### INNOVATIVE TREATMENT AND VOLUME CONTROL

Marty Wanielista
University of Central Florida
Stormwater Management Academy
Orlando, Florida 32816
407.823.4144

wanielis@mail.ucf.edu

www.stormwater.ucf.edu

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### Thanks to Individuals at

- State Departments of Environmental Protection, Community Affairs, and Transportation
- 2. Saint Johns River WMD
- 3. Southwest Florida WMD
- Orange County Florida Stormwater Management Division
- Many Students at UCF, especially Mike Hardin, Ewoud Hulstein, Vince Peluso, and Josh Spence.

### OUTLINE

- Slide presentations all on www.stormwater.ucf.edu
- Background and history
- Groundwater
- Volume control and inter-event dry periods
- Pervious concrete
- Irrigation and reuse
- Green Roofs
- Conclusions, discussion, and future considerations

### BACKGROUND ON REGULATIONS

FROM: Eric H. Livingston
Bureau of Watershed Management
Florida Dept. of Environmental Protection
Tallahassee, Florida

eric.livingston@dep.state.fl.us http://www.dep.state.fl.us/water/watershed

### STATEWIDE STORMWATER TREATMENT PROGRAMS

•	Florida	1979
	Fiorida	1979

- Maryland 1984
- Virginia 1990
- Delaware 1991
- South Carolina 1992
- Massachusetts 1998
- Rhode Island 2002
- Wisconsin 2002
- New Jersey 2003

### NPS PROGRAMS FOR NEW SOURCES The "early years"

- 1972 DRI/ACSC laws
   Land Conservation Act (EEL)
- 1975 Local Govt. Comp Planning Act
- 1979 State Stormwater Rule
  - Chapter 17- 4.248, F.A.C.
  - CARL Trust Fund
- 1981 OSDS rule revisions
   Save Our Coasts/Our Rivers
- 1882 Chapter 17.25 The Stormwater Rule
- 1984 Wetlands Protection Act
- 1985 State Comprehensive Plan

LGCP & LDR Act

1989 Preservation 2000

### NPS PROGRAMS EXISTING SOURCES

- 1986 Stormwater utility enabling legislation
- 1987 SWIM Act
- 1989 Dairy Rule for Okeechobee, Stormwater law
- 1991 SJRWMD Rule 40C-44 (Ag/Cost Share)
- 1992 SFWMD Rule 40E-63
- 1994 Nitrate Bill/Fee
- 1997 SRF opened to urban and ag stormwater
- 1998 Ag BMP Cost Share (\$200,000), SRBNMWG
- 1999 Forever Florida Act
   Florida Watershed Restoration Act FWRA
- 2000 Lake Okeechobee Protection Program Revised State Revolving Fund legislation
- 2005 FWRA amendments

### FLORIDA WATERSHED RESTORATION ACT Section 403.067, F.S.

- Enacted in 1999
- TMDLs are Total Maximum Daily Loads
- BMAPs are Basin Management Action Plans
- Requires "Good Science" DEP to adopt methodology for determining impaired waters = Impaired Waters Rule (62-303)
- Requires "Public Participation"
  - 303(d) lists are adopted by DEP
  - TMDLs, BMAPs are adopted by rule
- Requires equitable allocation of load reductions

### 403.067(7)(a) Development of BMAPs

- BMPs adopted by DEP or DACS shall serve as initial management strategy for NPS
- May provide credit to dischargers that already have implemented mgmt strategies
- BMAP shall identify how future sources of increased loading will be addressed

### 403.067(6)(b) TMDL Allocations

- Clarifies TMDLs are to reduce pollutant loads to achieve WQS, not full restoration
- Initial allocation (PS,NPS) when TMDL adopted
- Detailed allocation to individual PS and NPS categories in BMAP
- Consider allocation factors in both

403.067(6)(c) Adoption of Rules

- TMDLs rules are adopted.
- Phased TMDLs authorized where DEP determines added data collection and analyses are needed (i.e. coliforms).
- DEP must explain "detailed statement of facts and circumstances" why the data are inadequate and justify a phased TMDL.

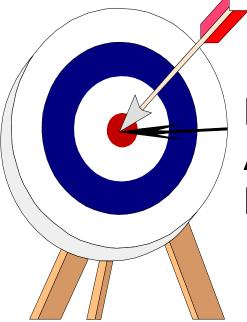
#### 403.067(7)(b) TMDL Implementation

- For MS4 permittees, TMDL implementation achieved via BMPs
- BMAP implementation schedule may > 5 yrs
- BMAP requirements put into NPDES permits may not be challenged
- NPS dischargers in a BMAP shall implement BMPs or do WQ monitoring
- DEP or WMD may enforce against a NPS discharger in a BMAP, if applicable BMPs not implemented
- "Safe Harbor" can't be required to do more than agreed to do in BMAP

### BMAPs and TMDLs

- BMAP & TMDL programs designate Loadings as the control based on WQ.
- Loadings are a product of concentration and volume.
- Thus either reduce concentration or reduce volume or do both.
- This presentation presents methods to reduce volume, but also concentration reductions can occur.

### STORMWATER PERFORMANCE STANDARDS



Load (volume) vs. concentration? Annual vs. seasonal vs storm? For what pollutants?

### Most common in U.S. programs

- Retain sediment onsite or not violate turbidity standard
- 80% average annual reduction of TSS loadings

SUMMARY OF CALCULATED AREAL POLLUTANT LOADING RATES FOR CENTRAL AND SOUTH FLORIDA
FROM HARVEY HARPER, 1995, "STORMWATER CHEMISTRY AND WATER QUALITY"

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LAND USE CATEGORY
Low Density Residential
Single-Family
Multi Family
Low-Intensity Commercial
High Intensity Commercial
Industrial
Highway
Ag – Pasture
Ag - Citrus
Ag - Row Crops
General Ag
Recreational
Open Space
Mining
Wetland
Open Water

TOTAL N	ORTHO-P
2.88	0.169
4.68	0.335
8.51	0.924
5.18	0.157
13.0	1.52
7.30	0.519
6.69	0.361
4.54	0.732
2.91	0.123
2.84	0.421
3.62	0.380
1.07	0.003
2.21	0.131
1.81	0.204
3.23	0.130

AREAL LOADING RATE (kg/ac-yr)

BOD

7.63

14.3

38.4

36.1

79.3

39.5

21.9

7.99

3.60

5.80

0.96

18.0

4.96

4.02

**TSS** 

31.9

56.1

256

343

435

383

182

126

21.9

74.0

7.60

176

11.2

8.05

TOTAL P

0.320

0.594

1.72

0.650

1.96

1.24

1.32

0.876

0.197

0.595

0.551

0.046

0.281

0.222

0.273

**TOTAL** 

Zn

0.06

0.122

0.188

0.511

0.782

0.543

0.508

0.005

0.229

0.009

0.073

TOTAL

Pb

0.052

0.083

0.299

0.635

0.985

0.872

0.727

0.021

0.378

0.039

0.065

## IMPACTS OF UNMANAGED STORMWATER

- Changes in watershed hydrology
- Changes in infiltration to ground water
- Changes in stream hydrology
- Changes in stream morphology
- Changes in riparian zone habitat
- Changes in water quality
- Changes in aquatic habitat
- Changes in aquatic ecosystem

### Performance Standard for New Stormwater Discharges

### **Erosion and sediment control**

- Retain sediment on-site
- Not violate turbidity standard

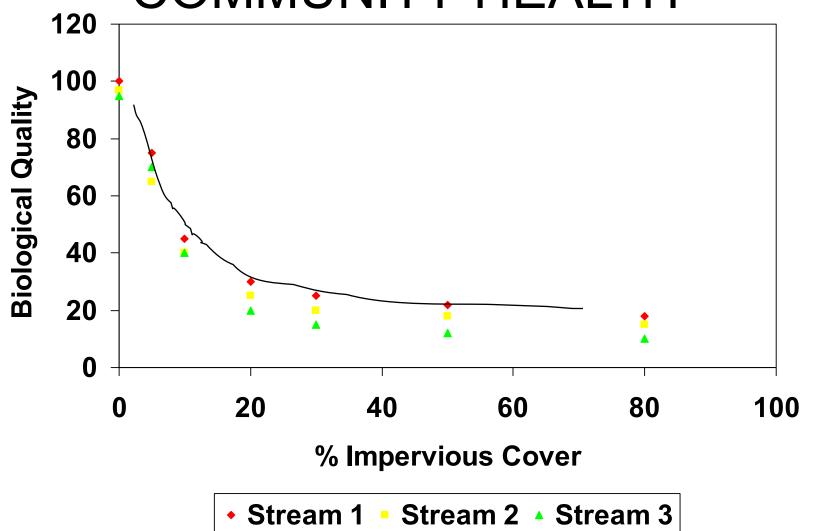
### Stormwater quantity

- Discharge rate WMD or local standards
- Volume control

### **Stormwater quality**

- 80% average annual load reduction
- 95% average annual load reduction
- Basin specific requirements

# RELATIONSHIP OF IMPERVIOUSNESS TO BIOLOGICAL COMMUNITY HEALTH



### **BMP Design Considerations**

#### **Land Use**

% imperviousness/DCIA, runoff volume, traffic

### **Precipitation**

Volume, number of storms, interevent dry period

### **BMP** efficiency

 Annual load reduction, on-line vs off-line, reuse, retention vs detention, BMP treatment train

#### **Pollutants**

 Annual vs seasonal loads, concentrations, first flush

## TMDL FUNDING SB 360 GROWTH MANAGEMENT

### 201.15, F.S. DISTRIBUTION OF TAXES

- Water Protection & Sustainability Program TF
  - \$100 million annually for 403.890 purposes
  - 60% Alternative water supply
  - 20% TMDL BMP implementation/research
    - 85% to FDEP for non-ag NPS pollution
    - 15% to FDACS for ag NPS pollution
  - 10% SWIM activities
    - 35% SFWMD, 25% SWFWMD, SJRWMD
    - 7.5% SRWMD, NWFWMD
  - 10% Disadvantaged Small grants

### TMDL IMPLEMENTATION FUNDING COME AND GET IT!!!!!!! eric

- In the bank:
  - \$9.2 m FY04/05 Florida Forever (2/1/06)
  - \$17.5 m FY05/06 WPSP TF (2/1/07)
  - ~\$8 m FY05/06 Section 319 grants (7/4/05)
- Purposes:
  - Stormwater treatment projects to reduce loads to waters with a TMDL
  - Stormwater BMP research
- How apply:
- http://www.dep.state.fl.us/water/watersheds/forever.htm
- http://www.dep.state.fl.us/water/nonpoint/319h.htm

## STORMWATER PROGRAM EVOLUTION



## EVOLUTION OF STORMWATER MANAGEMENT

Drainage

### IN THE BEGINNING

- Too much water was the common enemy
- Minimal funding except for flood control
- Assimilative Capacity > Pollutant Load
- People cared when they got flooded!



### **Management Dictum**

- Ditch to Daylight
- Drain Wetlands
- Limited Science/Data
- No Environmental Linkage



### Stormwater Quantity Evolution

### Peak Discharge Rate

- Post-development = Pre-development
  - 10, 25, or 100 year storm
- Multiple storms
  - 2-yr, 24-hour + 10, 25, or 100 year storm
  - Critical Storm

### Volume especially for land locked lakes

- Mass Balance
- Simple models
- Continuous simulation

## EVOLUTION OF STORMWATER MANAGEMENT

- Drainage
- Stormwater treatment

## FLORIDA'S STORMWATER RULES

1979 Chapter 17- 4.248, F.A.C.

1982 Chapter 17- 25, F.A.C.

1994 Chapter 62- 25, F.A.C.

"To prevent pollution of state waters by stormwater discharges"

Water management district MSSW/SW rules Water management district ERP rules

### Performance Standard for New Stormwater Discharges

### **Erosion and sediment control**

- Retain sediment on-site
- Not violate turbidity standard

### **Stormwater quantity**

- Discharge rate WMD or local standards
- Volume control

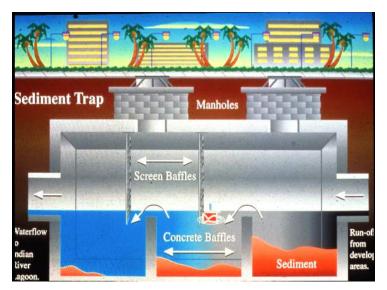
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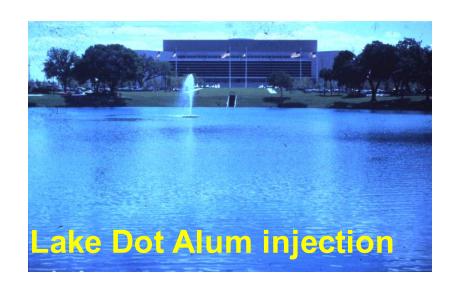
### STORMWATER RETROFITTING



**Greenwood Reuse** 



**Baffle Boxes** 





**Green Roofs** 

## STORMWATER MANAGEMENT IMPROVES, BUT...

- Flooding continues El Nino rains
- Assimilative Capacity ≤ Pollutant Load
- Channel erosion problems recognized
- Protecting ground water is an issue

### **Management Dictum**

- Monitor/collect data
- Improve H/H modeling
- Better watershed WQ models
- Decrease discharge volumes
- Use regional systems/basin criteria

## EVOLUTION OF STORMWATER MANAGEMENT

- Drainage
- Stormwater treatment for new
- Stormwater retrofitting

### **BUT**:

We are still not achieving our goal of protecting or enhancing aquatic ecosystems

Watershed management

## SOLVING STORMWATER PROBLEMS



## BEST MANAGEMENT PRACTICE

A CONTROL TECHNIQUE USED FOR A
GIVEN SET OF CONDITIONS
TO ACHIEVE
WATER QUALITY AND QUANTITY
ENHANCEMENT
AT A MINIMUM PRICE

## BEST MANAGEMENT PRACTICES

Nonstructural = prevention

Structural = mitigation

### PREVENTING STORMWATER POLLUTION USING NONSTRUCTURAL BMPs

#### LAND USE MANAGEMENT - PROMOTE LID

- Protect natural SWM system
- Protect natural areas, wetlands, riparian buffers
- Minimize impervious surfaces, veg clearing

#### SOURCE CONTROLS

- Street sweeping, litter control
- Natural landscaping (FYN Program)
- Green roofs and roof runoff to rain barrel/landscaping
- Prevent illicit connections & discharges

#### PUBLIC EDUCATION

- Storm sewer stenciling
- Pet waste collection and disposal

# MINIMIZING STORMWATER PROBLEMS

#### Increase use of source controls







#### STORMWATER TREATMENT PRACTICES



#### Structural BMPs.



#### **Swales**

- **Retention systems** 
  - Infiltration basins
  - Infiltration trenches
  - **Exfiltration trenches**

**Pervious pavement** 

Dry et ntion Filters stems

- Wet detention
- **Wetlands**
- **Green roofs**



#### **BMP TREATMENT TRAIN**

**Erosion control** Source controls Public ed Roof runoff Florida Yards LID

**Swales** Filter inlets Oil/water separators

Cistern Catch basins Sediment sump **Alum** 

Retention **Detention** Wetlands Reuse



#### INFILTRATION PRACTICES

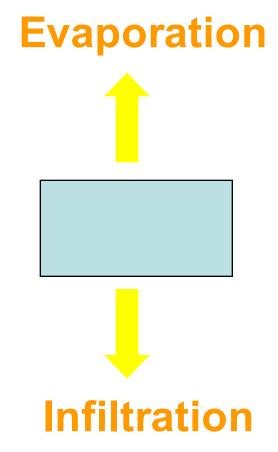
DESCRIPTION: Family of practices where the stormwater is infiltrated or evaporated rather than discharged.

#### **PURPOSE:**

- Reduce total volume
- Reduce pollutants

#### **POLLUTANT REMOVAL:**

- Percolation
- Filtering and adsorption







#### DETENTION PRACTICES

**DESCRIPTION:** A family of practices which detain runoff and discharge it.

#### **PURPOSE:**

- Flood protection
- Water storage
- Pollutant removal

#### **POLLUTANT REMOVAL:**

Depends on type of detention BMP



### KEY ELEMENTS FOR RESTORING YOUR COMMUNITY'S WATERS

Reducing Impacts from Existing Development

- Increase use of source controls
- Agricultural BMPs
- Better maintain existing stormwater treatment systems
- Upgrade existing stormwater treatment systems
- Convert existing stormwater treatment systems
- Stormwater retrofitting

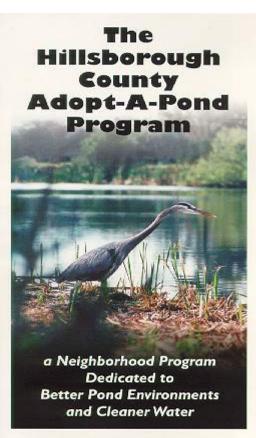
## REDUCING STORMWATER LOADS FROM EXISTING DEVELOPMENT

Better maintain existing stormwater

treatment systems



- More inspections
- Inspector training
- Local OM permits
- Utility fee credits





## STORMWATER RETROFITTING REGIONAL SYSTEMS

- Lake Jackson
- Greenwood Wetland
- Clear Lake Packed Bed Filter
- Brevard Chain of Lakes
- 10 Mile Filter Marsh





#### Lake Greenwood Urban Wetland

Watershed Area: 527 acres

Land Use: 275 acres - Residential

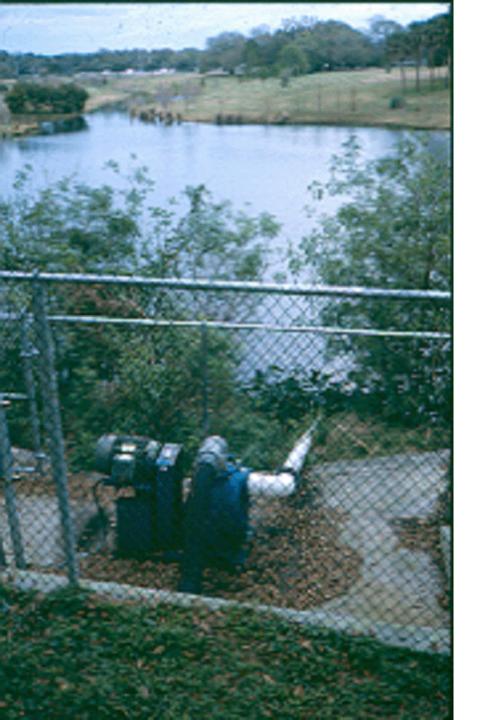
210 acres - Commercial/residential

28 acres - Open space

14 acres - Water

Project Cost: \$581,000 1990 dollars





Stormwater reuse saves the City of Orlando over \$25,000/year 1990 dollars

# Bath Club Concourse Stormwater Rehabilitation Using

Watershed Areavious. Cogresete

Land Use: 2.12 acres - Parking/road

Project Cost: Total Project - \$147,015

Town of North Redington Beach

**Effectiveness:** 

Parameter Lead Zinc TSS BOD TP OrthoP TN % Removal 73 72 73 61 49 26 65







# Oleander Avenue Exfiltration Trench System

Watershed Area: 49 acres

Land Use: Single family residential/street

**23% DCIA** 

**Project Cost:** Total Project - \$513,700

DER - State Stormwater Demonstration Grant City of Daytona Beach Stormwater Utility

Effectiveness: The exfiltration trench has not discharged during storms of up to 2". Based on the city's rainfall, the system will retain at least 80% of the annual stormwater volume and pollutant loading.





### INNOVATIVE SOLUTIONS





- Disinfection
- Stormwater Reuse
- Green Roofs
- Certified pervious surfaces





#### ENCINITAS COTTONWOOD CREEK

- Watershed Area: 2000 acres
- Land Use: Highly urbanized
- Project Cost: \$956,000
- Project OM Cost: \$ 5,000/yr
- BMP Treatment Train:

Coarse filters

Multimedia filter tanks

**UV** purification

Flow rates: Up to 150 gpm



#### **Coarse filters**

#### **Multimedia filters**





#### STORMWATER RETROFITTING STORMWATER REUSE SYSTEMS

- SMART Winter Park
- Cocoa Village
- Rainbowls
- South Bay Utilities
- UCF Green Roof





### COCOA VILLAGE RETROFITTING

- 12 acre downtown drainage basin
- Discharge to Indian River Lagoon
- Stormwater reuse system
  - Off-line system captures 0.75" runoff
  - Baffle box pretreatment
  - Underground storage pipes
  - Pumped to wastewater plant
  - Mixed with reclaimed water
- Cost: \$328,000 (1999 dollars)
  - City, DEP 319 grant, SJRWMD



#### South Bay Utilities Inc.

- Upscale residential
- Some Commercial
- No CUP
- No FPSC







- 50¢/1,000 gallons
- Shallow wells
- Customer agreements
   900 homes HOA
- Coastal / fragile resource

#### UCF Student Union Green Roof







CHAPTER 62-40, FAC
STORMWATER GOAL
FUTURE STORMWATER PERFORMANCE
STANDARD?

#### POST < PRE

- Peak discharge rate
- Volume
- Recharge
- Pollutant loading (nutrients)\*

\*In effect in Lake Apopka, Lake Okeechobee, and SW Florida

# KEY ELEMENTS FOR RESTORING YOUR COMMUNITY'S WATERS Reducing Impacts from New Development

- Revise Land Development Regs -Promote Low Impact Design
  - Minimize clearing, protect vegetation
  - Promote clustering
  - Reduce imperviousness
  - Save the swales
  - Landscaping
  - Green roofs
- Increased stormwater treatment
  - Reuse stormwater or reduce discharges
  - Better operation and maintenance

#### WATERSHED TREATMENT TRAIN

#### **Pollution Prevention**



- Low impact design
- Public education
- Spill prevention
- Landscape design

#### **Source Controls**

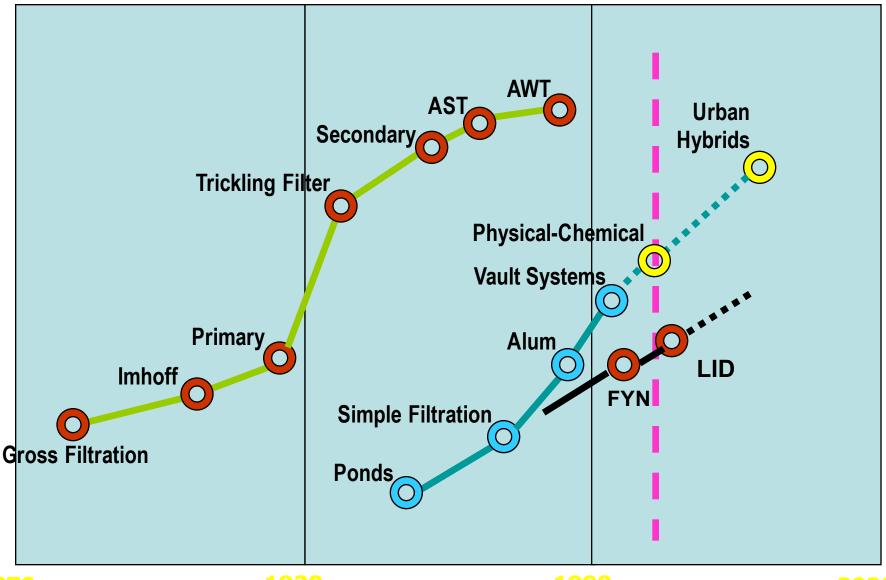


- Filter strips, buffers
- Lawn chemical mgmt.
- Pervious pavement
- Green Roofs

#### **Treatment Controls**

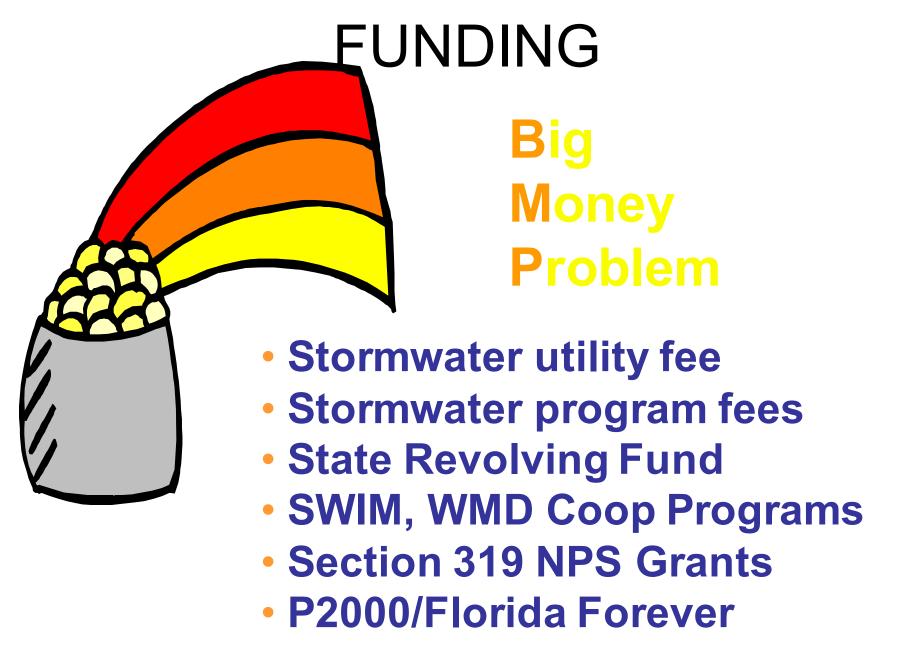
- Infiltration basins
- Wet detention basins, wetlands
- Alum injection
- In water-body pollutants

#### Historical Perspective



1870 1920 1990 2020

#### STORMWATER MANAGEMENT





BE PART OF THE SOLUTION

#### PUBLIC EDUCATION

- Pointless Personal Pollution
  - -www.tappwater.org
- Children Water Festivals
- Inspector training program
- Operator training program
- BMP designer courses
- Ag BMP workshops (CES, IFAS)
- Florida Yards & Neighborhoods
- Animations www/stormwater.ucf.edu and Stormwater Education Training tool box



### QUESTIONS??





