Jacobs Challenging today. Reinventing tomorrow.

Potable Reuse: Nature reuses water endlessly, why don't we?

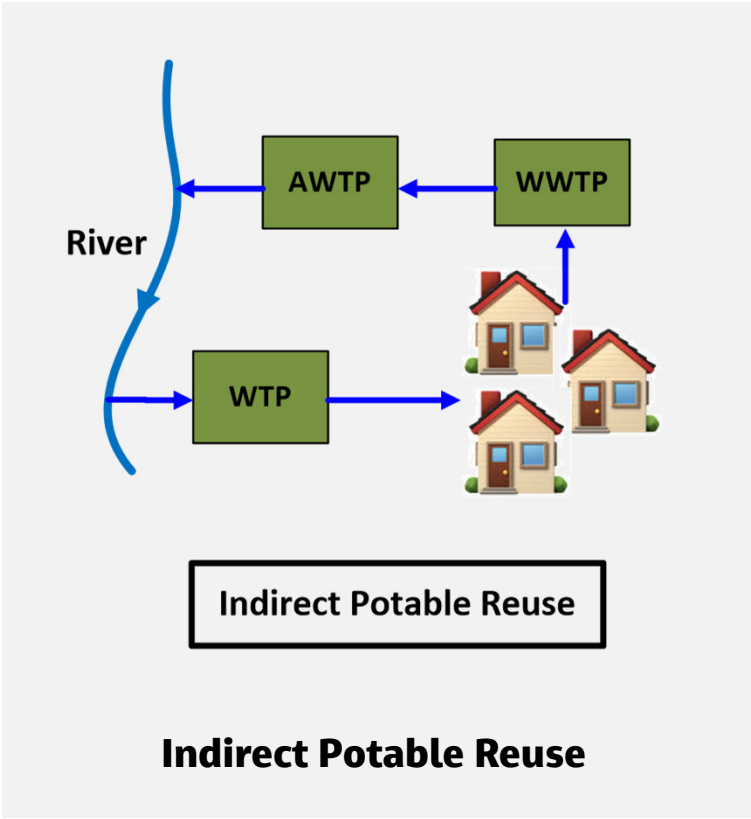
In the kNOW Webinar Series

Dec. 10, 2020

Agenda

- **Larry Schimmoller**, Jacobs Global Technology Director for Water Reuse
- **Germano Salazar-Benites,** Hampton Roads Sanitation District SWIFT Project Manager
- **Tyler Nading**, Jacobs Senior Technologist
- **Jim Lozier**, Jacobs Global Technology Director for Desalination
- **David Pedersen**, General Manager of Las Virgenes Municipal Water District and Administering Agent for the Las Virgenes-Triunfo Joint Powers Authority
- **Q & A**

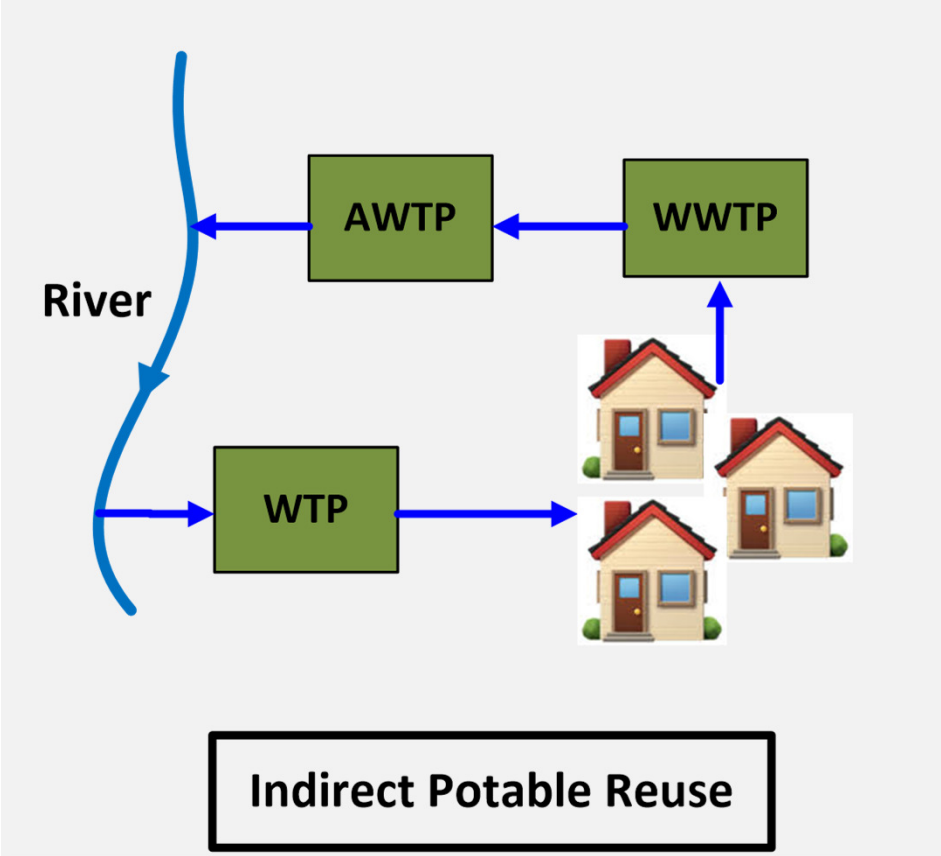
Potable Reuse Definitions (IPR vs DPR)

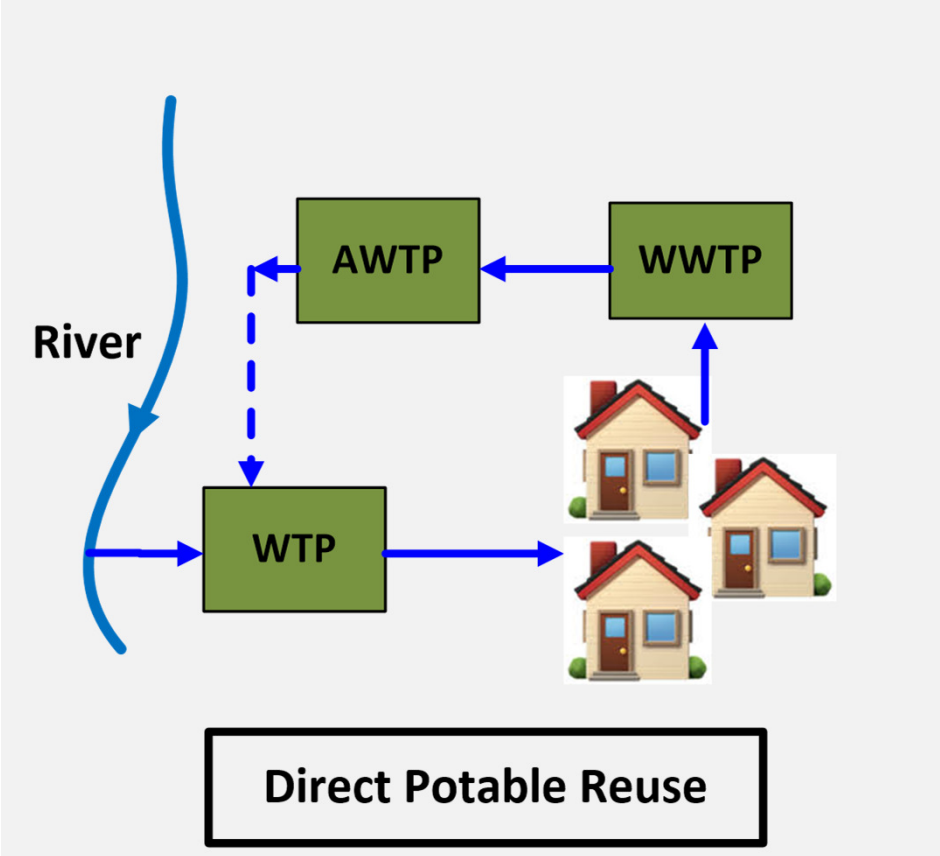


Indirect Potable Reuse

Indirect Potable Reuse Approaches	Examples
De Facto WWTP → River → WTP	Common throughout the world (e.g., Mississippi River, Colorado River, etc...)
Surface Water Augmentation WWTP → AWTP → Reservoir → WTP	Upper Occoquan Service Authority (Northern Virginia); Gwinnett County (Georgia); Singapore NEWater
GW Recharge via Spreading Basins WWTP → AWTP → Spreading Basins	Montebello Forebay (Los Angeles, CA); El Paso (Texas); Chino Basin (Chico, CA)
GW Recharge via Direct Injection WWTP → AWTP	GWRS (Orange County, CA); West Basin (CA); Los Alamitos (Long Beach, CA); Scottsdale Water Campus (AZ)

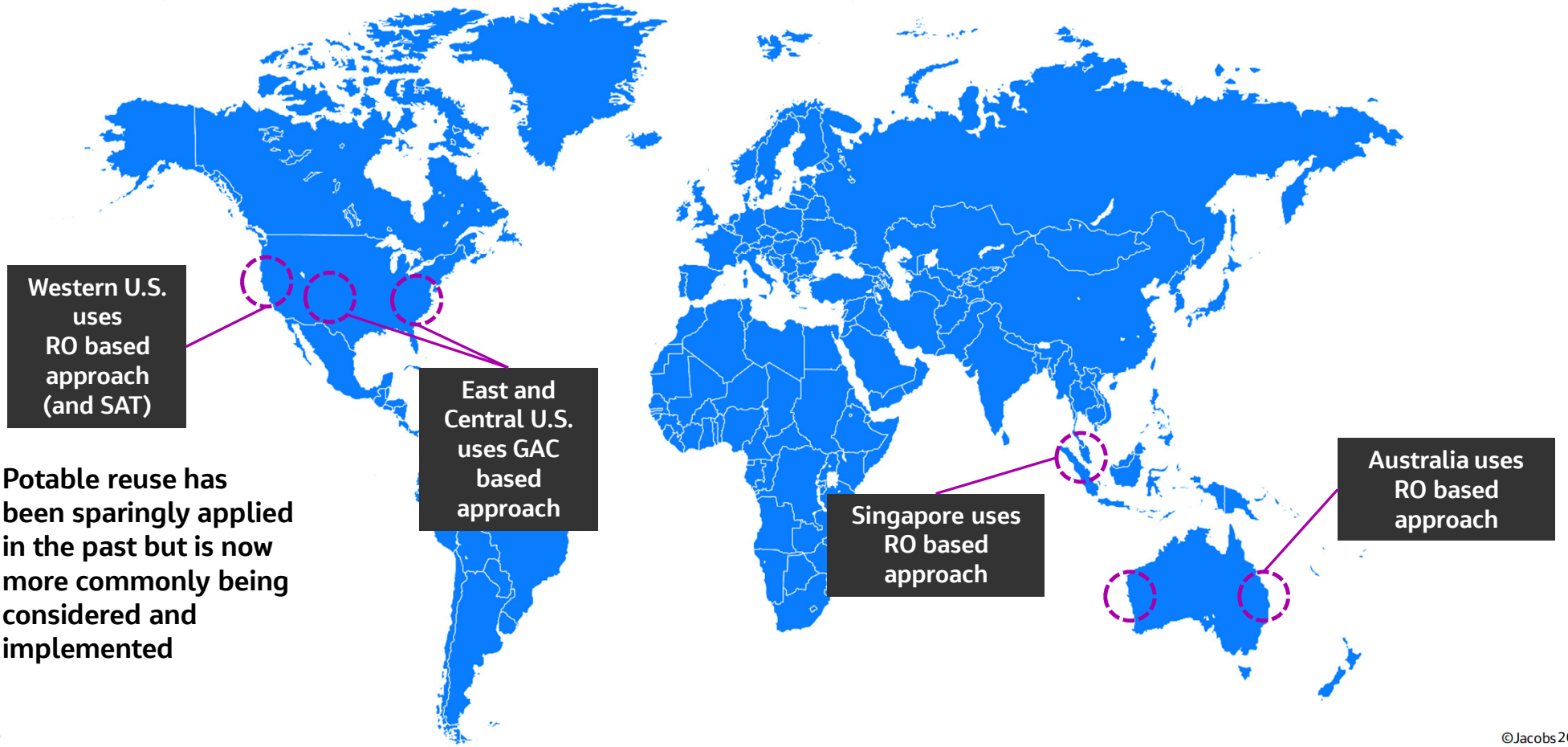
Potable Reuse Definitions (IPR vs DPR)





Operational Potable Reuse Plants

RO-Based (West U.S. and International vs. GAC-Based (East and Central U.S.)



Potable reuse has been sparingly applied in the past but is now more commonly being considered and implemented

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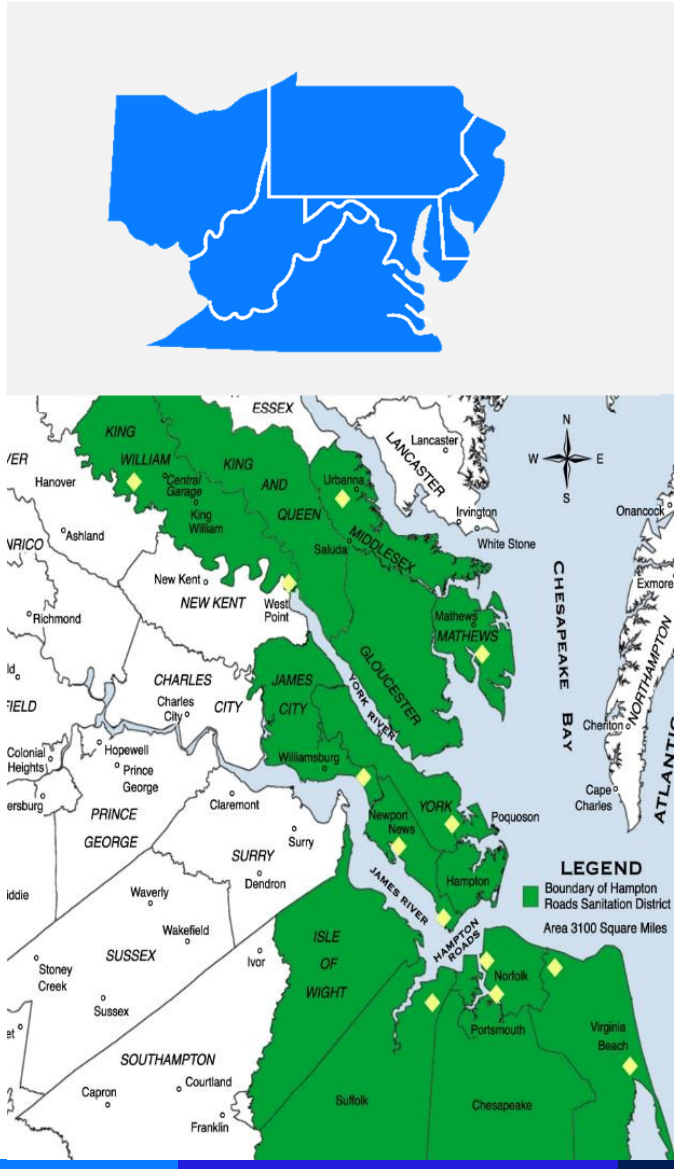
Sustainable Water Initiative for Tomorrow

Germano Salazar-Benites, Hampton Roads Sanitation District SWIFT Project Manager

Tyler Nading, Jacobs Senior Technologist

Hampton Roads Sanitation District (HRSD)

- Provide wastewater treatment for 18 localities in SE Virginia
- Serve 1.7 million people (20% of all Virginians)
- 250 MGD of treatment capacity at 13 treatment plants
- Sustainable Water Initiative For Tomorrow (SWIFT) will add over 100 MGD of advanced treatment for 7 of the treatment plants



SWIFT Program Drivers

WWTP Nutrient Discharge Requirements

- Frequent, intermittent regulatory changes have driven historical capital improvement projects
- Chesapeake Bay is nutrient sensitive
- Opportunity to create a nutrient credit trading system

Rapidly Depleting Groundwater Levels

- Potomac Coastal Plan Aquifer System has seen a 200 ft drop in water levels in some places, leading to:
  - Reduced groundwater withdrawals
  - Saltwater intrusion
  - Land subsidence

Water reuse project that is <u>not</u> driven by water scarcity!

SWIFT Program Timeline

SWIFT Program Timeline

- 2013-2014
  Concept Evaluation
- 2015-2017
  Pilot Operation & Test Well Construction
- 2016-2018
  1 MGD SWIFT Research Center
- 2019-2030
  Full-Scale Implementation
  - **5 full-scale Advanced Water Treatment Plants**
  - **100 MGD total capacity**

1 MGD SWIFT Research Center

York River Test Well

York River Pilot Plant

Pilot Testing

- Membrane-Based Pilot (UF-RO-UVAOP)
  June 2016 – Dec 2016
- Carbon-Base Pilot (F/S-O3-BAF-GAC-UV)
  July 2016 – Nov 2017
- Both pilots were run by HRSD staff and a team of graduate students
- Intensive sampling campaign to quantify performance
- Both pilots met treatment goals
  - EPA MCLs
  - TOC
  - CECs
  - Pathogens

1 MGD SWIFT Research Center

- 1 MGD Facility with Aquifer Recharge
- Carbon-Based Treatment Process Selected (F/S-O3-BAF-GAC-UV)
- Startup in April 2018
- Extensive education components for outreach, including ribbon cutting
- Reasons for building the SRC:
  - Public outreach
  - Operator training
  - Get data for full-scale permits
  - Learn as much as we can

Defining A Regulatory Approach

Existing Potable Reuse Regulations

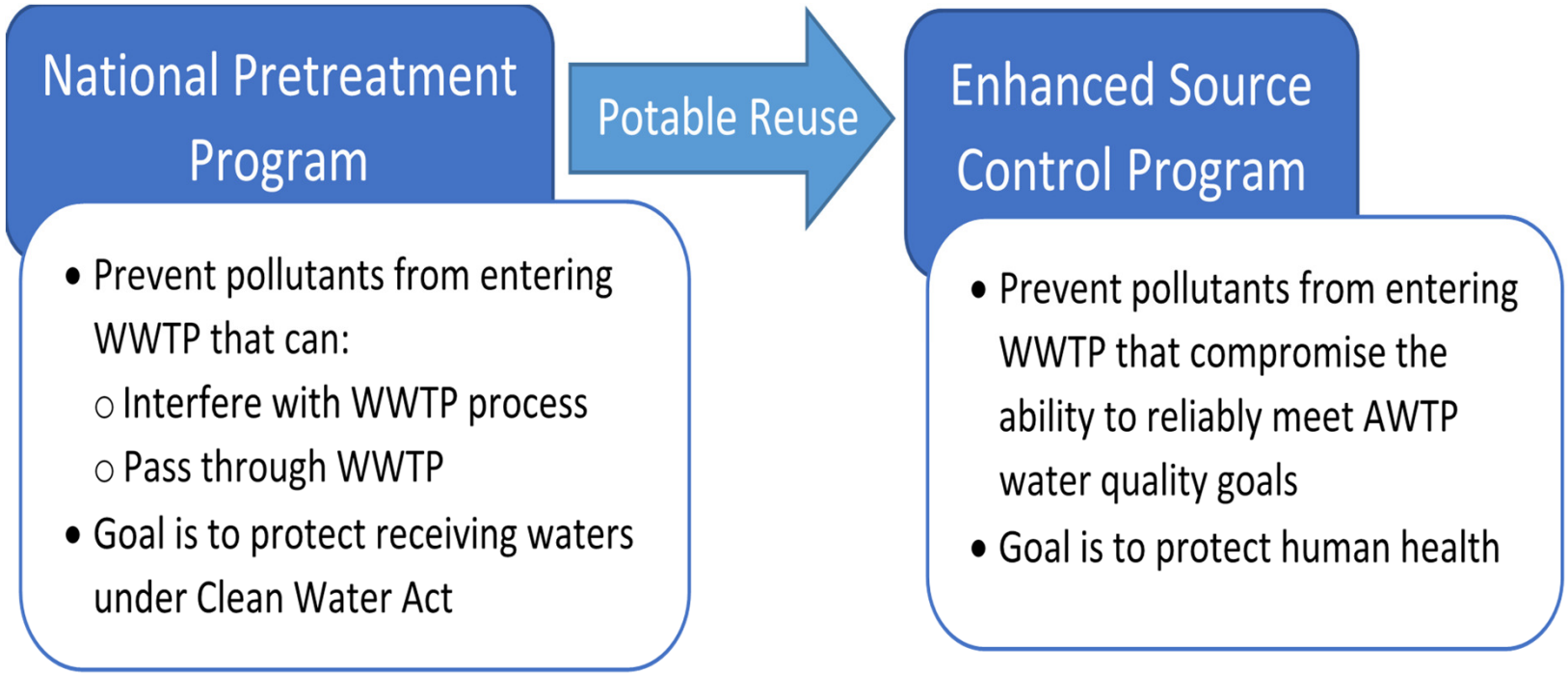
- No federal or state regulations for indirect potable reuse projects
- VA has existing IPR regulation specific to UOSA

HRSD's Approach

- Propose a reasonable regulatory framework that ensures public health safety and is built on data
  - Provide a multi-barrier approach to pathogens and organics
  - Avoid a TOC limit that requires RO treatment
- Get all regulatory stakeholders involved early and often
- Assemble an NWRI independent advisory panel
- Use 1 MGD RC as a regulatory stepping-stone

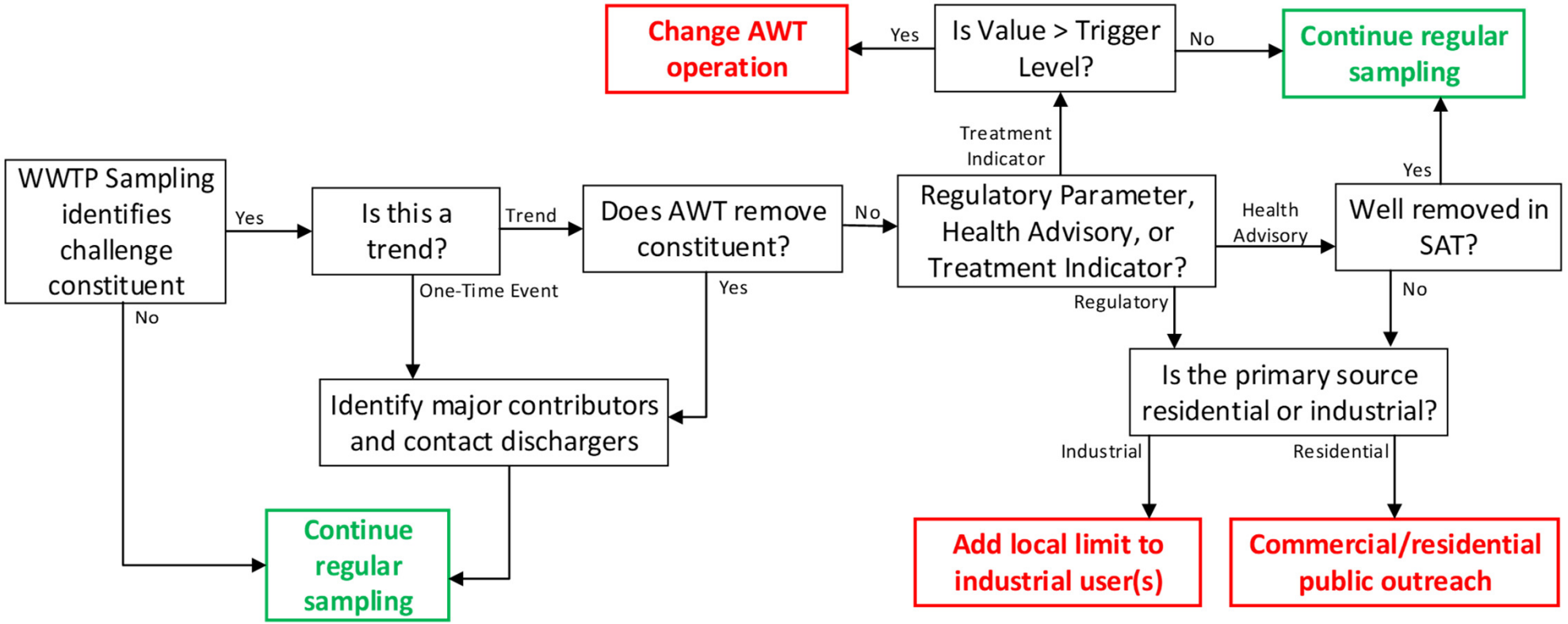
Parameter	Proposed Regulatory Limit	Water Quality Goal (non-regulatory)
MCLs	Meet all primary MCLs	N/A
Total Nitrogen	5 mg/L monthly average; 8 mg/L max daily	Secondary Effluent CCP Action Limit for TIN = 6 mg/L
Turbidity	IFE <0.15 NTU 95% & >0.3 NTU for no more than two consecutive samples	CCP Action Limit at 0.10 NTU
TOC	4 mg/L monthly average (TBD)	CCP Action Limit at 6 mg/L
Total coliform	< 2 CFU / 100 mL; 95th perc.	CCPs to achieve 12 LRV for viruses and 10 LRV for Crypto & Giardia
E. Coli	Non-detect	
Unregulated Chemicals	None	Monitor suite of chemicals and address as necessary
Total Dissolved Solids	None	None

Enhanced Source Control Programs



Enhanced Source Control Programs are needed for potable reuse projects

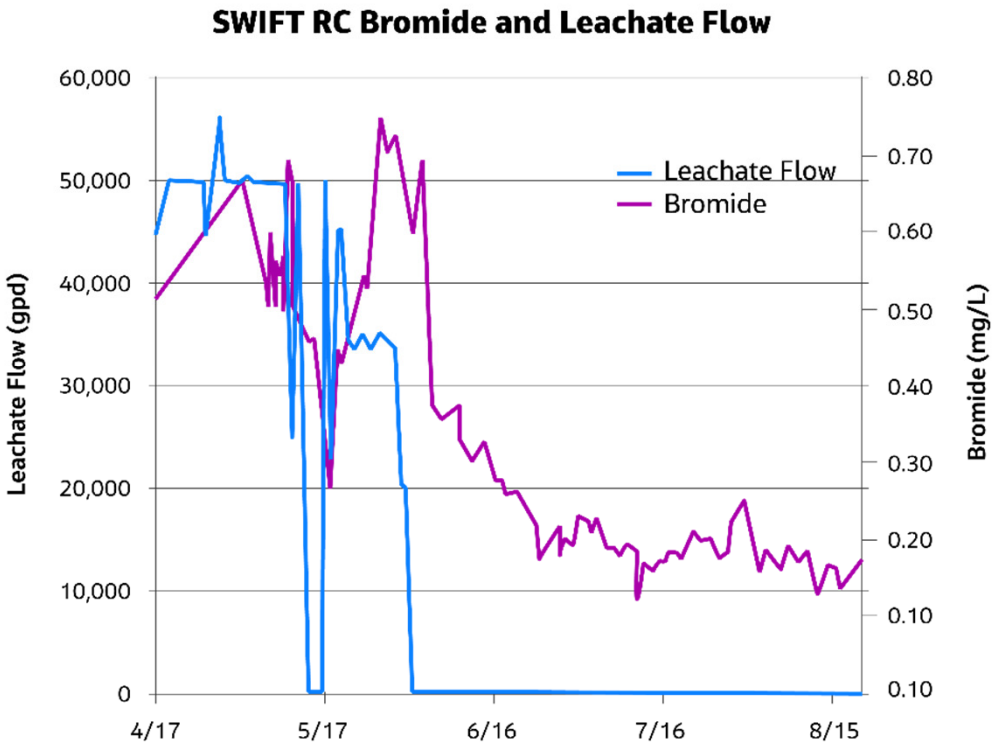
Framework for HRSD's Enhanced Source Control Program



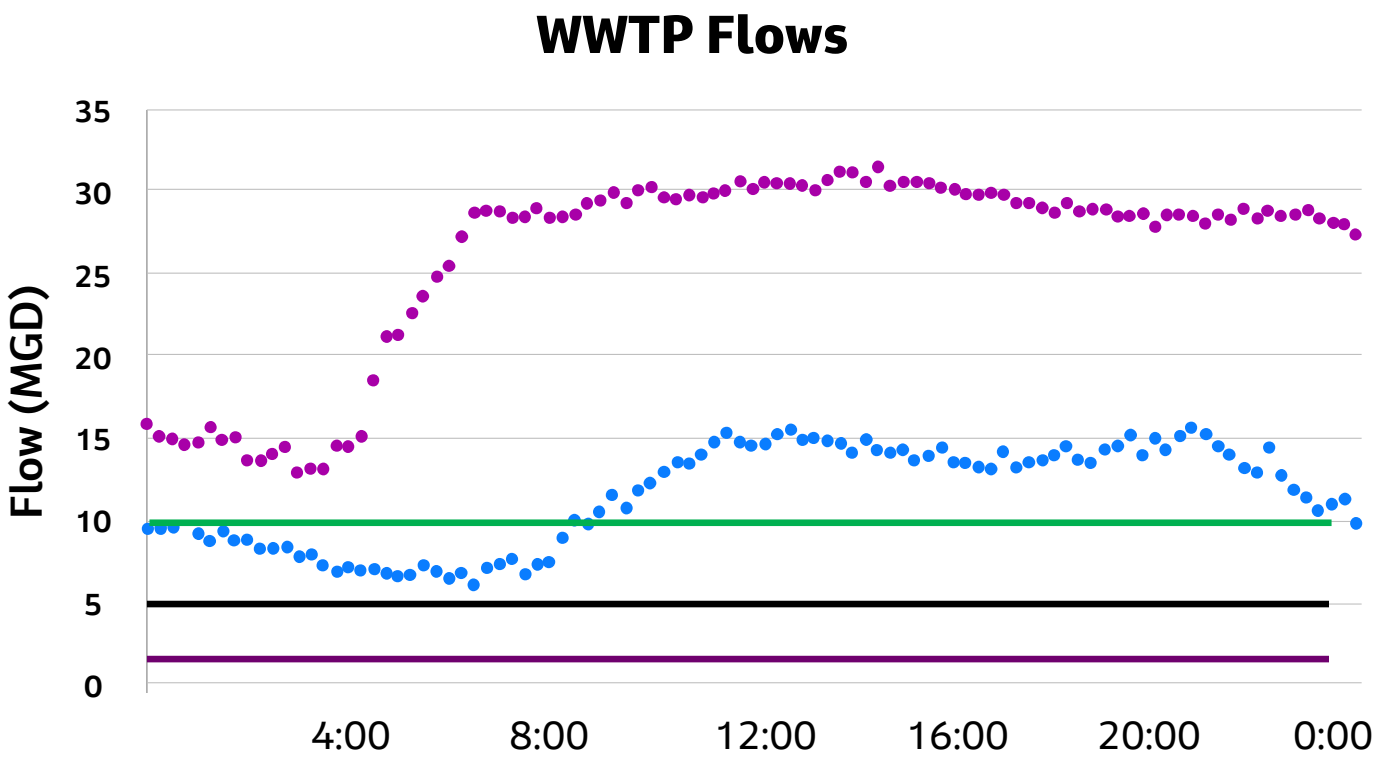
Excerpt of framework developed for HRSD

SWIFT RC Bromide – Source Control in Action!

- From existing data set, influent bromide was 0.53 mg/L
- Source identification showed that landfill leachate contributed **close to 100% of influent bromide load!**
- When leachate flow was stopped, bromide reduced below 0.2 mg/L
- Short-term solution: work with landfill to target a lower, continuous flow
- Long-term solution: divert leachate to a different WWTP



Challenges with AWTP Sizing for Potable Reuse



Storm flows must be considered

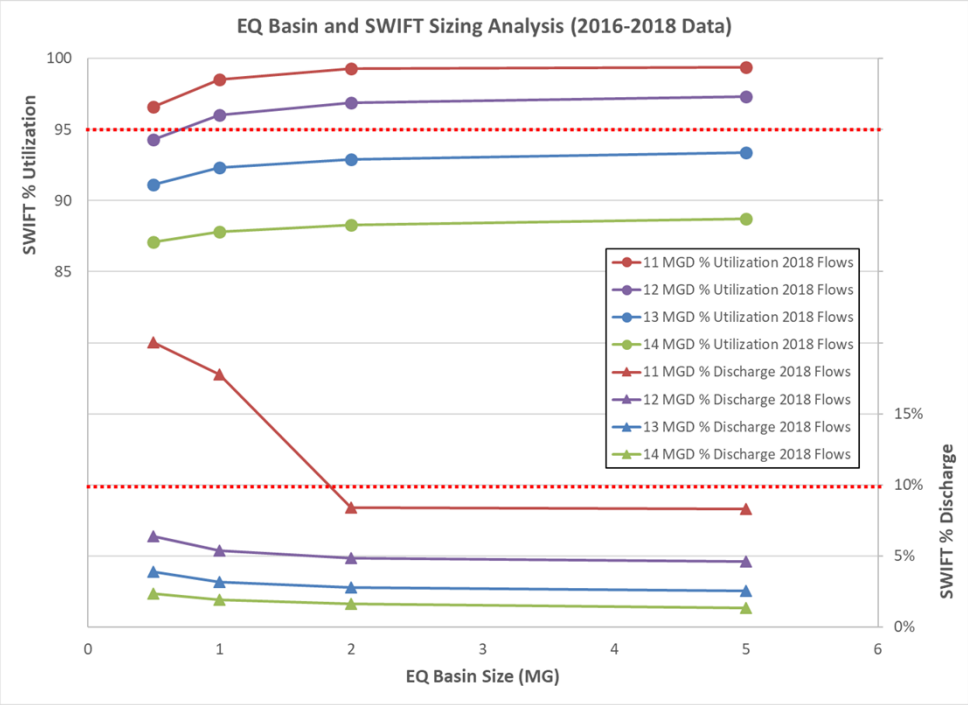
AWTP Capacity w/ Equalization

Baseloaded AWTP Capacity

Reclaimed System Demand?

SWIFT Facility Sizing Analysis

EQ Basin and AWTP Sizing Analysis

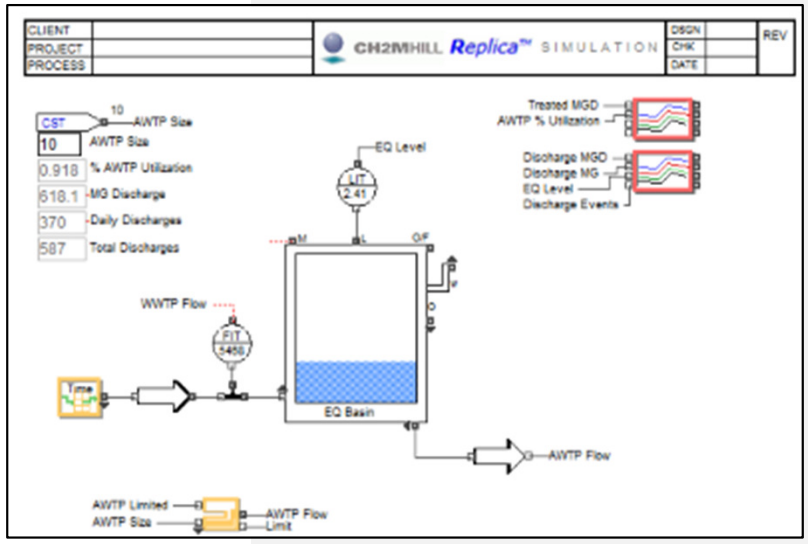


SWIFT facility utilization analysis based on 3-yrs of historical data

SWIFT facility sizing drivers for HRSD:

1. Total water treated
2. AWTP utilization

Dynamic simulation model with rules-based control logic



Facility Costs and Footprints

- Identifying size of each facility allows for:
  - Improved cost estimates
  - Estimate of AWT footprint to determine if additional land is needed

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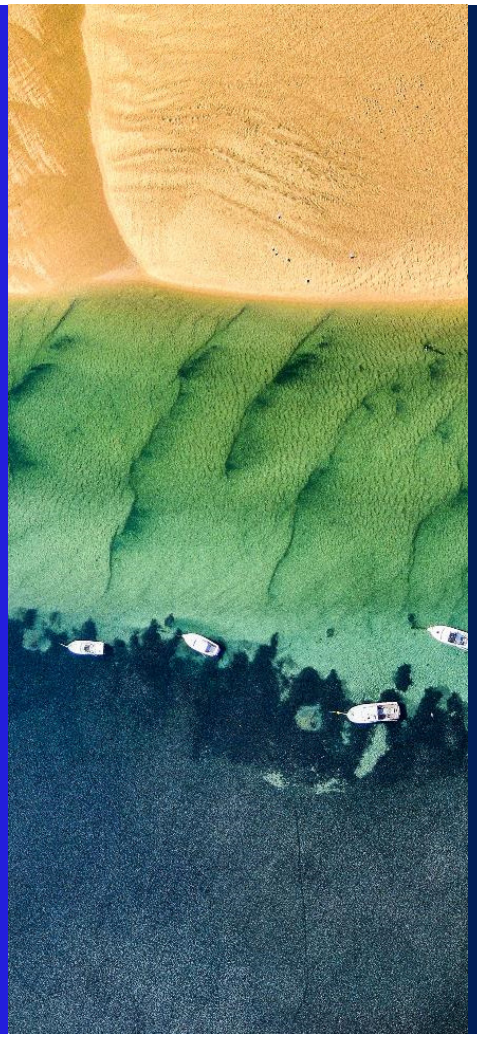
Beenyup Advanced Water Recycling Plant

Australia's First Groundwater Replenishment Scheme

Jim Lozier, Jacobs



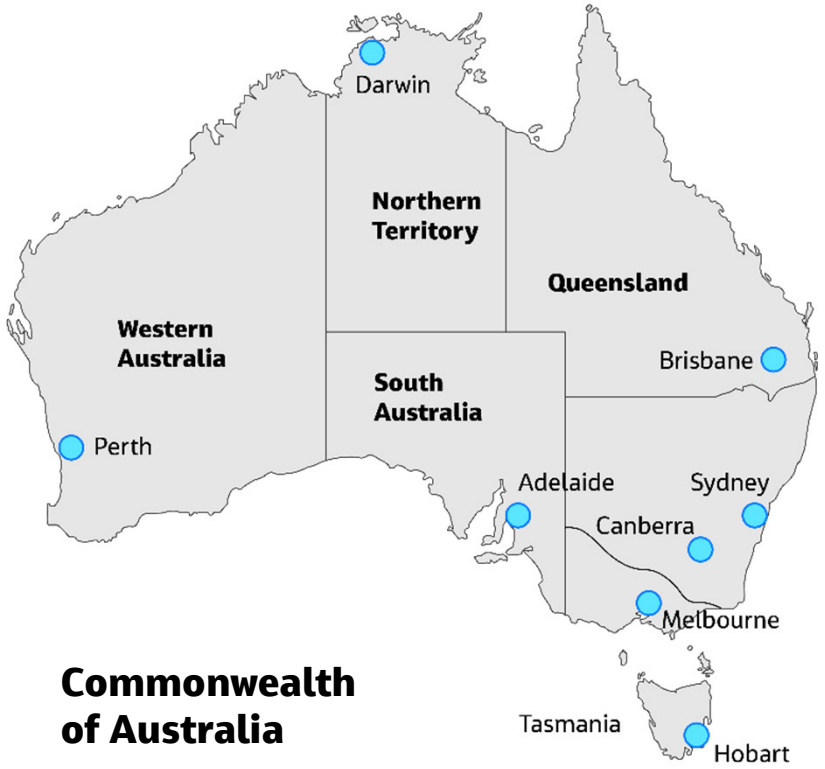
Project Location/Developer

Project Location

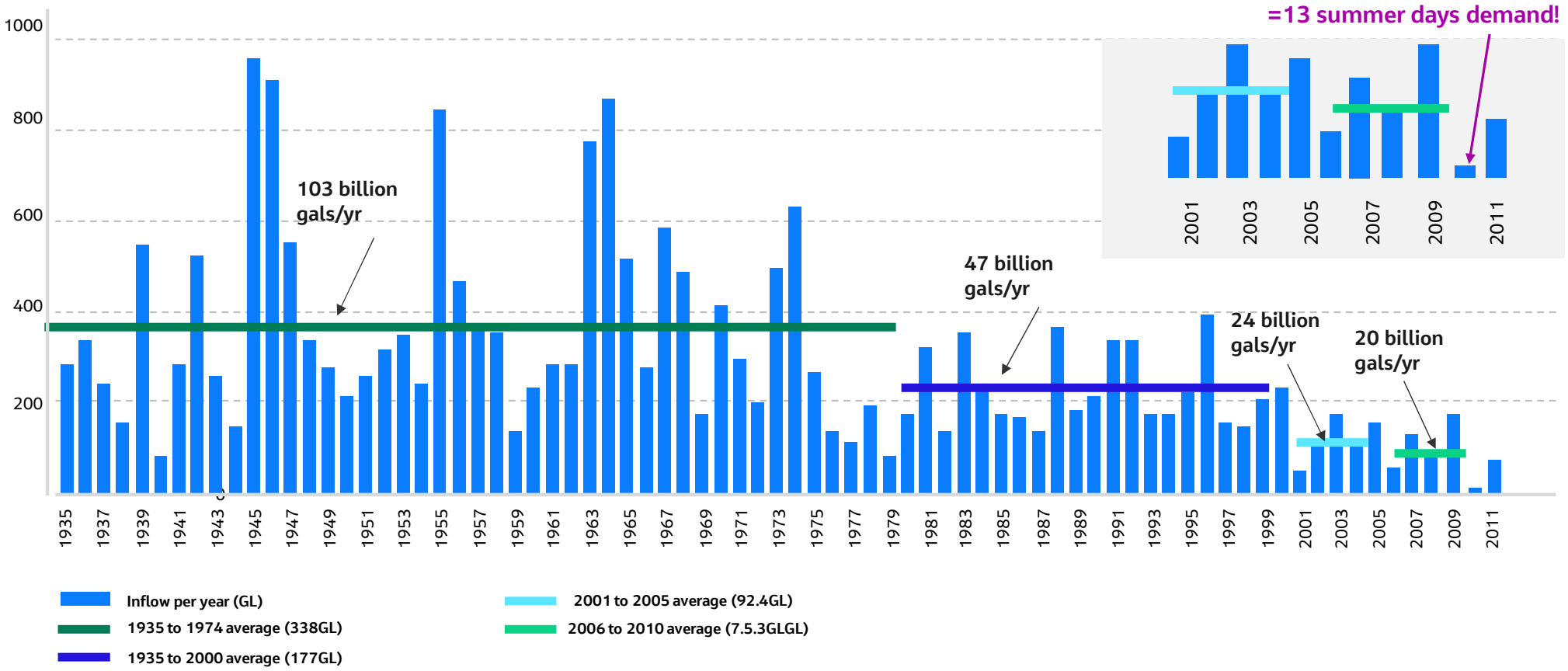
- Perth - capital and largest city of Western Australia
- ~2 million residents in metro area

Project Developer

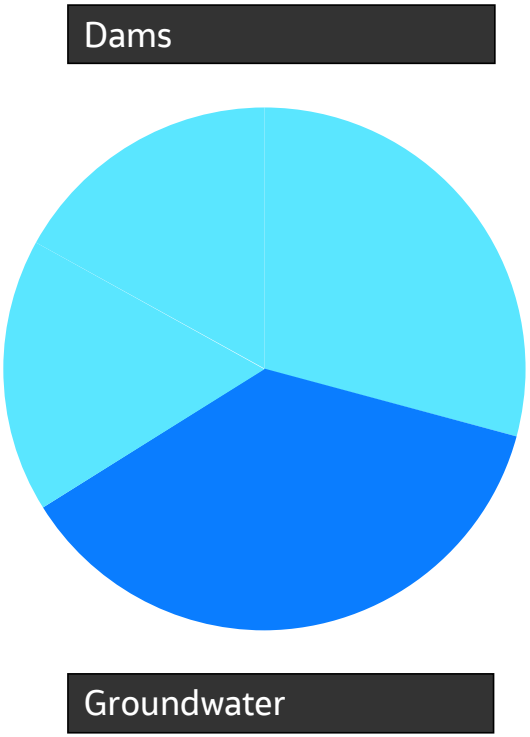
- Water Corporation (of Western Australia)
- Supplier of W&WW services throughout WA
- Activities span 1 million square miles
- ~2,800 employees

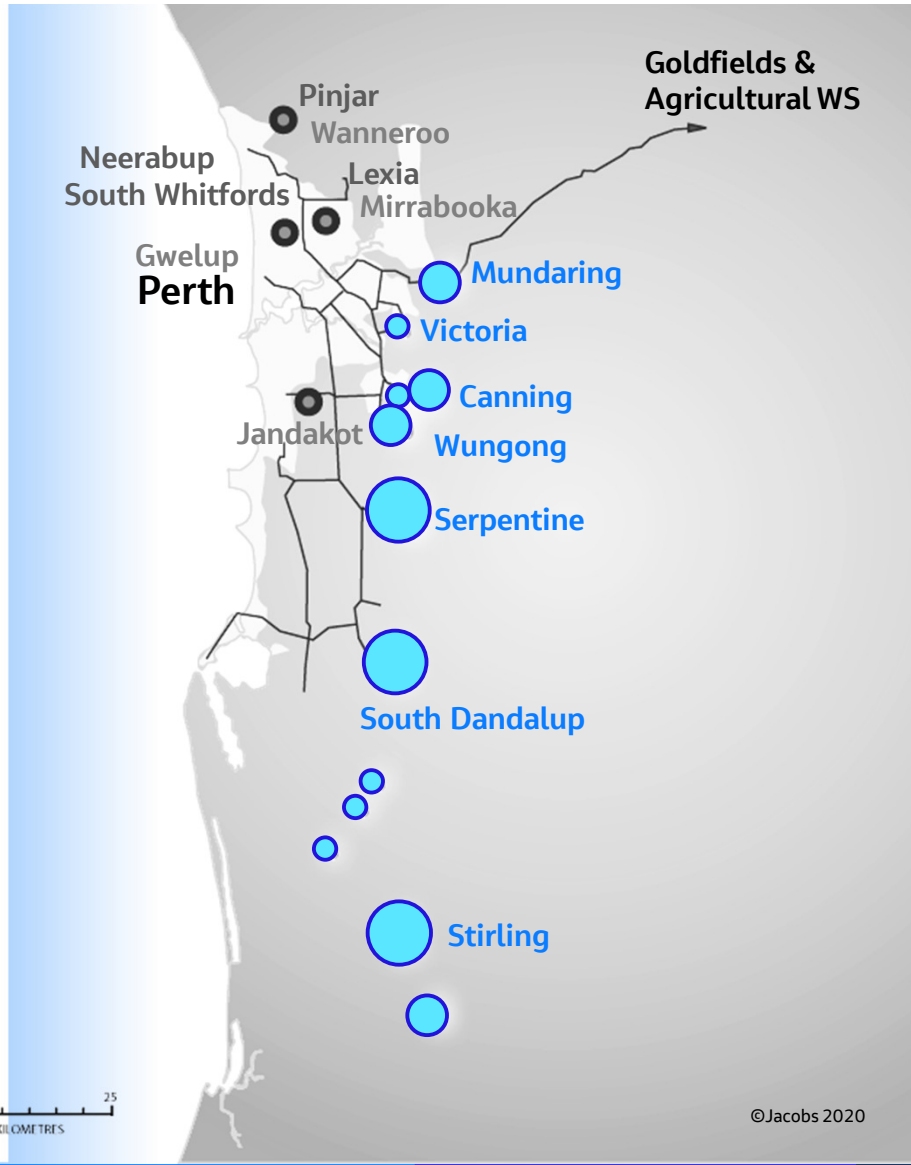


Why the Need for Groundwater Replenishment



Integrated Water Supply Scheme1993





Integrated Water Supply Scheme 2013

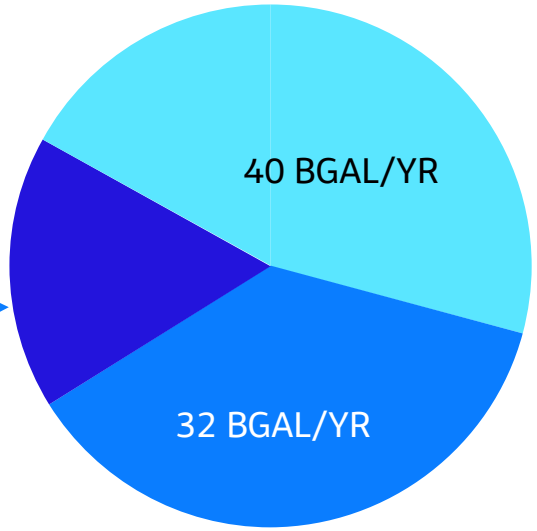
Target of Groundwater Replenishment Program

16 BGAL/YR

Dams and lower security Groundwater

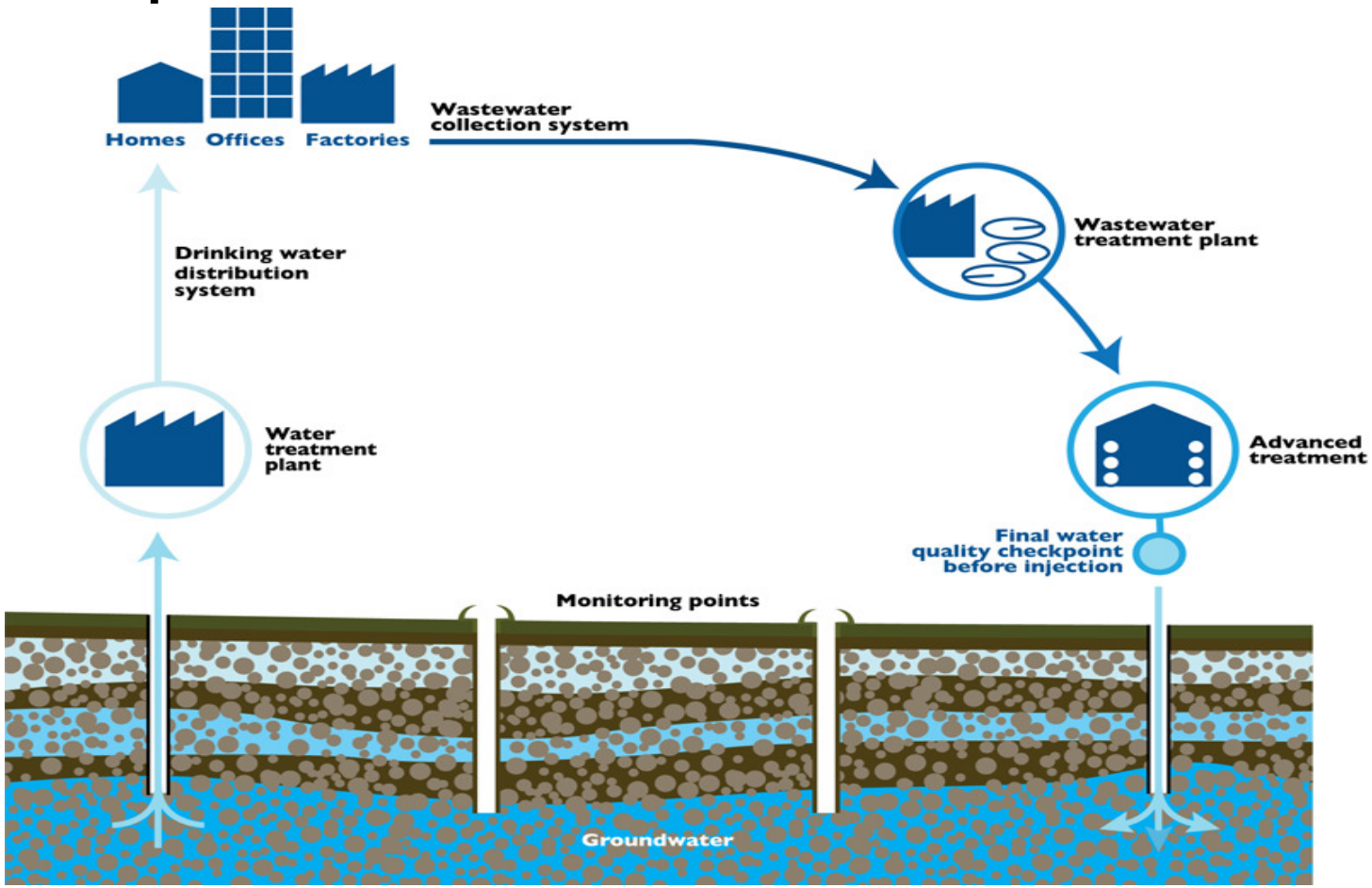
Beenyup Advanced Water Recycling Plant (3.7 BG/YR)

Ocean Desalination



Secure Groundwater

Groundwater Replenishment Scheme



Treatment Train

Wastewater Treatment

- Effluent suitable for discharge to ocean

Ultrafiltration – Removes:

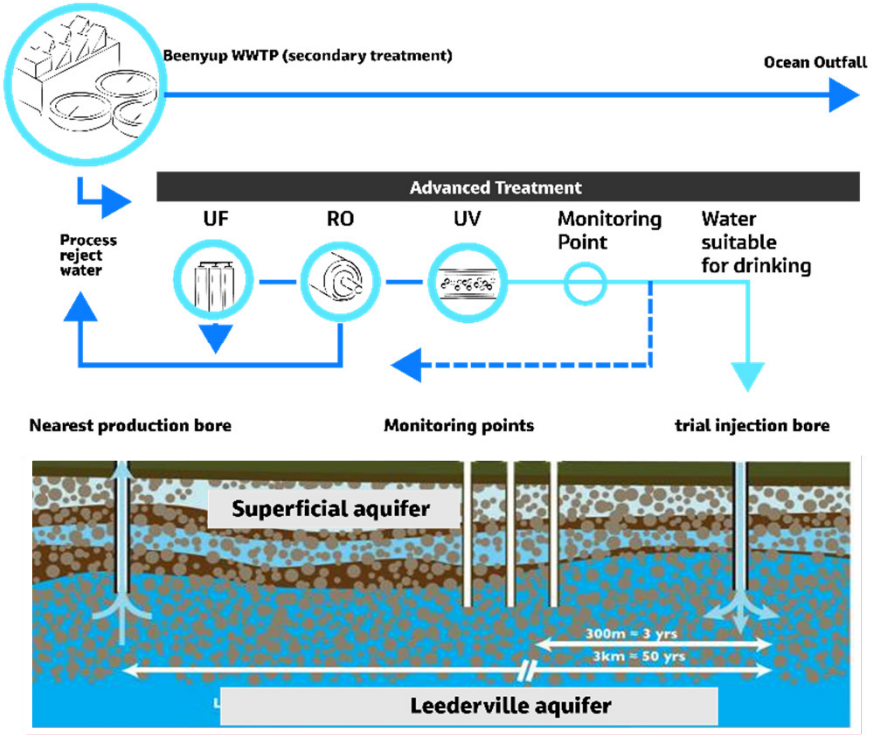
- All suspended solids
- Crypto, giardia, all bacteria
- Viruses (pore size dependent)

Reverse Osmosis – Removes:

- All viruses
- Inorganics, including nitrogen
- Bulk and trace organics

Ultraviolet Treatment

- Final disinfection step
- Inactivation of bacteria, crypto, giardia and viruses

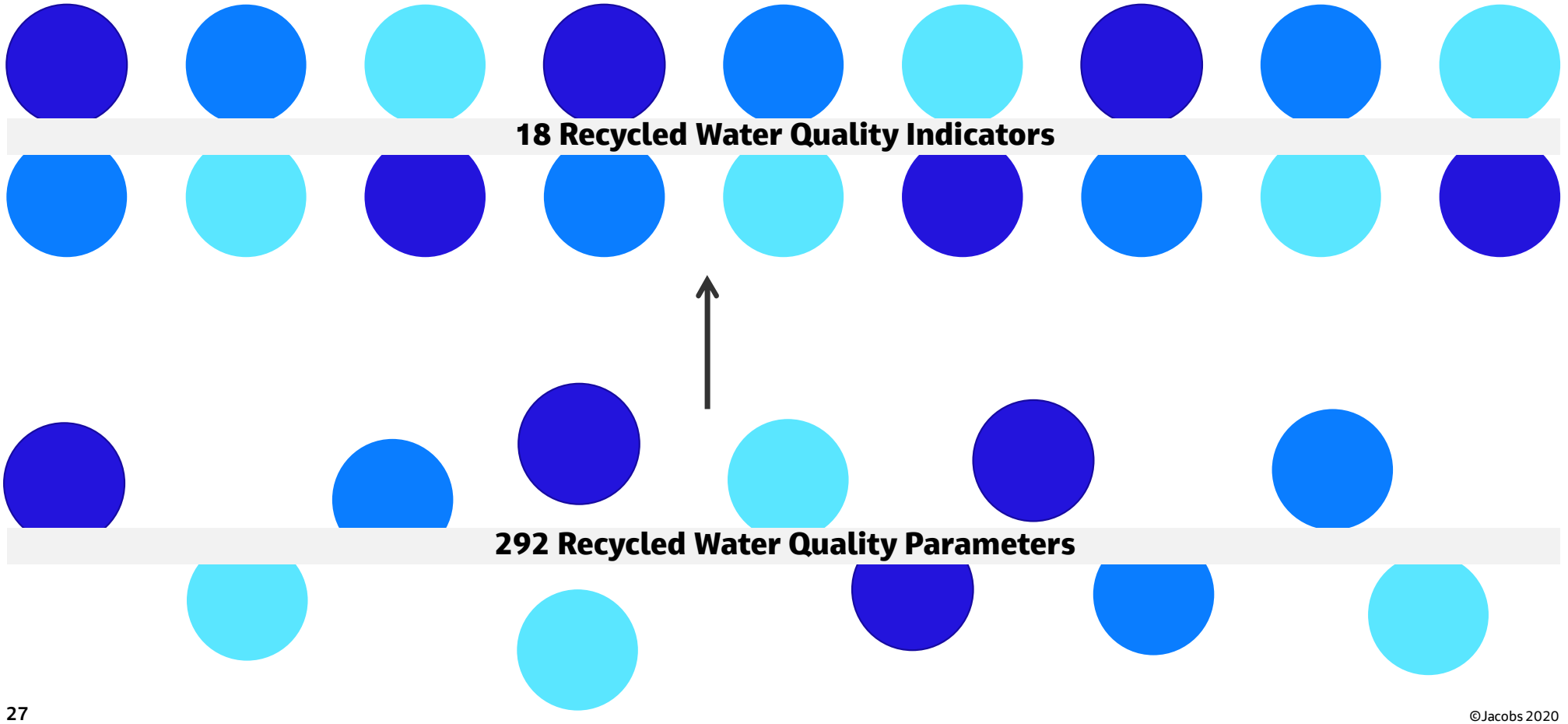


Pathogen Control is Paramount

	Equivalent Log Reduction Credits		
	Bacteria	Virus	Protozoa
Wastewater Treatment	1	1	0.5
BAWRP Process Unit			
UF with chloramination >1.5 mg/L	3	3	3
Reverse Osmosis	3	3	3
UV Disinfection at >186 mJ/cm2	4	4	4
Total AWRP ELRC	10	10	10
Total (WWTP & BAAWRP)	11	11	10.5
DoH Requirement	8.5	9.5	8
Excess credits (safety factor)	2.5	1.5	2.5

Required full-scale validation testing!

Robust Chemical Monitoring Plan Required



Ultrafiltration System

Parameter	Value
Filtrate Flow	17.3 mgd
Flux (instantaneous)	30 gfd
Recovery	≥92%
Module Supplier	Dow (DuPont)
Module Type	SFD-2880
Membrane Pore Size	0.03 µm
Log pathogen removal	≥3

Reverse Osmosis System

Parameter	Value
Permeate Flow	13 mgd
Flux	11.3 gfd
Recovery	75 - 80%
Module Supplier	Hydranautics
Element Type	ESPA2-LD
Membrane Type	Thin-film polyamide
Array	2 stage
Log pathogen removal	≥3

Ultraviolet Disinfection System

Parameter	Value
Effluent Flow	12.7 mgd
UV Dose	186 mJ/cm^2
UV Transmittance	≥94%
Supplier	Calgon
Reactor Model	Sentinel 9L24
Type	Med Pressure
Skids	4+0
Pathogen removal	≥4

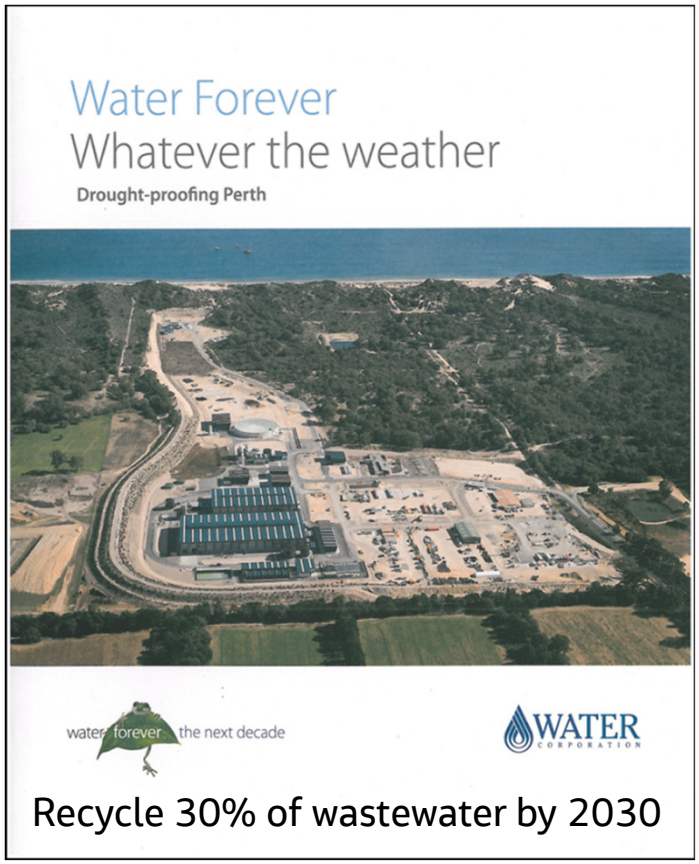
BAWRP Project Implementation

Joint Venture of Jacobs and Thiess Constructors selected by Water Corp for BAWRP implementation

Milestone	Date
Project Award	July 2014
Start of Design	Aug 2014
Design Completion	Feb 2015
UF/RO/UV Systems Delivery	Jun 2015
Construction Completion	Mar 2016
Validation & Verification Completion	Nov 2016
DoH Approval to Recharge	Aug 2017

Over 9 billion gallons of purified water from the BAWRP have been recharged into Perth's aquifers in 2+ years of operation

Groundwater Replenishment is Key Component of Drought Proofing Perth



Recycle 30% of wastewater by 2030

PURE WATER PROJECT
LAS VIRGENES-TRIUNFO
Bringing Our Water Full Circle

Jacobs
Challenging today.
Reinventing tomorrow.

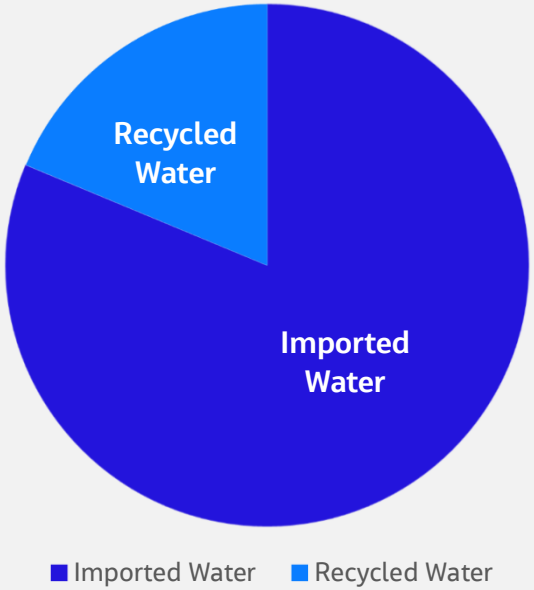
Pure Water Project

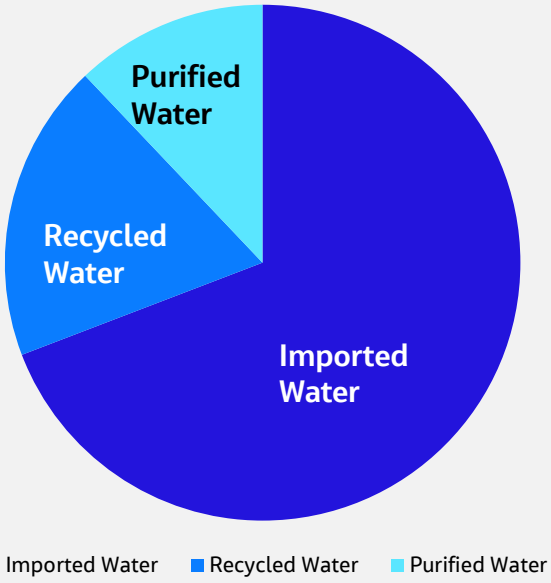
David Pedersen
Las Virgenes -Triunfo


Legend
LVMWD
Triunfo Sanitation District
Simi Valley
Oak Park
Agoura Hills
Calabasas Landfill
Las Virgenes Reservoir
Rancho
Malibu Creek State Park
WTP

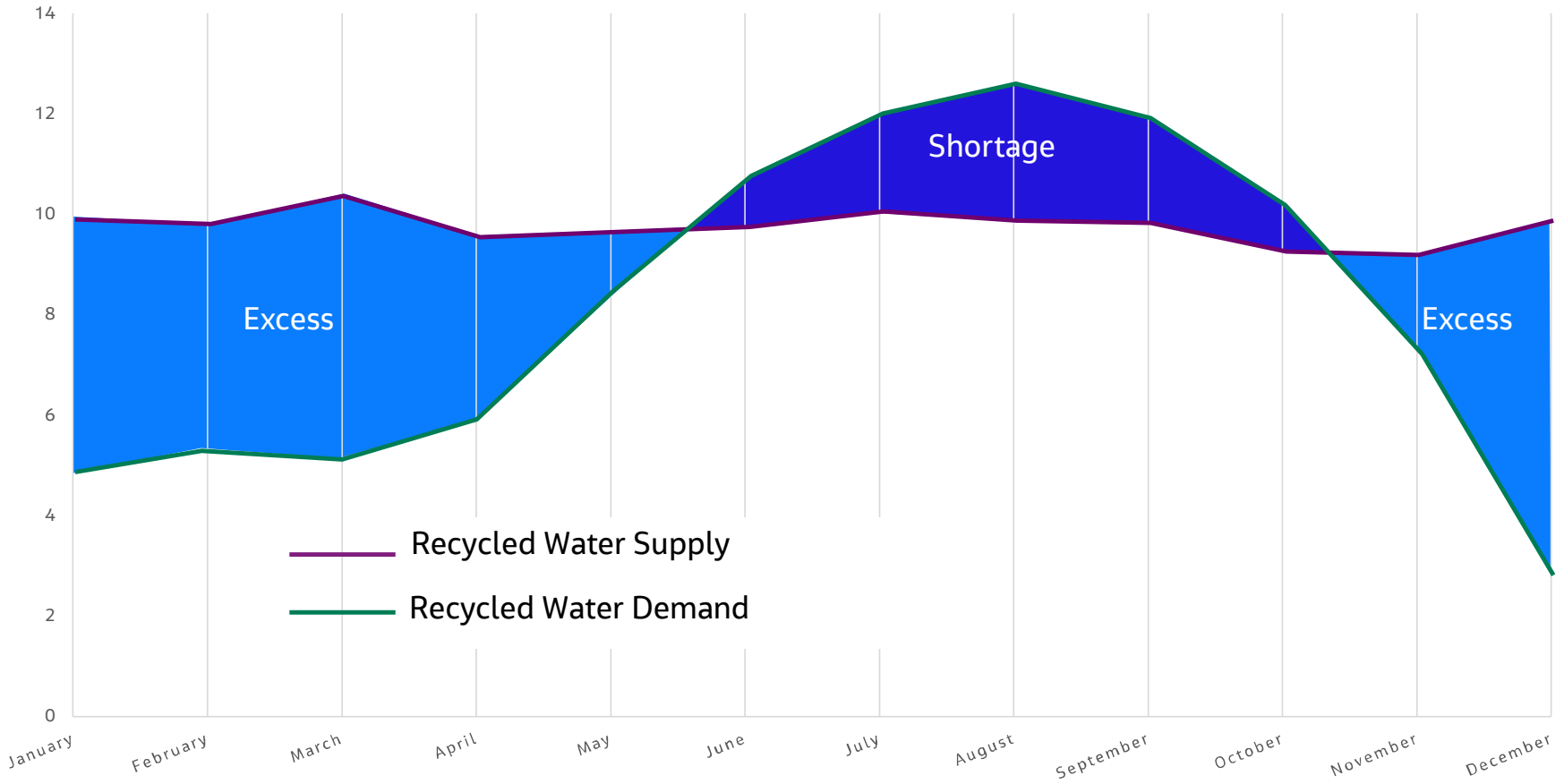
Challenges/Drivers

- Improve water supply reliability
- Meet regulatory requirements





Supply/Demand Imbalance



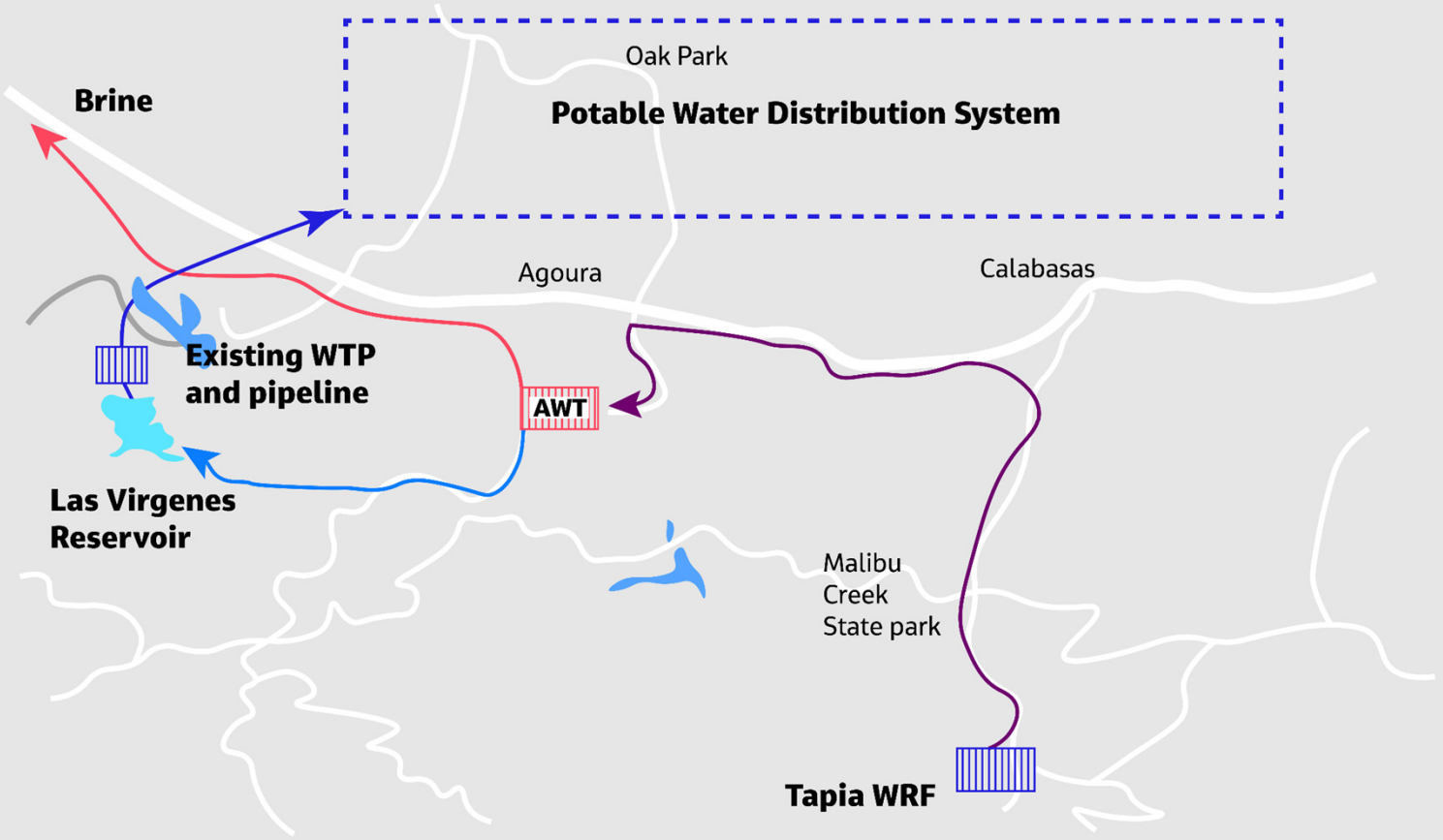
Stakeholder-Driven Process

- Began in January 2015
- Developed a “roadmap” to fully utilize recycled water
- Established “Guiding Principles”
- Maximize beneficial reuse
- Seek cost-effective solutions
- Seek partnerships beyond JPA
- Gain community support
- Govern with a partnership
- Be forward thinking

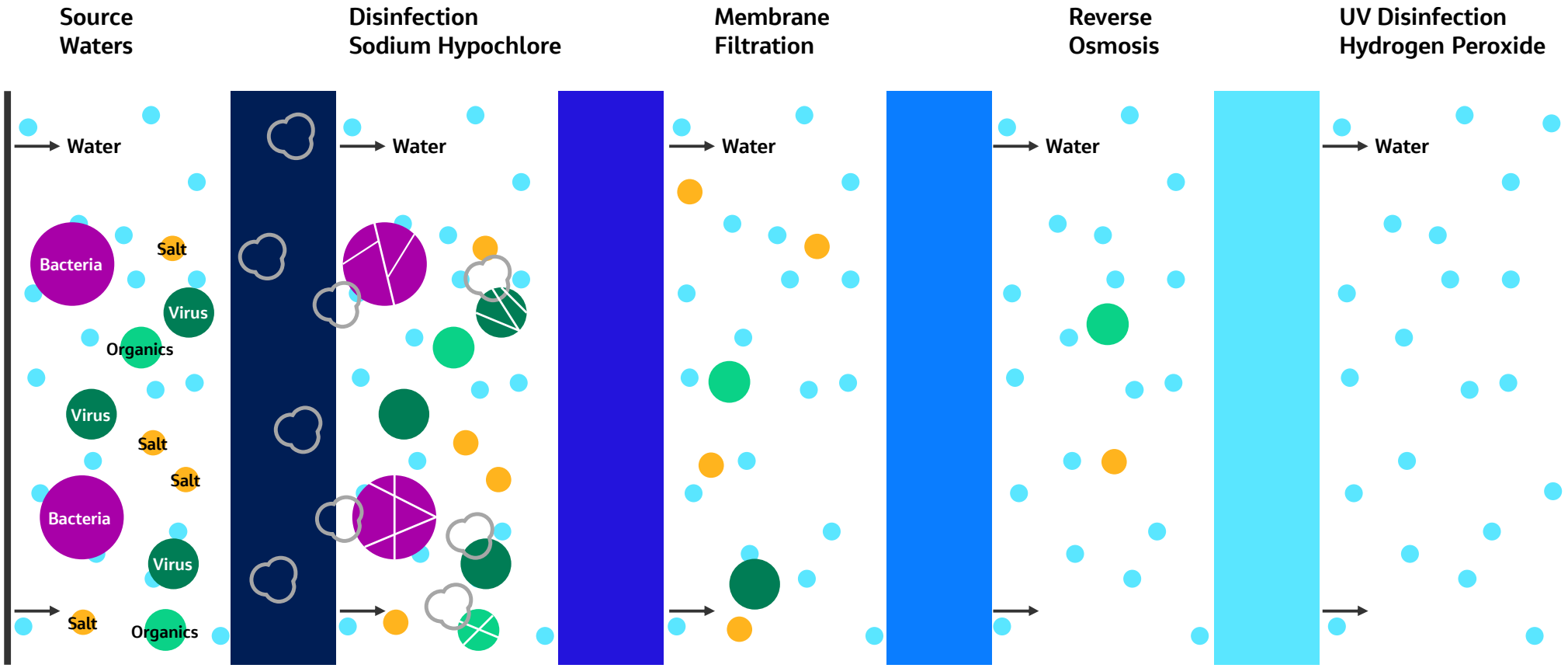
Stakeholder-Driven Process

- Heal the Bay
- Los Angeles Waterkeeper
- National Park Service
- California State Parks
- Mountains Restoration Trust
- Santa Monica Mountains Conservancy
- Resource Conservation District of Santa Monica Mountains
- Santa Monica Mountains Fund
- Los Angeles DWP
- Calleguas Municipal Water District
- Senator Fran Pavley's Office
- Supervisor Sheila Kuehl's Office
- City of Calabasas
- City of Thousand Oaks
- Malibu Creek MS4 Watershed Management Committee (Agoura Hills & Westlake Village

Potable Reuse w/ Las Virgenes Reservoir



Advanced Water Treatment Proven Technology



Pure Water Demonstration Project

Why?

- Permitting
- Full-Scale Design Optimization
- Staff Training
- Public Outreach/Confidence
- Research/Innovation

Pure Water Demonstration Project

Pure Water Demonstration Project

Experience – Interior


PURE WATER PROJECT
LAS VIRGENES-TRIUNFO

Questions and Answers

Thank You!

Jacobs