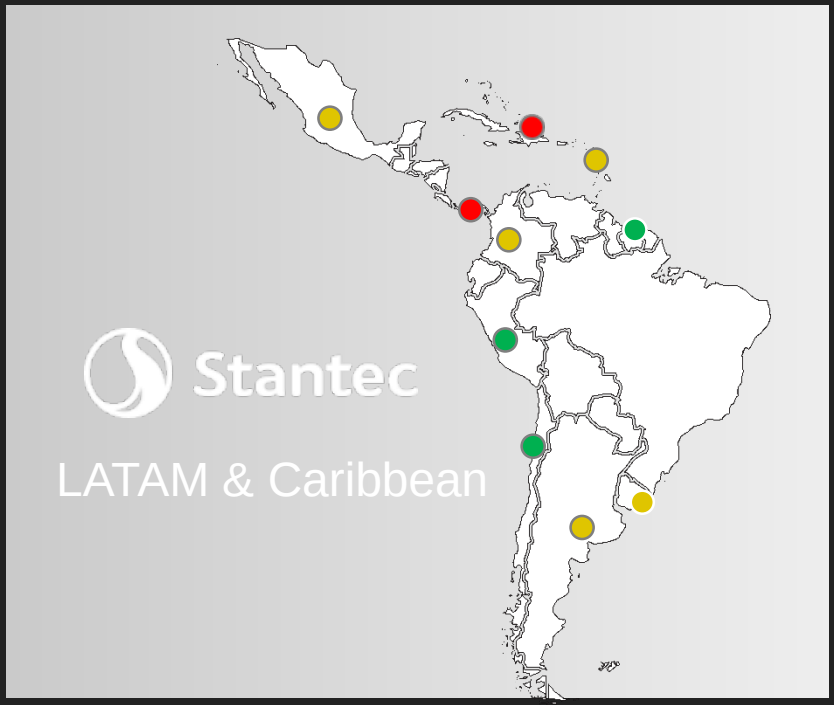
Stantec

ACODAL 2019

Cartagena May 30

Water Reuse:
Drivers and Success

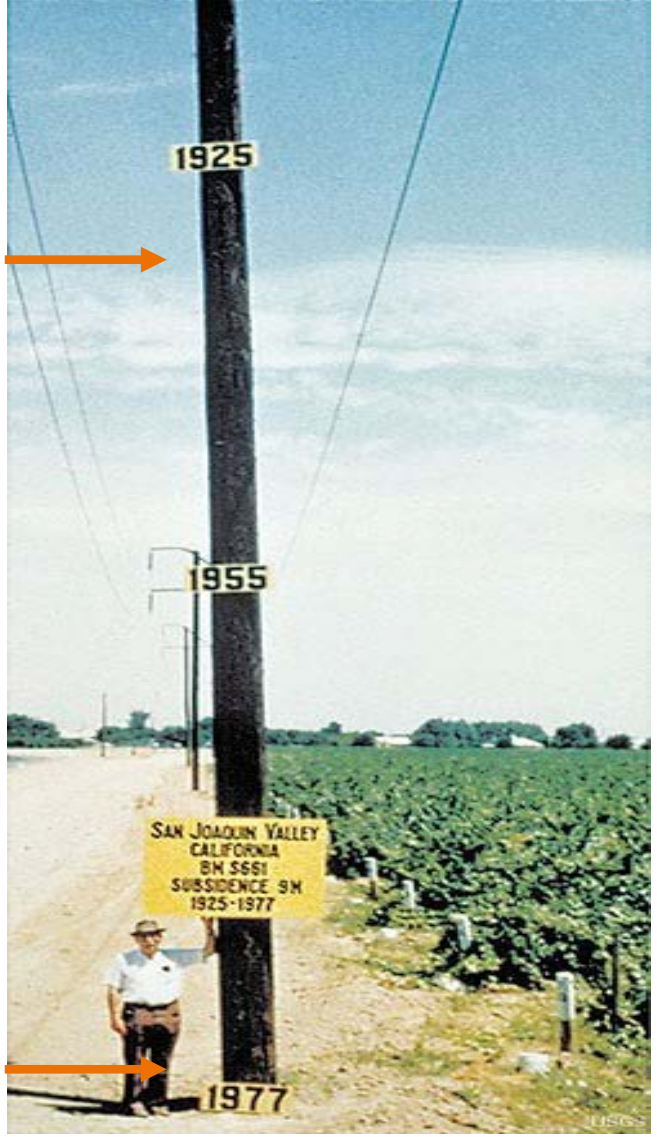


Alex Sandu, PhD, PE
RBL / Regional Sector Leader WATER – LATAM & Caribbean

Zakir Hirani, PhD, PE
Southern California Recycle Water Practice Lead

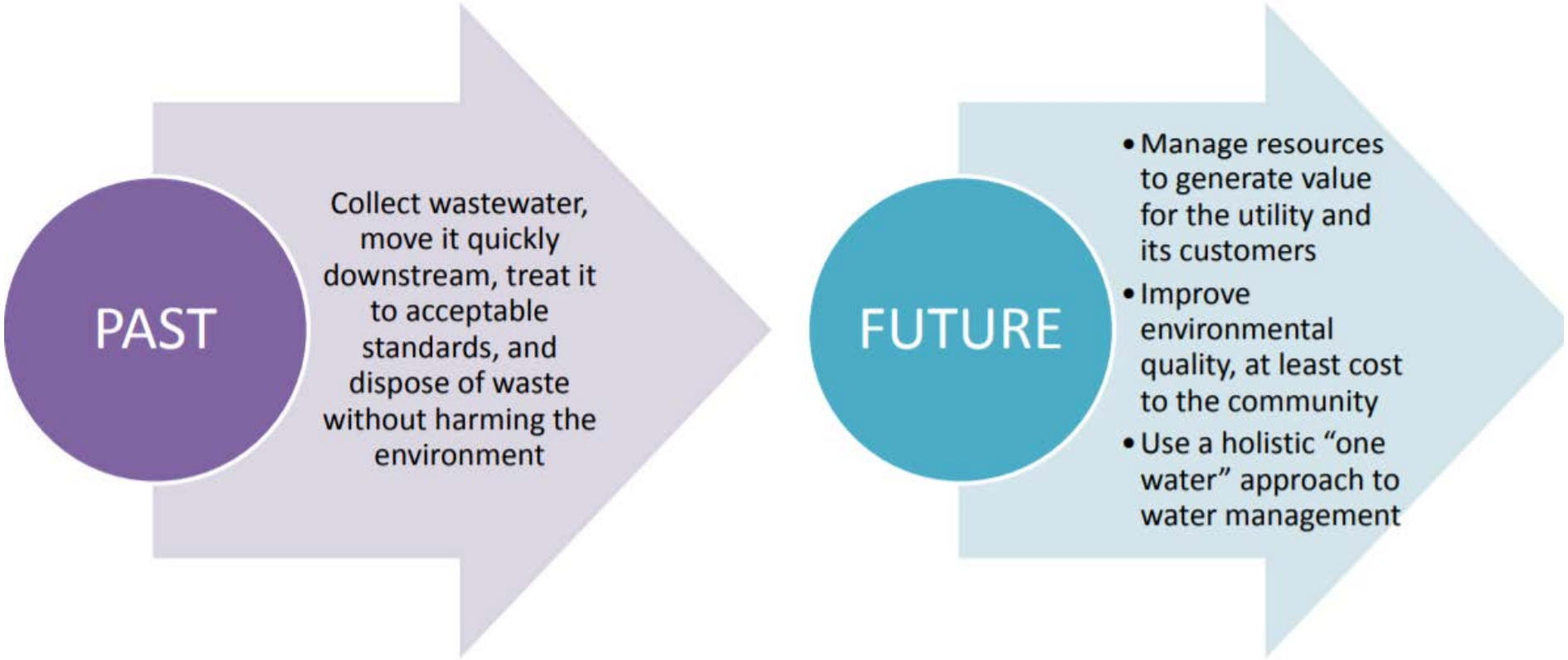
GW Overdraft Condition

Recycling Waste
In Orange County, Calif., the Groundwater Replenishment System treats 70 million gal of wastewater every day and injects it into the region's groundwater basin.

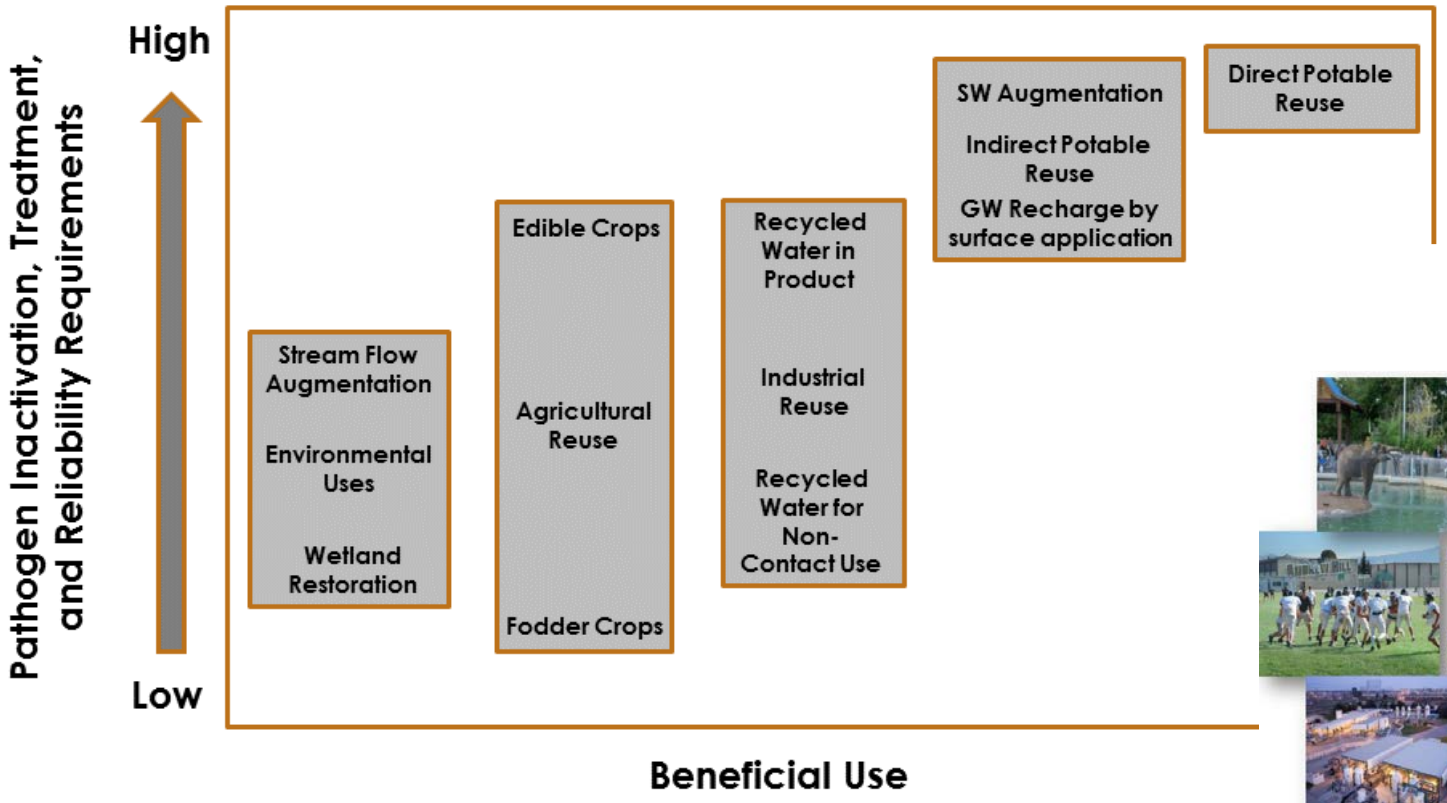


Groundwater Collapse
Over five decades, the ground level in California, dropped by almost 30 feet because of groundwater overdraft.

Major Paradigm Shift



The Water Reuse Spectrum – End Users



Challenges in Water Reuse

Organics

Contact

Brine stream for discharge

Expensive technology

Failure and Resilience

"We know that the technologies exist to create water that is equal to or better than many source water qualities," **BUT**

- Treatment requirements
  - *Need for criteria for pathogen and chemical control*
- On-line monitoring
  - *Performance monitoring*
- Treatment technologies
  - *Defining reliability*
- Source Control
  - *Managing the collection system*
- Operations and operators
- Response time (respond to off-spec water)
- Public acceptance

Southern California, USA

Drivers for Water Reuse

Liquids Treatment / Reuse

- Limited fresh water supply
- Increasing population and domestic water needs
- Upcoming stringent wastewater effluent nutrient regulations
- Depleting groundwater aquifers resulting in land subsidence
- Sustainability of water supply
- Industrial applications

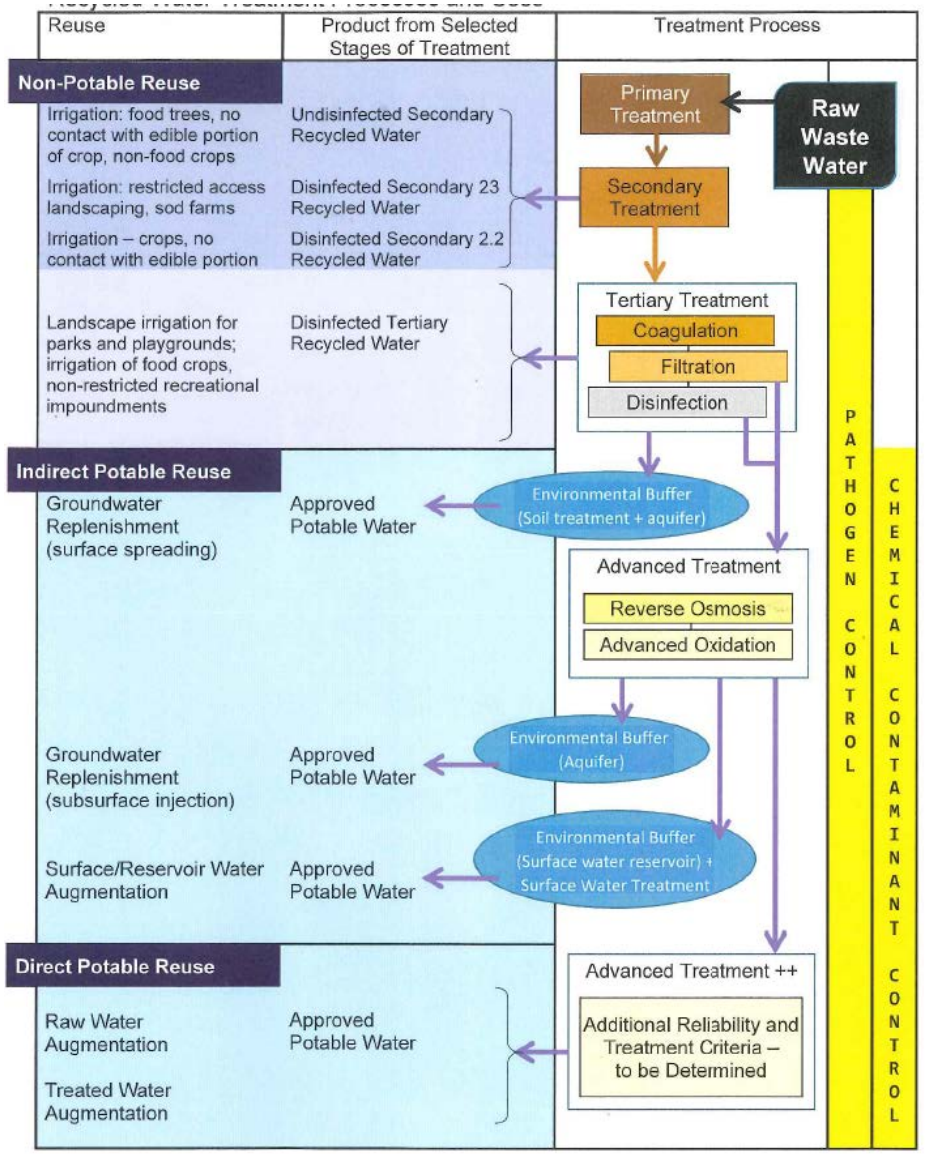
Treatment Levels for Various Reuse Applications

Types of Use	*Treatment Level*		
	Disinfected Tertiary	*Disinfected Secondary*	*Undisinfected Secondary*
Urban Uses and Landscape Irrigation			
Fire protection	☑		
Toilet & urinal flushing	☑		
Irrigation of parks, schoolyards, residential landscaping	☑		
Irrigation of cemeteries, highway landscaping		☑	
Irrigation of nurseries		☑	
Landscape impoundment	☑	☑*	
Agricultural Irrigation			
Pasture for milk animals		☑	
Fodder and fiber crops			☑
Orchards (no contact between fruit and recycled water)			☑
Vineyards (no contact between fruit and recycled water)			☑
Non-food bearing trees			☑
Food crops eaten after processing		☑	
Food crops eaten raw	☑		
Commercial/Industrial			
Cooling & air conditioning - w/cooling towers	☑	☑*	
Structural fire fighting	☑		
Commercial car washes	☑		
Commercial laundries	☑		
Artificial snow making	☑		
Soil compaction, concrete mixing		☑	
Environmental and Other Uses			
Recreational ponds with body contact (swimming)	☑		
Wildlife habitat/wetland		☑	
Aquaculture	☑	☑*	
Groundwater Recharge			
Seawater intrusion barrier	☑*		
Replenishment of potable aquifers	☑*		

**Restrictions may apply*

Source: California Department of Water Resources

Treatment Needs for Various Reuse Applications



Source: California State Water Resources Control Board

Stantec Projects with 2 Major Clients in SoCal

- **Metropolitan Water District (MWD) of Southern California**
- **19 Million Users**
  - 0.5 MGD (**80 m3/hr**) Advanced Water Treatment (AWT) Demonstration Facility
  - 150 MGD (**23,655 m3/hr**) AWT Facility at the Joint Water Pollution Control Plant: MBR + RO + AOP facility **($770M OPCC)**

- **City of Los Angeles**
  - 1.0 (**158 m3/hr**) MGD AWT Demonstration Facility
  - 70 MGD (**11,039 m3/hr**) MBR conversion at Hyperion WRP for AWT / IPR **($550M OPCC)**
  - Terminal Island WRP - Solids Management Study
  - Hyperion WRP - Full Reuse Feasibility Study
  - Hyperion WRP - Solids Management Study

Metropolitan Water District (MWD) of Southern California

MWD's Advanced Water Treatment (AWT) Facility

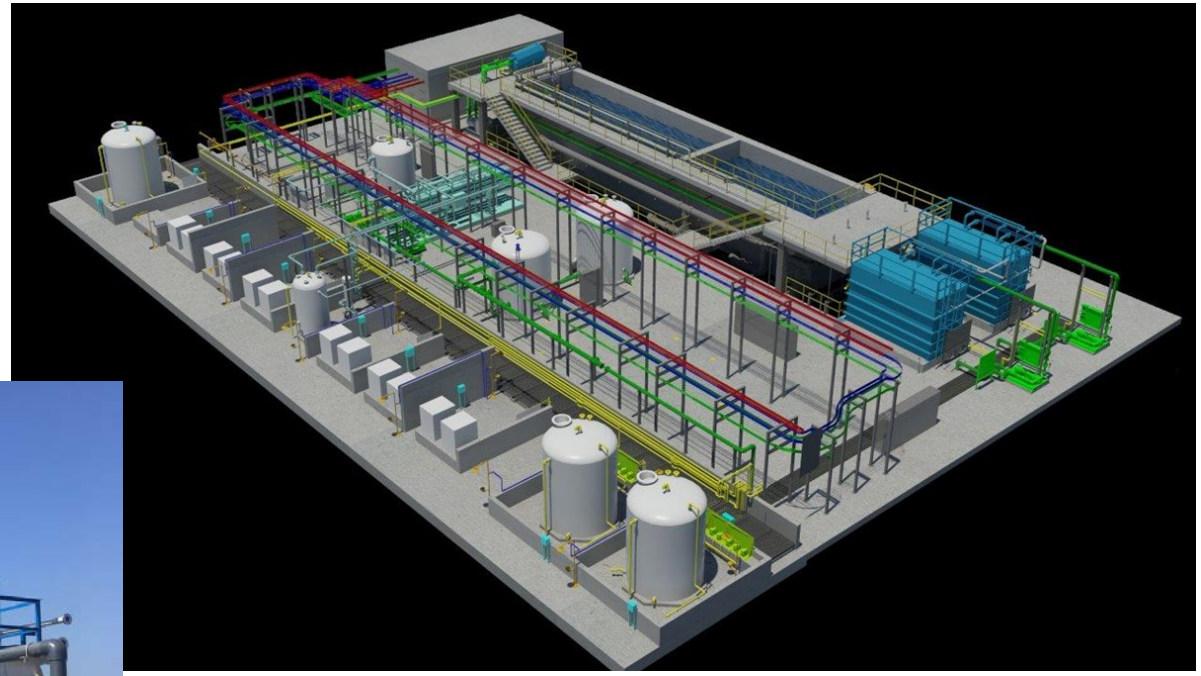
- Will be the largest AWT Facility in the world when fully implemented
- Will produce 150 MGD (23,655 m3/hr) of recycled water to recharge four groundwater basins in Los Angeles and Orange County
- Will be first in the U.S. to implement MBR – RO – AOP process train for IPR
- Capital cost estimated at $2.7B including treatment and conveyance

Location of AWT Facility at JWPCP

MWD's AWT Demonstration Facility

Stantec designed the demonstration facility; construction to be complete by the end of this year

- Construction Cost - $13.8M
- Design Fees - $2.5M



City of Los Angeles

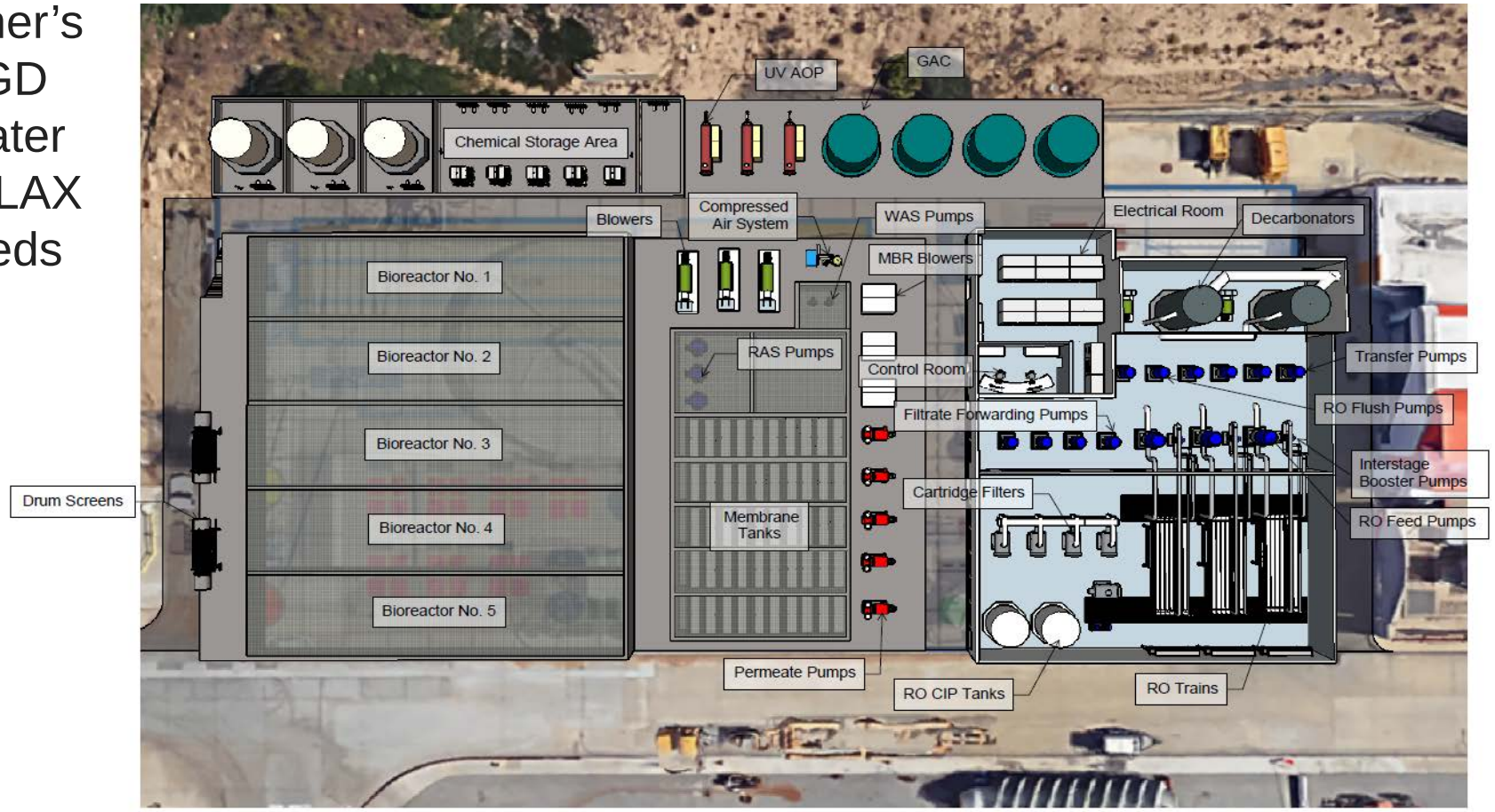
Hyperion WRP - AWT Facility

- 70 MGD of Hyperion's 450 MGD capacity will be converted from HPOAS to MBR during the first phase
- High quality effluent to be further treated with RO and AOP for IPR
- MBR at Hyperion will allow eliminating Ozone + MF at West Basin MWD
- City plans for full reuse of Hyperion effluent so eventually the entire facility will be converted to MBR

Location of AWT Facilities at Hyperion WRP

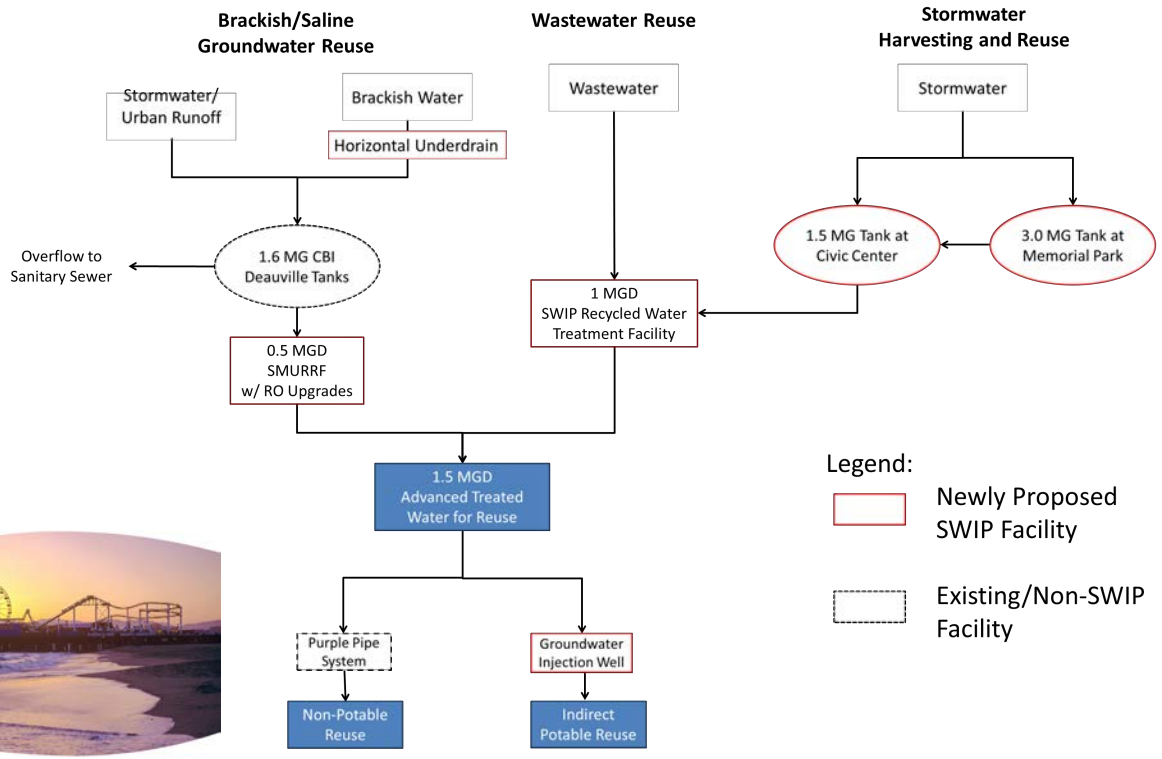
Hyperion WRP - AWT Production Facility

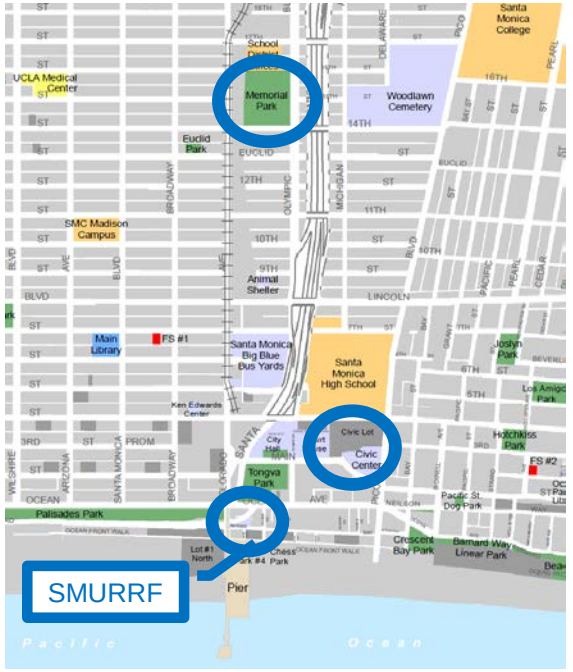
Stantec serving as owner's engineer on the 1.5 MGD Hyperion Advanced Water Purification Facility for LAX High Quality Water Needs



Multiple Sources

Stantec Santa Monica
Sustainable Water Infrastructure Project (SWIP)



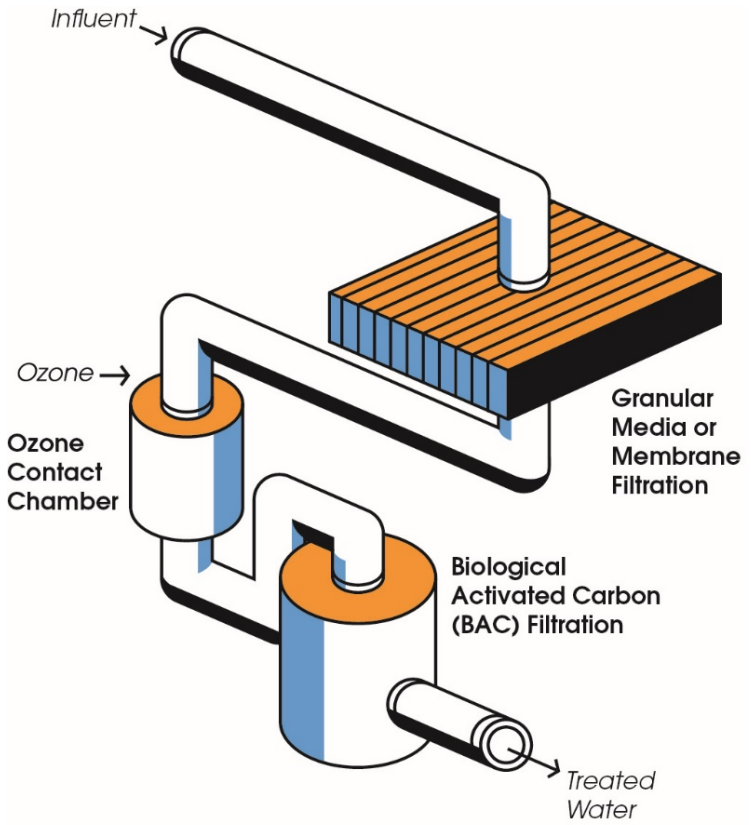


Challenges:

- Combination of technology
- Health regulations

Indirect Potable: Ozone-BAC: Alternative to RO AWTF

- Most refractory organics destroyed, not concentrated in brine stream
- No brine stream generated needing treatment and/or disposal
- Lower capital cost
- Lower energy utilization and O&M cost

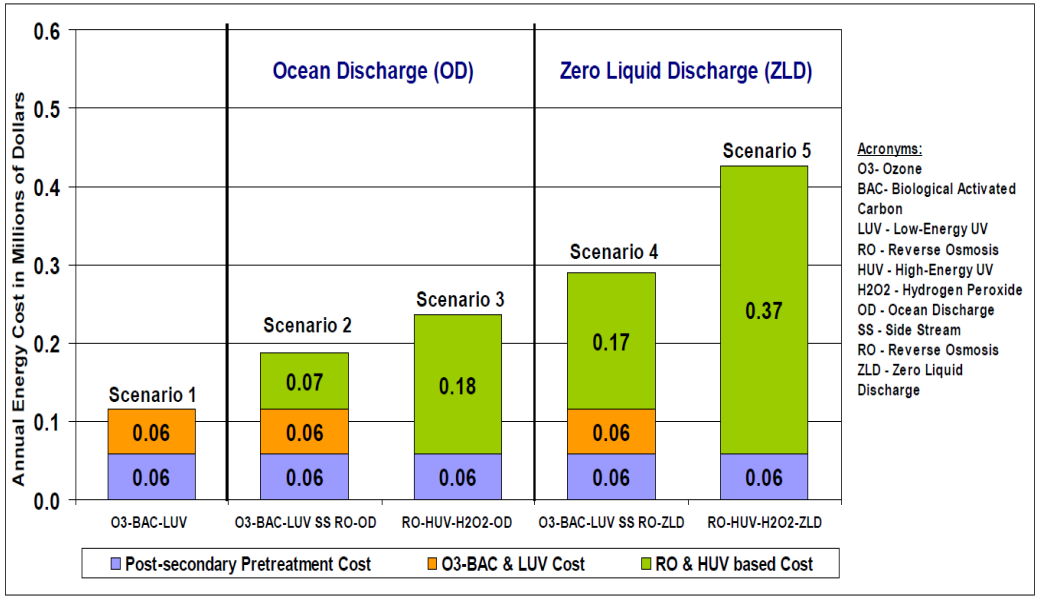


Why Ozone-BAC Treatment Trains for Inland Locations?

Technology	Preliminary Relative Capital Cost
O3-BAC-LUV	$ 1.0x
O3-BAC side-stream RO-OD	$ 1.4x
RO-H2O2-HUV-OD	$ 1.7x
O3-BAC-LUV side-stream RO-ZLD	$ 2.5x
RO-H2O2-HUV-ZLD	$ 3.3x

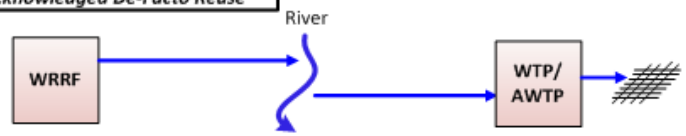
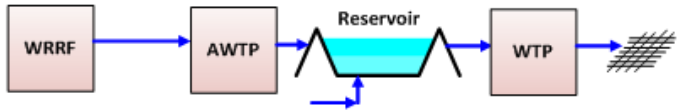
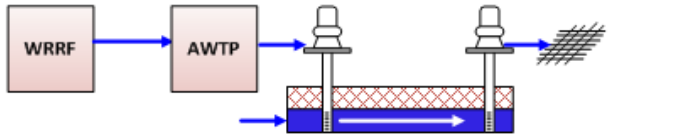
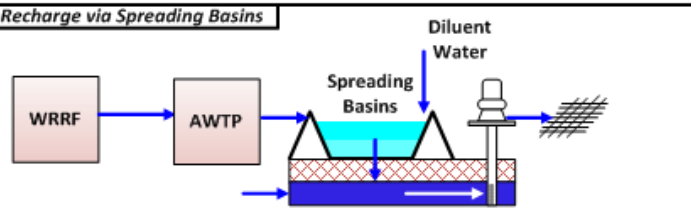
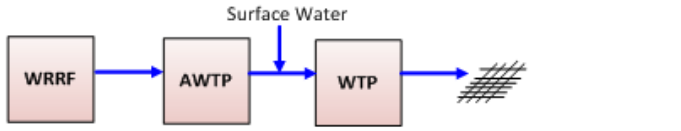
Acronyms:
O3: Ozone
BAC: Biological activated carbon
LUV: Low-energy UV
RO: Reverse Osmosis
H2O2: Hydrogen Peroxide
HUV: High-energy UV
OD: Ocean discharge
ZLD: Zero liquid discharge

Figure 2: Annual Energy Cost Per MGD (Unit Power Cost = $0.14/kWh)

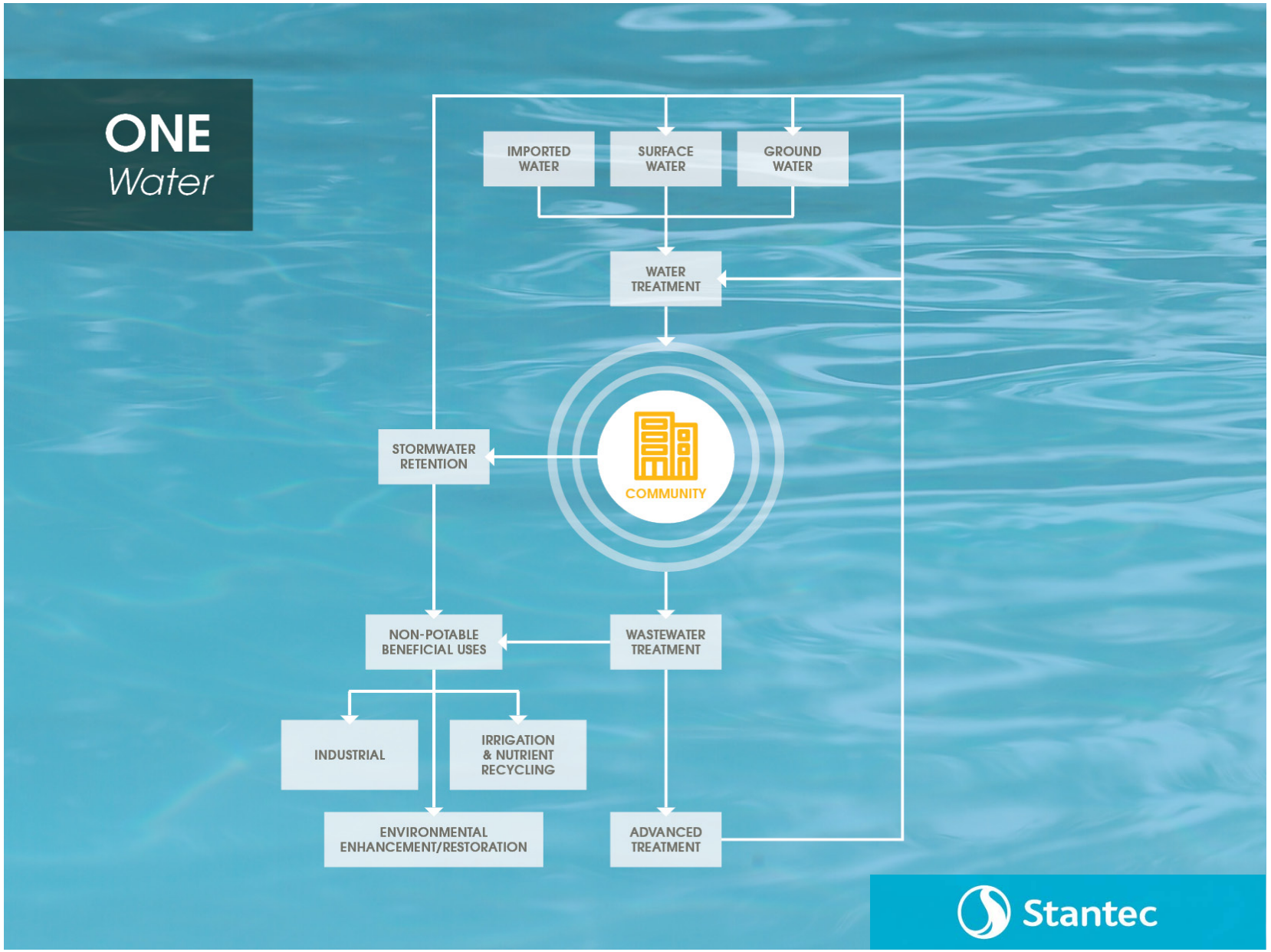


Sundaram, V., Emerick, R.W., Enloe, J.P., Curtis, J.R., Shumaker, S.E., (2010). Saving Energy and Costs on Microconstituent Removal and Inland Desalination. *Proceedings of the WaterReuse Annual Symposium*.

Potable Reuse Approaches

Potable Reuse Approaches	Examples
Acknowledged De-Facto Reuse 	Binney Water Purification Facility (Aurora, CO)
Surface Water Augmentation 	Upper Occoquan Service Authority (Northern Virginia); Gwinnett County (Georgia); Singapore NEWater; San Diego (In Progress - San Vincente Reservoir)
GW Recharge via Direct Injection 	GWRS (Orange County, CA); West Basin (CA); Los Alamitos (Long Beach, CA); Scottsdale Water Campus (AZ); El Paso (TX); HRSD (VA)
GW Recharge via Spreading Basins 	Montebello Forebay (Los Angeles, CA); GWRS (Orange County, CA); Chino Basin (Chico, CA)
Direct Potable Reuse 	Big Spring, TX; Windhoek, Namibia

Source: The Water Reuse Roadmap Ch. 7


ONE
Water
IMPORTED WATER
SURFACE WATER
GROUND WATER
WATER TREATMENT
STORMWATER RETENTION
COMMUNITY
NON-POTABLE BENEFICIAL USES
WASTEWATER TREATMENT
INDUSTRIAL
IRRIGATION & NUTRIENT RECYCLING
ENVIRONMENTAL ENHANCEMENT/RESTORATION
ADVANCED TREATMENT
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