WATER SERVICES
ASSOCIATION OF AUSTRALIA

INTEGRATED WATER MANAGEMENT

Principles and best practice for water utilities

October 2020

WATER SERVICES
ASSOCIATION OF AUSTRALIA

About WSAA

The Water Services Association of Australia (WSAA) is the peak industry body representing the urban water industry. Our members provide water and wastewater services to over 24 million customers in Australia and New Zealand and many of Australia's largest industrial and commercial enterprises.

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List of acronyms

ASR - Aquifer Storage and Recovery

CMA – Catchment Management Authority (Victoria)

CRC WSC - The Cooperative Research Centre for Water Sensitive Cities

DELWP – Victorian Department of Environment, Land, Water and Planning

GHG – Greenhouse Gas

IWM - Integrated water management

IPART – Independent Pricing and Regulatory Tribunal

KPI – Key Performance Indicator

MSDI – Monash Sustainable Development Institute

NHMRC - National Health and Medical Research Council

PC - Productivity Commission

SDG – Sustainable Development Goals

SEPP - State Environment Protection Policy

WERF – Water Environment Research Foundation

WSUD – Water Sensitive Urban Design

EXECUTIVE SUMMARY

Australian and New Zealand water utilities have a long and successful history of providing safe, secure and affordable water, wastewater and drainage services to cities and regions. The water industry contributes to the productivity, public health and public safety of urban areas.

However, Australian and New Zealand cities and regions are in a rapid transformation as populations grow, our climate shifts and community expectations change. These challenges, and the increasing density and urbanisation of our cities and regions mean that the traditional central planning and delivery role of water utilities is now being broadened to encompass improved community outcomes in three areas:

1. Optimising water cycle management

As our climate continues to get hotter and drier, heat increases the demand for water and the drying climate reduces the water we have available. Total water yield from many catchments is in a long-term decline. In response, water utilities are working towards optimising and investing in a diverse portfolio of water supply sources. There are potentially major gains for communities when water utilities apply an integrated water management approach across water, wastewater and drainage systems planning at all scales (central and local-place based). A critical condition for resilience is to have systems that are adaptable to sudden and significant changes in conditions – for utilities this requires working towards an adaptive planning approach.

2. Liveability

Liveable, sustainable and productive cities and regions are critical to our economic wellbeing and quality of life. In addition to supplying safe, secure and affordable drinking water, wastewater and drainage services, water utilities contribute to broader liveability outcomes, including:

- The provision of water and land for green infrastructure including green parks, open space and corridors to support active healthy lifestyles;
- Supporting blue infrastructure including clean, healthy beaches and waterways;
- Supporting cool, healthy environments by using water and greening to reduce heat in the urban landscape, providing resilience to chronic and acute heat events and improving air quality; and
- Supporting the community through engagement, education, hardship programs and other initiatives.

Liveability outcomes are sometimes the responsibility of water utilities, but often local government or the private sector are responsible, and so water utilities should aim to integrate their planning and delivery activities with a broader range of stakeholders and the community.

3. Circular economy and integrated water servicing

Water utilities are moving towards a vision of integrated resource recovery. The impacts of the long-standing, linear approach of extracting freshwater, treating it, using it, collecting it and disposing of it can no longer be sustainably managed - the approach does not allow for the realisation of the full value of all resources. This is particularly true in the Australian and New Zealand context, where many urban centres are vulnerable to variable and declining water resources and the disposal of additional biosolids to landfill or to the oceans is no longer acceptable.

Water utilities can become agents for the circular economy and have an opportunity to play an important role as resource stewards. There are opportunities for water utilities to work with a broad range of stakeholders and customers to transform the way the total flow of energy and resources is managed and optimised.

Integrated Water Management (IWM) planning provides water utilities with an approach to optimise water cycle management, liveability and the circular economy.

Definition and scope of Integrated Water Management

Integrated Water Management is a process that brings together all stakeholders involved in the planning and management of all water across the entire water cycle, to ensure that the liveability, resilience and sustainability outcomes that the community is seeking are maximised across our cities and regions.

An IWM approach:

- Is a collaborative process that is owned by all stakeholders involved in the water cycle, from its planning to ongoing management.
- Is customer and community outcomes-driven.
- Takes a whole of water cycle approach to planning with all supply and demand options on the table.
- Takes into account all options related to water, wastewater and drainage services.
- Takes into account the environmental, cultural, social and economic dimensions of place.
- Strategic and statutory land use planning and water planning are closely integrated.
- Supports a circular economy through maximising efficiency and working towards regenerative outcomes.
- Is fit for purpose – can be suited to different scales (e.g. catchment, region, precinct) and context (places and communities).
- Is ambitious and transformative in striving for the broader outcomes of the Sustainable Development Goals.

Principles and best practice outcomes

Presented here is a set of principles and agreed best practice outcomes that allow water utilities to step through the IWM planning process in a way that suits their own particular circumstances:

Step 1 – Being clear on what the IWM process is trying to achieve: Co-designing with stakeholders the vision, objectives and outcomes for IWM projects.

Step 2 – Establishing the enabling environment: Establishing the enabling environment of institutional and organisational leadership foundations exist that underpin the delivery of such outcomes.

Step 3 – Integrated systems planning and delivery: Delivering on-the-ground the IWM outcomes and measures identified in Step 1 by integrating water systems and land use planning.

Step 4 – Developing the case for IWM projects: Applying economic evaluation, funding and financing, and considering the associated challenges and risks.

IWM Outcomes – what are we trying to achieve?

What does the desirable level of liveability, resilience and sustainability of our cities and regions look like? What specific and measurable outcomes is the IWM project seeking to deliver?

This paper proposes a set of **8 Key Outcome Areas with 27 specific Outcomes**, as summarised in Table 1 below.

The outcomes are separated into **enabling** and **delivery** outcomes:

- The first three Key Outcome Areas are referred to as **enabling outcomes** that relate to the establishment of institutional, leadership and authorising foundations
- Key Outcomes 4 to 8 relate to the 'on-the-ground' or **delivery outcomes** of IWM.

A foundational premise of IWM is that the successful achievement of on-the-ground delivery outcomes is critically dependent on ensuring all the enabling outcomes are in place before the problem-solving phases commences.

The IWM outcomes presented below in are regarded as 'best practice' but it is unlikely that any one project will aspire to achieve all these outcomes. Any project will have outcomes that the project proponent and relevant stakeholders regard as critical for project delivery, and then determine what the **levels of service** and appropriate **measures** for each outcome should be.

Image: Brisbane City Park. Source: Shutterstock.

Table 1. Best practice IWM outcomes list

Enabling Outcomes

Key Outcome Area 1 - An engaged, inspired and knowledgeable community that drives decision making.

Outcome 1a - Connection with water and water literacy

Outcome 1b - Shared ownership, management & responsibility

Outcome 1c - Community preparedness and response to extreme events

Key Outcome Area 2 - Leadership and capacity

Outcome 2a - Collective leadership, long-term vision and commitment

Outcome 2b - Knowledge, skills and organisational capacity

Outcome 2c - Indigenous partnership in water planning

Outcome 2d - Constructive organisational culture

Key Outcome Area 3 - Institutional, policy and regulatory arrangements that drive integrated and collaborative approaches to water cycle planning.

Outcome 3a - Policy, legislation and regulations

Outcome 3b - Cross-sector institutional arrangements and processes

Outcome 3c - Public engagement, participation and transparency

Outcome 3d - Economic and financial/funding systems

Delivery Outcomes

Key Outcome Area 4 - Water Infrastructure and systems that are fit for purpose, resilient and adaptable to change

Outcome 4a - Diverse fit-for-purpose water system services

Outcome 4b - Adaptable and robust systems

Outcome 4c - Integration and intelligent control

Outcome 4d - Adequate maintenance

Outcome 4e - Equitable access to water system services

Key Outcome Area 5 - Improved ecological health and biodiversity of natural environments

Outcome 5a - Healthy and biodiverse habitat

Outcome 5b - Groundwater quality and replenishment

Key Outcome Area 6 - Healthy, cool, green cities and regions supported by blue and green infrastructure

Outcome 6a - Activating connected green - blue space

Outcome 6b - Infrastructure elements functioning as part of the urban water system

Outcome 6c - Urban heat mitigation

Outcome 6d - Equitable access to amenity values of water-related systems

Key Outcome Area 7 - Resource efficiency and recovery

Outcome 7a - Highly efficient use of all sources of water

Outcome 7b - Maximised resource recovery and reuse

Outcome 7c - Low GHG emissions in water sector

Key Outcome Area 8 - Innovative system-wide transformations towards a circular economy

Outcome 8a - Beneficial outcomes across other sectors beyond water-related services

Outcome 8b - Water-related business opportunities

Developing the case for IWM projects

Developing a compelling reason for proceeding with an IWM project requires three conditions to be met:

1. There is common agreement across all stakeholders on the problem to be solved and the outcomes to be achieved.
2. The overall total societal benefits of adopting the proposed solution justify the capital and operating costs being imposed over the whole of the project's life.
3. There are parties who are willing and able to pay for the costs, both up-front capital and ongoing maintenance.

Once the first condition is completed, and the supporting and enabling conditions have been established, developing the case for an IWM project follows a set of logical steps:

1. Identification of options
2. Measuring the outcomes of options
3. Economic evaluation
4. Financing and funding of projects.

INTRODUCTION

Integrated Water Management (IWM) is a response to an era of unprecedented challenges for urban water service provision, and represents a maturing of water industry approaches to managing those challenges. Governments have created governance structures to manage these challenges, however this has resulted in a siloed approach. Although this approach has largely met community expectations to date, it is reaching its limits due to the size and complexity of the current challenges we face.

Many of the responsibilities for planning and delivery of outcomes benefitting urban communities and the urban environment are not vested in water utilities. The urban water industry is therefore looking to collaborate with other sectors to integrate planning across the whole water cycle, to deliver best whole of community outcomes and meet society's challenges head on.

Integrated water management (IWM) is the process that will deliver this integration.

Some of the IWM Outcomes listed in this report may not be directly relevant for some water utilities today because:

- The utility may not have direct responsibility for these outcomes (e.g. drainage and stormwater); or
- The outcomes are the responsibility of other jurisdictions or arms of government and are therefore out of their direct control (e.g. environmental regulations).

However, a complete set of IWM Outcomes are presented here so that water utilities can:

- Consider their role in contributing to the broad objectives and outcomes of IWM planning; and be aware of outcomes they need to support or influence (eg. policy, legislation and regulations); and
- Identify IWM outcomes that their customers or stakeholders desire, even if the water utility itself is not strictly required to deliver them (eg. collaborating with human services agencies to support vulnerable customers).

This report was developed in collaboration between Monash Sustainable Development Institute Water (MSDI Water) and WSAA, including significant input from WSAAs Adaptive Planning and Integrated Water Management Network.

How to read this report

This report provides water utilities with a set of principles for both influencing the enabling environment to support IWM approaches in their jurisdiction, and for developing IWM strategies and plans to suit their own circumstances.

Following the definition and scope of IWM, a set of steps are presented that allow water utilities to embed this type of approach in their planning:

Step 1 – Being clear on what the IWM process is trying to achieve: Co-designing with stakeholders the vision, objectives and outcomes for IWM projects.

Step 2 – Establishing the enabling environment: Establishing the enabling environment of institutional and organisational leadership foundations that underpin the delivery of IWM outcomes.

Step 3 – Integrated systems planning and delivery: Delivering on-the-ground the IWM outcomes and measures identified in Step 1 by integrating water systems planning and land use planning.

Step 4 – Developing the case for IWM projects: Applying economic evaluation, funding and financing, and considering the associated challenges and risks.

The report is designed to be read in two parts, and can be read start to finish, or is able to be read in sections of interest only.

Part 1 provides a high level snapshot of the aims, principles and challenges associated with each of the steps. It is a roadmap for practitioners. Brief reference is made to case studies that illustrate best practice for each IWM outcome.

Part 2 presents detailed case studies that are intended to illustrate the best practice IWM outcomes in a long form case study format.

There are a number of Appendices at the end of the report, including Appendix A that presents the IWM Outcomes in a consolidated list with brief description, and Appendix B that provides more detail to matters raised in Part 1, specifically:

- Enabling regulations for IWM;
- Taking into account uncertainty and risk; and
- Economic evaluation.

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OVERVIEW

Part 1

OVERVIEW

Definition and Scope of IWM

The Productivity Commission has defined IWM as a process,

"that is a whole-of-system, multi-disciplinary approach that aims to manage the entire urban water cycle by integrating the delivery of water, wastewater and stormwater services to contribute to the full suite of water security, public health, environmental and urban amenity outcomes that the community is seeking". They note that IWCM will "require significant, ongoing collaboration between the land-use planning and local government sectors and the water sector, in both policy and planning at a range of different scales (Productivity Commission 2020)".

The Productivity Commission report is sub-titled '*Why a good idea seems hard to implement*'. As this report demonstrates, IWM raises complex challenges that require new planning processes. At times IWM needs to deal with seemingly intractable challenges (climate change impacts, rapid population growth, technological changes, etc.); a range of interrelated needs (bio-physical and social-economic); and a range of policy, regulatory and institutional contexts. **Integrated Water Management is defined here as:**

A process that brings together all stakeholders involved in the planning and management of water across the entire water cycle, to ensure that the liveability, resilience and sustainability of our cities and regions is maximised.

An IWM approach:

- Is a collaborative process that is owned by all stakeholders involved in the water cycle, from its planning to ongoing management.
- Is customer and community outcomes-driven.
- Takes a whole of water cycle approach to planning with all supply and demand options on the table.
- Takes into account all options related to water, wastewater and drainage services.
- Takes into account the environmental, cultural, social and economic dimensions of place.
- Strategic and statutory land use planning and water planning are closely integrated.
- Supports a circular economy through maximising efficiency and working towards regenerative outcomes.
- Is fit for purpose – can be suited to different scales (e.g. catchment, region, precinct) and context (places and communities).
- Is ambitious and transformative in striving for the broader outcomes of the Sustainable Development Goals.

Importantly, IWM is not to be confused with Water Sensitive Urban Design (WSUD) – IWM is a planning approach, whereas WSUD is generally understood as a catch-all term for a variety of decentralised infrastructure options to meet one or more IWM outcomes.

Step 1: IWM outcomes – what are we trying to achieve?

Before any IWM solutions are contemplated there is a need to co-design with stakeholders the vision for the project, its objectives and the outcomes that are to be achieved through the IWM process. A subsequent exercise is to specify the level of service to be achieved by each outcome (also referred to as indicators) and ultimately measures for each level of service, for use as a basis for comparing options.

Developing vision and objectives

The vision of a strategy or project is the overarching purpose and shared expectation of the future, and inspires stakeholders to commit to the project.

There are a range of stakeholders who play a role in the delivery of an IWM project's outcomes – whether they are enabling outcomes (from community representatives to regulators) or service planning and delivery outcomes (including water utilities, local government and private sector developers).

Involving all relevant stakeholders in a process of co-developing the vision and objectives of a project is critical, along with the need to clarify project outcomes and targets. At the end of the IWM process it is expected that relevant stakeholders will be committed to funding the project and/or providing resources to its ongoing operation and maintenance – which means that stakeholders owning the vision from the outset is critical.

The objectives of the project should be a clear statement of the purpose of the project and framing the problems the project is aiming to solve.

It is important not to move into problem solving mode until all stakeholders are absolutely confident that the problem(s) is clearly specified and understood.

Western Sydney Regional Master Plan (Case Study 3)

Demonstrates: Developing collaborative vision and shared objectives

Priority strategic context: The Greater Sydney Commission's Vision for a Western Parkland City includes "neighbourhoods with fine grain fabric and human scale that support healthy lifestyles and connected communities".

Vision: To maximise the value to Sydney Water's customers by securing the long term vision and benefits of the emerging Western Parkland City … 'Our customers enjoy affordable and essential water services, healthy waterways and vibrant, cool and green places.'

Problems and challenges in Western Sydney: Population growth, climate change, cost of new services, waterway health, unprecedented infrastructure investment, place making imperative.

Image: Western Parkland City. Source: Sydney Water

Outcomes development for this paper

What does the desired level of liveability, resilience and sustainability of our cities and regions look like? What specific and measurable outcomes is an IWM project seeking to deliver?

The process to develop the IWM Outcomes presented in this paper involved a review and analysis of current practices adopted by authorities in Australia and internationally (IWA 2016). This review was undertaken in close collaboration with WSAA's Adaptive Planning and IWM Network Group involving a number of workshops and review exercises.

A starting point for this review were the seven IWM outcome areas adopted by the Victorian IWM Framework (see Case Study 2 in Part 2). The Victorian IWM Framework was then overlain with the Sustainable Development Goal (SDG) Targets that are identified as relevant for water utilities – those that water utilities impact on directly or indirectly (Skinner and Satur, 2020). This resulted in an expansion and refinement of the original set of outcomes.

At this stage the measures included in the Water Sensitive Cities Index[1] (WSCI) developed by the CRC for Water Sensitive Cities (CRC WSC) were reviewed and found to be consistent with the IWM outcomes that had been developed to this stage.

Further consideration and sense-checking by the WSAA project working group resulted in a final set of IWM Outcomes with **8 Key Outcome Areas and 27 specific Outcomes**, as presented in summary form in the Table 2 below and in more detail in Appendix A.

The outcomes are separated into **Enabling** and **Delivery** outcomes:

- The first three Key Outcome Areas are referred to as **enabling outcomes** that relate to the establishment of institutional, leadership and authorising foundations
- Key Outcomes 4 to 8 relate to the 'on-the-ground' or **delivery outcomes** of IWM.

The successful achievement of on-the-ground outcomes is dependent on ensuring all the enabling outcomes are in place at the outset or as the project proceeds.

[1] The Water Sensitive City Index is a tool developed by the CRC for Water Sensitive Cities to benchmark a city's current performance against seven goals of a water sensitive city (Ferguson, Frantzeskaki and Brown 2013).

Table 2: Best practice IWM outcomes list

Enabling Outcomes

Key Outcome Area 1 - An engaged, inspired and knowledgeable community that drives decision making.

Outcome 1a - Connection with water and water literacy

Outcome 1b - Shared ownership, management & responsibility

Outcome 1c - Community preparedness and response to extreme events

Key Outcome Area 2 - Leadership and capacity

Outcome 2a - Collective leadership, long-term vision and commitment

Outcome 2b - Knowledge, skills and organisational capacity

Outcome 2c - Indigenous partnership in water planning

Outcome 2d - Constructive organisational culture

Key Outcome Area 3 - Institutional, policy and regulatory arrangements that drive integrated and collaborative approaches to water cycle planning.

Outcome 3a - Policy, legislation and regulations

Outcome 3b - Cross-sector institutional arrangements and processes

Outcome 3c - Public engagement, participation and transparency

Outcome 3d - Economic and financial/funding systems

Delivery Outcomes

Key Outcome Area 4 - Water Infrastructure and systems that are fit for purpose, resilient and adaptable to change

Outcome 4a - Diverse fit-for-purpose water system services

Outcome 4b - Adaptable and robust systems

Outcome 4c - Integration and intelligent control

Outcome 4d - Adequate maintenance

Outcome 4e - Equitable access to water system services

Key Outcome Area 5 - Improved ecological health and biodiversity of natural environments

Outcome 5a - Healthy and biodiverse habitat

Outcome 5b - Groundwater quality and replenishment

Key Outcome Area 6 - Healthy, cool, green cities and regions supported by blue and green infrastructure

Outcome 6a - Activating connected green - blue space

Outcome 6b - Infrastructure elements functioning as part of the urban water system

Outcome 6c - Urban heat mitigation

Outcome 6d - Equitable access to amenity values of water-related systems

Key Outcome Area 7 - Resource efficiency and recovery

Outcome 7a - Highly efficient use of all sources of water

Outcome 7b - Maximised resource recovery and reuse

Outcome 7c - Low GHG emissions in water sector

Key Outcome Area 8 - Innovative system-wide transformations towards a circular economy

Outcome 8a - Beneficial outcomes across other sectors beyond water-related services

Outcome 8b - Water-related business opportunities

The IWM Outcomes presented here are regarded as best practice, but it is unlikely that any one project will be able to achieve all these outcomes. For any project it is necessary to identify the outcomes that the project proponent and relevant stakeholders regard as critical for project delivery, determine what the levels of service for each outcome should be, as well as appropriate measures.

Kilmore Treatment Plant Offsets Scheme (Case Study 6)

Demonstrates: Developing outcomes and influencing the enabling environment

The water systems outcomes of the project related to the following IWM Outcomes:

Outcome 4a – Diverse fit-for purpose water systems
Outcome 5a – Healthy and bio-diverse habitat
Outcome 7c – Low GHG emissions in water sector

However, because this project relied heavily on a non-conventional ('non-structural') option, many of the critical IWM outcomes related to the establishment of institutional foundations and enabling environment:

Key Outcome Area 1 – Engaged, inspired and knowledgeable community that drives decision making.
Key Outcome Area 2 – Leadership and capacity
Key Outcome Area 3 – Institutional, policy and regulatory arrangements that drive integrated and collaborative approaches to water cycle planning

Paying attention to these Key Outcomes was vital to the success of the project.

Image: Wetlands at Kilmore Treatment Plant Offsets Scheme. Source: GVW.

Levels of service indicators and measures

Having determined particular outcomes for an IWM project, the indicators and measures for each outcome should be agreed by all stakeholders, including both community groups and potential funding partners. These measures will be used to evaluate options at a later stage of the IWM process. Outcome measures will be unique to individual projects and should be quantifiable.

Victorian IWM Framework (Case Study 2)

Demonstrates: Developing indicators and measures

The Victorian IWM **Forums established under the auspices of the Victorian IWM Framework,** have adopted seven Strategic Outcomes**,** for which there are a total of 28 measures. For example, one of the Strategic Outcomes is “Community values are reflected in place-based planning”. For this strategic outcome, an indicator is:

> **Indicator:** Increase IWM’s contribution to a community’s sense of place, health and well-being
> **Measure:** Hectares of blue-green infrastructure created or enhanced by collaborative water management

Work is also being undertaken with Traditional Owners to develop an appropriate indicator to reflect the need to increase the incorporation of Aboriginal people’s values, knowledge and obligations to country in IWM planning and projects.

Image: The Dandenong IWM Forum. Source: DELWP

Step 2: Establishing the enabling environment

There are three key outcome areas necessary for laying the foundation for delivering effective on-ground IWM outcomes:

Key Outcome Area 1	Key Outcome Area 2	Key Outcome Area 3
An engaged, inspired and knowledgeable community that drives decision-making.	Leadership and capacity.	Institutional, policy and regulatory arrangements that drive integrated and collaborative approaches to water cycle planning.

Key Outcome Area 1: An engaged, inspired and knowledgeable community that drives decision making.

The capacity and motivation of both customers and community is a key factor in their ability to be water literate and play their role in urban water management. Because of this, water utilities are continually reassessing the way they engage with their customers and the community to determine expectations and to collaborate with other stakeholders in creating value.

Financial regulators are also requiring that water businesses "express their entire proposals in terms that reflect the **outcomes and value** they will be delivering to their customers" (Ben-David 2016). In this case the Victorian Essential Services Commission expects pricing submissions to reflect the concerns, priorities and preferences of their customers.

Attaining **an engaged, inspired and knowledgeable community that drives decision-making** requires:

- Connection with water and water literacy (Outcome 1a)
- Shared ownership, management & responsibility (Outcome 1b)
- Community preparedness and response to extreme events (Outcome 1c).

Outcome 1a – Connection with water and water literacy

Achieving this outcome would see customers and community actively participating in IWM processes because they have adequate knowledge of water cycle, water sector and current state of water affairs. Non-Indigenous people would have increased knowledge of the economic, cultural and/or spiritual interests of Indigenous people. People would have pride and connectedness with water through improved understanding of water's role in urban liveability, physical and mental health, and culture.

A pre-condition for a successful engagement process is that all participants have a reasonable knowledge of the water related issues being addressed. The aim is for the community to be connected to the IWM process through an understanding of water's role in achieving the outcomes of the project – which may be broader than water.

In all processes it is important to consider the diversity of the customer base and the extent to which it may be necessary to develop targeted messages and language for different community groups. The Water Research Foundation (Mukheibir, Howe and Gallet 2015) advises that these stakeholder engagement processes should include consideration of the following:

- Meaningful two-way processes at the right scale;
- Learning to speak in plain English or appropriate languages without jargon;
- Allowing sufficient time for engagement and considering feedback; and
- Getting savvy with appropriate technology.

Outcome 1b – Shared ownership, management and responsibility

This outcome ensures customers and community, including Indigenous people, are active participant in creating, operating and maintaining relevant water system and its infrastructure.

Having customers and community members as active participants in the creation and planning of water systems will help result in people feeling a strong connection with water-related assets.

The level of involvement will vary between projects and be dependent on the nature and scale of each project.

A further aim is to encourage and enable households and communities to play an appropriate role in the ‘ownership’ and management of these solutions once IWM solutions are developed and delivered.

Oaklands Stormwater Harvesting and Reuse project (Case Study 9)

Demonstrates*: *Key Outcome Area 1 – An engaged, inspired and knowledgeable community that drives decision making

Detailed and extended consultation occurred during the feasibility, viability, funding, development application and construction phases of the Oaklands project. This ranged from early engagement with the Kaurna Nation, State and Federal Governments, residents and contractors.

This process enabled the IWM project team to fine-tune the project, delivering multiple community benefits, not limited to stormwater harvesting.

The City of Marion uses the wetland for community education purposes. Site tours are promoted via the Council website. Local schools regularly visit the site. Flinders University students also use the wetland for water quality monitoring and ecology classes.

Image: Oaklands Wetlands. Source: City of Marion, Michael Mullan.

Outcome 1c – Community preparedness and response to extreme events

This outcome sees customers and community empowered to cope with impacts associated with a water-related extreme event and minimise the severity and duration of its impacts.

There are a range of risks associated with the achievement of the outcomes of all IWM projects, at all scales. Some obvious ones relate to extreme climatic events such as droughts, floods and heat waves, all of which are being exacerbated by climate change.

In this respect an engaged, knowledgeable and connected community is essential for building operational and social resilience, and necessary to provide community-based responses to extreme events.

To support communities to cope, adapt and strengthen their resilience to extreme events, IWM outcomes should[2]:

- Build community experience, awareness and understanding of local risks to lives and livelihoods;
- Foster community values, expectation and opportunities (a culture) for participation in risk planning and management;
- Build community capacity for preparedness through strengthening community networks, relationships and trusted avenues for information exchange between emergency services and citizens;
- Widely share information about extreme events and event responses; and
- Coordinate regional, community and household response plans through participative and co-design processes.

[2] See for example, Bird et. al. (2013); Boon et. al. (2012); Khalili, Harre and Morley (2015)

Example – Brisbane River Flood Plain Management Plan

Demonstrates: Outcome 1c – Community preparedness and response to extreme events

Following the 2010-11 floods the Queensland Government together with Brisbane, Ipswich, Lockyer Valley and Somerset councils developed a flood plain management strategy that has a number of components:

- Disaster management
- Land-use planning
- Resilient buildings
- Structural mitigation
- Landscape management
- Community resilience

In relation to community resilience, the strategy states that community awareness, understanding and response is the foundation for community resilience. In 2017, consultation was undertaken with more than 1000 residents across the Brisbane River floodplain, providing insights into community behaviours and attitudes toward flood risk.

Community input has helped identify opportunities for even greater collaboration across government to support clear and consistent information being available before, during and after a flood.

State and local governments are now working together to develop regionally consistent flood-risk information for people living and working in different parts of the floodplain. This includes greater consistency in the following:

- Online flood awareness mapping
- Property-scale flood information
- Community information

Image: Brisbane's Storey Bridge over the Brisbane River. Source: Shutterstock.

Key Outcome Area 2: Leadership and capacity

IWM requires an authorising environment where customers and the community are able to partner with planning agencies to articulate their needs and priorities. Demonstrating authenticity in this leadership will assist in bringing customers and community along for the journey.

In this context, leadership requires both external and internal perspectives. An external focus provides public communications and behaviours of the utility that are trusted, as well as a leadership culture and capacity within the utility that ensures engagement with customers and community is authentic and constructive.

In summary, the leadership and capacity that is needed to deliver IWM outcomes requires:

- Collective leadership, long-term vision and commitment (Outcome 2a)
- Knowledge, skills and organisational capacity (Outcome 2b)
- Indigenous partnership in water planning (Outcome 2c)
- Constructive organisational culture (Outcome 2d)

Outcome 2a – Collective leadership, long-term vision and commitment

Within a water utility, this outcome sees a well-articulated IWM vision and narrative that drives innovation to achieve IWM outcomes. As a consequence, IWM processes are valued and implemented as 'business-as-usual' throughout the organisation at all levels, in both strategy and operation.

Achieving this outcome requires a commitment by the water utility to demonstrate leadership by initiating and inspiring collaboration with other IWM stakeholders, whether they are government agencies and regulators, local government, planning agencies, Traditional Owners, or other relevant agencies or customer and community groups.

A key role of leadership is in the area of external advocacy and influence for IWM. If the institutional policy and regulatory settings need improvement or reform, water utility leaders have a responsibility to work with authorities to achieve such changes in their jurisdiction.

Achieving this change requires a whole of industry approach, and the initiatives of WSAA and other organisations (including for example those of the Productivity Commission, IPART, Infrastructure Victoria, NHMRC, CRC WSC and the International Water Association) to expand the state of knowledge, and influence key policy reform processes at state and federal levels is an important part of the long term vision of the sector as a whole.

As a water utility, particularly those with government shareholders, this may seem quite a daunting task. However, as with progression in other areas of society, this is the responsibility of no single organisation, but a collective collaboration to use the best evidence to galvanise professional and public opinion, influence decision makers, and achieve the desired change.

At a project level, all IWM projects, at all scales will need at least one organisation to provide overall project leadership. Part of the process of establishing governance accountabilities at the outset is to clarify, and agree on, who has ultimate responsibility for delivering the IWM

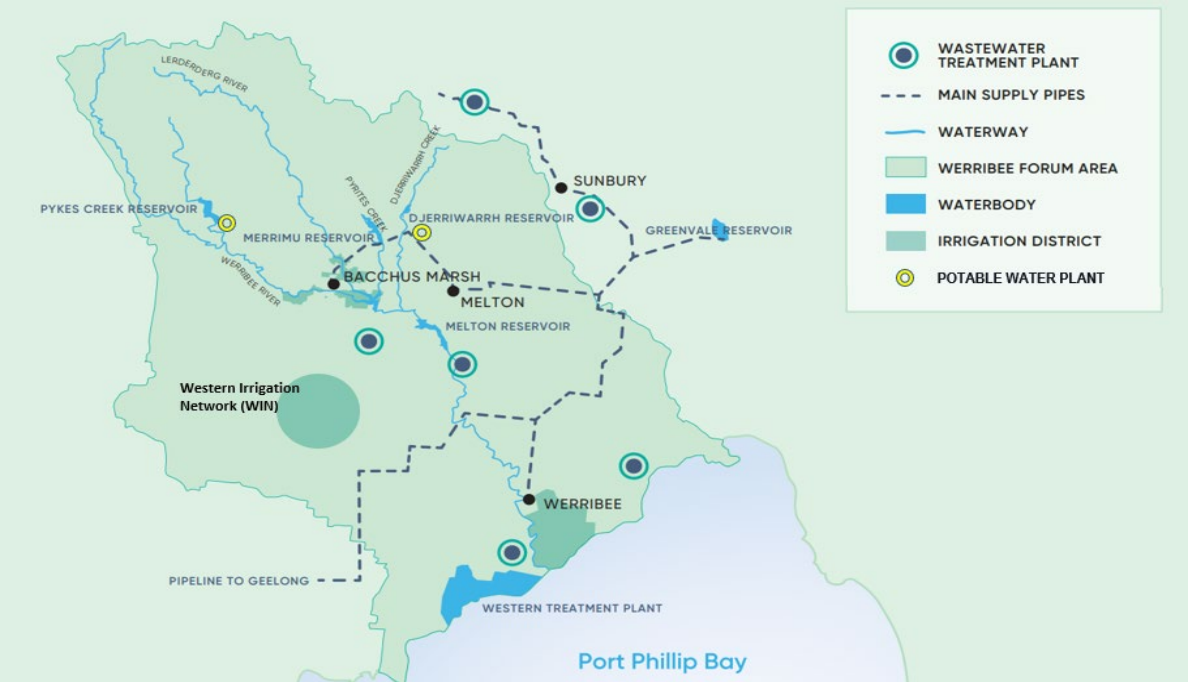
planning process. Different organisations will be better placed depending on context – often it will be water utilities but not always, particularly with stormwater projects and growth area planning projects.

Outcome 2b – Knowledge, skills and organisational capacity

Achieving this outcome requires the multi-disciplinary group of staff involved in any IWM project to be appropriately trained and educated on community engagement philosophy and techniques. Additionally, leadership should actively foster supportive organisational cultures (see **Outcome 2c**) and commitment to collaborative processes.

A suggested checklist of required capacity includes (Mukheibir, Howe and Gallet, 2015):

- Knowledge building – continually improving both the individual's and organisation's awareness and understanding of how best to manage the water system.
- Professional development – developing effective human resource capacity – both technical and 'people' skills (see following section for further discussion).
- Organisational strengthening – involving the review and improvement of management structures, processes and procedures – both inter- and intra- organisational.



Example – Western Melbourne Corridor IWM Plan (DELWP, 2018)

Demonstrates: *Outcome 2a – Collective leadership, long-term vision and commitment; Outcome 2b – Knowledge, skills and organisational capacity*

This IWM project is managed by a project working group comprising representatives from DELWP, four water utilities and all **local governments. The working group** reports to and is overseen by the Werribee IWM Forum.

There is no single organisation with overall project leadership responsibility. At the time of writing, the project is being led by Melbourne Water, however earlier phases have been led by other organisations. DELWP has played a key role in providing overall direction and support for the strategic intent of this project.

The complexity of the project has meant that a clear single-focused approach for progressing the project was not evident from day one. While this has perhaps slowed down parts of the project it is seen as an expected and necessary consequence of the IWM planning process – there is a 'gestation period' that is needed for stakeholders to clarify the problems to be solved, and the critical outcomes to be achieved, with agreed indicators and measures. This is an important component of ensuring stakeholder buy-in to the project and a basis for the generation of innovative solutions. It is a very good example of collective leadership and developing long term vision and commitment.

In most cases members of the project working group have undertaken much of the planning analyses for their individual areas of responsibility themselves, rather than engaging consultants as is often the case. For example, to define and measure the BAU conditions, each of the organisations have done their own analysis. Anecdotally this has increased buy-in and capacity building through the project and within individual organisations. There has been knowledge transfer and group learning and in the process, sustainable organisational development.

Image: Western Melbourne Corridor IWM Plan. Source: DELWP.

Outcome 2c – Indigenous partnership in water planning

This outcome sees Traditional Owners included as partners in water planning, supporting their self-determination and their social, economic and cultural development in a mutually beneficial process.

Historically, Indigenous water rights and perspectives have been largely ignored in water planning processes by governments, at all levels. However, since the 2004 National Water Initiative – an intergovernmental agreement that explicitly recognised Indigenous rights to water – there has been a slow emergence of legislative, policy and practice change in these areas, across federal, state and local jurisdictions.

A common assumption has been that Indigenous water aspirations could largely be encompassed through environmental water allocations, with appropriate cultural heritage protection mechanisms in place to protect water sites of significance. But as numerous Indigenous declarations, policy statements and research[3] suggests, this perspective substantially under-recognises the numerous and varied roles water plays in the cultural, spiritual, social, environmental and economic livelihoods of Indigenous people.

A number of Indigenous organisations and advocates[4] have emphasised that the water related rights and aspirations of Indigenous people should first and foremost be established and recognised from Indigenous perspectives, rather than seeking to categorise them under current water planning and management terms, processes and doctrines. These calls have been reinforced in policy through the adoption of the United Nations Declaration of the Rights of Indigenous Peoples[5] (adopted by Australia in 2009), and subsequent Indigenous-led policy initiatives including for example, A Policy Statement on North Australian Indigenous Water Rights (2009), the Policy Framework (2012)[6], and the Victorian Traditional Owner Water Policy Framework (2014).

While it is recognised that this is a stretch goal for water utilities, an Indigenous perspective should ideally be incorporated at all levels of an IWM approach, including the institutional and legislative enabling environment, through to processes and protocols for genuine engagement of Traditional Owners and Indigenous communities in planning, management and decision-making.

Practically, this involves at a minimum water utilities meeting their legislative responsibilities (both state and Commonwealth) towards the Traditional Owners within their service area, and supporting their self-determination by engaging early and comprehensively. Currently,

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[3] Including the Boomanulla Statement (2002), the Indigenous Peoples Kyoto Water Declaration (2003), the Echuca Declaration (2007), the Mary River Statement (2009), the Garma International Indigenous Water Declaration (2009) the Fitzroy River Declaration (2016), The Uluru Statement from the Heart (2017), and the National Cultural Flows Research Project (2018).

[4] NAILSMA (2008); Maine (2014); Cultural Flows Planning and Research Committee (2017); Walker and Grey-Gardener (2017); Jackson, Stewart and Beal (2019); Poelina, Taylor and Perdrisat (2019); Woodward et. al. (2020).

[5] Macklin J (2009). "Statement on the United Nations Declaration on the Rights of Indigenous Peoples" media release. https://parlinfo.aph.gov.au/parlInfo/download/media/pressrel/418T6/upload_binary/418t60.pdf;fileType=application%2Fpdf#search=%22media/pressrel/418T6%22

[6] Duncan P and First Peoples' Water Engagement Council, 2019. *Policy Framework: FPWEC: First Peoples' Water Engagement Council.* Presented at Indigenous Water Justice Symposium (6/06/2019). https://scholar.law.colorado.edu/Indigenous-water-justice-symposium/3.

this often results in Traditional Owners being swamped by engagement requests from organisations across multiple sectors – agreeing with each Traditional Owner on their priorities for involvement, and developing a strong working partnership based on mutual respect can assist in progress towards this outcome while reducing engagement burden.

With Traditional Owners spread across diverse geographic contexts and possessing unique customs, protocols and languages, there is no 'one size fits all' approach. Instead, a place-based approach is required to ensure that partnership processes and outcomes at all levels of an IWM approach are culturally respectful and contextually appropriate to empower Traditional Owners in ways that support their aspirations for Country, culture and people.

Guidelines have been developed by several authors and institutions for ethical and respectful conduct in Indigenous research and collaboration in Australia (AIATSIS 2012; NHMRC 2018; Woodward et al 2020). These guidelines identify a range of core values and principles to be considered in the conduct of appropriate and respectful research and collaboration with Indigenous people. These can support processes for Traditional Owner partnerships in IWM planning, and have been characterised as the Four R's as outlined in Figure 1.

Case studies 5a and 5b (Part 2) provide examples of how these principles have been adopted and incorporated in relevant legislative and policy settings, institutional process and local decision making for the Upper Merri Creek sub-catchment in Melbourne. These case studies do not necessarily serve as a unifying framework for best practice, but they do offer an example of localised stakeholder experiences and processes in which the above stated foundational principles have been harnessed to deliver co-led, designed and implemented IWM processes and outcomes.

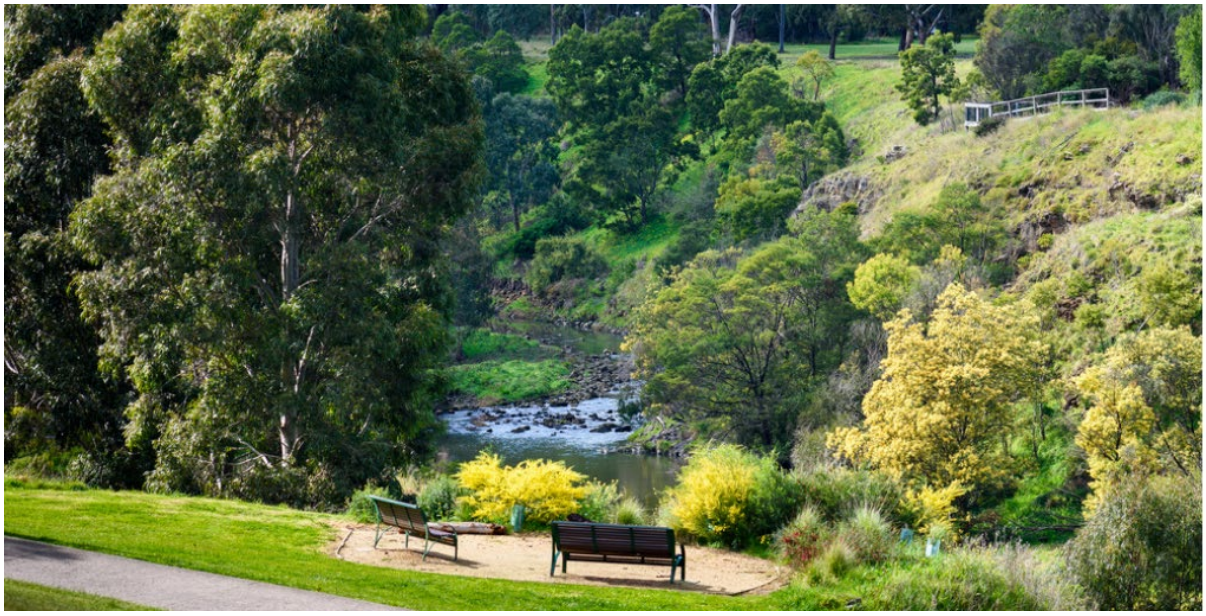
Figure 1. Core values and principles to be considered in partnering with Indigenous people. Source: Adapted from AIATSIS (2012), DELWP (2016), Markiewicz (2012), NHMRC (2018), Woodward et. al. (2020)

Outcome 2d – Constructive organisational culture

IWM deals with complex problem solving, involving a range of technical options delivered by a range of stakeholders, in a planning environment of deep uncertainty. Success requires an organisation and leadership culture which is a ‘problem solving’, or constructive culture that:

- Expects and encourages people to collaborate and share ideas openly;
- Understands the importance of ‘below the line’ drivers (trust, openness, relationships, identity);
- Rewards innovative risk-takers;
- Seeks to understand the commitments of all parties involved and then works to achieve alignment on future success; and
- Focuses on strengths that help with problem solving rather than focusing on problems.

A common lesson learned in a number of IWM planning processes, as highlighted in the Upper Merri Creek IWM Plan (Case Study 5a), is that executive level support is required to deliver constructive organisational cultures. Generating a collective understanding and communicating a shared perspective within organisations requires dedicated effort and support. It cannot be delivered effectively by a single individual or small team.



Upper Merri Creek IWM Plan (Case Study 5a)

Demonstrates: Outcome 2d – Constructive organisational culture

Each partnering organisation in the Upper Merri Creek IWM Plan had a unique perspective on the outcomes being sought and a range of information was collected to create a shared understanding of key issues.

A key to this was workplace cultures that support diverse perspectives and bold conversations to complement robust processes such as Scenario Thinking, to not only challenge the status quo, but commit to action for doing things differently.

Yarra Valley Water (YVW) is a lead partner in the project and brought a strong history and commitment to constructive leadership.

In 2001 YVW management recognised the need to improve efficiency while maintaining high levels of customer satisfaction. To achieve this, they committed to a long-term broad culture change programme designed to deliver high performance in all areas of their business.

It has been reported that strong support from the Executive and the Board was one of the most important factors in the success of the business's culture change programme. Without active leadership and strategic commitment, change management programmes of this nature are bound to fail.

The Managing Director of YVW, Pat McCafferty has stated that the organisation is a strong believer in collaboration, learning from others and providing industry leadership. The challenges faced in the water sector globally such as climate change and population growth call for a new way of doing business.

Image: Merri Creek. Source: Shutterstock.

Key Outcome Area 3: Institutional, policy and regulatory arrangements that drive integrated and collaborative approaches to water cycle planning

Outcome 3a – Policy, legislation and regulations

While the achievement of this outcome is not the sole or even main responsibility of water utilities, success here sees policy, legislation and regulatory instruments that provide clear and consistent direction on how integrated water management outcomes should be achieved, with joint accountability established between all sectors and levels of government.

A unified water sector voice involving state bureaucrats, state and national peak bodies and local governments on what is to be achieved through an integrated process, built over time, can assist to strengthen the narrative around IWM. This may assist influencing policy-makers to develop enabling policy, legislation and regulations in areas where barriers to effective IWM planning may currently exist.

WHOLE OF GOVERNMENT STRATEGIC INITIATIVES

Many IWM outcomes are interconnected with the strategies or policies of multiple government agencies or levels of government. Identifying and maximising such synergies is an important first step in understanding the policy and regulatory contexts. Regional or sub-regional IWM strategies are most often linked to broader planning outcomes and deliberate collaboration at this planning level is necessary for developing joint ownership of outcomes, which in turn can open up opportunities for joint funding and financing opportunities.

The Victorian IWM Framework and Western Sydney Regional Master Plan are case studies (see Part 2) that demonstrate IWM planning driven by whole of government policy and strategy.

At a more decentralised scale, local governments are also involved in delivering IWM outcomes and their municipal strategic plans can provide important context and a hook for gaining greater participation in water utility IWM planning, particularly given that the mechanisms for collaboration are usually non-statutory. A good example here is that for local governments, participating in IWM planning with water utilities can help them achieve their own objectives and desired outcomes as captured in multiple council plans such as health and wellbeing plans, and stormwater management plans, among others. This is discussed further in the later section on developing the case for IWM projects.

Oaklands Stormwater Harvesting and Reuse project (Case Study 9)

Demonstrates: *Outcome 3a – Policy, legislation and regulations*

Whole of government strategic initiative
The Oaklands Stormwater Harvesting and Reuse project is driven by the City of Marion Strategic Plan, which states that “by 2040 our city will be deeply connected with nature to enhance peoples’ lives, while minimising the impact on the climate, and protecting the natural environment”. And, “by 2029 we will improve stormwater management, increase energy efficiency, promote biodiversity and improve opportunities for people to play in open spaces and interact with nature”.

ENABLING REGULATIONS, LEGISLATIVE FRAMEWORKS AND PLANNING PROVISIONS

The development and delivery of IWM projects can involve a large range of stakeholders and a range of options. In addition to water resource and service delivery requirements, IWM is subject to environmental, public health, economic, and planning or built environment regulations (CRC WSC 2014). Water utilities should endeavour to understand all relevant policy, legislation and regulatory opportunities and constraints that relate to their IWM objectives.

This knowledge is important to ensure compliance and to identify clearly what outcomes the regulations and policy settings are aiming to achieve, though in some jurisdictions this may not be clear. Underpinning success here is a water utility mindset that sees government agencies as constructive and collaborative partners in IWM processes.

State and territory government regulations, and the actions of regulators, shape the environment in which water providers deliver their services… While important for all water options, they are particularly influential in determining the viability of integrated solutions, as simultaneous delivery of multiple outcomes means that integrated solutions may be subject to more regulation than traditional water solutions." (Productivity Commission 2020)

The underlying principles for managing the policy, legislation and regulatory contexts of IWM planning processes relate to the need to:

- Review all relevant policies, strategies and regulations to determine:
    a. The ability of the instruments to enable or drive the IWM project under consideration; and
    b. The outcomes the instruments themselves are aiming to achieve, and how they are aligned to the IWM Outcomes of the project.
- Engage policy makers and regulators in the initial review to gain their understanding of the project and outcomes of mutual benefit that will result.
- Engage all stakeholders in 'brainstorming' IWM solutions that can achieve the outcomes of both the policies and regulations and the IWM project.
- If relevant instruments are not outcome-based, consider whether collaboration with policy makers or regulators is possible to better align outcomes – that is, influence the instruments themselves or clarify alignment uncertainties.

Underpinning these principles should be a mindset that sees policy, strategy and regulations as an opportunity to look at IWM solutions in new ways. This mindset encourages water utilities to see their government counterparts as allies, hence the principle about engaging with them as early as possible in the planning process.

More information on IWM and enabling regulations is presented in Appendix B1.

Kilmore Treatment Plant Offsets Scheme (Case Study 6)

Demonstrates: Outcome 3a – Policy, legislation and regulations

Working with the environmental regulator on an outcomes-based approach Goulburn Valley Water (GVW) proposes to implement an Environmental Offsets Scheme that will see GVW fund a reduction of nutrient offsets by third parties, while discharging recycled water to the local waterway in quantities excess of what would normally be allowed under GVW's discharge license from the Environment Protection Authority (EPA).

This is a much cheaper solution for coping with growth in demand than building significant upgrades to their treatment system. The EPA will allow the discharge to the waterway provided GVW pay third parties to do works on their properties that will reduce their nutrient run-offs to an extent that is greater than the amount that GVW is discharging. That is, GVW is paying others to offset the environmental impact of their discharges.

Outcome 3b – Cross-sector institutional arrangements and processes

This outcome sees urban planning processes coordinated and undertaken in a collaborative and adaptive manner, supported by adaptive governance arrangements and involving the consideration of a full range of diverse options, both structural and non-structural. It will see IWM stakeholders having clearly defined roles and responsibilities. Active and responsive networks will be established that are highly valued and exist across different sectors, organisations and levels.

Continuous review and evaluation of governance arrangements and lessons learned from projects is important for improving the efficiency of the IWM planning process, and over time should lead to strengthened investment potential as a result of streamlined and more sophisticated processes, and better community outcomes. Ensuring lessons learned are shared with the industry will enable the whole industry to shift in a positive direction.

It has been argued that a consequence of the lack of clear policy objectives is that the roles and responsibilities for providing water-related urban amenity are often perceived to be unclear (Productivity Commission 2020). It follows that engaging all stakeholders in co-designing a project's vision and outcomes from the outset is predicated on being able to clearly understand and agree on the accountabilities and responsibilities of all stakeholders, as they relate to:

- Policy and regulation development, implementation and monitoring;
- Service delivery obligations (for system development and maintenance);
- Financing and funding responsibilities and opportunities;
- Resources with the right skill sets and capabilities;
- Developing goals for collaboration, including commitments to use best endeavours to explore opportunities; and
- Building inter-organisational trust and modelling constructive and collegiate behaviour.

The Victorian IWM Framework is an attempt to put these principles into practice.

Victorian IWM Framework – IWM Forums (Case Study 2)

Demonstrates: Outcome 3b – Cross-sector institutional arrangements and processes

The urban water cycle is made up of natural and constructed assets, including waterways, groundwater, water supply, sewerage and drainage. These are influenced by landscapes and land development. IWM Forums (non-statutory) consider the water cycle with an urban focus that extends across peri-urban boundaries.

The objectives of the IWM Forums are to:

- Facilitate enduring collaboration in water management planning across organisations, sectors and disciplines;
- Create a shared vision for water management at a defined geographical scale;
- Develop a pathway to achieve the vision, including identifying and prioritising projects;
- Coordinate and oversee the ongoing planning and delivery of priority projects at the IWM Forum Area scale;
- Ensure community and traditional owner values are represented in water management planning;
- Identify barriers to efficient IWM delivery; and
- Ensure investment in water management projects is optimised to deliver multiple benefits and best community value solutions.

Each IWM Forum process requires all partners to:
- Clearly understand their own accountabilities and responsibilities;
- Have clear collaborative goals;
- Build inter-organisational trust;
- Model collegiate behaviour;
- Provide resources with the right skill sets and capabilities.

The Werribee IWM Forum comprises CEOs or senior representatives from four water utilities, six local governments, two Traditional Owners groups, the Port Phillip and Westernport Catchment Management Authority (CMA), the Department of Land, Water and Planning (DELWP) and the Victorian Planning Authority.

The IWM Forum's 2018 Strategic Directions Statement supported 15 'IWM opportunity' projects, all of which involved collaborative partners from the Forum. Each project has a nominated lead agency, often but not necessarily a water utility, depending on nature of the project.

Outcome 3c – Public engagement, participation and transparency

The aim of this particular IWM Outcome is to ensure the inclusive representation of different perspectives, meaningful involvement and empowerment of community in decision-making. When it comes to identifying the 'human needs' associated with liveability, those with the most expert opinions on the subject are the community themselves, and their views should be understood and incorporated into IWM processes.

In practice this is often achieved through engagement on water utility pricing submissions, through engagement on particular IWM projects, and via local government as a proxy representing the community. There are also deliberative community forums such as:

- Citizen's juries, for example completed by Yarra Valley Water in their pricing submission reviews, and by Sydney Water as part of a project understanding customer views on stormwater (WSAA 2017); and
- Town-based community workshops in regional areas, for example by Barwon Water as part of their community engagement on water security and supply options for their next Urban Water Strategy.

These community forums can provide an environment for genuine public discourse, particularly on politically sensitive issues such as purified recycled water that water utilities sometimes find challenging to discuss with government shareholders, and have the dual benefit of building community water literacy (**Key Outcome Area 1**). In this way, deep community engagement strategies can help achieve multiple outcomes that enable IWM implementation.

The principles below can be applied in achieving this outcome:

- No preconceived 'best solutions' – be open minded with problem definition and outcomes.
- Transparency and open dialogue – once roles and responsibilities are set and understood, customers and community need to have a clear view of how the process is proceeding, noting that this is a two-way learning process.
- Meaningful and inclusive processes that consider and respond to diverse community needs, capacities, cultures and contexts, at the right scale (Mukheibir, Howe and Gallet 2015).
- The socio-political nature of place – IWM aims to deliver place-based solutions, but 'place' is differentially defined and valued differently by communities geographically, socially and culturally. Defining a 'place' needs to be specified and managed in an open transparent manner. This is a cornerstone of understanding and delivering equitable outcomes.
- Customers and community need to be part of the planning for the process itself, and importantly they need to know from the outset what the project decision-making process is and what roles they will be empowered to undertake. The IAP2 framework (Figure 2) provides sound guidance on this principle. The level of involvement will vary between projects and be dependent on the project's nature and scale. However, the decision on the level of engagement is crucial and the reasons for adopting a particular level of engagement should be made clear at the outset.

INCREASING IMPACT ON THE DECISION

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
PROMISE TO PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision. We will seek your feedback on drafts and proposals.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will work together with you to formulate solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

Figure 2. The IAP2 Community engagement spectrum. Source: IAP2, https://iap2.org.au/wp-content/uploads/2020/01/2018_IAP2_Spectrum.pdf

Outcome 3d – Economic and financial/funding systems

Proponents of IWM projects should have a good idea upfront of how they will go about economic evaluation and the tools they may use. Economic evaluation frameworks are designed to deliver broad societal value and are accompanied by innovative financing and funding opportunities – frameworks that incorporate different priorities and trade-offs as part of integrated planning. The ultimate aim of the economic evaluation is to direct investment towards the highest value option that considers and quantifies externalities and non-market values of water services.

This process is discussed further as part of **Step 4: Developing the case for IWM Projects**, and **Appendix B3** goes into more detail about the various elements of economic evaluation.

Step 3: Integrated systems planning and delivery

Key Outcome Area 4: Water infrastructure and systems that are fit for purpose, resilient and adaptable to change

Outcome 4a – Diverse fit-for-purpose water system services

In times of increasing stress on supply sources, an IWM process can deliver flexible and adaptive water systems that are appropriate to the **quality** of service required (including drinking water quality) and **demand** requirements of the end use (consumptive and non-consumptive uses). The guiding principles for achieving this outcome are:

- In the case of water supply options, all sources of water to be considered;
- All geographic scales of systems (centralised and decentralised) to be considered, and integrated where necessary; and
- All critical IWM outcomes addressed systematically from the outset – for example, the impact on outcomes related to ecological health, green-blue infrastructure or flood protection should be considered at the same time as traditional water security options being considered – rather than added on later in the process.

Case Studies demonstrating Outcome 4a – Diverse fit-for-purpose water system services

Integrated decentralised systems

Central Park, Sydney (Case Study 7)

The recycled water network harvests multiple water sources and distributes three types of water (drinking water and two types of recycled water), covering all the water requirements of the community.

Drinking water is sourced from Sydney Water's drinking water network. Non-potable water is sourced from:

- Wastewater from all buildings within the Central Park community;
- Wastewater from an adjacent Sydney Water wastewater trunk main ('sewer mining');
- Rainwater from roofs;
- Stormwater from impermeable surfaces/planter box drainage; and
- Irrigation water from all greenwalls (as return flow from recycled water irrigation).

Localised Systems

Oaklands Stormwater Harvesting and Reuse, Adelaide (Case Study 9)

- Pre-treatment – GPT removes sediment and debris
- Wetland – for the removal of nutrients, suspended solids, hydrocarbons, pesticides and herbicides
- ASR system – filtered outflows from wetlands.

Image: Central Park. Source: Frasers Property Australia

Outcome 4b – Adaptable and robust systems

A critical question for utilities engaged in IWM planning and management is how to ensure robust decision pathways that are also flexible and adaptive in order to effectively account for uncertain futures. This outcome sees water service systems[i] developed with appropriate governance and procedures to support an adaptive capacity that can embrace complexity and cope with uncertainty. To achieve this:

- Planning processes should embrace a 'no-regrets' mindset from the outset;

- All options are considered and attributed value, based on their ability to cope with a range of possible scenarios – rather than the most likely scenario;
- Balancing short and long term needs – identifying actions to be taken now for addressing current and near future needs, and those to be taken to keep options open to adapt if needed in the future; and
- No single organisation has ownership of knowledge and techniques – the adaptive planning mindset is one that openly and generously shares knowledge between stakeholders as a formal part of the planning process.

DECISION MAKING UNDER DEEP UNCERTAINTY

Importantly, adaptive approaches do not try to make plans based on likely predictions of the future. Instead, they aim to prepare for uncertain events and adapt over time through monitoring how the future evolves (and as knowledge is gained). In general, adaptive approaches that support decision making under deep uncertainty comprise the following steps (Malekpour et. al. 2020):

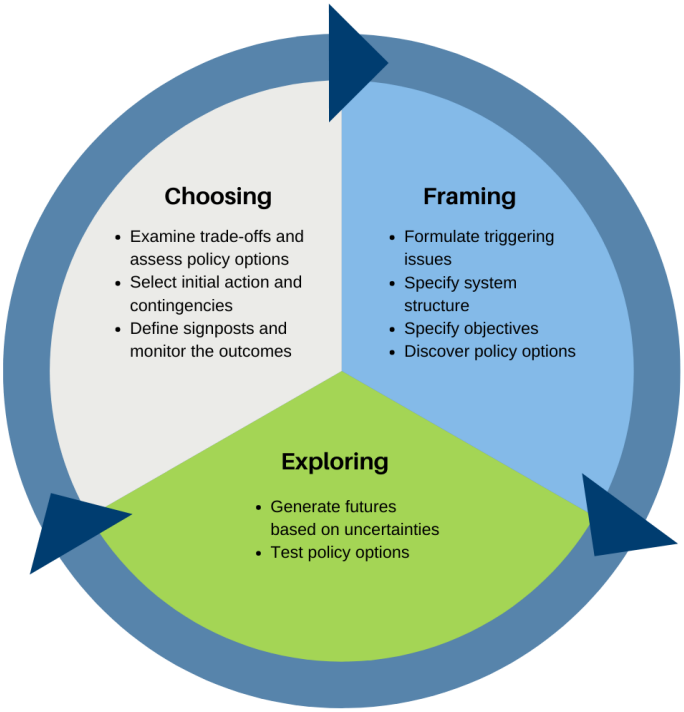


Figure 3. A framework for decision making under deep uncertainty. Source: Malekpour et .al. 2020.

1. Frame the analysis

This step involves identifying the problems or opportunities, in relation to the chosen system of interest. Key considerations should be given to the people and organisations who will be involved in decision making or will be affected by it.

This step also involves defining decision objectives and setting measurable indicators for outcomes of interest.

2. Explore uncertainties

Uncertainty can exist in external forces affecting the system:

a. How the system responds to these forces or to different policy changes;
b. How outcomes of interest may be affected; and
c. How the relevant stakeholders value the outcomes.

This step involves exploring how identified policy or planning option would perform, under a wide variety of external circumstances and/or alternative value systems.

3. Choosing initial action and contingencies

This step involves identifying and assessing different policy options given their vulnerabilities and robustness against uncertainties. It also involves identifying processes for future adjustments as more information becomes available or as future events unfold. This often involves the identification of:

a. Tipping points (these are biophysical system limits such as biodiversity loss in a creek); and
b. Turning points (these are socio-political game changers such as carbon pricing or a change in discharge legislation).

From these, triggers or signposts can then be developed which serve to indicate the lead time for action – before a tipping or turning point is reached. This enables options to be anticipatory, rather than reactive.

After this a monitoring program must be established to track key indicators, or signposts, of the identified system changes.

Importantly, there is no unifying tool or approach to adaptive governance and planning. Instead, an integrated suite of tools should be considered and adapted where necessary to suit the specific requirements and context of a project.

Appendix B2 provides further details on adaptive governance and planning principles and relationship to the incorporation of the UN Sustainable Development Goals.

Example – Adaptive Planning at Icon Water

Icon Water used adaptive planning techniques to develop Phase 1 of their iterative, adaptive strategies for the sewerage and non-drinking water systems. Phase 1 intended to answer four primary questions:

1. What type of future(s) should we plan for?
2. How could the purpose of the sewerage system change?
3. How do the strategic responses impact the treatment plants and the sewer collection assets?
4. How strategic responses in the sewerage system impact Icon Water's other water and wastewater services?

In 2018-19 Icon Water reviewed their 2010 Sewerage System Strategy. They discovered that the detailed technical plans created either needed to be initiated early or were no longer appropriate, due to rapid population growth in the ACT and an end to the Millennium Drought. This led to a need to review the strategy and an opportunity to adopt new planning techniques allowing for future uncertainty.

Icon Water is using adaptive planning techniques for long-term planning to:

- Increase efficacy of asset class strategies and other asset management (AM) artefacts as decision-making tools which integrate future flexibility and present needs;
- Unify the future world view of the organisation and resolve differences in planning priorities across the business; and
- Highlight adaptive planning tools for long-term planning in the face of a swiftly changing and uncertain future environment.

Icon Water used play-style facilitation to co-create a contrasting but plausible set of future scenarios for the sewerage and non-drinking water systems. Top-level management set the business posture to each of the scenarios, which included the establishment of multiple assumptions of key planning variables which integrated flexibility and adaptability into asset lifecycle decision-making.

The scenarios and resulting asset class strategies are already improving planning and decision-making at Icon Water. The asset strategies have a clear purpose which has flowed to other AM artefacts like asset management plans. Icon Water also has unified pictures of the potential futures across the business and clear guidance around the level of prepared-ness expected and response pathways for each scenario. This has particularly helped decision-making for asset classes like the non-drinking water system, which has less mature service offerings than other systems.

Critical to this success is two factors. First, co-creation of scenarios with the business resulted in a common understanding of the potential futures. It also organically increased literacy of adaptive planning techniques across the business. Second, top-level management direction on postures to scenarios has unified decision-making and allowed for clear integration of adaptability in decision-making.

Icon Water is now well-placed to continue with Phase 2 of the strategy development, which includes significant engagement with our community on their values. Phase 2 also includes development and validation of pathway thresholds, triggers and options, and practical application of the strategy to project and asset lifecycle work.

Contributed by: Caitlin Launt, Icon Water

Outcome 4c – Integration and intelligent control

IWM water system performance can be optimised through the use of digitised intelligent control systems at both a network and local level. At a network level, assets can respond to stresses through the use of redundancy measures and by-pass systems. At the precinct and household level it is possible to develop systems that optimise performance outcomes by using technologies that provide real-time responses to variations in weather or market/pricing events.

Technologies are now available to address critical IWM outcomes related to water conservation, flood protection and energy/GHG targets. Important lessons and principles for achieving this outcome include:

Customer education and ownership – if customers understand the value of such digital offerings it can help ensure broader uptake and ongoing use;

Trial led introductions – introducing technology that is initially expensive and complex is aided by local trials that demonstrate to all stakeholders both its efficacy and transferability/scalability; and

The total resource flow is more critical than ever. Benefit-cost assessments need to pay close attention to benefits and costs associated with whole of life impacts of water and energy consumption.

Aquarevo, Melbourne (Case Study 8)

Demonstrates: *Outcome 4c* **–** *Integration and intelligent control*

The Aquarevo development incorporates a range of best practice integrated and intelligent controls, including:

- Intelligent water and energy systems – Rain to hot water system.
- The Aquarevo home harvests rainwater for hot water end-uses combined with the use of Class A recycled water for toilets, gardening and washing clothes end uses. As a result homes can use up to 70 per cent less drinking water.
- Tank Talk technology including OneBox®.
- Adoption of wireless technology that releases water to the environment, minimising nuisance flooding and the assessment of this technology to reduce infrastructure required in drainage works.
- Closed loop – Recycled water system.
- Identifying systems and opportunities that can be distributed across Aquarevo for the use of recycled water and efficient sewer services. This includes the development of a pressure sewer system and a waste recycling plant on-site.

Image: The Aquarevo house. Source: South East Water

Outcome 4d – Adequate maintenance

In considering the financial sustainability of options it is important to ensure that appropriate resources are committed and maintenance practices are provided to secure the long-term integrity of infrastructure, particularly where water utilities will not be the final asset owner. This is often seen as a disincentive for decentralised options involving WSUD assets, and needs to be addressed in the options assessment and evaluation stages of planning.

Principles to be incorporated in the options assessment include:

- Documentation of all whole-of-life operating and maintenance activities and associated costs;

- Recognition of all whole of life benefits; and
- Assessment should consider all stakeholders associated with operating and maintaining assets.

Outcome 4e – Equitable access to water system services

When considering whether water infrastructure and systems are fit for purpose it is possible to set overall targets and measures for outcomes, and then assess or report on whether such targets are being met. Traditionally this has been done by reporting on the average level of service achieved by customers, or the percentage of customers receiving a particular level of service, or the total number of customers receiving a particular level of service for example.

However, best practice in achieving this outcome requires attention to equity.

Components of equity include level of service (the percentage of customers or community that receives service) and affordability. In terms of affordability, targets might include, for example, total cost thresholds such as the percentage of customers who pay more than x per cent of their disposable income on water services. Other metrics could include the ratio of customers serviced vs not serviced by a scheme.

Setting equity measures or targets for an IWM project should involve the following principles:

- Agreement on equity targets should be a transparent process involving all stakeholders and citizens impacted by the targets (from the perspectives of both suppliers and receivers of services); and
- The costs of achieving equity outcomes should be detailed in whole-of-life terms.

Key Outcome Area 5: Improved ecological health and biodiversity of natural environments

Outcome 5a – Healthy and biodiverse habitat

This outcome area sees water utility infrastructure (green and blue) contribute to ecological resilience, and includes leadership and advocacy in planning processes. Surface water quality and flows, and marine environments are improved and protected. Existing areas of high ecological values are protected from impacts of catchment urbanisation, and restored and regenerated where possible and where stakeholders have agreed on the degree to which this is economically feasible.

Progress towards this outcome could enable further opportunities to be achieved more holistically:

- Meaningful discussions with Traditional Owners and Indigenous people about cultural opportunities associated with water, and connection to the landscape prior to European influence;
- Extending the concept of environmental flows to achieve regeneration rather than simply protecting values that are identified pre-development;

- Further investment into regeneration of natural environments to allow natural species of flora and fauna to exist again, which typically already exist in the seedbank and can be regenerated by adding water;
- Higher chance of vegetation survival through appropriate selections for the area, and opportunity for environmental values to return faster if there is no step of complete destruction of values required prior to building the engineered solution;
- Alignment to broader biodiversity and parks strategies that exist outside the water industry; and
- Biodiversity and the natural environment are some of the most efficient solutions to meeting Key Outcome Area 6.

Example – Western Melbourne Growth Corridor IWM Planning

A critical outcome of this project will be a strategy to manage up to an additional 40-50 Gigalitres per year of stormwater from the imperviousness of new urban areas across the Western Growth Area. The impact of additional stormwater on downstream waterway health and other water-cycle related liveability impacts would be significant under currently mandated business-as-usual stormwater management approaches. This is reflected in the Healthy Waterways Strategy (Melbourne Water, 2018) which identifies much of the Western Growth Area as priority areas for enhanced stormwater management.

The two main threats to waterway health are water quality and water quantity in water dependent environments and ecosystems.

Water quality pollution can be categorised into point source or diffuse (non-point) source. Common regulatory tools to control point source pollution involve legislation and authorisation or licensing tools – more detail provided in **Appendix B1**.

Water utilities responsible for water and wastewater treatment plants will be well versed in these requirements. It is the regulations concerning diffuse sources of pollution that can be most challenging when urban stormwater is a component of the IWM options under consideration.

There are a range of WSUD solutions that provide the main interventions for achieving desirable stormwater quality and quantity outcomes. An important principle is to design WSUD treatment train techniques that systematically address both quality and quantity control in a way that considers:

- As a starting point, controls that are effective and efficient to apply at the source – built into construction at the household or lot-level;
- Designing with the landscape rather than against it; and
- Methods that are responsive to the particular downstream conditions of water bodies that they are being installed to protect or enhance.

Because biophysical (and socio-economic) conditions will differ between sites, and particularly between regions, it is necessary to review WSUD guidelines that are most suited to local conditions (Western Australian Department of Water and Environmental Regulation, 2011).

Case studies demonstrating Outcome 5a – Healthy and biodiverse habitat

Kilmore Treatment Plant Offsets (Case Study 6)

Overcoming point source pollution with more dispersed but identifiable and controlled sources

Central to this scheme was the effectiveness of the offset works, which were rigorously assessed to identify the highest value offsets for Goulburn Valley Water (GVW) to fund. This exercise identified that three types of works offered the best potential to restrict the movement of nutrients from the catchment into the waterways. They were: gully rehabilitation, riparian fencing for stock exclusion; riparian vegetation.
The scheme to be implemented with formal approval of the EPA Vic systematically documents a program of work that GVW will fund, but delivered in collaboration with Mitchell Shire Council, Goulburn Broken CMA, regional Aboriginal communities and local landholders.

Oaklands Stormwater Harvesting and Reuse project (Case Study 9)

The stormwater reuse scheme not only relieves the pressure on drinking water supplies, but also reduces the pollutant loads from stormwater that would otherwise flow downstream to adversely impact marine life in the Gulf St Vincent. The wetlands provide a diversity of flora and increase the biodiversity of the area with a safe environment for recreation. Scaling up projects like this can result in further measurable improvements in downstream water quality.

Outcome 5b – Groundwater quality and replenishment

This outcome sees IWM projects contributing to protected and improved groundwater-connected environments. Groundwater is an important resource and its quality and quantity should be maintained with actions where necessary, to address domestic and industrial wastewater, and urban runoff that may impact on groundwater.

The underlying principle for the protection of groundwater resource is the recognition that groundwater is part of the entire hydrologic cycle and is inextricably linked with marine and terrestrial surface water. This means that any activities related to surface water quantity and quality will invariably impact in some way on groundwater – and vice versa.

The National Water Quality Management Strategy‘s Guidelines for Groundwater Protection in Australia (Agriculture and Resource Management Council of Australia and New Zealand 1995) note that nearly all groundwater exploitation or protection strategies will rely on government intervention in the form of regulation and licensing, backed by community support.

Key Outcome Area 6: Healthy, cool, green cities and regions supported by blue and green infrastructure.

Outcome 6a – Activating connected green – blue space

This outcome sees the presence of many, distributed and well-connected green spaces and water assets. Green spaces can include formal or informal parkland, and public realm open space that is designed and maintained as a shared/accessible green landscape, for example urban streetscapes.

It is through this outcome that water planning meets urban design – most often involving water utilities collaborating and co-designing with local government.

Achieving this outcome requires interdisciplinary and inter-agency collaboration, with community engagement at the centre. For example, in Perth the White Gum Valley project planning process established a Local Council Precinct Group as the main vehicle for engagement and as a conduit to the broader community (see Case Study 1, Part 2). A precinct design process was subsequently undertaken with the local community that led to strong support for key elements of blue green infrastructure.

Water utilities can contribute to this outcome in at least two ways:

- By reviewing land holdings (eg. pipe easements, catchment and reservoir reserves, flood management structures) to identify land that can fulfil its original purpose while at the same time can be repurposed to provide publicly accessible recreation corridors or spaces (a good example here is Melbourne Water's Our Space, Your Place program); and
- Working with local government and other planning authorities to maximise the way that water can be incorporated into areas in terms of irrigation and/or providing water features such as lakes or wetlands.

Example – Melbourne Water's Our Space, Your Place program

Melbourne Water manages 33,000 hectares of land, which is the equivalent of around 60,000 AFL football fields.

The Our Space, Your Place initiative is designed to change the way communities and local groups use Melbourne Water's land assets. Incorporated community groups can apply to use land to enhance neighbourhood health and wellbeing, and responds to a need identified in the community for space to exercise, relax, interact, and connect to people, local waterways and nature.

Melbourne Water is looking for local government or community groups to explore options for using Melbourne Water land and turn them into multi-functional spaces.

Image: CEO of Hope City Mission with Melbourne Water staff. Source: Melbourne Water

Case Studies demonstrating Outcome 6a – Activating connected green – blue space

White Gum Valley, Perth (Case Study 1)

Passively irrigated trees and water efficient landscapes – water sensitive landscaping features have been integrated into the public and private realm across the site, including:

- Waterwise trees, shrubs, and lawn varieties incorporated into public areas;
- Passively irrigated street trees were trialled where stormwater was directed from the road to the root zone. Lessons learned from these prototypes have informed next generation designs on other Development WA projects;
- A list of suitable waterwise plants is provided to residents within the WGV Design Guidelines to assist residents with their own gardens; as well as in the public realm and street verges; and
- Guidance is provided for water efficient planting techniques, irrigation and creation of permeable surfaces.

Western Sydney Regional Master Plan (Case Study 3)

The Western Water Cycle City, promotes a higher level of recycled water for non-drinking consumption in the region to satisfy increased cooling, irrigation and agricultural demands. It includes:

- Irrigation of open spaces, as it is proposed the Western Parkland City would increase the amount of public recreational spaces;
- Water storages to function as blue spaces to cool the region in warmer months, and potentially play a role in recreational use; and
- A shift to centralise stormwater management with a focus on reuse by mean other than rainwater tanks at a property level.

Salisbury Infill Development, Adelaide (Case Study 4)
Generating water sensitive outcomes in infill developments; exploring non-structural approaches

The study compar**es** the performance of BAU and water sensitive infill development scenarios.

The evaluation has found that smarter water sensitive dwelling designs and green streets makes it possible to increase dwelling densities without adversely altering current hydrological balance. The smarter designs use two-storey instead of single-storey designs to free up valuable pervious surfaces, use permeable paving, and make space for deep rooted trees.

Having supplementary water to support dense tree canopies was a very important ingredient. Maximising water storage capacity in the urban landscape is crucial, which Salisbury has in its large Aquifer Storage and Recovery (ASR) scheme. The right water pricing could make this valuable water more viable for greening and cooling this densifying precinct.

Image: White Gum Valley detached lots. Source: Rob Frith

Outcome 6b – Infrastructure elements functioning as part of the urban water system

This outcome sees adequate urban space and the built form functioning as an integral part of the water system. Raingardens and other WSUD assets that reduce imperviousness and enhance heat mitigation through green and blue infrastructure are good examples of success in meeting this outcome, and requires an understanding of the multi-purpose and interconnected opportunities of water service systems.

This is readily evident with flood protection services (Figure 4), where the provision of an engineered flood management structure can be designed in collaboration with council planners to deliver benefits such as:

- Improved downstream water quality;
- Improved biodiversity;
- Water for parks and agriculture;
- Greater green space for recreation purposes; and
- Improved property value.

Figure 4. Multiple benefits of flood protection services. Source: CRC WSC

Case Studies demonstrating Outcome 6b – Infrastructure elements functioning as part of the urban water system

Upper Merri Creek IWM Plan (Case Study 5a)

Revised infrastructure approaches will promote more diverse housing designs which retain and reuse stormwater at a residential level and streetscapes that treat and harvest stormwater for localised uses e.g. watering public open space, supporting local food production and/or groundwater recharge (reducing urban heat island effects).

White Gum Valley, Perth (Case Study 1)

Stormwater runoff from a 12ha catchment previously drained to an infiltration basin. Infiltration basins are common features in the Perth urban landscape, but unfortunately these assets often become maintenance burdens for councils and unsightly blights on the landscape for local communities. In this case the infiltration basin became a key water management feature for the site, even though it doesn't manage stormwater from the site itself. Instead, the WGV development includes retention of a 20 year ARI storm on-lot and infiltration galleries within the street network to manage a 100 year ARI event. Following a proposal from the project team, LandCorp and the City of Fremantle co-funded the redevelopment of the sump to become a community asset with multiple benefits, including passive recreation and high biodiversity value, while maintaining its current drainage function.

Outcome 6c – Urban heat mitigation

This outcome sees water infrastructure incorporated into the design of urban precincts in a way that reduces urban heat impacts through shading by trees and evapotranspiration (tree canopies, vegetation cover and soil moisture).

Extreme heat events pose a risk to the health of all individuals, especially the elderly and the chronically ill. Modelling can produce maps of spatial vulnerability that pinpoint areas of high heat-related risks. The challenge is to use this knowledge and work with planning authorities to achieve measurable reductions in the urban heat islands of cities and towns.

Example – Mawson Lakes, South Australia

One of the most comprehensive studies of micro scale cooling effects of water sensitive urban design (WSUD) was undertaken in the suburban area of Mawson Lakes, a mixed residential suburb located 12 km north of Adelaide's central business district (Loughnan et. al. 2013).

The study examined the potential for WSUD and irrigation to provide cooling benefits and reduce human exposure and heat stress and thermal discomfort. Clear evidence was found that WSUD features and irrigation can reduce surface temperature and air temperature and improve human thermal comfort (HTC) in urban environments. For example, an average air temperature near water bodies was found to be up to 1.8 degrees C cooler than the area maximum.

Design and placement of water bodies were found to affect their cooling effectiveness. HTC was improved by proximity to WSUD features, but shading and ventilation were also effective at improving thermal comfort. This study demonstrates that WSUD can be used to cool urban microclimates, while simultaneously achieving other environmental benefits, such as improved stream ecology and flood mitigation.

A planning process to deliver urban heat mitigation outcomes would involve a similar set of steps to the overall IWM process:

- Engaging all stakeholders with an interest in the water cycle (from all levels of government and all branches of planning) in a process that can demonstrate how the models reveal specific areas of heat vulnerability – to allow stakeholders to gain confidence in the voracity of the modelling – and in addition, how the areas of heat vulnerability can be reduced by landscape management and irrigation;
- Providing the opportunity to brainstorm IWM solutions that can achieve agreed heat stress mitigation targets;
- Identifying all whole-of-life capital and operating and maintenance activities and associated costs needed to deliver these solutions;
- Recognising all whole-of-life benefits; and
- Gaining commitment that relevant stakeholders will use their best endeavours to deliver the proposed options.

Aquarevo, Melbourne (Case Study 8)

Demonstrates: Outcome 6c – Urban heat mitigation

The development plan for the Aquarevo estate included an important regional connection between Cranbourne Wetlands and the South East Green Wedge. The intention is to create a corridor through the Aquarevo site which provides arboreal, terrestrial and aquatic connections.

This supports an active, vibrant and walkable community in addition to providing ecological benefits. A corridor link would facilitate pedestrian and cycle access and by extending green infrastructure corridor landscape templates into residential streets, provides physical and visual connectivity with multiple ecological and social benefits.

The creation of an urban forest along with well vegetated streets throughout the estate, can reduce peak summer temperatures across significant areas of the site by 1-1.5 degrees C.

Street trees will be watered by a dedicated irrigation system drawing from the water recycling plant. In addition, maximising vegetation cover (particularly tree canopies), taking advantage of the natural wind, availability of water and vegetation adjacent to Aquarevo will help cool the local microclimate.

Outcome 6d – Equitable access to amenity values of water-related systems

This outcome ensures that enhanced amenity values and benefits associated with urban water assets are accessible to everyone.

It is widely accepted that the amenity and liveability values associated with water-related infrastructure such as green and blue streetscapes, parks, WSUD features and waterways provide substantial social, cultural, economic and environmental benefits to communities.

For example, findings from an extensive review of the current research and evidence on the connection between human health and nature (Townsend et. al. 2015) found that:

- People living more than 1 kilometre away from a green / blue asset have 1.4 times the probability of experiencing stress than those living less than 300 metres.
- Residents in neighbourhoods containing more than 20 per cent green and blue space were significantly more likely both to walk and to participate in moderate to vigorous physical activities at least weekly.

However throughout Australian and New Zealand urban areas, there is increasing inequity in access to green and blue space. Recent research (Astell-Burt et. al. 2014) has indicated that across Australia's five most populous cities, those living in the most disadvantage suburbs had significantly less availability of green and blue infrastructure, and were less likely or had to travel further distances to access public green and blue infrastructure. This has become further apparent through the various lockdowns imposed in Australia as part of the public health response to the Covid-19 pandemic.

Water utilities rarely have opportunities to directly determine planning decisions about provision of green infrastructure for community use, but they can be involved in planning processes that determine such matters, and can be involved in IWM processes that influence

the quality, quantity and source of water for these assets, assisting to indirectly influence this outcome.

As with **Outcome 4e**, which is concerned with equitable access to water systems services themselves, components of equity could include measures such as average distance to green-blue infrastructure, and ensuring infrastructure arrangements effectively support local needs, values and aspirations.

Setting equity measures or targets for an IWM project should involve the following principles:

- Agreement on equity targets is a transparent process involving all stakeholders and community impacted by the targets (from the perspectives of both suppliers and receivers of services including those that have traditionally had less input and engagement in planning and decision-making processes to date).
- Agreement needs to be reached on principles for funding and financing. One principle could be that the costs of achieving equity outcomes be spread evenly over all rate payers or customers on a postage stamp pricing basis, to ensure those in vulnerable contexts (e.g. communities at greater risk of urban heat and flood exposure) do not incur disproportionately greater costs.
- The costs of achieving equity outcomes are detailed in whole-of-life terms.

Western Sydney Regional Master Plan (Case Study 3)

Demonstrates: *Outcome 6d – Equitable access to amenity values of water-related systems*

The Master Plan's aim is to maximise the value to Sydney Water's customers by securing the long term vision and benefits of the emerging Western Parkland City. The specific goal of the Master Plan is that 'Our customers enjoy affordable and essential water services, healthy waterways and vibrant, cool and green places'.

The case study makes explicit reference to equitable access to services being a driver of the Master Plan.

Key Outcome Area 7: Resource efficiency and recovery

Outcome 7a – Highly efficient use of all sources of water

This outcome sees water use efficiency maximised with measures in place to protect community values during periods of high scarcity.

Water use efficiency relates to both the supply and demand side measures that are available to deliver liveability and productivity outcomes valued by all water users, including:

- Residential customers;
- Business and industrial customers;
- Public use (parks, gardens, other recreation uses);

- Indigenous water needs; and
- Environmental flow needs.

The first step is to determine the levels of service and related measures that an IWM project is required to deliver. As has been argued earlier in this document, these measures should be determined and accepted in as transparent a process as possible. The measures should be quantified and presented in a way that clearly identifies the probability – or level of security – that is associated with that level of service – and in a way that the community and all stakeholders can understand (for example, for water that will be available for park use, expressed as the probability of water being available for adequately irrigating all playing fields during a drought of X year return period. The same can be stated for the probability of water restrictions for domestic of industrial customers; or security of supply for environmental flow allocations.

In terms of analysing water supply options, bulk water allocation for these purposes is often set, at an aggregate level, by state government strategies (see Case Study 2 for the Victorian Water Planning Framework). Within these settings IWM projects can optimise water use efficiency at:

- Regional scale (see Case Study 3, Western Sydney); or
- Local and precinct scales (see Case Study 7, Central Park and Case Study 8, Aquarevo).

On the demand side there are a range of mechanisms that can be utilised, including water conservation programs and pricing programs.

The underlying principles for delivering efficient use of all sources are:

- All options – both supply and demand – should be on the table;
- Levels of service outcome measures – including levels of security – should be determined in manner that is transparent to all stakeholders and community from the outset; and
- Adaptive planning principles (see **Outcome 4b**) should be considered from the outset.

Case Studies demonstrating Outcome 7a – Highly efficient use of all sources of water

Central Park, Sydney (Case Study 7)

Alternative water supply – The Central Park local water centre supplies two types of fit-for-purpose recycled water to 2,271 residential apartments and 75,000 m2 of commercial and retail space sourced from six different sources of water. Residents may save up to 50 per cent of mains water compared with typical developments while maintaining a secure water supply free from water restrictions in drought.

Aquarevo, Melbourne (Case Study 8)

Rain to hot water system. The Aquarevo home harvests rainwater for hot water end-uses combined with the use of Class A recycled Water for toilets, gardening and washing clothes. As a result homes can use up to 70 per cent less mains water.

Outcome 7b – Maximised resource recovery and reuse

This outcome sees maximised cost-effective resource recovery and reuse through innovative system design. This includes all elements of the water cycle and concepts of waste to energy and the circular economy.

The Ellen Macarthur Foundation has provided the following definition of a circular economy[7]:

Looking beyond the current take-make-dispose extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles:

- Design out waste and pollution;
- Keep products and materials in use; and
- Regenerate natural systems.

For some time water utilities have been involved in delivering many of the elements of a circular economy and IWM can progress this further by providing a framework for addressing these three circular economy principles in a systematic way for all water-related resources, across the entire water cycle – as illustrated in Figure 5.

[7] https://www.ellenmacarthurfoundation.org/circular-economy/what-is-the-circular-economy

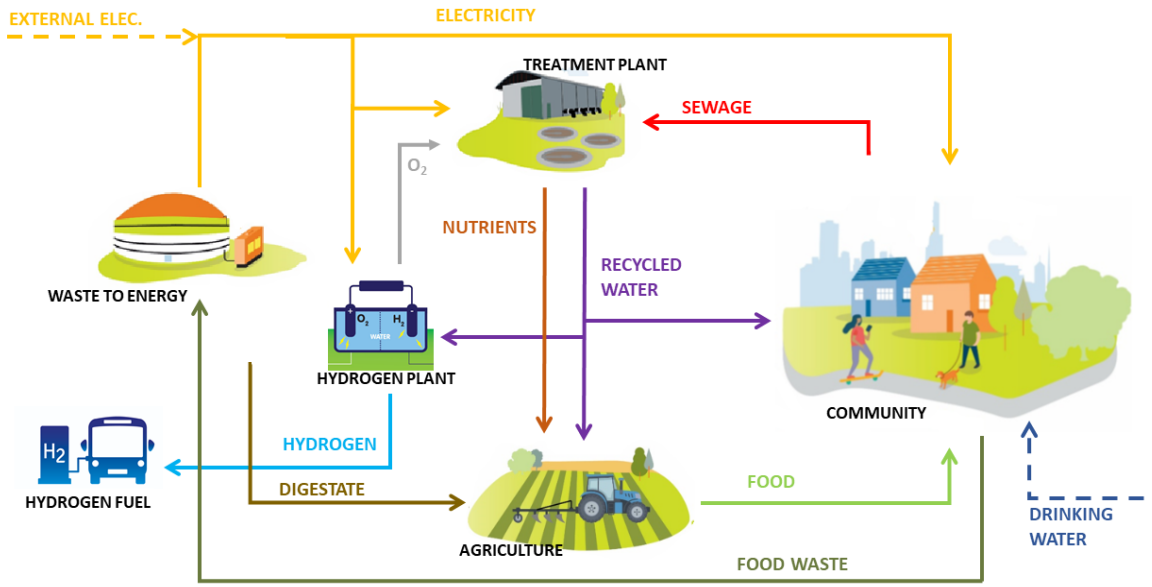


Figure 5. Circular economy concept. Source: Yarra Valley Water

Example – Anglian Water, UK

Water is considered vital to the environmental and public health, wellbeing and prosperity of East England. Population growth in the region and the escalating climate emergency are challenging reliable supplies. While Anglian Water has striven to minimise their impact on the environment while positively contributing to local communities, they had no way of codifying and measuring their approach.

The senior leadership of Anglian Water sought a mechanism to take account of the wider impact they were having on their customers, communities and the environment, as well as delivering a fair return for their shareholders.

In July 2019 Anglian Water became the first water company to lock public interest into the way they run their business, both now and for future generations, even though water companies are not defined by the UK government as Public Interest Entities.
Each year they intend to publish a statement which sets out how they are tracking towards key circular economy indicators that go far beyond their financial obligations.

Based on three key circular economy principles, Table 3 provides water servicing examples where considering water use and the associated resources together (energy, nutrients and minerals) can reduce the resource footprint, and helps to move towards delivering restorative and regenerative outcomes (Jazbec, Mukheibir and Turner 2020).

Table 3. Circular economy principles and examples. Source: WSAA.

CIRCULAR ECONOMY PRINCIPLES (FROM ELLEN MACARTHUR) [21]	CIRCULAR ECONOMY EXAMPLES IN INTEGRATED WATER SERVICING
DESIGNING OUT WASTE EXTERNALITIES	• Designing for the most efficient amounts of energy, minerals and chemicals to be used in the delivery of water services. • Optimising the amount of water used to deliver efficient customer services and benefits. • Designing best value use of water whenever possible.
KEEP RESOURCES IN USE	• Maximising the reuse and recycling of water and input resources. • Optimising the use and extraction of energy, nutrients, minerals and chemicals.
REGENERATE NATURAL CAPITAL	• Maximising environmental flows by reducing consumptive and non-consumptive uses of water. • Returning treated wastewater to waterways where viable and best value. • Preserving and enhancing the natural and urban environment by maintaining water in the landscape for greening and cooling. • Minimising disruption to natural waterways through preventing pollution and improving the quality of discharge effluents.

Case Studies demonstrating Outcome 7b – Maximised resource recovery and reuse

Aquarevo, Melbourne (Case Study 8)
Closed loop – Recycled water system

To use recycled water, wastewater is treated at a local water recycling plant which will treat all wastewater from the estate to Class A standard.
Each house has a 1,100 L pressure sewer storage pod in their front yard. When wastewater volumes reach a set level, the OneBox+® controller will activate the pump and transfer the waste to the WRP, thereby remotely monitoring and regulating sewer flows.
The WRP will look like a natural garden within a greenhouse to blend into the surrounding landscape.

Central Park, Sydney (Case Study 7)
A decentralised wastewater treatment – harvested wastewater and stormwater is treated at the local water centre through eight filtration and purification processes.
The system collects and treats wastewater from apartments, student accommodation, shops, cafes and offices. It also includes local rainwater and stormwater runoff and excess irrigation water from the gardens and greenwalls on-site.

Multiple pipelines are provided within the precinct to deliver water of a quality that is suited to the intended uses. This includes drinking water from the closest water supply for drinking water and two qualities of locally treated recycled water for toilet flushing, washing machines, irrigation, greenwall watering, car washing and ornamental water features and cooling towers.

Outcome 7c – Low GHG emissions in the water sector

This outcome sees progress towards net-zero GHG emissions by maximising the use of alternatives to high carbon emitting energy sources for water services.

Given that urban water influences approximately 9 per cent of Australia's per capita GHG emissions (Kenway et. al. 2015), water utilities have a significant role to play in national emissions reduction, though a significant portion is from behind the meter (eg. heating water within homes).

Many utilities have their own renewable energy and emissions reduction targets that are typically (but not always) driven by government shareholder strategies. Utilities achieve these targets using a range of opportunities, including through the way they store, treat and deliver water to properties and then subsequently collect, treat and dispose of water. These system efficiencies can be included in the evaluation of all water systems options in an IWM project (including structural and non-structural options).

However, IWM provides additional opportunities for utilities to engage in programs and projects that have the potential to achieve even greater GHG reductions. Two examples are:

- Collaborating with residential and business customers to deliver behind the meter savings; and
- Collaborating with urban planners and designers to deliver more energy efficient developments.

Behind the meter energy saving initiatives can be large, and can potentially achieve savings far greater that those in the remainders of the water cycle (upstream and downstream of the property). In South East Queensland, for example, it has been estimated that of the total amount of energy used in the whole urban water cycle (5,900 GWh), only 7 per cent is used in water supply and wastewater treatment, 54 per cent is used in water related energy use in residential households and 39 per cent in industrial and commercial use (Kenway et. al. 2015).

Example – Net Zero Water Cycle program, Victoria

In Victoria, DELWP, MSDI and UQ are working with the retail water companies in Melbourne (City West Water, South East Water and Yarra Valley Water) to undertake a program of applied research to explore alternative technical and household water behaviours that could bring about reduction of water-related energy use in households. The program could see utilities contributing to outcomes beyond their existing emissions commitments as well as adding value to customers and their own business.

In a response to this opportunity, the Aquarevo project by South East Water in Melbourne (Case Study 8) has built energy saving devices into the houses that are part of their total land and house 'package'.

Significant water-related emissions reductions in urban developments could also be delivered through IWM processes, such as incorporating planning and design features that reduce urban heat mitigation (**Outcome 6c**). The subsequent reduction in air conditioner use for cooling could see major energy use and emissions reductions during heat waves. This type of non-structural initiative is examined in the Salisbury case study from Adelaide (Case Study 4).

Case Studies demonstrating Outcome 7c – Low GHG emission in water sector

Aquarevo Melbourne (Case Study 8)

Collaborating with customers 'behind the meter'

At the commencement of the Aquarevo project the requirement to install solar panels was stipulated in the Design Guidelines. Purchasers of lots were obligated to install at least a 3kw solar panel system. Provision was also made for those purchasers to install a 5kw battery. This could be installed at a later date at the customers cost. Aquarevo is providing the opportunity for residents to have houses that are all electric (no gas supplied), with a 5kw solar power system and 7.5kwh Sonnen battery which would mean a typical family will be 80 per cent self-sufficient and benefit from immediate savings.

Key Outcome Area 8: Innovative system-wide transformations towards a circular economy

Outcome 8a – Beneficial outcomes across other sectors beyond water-related services

This outcome sees benefits attained in other sectors beyond those generated through water-related services.

Benefits across other sectors may include:

- Potential energy-savings from reduced use of air conditioning because of green infrastructure;
- Cost-savings to the community gained from avoided flooding as a result of WSUD or other green-blue infrastructure; and
- Increased property price values because of presence of water-related assets such as green-blue infrastructure.

Ensuring the **enabling outcomes** for IWM are achieved at the start or during a project will assist to identify innovative system-and-sector-wide beneficial outcomes – in particular in the process of co-designing IWM outcomes with multiple stakeholders, and through a leadership culture that rewards interdisciplinary and inter-agency collaboration.

Outcome 8b – Water-related business opportunities

This outcome envisages new business opportunities being stimulated through innovation in the water sector and in collaboration with other sectors.

Examples here include green infrastructure entrepreneurs (beyond rainwater tank suppliers), technology providers, service providers (nursery, consultants, monitoring and reporting, etc), software developers, employment or further opportunities through resource recovery.

Example – Water-related business opportunities

Many of the case studies presented in this report have described innovative systems and technologies that will be transferrable to other IWM strategies and projects in Australia, New Zealand and elsewhere. This is particularly evident for new systems and governance models that have been developed to drive efficiencies in projects such as the Central Park and Aquarevo projects.

Other areas of innovation highlighted in these case studies relate to the Enabling Outcomes presented in this paper, where innovative approaches to institutional, regulatory and leadership processes have been developed and which in themselves represent business opportunities for application not only in the Australian and New Zealand contexts but also internationally.

These opportunities are of value in terms of potential business profit. However, they are also of significant value to Australian water utilities in their commitment to delivering the Sustainable Development Goals both in Australian and New Zealand cities and for more vulnerable remote communities in Australia, New Zealand and developing countries.

Step 4: Developing the case for IWM projects

Developing a compelling reason for proceeding with an IWM project requires three conditions to be met:

1. There is common agreement across all stakeholders on the problem to be solved and the outcomes and targets to be achieved.
2. The total societal benefits of adopting the proposed solution justify the capital and ongoing operating costs being imposed, over the whole of the project's life.
3. There are parties who are willing and able to finance the cost of the project and then provide the funds to pay for it over the long term.

These conditions are also expected by government financial and regulatory agencies. For example, the Victorian Department of Treasury and Finance guidelines on investment management (DTF 2017) requires a 'line of enquiry' that helps decision makers determine whether:

- There is a real, evidence-based problem that needs to be addressed;
- The benefits which will be delivered are of high value … to the organisation and the community;
- The benefits' KPIs are meaningful and measurable;
- The way the problem will be addressed is strategic, feasible, and innovative;
- The solution will be delivered within time and budget constraints; and
- The solution can be applied flexibly to manage uncertainty and adapt to changing conditions and demand.

Once the first condition is completed, and the supporting and enabling conditions have been established, developing the case for an IWM project follows a set of logical steps:

1. Identification of options;
2. Measuring the outcomes of options;
3. Economic evaluation; and
4. Financing and funding of projects.

IDENTIFICATION OF OPTIONS

Water utilities are often required to lead IWM projects in collaboration with a range of stakeholders. However, that does not necessarily mean that the solutions to the IWM 'problems' are systems or assets that are owned or managed by the water utilities. It is not uncommon for outcomes to be achieved by a combination of different initiatives, depending on which deliver best levels of service for each of the outcomes.

There may be options other than infrastructure provision that can help meet the project objectives. Influencing government policy, regulations and programs in the areas of planning, health, environment, energy policy and programs can directly or indirectly deliver IWM outcomes, and may reduce the need to use infrastructure options.

The beneficiaries of IWM projects that are co-developed in the IWM process are not always customers of the water utility, raising the question of who should be contributing to the funding of such projects – this is addressed in later in this paper.

Developing a long list of options involves casting a wide net over a full range of solution possibilities. Figure 6 presents a matrix framework for searching option possibilities for such a long list. This option matrix can provide a useful categorisation although it is indicative rather than prescriptive.

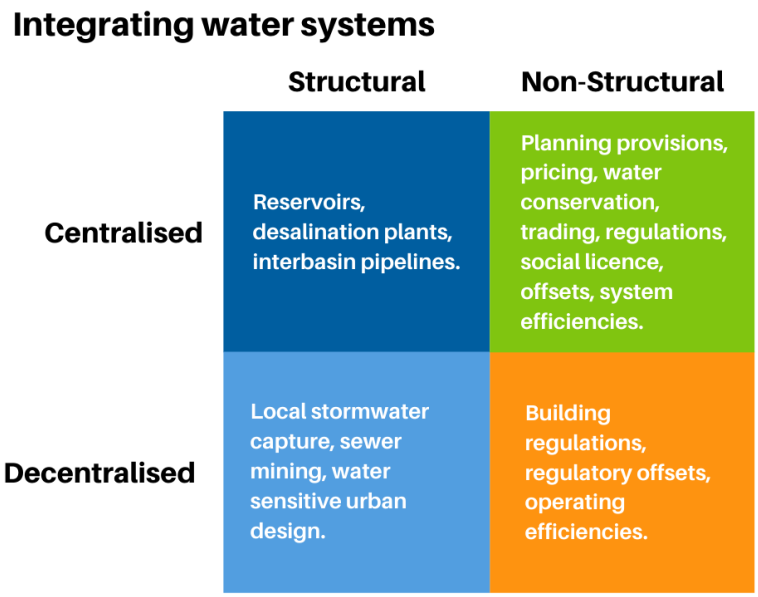


Figure 6. Matrix of options framework for scanning possible integrated options. Source: MSDI

The process of identifying options should consider:

- A diverse range of water supply sources to balance supply and demand efficiently;
- All options within their local context; and
- A suite of options within a portfolio across centralised, decentralised, structural and non-structural solutions.

Centralised solutions are usually at a regional level and built and operated by water utilities, whereas decentralised solutions can be provided by a range of stakeholders, including water utilities, local government and the private sector.

Inclusion of non-structural solutions in the options portfolio may provide more cost-effective solutions than some structural solutions, involving the achievement of outcomes by mechanisms such as pricing, water conservation measures, planning provisions and building design codes, water trading and regulatory offsets.

Case Studies of non-structural solutions include – Salisbury Infill Development, Adelaide (Case Study 4) and Kilmore Treatment Plant Offsets Scheme (Case Study 6)

IWM has sometimes been thought of as only decentralised or local projects (eg. WSUD or local recycled water projects) to complement and add marginal value to central networked systems. In fact, IWM does include the integration of regional or sub-regional strategies with system-wide and other long-term strategies and is a major contributor to achieving system-wide outcomes. A good example of a larger scale IWM strategy is the Western Sydney Regional Master Plan (Case Study 3, Part 2).

To be effective in delivering solutions at a city-wide scale IWM needs be integrated into state level planning policy and strategic frameworks. The Victorian Water Planning Framework (see Case Study 2) provides for a range of strategies for different time-frames and different system opportunities, which the Victorian IWM Framework is designed to integrate with rather than adding another level of complexity in reporting.

OPTIONS ASSESSMENT

Many tools for measuring outcomes are tried and tested and come with widespread understanding and acceptance of their efficacy. For outcomes that relate to physical water systems performance such as Key Outcome Area 4 (Water infrastructure and systems that are fit for purpose, resilient and adaptable to change) the range of analysis tools includes:

- Hydrological modelling of stormwater flows and loads (for example MUSIC or Source);
- Flooding network performance (for example RORB, HECras or TuFlow);
- Hydraulic network performance (for example InfoWorks); and
- Resource allocation (REALM or Source).

However, with IWM there is often a need to assess multifaceted and interrelated outcomes. This is particularly so for liveability outcomes such as **Key Outcome Area 5** (Improved ecological health and biodiversity of natural environments) and **Key Outcome Area 6** (Healthy, cool and green cities and regions supported by blue and green infrastructure) where water sensitive solutions can deliver a range of liveability outcomes as well as traditional water security outcomes. The CRC WSC has now developed a suite of tools and processes that model many of these interrelated outcomes, referred to as their Tools and Products (TAP) program.

It is important to note here:

- The model outputs are only as good as the quality of the data inputs and skill of the analyst in inputting date and interpreting results; and
- The engagement process around the modelling is critical to the interpretation and application of the results and stakeholder acceptance of the results.

Example – CRC for Water Sensitive Cities TAP Program
The TAP program provides software-based tools that assists in creating and/or evaluating various concept designs, technologies, or policy solutions to address and promote water sensitive objectives and outcomes across the urban development sector.

The suite of tools and products can broadly be categorised into Visioning and Concept planning (TAP 1), or City shaping and solutions (TAP 2 & 3). They can be applied by water utilities, local councils, developers and other organisations that need to develop the evidence base when assessing the benefits of IWM outcomes.

These work packages have been merged into one web-based planning tool called the WSC Scenario Tool. This tool can assess the multiple benefits of green infrastructure solutions. It comprises four analytical modules integrated within an online geospatial modelling environment:

- Urban Development Module
- Simple 'Extreme Heat Day' Land Surface Temperature Module.
- The Air-temperature Response to Green/Blue infrastructure Evaluation Tool (TARGET)

There are outcomes or circumstances that do not lend themselves easily to quantitative modelling and for which different assessment techniques may be required. These include data poor contexts, or outcomes such as **Outcome 4e – Equitable access to services and Outcome 6a – Activating connected green – blue space.**

Options assessment processes related to such outcomes might simply involve the documentation and recording on spreadsheets of agreed measures such as:

- The area of green space created (in hectares);
- The quality and amount of open space created in terms bio-physical metrics (tree canopy cover, density of tree planning, desired diversity, biological diversity);
- Visitor numbers; and
- Community satisfaction from user surveys.

Whatever assessment tools are adopted, to ensure the measures of outcomes have legitimacy, special care is required to ensure the assessment process is:

- Evidence based, and produce measures useful for the evaluation process and can be replicated;
- Proportionate to the task at hand; and
- Transparent to the extent that all stakeholders are informed and support the methodology.

OPTIONS EVALUATION

The ultimate aim of a project evaluation is to direct investment towards the highest value option that considers all benefits and costs over the life of the project, including externalities and non-market values of water services.

To unlock the full value of water and scale up liveability investments, WSAAs Blue + Green = Liveability report calls for stronger economic evaluation of the health, social and environmental benefits, and points to a need for a robust and consistent economic evaluation framework (WSAA 2019b).

The CRC for Water Sensitive Cities INFFEWS Benefit-Cost Tool[8], and their accompanying Non-market Values and Benefit Transfer Tool[9] (a database of Australian willingness to pay dollar values for various liveability benefits) are specifically designed to assist the water industry to assess these sorts of benefits, and help IWM projects meet the best practice **Key Outcome Area 6** presented in this paper.

Example - Western Melbourne Growth Corridor IWM Plan

For this project the economic evaluation will be based on a triple bottom line approach and robustness under uncertainty. Portfolios will be examined against the specific masterplan objectives and characterised for the financial, environmental and social impacts on the region.

Portfolio options will be initially assessed in line with the Victorian Department of Treasury and Finance investment management guidelines using assessment methods including a benefit cost analysis (BCA), cost effectiveness analysis (CEA) and multi-criteria analysis (MCA).

For the BCA, the Cooperative Research Centre for Water Sensitive Cities (CRC WSC) Investment Framework for Economics of Water Sensitive Cities (INFFEWS) tool will be employed. For robustness analysis, the assessment will consider two different climate scenarios. Finally, the DELWP Cost Allocation Framework for IWM Projects (2017) approach will guide the decisions on the cost allocation.

Completing a full Benefit-Cost Analysis (BCA) can be a large and costly undertaking. Infrastructure Australia supports using less costly methods to narrow a large range of options ('the long-list') and then using more resource intensive, but robust methods for a smaller range of options ('the short-list') (Figure 7).

More detail on this is available in **Appendix B3**, however, at a high level, an economic evaluation suitable for the complexities of IWM projects should incorporate the following principles (CRC WSC 2018):

- Capability to account for all direct and indirect benefits and costs associated with the water-related IWM Outcomes;
- Whole-of-life-cycle assessment – including capital and operating and maintenance costs over the life of the project, as well as costs, risks and benefits for the broader system;
- Values the use of all resources – water, energy and waste in the circular economy; and

[8] https://watersensitivecities.org.au/content/inffews-benefit-cost-analysis-tool-booklet-of-applied-examples/

[9] https://watersensitivecities.org.au/research/our-research-focus-2016-2021/integrated-research/irp2-wp2/

- Incorporates a mechanism to identify appropriate funding sources, recognising the variety of costs and benefits and variety of stakeholders.

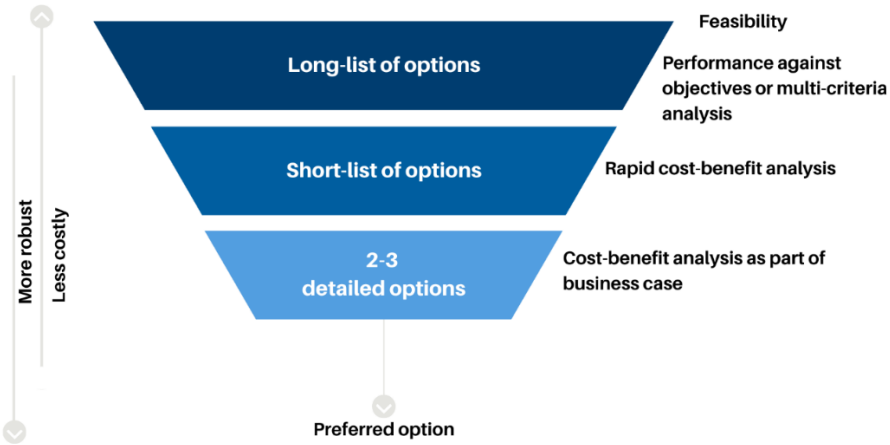


Figure 7. Different evaluation techniques to suit phases of planning. Source: Infrastructure Australia.

Appendix B3 provides details of this economic evaluation process through the following steps:

1. Choose type of economic assessment;
2. Quantify benefits and costs;
3. Identify who benefits and who bears the costs over time;
4. Discount future costs and benefits;
5. Computing decision metrics (e.g. benefit cost ratio); and
6. Addressing uncertainty and risk, including sensitivity analysis.

Several industry-leading case studies, some presented in Part 2 of this paper evaluated (or plan to evaluate) their project with regard to the above principles, as illustrated below.

Case Studies: Economic evaluation of IWM projects

Western Sydney Regional Master Plan (Case Study 3)

Following a financial costing, an economic analysis of the four servicing pathways was conducted to establish the net present value of costs and benefits. This work determined the best value servicing pathway and a preferred adaptive pathway over the long term.

Pathway 2, the Water Cycle City, was chosen as the primary, or preferred, pathway as it delivers the greatest economic value to the region at the least cost to realise the Parkland City vision. Pathway 2 is also the most readily deliverable in the current regulatory and socio-economic setting.

Kilmore Treatment Plant Offsets Scheme (Case Study 6)

For this project the raw comparison of the costs of the Offsets Option compared with Business as Usual Option was compelling. The capital cost for the BAU was around $50 Million compared with $15 Million for the Offsets Proposal and the ongoing operating costs were significantly less for the Offsets option.
Other factors that were not quantified but which supported the offset proposal included:

- Significant social benefits (improved creek amenity, improved ecological value and use of the creek)
- GHG savings – based on typical electrical consumption of an activated sludge plant versus the current operational arrangements.

FINANCING AND FUNDING OF PROJECTS

Financing is about who, at the outset, raises the cash for a project. This can be one of, or a combination of, water utilities, local government, commonwealth and state government or private sector.

Funding is about who ultimately pays for it over the long term – the utility's customers, council rate-payers, government taxpayers, or the users.

For IWM projects aimed at delivering a broad range of liveability outcomes, determining and agreeing on appropriate financing and funding arrangements can be a complex matter. IWM projects often propose innovative investments that provide multiple benefits to many different entities including developers, water utilities and their customers, new householders, waterway managers, and the local environment (and community).

For each IWM project, it is important to identify from a broad group of stakeholder and community groups, which of those may meaningfully contribute to the IWM planning process, and potentially contribute to funding a benefit stream of relevance to them. Usually those with direct responsibilities in the water cycle are a starting point that can serve to demonstrate the value of the project. For projects involving multiple beneficiaries, the most challenging task is often to gain agreement between parties to the levels of contributions or cost shares, and developing agreed ways in which these contributions can be transferred.

Mapping the various parties who benefit and those who can potentially finance and fund a project – and subsequently negotiating and agreeing financing and funding responsibilities – is assisted by a cost allocation framework of the sort outlined Figure 8 below (DELWP 2017).

For projects involving multiple beneficiaries the most difficult element is likely to be gaining agreement between parties to the levels of contributions or cost shares. The proposition is that:

> If it can be shown that 'Party A' receives a net benefit from the project of $10M compared to business as usual, and that 'Party B' incurs a net cost of $5M, a transfer from Party A to Party B of at least $5M can be undertaken to offset Party B's losses and facilitate delivery of the project (DELWP 2017).

There are mechanisms by which these transfers can be facilitated in practice, for example:

- Creating separate entities to manage a new function funded by different parties according to the scale of their benefit;
- Developer charges; and
- Value capture instruments that levy beneficiaries according to the portion of value of the project they receive

The process will ultimately be one of negotiation by parties informed by data developed in the earlier steps of this paper.

1	Quantify the benefit for each party
2	Allocate roles, responsibilities, costs and risks to parties
3	Compare costs to benefits for each party
4	Transfer between parties
5	Define gap and transfer from party responsible for 'unquantified benefits'

Figure 8. DELWP's Cost allocation framework. Source: DELWP 2017).

Successfully achieving agreements to contributions will be dependent upon a number of factors. An essential starting point is the agreement by all stakeholders to the vision, objectives and desired outcomes of the project and associated measures for each of the outcomes. With this understanding should come a commitment from the outset that stakeholders will use their best endeavours to find financing and funding solutions.

If the outcome measures are mandatory, subject to statutory planning provisions or other legal requirements, the costs of achieving the outcomes can be passed on to customers, ratepayers or through state taxes, whichever is applicable.

Having outcomes included as obligations also provides the market with certainty, which in turn provides the environment for innovation in both the public and private sector. Innovation will emerge in the range of solutions that are explored (structural and non-structural solutions) and financing options (for example, outcome-focused grants, incentive payments, green and social impact bonds, private equity investments, crowd funding) (DELWP 2017; Marsden Jacobs 2019).

Some work in the United States has investigated the applicability of financing models that are used in the electricity sector, in areas such as renewable generation and demand-side management measures (Quesnel et. al. 2016). Areas of innovation, including financing models from other sectors, should continue to be explored in Australia, for use when appropriate.

If the outcome measures are not mandated by regulation, it places a higher importance on IWM collaborative agreements between parties to commit their best endeavours to finding financing and funding arrangements. In many IWM projects there are co-benefits to be gained for different groups. What stakeholders will realise in early stages of the IWM process – and what will encourage them to stay in the process – is that these co-benefits would in many cases not be generated in the absence of the IWM process.

CHALLENGES AND RISKS IN ESTABLISHING THE CASE

Understanding the value of a project through a rigorous evaluation process and demonstrating how costs can be allocated equitably does not always guarantee that the decision makers will ultimately agree to the project proceeding. That is, there is a range of risks and challenges in the IWM planning process that, if not addressed carefully, can undermine the seemingly compelling arguments in favour of the project. Water projects often have a further hurdle to climb due to water being inherently political in nature. The CRC for Water Sensitive Cities has presented these risks in the following way (CRC WSC 2018):

Risk 1 – The problem is not perceived to be urgent (or the business case isn't addressing the real problem).

Strategies for addressing this risk include:

1. Knowing the real decision maker

The key message is to understand your audience what will influence their decision.

2. Framing your business case within a broader context

- Link the project to an outcome that others need to deliver (for example whole of government priorities, local government strategies, election commitments etc). The aim is to show that this project can help others to deliver the outcomes that they are accountable for.
- Develop strategies to ensure that potentially influential stakeholders who support the project, but do not see a reason for actively supporting the project, are encouraged to express their support – the more influential advocates the better. Good examples are

planning and development lobby groups such as the Greater Sydney Commission and the Geelong Regional Alliance.

- Develop unique political and community engagement communications strategies – understand what the motivations are for each stakeholder group and ultimate decision maker (Thwaites 2017).

Risk 2 – The case for change is not compelling – status quo approaches appear effective at dealing with the problem. Strategies for addressing this risk include:

- Build a team of advocates for your project;
- Reframe with future (scenario) focus – not a picture of today; and
- Scale – tell story of local and system-wide benefits.

Risk 3 – **Funders who are paying don't see the benefits.** Strategies for addressing this risk include:

- Valuing all costs and benefits, and communicating them effectively;
- Distributional impacts – being clear on who benefits and who pays; and
- Address the counter argument. Ensure that you understand – and can respond to – any argument that the project is not needed.

Other risks relate to situations where:

- There is policy ambiguity or a lack of policy to guide the development of IWM solutions;
- It is not possible to provide perfect data for, or full answers to, all questions related to option assessment; and
- There may be a tendency to be reactive rather than proactive when risks or benefits are uncertain or have long payback.

These risks are always present in project development exercises and a systematic engagement and communications strategy is required to best deal with them.

However, the good news is that the challenge of managing these risks is minimised by efforts towards putting in place all the **IWM enabling outcomes** at the beginning of the project. That is, the best risk mitigation strategy is to invest appropriate resources into achieving:

1. An engaged, inspired and knowledgeable community that drives decision making
2. Leadership and capacity
3. Institutional, policy and regulatory arrangements that drive integrated and collaborative approaches to water cycle planning.

WATER SERVICES
ASSOCIATION OF AUSTRALIA

CASE STUDIES

Part 2

CASE STUDIES

The following long form case studies have been chosen to provide best practice examples of how the IWM outcomes presented in this paper can be achieved within the particular utility's context. It should be noted that no case study incorporates all of the IWM outcomes.

The case studies involve projects that have a range of scales, objectives, outcomes and jurisdictions.

Some of the projects are led by water utilities whilst other projects are led by other authorities (state government, local government, private sector) but in all cases water utilities are key stakeholders and collaborators.

There is also a spread of projects across the categories of centralised versus decentralised projects, and structural versus non-structural projects.

Case study summary

Case Study 1: White Gum Valley, Perth

Contributed by: Greg Ryan, Development WA; Josh Byrne, JBA

A precinct design process was undertaken to achieve lower energy and water use, while increasing biodiversity and tree retention, aimed at achieving new models of sustainable living.

Case Study 2: Victorian IWM Framework

Contributed by: Abby Farmer and Deb Brown, DELWP

An example of a comprehensive governance framework for delivering IWM policies, strategies programs.

Case Study 3: Western Sydney Regional Master Plan

Contributed by: Persephone Rougellis, Sydney Water

Involves developing Sydney Water's first regional master plan for the management of the whole water cycle to deliver more sustainable, resilient and liveable urban outcomes across the Western Sydney growth area.

Case Study 4: Salisbury Infill Development, Adelaide

Contributed by: Melissa Bradley, Water Sensitive SA

Examines the impacts of differing infill development designs (and planning guidelines) on factors that have a direct impact on outcomes related to the resilience and liveability of urban developments.

Case Study 5a: **IWM Plan for the Upper Merri Creek Sub-Catchment**

Contributed by: Marnie Ireland, Yarra Valley Water

Illustrates an IWM place-based planning process for collaboration between partnering organisations, participation from Traditional Owners in water resources planning and management, and integrated and robust infrastructure supporting collectively agreed objectives.

Case Study 5b: **The case for place-based planning on Wurundjeri Woi Wurrung Country**

Contributed by: Jordan Smith and Karmen Jobling, Water Unit Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation

Provides the perspective of the Traditional Owners of Country in Melbourne, the Wurundjeri Woi Wurrung, of their involvement in the Upper Merri Creek IWM Plan pilot project, which includes the first application of the Cultural Flows Assessment methodology developed by the National Cultural Flows Research Project in an urban / peri-urban context.

Case Study 6: Kilmore Treatment Plant Offsets Scheme

Regan Flanagan, Goulburn Valley Water

Goulburn Valley Water achieved increased wastewater treatment capacity to service a rapidly growing population whilst at the same time met the EPA's downstream water quality objectives by through an outcomes-based approach, funding third parties to undertake work that offsets the utilities nutrient flow into the waterways.

Case Study 7: Central Park, Sydney

Contributed by: Darren Wharton, Flow Systems

Provides an example of a decentralised IWM system being operated by a private water utility, enabled by the NSW Water Industry Competition Act 2006.

Case Study 8: Aquarevo development, Melbourne

Contributed by: Charlie Littlefair, South East Water

Aquarevo is a leading-edge example of the use of innovative and intelligent systems to maximise the use of all available water sources within a residential estate.

Case Study 9: Oaklands Stormwater Harvesting and Reuse project, Adelaide

Contributed by: Glynn Ricketts, City of Marion; Melissa Bradley, Water Sensitive SA

The 12 hectare system captures and reuses water from the Sturt River that would otherwise be discharged downstream. A comprehensive wetland treatment stream in in place to treat the harvested water to comply with license conditions for injection into the deep aquifer below the site.

CASE STUDY 1: WHITE GUM VALLEY, PERTH

Project description

The White Gum Valley (WGV) development is an infill development located approximately 3km inland from Fremantle in Western Australia. The site was previously a special school that closed in 2008. The development includes more than 85 residential dwellings on a 2.3ha site and is classified as a medium-density infill development.

A precinct design process was undertaken by the developer in order to gain support from the City of Fremantle council and local community for climate responsive, higher density and more diverse housing. The local community further supported innovation to demonstrate lower energy and water use, while increasing biodiversity and tree retention. LandCorp (now Development WA) responded to these expectations by investing in White Gum Valley as a demonstration project to try innovation and new models of sustainable living.

Image: Evermore, White Gum Valley. Source: Rob Frith

Project drivers

For this project there was an alignment of drivers from the full range of stakeholders:

1. Community

It has been said that the broader White Gum Valley community is a well-informed, environmentally conscious community with very strong local government representation. This

interest led to the community playing an ongoing role in process of design, refinement, and community consultation.

2. The City of Fremantle

Council has committed to be One Planet Living (OPL) council, and LandCorp saw this was an opportunity to apply the same sustainability principles at a residential precinct level. WGV contributed to council's efforts towards maintaining their international certification level. Under the OPL framework, WGV received national, and then international certification as a 'One Planet Community'.

3. Western Australian Department of Water and Environmental Regulation (DWER)

Greg Claydon from DWER stated that:

"There was a mutual desire between the Department of Water, LandCorp, and Water Corporation to get better water sensitive urban developments happening … recognising our respective and comparative risk profiles, we can consider putting ourselves further out at the leading edge with these types of opportunities."

Stakeholder and community engagement

When the site was earmarked for development, a traditional 'top down' approach to community engagement was not considered acceptable by the community, and a Local Council Precinct Group was the main vehicle for engagement and as a conduit to the broader community. A precinct design process was subsequently undertaken with the local community which highlighted a strong desire for tree retention. Through an education process the community was shown by LandCorp that the site was capable of delivering more diverse housing types to suit people at different stages of their lives, and to demonstrate what could be done in terms of energy use, water use, biodiversity and tree retention. LandCorp selected White Gum Valley as a site to demonstrate innovation and more diverse, higher density living.

- The key stakeholder agencies and collaborators for WGV were:
- Land Corp (Now Development WA) – Western Australian Government's land and development agency.
- The City of Fremantle who now manage and maintain the public realm and community bore system in the WGV development and is the planning authority for the site.
- Water Corporation is a project partner that has utilised WGV as a waterwise development exemplar.
- Cooperative Research Centre for Water Sensitive Cities (CRC WSC) is a project partner, providing support for ongoing monitoring of the site and dissemination of lessons.
- Department of Water and Environmental Regulation (DWER) is responsible for water supply licensing, development of stormwater management guidelines and the facilitation of necessary approvals for non-drinking water supplies.

- Cooperative Research Centre for Low Carbon Living (CRCLCL) is a project partner that provided support for renewable energy initiatives, monitoring and communication activities.
- Josh Byrne & Associates (JBA) were the landscape architects, urban water and sustainability consultants for WGV and also coordinated the 'Waterwise Development Exemplar' communication and industry engagement program on behalf of the project partners.

Image: Gen Y Living, White Gum Valley. Source: Rob Frith. Image: Ringnecks, White Gum Valley. Souce: Mandy Bamford

Outcomes sought

The critical IWM Outcomes for the project were:

Outcome 1a – Connection with water and water literacy – Citizens actively participate in IWM processes because they have adequate knowledge of water cycle, water sector and current state of water affairs.

Outcome 1b – Shared ownership, management & responsibility – Citizens are active participants in creating, operating and maintaining relevant water system and its infrastructure.

Outcome 2c – Constructive organisational culture – Employees in all organisations are empowered and inspired to work in a collaborative and interdisciplinary manner to achieve IWM outcomes.

Outcome 3b – Cross-sector institutional arrangements and processes – Urban planning processes are coordinated and collaborative, involving the consideration of all long-term planning options and where stakeholders have clearly defined roles and responsibilities.

Outcome 3c – Public engagement, participation and transparency – Inclusive and representation of relevant different perspectives and meaningful involvement and empowerment of citizens in decision-making.

Outcome 6a – Activating connected green – blue space – The presence of many, distributed and well-connected green spaces and water assets. Green spaces can include

formal or informal parkland, and public realm open space that is designed and maintained as a shared/accessible green landscape e.g. streetscapes.

Outcome 6b – Infrastructure elements functioning as part of the urban water system – Adequate urban space and built form functions as an integral part of the water system. For example, raingardens, rainwater and stormwater harvesting, flood storage and conveyance, and water sensitive landscaping (pervious surfaces, heat mitigation), green roofs and walls that capture and treat rainwater or greywater.

Outcome 6c – Urban heat mitigation – Water systems are incorporated into the design of urban precincts in a way that reduce urban heat impacts through shading by trees and evapotranspiration (tree canopies, vegetation cover and soil moisture).

Options assessed

The options developed to meet the desired outcomes include:

1. Design guidelines and a sustainability upgrade package to make greener living easy for residents.

LandCorp developed design guidelines that amongst other things provides for a package to allow residents to achieve One Planet Principles. The package includes:

- Roof top PV system upgrade from the mandated 1.5kW to 3.5kW to make the detached homes achieve 'Net Zero Energy' status.
- A plumbed rainwater tank – the supply and installation of an above-ground plumbed rainwater tank (minimum 3,000L) with pump and accessories. This augments the mandated rainwater-ready plumbing.
- Shade tree – the supply and planting of a large (100L pot size) deciduous shade tree. This augments the recommendation for the inclusion of deciduous shade trees on the northern side of houses, and contributes to the precinct's tree canopy target of 25 per cent.

2. Rainwater supply and water efficiency measures.

WGV homes are targeting a 60-70 per cent reduction in mains water consumption across the various typologies. Key mains water saving initiatives include a community bore irrigation supply for use in both public and private gardens, as well as lot scale rainwater harvesting systems for toilets and washing machines. In addition, internal water fixtures were required to exceed the WELS rating currently required under the Building Code of Australia.

3. Passively irrigated trees and water efficient landscapes.

Water sensitive landscaping features have been integrated into the public and private realm across the site, including:

- Waterwise trees, shrubs, and lawn varieties incorporated into public areas
- Four passively irrigated street trees were trialled where stormwater was directed from the road to the root zone. Lessons learned from these prototypes have informed next generation designs on other Development WA projects.

- A list of suitable waterwise plants is provided to residents within the WGV Design Guidelines to assist residents with their own gardens, as well as in the public realm and street verges.
- Guidance is provided for water efficient planting techniques, irrigation and creation of permeable surfaces.
- As part of the sustainability package, homeowners were also offered a large (100L pot size) semi-mature shade tree for their backyard which will be managed for the first year.
- Communal bore for garden and open space irrigation.

A major innovation for the site was the creation of a community bore for irrigation of public and private green spaces. Whilst the use of groundwater from the superficial aquifer is common in Perth for irrigation of pubic open space, the servicing of private green space under a shared scheme is less common. What was unique with this scheme is that the City of Fremantle operate the system, with an option for the community to take over management in the future. Water use is separately metered at each lot to monitor water use. The City recover their operating costs via a special area rates scheme.

4. Landscaped infiltration basin and onsite stormwater retention.

Stormwater runoff from a 12ha catchment (excluding the WGV site) previously drained to an infiltration basin or sump located adjacent to the WGV site. Infiltration basins are common features in the Perth urban landscape, but unfortunately these assets often become maintenance burdens for councils and unsightly blights on the landscape for local communities.

The infiltration basin alongside the WGV site became a key water management feature for the site, even though it doesn't manage stormwater from the site itself. Instead, the WGV development includes retention of a 20 year ARI storm on-lot and infiltration galleries within the street network to manage a 100 year ARI event.

Following a proposal from the project team, LandCorp and the City of Fremantle co-funded the redevelopment of the sump to become a community asset with multiple benefits, including passive recreation and high biodiversity value, while maintaining its current drainage function.

Evaluation and financing

WGV has been recognised as an industry leader in sustainability, attracting visitors from across Australia and around the world to see first-hand how the challenges of sustainable development have been addressed.

The successful implementation of precinct-scale initiatives has demonstrated that sustainable developments can deliver strong social, environmental and economic dividends; it has provided a roadmap for a range of new, diverse opportunities in Western Australia and elsewhere; and highlighted the demand for innovative, sustainable housing product.

While financial factors were not the primary driver for WGV, the project has delivered sound returns.

All lots at the estate are sold out, with an average rate of one settlement every two months – including 23 single residential lots and five multi-unit sites.

One multi-unit site has been retained by Development WA for the development of a demonstration Baugruppe project in partnership with the University of Western Australia.

The three ground-breaking Gen Y apartments all settled within a six-month period following construction and their exhibition period of six months.

The return to Development WA was on par with a private developer's expected market return and was well in excess of Development WA's statutory hurdle rate, required by government to ensure no project undertaken achieves less than a defined rate of return.

Reflections and lessons learned

WGV has been the subject of detailed water use monitoring to understand the impact of the various water efficiency and alternate water source initiatives put in place at the site. Overall a 65 per cent[10] reduction in mains water use was achieved across the various typologies, including 51 per cent in the detached homes, 73 per cent in the attached homes and 75 per cent in the apartments.

From a hydrological perspective, the landscaped infiltration basin at WGV is performing well, overcoming early concerns from stakeholders regarding public risk. Results from monitoring has demonstrated that shallow surface water appears in extreme events only (50 year ARI or greater) and subsides within a few hours. The waterwise landscaping has also established successfully across the precinct, presenting a high level of amenity and providing valuable urban habitat. Other local government authorities are now looking at what has been achieved at WGV as a successful case study.

The story of WGV has been widely shared with industry and the broader community through various engagement activities, and it continues to be used as an example of how medium density development can lead to improved urban water management and liveability outcomes. Experience from WGV has been taken into subsequent infill projects by Development WA including East Village at Knutsford (also within the City of Fremantle) and the redevelopment of the former Hamilton Senior High school site (City of Cockburn). These 'next generation' projects are looking to scale-up what has worked at WGV and improve on lessons learned with the aim of progressing the vision for a waterwise Perth.[11]

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[10] When compared with Water Corporation's 2008/09 Perth Residential Water Use Study benchmark of 106kL per person per year.

[11] https://dwer.wa.gov.au/sites/default/files/Waterwise%20Perth%20Action%20Plan.pdf

CASE STUDY 2: VICTORIAN INTEGRATED WATER MANAGEMENT FRAMEWORK

Project description

The Victorian IWM Framework ensures that water planning delivers on community expectations for resilience and liveability as we adapt to a changing climate and growing population. The Framework also ensures that broader investment in urban and peri-urban infrastructure takes an integrated approach to maximise water-related community outcomes. The Framework provides a platform to:

- Identify how Integrated Water Management planning contributes to the development of water utility Urban Water Strategies, local government strategies and catchment management and Traditional Owner activities across Victoria;
- Standardise the process of identifying, prioritising and investigating IWM opportunities for inclusion in IWM Plans;
- Identify key areas of policy and regulation reform necessary to deliver IWM;
- Establish IWM Forums across the State involving collaboration between water authorities, local government, catchment management authorities, traditional land owners, state regulators and planning bodies; and
- Guide the development of IWM Plans that reflect community values at a local level.

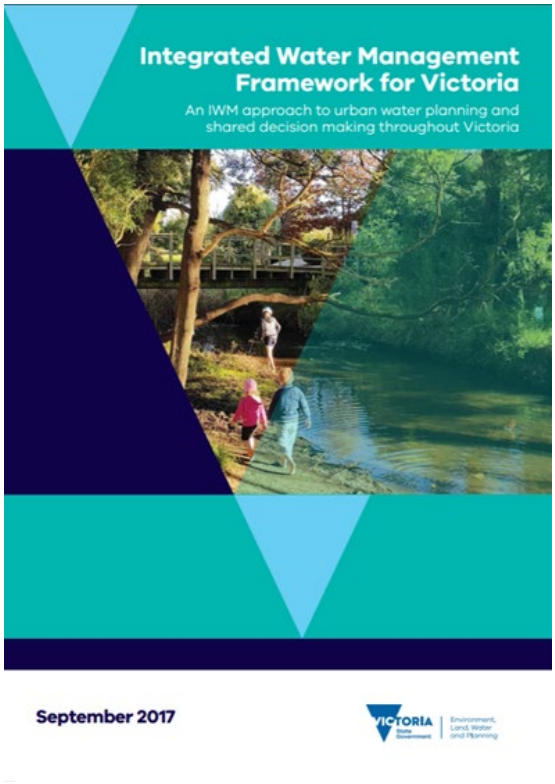

Image: IWM Framework for Victoria. Source: DELWP

Project drivers

THE VISION

The vision for the IWM Framework is supported by the whole-of-government planning policy, including the Victorian state water plan, Water for Victoria, and importantly, land-use planning strategies such as Plan Melbourne[12], and the Regional Growth Plans for each state

[12] DELWP 2017, Metropolitan planning Strategy, *Plan Melbourne, 2017-2050*.

planning region. Plan Melbourne states that “by considering the whole water cycle when planning for urban areas, we can improve wastewater management and recycling, support urban greening and cooling, protect waterways, minimise the impact of flooding and improve water security”.

The IWM Framework itself aims to “provide a consistent process for collaborative integrated water management planning with clear roles and responsibilities to deliver effective urban water management, including water supply, wastewater, flood resilience, urban waterway health and management of public places” [13].

THE PROBLEM

Over the long term, climate change will mean more extreme climatic events, less rainfall, and potentially 50 per cent reduction in streamflow in parts of Victoria by 2065. Victoria’s population will almost double by 2051, placing further demand on scarce water resources. Our challenge is to do more with less water.

Climate change will also see significant changes to the intensity and frequency of storms resulting in impacts on the quantity and quality of stormwater runoff which in turn impacts on public safety (floods), ecological health of downstream water ways and urban amenity. Increases in impervious area from urban development will exacerbate these impacts.

Population growth increases the generation of wastewater which, when coupled with climate change, also leads to a range of environmental pressures.

Climate change and population growth are also threatening the liveability of urban areas through impacts such as increased urban heat, increased flooding and reduced green spaces.

Significant investment will be made by multiple organisations, including water utilities to accommodate these two drivers – the challenge is to integrate these efforts to optimise total societal benefit.

Stakeholder and community engagement

A central component of the IWM Framework is IWM Forums, which are a non-statutory method of embedding collaboration across stakeholders with responsibility in the water cycle in Victoria. There are five forums across metropolitan Melbourne, corresponding to the five main waterway catchments, and include the metropolitan water corporations, local governments and Traditional Owners within those boundaries. Forums have also been established across regional Victoria based on urban water corporation boundaries, and includes the local governments, Catchment Management Authorities, and Traditional Owners within their service areas.

IWM Forums are attended typically by CEOs and MDs of participating organisations – this helps provide an authorising environment for practitioners at lower levels of the

[13] Minister for Water, in DELWP, 2017, *Integrated Water Management Framework for Victoria.*

organisations, who attend working groups comprising the same stakeholders, and who work collaboratively to develop projects.

Each IWM Forum has a Chair whose role it is to keep the Forum on track and to manage the often complex strategic process. Chairs can be independent (ie. external to government and agencies) or from one of the agencies involved in the IWM Forum process.

The Victorian IWM Framework states that IWM Forums will consider the water cycle with an urban focus that extends across peri-urban boundaries. The urban water cycle is made up of natural and constructed assets, including waterways, groundwater, water supply, wastewater and drainage. These are influenced by landscapes and land development.

The IWM Forums' objectives are to:

- Facilitate enduring collaboration in water management planning across organisations, sectors and disciplines;
- Create a shared vision for water management at a defined geographical scale;
- Develop a pathway to achieve the vision, including identifying and prioritising projects;
- Coordinate and oversee the ongoing planning and delivery of priority projects at the IWM Forum Area scale;
- Ensure community and traditional owner values are represented in water management planning;
- Identify barriers to efficient IWM delivery; and
- Ensure investment in water management projects is optimised to deliver multiple benefits and best community value solutions.

Outcomes sought

The IWM Framework proposes seven strategic water-related outcomes that will deliver on the vision in the state water plan, Water for Victoria, to "build resilient and liveable cities and towns". These are presented in Figure 9 below.

Victoria's IWM strategic outcomes

Safe, secure, affordable supplies in an uncertain future	Effective and affordable wastewater system	Avoided or minimised existing and future flood risks	Healthy and valued waterways and marine environments	Healthy and valued urban landscapes	Community values are reflected in place based planning	Jobs, economic growth and innovation
A diverse range of water supplies and resources Water quality meetings regulatory standards and community expectations Efficiently managed water and demand Secure water supply for industry and economy Water available to maintain valued green community assets	Meets public health and environmental standards Effective sewerage systems Optimised onsite domestic systems Waste-to-resource opportunities are maximised	Appropriate levels of flood protection in urban areas Community and property resilient to local flood risk	Waterway health is maintained and improved Health of marine environment is maintained and improved	Active and passive recreation supported by water Improved connectivity and access for active transport links Urban landscapes retain moisture for cooler, greener cities and towns Waterways and coast environments accessible as valuable open space Aboriginal cultural values associated with waterways protected	Diverse urban landscapes that relfect local conditions and community values Empower and engaged community Local water related risks and issues understood and managed	Jobs and economic growth supported by water Innovative planning and operation Strong governance, collaboration and performance

Figure 9. Strategic outcomes from the Victorian Integrated Water Management Framework. Source: MSDI

Subsequent work recognised that all seven outcomes need to be supported by three strategic enablers that reflect the ability and willingness of organisations to implement IWM, that is: commitment, collaboration and capacity.

These are reflected in the *IWM Principles and Best Practice for Water Utilities* paper as the three Enabling Outcome Areas:

- Key Outcome Area 1 – An engaged, inspired and knowledgeable community that drives decision making
- Key Outcome Area 2 – Leadership and capacity
- Key Outcome Area 3 – Institutional, policy and regulatory arrangements that drive integrated and collaborative approaches to water cycle planning

The major deliverable of each IWM Forum is to develop a Strategic Directions Statement – essentially a statement of collaborative intent by all stakeholders involved in each Forum, to work towards 'best endeavours' (as IWM Forums are not a statutory process). Importantly, these documents were developed collaboratively with input from practitioners in each participating organisation, contain each organisation's logo, and are publically available.

The above list of Strategic Outcomes is used in the analysis and evaluation of all the Victorian IWM programs and projects, and are tailored to the particular needs of each region as part of the region's Strategic Directions Statement.

Options assessed

The Victorian IWM Framework was developed as a top down and bottom up approach, in response to both government leadership and industry and community expectations. DELWP

undertook a scan of policy and strategic approaches elsewhere in Australia and overseas before developing this approach in consultation with stakeholders and the community.

Discussion

OUTCOMES TO DATE FROM IWM FORUM PROCESS

To date each of the metropolitan Forums, and most of the regional Victorian Forums have developed a Strategic Directions Statement[14] which contains their own unique place-based sets of outcomes, within the overall framework outlined above. These documents contain a transparent pipeline of priority IWM projects that have been co-developed with stakeholders.

In addition, the metropolitan Melbourne Forums are overseeing the development of their own catchment-scale IWM Plans[15]. For each of the outcomes identified in their Strategic Directions Statement a total of 27 measures have been approved by all stakeholders and a corresponding set of indicators. For example, for the strategic outcome "Community values are reflected in place-based planning", the indicators developed include:

Indicator: Increase IWM's contribution to a community's sense of place, health and well-being.

Measure: Hectares of blue-green infrastructure created or enhanced by collaborative water management.

Work is also being undertaken with Traditional Owners to develop an appropriate indicator to reflect the need to increase the mutual capacity of Traditional Owners and government agencies to partner in IWM programs, planning, and policy and project delivery.

STRATEGIC AND POLICY CONTEXTS

The Victorian water planning framework (Figure 10) provides for a range of strategies for different time frames and different system opportunities, for example: the Long Term Water Resource Assessment – undertaken every 15 years; Sustainable Water Strategies every 10 years; urban water and river health strategies undertaken every 5 years; and annual plans such as drought response plans and environmental watering plans.

This framework has served Victoria well over recent years and provided the strategic foundation for big decisions such as:

- The Victorian Desalination Plant to provide additional water security for Melbourne;
- Determining how much water should be allocated to the Yarra River for environmental flows;
- Flood management and river health strategies;
- Demand Management programs; and

[14] https://www.water.vic.gov.au/liveable/integrated-water-management-program/forums

[15] See, for example, DELWP, 2018.

- Local recycled water schemes.

However, the Victorian IWM Framework builds on this existing water planning framework and systematically considers the broader range of liveability outcomes that are often delivered – or co-delivered – by local government, Traditional Owners, catchment management authorities, planning authorities and private developers.

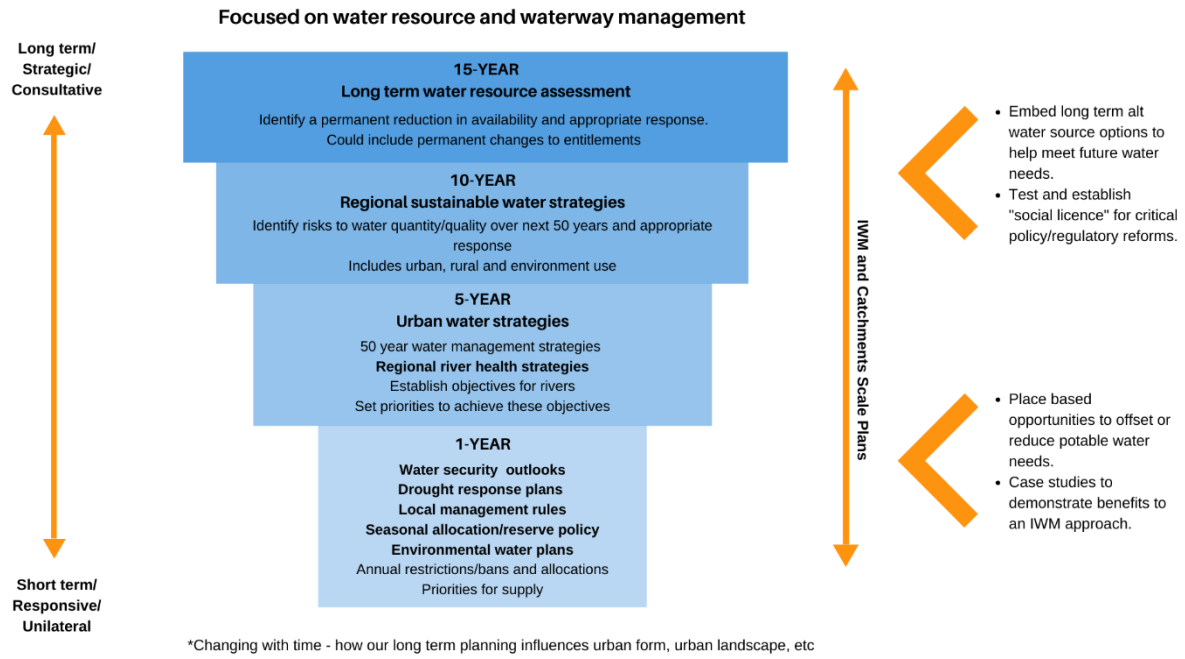

Figure 10. Victoria's strategic water planning context. Source: MSDI.

CLEAR ACCOUNTABILITIES AND SHARED VALUES

The value of an IWM planning approach lies in its holistic consideration of the entire water cycle. This requires each stakeholder involved in delivering IWM outcomes to recognise the accountabilities and opportunities of other organisations. IWM options are present where there is overlap. The range of stakeholders in IWM in Victoria are presented in Table 3.

Table 4. IWM stakeholders in Victoria.

Agency	Accountability
Victorian Government and Departments	Legislation Policy Regulation Planning
Environment Protection Authority	Environmental regulation (including best practice guidelines and protection policies)
Essential Services Commission	Economic regulation
Water Corporations	Water supply Wastewater management and trade waste management Waterway and major drainage systems (Melbourne Water only) Waterway health (Melbourne Water only) Floodplain management (Melbourne Water only) Urban stormwater management (Melbourne Water only) Environmental water (Melbourne Water only)
Catchment Management Authorities	Catchment scale land capability and management
Local government	Urban stormwater management Parks and gardens management Onsite domestic wastewater management Urban planning Building and planning approvals
Other government agencies responsible for delivering directly, or indirectly, IWM Outcomes	Transport Health Energy
Property owners, residents and businesses	Meeting terms and conditions of services provided Following permit conditions Onsite water management, e.g. rainwater, stormwater
Victorian Planning Authority	Urban growth structure planning for Melbourne and (where invited) regional Victoria
Developers	Construction of development scale water infrastructure

POLICY AND REGULATORY MATTERS

The Victorian IWM Framework sets up an authorising environment for a dual process:

1. Stakeholders take part in non-statutory IWM Forums and commit to best endeavours to deliver lowest community cost outcomes; and

2. Government and regulators commit to prioritising and working towards removing policy, legislative and regulatory barriers to effective IWM implementation.

Importantly, taking on some of the more challenging policy and regulatory barriers (such as stormwater policy, and working with the state government Planning department to embed IWM in planning policy) has helped ensure transparency and accountability for the state government departments involved in IWM, and galvanise external stakeholders to more fully engage with the IWM Forum process, despite it being non-statutory.

There are a number of policy and regulatory matters that need to be reviewed and in some cases amended or developed anew to enable the delivery of the IWM Outcomes (ie. the **enabling outcomes** as presented in this report). The priority areas being reviewed are illustrated in Figure 11. These priority areas were identified and prioritised by the IWM Forums and DELWP receives expert advice on these matters from a Resilient Cities and Town Reference Group that comprises senior and experienced policy practitioners from a cross section of external stakeholder groups.

Figure 11. Victorian government urban water policy reform priorities. Source: DELWP.

EVALUATION AND FINANCING

Some of the most accessible economic evaluation guidance and tools are those produced by the CRC for Water Sensitive Cities[16], and referred to in earlier sections of the IWM Principles and Best Practice for Water Utilities paper.

Recognising that many IWM projects have encountered difficulties at the distributional analysis stage, DELWP has produced guidance for dealing with questions of allocation of

[16] CRC WSC, 2020.

costs of projects[17]. A summary of the steps recommended by DELWP is presented in Figure 12.

1	Quantify the benefit for each party
2	Allocate roles, responsibilities, costs and risks to parties
3	Compare costs to benefits for each party
4	Transfer between parties
5	Define gap and transfer from party responsible for 'unquantified benefits'

Figure 12. DELWP Cost Allocation Framework steps. Source: DELWP

Reflections and lessons learned

IWM Forums continue to draw on the strategic outcomes collectively defined at the beginning of the process (and embedded in Strategic Directions Statements) to guide and prioritise work, including individual IWM projects and the catchment-scale IWM plans. The key learnings from the IWM Forum process so far are:

a. The evidence is continuing to justify why a catchment/region-based approach is needed to deal with the challenges of managing the water cycle as populations grow and climate change takes hold.

b. Addressing these significant challenges require resources to be allocated to priority collaborative planning activities that deliver multiple benefits for communities and the environment.

c. Multi-organisational collaborative planning exercises are more expensive and often slower, but enable optimal efficient servicing and planning solutions to be identified, leading to long term cost-effectiveness and improved outcomes.

d. IWM planning is often necessary at multiple scales, must be adaptive and is consequently complex.

e. It is essential to invest in capability/capacity-building qualities relevant to the IWM collaboration and the planning process to ensure transparency, particularly around funding, which over time will work to support inter-organisational trust and relationship building.

[17] DELWP, 2017. *A cost allocation framework for IWM projects*.

A number of policy and regulatory challenges associated with implementing collaborative IWM plans have been identified. Whole of government commitment to resolving these challenges is proving successful to maintaining buy in from stakeholders to commit their best endeavours to progress projects. The key learnings from this process are:

1. Supportive authorising environments are essential to empower the multi-disciplinary / multi-organisational teams undertaking IWM planning. The IWM Forums facilitate this by ensuring senior executives are providing the strategic direction and supporting their staff to enable working groups and forums to hold themselves to account, and ensuring that this complex planning remains a priority for each organisation and progresses.
2. Independent (ie. external) IWM Forum Chairs have proven invaluable in obtaining and maintaining senior executive buy-in and facilitating the collaborative leadership demonstrated by the forum members.

CASE STUDY 3: WESTERN SYDNEY REGIONAL MASTERPLAN

Project description

The project involves developing Sydney Water's first regional servicing master plan. The Master Plan:

- Examines different regional-scale servicing concepts and directions to better understand the role water plays to support the NSW Government's vision for the Western Parkland City;
- Presents the opportunity of managing the whole water cycle to deliver more sustainable, resilient and liveable urban outcomes; and develop economically viable proposition/s for servicing the region that work towards realising the aspirations of Sydney Water, its customers and its stakeholders; and
- Delivers strategic guidance and feedback into downstream service planning projects for growth areas and developments in the Western Sydney region. It also informs discussions with external stakeholders on potential servicing offerings.

The Master Plan was divided into a number of stages:

1. Issues and Directions
2. Concept Development
3. Adaptive Servicing Pathway Development
4. Economic Assessment
5. Preferred Pathway.

The initial Issues and Directions stage (1) sought to understand the servicing context in Western Sydney and provided a comprehensive outline of the planning challenges; documentation of key regional issues, and directions for the future. It also proposed nine alternative servicing concepts that could address the servicing challenge in Western Sydney by various degrees. This stage reinforced the importance of linking water servicing with liveability and amenity and defined the vision for the master plan.

The Concept Development stage (2) focused on developing each of the alternative servicing concepts. These servicing concepts are not complete regional servicing options but 'building blocks' to be used in developing adaptive pathways in the subsequent preferred or primary pathway. These concepts were studied to establish high level investment costs and economic benefits.

Stage 2 also sought to establish a 'baseline' level servicing approach based on Sydney Water's current servicing plans for Western Sydney's major growth areas. This served as a reference point to test the effectiveness of each of the alternative servicing concepts.

The Preferred Pathway stage (5), focused on developing a preferred long-term integrated water management servicing plan for Western Sydney. This stage followed combining the alternative servicing concepts into a series of adaptable servicing pathways (3) and an economic assessment comparing the costs and benefits of each pathway (4).

Image: Western Parkland City. Source: Sydney Water.

Project drivers

The work of the Greater Sydney Commission has provided a strong driver for a different desired outcome for development in Western Sydney. Their Vision for a Western Parkland City includes[18]:

- Neighbourhoods with fine grain fabric and human scale that support healthy lifestyles and connected communities;
- Development along the spine of South Creek and its tributaries to re-imagine liveability and sustainability, providing new cool and green neighbourhoods and centres with generous open space in a parkland setting; and
- Increased tree canopy cover to provide shade and shelter for walkable neighbourhoods within easy reach of shops and services.

THE VISION

Sydney Water's vision is to create a better life with world-class water services. Thus the Master Plan's ultimate aim is to maximise the value to Sydney Water's customers by securing the long term vision and benefits of the emerging Western Parkland City. The specific goal of the Master Plan is that 'Our customers enjoy affordable and essential water services, healthy waterways and vibrant, cool and green places.'

[18] https://www.greater.sydney/metropolis-of-three-cities/vision-of-metropolis-of-three-cities/western-parkland-city-vision

THE PROBLEM

Problems and challenges in Western Sydney include:

Population growth – By 2056 Western Sydney's population is forecast to double reaching a total of 1.5 million people.

Climate – Western Sydney is a hot, and dry place. In 2018, Sydney's west experienced 46 days over 35 degrees. Even hotter and drier conditions are expected in coming decades.

Cost of new services – Much of the growth area is currently rural with limited or no existing water or wastewater infrastructure which can be leveraged for new urban growth. Significant capital investment would be needed to deliver essential services.

Waterway health – Growth will occur almost wholly within the South Creek catchment, a tributary of the Hawkesbury-Nepean River. Increasing volumes of wastewater and stormwater will need to be carefully managed as the city's urban footprint expands.

Unprecedented infrastructure investment – Sydney's new international airport at Badgerys Creek and other catalytic infrastructure will unlock significant business and employment opportunities.

Place making imperative – About 80 km west of Sydney's beaches, South Creek also represents the primary landscape feature for new communities. This offers an opportunity to co-create a significant 'green and blue' corridor with government agencies, local councils, developers, and communities.

These problems also present as opportunities to think differently about water servicing for this emerging City.

Stakeholder and community engagement

Engagement with government stakeholders was central to the Master Plan's development from the outset. Stakeholders from about 30 Australian and NSW Government agencies, and Western Sydney local councils were involved in workshops to help Sydney Water shape the Master Plan at key stages. The stakeholders broadly ranged from planning, infrastructure, environment, resource and land management and development sectors.

Each stage acted as an opportunity to engage key stakeholders and confirm the plan's direction. The Master Plan's goal (see above) was developed in collaboration with stakeholders.

Outcomes sought

The development of the Master Plan aimed to:

- Develop, test and evaluate a set of regional servicing concepts under alternative future growth and consumption scenarios;
- Consider customer, community and stakeholder needs to understand values, and preferences;

- Develop an evidence base of costs, benefits and risks of different regional servicing approaches for discussion with planning partners, regulators and shareholders; and
- Advance organisational capacity to be future focused and conceptualise solutions that are aligned with Sydney Water's corporate vision.

In terms of the IWM Outcomes presented in IWM Principles and Best Practice for Water Utilities, these aims relate to the following outcomes:

- **Outcome 1a** – Connection with water and water literacy
- **Outcome 2a** – Collective leadership, long-term vision and commitment
- **Outcome 3b** – Cross-institutional arrangements and processes
- **Outcome 3d** – Economic and financial/funding systems
- **Outcome 6d** – Equitable access to amenity values of water-related systems
- **Outcome 7a** – Highly efficient use of all sources of water.

Images: Western Sydney Adaptive Pathways Workshop and final stakeholder briefing. Source: Sydney Water.

Options assessed

Using the concepts as building blocks, four alternative servicing pathways were developed to reflect different levels of water integration in the region inspired by the Urban Water Transitions Framework[19].

The land uses in the catchment, including potential future urban typologies, were investigated in collaboration with the Greater Sydney Commission and Infrastructure NSW as part of parallel work being conducted for the South Creek sector review.

Pathway 1 – the Western Drained City

This represents what could be considered the baseline servicing approach for the region. It relies on:

[19] Brown RR, Keath N, and Wong THF, 2009. Urban water management in cities: historical, current and future regimes. *Water Science Technology* 59 (5): 847-855.

- Existing water supply sources for drinking water;
- Minimal recycling (limited to existing commitments);
- Discharge of treated wastewater, either into existing systems or into local waterways;
- Limited irrigation demands would be met with drinking water; and
- Stormwater management remains decentralised and managed separately by relevant local councils.

Pathway 2 – the Western Water Cycle City

This promotes a higher level of recycled water for non-drinking consumption in the region to satisfy increased cooling, irrigation and agricultural demands. It relies on:

- Irrigation of open spaces as it is proposed the Western Parkland City would increase the amount of public recreational spaces
- Residential land use shift towards medium density multi dwellings, a common feature of pathways 2 to 4
- Greater extent of recycled water would reduce reliance on existing drinking water supplies
- Recycled water generated in cooler months would be stored, and storages established and spread throughout the region
- Water storages to function as blue spaces to cool the region in warmer months, and potentially play a role in recreational use
- A shift to centralise stormwater management with a focus on reuse by mean other than rainwater tanks at a property level.

Pathway 3 – the Western Water Centric City

This considers discrete integrated water servicing through the region with greater reliance on decentralised servicing. This pathway:

- Enables servicing out of sequence growth and also provides an opportunity for tailored servicing of development at a precinct level.
- In the short term, there might be increased irrigation demands supplied from package plants.
- Future greenfield developments could take on a much more integrated vision with purified recycled water for drinking featuring more prominently in servicing.
- Similar to Pathway 2, stormwater management is centralised, however rainwater tanks at a property level are included.

Pathway 4 – the Western Water Resilient City

This considers the role of centralised wastewater servicing with purified recycled water via surface water or groundwater augmentation. With recycled water sourced from highly treated wastewater and stormwater. This could have several benefits to the region, including:

- The ability to increase the resilience of the city's drinking water supply and reducing the discharge impacts on local waterways.
- As it currently stands, purified recycled water for drinking may not be considered acceptable by Sydney Water's customers, which makes implementation of such an option challenging at present.

Discussion

Unprecedented investment in Western Sydney is driving an exciting transformation centred on Greater Sydney's new second international airport, driving economic and housing growth, and is coupled with the NSW Government's vision of a new Western Parkland City.

In parallel, the master plan goes beyond essential water services to consider, integrate, and understand the economic value of water in all its forms for shaping, building, greening and cooling a new Parkland City.

Examining a series of regional-scale servicing concepts and four alternative servicing pathways the master plan finds that an adaptable and integrated water cycle management approach to deliver the Parkland city vision delivers the greatest economic value, over a conventional servicing approach.

Evaluation and financing

Following a financial costing, an economic analysis of the four servicing pathways was conducted to establish net present costs and benefits. This work determined the best value servicing pathway and determine a preferred adaptive pathway over the long term.

Pathway 2, the Water Cycle City, was chosen as the primary, or preferred, pathway as it delivers the greatest economic value to the region at the least cost to realise the Parkland City vision. Pathway 2 is also the most readily deliverable in the current regulatory and socio-economic setting.

However, Pathways 3 and 4, for a Water Centric City and a Water Resilient City respectively, are also favourable as they deliver greater economic value than Pathway 1, the Drained City. Indeed the Drained City pathway, does not meet the Parkland City vision, and costs marginally less than an integrated water pathway (less than 10 per cent).

The incremental cost of servicing the Parkland City vision ($2 billion) also brings substantial economic benefit (additional $10 billion) due to improved liveability and amenity outcomes.

The Master Plan sets a new direction for water servicing. An adaptive serving plan was built and key decision points highlighted over time to illustrate the servicing path potentially moving across the pathways depending on opportunities or issues at those critical points. The master plan also identifies nine strategic servicing outcomes and an action plan to shape implementation.

The Master Plan took an agnostic view of water servicing providers in Western Sydney, including services beyond Sydney Water's current role and responsibility in Western Sydney

to ensure the whole urban water cycle was considered (e.g. stormwater management). Later more detailed planning stages and projects would consider responsibilities and funding aspects.

Reflections and lessons learned

a. There will be more than enough water to support Western Sydney as the emerging Parkland City provided water is valued, managed and funded appropriately. A more integrated, water sensitive pathway would mean more than enough water for the Parkland City in 2056 and flows to rivers and creeks significantly reduced.

b. To deliver high-value outcomes for the Parkland City, management, ownership and funding of stormwater services across the South Creek catchment will require coordination between government agencies to deliver consistent outcomes.

c. Although each servicing pathway was individually developed as a discrete servicing plan for the region, no single pathway provides a viable servicing option for the region beyond today. Rather each pathway plays or may play a significant role at some point in time over the next 40 years. An adaptive path is therefore called for.

d. Revaluing the vast volumes of stormwater and wastewater to be generated ensures water is put to its best use and supports community-wide outcomes.

e. Land use urban typologies play a major part in soil permeability and retention of water in the landscape.

f. There is great value in starting evidence-based conversations about the value of water services and its broader benefits with stakeholders and ultimately, customers.

CASE STUDY 4: SALISBURY INFILL DEVELOPMENT, ADELAIDE

Project description

The *IWM Principles and Best Practice for Water Utilities* paper describes how options for delivering IWM outcomes can be achieved by non-structural means (achieving outcomes through policy or regulatory instruments – eg. pricing, water conservation, off-sets, or land use planning and urban design regulations).

Pricing and water conservation programs are often used as non-structural responses to IWM challenges and the use of offsets has been used on occasions (**see Case Study 6 – Kilmore Treatment Plant Offsets Scheme**), but the Salisbury Project is a unique attempt by the CRC for Water Sensitive Cities to examine the impacts of differing infill development designs (and planning guidelines) on factors that have a direct impact on outcomes related to the resilience and liveability of urban developments. The outcome factors examined are altered hydrology, urban heat, and urban amenity.

The site chosen for the research is a 130 ha precinct on the eastern perimeter of the Salisbury city centre, in the northern Adelaide suburbs. In 2019 a population of approximately 1,900 was supported with a net density of 16 dwellings/ha.

A number of different planning scenarios were tested. The BAU future planning and design option is assumed to support 5,000 people. However, a maximised water sensitive intervention is designed in a way that would support a population of 11,000 without adversely altering current hydrological balance. Along with residential transformation, roads and verges are redeveloped in each development scenario.

The Salisbury analysis is guided by the CRC WSC IRP4 project's Infill Performance Evaluation Framework[20]. The final framework, case study and project report is expected to be publicly available in late 2020. Ultimately, the work is expected to contribute to improved infill governance.

Project drivers

Most major cities in Australia expect significant infill development over the coming decades. Without significant intervention, 'business as usual' planning and design approaches will have a considerable influence on the hydrology, resources efficiency, liveability and amenity of our cities. The Salisbury Project aims to develop and apply a performance framework to understand impacts of urban infill development, create design options and processes through case studies, and identify improved governance options and arrangements.

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[20] https://watersensitivecities.org.au/content/project-irp4/

Stakeholder and community engagement

The research project is being undertaken by the CRC for Water Sensitive Cities in collaboration with:

- Salisbury City Council
- Salisbury Water[21]
- Water Sensitive SA

Outcomes sought

The critical IWM Outcomes desired for this project are:

- **Outcome 3a** – Policy, legislation and regulations
- **Outcome 3b** – Water a key element in urban infrastructure planning and design
- **Outcome 7a** – Activating connected green – blue space
- **Outcome 7b** – Infrastructure elements functioning as part of the urban water system
- **Outcome 7c** – Urban heat mitigation

Options assessed

The project has developed a model for systematically quantifying the performance of urban developments across a range of performance indicators:

- Hydrology;
- Water resource management;
- Urban heat; and
- Architectural and urban space quality.

The study compared the performance of business-as-usual and water sensitive infill development scenarios against the existing state, to explore:

- Changes in land use and imperviousness;
- Changes in hydrology (stormwater runoff, infiltration and evapotranspiration);
- The degree of water self-sufficiency that can be achieved; and
- Changes in urban heat, which is an important factor in the hot Adelaide context.

[21] Salisbury Water is the term used for Salisbury Council's recycled non-drinking water that is distributed to parks, reserves, schools, industry and some new residential sub-divisions. Salisbury Water is primarily recycled water and native groundwater which is treated to a fit for purpose standard.

Discussion

The Salisbury Project's precinct is very typical of the scattered lot-scale densification occurring in many cities in Australia. The evaluation has found that smarter water sensitive dwelling designs and green streets makes it possible to increase dwelling densities without adversely altering current hydrological balance. The smarter designs use two-storey instead of single-storey designs to free up valuable pervious surfaces, use permeable paving, and make space for deep rooted trees.

Having supplementary water to support dense tree canopies was a very important ingredient. So significantly more water storage capacity in the urban landscape is crucial, which Salisbury has in its large Aquifer Storage and Recovery (ASR) scheme. The right water pricing could make this valuable water more viable for greening and cooling this densifying precinct.

The project builds on previous CRC WSC research that developed an urban metabolism, documented best practice water sensitive urban design and identified the cooling effects of water sensitive practices in urban renewal works.

The project will also utilise a range of existing CRC WSC tools and products such as the WSC Toolkit and the WSC Index.

The project principally focuses on developments from individual lots through to the precinct scale. To achieve its objectives, the project will work closely with the CRC WSC Tools and Products (TAP) program.

Image: Edinburgh, City of Salisbury and a Salisbury City Council sign for recycled water. Source: Salisbury City Council

Evaluation and financing

The project team collaborated closely with urban planners and water practitioners in the case study region to better understand the local context, needs and the aspirations of the

community in the study area. The process of application of the Evaluation Framework incorporates the following steps:

a. Site-plans were created for dwelling and street typologies for the chosen in-fill design scenarios. Site-specific parameters related to architectural design and water were defined.
b. The typologies created were expanded to the full 130ha precinct to represent the three scenarios to produce the precinct plan. It also involves the definition of water servicing assumptions.
c. The site and the precinct plans developed were evaluated in terms of urban water flows, urban heat and the architectural and urban space quality using the Evaluation Framework against several performance principles.
d. Finally, performance indicators were generated from the Evaluation Framework to understand the overall performance of the water-sensitive design scenarios against others. The indicators are compared with the context-specific targets where available.
e. Water performance was assessed at precinct-scale using daily water balance with “Aquacycle”. Urban heat was evaluated using Urban Multi-scale Environmental Predictor (UMEP) model.

Conclusions

This case study demonstrates that the water-related impacts of infill development are significant and the benefits of good design can be substantial. Alternative and water sensitive designs can lead to considerable influence on runoff, infiltration, evapotranspiration, urban heat and other changes improving liveability, resilience and water security.

This case study demonstrated it is possible to provide housing for additional (beyond target) population growth, and simultaneously mitigate existing previous negative consequences of relatively unplanned (hydrologically) development, an important outcome to be able to engage land use planners and state planning departments concerned with providing housing to meet growth.

A range of design variables was observed to have strong influence on hydrological outcomes. For example, the overall pervious/impervious fraction, coupled with on-site water storage, and degree of local use of water, had substantial influence on most outcomes such as stormwater runoff, infiltration and evapotranspiration.

The work also provides a significant foundation from which a more quantified business case for water sensitive outcomes can be achieved from new development designs and typologies. As example, the impact on water supply, wastewater flow, flooding, building costs, air-conditioning could be quantified from the designs presented in this case study.

CASE STUDY 5A: IWM PLAN FOR THE UPPER MERRI CREEK SUB-CATCHMENT

This case study has been chosen to illustrate a place-based process for sub-catchment scale IWM planning. It highlights key learnings and best practice examples of:

- Collaboration between partnering organisations;
- Embedding Traditional Custodians in water resources planning and management;
- Accountability and transparency with communities and customers; and
- Integrated, robust and adaptive infrastructure planning supporting collective objectives

Project description

The Merri Creek sub-catchment comprises creeks and waterways that are highly valued by the community, with some of the largest and most diverse remnants of native vegetation in the northern suburbs of Melbourne. The area is also home to protected, threatened and iconic plants and animals such as Platypus, the Growling Grass Frog, Golden Sun Moth and the Matted Flax-lily, and contains some of the best remnant grassland plains in Victoria.

Current development pressures stand to place substantive impact on the region. With large tracts of undeveloped rural and natural land in the Upper Merri Creek sub-catchment and a population predicted to grow from 196,000 in 2019 to 372,000 by 2031, urbanisation and climate change could have an enormous impact on habitat for vulnerable plants and animals, local waterways and sites of cultural significance.

How this development is managed has significant implications for the future character of the area. Unless a very large volume of stormwater (over 21 GL), is reused or managed effectively, the creeks in the Upper Merri Creek sub-catchment will be fundamentally changed by the increased amounts of stormwater as large portions of the rural landscape become urbanised.

The Wurundjeri Woi Wurrung Cultural Flows Assessment for the Upper Merri Creek states: “The wetlands are the kidneys, filtering the water as it passes through the land. In the Upper Merri Creek we note the importance of the wetlands areas currently referred to as Hearne’s and Hanna Swamps but also the role that constructed wetlands will play as urban development occurs in this part of our Country.”

To ensure the future prosperity of the environmental, social and cultural qualities of the Merri Creek sub-catchment, the community, together with Traditional Custodians, councils and government agencies were required to come together to consider key questions such as:

How can we protect the environment and preserve biodiversity as the population expands?

- What unique characteristics do we want to preserve?
- What sort of neighbourhoods do we want to live in?
- How do we ensure everyone has access to open space?
- How can we manage growth in a way that fosters inclusive communities?

IWM AT THE SUB-CATCHMENT SCALE

This project piloted a new partnership approach to address the complexities of integrated water management in the Upper Merri Creek sub-catchment, in Melbourne's northern growth corridor.

The Upper Merri Creek sub-catchment is made up of the rural and forested parts of Merri Creek and the upper parts of the urban component of the Merri Creek catchment.

Figure 13. Boundary of Upper Merri Creek Sub-Catchment area (highlighted in green) in the context of Melbourne Water's Healthy Waterways Strategy designated sub-catchments. Source: Adapted by Yarra Valley Water from Melbourne Water (2018).

Using a 'sub-catchment' (corridor geo-spatial scale) as the basis of an integrated water management plan is a new approach. Typically, water services have been planned by individual organisations (such as utilities or councils) to match their jurisdictional boundaries or to match urban planning boundaries such as a precinct structure plan or development site.

There is a growing sense of frustration amongst stakeholders with these approaches and a concern that opportunities for synergies between organisations or alignment with broader strategic objectives for optimising use of available water resources are being missed.

The IWM approach at a sub-catchment level is purposely focused on embedding a proactive and iterative (adaptive planning) approach that has the following benefits:

- Builds on the existing servicing schemes methodologies and further water management towards water sensitive city outcomes;
- Positions the water industry to collaboratively move to proactive planning for greenfield, infill and renewal development, and facilitates input to formal Victorian Planning Authority-led Precinct Structure Plans as they occur;
- Incorporates planning, development and infrastructure responses to collectively agreed issues and objectives at a sub-catchment level;
- Flexible and adaptive framework to support long term objectives and adoption emerging knowledge and technologies;
- Infrastructure is built not just to service individual development site needs, but also to service broader public objectives;
- Facilitates optimised and coordinated infrastructure investments and transparent cost sharing to achieve agreed outcomes, as well as more equitable funding;
- Development contributions more aligned with the costs of developing in defined (sub-catchment) areas; and
- Specifically engages all organisations with an influence on water, and includes Traditional Custodians and the community / customers in collaborative decision-making processes.

Stakeholder and community engagement

Stakeholder and community collaboration was designed into the process from the outset.

The collaborating partners were the Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation, Hume City Council, City of Whittlesea, Mitchell Shire Council, Yarra Valley Water, Melbourne Water and the Victorian Planning Authority.

The process aimed to develop:

- Stakeholder and community understanding of the complex challenges and opportunities for the Upper Merri Creek catchment;
- Insights and directions that build on past engagement in understanding community values, avoiding consultation fatigue;
- Trust with the community by ensuring the process was and continues to be transparent; and
- Use of scenario thinking and adaptive planning methodologies to support challenge the status quo.

At a workshop held on 25 September 2019, the community articulated a range of complimentary vision statements for the Upper Merri Creek sub-catchment. These were merged by the Steering Committee into the following Vision for the Upper Merri Creek:

We all respect, care for, protect and enjoy our places and nature; supporting a connected and sustainable Community

The overarching key messages that came through the discussions with the community are summarised as follows:

- Business-as-usual is not OK. Minimising the impact on the environment is important but the focus needs to be on regenerative practices.
- Water is central to how to design and develop sustainable, connected and climate resilient neighbourhoods.
- Traditional and natural methods are preferred over engineered solutions.
- Stormwater and recycled water need to be used more effectively to minimise impact on potable water supplies and to stop runoff into our waterways. However, there were some concerns around the quality of water and how to make alternative water sources fit-for-purpose.
- Choice is essential, particularly regarding housing options and design of neighbourhoods.
- Collaboration with the community is highly valued to create shared ownership of the solutions and build the capacity of the community to get involved.

Outcomes sought

The Upper Merri Creek IWM sub-catchment principles were developed by the community and stakeholders to drive collective activities.

Participants were asked to provide input into a set of guiding community principles for the future of the Upper Merri Creek sub-catchment. The draft Principles were:

1. Design of neighbourhoods demonstrate our shared values of Caring for Country.
2. Neighbourhoods are place-based, supporting opportunities for people to be healthy, connect with one another and with nature.
3. Opportunities to learn, collaborate and work together to build stronger communities are ongoing.
4. Available natural resources are efficiently managed to ensure the needs of our waterways and natural landscapes are met.
5. Biodiversity and ecological systems are protected and enhanced across the sub-catchment and throughout residential and commercial areas.
6. Supply and use of water are fit-for-purpose and make best use of locally captured and treated stormwater and recycled water.
7. Knowledge of the natural aquatic system and achieving the required water quality is continually building and being drawn on.
8. Housing options and designs are sustainable, supporting stronger communities and provide for choice and affordability.
9. Local food production is planned at a variety of scales within the sub-catchment, and food growers are supported.

In the IWM plan these principles will be interpreted and aligned with broader Yarra catchment outcomes and associated indicators and measures, as defined in the Yarra Strategic Directions Statement (see Case Study 2 – Victorian IWM Framework).

The overarching key messages received from the community together with the Yarra Strategic Directions Statement have guided the development of targets for the Upper Merri Creek sub-catchment which also draw upon key information sources including:

- Healthy Waterways Strategy (September 2018): Co-designed Program for the Yarra Catchment
- DELWP IWM Strategic Direction Statement Outcomes – Indicators and Measures (2020)
- Wurundjeri Woi Wurrung's Upper Merri Creek Cultural Flows Assessment (Expected in late 2020).

Within this context, the iterative and ongoing process for sub-catchment planning (being piloted in this project) aims to support each of the outcomes defined in *the IWM Principles and Best Practice for Water Utilities* paper.

Reflecting on the process and anticipated outcomes of this pilot project has prompted the drafting of Place-making Guidelines with three linked parts. This is a key outcome associated with Action Item 9 in the Yarra IWM Forum Strategic Directions Statement. The guidelines are currently being approached as follows:

- Part A: Place-based Planning
- Part B: Effective Engagement – incorporates supporting information on embedding Traditional Owner involvement and community engagement
- Part C: Customer Experiences – incorporates implementation platforms for agreed planning controls, development conditions, infrastructure investments, information/data sharing and coordinated communications.

To date, the developmental phase of the initial Upper Merri Creek IWM plan has particularly focused on delivering the following IWM Outcomes from this paper:

Outcome 1b: Shared ownership, management & responsibility

A Partnership Agreement was requested by Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation. This was developed (based on similar agreements with Victorian Catchment Management Authorities) and has been signed by each of the partnering organisations. It commits to Wurundjeri's equitable involvement in the collaborative planning process.

Outcome 2a: Collective leadership, long-term vision and commitment

Place-making Guideline Part A: Place-based Planning details the foundations of a collaborative approach. Notably, the way in which the process is implemented is as important as the outcomes generated. The foundations of this approach are:

a. **Equitable involvement** – all partnering organisations including (but not limited to) Registered Aboriginal Parties / Traditional Custodians, local government, water authorities and the Victorian Planning Authority have equal input to the process.

b. **Transparency** – all partnering organisations work collaboratively to identify the collective key issues and opportunities and engage with the community in developing agreed approaches for how water resources and services will be delivered in order to achieve collectively agreed outcomes.

c. **Continual improvement** – the initial sub-catchment plan will articulate an agreed vision and detail how the outcomes will be achieved through planning requirements, development conditions, infrastructure investments and servicing approaches. These will be periodically reviewed and updated.

Outcome 2c: Indigenous partnership in water planning

This IWM project had a commitment to partner closely with the Traditional Owners of this land, the people of the Wurundjeri Woi Wurrung Country. From the outset, the Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation was invited to partner in this project.

The Corporation was asked to provide a commentary on the process to date which is presented in this report as **Case Study 5b: The case for place-based planning on Wurundjeri Woi Wurrung Country**. In this case study the Corporation provides commentary and a cultural perspective on the Upper Merri Creek IWM Plan pilot project which includes the first application of the Cultural Flows Assessment methodology in an urban / peri-urban context.

The cultural flows assessment methodology was developed in 2018 as part of the National Cultural Flows Research Project (NCFRP)[22]. The project drew on a range of scientific research methodologies and generations of cultural knowledge to:

- Provide a greater understanding of Aboriginal values relating to natural resources, especially water;
- Equip First Nations with information and tools to ensure that Aboriginal water requirements and preferences are reflected in water policy; and
- Inform the development of new governance approaches to water management that incorporate aspects of First Nations' governance and capacity building.

In the Upper Merri Creek project, the Wurundjeri Woi Wurrung Water Unit have led the cultural flows assessment to identify and prioritise the economic, social, ecological and cultural values that are connected to the Upper Merri Creek sub-catchment, including areas of cultural significance that require access to water or protection from water.

Outcome 2d: Constructive organisational culture

Within each partnering organisation it is important that diverse perspectives and a range of information is collected to create a shared understand of the key issues and opportunities from an individual organisations perspective. Workplace cultures which support diverse perspectives and bold conversations complement robust processes such as Scenario Thinking and adaptive planning and governance. This not only challenges the status quo, but

[22] http://culturalflows.com.au/

commits to action for doing things differently, and requires dedicated effort as well as a new leadership paradigm.

For the Upper Merri Creek sub-catchment each partnering organisation sought to contribute to a shared perspective. This typically involved collation of organisation specific information from a range of sources and a workshop to synthesise the information, develop agreed priorities and identify issues and opportunities.

Outcome 3c: Public engagement, participation and transparency

Place-making Guidelines Part B: Effective Engagement is intended to provide:

- Structure to support equitable engagement of partnering organisations;
- Specifically embed Registered Aboriginal Parties (RAPs) and Traditional Custodians in the planning and management of water resources and services; and
- Tools and advice to support communities to collaborate with partnering organisations in the development and implementation of sub-catchment (or alternative place-based) IWM plans.

Outcome 4a: Diverse fit-for-purpose water system services.

Consideration of the collective objectives in the Upper Merri Creek has driven a strategic organisational change in how alternative water resources will be utilised – specifically, to enable more liveable communities and protect and/or enhance biodiversity in receiving environments.

For example, Yarra Valley Water will redesign their alternative water sourcing strategies – transitioning from prioritising use of recycled water in mandated purple pipe areas (which preserves capacity in downstream wastewater infrastructure), to prioritising the use of harvested stormwater for localised use.

This means there will now be a surplus of recycled water available, which can be used to support horticultural schemes and local food production – consistent with community principles.

A willingness for an organisation to re-prioritise and amend strategies to support the collective objectives is a fundamental element required in effective collaborative processes.

Options assessed

The development and assessment of options drew upon well established and recognised water sector adaptive planning methodologies. These included place-based servicing schemes (single agency), scenario thinking, and the NCFRP Cultural Flows Assessment framework.

Key elements of the assessment process include:

- Understanding the key issues and opportunities in this sub-catchment from a broad range of perspectives;
- Balancing a range of statutory and community expectations; and

- Harnessing new technologies / creating new products (e.g. urban form, housing and commercial buildings).

Three scenarios were built using the process of scenario thinking. This enhanced the evaluation and integration of information from the partnering organisation and promoted contingency planning.

In the Upper Merri Creek three scenarios were developed which included:

1. Scenario A: Status quo

What will happen over the coming 5, 10, 20 and 50 years if we keep doing what we are doing?

2. Scenario B: Sustainability

What will happen over this period if we seek to have sustainable communities within the sub-catchment? This considers:

- Alternative urban forms (housing and building design, streetscapes, public open spaces);
- Different options for the provision of services; and
- Fit-for-purpose use of all available water resources.

3. Scenario C: Regenerative

What will happen over this period if we seek to have regenerative communities within the sub-catchment? This considers:

- Innovative approaches for achieving significant social, cultural, environmental and economic outcomes through alternative urban forms;
- Significantly different options for the provision of services; and
- Fit-for-purpose use of all available water resources.

In each scenario descriptions of housing stock, streetscapes, public open spaces, and commercial / industrial areas were described and examples illustrated. Options for governance and servicing approaches were outlined and indicative funding models were included in discussions to gage community preferences and supported the development of the community's vision, overarching messages and principles for IWM in the Upper Merri Creek sub-catchment.

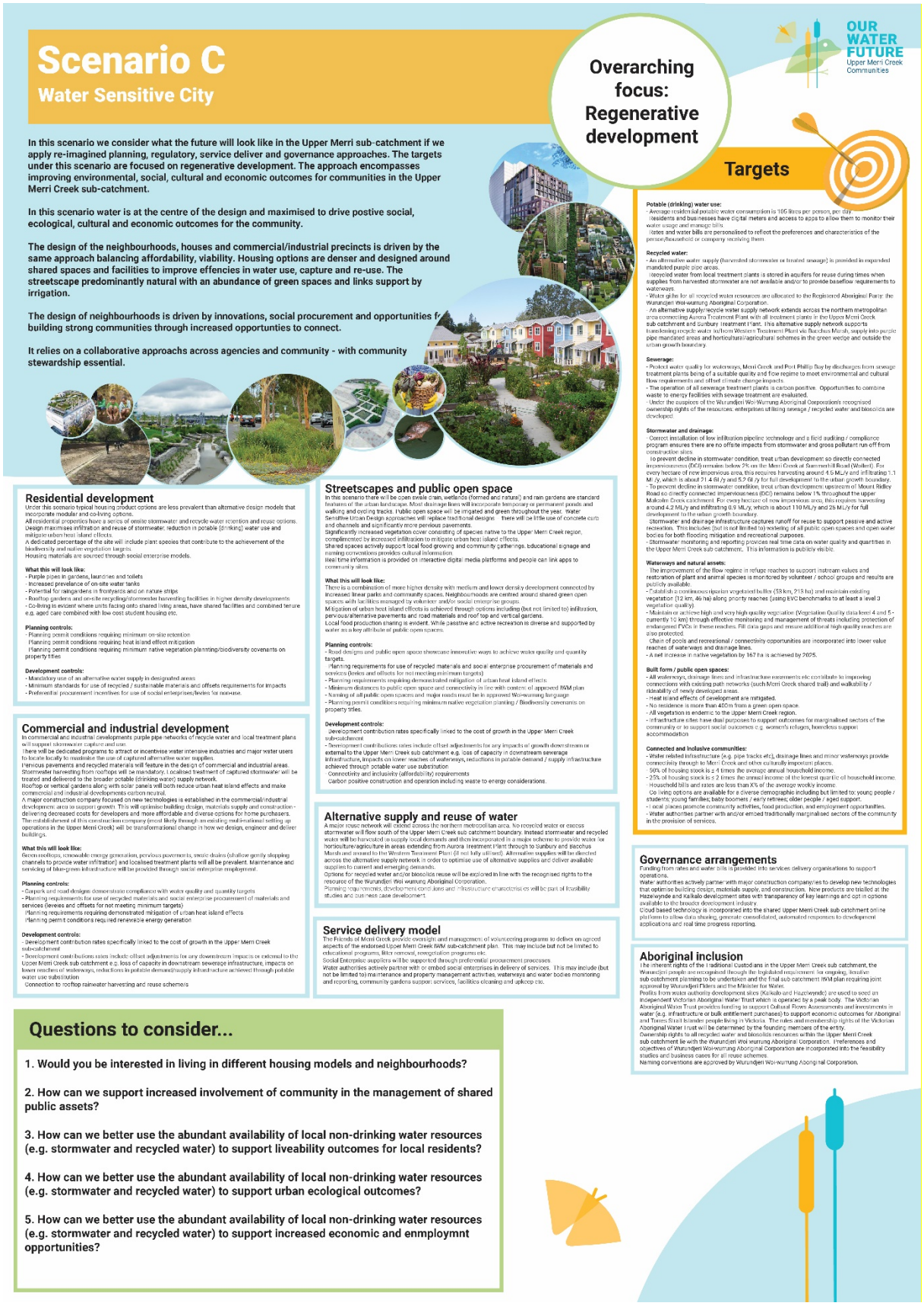

Figure 14. Example of a scenario presented to Upper Merri Creek Community for discussion at 2019 Community Symposium. Source: Upper Merri Creek Steering Committee (2019).

A water balance for each scenario was generated to support comparisons and evaluation against the agreed vision and mission, as well as the obligations of each of the partnering organisations.

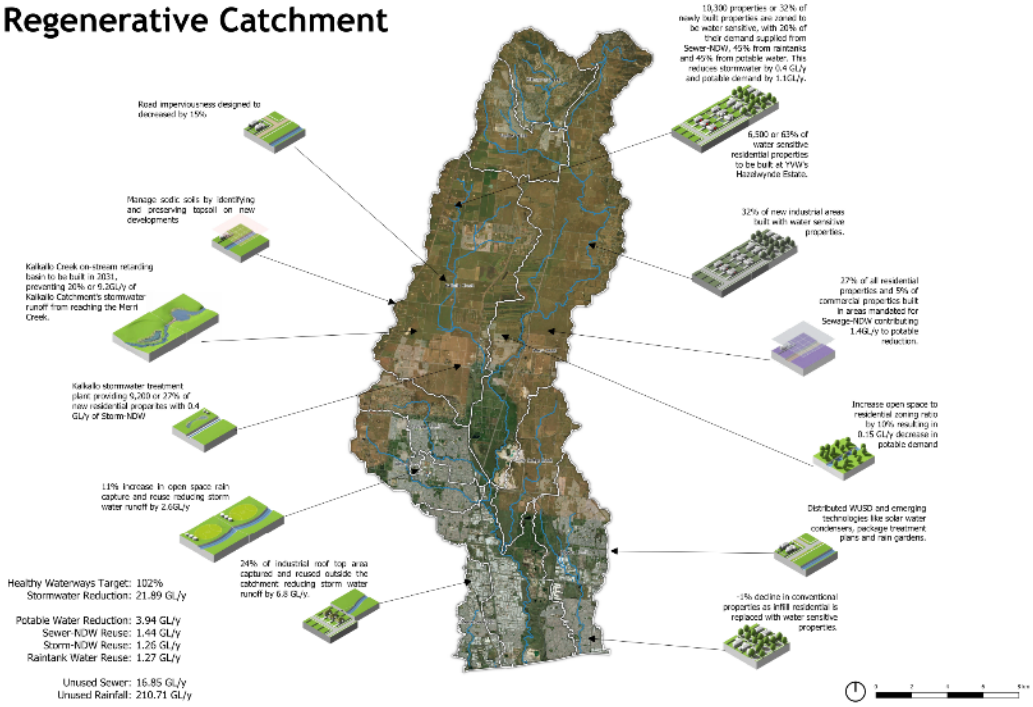

Figure 15. Mapping of proposed outcomes to be integrated into a water balance for the Upper Merri Creek, under a regenerative scenario. Source: Upper Merri Creek Steering Committee (2020).

A range of draft targets and key actions (yet to be endorsed as of July 2020) have emerged from this process which align with the community principles and Yarra IWM Strategic Directions Statement indicators and measures. These specify:

- **Planning requirements** – to be incorporated into preliminary advice and permits;
- **Development conditions** – to inform Victorian Planning Authority (VPA)-led Precinct Structure Plans (land-use planning documents) and developer constructed assets;
- **Concept locations of infrastructure** – to update and inform asset sequencing plans, servicing schemes and business plans and budgets;
- **Commitments to projects** – for example recycled water horticultural schemes, servicing contracts and joint ventures; and
- **Engagement events** – for example urban form design competitions, knowledge sharing Apps, community activation.

Evaluation and financing

It is important that the initial discussion paper does not detail any preferred options or economic evaluations of projects and/or servicing approaches at this stage of the process as this can bias development of the scenarios.

Once targets and actions have been proposed as outcomes for the IWM plan these can then be evaluated using a range of tools currently available. Specific economic analysis is undertaken to evaluate alternative servicing approaches, for example the development of social enterprises, and working in partnership with community non-profit organisations, which deliver a broader range of social benefits.

The achievement of sub-catchment targets requires broad economic analysis to ensure the social and health benefits can be leveraged in incentives schemes.

Reflections and key learnings

Key learnings from the Upper Merri Creek IWM process to date are:

- Collaboration between organisations requires significant time and effort (resourcing and support). Commitment to the collaborative process involves working on joint objectives that may not always be considered a priority of each organisation.
- Executive level commitment and support is required to support constructive organisational cultures that enable place-based planning and the sign-off, endorsement and delivery of joint IWM objectives and outcomes.
- Generating a collective understanding and communicating a shared perspective within organisations requires dedicated effort and support – it cannot be delivered effectively by a single individual or small team.
- A willingness to share issues and opportunities and amend organisational perspectives based on considerations of others is fundamental to moving beyond delivering services and infrastructure using the same BAU approaches. It requires leadership and focused effort.
- Significant capacity building and increased resourcing is required within government agencies, water authorities and with Traditional Custodians to develop effective, respectful and collaborative relationships that enable all parties to participate equitably in water planning and management.
- As this is not a statutory or legislated process, some partners have concerns about how the IWM Plan will become an effective tool in practice.

CASE STUDY 5B: THE CASE FOR PLACE-BASED PLANNING ON WURUNDJERI WOI WURRUNG COUNTRY

Project description

The Upper Merri Creek is a sub-catchment area within the Birrarung which includes a major growth area to the north of Melbourne. Wurundjeri Woi Wurrung Corporations' Water Unit, Hume City Council, City of Whittlesea, Mitchell Shire Council, Yarra Valley Water, Melbourne Water and the Victorian Planning Authority are working together to develop and implement an Integrated Water Management (IWM) plan for the Upper Merri Creek sub-catchment.

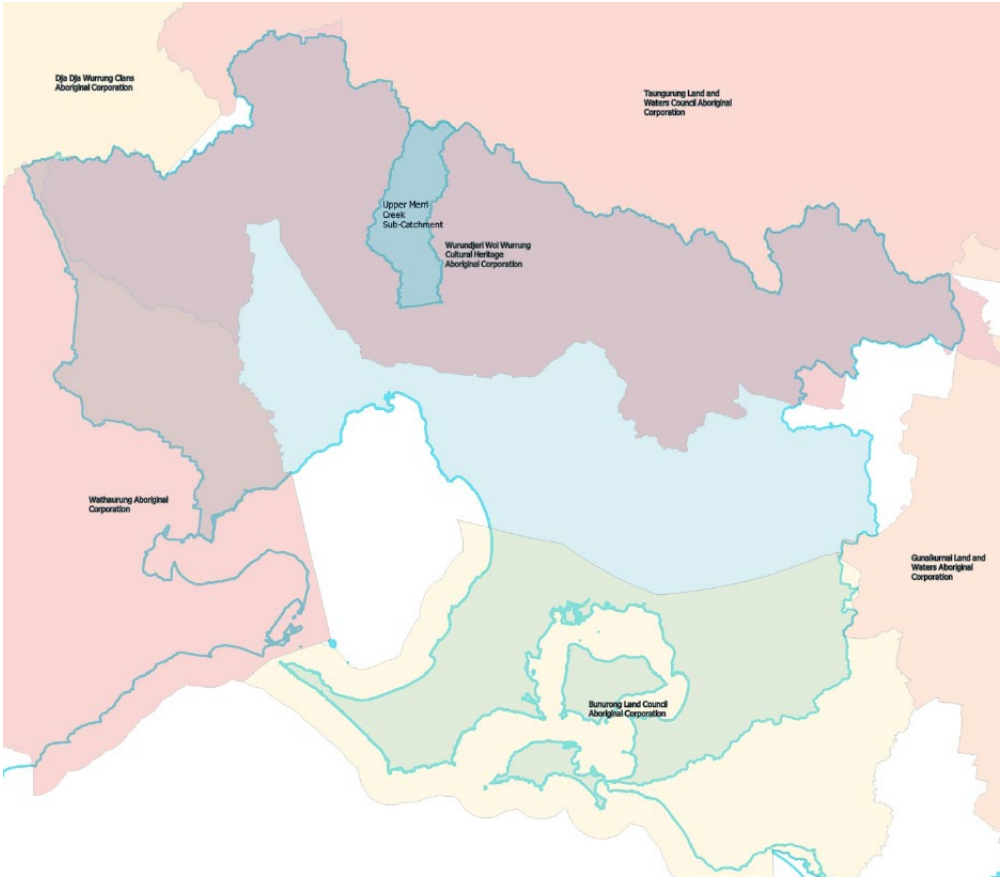

Figure 16. Boundaries of Registered Aboriginal Parties in the context of the Upper Merri Creek Sub-Catchment. Source: Adapted by Yarra Valley Water from Victorian Dept. Premier and Cabinet (2020).

This project is piloting a new partnership approach to managing all water resources. This approach supports all agencies working collaboratively to address challenges and create positive outcomes for the evolving local community and the environment in the Upper Merri Creek sub-catchment. Unlike the other IWM processes that have occurred on Country, fundamental to the Upper Merri IWM is the recognition of Wurundjeri Woi Wurrung people's inherent rights as sovereign people.

It is also understood that for genuine Wurundjeri Woi Wurrung participation, resourcing is a prerequisite for participation, as determined by Wurundjeri Woi Wurrung. A Cultural Flows Assessment (applying the methodology developed by the National Cultural Flows Research Project (2018)) and Wurundjeri Woi Wurrung community engagement are fundamental to the ongoing, iterative process for place-based planning on Wurundjeri Woi Wurrung Country.

Purpose of this case study

1. To clearly articulate the collaborations required to deliver outcomes described in Wurundjeri Woi Wurrung people's Country Plan and supporting frameworks including (but not limited to): the Yarra Strategic Plan, Nhanbu narrun ba ngargunin twarn Birrarung, Cultural Flows Assessments, Cultural Values Assessments and Cultural Heritage Management Plans.
2. To provide feedback on the Upper Merri Creek IWM Plan pilot project which includes the first application of the Cultural Flows Assessment methodology developed by the National Cultural Flows Research Project in an urban / peri-urban context.

Priority strategic context

We, the Woi-wurrung, the First People, and the Birrarung, belong to this Country. This Country, and the Birrarung are part of us. The Birrarung is alive, has a heart, a spirit and is part of our Dreaming.

We have lived with and known the Birrarung since the beginning. We will always know the Birrarung. Bunjil, the great Eagle, the creator spirit, made the land, the sky, the sea, the rivers, flora and fauna, the lore. He made Kulin from the earth. Bunjil gave Waa, the crow, the responsibility of Protector. Bunjil's brother, Palliyang, the Bat, created Bagarook, women, from the water. Since our beginning it has been known that we have an obligation to keep the Birrarung alive and healthy—for all generations to come.

In lieu of formal (legislated) recognition of the inherent rights of Traditional Custodians, a framework for embedding Registered Aboriginal Parties (RAPs) into planning processes is required. In the Upper Merri Creek IWM pilot project we requested a Partnership Statement from all partnering organisations to recognise our inherent rights and acknowledge our equitable involvement with government agencies in the process.

Wurundjeri Woi Wurrung have rights and a moral obligation to care for water under our lore {law} and customs.

These have never been forfeited, and are yet to be protected through Treaties.

The UN Declaration on the Rights of Indigenous People (UNDRIP), which Australia is a signatory to, includes references to water. Details of these are contained in our Cultural Flows Assessment.

In Victoria the following policy positions of government support the recognition of Aboriginal rights:

1. Victorian Aboriginal Inclusion Framework

This framework provides policy makers, program managers and service providers in the Victorian Government with a structure for reviewing their practice and reforming the way they engage with and address needs of Aboriginal people. Key elements of this framework include:

- Munganin–Gadhaba 'Achieve Together' (DELWP Aboriginal Inclusion Plan) commits to contributing to the wellbeing of Aboriginal communities by reconnecting us to water for cultural, economic, customary and spiritual practices. It aims to:
    - Provide Victoria's Traditional Custodians with access to water
    - Involve Traditional Owners in water management and planning decisions
    - Increase Aboriginal employment and business opportunities in water management.

2. Victorian Aboriginal Affairs Framework (VAAF) 2018-2023

The goals, objectives, measures, guiding principles for self-determination, and actions within the VAAF set a clear direction for how government will plan, act, measure and evaluate to progress change. The VAAF action logic identifies "transfer power and resources to communities".

3. Water for Victoria (August 2016)

Includes commitments for inclusion of Aboriginal people in the planning and management of water resources. Chapter 6 specifically commits to:

- Recognise Aboriginal values and objectives of water;
- Include Aboriginal values and traditional ecological knowledge in water planning;
- Support Aboriginal access to water for economic development; and
- Build capacity to increase Aboriginal participation in water management

4. Yarra River Protection (Wilip-gin Birrarung murron) Act (2017)

The Yarra River Protection (Wilip-gin Birrarung murron) Act focuses on a relatively narrow corridor set back from the Yarra river channel, but the Wurundjeri Woi Wurrung people maintain that management needs to consider values, priorities and aspects that lie beyond the designated Yarra River Land and are seeking to be independent and active partners on an equal level and be contributors to the future of the Yarra catchment (Birrarung) management.

5. Water and Catchment Legislation Amendment Act 2019

Intended to embed recreational and Aboriginal cultural values into the planning and operations of water resource managers. The Act provides (amongst other objectives) greater

recognition and involvement of Traditional Custodians. This legislation supports Aboriginal cultural uses of water and underpins opportunities to use water for economic development for Traditional Owners and Aboriginal Victorians. It will also support the self-determination of Traditional Custodians by providing opportunities that best meet their water management needs.

6. Water corporation Letters of Expectations

Each year the Minister for Water writes to all 19 Victorian water corporations to outline performance expectations for the coming business planning year, taking the opportunity to communicate the government's priorities for the water sector with a Letter of Expectations (LOE). The current LOE outlines expectations for the water sector's role in recognising and supporting Aboriginal cultural values and economic inclusion. Water corporations need to:

- Include Aboriginal values and objectives for water through water planning, increased participation and supporting access to water for economic development. Collaborating with Traditional Custodians in water planning and management is an aspect of maintaining access to Country and its resources.
- Improve access to water for Traditional Custodians and Aboriginal Victorians to provide opportunities for economic development. Water-related Aboriginal enterprises can contribute to economic self-determination for Traditional Custodians.
- Incorporate Aboriginal customary knowledge into water management (where appropriate), and assist Traditional Custodians to plan for, and adapt to, the impacts of climate change.

THE ECHUCA DECLARATION

The Wurundjeri Woi Wurrung acknowledge the statements made by the Murray Lower Darling Indigenous Nations (MLDRIN) and endorsed by the Northern Basin Aboriginal Nations (NBAN) in the Echuca Declaration (2010):

"Cultural Flows are water entitlements that are legally and beneficially owned by the Indigenous Nations and are of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations. This is our inherent right."

We extend these statements to cover the lands and of the Wurundjeri Woi Wurrung people and emphasise that we maintain our spiritual and cultural identity, life and livelihood from our lands and waters; and have never given up our sovereignty over our Country and it is our Country that has always sustained us.

Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation (Wurundjeri Woi Wurrung) is currently finalising a Country Plan which details the overarching objectives for managing the land and waters of the Country for which Wurundjeri Woi Wurrung people are Traditional Custodians.

Project drivers

Melbourne Water's Healthy Waterways Strategy 2018-28 is a co-designed strategy developed in partnership with state and local government, retail water corporations and the community. The strategy for the Yarra catchment provides direction towards a regional vision for the health of rivers, estuaries and wetlands in the Birrarung.

The Yarra River Protection (Wilip-gin Birrarung murron) Act (2017) and the Yarra Strategic Plan give effect to this long-term community vision. One of the key features of the Act for Aboriginal people in Victoria is the establishment of an independent entity, the Birrarung Council, to help develop and oversee the implementation of a strategic plan for the management of the Yarra River. The Yarra Strategic Plan is intended to give effect to Wurundjeri Woi-wurrung people's place-based policy response to the Act and Community Vision, Nhanbu narrun ba ngargunin twarn Birrarung. The Yarra Strategic Plan is currently being developed.

Outcomes sought

The Wurundjeri Woi Wurrung Water Unit piloted a process known as a Cultural Flows Assessment to identify the objectives of the Wurundjeri Woi Wurrung Corporation for the Upper Merri Creek sub-catchment. These objectives will inform others on how they can work with us to achieve mutually beneficial outcomes.

- Cultural flows for First Nations can build a pathway for reform in water law and policy across Australia. This pathway can:
- Strengthen First Nations' interests and roles in water management (governance, decision-making and delivery of on ground works);
- Support and celebrate cultural values as well as allowing Traditional Owners to deliver their responsibilities for Country;
- Enhance environmental outcomes; and
- Build socio-economic opportunities around water.

The National Cultural Flows Research Project outlined three law and policy approaches: 'Water Rights', 'Increase Influence', and 'Transform Foundations' which will advance cultural flows. Each approach, has different legal outcomes and effects, and each approach offers specific opportunities to build cultural flows objectives along a broader pathway of legal and policy reform. Each approach, therefore, is an essential, integral dimension of any overarching cultural flows program.

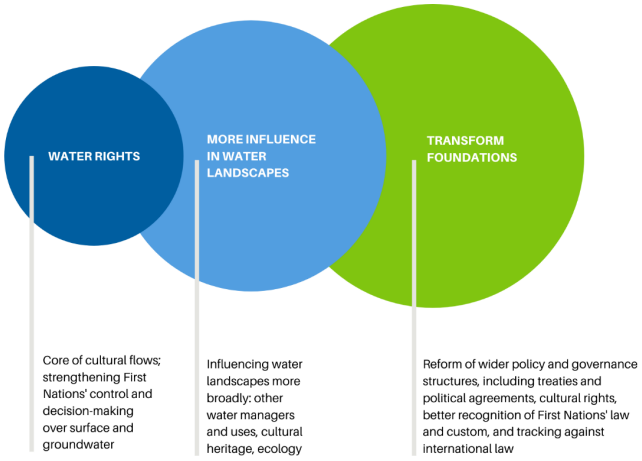

Figure 17. Three major law and policy approaches to cultural flows.[23]

Implementing cultural flows can help to:

- Show proper recognition of First Nations' roles in relation to water;
- Give responsibilities to different entities (including governments) to bring about cultural flows;
- Strengthen water governance and outcomes;
- Ensure organisations carry out their responsibilities for cultural flows; and
- Work towards cultural flows assessments being a legislated process.

The process for undertaking a cultural flows assessment requires resourcing and time to complete. It may be part of a broader set of inputs to a Country Plan (such as Cultural Values Assessment or survey, Cultural Heritage Management Plans). An overview of this process is as follows:

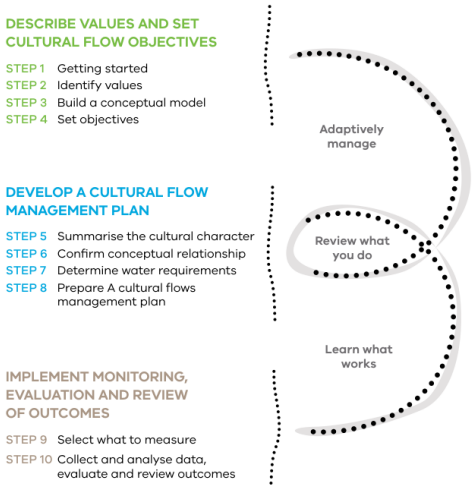

Figure 18. Steps involved in a cultural flows assessment. Source: National Cultural Flows Research Project

[23] http://www.culturalflows.com.au/~culturalflowscom/images/documents/Water%20Managers%20Guide.pdf

Wurundjeri Woi Wurrung Water Unit have led this cultural flows assessment to identify and prioritise the economic, social, ecological and cultural values that are connected to the Upper Merri Creek sub-catchment.

The outcome of this assessment was to identify areas of cultural significance that require access to water or protection from water. This assessment went further than other assessment methodologies, as it also looked to future water and land management and ownership aspirations, including social, cultural and economic opportunities for Wurundjeri Woi Wurrung people.

The cultural values that have been identified through the cultural flows assessment link to land and water health as well as Wurundjeri Woi Wurrung prosperity. Each of the identified outcomes will have its own cultural flows management plan (including identifying and managing risks), to ensure the ongoing sustainability of the outcomes and their contribution to the aspirations of the Wurundjeri Woi Wurrung Country Plan.

Incorporation of outcomes from the Cultural Flows Assessment into the Upper Merri Creek IWM Plan (and other strategies and plans) will inform others on how they can work with us to achieve mutually beneficial outcomes.

Furthermore, the outcomes seek to support Wurundjeri Woi Wurrung access to water for economic development through:

- Capacity building with Wurundjeri Woi Wurrung Water Unit;
- Capacity building (cultural competencies) with partnering organisations;
- Identify opportunities for partnerships and projects that deliver cultural flow / Wurundjeri Woi Wurrung Country Plan outcomes;
- Alignment of strategic outcomes of various parties wherever possible; and
- Development and delivery of a replicable process for engagement of Wurundjeri Woi Wurrung in the Integrated Water Management process.

If this process works well, the Water Unit will look to use the Cultural Flows Assessment process in other sub-catchments.

Reflections and key learnings

Traditional Custodians, until recently, have had very little involvement and input into water planning and management across the greater Melbourne area. The recent changes in Victorian legislation, requiring water authorities to collaborate and consult with Traditional Custodians is long overdue and is an inherent right that is now being recognised.

However, the changes in the legislation and the Letters of Expectations issued by the Minister must be matched with resources and support to ensure Traditional Custodians are able to participate effectively and equitably. The Wurundjeri Woi Wurrung Corporation, via its Water Unit, has stepped up to the challenge and with the support of partners, has identified areas to be addressed so that the rivers, creeks and Country provide regenerative benefits not only for Wurundjeri Woi Wurrung people and Country, but also to Settler-Melburnians living on Wurundjeri Woi Wurrung Country.

Merri Creek and its sub-catchment remains an important cultural link to Wurundjeri Woi Wurrung people's pre and post-contact heritage in the greater Melbourne area. It remains to be seen if commitments made through the Upper Merri Creek IWM Project Partnership Agreement will deliver on the ground actions aligned with the outcomes identified in the Cultural Flows Assessment.

Key elements that differentiate the Upper Merri Creek Integrated Water Management (IWM) process from other IWM processes are:

- Resourcing has been provided at the outset and with no strings attached: we have received support when it has been requested and have been able to utilise funding at our own discretion.
- Commitment from partnering organisations to building ongoing relationships founded on trust and respect. This is a key risk if individuals move on and the process has not been embedded or legislated. The timeframes have been flexible and not burdensome. The group has appreciated the Wurundjeri Woi Wurrung people have many competing priorities and governance. It can be challenging to integrate the wide ranging aspirations being pursued separate to but aligned with cultural flows.
- There was a 'blank canvas', nothing was already partially decided or designed in relation to the expectations or ideas and we have been part of a co-design of the outcomes: we can see how Wurundjeri Woi Wurrung objectives are being considered rather than being asked to endorse the objectives of others.

We would advocate for these reflections and learnings to be incorporated into IWM outcomes for projects involving water utilities (presented in the *IWM Principles and Best Practice for Water Utilities* paper), through the commentary below:

Outcome 1b – Shared ownership, management & responsibility

WW (Woi Wurrung) Comment: Does that mean WW will be gifted a water entitlement? Ownership has a very different meaning. How is "ownership" intended here for WW people?

Outcome 2a – Collective leadership, long-term vision and commitment

WW Comment: How will the projects invest in WW capacity? What is the commitment to this?

Whose long-term vision and commitment? Need to list everyone who has signed on? What circumstances exist that allow their participation?

Outcome 3a – Policy, legislation and regulations

WW comment: How will projects work with WW to develop policy, legislation and regulations? This must be a co-design process. How will you resource WW participation in this process.

Outcome 3b – Cross-sector institutional arrangements and processes

WW Comment: Does this mean treaties with each of the sectors and WW? This would be consistent with Cultural Flows methodologies.

Outcome 3d – Economic and financial/funding systems

WW Comment: What systems is the project planning (and ideally co-designing with WW) to ensure a system of funding that works for WW?

Key Outcome Area 4: Water Infrastructure and systems that are fit for purpose, resilient and adaptable to change

WW comment: Infrastructure that supports the health of Country.

Outcome 4f – Equitable access to water system services

WW Comment: How will project address the current inequity for WW? This section does not address the foundational equity issue, and it really should

Key Outcome Area 5: Improved ecological health and biodiversity of natural environments

WW Comment: It's hard to separate environmental and cultural values. WW cultural values included here

Outcome 5a – Healthy and biodiverse habitat

WW Comment: Work with WW to identify those areas of interest to WW so that cultural values can be recorded and embedded to enhance Country. This requires substantial resourcing.

Key Outcome Area 6: Healthy, cool, green cities and regions supported by blue and green infrastructure.

WW Comment: and Healthy Country

Key Outcome Area 7: resource efficiency and recovery towards regenerative outcomes

WW Comment: For a healthy, sustainable Country.

Outcome 8b – Water-related business opportunities

WW Comment: what are these opportunities for WW people? Traditional Custodians rights to resources can align with delivering recognition and support of Aboriginal cultural values and, particularly, economic inclusion (consistent with requirements in water authorities Letter of Expectations and Chapter 6 of Water for Victoria).

Partnership Statement for Upper Merri Creek

Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation and Upper Merri Creek sub-catchment partners: Victorian Planning Authority, Mitchell Shire Council, City of Whittlesea, Hume City Council, Yarra Valley Water, and Melbourne Water.

As the Traditional Owners of the Birrarung and its surrounding Country, the Wurundjeri Woi Wurrung First Peoples will bring their unique knowledge, connections and understandings of the Merri Creek and the wider Yarra catchment into the Upper Merri Creek integrated water management plan to enhance its integrity. At the same time the Wurundjeri Woi Wurrung

recognises the role and contribution to the process that other partner stakeholders will bring to the development and strength of the plan.

The project partners acknowledge the following key issues must be addressed to improve the First Peoples' water rights and First Peoples' ability to genuinely engage and participate in water planning and management processes.

1. First Peoples' desire for water rights and interests to be further acknowledged and protected by law.
2. Existing water planning and management regimes and institutions need to increase First Peoples' participation, influence, self-determination and control.
3. First Peoples' interests in water ownership, management, use and development do no always map easily onto existing "Western" legal, cultural, scientific, environmental and economic frameworks.
4. We need to invest for the long term to improve First Peoples' water rights and involvement in water management.

In recognition of these issues, the following Partnership Statement is entered into by all partners working collaboratively on the Upper Merri Creek IWM Plan. All partners recognise that the successful delivery of the below is contingent upon the Wurundjeri Woi Wurrung First Peoples being adequately resourced:

COMMITMENTS

All parties recognise that the Partnership Statement is an important opportunity to further develop our relationships, building a foundation for working together into the future.

All parties commit to developing mutually beneficial relationships (ie. a collaborative partnership).

We commit to work together and view the quality of our working relationship as an important measure of success.

To achieve a strong working relationship we will:

1. Dedicate effort and resources to developing and managing relationships across our organisations
2. Provide opportunities for and encourage ongoing open and honest communication and feedback
3. Work proactively to resolve conflicts where necessary.

It is important to understand that as well as having statutory obligations, the Corporation is a representative community advocacy based organisation governed by Elders who represent the broader membership.

COMMON GOALS

All parties recognise that we have common goals that underpin this Partnership Statement.

We have a joint interest in the Upper Merri Creek sub-catchment:

- The Wurundjeri Woi Wurrung First Peoples input to the Yarra Strategic Plan: Nhanbu narrun ba ngarunin twarn Birrarung (Ancient Spirit and Lore of the Yarra) which is an evolving document;
- The Yarra Strategic Plan;
- The (Melbourne Water) Healthy Waterways Strategy; and
- The Upper Merri Creek IWM Plan.

There are benefits to our organisations from working together:

- We can deliver commitments detailed in the Upper Merri Creek IWM Plan; build capacity, capability and sustainability; and
- Maxmise the benefits of integrated and strategic planning and jointly pursue opportunities for innovation.

OVERARCHING ACTIONS

The following overarching actions, arising from the UN Declaration on the Rights of Indigenous People, relating specifically to Cultural Flows; the Echuca Declaration (Sep 2010); Munganin-Gadhaba ('Achieve Together' – the Victorian Government Aboriginal Inclusion Framework) and Water for Victoria (in particular Chapter 6 commitments):

- Recognise Traditional Owner values and objectives of water
- Agree to include Wurundjeri Woi Wurrung Traditional Owners as well as their values and knowledge in water planning
- Support Traditional Owner access to water for economic development
- Build capacity to increase Traditional Owner participation in water management

Will guide what we work together on as part of this Partnership Statement:

The Upper Merri Creek IWM project partners will work collaboratively with Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation in ongoing planning and management of water in the Upper Merri Creek sub-catchment and to develop joint project funding proposals to undertake identified projects.

SPECIFIC ACTIONS

To create clarity about specific areas where the Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation and the Upper Merri Creek IWM partners will work together in partnership, an annual action plan will be developed and included as Schedule 1of this Partnership Statement. This annual action plan will identify:

1. Planning integration opportunities
2. Specific project initiatives

3. Capacity building opportunities

MONITORING

The Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation and Upper Merri Creek IWM partners will work together to ensure this Partnership Statement is achieving mutual benefits. We will:

- Meet at least quarterly with Management representatives to review progress against the annual action plan.
- Meet annually to review achievements and identify opportunities for the next action plan, including an annual update to the Yarra Strategic Directions Statement.

CASE STUDY 6: KILMORE TREATMENT PLANT OFFSETS SCHEME

This case study demonstrates that a water authority does not always have to build bigger and better infrastructure to meet their regulatory obligations.

In this case, Goulburn Valley Water (GVW) achieved increased wastewater treatment capacity to service a rapidly growing population in Kilmore whilst at the same time meeting the EPA's downstream water quality objectives for discharge to a waterway, in a way that was cheaper, improved the health of a degraded waterway and produced significantly less GHG emissions when compared with the business as usual engineering solution.

A key to the success of the proposal was widespread and deep engagement by GVW with range of stakeholders. In particular, there was a close collaboration and partnership with the Goulburn Broken Catchment Management Authority (CMA). This was crucial to gaining an understanding of the 'win-wins' that were to be achieved by all stakeholders.

Project description

Image: Post wetland construction looking east. Source: GVW.

GVW provides water supply and wastewater services to the town of Kilmore – with a population of around 8,000. Wastewater is currently treated at a lagoon-based wastewater management facility (WMF), with the recycled water irrigated to land.

Kilmore is expected to undergo a significant population growth over the next 30 years that will increase the volume of recycled water requiring management from around 400 ML/yr today to 1,000 ML/yr in the year 2040. Current recycled water management practices (i.e. irrigation) will continue, and GVW has committed to supplying new irrigation customers if the opportunity presents itself, including other IWM projects related to the use of recycled wastewater for watering sporting facilities and other open spaces in town.

However, GVW has also implemented an Environmental Offsets Scheme that will see the increased recycled water returned to the local waterway. Under this scheme, the EPA will allow this discharge to the waterway provided GVW undertake works in the immediate catchment, including:

- Fencing of stock out of waterways;
- Riparian zone planting; and
- Erosion rehabilitation.

In combination, these actions will reduce nutrient run-off into the waterway to an extent that is greater than the amount of nutrients that GVW will discharge in catering for the growth of Kilmore's population. In so doing positive outcomes are created in terms of:

- Sustainable recycled water management;
- Improved ecological values of the Kilmore Creek;
- Community values; and
- Significantly reducing capital and operating expenditure.

Project drivers

THE VISION

To develop a wastewater treatment process that caters for future population growth of Kilmore whilst meeting required environmental and community recreation outcomes in the most cost-effective way.

THE PROBLEM

Kilmore is growing rapidly so simply expanding the existing wastewater facility will be very expensive and have a large GHG emissions profile.

Stakeholder and community engagement

Image: GBCMA Board, a key partner, receiving an onsite briefing at the Kilmore Offsets Project. Source: GVW.

A key to the success of this program was widespread and deep engagement by GVW with range of stakeholders. Because this was a novel approach it required adequate time for all parties to clarify their roles and expectations of the project. GVWs close collaboration with EPA was crucial to gaining:

- A shared understanding of expected outcomes;
- What was needed to measure and 'prove' that offsets were actually being achieved on the ground; and
- Appreciation that the project was a win-win for all stakeholders.

Those involved in the engagement processes included: EPA Victoria; Mitchell Shire Council; regional Aboriginal communities; local landholders and Landcare groups. The Goulburn Broken CMA were an important partner in the project and assisted with the engagement activities.

Outcomes sought

Because this project was taking a non-traditional (non-structural) approach to solving the problem, nearly half of the IWM outcomes achieved by this project were in the Enabling Outcomes area:

Key Outcome Area 1: An engaged, inspired and knowledgeable community that drives decision making;

Key Outcome Area 2: Leadership and capacity; and

Key Outcome Area 3: Institutional, policy and regulatory arrangements that drive integrated and collaborative approaches to water cycle planning.

It was vital to the success of the project that all stakeholders were part of co-developing a win-win set of bio-physical outcomes. The bio-physical outcomes related specifically to:

- Outcome 4a – Diverse fit-for-purpose water system services
- Outcome 4e – Equitable access to water system services
- Outcome 5a – Healthy and biodiverse habitat
- Outcome 7c – Low GHG emissions in the water sector

It was inevitable the different stakeholders prioritised each of these outcomes differently in terms of their own organisation's objectives, and the challenge was to ensure each stakeholder understood how the offset project delivered on their objectives.

Options assessed

Image: Riparian plantings that show the setback from the creek to the fence line and the number of plants that will eventually provide the dense riparian zone. Source: GVW Water.

GVW knew that a business as usual approach to achieving the outcomes it had set would incur considerable capital and operating costs as well as significant GHG impacts. For this reason it re-evaluated and considered a wider range of options.

After considering a large range of options a shortlist of seven feasible approaches were assessed and modelled in detail:

Option 1. Expanding the current irrigation scheme (business as usual – the base case for the purpose of later evaluation).

Option 2. Using demand management with customers to reduce flow rates to the wastewater treatment plant.

Option 3. Re-using the recycled water for indirect potable supply or for a third-pipe supply to residential properties and public open space.

Option 4. Piping the recycled water south to connect to Yarra Valley Water's wastewater system at Wallan.

Option 5. Piping the recycled water north to GVW's treatment plant in Seymour and discharging it into the Goulburn River.

Option 6. Aquifer storage and recovery (ASR).

Option 7. Disposing recycled water locally into Kilmore Creek while engaging third parties to implement activities to offset the increased loads.

These options span all quadrants of the matrix of options –

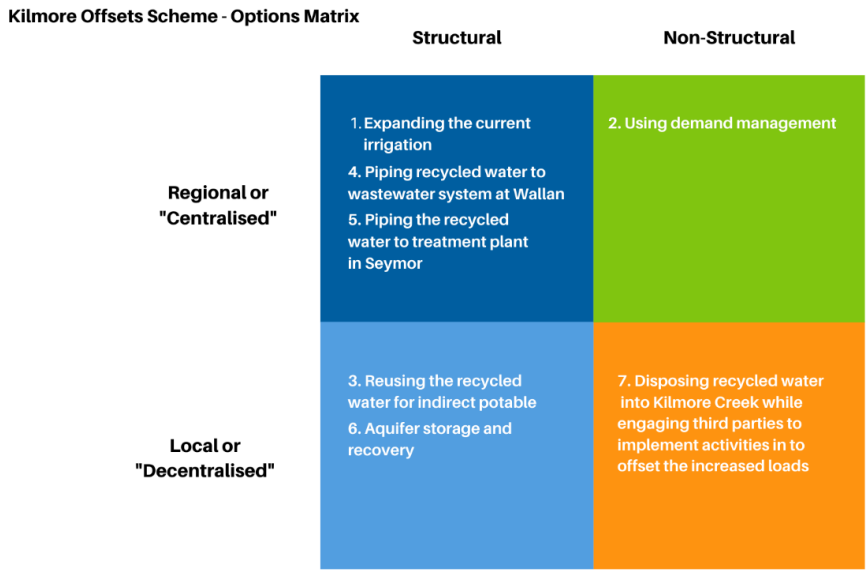

Figure 19. Kilmore offsets scheme, represented through an options matrix. Source: MSDI.

Detailed assessment of options

Option 1 – Irrigation: Long-term expansion of the existing irrigation option would be very costly and problematic due to the practical limitations on available sites and the cost of building new capacity.

Option 2 – Demand management: This was a cost-effective option that would help minimise flows, defer the need for investment and establish regulatory goodwill, irrespective of which other options were chosen. However, it would not be a sufficient option by itself.

Options 3, 4, 5 and 6: These dropped off the list in the first round because of high cost.

Option 7 – Offsets: Discharging increased flow to the creek and investing in offsetting investments would generate an improved environmental quality outcome. This would be less costly, able to be scaled up incrementally over time, and likely to generate community benefit. However, since this would be a relatively innovative approach, it would need considerable investment in regulatory and stakeholder management.

Details of offsets scheme

To achieve the required ecological outcomes, GVW commissioned an ecological risk assessment in line with EPAs requirements. The assessment proposed a range of

improvements to GVWs plant operations as well as the offsets that were achieved by the mitigating work to be done on land at other sites in the area. The package of work involved:

GVW works

- Treatment within the facility to reduce the concentrations of nitrogen, phosphorus, ammonia and oxygen-demanding substances entering the creek;
- The development and management of a mixing zone to further reduce the concentration of nutrients and oxygen-demanding compounds and progressively reduce the size of the mixing zone; and
- Managed flow discharges through use of existing storages to mimic natural seasonal variability and add to low-flow scenarios.

Offset works

The effectiveness of alternative offsetting actions was rigorously assessed to identify the highest value offsets for GVW to fund. This exercise identified that three types of works offered the best potential to restrict the movement of nutrients from the catchment into the waterways:

- Gully rehabilitation;
- Riparian fencing for stock exclusion; and
- Riparian revegetation.

The scheme is to be implemented with formal approval of the EPA, and systematically documents a program of work that GVW will fund, but be delivered in collaboration with Mitchell Shire Council, Goulburn Broken CMA, local Aboriginal communities and local landholders.

The scheme is to be trialled for a period of 10 years, however GVW has committed to the licence (and hence scheme) being reviewed every 5 years to assess the success of the project.

Monitoring and reporting – governance

GVW has developed a monitoring program that has been approved by the EPA. This program considers two main areas:

- The quality of the treated water being discharged to the waterway; and
- The overall condition of the creek system. This involves water quality sampling, macro-invertebrate surveys, habitat assessments and ongoing auditing of the offsets assets. GVW also has a requirement to undertake a review of the overall creek system every 5 years.

In selecting this suite of works and measures, a parallel driver for GVW was a decision to maintain a passive, low-energy treatment system that had minimal labour requirements. This has even greater significance given the commitment to reduce energy consumption by the water industry required by the 2016 Victorian Government *Water for Victoria* state water plan.

Evaluation and financing

FINANCIAL ASSESSMENT

Option 1 – Business as usual

Capital cost – $50 Million

Operating cost – significant operating cost and GFG emissions.

Option 7 – Offsets proposal

Capital cost- $15 Million

Operating cost – paid to offset project.

- Other factors that were not quantified but supported the offset proposal included:
- Significant social benefits (improved creek amenity, improved ecological value and use of the creek)
- GHG savings – based on typical electrical consumption of an activated sludge plant versus the current operational arrangements. An activated sludge plant would also have treatment emissions and emission from the sludge management.

Ongoing funding for the offsets (payment to landowners for on-site works) and for on-site improvements to GVW treatment systems will be provided by GVW.

Reflections and lessons learned

- Partnership with the Catchment Management Authority was a critical to the success of the project. CMAs have a stronger skillset in the area of riparian zone management and improvement. Partnership rather than simple engagement is recommended.
- The preferred option was a relatively novel approach compared to other options and therefore required early conversations with the Regulator to ensure all expectations are met.
- All stakeholders had a genuine commitment to the improvement of the health of the creek system, not just obtain a licence to discharge. The co-ownership of the social and environmental benefits under-pinned this approach – it was not simply a means to an end to discharge to a waterway.
- Although this is not the normal approach it is something that Water Authorities and Regulators must become comfortable with, in order to continue to progress these types of projects.
- The CMA and GVW spent a considerable amount of time meeting with individual landholders at their property to discuss the project and the potential for offsets works to occur on their property. This meant that when the time came to implement offsets a significant number of landholders were already on board and were willing to have works undertaken on their property.

CASE STUDY 7: CENTRAL PARK, SYDNEY

Project description

This case study provides a good example of the different context in the NSW water industry as a result of the Water Industry Competition Act 2006 (WIC Act). The WIC Act has enabled decentralised IWM systems being operated by a private water utilities – in this case the multi-utility business Flow Systems, and its subsidiary Central Park Water.

The $2 billion urban village of Central Park sits on a 5.8 hectare former brewery site in inner Sydney with one third of the area dedicated to open space. The site has 11 buildings, 2,271 apartments, shops, cafes, restaurants, laneways, terraces and offices.

Wastewater is collected from the precinct's residential, commercial and retail buildings and an adjacent Sydney Water wastewater pipeline with top-up from stormwater runoff and rainwater. These various locally-captured water sources are treated at the Central Park local water centre located within the basement of one of the buildings. Wastewater is treated to two different recycled water types for different end uses. Both recycled water types meet the required dual reticulation standards using a membrane bioreactor (MBR), ultraviolet and chlorine disinfection plus one stream is also treated through reverse osmosis (RO).

The two separate fit-for-purpose recycled water types are distributed within the precinct to supply water for irrigation, including the substantial greenwalls, toilet flushing, clothes washing, car washing and ornamental water features plus for cooling towers. The recycled water systems mean that the precinct uses saves 40 to 50 per cent less drinking water, without restricting its use of water during drought.

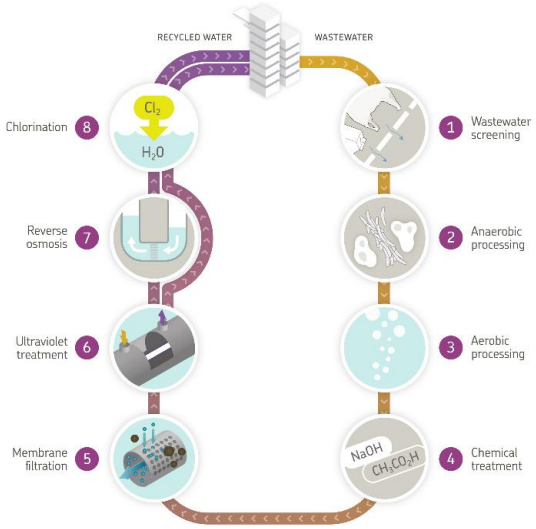

Figure 20. Recycled water production flowchart for Central Park. Source: Flow Systems.

Project drivers

VISION

The vision for Central Park is to “raise the bar for sustainable living using green technologies” in a high density urban development, achieving a minimum 5-star Green Star rating for each building to push the boundaries on what is possible for self-sufficient mixed use urban development precincts.

Stakeholder and community engagement

The main collaborators for the planning and delivering of this project are:

- Flow Systems, its subsidiary Central Park Water (licensed owner, and operator and customer-facing billing utility) and its consultants and contractors including Permeate Partners
- City of Sydney (local government authority)
- Frasers Property (developer)
- Sekisui House (developer)
- Institute for Sustainable Futures at the University of Technology Sydney (research and sustainability advice)
- Education partners – Flow Systems also works closely with the University of Technology Sydney, located across the road from the Central Park precinct. UTS students participate in studies at the Central Park local water centre. The Central Park recycled water network has also been expanded to export available recycled water to the UTS precinct and has the potential for further expansion
- Sydney Water – an inter-utility services agreement between Flow Systems and Sydney Water sets the parameters for the bulk provision of drinking water to the precinct and for accepting waste streams from the scheme.
- NSW Government (including IPART, Department of Planning, Industry and Environment, NSW Health)

The WIC Act allows private water utilities to obtain a licence to operate infrastructure and supply water and wastewater services to customers. As with other water utilities, Central Park Water (the private water licence holder at Central Park) is subject to strict health and water quality guidelines.

The Independent Pricing and Regulatory Tribunal (IPART) and the NSW Minister for Water, Property and Housing administers the WIC Act and regulates Flow Systems and Central Park Water as a licensee making them critical stakeholders in the project. As with any recycled water project, considerable engagement is also held with the local health authorities, in this case, the local Public Health Unit and Water Unit of NSW Health.

Outcomes sought

The major IWM outcomes for Central Park are:

Community participation in water

Demonstrates: *Outcome 1a – Connection with water and water literacy*

The Central Park Local Water Centre (LWC) is host to several group tours every year from local residents to school and university education groups, government delegations and other likeminded developers looking to see what is possible in IWM. For this reason, the LWC is set up with wayfinding signage throughout to help educate the community on the water cycle and the benefits of water recycling.

Leadership and capacity

Demonstrates: *Outcome 2a – Collective leadership, long-term vision and commitment; 2b – Knowledge, skills and organisational capacity; and 2d – Constructive organisational culture*

Flow Systems was founded on the principles of IWM, becoming a leader in integrated water management utility services with a strong long-term vision and capacity for creating sustainable communities, shared across the organisation.

Cities as Water Supply Catchments

Demonstrates: *Outcome 4a – Diverse fit-for-purpose water supply system*

- Alternative water supply – The Central Park local water centre supplies two qualities of fit-for-purpose recycled water to 2,271 residential apartments and 75,000 m2 of commercial and retail space sourced from six different sources of water.
- Drinking water savings – Residents save up to 50 per cent of drinking water compared with typical developments and maintain a secure water supply free from water restrictions in drought.

Cities comprising Water Sensitive Communities

Demonstrates: *Outcome 4c – Integration and intelligent control*

Engaged customers – Water use monitoring and monthly e-bills keep residents aware of their water use and avoids bill-shock.

Cities providing Ecosystem Services

Demonstrates: *Outcome 5a – Healthy and biodiverse habitat*

Keeping wastewater out of the environment – ultimately at least 1 ML of treated wastewater will be harvested from the sewer and stormwater systems each day, rather than discharged to the ocean.

Options and operation

Central Park Water as the licensed network operator owns, operates and maintains all water related infrastructure within this community – effectively taking over the management of the water cycle within the precinct.

Flow Systems, the parent company, holds the retail supplier licence and bills customers directly under conditions imposed by the licence, as with other water utilities.

The recycled water network harvests multiple water sources and distributes three types of water (drinking water and two types of recycled water), covering all the water requirements of the community.

- Drinking water is sourced from Sydney Water's drinking water network. Non-potable water is sourced from:
- Wastewater from all buildings within the Central Park community;
- Wastewater from an adjacent Sydney Water wastewater trunk main ('sewer mining');
- Rainwater from roofs;
- Stormwater from impermeable surfaces/planter box drainage; and
- Irrigation water from all greenwalls (as return flow from recycled water irrigation).

DECENTRALISED WASTEWATER TREATMENT

Harvested wastewater and stormwater is treated at the local water centre through eight filtration and purification processes including the membrane bioreactor, ultraviolet and chlorine disinfection and reverse osmosis technologies. The treatment system requires minimal space and does not generate excessive noise or unpleasant smells so it can be incorporated into the basement levels of the building in the high-density urban area.

REMOTELY CONTROLLED

The wastewater treatment system has been designed to minimise operation and maintenance requirements so that it can be controlled remotely and doesn't require constant onsite supervision.

COLLECTING AND TREATING ALL FORMS OF URBAN WATER

The system collects and treats wastewater from apartments, student accommodation, shops, cafes and offices, where necessary with trade waste agreements in place. It also includes local rainwater and stormwater runoff and excess irrigation water from the gardens and greenwalls on-site.

FIT-FOR-PURPOSE USE OF WATER

Multiple pipelines are provided within the precinct to deliver water of a quality that is suited to the intended uses. This includes drinking water from Sydney Water's drinking water network and two qualities of locally treated recycled water for toilet flushing, washing machines, irrigation, greenwall watering, car washing and ornamental water features and cooling towers.

Discussion

The Central Park IWM solution has applied an innovative decentralised recycled water schemes for a masterplanned inner-city development.

Harnessing water sources from across the precinct, it can balance demand requirements with the appropriate quality of water and minimise the draw from centralised, rain-dependent potable water resources.

It is possible to export recycled water for further potable water savings in surrounding precincts.

This is largely made possible by the enabling legislation of the NSW Water Industry Competition Act 2006 (WIC Act) developed during the Millennium Drought. The WIC Act's principles include:

- Protection of public health, the environment, public safety and consumers.
- Encouragement of competition
- Sustainability of water resources
- Promotion of production and use of recycled water.

The WIC Act has proven to harness the innovation of the private sector, provide recycled water to areas that would otherwise not have access and enable servicing of residential and commercial development sooner than by public water utilities.

Whilst there is largely nothing preventing these types of decentralised recycled water schemes being developed in other states, the WIC Act in NSW provides a provides a case study of private sector involvement in the water industry for other states.

The WIC Act also allows licensed NSW water utilities to retail and distribute drinking water (sourced from public water utilities). This has enabled improved IWM Outcomes, more efficient utility interfacing for the developer and less confusing bills for customers.

Image: Ultraviolet disinfection at Central Park Local Water Centre. Source: Flow Systems

Evaluation and financing

COSTS

In the case of Central Park, the developer funded the sustainable servicing infrastructure to achieve its goal of achieving a 5-star Greenstar rating across the precinct, including the first stage of the Central Park local water centre. This achievement allowed for uplift in gross floor area which could offset these costs. There are other financial models that can be applied depending on site-specific geographic, regulatory and timing factors.

An IWM approach means that revenue can be extracted from the entire water cycle to pay for the infrastructure and operation of the recycled water scheme, although a fee for management of trunk stormwater is still collected from residents by the local public water utility.

Future capacity expansions involving greater harvesting of water sources and exportation of the recycled water to neighbouring customers assists with the scheme's economic viability by leveraging fixed assets and operating costs and reducing trade waste discharge fees given the reduced bypass of wastewater.

BENEFITS

Production of fit-for-purpose recycled water from local water sources at Central Park has proven to have many benefits, including:

- Supporting sustainable irrigation of gardens and substantial greenwalls on the award-winning One Central Park building which in turn minimises the heat island effect from this mixed-use development in inner Sydney;
- Achieves the sustainability objectives of building owners and tenants; and
- Supports the City of Sydney's Sustainable Sydney 2030 Masterplan target to maintain drinking water use across the local government area below a 2006 baseline, despite increasing development.

Reflections and lessons learned

The Central Park IWM scheme has shown what is possible in integrated water services and technology. The enabling legislation, whilst not perfect in its current form, has inspired the private sector to apply best practice integration across the full breadth of the water cycle for optimal use of fit-for-purpose water supplies. It has required perseverance but it has paid off and now serves as a living example of what is possible at this scale. The enabling legislation is currently undergoing amendment which will see even greater and more efficient application to provide recycled water and IWM servicing in new growth areas which otherwise would not have had access to such services from the public water utility.

Forward thinking has allowed the expansion and optimisation of the Central Park scheme. Recycled water produced at the Central park local water centre may now be exported to surrounding precincts because the opportunity was identified and seized to bore connecting pipework whilst the basement was excavated and exposed for the Duo building.

Planning for multi-utility sustainable services has also enabled a symbiotic relationship with the energy services in the precinct with the provision of recycled water to the precinct's central thermal plant which in turn powers some of the water network infrastructure.

The establishment and ongoing success of the Central Park water utility shows that high density new urban development can be sustainably serviced while adhering to IWM principles for the benefit of not just the new residents of that precinct, but the surrounding areas as well, which benefit from open space irrigated with recycled water and reduced heat island where recycled water is used for greening and cooling.

Regular tours and visitor-friendly signage has also enabled the scheme to provide leadership and inspiration to others to implement similar IWM Outcomes in new urban developments around the world.

Given technological advances since the first stage of the Central Park local water centre was commissioned in 2015, options for the optimal use of the physical constraints of the site are now being investigated to maximise recycled water output and beneficially reuse other waste streams, supporting circular economy principles.

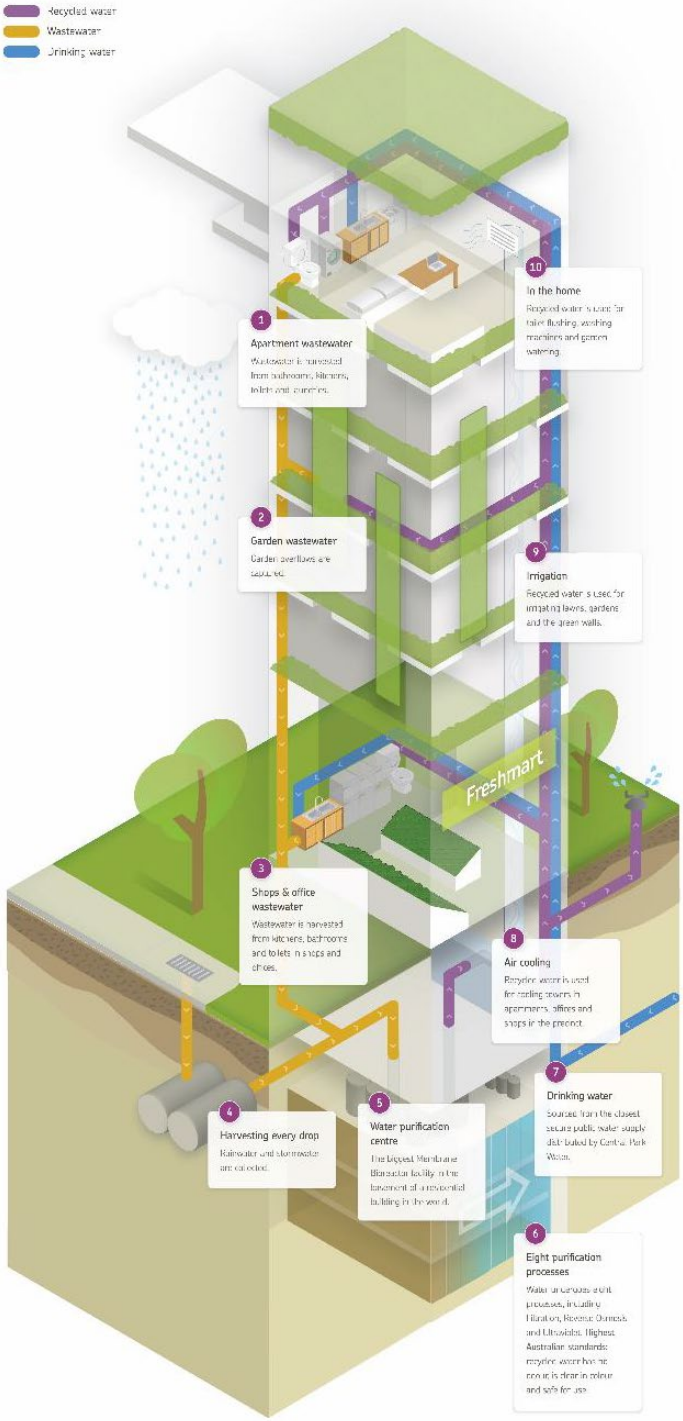

Figure 21. Central Park water system schematic. Source: Flow Systems.

CASE STUDY 8: AQUAREVO, MELBOURNE

Project description

Aquarevo is being developed on a former wastewater treatment plant owned by South East Water. It is located at Lyndhurst, 50 km south east of Melbourne's CBD and will have 460 houses upon completion.

Each home at Aquarevo is plumbed with three types of water: drinking, recycled and rainwater. Each property is fitted with a 2,400 litre rainwater tank, to capture water from the roof. After filtration, ultra violet and heat treatment, this water is used in the home to supply hot water in showers, baths, laundry and washing machines.

Pressure sewer pods are located at the front of each property where the waste is stored and intermittently pumped through the pressure sewer network to a proposed local waste recycling plant (WRP), treated and then returned for use as Class A recycled water. This water will be available for use in gardens, toilets and washing machines.

Each Aquarevo home is installed with OneBox® which monitors and controls remotely the rain to hot water system, the pressure sewer, records information about each home's water use and energy use and TankTalk®.

South East Water's TankTalk® technology is connected to each rain tank which receives weather forecasts data and then releases water to stormwater before predicted heavy rainfall, to create more storage capacity for fresh rainfall and to mitigate localised flooding by 25 per cent.

Figure 22. Masterplan of the Aquarevo Estate, Melbourne. Source: South East Water

Project drivers

VISION AND OBJECTIVES

Aquarevo is to be a blueprint for water-sensitive communities, both in Australia and beyond, with highly efficient water and energy housing capable of being adopted anywhere, including remote communities.

All water sources are to be available for use, finding better ways to use water without losing the health and liveability that it provides.

THE PROBLEM

Climate change, population growth and water scarcity will continue to challenge the water industry, so using all alternative water sources, ensuring resilience and liveability outcomes are achieved without jeopardising public health.

Stakeholder and community engagement

A stakeholder and community engagement plan was developed for the Aquarevo project to ensure that stakeholder and potential purchasers were aware of all the initiatives and requirements prior to purchase.

A separate engagement plan was developed and implemented to support the Environment Protection Authority (EPA) Victoria works approval submission for the Aquarevo WRP.

The stakeholders involved in the project included:

- South East Water
- Villawood Properties
- Cooperative Research Centre for Water Sensitive Cities (CRC WSC)
- City of Casey
- Melbourne Water
- Department of Environment, Land, Water and Planning (DELWP)
- Numerous consultants, contractors and builders

Engagement for planning of the Wastewater Recycling Plant was undertaken to address concerns related to perceived health issues around recycled water and having water recycling plant in a housing neighbourhood. Key principles included:

1. Engage before we engage

This allows the project team to tap-into insights not previously identified during preliminary desktop investigations.

2. Setting the foundations

An integral part of the engagement strategy was the development of an online hub with OurSay. This was done to provide purchasers of land a portal to visit, to ask questions in real time and view collateral information about the development.

3. Implementing engagement

Engagement and communication activities with the broader community were implemented including the online forum, community information sessions, community pop ups, social media, print media and emails. A Virtual Reality model of the WRP to assist with engaging the community is on the Aquarevo webpage.

During construction of the development a high level of interaction with the Aquarevo community was achieved via a series of events, including meet the builder events, community Christmas parties and family days.

Prior to purchasing lots at Aquarevo, all purchasers are fully informed of the water and energy saving features mandated for each home, and for the future waste recycling plant (WRP), including hard copy communications and events.

When houses were completed, all new customers were visited by South East Water staff and provided with an Aquarevo brochure. This contains all information about the development and the details of all the initiatives. This also included a thorough briefing of all equipment, South East Water maintenance responsibilities.

After 3 months another customer visit is arranged to check on all equipment and undertake another water sample as per the periodic water sampling regime.

Outcomes sought

The standout outcomes related to this project were:

Outcome 1a – Connection with water and water literacy

Outcome 3a – Policy, legislation and regulations; and 3c – Cross-sector Institutional arrangements and processes

Outcome 4a – Diverse and fit-for-purpose water systems services

Outcome 4c – Integration and intelligent control

Outcome 6c – Urban heat mitigation

Options assessed

During the initial planning and design stages, South East Water and Villawood Properties conducted a workshop with CRC for Water Sensitive Cities (CRC WSC). The aim of this workshop was to identify specific opportunities to create a water sensitive urban development. Options considered included:

- Intelligent water and energy systems – Rain to hot water system;

- Harvesting rainwater for hot water end-uses combined with the use of Class A recycled water for toilets, gardening and washing clothes. As a result homes can use up to 70 per cent less potable/mains water;
- Tank Talk technology including OneBox®;
- Adoption of wireless technology that releases water to the environment, minimising nuisance flooding and the assessment of this technology to reduce infrastructure required in drainage works;
- Closed loop – Recycled water system;
- Identifying systems and opportunities that can be distributed across the site for the use of recycled water and efficient sewer services. This includes the development of a pressure sewer system and a waste recycling plant on-site; and
- Urban heat mitigation – consideration of greening nature strips, including tree canopies and implementing waterbodies over the estate to reduce the heat island.

Discussion

INTELLIGENT WATER AND ENERGY SYSTEMS – RAIN TO HOT WATER SYSTEM

This is the first instance of a rain-to-hot water system being used in an urban setting. The rainwater tanks will store one million litres of rainwater at Aquarevo and use TankTalk® wireless technology which receives weather forecast data and then releases water before heavy rainfall to create room to capture new rainwater and reduce stormwater run-off by 25 per cent. Every Aquarevo house is fitted with a system that collects rainwater off a roof, screens, filters and treats it and then provides it for hot water use.

Image: Monash University rainwater to hot water study. Source: South East Water.

A rigorous Quantitative Microbial Risk Assessment (QMRA) by Ecos was used to assist in optimising the design of the rainwater to hot water system, to create a system that delivered the required log4 dose and a micro DALY of <1 (as recommended by the World Health Organisation for drinking water).

Subsequently, a study by Monash University's Environmental and Public Health Microbiology Laboratory (EPHM LAB) focused on assessing the performances of the filter, UV and heat-pump treatment-train to treat roof-harvested rainwater as an alternative supply of hot water for each household part of Aquarevo.

Finally, this system was tested and studied at a purpose-built test rig at Holmesglen TAFE with a program logic controller ‘PLC’ to run simulated daily household usage scenarios to demonstrate the heat treatment performance and test the design and its components.

ONEBOX+® AND TANKTALK TECHNOLOGY

Using innovative technology developed by South East Water, the OneBox+® device monitors and controls the pressure sewer system; the rain-to-hot water system and its treatment and filtering functions; and the rainwater tank, including tank levels through TankTalk® and hot water temperatures to make sure it stays at the programmed temperature.

Image: OneBox technology by Iota. Source: South East Water.

It also tracks each home’s water and energy (gas, electricity and solar power) use through their individual digital meters. Residents can see all their water and energy usage data in one place – through the ‘mySouthEastWater’ app, supporting ongoing community water literacy (**Outcome 1a**).

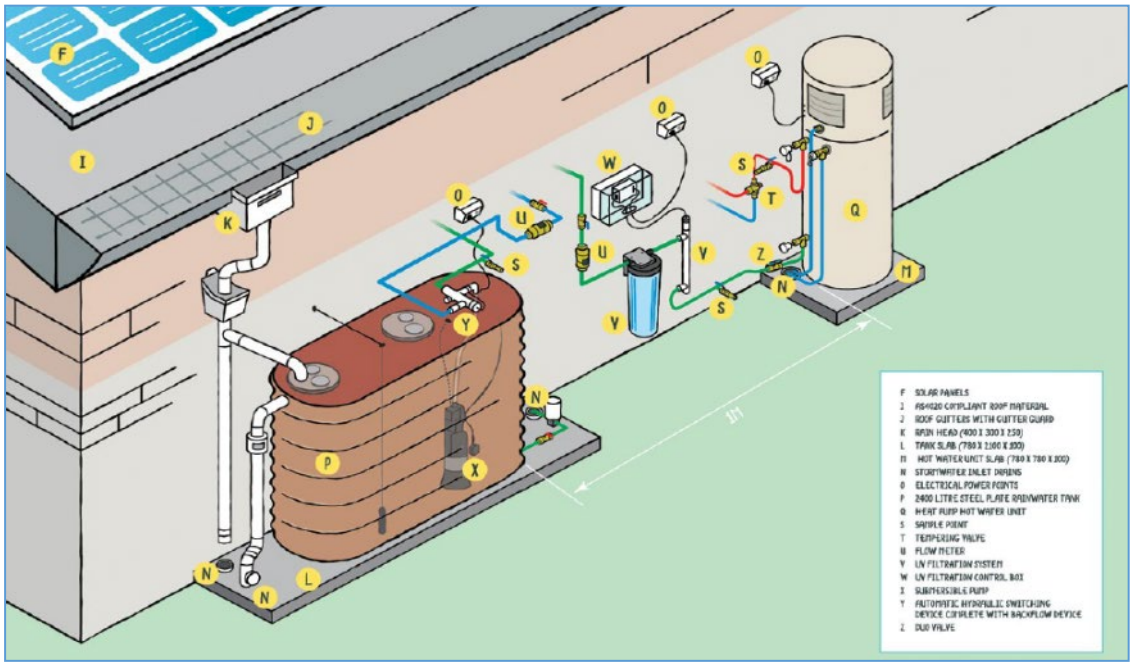

Figure 23. Schematic of rain to hot water system. Source: South East Water.

CLOSED LOOP – RECYCLED WATER SYSTEM

To use recycled water, wastewater will be treated at a local WRP. Each Aquarevo home uses Class A treated recycled water for toilet, washing machine and garden uses. The water recycling plant will be an Organica Food Chain Reactor called a 'Bluehouse', the first of its type to be built in Australia. The Bluehouse will treat all wastewater from the estate to Class A standard.

Image: Pressure sewer pod. Source: South East Water.

South East Water intends the Bluehouse to be constructed in close proximity to adjoining residential houses. Studies have been undertaken into customer engagement, odour modelling and noise assessment. A 25m buffer will be sufficient to ensure any odour emissions or nuisance noises are mitigated.

Each house has a 1,100 L pressure sewer storage pod in their front yard. When wastewater volumes reach a set level, the OneBox+® controller will activate the pump and transfer the waste to the WRP, thereby remotely monitoring and regulating sewer flows. The WRP will look like a natural garden within a greenhouse to blend into the surrounding landscape.

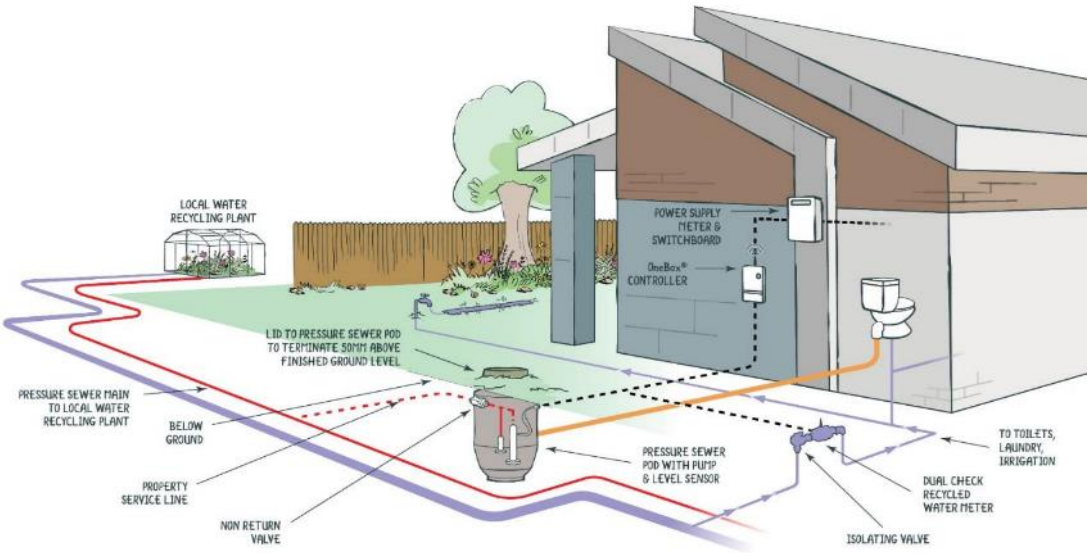

Figure 24. Schematic of the pressure sewer system. Source: South East Water.

Image: Proposed water recycling plant at Aquarevo (artist's impression). Source: South East Water.

URBAN HEAT MITIGATION

The development plan for the Aquarevo estate included an important connecting piece between Cranbourne Wetlands and the South East Green Wedge. The intention was to create a corridor through the Aquarevo site which requires arboreal, terrestrial and aquatic connections. This supports an active, vibrant and walkable community in addition to providing ecological benefits. A corridor link would facilitate pedestrian and cycle access and by extending green infrastructure corridor landscape templates into residential streets, provides physical and visual connectivity with multiple ecological and social benefits. It also has the potential to provide economic returns through increasing the number of premium properties with direct visual connection to green space.

The creation of an urban forest along with well vegetated streets throughout the estate, can reduce peak summer temperatures across significant areas of the site by 1-1.5 degrees Celsius. Street trees will be watered by a dedicated irrigation system drawing from the WRP. In addition maximising vegetation cover (particularly tree canopies), taking advantage of the natural wind, availability of water and vegetation adjacent to Aquarevo will enhance the local microclimate.

At the Aquarevo home, to address the challenge of irrigating the plants only when required, the installation of several temperature and moisture sensors around the landscape to measure real-time ambient temperature and moisture content of the soil. The sensors send this information to the OneBox®+ controller via wireless communication working on Zigbee protocol. If the OneBox®+ controller decides irrigation is required at a particular zone, it sends a signal to activate the solenoid feeding water to that zone and the zone is irrigated. When the required level of irrigation is achieved, as indicated by the soil moisture sensors, the OneBox®+ controller deactivates the solenoid.

Evaluation and financing

The commercial model between South East Water and Villawood Properties is based on each party's financial contribution to the project. South East Water was responsible for all the water initiatives into the development and for the contribution of the land that is owned by South East Water. Any costs that were considered additional to basic development costs, would be borne by South East Water.

Villawood Properties would be responsible for all development costs and accordingly accepted the development risk. Based on the contributions there is a percentage financial return to South East Water and Villawood Properties.

The project is funded from regulated income from the South East Water customer base. All expenditure and income generated, is treated as regulated income and expenditure.

Reflections and lessons learned

South East Water and Villawood Properties have stated that the Aquarevo project has demonstrated:

- Rainwater can be utilised as a supply for hot water
- A local WRP can be integrated, providing an additional high quality recycled water source to homes
- Real-time monitoring systems
- A new model can be delivered through public / private sector collaboration

LESSONS LEARNED

1. Challenges to existing regulation, policy, statutory requirements

- To supply rain water as a source of non-drinking water required south East Water to undertake extensive risk and mitigation. To comply with existing Drinking Water guidelines, it also required the customer to install a second hot water system to provide hot water to areas of the house where a customer would ingest hot water (kitchen and vanities) thereby ensuring that those taps were provided with drinking water.
- Being the first-of-its-kind development that integrates water and energy management, there were several challenges to overcome. However, Villawood and South East Water adopted a highly collaborative approach with the City of Casey and relevant authorities, including Melbourne Water, Cooperative Research Centre for Water Sensitive Cities, Department of Environment, Land, Water and Planning, Victorian Department of Health and Human Services, EPA Victoria and Monash University, to identify risk, solve problems and resolve issues early and in a positive manner.
- Due to the unique requirements for water management on each lot, Villawood Properties and South East Water engaged extensively with house builders so they understood the initiatives and could modify existing house designs.

- South East Water had to deal with the many challenges posed by the DHHS and EPA in instigating reform, seeking works approvals and challenging regulations while still ensuring the safe supply of water.
- Existing Environment Protection Authority (EPA) guidelines for Water Recycling Plants are based on open plants. The proposed Water Recycling Plant at Aquarevo is housed in a container. As such guidelines do not exist that stipulate the buffer zone required between the plant and residential properties.
- The works application has been submitted to the EPA is being assessed at the time of writing this case study (July 2020).

2. Allow time for innovation and collaboration

- In order to accommodate risk assessments, consultation, and design modifications, extra time was required during the development of the program. These aspects were necessary to protect the reputation of the development, instil confidence in the stakeholders and to provide good information to purchasers.

3. Engage the right team and be clear about responsibilities

- The success of the project is partly due to a recognition of the skills of the key stakeholders, whereby development risk was held by Villawood Properties, and responsibility for water initiatives was held by South East Water.
- Ongoing maintenance still seen as a barrier to greening and water sensitive urban design.
- During the initial plans to increase canopy cover and to introduce stormwater treatment, uncertainty over long-term maintenance of the public realm caused a hindrance to these initiatives. Ongoing collaboration with the local council recognised a need to innovate in the broader landscape.

4. Lack of community interest in wastewater

- During engagement activities it was found that there is a lack of interest in wastewater and its disposal by the general public. Given that the WRP only serves the Aquarevo estate, those outside this community attribute to the low interest.
- Customers are not well versed in Melbourne's standard water and wastewater infrastructure and plumbing.
- A lot of time has been spent educating customers on the Aquarevo initiatives as well as standard water and wastewater infrastructure.

5. Educating builders and plumbers

- Ongoing training of builders and their plumbers to ensure proper installation of rain-to-hot assets is crucial to the success of the project. A lot of time was spent monitoring and reacting to house construction with builder intervention.

6. Recycled water irrigation to public areas (ultimately council land)

- The inclusion of recycled water for irrigation purposes throughout the estate was limited to the trees in the nature strips and the parkland / wetland areas.

- Council did not allow irrigation of the grass area in the street nature strips.
- The irrigation of the trees was funded by South East Water and provision allowed for grass irrigation in the future if this was allowed by Council or operated and maintained by South East Water.
- It was important to ensure that Aquarevo vision remained a green estate.
- It is expected that if Council do not accept responsibility for public land irrigation then South East Water would accept this responsibility.
- It was imperative that provision for irrigation be included in the development and responsibility could be determined in the future.

Image: The Aquarevo House. Source: South East Water.

CASE STUDY 9: OAKLANDS STORMWATER HARVESTING AND REUSE PROJECT

Project description

The Oaklands Stormwater Harvesting and Reuse project has been designed by the City of Marion in Adelaide's southwestern suburbs, to support the redevelopment of 12 hectares of a former driver education centre site.

The system captures and reuses water from the Sturt River that would otherwise be discharged downstream. This is achieved through harvesting pumps, a gross pollutant trap (GPT), and a 2.3 hectare Oaklands Wetland treatment train. All these steps are required to treat the harvested water to comply with licence conditions for injection into the deep aquifer below the site.

Water treated through the wetland is collected into an underground sump where an injection pump delivers water under pressure into four wells. The Aquifer Storage and Recovery (ASR) system can treat up to 700 ML of stormwater each year, although the wetland needs to be augmented with additional electrical and mechanical treatment to increase from its current treatment capacity (400 ML).

The stormwater reuse scheme not only relieves the pressure on drinking water supplies, but also reduces the pollutant loads from stormwater that would otherwise flow downstream to adversely impact marine life in the Gulf of St Vincent. The wetlands provide a diversity of flora and increase the biodiversity of the area with a safe environment for recreation.

At full capacity the scheme is expected to provide up to 700 ML of stormwater for the irrigation of up to 31 council reserves, and 3rd party supply replacing mains or groundwater use.

Project drivers

THE VISION

The City of Marion has an overarching objective of becoming a Water Sensitive City and is seeking to harness the potential of stormwater to overcome water shortages, reduce urban temperatures, improve waterway health and the urban landscape.

The South Australian government has also been developing a Green Adelaide strategy with a vision for the city to become a world-leading, sustainable, green and climate resilient city achieved through an integrated approach to urban water and coastal management, greening streets and enhancing biodiversity.

Part of this vision is for Adelaide to be one of the world's first National Park Cities, bringing together health, education, climate, sustainability, biodiversity, water and coastal management outcomes. The Green Adelaide strategy aligns well with the outcomes of this project and provides a strategic justification for possible future expansion of the project including the ASR component.

THE PROBLEM

Though developed prior to the strategy, the Oaklands project aligns well with the Green Adelaide strategy as a local, place-based response to the problems it has outlined. These problems include:

1. *Urbanisation* – resulting in reduced green open space, stormwater management, increased rainwater runoff and water security issues. The 30 Year Plan for Greater Adelaide identified that 85 per cent of all new housing in metropolitan Adelaide will be built in established urban areas by 2045. The aim is to ensure a healthy balance of public green space, important backyard habitats for wildlife and increased stormwater runoff.

2. *Climate Change* – the consequences of global warming can already be observed in Adelaide through more extreme weather, rising sea levels, diminishing rainfall and increasing temperatures.

Image: Oaklands Wetland. Source: City of Marion, Michael Mullan.

3. *Maintaining health and wellbeing* – Currently 46 per cent of South Australians have been diagnosed with at least one chronic disease or condition[24]. Spending time in nature and living close to parks and other green spaces provides benefits for physical, mental and social health and wellbeing.

4. *Community connections* – The increase in people living in urban areas and the reduction of urban green spaces contribute to a growing disconnect from nature and from each other, resulting in declining health, wellbeing and social connections.

Stakeholder and community engagement

Detailed and extended consultation occurred during the feasibility, viability, funding, development application and construction phases of the project. This ranged from early engagement with Kaurna Nation, State and Federal Governments, residents and contractors.

[24] SA Health, 2009. *Chronic disease action plan for South Australia 2009-2018*. Government of South Australia.

This process enabled the City of Marion to fine tune the project delivering multiple community and benefits, not just stormwater harvesting.

The City of Marion uses the wetland and has an educational viewing platform. Site tours are promoted via the Council website. Local schools regularly visit the site. Flinders University students also use the wetland for water quality monitoring and ecology classes.

Image: Oaklands Wetland. Source: City of Marion, Michael Mullan.

Outcomes sought

The standout IWM outcomes of this project were:

Outcome 4a – Diverse fit-for-purpose water supply system

Outcome 5a – Healthy and biodiverse habitat

Outcome 5b – Groundwater quality and replenishment

Outcome 6a – Activating connected green – blue space

Outcome 6d – Equitable and affordable access to amenity values of water-related assets

Options assessed

The main project features include:

1. Stormwater Harvesting

- *Pre-treatment* – A Gross Pollutant Trap (GPT) removes sediment and debris. An inlet pond consisting of open water with edge vegetation and existing significant trees.
- *Wetland* – for the removal of nutrients, suspended solids, hydrocarbons, pesticides and herbicides. An outflow pit also includes a high level weir to prevent the site flooding, spilling treated stormwater back into the Sturt River.

- *ASR system* – Filtered outflows from wetlands pass from the pit into an underground pump chamber from where a submersible pump delivers flows to the four ASR wells, if water quality meets the required standard for aquifer injection. Otherwise, the water is either recirculated or returned to the Sturt River.

Currently the scheme provides an alternative water supply for 31 reserves, including two large sports fields.

The scheme has capacity to supply other users seeking an alternative, climate resilient water supply.

2. Regulation of water quality

Water is injected into the deeper aquifer, under the terms of a licence issued by the Environment Protection Authority. This protects the precious groundwater resource from adverse impacts.

Evaluation and financing

The project was funded 33.3 per cent each by Federal and State Governments and Marion Council.

Reflections and lessons learned

TECHNICAL

Harvesting the water from a river that carries a high loads of sediment and debris has proven to be a challenge. Various off-take structures were considered, with a grate system eventually being selected that was effective at minimising sediment loads across a range of flow conditions.

Other challenges encountered relate to the hydrogeology. Groundwater injection rates were based on limited well development during feasibility studies. Actual operational rates are lower than predicted but more than adequate to supply current and future Council demand. The site is future-proofed in that any additional demand for treated stormwater can be serviced by installing additional bores.

STRATEGIC

The project is playing an important role in delivering the state government's Green Adelaide vision and Marion Council's vision to become a water sensitive city. The wetland itself is part of an integrated water recycling system helping to keep reserves green across the municipality, reducing the use of mains water and protecting natural groundwater reserves.

WATER SERVICES
ASSOCIATION OF AUSTRALIA

APPENDICES

APPENDIX A – IWM OUTCOMES FRAMEWORK

The descriptions adopted here were developed with reference, in some cases, to descriptions used in the Water Sensitive Cities Index (CRC Water Sensitive Cities).

Enabling Outcomes

Key Outcome Area 1: An engaged, inspired and knowledgeable community that drives decision making

Outcome 1a – Connection with water and water literacy

Customers and communities can actively participate in IWM processes because they have adequate knowledge of water cycle, water sector and current state of water affairs. Non-Indigenous people have increased knowledge of the economic, cultural and/or spiritual interests of Indigenous people. Pride and connectedness of people with water through improved understanding of water's role in urban liveability, physical and mental health, and culture.

Outcome 1b – Shared ownership, management & responsibility

Customers and community, including Indigenous people, are active participants in creating, operating and maintaining relevant water system and its infrastructure.

Outcome 1c – Community preparedness and response to extreme events

Customers and community are empowered to cope with impacts associated with an extreme water-related and minimise the severity and duration of its impacts.

Key Outcome Area 2: Leadership and capacity

Outcome 2a – Collective leadership, long-term vision and commitment

Well-articulated IWM vision and narrative exists that drives innovation and IWM outcomes, so that IWM is valued and implemented throughout an organisation at all levels, in strategy and operation.

Outcome 2b – Knowledge, skills and organisational capacity

Continuous processes exist for strengthening employee skills and knowledge to enable cross-sectoral and multidisciplinary project planning and delivery.

Outcome 2c – Indigenous partnership in water planning

Strengthened Indigenous leadership and capacity to participate in water planning as a result of mutual respect and collaboration, which facilitates self-determination and leads to their

economic, cultural and/or spiritual interests being embedded through partnership in the planning and management of water systems.

Outcome 2d – **Constructive organisational culture**

Employees in all organisations are empowered and inspired to work in a collaborative and interdisciplinary manner to achieve IWM outcomes. An active learning culture is established within organisations that embraces learning with new insights actively shared and discussed across multiple sectors.

Key Outcome Area 3: Institutional, policy and regulatory arrangements that drive integrated and collaborative approaches to water cycle planning

Outcome 3a – **Policy, legislation and regulations**

Policy, regulations and regulations that provide clear and consistent direction on how integrated water management goals should be achieved and provide for joint accountability between all sectors and levels of government.

Outcome 3b – **Cross-sector institutional arrangements and processes**

Urban planning processes are coordinated and collaborative, involving the consideration of all long-term planning options and where stakeholders have clearly defined roles and responsibilities. Strong, responsive and active networks are established that are highly valued and exist across different sectors, organisations and levels.

Outcome 3c – **Public engagement, participation and transparency**

Inclusive and representation of relevant different perspectives, meaningful involvement and empowerment of community in decision-making.

Outcome 3d – **Economic and financial/funding systems**

Economic evaluation frameworks are designed to deliver broad societal value and are accompanied by innovative financing and funding opportunities – frameworks that incorporate different priorities and trade-offs as part of integrated planning. The ultimate aim of the economic evaluation is to direct investment towards the highest value option that considers and quantifies externalities and non- market values of water services.

Delivery Outcomes

Key Outcome Area 4: Water Infrastructure and systems that are fit for purpose, resilient and adaptable to change

Outcome 4a – **Diverse fit-for-purpose water system services**

Flexible and adaptive water systems that are appropriate to the quality of service required (including drinking water quality) and demand requirements of the end use (consumptive and non-consumptive uses). Systems that are optimised by the integration of all sources of water through centralised and decentralised infrastructure.

Outcome 4b – **Adaptable and robust systems**

Water systems that are able to cope with uncertain futures, with assets that can respond to stresses through the use of redundancy measures and bypass systems.

Outcome 4c – **Integration and intelligent control**

Water system performance is optimised through the use of intelligent control systems at a network and local level.

Outcome 4d – **Adequate maintenance**

Appropriate resources are committed and maintenance practices are provided to ensure the long-term integrity of infrastructure. Policies are in place for the operation and maintenance of all water infrastructure (including green and blue infrastructure).

Outcome 4e – **Equitable access to water system services**

Safe, secure and affordable water supply, sanitation and flood protection services are accessible to all.

Key Outcome Area 5: Improved ecological health and biodiversity of natural environments

Outcome 5a – **Healthy and biodiverse habitat**

Water system services help to protect, restore and create well-functioning ecosystems that contribute to ecological resilience. Quality of surface waters and marine environments are improved and protected. Existing areas of high ecological values are protected from impacts of catchment urbanisation, and restored and regenerated where possible and practicable.

Outcome 5b – **Groundwater quality and replenishment**

Improved and protected groundwater-connected environments. Groundwaters are of good quality and not being depleted and extensive action is undertaken where necessary to address domestic and industrial wastewater and urban runoff that impacts on groundwater.

Key outcome Area 6: Healthy, cool, green cities and regions supported by blue and green infrastructure

Outcome 6a – **Activating connected green – blue space**

The presence of many, distributed and well-connected green spaces and water assets. Green spaces can include formal or informal parkland, and public realm open space that is designed and maintained as a shared/accessible green landscape e.g. streetscapes.

Outcome 6b – **Infrastructure elements functioning as part of the urban water system**

Adequate urban space and built form functions as an integral part of the water system. For example, raingardens, rainwater and stormwater harvesting, flood storage and conveyance, and water sensitive landscaping (pervious surfaces, heat mitigation), green roofs and walls that capture and treat rainwater or greywater.

Outcome 6c – Urban heat mitigation

Water systems are incorporated into the design of urban precincts in a way that reduces urban heat impacts through shading from trees and evapotranspiration (tree canopies, vegetation cover and soil moisture).

Outcome 6d – Equitable access to amenity values of water-related systems

Enhanced amenity values associated with urban landscapes and water related assets with high amenity values, including health and wellbeing benefits.

Key Outcome Area 7: Resource efficiency and recovery

Outcome 7a – Highly efficient use of all sources of water

Maximise water use efficiency with measures in place to protect community values during periods of high scarcity.

Outcome 7b – Maximised resource recovery and reuse

Maximised cost-effective resource recovery through innovative system design. This includes all elements of the water cycle and concepts of waste to energy. Planning that is moving to a circular economy.

Outcome 7c – Low GHG emission in water sector

Towards net-zero GHG emissions by maximising the use of alternatives to high carbon emitting energy sources of water services.

Key Outcome Area 8: Innovative system-wide transformations towards a circular economy

Outcome 8a – Beneficial outcomes across other sectors beyond water-related services

Beneficial outcomes across other sectors beyond those attained through water related services. Benefits across other sectors may include for example: potential energy-savings from reduced use of air conditioning because of green infrastructure; cost-savings gained from avoided flooding; increased property market values because of water related presence of green-blue assets.

Outcome 8b – Water-related business opportunities

New business opportunities are stimulated through innovation in the water sector and in collaboration with other sectors. Business opportunities examples include for example: green infrastructure entrepreneurs (beyond rainwater tank suppliers), technology providers, service providers (nursery, consultants, monitoring and reporting, etc.), software developers, employment or profits from resource recovery. Support for recreation and tourism based businesses.

APPENDIX B1 – ENABLING REGULATIONS FOR IWM

IWM is subject to environmental health, public health, price regulations, and planning or built environment regulations (CRC WSC 2014). IWM practitioners should be fully aware of all regulations that relate to their service delivery responsibilities and to clarify the outcomes **the regulators** are aiming to achieve with each regulation. In most cases regulations are seeking outcomes that are consistent with objectives of IWM and the challenge is to use the objectives of regulations to drive innovative IWM solutions[25].

ENVIRONMENTAL REGULATION

For the purpose of these Guidelines the two main categories of threat to environmental health are *water quality and water quantity* in water dependent environments and ecosystems.

A common regulatory framework for managing diffuse stormwater involves catchment scale environmental targets being set in an overarching policy. For example, in Victoria (similar frameworks exist in other states) the *Environment Protection Act 1970* provides a risk-based framework for the protection of the environment, with power to develop State Environment Protection Policies (SEPPs) that set out specific standards required for the protection of particular parts of the environment. In Victoria, Best Practice Environment Management Guidelines enshrine targets that are required to meet the objectives of the SEPP. For stormwater runoff from development sites, these include both *quality* (e.g. nutrient loads) and *quantity* (often expressed as a percentage of pre-development runoff load).

So, if urban stormwater is a component of the IWM options under consideration then *it is crucial for planners to understand the outcomes that stormwater regulations are aiming to achieve.*

Regulators are a key stakeholder in IWM and their only concern is with outcomes – there are good examples of innovative solutions being developed when the focus of analysis in on outcomes and process (eg. Case Study 6: Kilmore Treatment Plant Offsets Scheme).

PUBLIC HEALTH REGULATION

There are two components of public health that are relevant to IWM for which there are national guidelines:

Drinking (potable) water – for which the Australian Drinking Water Guidelines (ADWG) provide best practice guidance. The ADWG contain standards relating to the safety and aesthetic quality of water but acknowledge that the greatest risk to human health comes from pathogenic microorganisms (NHMRC 2011).

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[25] If regulations are not consistent with IWM outcomes then the challenge for all stakeholders is to work together to develop or influence new regulations that are.

Non-potable water – The Australian Guidelines for Water Recycling (AGWR) provide best practice advice on both the health and environmental aspects of water recycling and establish water quality objectives for individual treatment systems, which identify the tolerable risk levels for each system, and ensure the system operates so that it performs to meet these targets.[26]

Given that IWM is moving to integrating decentralised and place-based solutions to deliver outcomes it is an increasingly important area for utilities and state regulatory agencies to clarify (see box below for the major policy and regulatory matters currently being addressed by Victoria).

ECONOMIC REGULATION

Water utilities in most jurisdictions are subject to pricing regulation that ensure *secure and affordable* water services (water supply, wastewater disposal and drainage) to all businesses and households that require them at prices that enable utilities to recover their costs and earn a reasonable profit (but not earn a monopoly profit).

Pricing regulators support price submissions for projects provided that:

They are delivering outcomes that are consistent with legislation, regulations or policies (that may be expressed in statements of obligations on water utilities);

They are prudent – that is, effective and efficient in achieving the outcomes; and

They have customer support – delivers value to customers that they are willing to pay for.

ENABLING PLANNING PROVISIONS

"While broad government statements support the need to enhance urban amenity by providing green public open space for communities, there are no clear, government-endorsed objectives for this aspect of urban amenity that would enable effective planning to meet this community need. This means that the authorising environment is ambiguous, which weakens the incentives for water and urban planners to work together at critical early stages of planning processes to identify and then evaluate a range of options" (Productivity Commission 2020)."

All jurisdictions are aware of these challenges and are exploring solutions to them. The *IWM Principles and Best Practice for Water Utilities* paper provides a framework for defining liveability outcomes and for stakeholders to address the institutional and planning instruments that can deliver the certainty that the Productivity Commission is asking for.

Water-related **urban amenity** is covered in this paper under **Key Outcome Areas 5 and 6**.

[26] Non-binding national guidelines from the National Health and Medical Research Council (NHMRC) exist for human health management of water bodies such as rivers and bays which are used for recreational water based activities.

Urban Amenity as defined by IWM Outcomes

Key Outcome Area 5: Improved ecological health and biodiversity of natural environments

Outcome 5a - Healthy and biodiverse habitat

Outcome 5c - Groundwater quality and replenishment

Key Outcome Area 6: Healthy, cool, green cities and regions supported by blue and green infrastructure.

Outcome 6a - Activating connected green - blue space

Outcome 6b - Infrastructure elements functioning as part of the urban water system

Outcome 6c - Urban heat mitigation

Outcome 6d - Equitable access to amenity values of water-related systems

If governments are to provide clear objectives for these aspects of urban amenity it is necessary for communities and regulators to collaborate to define what indicators and measures they want for these outcomes. It will require bottom-up and top-down processes as described in these guidelines. This is currently being done in a number of states, which is leading to significant reforms in state planning provisions and guidelines (see for example the *Victorian IWM Framework* and *Salisbury* in Part 2).

Clear government-endorsed objectives are certainly an essential component of delivering IWM solutions – but given a substantial portion of urban amenity outcomes are the responsibility of local government and private developers it is also necessary to ensure that cross-institutional arrangements and processes, and accountabilities, are clearly defined.

APPENDIX B2 – TAKING INTO ACCOUNT UNCERTAINTY: ADAPTIVE GOVERNANCE AND PLANNING

Strategic planning has traditionally been able to rely on predictions extrapolated from past experience. However, the impacts of climate change, population growth, changing customer expectations, technology disruptions and now pandemics (amongst others) continue to place added uncertainty and present complexity on future states. Therefore, it is no longer possible to rely solely on past trends and trajectories for future planning, and it is no longer sufficient to plan to deliver resilient systems that will return to an assumed business as usual state after the system recovers from such shocks.

WSAA's *Adaptive Planning Pathways and Methods* (WSAA 2019a) report provides a comprehensive overview of best-practice Adaptive Planning tools, techniques and processes. Drawing on wide ranging review of planning practices, the report highlights a range of tools, methods and approaches to adaptive planning, including:

- Adaptive planning pathways, e.g. the Deltares Dynamic Adaptive Policy Pathways (DAPP) tool
- Scenario planning
- Real options analysis
- Strategic foresight to identify possible trends and disruptions
- Stress testing to increase robustness
- Root cause analysis
- Causal loop diagrams

The report describes four important principles for the success of adaptive planning, all of which are applicable to the IWM process:

1. Supporting a maturity of knowledge

- Policies and strategic directives that support the continued development of competencies for adaptive planning tools and methodologies and how/when to implement them;
- Share key learnings and participate in knowledge exchange processes both within the water industry and with other sectors; and
- Document processes to support consistent processes of execution and embedding in business policy and practice.

2. Encouraging buy-in and support from IWM partners and internally, particularly at executive management levels

- Provide a clear line of sight across plans, strategies and operational documents;
- Ensure strategies are accessible and readable to promote uptake;
- Develop a shared language to assist in knowledge building and collective uptake; and
- Consider the appropriateness of communication for different internal and external stakeholders.

3. Fostering an enabling legislative/policy environment to bolster Adaptive Planning approaches

- Upskill internal advocates and stakeholders to champion the role of adaptive planning as a tool for addressing uncertainty; and
- Develop collateral (including fact sheets) noting the benefits of best practice adaptive planning, to drive business cases and a supporting policy landscape.

4. Identify adaptation signals, indicators and sign-posts

- Establish early indicators and measurements that detect shifts from a current/baseline scenario towards an alternative trend;
- Consider short-term signals and shocks (eg. drought and flooding events) and long-term trends (eg. climate change, resource stress);
- Identify global drivers (eg. pandemics, technology emergence, economic shift), and regional and local drivers (eg. community expectations and demand, urban densification, levels of service); and
- Engage customers, stakeholders and communities more broadly in information sharing, data collection and trend identification processes.

Example – Melbourne Water's Sewerage Strategy

Demonstrates: Outcome 4b – Adaptable and robust systems

Melbourne Water explored different adaptive planning methodologies to assist with strategic thinking for a 50 year horizon plan. A Dynamic Adaptive Pathway Planning (DAPP) approach was used collaboratively with key partners to extend strategic thinking beyond a static blueprint for the future. The DAPP approach is useful for identifying and planning for:

- Deeper uncertainty, and requirements for adaptation;
- The identification of potential risks associated with existing 'static' arrangements and within their operational environment; and
- Key current and emerging trends, signals, sign-posts and indicators that can enable transformation to meet strategy goals and objectives.
- The use of a DAPP process and related tools helped to identify the need for flexibility and the ability to respond to changing drivers facing the water industry.

Key challenges that confronted the business to deliver these outcomes included:

- The need for deeper understanding and connectivity between system limits, complex interactions and adaptation pathways stemming across and between a range of critical service delivery areas, assets and products;
- Mindset change and acceptance of the approach to be developed across the different and equally important business horizons, personnel and stakeholders;
- Linking Plausible Futures work with Adaptive Pathway Planning; and
- The concept of adaptive learning versus some expectations of 'having all the answers' now.

Further details on the specific tools and methodologies and outcomes of this work can be found in WSAA's ***Adaptive Planning Pathways and Methods*** report.

The UN Sustainable Development Goals: A Blueprint for collaboration and innovation

Decision makers have often experienced difficulty in selecting development pathways in the face of uncertainty, given the complex and interconnected nature of sustainability challenges. The siloed nature to approaches within, as well as between, organisations can lead to trade-offs and blind spots occurring beyond the immediate scope of single interest challenges.

Utilities can use adaptive planning practices to extend beyond a single sector focus to embrace other dimensions of cities and city planning including food security, transport, public health, energy, equality and more.

The United Nations SDGs serve as a useful enabling framework for facilitating these considerations. The 17 goals and 169 time-bound Targets offer a common framework (or blueprint) for organisations across all sectors to identify a full range of scenarios to be tested in the face of uncertainty.

WSAA's *Global Goals for Local Communities*[27] report, suggests harnessing the SDGs will require water utilities and water sector stakeholders to first assess how current operations contribute to the SDGs, monitor existing outputs against SDG Targets and consider how these can be harnessed for integrated sustainable management outcomes in the future.

The WSAA and MSDI *SDG Indicator Framework for driving sustainability outcomes for Australian and New Zealand urban water utilities* discussion paper (Skinner and Satur 2020, in press) provides a comprehensive framework to guide future business strategy and operations for sustainable development outcomes.

[27] https://www.wsaa.asn.au/publication/global-goals-local-communities-urban-water-advancing-un-sustainable-development-goals

APPENDIX B3 – ECONOMIC EVALUATION OF IWM PROJECTS

This Appendix draws on material provided by Ben Furmage, Prof. David Pannell and Dr. Md Sayed Iftekhar of the CRC for Water Sensitive Cities.

TYPES OF ECONOMIC ASSESSMENT

The economic evaluation principles in this report highlight the importance of considering a wide range of structural and non-structural options as well as centralised and decentralised options. These options can range from large scale infrastructure (e.g. dams and desalination plants) through to smaller scale nature-based or community-based solutions (e.g. wetlands and demand management initiatives).

The costs, risks and benefits of this broad range of options can vary significantly across time, location, scale and stakeholder groups. For example, a desalination plant has high upfront capital costs and is a largely closed system, whereas a demand management program that reduces water consumption has low/no capital costs and will rely significantly on influencing customer and community behaviour rather than controlling a treatment process.

A key question is how can we compare very different options to determine what is the best option for the community overall?

There is a range of techniques that can help address this question. For example, Infrastructure Australia[28] identify three common approaches:

1. Cost–benefit analysis (CBA) / Benefit-Cost Analysis (BCA)

This seeks to systematically measure the costs and benefits of each option over time from the perspective of the Australian community. Costs and benefits are typically expressed in dollars for comparison. CBA can be undertaken at different levels of analysis. For example, 'rapid CBA' is often used to support a preliminary/strategic business case, while a 'detailed CBA' is applied for a final business case. Furthermore, CBA can be applied to different levels of scope and different types of interventions. It can be applied to policy and regulation changes, projects and programs.

2. Cost–effectiveness analysis (CEA)

This compares costs against a specified level of service or output. It does not seek to place a value on the outputs, which provide benefits to the community. For example, CEA might indicate a cost for Option A of $3 per kL of additional water supply, while Option B has a cost of $2 per kL of water supply. In this case, as the outputs are the same, Option B is the preferred option as it is more cost effective. CEA should only be used when the size or value

[28] https://www.infrastructureaustralia.gov.au/sites/default/files/2019-06/infrastructure_australia_assessment_framework_2018.pdf

of benefits do not differentiate between the options. This is essentially a 'least cost' approach for the same output. If there are differential benefits between options, then CBA should be used.

In practice, CEA is rarely applied for infrastructure projects, with the exception of projects in very small communities.

3. Multi-criteria analysis (MCA)

This differentiates and evaluates options using a set of identified assessment criteria with weights assigned to each criterion. The analysis involves subjectively scoring each option against each criterion and calculating a weighted score.

BCA is the most widely accepted of the above approaches by government and infrastructure agencies around Australia and globally.

However, completing a full BCA can be a significant undertaking. Where the number of options is large, data or time are limited, other methodologies may help. Infrastructure Australia supports using less costly methods to narrow a large range of options ('the long-list') and then using more resource intensive, but robust methods for a smaller range of options ('the short-list').

The CRC WSC has developed a 'Rough BCA' approach that can act as a screening process.[29]

A key issue for **all methodologies** is that they need to be developed through an inclusive and transparent process (no black boxes) which includes appropriate sensitivity testing (discussed below). An inclusive process can:

- Build shared understanding of project objectives key assumptions
- Reveal additional information
- Identify areas for further investigation for shortlisted options
- Build support for project funding and delivery
- Better manage uncertainty and risk and manage stakeholder expectations.

Pannell (2020)[30] notes that good decision making typically acknowledges the following key principles:

Objective focused – Decisions should meet clear, measurable and prioritised objectives.

Effective – Chosen options should make a difference and be effective.

Efficient use of resources – Chosen options should deliver objectives most cost-effectively.

Avoids adverse side effects – Decision makers should avoid options that adversely impact or increase the vulnerability of other systems, sectors or social groups.

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[29] https://watersensitivecities.org.au/content/inffews-rough-bca-tool/

[30] https://watersensitivecities.org.au/content/benefit-cost-analysis-and-strategic-decision-making-for-water-sensitive-cities/

Adaptive – Chosen options should encourage adaptation strategies that are flexible and reversible or modifiable.

Relevant – Decision makers should use data, methods, criteria and assumptions that are appropriate and meet stakeholders' expectations and requirements.

Complete – Decision makers should consider all direct and indirect benefits and costs, and all winners and losers. They should also consider a wide range of options.

Consistent – Data, methods, criteria and assumptions should allow for meaningful and valid comparisons with similar decisions.

Consultation – Decision makers should undertake meaningful consultation and engagement, so that decisions reflect stakeholder and community values and preferences. The level of engagement should reflect the significance of the decision.

Collaborative – Decisions should be collaborative, involving close cooperation with other relevant decision makers.

Transparent – Analysis should provide clear and sufficient information for reviewers to assess the decision's credibility and reliability.

Compliant – Decisions should comply with relevant national and state legislation, policies and guidelines.

The concept behind BCA is simple: compare the benefits of a project or policy with its costs to assess whether it has value. A BCA "is primarily about organising available information in a logical and methodical way".[31]

However, putting this simple idea into practice can be challenging and involves collecting and integrating many types of information. The CRC WSC have developed a range of tools, guidelines and case studies to support the practical application of BCA to IWM projects[32].

UNDERTAKING A CBA

An essential first step for any BCA is clearly understanding 'business as usual' baseline information and defining the base case. The base case is the 'without' project scenario, and the benefits 'with' the project are measured relative to the benefits 'without' the project. Importantly, comparing values 'with' and 'without' the project is not the same as comparing values 'before' and 'after' the project. For example, an environmental asset may degrade without the project, but the project would improve its condition, relative to its current condition (see Figure 25 below).

[31] New Zealand Government Treasury, *Guide to Social Cost Benefit Analysis*, New Zealand, 2015, p. 6.

[32] https://watersensitivecities.org.au/content/project-irp2/

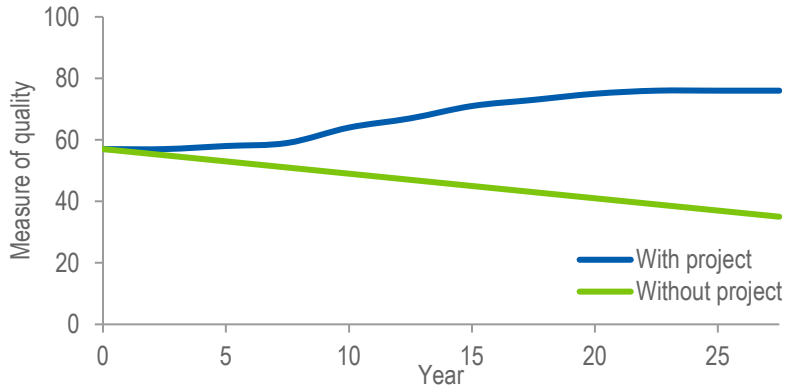

Figure 25. Estimating values 'with' vs 'without' the project, when the project turns a predicted decline in value into a rise. Source: CRC WSC.

On the other hand, a project that superficially appears to generate large benefits may actually not do so, because those benefits would have been generated even without the project. In other words, the benefits are not additional to what would have happened anyway. The without-project trajectory for benefits would be almost the same as the with-project trajectory, so the difference between them, and hence the benefits of the project would be small (see Figure 26).

For example, an analysis of a cleaner production program may include a forecast of large reductions in wastewater discharges but if a local major industry is already planning to close then the additional benefits of the program may be a small proportion of the total reduction. The program may still deliver a net benefit but this conclusion should be based on comparing the additional benefits with the additional costs.

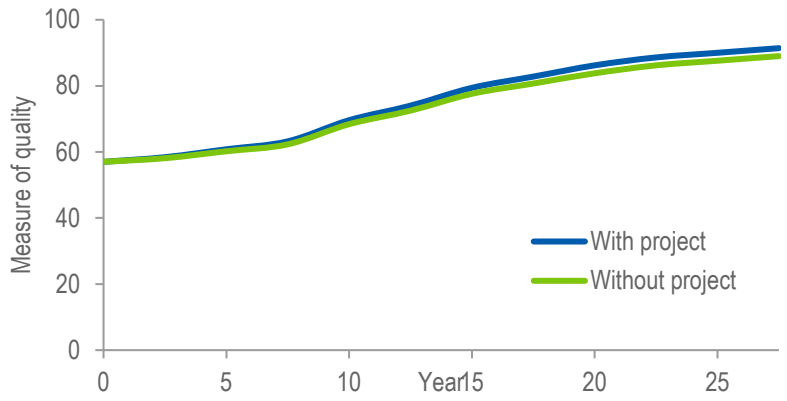

Figure 26. Estimating values 'with' vs 'without' the project, when values would increase even without the project. Source: CRC WSC.

The ‘with versus without’ principle is possibly most important idea behind BCA. Applying it incorrectly results in worthless BCA results. The benefit of a project is the change in values generated as a result of the project only. It is the difference between welfare with the project and without the project.

Usually, a project is evaluated before it is implemented, so the results have to be predicted for both scenarios (with and without the project). Either set of results cannot be observed because they are in two different hypothetical futures.

Because of the 'with versus without' principle, a project can generate benefits even if it does not completely prevent a decline in values (such as environmental degradation). As long as it slows or reduces degradation, this is measured as a benefit.

Making good predictions about the 'without-project' scenario can be difficult, and needs good knowledge of the issue, the context, the proposed management practices and the people whose behaviour matters. Inaccurate or insufficient thinking about the "without" scenario exaggerates the estimates of benefits.

The CRC WSC BCA Tool User Guide includes a checklist of issues to consider when thinking about the with- and without-project scenarios.

QUANTIFY BENEFITS AND COSTS

IWM projects can deliver a range of benefits, which can vary significantly over time and from one context to the next.

Using BCA to identifying the best IWM option involves presenting as many benefits and costs in monetary terms (or monetary-equivalent terms) as possible.

IWM projects can provide tangible effects that are easily quantifiable (e.g. deferral of centralised water supply system infrastructure augmentation, avoided pumping and treatment costs, additional biogas or hydro electric energy generation that can be sold into the grid).

However, they also produce intangible effects that can be difficult to quantify and monetise (e.g. the amenity benefits of having access to public green space). Due to the fact that they are difficult to quantify and monetise, these intangible benefits are often not included in formal economic and financial assessments of project value.

Intangible benefits and costs can sometimes be valued through pre-existing markets, such as markets for houses, however this is not always the case.

Non-market benefits are generated by goods that are not bought and sold in markets. Some benefits have both market and non-market aspects (e.g. improved health and recreation). The absence of information about market prices, and changes in supply and demand as price changes make it more difficult to monetise these benefits. Some non-market values are 'non-excludable goods' (e.g. lower ambient temperatures in a region as a result of urban greening); it is not possible to charge a price, so there is no market for them.

Some non-market goods relate to externalities—impacts on third parties who are not involved in the economic activity that generates the externalities. The downstream flooding impacts of forested catchment clearing is one example. There may not be a market in flood abatement because of high transaction costs of negotiating between those benefiting from catchment deforestation and victims, for example, or because of the absence of well-defined rights (such as a public right to flood protection).

Estimating the non-market benefits of a project requires two types of information:

1. **The additional quantity of the benefit that results from the project**

This information may come from technical experts (such as scientists and engineers), or from community members (e.g. through a survey or focus group). The appropriate technical experts will vary depending on the benefit: estimating improvements in biodiversity may need input from ecologists, estimating reduced morbidity may need input from public health researchers, and estimating increased vegetation may need input from plant scientists.

2. The monetary-equivalent value of that additional quantity of the benefit

Placing a monetary-equivalent value on the benefits is often challenging. There are several well-tested techniques for monetising non-market values. Ideally, it involves conducting a primary non-market valuation study.

Figure 27 summarises some of the different primary research methodologies. These studies can be both expensive and time consuming but may be justified for very large projects or where the consequences of a poor choice are significant.

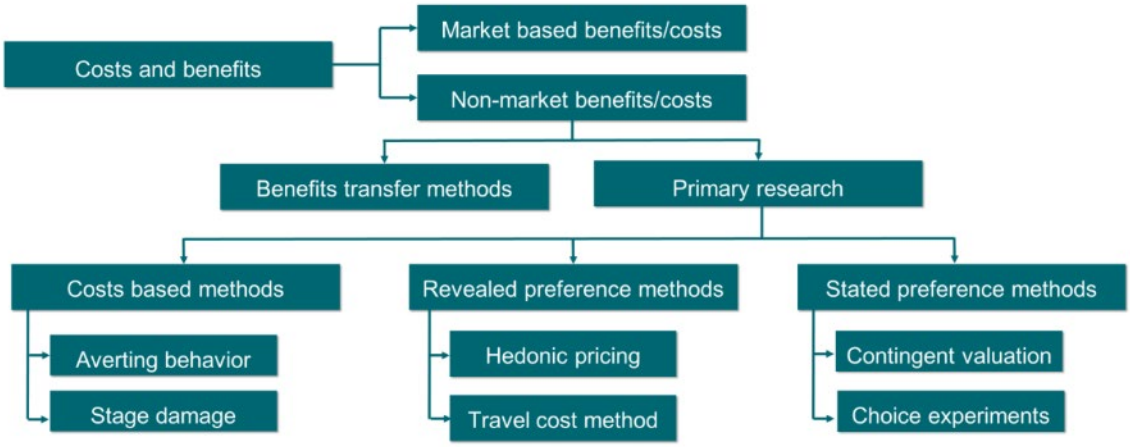

Figure 27. Example methodologies for valuing costs and benefits. Source: CRC WSC.

See the CRC WSC BCA Tool User Guide for more details of this methodology (CRC WSC 2020).

An alternative is to apply the benefit transfer method, to reasonably approximate the non-market benefits associated with the proposed investment. This approach can also be used as part of an initial assessment of options or for decisions where the size or risks of the investment decision are low.

The CRC's Investment Framework for Economics of Water Sensitive Cities (INFFEWS) Value Tool uses a database of values drawn from other studies to generate monetary values for non-market benefits. Guidelines explain how to conduct benefit transfer, including how to choose appropriate adjustment methods when relevant.

IDENTIFY WHO BENEFITS AND WHO BEARS THE COSTS OVER TIME

Benefit cost analysis can provide insights into the most efficient means of achieving an outcome from a whole of community perspective. It can also provide transparency around

the distribution of costs and benefits among different stakeholders but it cannot judge whether that distribution is fair.

As outlined by the Australian Government: the costs and benefits to all people are added without regard to the individuals to whom they accrue: a $1 gain to one person cancels a $1 loss to another. This 'a dollar is a dollar' assumption enables resource allocation to be separated from distribution effects—or efficiency from equity effects. That does not mean that distributional considerations are unimportant or should be neglected. It means that they should be brought into account as a separate part of the overall analysis of the proposal in question (Office of Best Practice Regulation, 2020, p. 5). That said, distributional effects are often relevant to consideration of who should pay for the project and over what timeframe.

Once the best for community outcome is established through the BCA, a range of factors can be accounted for in working through any distributional issues including:

Beneficiary pays – When beneficiaries can be identified, and ideally the benefits can be quantified, the beneficiary pays principle may be an appropriate basis for sharing the costs of the interventions (e.g. the downstream residents of a new dam providing them flood protection, hydroelectricity and water for drinking and industry).

Polluter pays – When the issue being addressed by the project is largely attributable to a particular action or event (e.g. land clearing causing downstream flooding or water quality issues) by a party, it may also be appropriate that they contribute to the mitigation and management of that issue.

Intergenerational equity – Large structural IWM investments often involve significant upfront capital investment but deliver benefits over many years. For example, the useful life of a well maintained levee or dam could be greater than 100 years. Consequently, smoothing the funding of these construction costs over the life of the asset better aligns these costs with the beneficiaries.

Capacity to pay – Levels of wealth and disposable income can vary significantly across a community, yet for public goods in particular, each should contribute according to their means. This principle is sometimes used as a secondary guide. For example, beneficiary pays might be adopted subject to people being able to pay for their share of the benefits. Determining who can pay and how much they should pay can be a sensitive issue.

The INFFEWS BCA Tool can provide a starting point for funding discussions, using the information provided in the Stakeholder Sheet. This sheet breaks down the benefits, for each benefit type, across the lead organisation and up to eight other stakeholders. It shows the aggregate present values of benefits and costs, and the net present value for each group. In this way, it provides a first pass of who received the benefits and who incurs the costs of the project relative to a do-nothing scenario.

DISCOUNTING FUTURE BENEFITS AND COSTS

Discounting ensures that the costs and benefits of the project over the full lifecycle are assessed using their present values. It reflects the opportunity cost of investing in a particular project.

The discount rate used in project evaluations should reflect the risk profile associated with the project. There are many ways of estimating the discount rate. Ultimately, no single discount rate can precisely meet the characteristics of every public sector project. It is therefore important to sensitivity test results.

COMPUTING DECISION METRICS (E.G. BENEFIT COST RATIO)

BCA is not fundamentally different from what decision makers in the water sector already do – they weigh up the pros and cons and try to identify which choices will deliver the best outcomes. The difference is that, compared with the sort of subjective decision making that we all do, BCA if done well is more systematic, transparent, balanced, evidence-based and consistent with important principles that do not necessarily come naturally to people. This is not to say that BCAs necessarily include all relevant information.

The INFFEWS BCA Tool and INFFEWS Value Tool help users to express many non-market values in monetary-equivalent terms, but there may be considerations that cannot be factored in, such as certain social, administrative or political factors. Even so, BCA can be extremely useful in establishing which choices would best deliver particular outcomes.

Ranking projects using BCA is the recommended first step, after which any adjustments can be made. The advantage of this approach is that the cost of making adjustments for social, administrative or political reasons becomes transparent. There are two main criteria used in BCAs to evaluate and rank options, the Net Present Value (NPV) and the Benefit: Cost Ratio (BCR). The NPV is simply the difference between the aggregate benefits and the aggregate costs (after they have been discounted to express them in present value terms). The BCR uses the same information, but expresses it as a ratio rather than a difference: the aggregate benefits are divided by the aggregate costs.

There are two factors to consider when deciding whether to use NPV or BCR to evaluate projects. One is whether there is a limited amount of money available to allocate to projects (there almost always is limited funds), and the other is whether the projects being compared are mutually exclusive. Sometimes you wish to compare different versions of the same project (e.g. at different scales, or using slightly different sets of actions). These projects are mutually exclusive – you can select only one of them. A rule of thumb for selecting the best of these projects is to choose the one with the largest NPV that can be afforded within the available budget (if comparing multiple versions of multiple projects, things are trickier. See the INFFEWS BCA Tool Guidelines for advice).

ADDRESSING UNCERTAINTY, INCLUDING SENSITIVITY ANALYSIS

Sensitivity analysis is the formal term for ‘what if’ analysis, and is a strength of economic models. The benefit and cost estimates used in any BCA are uncertain, and factors affecting those estimates will likely vary over time. So, sensitivity analysis can be used to get useful information and insights from the analysis. The possible uses of sensitivity analysis include:

Testing the robustness of an optimal solution – Sensitivity analysis can test the stability of results. For realistic changes in the parameters, how widely do the results — NPV and BCR change?

Identifying sensitive or important variables – By comparing the sensitivity analysis results for different individual variables, the analyst can determine which variables have the biggest influence on results. The analyst can then focus on those variables, and collect the best available data about them.

Identifying critical values, thresholds or break-even values – Sensitivity analysis can help answer questions about how much a variable can change before it affects the outcomes of a BCA (for example changing the results from favourable (BCR > 1) to unfavourable (BCR < 1)). It is particularly useful for assessing whether the threshold value of the variable (the point at which the BCA result changes) falls within a range of reasonable values. A break-even value within the reasonable range may justify collecting additional information to predict the variable's actual value.

Making recommendations more credible, understandable, compelling or persuasive – Decision makers can use sensitivity analysis to judge how much faith they can place in the BCA results. A BCR greater than one in almost all cases despite wide variations in the assumptions provides confidence in supporting the project. Similarly, a BCR less than one in almost all cases provides confidence in rejecting the project.[33]

[33] Pannell DJ, 1997. Sensitivity analysis of normative economic models: theoretical framework and practical strategies. *Agricultural Economics* 16: 2.

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i Water service systems are defined as the systems that deliver water, wastewater and drainage services, including infrastructure assets, green and blue infrastructure, governance frameworks, policy and regulation.