

# Groundwater Replenishment



With Fresh Water Thinking, we are diversifying our water sources and focussing on those that are not climate dependent.

Groundwater replenishment is where treated wastewater is further treated so it's good enough to drink, and then it is recharged into our groundwater supplies.

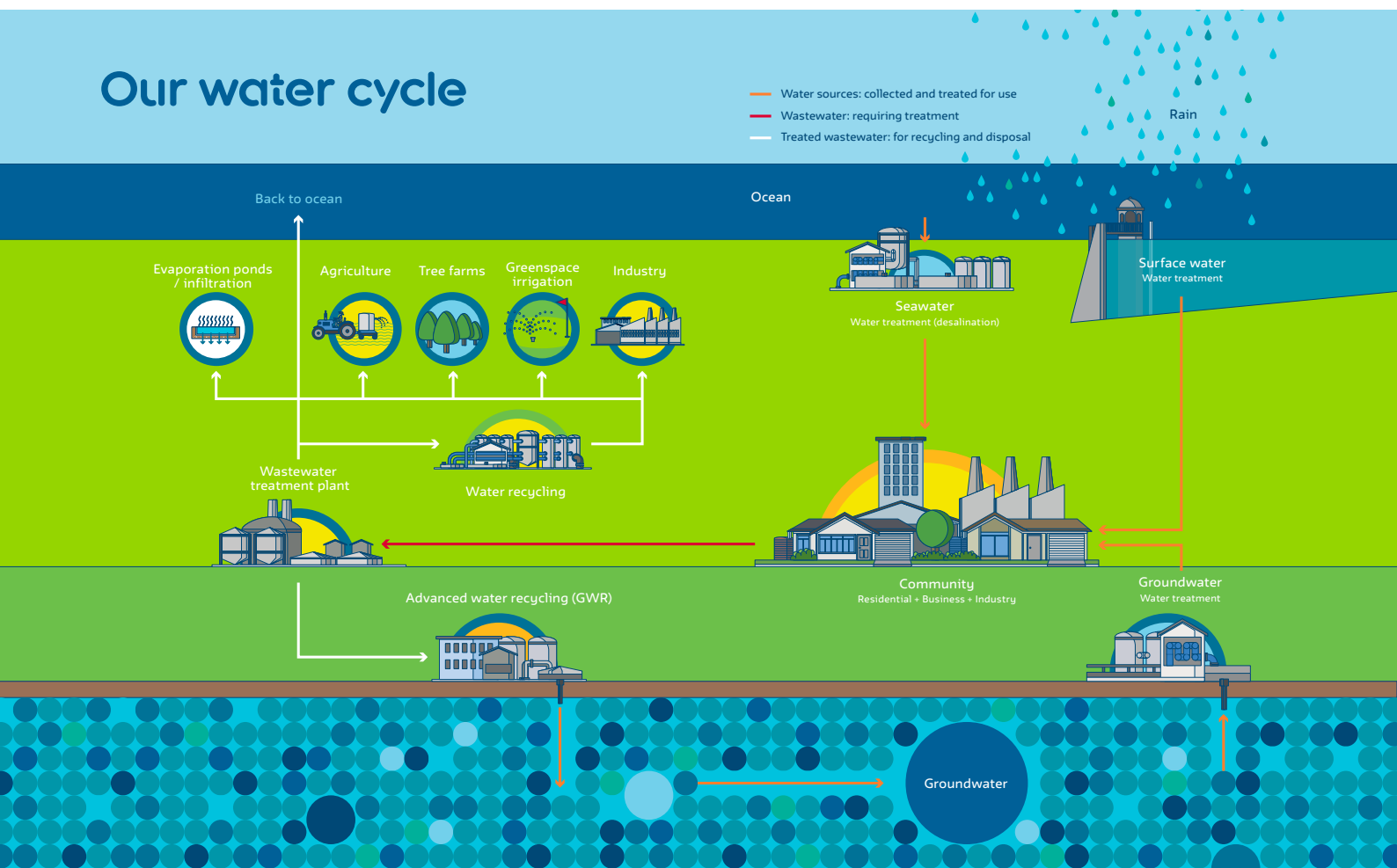
The water is then stored or 'banked' in the ground and taken out later for further treatment and supplied to a drinking water system.

This is just one of the many solutions that will help us become more climate resilient and secure our water supply for generations to come.

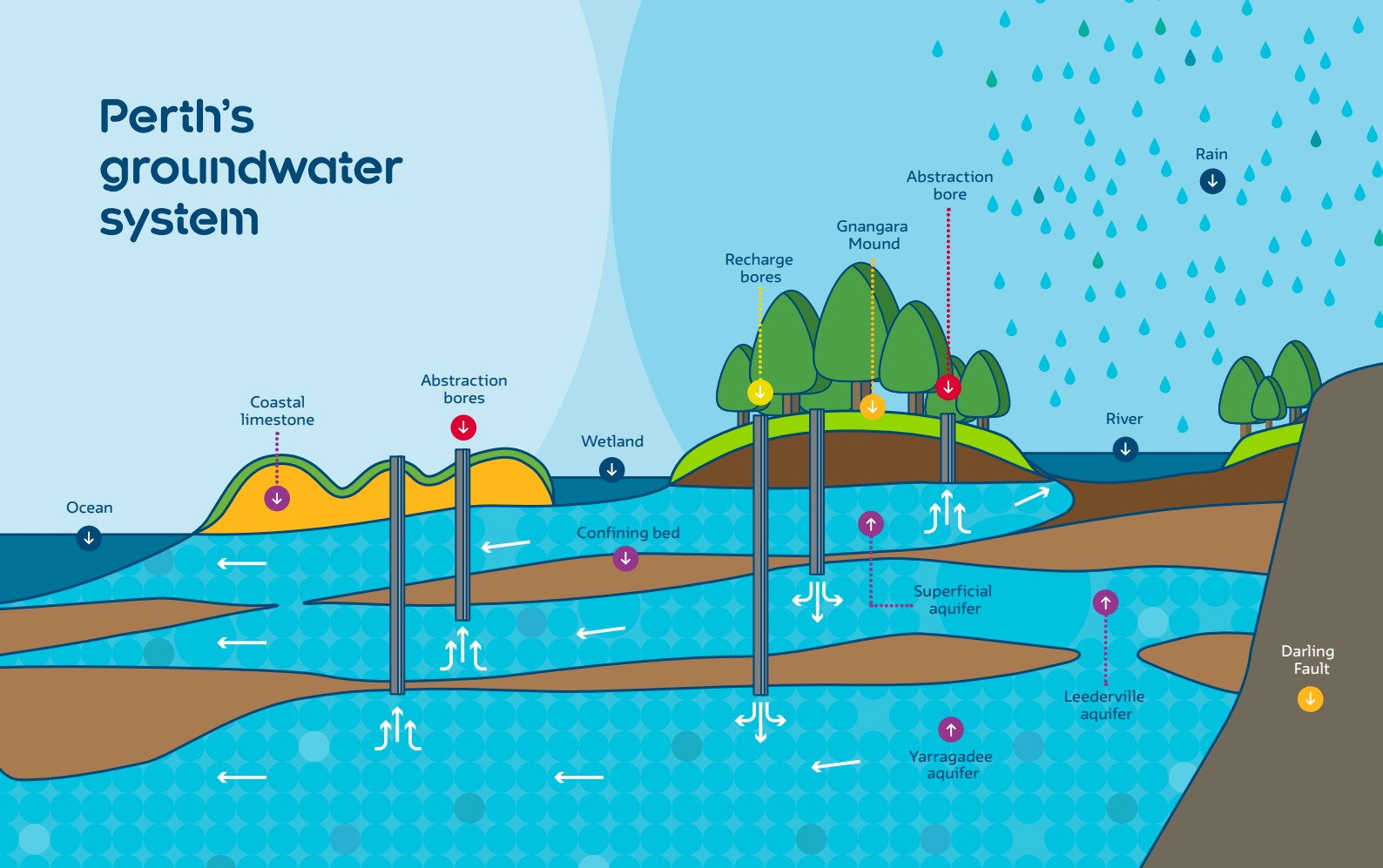
You can do your bit too, by reducing your water use. Together, we can expand our fresh water thinking.



## Our water cycle



# Perth's groundwater system



## Perth's groundwater system

Perth has a vast groundwater system. It currently provides about 40% of the drinking water supply for about 2 million people.

Groundwater is mostly rain that has trickled down from the surface through rocks and soils into aquifers.

Our aquifers aren't the underground rivers and lakes you might imagine. They're actually made up of sand, sandstone and limestone, which allow water to move between the particles.

## Perth's aquifers

### Superficial aquifer

- Is located close to the surface
- Often appear as wetlands or lakes
- Is the main groundwater source for home garden bores, and bores used for schools, parks and playing fields
- Includes the Gnangara Mound

### Leederville aquifer

- Sits below the Superficial aquifer
- Is generally separated by dense layers of materials, such as clay and shale, that minimise water movement between aquifers
- Connects with the surface in some areas

### Yarragadee aquifer

- Is generally separated from the upper aquifers by dense layers of materials, such as clay and shale, that minimise water movement between aquifers
- Provides a stable supply of water, even in dry years, because of its vast storage capacity
- Has limited connection to the surface environment
- Extends from Geraldton in the north to Albany in the south



Australia's first full-scale Groundwater Replenishment Scheme is located in Perth's northern suburbs, in Craigie, Western Australia.

The water we recharge through the scheme gives us the opportunity to take out equivalent groundwater, adding to Perth's drinking water supply.

The scheme has the capacity to recycle around 28 billion litres of water per year. That's enough to supply up to 100,000 households.

### Benefits of groundwater replenishment

- Doesn't rely on rainfall
- Sustainable water source
- Has the potential to recycle large volumes of water naturally
- Enables equivalent groundwater to be taken out while reducing impacts to the environment or other water users

Using recycled water to replenish groundwater has been successful in other parts of the world such as Orange County California, USA, since the 1970s.

Water recycling schemes are also used to supplement drinking water supplies in Singapore and in Windhoek, Namibia.



## Wastewater: how is it treated?

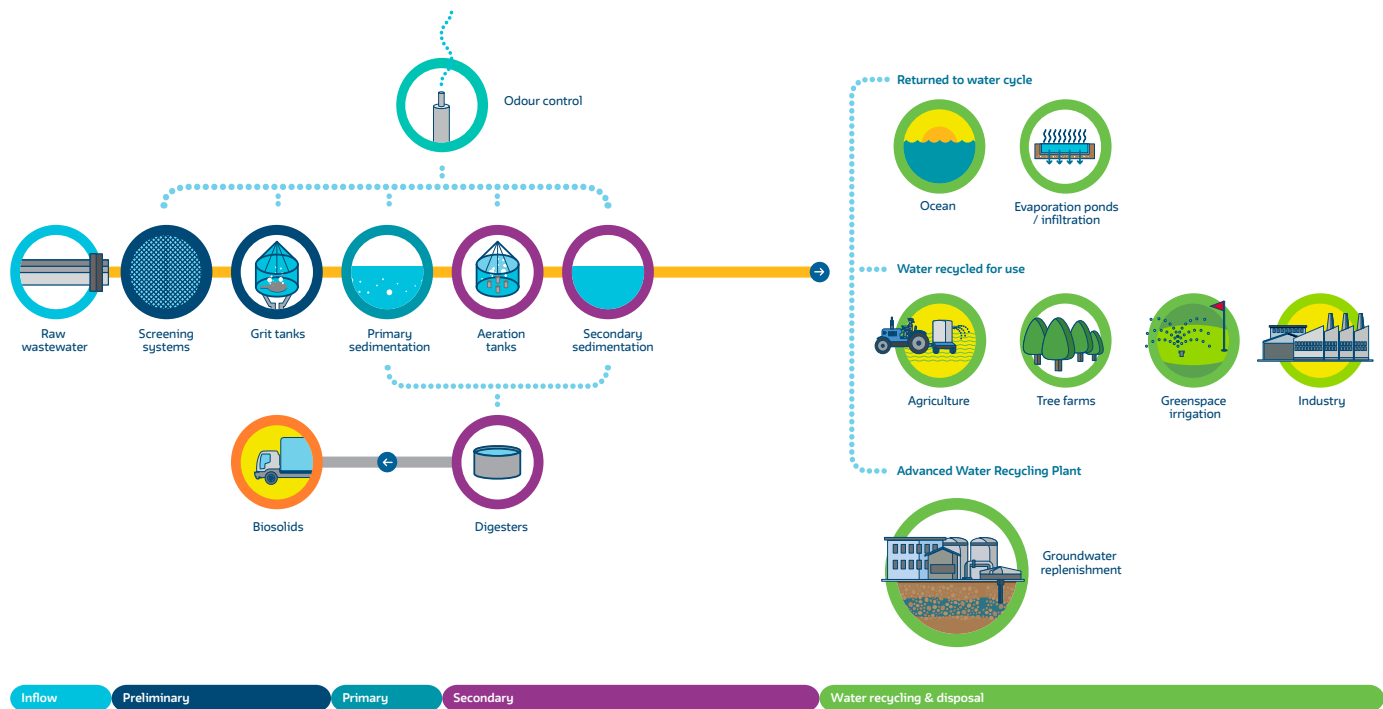
Wastewater from the community (households, businesses, industry) flows by gravity or is pumped through a network of pipes until it reaches a wastewater treatment plant.

The five main Perth wastewater treatment plants are Beenyup (located in Craigie), Subiaco, Woodman Point, Alkimos and East Rockingham.

**Wastewater is 99.97% water.**  
It mostly comes from household uses such as showers, baths and washing machines.



# Wastewater treatment process



The collection, treatment and disposal of wastewater are integral parts of the water cycle.

- Recycled water can be used for industry, greenspace irrigation, agriculture and tree farms.
- The bi-product of this process can be made into biosolids for certain horticultural and agricultural uses.
- Groundwater replenishment and other water recycling schemes will reduce the amount of treated wastewater released to the environment.

## How is water treated for groundwater replenishment?

Before entering the Advanced Water Recycling Plant, the wastewater has already undergone rigorous treatment at a wastewater treatment plant, including the removal of most chemicals and micro-organisms such as bacteria, nutrients, detergents and heavy metals.

It then undergoes further treatment to remove any trace levels of micro-organisms and chemicals so that it meets drinking water standards.

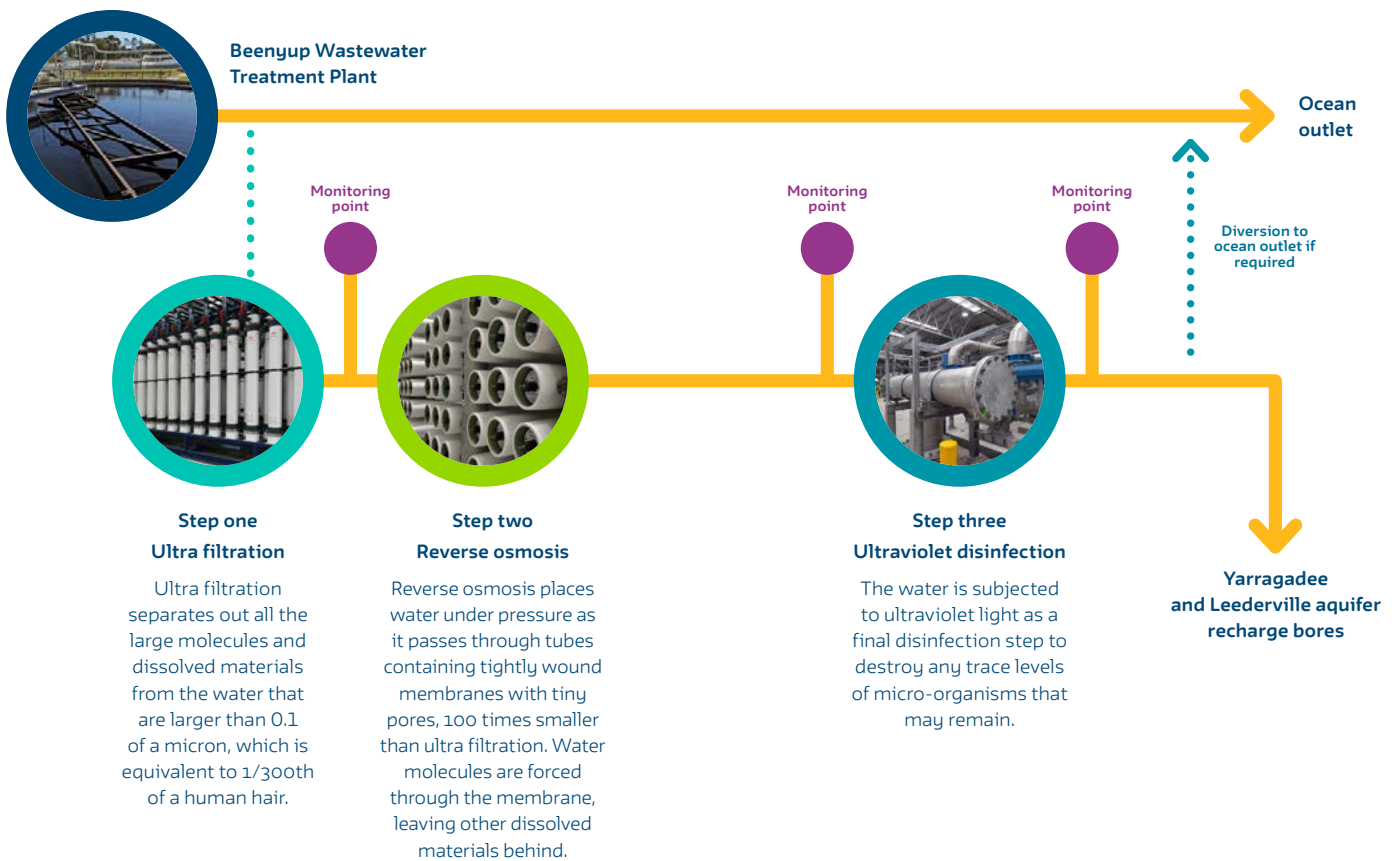
Throughout the treatment process, the water is continuously monitored to ensure strict water quality guidelines are met.

After this process, the recycled water is now of drinking water quality. It's then recharged into an aquifer where it mixes with the existing groundwater. This recharge amount is less than 0.1% of their total storage, so it's only a drop in the aquifer. Over time, we won't be able to tell the difference between the recycled water and existing groundwater.

Our goal is to recycle  
**30%**  
of wastewater  
by 2030

And  
**60%**  
by 2060

# Advanced water treatment process



The success of the Groundwater Replenishment Trial, which ran from 2010-12, proved it can safely be used to boost our drinking water supplies.

During the trial, treated wastewater from the Beenyup Wastewater Treatment Plant in Craigie was transferred to the nearby Advanced Water Recycling Plant to undergo further treatment. The recycled water was recharged into the Leederville aquifer to depths of between 120 to 220 metres.

**It was the first trial of its kind to be conducted in Australia, on this scale.**

We have the systems, processes and regulations to ensure groundwater replenishment does not put public health or the environment at risk.

The systems include water quality checkpoints to ensure each stage of the plant works at optimum levels.

- If the water is not treated to a safe level when it reaches a checkpoint, the treatment process shuts down and water is diverted to the ocean outlet.
- Groundwater monitoring tells us if there are any changes to the groundwater environment.
- The Department of Health has set very strict water quality guidelines that the recycled water must meet at the point of recharge and in the aquifers.
- Information about these water quality guidelines can be found on our website.
- Independent laboratories test water quality samples to ensure they meet the guidelines.
- The recycled water must meet drinking water standards before it's added to groundwater, giving the highest level of protection for our water supplies and the environment.

## Key facts and figures



- 1 The Groundwater Replenishment Trial ran for three years, from 2010 to 2012.
- 2 The trial plant continued to operate until September 2014. From the start of the trial until closure in 2014, the plant recharged nearly four billion litres of recycled water into groundwater supplies.
- 3 More than 11,000 community members toured the trial's Advanced Water Recycling Plant and Visitor Centre.
- 4 During the trial plant's operation from 2010 to 2014, more than 85,000 water quality samples were taken.
- 5 All of these samples met the stringent guidelines set by the regulators.
- 6 Water from the full-scale scheme will be recharged via both onsite and offsite recharge bores. This comprises both Leederville and Yarragadee bores, with the Leederville bores about 300 metres deep and the Yarragadee bores about one kilometre deep.
- 7 The Groundwater Replenishment Scheme will have the capacity to recharge some 28 billion litres of water into groundwater supplies each year.
- 8 By 2060, we could recycle 115 billion litres of water each year through groundwater replenishment from Perth's main wastewater treatment plants. If not recycled, this water would otherwise go out to the ocean.

## Glossary



### Abstraction bore

A bore used to pump groundwater from the aquifers to the earth's surface.

### Aquifer

Soil, sand and rocks that are able to store and transmit useable quantities of groundwater.

### Coastal limestone

Extends along the coastal strip of Perth made up of quartz sand, fine to medium grained shell fragments and clay.

### Confining bed

A layer of rock, or sediments, that restricts the movement of water in and out of an aquifer.

### Darling Fault

A fracture in the earth's surface running in a north-south direction that forms the eastern edge of Perth's largest source of groundwater, the Gnangara groundwater system.

### Gnangara Mound

The common name for the Superficial aquifer in a large mound of sandy soil located north of Perth.

### Groundwater

Water that is found below the earth's surface and is stored in the cracks and spaces in soil, sand and porous rocks.

### Recharge bore

A bore used to pump recycled water into the aquifers below the earth's surface.

### Surface water

Water that is collecting either on the ground, in a stream, river, lake, wetland, dam or ocean.

### Wastewater

Water that has been used inside a home, business or industry that travels to a wastewater treatment plant.



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