

Frameworks for sustainable urban water management

Water systems intersect with our urban communities, culture, landscape, economy and environment in many ways.

The way we deliver water services today directly affects the sustainability of our cities and towns: that is, the ability of future generations to also meet their needs.

These cities and towns face significant sustainability challenges:

- Rising urban water demand, driven largely by population growth and urbanisation
- Climate change reducing the reliability of rainfall-dependent water sources and increasing the frequency of extreme weather events
- A growing waste challenge
- A strong desire to improve local neighbourhood quality for public health and wellbeing, and ecological reasons.

To meet these challenges, we need to manage resources, including water, differently. Typically, urban water management follows a **linear model** (below).

We see this model being repeated at multiple scales, from household to city level.

In recent decades, water utilities have helped conserve precious water supplies, better treat then recycle wastewater discharges and introduce water sensitive urban design. These actions reduce the negative environmental impacts of the linear model and create positive economic and social outcomes along the way.

But these sustainability actions only make the linear model more efficient, and ensure we don't make our current situation any worse. They are not enough to achieve our sustainability goals.

We now need a different model to manage urban water that allows us to restore and add, rather than conserve and maintain. The latest thinking and research points to delivering water services in this regenerative way. It's a fundamental shift from a linear model to a **closed loop model** (below) that keeps resources in use for longer.



We **TAKE** water from the natural environment



We **USE** water (typically) once



We **DISPOSE** of water back to the environment (after treating it)

Linear model



Closed loop model

Transitioning from the old model to this new one takes time.

Water utilities are already taking big steps to go beyond improving linear processes, largely through various forms of recycling. Two prominent frameworks guiding this continuing transformation are the **water sensitive cities framework** and the **circular economy framework**.



Both can help a water utility move its focus:

FROM EFFICIENCY

in a linear model
(e.g. efficient water use)

TO REGENERATION

in a circular model
(e.g. (re)using water in more ways)

And both can help utilities meet their obligations to achieve the United Nations' Sustainable Development Goals (SDGs).

The SDG framework sets out a comprehensive vision for economic, social and environmental development in the context of 'leaving no-one behind'. By encouraging sustainable water use and improving environmental and urban outcomes, the circular economy and water sensitive cities frameworks help achieve all 17 of the SDGs.

What are water sensitive cities and circular economies?

Each has 3 principles that tell us how we should conduct our work.

A **WATER SENSITIVE CITY*** is achieved when we deliver urban water services in ways that enhance an urban area's sustainability, liveability and resilience.



- 3 principles of a water sensitive city:
1. Cities as water supply catchments
 2. Cities providing ecosystem services
 3. Water sensitive communities

A **CIRCULAR ECONOMY** (for water) is achieved when we harness the full value of water at all stages of the water cycle – as a service, an input to processes, a source of energy and a carrier of nutrients.



- 3 principles of circular economy:
1. Design out waste and externalities
 2. Keep resources in use
 3. Regenerate natural capital

* In this context, 'city' covers all urban areas, including regional cities and towns

The 2 frameworks are similar in what they want to achieve:

They recognise the broader value of water

They acknowledge the scarcity of water in the natural environment, recognise the many forms of water available in cities (and the value of what that water can provide), and eliminate impacts caused by wastes.

They reimagine water sector infrastructure

They move utility thinking away from only focusing on the efficiency of basic services. By considering water's role within cities, utilities can transform their assets to provide more cultural value, public health and biodiversity.

They recognise the importance of natural systems and ecosystem services

Our cities are healthier when we protect natural spaces and ecological processes, and we benefit from the ecosystem services (such as shade, cleaner air, cleaner water) that are provided in return.

Analysis of the metrics shows that neither framework fully delivers the outcomes of the other. But there are no conflicts between the frameworks either.

CE actions directly and indirectly contribute toward each WSC goal



WSC metrics directly and indirectly contribute toward each CE action



So, on their own, each framework shows how to transform urban water management to address the challenges facing our cities. But together, the 2 frameworks complement each other to speed up this transformation:

- Water sensitive cities (WSC) consider how water services affect the shape of cities by influencing the amount and connectivity of green and blue spaces, and by managing urban development to ensure the built form is sustainable.
- Circular economies (CE) look at the supply chain of the water sector, and other sectors, to influence the design of infrastructure, resources, business models and manufacturing processes.
- The WSC partnership model encourages us to think about collaboration for co-design and co-investment. The CE partnership model brings new commercial models that make sustainability viable.
- WSC highlights the importance of an empowered community in decision making. It is also more explicit about breaking down siloed approaches to service delivery.
- CE highlights the value chain of the water cycle and how value is added at each step if it is designed in from the outset.

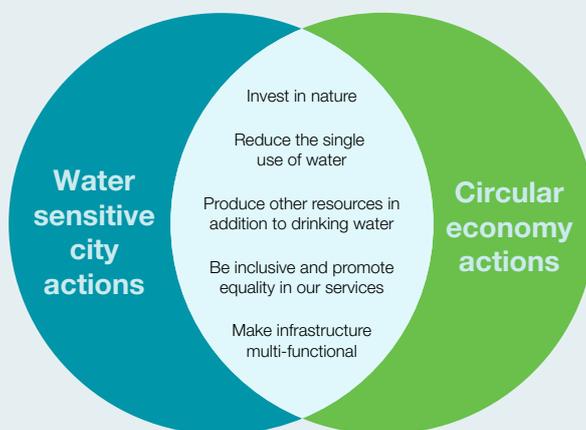
Regeneration by design

Doing something 'by design' means doing it intentionally and consistently. Together, these frameworks make us think about how we can achieve sustainability by design:

- design water infrastructure and services to design out waste, design in reuse and design for ecosystem services
- work with others through engagement, inclusion and new business models
- look beyond the core water services and the infrastructure we directly manage. Design also relates to land use planning, natural capital and cultural connections as part of a water utility's new model.

Practical next steps

Each new project or new infrastructure is an opportunity to design for sustainability. The best way to start is by working on actions that are common to both frameworks:



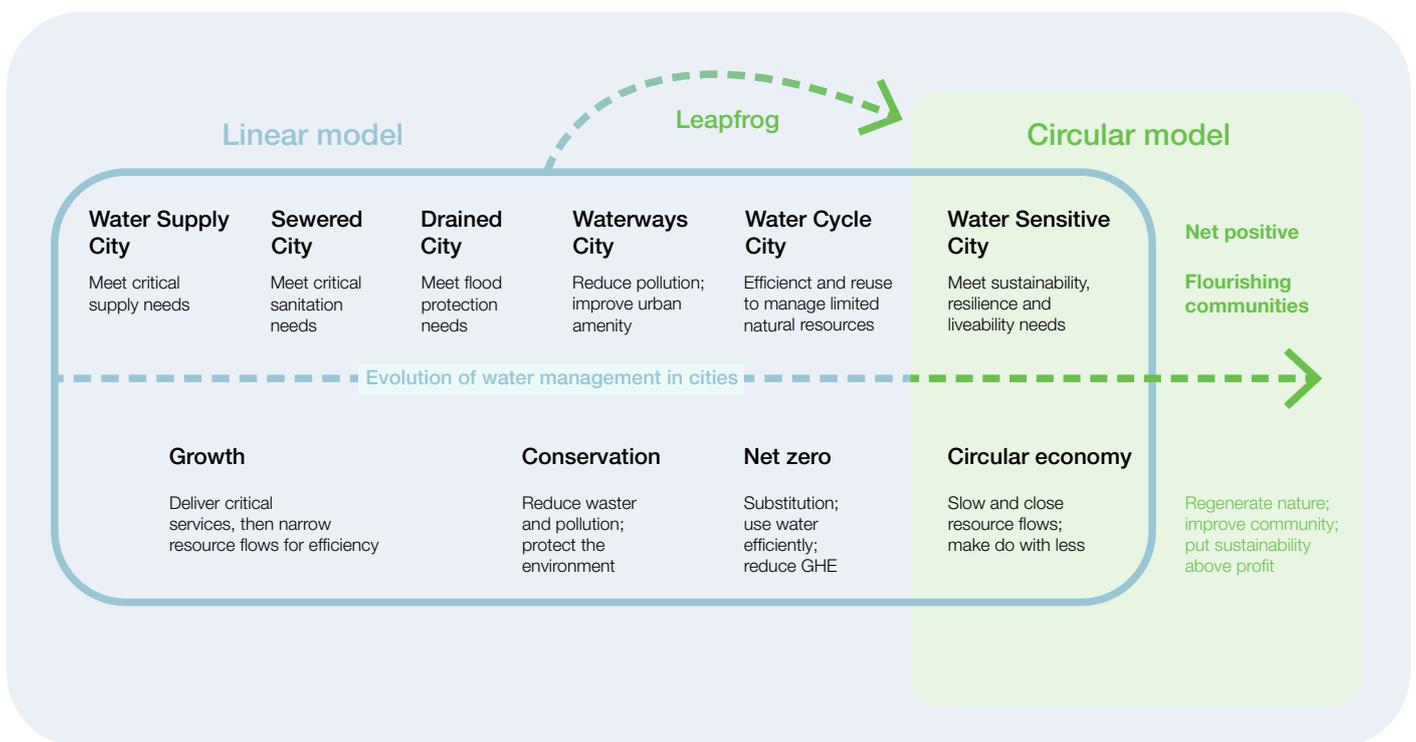


Sustainability is a journey, but it doesn't have to take a long time

Cities will pass through different stages on this journey, but all cities follow a similar pattern.

The CE and WSC frameworks explain these stages using similar pathways, even if the language differs (below). These pathways help us understand where we are now and where we're going on our journey towards sustainability.

What is evident is the tipping point when cities transform from efficiency to regeneration. This marks the shift from a linear to a circular model.



WSC¹ (top) and CE² (bottom) pathways towards sustainability and beyond

¹ Bocken NMP, Niessen L and Short SW, (2022) The Sufficiency-Based Circular, Economy—An Analysis of 150, Companies. Front. Sustain. 3:899289. doi: 10.3389/frsus.2022.899289.

² Brown, R.R., Keath, N., & Wong, T.H.F. (2009). Urban water management in cities: Historical, current and future regimes. Water, Science and Technology, International Water Association, 59(5), 847–55.



Innovative water utilities can learn from others who are ahead on the pathway, by adopting WSC and CE initiatives and leapfrogging intermediate stages to more advanced stages:

1. **Icon Water's** (ACT) ['No Opportunity Wasted'](#) program highlights the importance of cultivating **CE and WSC as a mindset**, not just a project. This Banksia Award winning program includes resource recovery initiatives that recycle waste including using Agri-Ash from wastewater treatment as a soil enhancer and creating biochar by combining wastewater biosolids with forest residue.
2. **Yarra Valley Water** (Victoria) operationalises CE thinking through detailed analysis of their flows of water, nutrients and materials. This allows YVW to identify untapped CE opportunities. Tracking the use of recycled materials in construction is one example. Another is the [Aurora Waste to Energy](#) facility which converts commercial food waste into renewable energy to power the adjacent wastewater treatment plant and supply electricity to the grid.
3. The [Western Parkland City](#) (NSW) shows how WSC and CE concepts can be **embraced at the design stage** of developing a greenfield area. **Sydney Water's [Western Sydney Regional Master Plan](#)** uses integrated water solutions to keep water in the landscape, reuse treated wastewater and stormwater, and design treatment processes to use local organic waste to produce renewable gas and heat.
4. **Water Corporation's** (WA) pioneering [Groundwater Replenishment Scheme in Perth](#) purifies recycled water to drinking water standard and uses it to replenish groundwater supplies. The 2017 scheme is now being doubled in size and will ultimately supply 8% of the city's overall water supply as part of an ongoing **transformation of the city's water supply and wastewater systems**.

Where to find more information

Water Sensitive Cities Australia provides information on water sensitive cities, with tools and research to support this. Find case studies of water sensitive city actions in practice [here](#).

Water Services Association of Australia helps the urban water sector position itself to lead the transition to a circular economy. Read more about this action plan [here](#).

Circular economy is broader than the water sector. Read more about the underlying concepts on the **Ellen MacArthur Foundation's** webpage [here](#).

