WHY AUSTRALIA NEEDS RAINWATER HARVESTING

Peter J Coombes

MOTIVATION

PERSPECTIVE

Systems scientist specializing in bottom up systems analysis using big data and ground truth. Long experience in understanding the contribution of local communities and actions to global outcomes

INSIGHT

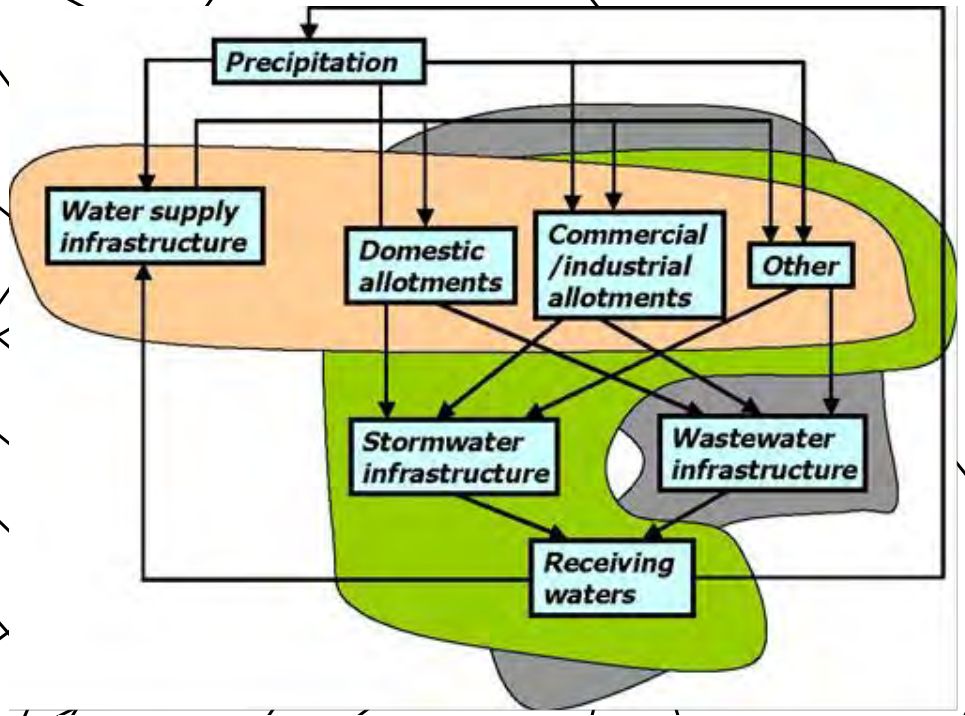
The future of cities is dependent on water cycle resources
We have mature analysis processes but are continually surprised by droughts, floods, social impacts and environmental damage

A BOTTOM UP SYSTEMS APPROACH

We live in a system – not a collection of isolated silos
Policy applies at multiple distributed scales within a system – usually acts locally

PLACES TO INTERVENE?

THE OPPORTUNITY FOR RESILIENCE



Source control – an important opportunity

National Rainwater Benefits in 2050

Total water saving: > 385 GL/year

Net Present value: > $25.7 billion

Reduced GHG: > 675 kTonnes

Decreased nutrients: > 470 tonnes/year

CHALLENGES

Population growth, economic shocks, declining welfare and environment, variable weather and a changing climate

LOCAL CONTRIBUTION

Rainwater is an important source of water for rural and urban Australians - more that 34% of households

A catalyst for increased water savings, improved stormwater management and improved household welfare

Increases the resilience of centralized water supply, waterway health and cohesion of society

OUT OF SCOPE AND INCONVENIENT?

Most measurement, reporting and decision making is from the utility perspective for regulatory purposes. How do we include local communities and solutions?

A WHOLE OF SOCIETY RESPONSE

Water is a business and power opportunity for monopolies but solutions at multiple scales increase resilience

URBAN WATER SECURITY, DEMOGRAPHICS AND ECONOMICS

Serviced population: + 50%

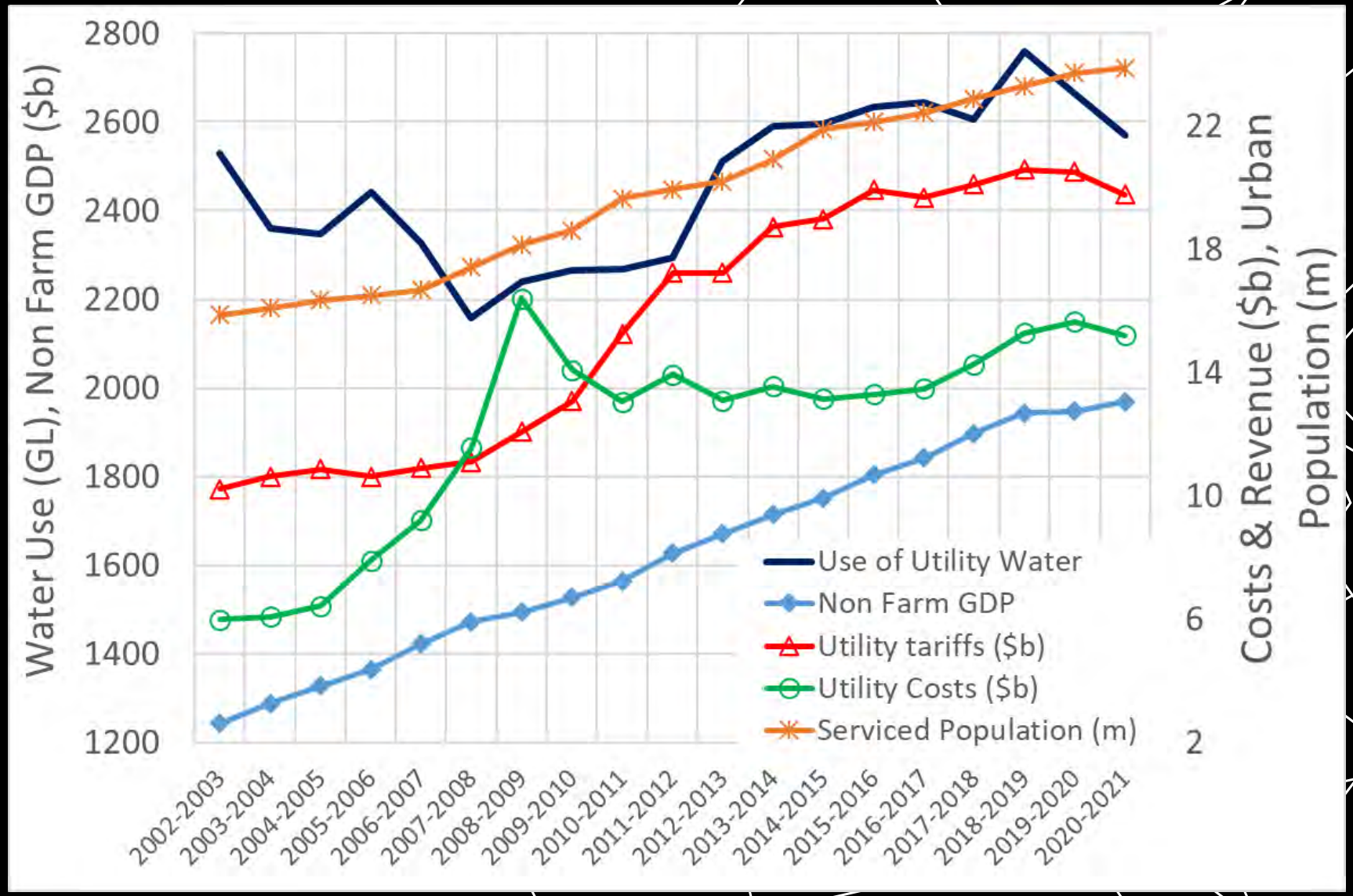
Water Use: +2%; (-32% per capita)

Tariffs: +93%; (+29% per capita)

Costs: +154%; (+69% per capita)

GDP: +58%; (+27% per capita)

Per capita urban water use has reduced but population, utility costs and tariffs have increased at a greater rate than economic growth

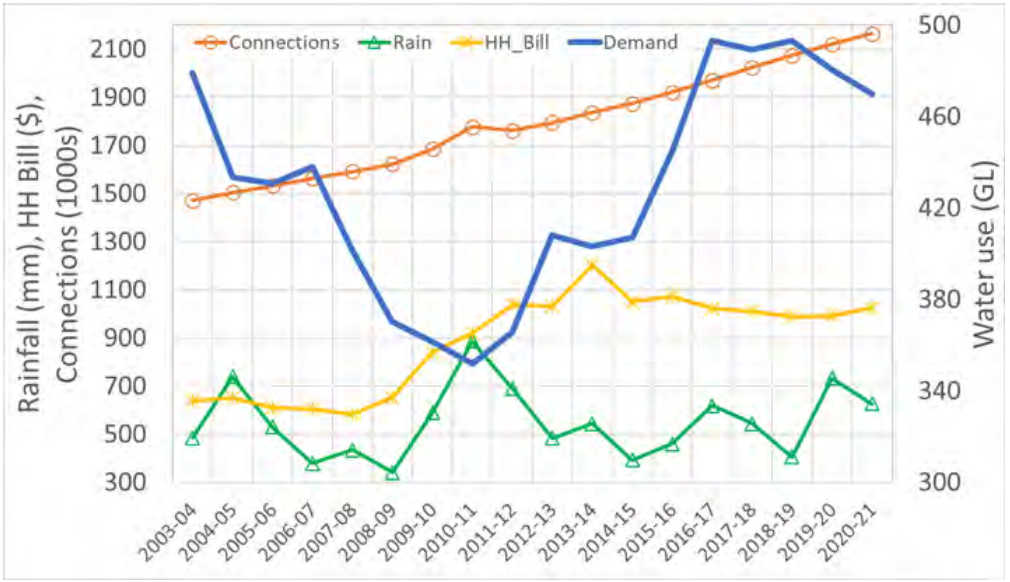


Coombes, P. J. (2024). The influence of regulation on preference for utility infrastructure investment to generate income for Australian water corporations. *Australasian Journal of Water Resources*, 1–22. https://doi.org/10.1080/13241583.2024.2393933

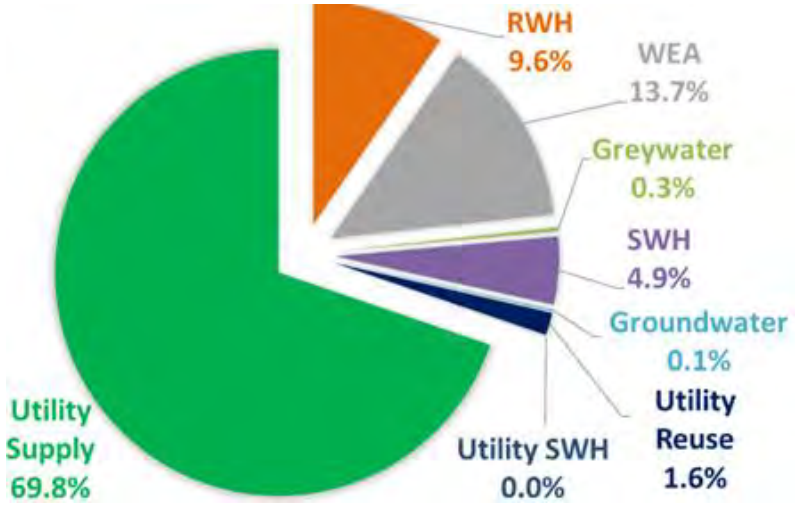
URBAN DYNAMICS – WATER MARKET IS GREATER THAN UTILITY SERVICES

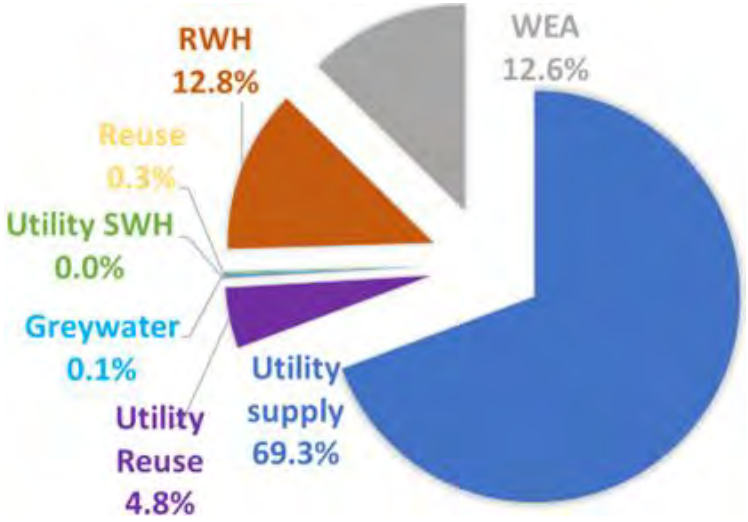
- Strong urban growth
- Decline in urban demands for utility water
- Real increases in bills
- Resilience during drought provided by local solutions and conservation
- Urban rainfall during drought
- More than 30% of urban water from alternative and community sources

MELBOURNE

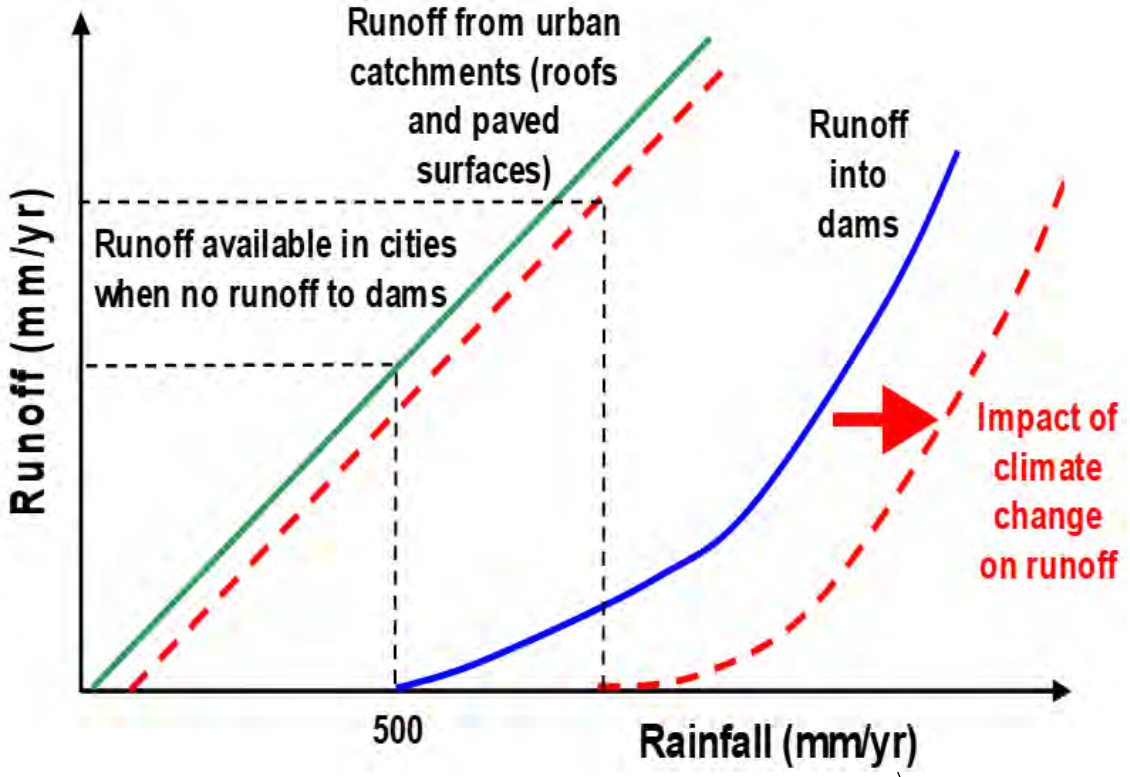


SYDNEY

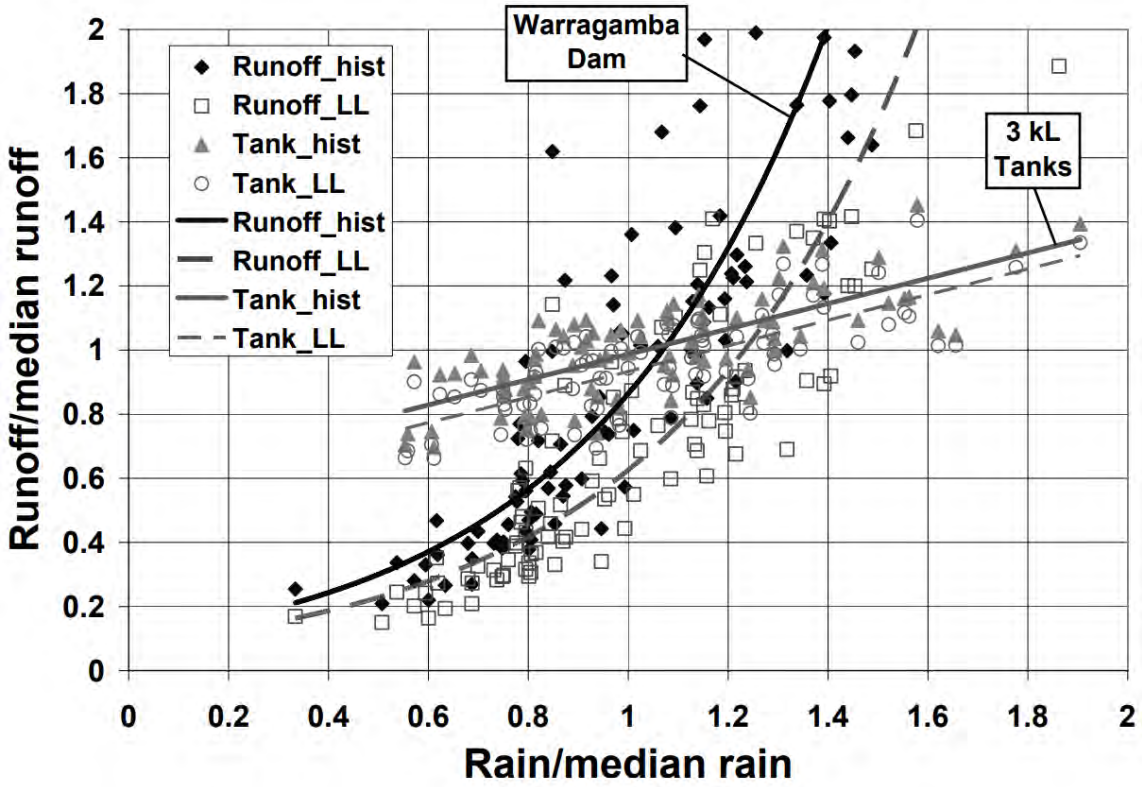




CLIMATE CHANGE AND DROUGHT



Urban catchments more efficient at generating runoff than natural catchments

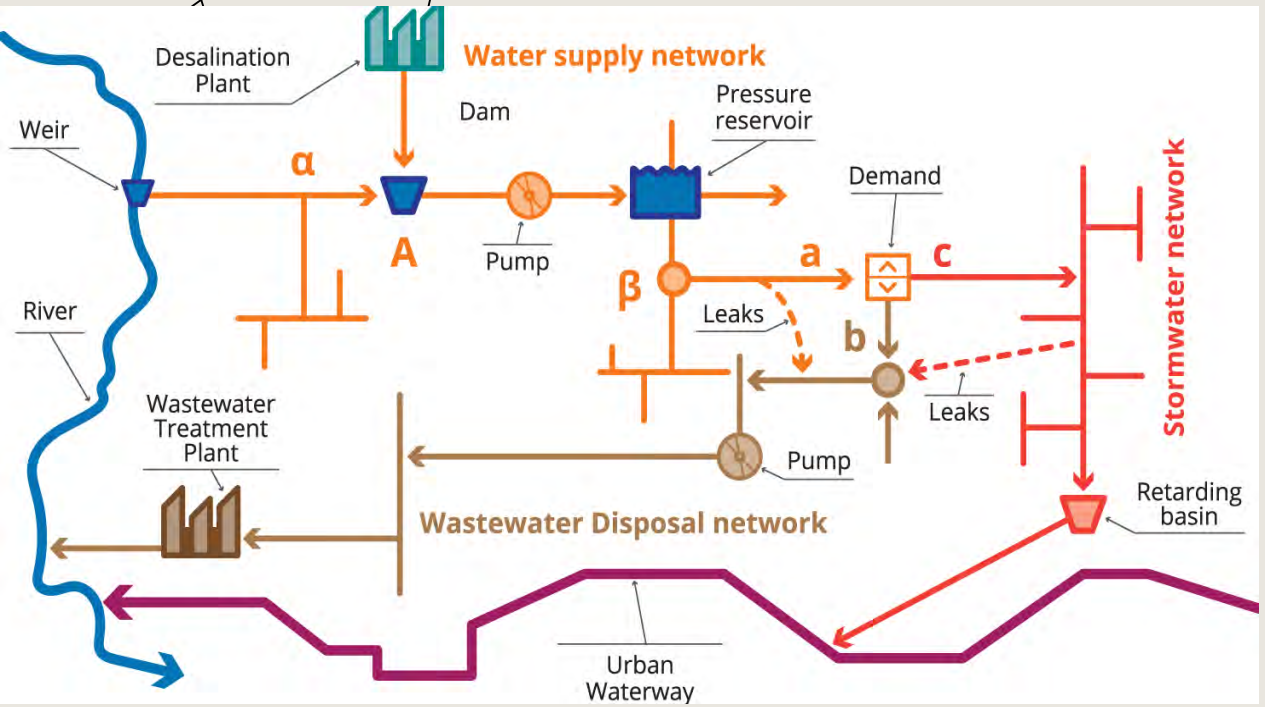


Sydney: Climate change and drought reduces dam yield by 29% - 79% but rainwater yield only reduces by 0% - 5%

Coombes P. J., Barry M. E., The relative efficiency of water supply catchments and rainwater tanks in cities subject to variable climate and the potential for climate change, *Australian Journal of Water Resources*, 12, 85-100, 2008

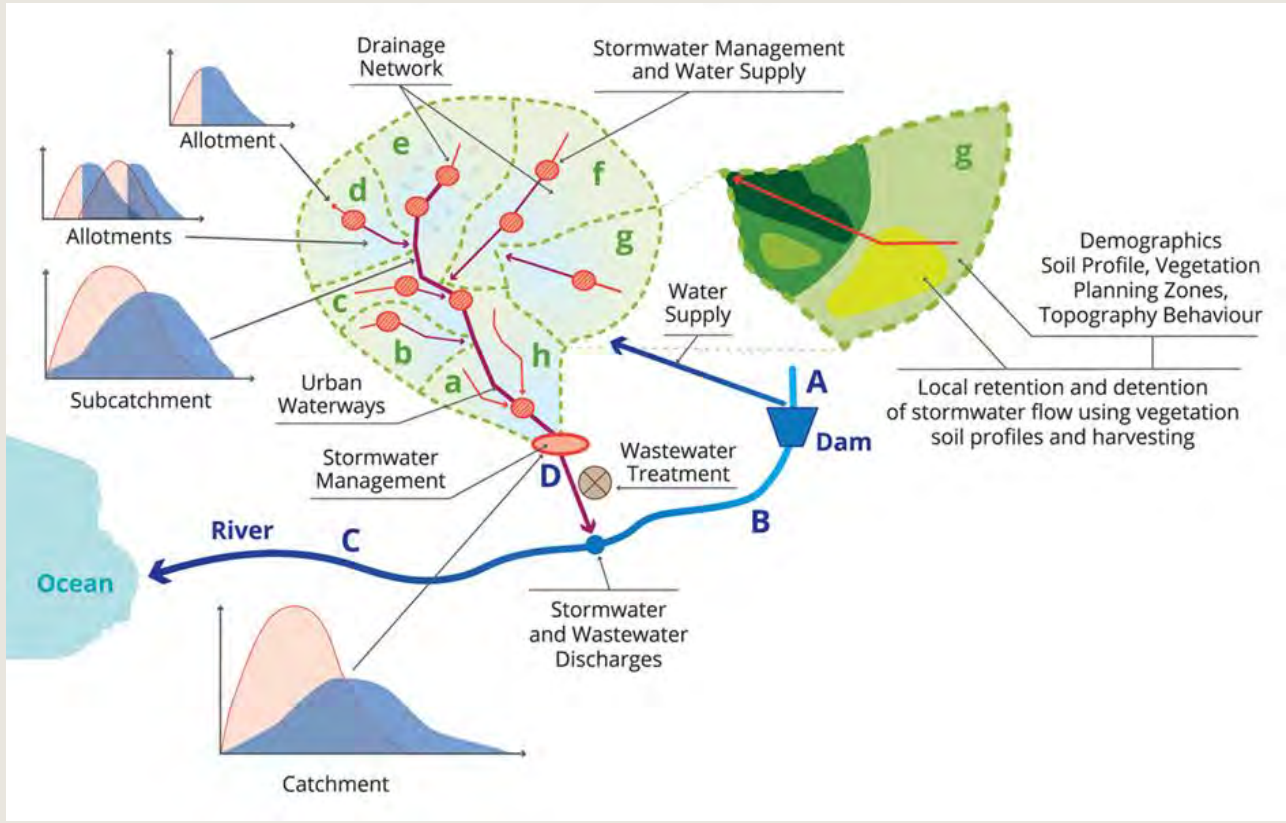
A NON-LINEAR AND LINKED COMMULATIVE SYSTEM

CONNECTIVITY



Costs and benefits linked across the system

CUMULATIVE SYSTEM



Costs (risks) and benefits (opportunities) accumulate from lot to regional scale

Coombes P. J., Status of transforming stormwater drainage to a systems approach to urban water cycle management – moving beyond green pilots, *Australasian Journal of Water Resources,* 22:1, 15-28, 2018

SPATIAL VARIANCE IN UTILITY COSTS

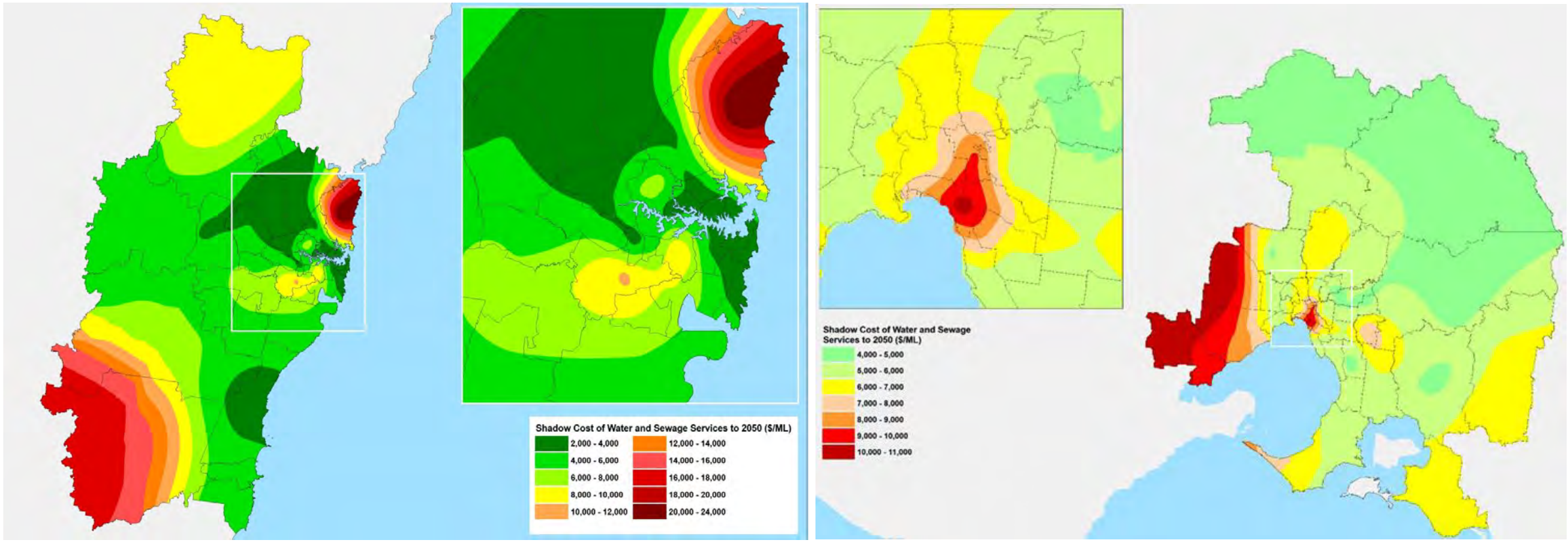
Sydney real costs of water utility services: $2/kL – $24/kL

Melbourne real costs of water utility services: $4/kL – $11/kL

Local solutions avoid these real spatial costs! These are the costs to source and transport water to local areas, and then manage the discharge of water from those areas.

SYDNEY

MELBOURNE



HEALTH AND BACKFLOW RISKS?

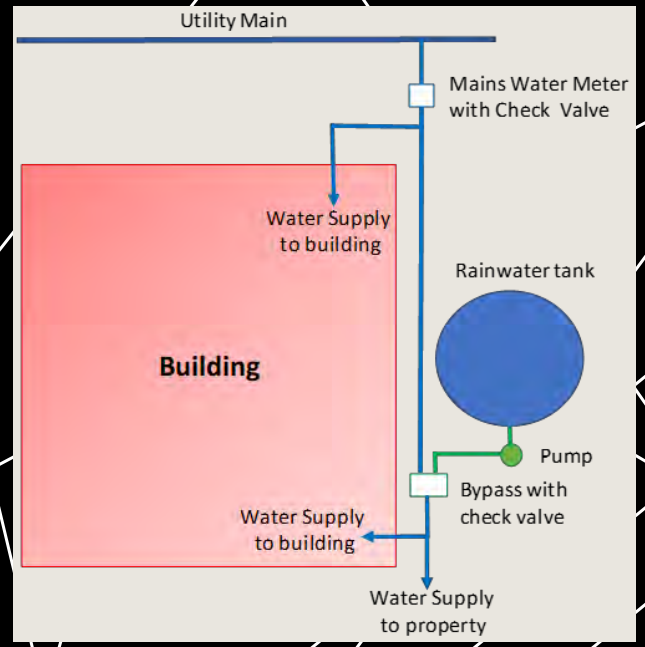
Review of health and backflow risks across Australia, UK and USA

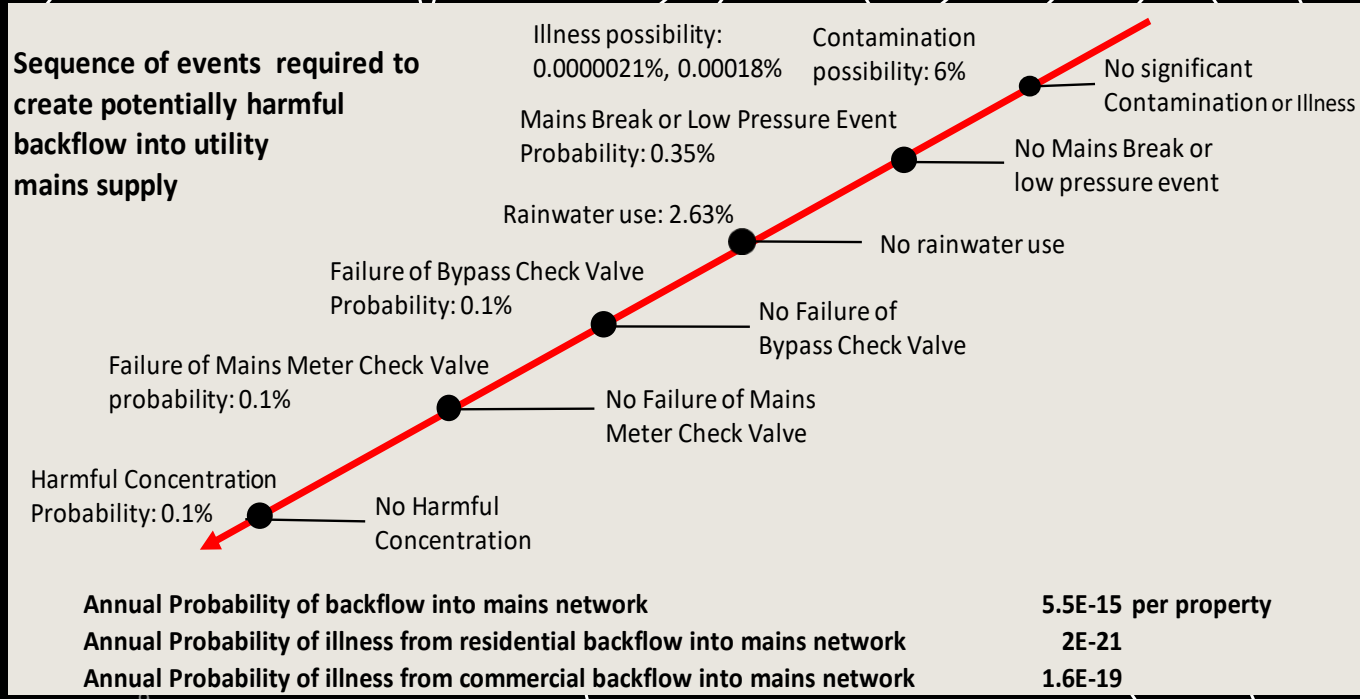
Health risks from rainwater (0.000079 chance of illness) are less than mains water (0.0013 chance of illness)

No record of harmful cross connection or backflow from urban rainwater harvesting.

Most observed backflow events are from utility, firefighting or pest control activities

Calculated backflow risk is 5.5 times 10^{-15} and health risk from a backflow event is 1.6 times 10^{-19}



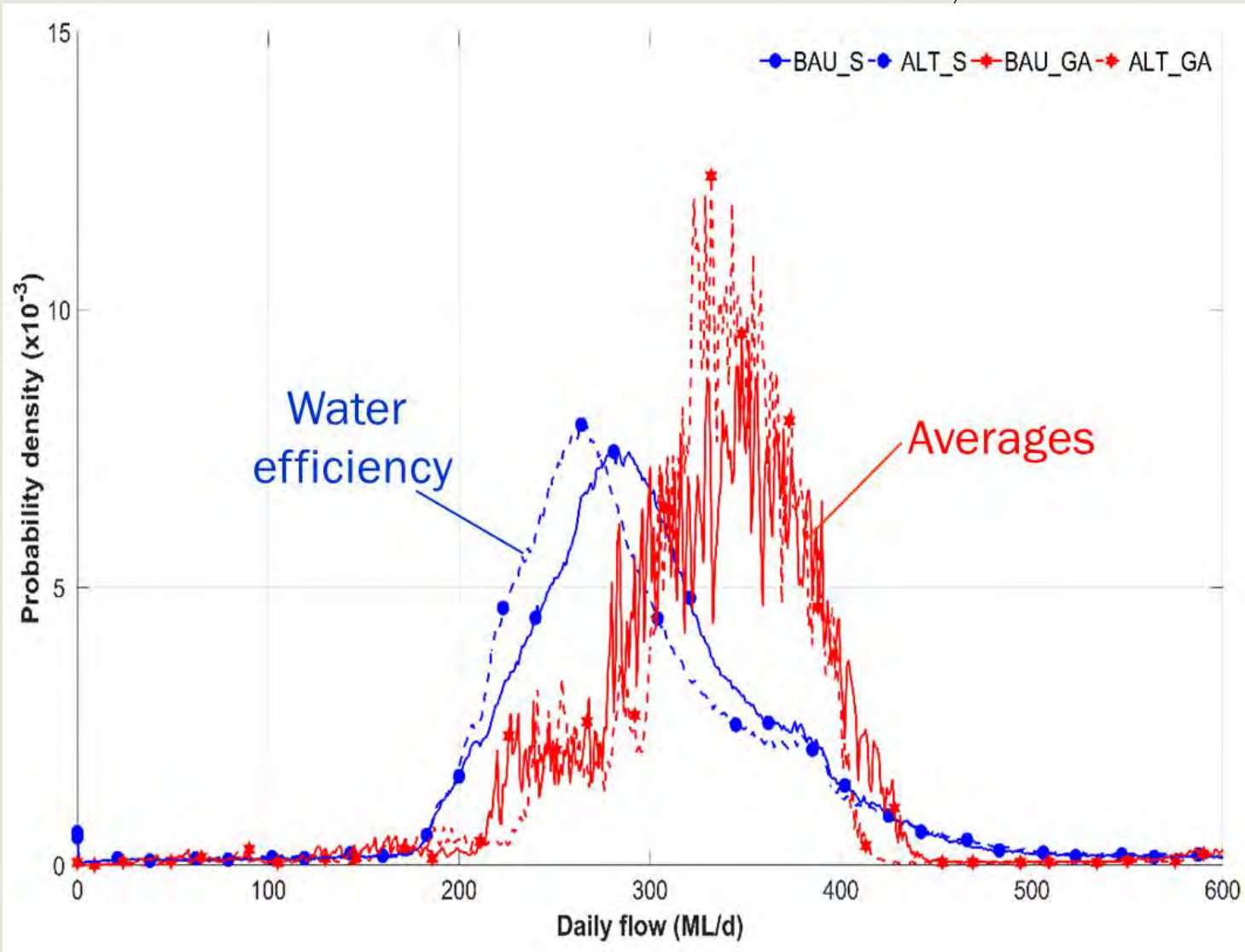


Coombes P.J, (2021), Review of the potential for cross connection and backflow from properties with rainwater harvesting, Urban Water Cycle Solutions, November 2021

THE ILLUSION OF AVERAGES

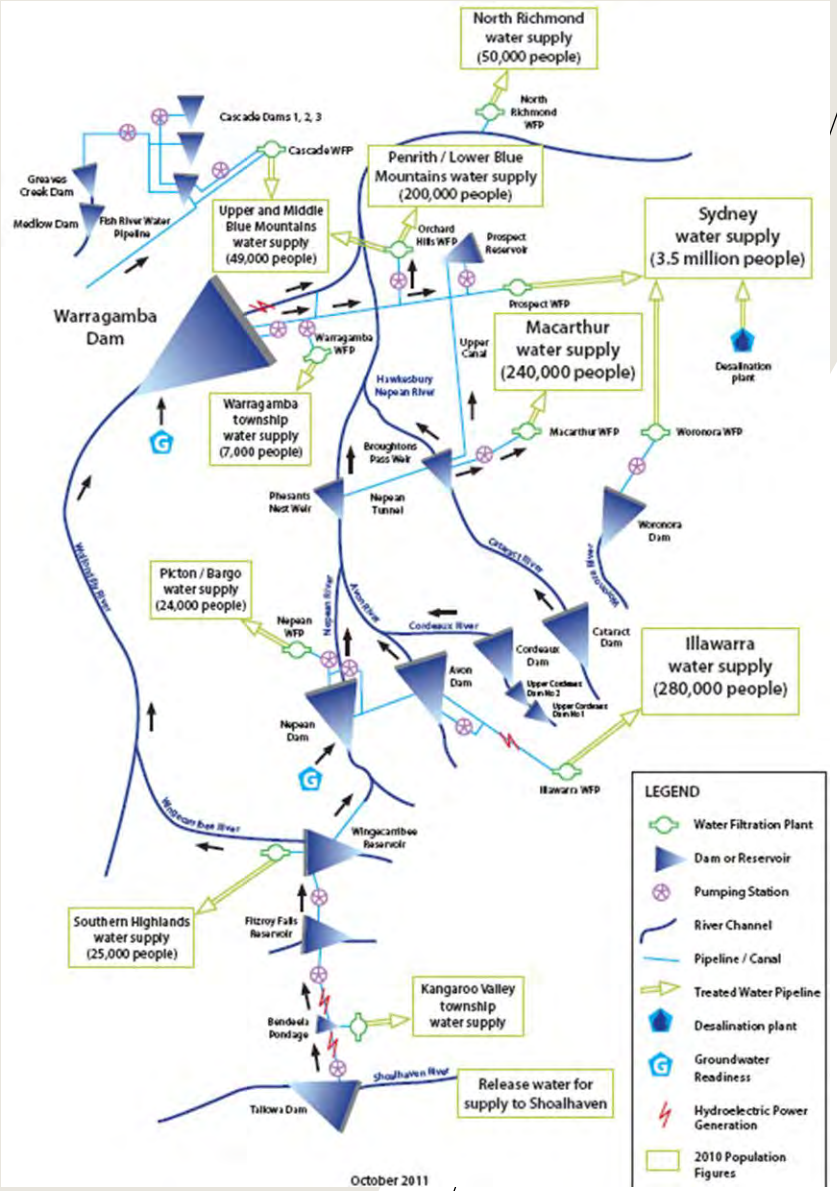
Bottom up systems analysis (blue) shows reduced flows in infrastructure created by distributed solutions

But global average inputs (red) show higher flows and ***illusion*** of no benefits from distributed solutions



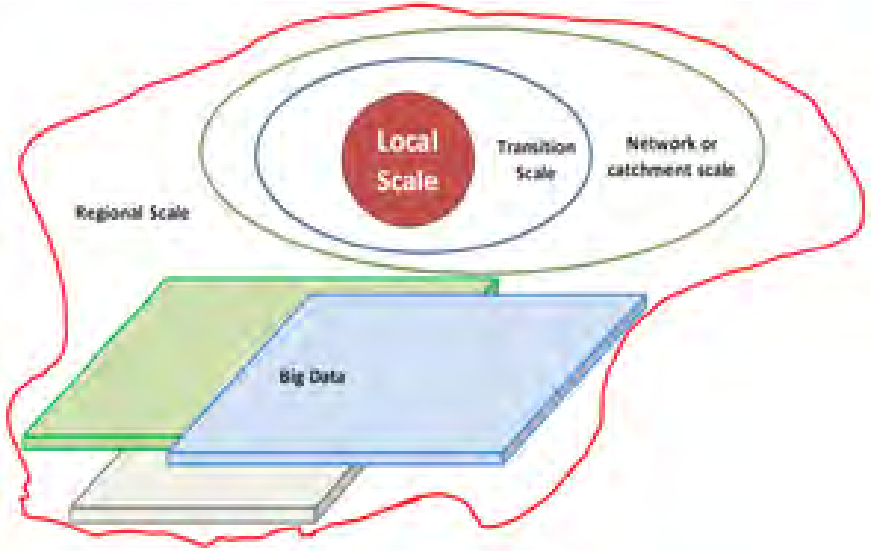
Barry, M. E., and Coombes P. J., (2018), Planning resilient water resources and communities: the need for a bottom-up systems approach, Australasian Journal of Water Resources, 22(2), 113-136.

SYSTEMS ANALYSIS OF GREATER SYDNEY TO TEST TARGETS



Used systems framework to test responses of Sydney's water services

* Rainwater harvesting and water efficient appliances



Climate, environment, dwelling types, land uses, historical behaviour, costs

LOCAL SIMULATIONS

Basis of all modelling. Determines underpinning local water balances, environmental impacts and financial transactions

PRICE

Population, dwelling numbers, antecentent dry days, season, rainfall, temperature, behaviour, infrastructure, planning zones

TRANSITION PROCESS

Translation of historical data and local simulation results for inputs to nodes in the stochastic system model

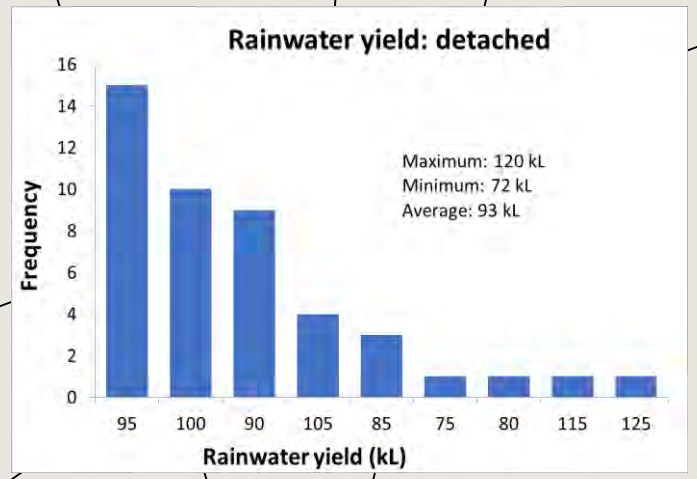
Water, wastewater and stormwater networks, rivers, urban waterways, infrastructure, policy, regulations, operating rules.

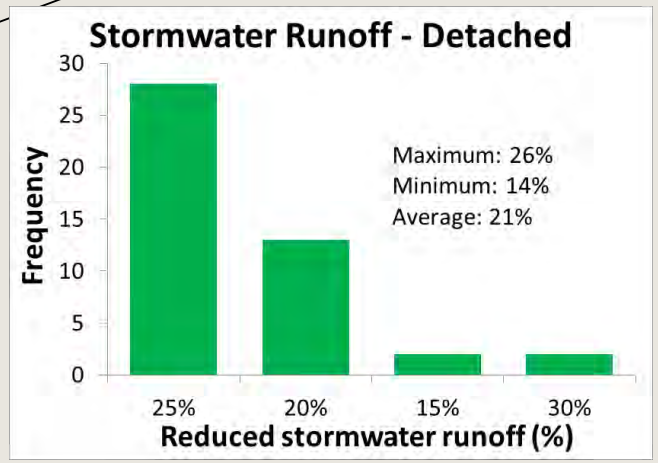
CATCHMENT BEHAVIOURS

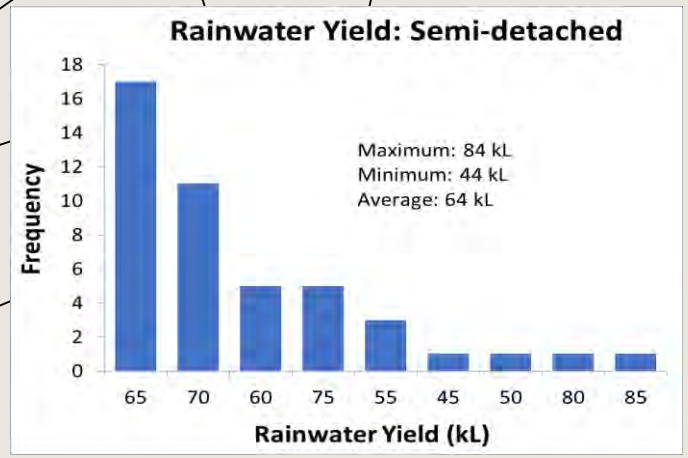
Simulates multiple replicates of system behaviours using results from earlier analysis in statistically significant manner

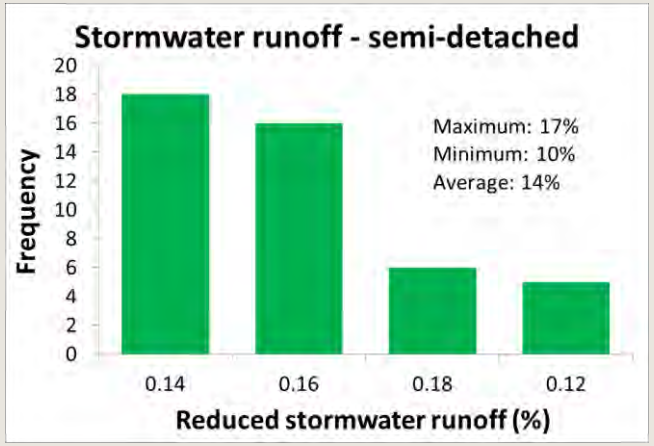
SYSTEM FRAMEWORK WITH FEEDBACK LOOPS

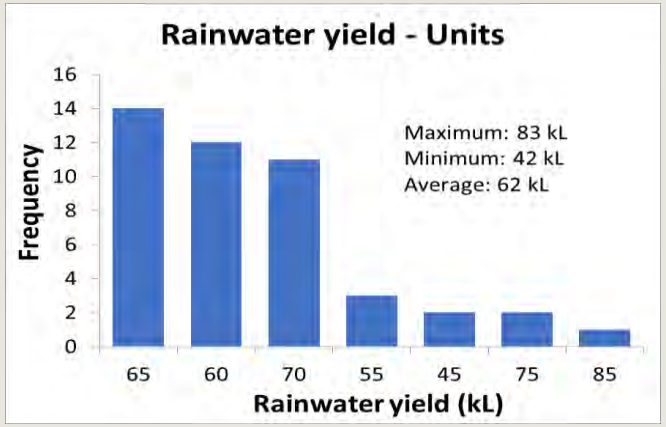
Water, wastewater and stormwater flows, water security, flood risks, waterways health, economics, greenhouse gas emissions

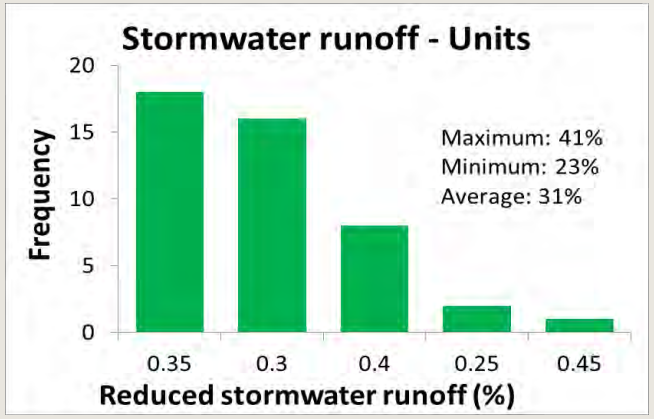












LOCAL SCALE RESULTS

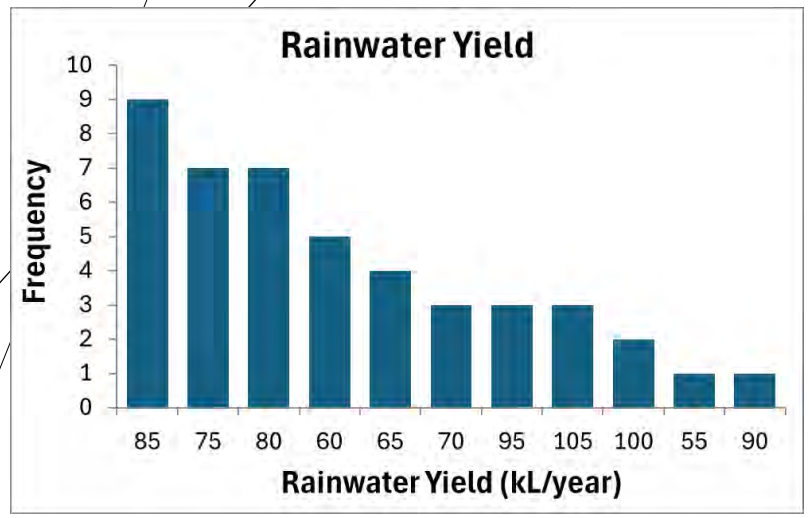
1. Rainwater target for reduced mains water demand: 35% (64 kL – 93 kL)
2. Target for reduced stormwater runoff: 30%
3. Rainwater and water efficient appliances: 45% - 60% reduced mains water demand

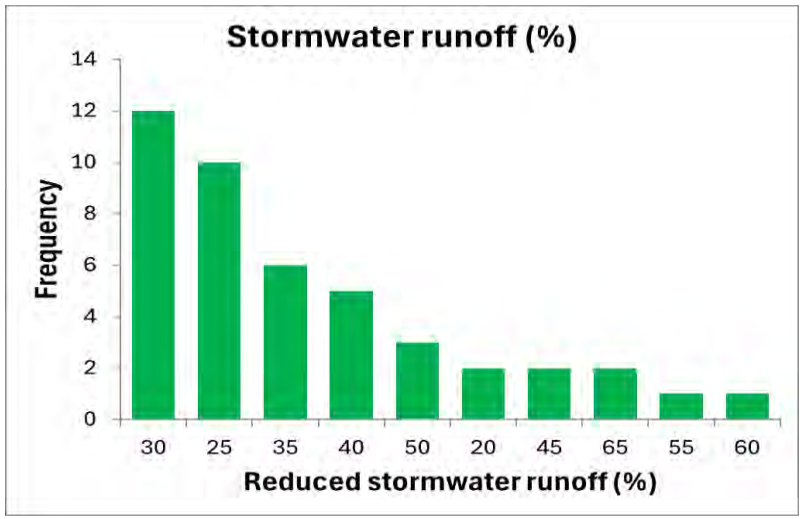
Addition of greenspace, trees or raingardens increases reduced stormwater runoff to 40% - 50%

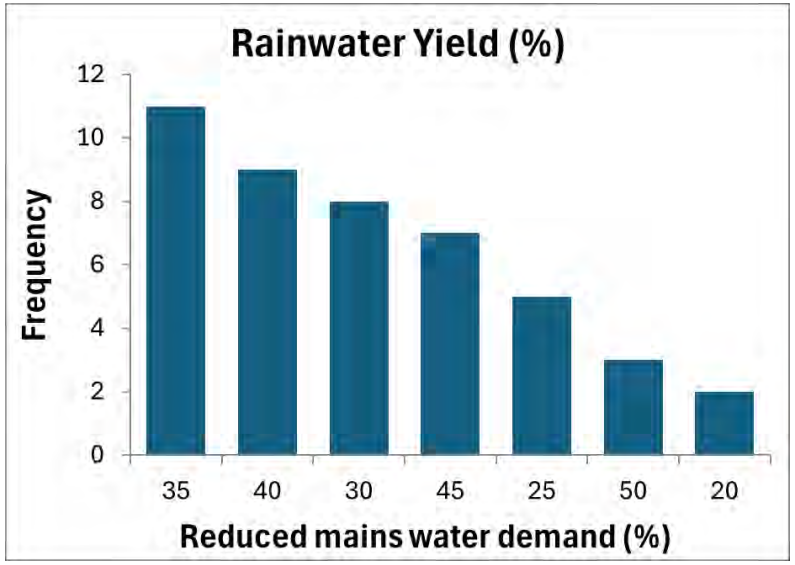
Results for Non-residential properties

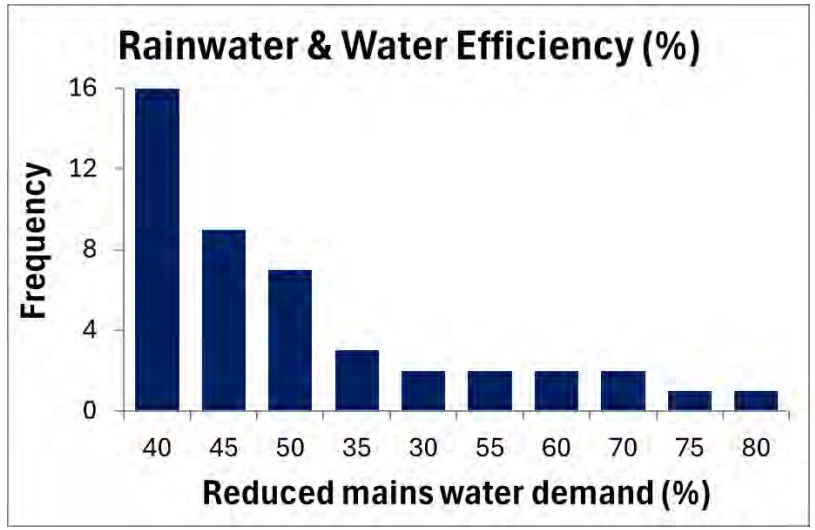
Criteria	SW	RW	RW + WEA
Min	3%	9%	29%
Max	21%	50%	66%
Average	9%	25%	43%

LGA SCALE RESULTS









Annual results at Local Government scale per property

Combines weather, building typologies, socioeconomics and demographics

Rainwater yield: **77 kL** (105 – 52 kL)

Rainwater proportion of water demand: **34%** (19 – 57%)

RW + WEA proportion of water demand: **44%** (27 – 80%)

Reduced stormwater runoff: **33%** (18 – 75%)

SUMMARY OF GREATER SYDNEY RESULTS

Legacy Sydney results (circa 2019)

Rainwater supply = 30 GL/year

Water Conservation = 49 GL/year

Total saving = 79 GL/year

Reduced nutrients to waterways: 47 tonnes/year N

Reduced greenhouse gas emissions: 123 tonnes/year

Net Present value: $3.4 billion

Household water savings has driven down utility water tariffs which decreases household expenses for all Sydney people – especially low income houses

Total results in 2050

Total water saving = 156 GL/year

Reduced sewage discharges = 80 GL/year

Reduced stormwater runoff = 80 GL/year

Decreased nutrients = 187 tonnes/year N

Less GHG = 273 ktonnes/year

Net present value = $10.4 billion

Rainwater Results in 2050

Mains water saving = 19%

Reduced stormwater runoff = 24%

Decreased nutrients = 90 tonnes/year N

Less GHG = 180 ktonnes/year

Net present value = $6.7 billion

MY PLACE (CARRINGTON)

RAINWATER SUPPLY FOR ALL USES (**FROM 2003**):

5 KL STORAGE, 90 M^2 ROOF, VARIABLE SPEED PUMP (2017)

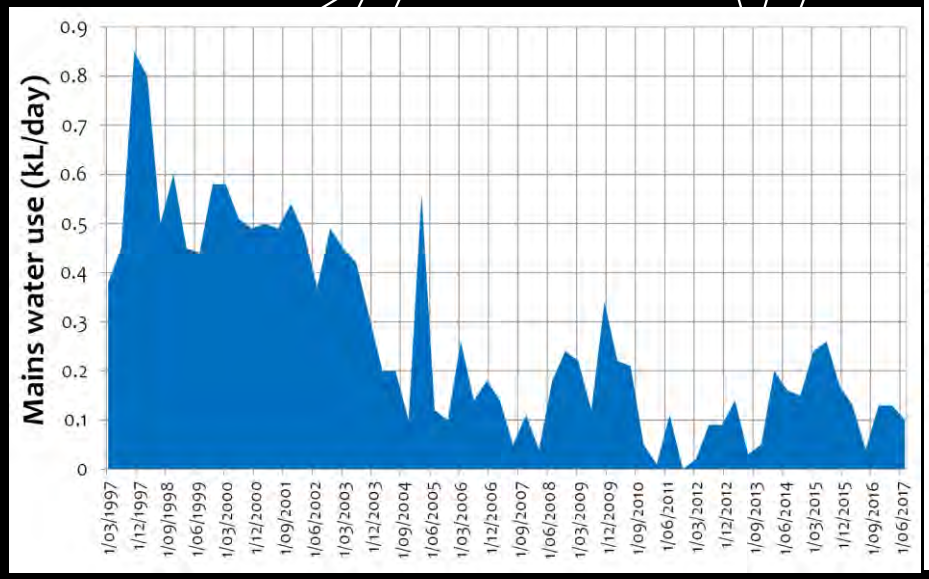
SOLAR ENERGY FOR ALL USES: SOLAR PANELS (2012) AND BATTERY (2017)

LOCAL SUPPLY FIRST THEN GRID WATER AND ENERGY

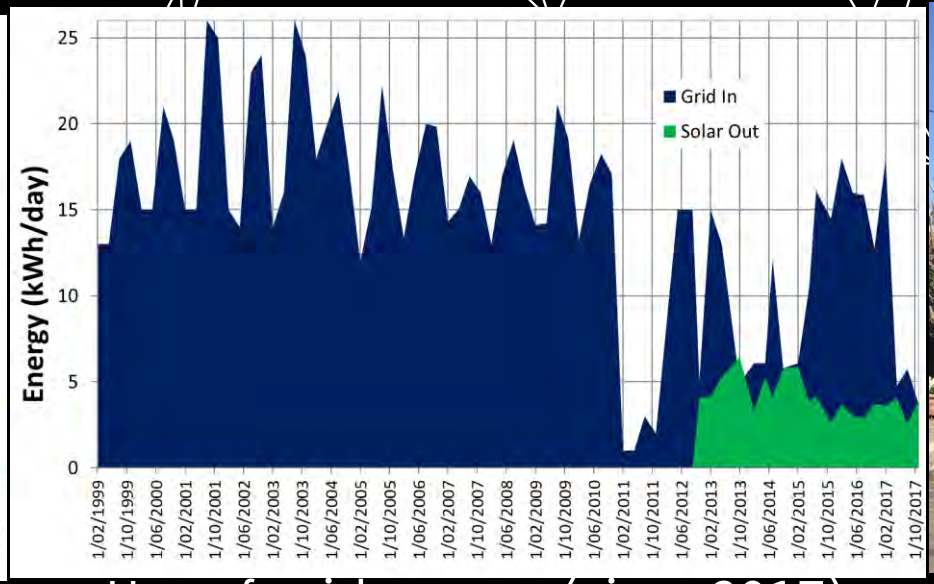
SINCE 2017: MAINS WATER 0.12 KL/DAY, RAINWATER 0.12 KL/DAY, WATER CONSERVATION 0.19 KL/DAY (76% REDUCTION)

GRID ENERGY IMPORT 3.81 KWH/DAY (79% DECREASE), SOLAR EXPORT: 4.89 KWH/DAY (BETTER THAN NET ZERO)

Economic Benefit: Rainwater and water conservation: $0.42/kL, Solar energy: $0.03/kWh



Use of utility water (circa 2017)



Use of grid energy (circa 2017)

Carrington (circa 2017)

SUMMARY

Australia needs rainwater harvesting

Local scale interventions are key to building resilience to population growth and climate change

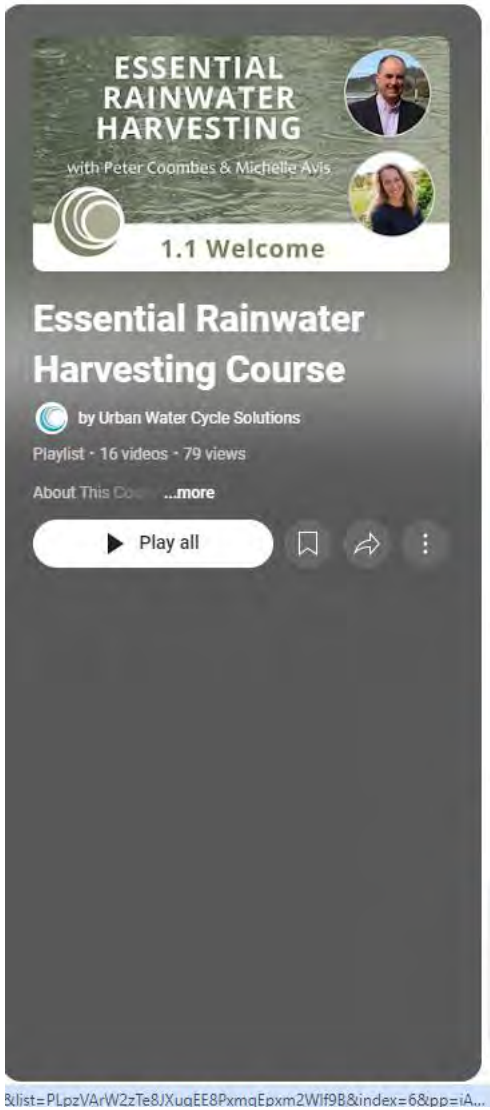
Integration of rainwater harvesting and water conservation into urban areas improves

- the performance of centralized utility infrastructure
- the welfare and equity of society
- the health of waterways
- Minor flooding.

A rainwater policy should include volumetric targets for reduced water demand and stormwater runoff

- 35% reduction in water demand
- 30% reduction in stormwater runoff
- 60% reduction in water demand and 50% reduction in stormwater runoff with water efficiency and vegetation

ESSENTIAL RAINWATER HARVESTING – YOU TUBE CHANNEL



1 

1.1 Welcome
Urban Water Cycle Solutions • 41 views • 2 months ago

2 

1.2 The Context For Rainwater Harvesting
Urban Water Cycle Solutions • 34 views • 2 months ago

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1.3 Key Concept: The Treatment Train
Urban Water Cycle Solutions • 22 views • 2 months ago

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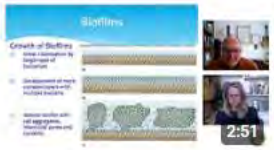
1.4 Key Concept: Tank As A Bio-Reactor
Urban Water Cycle Solutions • 9 views • 1 month ago

5 

1.5 Key Concept: Biofilms
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1.6 Key Concept: Hot Water Supply
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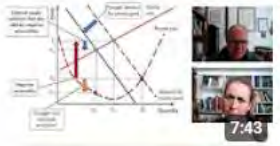
1.7 Key Concept: Ecosystem and Elements in Rainwater

9 

1.9 Systems Thinking Part 1
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1.10 Systems Thinking Part 2
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1.11 Systems Thinking Part 3
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1.12 Resilience and Integrated Design Part 1
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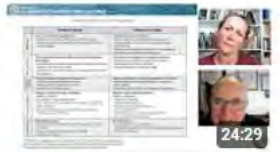
13 

1.13 Resilience and Integrated Design Part 2
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1.14 Resilience and Integrated Design Part 3
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THANK YOU

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