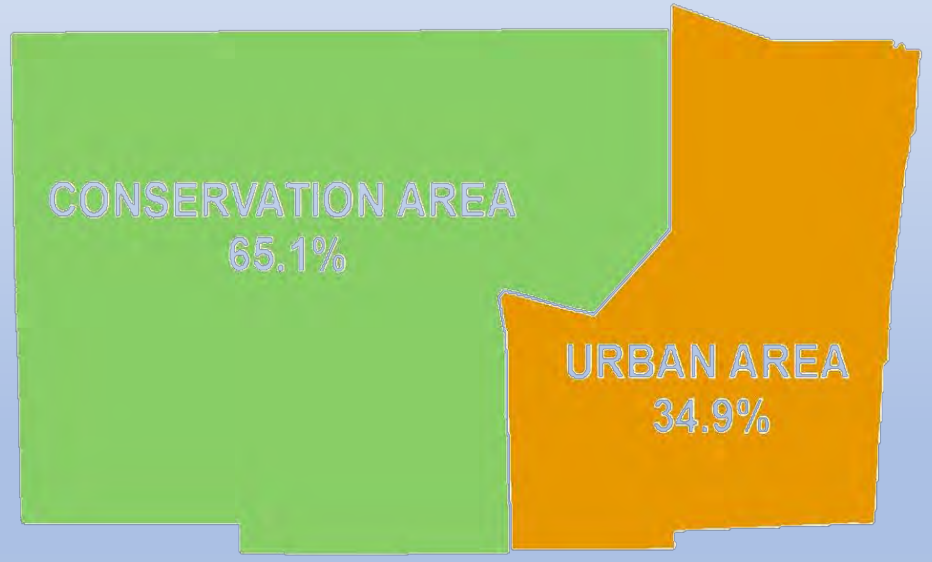
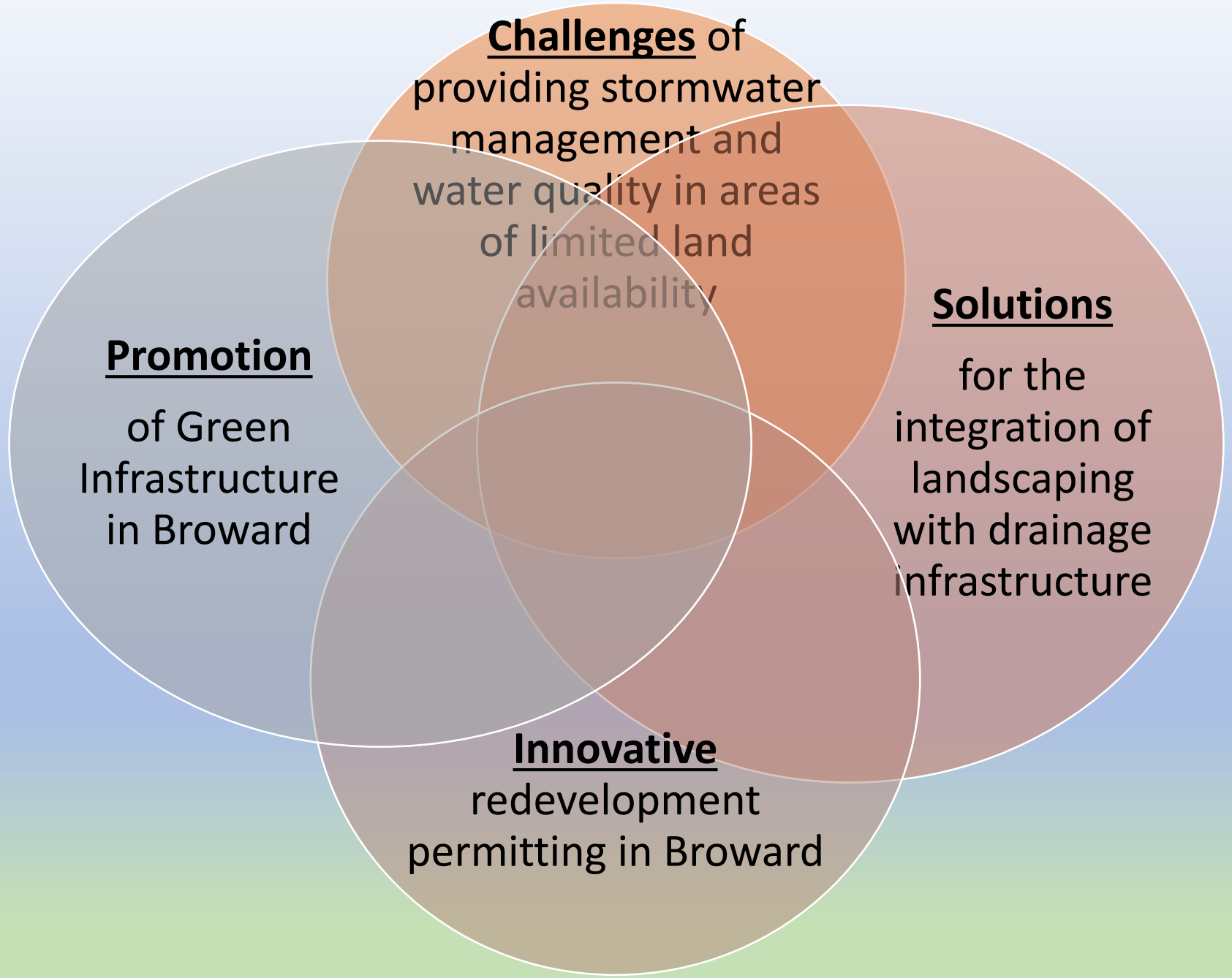
Slow the Flow; Promoting Green Infrastructure In A Built-Out Environment

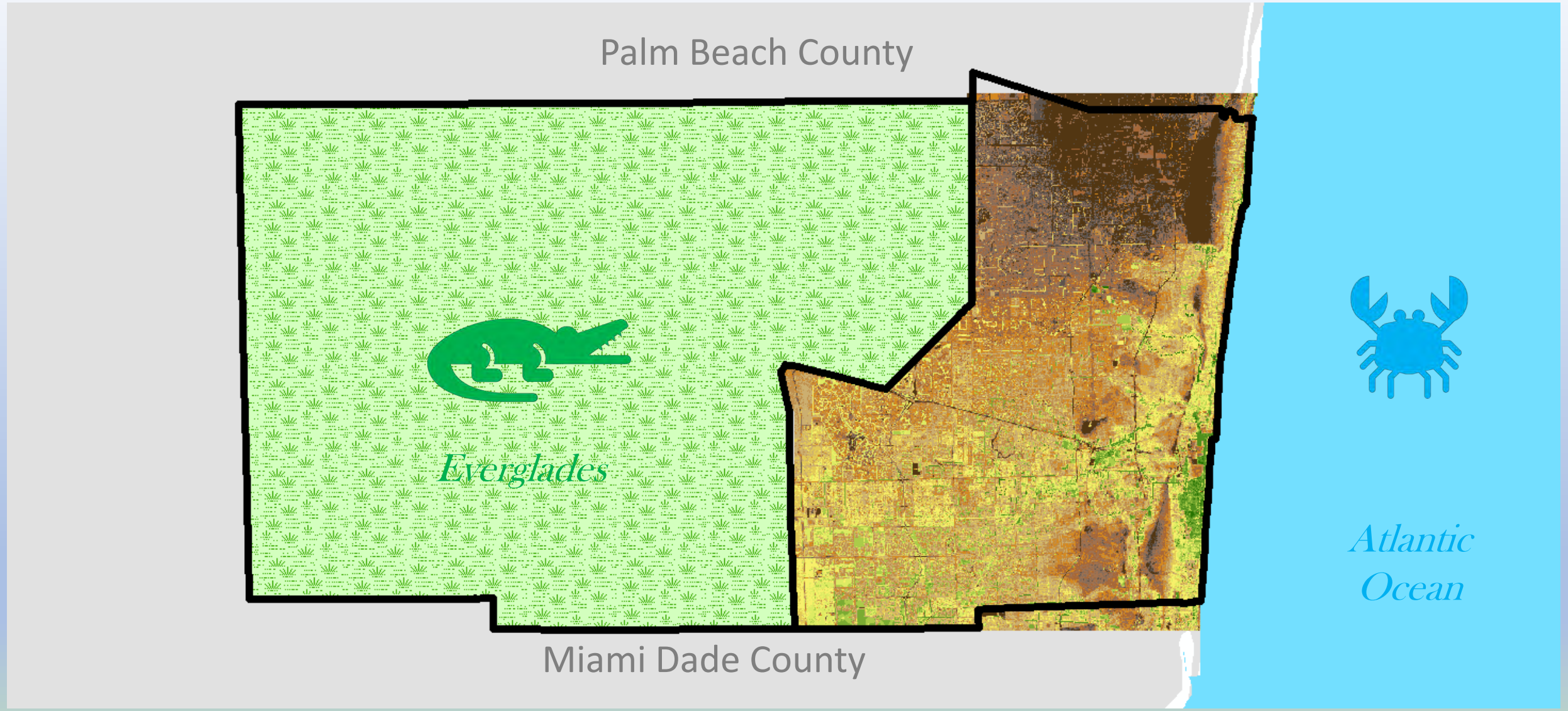
FSA Annual Conference June 2019, Fort Myers FL



Maena Angelotti, Program Project Coordinator
Environmental Planning and Community Resilience Division

BROWARD COUNTY FLORIDA


Challenges of providing stormwater management and water quality in areas of limited land availability
Promotion
of Green Infrastructure in Broward
Solutions
for the integration of landscaping with drainage infrastructure
Innovative
redevelopment permitting in Broward



Elevation 2-10’ above sea level, highest 29’ at Pine Island Ridge

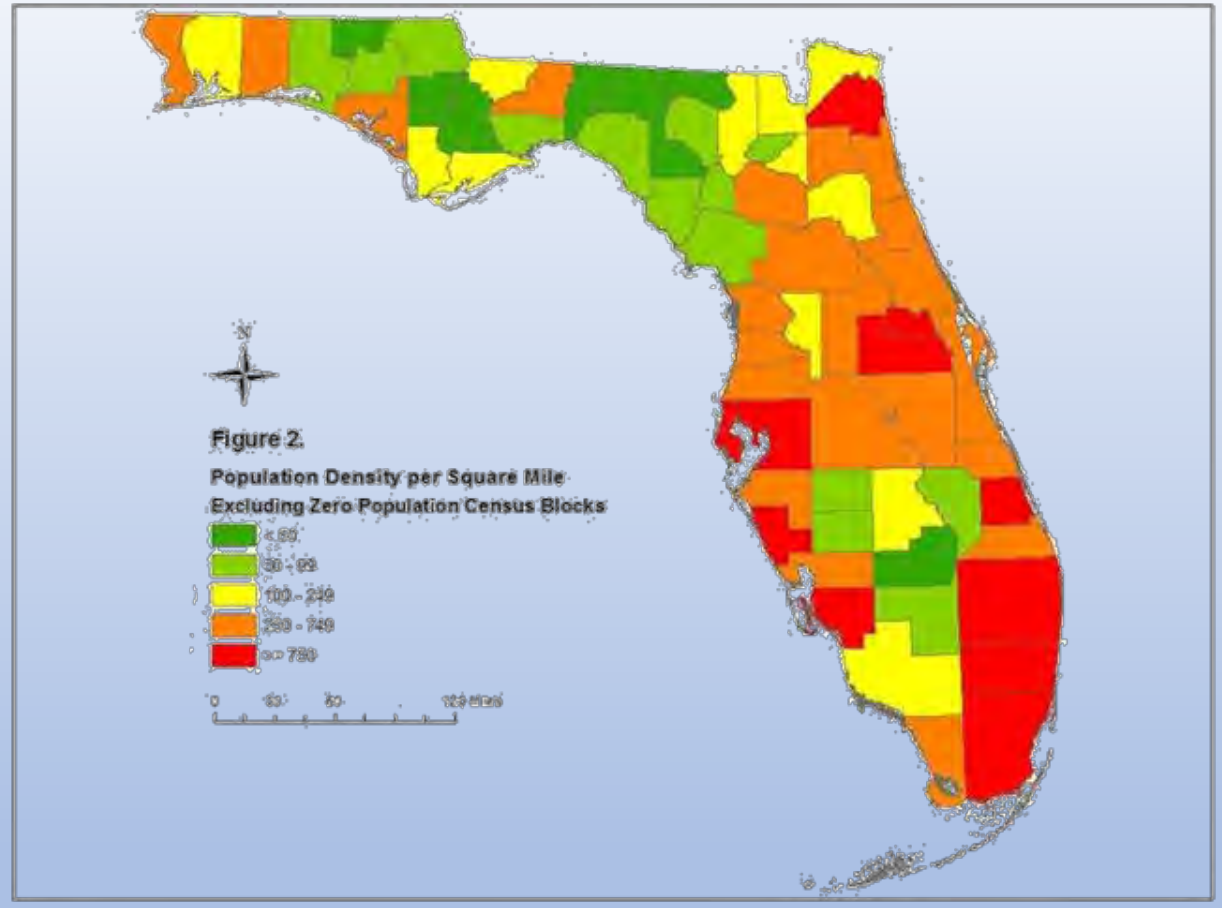
Broward County

1.9 million residents

- 14 million visitors (2018)

1224.7 square miles

- ***427.8 developable***
- 796.9 square miles Everglade's WMA and Miccosukee Reservation Lands

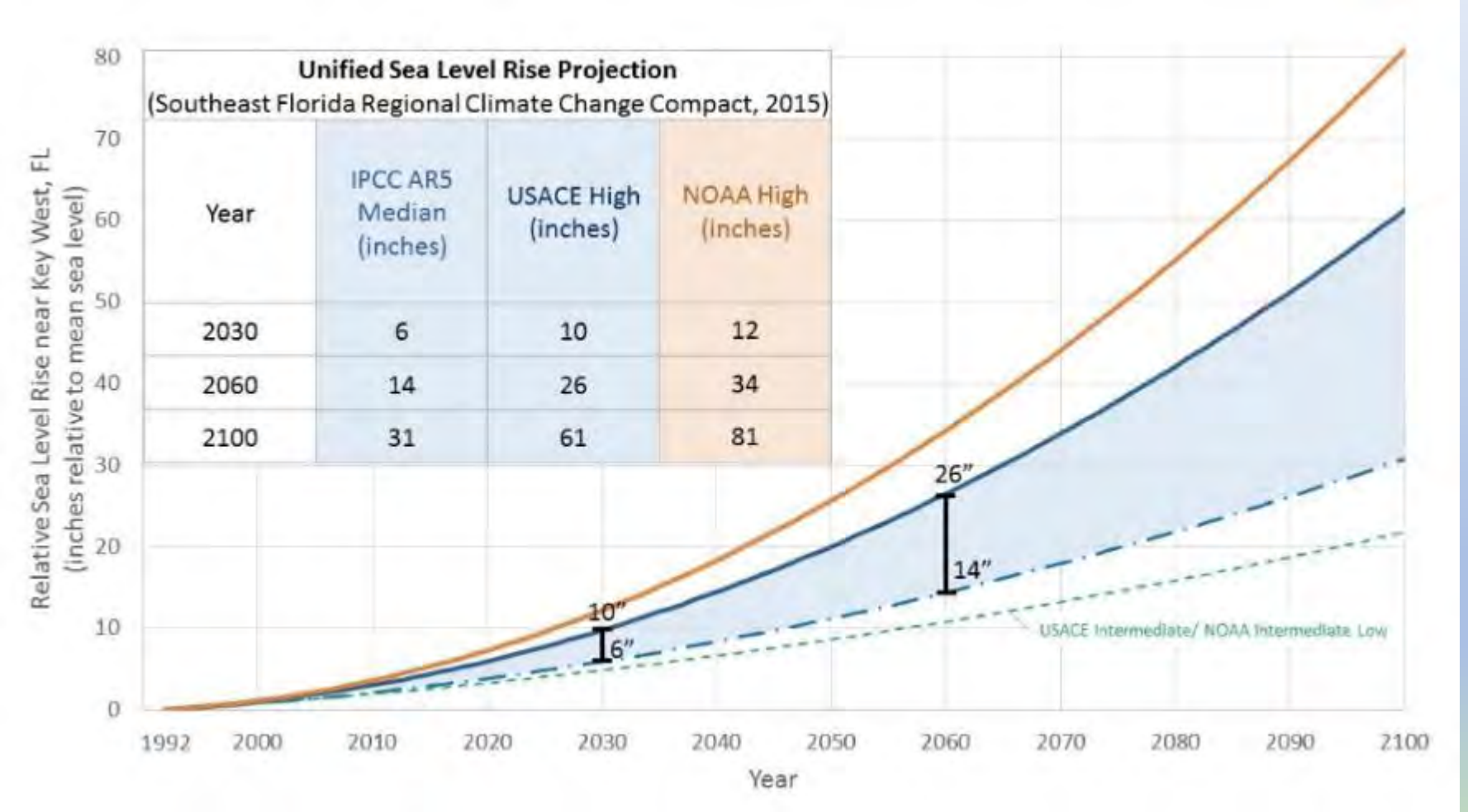


Broward County

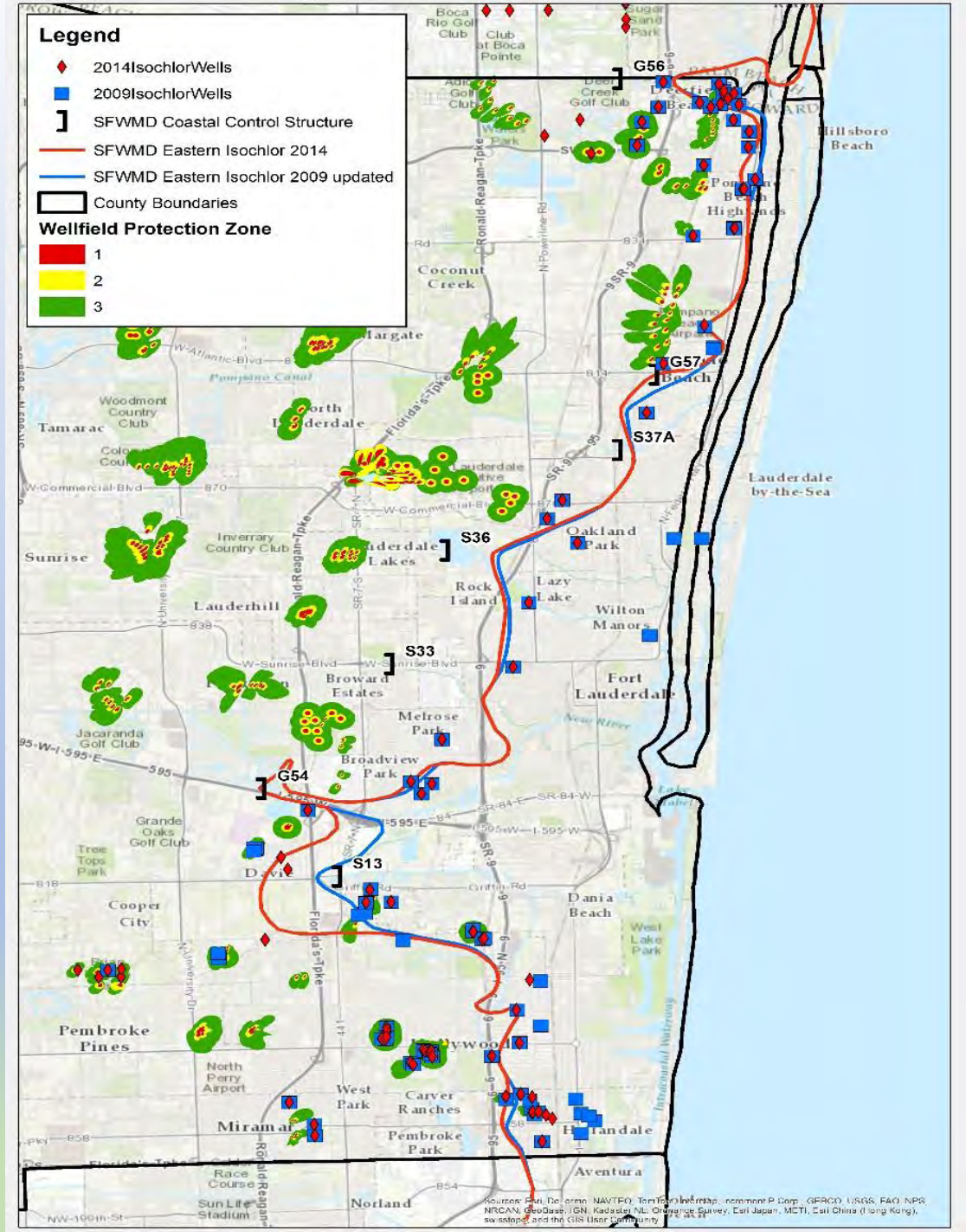
Rank	Total Land Area[1]		Excluding Zero Population Blocks[2]		Census Block Median[3]		Census Block 95th Percentile[4]	
	Density	County	Density	County	Density	County	Density	County
1	3,348	Pinellas	5,070	Broward	8,343	Miami-Dade	31,550	Miami-Dade
2	1,445	Broward	4,008	Pinellas	7,167	Broward	20,277	Broward
3	1,367	Seminole	3,639	Miami-Dade	5,313	Pinellas	19,083	Orange
4	1,315	Miami-Dade	2,325	Palm Beach	4,909	Hillsborough	16,055	Monroe
5	1,268	Orange	1,983	Orange	4,820	Palm Beach	15,515	Seminole
6	1,205	Hillsborough	1,567	Seminole	4,811	Orange	15,433	Hillsborough
7	1,134	Duval	1,440	Hillsborough	4,209	Duval	15,294	Palm Beach
8	789	Lee	1,336	Duval	4,098	Manatee	13,844	Osceola
9	683	Sarasota	1,042	Sarasota	4,002	Pasco	12,794	Pinellas
10	670	Palm Beach	930	Lee	3,958	Seminole	12,709	Collier

BEBR Rayer and Yang 2014

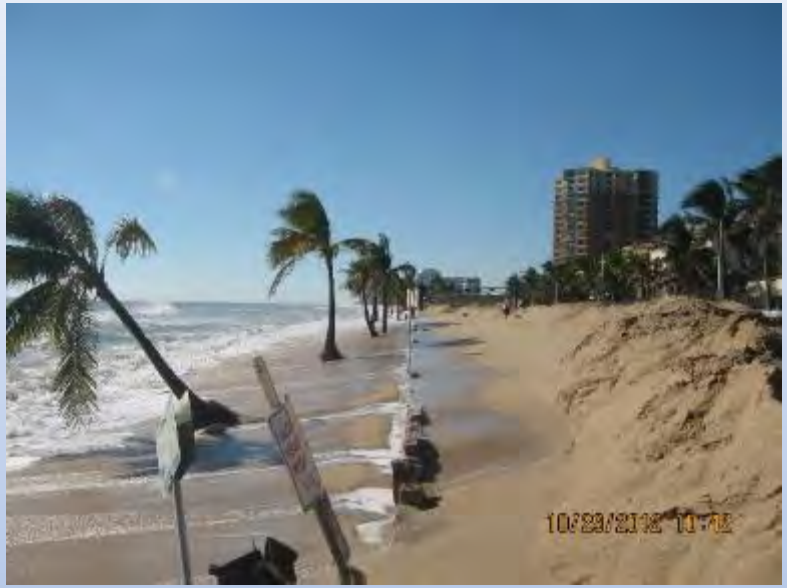
Unified Sea Level Rise Projections

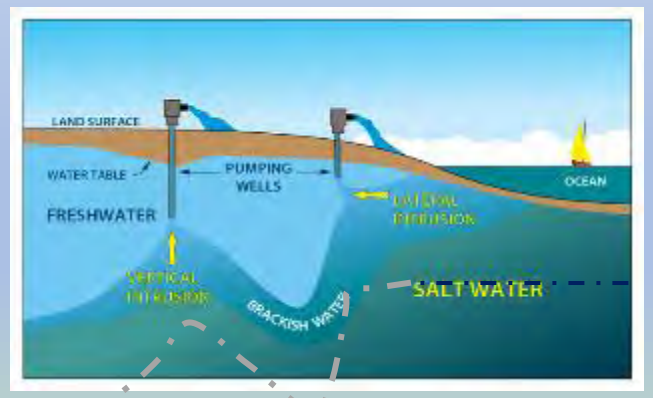


- More extreme weather
- Tidal flooding
- More intense wind damage and storm surge
- Impacts to water supplies
- Saltwater Intrusion
- More severe beach erosion



The water is rising.....





Saltwater contamination exacerbated by sea level rise and water consumption

- **Option 1: Conservation**
- **Option 2: Adaptation**
- **Option 3: Drink Briny**

New Challenge: Sea-level Rise

Sea-level Rise Flood Prevention

Flooding Due to Sea Water Inundation to Stormwater System

Broward County Policies

Broward County Comprehensive Plan

..use GIS and hydrologic maps to facilitate informed decisions regarding adaptation, ***regionally appropriate green infrastructure*** *and low impact design techniques*

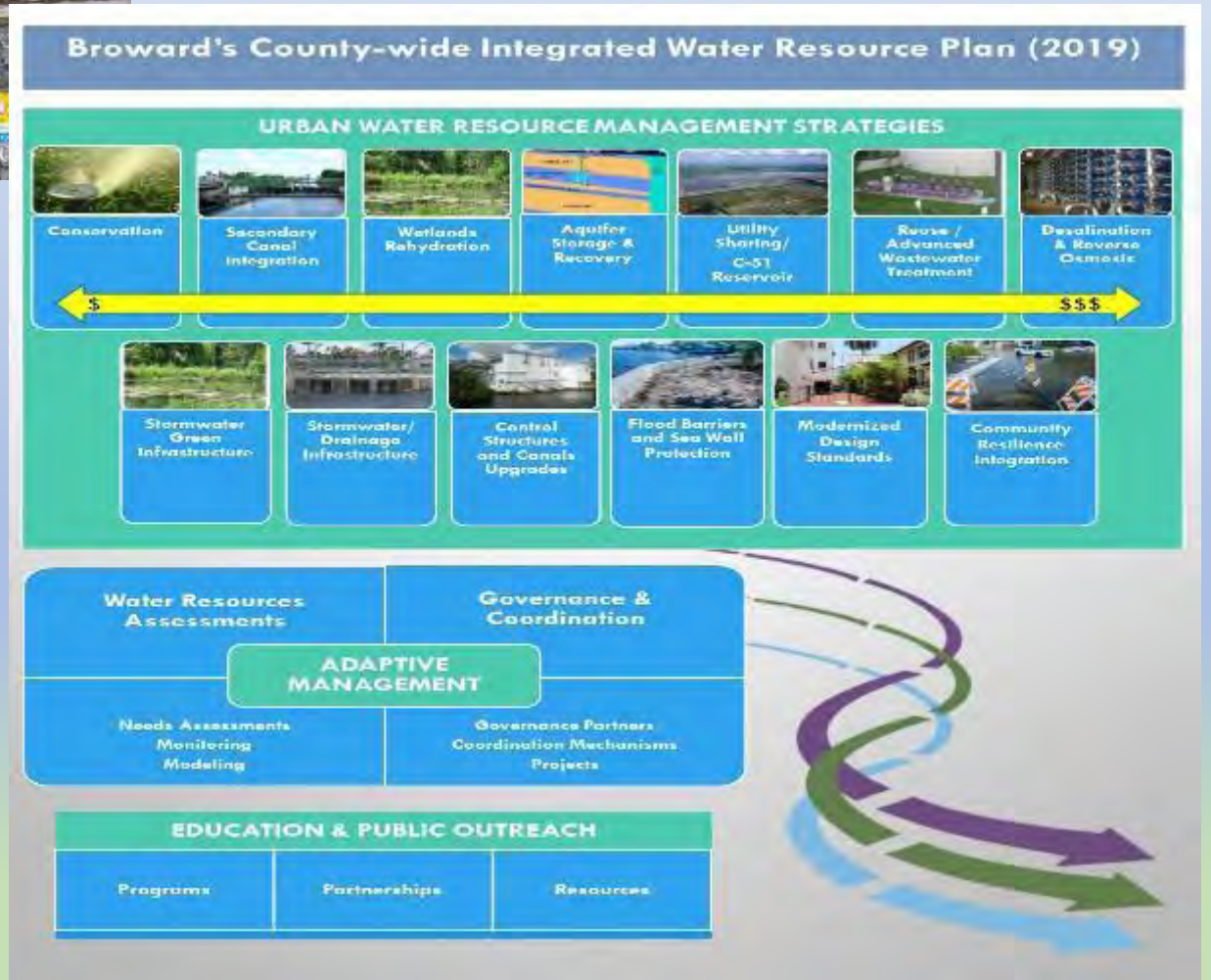
…*will address storm water management issues on a watershed (basin) basis as a means of advancing green infrastructure strategies*

Broward County Land Use Plan

In order to enhance water management…Broward County shall support the integration ***of "green infrastructure****" into the built urban environment.*

*Broward County shall promote and encourage, and shall implement to the maximum extent feasible ….****green infrastructure*** *management systems.*


Broward's County-wide Integrated Water Resource Plan Update: Building Resiliency in Water Management


Broward's County-wide Integrated Water Resource Plan (2019)
URBAN WATER RESOURCE MANAGEMENT STRATEGIES
Conservation
Secondary Canal Integration
Wetlands Rehydration
Aquifer Storage & Recovery
Utility Sharing/ C-51 Reservoir
Reuse / Advanced Wastewater Treatment
Desalination & Reverse Osmosis
$
$$$
Stormwater Green Infrastructure
Stormwater/ Drainage Infrastructure
Control Structures and Canals Upgrades
Flood Barriers and Sea Wall Protection
Modernized Design Standards
Community Resilience Integration
Water Resources Assessments
Governance & Coordination
ADAPTIVE MANAGEMENT
Needs Assessments
Monitoring
Modeling
Governance Partners
Coordination Mechanisms
Projects
EDUCATION & PUBLIC OUTREACH
Programs
Partnerships
Resources

Future Conditions Average Wet Seasons Map

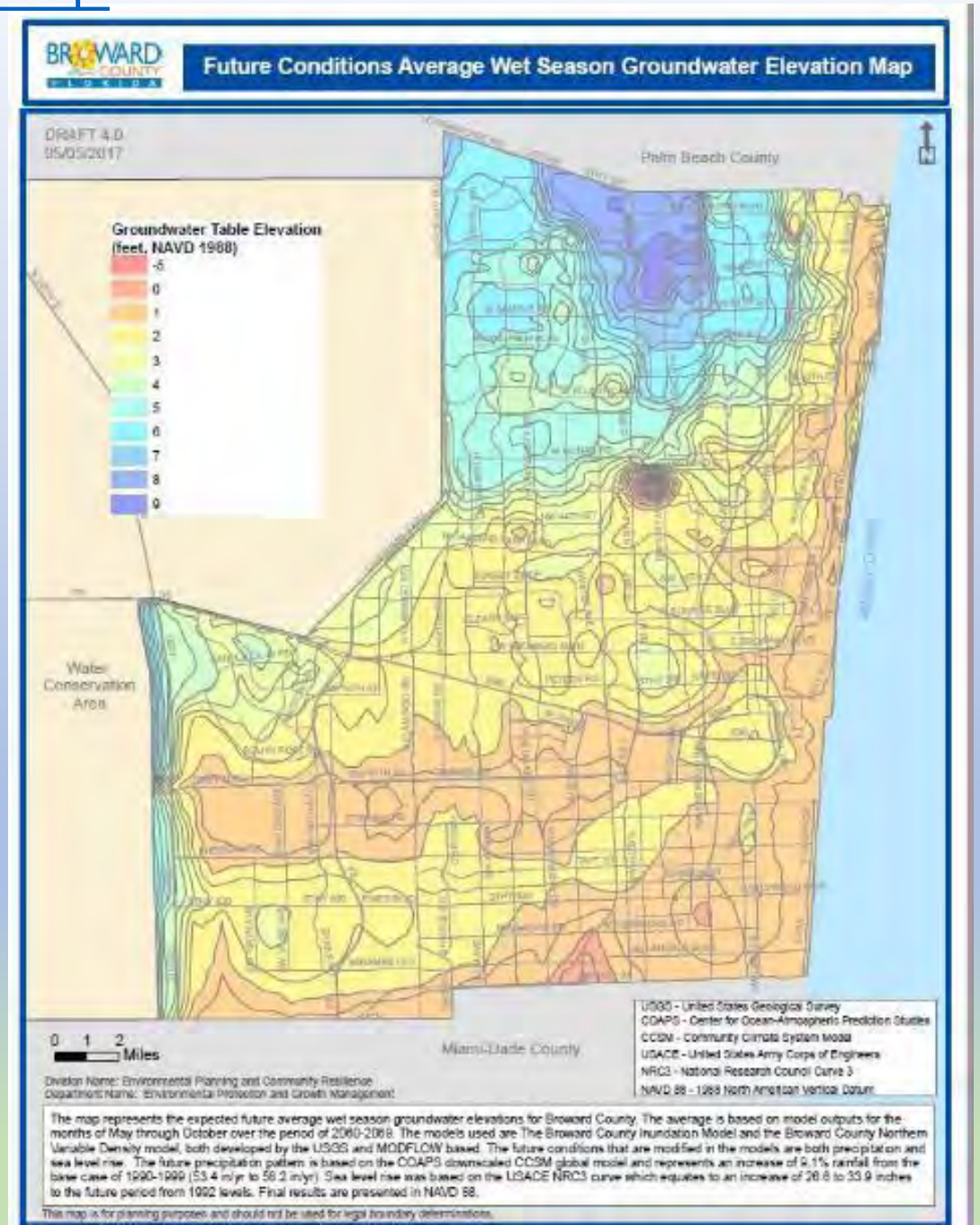
Previously permitting criteria was based on ***current or historic conditions***

Based on models of May thru Oct 2060-2069

Conditions modified are:

Precipitation: *9.1 % increase from 53.4in/yr to 58.2in/yr*

Sea level rise*: increase from 26.6 to 33.9 inches*



Sea-level Rise Flood Prevention

Backflow Preventers at Ocean Outfalls

Conventional Engineering Solutions:
Raise road & drainage system

Innovative Solution:
Install tidal control valves (low cost)

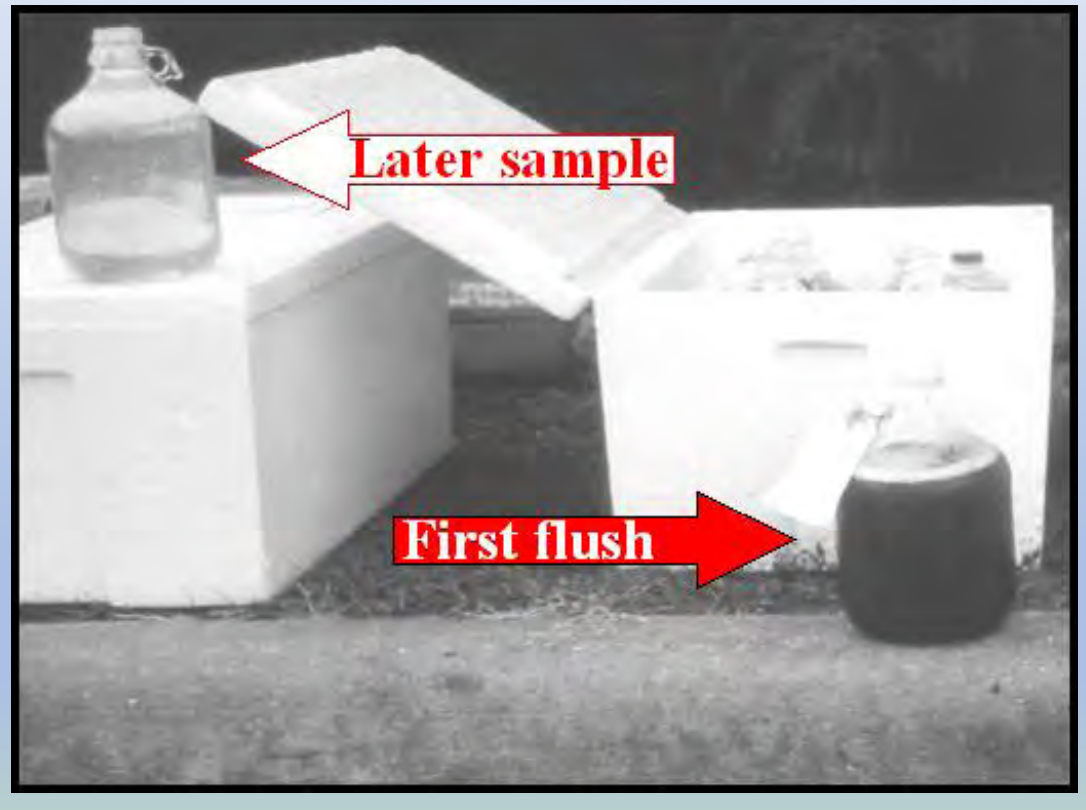
The Volume of Stormwater Runoff is Related to:

- Amount of Rainfall
- Infiltration
- Stormwater Storage – Soil (limited by GW levels)
- Evaporation & Transpiration

- **Average of 52 inches of rain/ year**
- **Almost 45 inches “lost” to evaporation and transpiration**

First Flush

"the flushing action the stormwater has on accumulated pollutants…"



Studies in Florida have determined that the first inch of stormwater runoff generally carries 90% of the pollution!

The Maps

- Citywide
- Goal set for each map
- Baselines established
- 3 colors, darker is better

Solar Installations

Food Desert

Turtle Lighting

Coastal Vegetation

Water Reuse

Light at Night

Natural Lands & Parks

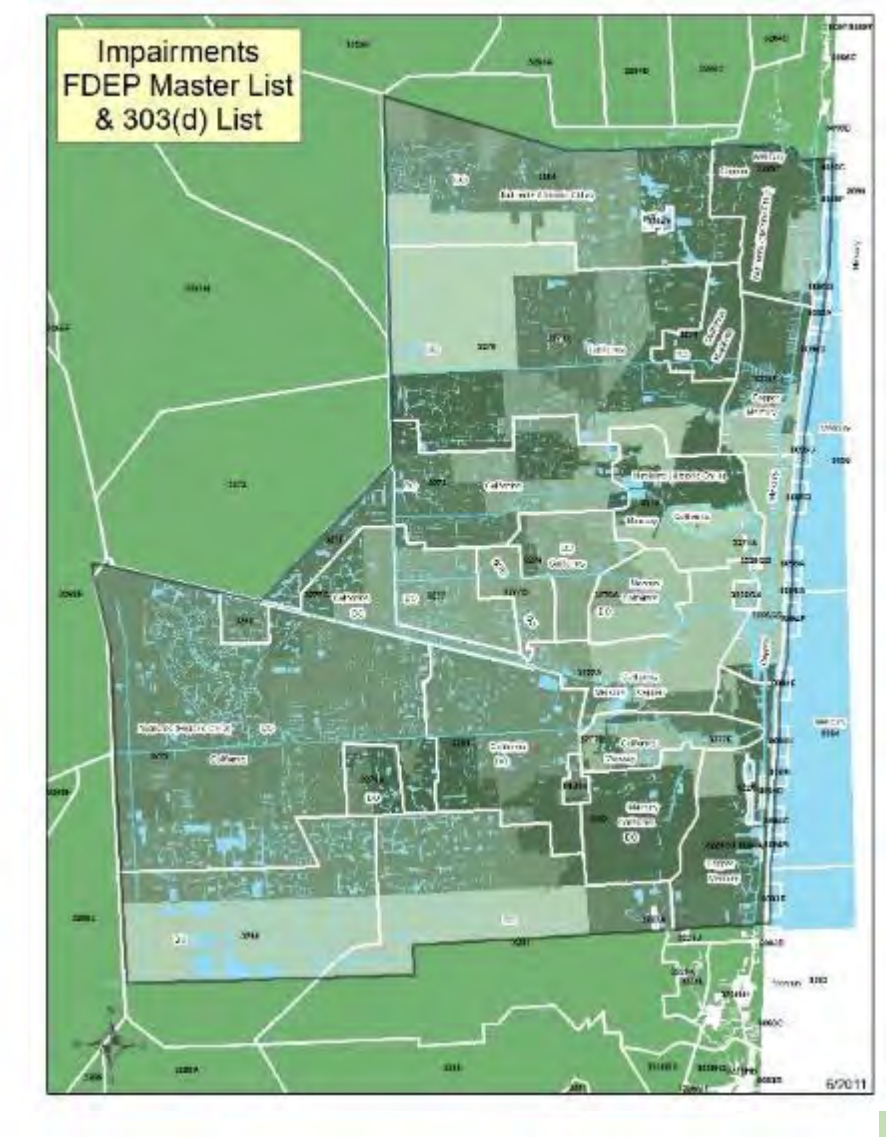
NatureScape

Urban Forest

Green Infrastructure

Nature-based System Benefits

- *Enhance ecosystem value*
- ***Help meet TMDL***
- *Increase resiliency*
- *Low-cost* water *management services*
- *Increase in scientific literature*



Challenge #1: Limited Land Availability

Squeeze traditional retention/detention areas into the design anyway in response to:

- **Time constraints -**belief that traditional design features will ensure speedy permits;
- **Concerns** that alternatives will present higher design, construction and maintenance **costs;**
- **Other driving factors**, such as “we’ve always done it this way”;
- **Liability concerns** (trip/fall or toddler drowning potential).

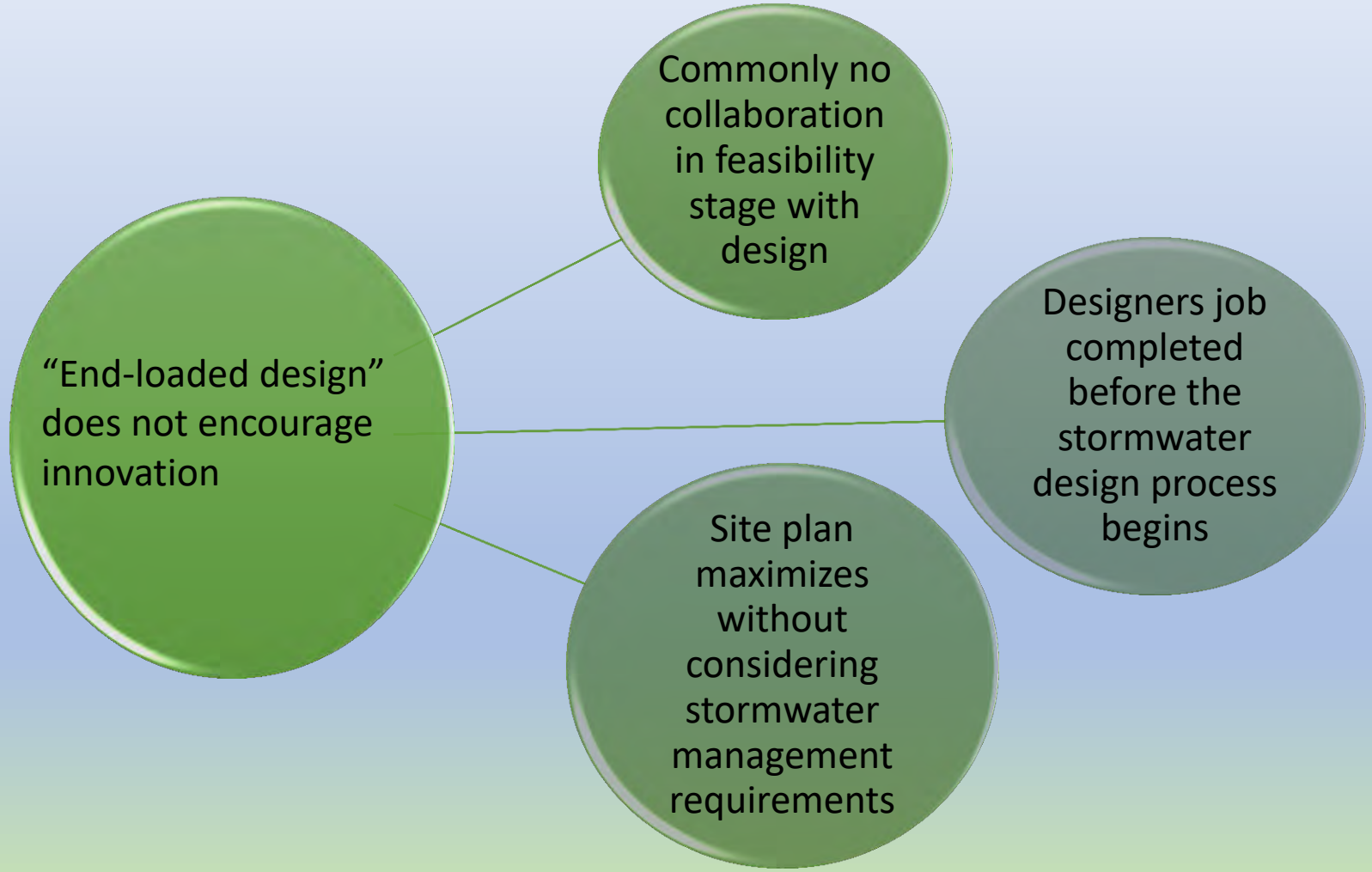
Challenge #1: Limited Land Availability

- No room to hide traditional stormwater facilities **“out back”**

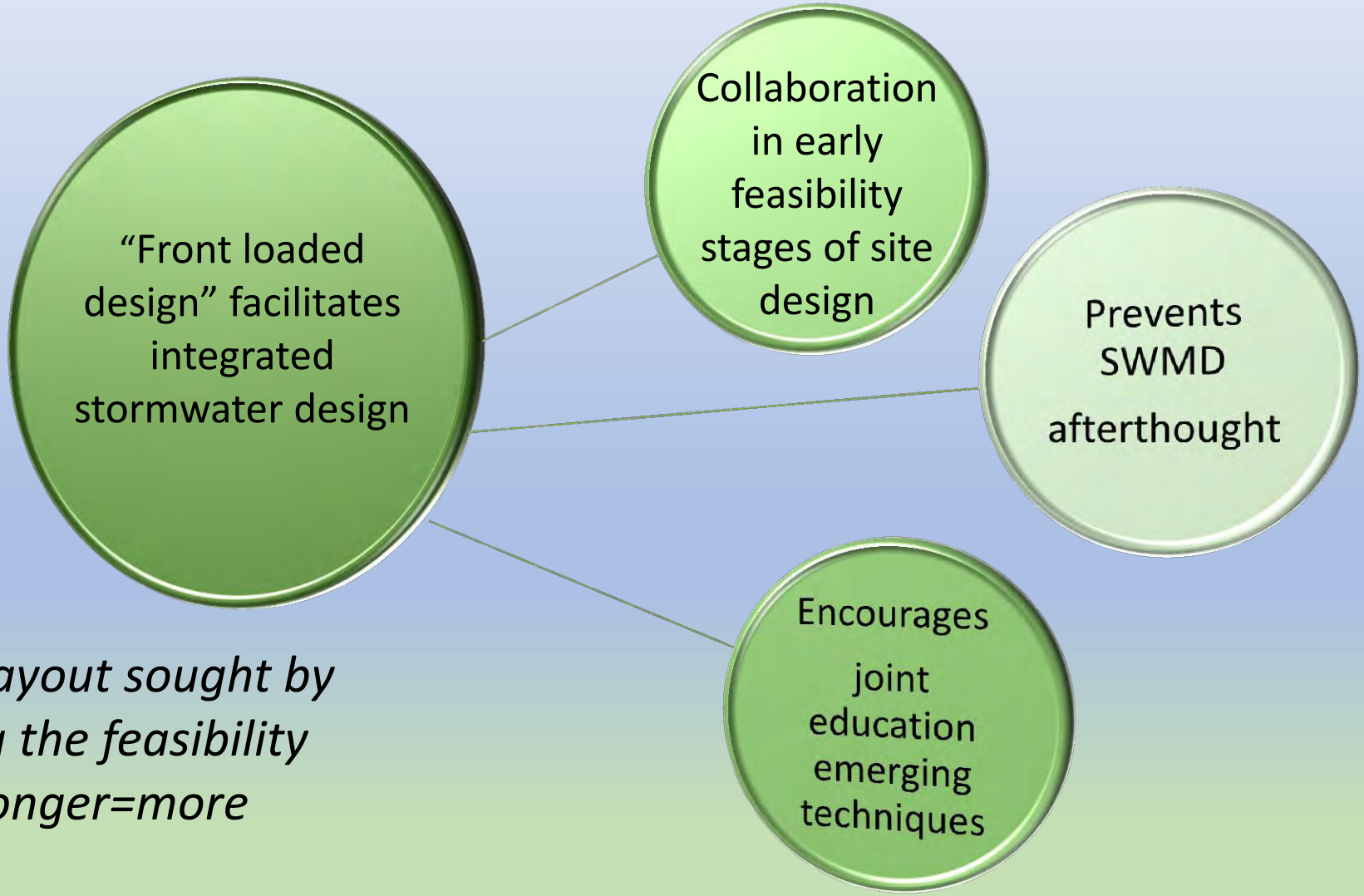
- The typical “retention/detention pond” facilities are often **out of place i**n the urban environment and detract from neighborhood.

Which sometimes results in**…**

Challenge #2: Typical Site Design Process



Solutions- Front loaded design



Drawback quick layout sought by developers during the feasibility phase may take longer=more expensive.

Broward Innovation Examples

- Broward County Code is flexible and allows innovative/alternative designs, but needs more incentives.

- Each of the following projects demonstrates an innovative way in which water quality treatment standards and flood protection were achieved and permitted in Broward County.

When County Code would allow the use of something like…

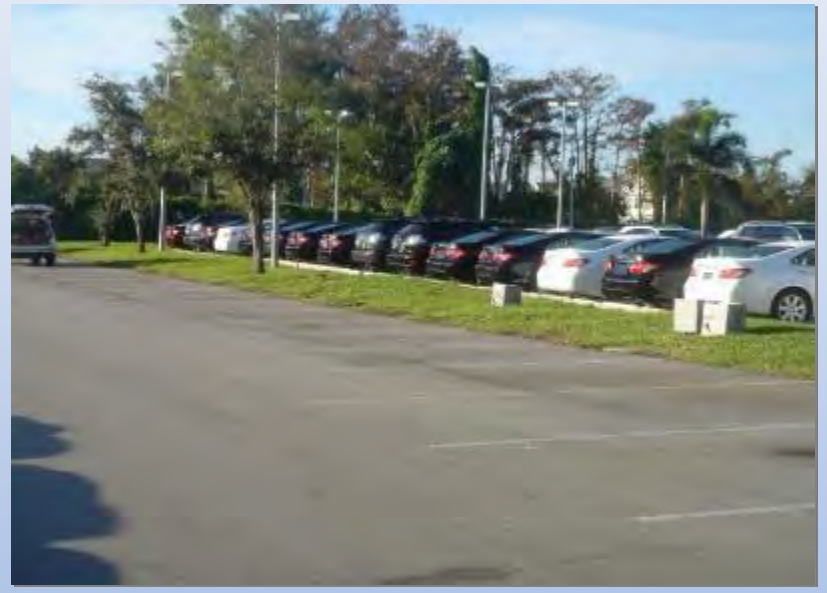
Or this….a voluntary Constructed Wetland with Conservation Easement

Or even this…

Shifting developer's inclination from retention pond to multi-use green stormwater management practices

Dry retention area with pervious rubber surface

Underground vault storage replaced a traditional aboveground retention area- JM Lexus



Composite underground tank storage allowed a passive park and two parking lots to be constructed in place of a traditional lake

Permeable Pavement

Coconut Creek

Pompano Beach Library

Exfiltration Trench

Fort Lauderdale

Voluntary Constructed Wetland with Conservation Easement

Bank Atlantic

Micro pool

Crushed recycled brick walkway

Parking lot without swale, slopes to bioswale

Native Plantings

Vertical Green Wall

Solutions- Outreach & Education

- Demonstrate ***the need and ability*** for stormwater management to be integrated into the site design.

  Encourage design professionals to consider the entire site for potential stormwater management uses, including roof tops.

  Highlight multi-functionality (landscape area, parking, playground, pedestrian space, etc.)

- Landscape areas often provide the easiest to construct and the lowest cost multi-use stormwater management features on an urban site:

  Those used for stormwater management require seamless coordination between civil engineers and landscape architects to ensure that both objectives are achieved.

- Educate appropriate plantings and layouts using Naturescape Broward principles that consider the frequency of inundation and allow for periodic removal of sediments without significant disruption or removal of plant materials.

  Stress the importance that these areas be ***functional***, ***maintainable***, and ***attractive*** if they are to succeed.

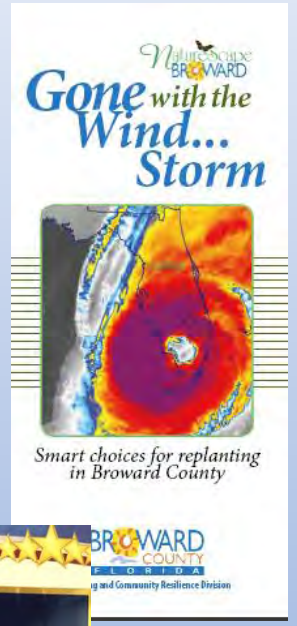
Water Resources

- Reduce stormwater pollution caused by pesticides and fertilizers
- Right Plant, Right Place for healthy vegetative cover
- Provide food, water, and shelter for resident and migrating wildlife
- Citizen Science/Crowd Source
- Partnerships with School District, NGO's ,Municipalities, Private

NatureScape BROWARD

NATIONAL WILDLIFE FEDERATION SINCE 1936 ™

Solutions- Outreach & Education



2017 NACIO
Awards of Excellence
"Superior"
"Best In Class"

Over 20, 000 distributed since 2016
for just these two publications

- Encourage urban reforestation and green infrastructure
- Increase the regional tree canopy to 40%"

Approx. 4,000 attendees each year

Sistrunk Bioswale Collaboration

Rain gardens

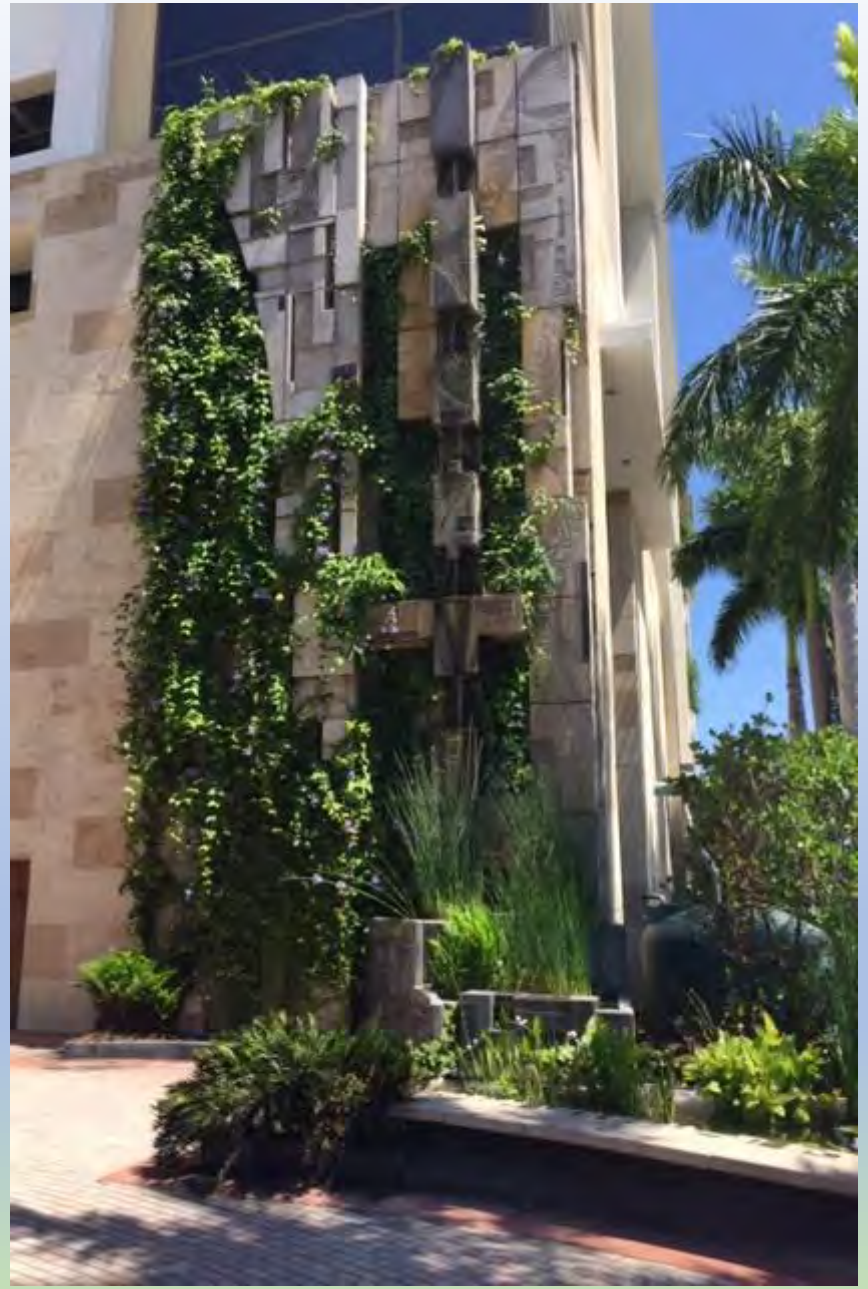
Port Everglades

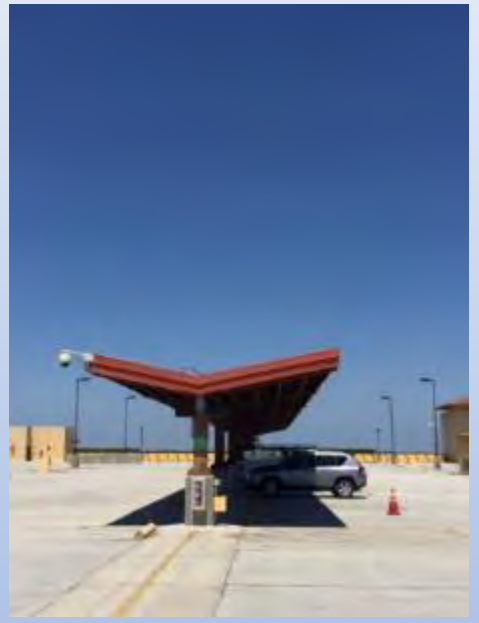
Pompano Beach

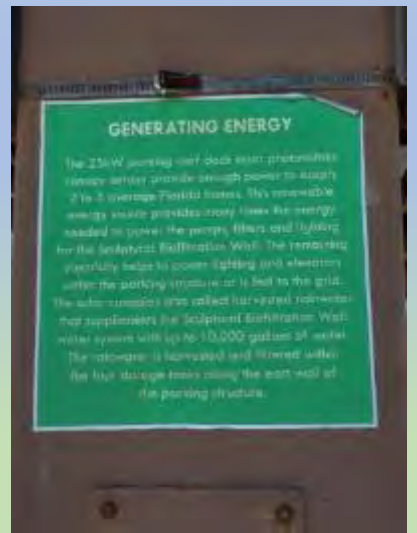
Partnerships Make It Happen

Whispering Pines Park
Coral Springs

Seminole Casino







Coconut Creek Canal Retrofit

Deerfield Beach Middle School


GREENING
GATEWAYS
05/30/2019 13:05


05/30/2019 13:14

Urban Trees

Before

Avoid torn-up sidewalks

2013

2017

“Rock Burrito”

BROWARD COUNTY FLORIDA

Retrofit of an existing retention area to incorporate NatureScape principles

Pompano Beach Transit Bioswale

Coastal

Dune restoration

New River Middle School-Living shoreline

Integrated Water Resources Plan (IWRP)
Wiles Road Cypress Dome

Broward County recognizes the value of promoting and encouraging innovative stormwater design and the thoughtful integration of landscaping into drainage features.

- ✓Robust model results identify critical / vulnerable flood areas in the county – guide future investments.
- ✓Widespread adoption of these types of practices is limited by design, construction and maintenance cost concerns.
- ✓Illustrate the value of proposition and benefits with data
- ✓Improve design for greater value & benefit at scale

Inventory and mapping of existing GI on an open source website

Developing prioritization models/matrix

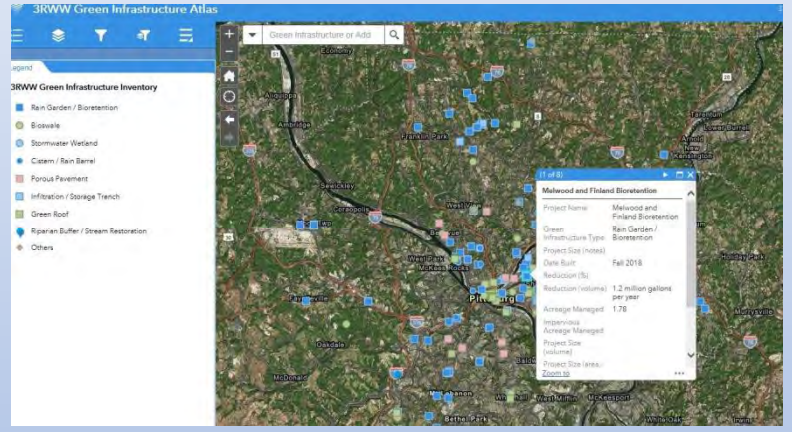
Developing SOP’s to be included in a manual

Regional permit-based stormwater/green infrastructure utility

Engaging stakeholders to identify and breakdown barriers-regulations, funding, maintenance

Encourage implementation for homeowners and businesses

Communicate the benefits of green infrastructure-brochures, workshops



Example from Pennsylvania

Crafting new financing options, public-private partnerships, taxes, transportation funding

Smart growth and smart community grants for pilot projects

State and private funding/grants for pilot projects

Pursue innovative funding mechanisms

Innovate, Replicate, Repeat

Questions?

Thank you.

Maena Angelotti, Program Project Coordinator

Environmental Planning and Community Resilience Division

mangelotti@Broward.org

954-519-1462