Australian Rainwater Harvesting

Rainwater Harvesting Australia

2022 Presentation to ICID Rainwater Harvesting Working Group, Adelaide Australia

PALMYRA II, Kangaroo Valley by TURNER

Rainwater Harvesting AUSTRALIA

A SUBSIDIARY OF IRRIGATION AUSTRALIA

Rainwater Harvesting Australia

Rainwater Harvesting Australia is the peak body for the rainwater harvesting industry in Australia and a division of Irrigation Australia. Rainwater Harvesting Australia hosts the ICID Rainwater Harvesting Working Group

The Chair is Mr Michael Thompson supported by Geoff Harvey from Irrigation Australia

The committee members include rainwater tank, pump, plumbing and rainwater harvesting accessories manufacturers and retailers.

The committee acknowledges the expertise and contribution of Professor PJ Coombes as a leading expert to inform rainwater harvesting discussion

Rainwater Harvesting in Pictures

What does Rainwater Harvesting in Australia look like?

The Gutter and Downpipe

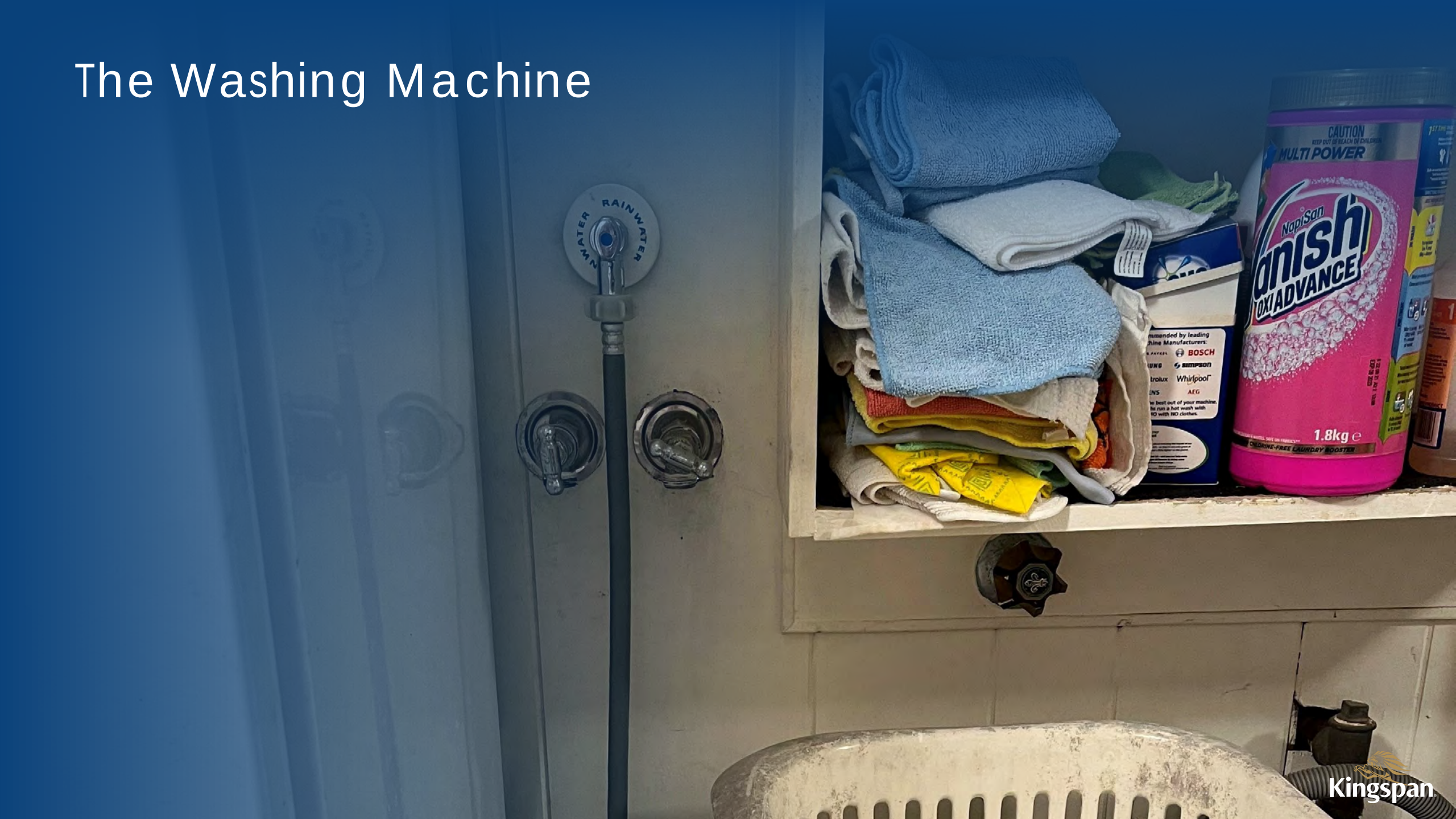
The Leaf Diverter

The Filling

The Storage Tank with Bypass Unit and SmartTank Sensor

The Loo

The Washing Machine



Kingspan

The Garden

What Role does Rainwater Harvesting play in Australia?

Rainwater Harvesting is a significant source of water in Australia including urban areas providing 513GL annually with an estimated economic value to the water industry of $29.7 billion. (Coombes 2018)

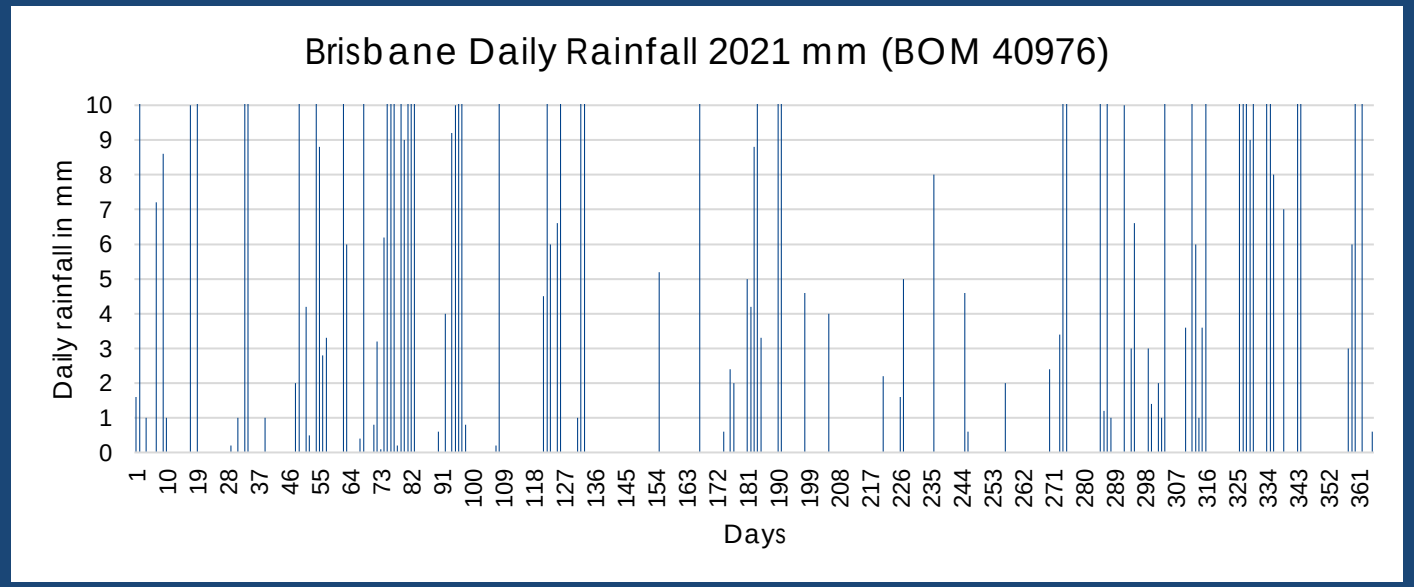
2.7 million residential properties use rainwater harvesting and nearly 1 million use rainwater as a source of drinking water. (Coombes 2021)

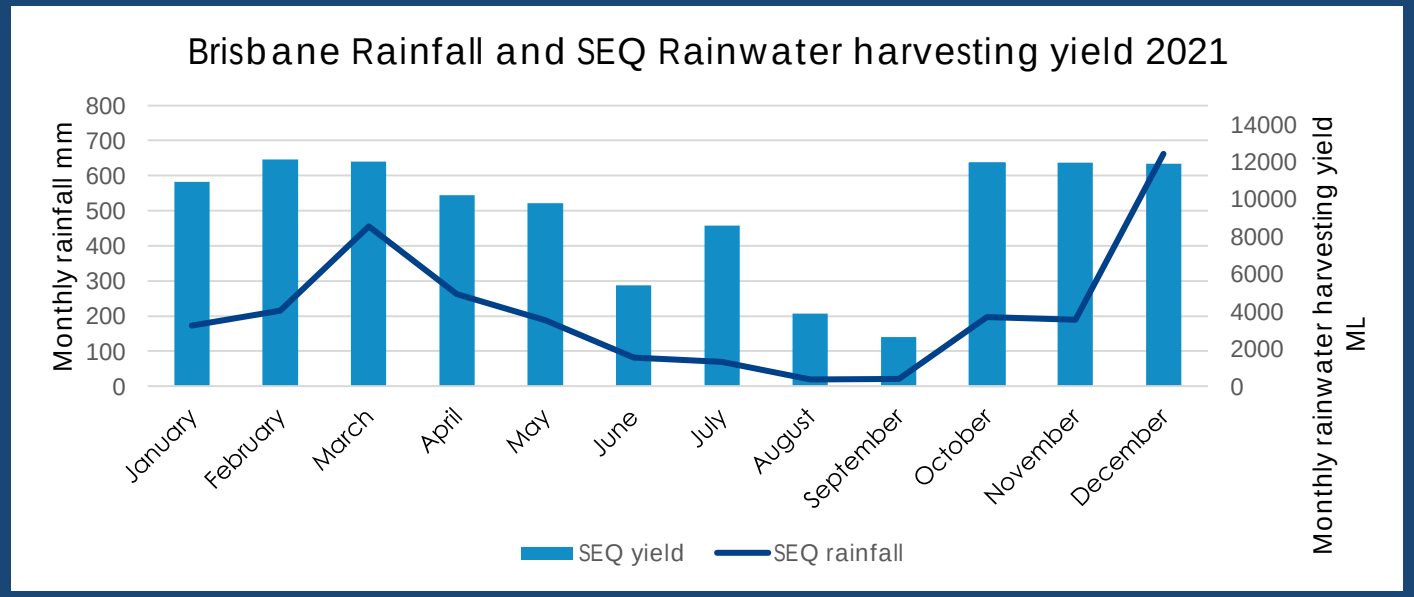
According to the Australian Bureau of Statistics one in four houses in Australia has a rainwater tank providing 9% of residential water use (ABS 2013)

Rainwater Harvesting is defined as rainwater captured from a roof into a container. Residential houses capture 40,000 to 60,000 litres annually but some yields are much higher

Rainwater Harvesting underestimated

Because of our focus on large centralised systems most water professionals underestimate the regularity and importance of small rain events and the potential volume of rainwater harvesting





RAINWATER HARVESTING

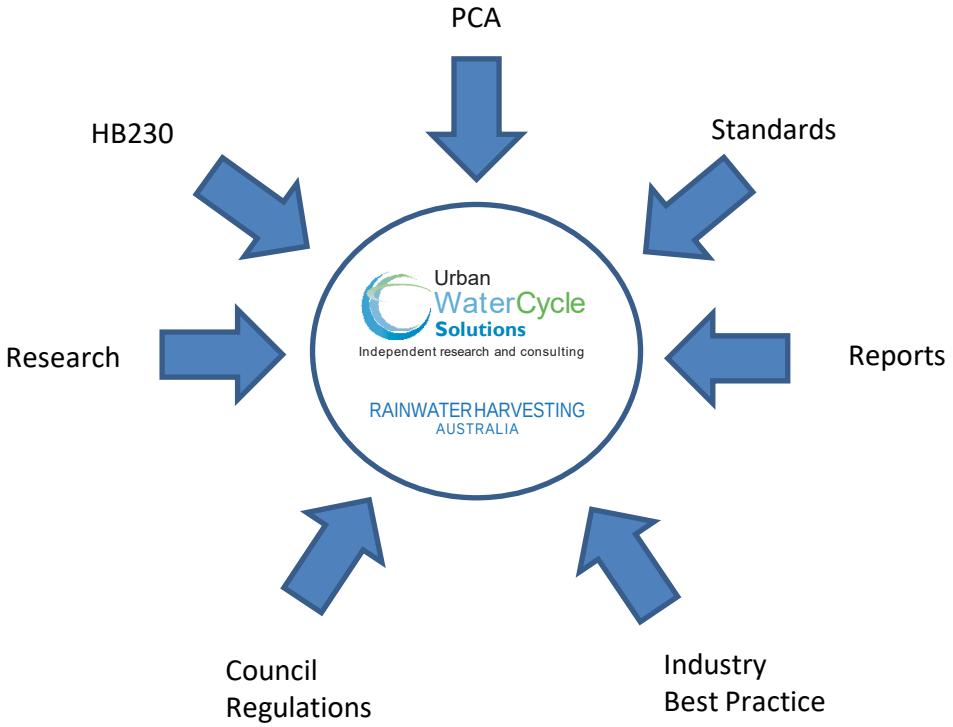
DESIGN SPECIFICATION

RAINWATERHARVESTING
ASSOCIATION OF AUSTRALIA

ARID

Urban WaterCycle Solutions
Independent research and consulting

Why the need for a Design Specification



RAINWATER HARVESTING

DESIGN SPECIFICATION

The Scope

- This guideline is for above ground rainwater harvesting systems connected to residential dwellings in urban areas.
- The specification is for a dual water supply, using mains water and rainwater sourced from roof catchments.
- The dual water supply system sources rainwater first, when stored rainwater is available, for outdoor, toilet, laundry and hot water supply. When stored rainwater is not available, all household water demands are supplied with mains water.
- The household is encouraged to choose the highest level of water efficiency.

The Theory

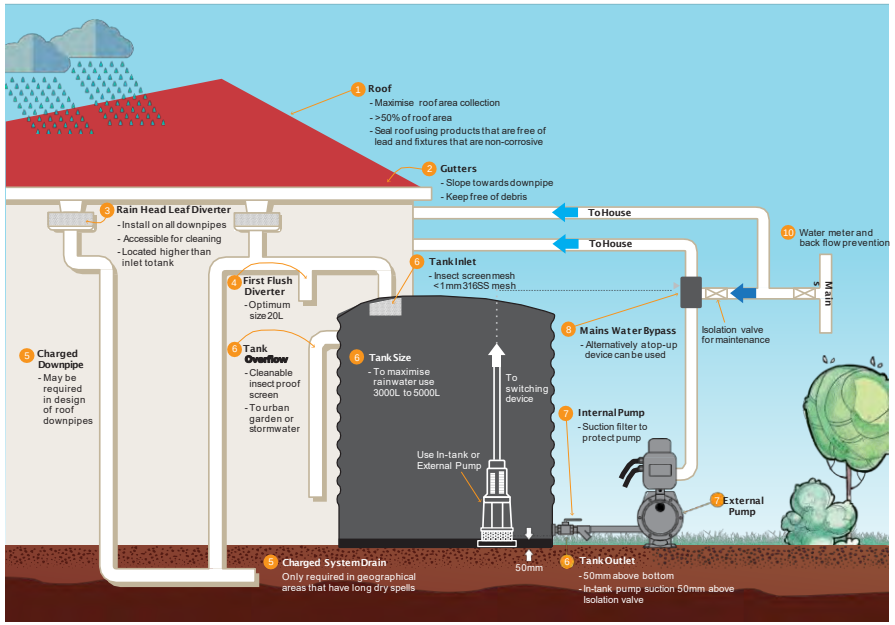
- Correctly installed rainwater harvesting systems develop a natural treatment train that addresses many of the potential contamination issues that may be associated with a roof catchment.

- This is an important reason why rainwater harvesting is so widely used in Australia and rainwater users remain healthy.

- The RHAA, through Professor PJ Coombes from UWCS and other independent scientists, have extensively monitored the inputs and outputs of residential rainwater harvesting systems and used that data to inform this design specification.

- This evidence provides a perspective that is independent of the traditional water industry and a centralized distribution paradigm.

The System


1 Roof
- Maximise roof area collection
- >50% of roof area
- Seal roof using products that are free of lead and fixtures that are non-corrosive
2 Gutters
- Slope towards downpipe
- Keep free of debris
3 Rain Head Leaf Diverter
- Install on all downpipes
- Accessible for cleaning
- Located higher than inlet to tank
To House
To House
10 Water meter and back flow prevention
6 Tank Inlet
- Insect screen mesh <1mm 316SS mesh
4 First Flush Diverter
- Optimum size 20L
8 Mains Water Bypass
- Alternatively a top-up device can be used
Isolation valve for maintenance
MAIN
5 Charged Downpipe
- May be required in design of roof downpipes
5 Tank Overflow
- Cleanable insect proof screen
- To urban garden or stormwater
6 Tank Size
- To maximise rainwater use 3000L to 5000L
To switching device
7 Internal Pump
- Suction filter to protect pump
Use In-tank or External Pump
7 External Pump
5 Charged System Drain
Only required in geographical areas that have long dry spells
50mm
6 Tank Outlet
- 50mm above bottom
- In-tank pump suction 50mm above Isolation valve

Elements of the design

PRE – TANK

- **Roof**
- **Roof Gutters**
- **Leaf Diverters**
- **First Flush Diverters**

TANK

- **Size**
- **Inlet**
- **Overflow**
- **Outlet to Household**

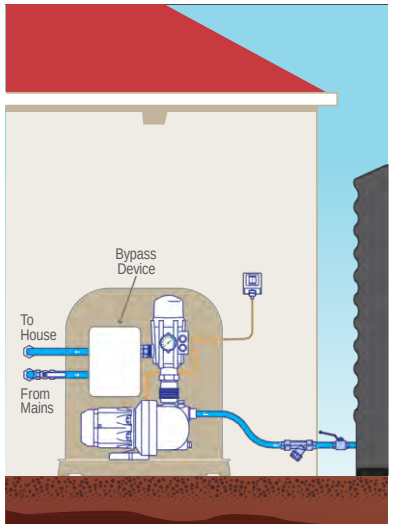
POST – TANK

- **Pump**
- **Mains Water Bypass**
- **Pipework**

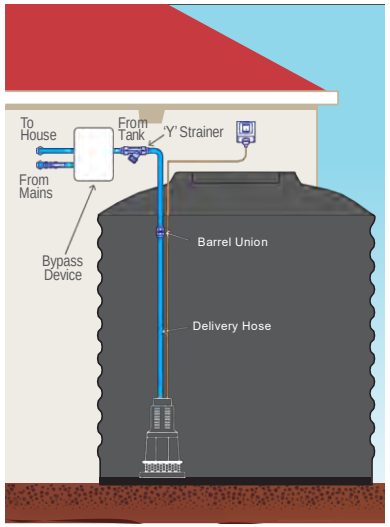
7. RAINWATER TANK PUMP SYSTEMS

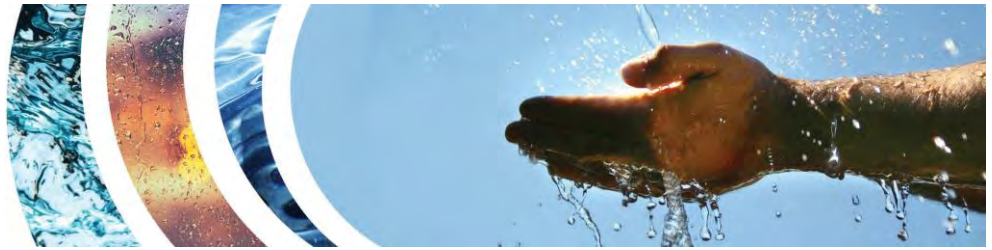
Toilet	5 litres/minute
Washing Machine	< 12 litres/minute
Hot Water (Shower)	< 9 litres/minute
Garden Hose	15 litres/minute
Garden Sprinkler	15 litres/minute

EXTERNAL OPTION



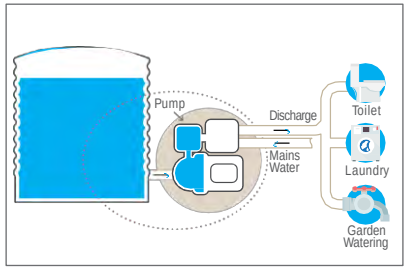
IN TANK OPTION



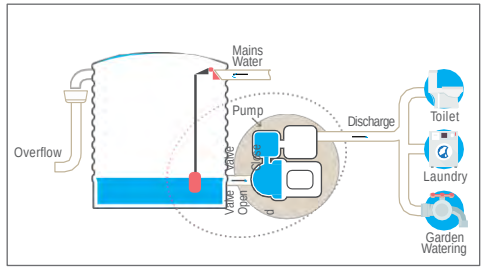


MAINS WATER BYPASS

Mains Water Bypass System



Top-up System



FILTRATION & BACKFLOW

14. KEY POINTS FOR UNDERSTANDING RAIN HARVESTING

- **Rainwater harvesting systems are inexpensive, easy to maintain, provide a reliable source of water and have greater benefits than costs for the majority of households.**

- **Rainwater harvesting saves water utilities and government billions of dollars in capital investment and operating costs by reducing demand for mains water and impacts on waterways across the community.**

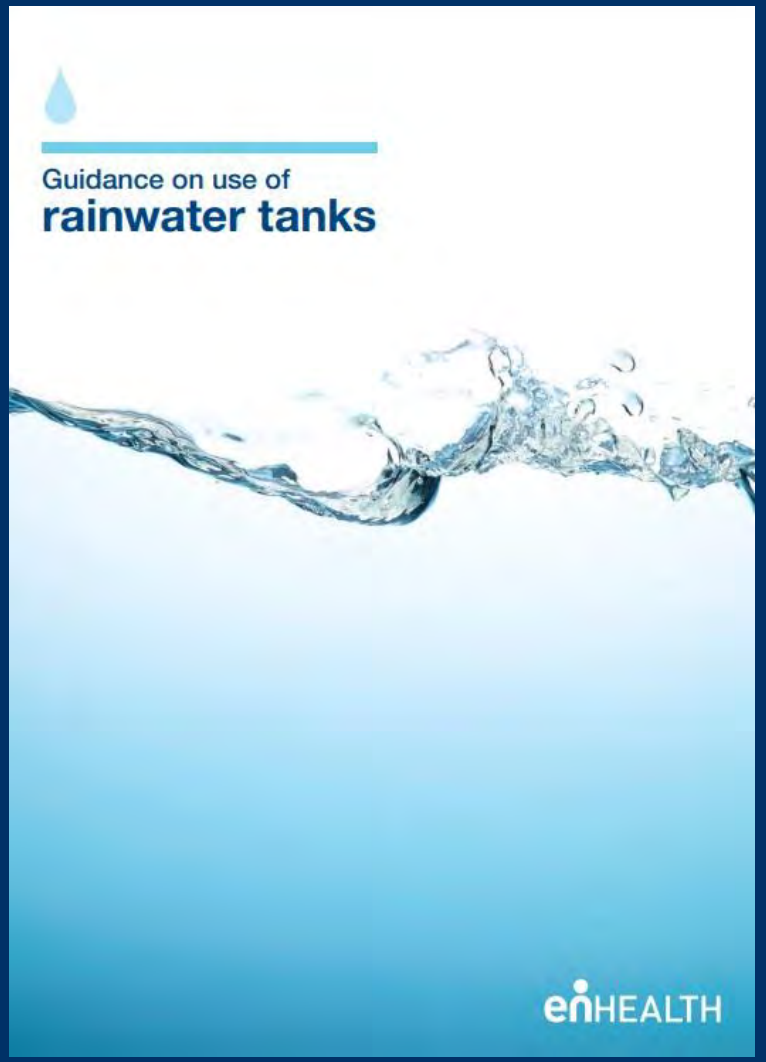
- **Rainwater harvesting reduces stormwater management costs and reduces the environmental impact of water management in our cities and urban development**

- **Over 3 million Australians drink rainwater every day, drinking quality rain water is easily achieved**

- **Rainwater harvesting combined with mains water services provides water services more efficiently than either system alone**

If you need help with your rainwater harvesting experience please visit the Rainwater Harvesting Australia website

Health impacts of Residential Rainwater Use



Health Impacts of Residential Rainwater Use

2.7 million residential properties use rainwater harvesting and nearly 1 million use rainwater as a source of drinking water. (Coombes 2021). There is no evidence of wide-spread health impacts or epidemics

Enhealth Australia finds that in most areas of Australia the risk of illness arising from consumption (of rainwater) is low, providing it is visually clear, has little taste or smell and importantly the storage and collection of rainwater is via a well maintained tank and roof catchment system

A current study of the health impact of backflow from rainwater tanks was not able to identify anyone in Australia ever having become ill as a result of backflow from a rainwater tank and illness from rainwater consumption is rare

Rainwater Harvesting Australia follows Enhealth advice and does not recommend rainwater for drinking where utility water is available

Health Impacts of Residential Rainwater Use

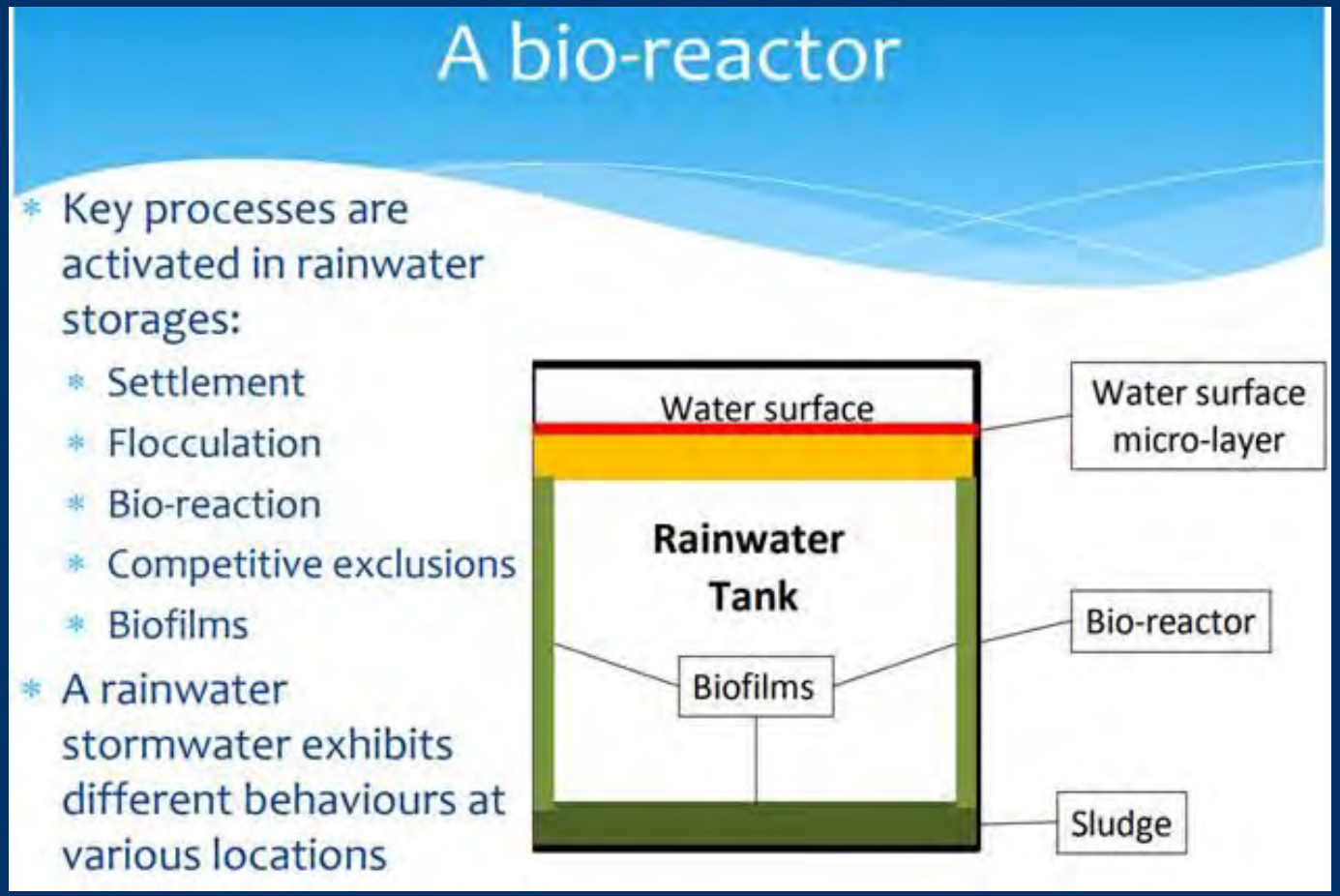
Rainwater Harvesting Australia recommends that health impacts consider actual health outcomes.

Jane Heyworth (Heyworth, 2001; Heyworth, 2006) found that drinking rainwater posed a similar health risk to drinking mains water in Adelaide. Further, a relationship between the presence of Coliform bacteria in rainwater tanks and frequency of illness could not be found.

Rodrigo et al (2010) confirmed the results from the Heyworth research in an independent study that found that the consumption of untreated rainwater did not produce additional health risks to the community.

Natural Treatment Train

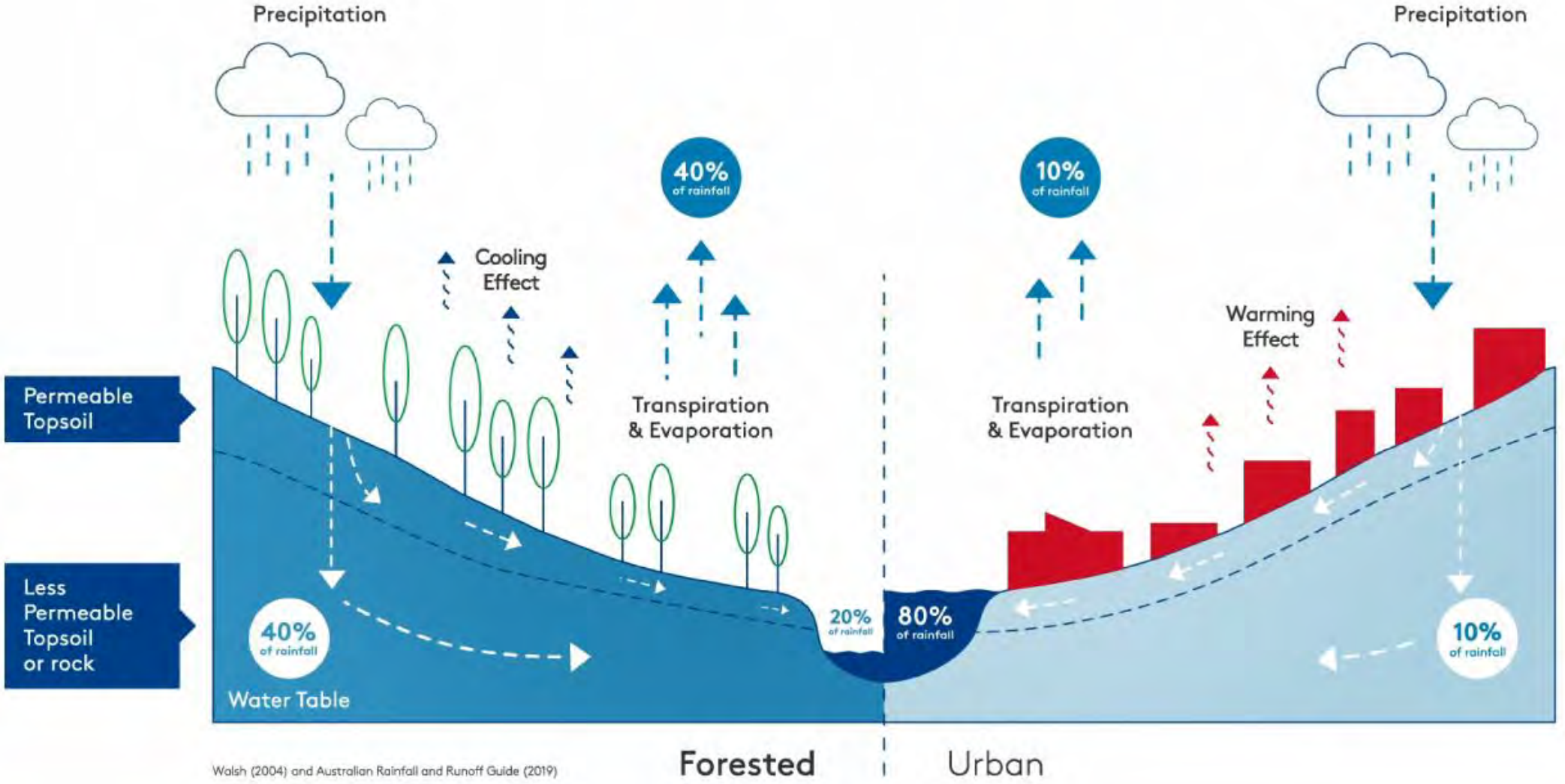
Correctly installed rainwater harvesting systems develop a natural treatment train that addresses many of the potential contamination issues that may be associated with a roof catchment. (Spinks, 2007)



Slide courtesy of Professor Coombes

Stormwater

Impact of Urban Areas on Natural Systems



Walsh (2004) and Australian Rainfall and Runoff Guide (2019)

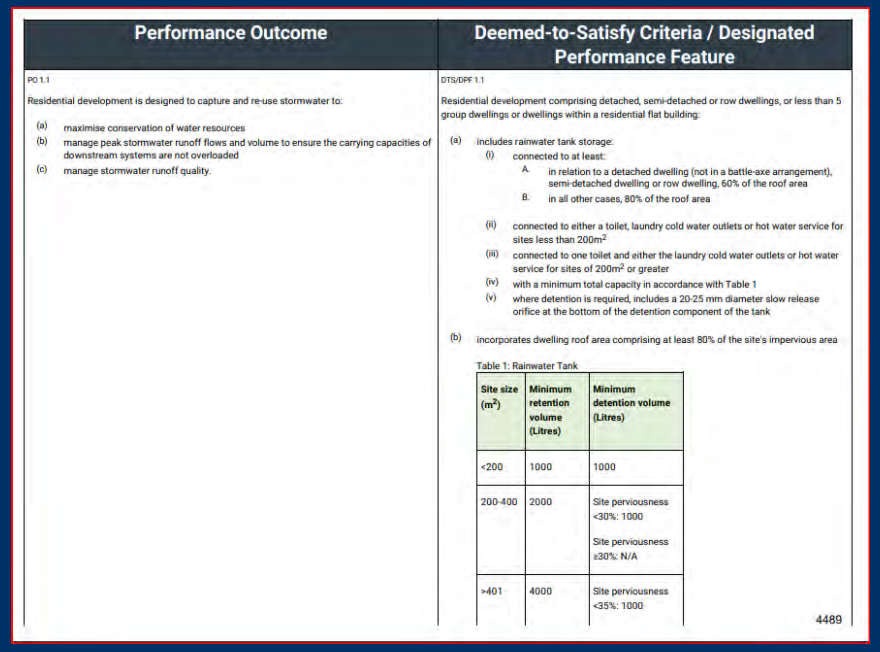
Australian Rainfall and Runoff Guidelines 2019

The urban designer (Argue 2004) aims to manage the impact of urban stormwater runoff ‘at source’ and at multiple scales by retaining stormwater in landscapes and soil profiles, rainwater harvesting and disconnecting impervious surfaces from drainage networks (Poelsma et al., 2013). *Book 9, Ch 3, ARR 2019*

Rainwater Harvesting is recognised as being suitable for multiple objectives of stormwater management including controlling peak discharge, improving water quality and harvest or infiltrate stormwater: *Table 9.4.4 Indicative Suitability of Common Volume Management Design Solutions*.

Stormwater South Australia – Policy Response

- Policy identifies infill area runoff increasing to 250% of design capacity
- Cost Benefit analysis supported rainwater harvesting
- Rainwater harvesting is a deemed to satisfy response for WSUD in the SA Planning Scheme

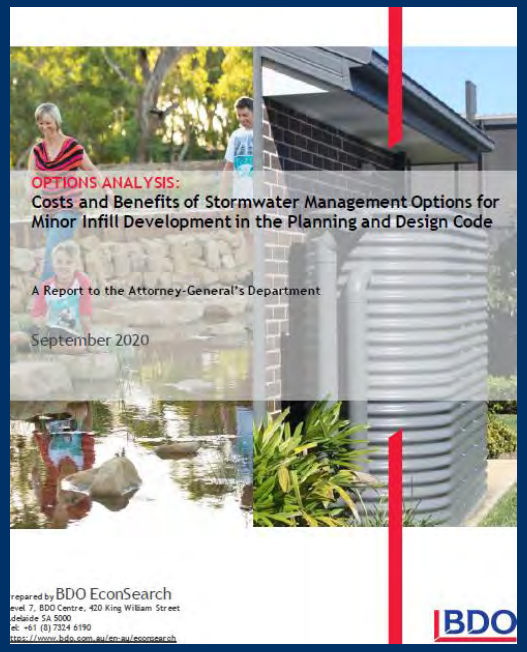


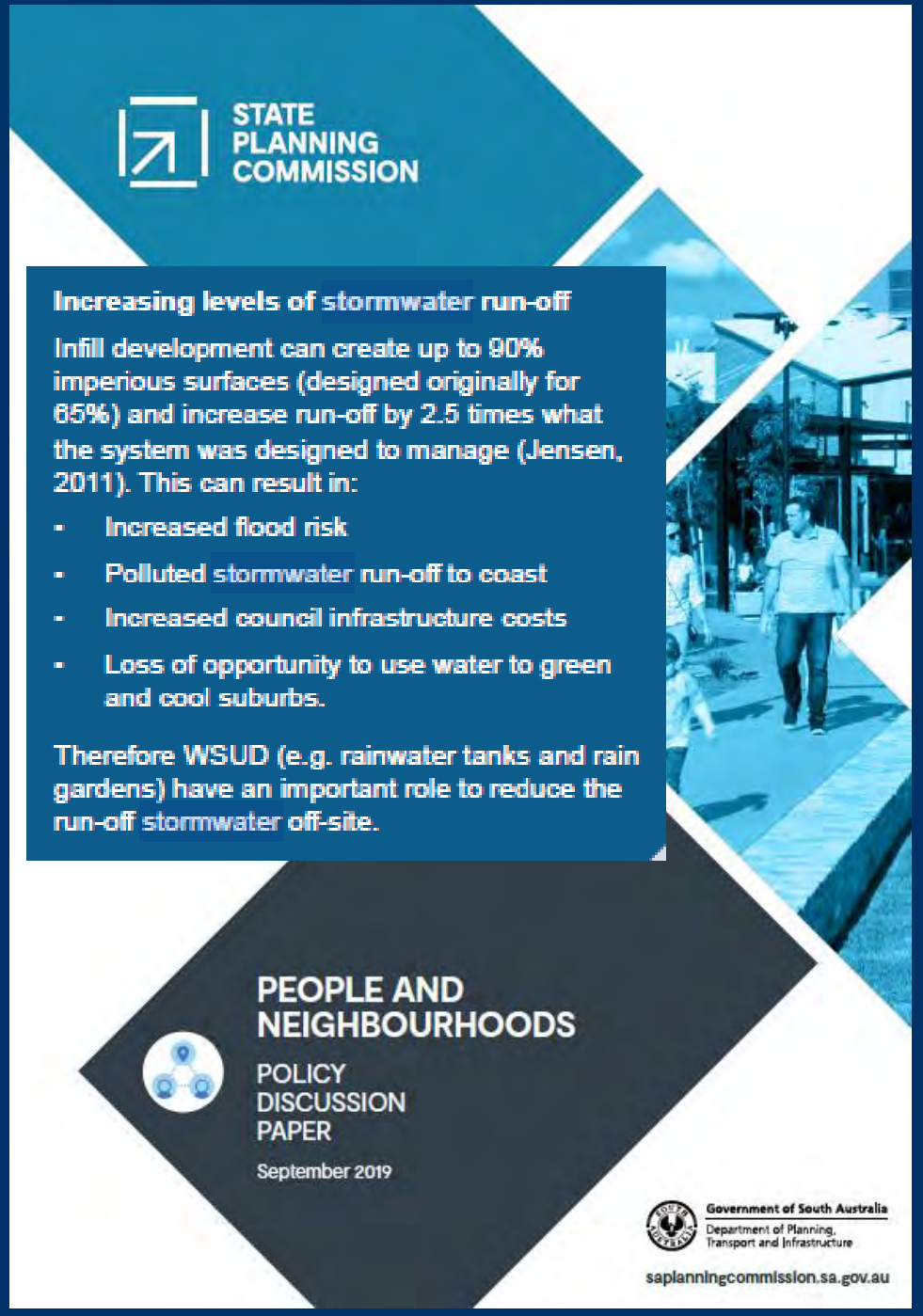
Performance Outcome	Deemed-to-Satisfy Criteria / Designated Performance Feature
PO 1.1 Residential development is designed to capture and re-use stormwater to: (a) maximise conservation of water resources (b) manage peak stormwater runoff flows and volume to ensure the carrying capacities of downstream systems are not overloaded (c) manage stormwater runoff quality.	DTS/DPF 1.1 Residential development comprising detached, semi-detached or row dwellings, or less than 5 group dwellings or dwellings within a residential flat building: (a) includes rainwater tank storage: (i) connected to at least: A. in relation to a detached dwelling (not in a battle-axe arrangement), semi-detached dwelling or row dwelling, 60% of the roof area B. in all other cases, 80% of the roof area (ii) connected to either a toilet, laundry cold water outlets or hot water service for sites less than 200m² (iii) connected to one toilet and either the laundry cold water outlets or hot water service for sites of 200m² or greater (iv) with a minimum total capacity in accordance with Table 1 (v) where detention is required, includes a 20-25 mm diameter slow release orifice at the bottom of the detention component of the tank (b) incorporates dwelling roof area comprising at least 80% of the site's impervious area

Table 1: Rainwater Tank

Site size (m²)	Minimum retention volume (Litres)	Minimum detention volume (Litres)
<200	1000	1000
200-400	2000	Site perviousness <30%: 1000 Site perviousness ≥30%: N/A
>401	4000	Site perviousness <35%: 1000

4489





Drought

History of Drought and Drought Response

Australia has a long history of regular, severe droughts that could last for more than ten years

Historically water utilities found their entitlements were insufficient to meet supply needs for critical human needs. Emergency water restrictions and water efficiency programs were required to meet the shortfall.

Drought response in Australia has been an emergency response to a natural disaster, significant water restrictions, retrospective water efficient appliance installations, water management plans for major water users. However when rain falls and storages recover these programs are discontinued.

Alternative Drought Approach

Rainwater Harvesting Australia proposes that Australia should also invest in water efficiency measures when Australia is not in drought

For example The BASIX land use planning system in NSW has implemented Rainwater Harvesting and Water Efficient Appliances since 2004. Estimated savings are 90 billion litres annually, equivalent to the capacity of the $1.8B Sydney desalination plant.

Sustainable Buildings

Image source: Watersmart Futures / E2DESIGNLAB

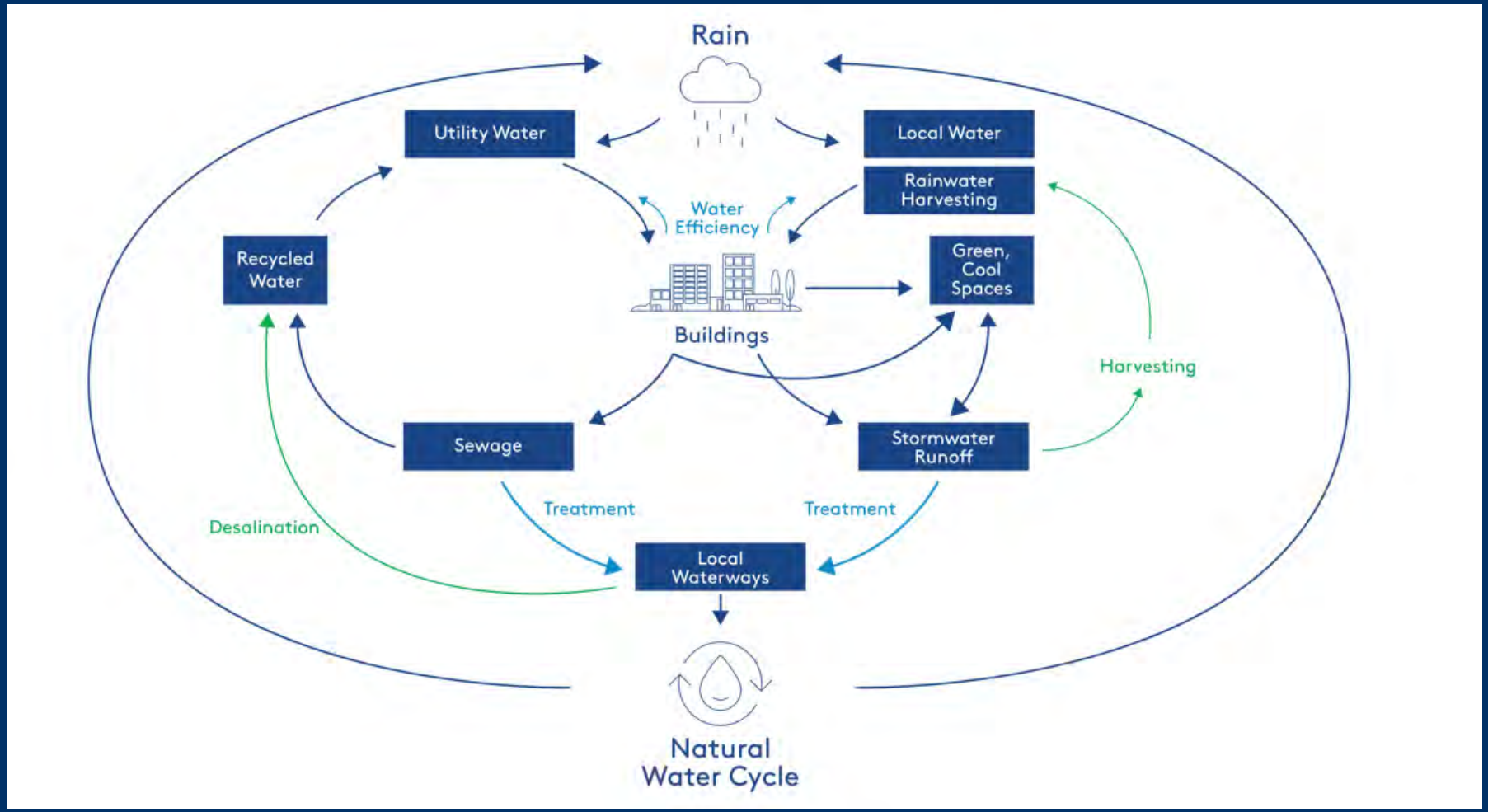
Sustainable Buildings

Systems based thinking has shown that universally applied small changes at the individual building scale has non-linear system wide urban benefits. A combination of centralised and decentralised infrastructure reducing infrastructure costs, operating costs and supply risks. Rainwater Harvesting at the building scale provides water supply, stormwater, waterway, green infrastructure and urban cooling benefits in excess of the costs of implementation. (Coombes, 2021)

This ‘multi-scale systems thinking’ applies to many core urban management issues and is captured in the Australian Rainwater Harvesting Vision:

Our vision is for a *community driven sustainable Urban Footprint, achieved by every building having access to rainwater harvesting, renewable energy and a nature space.*

Sustainable Buildings



Economics of Rainwater Harvesting

Cost Benefit Analysis of rainwater harvesting is contested based on different assessments of the benefits of rainwater harvesting and the cost of alternative water sources

The most recent CBA in Australia found that benefits exceeded costs based largely on the stormwater benefits

Property value analysis found that a rainwater tank added about $18,000 to the value of an Australian home, significantly more than the cost of the tank (Zhang 2015)

A major tension arises because the business model for water corporations favours investment in infrastructure over investment in water efficiency

Water Efficiency Investment

Water Efficiency is recognised as an important policy tool in Australia, however investment is low relative to supply infrastructure investment

Drought response is based on triggers as storage levels decline and investments are based on the value of water. However when storages are full the value of water is low and there is insufficient investment.

For example the economic level of water conservation in Sydney is around $0.31/KL but the value of water in a severe (50%) supply failure in a regional centre is estimated at $28/kl. (Beatty 2020)

Resilience

Australia is experiencing high levels of uncertainty in relation to climate and natural disasters. Decentralised infrastructure solutions are generally more resilient than highly centralised infrastructure solutions

Rainwater Harvesting considers that providing a rainwater tank for each building would provide greater self sufficiency to communities in the event of

- Contamination of water supplies or catchments
- Cyberthreats to urban water and electricity grids
- Bushfires, due to contamination of catchment and loss of electricity
- Flooding, due to contamination of treatment plants and loss of electricity
- Droughts, due to supply failures particularly in regional areas
- Earthquakes, due to water grid disruption eg Christchurch NZ

PRODUCT TECHNOLOGY

Pre-tank collection & quality improvement

Optimising Pre Tank Design is critical to ensure rainwater tank performance. The benefits of planning here are:

- Ensuring maximum water collection,
- Ensuring water quality,
- Preventing system issues.

Pre-tank design is focused on implementing multiple, progressive barriers to maximise the volume collected and optimise the water's quality to suit its final use.

Design considerations for pre-tank filtration are generally driven by:

- Optimising the filtration level,
- Maximising the flow rate capacity to handle expected rainfall rates,
- Minimising water loss,
- Making maintenance easy.

Balancing these considerations with an understanding of the end user's drivers and desired outcomes will help drive innovation in the field.

FILTERING ON EACH DOWNPIPE

Rain Heads

Pre tank design considerations include:

- Filtering on each downpipe to spread the filtration effort throughout the system rather than a single location.
- Optimising automatic leaf shedding for reduced maintenance requirements,
- Using hoods to create enclosed systems to eliminate splashing. This suits splash-sensitive locations and maximises water collection,
- Balancing the ability to capture maximum volume (perhaps with a hood) with the easy or frequency of maintenance – each property and end user has different requirements.

FILTRATION AT THE TANK

All-in-one Pre-Filters

Benefits and considerations of single point filtration:

- Filtering at one location on the tank results in the need to manage a higher flow and debris rate.
- Heavy downpours can overwhelm filters if the product itself, or system, are not designed correctly. The technical challenge is to create mechanisms which can filter very fine particles yet still allow high flow rates to pass through.
- Maintenance can be easy since there is only a single filter to clean, BUT, the challenge is still to allow the product to function correctly and capture high flow rates even if maintenance is neglected.

First Flush Diverters

First flush diversion's efficacy has faced some debate, though the research shows it to be a critical element of a rainwater system. Some considerations and innovations are:

- Traditional designs have faced maintenance issues,
- The design of chamberless First Flush diverters which do NOT require water to be stored – unlike traditional designs,
- Automatic release valves which evacuate the First Flush chamber rapidly and on accurately controlled schedules,
- First Flush volumes pre set into the product to make configuration and installation easier,
- Simple to use tools to accurately calculate required volumes.

Tank Inlets and Overflows

One of the most critical points of a rainwater system – this is where major loses can occur if the system is not set up or maintained correctly. Innovations focus on:

- Ensuring maximum flow rates can pass through the inlet strainer, even under heavy debris loads. Maximising catchment areas, preventing splashing, and managing the flow of water and debris,
- Making inlet maintenance easy with click on solutions,
- Blocking sunlight from tank inlets while still maximising the volume of water which can flow through the system,
- Maximising the overflow capability so that even in heavy rainfall events, the overflow is not choked, causing spillover at the inlet
- Making mozzie stoppas and overflows simple to maintain to ensure they perform as they should.

IoT Digital

Simple data can make rainwater tanks more efficient;

Combining different datasets can improve and maximise a rainwater system's performance;

Aggregating data can highlight the benefits of decentralized systems in creating community water balance.

Tank Level Gauges:

- They help individuals assess their own data to make better decisions,
- Data aggregation can highlight usage and adoption at a community level.

Rain Gauges:

- When paired with Tank Level Gauges, can assess the efficiency of the entire rainwater system, including its catchment area.

Future solutions:

- Smart First Flush Diverters
- Water quality assessment
- Smart stormwater attenuation

Industry Perspective – Rainwater Tanks

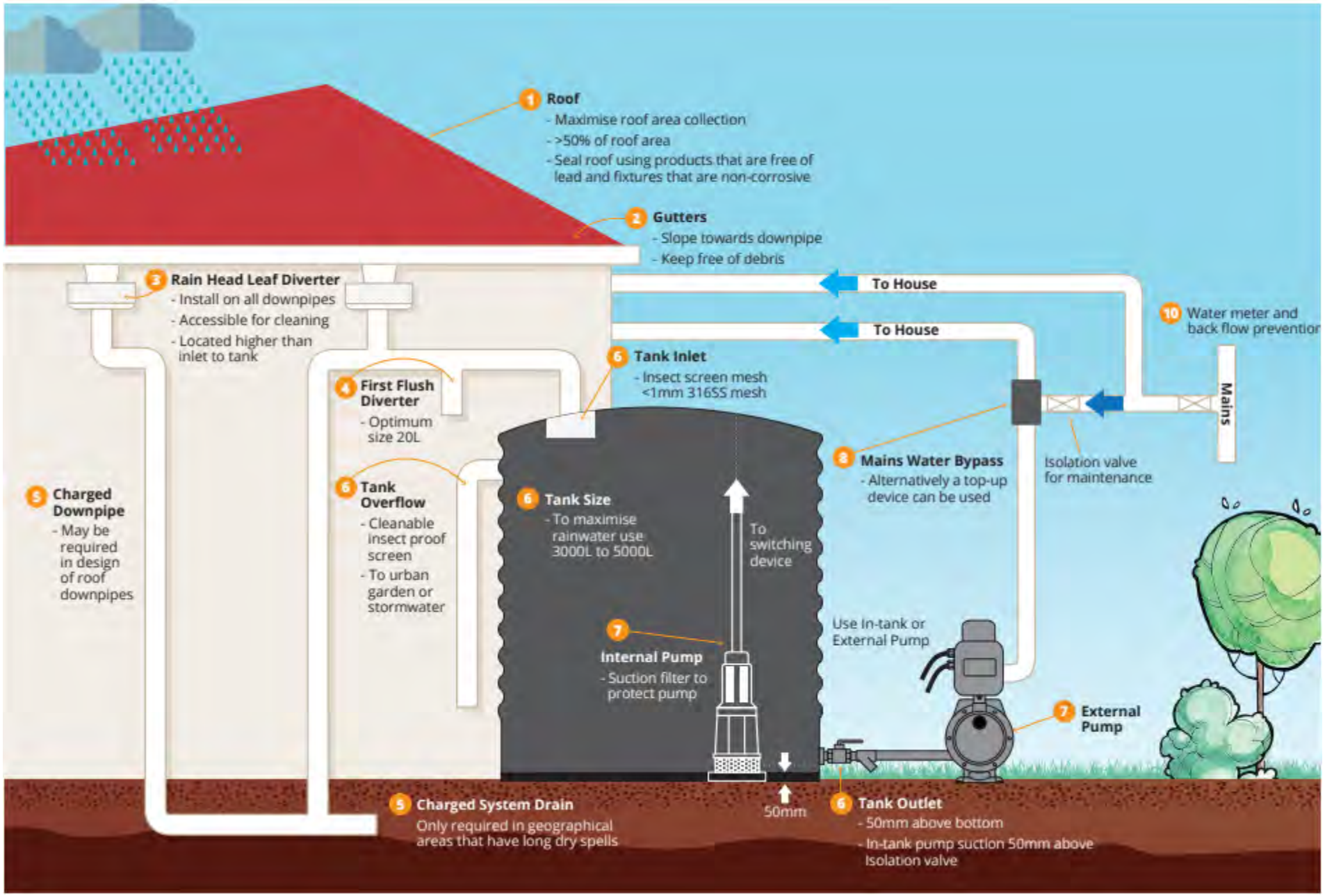
Rainwater Tanks in Australia are manufactured for rural, residential and commercial uses for stock and domestic, household and garden and production and fire safety uses

About 100 tank manufacturers use polyethylene, steel, concrete and fibreglass materials for tank manufacture

Manufacturing and installation is informed by a series of Australian standards. Most tanks are manufactured locally in Australia due to relatively high transport costs.

Industry Perspective – Pump Technologies

Rainwater tanks in Australia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Only required in geographical areas that have long dry spells
50mm
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- 50mm above bottom
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BENEFITS

1 SOLUTION: EASY TO INSTALL

- ✓ Cost (and time) of installation is reduced
- ✓ Easier Maintenance
- ✓ Installation space saving
- ✓ Handle, quick coupling cable, integrated check valve, integrated inverter


+

+

+

VS


BENEFITS

OUTDOOR USE

IP68

No need to protect the pump from anything ever.

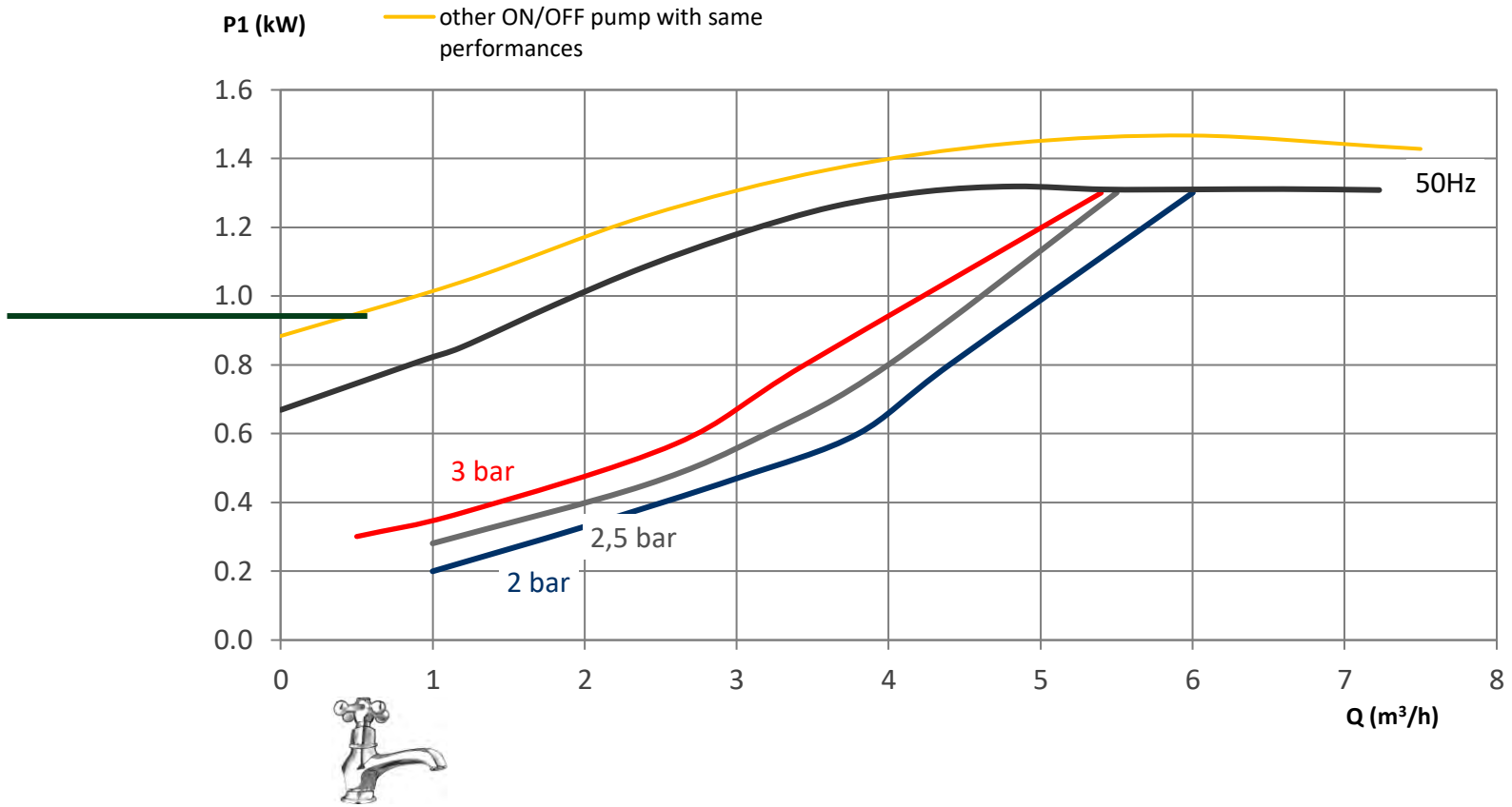
Even if the pump is used as DRY version, then it works outdoor without any other protections in any weather conditions (rain / snow / sand storm..) or in other particular situations (for example situations where insects/small rectiles might go inside the pump)

BENEFITS

SAVING

Absorbed power @0,54 m3/h
(Q of an open tap)
is 68% less for Esydiver compared to traditional ON/OFF pumps with the same performances.

68%
SAVING



BENEFITS

Included
D.CONNECT
BOX 2

REMOTE CONTROL via APP D.CONNECT

EASY TO MANAGE

- ✓ Monitoring the status of the pump
- ✓ Monitoring istantaneous and monthly consumptions (energy and flow)
- ✓ Monitoring Saving (effective)

PEACE OF MIND

- ✓ Real time Alarms control and notifications
- ✓ Quick call in case of failure

COMFORT

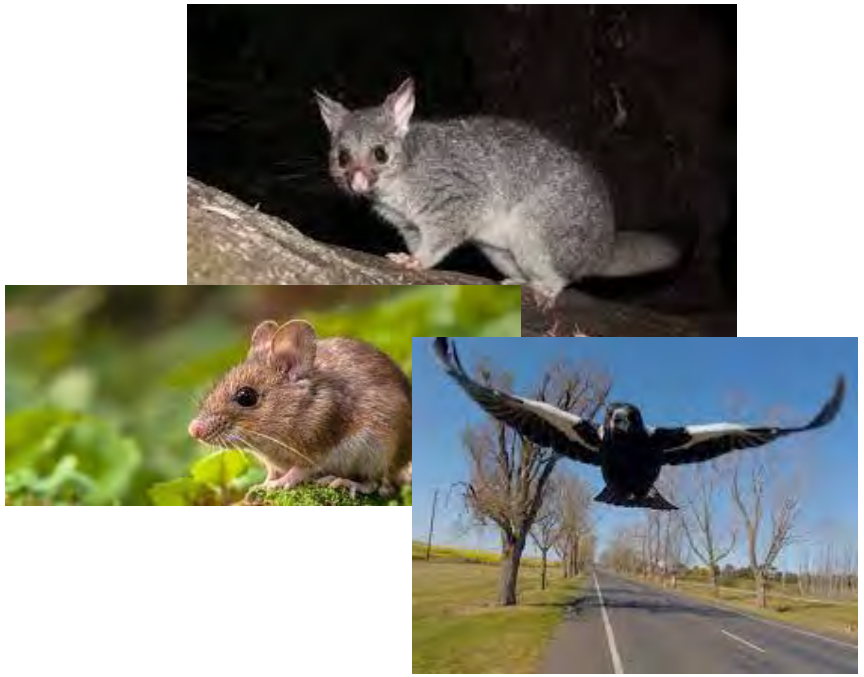
- ✓ Possibility to know the remaining Water Volume in the tank (through the accessory WATER LEVEL MEASUREMENT)


Rainwater
Harvesting
AUSTRALIA
RAINWATER
TREATMENT

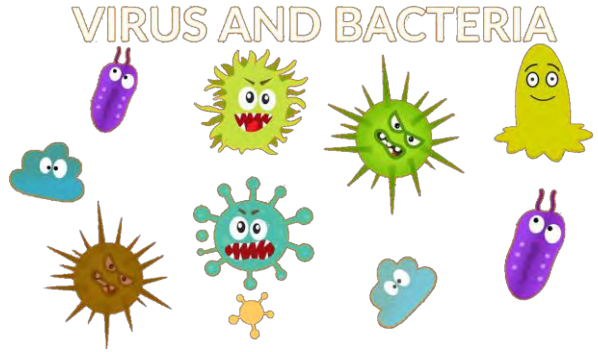
Improving the quality of your rainwater

- Animal and Bird Droppings washed into your tank

- Deceased Animals/Birds Rodents (that have fallen into the tank)



- Results in Bacteria and cysts growing in your tank water that can make you and your family ill and run down



Metro Areas

Harvested Rainwater in Metro areas are a great way to reduce storm water run off, as well as reducing household mains water consumption.

Metro Harvested rainwater is most often utilised untreated for non-drinking water applications:

- Supplying Toilets / Laundries

- Outside Watering / Cleaning

Fringe Metro / Lifestyle Blocks / Rural Areas

These home-owners often rely on their harvested Rainwater as their main or secondary household water supply for use in all areas inside and out of the home.

- Supplying Toilets / Laundries


- Outside Watering / Cleaning


- Kitchen

- Bathrooms

- Ingested / Drinking Water


- Pools/Spa

Improving rainwater quality. Here are three common solutions.

Hydrogen Peroxide based Liquid Disinfection

Filtration and Ultra-Violet Light Water Disinfection

Cartridges & UV Disinfection

Complete Pump and Treatment Plug and Play Packages

(Water Pressure Transfer, Filtration, Disinfection)

Liquid Disinfection – For Drinking Water

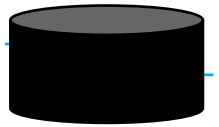
Using Hydrogen Peroxide based options

- 1L of this type of disinfectant can be enough to disinfect 15,000 of Harvested rainwater. Kills 99.9% of Bacteria & Viruses.
- Easy to use by adding the required dose for the number of litres of tank water and let sit for 24 hours
- Works via an oxidation process that mimics nature and renders micro-organisms such as Bacteria, Viruses, Pathogens harmless
- Safer than many alternative chemical disinfection options (No by-products besides water and oxygen)
- No taste or odour
- Economical/affordable
- If cysts are suspected in drinking water supply, install a one micron cartridge for protection
- Regular testing with test strips every couple of months or after a significant rain event

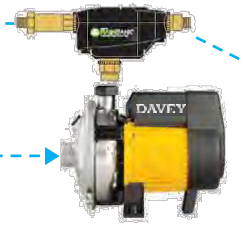
Filtration & UV Disinfection Systems – How they work

Roof

Mains



Rainwater Tank



Pump

UV Disinfection
(Inactivating Micro-organisms)

3 **UV DISINFECTION**

Inactivates Micro-organisms

Inactivates: Bacteria, mould, viruses & yeast.

Valve To Supply

FINE FILTRATION

Removes small solids and Parasitic Cysts over 1 micron in size

Removes: Parasitic cysts & fine particles.

COARSE PRE-FILTRATION

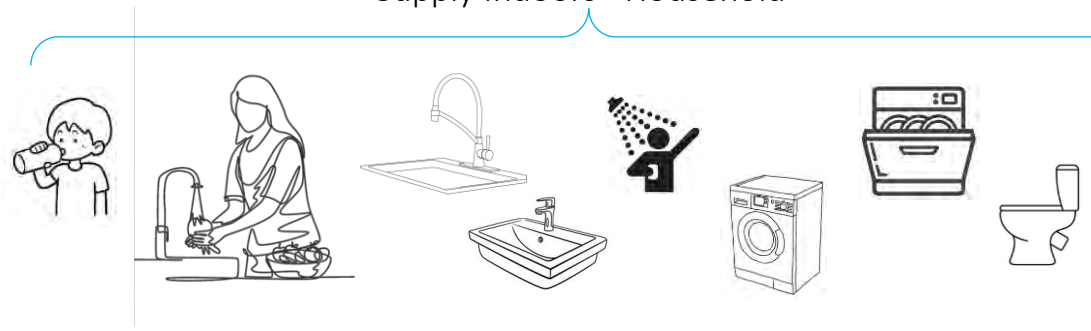
1

Removes solids over 20 Micron

Removes: Dirt, rust, sediment and leaf matter.

2

Supply Indoors - Household



Supply Garden/Outdoor/Animals

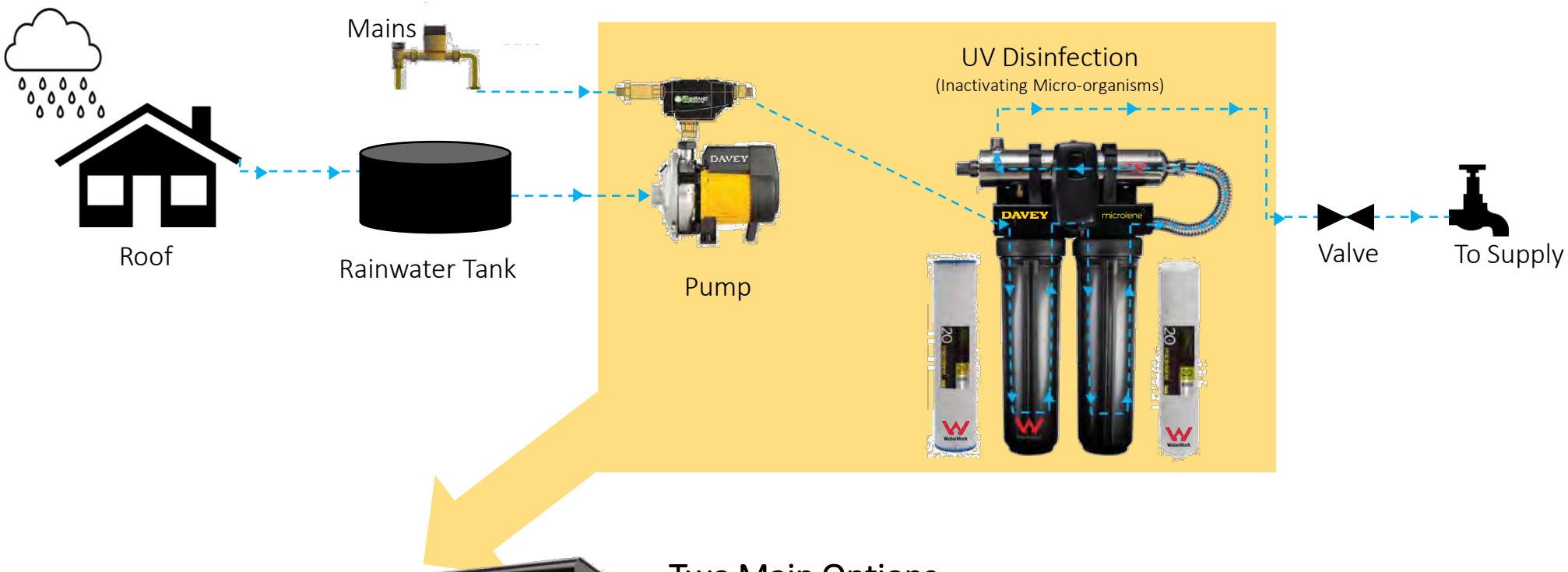
Filtration & UV Disinfection Systems – What does it look like installed?

Untreated water line into the UV System

Outlet from UV System into the house (Treated, Disinfected, Safe household drinking water from any outlet in the house)

Rainwater Tank inlet to the pump from Tank

Treatment Packages



Two Main Options

- **Tank water only Option**

(Variable Speed Drive Pump and 3 Stage UV System)

- **Tank water with Mains Back Up**

(Multistage Pump, Switch over Device and 3 Stage UV System)

Thank You

Industry Perspective – Mains Bypass Devices

Water Diversion Valve

- Hydraulically Operated
- Solid Brass Construction
- Built-in Dual Check Valves

Industry Perspective – Mains Bypass Devices

The AcquaSaver® Valve is a fully automatic mechanical rainwater/mains water changeover device designed for pressure pump supply systems for harvesting rainwater for the toilet, laundry and household applications with automatic mains backup

Features

- Easy to install
- Patent design
- Solid Brass mounting bracket (optional)
- Watermark approved to WMTS-477:2016
- Does not require regular maintenance
- No electrical consumption - No electronic components
- Solid brass construction - Fully weatherproof - Built to last
- Suitable for any pressure pump with sufficient head pressure
- Can be mounted in any position M Dual Outlets
- Built-in dual check valve for backflow prevention
- 3 Year warranty

Thank you!

Rainwater Harvesting Residential Design Specification
https://rainwaterharvesting.org.au/rainwater-harvesting/papers/

Alternate Strategy for Greater Sydney
https://www.kingspan.com/au/en-au/products-brands/water-tanks/resources/news/2020/sustainable-buildings-saving-billions-an-alternat

Kingspan