# Integrated Urban Water Management in Dunedin, Florida, USA

*Sustainable Practices From a Small Coastal City in the Gulf of Mexico*


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USF UNIVERSITY OF SOUTH FLORIDA


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# Acknowledgements

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# SWITCH

- Dunedin joined SWITCH as an **Associate City** in June 2010
- First North American city in the network

SWITCH


**SWITCH Secretariat**

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**DUNEDIN – A SWITCH CITY**

Dunedin, situated on the Gulf of Mexico, faces challenges similar to many other coastal cities including protection of its urban well field from salt water intrusion, providing high quality water to its citizens and adapting to climate change.

Dunedin's innovative approaches to urban water management are providing concrete examples of how cities around the world can act now to ensure a more sustainable future, particularly

- Dunedin's careful management of its urban well field system
- A "near closed loop" urban water management approach, through the extensive use of recycled wastewater for irrigation and stormwater infiltration
- Innovative wireless metering for conservation and management of both drinking and reclaimed water systems
- A commitment to sustainability, through the Certified Green Local Government designation and other green initiatives.

We are pleased to recognise Dunedin as a "SWITCH Associate City" in recognition of your support of the SWITCH approach of more sustainable and integrated urban water management as evidenced by the collaboration between the University of South Florida (Daniel Yeh) and the University of Birmingham (Rae Mackay) to pilot the CityWater Decision making framework with local Floridian stakeholders

We believe that the City of Dunedin's experiences and leadership in managing its water resources can serve as a model for other coastal cities and be a valuable input into the SWITCH Global Learning Alliance network.

We look forward to further exchange of information and hope to see you at the SWITCH global meeting in Zaragoza in December 2010.

Sincerely yours,

Carol Howe
SWITCH Project Manager
UNESCO-IHE

Cc: Kala Vairavamoorthy-UNESCO-IHE, Rae Mackay-UBham, Daniel Yeh, USF



CITY OF DUNEDIN FLORIDA

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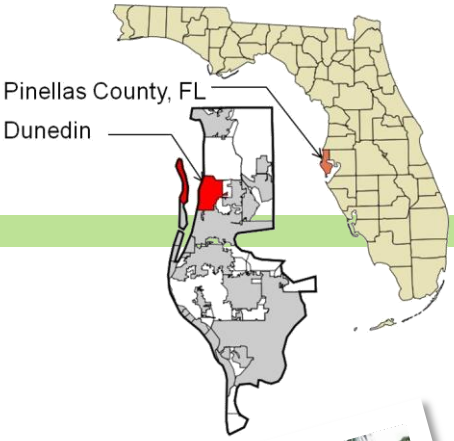
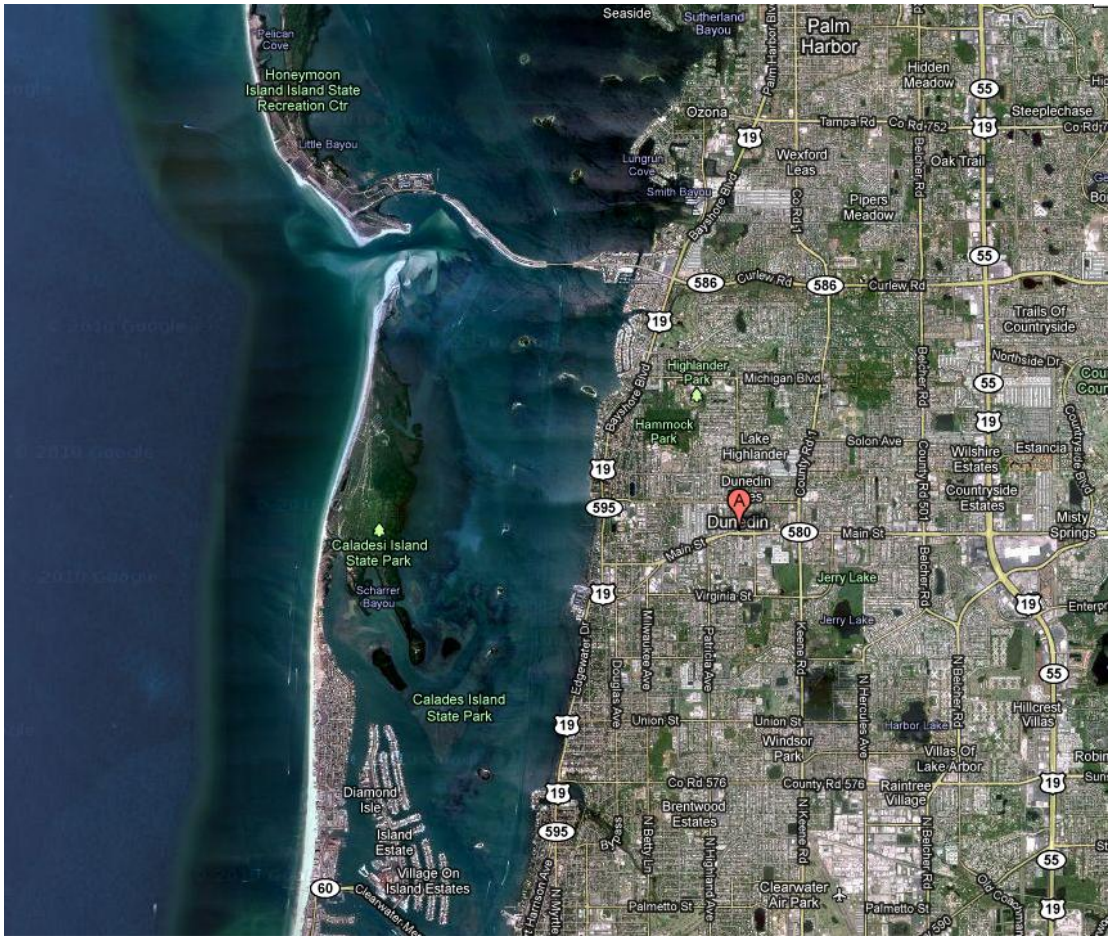
# Why? What can we learn?

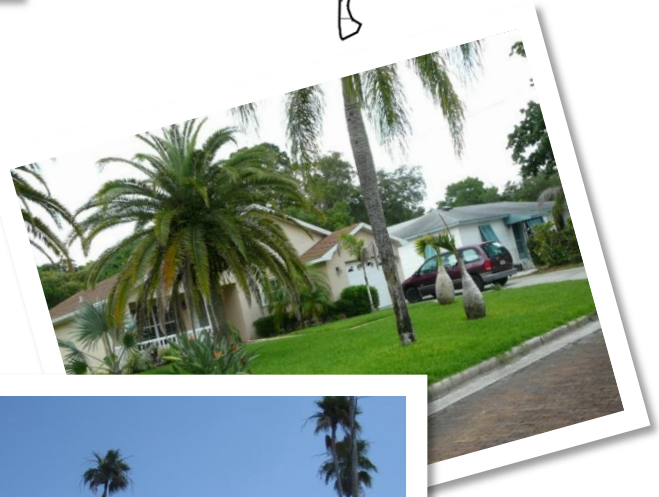
- Careful management of its urban wellfield
- ‘Near closed loop’ urban water cycle
- Traditional and innovative technology for conservation
- Investment in water reuse
- Institutional framework
- Commitment to sustainability

# Dunedin, Florida, USA




| | | |
|---|---|---|
| **Size (area):** | 10 mi$^2$ | (26 km$^2$) |
| **Population:** | 37,000 residents | |
| **Density:** | 3,700 people/mi$^2$ | (1,158 people/km$^2$) |

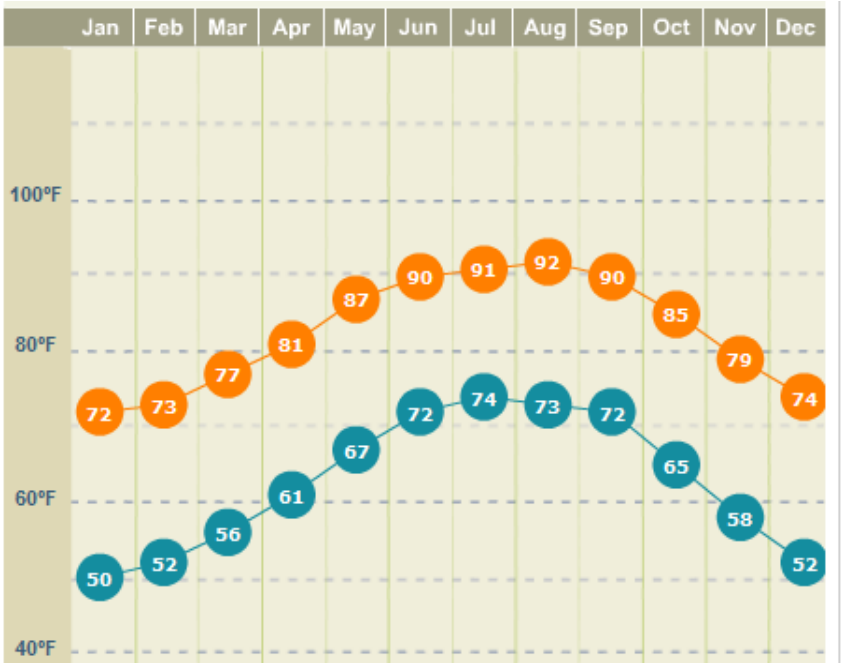


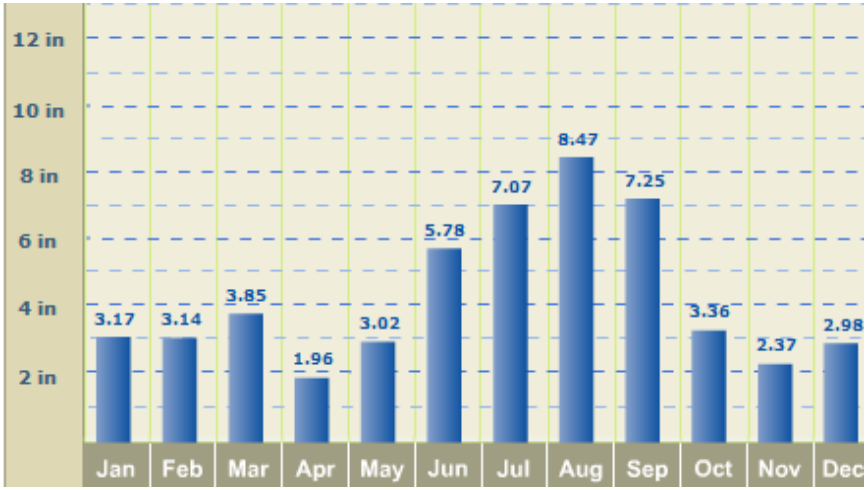



**Caladesi Island, among the beaches in the U.S.**

# Climate/Weather

| | | |
|---|---|---|
| **Precipitation:** | 52 inches/year | (132 cm) |
| **Temperature:** | 50°F - 90°F | (10°C - 32°C) |
| **Hottest Month:** | August | |
| **Wettest Month:** | August | |

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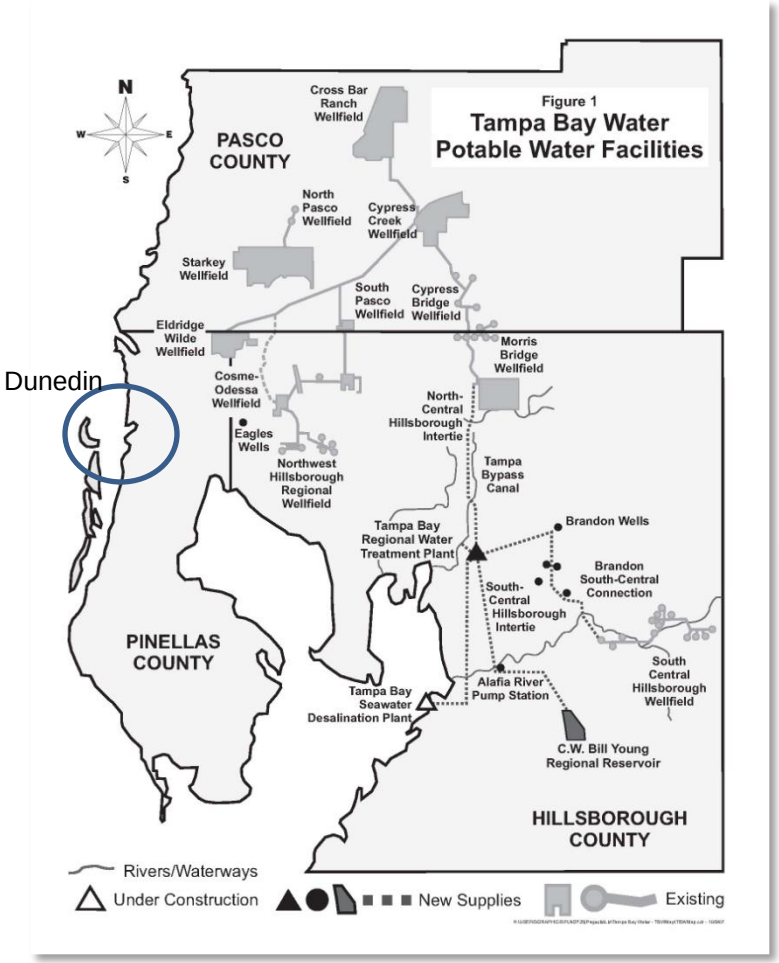
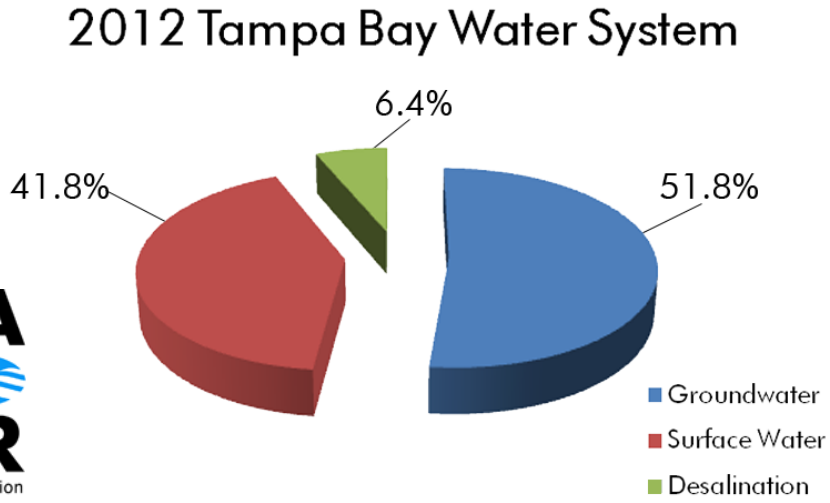
# Regional Water Supply




Dunedin

Regional Wellfields




TAMPA BAY WATER
Supplying Water To The Region

Desalination Plant

C. W. Bill Young Regional Reservoir

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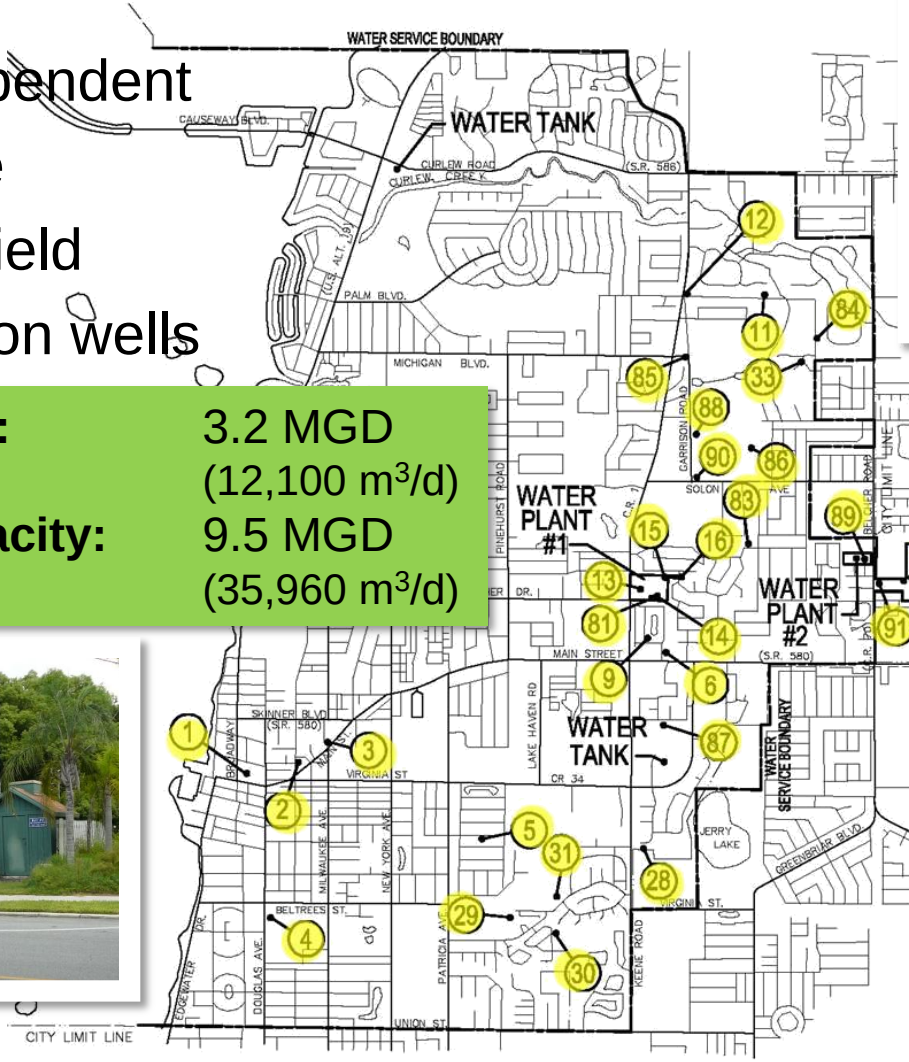
# Local Water Supply

- Water independent
- Sustainable
- Urban wellfield
- 26 production wells

**Avg. Production:** 3.2 MGD (12,100 $m^3/d$)

**Production Capacity:** 9.5 MGD (35,960 $m^3/d$)

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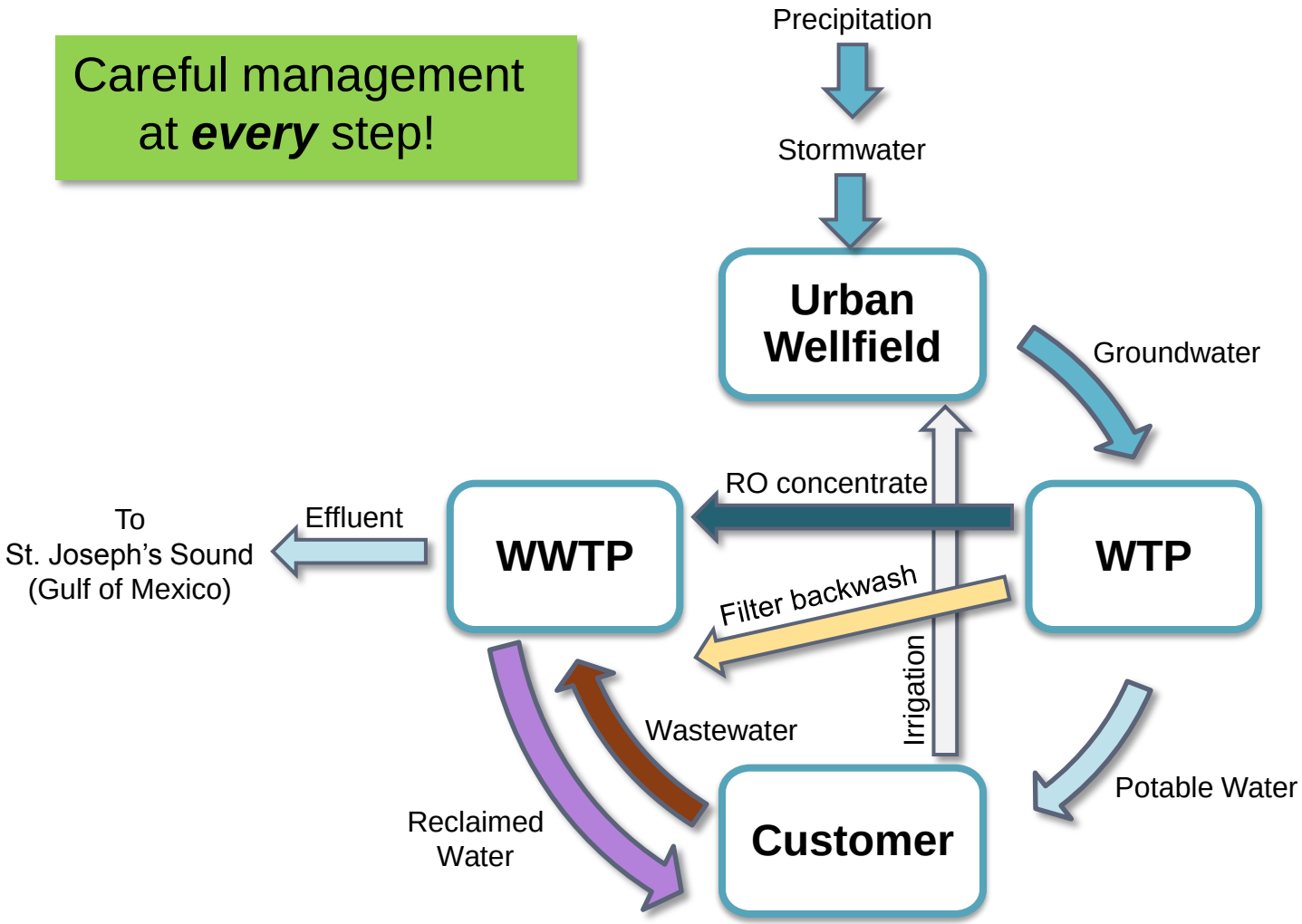
# Dunedin's Urban Water Cycle

Careful management at ***every*** step!



# Water Infrastructure - WTP

**Reverse Osmosis (RO) Water Treatment Facility**

- Membrane softening of GW to remove Ca, Mg, Fe, Mn, $H_2S$, etc
- Largest in US to use greensand filtration for pretreatment

Photo: Aimee Blodgett, USF

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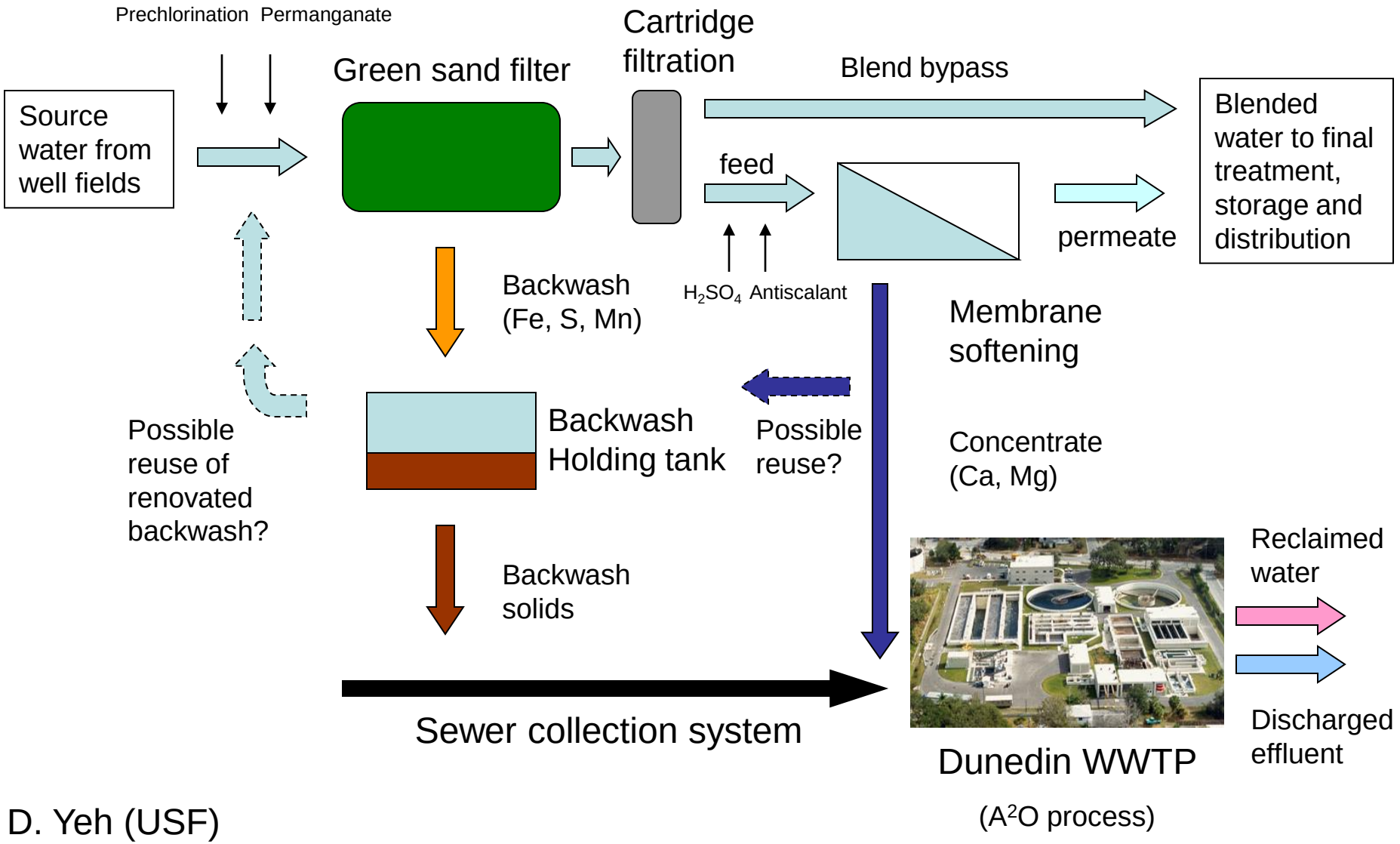
# Process streams of WTP and direct residual discharge to WWTP




D. Yeh (USF)

# Water Infrastructure - WWTP

**Advanced Biological Nutrient Removal ($A^2O$) Wastewater Treatment Plant**

- High effluent quality (N, P removed to protect Gulf of Mexico)
- Extensive wastewater recycling (reclaimed water)
- Recognized as one of the best reclaimed water systems in the State of Florida


http://www.swfwmd.state.fl.us/conservation/reclaimed/

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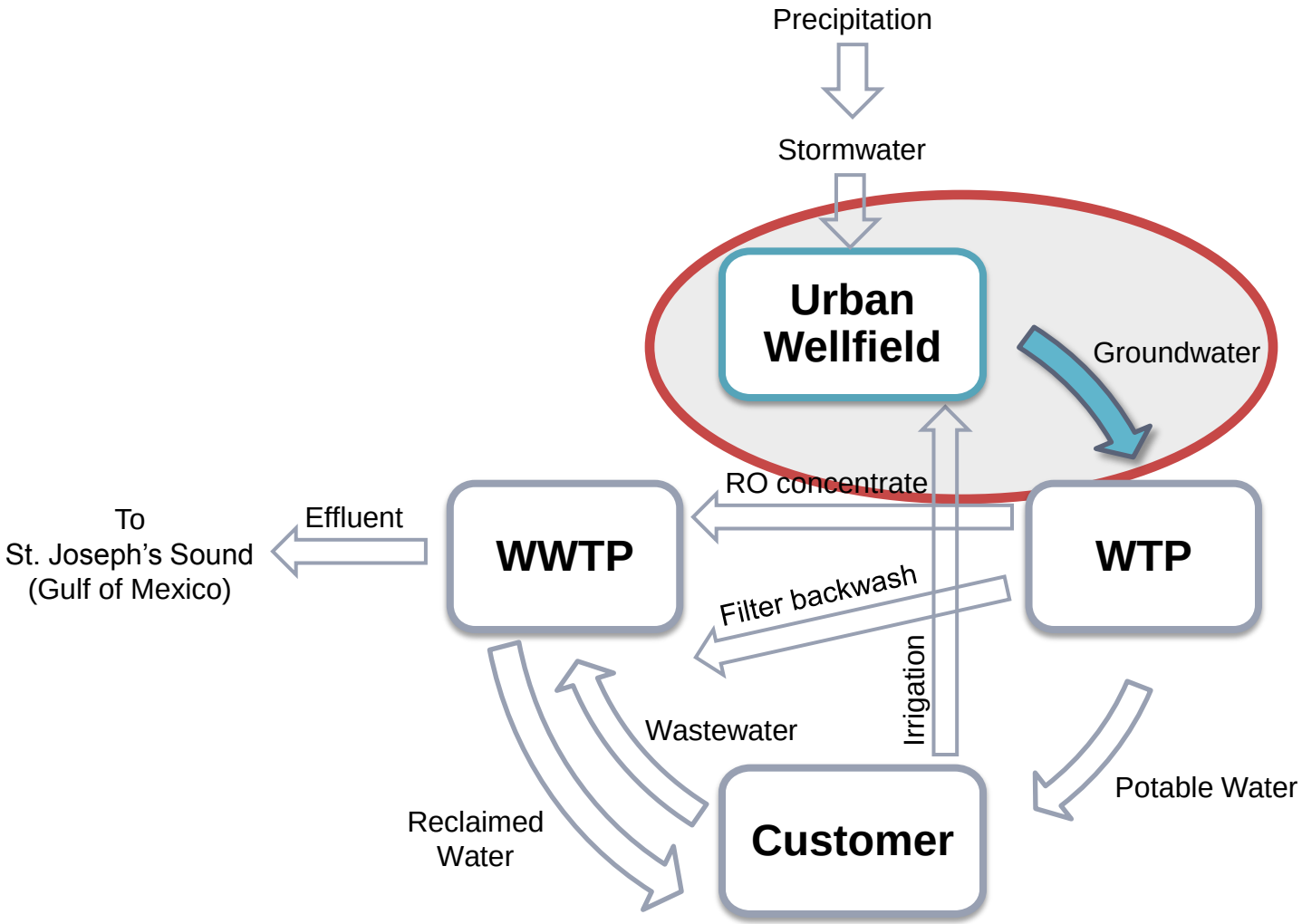
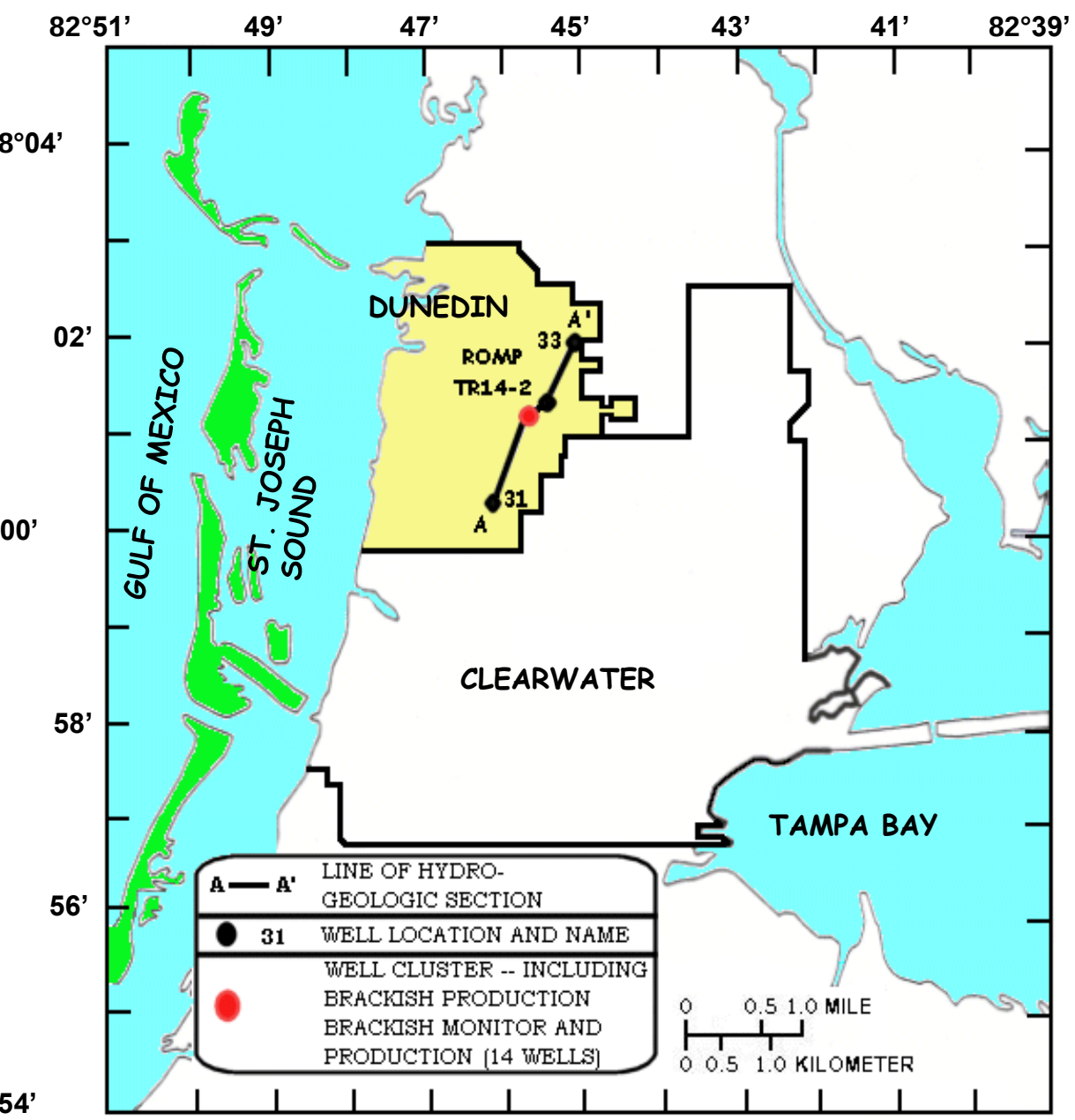
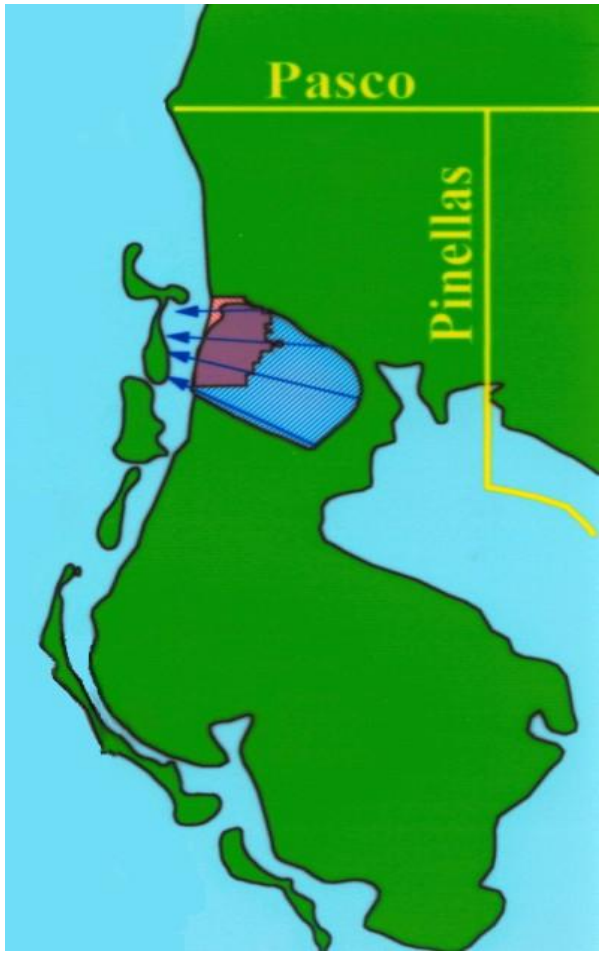
# Careful Wellfield Management






Base from Southwest Florida Water Management District digital data, 1:250,000, 1992 Universal Transverse Mercator projection, Zone 17.




**Source:**

**Knochenmus, L.A. and Swenson, E.S., 1996, Assessment of the Fresh- and Brackish-water resources underlying Dunedin and adjacent areas of Northern Pinellas County, Florida: U.S. Geological survey, Water Resources Investigation Report 96-4164 Tallahassee, Florida**

# CITY OF DUNEDIN WELLFIELD MAP

RECENTLY DRILLED WELLS

PRODUCTION WELL

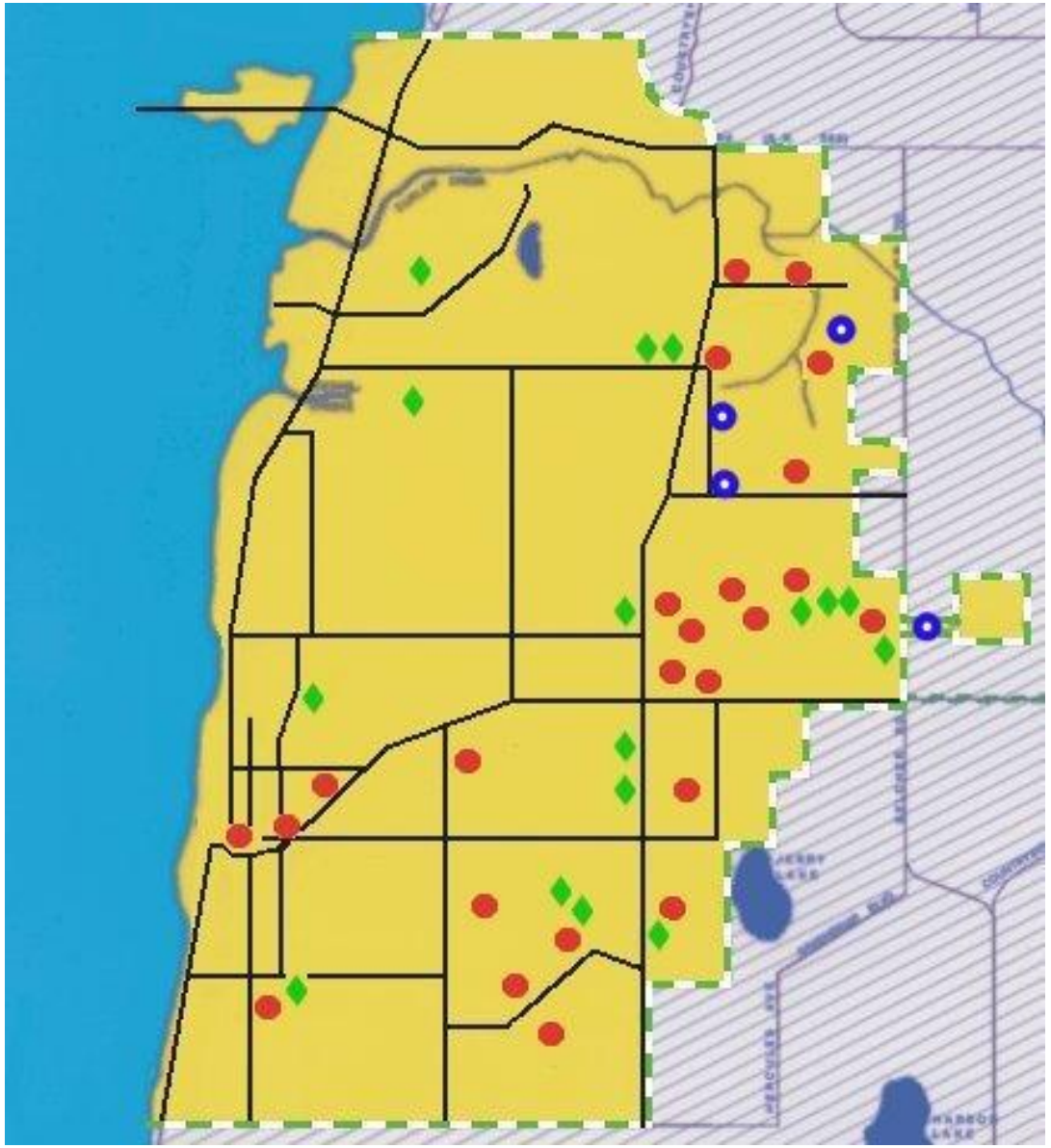
MONITOR WELL

CITY LIMITS

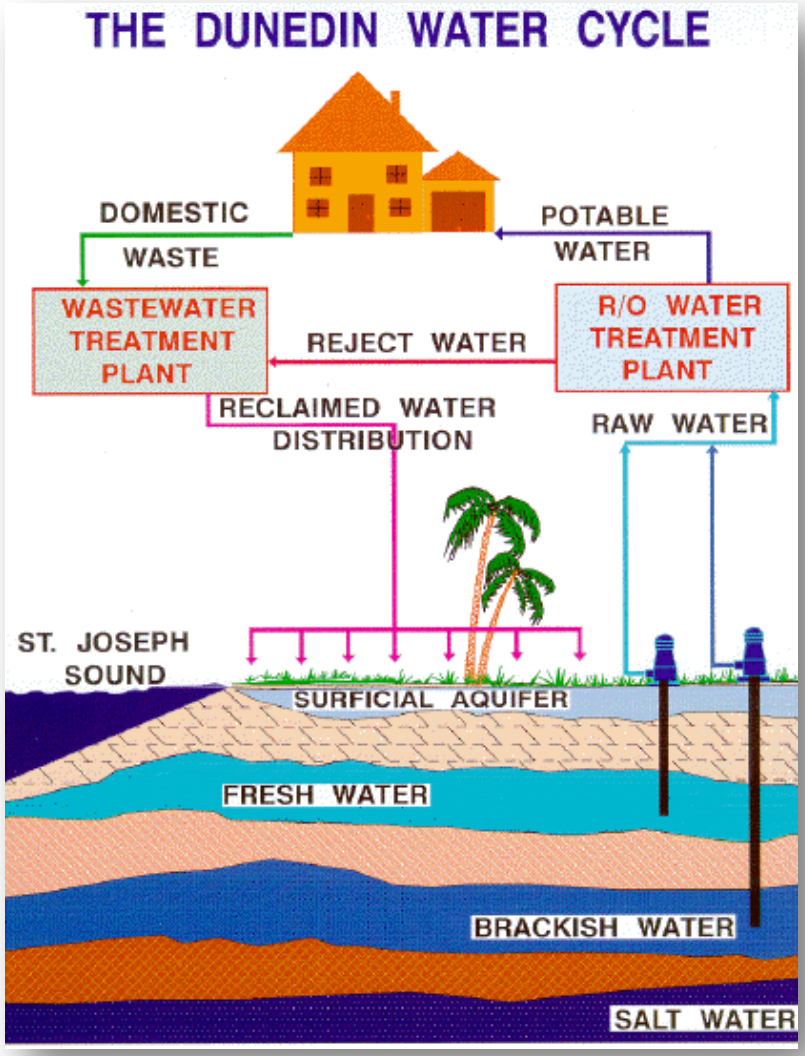
N

W E

S



# Water Management: Protection of the Urban Wellfield




- "Sippy Straw" Approach
  - More wells/better distribution of wells
  - Benefit: Even withdrawals throughout city; Consistent water quality

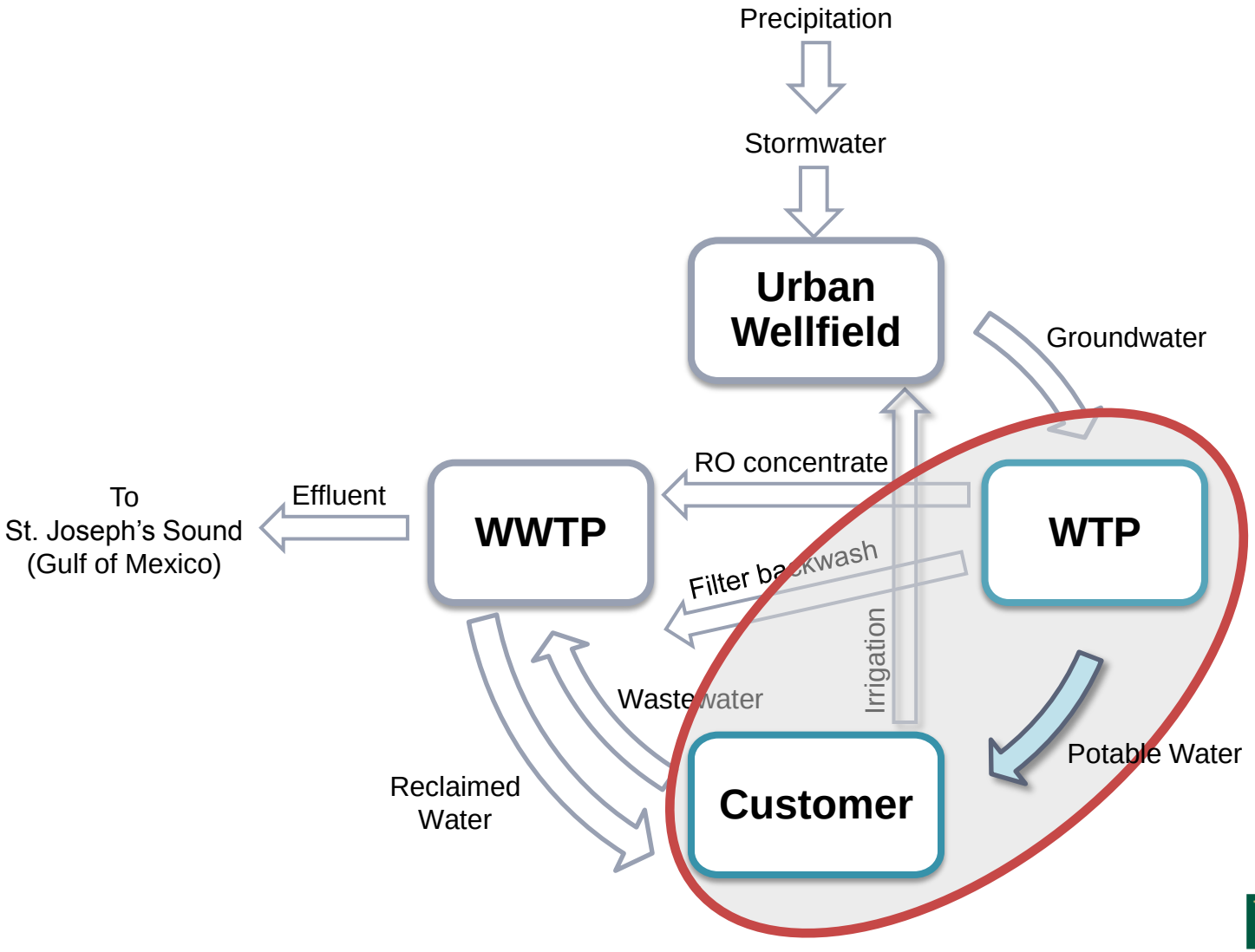
- Shallower wells
  - Reduce depth from 300 ft. to 200 ft. (91m to 61m)
  - Benefit: Higher quality water

# Water Management: Protection of the Urban Wellfield

- Less pumping, more uniform pumping
  - Benefit:
    - Less sink holes
    - Protection against salt water intrusion

knowledgera-theworld.blogspot.com

# Potable Water Conservation



# Potable Water Conservation

- Free ‘water saver kit’
  - 15.6% indoor residential reduction
- Inverted rate structure
  - Opposite to buying in bulk; the more water used, the higher the cost
- AMR (Automatic Meter Reading)
  - Real time usage
  - Transmitted wirelessly
  - Meter stores years of water data
  - Benefits:
    - Helps identify leaks
    - Helps customers track usage (Meter Magnet)
    - Cuts down meter reading man hours
- Watering restrictions
  - One day/week irrigation of lawn/garden

Meter Magnet


AMR device in meter box

New meter with AMR

http://www.dunedingov.com/

Installation complete ready for resodding by city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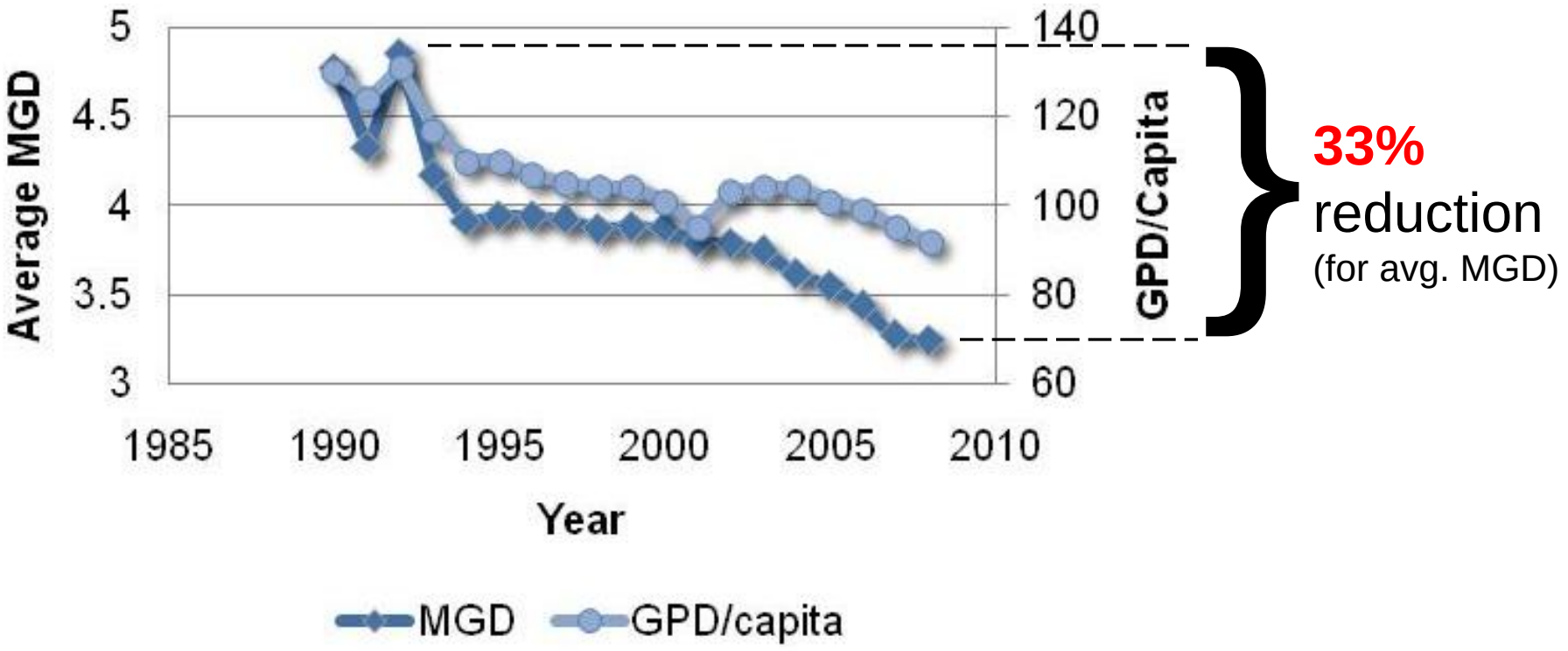
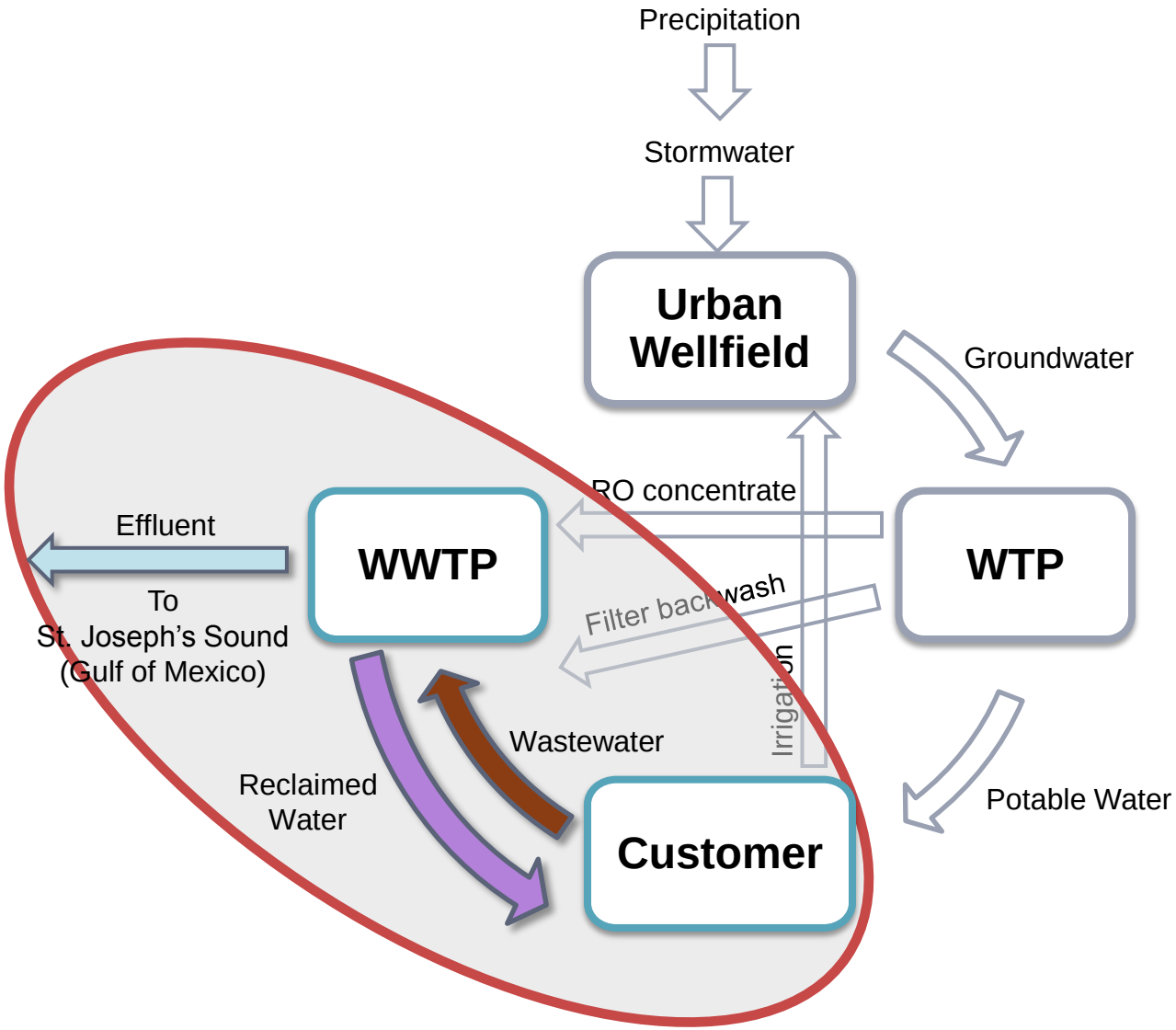
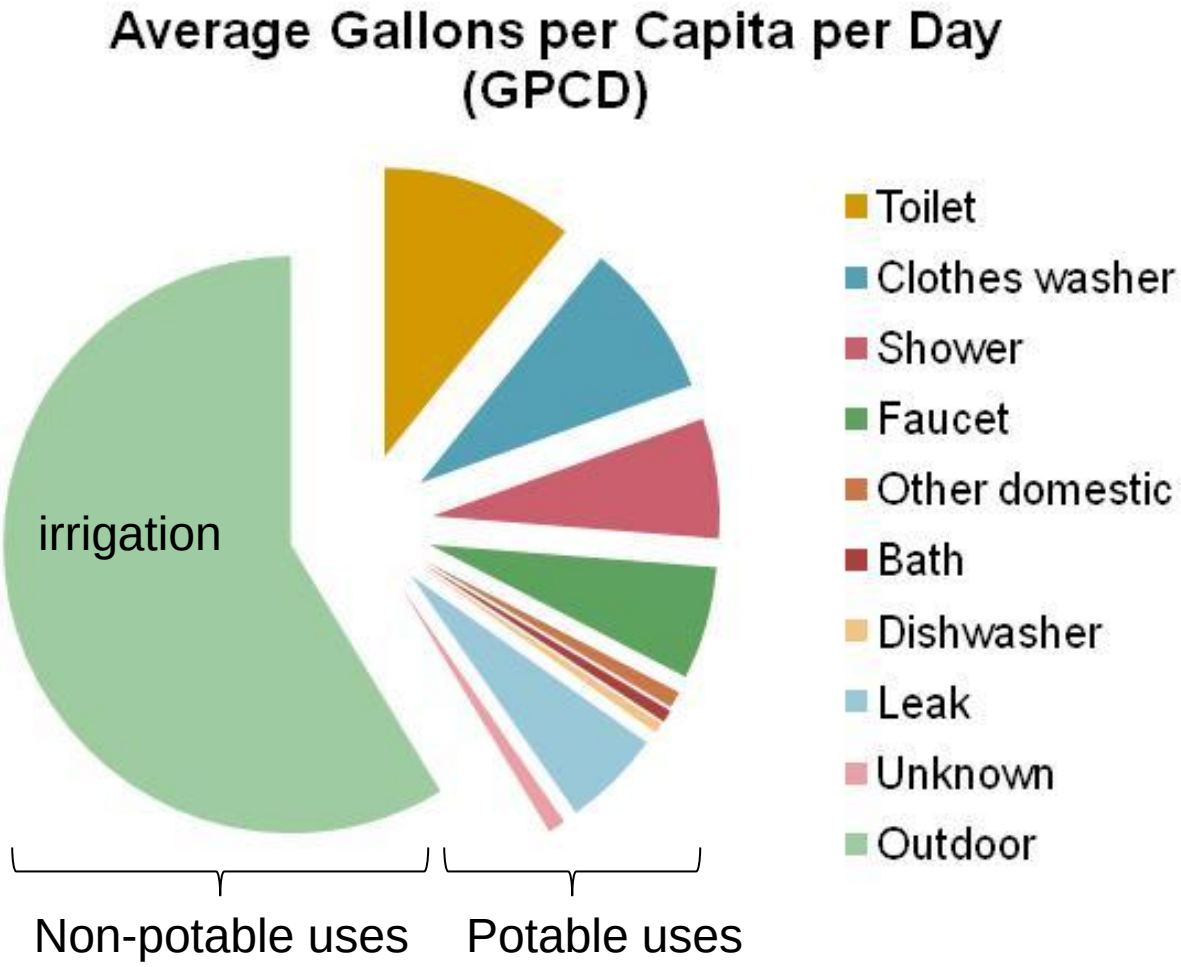
# Results:
# Historical Potable Water Demand



# Wastewater Reuse

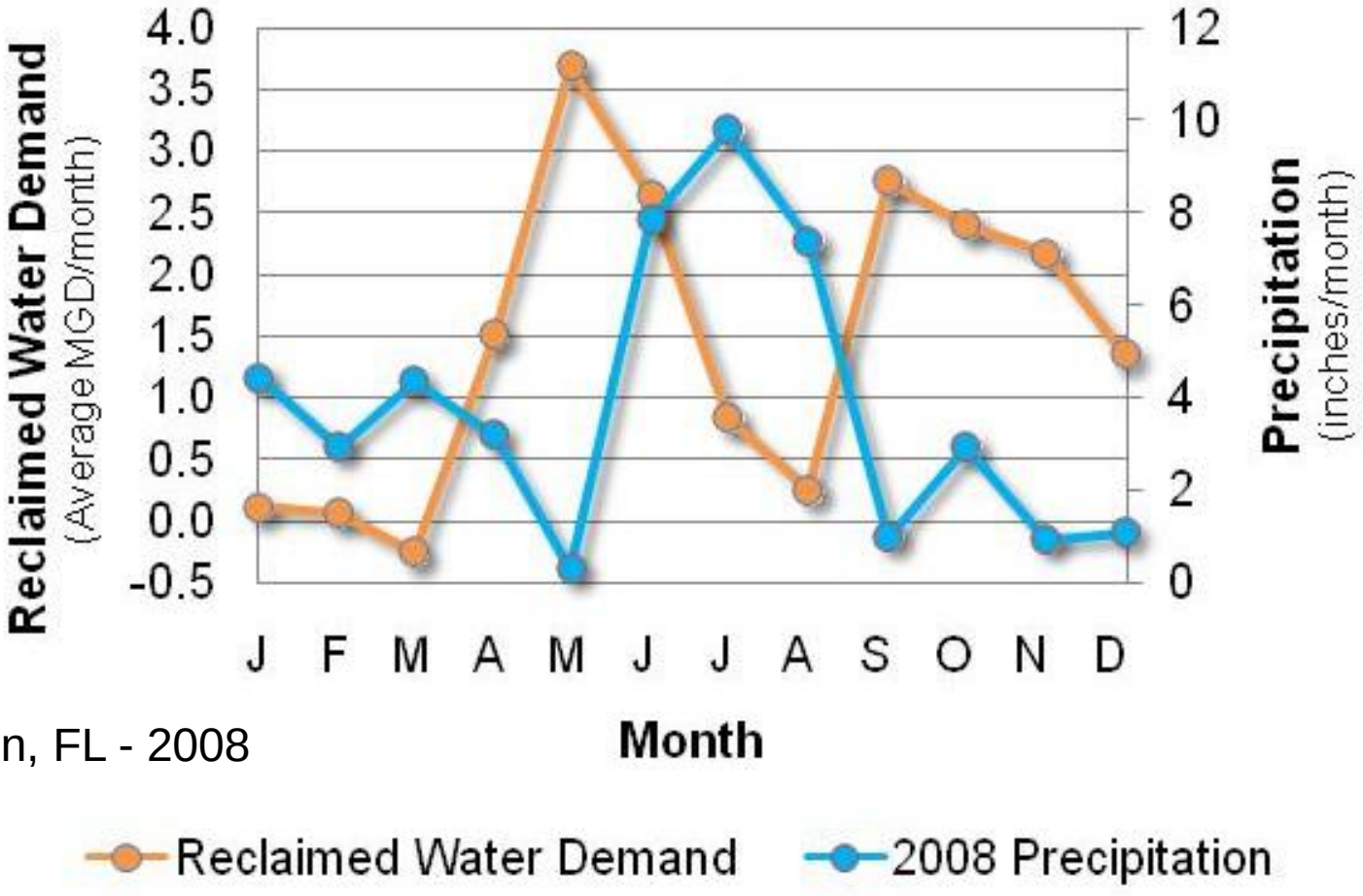


# Non-potable water uses in urban environments




*Source: AWWARF Residential End Uses of Water study*

# Variability: Rainwater vs. Reclaimed Water

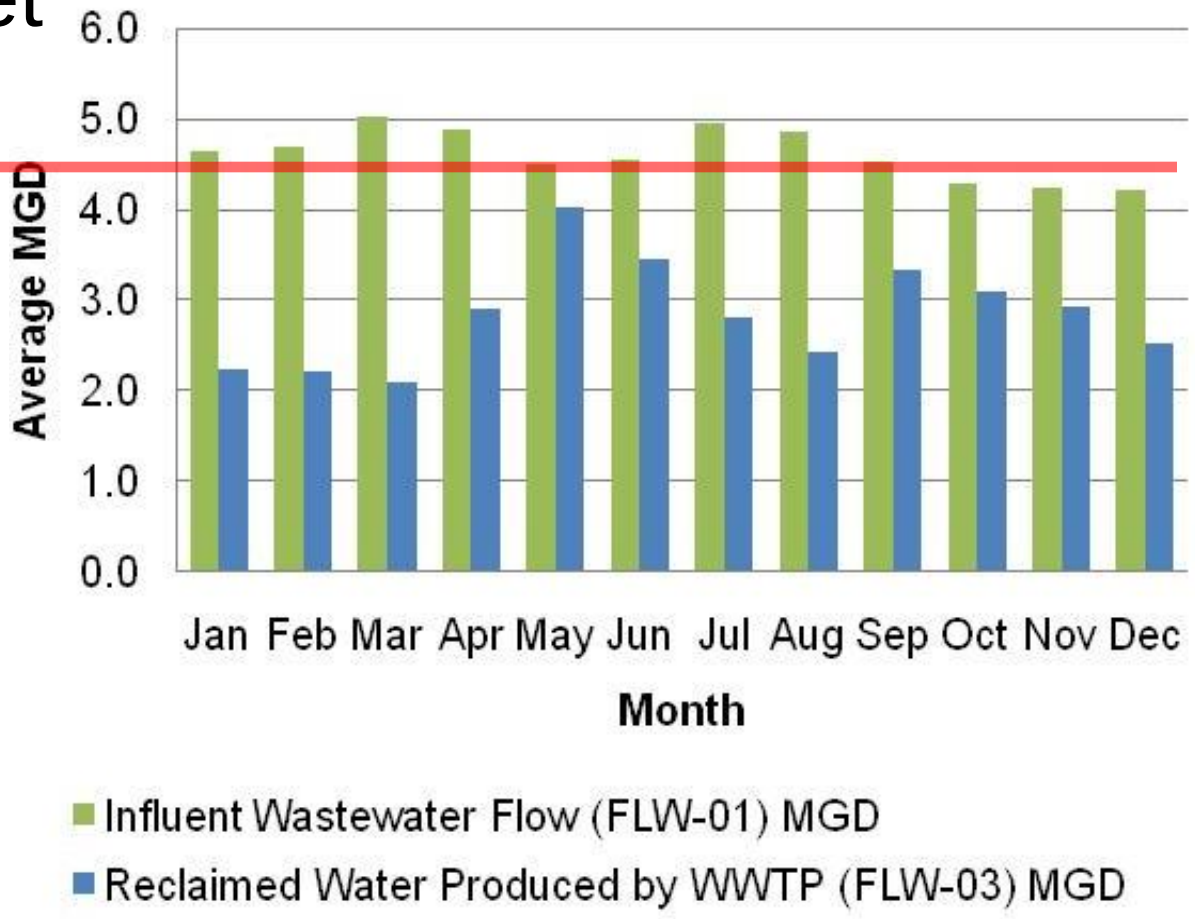



Dunedin, FL - 2008

# Reclaimed Water

- Benefit:  Drought-proof source for potable water offset

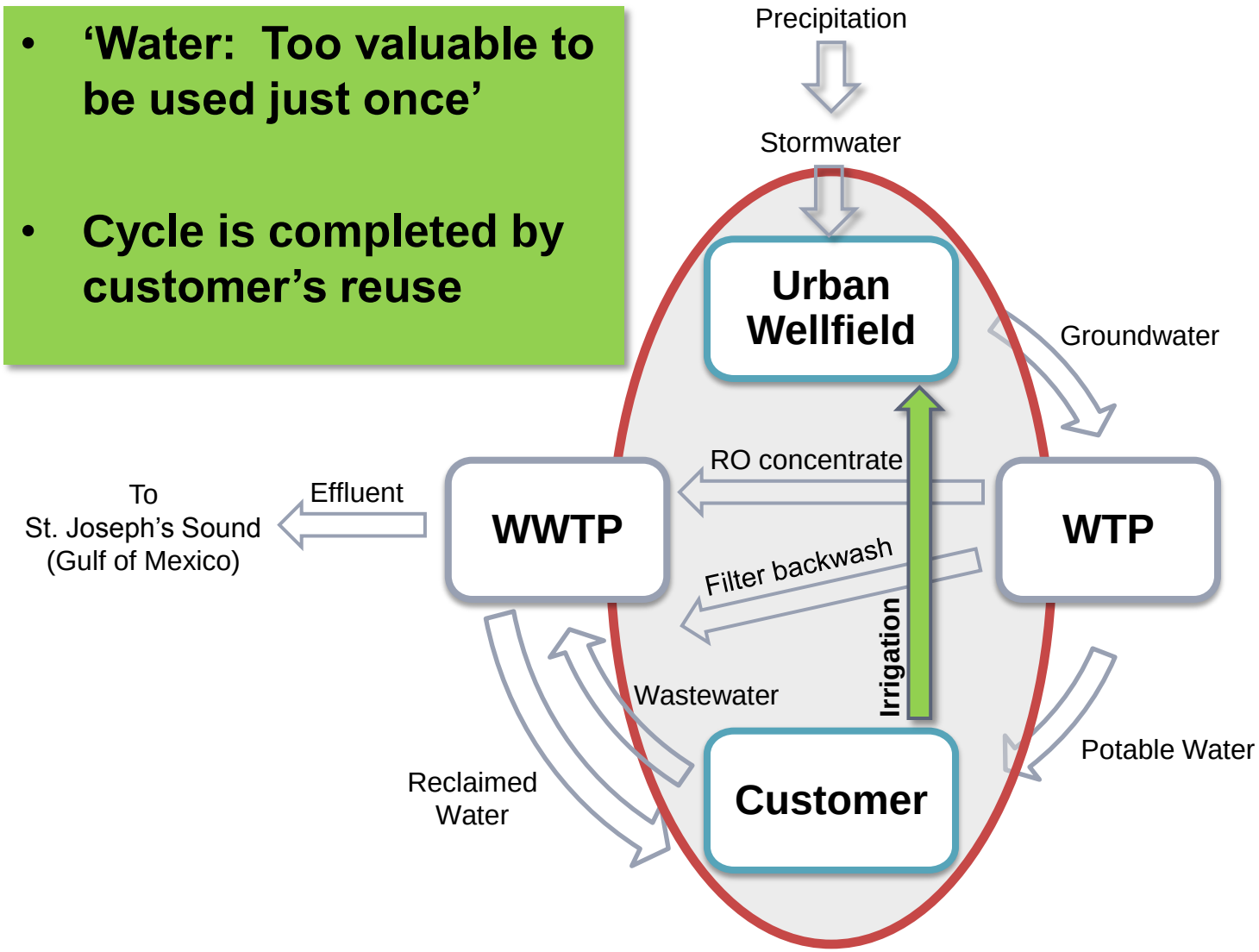
Urban environments produce a fairly consistent source of wastewater year-round.




Dunedin, FL - 2008

# Completed Cycle

- **'Water:  Too valuable to be used just once'**
- **Cycle is completed by customer's reuse**



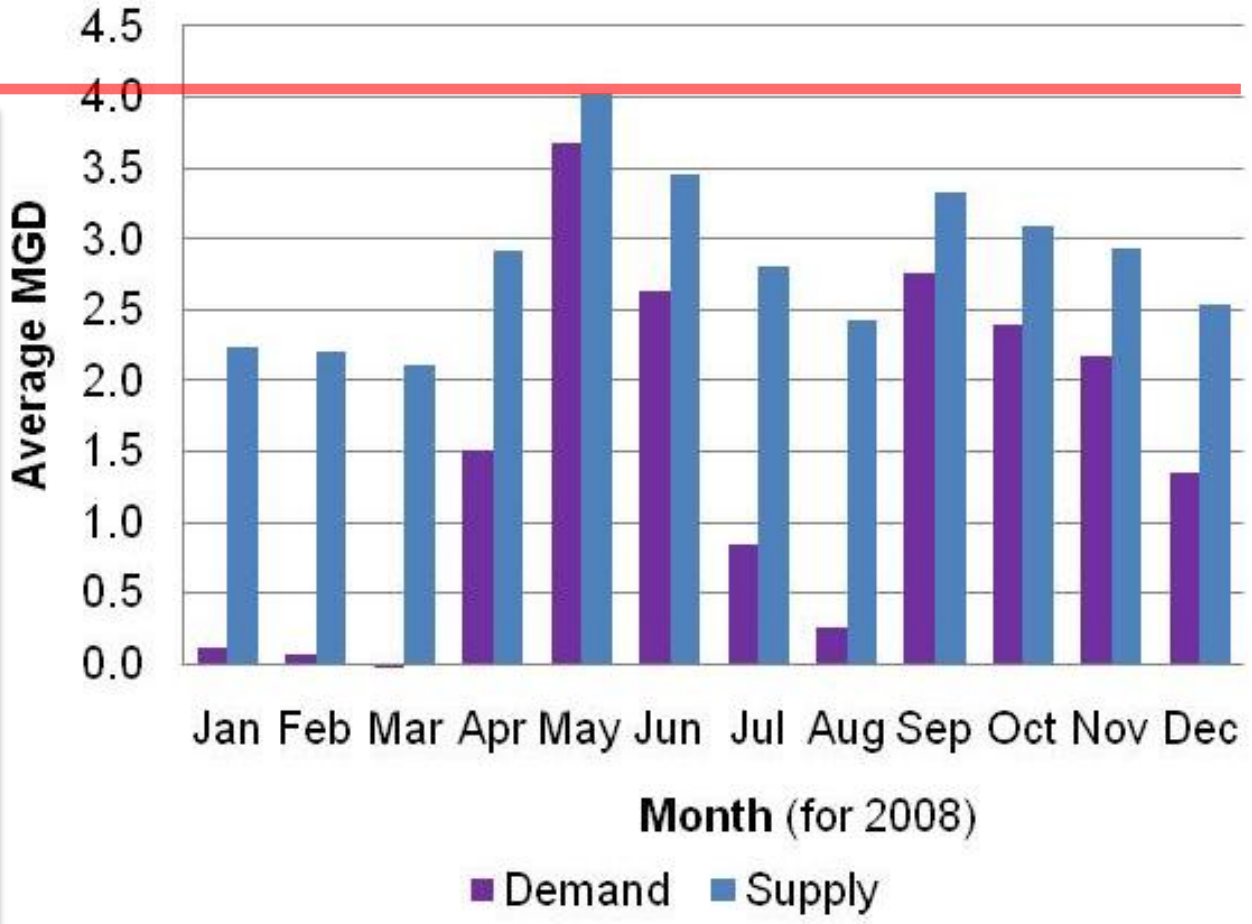
# Reclaimed Water: Demand vs. Supply

**Normal operation:** Discharge of excess reclaimed water to St. Joseph's Sound.

**Problem*:** Sometimes peak demand exceeds supply.

**Solution:** Groundwater is 'blended' with reclaimed water to meet "peak" demands, while still conserving groundwater supplies on annual basis.

***Exceeding supply = Zero discharge!**

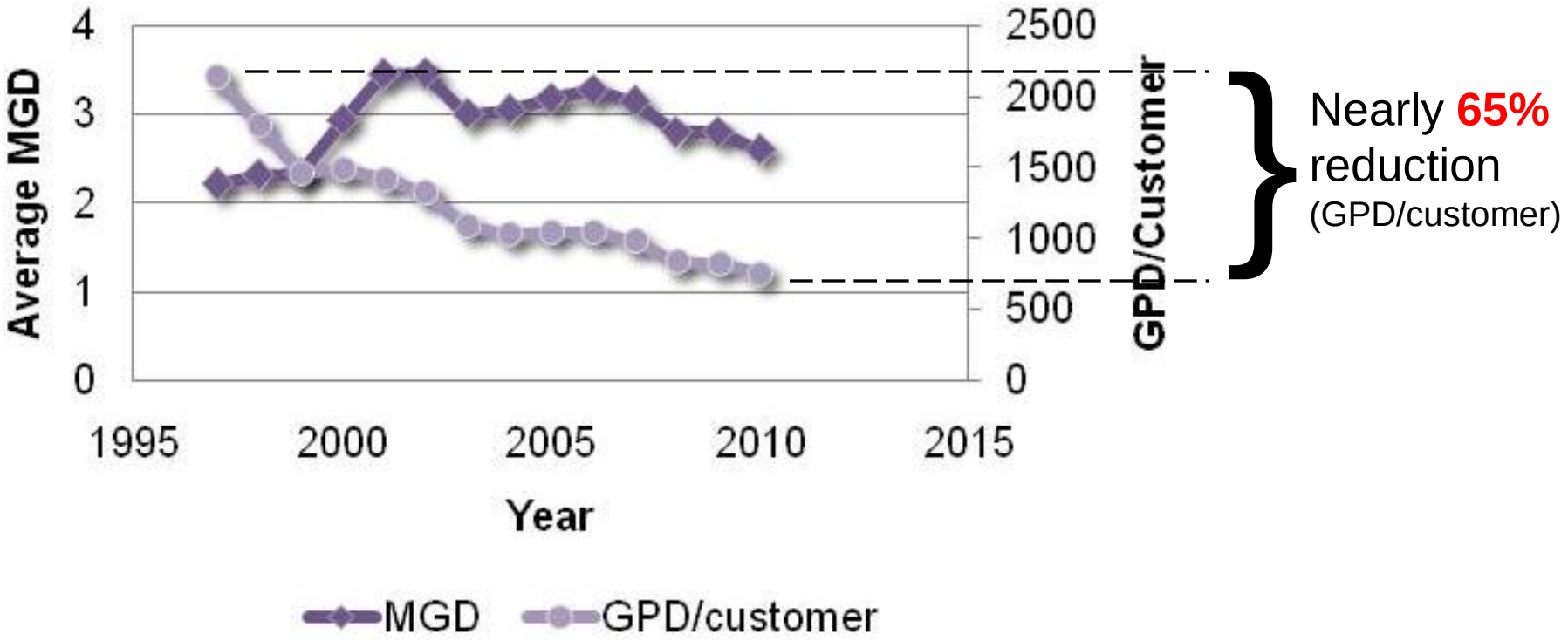


# Reclaimed Water Conservation

- RW availability
  - Offline on Wednesdays (to ‘catch up’ on production)
- Landscape Ordinance
  - Drought tolerant (Florida Friendly) landscaping
- Dry season allotment surcharge for overuse
- AMR (Automatic Meter Reading)
  - Discourages violations of water restrictions with real-time tracking of water usage

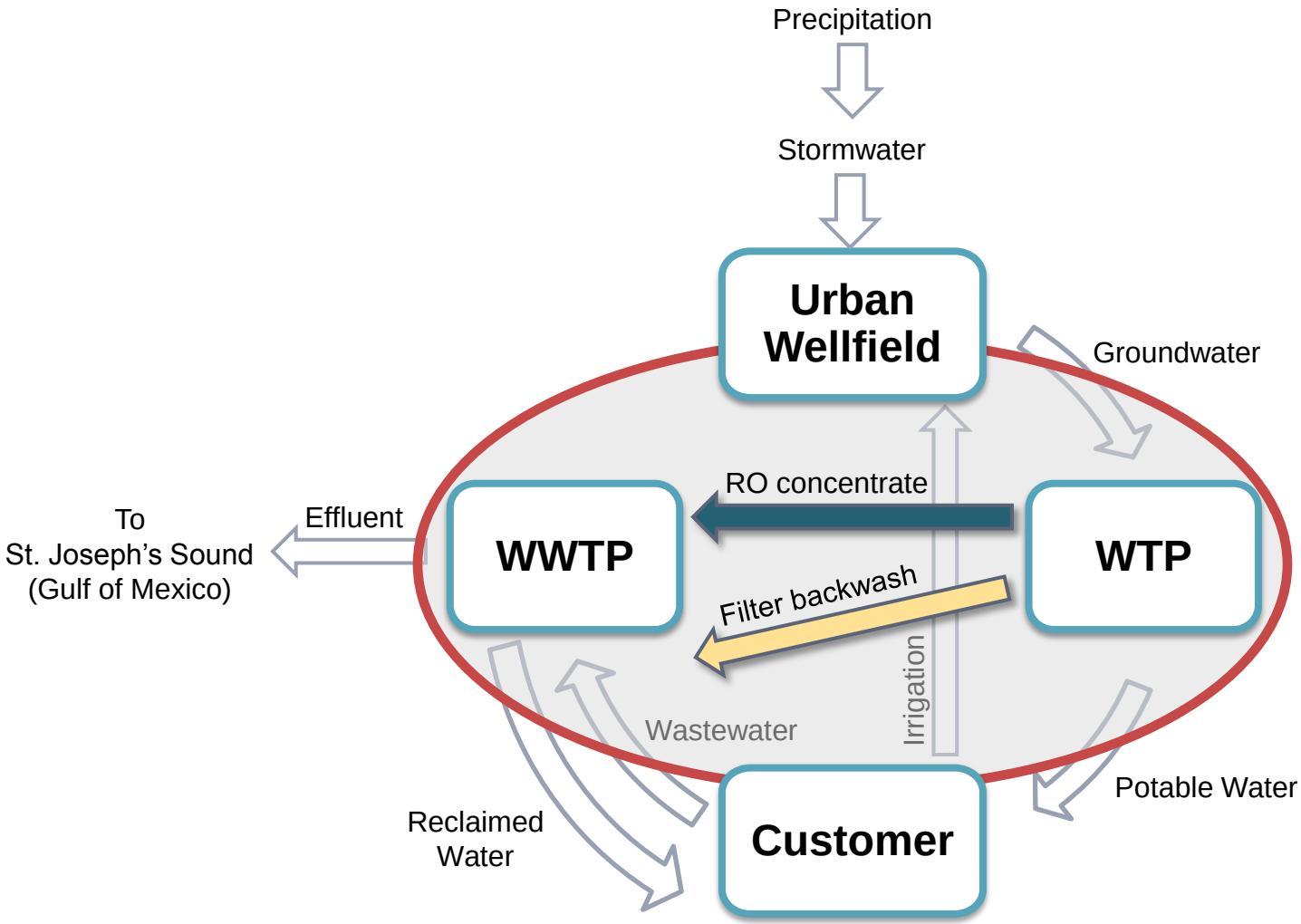
dunedingov.com, swfwmd.state.fl.us

# Results:
# Historical RW Demand




Customers include commercial customers, such as golf courses. RW system was constructed in phases, number of customers increase each year, which is reflected in average MGD trend prior to seeing a decrease.

# Coordination Between Utilities



# Coordination: Water and Wastewater Plants

- Byproduct stream from RO is treated by WWTP
- Salinity of byproduct stream can affect WWTP operations and quality of effluent/RW
- Drinking water production is:
  - Coordinated with WWTP assimilation capacity
  - Scheduled according to off peak electricity demand
  - Driven by demand after RW offset


*From left to right: Tom Burke - City Engineer, Paul Stanek - Water Division Director, and Ken Stidham - Wastewater Division Director*

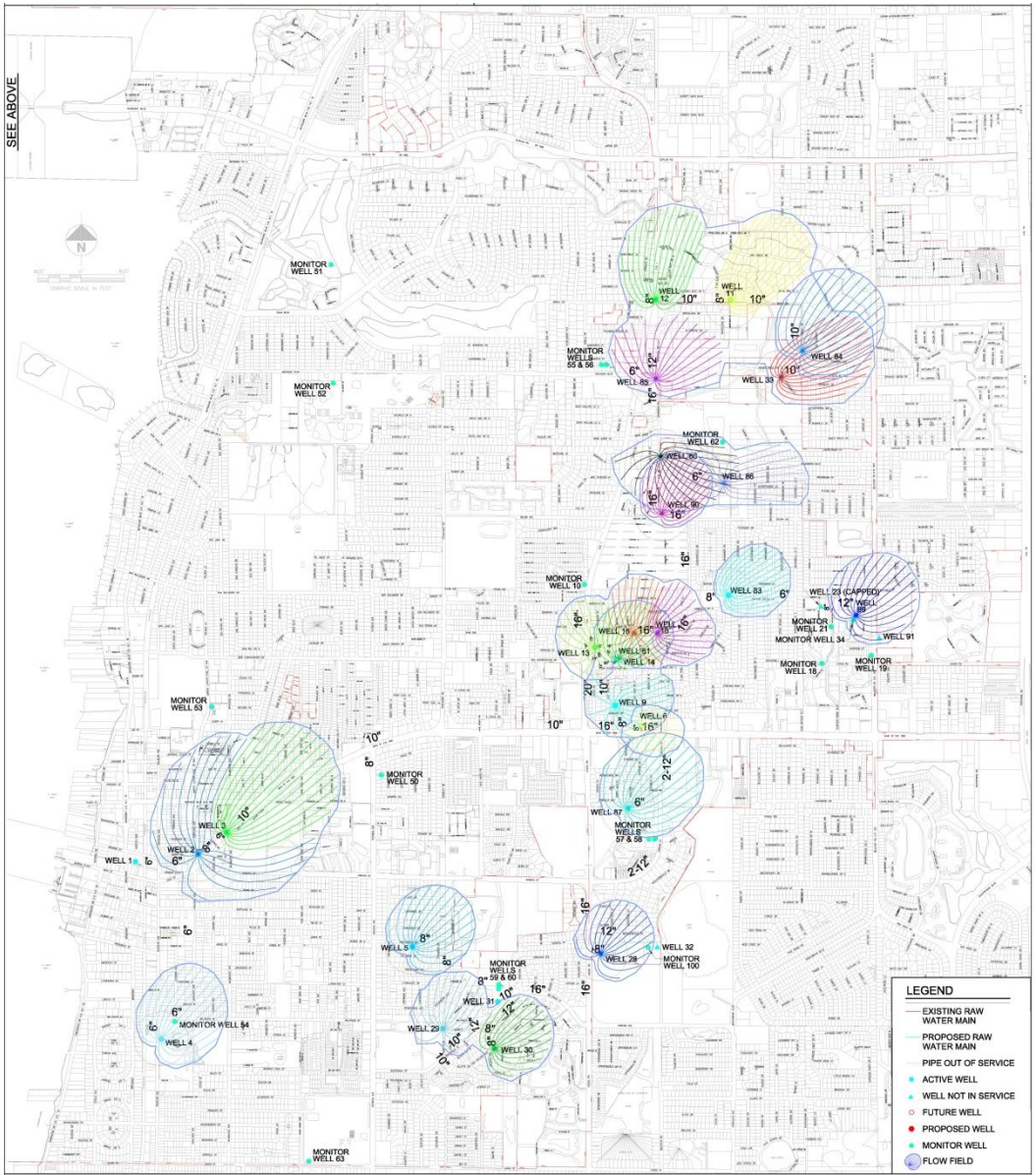
# Complexities of water system

- How many different pipes are there in the ground?

**6**

- Raw Well Water (pipes from wells)
- Potable Water (blue distribution)
- Wastewater + WTP backwash (sewer)
- Reclaimed Water (purple distribution)
- Stormwater (sewer)
- RO concentrate (direct pipe)

# Raw Water: Wells to WTP

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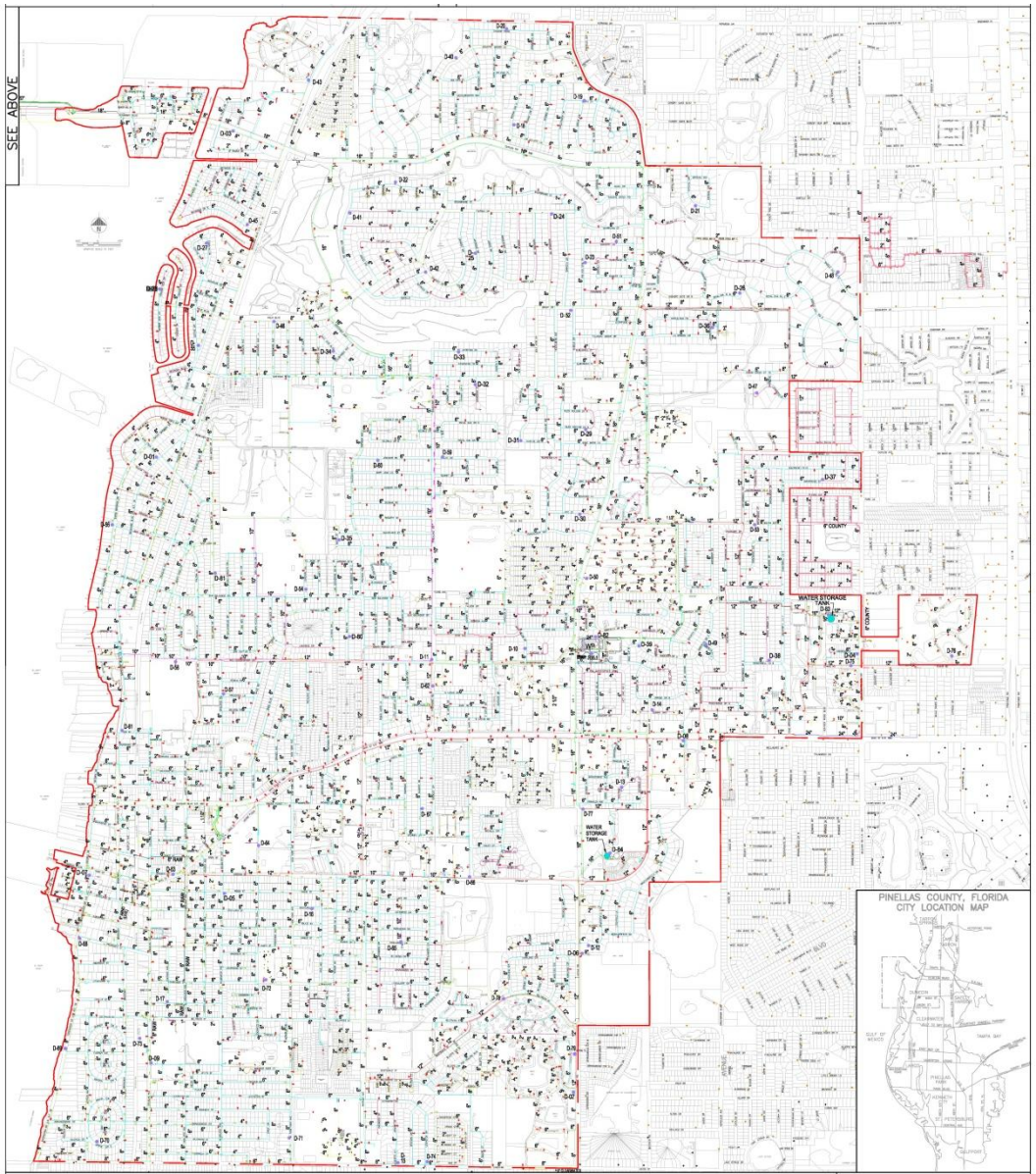
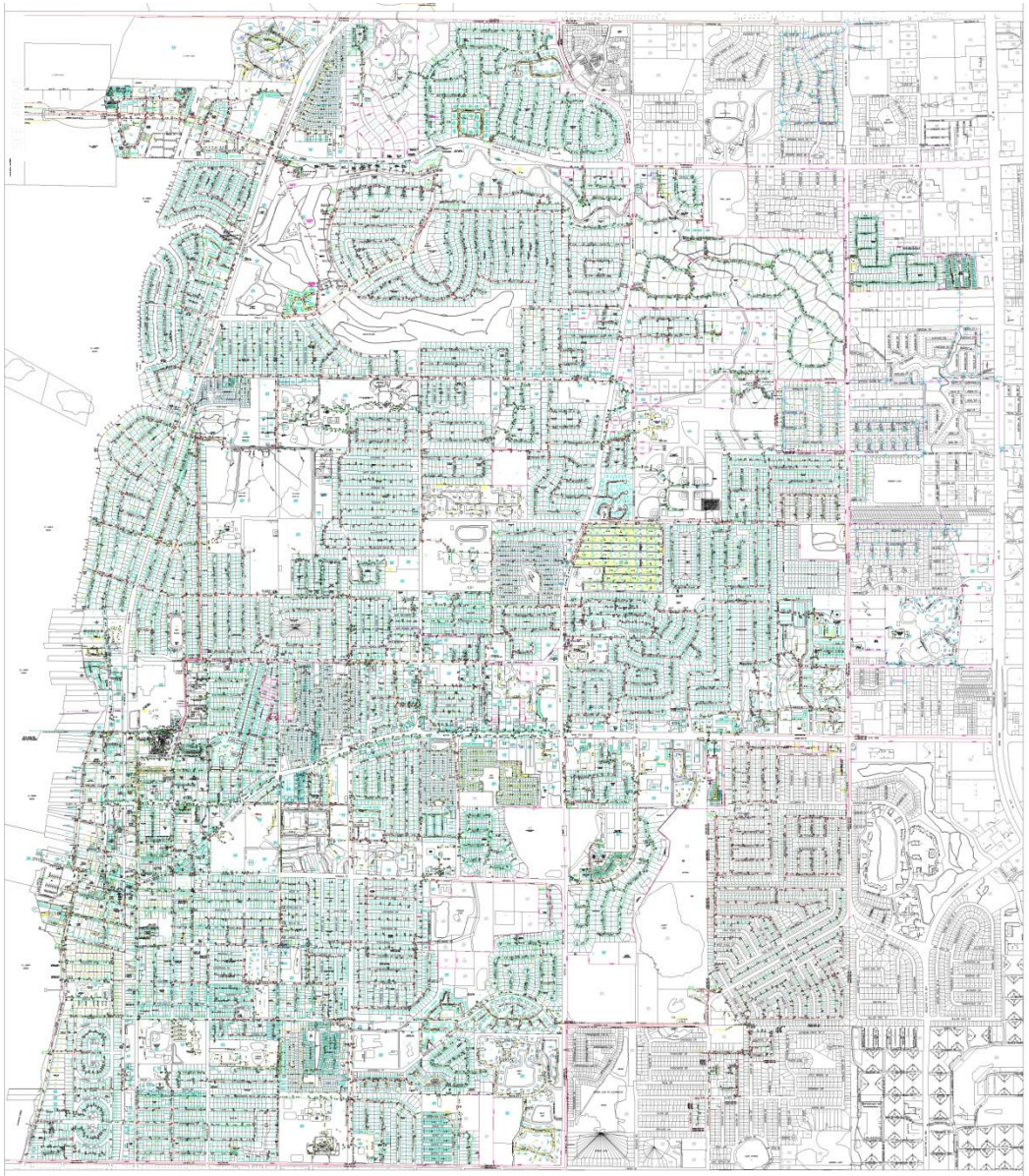
# Potable Water: WTP to Customers



# Wastewater: Customers to WWTP



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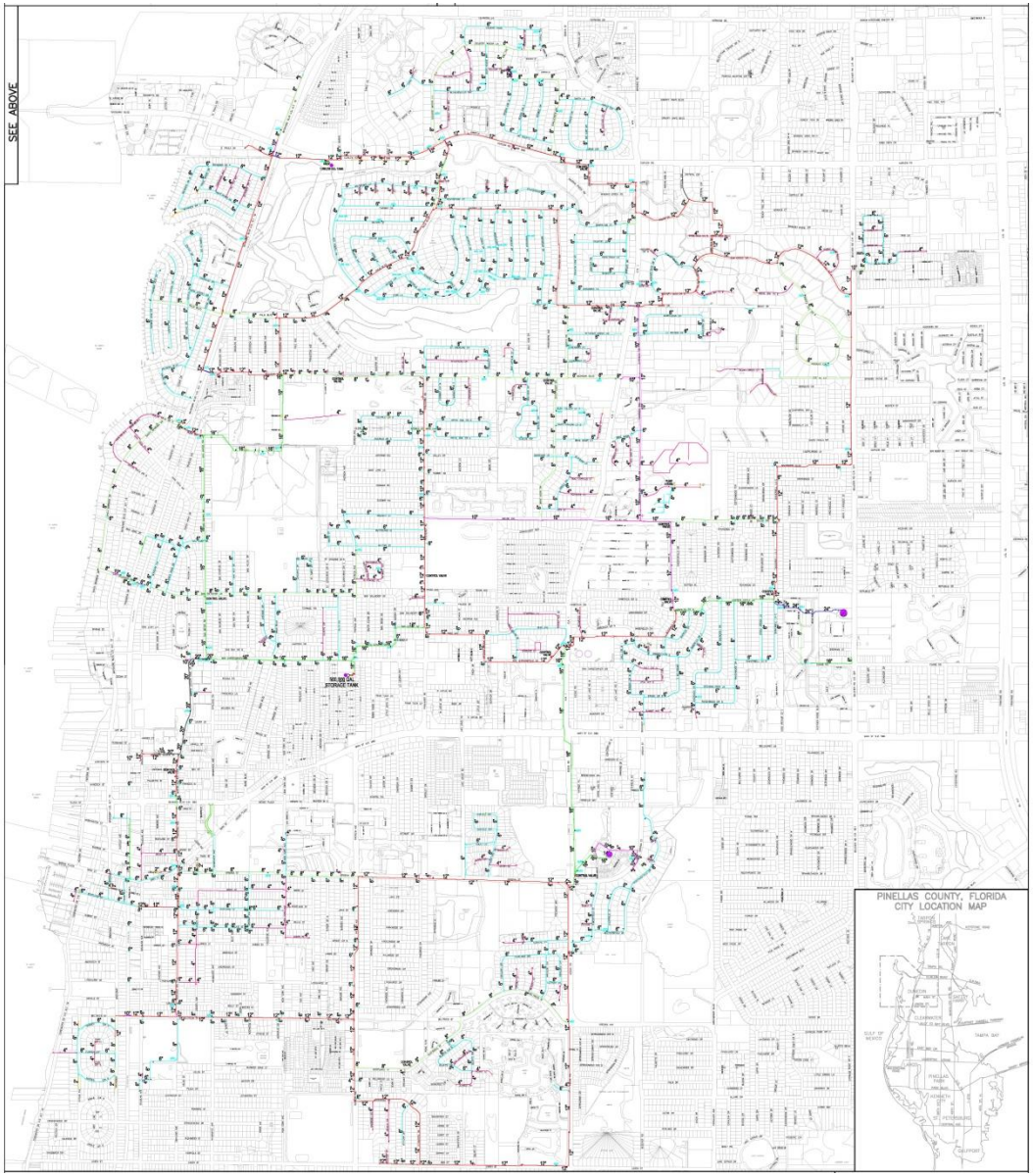
# Reclaimed Water: WWTP to Customers

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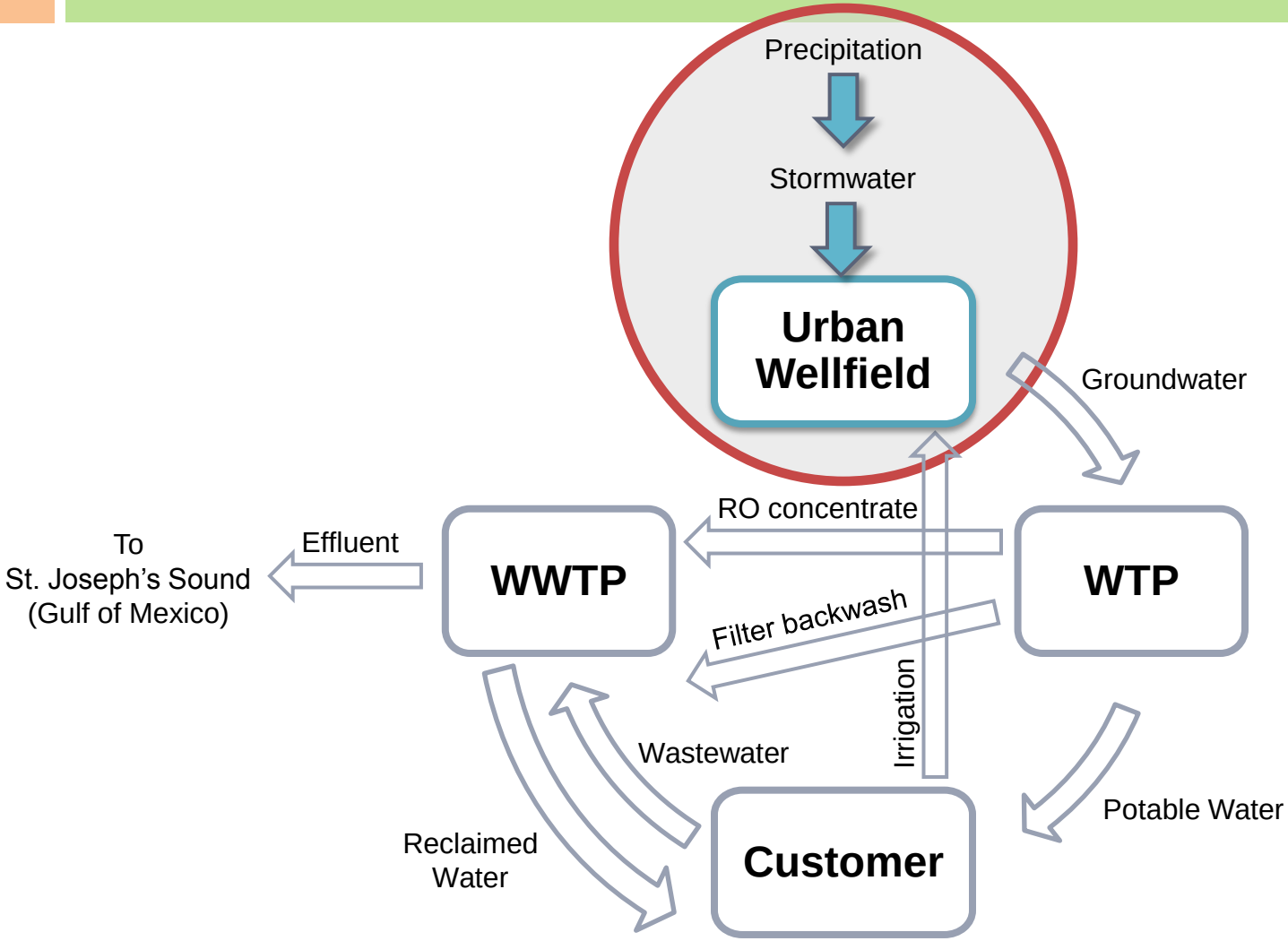
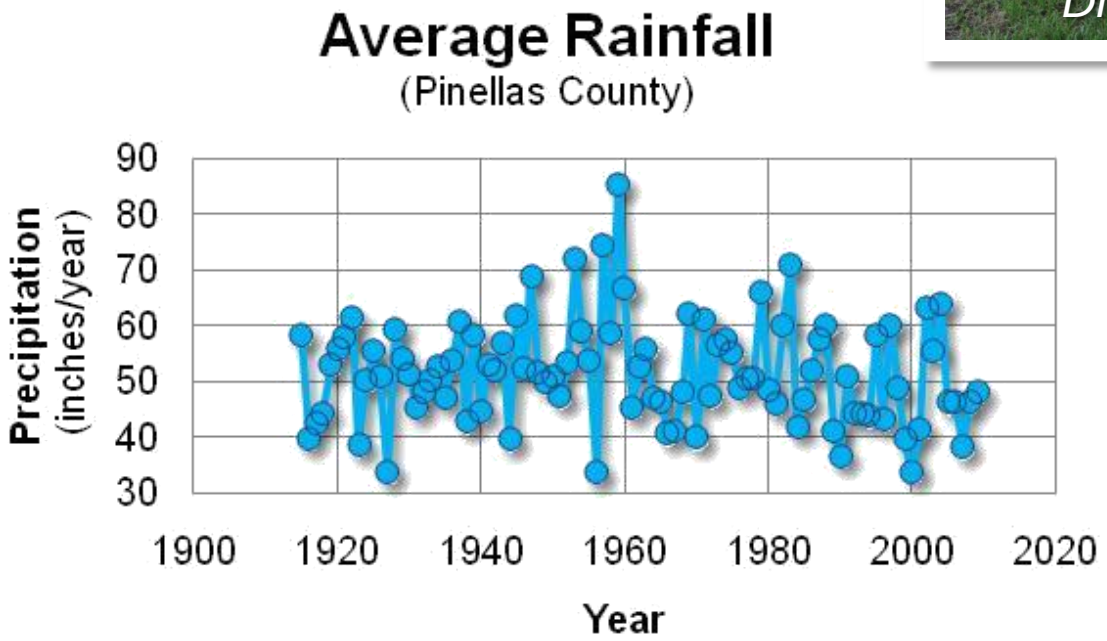
# Dunedin's Challenges



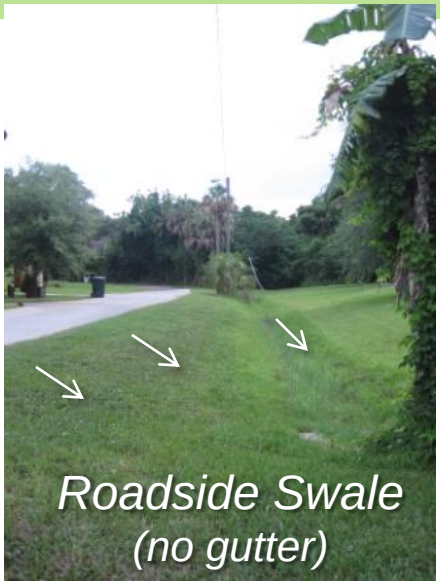
# Challenges: Stormwater management

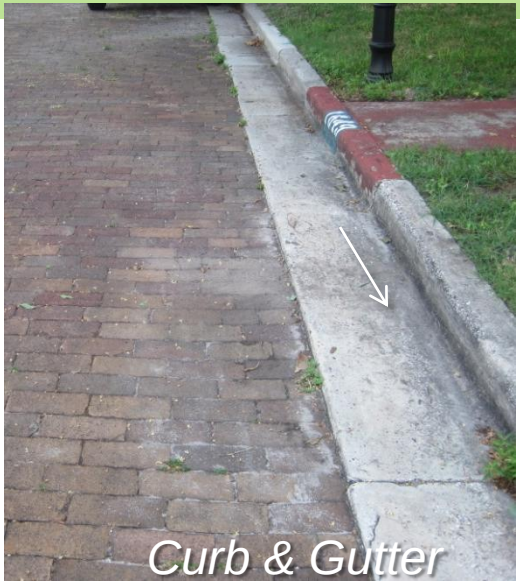
- Local topography
  - Relatively flat terrain
- Climate variability


swfwmd.state.fl.us

# Stormwater Management





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# SUDS/LID: Green Roofs

- Most homes in Dunedin don't have gutters/downspouts
- Green roofs would offer
  - Mitigated flooding in a dense urban environment
  - Reduced energy loads


*Dunedin Home*


*Example of Green Roof*
uwsp.edu

# SUDS/LID: Rainwater Harvesting

- Larger commercial/multifamily residences have gutter systems
- Opportunity for:
  - Flood control
  - Alternative water source

# Challenges:
## Stormwater management

- Storm surge potential
- Coastal flooding
- Stormwater backflow


msnbc.msn.com

**28 storms in 2005**

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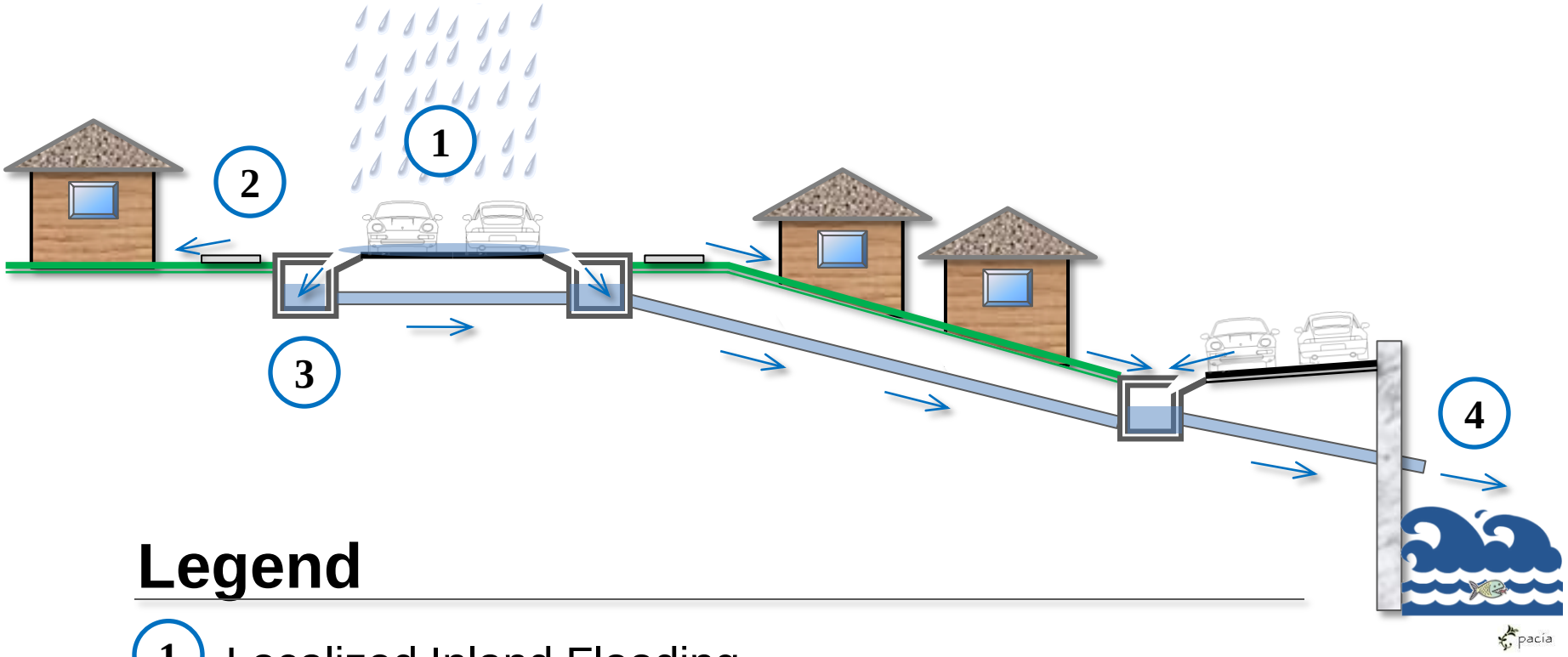
# Stormwater System – As Designed




## Legend

1. Localized Inland Flooding
2. Stormwater runoff to inlets
3. Stormwater conveyance system (traditional)
4. Outfall to nearby water body (saltwater)

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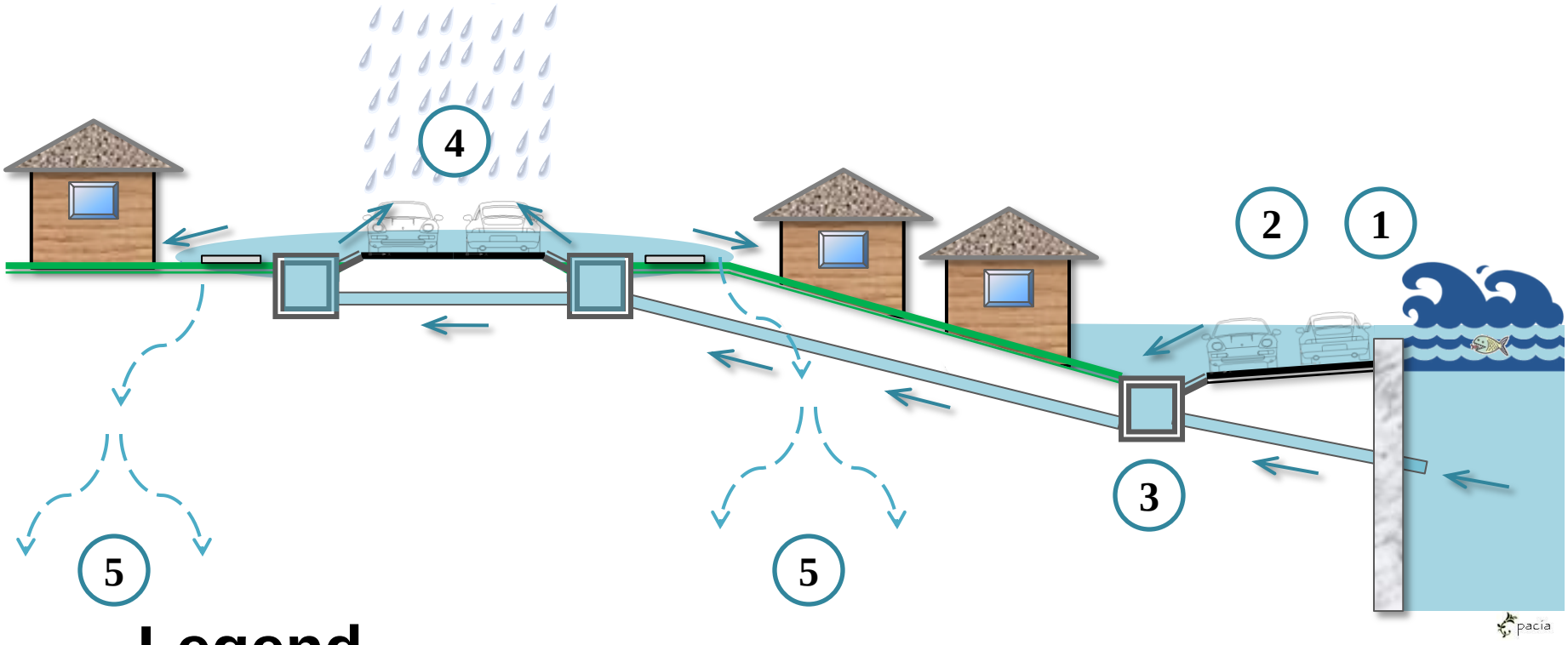
# Stormwater System – Potential for Backflow due to Storm Surge




## Legend

1. Storm Surge
2. Coastal flooding
3. Backflow
4. Inland flooding
5. Saltwater infiltration

# Dunedin's Success:
## Commitment to Sustainable Practices

- Sustainability Program
  - Newsletter
  - Recycling
  - Rainbarrel education
  - Etc.
- Sustainability Coordinator
- Valerie Lane, LEED AP
- Development Services Project Coordinator
- Lael Giebel, LEED AP

Photo: Ted McLaren, St. PetersburgTimes

# Dunedin's Success:
# Commitment to Sustainable Practices

**Embracing the Nation's most recognized sustainability rating system**

**Dunedin Community Center**
**LEED Silver Certified**

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# Dunedin's Success:
## Support from Community Leaders

**Certified Green Local Government by FGBC**

FGBC
FLORIDA GREEN BUILDING COALITION


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# Dunedin's Success: Sustainability Embraced by the Community Members

**Glencairn Cottages**
**Tampa Bay's First Certified Green Development by FGBC**

Development" • Energy saving R-30 insulation floor ceiling • Energy saving R-19 insulati bottom floor • Energy saving R-13 insu on exterior walls, plus an add ated Siding, providing an over all exterior walls • State-of-the- ystem, zoned to increase effi and reduce energy consumption • Tankless Heater, providing endless hot water and savi up to 40% over conventional electric hot wate systems • ENERGY STAR low-E, tinted, dual single-hung vinyl insulated windows with screen, and tilt lower sash for easy cleanin factor = 0.35, SHGC = 0.27) • Premium fibe insulated exterior doors with 25-year warranty flow shower heads to reduce water and energy use • Dual flush, low-flow toilets to minimize water consumption House Wrap for energy efficiency and


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**Glencairn Cottages**
**Florida's First Water Star Gold Certified Home**


Water efficient irrigation systems • Micro or drip irrigation • Well planned irrigation system and functioning correctly • Drought tolerant, Florida Friendly plants • Best management practices (mulching, etc.) • High efficiency appliances • Low flow plumbing fixtures

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# Dunedin's Success:
# Extended Partnerships with Academia


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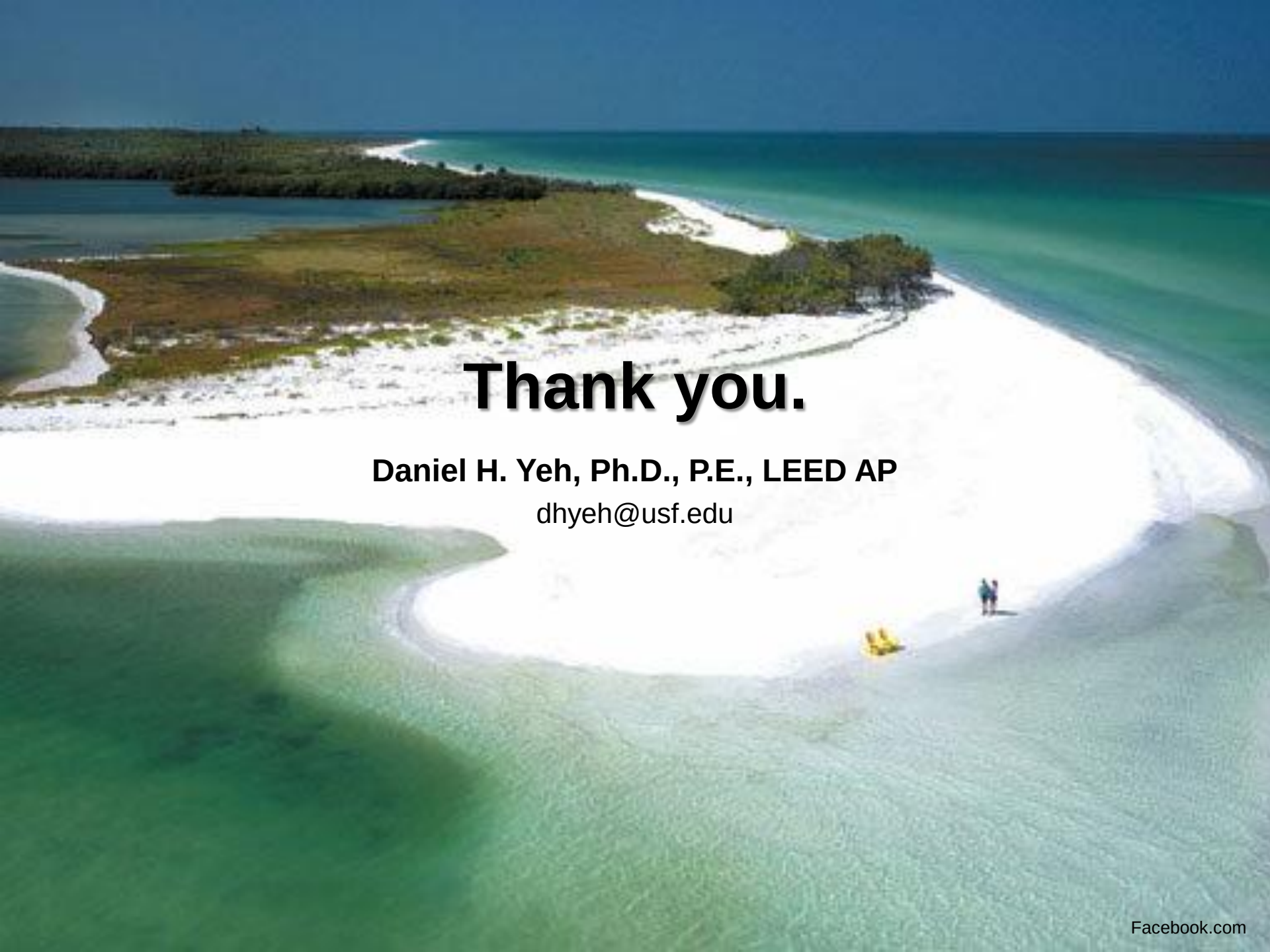
# Future Challenges

- Protection of wellfield
- Continued reduction of potable water demands
  - More conservation
  - More reclaimed water usage for demand offset (e.g., indoor use), export to neighboring county, ecosystem recharge
- Increasingly stringent water quality standards for drinking water (e.g., disinfection byproducts, pathogens) and effluent discharge (nutrients)
- Biosolids management
- Infrastructure upgrade and maintenance in face of declining revenue
- Stormwater management  - more SUDS/LID
- Coastal vulnerability
  - Storm Surge
  - Sea Level Rise



# Thank you.

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