was needed