



Water Sensitive Cities Benchmarking and Assessment

Shire of Mundaring, WA

urbaqua



CRC for
Water Sensitive Cities

Document Title

Water Sensitive Cities Benchmarking and Assessment: Shire of Mundaring

Authors

Shelley Shepherd and Helen Brookes

Urbaqua

Suite 4/225 Carr Place, Leederville 6007

p: 08 9328 4663 | f: 08 6316 1431

e: info@urbaqua.org.au

www.urbaqua.org.au

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1 Introduction

*Water sensitive cities are resilient, liveable, productive and sustainable. They interact with the urban hydrological cycle in ways that: provide water security for economic prosperity through efficient use of diverse water resources; enhance and protect the health of watercourses and wetlands; mitigate flood risk and damage; and create public spaces that harvest, clean and recycle water. Its strategies and systems for water management contribute to biodiversity, community health and wellbeing, carbon sequestration and reduction of urban heat island effects.*¹

The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) is an Australian research centre that brings together many disciplines, world-renowned subject matter experts, and industry thought leaders to revolutionise urban water management in Australia and overseas.

As cities develop, the provision of water services is considered to respond to a range of drivers, creating solutions to the need for water supply, public health and flood protection. As awareness increases around the need for social amenity and ecological protection as well as a sustainable water supply, the solutions become more complex and the journey towards a resilient, adaptive and liveable city - the water sensitive city (WSC), is challenging.

The CRCWSC has developed a tool driven by the best research to understand how far towards WSC places are, so they can take steps and track progress toward that goal. Communities expect efficient,

water-supported, vibrant cities and this is a great way to see how we are doing in delivering those outcomes.

Through the planning and delivery of a WSC conceptual framework, urban areas can exploit the synergies between local water management and urban greening while creating resilient and liveable neighbourhoods. This is achieved by strengthening governance arrangements, building community capital, and investing in multifunctional adaptive infrastructure. This is complimented by the provision of high quality and connected open spaces, protecting and enhancing the ecological values of the urban landscape, providing a diversity of water supply options and recreating a more natural water cycle that restores soil moisture while reducing stormwater runoff.

The purpose of the WSC Index is to guide governments and organisations to transition cities into liveable, resilient, sustainable and productive places through water related actions. The WSC Index aims to:

- provide a communication tool for describing key attributes of a Water Sensitive City.
- articulate a shared set of goals of a Water Sensitive City.
- provide benchmarking for a city's water-sensitive performance.
- measure the progress and direction towards achieving Water Sensitive City goals.

¹ <http://watersensitivecities.org.au/>

- assist decision-makers to prioritise actions, define responsibility and foster accountability for water-related practices.

The WSC Index Tool has undergone multiple development phases including a co-design process with industry partners. Its application relies on cross-organisational knowledge sharing and collaboration that strengthens broader industry relationships to deliver commitment to action.

2 WSC Index Tool

The WSC Index Tool identifies all the key components (indicators) of a Water Sensitive City. The Tool covers 7 goals and assesses 34 indicators that represent important attributes of a Water Sensitive City. It is designed to benchmark cities based on water sensitivity performance and provides users with the capacity to monitor and evaluate potential management actions against performance to make the most impact with available resources. It enables users to explore measures that deliver improvements in liveability, sustainability, resilience and productivity.

A summary of the goals and indicators of the WSC Index Tool is presented in Figure 2.

A full day benchmarking workshop was held at the Shire of Mundaring Administration Offices on 17th May, 2018. Participants included internal stakeholders from a range of Shire departmental units and external stakeholders operating within the boundaries of the Shire. A list of participants is contained in Appendix 1. This report summarises the outcomes of the benchmarking workshop.

It is anticipated that subsequent benchmarking will be undertaken every regularly in order to track progress and achievements.

2.1 Process for Rating Indicators

A three-step method for scoring each indicator was used:

1. Live polling to gauge individual participants' perspectives on the score for the indicator in question;

2. Interactive discussion to uncover evidence and justification to inform the indicator's score; and
3. Reach consensus amongst the participants on the score to be assigned and level of confidence in that score.

The live polling used the CRCWSC Index web-based tool which is accessed by individual participants through their mobile devices to rate the indicator from 1 to 5. The collective results were shown in real-time to the group. The results were discussed, with evidence identified (e.g. policy documents, organisational materials, expert views, etc.) before reaching consensus on a given rating and level of confidence.



Figure 1: Shire of Mundaring benchmarking workshop

Index goal areas and supporting indicators

Ensure good water sensitive governance	Increase community capital	Achieve equity of essential services	Improve productivity and resource efficiency	Promote adaptive infrastructure	Improve ecological health	Ensure quality urban space
Knowledge, skills and organisational capacity	Water literacy	Equitable access to safe and secure water supply	Maximised resource recovery	Diversify self-sufficient fit-for-purpose water supply	Healthy and biodiverse habitat	Activating connected urban green and blue space
Water is key element in city planning and design	Connection with water	Equitable access to safe and reliable sanitation	Low GHG emission in water sector	Multi-functional water infrastructure	Surface water quality and flows	Urban elements functioning to mitigate heat impacts
Sound institutional arrangements and processes	Shared ownership, management and responsibility of water assets	Equitable access to flood protection	Water-related business opportunities	Integration and intelligent control	Groundwater quality and replenishment	Vegetation coverage
Public engagement, participation and transparency	Community preparedness and response to extreme events	Equitable and affordable access to amenity values of water-related assets	Low end-user potable water demand	Robust infrastructure	Protect existing areas of high ecological value	
Leadership, long-term vision and commitment	Indigenous involvement in water planning		Benefits across other sectors because of water-related services	Infrastructure and ownership at multiple scales		
Water resourcing and funding to deliver broad societal value				Adequate maintenance		
Equitable representation of perspectives						

Figure 2: Summary of goals and indicators

3 Evaluation of Performance

Three analytical frameworks support interpretation of the index scores and provide insight into the management responses that should be prioritised to advance practice. These are (1) city state benchmarking, (2) water sensitive goals, and (3) water sensitive practices and outcomes.

3.1 City State Benchmarking

The Urban Water Transitions Framework (Figure 3, Brown et al. 2009) considers the drivers and service delivery functions for water infrastructure provision in cities as six developmental states that cities move through in response to society’s expanding objectives for urban water management. Although the transition from one state to the next is not always linear, the progression of water service delivery options can be driven towards the ultimate state that is a water sensitive city. The idealised city-states in the Urban Water Transitions Framework are associated with particular indicator scores. This enables an assessment of how far a city has progressed towards the water sensitive city state.

Figure 4 summarises the city state benchmarking results for the Shire of Mundaring. Percentage attainment for each city state ranged from 100% as a Supply City, Sewered City and Drained City down to 9 % as a Water Sensitive City. This section summarises the key elements that contribute to the overall percentage attainment of each city state.

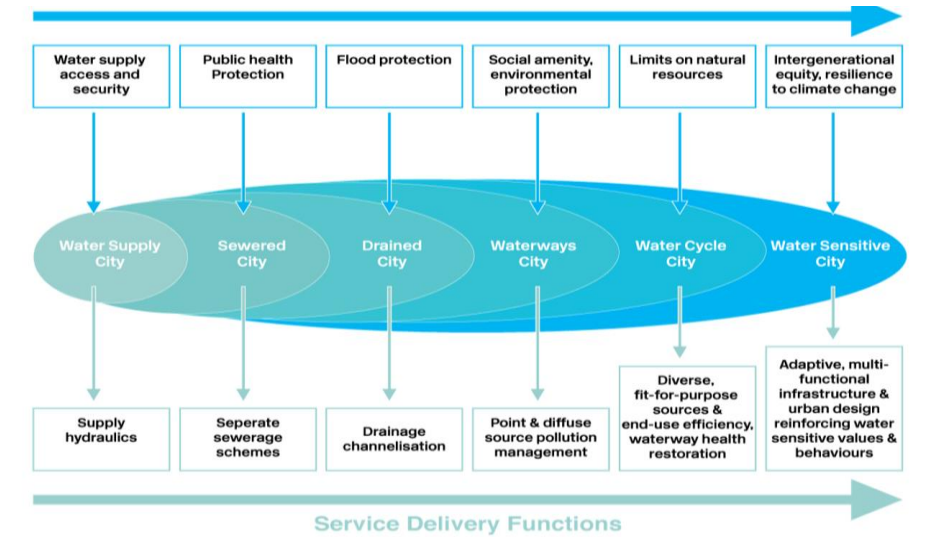


Figure 3: Urban water transitions framework

100% attainment of water supply city and sewered city

The Shire rated 100 % as a water supply city and 100 % as a sewered city. The entire community has equitable access to safe and secure drinking water, either through access to the Water Corporation’s Integrated Water Supply Scheme or via rainwater tanks. Water is affordable, and the Water Corporation has a number of programs to assist the community in the payment of water bills.

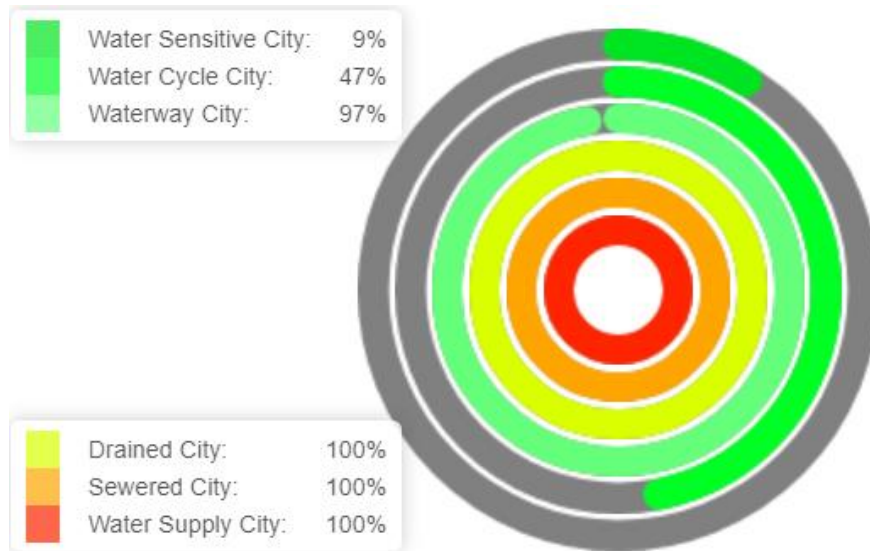


Figure 4: Benchmarking results for Shire of Mundaring

Similarly, the community has access to safe and reliable sanitation. Although urban areas of the Shire are connected to reticulated sewerage, many properties utilise on-site disposal of wastewater. The Shire is responsible for approving most household-scale onsite-wastewater disposal systems and has an audit program in place to ensure alternative treatment units are adequately serviced by homeowners.

100% attainment of drained city

The municipality rated 100% as a drained city. Rainfall events generally do not disrupt everyday activities. Catchments are designed to allow flood events (1% Annual Exceedance Probability events) to occur with

minimal disruption. Flood prone areas, which are largely only located at the bottom of the Scarp, are recognised via a Special Control Area in the Shire's local planning scheme. This ensures the floor height of new habitable buildings are set at a level that places them above the adopted flood level, protecting the community against flood risks.

97% attainment of waterway city

The Shire rated 97% as a waterway city. The Shire of Mundaring has a wide variety of natural water assets including drinking water catchments and healthy wetlands and rivers. Areas of native vegetation, waterways and wetlands provide significant biodiversity and habitat values, as well as cultural and social benefits to the community.

Key features in the Shire are Mundaring Weir, Helena River, Jane Brook and Lake Leschenaultia. These assets, together with the numerous local waterways that traverse the Shire are valued significantly by the community. A number of catchment groups have a long and active history of working with the Shire to advocate for and actively restore local waterway catchments, recognising the need to maintain habitat values together with water quality management and flood protection.

The Shire recognises the value of the environment and water resources, identifying the desire for the community to manage water sustainably as one of its priorities (Strategic Community Plan 2016-2026). The Shire has a progressive planning scheme which drives environmental outcomes and the planning system recognises the importance of water sensitive urban design. The Shire and water

agencies in the region have formed multi-disciplinary teams work to deliver outcomes in many areas.

The Shire is a participant of the EMRC's Water Quality and Conservation program to aid in reducing water consumption. They are also a previous participant in ICLEI's Water Campaign, however, the Shire's consumption per capita for community water use is currently at ~297 L/person/day (2016/2017). The Shire has retrofitted water efficient appliances in buildings with a minimum of 3 Wels Stars. The Shire of Mundaring was endorsed as a Waterwise Council in 2015.

47% attainment of water cycle city

The Shire rated 47% as a water cycle city. The water supply and sanitation systems incorporate both centralised services provided by Water Corporation and decentralised solutions which include rainwater tanks and on-site management of wastewater. All systems are adequately managed so that discharges to the environment do not pose a public health risk. There is some use of groundwater for local irrigation of green space where this is available. The Mundaring Waste Water Treatment Plant supplies some treated water to Harry Riseborough Oval.

Within urban areas and townsites, blue and green assets are well-connected via walk trails and cycle paths. Although new urban areas are required to implement water sensitive urban design principles, there has been some difficulty in translating these into a hills environment.

The community have a strong connection with water, understanding the relationship between the water catchments area and Mundaring

Weir, as well as the importance of self-supply where scheme water is not available. The history of Mundaring Weir and the C.Y. O'Connor pipeline form an important element of the Shire's tourism appeal.

9% attainment of water sensitive city

The Shire rated 9% as a water sensitive city. This is largely associated with the degree of equity of essential services for water supply, which is accessible to everyone, safe, secure and affordable. The cost of water supply is less for low income earners through discounted bills.

3.2 Water Sensitive Goals

There are 7 overarching WSC goals. They are:

1. Ensure good water sensitive governance
2. Increase community capital
3. Achieve equity of essential services
4. Improve productivity and resource efficiency
5. Improve ecological health
6. Ensure quality urban space
7. Promote adaptive infrastructure.

As noted in Section 2, each goal is broken down into a number of indicators (Figure 2). Results of the rating of each indicator are summarised and compared against each goal to provide insight into the Shire's key areas of strength and where improvements could be made.

Figure 5 summarises the performance of the Shire of Mundaring against the 7 goals of a Water Sensitive City. The results for the Shire (shown by the shaded light blue area) are compared to an idealised Water Cycle City (shown by the dashed dark green line).

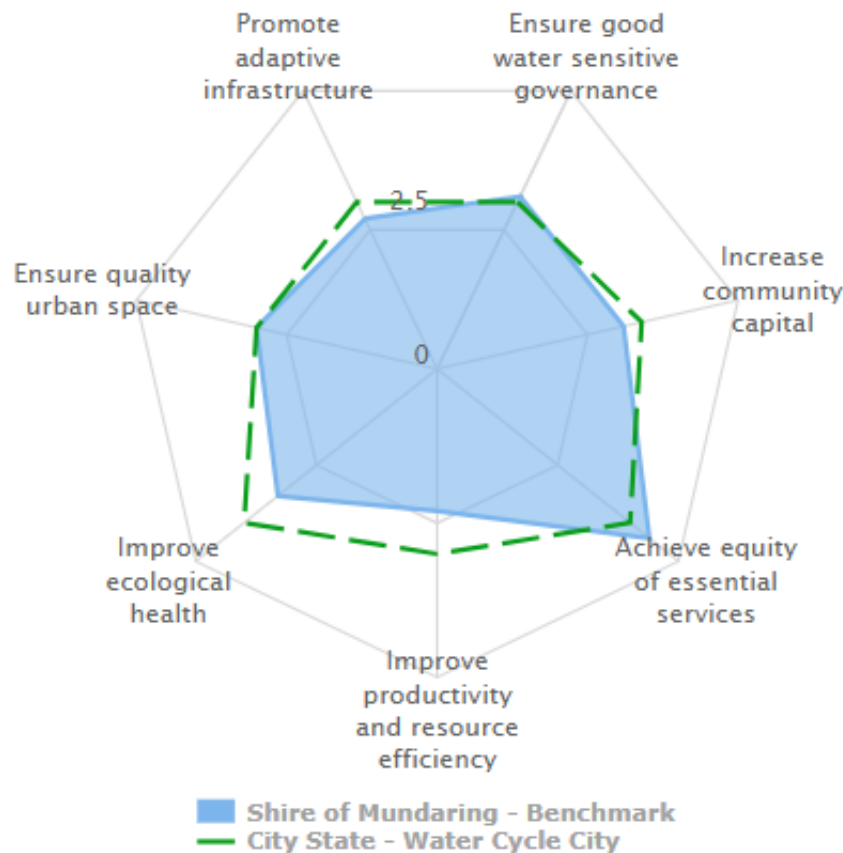


Figure 5: Performance against water sensitive goals

The Shire met or exceeded the Water Cycle City benchmark for the goals of water sensitive governance and quality urban space. For the goal of equity of essential services, the results are nearing the Water Sensitive City benchmark.

A deficit in attaining key attributes of a Water Cycle City is most evident across the goals to improve productivity and resource efficiency and ecological health. A small shortfall is evident for the goals to increase community capital and promote adaptive infrastructure.

An overview of the indicators that fall short of the attributes for a Water Cycle City is presented below. It is considered that these deficiencies provide the most effective opportunities to progress the Shire’s transition towards a Water Sensitive City.

Additional detail regarding the scores for the remaining goals and indicators is contained in Appendices 2 and 3. This should be used to assist in future benchmarking workshops and to track progress.

Goal 2 – Increase community capital

Indicator: Water literacy (3.0)

People in Mundaring have some interest and a general understanding of the water cycle. They generally understand that Mundaring Weir is associated with the water supplies for Perth and the Goldfields, but the complexity of sources and storage is unlikely to be broadly known. Many residents on larger lots are responsible for self-supply and management of wastewater on their own property; however, there is

a lack of understanding of stormwater and linkages between drains and creeks. Knowledge of groundwater could also be improved.

There is a need to improve water literacy across the community. Improved literacy is the precursor to community understanding and involvement in the planning, ownership and management of water related assets (both natural and constructed). This will also strengthen the understandings around water's contribution to liveability through contributing to greener, cooler and more pleasant urban spaces.

Indicator: Shared ownership, management and responsibility of water assets (2.5)

Particularly where scheme water and sewer are not available, households and communities have an acknowledged role in the ownership and management of local water management solutions. This includes use of rainwater tanks and bores for potable supply, and on-site wastewater devices such as septic tanks and alternative treatment units. The Shire has an effective system for monitoring the maintenance of alternative treatment units, but there are no requirements for monitoring of rainwater tanks, backyard bores or septic tanks. Few bores require licencing from the Department of Water and Environmental Regulation.

Where the community is connected to central water and wastewater infrastructure, the management and responsibility for these assets is with formal water governance organisations (Water Corporation).

There is some community responsibility for managing stormwater in creeks with well-known values (such as Jane Brook, Helena River, Susannah Brook); however, there is limited understanding of the

shared responsibility for drainage which crosses private properties. This is linked to the low water literacy with regards to stormwater management.

Goal 4 – Improve productivity and resource efficiency

Indicator: Water-related economic and commercial activities (2.5)

There is generally poor understanding of the potential for water-related economic and commercial activity in the Shire. There is some tourism and recreation industry activity associated with Lake Leschenaultia, Mundaring Weir, the Golden Pipeline and watercourses in the Shire. There is also some limited economic activity related to native and waterwise landscaping.

There are opportunities to foster new and expanded economic opportunities related to improved landowner water management. This may include installation of water-sensitive on-site wastewater treatment systems, stormwater harvesting systems, greywater recycling systems and groundwater bores.

Indicator: Low GHG emission in water sector (2.0)

Greenhouse gas (GHG) emissions in the water sector are known to be high for the Water Corporations activities. This predominantly results from high energy requirements for conveyance and treatment of drinking water and wastewater. GHG emissions for water sector activities are not currently measured by the Shire.

The Water Corporation are currently developing a Water Sensitive Cities Strategy which will include consideration of energy supply

strategies to reduce GHG emissions as well as strategies for increased resource recovery. The Shire is developing an Energy and Emissions Reduction Plan/Strategy that includes reducing emissions within the Shire's parks and reserves from irrigation and bore use.

Indicator: Maximised resource recovery (2.0)

There is limited resource recovery in the Shire currently. Some irrigation with treated wastewater is undertaken from Mundaring Wastewater Treatment Plant. Rainwater tanks are in common use by private landowners in the Shire where connection to scheme water supply is not possible.

The most significant opportunity to improve resource recovery in the Shire would be through increased use of treated wastewater for irrigation of public open space.

Goal 5 – Improve ecological health

Indicator: Healthy and biodiverse habitat (3.0)

The Shire is recognised as an area of outstanding natural beauty and has a high level of biodiversity in its terrestrial ecosystems. There is limited understanding of the level of biodiversity in the Shire's aquatic ecosystems, but some evidence exists to suggest that aquatic biodiversity has declined.

There is a need to improve understanding of biodiversity in aquatic ecosystems through increased monitoring and reporting. This information can then be applied to determine necessary actions to improve biodiversity.

Indicator: Surface water quality and flows (3.0)

Erosion and sediment mobilisation are noted as key issues for surface water quality resulting from uncontrolled surface water flows, particularly from newly developed and steep catchments. The Shire have been engaging with community groups and schools to establish riffles and riparian and instream vegetation along some natural watercourses. There is substantial open drainage infrastructure in the Shire which is generally maintained to be free of obstruction and vegetation.

There is a need to recognise the connections between constructed drainage assets and natural water systems. Design of new and retrofitted drainage systems should consider and mimic the natural hydrology of the Shire to incorporate flow and sediment control strategies such as riffles and riparian and instream vegetation.

Indicator: Groundwater quality and replenishment (2.5)

Groundwater is present in three predominant forms in the Shire: as well-defined layers in Swan Coastal Plain parts of the Shire, in small perched alluvial aquifers confined to valley floors in the hills, and in rock fissures and fractures. Use of the Swan Coastal Plain aquifers is controlled through licensing by the Department of Water and Environmental Regulation, whilst groundwater use in the hills is not licensed or managed. Declining groundwater levels in the hills caused by over-extraction is a common issue that is exacerbated by poor community understanding of the interconnected nature of groundwater systems. The extent of groundwater quality impacts from on-site wastewater treatment systems are poorly understood and

potentially significant because of poor maintenance and infrequent inspection.

Active management and licensing of aquifers present in the hills is complex and may not be realistic. There is however a need to improve community understanding of the nature of groundwater systems and to promote more responsible and responsive management by landowners and communities. There is also an acknowledged need to improve people's management of their on-site wastewater systems through increased awareness of inspection and maintenance requirements.

Goal 7 – Promote adaptive infrastructure

Indicator: Diverse fit-for-purpose water supply system (3.0)

The Water Corporation supplies the majority of the Shire's population through the Integrated Water Supply Scheme, which is a single centralised system incorporating multiple water sources. There is a moderate degree of self-supply with rainwater tanks and groundwater bores although this is generally confined to areas where there is no access to scheme water.

Long-term sustainable management of self-supply strategies are a concern in the Shire and there is a need to improve inspection and maintenance procedures. New developments in areas without access to centralised water supply may need to consider alternative servicing arrangements in future.

Indicator: Multi-functional water system infrastructure (2.0)

Some opportunities for recreation and tourism access to water supply catchments and Mundaring Weir have been realised but are strictly limited by risk management requirements. Drainage infrastructure is typically single-function and may be fenced to prevent access.

There is a need to consider alternative approaches to drainage design in steep catchments that can facilitate multi-functional outcomes. There is significant potential for water related assets such as Mundaring Weir, the Golden Pipeline and watercourses throughout the Shire to be a focal point for educational activity to improve community understanding and appreciation of these vital assets.

Indicator: Integration and intelligent control (2.0)

There is limited intelligent monitoring of water systems including most notably at Mundaring Water Treatment Plant and Mundaring Weir, although most controls retain some manual intervention requirements. Some Shire irrigation assets include some degree of intelligent monitoring but are generally manually controlled.

The Shire has a current program of upgrades to groundwater bores and installation of smart metering that could consider adoption of a greater level of integration and intelligent control.

3.3 Water Sensitive Outcomes and Practices

The WSC Index Tool can filter results based on WSC Outcomes and WSC Practices.

Water sensitive outcomes

Water sensitive outcomes assesses the performance of the urban water system against the delivery of resilience, liveability, sustainability and productivity.

Resilience in this context is defined as the capacity to maintain water system services under acute or chronic disturbances, through adaptation or recovery. Sustainability is the capacity of water system services to deliver benefits for current and future generations. Liveability is the capacity of the water system to deliver a high quality of life for communities (such as thermal comfort, aesthetics, amenity, connection to place, etc.). Productivity is the capacity of the water system services to generate economic value.

The ratings from each indicator can contribute to one or more of these outcomes. For example, improving the rating for the indicator ‘diversify self-sufficient fit-for-purpose water supply’ related to provision of alternative water supplies would improve both resilience and sustainability outcomes.

The results shown in Figure 6 indicate how the Shire of Mundaring compares to Water Cycle City outcomes (green circle). Liveability outcomes are well-aligned, and resilience is reasonably aligned to the desirable outcomes of a water cycle city. Improvements should be

directed at actions to deliver enhanced productivity and sustainability outcomes for the Shire. Delivering these outcomes is closely linked to improving water sensitive practices.

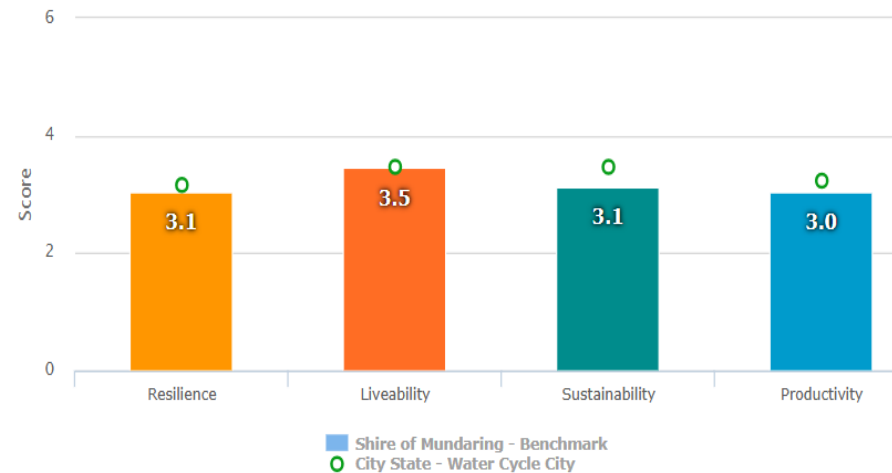


Figure 6: Assessment of water sensitive outcomes (Attainment of Water Sensitive City status requires a score equal to 5)

Water sensitive practices

The three pillars of practice that are essential to deliver water sensitive services (Wong and Brown, 2009) are:

- Water-Sensitive Communities where people engage in water-conscious behaviours, feel connected to their water environments and appreciate the many values of water;
- Cities as Water Supply Catchments to provide resources at different scales in fit-for-purpose applications; and

- Cities providing Ecosystem Services to integrate water sensitive practices into the urban landscape, providing multiple benefits such as heat mitigation, ecological health and landscape amenity.

The results shown in Figure 7 indicate how the Shire of Mundaring compares to Water Cycle City practices (green circle). The strong connection the Shire of Mundaring community have with their water environments and appreciation of the many values of water is demonstrated by the level of Water-Sensitive Communities practice.

Improvements in practice should be directed at enhancing ecosystem services and local benefits of water sensitive infrastructure and opportunities. This may be achieved through creation of local demonstration projects showcasing water sensitive infrastructure that are ecologically functioning landscapes to strengthen the Shire’s resilience against the increasing pressures of climate change.



Figure 7: Assessment of water sensitive practices
(Attainment of Water Sensitive City status requires a score equal to 5)

4 The Shire's Ten Point Plan

A ten-point action plan has been developed for the Shire of Mundaring as a result of its benchmarking. The order of actions listed does not reflect the priority of the actions to be undertaken. Actions are mutually reinforcing and provide an overarching framework to guide initiatives across the Shire to progress closer towards the aspirations of a water sensitive city.

Action 1: Develop a clear Vision for a Water Sensitive Shire of Mundaring

The Shire is supported by a wide range of water-related infrastructure and assets, most notably Mundaring Weir, Lake Leschenaultia and the Helena River. Although these assets underpin the key ecological, economic and social values of the Shire, the true value of water in current and future contexts has yet to be explored or explained in this local context.

The community should be engaged in developing a water sensitive vision and narrative for Mundaring that endorses the productive, liveable, sustainable and resilient water agenda. Explicitly link outcomes to broader community aspirations through the vision's collaborative development.

Action 2: Strengthen integration and collaboration across the Shire

Formalise interdisciplinary discussion and advice through establishing an Integrated Water Management (IWM) team within the Shire.

The purpose of the IUWM team is to work together to broaden knowledge sharing and skills to deliver holistic, water sensitive outcomes. This may include the responsibility to assess strategic plans and larger planning proposals, as well as develop and deliver capital and retrofit projects which optimise multiple outcomes. It will require a strong organisational learning culture which supports project delivery, underpinned by an appropriate risk management approach and development of internal networks through formal and informal activities. Embed a feed-back and review process to facilitate on-going learning and continuous improvement.

Action 3: Build relationships with agencies working within the Shire

Actively engage with infrastructure agencies such as Main Roads WA to share the Water Sensitive Cities vision and highlight points of intersection with work programs. Build understanding of the unintended consequences of current practices and work to develop shared objectives and outcomes. Use the established relationship with the Water Corporation as an example of delivering mutually beneficial outcomes.

Action 4: Require delivery of WSC practices beyond water efficiency

Water sensitive systems deliver multiple benefits to communities (including mitigation of the urban heat island effect, reduced nuisance flooding, improved health and well-being, etc.) and have widespread community appeal. The Shire should develop a water sensitive urban

design policy or guidelines to improve practices and on-ground outcomes.

Improvements in practice should enhance ecosystem services and local benefits of water sensitive infrastructure, such as providing high quality and connected open space networks, which support thriving natural systems or engineered systems that mimic natural processes (such as, systems that use soil and vegetation to infiltrate, evapo-transpire, treat and/or reuse urban runoff). Practices should also address bushfire concerns in townsites and retain native vegetation wherever possible with a managed understory.

Action 5: Ensure future development delivers stormwater management outcomes appropriate to the Hills

Develop guidance on locally appropriate strategies for stormwater management that can facilitate multi-functional outcomes. This should demonstrate how State-level stormwater management criteria should be interpreted to deliver outcomes that are appropriate for hills soils and conditions. This could be achieved through collaboration with other local governments with similar conditions (slope and impermeable soils). The guidance should focus on the principles of conveyance rather than detention, to reflect the natural waterways systems of the Hills rather than the wetland-based systems of the Swan Coastal Plain. Solutions may include establishing riparian vegetation along waterway corridors, rain gardens, tree pits, green roofs and walls, as well as recognising the multiple benefits of urban trees (urban forest principles).

Action 6: Foster community engagement, collaboration and ownership

Undertake a water literacy initiative in collaboration with the Water Corporation and Department of Water and Environmental Regulation to improve community understanding of the urban water cycle and the benefits of green-blue assets, including private water assets such as rainwater tanks. To fully enjoy the benefits of being a water sensitive city, this initiative should seek to create a shared understanding of the necessary changes in practices required to transition towards a water sensitive future beyond traditional water efficiency.

This initiative needs to be directed to all sectors of the community and should empower individuals to make choices that support a water sensitive future. This will ultimately enable the community to become more actively involved in the planning, management and maintenance of water infrastructure owned and operating at a range of scales.

Other critical elements of the program are to:

- Outline inter-disciplinary planning and co-design processes, involving the community.
- Clarify where and how community can make choices and contribute to solutions.
- Foster opportunities for water related economic activity through promotion of improved landowner water management.
- Provide schools-based opportunities to increase community awareness of water system infrastructure in the Shire.

- Provide guidance on responsible/responsive management of self-supply systems; on-site wastewater systems; drainage assets; and groundwater systems at lot-level by landowners.

Action 7: Recognise economic benefit of WSUD

Establish dedicated budgetary arrangements across departments for water sensitive practices (including for the maintenance of infrastructure that delivers multiple benefits to the community). Establish sound institutional arrangements and processes to support policy and make these transparent to the general public.

The incorporation of realistic maintenance costs into Shire budgets will help ensure these assets are adequately maintained and thereby help reduce the future risk and the financial burden associated with rectifying asset failure. The Shire should commence a life cycle costing data base to enable improved planning for maintenance of drainage assets, fit-for-purpose water supply infrastructure and other WSUD assets to assist the Shire to better forecast budgets for management into the future.

Investment decisions should be based on the broader economic, social and environmental benefits and mitigated costs to the future community. A multiple-criteria decision-making model should be used by the Shire to assist in the selection of projects and investment. Efforts should be made to monetise broader water related benefits and costs.

Action 8: Proactively maintain stormwater assets to improve water quality and biodiversity

Identify and prioritise opportunities to enhance water quality and water-related amenity values of drainage assets. This should prioritise areas with known maintenance problems as well as areas accessed by vulnerable sectors of the community. Consideration should be given to opportunities to reconnect patches of bushland, improving public access to healthy waterways and biodiversity corridors. Priority opportunities should be incorporated into open space master plans and other relevant strategic planning documents as they are updated. Provision should be made for aquatic biodiversity monitoring and reporting.

Action 9: Minimise water use across the Shire

Continue to work with the Water Corporation to reduce potable and non-potable water use within the community and across Shire operations. This may include mechanisms to reward households, businesses and public organisations for good water sensitive practices such as extension of verge enhancement programs, community recognition and awards.

Investigate opportunities to expand use of treated wastewater for irrigation and improve integration and intelligent control through upgrades to groundwater bores, irrigation systems and water meters.

Action 10: Consider the water-energy nexus & address GHG emissions

The strong linkage between energy and water means that the delivery of multi-functional water-related outcomes often provides an opportunity to reduce energy consumption as part of water-related projects. Although much of the energy cost of water services in the Shire is dictated by the Water Corporation, some opportunities exist in parts of the community with self-supply systems.

The Shire should also advocate for investment by Water Corporation and other stakeholders in technologies to reduce the energy footprint of the water sector.


In addition, the Shire should identify and implement strategies to reduce GHG emissions associated with water use in Shire facilities and activities.

Appendix 1: List of Workshop Participants

Workshop Facilitators: Shelley Shepherd and Helen Brookes (Urbaqua)

Shire of Mundaring		Industry stakeholders	
Kate Driver	Councillor	Tim Sparks	Department of Water and Environmental Regulation
Shane Purdy	Director Infrastructure Services	Winsome MacLaurin	Department of Water and Environmental Regulation
Jon Dooner	Coordinator Infrastructure Development	Emma Monk	Department of Biodiversity Conservation and Attractions
Brian Grout	Coordinator Parks	Suzanne Thompson	Department of Biodiversity Conservation and Attractions
David O'Brien	Supervisor Environment & Horticulture	Mario Carbone	Department of Planning, Lands and Heritage (NE metro)
Angus Money	Manager Planning & Environment Service	Richard Theobald	Department of Health
Briony Moran	Coordinator Environment & Sustainability	Natalia Shishkina	Department of Health
Jolene Wallington	Environmental Officer	May Carter	Department of Local Government, Sport and Cultural Industries
Chris Jennings	Senior Strategic Planning Officer	Lauren Waite	Water Corporation
Martin Shurlock	Senior Environmental Health Officer	Jason Mackay	Water Corporation
Neil Fletcher	Team Leader Lake Leschenaultia	Graham McAlpine	Perth NRM
Colleen Redmond	Community Facilities Officer	Jaya Vaughan	EMRC (scribe)
Karen White	Community Engagement Facilitator	Cristyn Fielding	EMRC (scribe)
Herb Titelius	Environmental Advisory Committee	Dr Ross Mars	Water Solutions
		Simon O'Hara	Planning consultant
		Michael Ferritto	McDowell Affleck
		Una Bell	Catchment Group
		Jenny Johnson	Catchment Group

Appendix 2 Summary of Ratings for Each Indicator

 Report a Bug Logout 	
1. Ensure good water sensitive governance	3.1 ▲
1.1. Knowledge, skills and organisational capacity	3.0
1.2. Water is key element in city planning and design	3.0
1.3. Cross-sector institutional arrangements and processes	3.0
1.4. Public engagement, participation and transparency	3.5
1.5. Leadership, long-term vision and commitment	3.5
1.6. Water resourcing and funding to deliver broad societal value	3.0
1.7. Equitable representation of perspectives	3.0
2. Increase community capital	3.1
2.1. Water literacy	3.0
2.2. Connection with water	4.0
2.3. Shared ownership, management and responsibility of water assets	2.5
2.4. Community preparedness and response to extreme events	3.0
2.5. Indigenous involvement in water planning	3.0
3. Achieve equity of essential services	4.4 ▲
3.1. Equitable access to safe and secure potable water supply	5.0
3.2. Equitable access to safe and reliable sanitation	4.5
3.3. Equitable access to flood protection	4.0
3.4. Equitable and affordable access to amenity values of water-related assets	4.0
4. Improve productivity and resource efficiency	2.3
4.1. Benefits across other sectors because of water-related services	2.0
4.2. Low GHG emission in water sector	2.0
4.3. Low end-user potable water demand	3.0
4.4. Water-related economic and commercial opportunities	2.5
4.5. Maximised resource recovery	2.0
5. Improve ecological health	3.3 ▲
5.1. Healthy and biodiverse habitat	3.0
5.2. Surface water quality and flows	3.0
5.3. Groundwater quality and replenishment	2.5
5.4. Protect existing areas of high ecological value	4.5
6. Ensure quality urban space	3.0
6.1. Activating connected pleasant urban green and blue space	3.5
6.2. Urban elements functioning as part of the urban water system	2.0
6.3. Vegetation coverage	3.5
7. Promote adaptive infrastructure	2.7 ▲
7.1. Diverse fit-for-purpose water supply system	3.0
7.2. Multi-functional water system infrastructure	2.0
7.3. Integration and intelligent control	2.0
7.4. Robust infrastructures	3.0
7.5. Infrastructure and ownership at multiple scales	3.0
7.6. Adequate maintenance	3.0

Appendix 3 Workshop Notes for Each Indicator

Indicator	Rating 0 to 5	Confidence High/Med/Low	Evidence
Goal 1. Ensure Good Water Sensitive Governance			
1.1 Knowledge, skills and organisational capacity	3	High	Willingness in the Shire to do better. Shire could do more to pass on knowledge to the community. Interdisciplinary approach for new development for everyone to have a say before decisions are made. New developments in Bellevue for Water Sensitive Cities – case study Environmental Management Plan (2012 – 2022) (EMRC, 2012): – action to participate with EMRC in the Cities for Water Supply Catchments Program (Page 56)
1.2 Water is key element in city planning and design	3	High	Significant state guidelines and policy available (SPP 2.9, Better Urban Water Management, Stormwater Management Manual) Not totally convinced that State government are effective in promoting use of guidelines to Shires Shire’s planning scheme has strong provisions - Shire of Mundaring: Local Planning Scheme No.4 Text (2014) - 1.6 (f) (The aims of the Scheme are to -) assist in effective management of water sources, river systems and other water-bodies to maintain the health of the ecosystems and human communities that they support - 4.2.1 (d) (The objection for the zones are -) to provide for residential subdivision and development incorporating water-sensitive urban design principles. Environmental Management Plan (2012 – 2022) (EMRC, 2012): A key performance indicator is 6.4 Use of WSUD principles when applying conditions for planning approvals (Table 36, page 56). The action is to implement BUWM and request UWMPs at the subdivision or development stage. 6.17 Work with Infrastructure Services to implement the Urban Drainage Strategy is another action from the Environmental management plan (EMP).
1.3 Cross-sector institutional arrangements and processes	3	High	Work well with WC and DWER - Water wise council – received gold status for 2015/16 Some processes include formal referrals Community engagement networking group – strategic working groups are working together but only some projects not all Embedded policy arrangements to consult with each other. Outside of the formal system – yes they do all talk together Sometimes Shire Health and Planning sections don’t work together – Difficult for agencies to discuss the same thing with both sections of the same Shire
1.4 Public engagement, participation and transparency	3.5	Medium	SoM LPS4 - facilitate public involvement in planning issues of significance to the character, amenity and environmental values of the Shire (Page 5) Water Action Plan - In achieving the (water conservation) community goal the main actions from the Shire will be influencing the community through planning and development and community education (Page 16) Local Climate Change Adaptation Action Plan - engage with the community and other stakeholders in planning for climate change As a community member – Yes they are consulted on projects through advertising and annual question submission session Also have an Environmental Advisory Committee – Formal recognition. Also Residents and Ratepayers associations are often consulted Shire and Water Corp do consult with the community, particularly due to the weir. Maybe not other agencies eg Main Roads Sub coordinators meeting – 1 community group attends Willingness to engage with community – Swan View resident had DWER, Water Corp and Shire engineer attend the property to assist with flooding issue
1.5 Leadership, long-term vision and commitment	3.5	Medium	Environmental Management Plan – implementation of Shires Water Campaign Action Plan and Water Efficiency Plan (Page 56) Local Climate Change Adaptation Action Plan – Ensure the Shire’s future planning minimise effects from climate change (Page 7) Strategic community plan – Priority 3 – Natural Environment, objective 1 – a community that manages water sustainably Yalambee compensating basin – Currently being implemented Money to examine catchments in the budget – to follow up and implement projects Limited funding to implement however there is a willingness Youth are active in this area Local planning strategy has water objectives embedded in it Main Roads are shifting water off the road into the creek – lack of leadership here
1.6 Water resourcing and funding to deliver broad societal value	3	Medium Some participants felt	Environmental Management Plan - Investigate opportunities to provide incentives for the installation of rainwater tanks and greywater reuse systems within the community (Page 56). Apply for funding to implement recommendations from water audits (Page 56).

Indicator	Rating 0 to 5	Confidence High/Med/Low	Evidence
		strongly about a 2 (only with big decisions) and others were a 4 (WC and DBCA support)	Water Corp - verge investment and community workshops. Waste water treatment plant upgrade was done but it was the cheapest option. Lack of integration for the future. Not in line with community requirements. Now a problem for the Shire? Money put in to workshops and WSC benchmarking Signage at weir funding investment DBCA funding available over the years, not always long term ERCMP funding TCUP funding Monitor water use at all facilities through Planet Footprint system Community puts water high on the agenda to council Herbie does small scale erosion control but small machinery could do a lot of good Concentrating on Swan Coastal Plain but moving towards opening up to slope and soil type - clay
1.7 Equitable representation of perspectives	3	Medium	Strategic community plan – Priority 2 – Community, objective 2 – residents of all ages, needs and backgrounds are engaged and supported by their community Shire working towards reconciliation action plans – Not in place yet Agencies working with all schools - Youth Cultural Advisory Group – Aboriginal reps present Policy in Shire for access and inclusion plans. Seniors plan Seniors are representing on groups
Goal 2. Increase Community Capital			
2.1 Water literacy	3	Low confidence	Environmental Management Plan – Distribute watercourse brochures to private landholders (page 57) Water Action Plan - In achieving the (water conservation) community goal the main actions from the Shire will be influencing the community through planning and development and community education (Page 16) Community education strategy – 2002 Strategic community plan – Priority 3 – Natural Environment, objective 1 – a community that manages water sustainably Weir is well-known. People are more aware of what their money pays for than on coastal plain People don't understand how integrated our water is. People aren't getting Mundaring water, it's from desal, Jandakot. Weir is just a holding tank. People don't understand how stormwater is going to creek. People think it gets treated somewhere. People with septic (need to be emptied) and water tanks are more aware of water If you are near a creek or drain you understand a bit better but not all People don't know what water treatment is being done at weir Don't understand reinjecting underground water Community perspective – people don't care about where their stormwater goes
2.2 Connection with water	4	High confidence	Eastern Catchment Management Plan – Work with the community to develop an environmental ethic Strategic community plan – Priority 3 – Natural Environment, objective 1 – a community that manages water sustainably People are very protective over their creeks but from an ownership point of view – not a management and responsibility point of view. People feel the sense of place with Weir and creeklines
2.3 Shared ownership, management and responsibility of water assets	2.5	High confidence	Eastern Catchment Management Plan – conduct functions and activities involving the community create environmental awareness and community opinion (Page 17) Eastern Catchment Management Plan – creation of over 80 "Friends Of" groups that undertake bush care activities Strategic community plan – Priority 3 – Natural Environment, objective 1 – a community that manages water sustainably Water bill information – Do people take notice? Private bores are not licenced. Not monitored Rainwater tanks aren't monitored People who don't have access to sewer are more aware because they have a septic. But not inspected by the Shire
2.4 Community preparedness and	3	High confidence	Local Climate Change Adaptation Action Plan - promote resilience and support local communities to partner with the Shire to improve the management of the local environment and community public assets (Page 7) Conduct community education about drainage and flooding events in the Shire (Page 14)

Indicator	Rating 0 to 5	Confidence High/Med/Low	Evidence
response to extreme events			Strategic community plan – Priority 2 – Community, Objective 1 – a community that is prepared for bushfire and other natural disasters. Priority 3 – Natural Environment, objective 1 – a community that manages water sustainably After Parkerville fire, long term water shortages because pumps were out. Heat and drought can also impact people who depend on rainwater Local Emergency Management Committee – test different types of scenarios. Emergency Locations are instated Money from Water Corp to help with clean up in the past Agencies come together in an event and Shire is well equipped with a Response program. Community awareness – low on what plans exist. People just rally together and work together in an emergency and do it themselves Aware that the SES is there
2.5 Indigenous involvement in water planning	3	High confidence	SALP grant you need to have indigenous heritage check Structure planning Helena River referral to Indigenous Affairs and desire to send out Hills Strategy (comment by Shane Purdy) out to the indigenous community. Subdivision and structure plans referred to Department of Indigenous Affairs Some of the national parks include indigenous planning Minimum consultation requirement given through policy Water Corp has a Reconciliation Action Plan Broad approach in strategy CALM act has changed to include customary activities which allows them to undertake traditional activities when they need to
Goal 3. Equity of Essential Services			
3.1 Equitable access to safe and secure potable water supply	5	High	Water Action Plan - New initiatives have been proposed to address additional water quality areas and are outlined in the Water Action Plan (Page 14) Local Climate Change Adaptation Action Plan - Design infrastructure that is resilient to flooding (Page 14) Water from rain water tanks is free. (affordable) However if they have more kids they need bigger tank and need to purchase it. Also drought means that people have to buy/cart in water Water standpipe at Chidlow for people to access who don't have water to the house Water Corporation programs for hardship include Hardship Utility Grant Scheme (HUGS), Water Assist Scheme, Start Over program, Medical Assist program and Time Assist program
3.2 Equitable access to safe and reliable sanitation	4.5	Medium	Environmental Management Plan – Continue to undertake a range of initiatives to reduce the amount of litter and pollutants entering waterways (Page 57) Water Action Plan – Quality wastewater management is one of the requirements in a checklist of the water quality management goal (Page 13) Local Climate Change Adaptation Action Plan - Review effluent disposal controls potentially affected by flood situations (Page 14) Everybody who moves into new house in the Shire get sewer or septic or Biomax. All regulated by council during installation Maintenance – Leach drain or septic (100 years in some cases) ATU have maintenance contracts. Local governments request quarterly maintenance evidence. Shire of Mundaring gets a red flag if maintenance report doesn't come in. They follow it up. Redundancies built into septic failed – A few compliance issues have occurred No program for people on ATU to assist with disadvantaged people but most people who have one are in brand new developments. Disadvantaged people tend to be in sewered areas. Water Corporation programs for hardship include Hardship Utility Grant Scheme (HUGS), Water Assist Scheme, Start Over program, Medical Assist program and Time Assist program
3.3 Equitable access to flood protection	4	High	Stormwater Management Policy (PS-10) - ensure that stormwater infiltration and run-off rates post development have no more of an off-site impact than pre-development rates (Page 1) Minimise the risk of localised flooding caused by increased stormwater run-off from impervious surfaces in new developments (Page 1) Local Climate Change Adaptation Action Plan - Identify risk areas for flooding in the Shire (Page 14) Localised flash flooding – but people don't build there Flood is an issue in flood prone areas but these are recognised in Local Planning Scheme with restrictions on building Disruptive to people on the flats after large rainfall event. Road flooding. Drainage isn't multi-functional
3.4 Equitable and affordable access to amenity values of water-related assets	4	High confidence	SoM LPS4 - preserve the Shire's biodiversity and environmental values through appropriate protection of areas of significant native vegetation, valuable habitat areas and other areas of environmental value (Page 4) Local Climate Change Adaptation Action Plan – investigate alternative water sources for ovals and review landscaping based on predicted climate change and change in species (Page 22)

Indicator	Rating 0 to 5	Confidence High/Med/Low	Evidence
			<p>Amenity is still present when a fenced off area exists but significantly reduced</p> <p>National Park entry fee – less of an access to everyone Lake Leschenaultia, Broz park – free to access</p> <p>Not just creeks and river – can have water in built up areas</p> <p>Low socio economic area is where the drainage program is currently focussing - main drains enter Public Open Space – Swan View</p> <p>Drainage and Liveability available – perhaps new project near the weir</p>
4. Improve Productivity & Resource Efficiency			
4.1 Benefits across other sectors because of water-related services	2	High	<p>Mundaring Waste Water Treatment Plant supplies some treated water to Harry Riseborough Oval</p> <p>Not much other resource recovery in the Shire, most of the area is septic tanks and other types of disposal</p> <p>The benefits are currently not measured and not sure on mechanisms to quantify them</p> <p>Golden pipeline and Mundaring Weir have tourism benefits – WC planning processes take into consideration the tourism of those assets. It is something that is considered more and more although, again, difficult to quantify</p> <p>Thoughts that the greatest benefit would be to improve water quality before it goes downstream to the Swan River. More of a priority than if people can walk their dogs around it</p> <p>Cannot definitely express what they are and not seeing too many benefits across the services.</p> <p>Some benefits from ATU's recognised but are isolated</p> <p>Belle View Estate mentioned – new development that will have living streams and a series of created wetlands will be used to manage stormwater and provide residents with opportunities to connect to water. Structure Plan has been approved</p> <p>https://planning.wa.gov.au/StructurePlans/DATA/Mundaring%20Shire/Belle%20View%20Estate%20Structure%20Plan%20WAPC%20ref%20SPN%202043.pdf</p> <p>Environmental Management Plan - Establish a long term program to install alternative water sources and water efficient technologies on Council buildings and facilities (Page 56)</p>
4.2 Low GHG emission in water sector	2	Medium	<p>Water Corporation (WC) has high GHG emissions from pumps/ pipelines/ desalinations – treating and moving water is very intensive. Water corporation levels have always been on the lower end of the rating scale</p> <p>WC is developing WSC Strategy since they such an energy intense industry – looking at increasing solar panels and resource recovery. Moving into that space.</p> <p>GHG in shire is not currently measured but looking at it into the future as part of the Shire's emissions boundary</p> <p>Some gravity feeding systems on the bottom of the hills for bores.</p> <p>Shire has a draft Energy and Emissions Reduction Plan/Strategy currently under consultation that includes reducing emissions within the Shire's parks and reserves for irrigation and bore use.</p> <p>Residents with self-supply rainwater tanks would use energy for pumps</p> <p>Sustainability at the Shire – community info sheet</p> <p>Sustainable living guide – community guidelines (2013)</p>
4.3 Low end-user potable water demand	3	Medium	<p>Mundaring top 10 councils for water use (per capita)</p> <p>Shire's consumption per capita for community water use is currently at ~297 L/person/day as of 2016/2017 (OR 109 kL per capita per annum as of the Shire's corporate water reporting). To get to below 200L/person/day - would have to reduce annual consumption for community from 109 to below 73 kL.</p> <p>Water Report Card – 2016/2017 – EMRC</p> <p>Shire has retrofitted water efficient appliances in buildings with a minimum of 3 Wels Stars</p> <p>Shire is a participant of the EMRC's Water Quality and Conservation program to aid in reducing water consumption. They are also a previous participant in ICLEI's Water Campaign</p> <p>Drinking water used on gardens in some parts of the Shire</p> <p>There has been lots of community education performed in the Shire over the years by WC and Shire staff – e.g. waterwise workshops, school programs, garden workshops</p> <p>Waterwise Council Reporting – 2016/2017</p> <p>Environmental Management Plan - Investigate opportunities to provide incentives for the installation of rainwater tanks and greywater reuse systems within the community (Page 56)</p>
4.4 Water-related economic and	2.5	Low	<p>Mundaring Waste Water Treatment Plant – Business opportunity – is potentially being sold</p>

Indicator	Rating 0 to 5	Confidence High/Med/Low	Evidence
commercial opportunities			<p>Tourism opportunities with Mundaring Weir and Lake Leschenaultia (although recent proposals to develop Lake Leschenaultia for more people to come through have been declined)</p> <p>Industry with ATU's – Pushing geotechnical investigators for ATU's</p> <p>North Stoneville Townsite – Invasion of activities by locals – WW providers coming from over east to provide expertise.</p> <p>Not sure on local opportunities beyond those needed through necessity</p> <p>Shire does native plant program – promoting waterwise gardens – native plant industry – lots of scope for small businesses</p> <p>Very limited for others to join</p> <p>Issue in poor water literacy – the number of GW system is only 2% of the population. There is no understanding of water management</p>
4.5 Maximised resource recovery	2	High	<p>WC Waste Water recovery with the groundwater replenishment trial is not related to Mundaring since wastewater is treated and discharged locally at Mundaring Waste Water Treatment Plant and therefore doesn't contribute to the replenishment</p> <p>Some irrigation with WW treated – to equestrian centre and primary school, Low resource recovery</p> <p>Rainwater tank at administration centre is used for irrigation but is not very efficient</p>
Goal 5. Improve Ecological Health			
5.1 Healthy and biodiverse habitat	3	Medium	<p>SoM LPS4 - assist in effective management of water sources, river systems and other water-bodies to maintain the health of the ecosystems and human communities that they support (Page 4)</p> <p>High biodiversity in terrestrial ecosystems with evidence of kangaroo, quenda etc from various areas. Really good indicator.</p> <p>Lots of biodiversity evident, frogs are thriving.</p> <p>However, there is considered to be limited biodiversity of aquatic variety – low research and information - disconnect in the stream since they go through lots of private property. Limited understanding suggests fish diversity is low. Not clear if the benchmark for fish diversity in these streams is really well understood.</p> <p>Increased development is observed to increase the amount of flash flooding in waterways. This altered flow regime causes issues with erosion, sediment mobilisation and downstream nutrient loads.</p> <p>Parkerville and Hovea – have seen long neck tortoise – native fish – in the summer you can see evidence</p> <p>Vegetation plantings are common in Shire and some supplied by council. Catchment groups also put effort into weeding and revegetating degraded areas</p> <p>There is need for more research and data to confirm status of non- conservation areas, steaming to success</p> <p>The Shire continued with the annual 'Tree Canopy and Understorey Program' in 2017 giving away 52,000 seedlings of local native plants to the community. This program ensures appropriate species are planted throughout the Shire, species that are native, water efficient and most adapted to the local environment.</p>
5.2 Surface water quality and flows	3	Medium	<p>SoM LPS4 - assist in effective management of water sources, river systems and other water-bodies to maintain the health of the ecosystems and human communities that they support (Page 4)</p> <p>Development in hills is observed to increase the amount of flash flooding in waterways. This altered flow regime causes issues with erosion, sediment mobilisation and downstream nutrient loads. Typical approaches to stormwater management imported from coastal plain are not necessarily applicable and in particular there are problems with soakage in the upper part of the hills.</p> <p>Some examples of better management approaches being applied/trialled include:</p> <ul style="list-style-type: none"> • Broz Lake (artificial) fed by drainage in subdivision – Belle View farm area – wetlands being developed to filter • Open drains for storm water are being amended to include riffles and vegetation to help control sediment and erosion issues • Work with high schools to install rock riffles in degraded areas and aid in flows • Sedging and vegetating of creeklines and drainage outlets have been conducted by schools, volunteers and the Shire. • There are a few things that the shire does to integrate community to help plant vegetation and improve drainage • Jane Brook has some pollutant monitoring including bacteria analysis every quarter • EMRC has done some projects within shire such as Helping the Helena. Freshwater fish, non-nutrient water quality monitoring, permanent pools mapping, steaming to success. <p>DBCA and DWER – undertaking some catchment scale “end point” monitoring</p> <p>Lots of revegetation action near streams and creeklines involving friends of groups and the community</p>

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Indicator	Rating 0 to 5	Confidence High/Med/Low	Evidence
5.3 Groundwater quality and replenishment	2.5	Medium	<p>SoM LPS4 - Groundwater management is one of the requirements in a checklist of the water quality management goal (Page 13)</p> <p>Swan view – superficial swan aquifer is declining – looking to reduce impact on that Hard to quantify in the fractured rock area – groundwater use is not licensed in these areas but impacts of over-use are still evident because people are often not aware that their groundwater use is impacting on other properties – neighbours are noticing water being extracted extensively</p> <p>Areas where groundwater exists in small ‘perched’ aquifers (upper valley floors) Very limited recharge in these areas and groundwater bore water is being depleted.</p> <p>Septic tanks are not monitored in terms of what is being leached – it is inefficiently treated</p> <p>Some management – groundwater table is falling and not supporting ecosystem because you can’t put a bore near a creekline and pump as much as you want. Needs to be more monitoring of private (unlicensed) groundwater use Real issues with groundwater and can’t be too optimistic Water quality in groundwater in the shire is mostly acidic and not great quality – however this is generally natural acidity</p>
5.4 Protect existing areas of high ecological value	4.5	Medium	<p>SoM LPS4 - preserve the Shire’s biodiversity and environmental values through appropriate protection of areas of significant native vegetation, valuable habitat areas and other areas of environmental value (Page 4)</p> <p>There is state wide legislation in place, there are areas that are not allowed development, offsets are required for some clearing. Shire does a lot of regulation of policy – legislation at least a 4 – council supportive of protecting conservation areas. Zoning may impact in future</p> <p>Community engagement is engaged in catchments – 85 friends groups exist in the Shire https://www.mundaring.wa.gov.au/AboutCouncil/Policieslocallaws/Council%20Policies/EV-01%20-20Roadside%20Conservation.pdf? https://www.mundaring.wa.gov.au/ResidentServices/Environment/Documents/Policies/PrivateLandConservationAwareness.pdf#search=conservation Local Biodiversity Strategy - https://www.mundaring.wa.gov.au/ResidentServices/Environment/Documents/Local%20Biodiversity%20Strategy%20FINAL%20PDF.pdf#search=conservation</p>
6. Ensure Quality Urban Space			
6.1 Activating connected pleasant urban green and blue space	3.5	Medium	<p>Environmental Management Plan - Consider the need to update Public Open Space Strategy to guide the Shire’s management of public, open, space, verges and medians including the use of hydrozoning (Page 56).</p> <p>10 minute walk to any blue-green space in Mundaring is almost impossible due to spread of properties and rural lifestyle in most areas but it is achievable in all urban areas/ villages within the Shire. Most are connected to some sort of waterway and/or walk trail There is still need for improvement in areas that are not connected Mundaring has a range of water bodies (e.g. Lake Leschenaultia) which has recreational use and the Mundaring Weir is accessible to the public Broz Park also has an accessible water body Creeklines in the Shire are sometimes on private property and not accessible to public. Although provide a visual connection. Most are seasonal Public Open Space (POS) are constructed in new urban areas and installed ad hoc but can’t really use them very well. Seem too small to be properly connected. Urban areas seem to be lacking natural green and blue space Heritage trails are present near some waterways Priority drinking water locations are usually not accessible.</p>
6.2 Urban elements functioning as part of the urban water system	2	Medium	<p>Environmental Management Plan - Implement the Department of Water’s Water Sensitive Urban Design (WSUD) Best Management Practices (Page 56)</p> <p>Old and new urban areas are leading towards the lower end of the scale due to the fear of bushfires New areas do not have great functional water systems Central Business District (CBD) have cut down trees and new development on the highways have no trees and tiny vegetation. CBD is a heat sink. The Shire is in transition towards a major risk associated with high urban heat if not addressed</p>

Indicator	Rating 0 to 5	Confidence High/Med/Low	Evidence
			<p>There is evidence of Water Sensitive Urban Design (WSUD) but new houses are cheap and poorly built.</p> <p>Permeability of soils is low and cannot hold water</p> <p>Conscious integration is lacking in combining blue and green. Integration is low</p> <p>Can see things going backwards – Jane Brook Catchment have noticed the run off from urbanisation and the degradation of the creeklines. Trying to revegetate in those areas is now harder – run off water is polluted.</p> <p>100 years ago it was chance – not a conscious integration and that’s why it went 2</p>
6.3 Vegetation coverage	3.5	High	<p>Street Tree Policy (PS-08) - To increase the tree canopy cover within the Shire’s road reserves and mitigate the urban heat island effect, support biodiversity and enhance the character and amenity of local streets (Page 1)</p> <p>The Shire currently does not have a tree canopy vision</p> <p>Some mapping via Catchment Management Plan – there is some gaps. Canopy Cover estimated at 54% canopy cover according to 2020 Vision.</p> <p>Road Reserves have no controls for tree removal or planting</p> <p>Planning protection for scheme to protect vegetation got the Shire an award: PIA website - https://www.planning.org.au/awards/Implementing-Bushfire-and-Biodiversity-Controls-WA . Shire media release and photo with awards</p> <p>https://www.mundaring.wa.gov.au/News/Pages/Shire%E2%80%99s%20planning%20initiative%20among%20the%20best%20in%20the%20country.aspx</p> <p>Local news article https://www.communitynews.com.au/hills-gazette/news/mundaring-shire-leading-the-nation-with-bushfire-and-biodiversity-initiative/</p> <p>New urban areas don’t have very much vegetation – There is an increase density in some areas.</p> <p>Aerial photo of Shire showed lower hills at about 10-20% coverage and upper hills are higher</p> <p>Voted 3.5 mainly on street trees – as there is a good protection of street trees.</p> <p>Have strong protection in planning scheme</p>
7. Promote Adaptive Infrastructure			
7.1 Diverse fit-for-purpose water supply system	3	High	<p>Single centralised system with multiple sources, Water Corp is main supplier</p> <p>Some residents on rainwater – plenty catch their own with some lower areas on groundwater</p> <p>Concern for the longer term prospects. Water tanks is the only option for some residents who don’t have access to Water Corp services</p> <p>Some new areas may be using alternatives in the future</p>
7.2 Multi-functional water infrastructure system	2	High	<p>WC – catchment areas have lots of exclusion of the public for drinking water protection. Some parts of Mundaring Weir and surrounds are accessible. Some other areas are accessible for recreation – mountain biking etc Risk management was main reason for blocking out residents. Walk trails along sections of golden pipeline are well used.</p> <p>Most drainage infrastructure is fenced for safety – because of the grades of the land – don’t have the ability to have six grade batters because the land won’t allow. Don’t have a water body all year round – they are seasonal and not a great asset. May need to consider alternative drainage design.</p> <p>Harry Riseborough oval uses some WW treated irrigation, New rec centre does not have rainwater. Helena valley – some developer funded sewer extensions</p>
7.3 Integration and intelligent control	2	Medium	<p>Typically, where automation is present there is still a manual response required. (Mainly focusing on shire assets/public assets- not private)</p> <p>WC – has lots of automated information provision (dam levels etc) but any control action is generally manually ‘triggered’. Dam operations are still out on the ground and turning taps etc. New water treatment plant – still retains fairly large on-site staffing.</p> <p>Some smart meters are installed on shire recreational assets, there is metering but not necessarily intelligent control</p> <p>Small degree of automatic control in irrigation in parks and gardens but again typically a manual response is required.</p>
7.4 Robust infrastructures	3	Low	<p>Mundaring arena – dual pumps support if one pump goes out – the other kicks in.</p> <p>Spur lines of Mundaring/Kalgoorlie pipeline serving rural areas have limited backups – if these goes down, there isn’t a lot of water options</p> <p>Some residents have water tanks (up to 24hrs) and some back-up systems.</p> <p>Significant variability in scoring across different asset types: Self supply systems and Local drainage may be at a 2 – WC system may be near a 4</p> <p>Properties that use on site wastewater systems are often not adequately checked/maintained – self supply systems are definitely more sensitive and many septic tanks are failing. Tank maintenance is reliant on service technician – there is no check mechanism – wait until it fails and the owner notifies. There is no monitoring of septics as well as rainwater.</p> <p>Shires Asset Management – annual report – 2015/2016 – 45 complaints of flooding – 16/17 – fewer complaints. Mundaring has put a lot of effort into flood mitigation and drainage is generally well maintained</p> <p>Infrastructure protection from bushfire has been a recent issue – clearing has occurred around tanks & pump stations etc</p>

Indicator	Rating 0 to 5	Confidence High/Med/Low	Evidence
			Split vote for 2.5 and 3 – very low confidence due to robust of WC but lack of monitoring in private tanks
7.5 Infrastructure and ownership at multiple scales	3	High	<p>Foothills are all sewered & other areas are self-serviced. Mundaring Water Treatment Plant is operated under a joint venture between Water Corporation and Trillity. No other examples of alternative service provision so far. Opportunity for innovation and alternative service models exist with policy support from State Govt.</p> <p>Self supply is generally a result of ‘no other option’ and usually consists of rainwater tanks, groundwater bores & septic tanks. ATU’s are required in some areas - Policy exists to encourage more water sensitive units. Survey on self-supply, 86% water garden with scheme water – 39% rainwater tank – 16% greywater</p>
7.6 Adequate maintenance	3	High	<p>Funding for maintenance of water/wastewater assets is generally better than for drainage. Long term planning with WC on trunk mains for maintenance</p> <p>Both Water Corporation and the Shire have a limited drainage budget – Both have some GIS records and are recording management and assets</p> <p>Funding is lacking and limited but development of the Shire’s Asset register is ongoing.</p> <p>Maintenance of building assets and water assets is generally reactive as there is no shire funding to have staff inspect them. Although, bore upgrades are being undertaken as an ongoing program (waterwise reporting 16/17)</p>



Cooperative Research Centre for Water Sensitive Cities



Level 1, 8 Scenic Boulevard
Monash University
Clayton VIC 3800



info@crcwsc.org.au



www.watersensitivecities.org.au