Integrated Urban Water Management (IUWM)
in a Small Coastal City on the Gulf of Mexico

2015 Water Efficiency Conference - University of Exeter, UK
5 to 7 August, 2015

DUNEDIN
Home of Honeymoon Island

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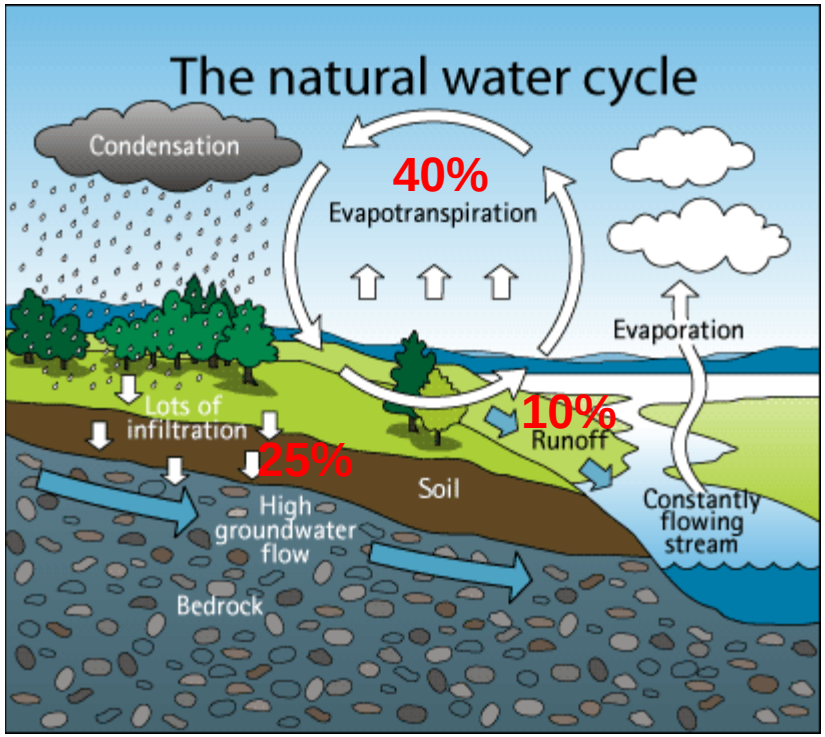
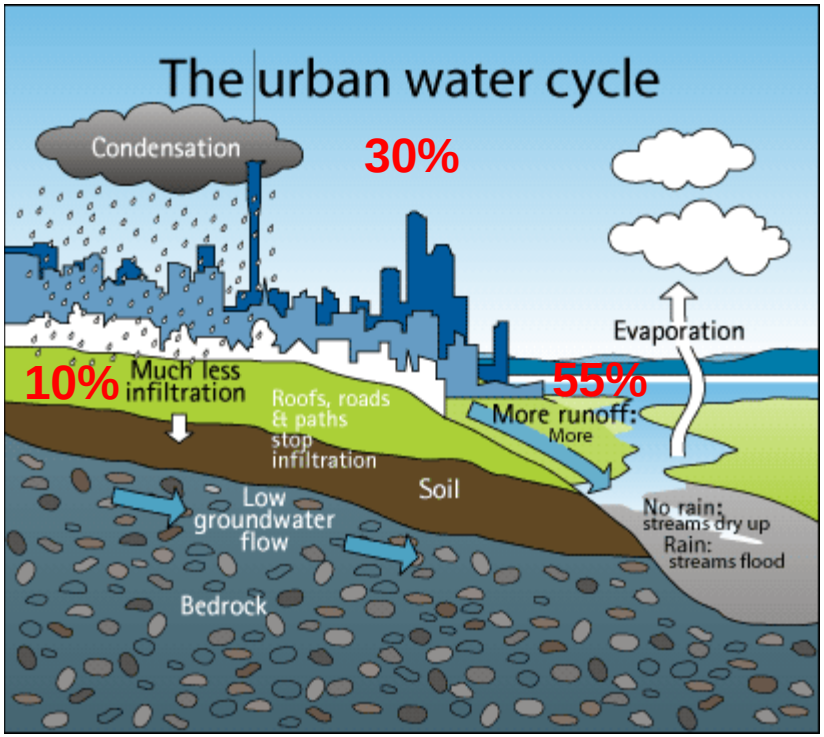
Pressures at cities

Interruption of the efficient, natural water cycle



Natural Ground Cover

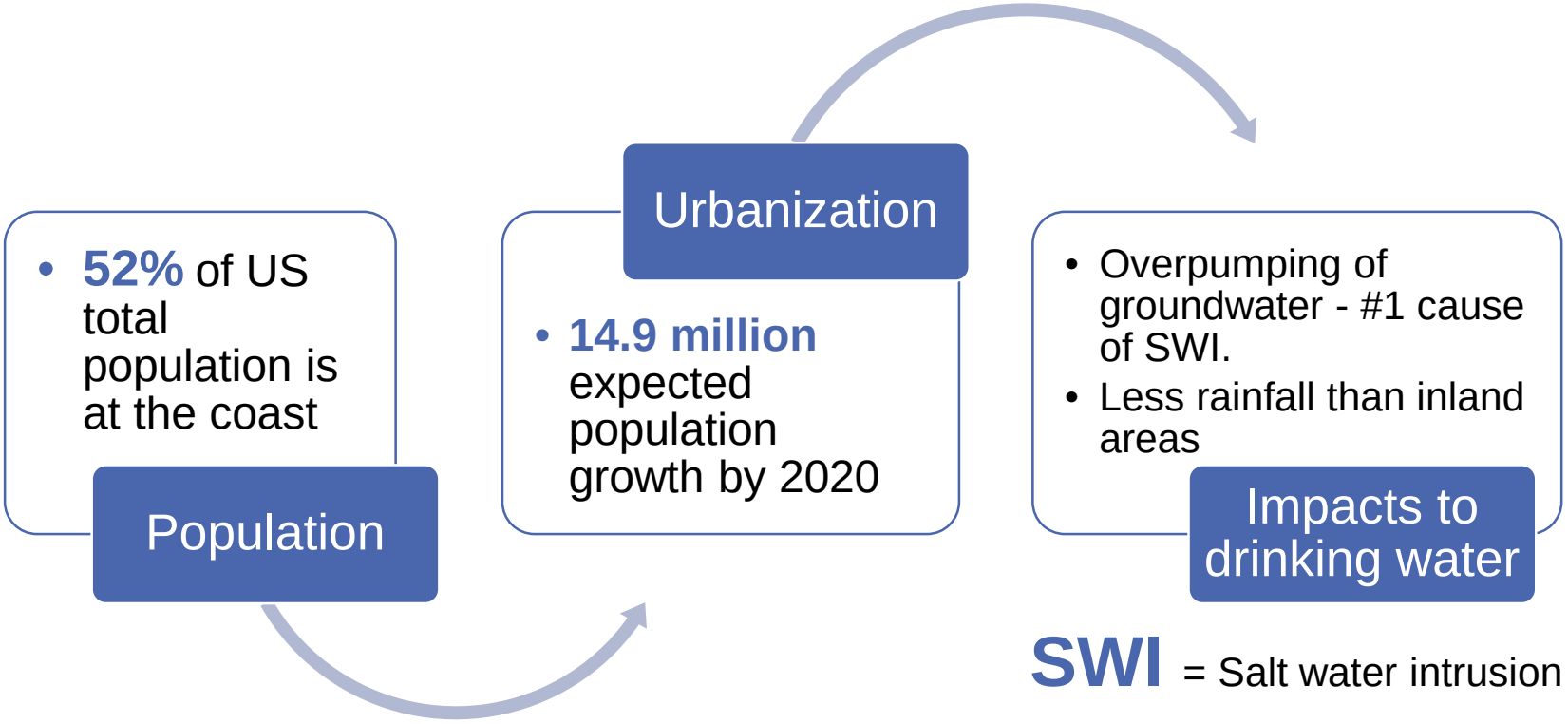


75% - 100% Impervious Area

Image: aucklandcity.govt.nz
Source: epa.gov

Pressures at the coast

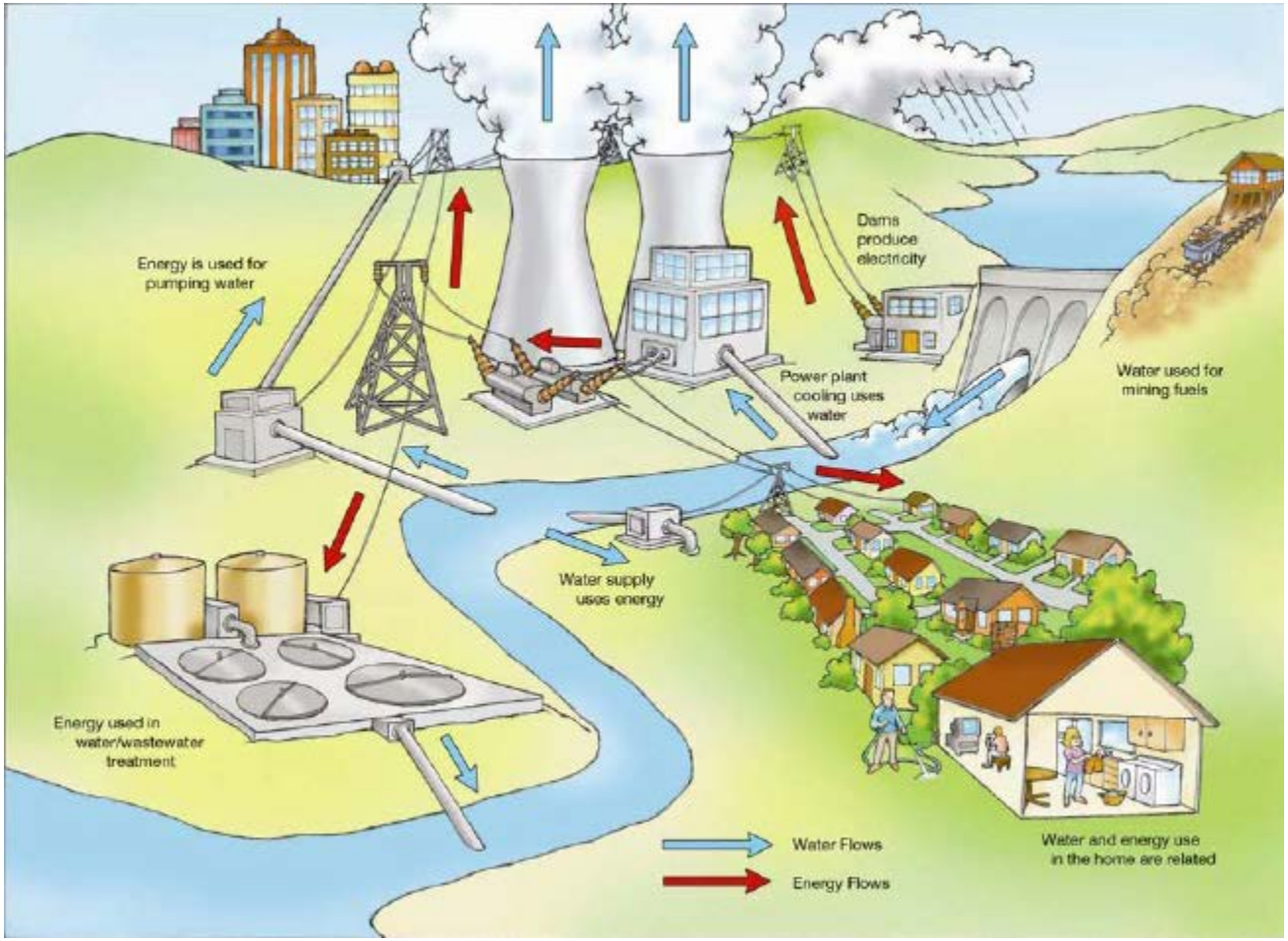
- *Increased water demands in coastal regions*
- *Sensitive coastal aquifers*
- *Limited access to fresh water sources*



SWI = Salt water intrusion

Source: Woods & Poole, 2011;NOAA, 2011; U.S. Census Bureau, 2011

Additional Pressure: Water-Energy Nexus



Source: ncsl.org

Water Management Paradigms

Current WM Paradigm

- Fragmented: segregated by infrastructure type
- Linear: extracted from the environment, used, polluted and disposed of

IUWM

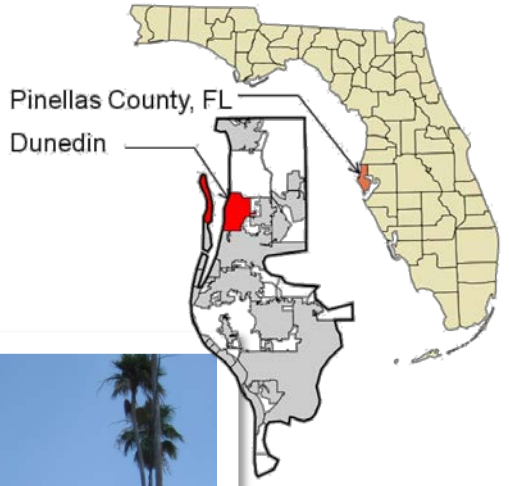
- Closes loops
  - Manages water as a single resource
  - Minimizes the amount of pollution generated and discharged to the environment
  - Uses/reuses water as close to its point of origination as possible

Source: Water Centric Sustainable Communities: Planning, Retrofitting, and Building the Next Urban Environment.

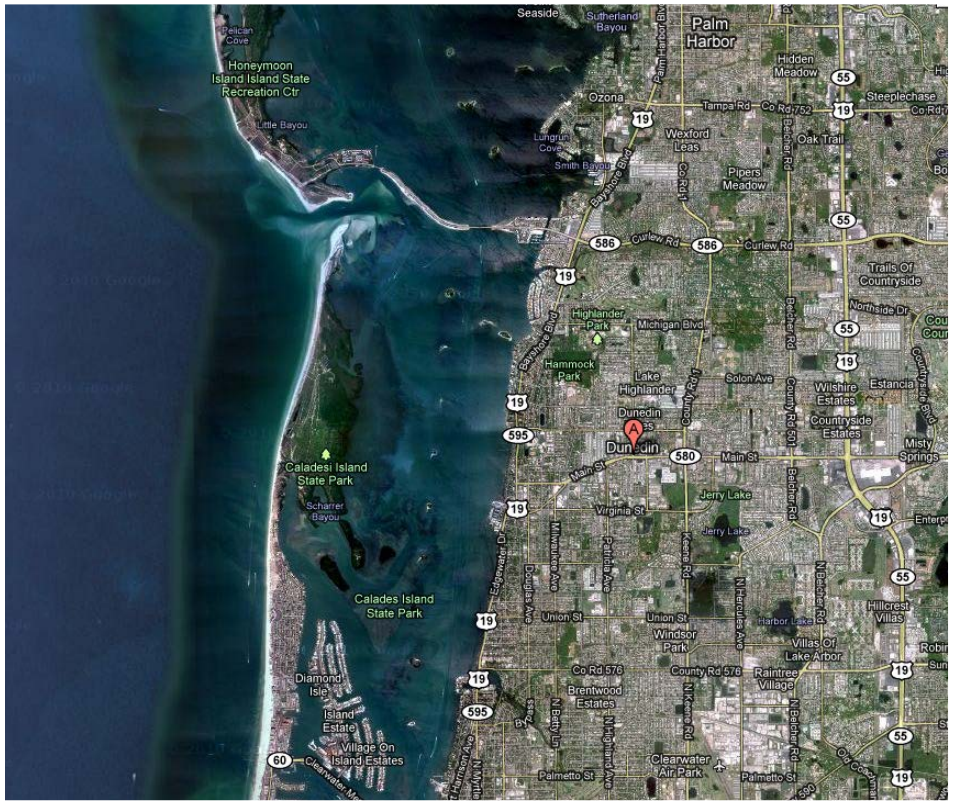
Key Points

- IUWM Case study
  - Demonstrates sustainable practices by managing the urban water cycle
  - Highlights innovative operational strategies and resource efficient practices
    - Protect: Prevent impairment of drinking water sources
    - Reduce: Conservation, water efficiency
    - Reuse: Waste streams, end-of-line capture
    - Recycle: Extensive waste water recycling
  - Energy savings

Dunedin, FL



Size (area):	10 mi^2
Population:	37,000 residents
Density:	3,700 people/mi^2



- **Density:** Pinellas County with the highest population density in the Gulf Coast region (NOAA, 2004).
- **Nearly built-out:** Watersheds are 98 to 100 percent developed.

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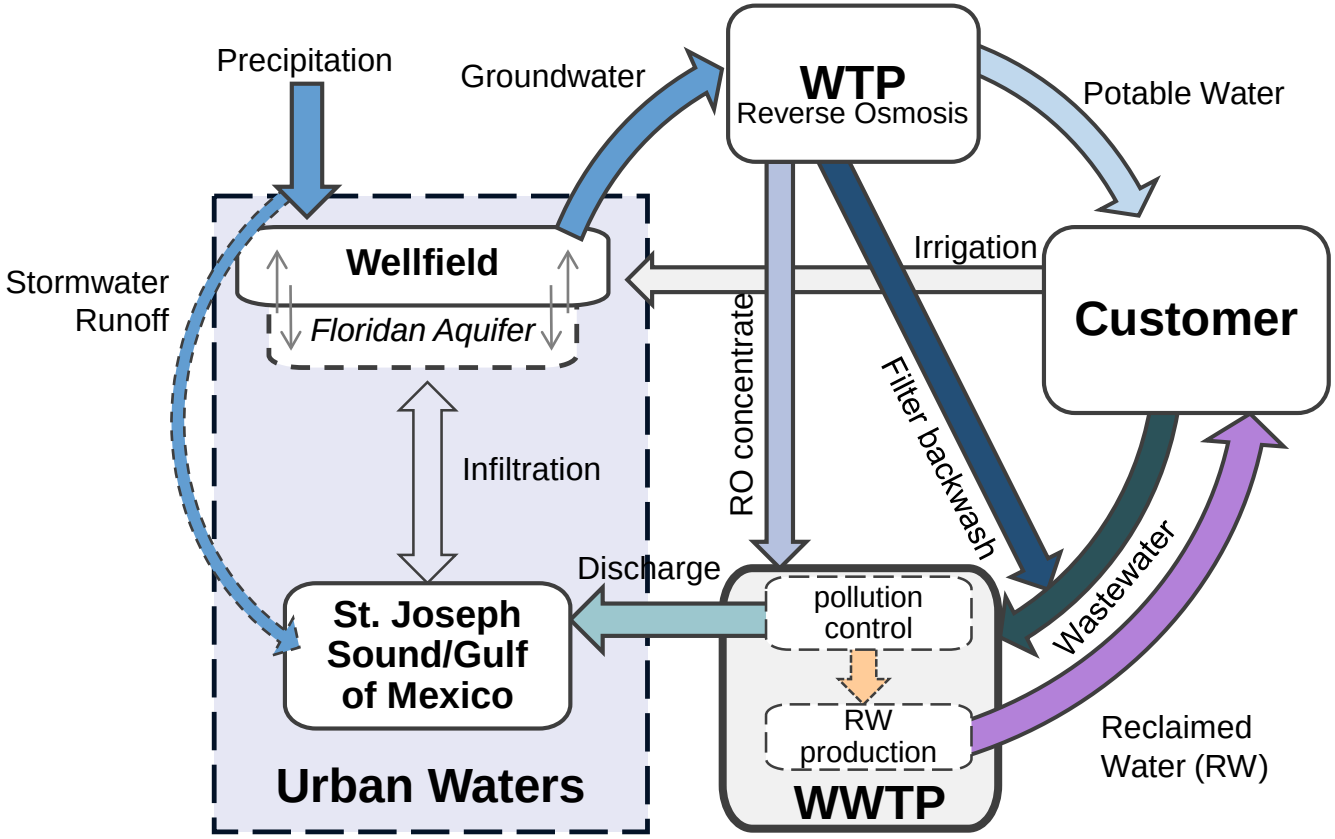
Dunedin's Urban Water Cycle

'Near Closed-Loop' & Integrated



ABBREVIATIONS

WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

WTP
Capacity: 9.5 MGD
Average production: 3.7 MGD

WWTP
Capacity: 6 MGD
Average treatment: 4.6 MGD
Average production: 2.8 MGD

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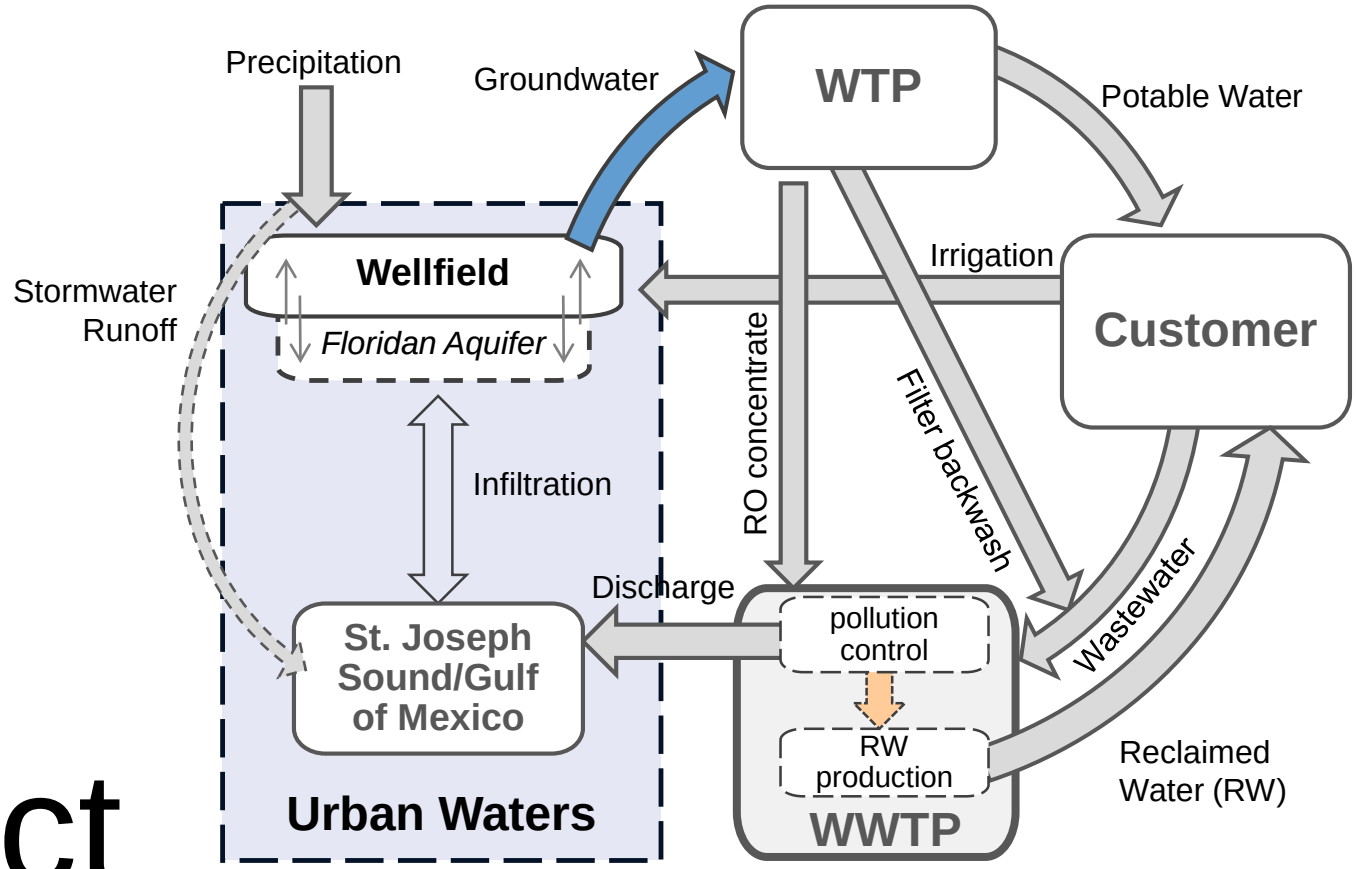


Protect

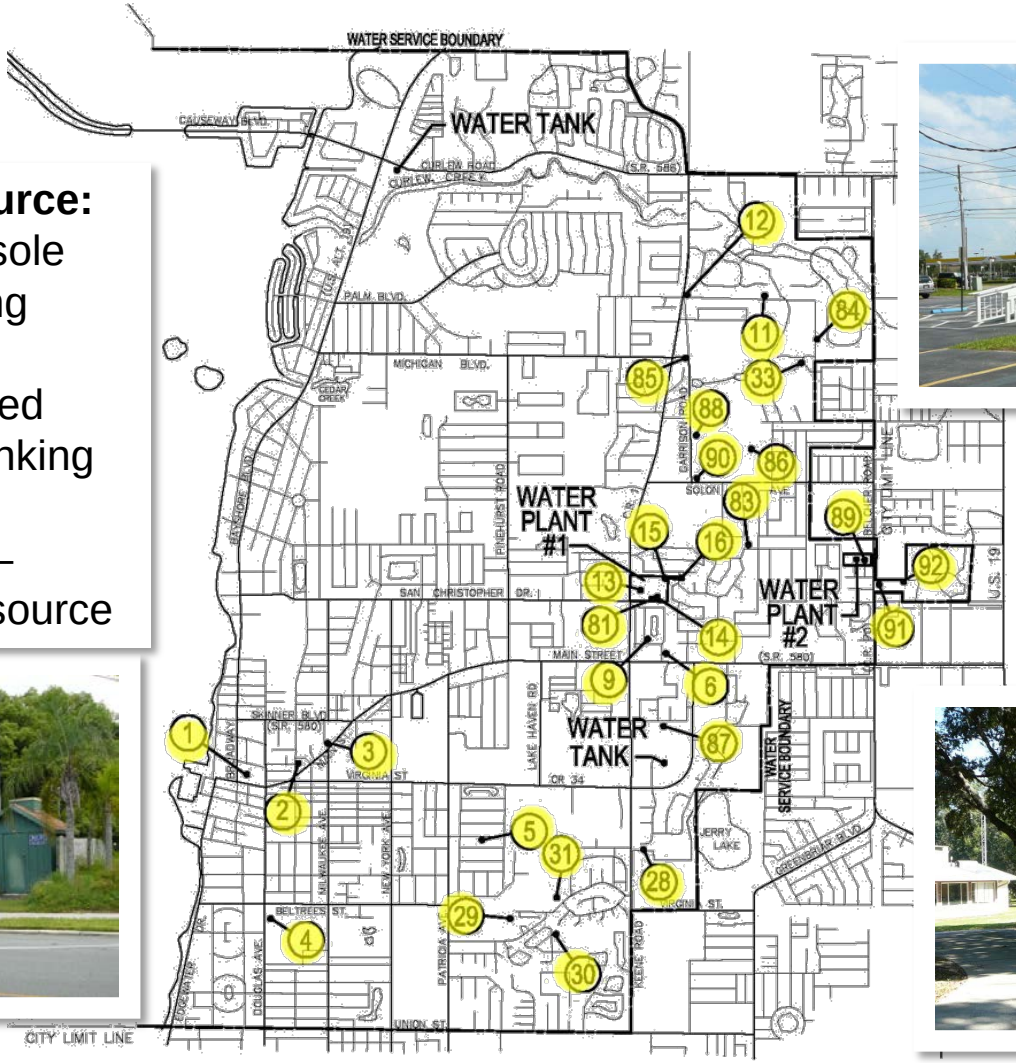
Prevent impairment of drinking water source

Sustainability is to "create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations"
(US White House - Federal Leadership in Environmental, Energy and Economic Performance, 2009)

Urban Wellfield

Drinking water source:

- Groundwater = sole source of drinking water
- Severely restricted expansion of drinking water source.
- Coastal aquifer – sensitive water source



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Sippy Straw Approach

PROTECT: Prevent impairment of drinking water source

- ***More*** wells
  - Better distributed abstraction throughout the city
  - Benefit: Consistent water quality
- ***Shallower*** wells
  - "Sip" from the surface
  - Reduce depth from 300 ft. to 200 ft. (91m to 61m)
  - Benefit: Higher quality water
- Rehab may also include
  - Geophysical logging
  - Acidization
  - Pump testing/Step testing

Sippy Straw Approach

PROTECT: Prevent impairment of drinking water source

Results of Rehab - (Last 5 years)

Well #	Chlorides (mg/L)		Hydrolic Cond (gal/min/ft)	
	Pre-Rehab	Post Rehab	Pre-Rehab	Post Rehab
Well 83	350	200	6.92	13.17
Well 89	400	200	11.16	16.60
Well 28	375	250	216.00	244.00
Well 90	250	180	10.30	12.50
Well 86	250	200	8.96	10.53
Well 87	300	240	44.02	40.96
Well 31	280	280	67.00	76.26

Improved Quality:
lower chlorides / fresher water

Improved Production

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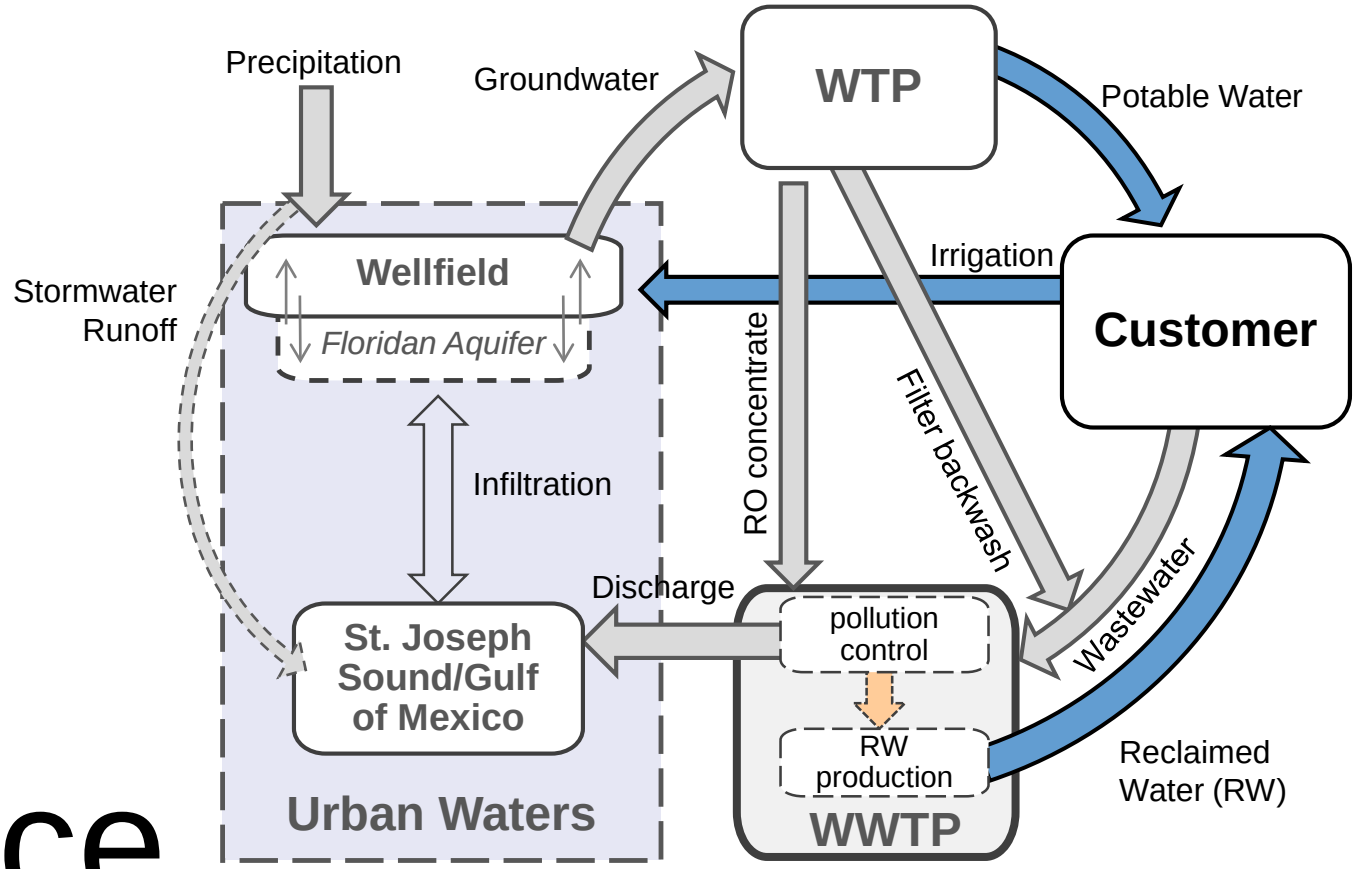
Sippy Straw Approach

PROTECT: Prevent impairment of drinking water source

- Co-Benefit
  - Sink hole reduction
  - from 30 to 10 in one year

knowledgera-theworld.blogspot.com



Reduce

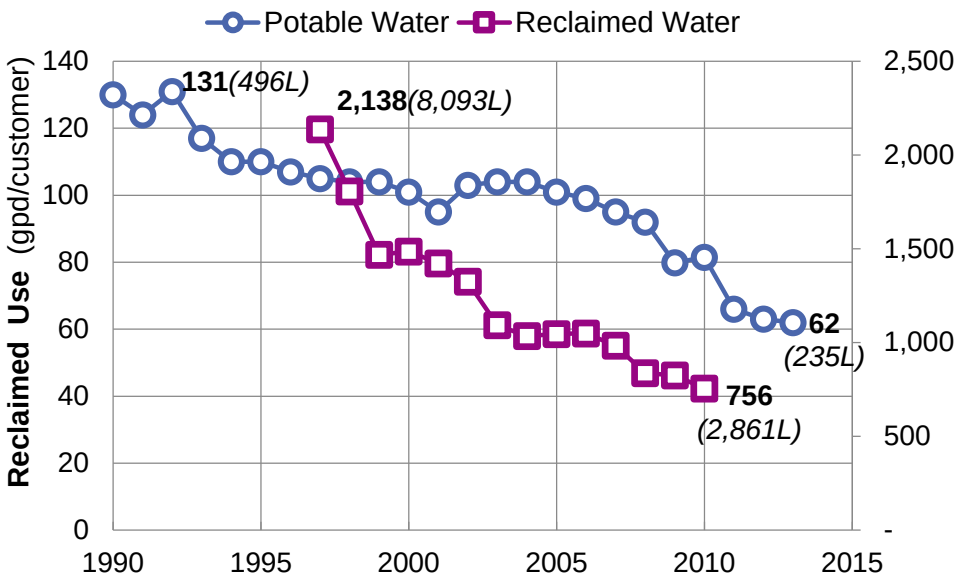
Conserve water resource

Improve water efficiency

Potable Water Conservation

REDUCE: Conserve water resource

- 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
- Watering restrictions
  - One day/week irrigation of lawn/garden



Results: Nearly 50% reduction in gpcd use

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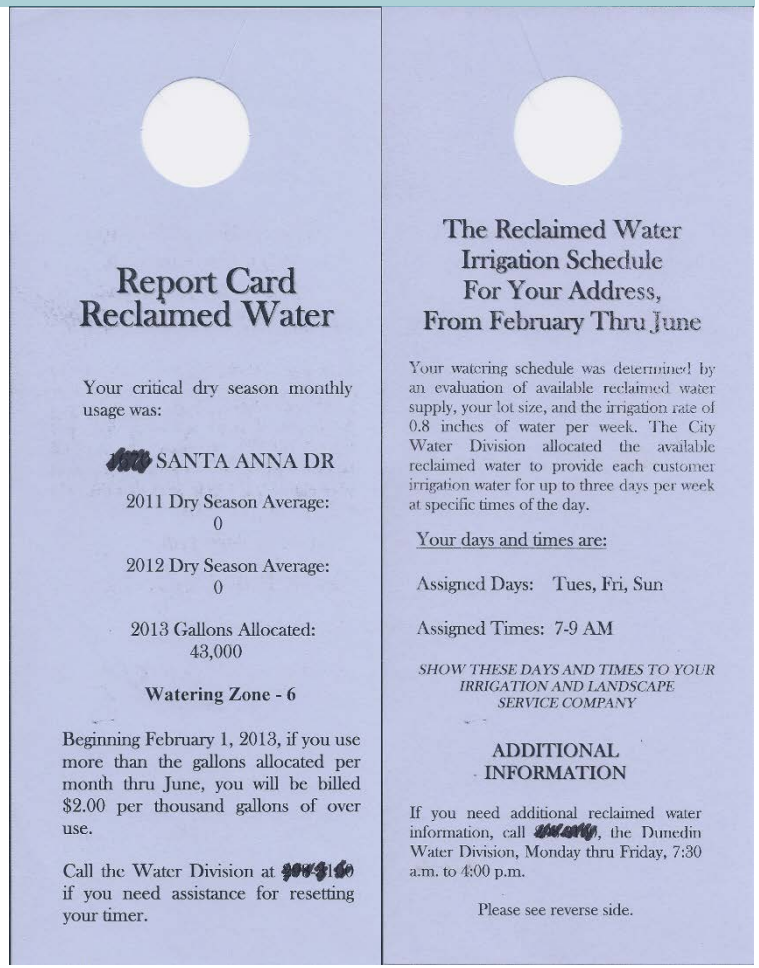
Reclaimed Water Conservation

REDUCE: Conserve water resource – “too valuable to use just once”

- Work closely with customers
  - Door tags
- Limit RW availability
  - Offline on Wednesdays (to ‘catch up’ on production)
- Landscape Ordinance
  - Drought tolerant (Florida Friendly) landscaping
- Dry season allotment surcharge for overuse

Results:
Number of chronic overusers reduced
Nearly 60% reduction in gpcd use



Report Card
Reclaimed Water

Your critical dry season monthly usage was:

[redacted] SANTA ANNA DR

2011 Dry Season Average:
0

2012 Dry Season Average:
0

2013 Gallons Allocated:
43,000

Watering Zone - 6

Beginning February 1, 2013, if you use more than the gallons allocated per month thru June, you will be billed $2.00 per thousand gallons of over use.

Call the Water Division at [redacted] if you need assistance for resetting your timer.

The Reclaimed Water
Irrigation Schedule
For Your Address,
From February Thru June

Your watering schedule was determined by an evaluation of available reclaimed water supply, your lot size, and the irrigation rate of 0.8 inches of water per week. The City Water Division allocated the available reclaimed water to provide each customer irrigation water for up to three days per week at specific times of the day.

Your days and times are:

Assigned Days: Tues, Fri, Sun

Assigned Times: 7-9 AM

SHOW THESE DAYS AND TIMES TO YOUR IRRIGATION AND LANDSCAPE SERVICE COMPANY

ADDITIONAL INFORMATION

If you need additional reclaimed water information, call [redacted], the Dunedin Water Division, Monday thru Friday, 7:30 a.m. to 4:00 p.m.

Please see reverse side.

AMR (Automatic Meter Reading)

REDUCE: Improve water efficiency

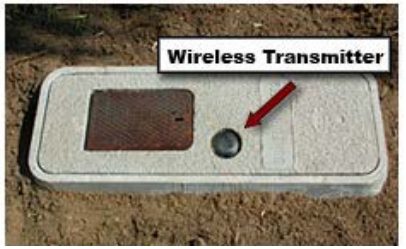
- All water supply is metered (potable and reclaimed)
- Real time usage
- Transmitted wirelessly
- Benefits:
  - Helps identify leaks
  - Helps customers track usage (Meter Magnet)
  - Cuts down meter reading man hours
  - Discourages violation of watering restrictions

Meter Magnet

AMR device in meter box

New meter with AMR

Installation complete ready for resodding by city



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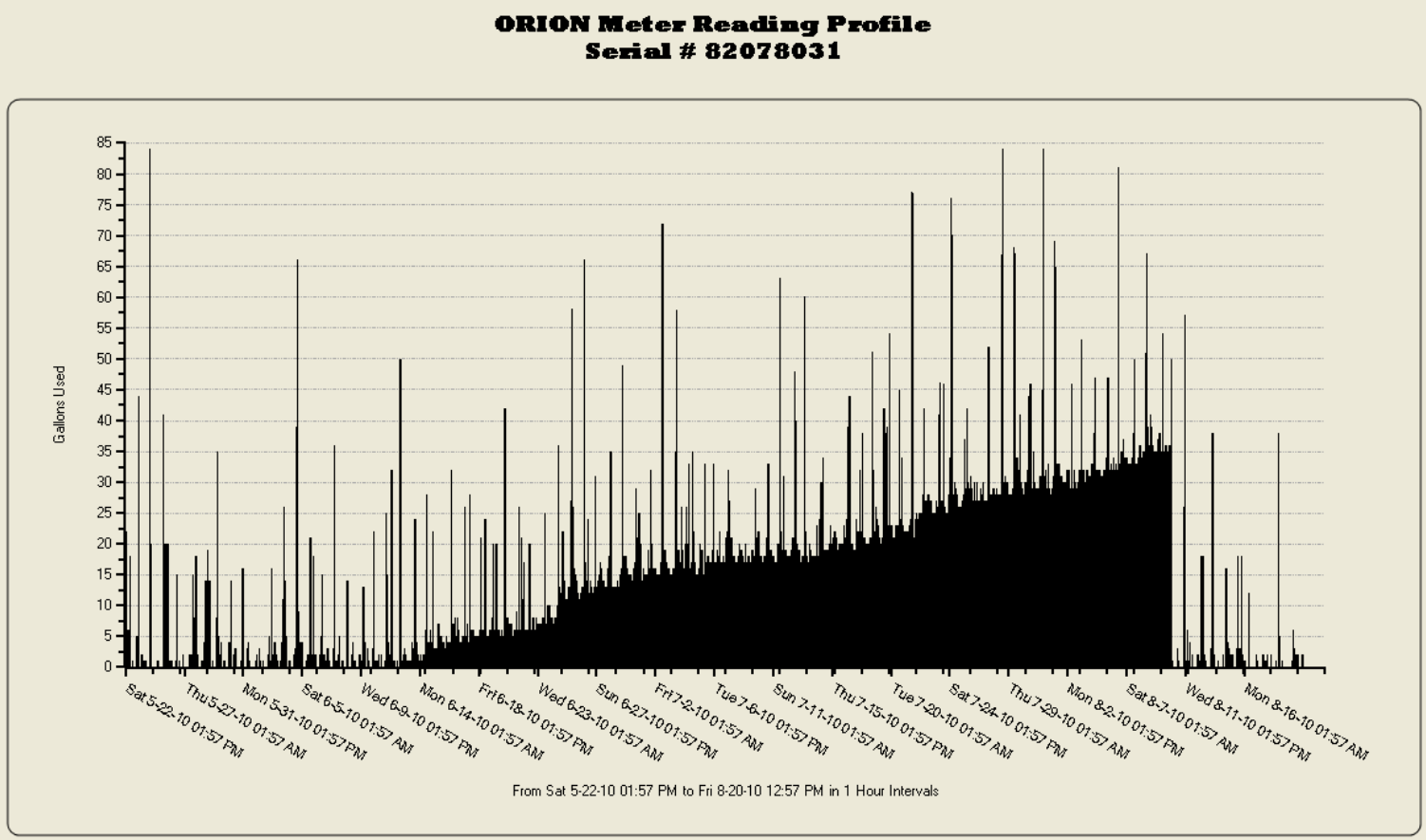
AMR: Example
Increased loss of a pinhole leak

Profile Graph

#	Read Time	Use
1	Sat 5-22-10 01:57 PM	0
2	Sat 5-22-10 02:57 PM	22
3	Sat 5-22-10 03:57 PM	0
4	Sat 5-22-10 04:57 PM	0
5	Sat 5-22-10 05:57 PM	2
6	Sat 5-22-10 06:57 PM	6
7	Sat 5-22-10 07:57 PM	0
8	Sat 5-22-10 08:57 PM	0
9	Sat 5-22-10 09:57 PM	18
10	Sat 5-22-10 10:57 PM	3
11	Sat 5-22-10 11:57 PM	0
12	Sun 5-23-10 12:57 AM	0
13	Sun 5-23-10 01:57 AM	0
14	Sun 5-23-10 02:57 AM	1
15	Sun 5-23-10 03:57 AM	0
16	Sun 5-23-10 04:57 AM	0
17	Sun 5-23-10 05:57 AM	0
18	Sun 5-23-10 06:57 AM	0
19	Sun 5-23-10 07:57 AM	0
20	Sun 5-23-10 08:57 AM	0
21	Sun 5-23-10 09:57 AM	0
22	Sun 5-23-10 10:57 AM	5
23	Sun 5-23-10 11:57 AM	0
24	Sun 5-23-10 12:57 PM	0
25	Sun 5-23-10 01:57 PM	20
26	Sun 5-23-10 02:57 PM	44
27	Sun 5-23-10 03:57 PM	0
28	Sun 5-23-10 04:57 PM	0
29	Sun 5-23-10 05:57 PM	0
30	Sun 5-23-10 06:57 PM	1
31	Sun 5-23-10 07:57 PM	2
32	Sun 5-23-10 08:57 PM	0
33	Sun 5-23-10 09:57 PM	0
34	Sun 5-23-10 10:57 PM	0
35	Sun 5-23-10 11:57 PM	1
36	Mon 5-24-10 12:57 AM	1
37	Mon 5-24-10 01:57 AM	1
38	Mon 5-24-10 02:57 AM	1
39	Mon 5-24-10 03:57 AM	0
40	Mon 5-24-10 04:57 AM	0
41	Mon 5-24-10 05:57 AM	0
42	Mon 5-24-10 06:57 AM	0
43	Mon 5-24-10 07:57 AM	0
44	Mon 5-24-10 08:57 AM	0
45	Mon 5-24-10 09:57 AM	2
46	Mon 5-24-10 10:57 AM	84
47	Mon 5-24-10 11:57 AM	20
48	Mon 5-24-10 12:57 PM	0
49	Mon 5-24-10 01:57 PM	0
50	Mon 5-24-10 02:57 PM	0
51	Mon 5-24-10 03:57 PM	0
52	Mon 5-24-10 04:57 PM	0
53	Mon 5-24-10 05:57 PM	0

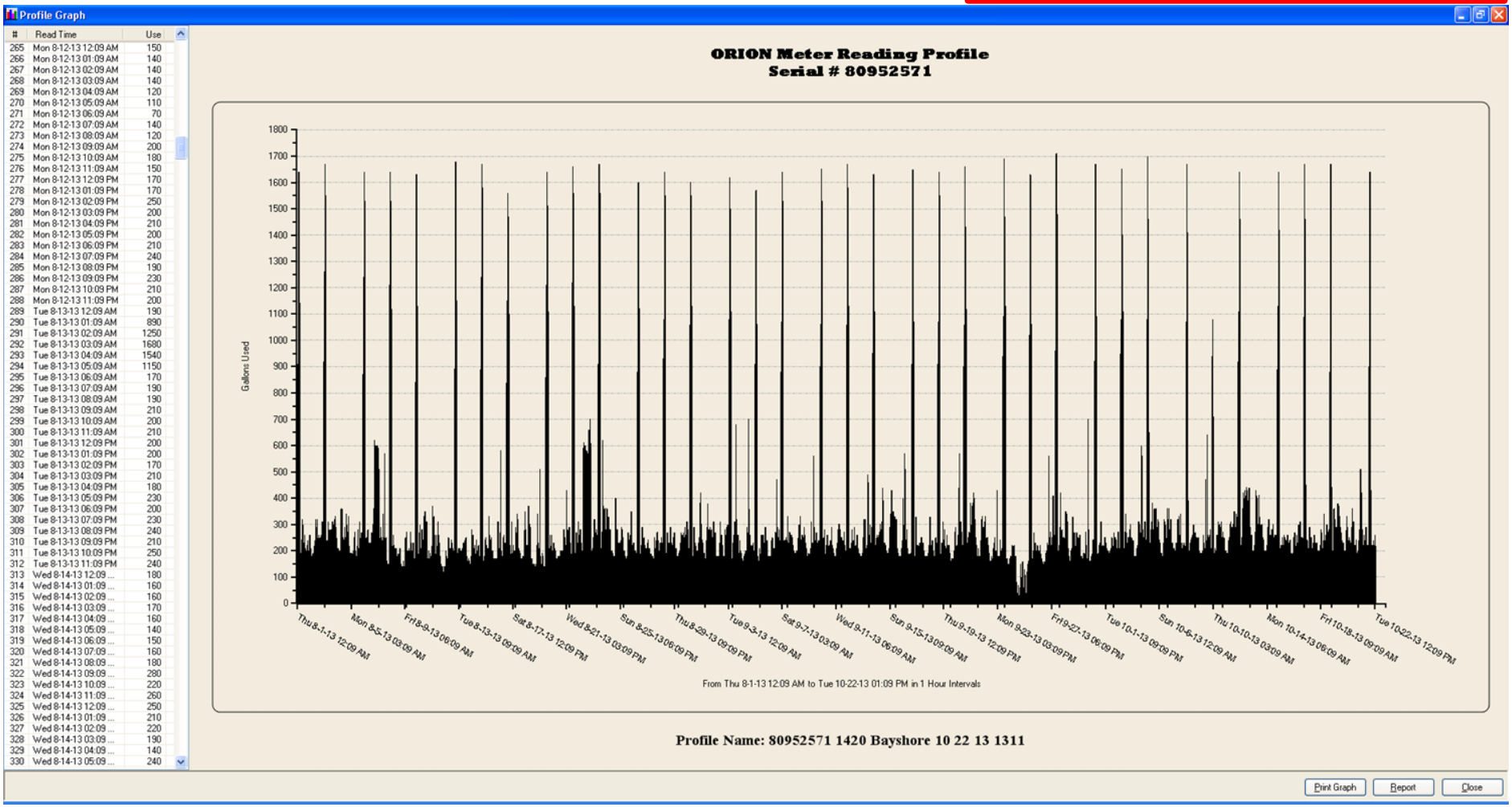


Profile Name: 82078031 563 shady pw 8 20 10

Print Graph | Report | Close

AMR: Example Constant loss

- **Leak:** ~125 gallons/hour
- **Irrigation violation:** 3 times per week instead of once per week



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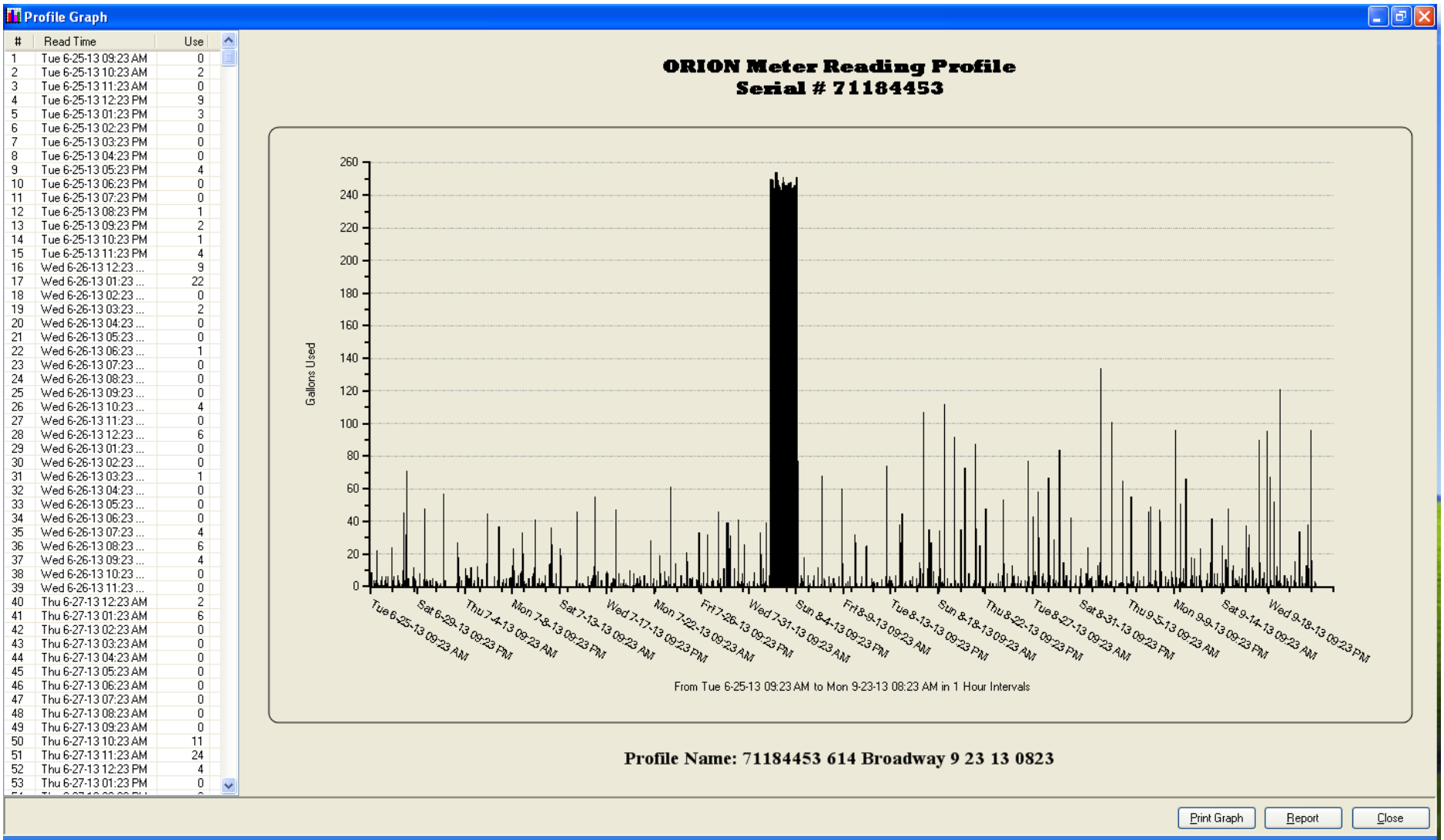
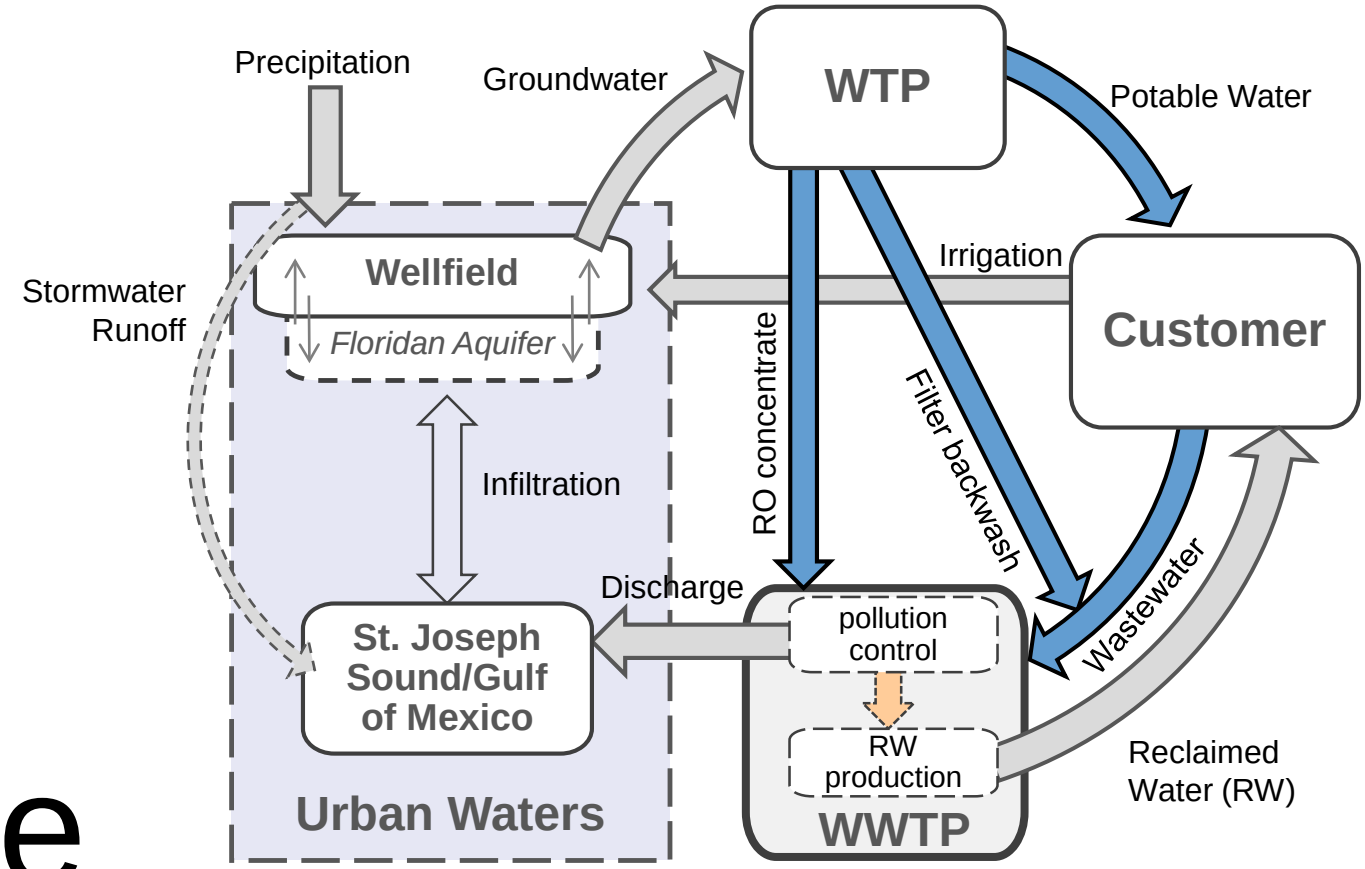
AMR: Example
“Instant On, Instant Off” loss



#	Read Time	Use
1	Tue 6-25-13 09:23 AM	0
2	Tue 6-25-13 10:23 AM	2
3	Tue 6-25-13 11:23 AM	0
4	Tue 6-25-13 12:23 PM	9
5	Tue 6-25-13 01:23 PM	3
6	Tue 6-25-13 02:23 PM	0
7	Tue 6-25-13 03:23 PM	0
8	Tue 6-25-13 04:23 PM	0
9	Tue 6-25-13 05:23 PM	4
10	Tue 6-25-13 06:23 PM	0
11	Tue 6-25-13 07:23 PM	0
12	Tue 6-25-13 08:23 PM	1
13	Tue 6-25-13 09:23 PM	2
14	Tue 6-25-13 10:23 PM	1
15	Tue 6-25-13 11:23 PM	4
16	Wed 6-26-13 12:23 ...	9
17	Wed 6-26-13 01:23 ...	22
18	Wed 6-26-13 02:23 ...	0
19	Wed 6-26-13 03:23 ...	2
20	Wed 6-26-13 04:23 ...	0
21	Wed 6-26-13 05:23 ...	0
22	Wed 6-26-13 06:23 ...	1
23	Wed 6-26-13 07:23 ...	0
24	Wed 6-26-13 08:23 ...	0
25	Wed 6-26-13 09:23 ...	0
26	Wed 6-26-13 10:23 ...	4
27	Wed 6-26-13 11:23 ...	0
28	Wed 6-26-13 12:23 ...	6
29	Wed 6-26-13 01:23 ...	0
30	Wed 6-26-13 02:23 ...	0
31	Wed 6-26-13 03:23 ...	1
32	Wed 6-26-13 04:23 ...	0
33	Wed 6-26-13 05:23 ...	0
34	Wed 6-26-13 06:23 ...	0
35	Wed 6-26-13 07:23 ...	4
36	Wed 6-26-13 08:23 ...	6
37	Wed 6-26-13 09:23 ...	4
38	Wed 6-26-13 10:23 ...	0
39	Wed 6-26-13 11:23 ...	0
40	Thu 6-27-13 12:23 AM	2
41	Thu 6-27-13 01:23 AM	6
42	Thu 6-27-13 02:23 AM	0
43	Thu 6-27-13 03:23 AM	0
44	Thu 6-27-13 04:23 AM	0
45	Thu 6-27-13 05:23 AM	0
46	Thu 6-27-13 06:23 AM	0
47	Thu 6-27-13 07:23 AM	0
48	Thu 6-27-13 08:23 AM	0
49	Thu 6-27-13 09:23 AM	0
50	Thu 6-27-13 10:23 AM	11
51	Thu 6-27-13 11:23 AM	24
52	Thu 6-27-13 12:23 PM	4
53	Thu 6-27-13 01:23 PM	0

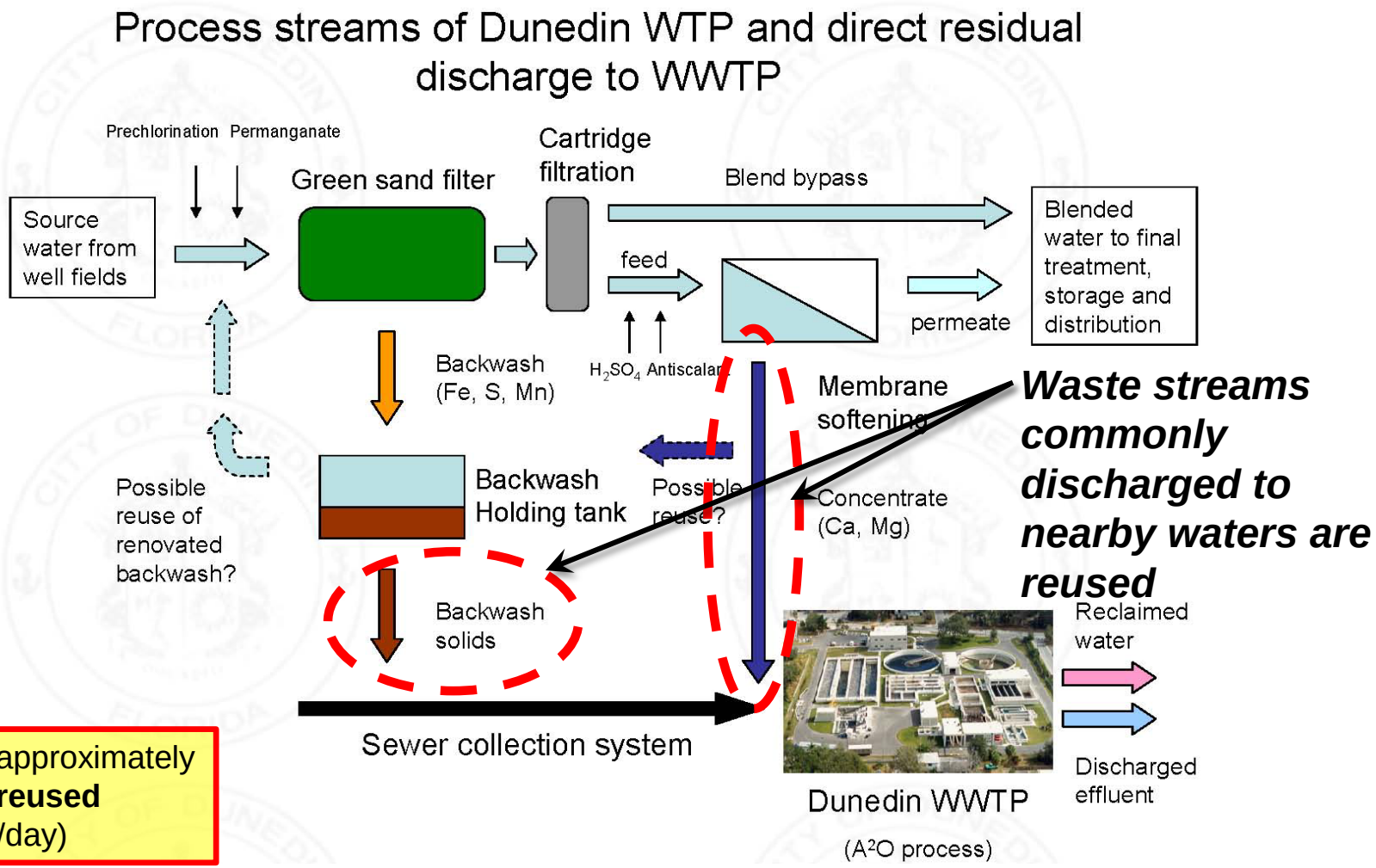


Reuse

Close the loop on waste streams

WTP process waste streams

REUSE: Close the loop on waste streams



Benefit: approximately **1.0 MGD reused** (3,785 m^3/day)

End-of-line reuse at Honeymoon Island

REUSE: Close the loop on waste streams

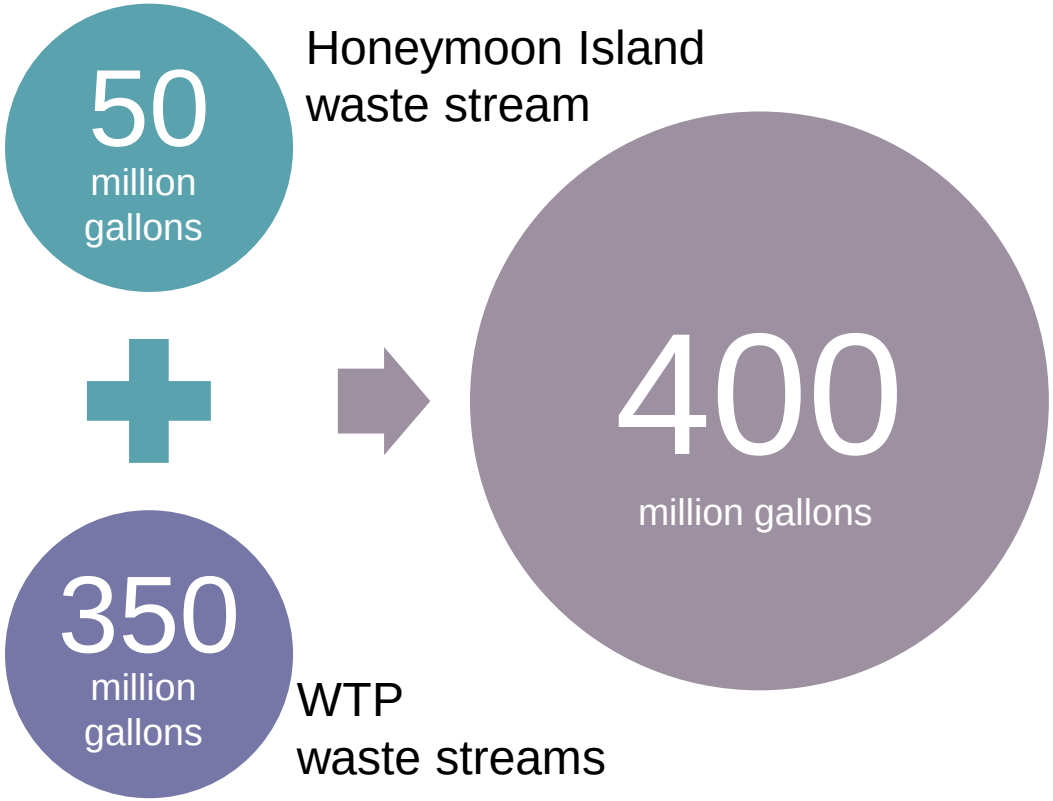
Benefit: Nearly **50 million gallons reused per year**

Barrier island slated for high density development. Only first phase completed.
End-of-line issues with:

- *Oversized water main*
- *Low flow lift station*

Water savings by closing loops

Approximate water saved annually due to reuse



38%

of reclaimed water annually

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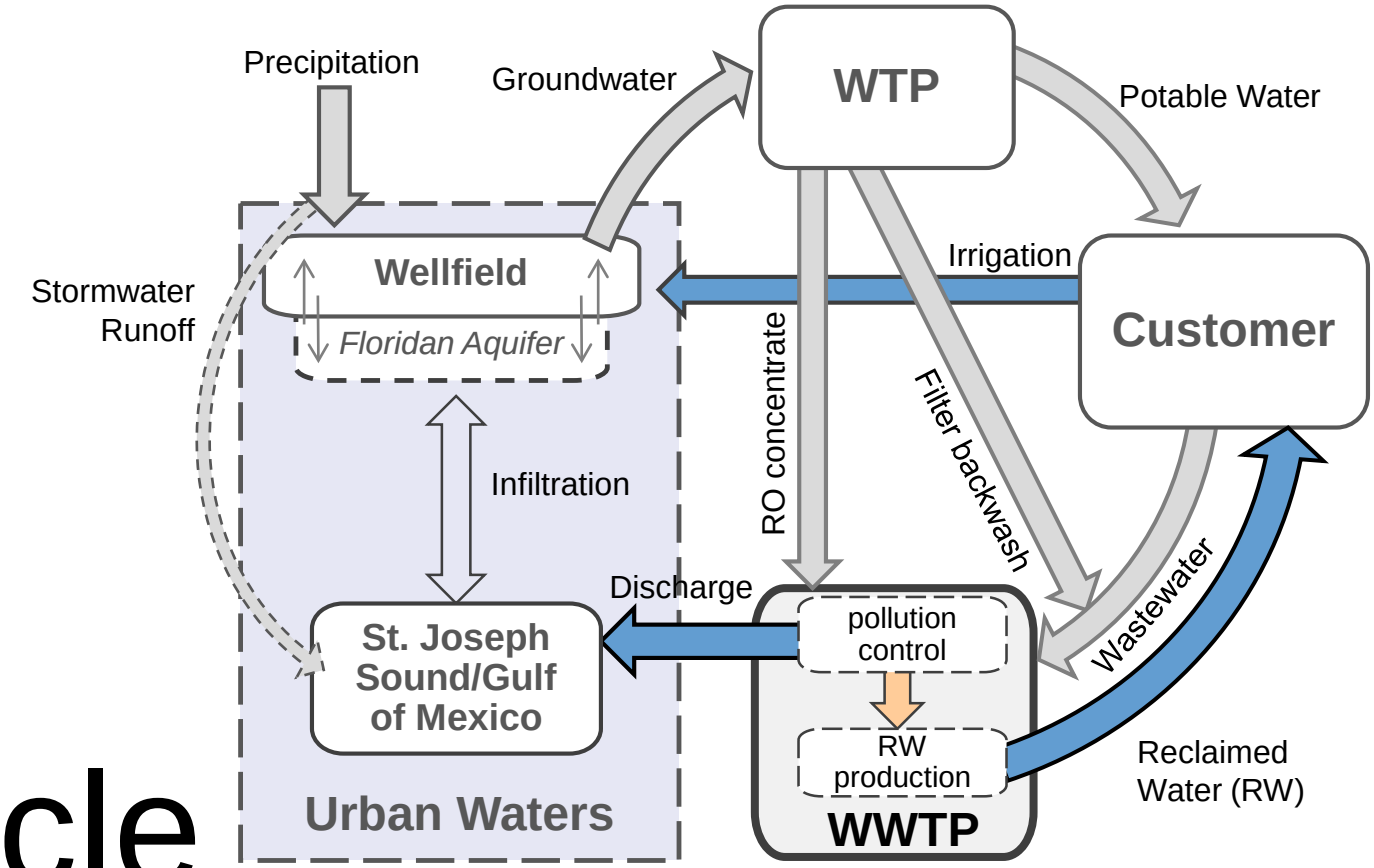


Recycle

Extensive wastewater recycling

Reduced discharges prevents impairment

Reclaimed water offsets potable water use

Consistent availability year round

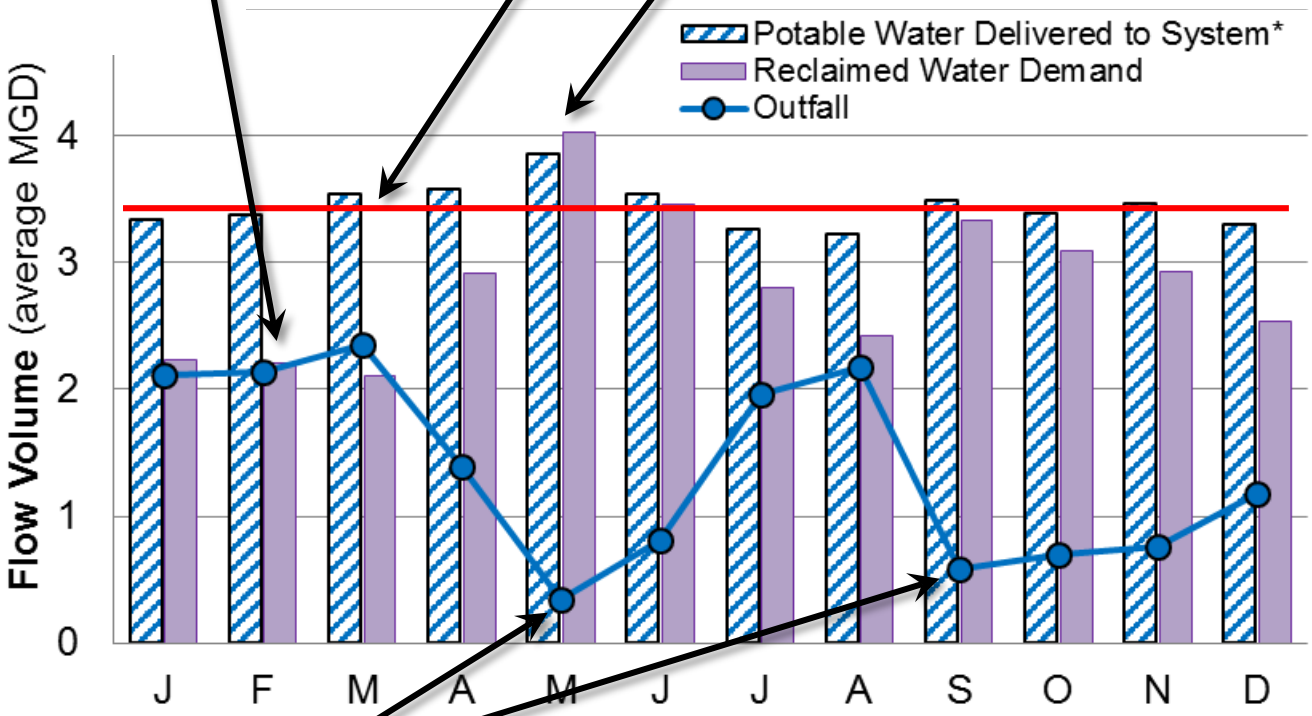
Extensive Recycling of Wastewater

RECYCLE: Minimizes the amount of pollution generated and discharged to the environment

Consistently available year round

100% recycled and used

Less demand during wet season



Near zero discharges

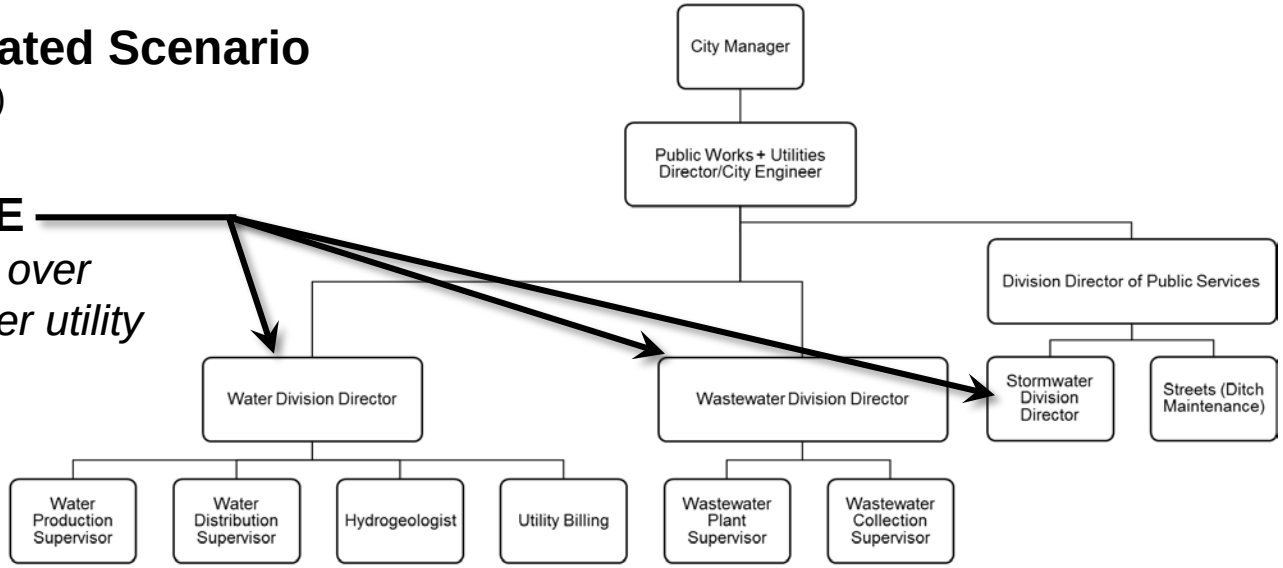
* **Assumption**: Potable water delivered = wastewater received. Surplus is due to I&I (inflow and infiltration).

Additional strategies for success

Integrated organizational structure for water management

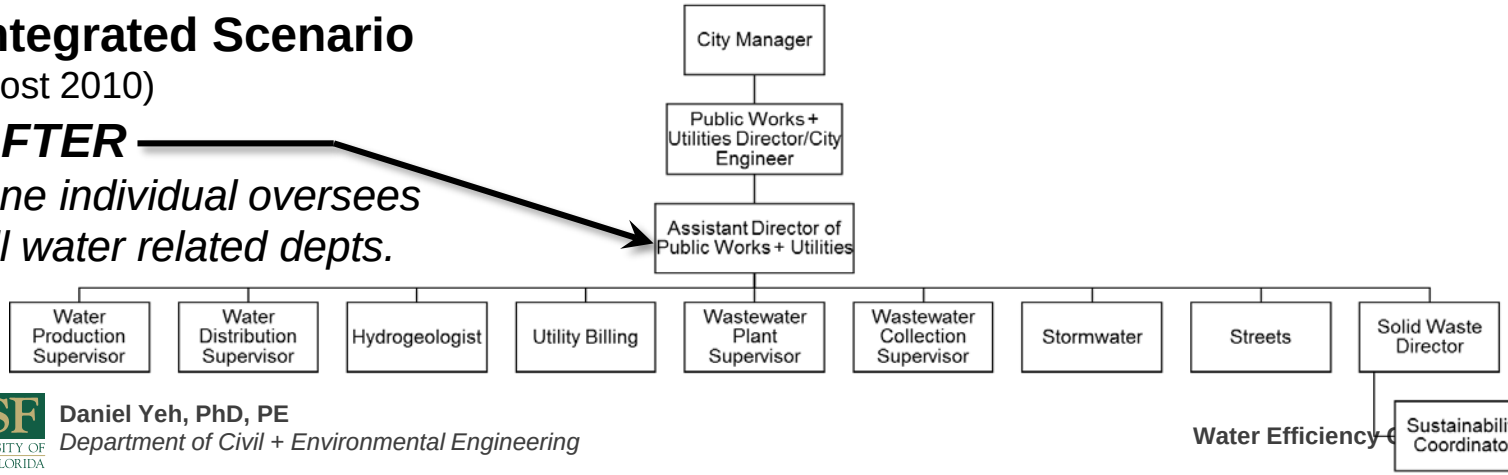
Segregated Scenario
(pre 2010)

BEFORE
Directors over each water utility



Integrated Scenario
(post 2010)

AFTER
One individual oversees all water related depts.



Coordination between utilities

- Coordination between WATER utilities
  - Byproduct stream from RO is treated by WWTP
  - Drinking water production is coordinated with WWTP per assimilation capacity
- Coordination with POWER utility
  - RO process is a high energy process
  - Reduced rates during off-peak operation is offered in exchange for shut down during peak times
  - RO plant uses backup generators

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

Extended partnerships with academia

DUNEDIN
Home of Honeymoon Island

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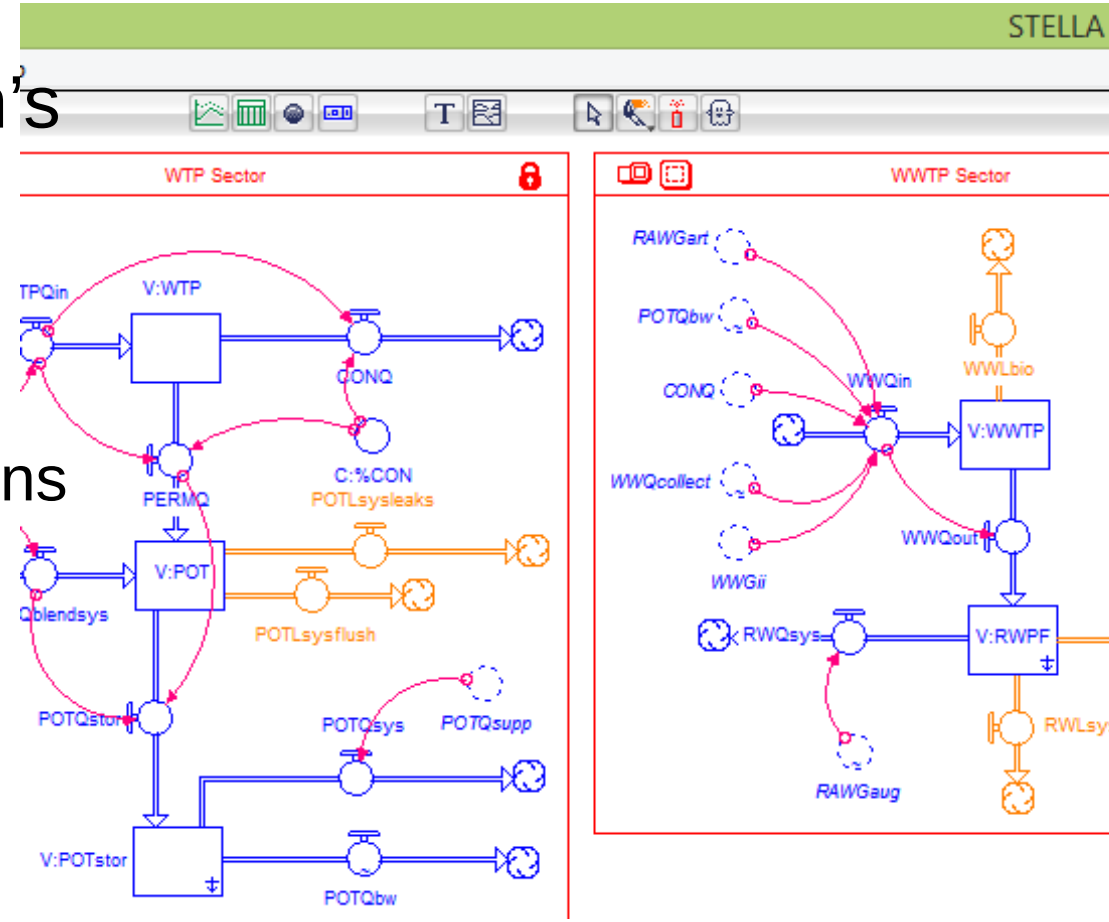
Current Research

- Modelling Dunedin's urban water cycle
  - Valuable tool for constructing and understanding dynamic interactions between plants
  - Water + Energy tradeoffs



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In summary….

- ✓ IUWM paradigm possesses characteristics that addresses contemporary water supply + energy issues
- ✓ Demonstrates sustainable practices by managing the urban water cycle
  - ✓ Judicious extraction protects the environment + drinking water source of human consumption
  - ✓ Demand reduction through conservation and aggressive recycling
  - ✓ Waste stream capture = significant water savings and reduces discharges to urban waters
- ✓ Water Efficiency = Energy Savings
- ✓ Applicable to all cities, not just coastal

Thank you.

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