Hazen

Considerations for Water Reuse

Incorporating Water Reuse into Integrated Planning

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Overview

- Why Reuse?
- Types of reuse
- Where is reuse happening, and why?
- Case studies
- Regulation

Drivers for Water Reuse (Both Potable and Non-potable)

Limited quantities of conventional source water supplies

Challenging qualities of conventional source water supplies

Limited drinking water treatment capacity (NPR offsets potable water usage)

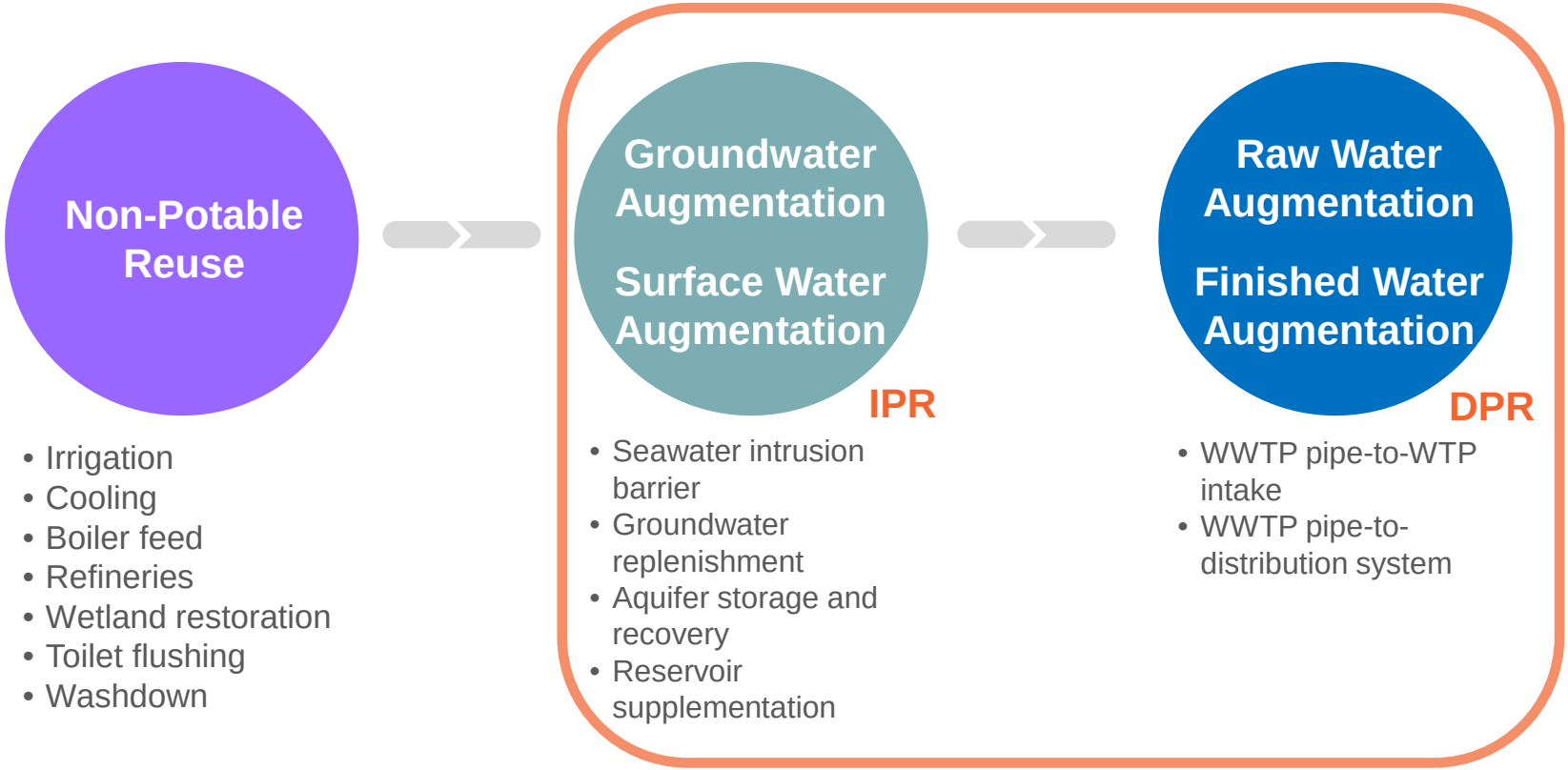
Limited drinking water distribution capacity

Environmental discharge limitations

Limited collection system capacity (onsite reuse)

Suitability of reclaimed water versus potable water (fit-for-purpose)

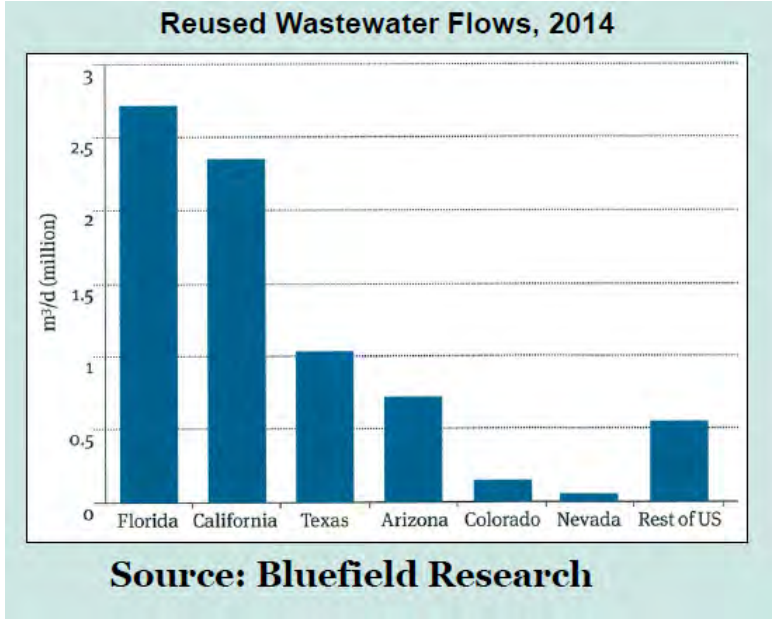
Types of Water Reuse



Where is Reuse Happening in the US?

Over 80% of reuse occurs in four states.

Map: Western Water, July/August 2008

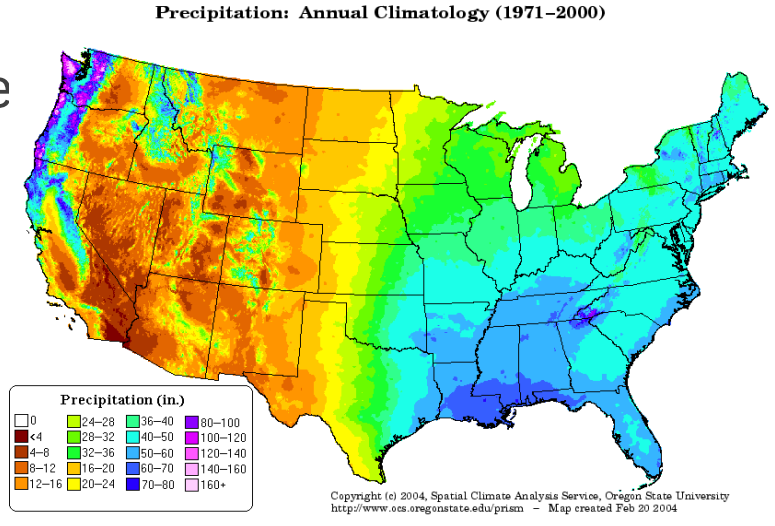


Source: Bluefield Research

Information from this slide courtesy Arizona Dept of Environmental Quality

The US Presents a Diverse Set of Climactic and Storage Conditions

- West—typically dry and major storage is snowpack on the Rocky Mountains - Climate change is decreasing snowpack
- Southeast—Storage can't keep pace with population growth
- Northeast—sustained rains but may have limited storage or groundwater



The Drinking Water Perspective

Meeting Community Needs with Available Supplies

Water supply limitations

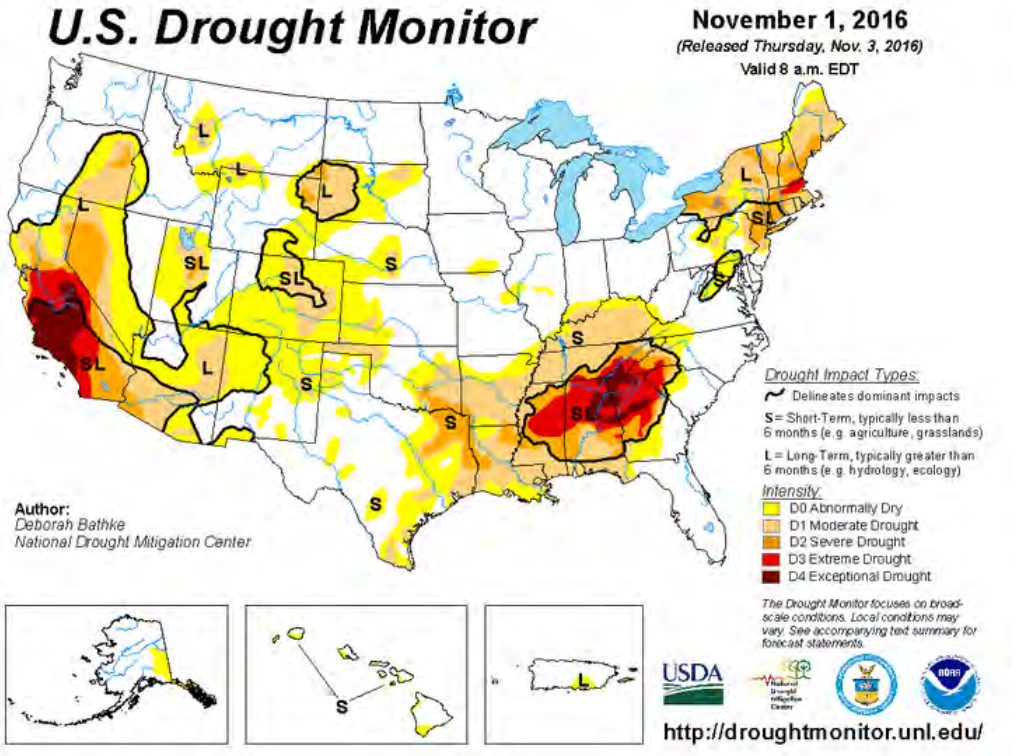
- Drought
- Declining groundwater levels
- Withdrawal limits

Deferral of potable water infrastructure expansion

Population expansion

Saltwater intrusion

Lack of storage

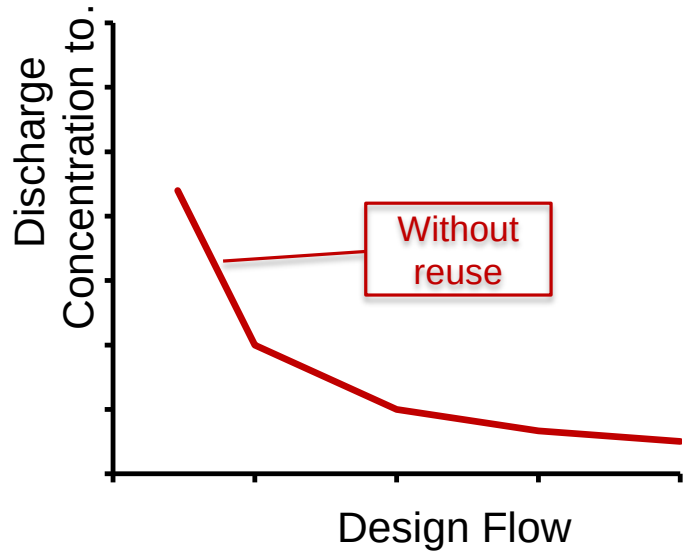


The Wastewater Perspective

The Role of Consumptive Reuse

- Nutrient management
  - Total Maximum Daily Loads (TMDLs), Waste Load Allocations (WLAs)

As flows increase and WLAs stay constant, WWTPs must achieve increasingly stringent effluent requirements

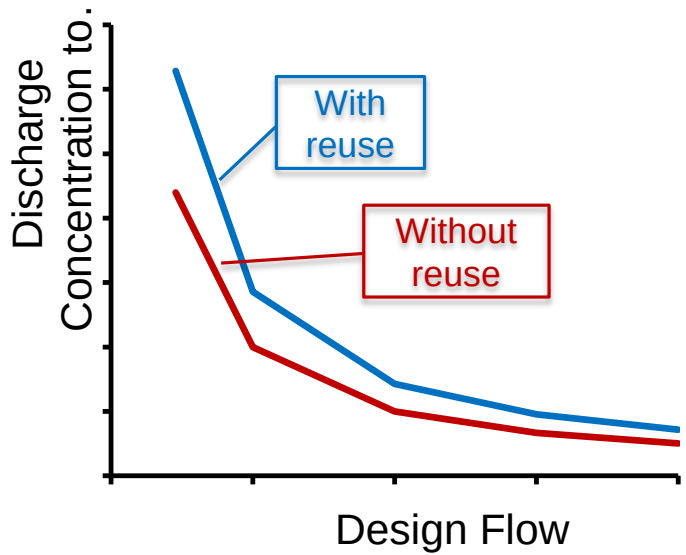


The Wastewater Perspective

The Role of Consumptive Reuse

- Nutrient management
  - Total Maximum Daily Loads (TMDLs), Waste Load Allocations (WLAs)
- Deferral of wastewater infrastructure expansion
  - Onsite reuse
- Maintaining environmental flows to parks and wetlands
- Revenue

Water reuse →
Decreased Flow to environment →
Increased allowable effluent concentration



Non-Potable Reuse – What are the Options for Use

Non-Potable Reuse

Irrigation

Water quality required linked to likely human exposure.

Challenges with salinity

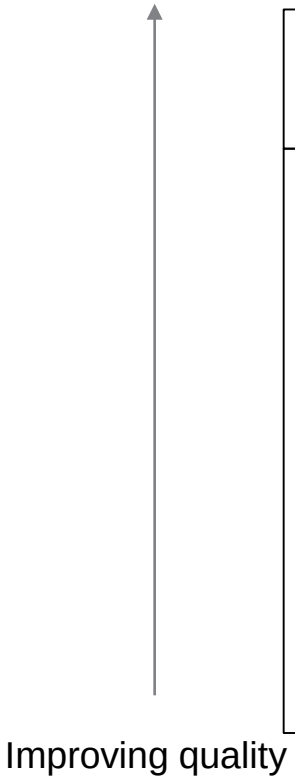
Seasonal Demand Variability.

Landscape irrigation

Golf courses (significant in Florida, Arizona and other states).

Irrigation of food crops

Quality Based on Human Exposure (e.g. New Mexico Guidelines)



Improving quality

Conventional secondary, filtration + disinfection.

Conventional Secondary treatment + disinfection.

Table 1. Approved Uses for Reclaimed Wastewater by Class

Class of Reclaimed Wastewater	Approved Uses
Class 1A	All Class 1 uses. *No setback limit* to dwelling unit or occupied establishment.
	Backfill around potable water pipes
	Irrigation of food crops[1]
Class 1B	Impoundments (recreational or ornamental)
	Irrigation of parks, school yards, golf courses [2]
	Irrigation of urban landscaping [2]
	Snow making
	Street cleaning
	Toilet flushing
	Backfill around non-potable piping
Class 2	Concrete mixing
	Dust control
	Irrigation of fodder, fiber, and seed crops for milk-producing animals
	Irrigation of roadway median landscapes
	Irrigation of sod farms
	Livestock watering
	Soil compaction
Class 3	Irrigation of fodder, fiber, and seed crops for non-milk-producing animals
	Irrigation of forest trees (silviculture)

NMED GROUND WATER QUALITY BUREAU GUIDANCE: ABOVE GROUND USE OF RECLAIMED DOMESTIC WASTEWATER January 2007 (New Mexico)

Irrigation – The Challenge of Salinity

- Salinity can impact the type of irrigation that can be used.
- May necessitate alternative treatment
- Challenge with coastal seawater infiltration

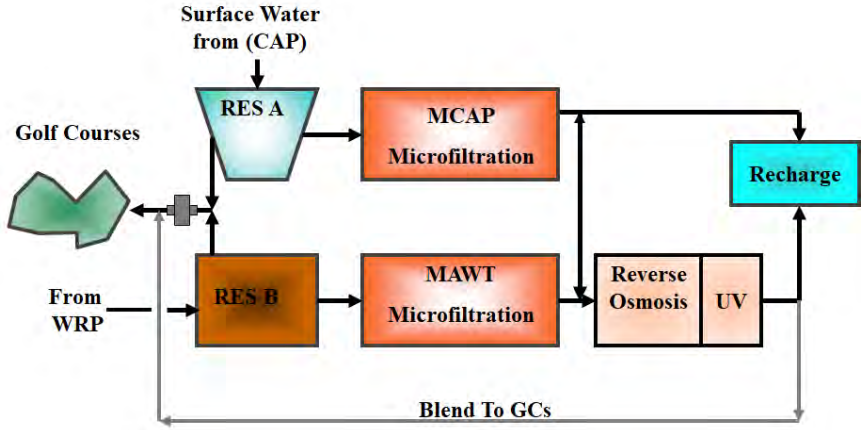
$$\mathrm{SAR} = \frac{Na^{+}}{\sqrt{\frac{1}{2}(Ca^{2+} + Mg^{2+})}}$$


Leaf burn


Surface sealing

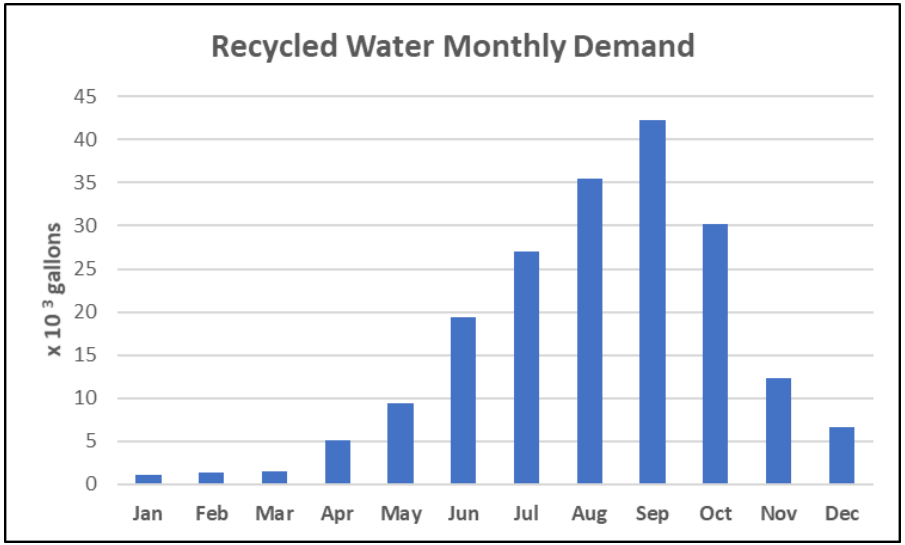
Case Study Managing Salinity - City of Scottsdale, AZ

- Scottsdale Water Campus – Reverse osmosis to provide desalinated water to golf courses.
- In winter (low demand) period, water is used for potable reuse (aquifer recharge)
- Facility also recharges Colorado River allotment.



Seasonal Demand Fluctuations

- Fluctuating demand presents water age challenge.
- Water age – disinfection residual.
- Operating costs at low production



OWASA (North Carolina). Water used for irrigation, toilet flushing, cooling water and chillers at UNC.

Industrial Use

- Cooling tower – low ammonia required.
- Boiler feed – low TDS, other specific ions (e.g. silica)
- Wash down water
- Dust suppression

Cooling towers

Palo Verde Power Station Arizona

100% cooled by recycled water

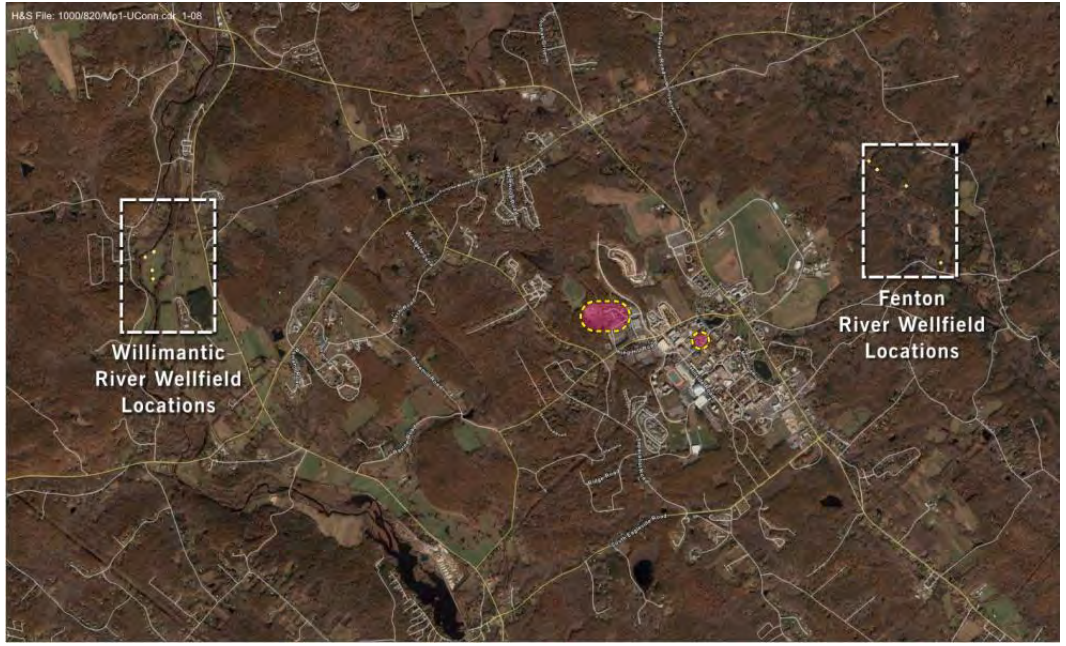
60 mgd received.

Boiler Feed Make up

Case Study – University of Connecticut

Project Background

- The Need for Reclaimed Water
  - Well fields UConn's primary water source
  - Increasing demand overtaxes wells
  - Drought!!



The Solution to UConn's Water Problem

- Construct a 1MGD capacity water reuse facility
  - Micorfiltration
  - UV Treatment
  - Chloramine Residual

Identify Sources of Water Use

- Residential Buildings
- Academic Buildings
- Commercial Buildings
- Irrigation
- Central Utilities Plant (CUP)
  - Provides heating, cooling and electricity to campus buildings
  - By far the largest consumer of water from the system

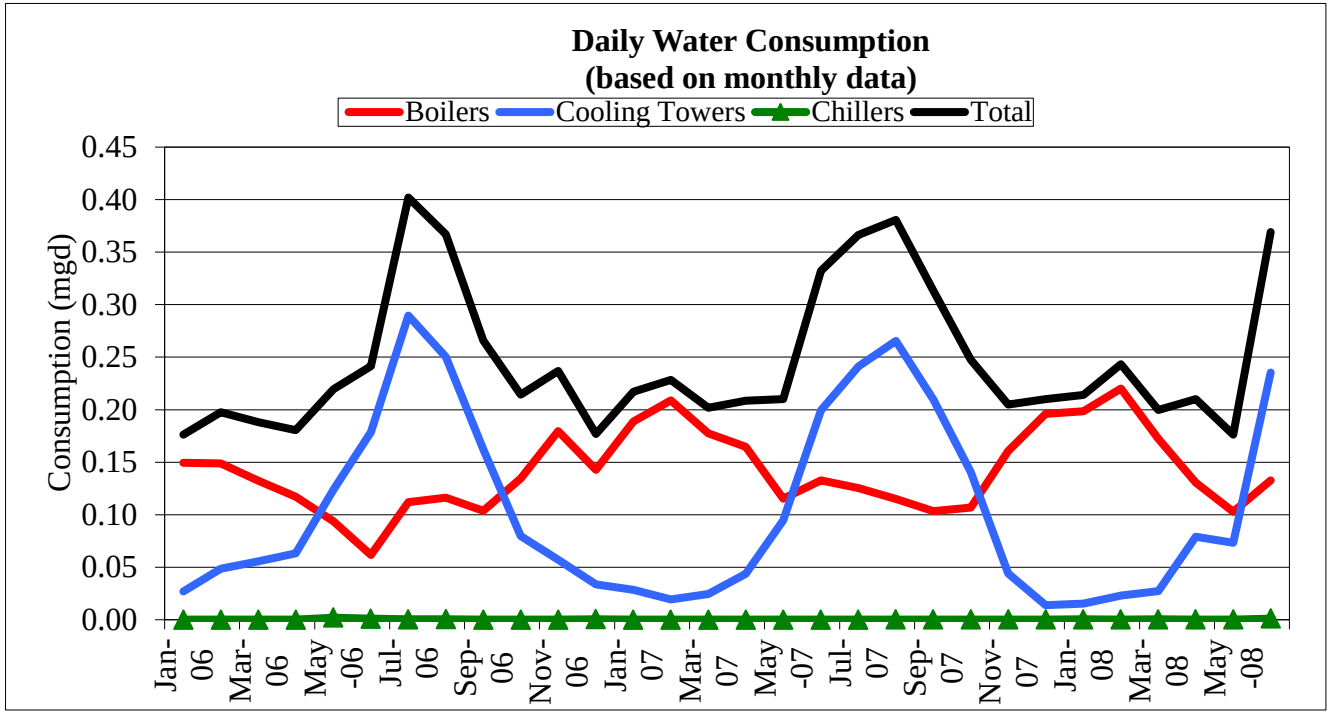
Why Use Reclaimed Water at the CUP?

- Uses upwards of 0.5 MGD on peak demand days (0.7 MGD Instantaneous demand)
- Most water used at the CUP can be non-potable

Demand (MGD)	Boilers	Cooling Towers
Annual Avg.	0.15	0.09
Current Day Max	0.35	0.45
Future 2016	0.35	0.60

Why Use Reclaimed Water at the CUP?

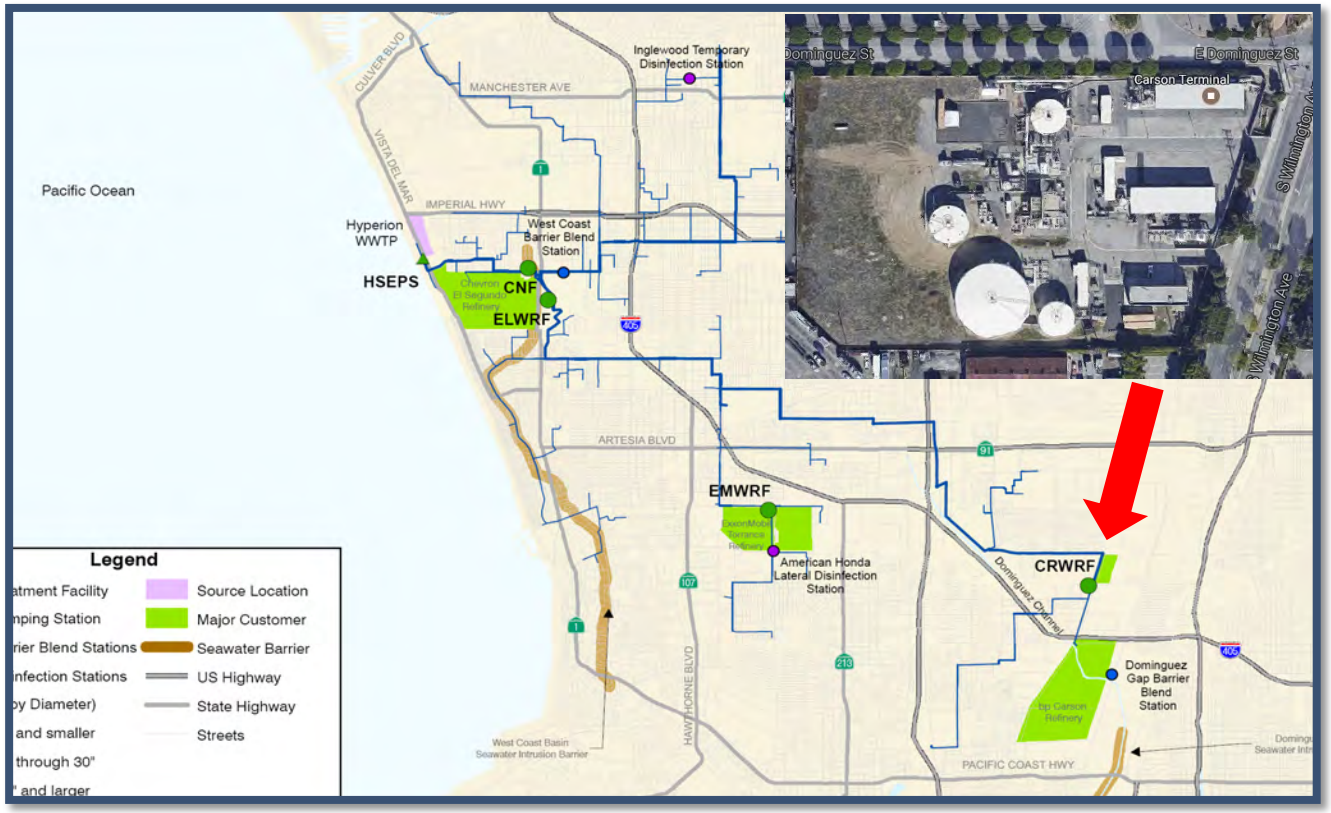
- Source of peak demand varies seasonally



UConn – Operations Challenges

- New Brine 25 ton Bulk Storage for softening system
  - Chemistry of reclaimed water required more brine for softener recharge
  - Bulk tank installed for salt delivery convenience/frequency
  - Softener regen cycles drove conductivity up!
  - Reclaimed Water Outlets Limited (permitting, other issues)
  - Plan mass balances for several operating scenarios

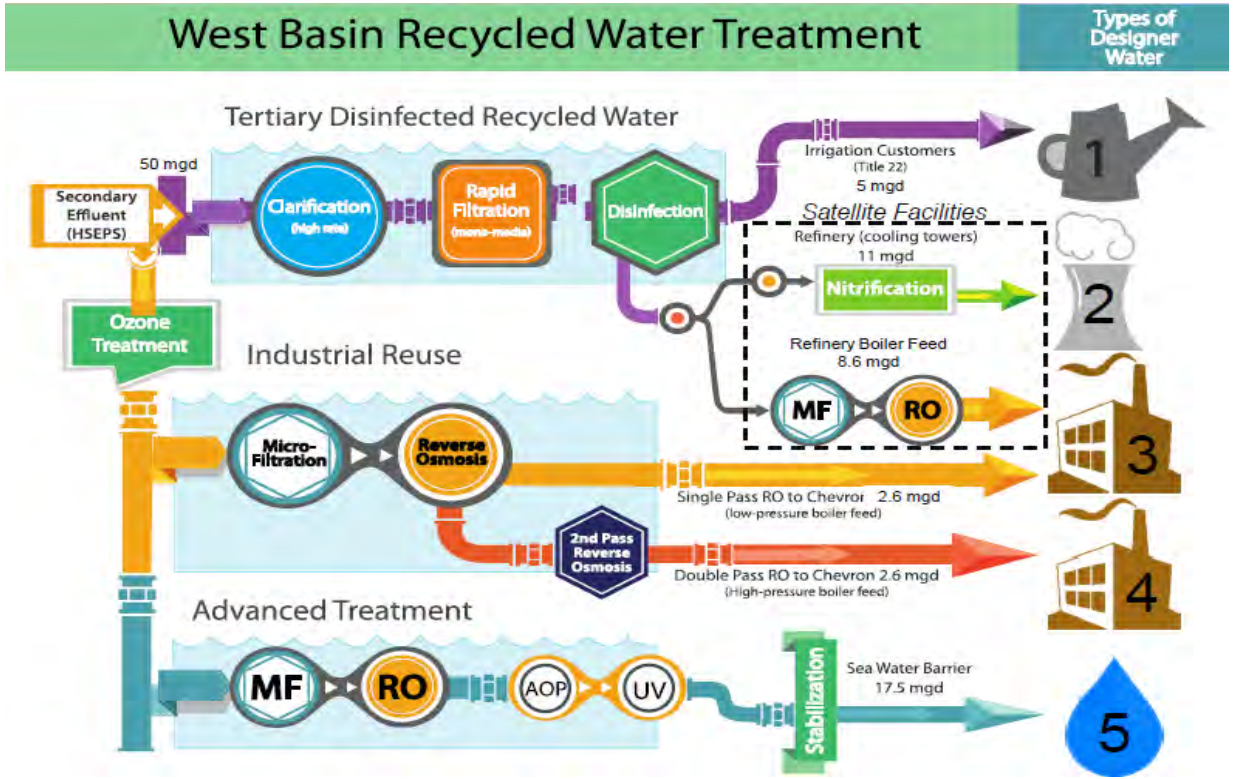
JMMCRWRF - Juanita Millender-McDonald Carson Regional Water Reclamation Plant



- One major facility near LAX.
- Several satellite facilities adjacent to industrial users.

Industrial Uses

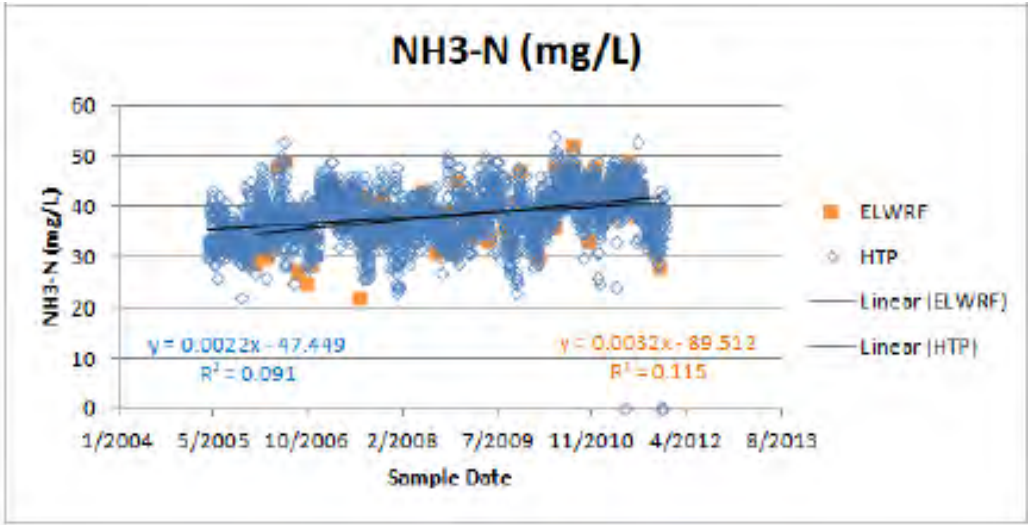
West Basin Water District California – 5 Qualities of Water



- Innovative District – Water and Recycled Water to 185 sq. mile service area (~1 M people)
- Designer Water: Irrigation, Cooling Tower, Seawater Barrier and Groundwater Replenishment, Low and High Pressure Boiler Feed

Industrial - Challenges

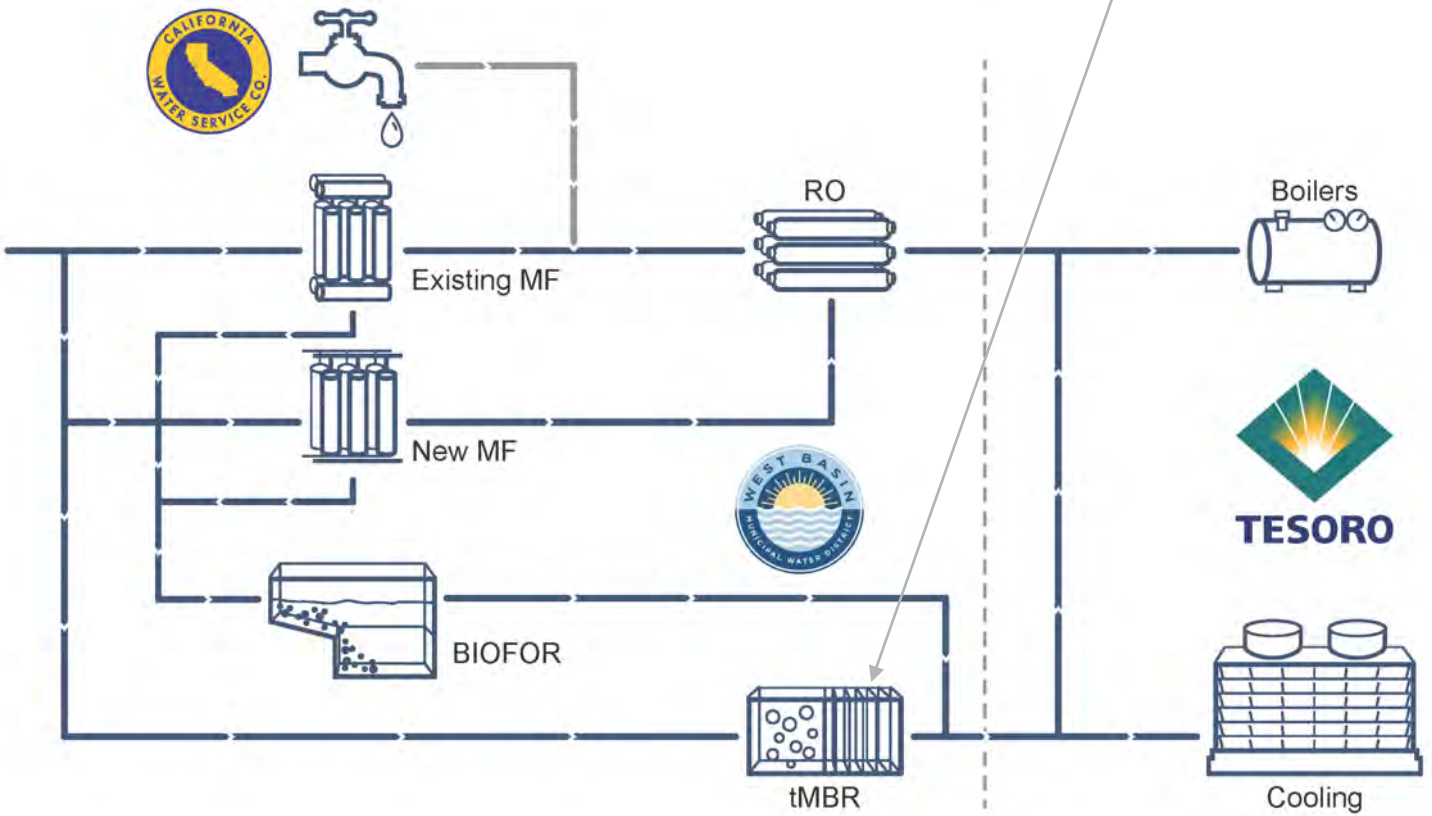
- Consistent water quality required.
- Some applications have very specific requirements:
  - **Cooling towers – minimizing scaling/corrosion. E.g low ammonia levels required.**
  - **Boiler feed – low TDS, low chloride.**
  - **Changes in feed source may not be under facilty control**



Increase in ammonia has put additional burden on treatment for cooling towers at West Basin Carson recycling facility.

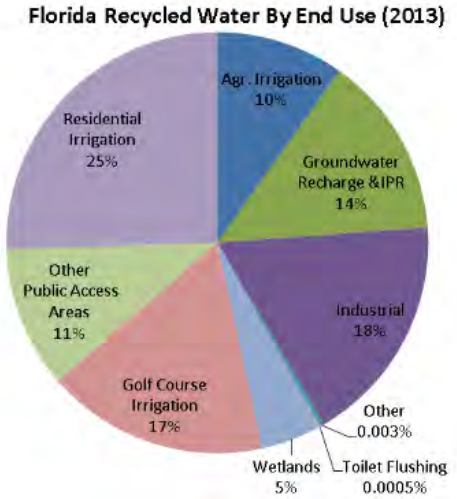
Challenges with high ammonia

- MBR technology to be used for consistent quality.



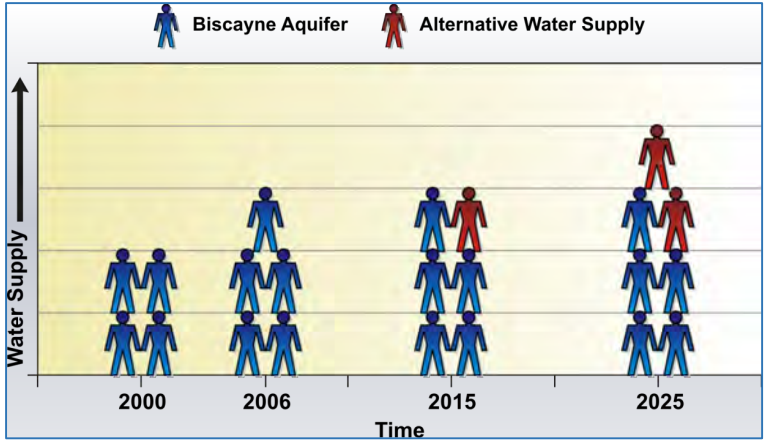
Case Study Florida Virtual Reuse

- SE Florida has led the country since 1980s with irrigation reuse
- 48% of water used for non potable reuse, significantly irrigating golf courses.
- 50 inches rain per year but falls in 4-month period.
- 75% of water supply derived from groundwater



Regulatory Drivers for Reuse

Alternative water supplies to Biscayne Aquifer required to take pressure off the Everglade feed source.



Regional Water Availability Rule

Protection of Everglades

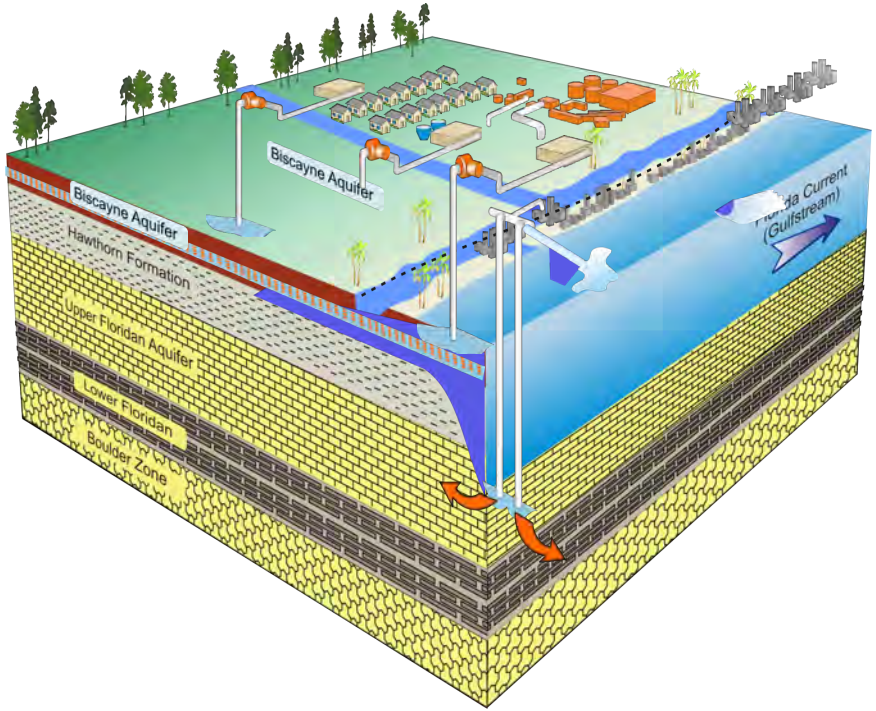
Environmental and Water Source Protection

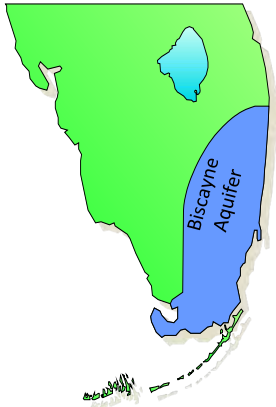
Ocean Outfall Rule – 60% Reuse Requirement

Protection of Coral Reefs

Environmental Protection

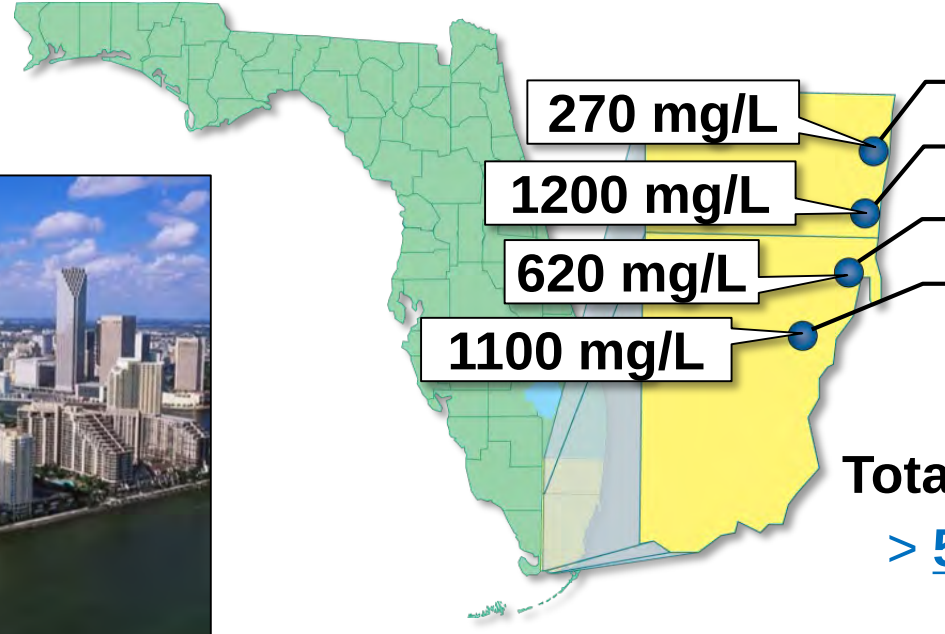
SE Florida – Unique Aquifer





Outfall Rule affected much of SE Florida

Chloride drives up costs



Reuse Required

- 22 mgd (Broward)
- 24 mgd (Hollywood)
- 48 mgd (Miami-Dade)
- 69 mgd (Miami-Dade)

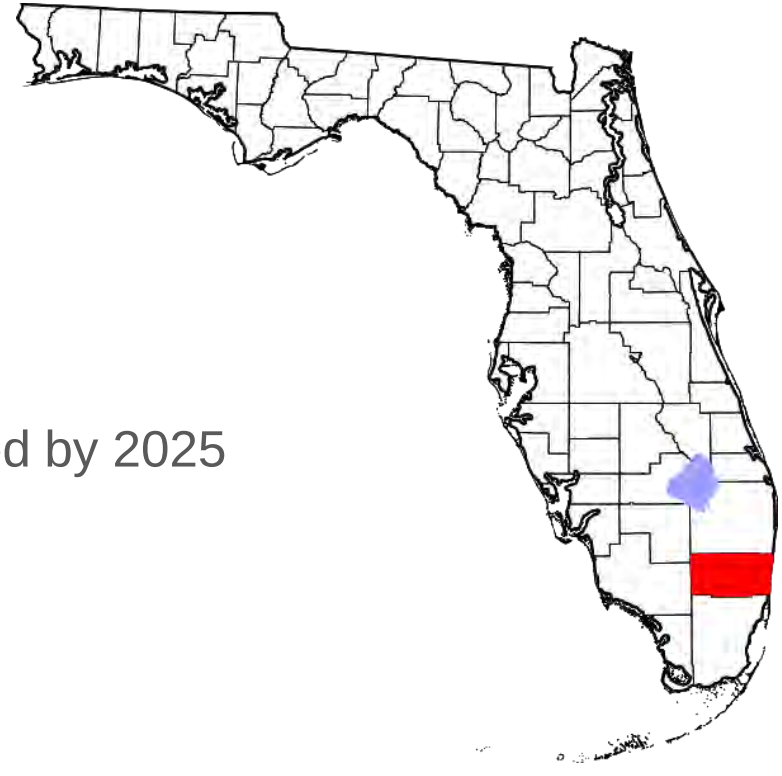
Total 163 mgd Reuse

> 54 mgd Demand Not Met
In year 2025

Urbanization drives up costs

Broward County, Florida

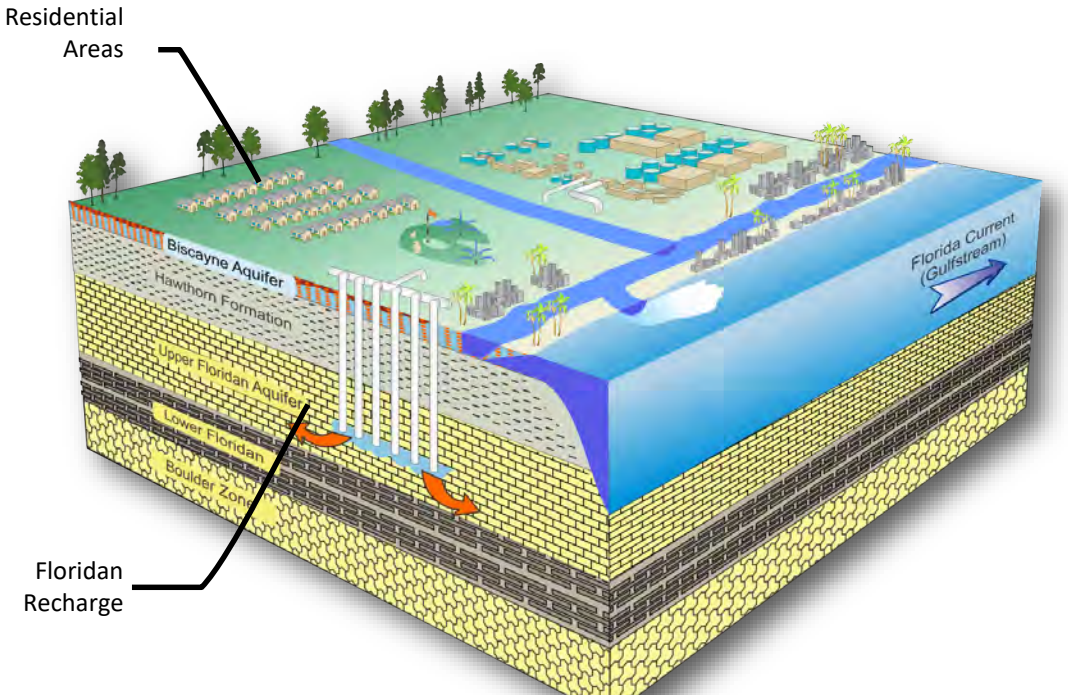
- 31 Municipalities
- 27 Water providers
- 15 Wastewater Providers
- 1.8 Million People
- 230 MGD Effluent
- Approximately 50 mgd of reuse is required by 2025



Reuse options available within jurisdictional boundaries

Options

- Biscayne Aquifer Recharge
- Floridan Aquifer Recharge



- Irrigation & process water uses:
  - **Large areas (parks, golf courses, etc.)**
  - **Residential**
  - **Industrial**
  - **Cooling towers**

SE Florida – Unique Aquifer

Not all jurisdictions had reuse demand.

Reuse option costs higher in some jurisdictions than others.

Legislation passed in 2013 allowing “virtual reuse”.

Created a Demand for Multijurisdictional Alternatives

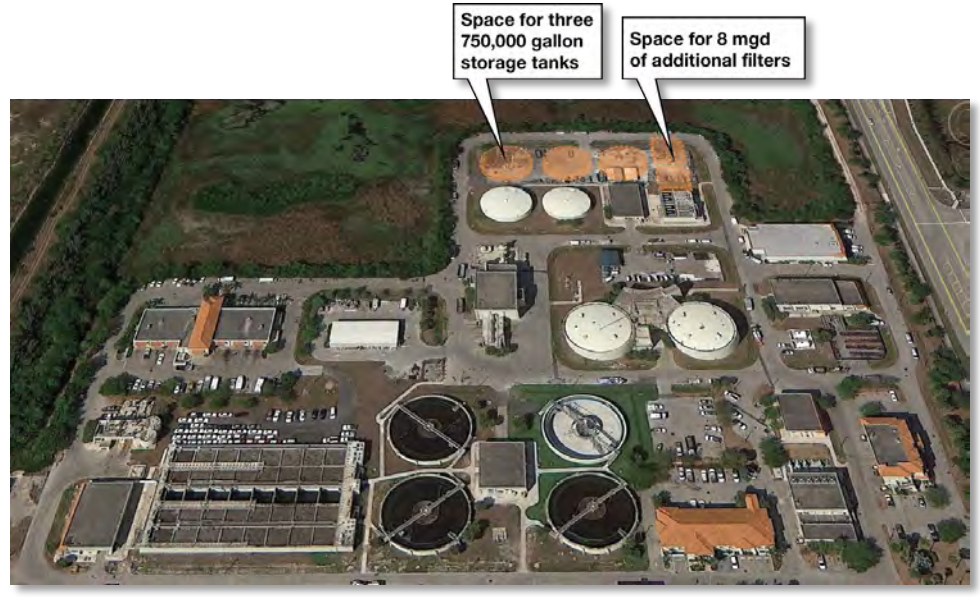
Cooper City and City of Miramar

Limited cost effective reuse options were a catalyst for “Virtual Reuse” partnership opportunities

Description	Present Worth ($M)
Alt 1: Slow Rate Land Application	~$9
Alt 2: Biscayne Aquifer Recharge	~$21
Alt 3: Floridan Aquifer Recharge (brackish)	~$12
Alt 4: “Virtual Reuse”	TBD

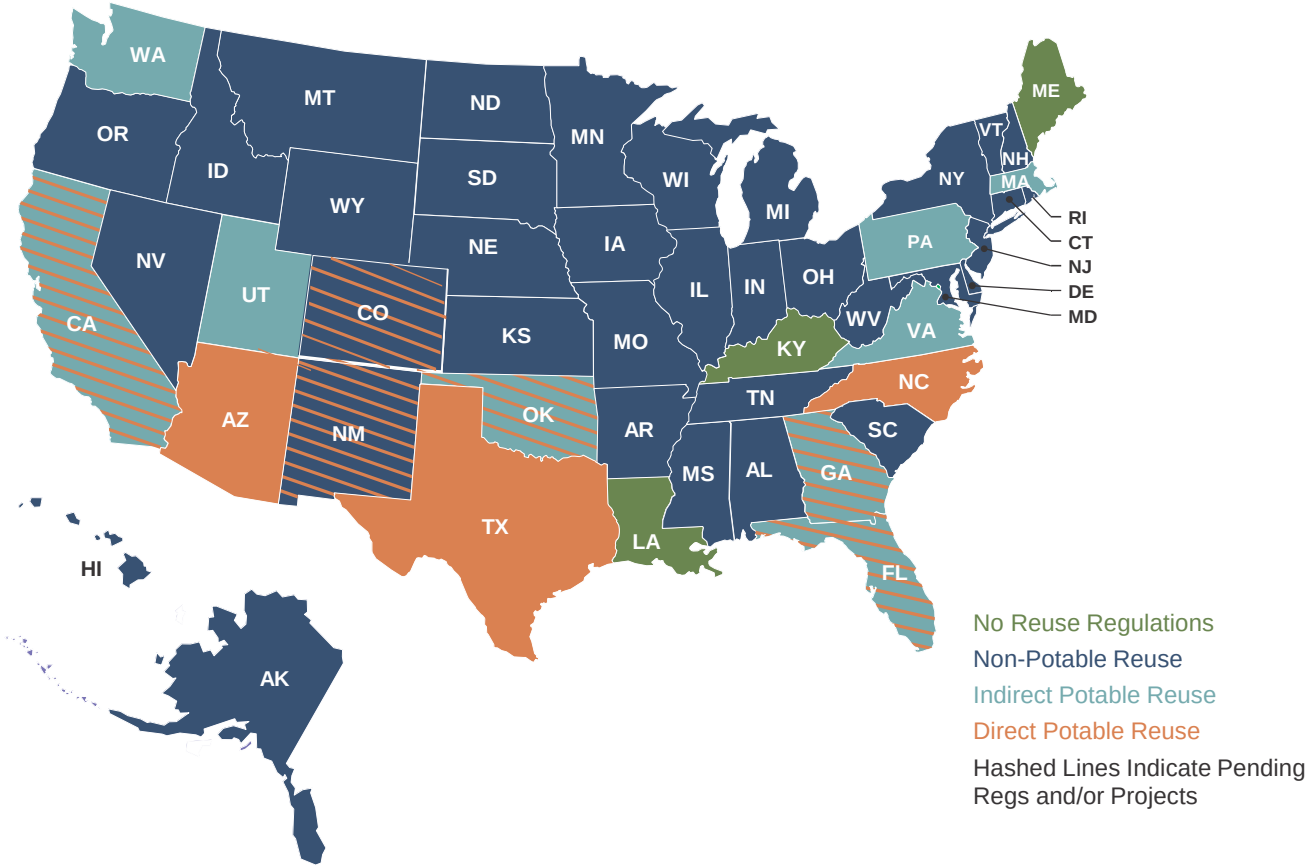
A partnership was formed between Cooper City and the City of Miramar

- Cooper City will pay $5M for 1 mgd of reuse credit from the City of Miramar
- The City of Miramar will expand their reuse capacity from 4 mgd to 6 mgd
- Filter and pipeline design was completed in 2018



Regulating Water Reuse: State Regulations & Guidelines

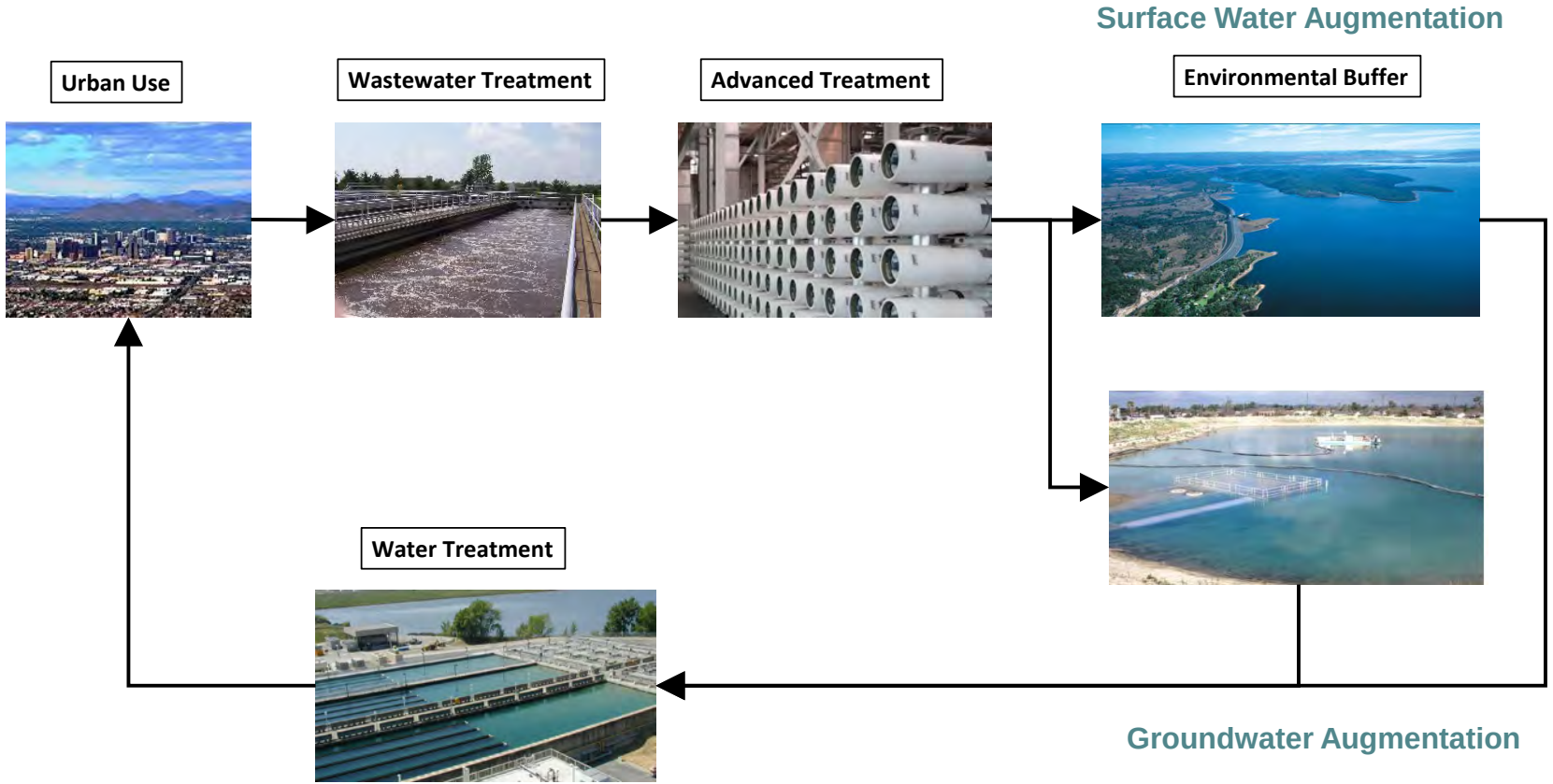
Many Moving Targets



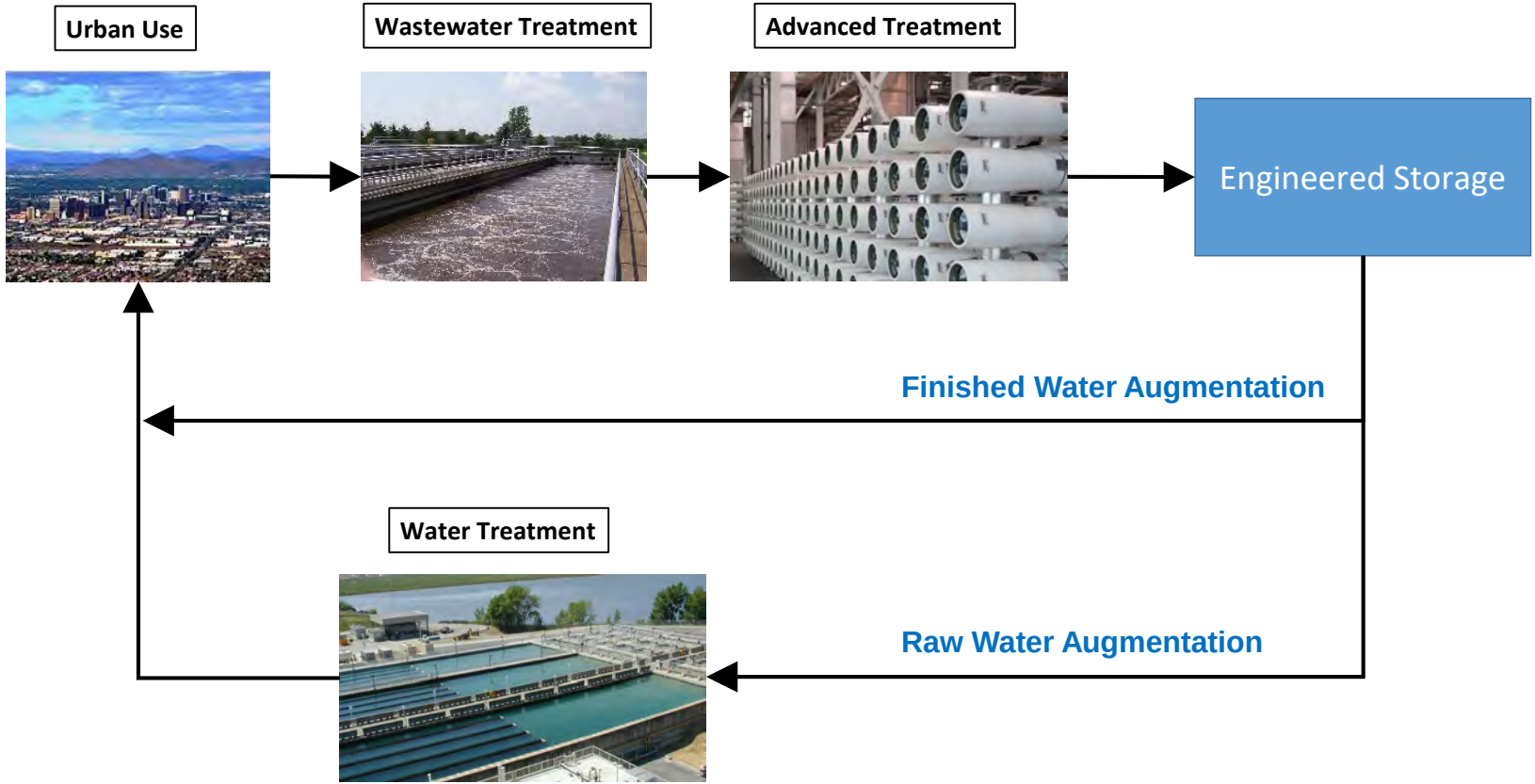
Non – Potable – Water Quality Requirements.

Class of Reclaimed Water	Wastewater Quality Parameter	Wastewater Quality Requirements		Wastewater Monitoring Requirements	
		30 day Average	Maximum	Sample Type	Measurement Frequency
Class 1A (Suitable for irrigation of food crops). Still no spray irrigation.	BOD_5	10 mg/L	15 mg/L	Minimum 6-hour composite	1 test per 2 weeks for minor WWTP
	Turbidity	3 NTU	5 NTU	Continuous	Continuous
	Fecal Coliform	5 per 100 mL	23 per 100 mL	Grab sample at peak flow	1 test per week for minor WWTP
	TRC or UV Transmissivity	Monitor Only	Monitor Only	Grab sample or reading at peak flow	Record values at peak hourly flow when fecal coliform samples are collected.
Class 1B (Suitable for irrigation and toilet flushing but not food crops)	BOD_5	30 mg/L	45 mg/L	Minimum 6-hour composite	1 test per 2 weeks for minor WWTP
	Turbidity	30 mg/L	45 mg/L	Continuous	1 test per 2 weeks for minor WWTP
	Fecal Coliform	100 organisms per 100 mL	200 organisms per 100 mL	Grab sample at peak flow	1 test per week for minor WWTP
	TRC or UV Transmissivity	Monitor Only	Monitor Only	Grab sample or reading at peak flow	Record values at peak hourly flow when fecal coliform samples are collected.

Potable Reuse: Indirect



Potable Reuse: Direct



Different Approaches to Protect Public Health

Non-Potable Reuse

- Targeted qualities set for end uses.
- Minimum requirements for treatment (e.g. biological, filtration, disinfection).
- Limited water quality targets

Potable Reuse

- Risk based approach (Quantitative Microbial risk assessment)
- Log removal targets (e.g California 12 virus, 10 cryptosporidium, 10 giardia)
- Multiple barrier treatment

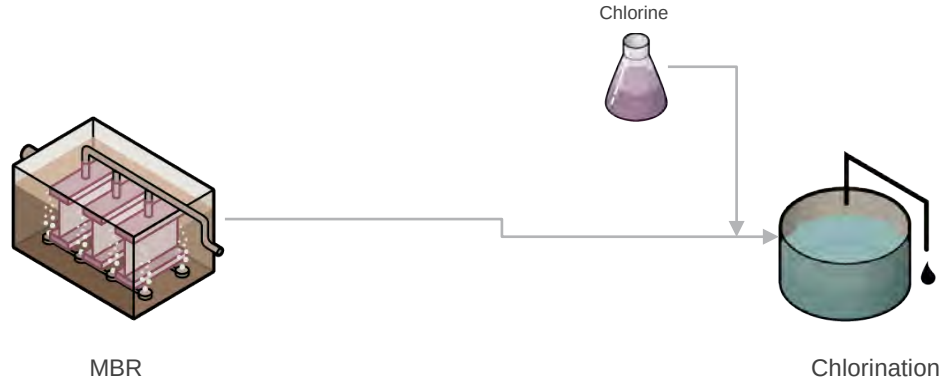
Blue Ribbon Panel on Decentralized Reuse

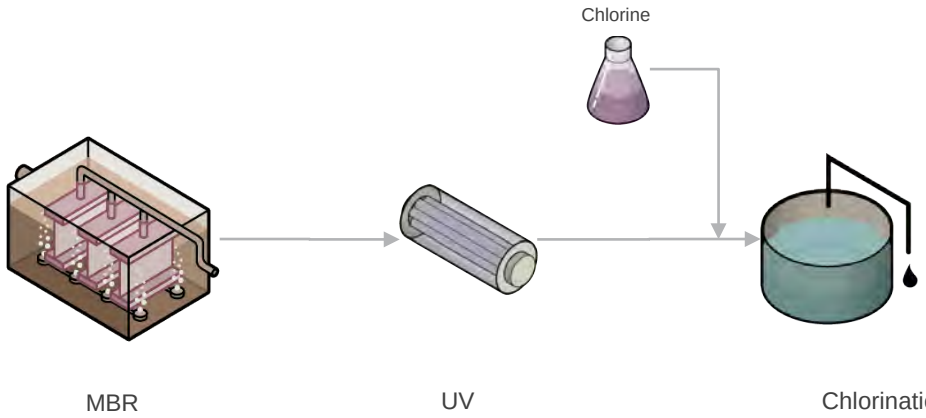
- "**A Guidebook for Developing and Implementing Regulations for Onsite Non-potable Water Systems**." Based on the Water Research Foundation report a "Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems" (Sharvelle et al 2017).
- Uses Quantitative Microbial Risk Assessment (QMRA).

Water Use Scenario	Log 10 reduction for 10^{-4} Per Person Per Year Benchmark.		
	Enteric Viruses	Parasitic Protozoa	Enteric Bacteria
Domestic Wastewater or Blackwater			
Unrestricted Irrigation	8.0	7.0	6.0
Indoor Use	8.5	7.0	6.0

Note: LRTs are not included in EPA or most state standards for reuse, including indoor uses

Impact – More Conservative Approach = Higher Cost





Meets class 1A New Mexico standard

Treatment Process	Log_{10} Reduction Credits		
	Enteric Viruses	Parasitic Protozoa	Enteric Bacteria
Membrane Bioreactor	1.5	2	4
Chlorine Disinfection	5	0	5
Total	6.5	2	9
Recommended by Sharvelle et al	8	7	6
UV Reactor	Up to 6	Up to 6	Up to 6

Requires UV process for log removal

What does this have to do with me?

- Water is not always available
  - **Storage Limitations**
- We don’t always need water that is treated to drinking water standards
- We can limit our nutrient discharges
- We can protect the environment

Questions? Call Troy!!!

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