Wastewater Recycling in Buildings: Best Practices from Down Under

PHOENIX
Exclusive U.S. aquacell™ Distributor

aquacell
water recycling solutions

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Onsite Wastewater Reuse is moving the needle in water conservation in the built environment like never before.

But you have to do it RIGHT…

And it's not easy to do right.

If Done Right…

- ✓SAFE
- ✓RELIABLE
- ✓ECONOMICAL
- ✓Viable Conservation Option

And the Potential is…

HUGE!!

90 installations in Greater Sydney =
13 billion gallons a year saved

Multiple Conservation Options Needed

- HE/Low Flow Fixtures
- Rain/Stormwater Reuse

- Onsite Wastewater Reuse

Uptake has not been rapid…. Why?

Challenge:

How to **safely** and **economically** implement and manage schemes over their life-cycle

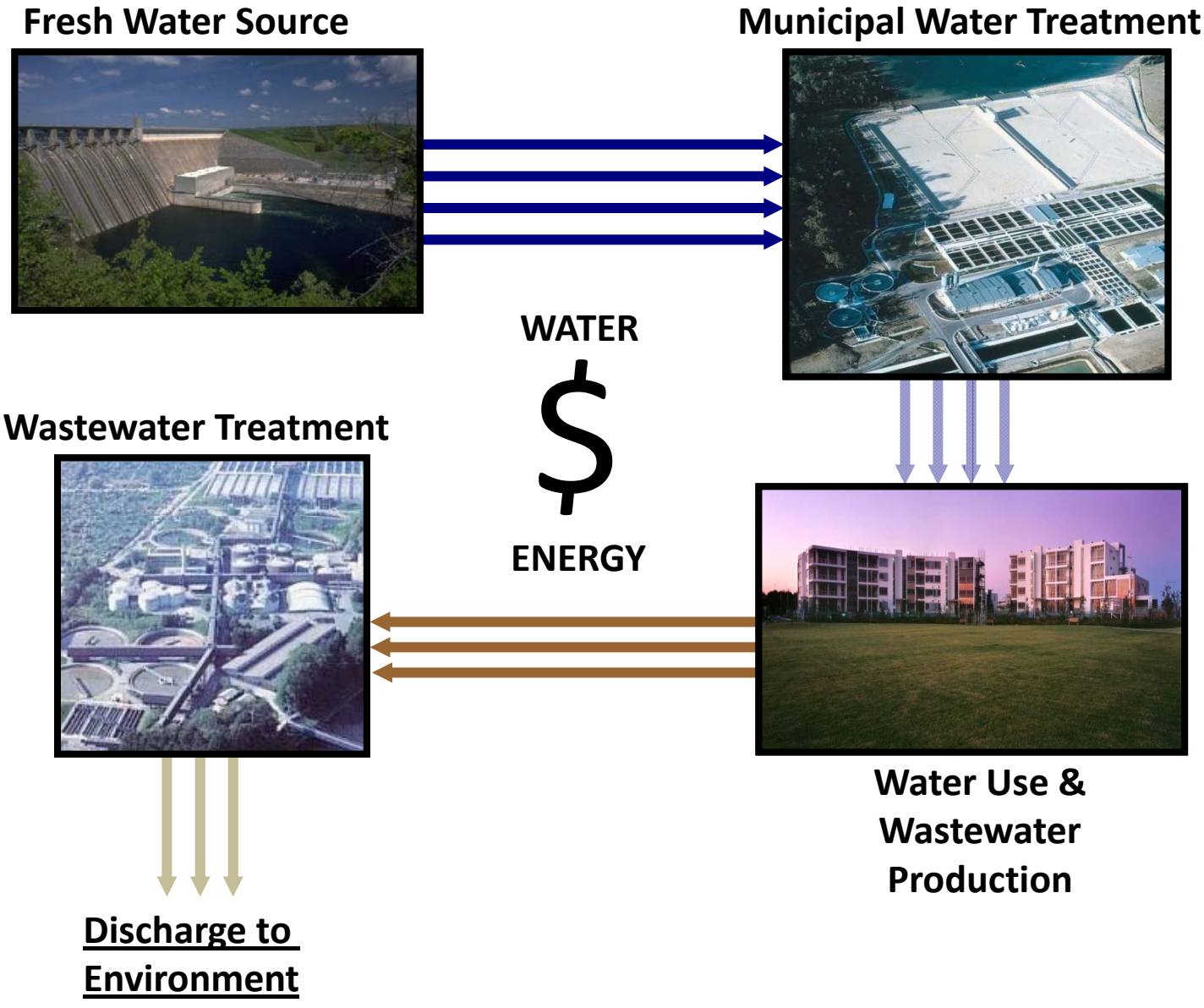
So How Is It Done Right?

AGWR – International Best Practice Framework

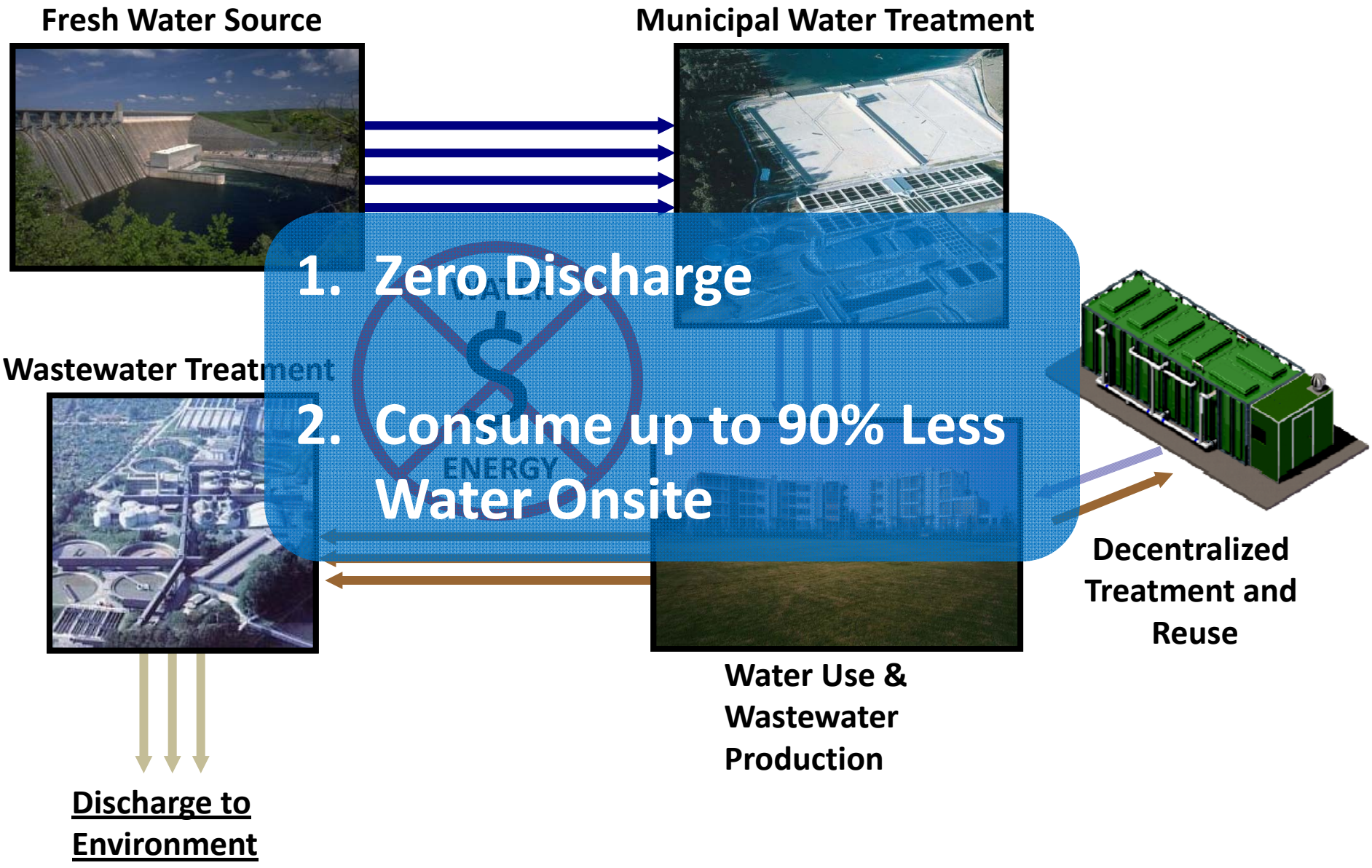
12 ELEMENTS

1. Commitment to responsible use and management of recycled water quality
2. Assessment of the recycled water system
3. Preventive measures for recycled water management
4. Operational procedures and process control
5. Verification of recycled water quality and environmental performance
6. Management of incidents and emergencies
7. Operator, contractor and end user awareness and training
8. Community involvement and awareness
9. Validation, research and development
10. Documentation and reporting
11. Evaluation and audit
12. Review and continuous improvement

“Waste”water – Is This the Future?

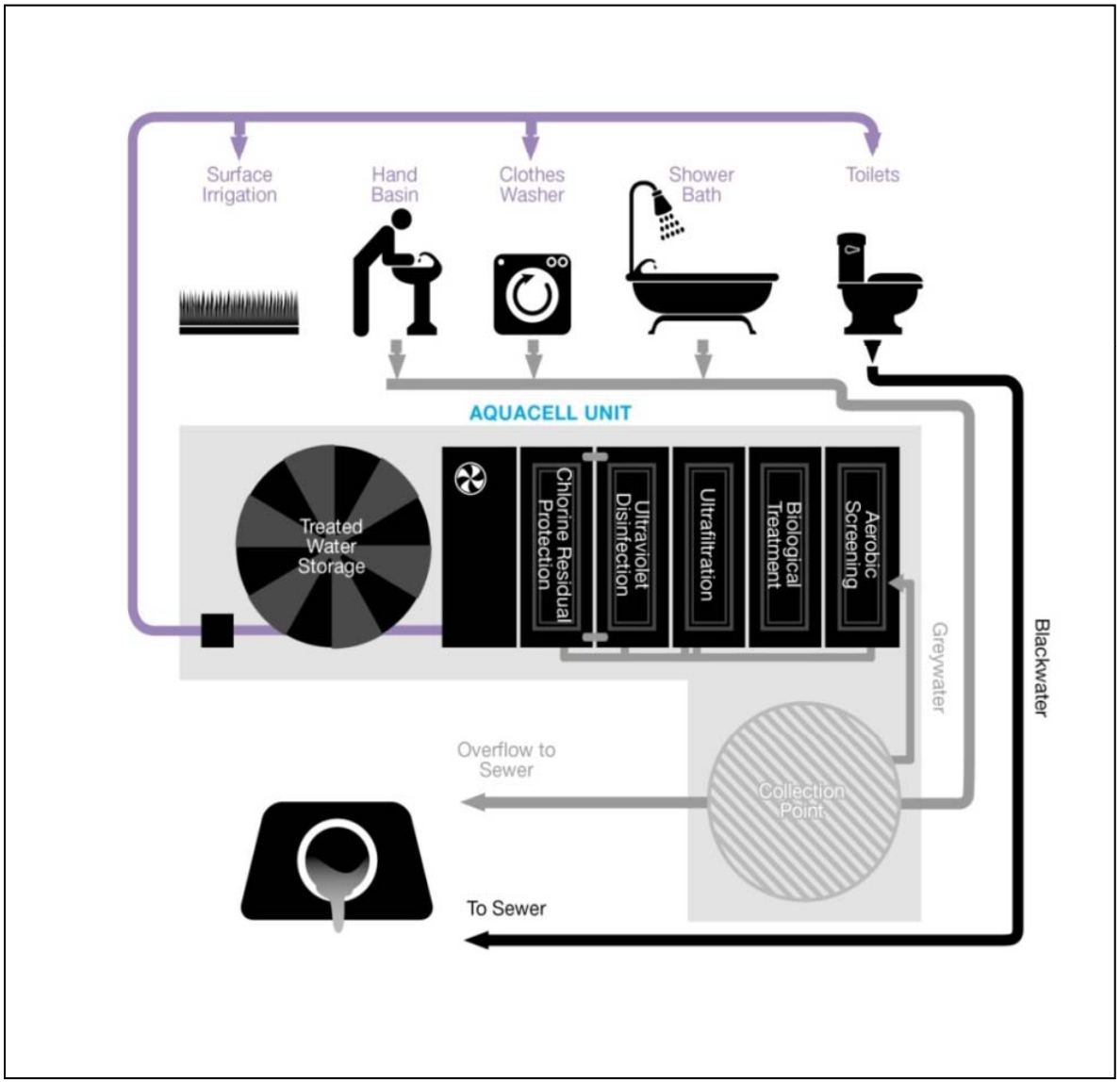


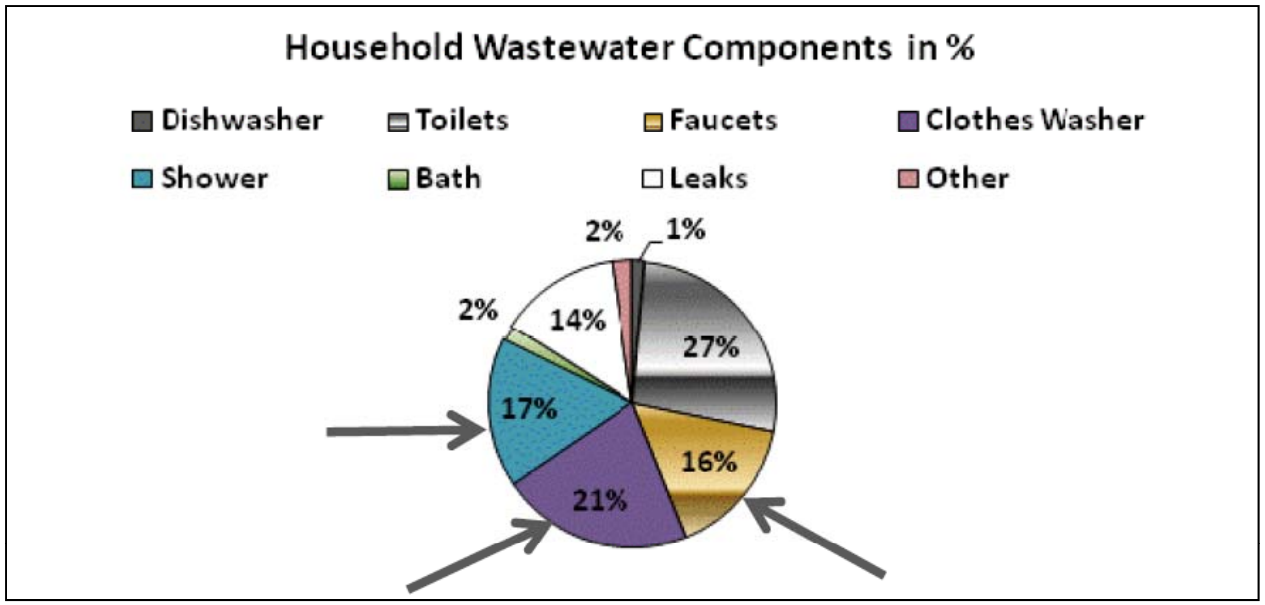
Decentralized Approach



Greywater Reuse

- Non-potable reuse
- 70% of waste stream (residential/hospitality)
- Conserve up to 60%
- Dual plumbing
- Robust treatment!!
- Targets: multifamily residential and hospitality

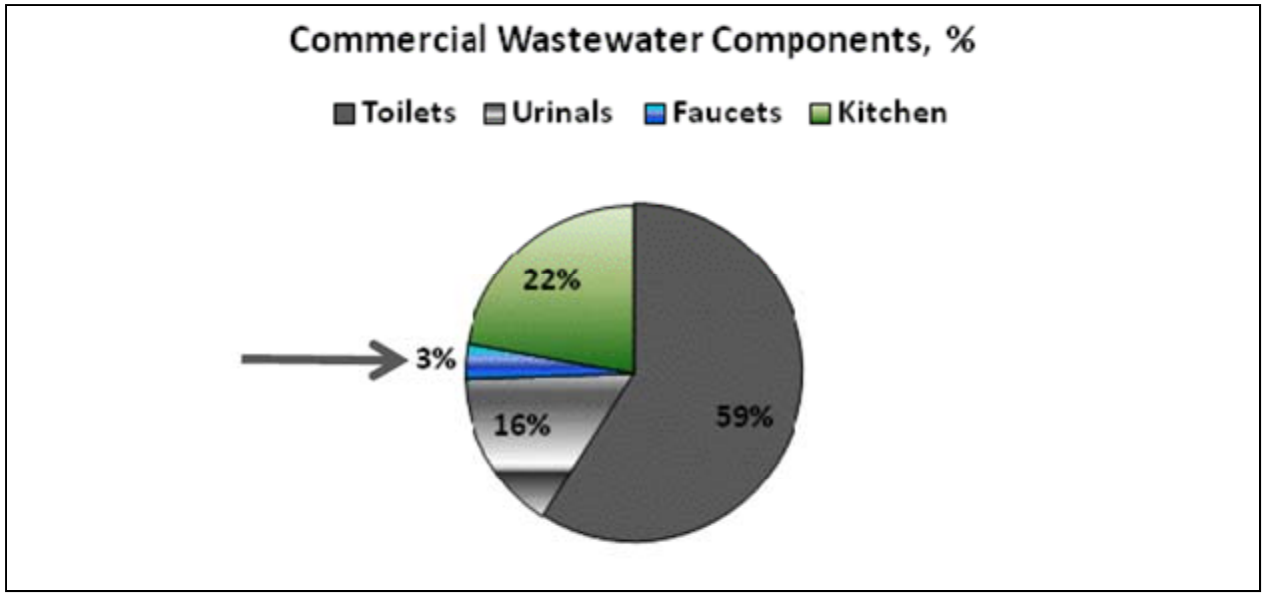




Source: Whitepaper on Graywater, Bahman Sheikh, 2010, WEF, Water Reuse Assoc, AWWA

Residential/Hospitality Greywater Supply

56%



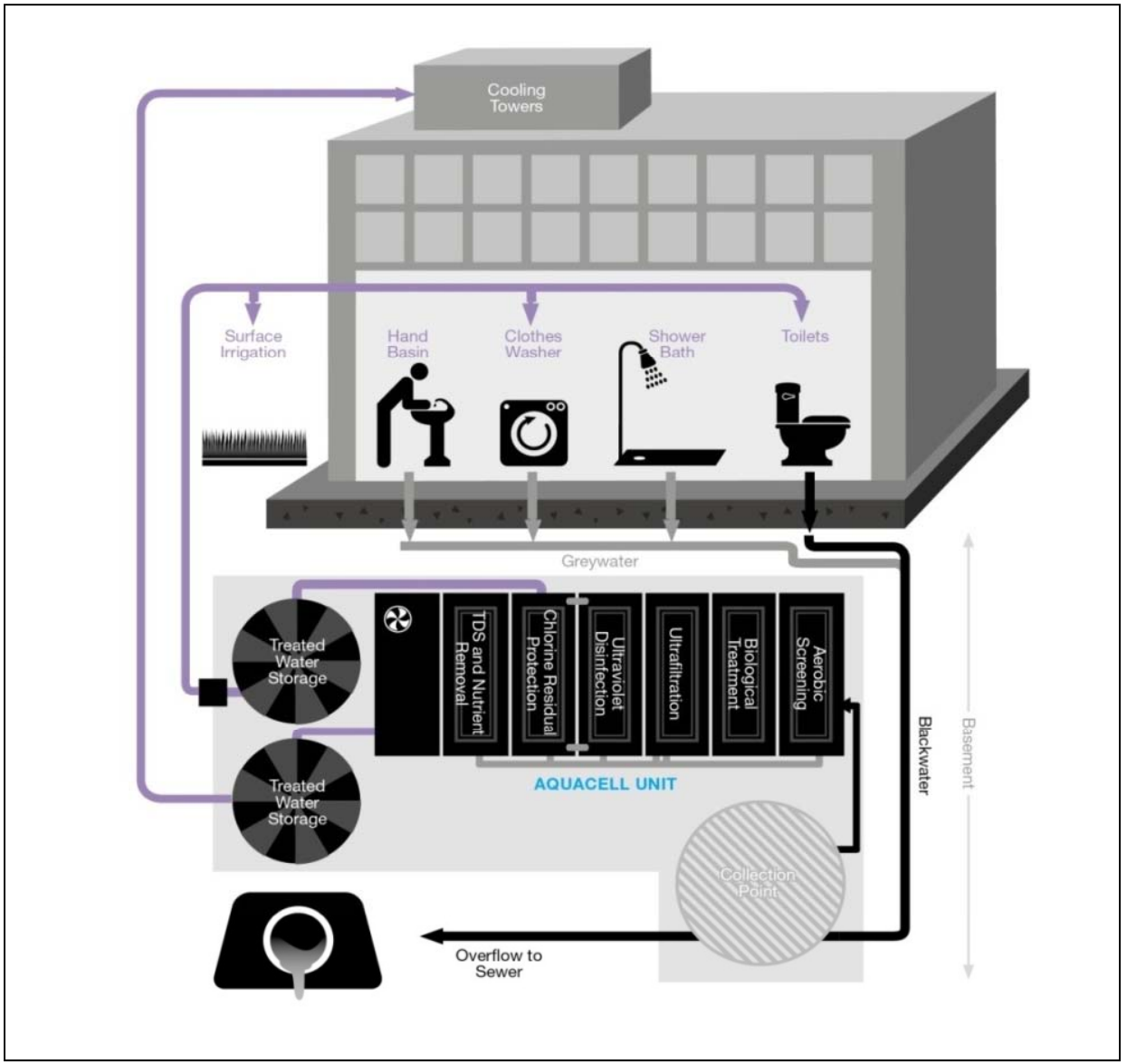
Source: Adapted from The Pacific Institute, The Potential for Urban Water Conservation in California. Mayer *et al*., 1999, Gleick *et al*., 2003.

Office/Institutional Greywater Supply

3%

Blackwater Reuse

- Non-potable reuse
- 100% of waste stream
- Conserve up to 90%
- No dual plumbing
- Retrofits/existing bldgs
- No infrastructure, no problem
- Targets:
  Low potable users - Office/institutional, business parks, airports, off grid projects



The Future is Decentralized?

Not IF…

But WHEN

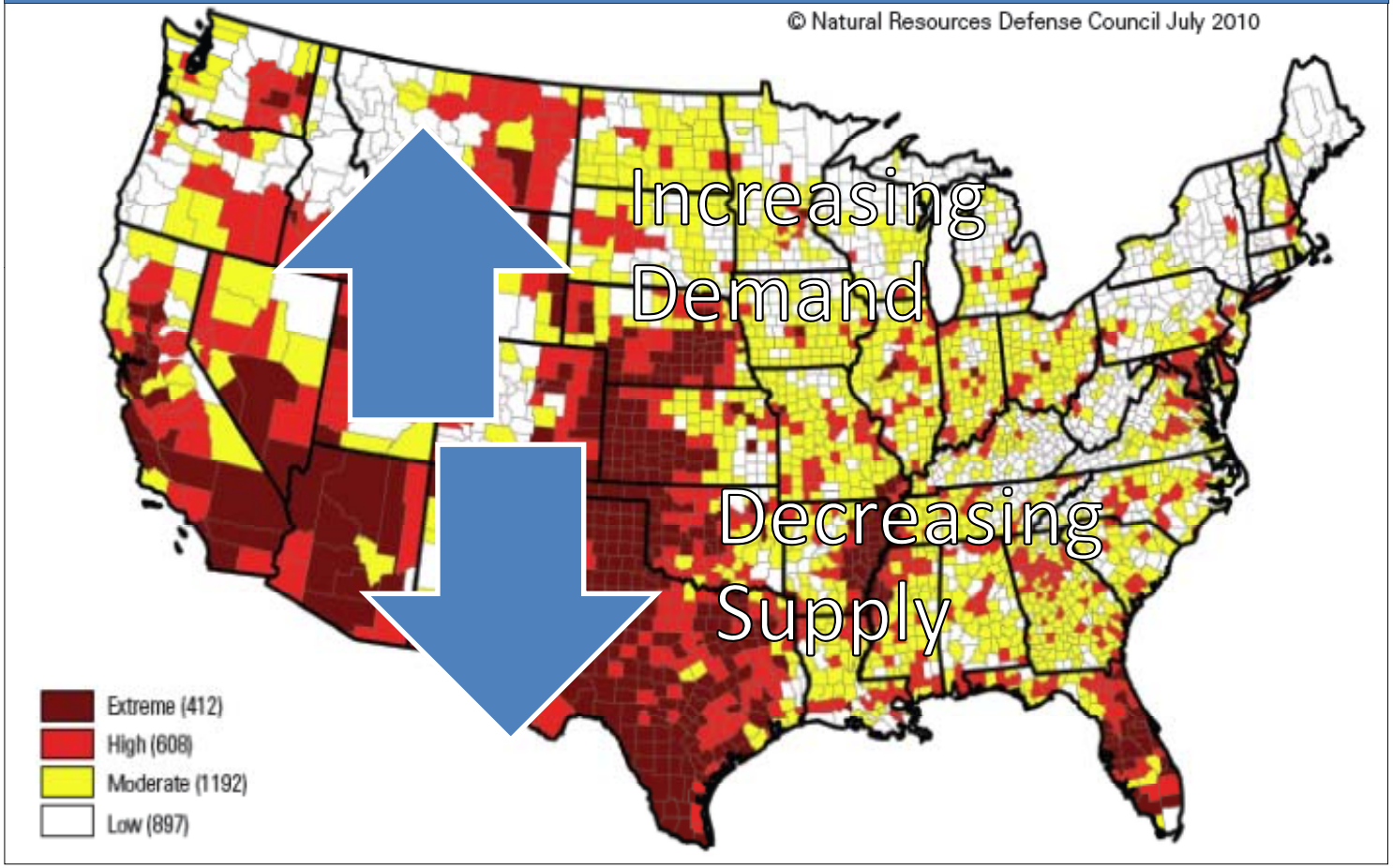
The Future is Decentralized?

- ✓ Technology on the rise, cost on the decline
- ✓ Sustainability goals
- ✓ New Regulations/Code
  - NSF 350
  - EPA U.S. Guidelines for Water Reuse
  - IGCC
  - IAPMO Green
  - New laws encouraging onsite reuse in some cities
  - Grants / Rebates for onsite reuse

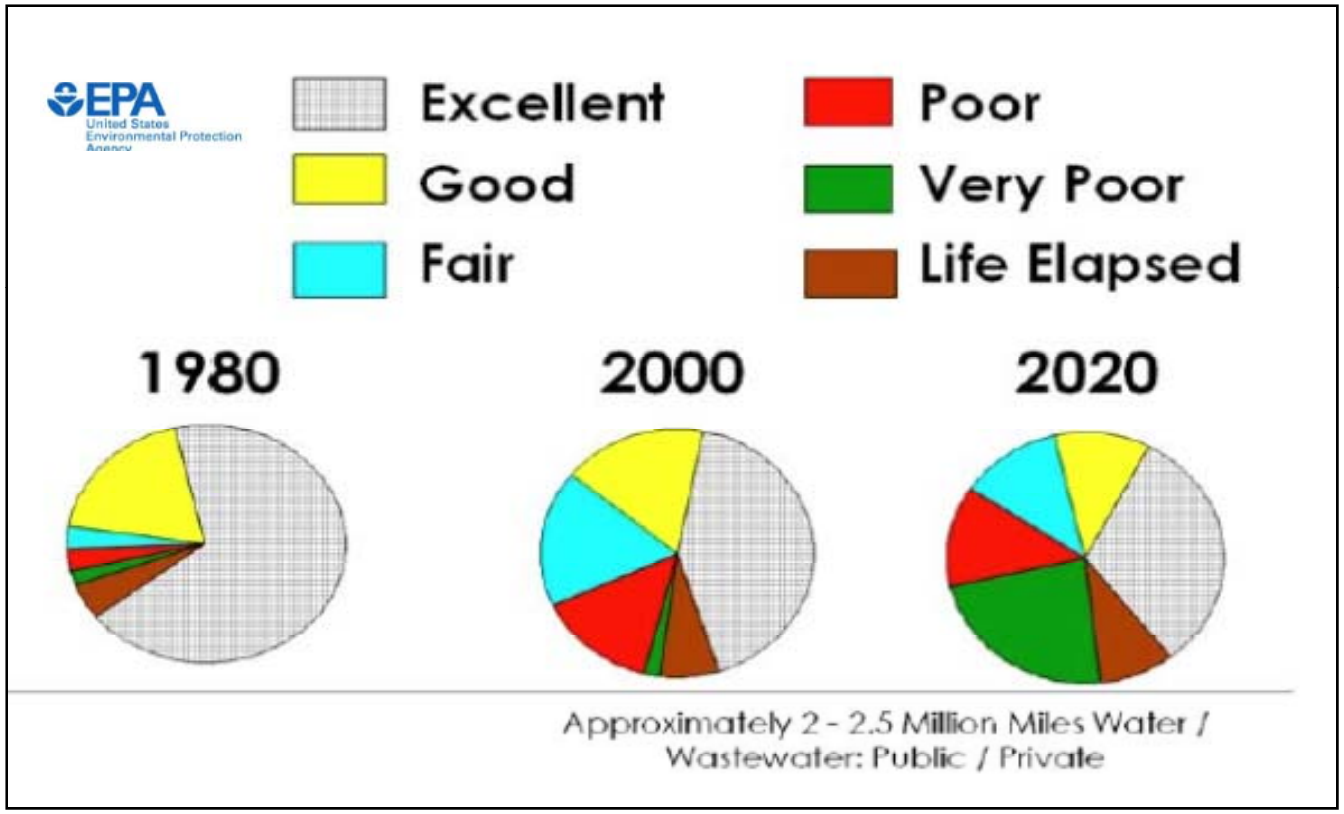
Growing Freshwater Demand

Waning Freshwater Supply

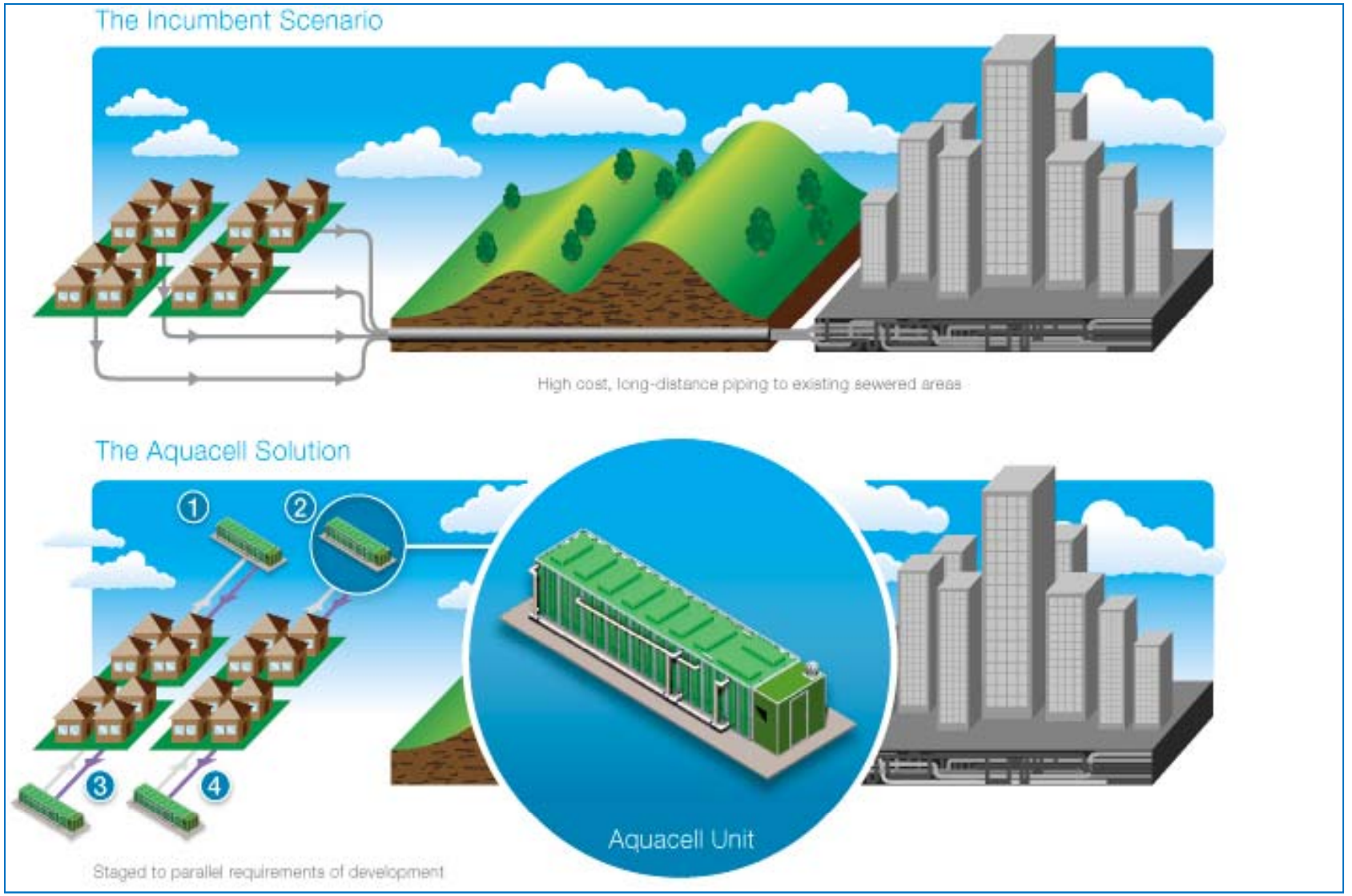
Risk of Water Shortage in 2050



Water/Sewer Infrastructure Woes



Smart Growth for New Developments



It's Time to WAKE UP!!!

Rates rising faster than any other utility…

18% Rise Since 2010*

What will building owners pay for water/sewer in 20 years?

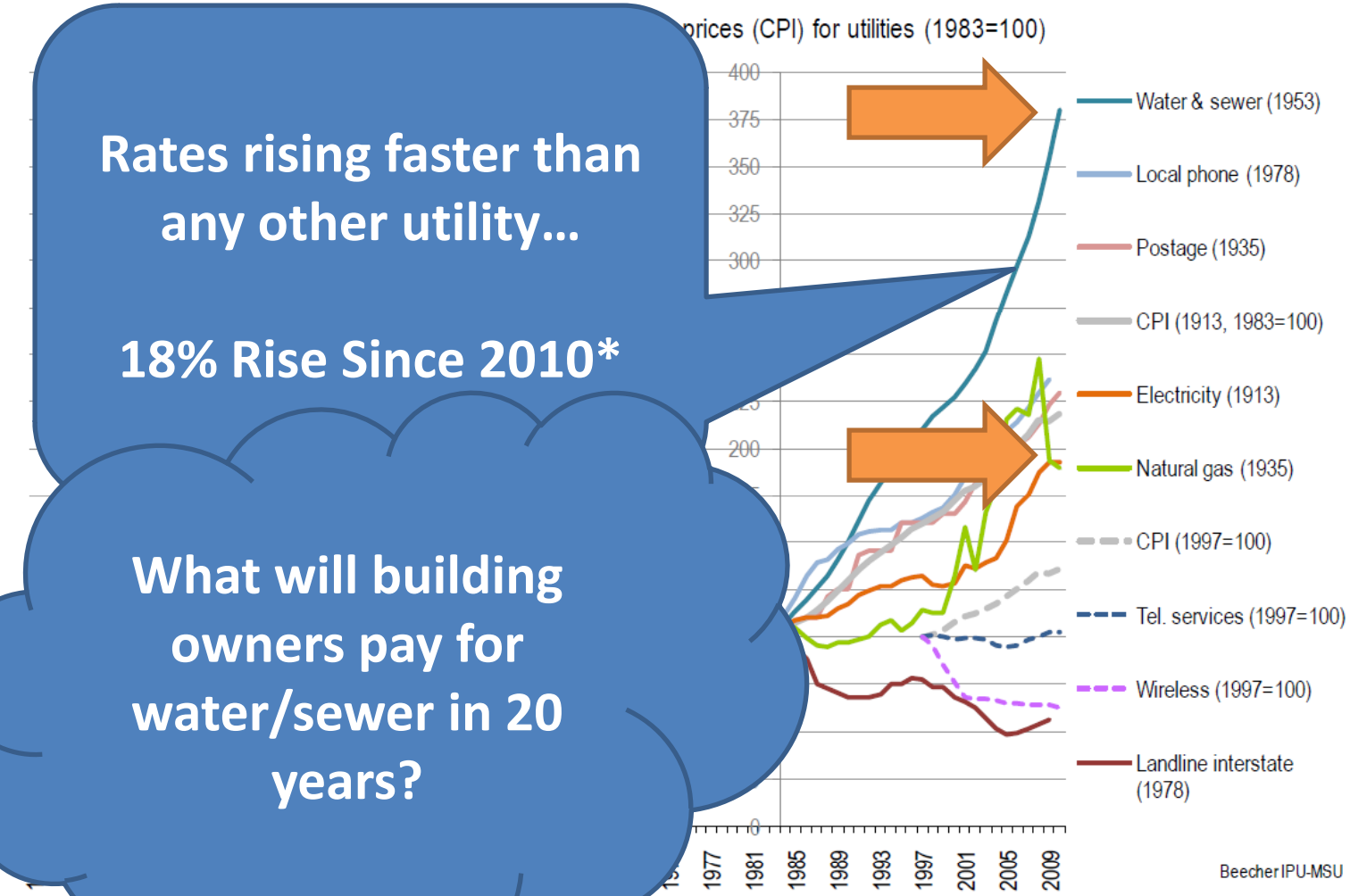


Exhibit 1.
PI) for utilities (1913-2010).
The index is se
and wireless services, where the index is set to 100 for 1997.

*Circle of Blue

The Future is Decentralized?

More Practical than Ever Before

- ✓ SAFE
- ✓ RELIABLE
- ✓ ECONOMICAL

Recipe for Success

- ✓Safe
- ✓Reliable
- ✓Economical

AGWR – International Best Practice Framework

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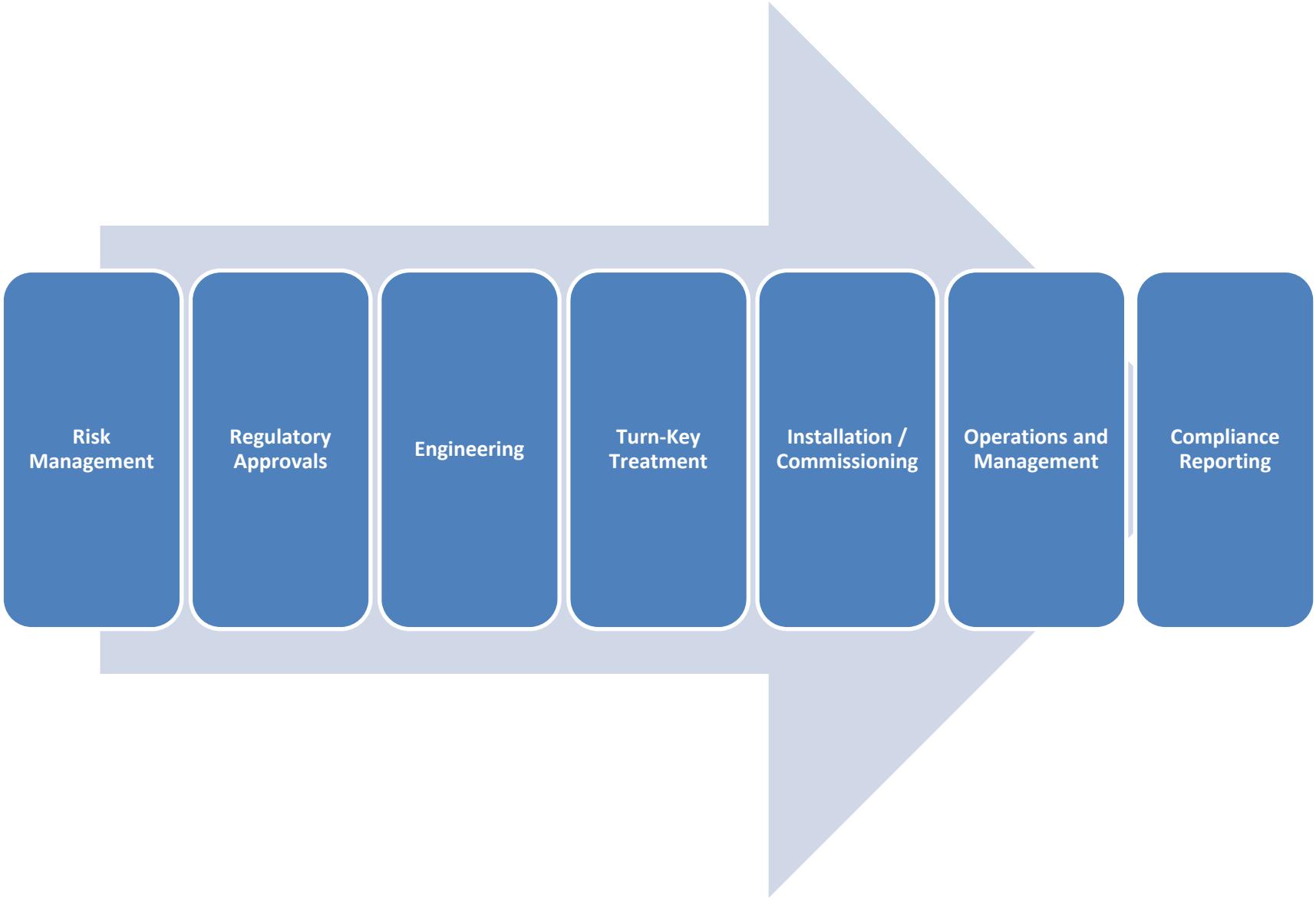
Continuity from A to Z



Risk Management

How can you be sure *every ounce* of treated water is safe for reuse?

Validation
(Can It Work?)

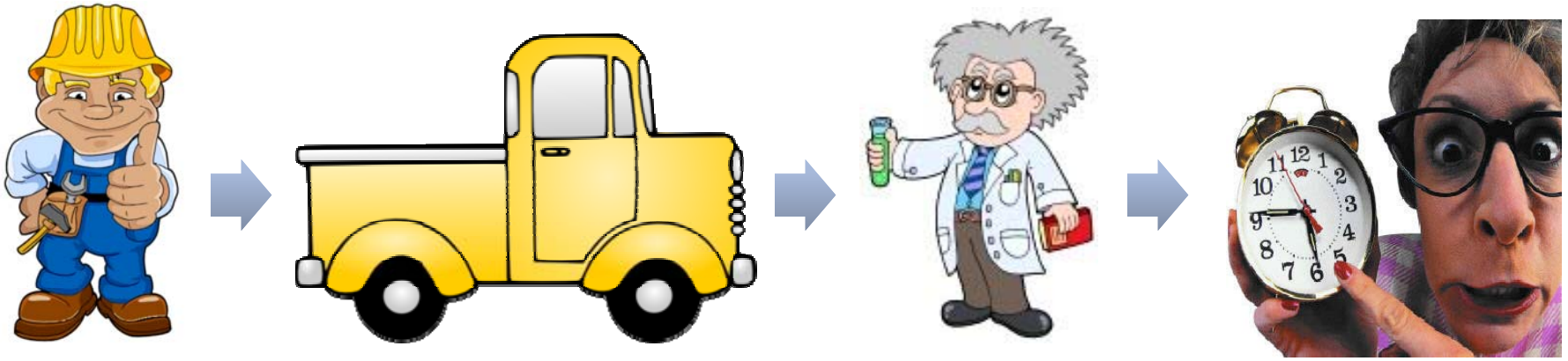
Verification Sampling
(Did It Work?)

Risk Management

How can you be sure *every ounce* of treated water is safe for reuse?

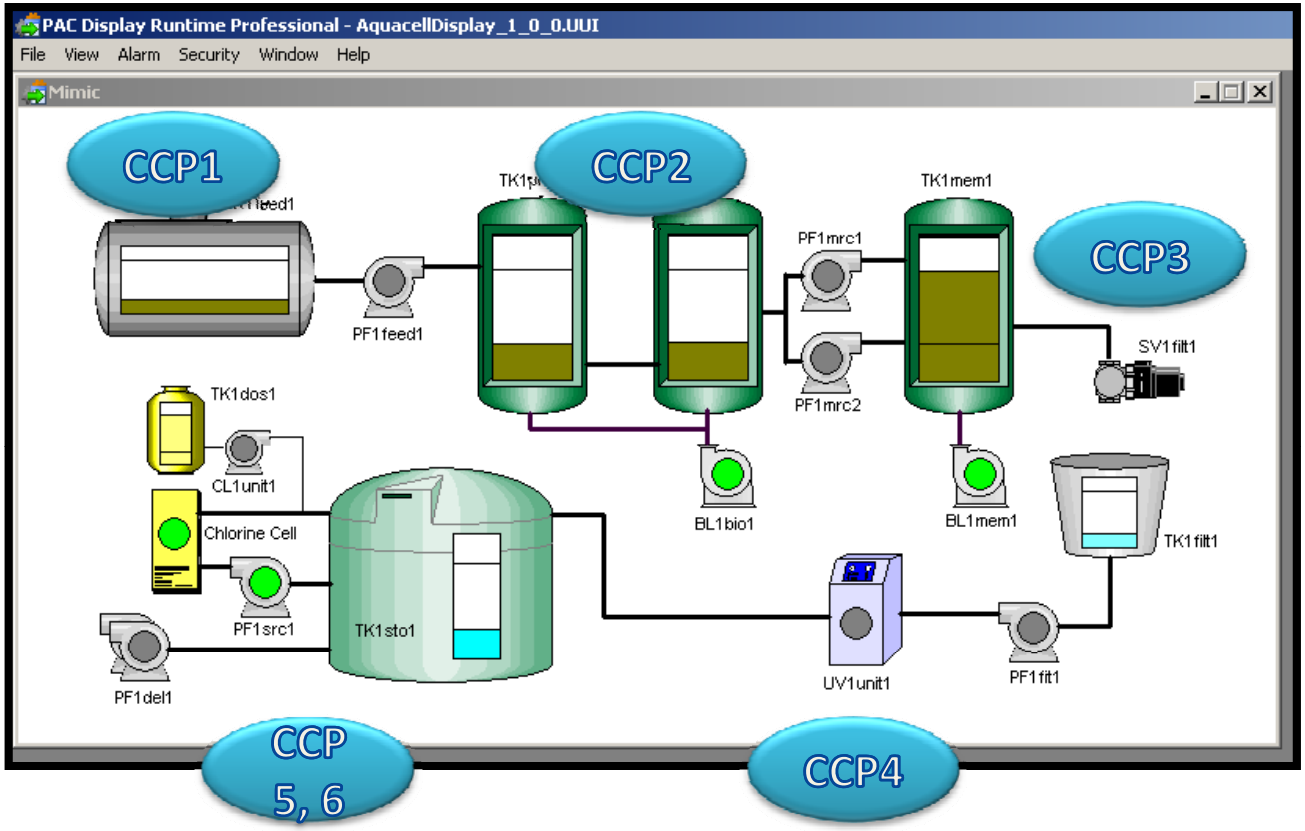
Verification Sampling
(Did It Work?)

=



Integrated Risk Management

How can you be sure *every ounce* of treated water is safe for reuse?



HACCP - Critical Control Points
24/7 Web-based Remote Monitoring

Intergrated Risk Management

How can you be sure *every ounce* of treated water is safe for reuse?

Operational Sampling
(Is It Working Now?)

=

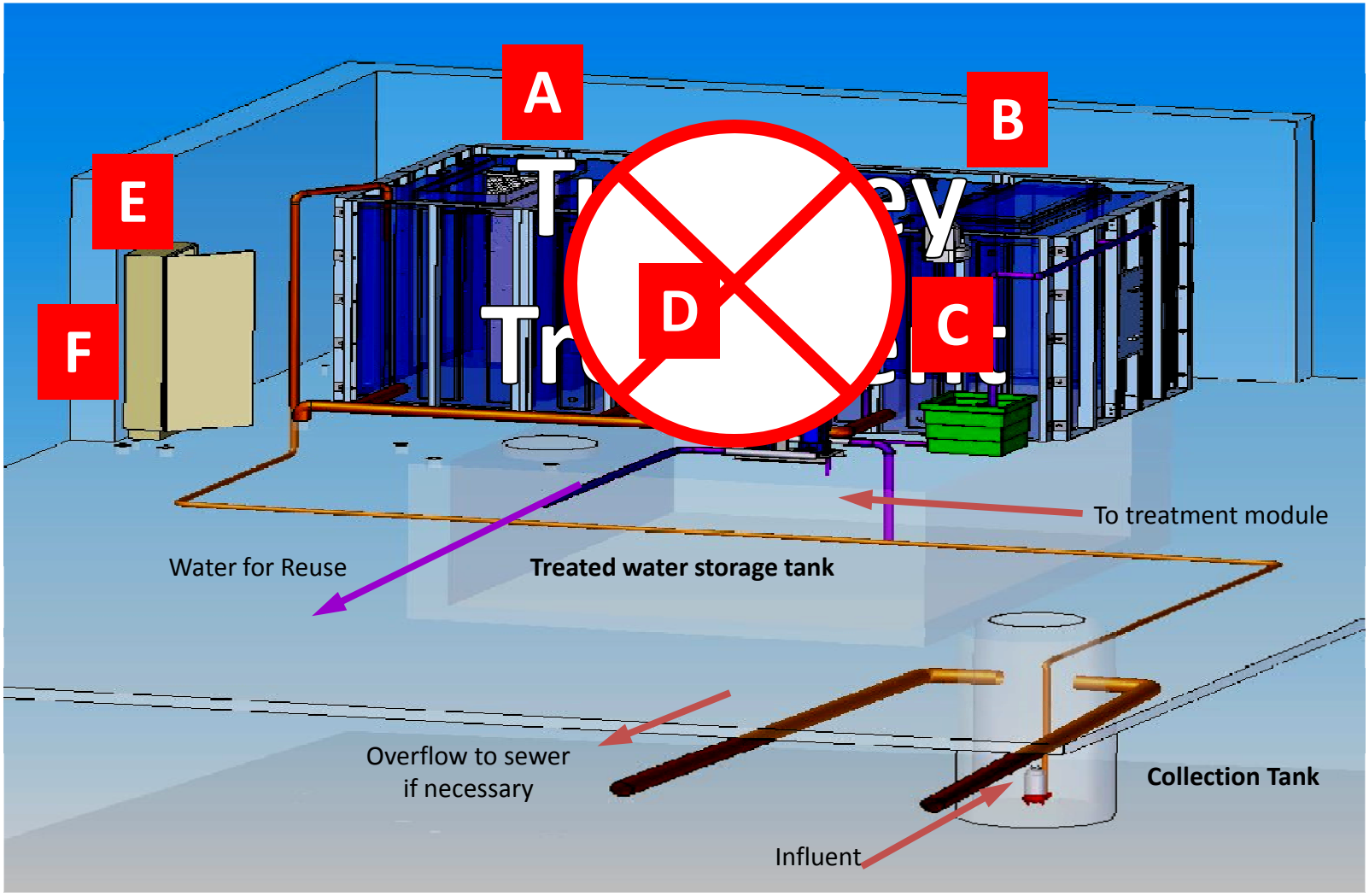
Real-time Quality Control

Less Onsite Supervision

Less End of Pipe Sampling

Less Operational Cost

More Safe, Less Cost



Proven Technology

Turn-Key Treatment System

Safe, Reliable and Economical: Things to Remember

1. **A to Z Solution**

   …Critical for Seamless Integration

2. **Integrated & Automated Controls**

   …Risk Management as Basis of Design – Failure Sensors Won't Do

3. **Turn-Key / Packaged Technology**

   …Science Project Otherwise

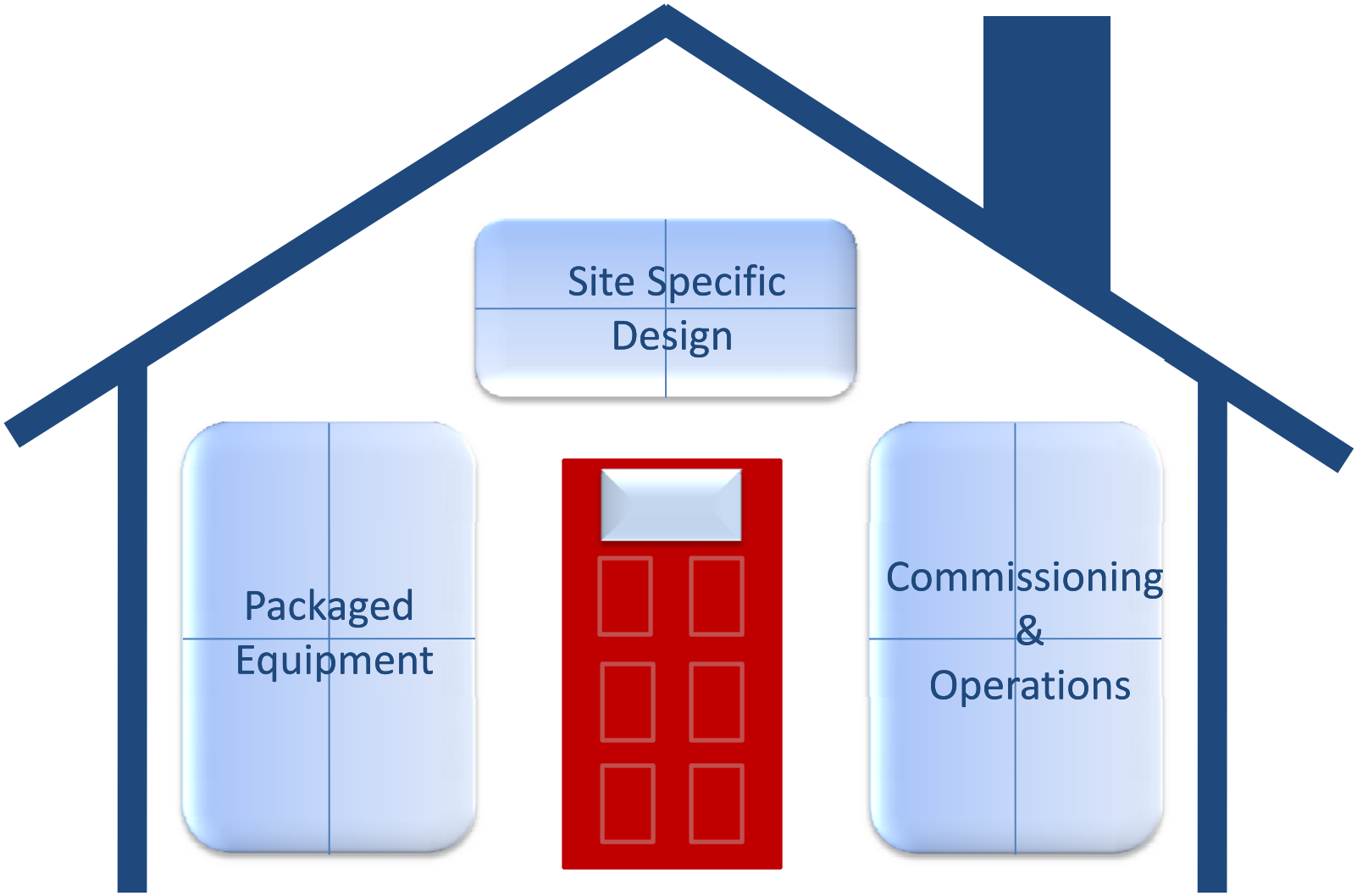
4. **Proven Track Record is Irreplaceable**

   …Where's the Data??

The Alternative…

Vancouver, BC Convention Center

All Under ONE Roof



Tools Make Life Easier

Water Reuse Calculator

Calculator: *To determine estimated savings, insert consumption values based on fixtures and fixture fittings installed*

Fixture Type	Consumption	Daily Uses	Duration	Occupants	Daily Water Use (gal)
1.28 gpf toilet - male (gallons per flush)	1.28	1	1	2,500	3,200
1.28 gpf toilet - female (gallons per flush)	1.28	4	1	2,500	12,800
0.5 gpf urinal - male (gallons per flush)	0.5	3	1	2,500	3,750
Kitchen sink - 2.2 gpm	2.2	1	0.25	5,000	2,750
Commercial Lavatory Faucet - 0.5 gpm	0.5	4	0.25	5,000	2,500
Showerhead - 1.5 gpm	1.5	0.01	5	5,000	375
Cooling Tower make-up					10,000

Irrigation	Landscaped area, acres	Irrigations per week	Irrigation rate, inches		
	1	3	0.5		6,277
				Annual Work Days	260

WATER SAVINGS SUMMARY (Projected Annual Savings from Baseline Water Usage)		
High-Efficiency Fixtures	2,080,000	**16.1%**
HE + Greywater Reuse	2,827,500	**21.9%**
HE + Blackwater Reuse	8,677,500	**67.2%**
HE + Blackwater Reuse + Sewer Mining	11,446,994	**88.7%**

High-Efficiency Fixtures Water Usage	
Total Daily Demand	41,652
Total Annual Usage	10,829,494
Annual Savings	2,080,000
% Reduction	-16.1%

Important Daily Totals	
Greywater Supply	2,875
Blackwater (total w/w) Supply	25,375
Toilet/Urinal Flushing Demand	19,750
Non-Potable Demand	36,027
Potable Demand	5,625
Total Daily Water Demand	41,652

Greywater Reuse	
2,875	daily savings (recycled daily)
38,777	new daily water usage
10,081,994	new annual water usage
747,500	annual water savings
-6.9%	in addition to HE water savings
-21.9%	HE fixtures & greywater reuse

(% Reduction / Total % Reduction)

Blackwater Reuse	
25,375	daily savings (recycled daily)
16,277	new daily water usage
4,231,994	new annual water usage
6,597,500	annual water savings
-60.9%	in addition to HE water savings
-67.2%	HE fixtures & blackwater reuse

(% Reduction / Total % Reduction)

Blackwater Reuse + Sewer Mining to Meet Non-Potable Demand	
1,462,500	new annual usage w/ sewer mining
-88.7%	HE fixtures, blackwater reuse & sewer mining

(Total % Reduction)

Wastewater Reuse Cost Analysis

Wastewater Reuse Cost Analysis

aquacell water recycling solutions

Web Links:
aquacell greywater solutions
aquacell blackwater solutions

Questions/Project Inquiries?
Mark Meredith
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502) 499-6198 ext. 151

Seattle Commercial Office Tower

Blackwater System
System Size / Daily Volume Treated (in gallons) 35,000

Assumptions:

Blackwater System Cost (CAPEX)	$1,100,000 (includes approvals, design, project mgmt, install, commissioning)
Water Smart Technology Rebate??	??New Price for Blackwater System
Secondary CAPEX Costs	$110,000 (includes buffer & storage tanks, purple pipe, site works)
Annual Operating Cost (OPEX)	$55,000
Annual Days in Operation	260
Ongoing Asset Maintenance	2% of CAPEX (annually)
Energy Cost	4% annual increase
3% annual increase in water/sewer rate (twice the rate of inflation - tagged at 3% in OPEX)	
Project coming online in 2012 - YEAR 1	

Energy Cost

$0.089 kWh cost (from US Dept of Labor, 2012)
$0.687.6 kWh per 1,000 gal

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
	$6,155	$6,401	$6,658	$6,924	$7,201	$7,489	$7,788	$8,100	$8,424	$8,761	$9,111	$9,476	$9,855	$10,249	$10,659	$11,085	$11,529	$11,990	$12,469	$12,968
Asset Maintenance																				
	$0	$0	$0	$22,000	$22,000	$22,660	$23,340	$24,040	$24,761	$25,504	$26,269	$27,057	$27,869	$28,705	$29,566	$30,453	$31,367	$32,308	$33,277	$34,275
System OPEX																				
	$55,000	$55,000	$55,000	$55,000	$55,000	$56,650	$58,350	$60,100	$61,903	$63,760	$65,673	$67,643	$69,672	$71,763	$73,915	$76,133	$78,417	$80,769	$83,192	$85,688
Total OPEX																				
$61,155	$61,401	$61,658	$83,924	$84,201	$86,799	$89,478	$92,240	$95,088	$98,025	$101,053	$104,176	$107,396	$110,716	$114,140	$117,671	$121,312	$125,067	$128,939	$132,931	

Baseline Water/Sewer Cost

0.0213 combined per gallon rate
53,000 gallons purchased daily from utility
$1,129 daily cost

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
	$293,514	$311,125	$329,792	$349,580	$370,555	$392,788	$416,355	$441,337	$467,817	$495,886	$525,639	$557,177	$590,608	$626,044	$663,607	$703,423	$745,629	$790,367	$837,789	$888,056
TOTAL		$604,639	$934,431	$1,284,011	$1,654,566	$2,047,354	$2,463,709	$2,905,045	$3,372,862	$3,868,748	$4,394,387	$4,951,564	$5,542,172	$6,168,216	$6,831,823	$7,535,246	$8,280,875	$9,071,242	$9,909,030	$10,797,086

HE Fixtures Water/Sewer Cost

0.0213 combined per gallon rate
43,000 gallons purchased daily from utility
$916 daily cost

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
	$238,134	$252,422	$267,567	$283,621	$300,639	$318,677	$337,798	$358,065	$379,549	$402,322	$426,462	$452,049	$479,172	$507,923	$538,398	$570,702	$604,944	$641,241	$679,715	$720,498
TOTAL		$490,556	$758,123	$1,041,745	$1,342,383	$1,661,061	$1,998,858	$2,356,923	$2,736,473	$3,138,795	$3,565,257	$4,017,307	$4,496,479	$5,004,402	$5,542,800	$6,113,502	$6,718,446	$7,359,687	$8,039,402	$8,759,900

Blackwater Recycling Water/Sewer Cost

0.0213 combined per gallon rate
11,500 gallons purchased daily from utility
$245 daily cost

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
	$63,687	$67,508	$71,559	$75,852	$80,403	$85,228	$90,341	$95,762	$101,507	$107,598	$114,054	$120,897	$128,151	$135,840	$143,990	$152,630	$161,787	$171,495	$181,784	$192,691
TOTAL		$131,195	$202,754	$278,606	$359,010	$444,237	$534,578	$630,340	$731,847	$839,445	$953,499	$1,074,396	$1,202,547	$1,338,387	$1,482,377	$1,635,006	$1,796,794	$1,968,288	$2,150,073	$2,342,764

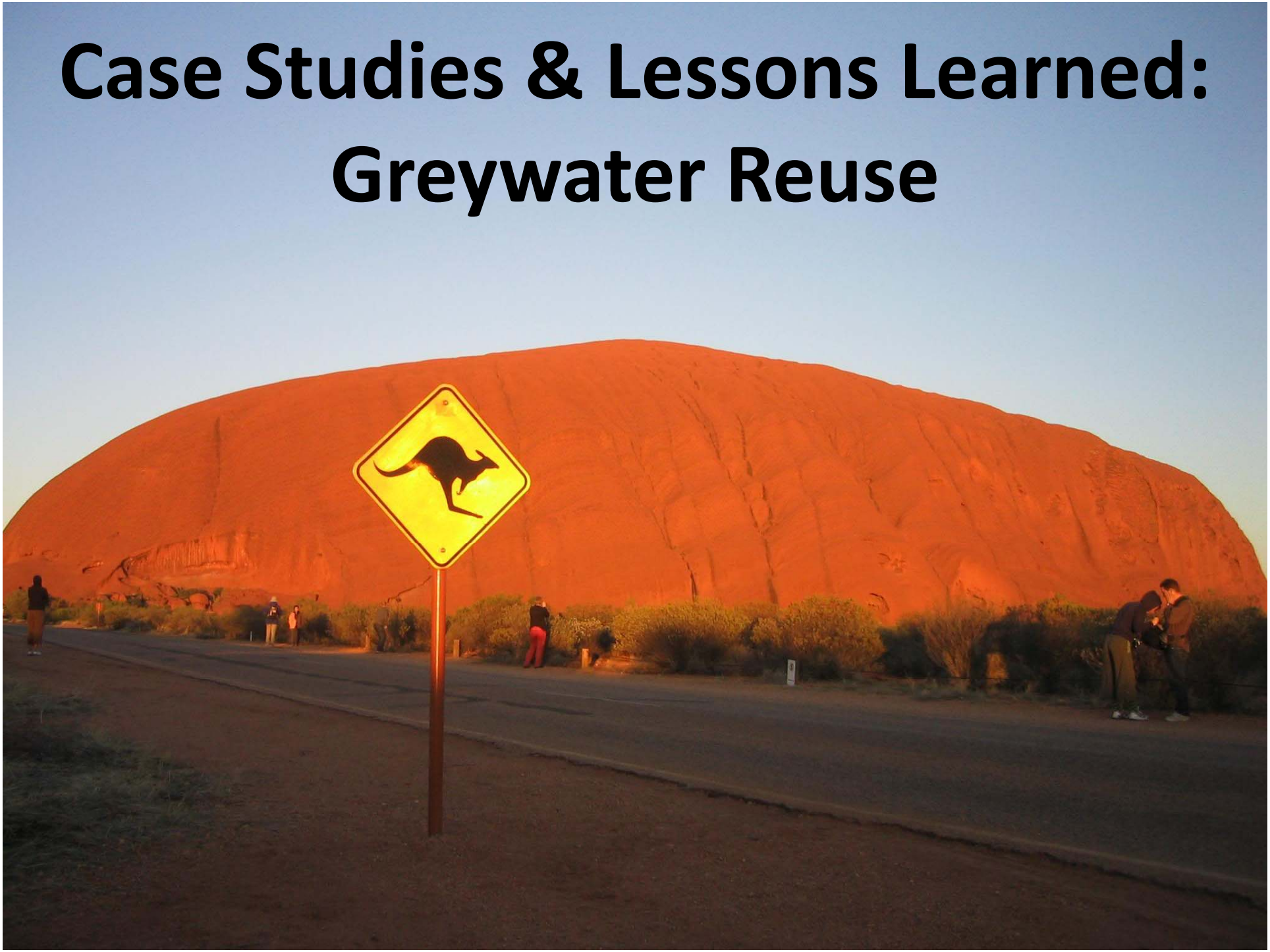
Blackwater CAPEX/OPEX (aggregate to operate blackwater system, incl. decreased water/sewer cost)

$1,334,842	$1,463,752	$1,596,968	$1,756,744	$1,921,348	$2,093,375	$2,273,194	$2,461,195	$2,657,791	$2,863,413	$3,078,520	$3,303,593	$3,539,140	$3,785,696	$4,043,827	$4,314,128	$4,597,227	$4,893,789	$5,204,513	$5,530,138

Summary

Payback achieved during Year 9
Saving $174,000 on water/sewer bills in Year 1
Save $3.2 million over 20 years

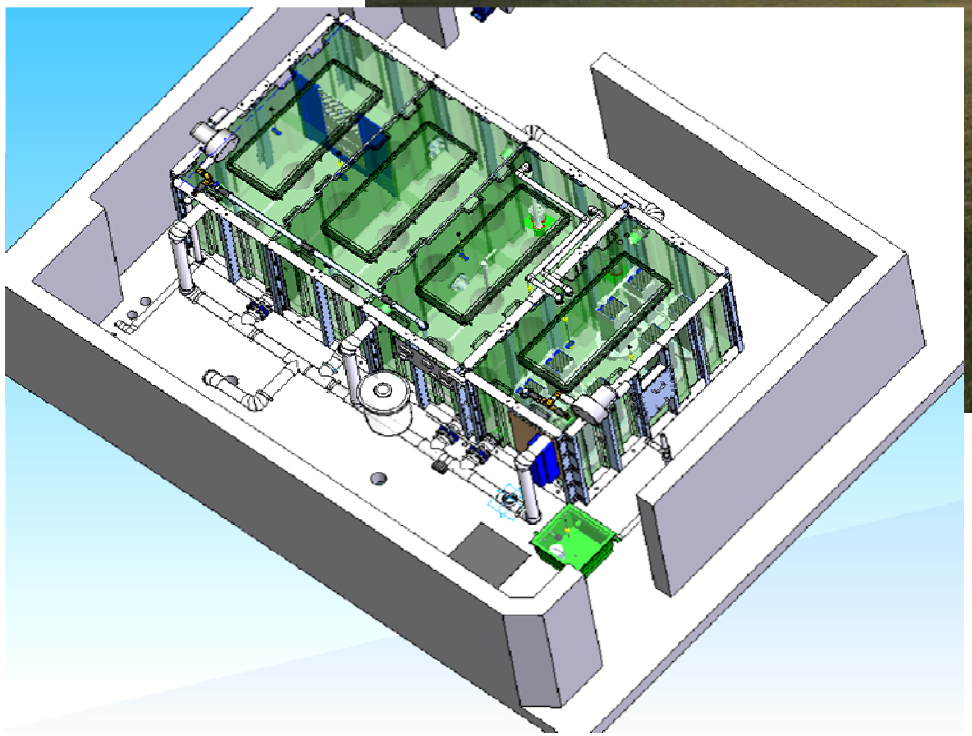
Case Studies & Lessons Learned: Greywater Reuse



2,600 gal/day
Multifamily Housing

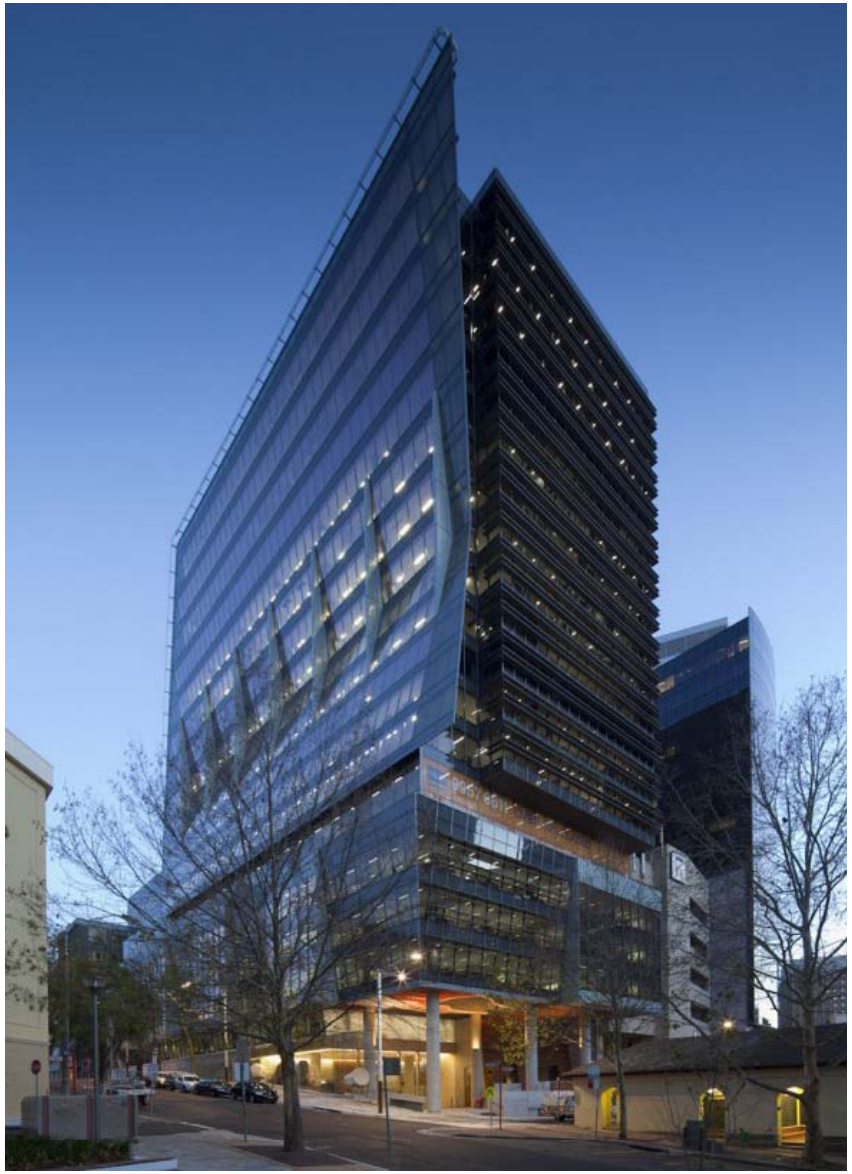
Master Planned Sustainable Community

5x Greywater Plants



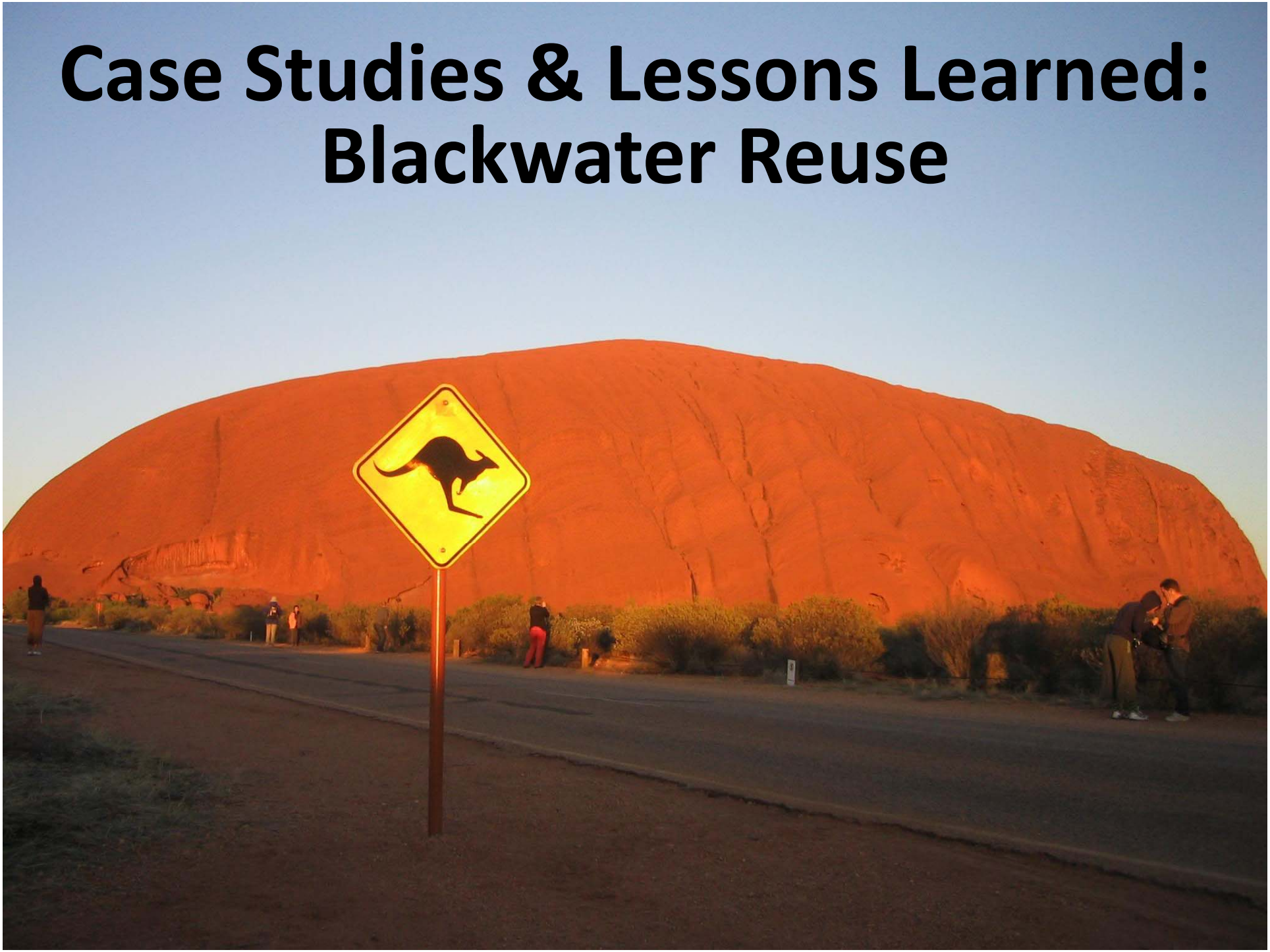
2,600 GPD
Luxury Condominiums

2,600 gal/day
Luxury Condominiums



3,000 gal/day
Commercial Office Tower

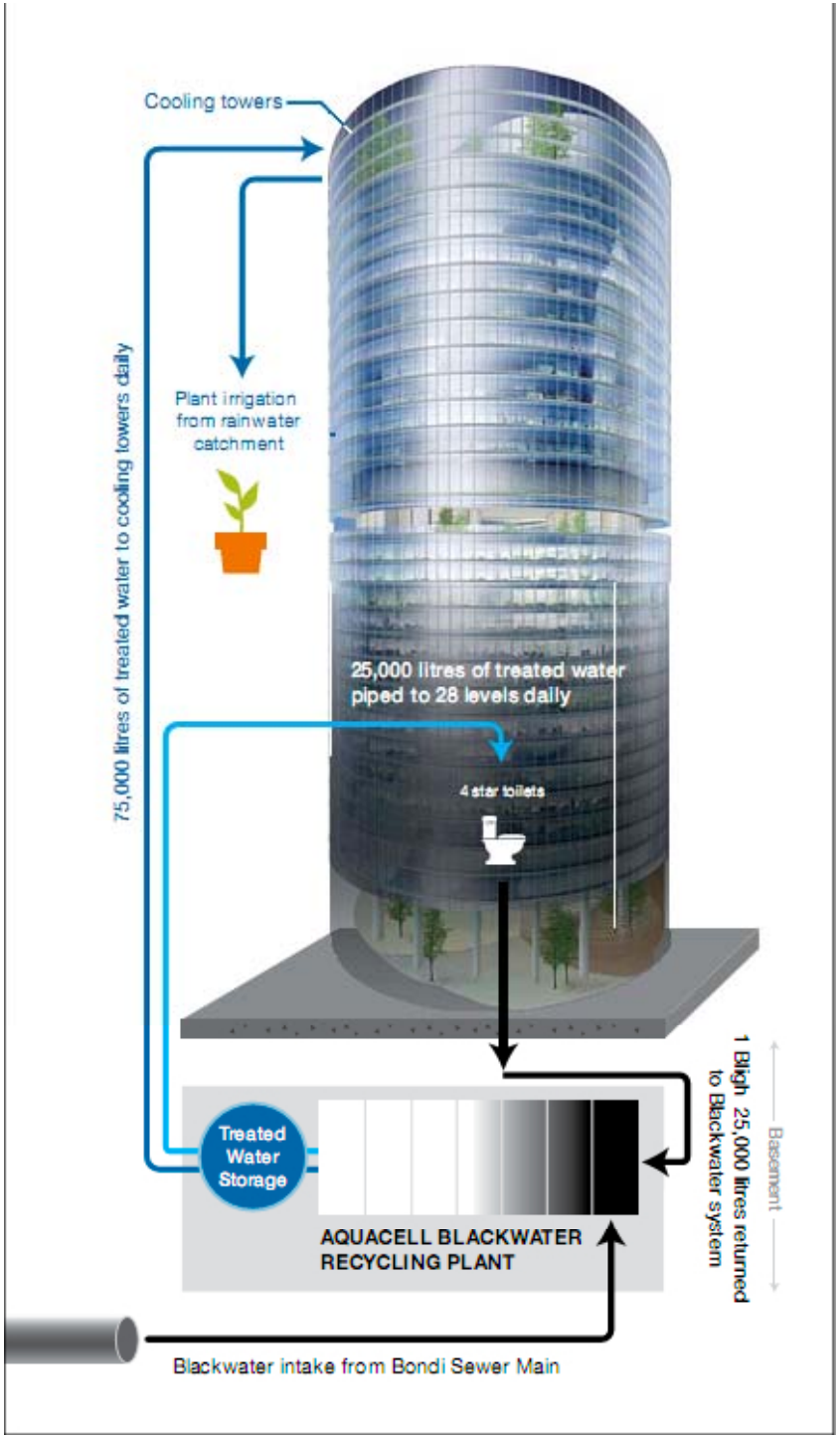
Case Studies & Lessons Learned: Blackwater Reuse

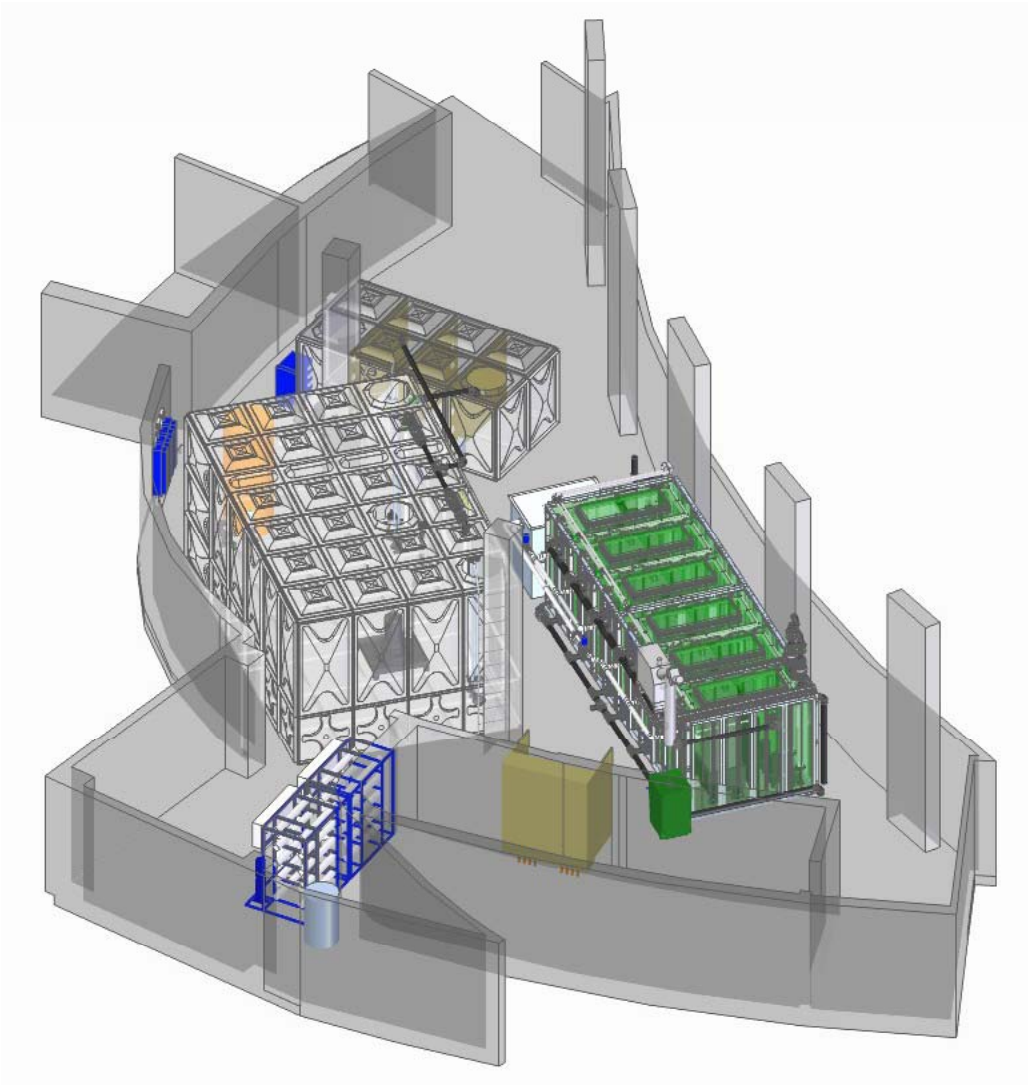


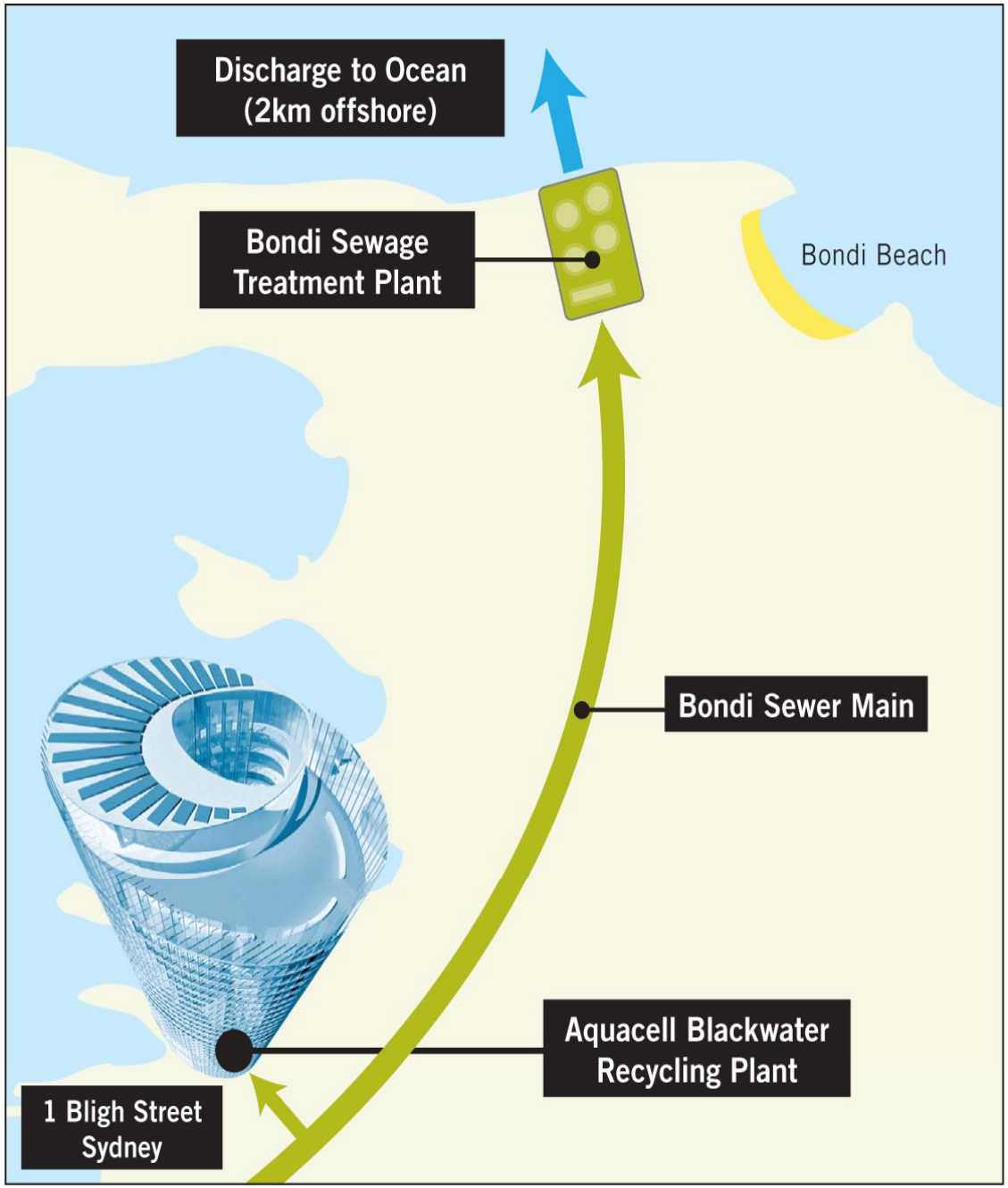
26,000 gal/day
Canberra Airport Business Park

26,000 gal/day
Hotel, Casino and Sports Complex

- 27-story development
- 6 star – Green Star
- 2012 CTBUH's Most Outstanding Tall Building in Australasia region
- Recycling 26,000 gal/day of blackwater
- Toilet/urinal flushing and cooling tower reuse
- 1 Bligh Street Video


Cooling towers
75,000 litres of treated water to cooling towers daily
Plant irrigation from rainwater catchment
25,000 litres of treated water piped to 28 levels daily
4 star toilets
Treated Water Storage
AQUACELL BLACKWATER RECYCLING PLANT
1 Bligh 25,000 litres returned to Blackwater system
Basement
Blackwater intake from Bondi Sewer Main





Sewer Mining

Want to learn more about design & technical side?

Go to ASPE.org for ‘Wastewater Reuse Technically Speaking’ webinar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