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REPORT:

Integrated Water Management – Background Report

March 2018

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Abbreviations

Alluvium	Alluvium Consulting Australia Pty Ltd
BPEM	Best Practice Environmental Management
CBD	Central business district
CoM	City of Melton
CRC	Co-operative research centre
CWW	City West Water
DELWP	Department of Environment, Land, Water and Planning
GL	Gigalitre
GPT	Gross pollutant trap
Ha	Hectare
HWS	Healthy Waterways Strategy
IWM	Integrated Water Management
LGA	Local Government Area
ML	Megalitre
MW	Melbourne Water
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total suspended solids
PSP	Precinct structure plan
SRW	Southern Rural Water
WfV	Water for Victoria
WSAA	Water Services Association of Australia
WSC	Water sensitive city
WSUD	Water sensitive urban design
WW	Western Water

1 Introduction

Integrated water management (IWM) is an approach to planning that brings together all elements of the water cycle and land use planning to achieve optimal social, economic and environmental outcomes. An IWM approach ensures the challenges of growth can be met while continuing to make the City of Melton a great place to live, work and recreate.

This Background Report provides the context, process, and technical analysis that was undertaken to inform the development of the City of Melton Integrated Water Management Plan (hereafter the IWM Plan).

The successful implementation of the IWM Plan relies upon all stakeholders having a shared understanding of the plan's vision, objectives and actions. While the focus of the plan is on Council's areas of direct responsibility including drainage and stormwater, Council buildings, public open spaces, streetscapes and community involvement, some actions will require collaboration with external stakeholders. The plan makes the interrelationships and responsibilities across the water cycle clear, so that internal and external parties can jointly pursue the plan's objectives.

1.1 Developing the plan

The IWM Plan has been informed by extensive consultation within and beyond Council. The consultation and associated analyses have led to the definition of objectives, outcomes, targets and actions for the period 2018 – 2028. Some analyses (specifically in relation to climate change and population growth) is extended to 2040 to make use of available data and to understand longer-term trends. The following elements are emphasised as being critical to the development of the plan:

A range of perspectives: Melton City Council has undertaken extensive engagement in developing the plan, internally and externally, to better understand the perspectives of individuals and organisations who will be involved in its delivery over time. This was a process of discovery where different views, experiences and aspirations were shared. A critical element was understanding the intersection between Council responsibilities and those of partner organisations to understand effective approaches to achieving a given outcome.

Clear outcomes and objectives: The consultation process captured a range of issues and opportunities. These formed the basis of a program logic guiding a connection between what was learned at workshops and the plan's objectives, outcomes and actions. This enables tracking of progress, invites scrutiny and supports buy-in from partners.

System understanding: IWM Plans require a sound scientific basis to understand the nature, interactions and magnitude of each element of the water cycle. Factors that influenced the plan include the nature of current and future land use, the condition and value of waterways, water use and the use of non-potable sources and the aspirations of the community. System understanding can be used to support or challenge the issues and opportunities identified and further shape objectives, outcomes, targets and actions.

Planning for the future: As one of the fastest growing municipalities in Victoria, managing water is critical to ensuring the future liveability of the Melton LGA. This growth will have a direct relationship with water consumption, the quality of natural assets (e.g. waterways and wetlands) and the need and condition of green open spaces.

1.2 A Water Sensitive City

To provide the overarching context to IWM, it is useful to understand the term 'water sensitive city' and what it looks like. This is described by the Co-operative Research Centre for Water Sensitive Cities (CRCWSC) as a city that:

- Is a potential water supply catchment, providing a range of water sources at different scales for different uses
- Provides ecosystem services and a healthy natural environment with social, ecological, and economic benefits, and
- Has a community whose citizens have knowledge and a desire to make wise choices about water and become actively engaged in decision-making.

The development of the IWM Plan and the concept of the water sensitive city are intrinsically linked, with the preparation of an IWM Plan an important step in that journey. The journey toward becoming a water sensitive city is defined by the six states of 'transition' (Figure 1). The early phases reflect the historical and engineering driven development from water supply and wastewater management through to traditional drainage infrastructure. As such most cities and towns in Australia can be defined as Drained Cities on this continuum. As understanding of the environment and ecology has grown and evolved along with the community's awareness of the value of waterways, cities like Melbourne have become Waterways Cities, by for example, legislating to protect waterways and installing water sensitive urban design (WSUD) in urban catchments to improve stormwater quality while continuing to move toward becoming Water Cycle Cities.

This continuum places Melton City Council and their approach to IWM within a broader context and by developing an IWM Plan with clear goals and targets in this context, the City of Melton can continue its evolution toward becoming a Water Cycle and Water Sensitive City.

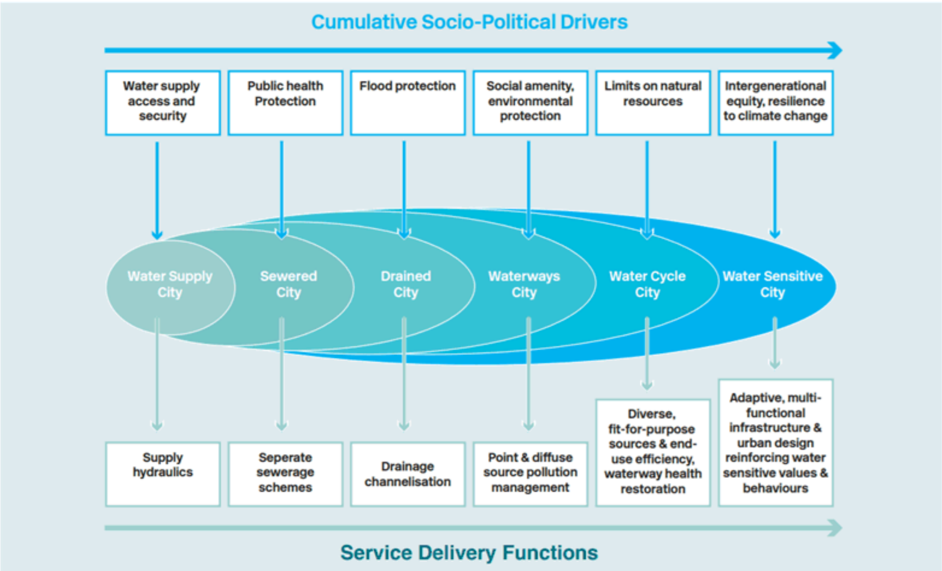


Figure 1. *Urban Water Transitions Framework (Brown, 2009)*

1.3 Melton City Council and IWM

The aim of the IWM Plan is to guide the City of Melton on the transition from a Drained City towards becoming a Water Cycle and Water Sensitive City. To date Melton City Council has demonstrated its commitment to IWM notably through their approach to water use efficiency, the application of water sensitive urban design and the restoration of urban waterways with partners like Melbourne Water.

The plan recognises that there are two levels at which Melton City Council can implement IWM. First through areas of Council's primary responsibility and secondly through influence and advocacy. Figure 2 below sets out Council's primary responsibilities and their potential links with elements of the water cycle.

Category	Role and tasks	Potential link to integrated water management
Planning	Land use planning Conservation and land management	• Drainage • Waterways and water sensitive urban design (WSUD) in new developments • Existing waterway, wetland and WSUD maintenance and rehabilitation
Recreation and culture	Sport and recreation facilities Parks, gardens and reserves	• Greening and irrigation of open spaces • Alternative water supply • Connectivity and shared pathways
Environmental education	Supporting community groups in protecting and enhancing the environment. Engaging and educating the community around environmental issues	• Waterway rehabilitation and revitalisation (through planting days, clean-up days) • Creating a water-wise community
Waste management	Collecting, reusing, recycling and disposing of waste Regulation of litter	• Waterway amenity (i.e. keeping litter from reaching waterways)
Building	Environmental specifications for new assets and renewals	• Water use efficiency • Alternative water sources • WSUD
Roads	Construction and maintenance of local roads	• Incorporation of WSUD and street trees (as part of traditional capital works)

Figure 2. *Council's role in integrated water management*

2 Context

Melton City Council (Figure 3) is located on the western extent of Melbourne's metropolitan area, between 30 and 45 kilometres from Melbourne's CBD. The municipality's current population of about 151,000 (City of Melton, 2017) is concentrated within the suburbs of Caroline Springs and Melton township. Much of the land between these urban centres is assigned for urban development that will house the greater proportion of the City of Melton's future population. This presents a significant opportunity to co-ordinate land use planning for new developments with an IWM approach to realise the vision and objectives defined within the IWM Plan.

This chapter outlines the policy, planning and water context for Melton City Council, highlighting where these characteristics feed into the IWM Plan objectives.

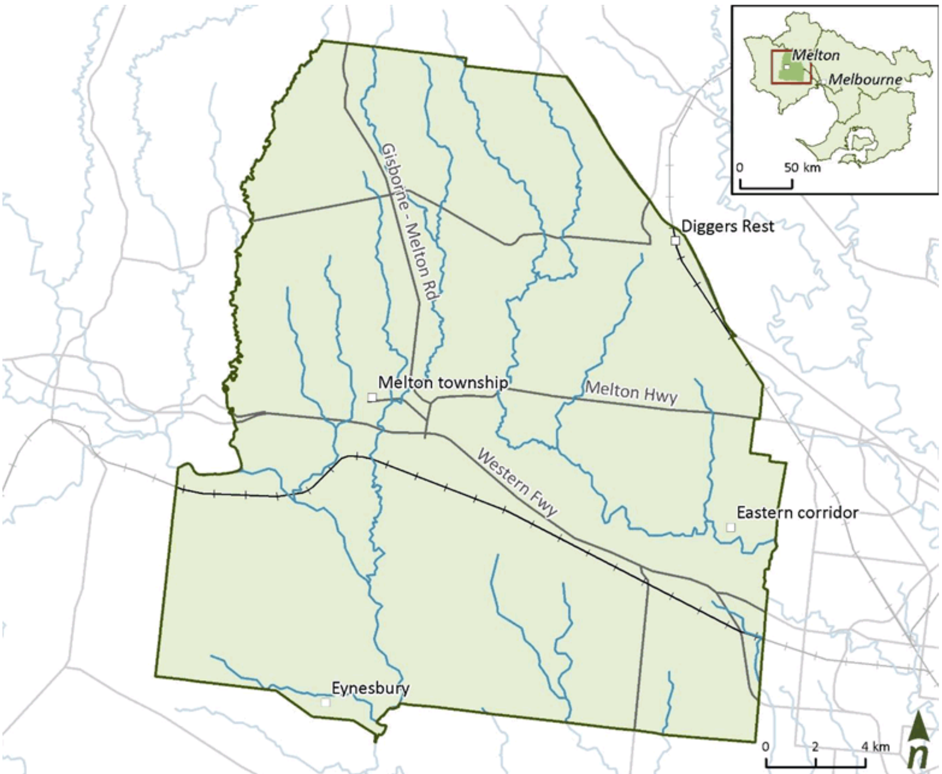


Figure 3. *City of Melton location*

2.1 The policy and planning context

The following section briefly summarises the water-related State and Local Government level strategies that have influenced the development of the plan.

Victorian Government

The Victorian Government's *Water for Victoria* (2016), and particularly Chapter 5: *Water's role in resilient and liveable cities and towns*, was significant in the development of the plan. The outcomes summarised in Chapter 5 (Figure 4) were adopted as a framework for initial discussions to tease out and categorise water cycle issues and opportunities. This ensured that as well as meeting the City of Melton's objectives, the plan aligned with desired outcomes described within *Water for Victoria*.

This process also enabled stakeholders to better understand where Council has direct and indirect responsibility for elements of the water cycle and where the emphasis of the plan should be.

Safe, secure and affordable supplies in an uncertain future	Effective and affordable wastewater systems	Effective stormwater management protects our urban environment	Healthy and valued urban landscapes	Community values reflected in place based planning
A diverse range of water supplies and sources	Meets public health and environmental standards	Waterway health is maintained and improved	Water is prominent in the urban landscape	Diverse urban landscapes that reflect local conditions and community values
Water quality meets regulatory standards and community expectations	Effective sewerage systems	Community and property resilient to local flood risk	Urban landscapes retain moisture for cooler, greener cities and towns	Empowered engaged community
Manage water efficiency and demand	Optimised onsite domestic wastewater	Appropriate levels of flood protection in new development	Waterways accessible as valuable open space	Local water related risks and issues understood and managed
Secure water supply for Victorian industry and the economy	Maximise waste-to-resource opportunities		Aboriginal cultural values associated with waterways are protected	
Water available to maintain valued green community assets including for climate change				

Figure 4. *Summary table from* Water for Victoria *Chapter 5 (DELWP, 2016)*

Chapter 6 of *Water for Victoria* refers to *Recognising and managing for Aboriginal values* highlighting four aims:

- 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

As part of the consultation for the plan the following groups were engaged: the Wathaurong Aboriginal Co-operative, the Wurundjeri Land Council and the Bunurong Land Council.

City of Melton

Several existing plans and strategies have informed the context for the IWM Plan. The *Council and Wellbeing Plan 2017 – 2021* highlights Council's commitment to 'promoting, improving and protecting public health and wellbeing'. The plan also identifies specific themes, outcomes and objectives, two of which align well with the objectives of the IWM Plan (see Figure 5), namely:

- A thriving and resilient natural environment, and
- A well planned and built city.

Theme	Outcome	Objectives
2. A thriving and resilient natural environment	A City that preserves and enhances its natural environment for future generations	• A resource efficient City • A City with healthy waterways, biodiversity and ecosystems • An environmentally aware community
3. A well planned and built City	A City with a clear vision to manage growth in sustainable and accessible way	• A City that strategically plans for growth and development • Public spaces that are vibrant and engaging places for all

Figure 5. *Council and Wellbeing Plan 2017-2021 summary*

The City of Melton's first *Environment Plan (2017 – 2027)* is also an important overarching document that touches upon all elements of Council's environmental management responsibilities and provides context for the IWM Plan. The *Environment Plan* sets out Council's responsibilities across three themes:

1. Built Environment
2. Natural Environment, and
3. Resource Use.

Theme 3 'Resource use' highlights water use and water use efficiency with an action to develop an Integrated Water Management Plan – this document. While Theme 3 relates specifically to water, Themes 1 and 2 also relate to elements that intersect with the water cycle such as land use planning, waterways, ecosystems, parks and open spaces. Figure 6 summarises the content of the Environment Plan, indicating where there are consistent themes between it and the IWM Plan.

Figure 6. *City of Melton Environment Plan (2017-2017): Summary of links to IWM*

Finally, the *Open Space Plan (2016 – 2026)* notes the importance of reducing Melton City Council's reliability on potable water through:

- The use of recycled water (along with stormwater) to meet irrigation and toilet flushing demand at Council facilities
- Water sensitive urban design to be incorporated in all landscape development
- The use of drought-resistant plants and warm season grass wherever practical.

Supporting these strategies are related guidelines, including the Stormwater and WSUD design guideline document, that direct how assets are to be designed and constructed to meet the specified objectives.

Figure 7. *Tenterfield wetland, City of Melton*

2.2 Population, land use and growth

Melton City Council is one of Australia and Victoria's fastest growing municipalities. In 2015-16 it was the fourth fastest growing Victorian municipality by percentage. By 2041 it is anticipated that Melton City Council will have a population of approximately 360,000 (Figure 8), with an ultimate population at full development of over 400,000 persons.

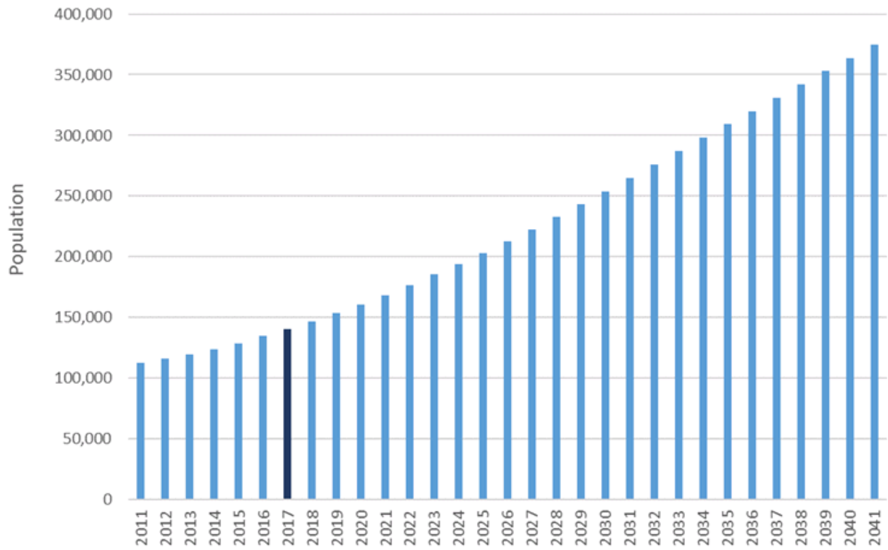


Figure 8. *City of Melton population growth to 2041*

Perhaps the key challenge for the IWM Plan is to understand the impact of urban development and population growth on the water cycle and to minimise its impact. While the population is currently concentrated within the Eastern Corridor (including the suburb of Caroline Springs) and the Melton Township, the future population will be housed predominantly within the land between these existing population centres, as well as around Diggers Rest (see Figure 9).

Figure 9 indicates both the established urban areas and areas planned for new development.

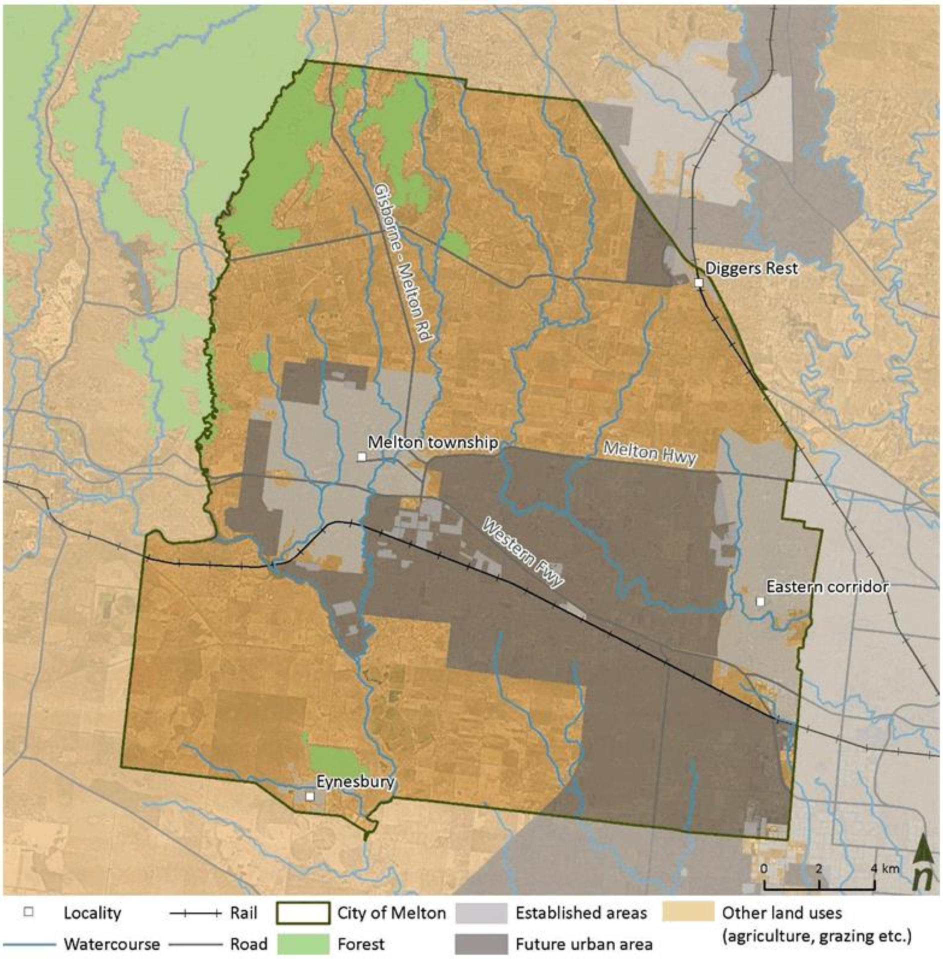


Figure 9. *Projected land use changes*

Urban development has numerous implications from an IWM perspective, and these drive many of the IWM Plan's objectives, outcomes and actions including:

- Greater stormwater volumes
- Stormwater quality and waterway health
- Growth in Council facilities including open spaces, buildings and recreation centres
- Community demand for potable water
- Urban heat island effect
- Community wellbeing and health
- Community connection to waterways, wetlands and other natural assets
- Incorporation of natural and constructed assets (i.e. waterways and wetlands) in new developments

2.3 Potable water consumption

Potable (or drinking) water is supplied to Melton City Council's residents by Western Water and City West Water. Western Water services the west of the municipality, including the Melton Township while City West Water services the Eastern Corridor (see Figure 11).

Melton City Council's water use profile is relatively typical of Melbourne municipalities in that the largest demand is the irrigation of parks and open spaces (being 73% of total use) with the next single greatest consumer being Melton Waves, a water-based recreation centre (13%). Other Council buildings accounting for 12% of total consumption. 2% is unaccounted for and is likely to be attributable to leakage or other system losses.

In recent years, the Melton City Council's water use has grown, particularly since 2011 and 2012, to over 100 ML in 2015. The data suggests this is related to growth in building and open space use irrigation. Water use may also have been influenced by the relaxation of water use restrictions in recent years.

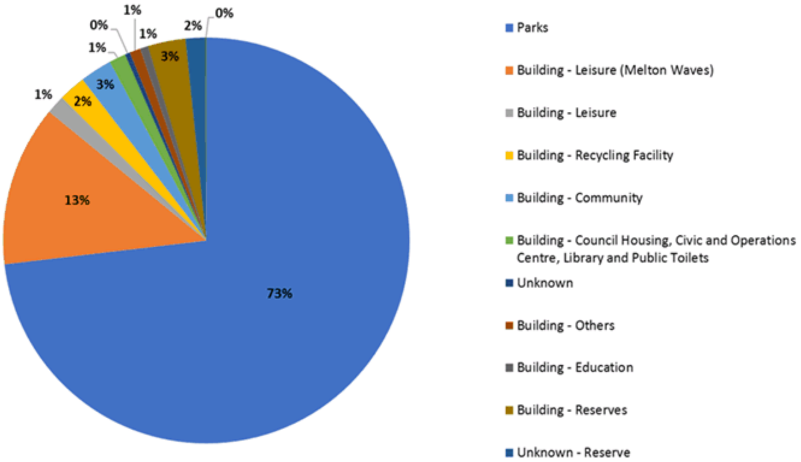


Figure 10. *Council water use breakdown (2016)*

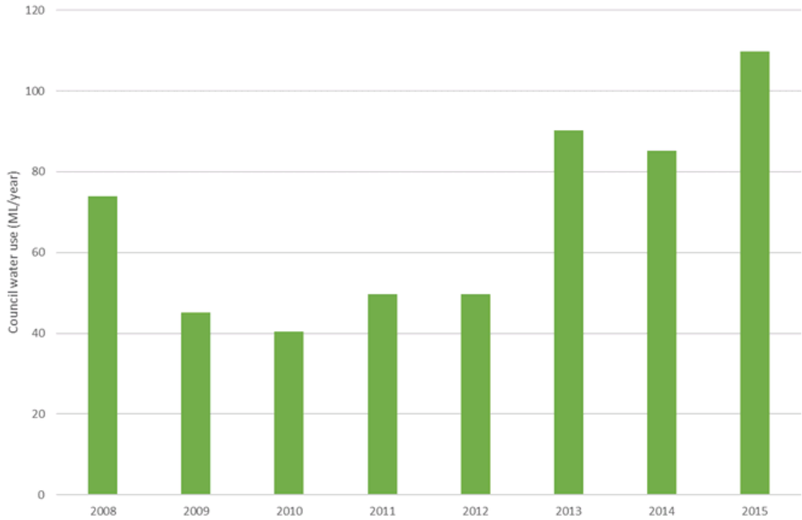


Figure 11. *Council's potable water use (2011-2015)*

2.4 Alternative water supply

Alternative water supply refers to any non-potable water source and can include rainwater, recycled wastewater or stormwater.

Recycled water

In the City of Melton recycled water is supplied by Western Water from their Surbiton Park wastewater treatment plant and from the Sunbury Recycled Water Plant for the northern rural areas. Recycled water is supplied to some residences for the purposes of toilet flushing and garden irrigation as well as to non-residential customers, including for the irrigation of nurseries and wineries.

Figure 12 shows the alignment of Western Water's recycled water network. The figure distinguishes between the 'Class A' network (with water quality suitable for toilet flushing and irrigation) and the 'Class B & C' network that is suitable for irrigation of open space, wineries and nurseries (not internal residential use).

Recycled water provides a climate-independent source of water i.e. its supply doesn't rely upon rainfall. The growing population ensures that incoming wastewater volumes grow presenting the potential for the increased supply of recycled water. Greenfield development provides a significant opportunity for recycled water infrastructure to be installed during construction and avoiding retrofitting in the future. The provision of recycled water infrastructure can also support productive agricultural enterprises with the Green Wedge by improving accessibility to water and therefore the viability of those enterprises.

Stormwater harvesting

There are two stormwater harvesting schemes within Melton City Council:

- Lake Caroline: this scheme is managed by City West Water and extracts stormwater from Lake Caroline for the irrigation of nearby open spaces within Caroline Springs; and
- Toolern Stormwater Harvesting Pilot (in Melton South): this scheme transfers harvested stormwater from a wetland in Atherstone Estate to Melton Reservoir for storage and reuse by Werribee irrigators.

In new developments, wetlands and other water sensitive urban design (WSUD) assets are required to treat stormwater to meet best practice stormwater treatment requirements. Good planning can ensure that these are located and designed to improve the potential viability of using this treated stormwater for the irrigation of nearby open spaces.

There will be numerous opportunities for this within Melton City Council as development progresses.

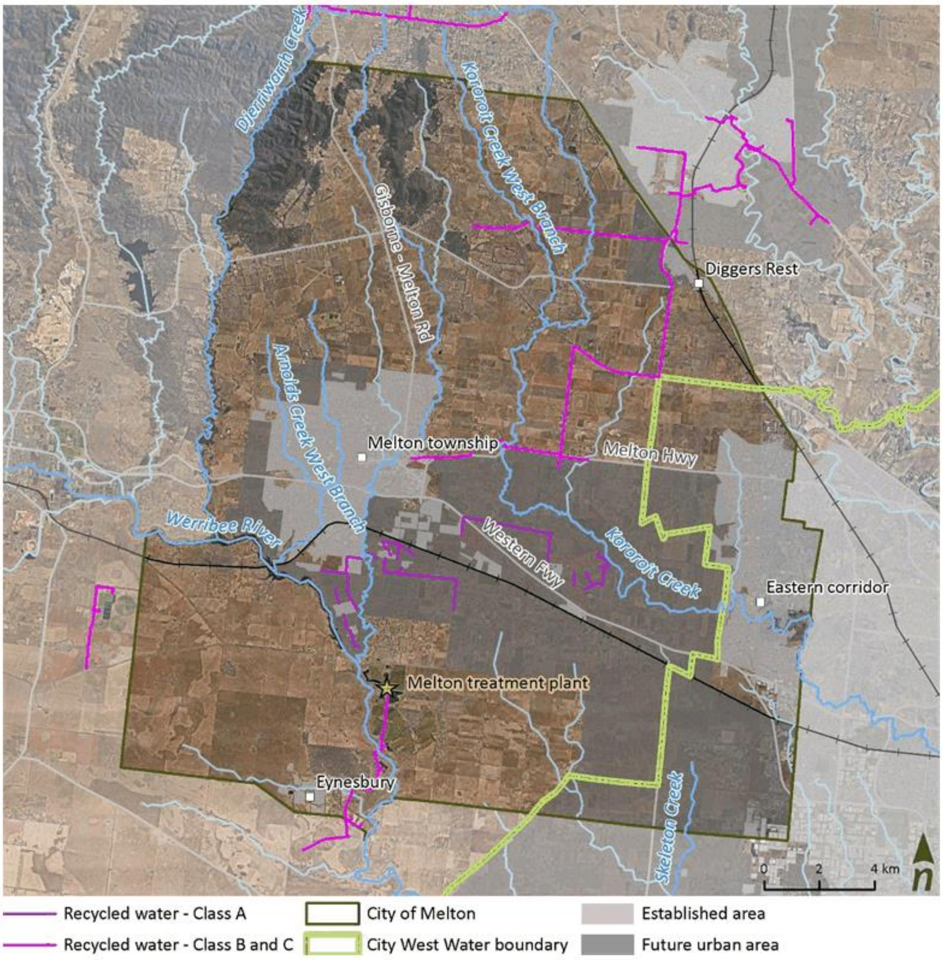


Figure 12. *Recycled water networks*

2.5 Waterways

Multiple waterways flow through Melton City Council including two of the major waterways in western Melbourne, the Werribee River and Kororoit Creek. Smaller creeks include the Toolern Creek, Ryans Creek, Arnolds Creek, Skelton Creek and Djerrwarrh Creek (Figure 13). The volumes and quality of water entering waterways is an important influence on waterway condition and the IWM Plan aims to influence both these parameters.

The physical form of these waterways is dominated by the underlying siltstone and basalt geology of the region. The condition of these waterways ranges from good condition, with healthy native riparian vegetation, connected waterway corridors and intact physical form, to highly degraded waterways that have, for example, been converted to concrete urban drains or significantly modified as they flow through agricultural land.

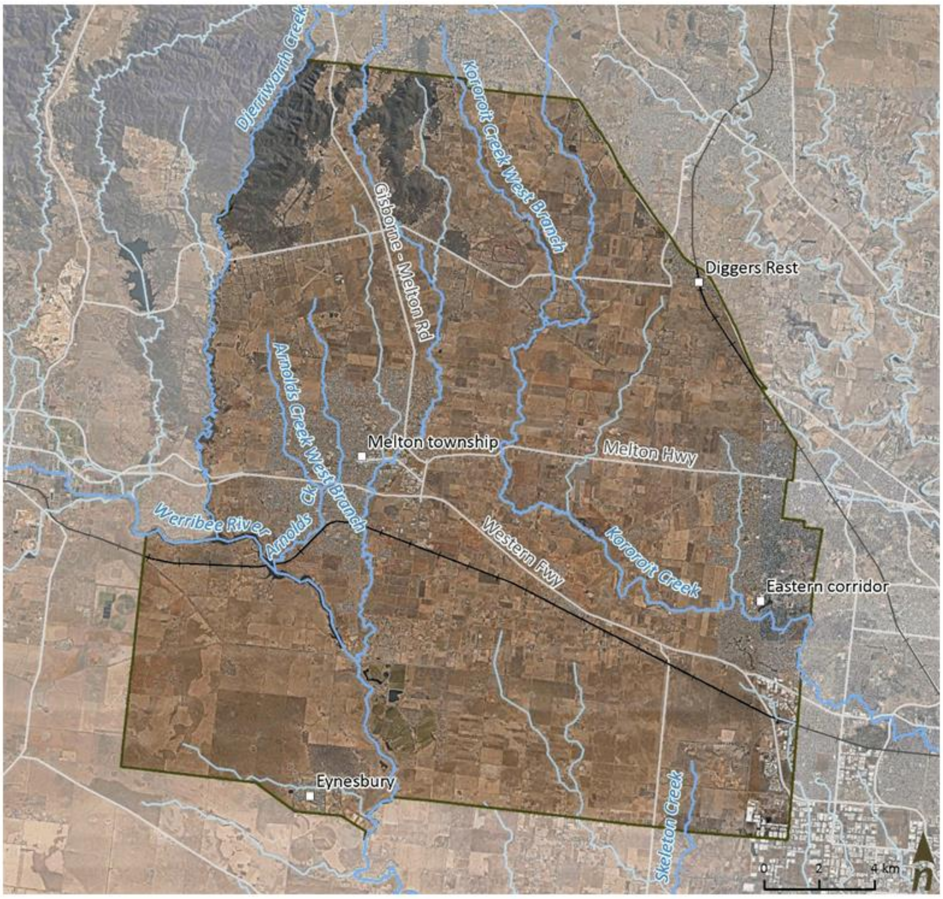


Figure 13. *City of Melton waterways*

A brief description of Melton City Council's waterways is provided below.

Werribee River: Werribee River rises in the Wombat State Forest on the Great Dividing Range and flows in a south-easterly direction through Bacchus Marsh, Melton and Werribee before draining into Port Phillip Bay. The middle reaches of the Werribee River stretch between the Pykes Creek confluence and the Melton Reservoir flowing along the south-western boundary of the Melton LGA. The mid reaches of the Werribee River flow predominately through an agricultural landscape with isolated pockets of remnant vegetation. Ongoing agricultural land use and planned urban expansion pose an ongoing to challenge to improving waterway health and maintaining important values.

Kororoit Creek: Kororoit Creek drains the eastern area of the Melton LGA before flowing east, through the western suburbs, before reaching Port Phillip Bay at Altona. The creek is in a largely intact condition, with localised human impacts and modifications. The creek is generally stable, with isolated bed and bank erosion in some areas.

Toolern, Arnolds, Skeleton and Ryans Creek: Numerous smaller waterways flow through the Melton LGA area. Urban water management in the LGA is likely to be a significant influence on these waterways, as much of their catchment is within the LGA boundaries. Many of these smaller waterways rise in the hills to the north of Melton, which are formed from sheetflow basalts. Once the waterways reach the flatter, wider floodplains there is limited intact riparian vegetation.

- Toolern Creek flows along the eastern edge of the urban area, and remains relatively unmodified, although it is actively eroding in some locations. Increased stormwater discharge to the lower reaches of Toolern Creek is likely to increase erosion.
- Arnolds Creek has two branches and has been contained in a concrete channel for much of its length through Melton.
- Ryans Creek has also been heavily modified, but significant investment has been made to rehabilitate short sections of the waterway.

Healthy Waterways Strategy

Melbourne Water is the responsible authority for waterways and their Healthy Waterways Strategy (HWS) defines the vision and goals for Melbourne's catchments. The waterways within Melton City Council overlap with two catchments within the HWS: the Lower Werribee, below the Melton Reservoir and Upper Kororoit Creek, where East and West Kororoit Creeks join at the basalt plains above Melton township and enters at Caroline Springs. At the time of writing (December 2017), draft HWS vision and goals had been prepared for these catchments with a description of nine values, where values are defined as the things that people consider beneficial about waterways, whether that be environmental, social, cultural or economic:

1. Amenity
2. Community Connections
3. Recreation
4. Birds
5. Fish
6. Frogs
7. Macroinvertebrates
8. Platypus
9. Vegetation

The IWM Plan has concentrated on the first three values that, arguably, Council can contribute to most. Table 1 provides definitions of these values, their current rating and identified risks to these values. The risks provide direction for the contribution Council can make to improving waterway values within these catchments and across the municipality.

Table 1. Healthy Waterways Strategy values summary – Lower Werribee and Upper Kororoit Creek

Values	Definition	Current rating		Risks (collated)
		Lower Werribee	Upper Kororoit	
Amenity	'Sense of escape from the urban environment' (includes good tree cover) and a 'sense of naturalness' (includes biodiversity values)	Moderate	Low	• Poor access to and along the waterway (physical and sensory) • Inappropriate development (encroachment/overshadowing) • Poor environmental condition (naturalness) • Lack of opportunities for different waterway experiences • Litter
Community connection	Connection with the waterway through grant projects and Citizen Science programs	Low	Moderate	• Poor access to and along the waterway (physical and sensory) • Inappropriate maintenance (unsafe vegetation or paths) • Lack of appropriate facilities
Recreation	Assessment of recreation value is currently based on bike paths	Moderate	Moderate	• Poor access to and along the waterway • Lack of appropriate facilities • Poor environmental condition makes less desirable

Additional feedback was gathered through the 'Your Say' section on the Melbourne Water website that captured the following feedback, highlighted where it overlaps with the risks described in Table 1:

- Support community groups
- More walking paths and habitat
- Planting days along creeks
- Reduce litter
- Promote waterway awareness
- Connectivity of creek paths
- Connect community actions to impact on the environment

2.6 Stormwater and water sensitive urban design (WSUD)

As well as the volume and quality of stormwater, the condition and value of urban waterways is strongly influenced by other factors, including erosion processes, riparian vegetation extent and condition. Increased volumes and reduced quality of stormwater are significant threats to river health in existing urban areas and future growth areas. A detailed assessment of current and future stormwater volumes and associated pollutant loads has been carried out to support the development of the IWM Plan (see Section 3). The challenge for Melton City Council is to manage increased stormwater runoff while protecting receiving environments, improve the quality of open spaces and green city streets. As such, stormwater management can influence a number of the plan's objectives and outcomes.

Melton City Council already manages stormwater quality via approximately 370 WSUD assets that are designed to remove nitrogen, phosphorus, sediment and litter. The location and type of those assets is set out in Figure 14, Figure 15 and Figure 16. Concentrations of WSUD can be observed around Caroline Springs and Eynesbury, with fewer WSUD systems in and around Melton township.

As noted above, for the purposes of the IWM Plan it is assumed that new developments will meet Best Practice Environmental Management (BPEM) targets for stormwater quality, while Council will focus on the retrofitting of established areas with WSUD.

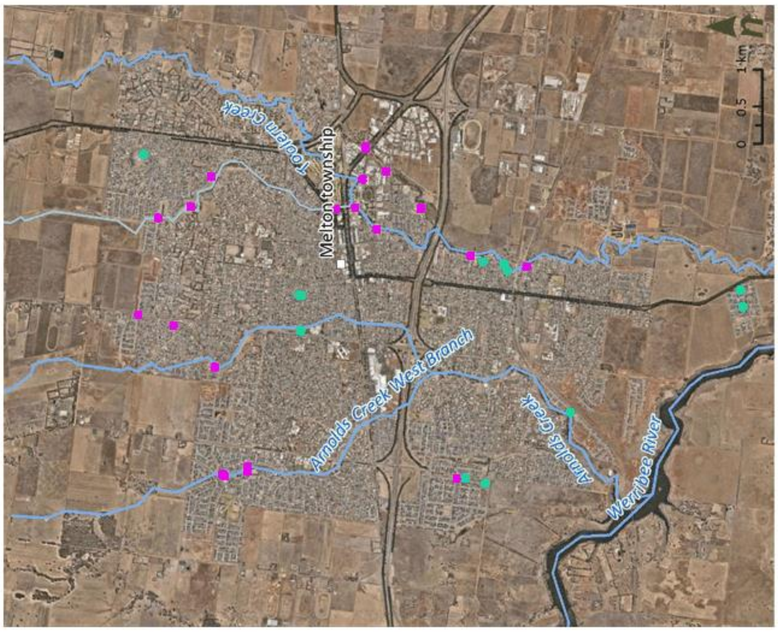


Figure 15. *Water sensitive urban design assets – Melton Township*

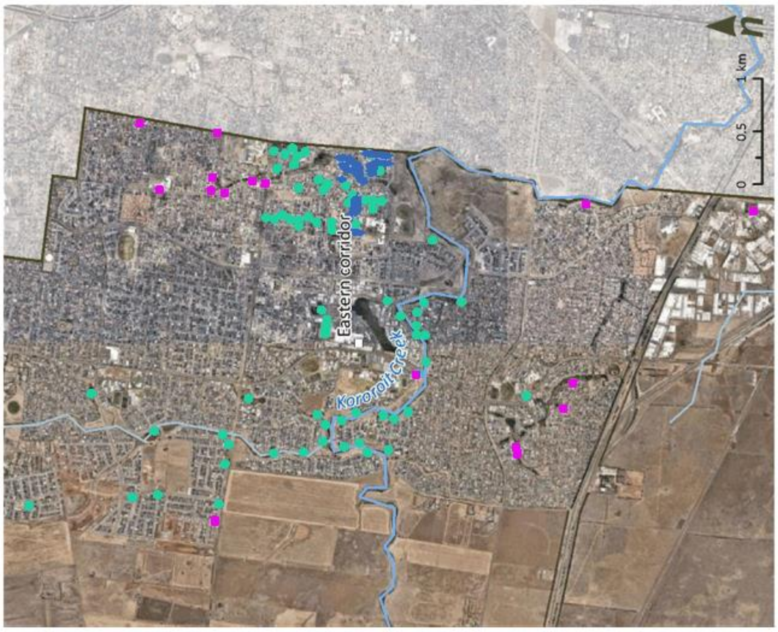


Figure 14. *Water sensitive urban design assets – Caroline Springs*

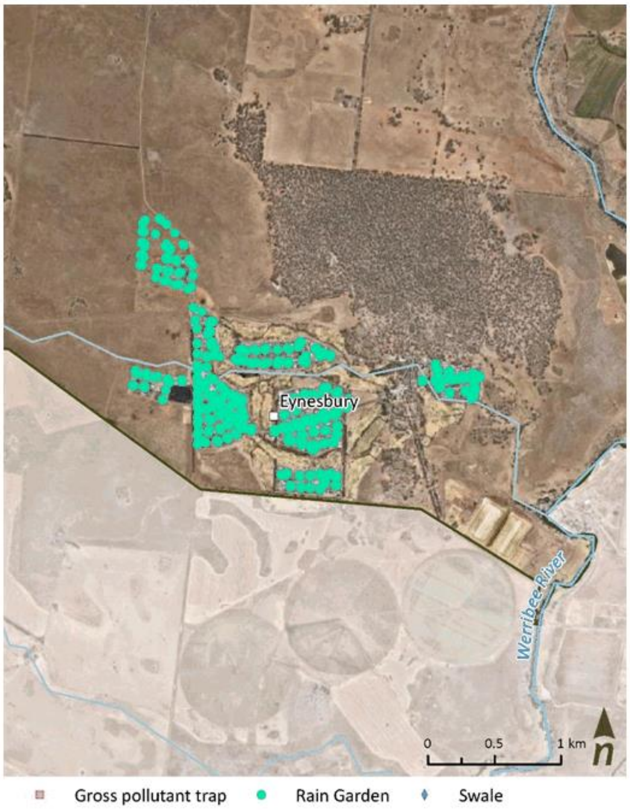
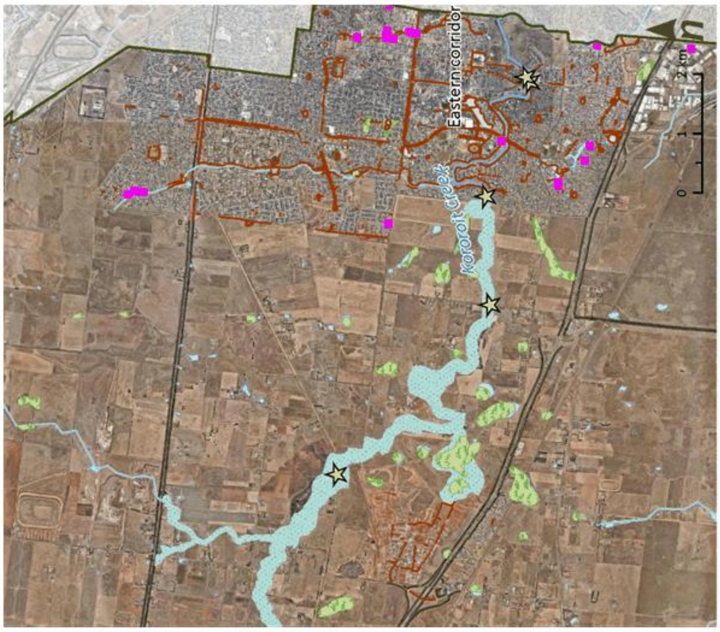


Figure 16. *Water sensitive urban design assets – Eynesbury*

2.7 Litter

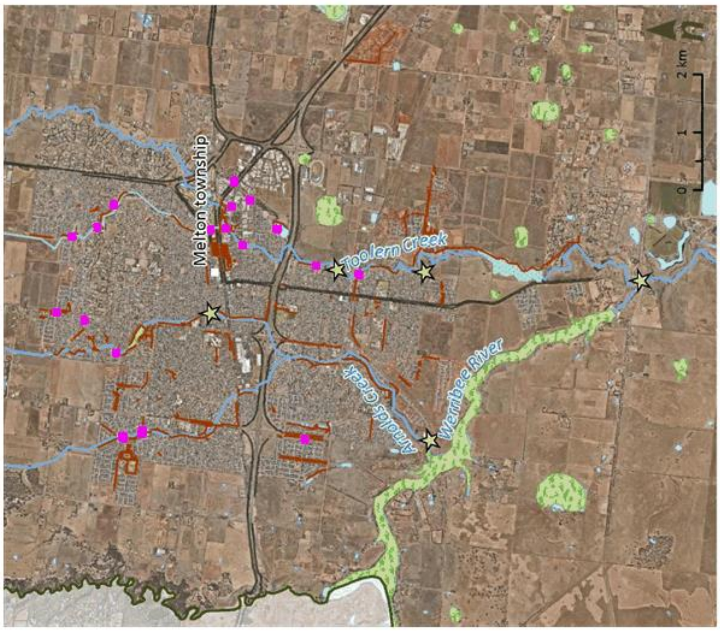
Litter can have a significant and detrimental impact on the amenity of waterways. Commercial areas including shopping centres and industrial areas represent litter hot spots, with litter conveyed to waterways via wind and stormwater. Council has identified litter as an issue and has installed approximately 45 gross pollutant traps (GPTs) in response. Council also logs information on litter 'hotspots', noting where litter is generated or dumped (Figure 17 and Figure 18). What can be observed is that many litter hotspots are located on or near waterways, suggesting these locations are typical recipients of litter through dumping or stormwater.

Litter and waste management is an important aspect of Council's direct responsibilities that can have a positive impact on waterway health and the community's perception of those waterways. Understanding the location of litter hotspots will assist Council to prioritise future interventions.



Litter hotspot
Gross pollutant trap
Shared Path
Water body
Natural wetland / waterbody
Biodiversity: Growling Grass Frog

Figure 17. *Litter hotspots – Caroline Springs*



Litter hotspot
Gross pollutant trap
Shared Path
Water body
Natural wetland / waterbody
Biodiversity: Growling Grass Frog

Figure 18. *Litter hotspots – Melton Township*

2.8 Climate change and urban heat

The anticipated impacts of climate change are well documented and include increases in average temperatures, more hot days, reduced average rainfall, increased evaporation, and a corresponding reduction in catchment runoff (DELWP, 2017).

The City of Melton *Environment Plan 2017 – 2027* addresses the risks of climate change referring to embedding climate resilient infrastructure into Council's capital programs. The Environment Plan also notes the pressure on water availability and Council's responsibility to reduce potable water use. The impact of climate change may be more acute within the Melton City Council area than the east of Metropolitan Melbourne given that the west typically receives less rainfall as illustrated within Figure 19.

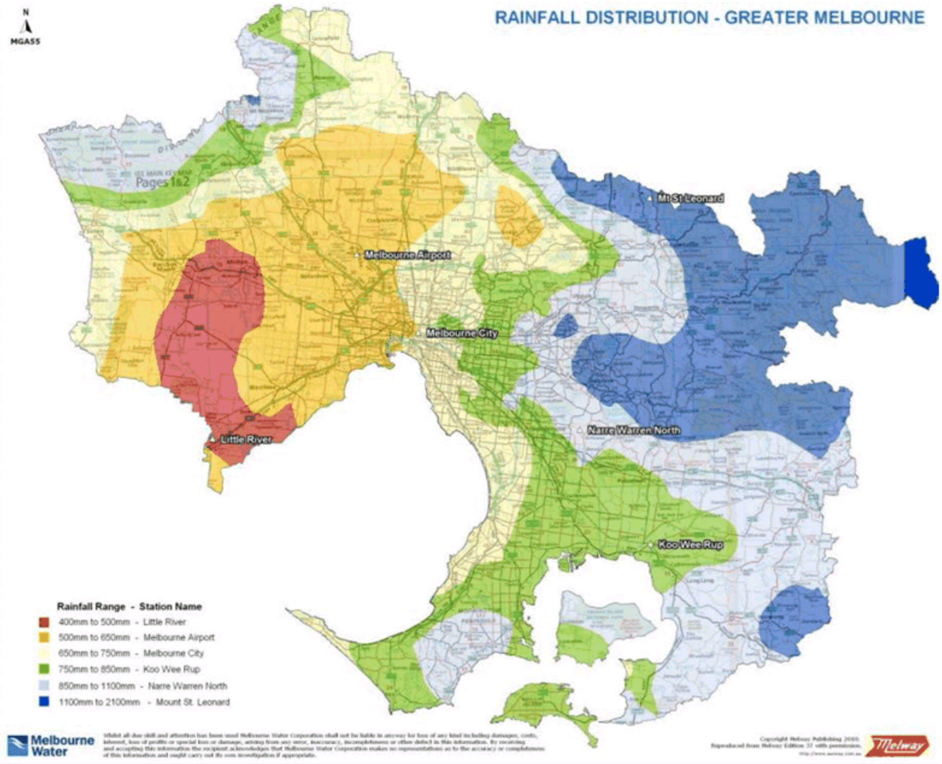


Figure 19. *Rainfall distribution – Greater Melbourne (Source: MUSIC Guidelines 2016, Melbourne Water)*

Estimates of the impact of climate change have been sourced from *Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria* (DEWLP, 2016). These guidelines set out anticipated changes in temperature, evaporation and run off from metropolitan and rural catchments, including the Werribee catchment, in 2040 and 2065.

The Werribee catchment climate change estimates have been adopted for the plan and are summarised in Table 2. For the purposes of modelling the water and pollutant balance for Melton City Council, the 50th percentile 2040 changes were adopted.

Table 2. Estimated changes relative to current climate baseline in the Werribee River Basin (Source: DELWP, 2016)

Criteria	2040	2065
Temperature change (°C)*	+1.3	+2.3
Potential evapotranspiration (%)*	+4.7%	+7.7%
Rainfall* (1975 – 2014 average: 619mm / year)		
10th percentile (low)	+2.2%	+2.4%
50th percentile (medium)	-2.7%	-6.2%
90th percentile (high)	-11.7%	-21.4%

*change relative to current climate baseline

Urban heat

Urbanisation has and will continue to replace the cooling effect of natural green and blue spaces with hard, engineered surfaces that absorb and re-radiate heat. The effect of this is described by the term the 'urban heat island' effect, where heat generated from the built environment exacerbates heat stress and amplifies the impacts of extreme heat events, above what they would otherwise have been. For example, roof and pavement surface temperatures can be between 27–50°C hotter than the ambient temperature, while shaded or moist surfaces remain close to air temperatures (Berdahl, 1997).

As well as reducing human comfort, the urban heat island effect has been implicated in increased levels of mortality, such that when daily minimum temperatures exceeded 30°C average daily mortality for those over 65 increased by 15–17% (Nicholls et al., 2008). Reducing the temperature even by a few degrees below this threshold will act to save lives.

Research shows that vegetation, especially trees, can effectively mitigate urban heat. The amount of cooling provided by vegetation is influenced by multiple factors including tree health and water availability. Trees provide maximum human thermal comfort (HTC) benefits when they have access to water during heat waves (CRCWSC, Accessed 2018).

Figure 21 shows the current location of trees based on Council and DELWP data. What this data shows us is that Council's and developer's tree planting has, not surprisingly, been within the Eastern Corridor and the Melton Township. Communications with Council indicates that of the total number of trees planted annually, 20% is planted by Council, with 80% planted in association with new developments. The total number of trees planted over the last seven years is summarised in Figure 20.

The opportunity that is being illustrated in Figure 21 is the 'gap' in tree coverage between those two areas and therefore the potential to 're-forest' that area when residential development occurs. This opportunity will be driven by tree planting in new developments, with health and growth of trees supported by a better understanding and application of passive irrigation of street trees. The tree canopy that is planted and grows with new developments will be a critical factor in mitigating the urban heat island effect in the City of Melton.

The focus of targets associated with passive irrigation of trees is on internal capacity through the establishment of a passive irrigation trial, peer to peer learning with neighbouring Councils who have undertaken similar trials and communication with developers to ensure that passive irrigation designs are agreed. New trees can be planted and passively irrigated by stormwater to reduce potential potable water demand while improving tree health and the cooling capability of the urban forest.

Furthermore, there is an opportunity to identify biodiversity corridors identified as part of the Western Plains North Green Wedge Management Plan in the northern rural areas of Melton. These corridors can provide access for fauna and may also assist in achieving the tree canopy cover target in rural areas.

Figure 20. *Total trees planted in the City of Melton*

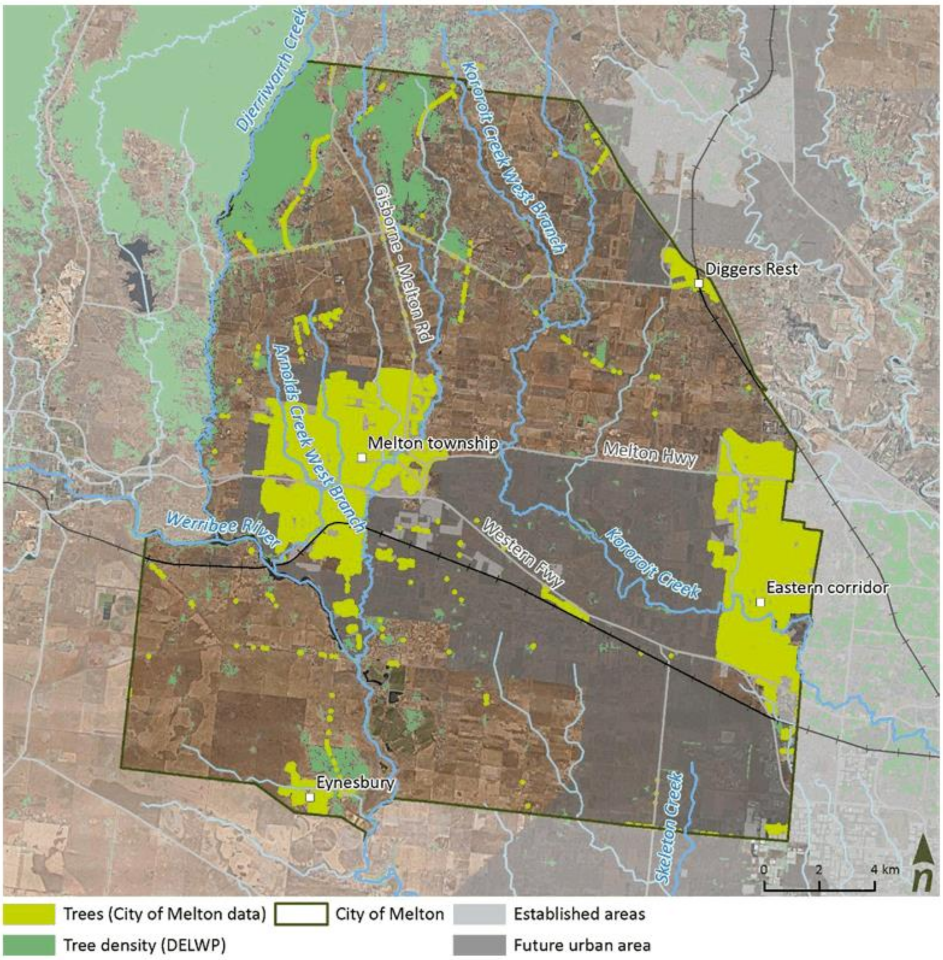


Figure 21. *Tree coverage*

2.9 Groundwater

There are multiple aquifers in City of Melton including the Werribee Delta Aquifer and Werribee Formation Aquifer. The Werribee Delta Aquifer is a key resource that is used by irrigators for water supply that falls within the Deutgam Water Supply Protection Area and hence has agreed sustainable extraction limits.

Melton City Council has a groundwater allocation, managed by Southern Rural Water, to top up Lake Caroline of 120 ML/year. A review of the Visualising Victoria's Groundwater website, indicates that the salinity of groundwater in Melton City Council is likely to be 1,000 – 3,500 mg/l or greater. Groundwater is therefore unlikely to be suitable for open space irrigation. There may however be some opportunities to combine this water with less saline sources to achieve that end, however the plan does not investigate this in any detail.

2.10 Liveability, health and well being

"Liveability means our communities remain places where people want to visit and live, and that our natural environment is healthy, accessible and well-managed for current and future generations." (State of Victoria, 2016). While the concept of liveability extends beyond water, ensuring that Melton City Council is a 'place where people want to visit and live' is central to the vision of the IWM Plan.

The *Economic Building Blocks for Victoria* document (State of Victoria, 2016) highlights liveability as a significant differentiator for Victoria, with 'Building Block 6: Liveable Places' noting that the following are critical to 'the performance of a modern economy':

- Well- designed places
- A healthy and accessible natural environment, and
- Sustainably used resources.

All of these relate to the objectives and outcomes sought by the plan. The role of the urban water industry in contributing to liveability (Water Services Association of Australia, 2014), calls for 'stronger integration of water and urban planning to ensure our water services secure the liveability of our cities and regions'. In addition to traditional services the water industry has shifted its focus toward waterway health, enhancing recreational sites and improving amenity.

Figure 22 illustrates the relationship between the range of water services and the community's physical and mental wellbeing. There are numerous overlaps with the objectives of the IWM Plan including links to quality and quantity of open space, natural ecosystems and urban cooling.

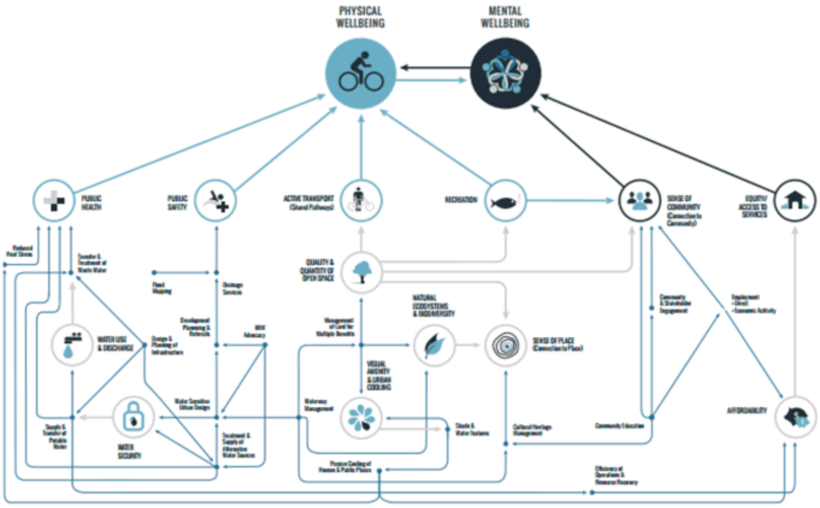


Figure 22. *Interactions between water and aspects of liveability (Holmes, 2013)*

3 Water and pollutant balance

The water and pollutant balance estimates the quantity of flows and pollutants that make up the water cycle. The analysis estimates current (2016) and future (2040) volumes of potable and non-potable water, stormwater and wastewater that are used and generated within the municipality. The pollutant balance estimates the pollutant loads associated with stormwater volumes, focussing on total nitrogen, total phosphorus, total suspended solids and litter.

The purpose of developing a water and pollutant balance for the City of Melton is to better understand anticipated changes in the volume of flows and pollutant loads over time thus quantifying the impacts of population growth and urbanisation on the water cycle and the receiving environment. The results highlight future issues and opportunities that in turn will drive the objectives and actions set out within the IWM Plan.

Two water and pollutant balance scenarios were examined:

1. **Baseline (2016)**: the water balance under current population, climate and urban development conditions.
2. **Projected (2040)** based on:
    - Estimated population increases
    - Anticipated land use changes and particularly urbanisation
    - Climate change and the projected changes in rainfall, evaporation and surface runoff.

3.1 Method

The water and pollutant balance was undertaken using MUSIC modelling software as well as Excel spreadsheets to process data from a range of data sources including:

- Population forecast data from 2016 to 2040 (http://home.id.com.au/)
- Community potable and recycled water use between 2013 to 2016 (City West Water and Western Water)
- Wastewater generated (as a proportion of potable water consumed)
- Council water use (2008 to 2016) based on Planet Footprint data. Council water use has been assumed to be potable except where recycled water supply is known to be supplied.
- Stormwater volumes and associated pollutant loads generated from MUSIC modelling
- Groundwater use based on Southern Rural Water data.

Additional assumptions made in estimating the baseline and projected water and pollutant balance are included in Appendix A.

A summary of the water balance for the City of Melton in 2016 and 2040 is provided in Figure 23 and Figure 24.

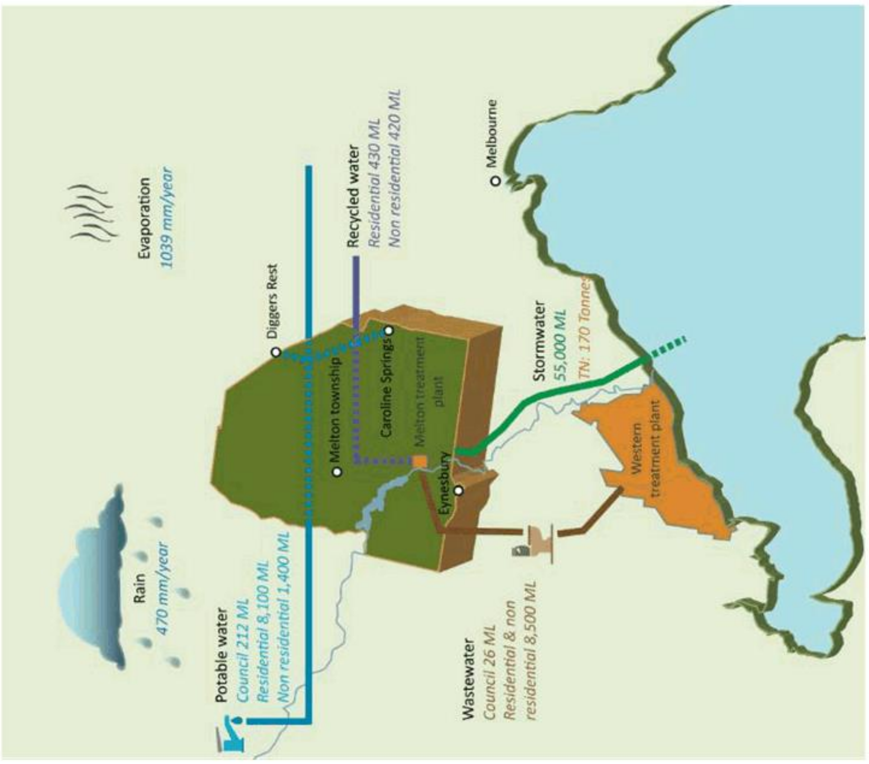


Figure 23. *2016 Water balance summary*

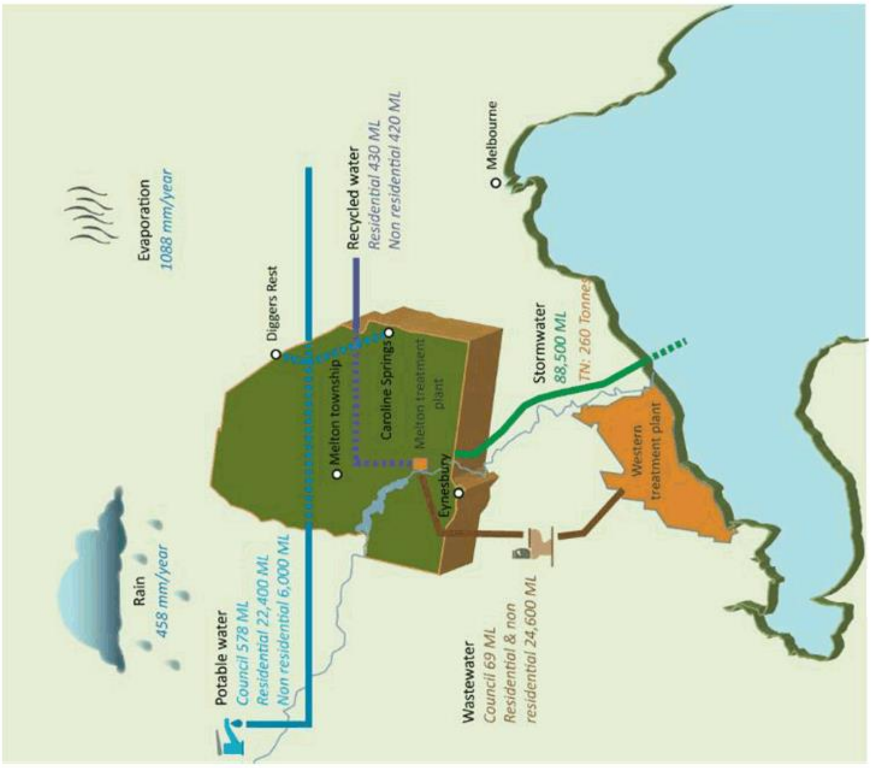


Figure 24. *2040 Water balance summary*

3.2 Potable and non-potable water consumption

Community

Potable water use data was gathered from City West Water and Western Water for the years 2013 to 2016. The data shows residential water use makes up 77% and 88% of total potable water use within Western Water and City West Water's business areas respectively. The remainder goes to non-residential demand e.g. commercial demands, golf clubs, wineries, nurseries and local industry.

Combining consumption and population data for 2016 shows residential water use of 166 litres/person/day for Western Water and 181 litres/person/day for City West Water customers.

These rates of consumption have been used to estimate future water use. When looking at overall community water use (i.e. including residential households, industry etc), this equates to approximately 65 kL/person/year on average. A number that has been relatively consistent over the last few years.

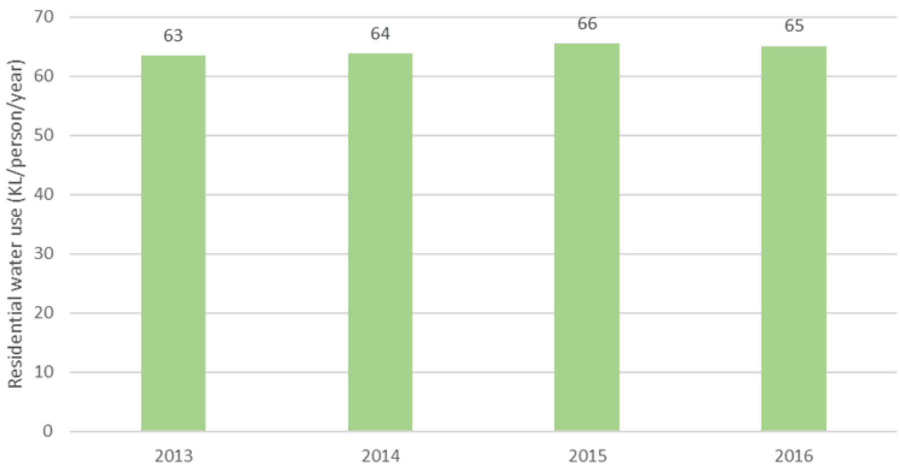


Figure 25. *Per capita water use – Community*

City of Melton

As noted above, Council's water use (2016) shows that the dominant use of potable water on open spaces (73%), with 13% used at Melton Waves, 12% at the remainder of Council buildings. 2% is unaccounted for and is assumed to be lost through leakage or bursts.

It should be noted that there have been new open spaces areas come on-line in recent years, with urban development, and these typically require more irrigation in early years to become established. For example, irrigation data suggests this may be 6-7 ML/ha/year (megalitres per hectare per year) compared to 5 ML/ha/year or less over the longer term. The irrigation aspect of Council's projected consumption figures have therefore been adjusted down (to 5 ML/Ha/year) to reflect what would be the longer-term average.

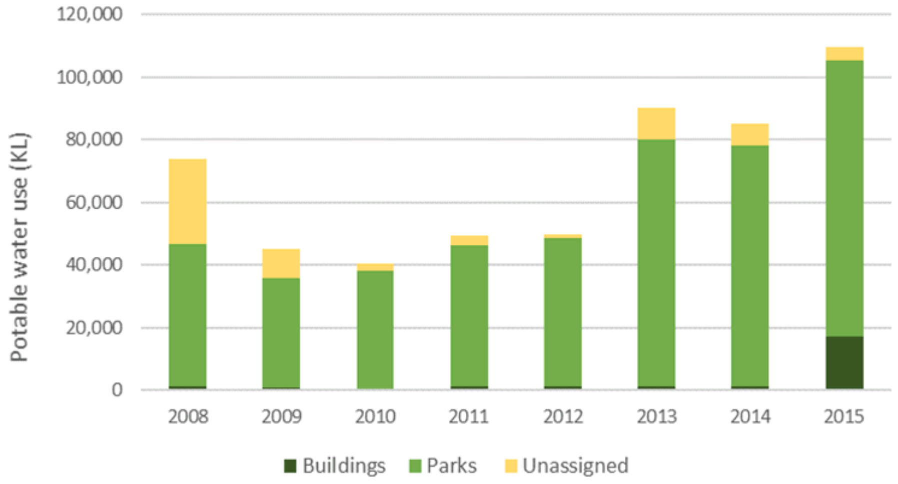


Figure 26. *City of Melton Potable water use (2008 – 2015)*

High water users
Council's higher water users are set out in Table 3. What is notable is the higher consumption volumes of open space when compared to buildings, and therefore why Council's aim to increase irrigation efficiency and identify alternative water sources to irrigate those spaces. Melton Waves is the outlier as a water-based recreation centre.

Table 3. *Snapshot of Council high water users in 2016*

Open space high water user	Water use (ML)	Building high water user	Water use (ML)
Blackwood Drive Recreation Reserve	21.2	Melton Waves	36.6
Taylors Hill Recreation Reserve	21.0	Melton Recycling Centre	6.1
Reserve Tenterfield Drive Caroline Springs	12.0	Melton Civic Centre water meter (irrigation)	1.5
Melton South Recreation Reserve	11.3	Caroline Springs Leisure Centre	1.3
Ian Cowie Recreation Reserve	9.8	Melton Library & Learning Hub	1.1
Mt Carberry Reserve	6.3	Pinnancle Crescent Community Centre	1.0

Projected water use (2040)

Future 'all of community' potable water demand has been estimated by multiplying per capita residential and non-residential water use by the estimated future population. Community potable water use is therefore estimated to triple to approximately 29.5 GL/year by 2040.

Future Council only water use has been estimated based on growth in the number or area of Council's facilities (including buildings and open spaces). Open space and sportsgrounds (using 21.6 ha as the 2016 baseline) and building water use was extrapolated based on population growth. This suggests Council's potable water consumption could grow from 212 to 578 ML per year by 2040.

A note on recycled water: Western Water supplies recycled water to the areas within the City of Melton as described in Section 2.4 above. At the time of writing, Western Water's position on providing recycled water was under review. However, it is understood that while current commitments will be honoured, future extensions of the network are in doubt. While this requires further investigation, it has been assumed within the water balance that there is no growth in residential or Council recycled water consumption.

Table 4 summarises the comparison between 2016 and projected 2040 water use.

Table 4. Current and projected water use (2040)

End user	Water type	Volume in 2016 (ML/year)	Volume in 2040 (ML/year)	Comments
City of Melton				
	Potable	212	**578**	Based on per capita water use adjusted for population growth
	Recycled water	1.5	1.5	Assuming no growth in recycled water use.
	Stormwater	Unknown	Unknown	No planned change in stormwater harvesting projects.
	Groundwater	120	120	Lake Caroline allocation (Southern Rural Water data)
Community				
Residential	Potable	8,110	**22,365**	Based on population data, City West Water and Western Water use per capita
	Recycled water	433	433	Assumed no growth in recycled water use
Non-residential	Potable	1,444	**5,979**	Based on population data, City West Water and Western Water use per capita
	Recycled water	422	422	Assumed no growth in recycled water use
Total demand		**10,322**	**29,477**	

3.3 Wastewater

Wastewater is not metered, so volumes are estimated to be a proportion of potable water consumed. These proportions equal 89% and 81% of total residential and non-residential water use for Western Water and City West Water respectively. Wastewater that is generated with Western Water's business area is conveyed to and treated at the Melton (Surbiton) Recycled Water Plant. Some of this treated wastewater is recycled for use in the suburbs of Eynesbury and Toolern Vale (Western Water, 2017) or discharged to the Werribee River. Wastewater generated within City West Water's business area is conveyed to and treated at Melbourne Water's Werribee Treatment Plant.

Projected wastewater flows were extrapolated based on growth in potable water use due to population growth and the proportions noted above. While Council does not manage reticulated (or piped) wastewater, the implications of growing volumes of wastewater include greater energy consumption to convey and treat wastewater with increased discharges of treated wastewater to the environment, including waterways such as the Werribee River and ultimately Port Phillip Bay. It also implies a significant, potential alternative water supply source, with its own energy and infrastructure cost implications.

Table 5. Wastewater summary

Wastewater generator	Volume in 2016 (ML)	Volume in 2040 (ML)	Data source / Comments
City of Melton	26	69	Assumed to be 80% of Council building water use.
Residential/Non-residential	8,532	24,577	Based on City West Water and Western Water wastewater generation assumptions
Total wastewater generation	**8,378**	**24,647**	

3.4 Stormwater

Stormwater volumes and pollutant loads were estimated using MUSIC modelling software taking into account anticipated changes in land use, rainfall and evapotranspiration as well as existing water sensitive urban design assets (WSUD) within each catchment. The location of each catchment within Melton City Council is shown in Figure 27. The assumptions around the stormwater modelling are included in Appendix A.

Figure 28 summarises the stormwater story for each catchment, including catchment area, stormwater volumes and what proportion of the catchment is urbanised. Most stormwater is generated within Kororoit Creek, Werribee River (lower) and Toolern Creek catchments. This is largely a function of area, while catchments like the Laverton main drain are highly urbanised and generate higher volumes of stormwater in proportion to their area.

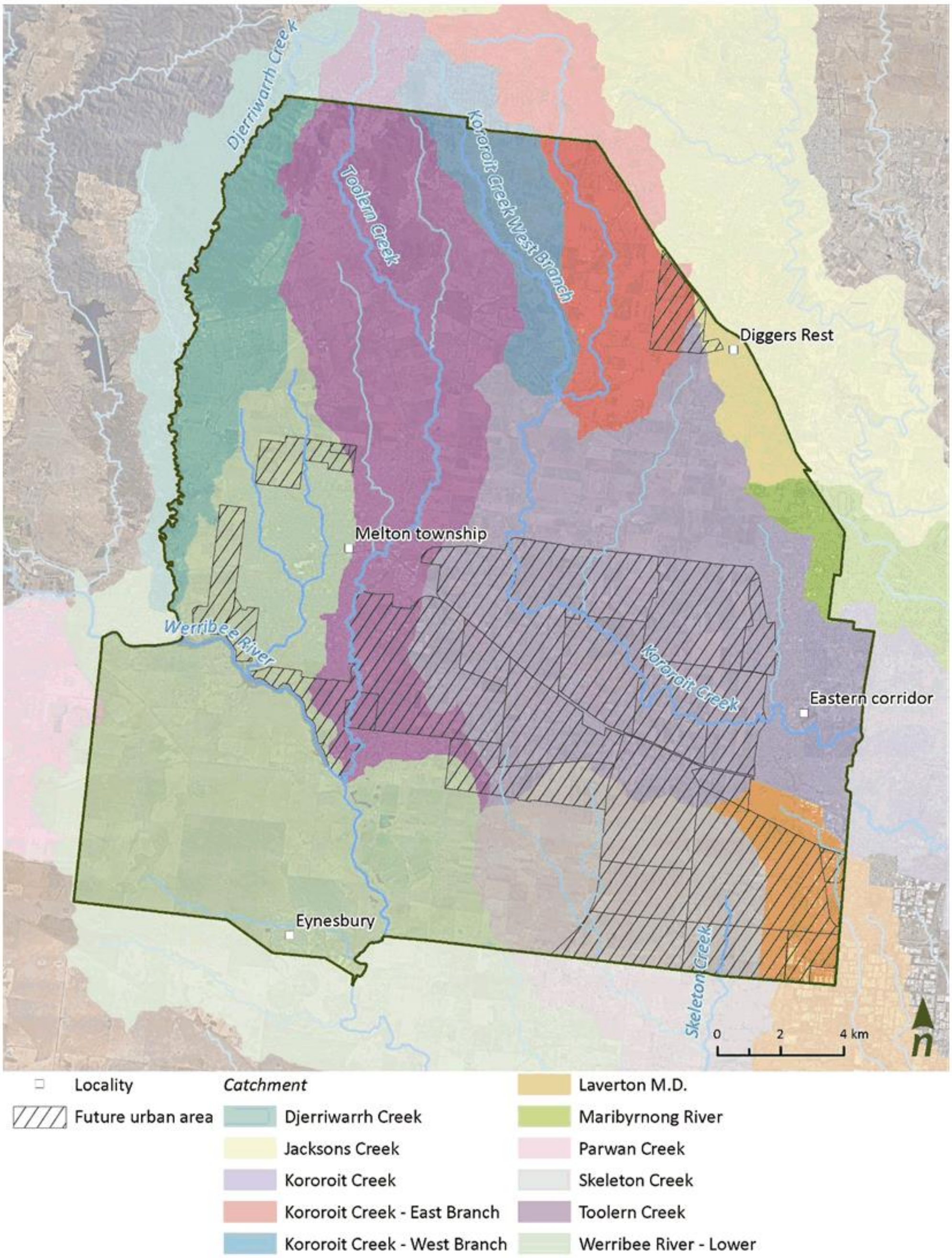


Figure 27. *Waterway and drainage catchments*

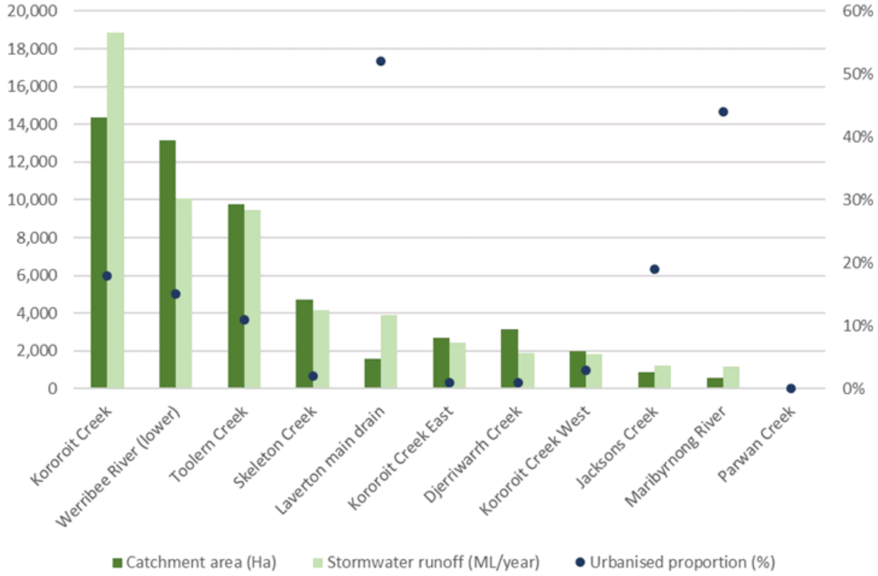


Figure 28. *City of Melton: catchment, stormwater and urbanisation summary (2016)*

Nitrogen load (in kg/year) is used here as a proxy for the broader pollutant load (including total phosphorus, sediment and litter). Figure 29 shows the relative nitrogen load contribution of the developed and undeveloped proportion of each catchment.

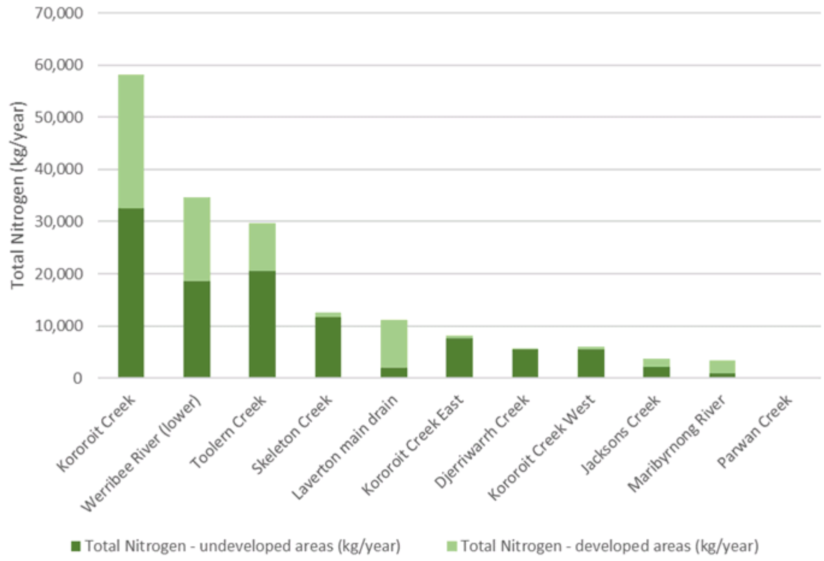


Figure 29. *Total Nitrogen generated by catchment (2016 average year)*

The reduction in stormwater pollutants that is attributable to Council's existing WSUD assets has been accounted for within these results. This analysis suggests there is an opportunity to both:

- manage and treat stormwater from existing developed areas where urbanisation contributes a significant proportion of Total Nitrogen loads, and
- implement WSUD over time as the proportion of urbanisation grows within these catchments.

Projected stormwater generation (2040)
Urbanisation will increase imperviousness and in turn stormwater runoff and pollutant loads. Overall, it is estimated that urbanisation will grow from 13% to 38% of the City of Melton's area by 2040. This change is estimated to increase stormwater generated from 55 GL per year to 88.5 GL in an average rainfall year. These estimates consider the impacts of climate change, discussed in Section 3.5 below.

Figure 30 shows this increase by catchment, with significant increase in runoff expected within the Kororoit Creek catchment. Note also the proportionate increase in runoff within the Skeleton Creek catchment.

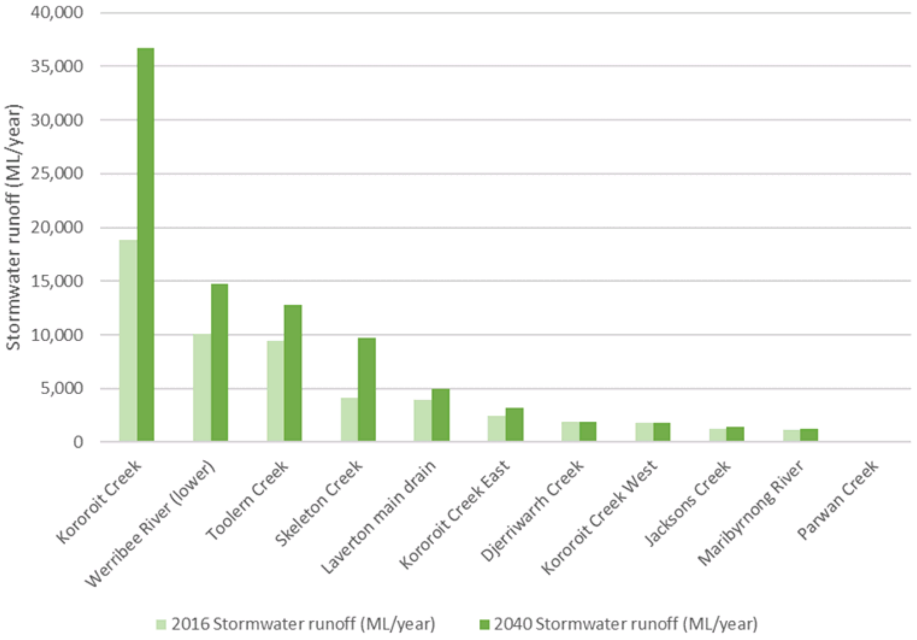


Figure 30. *Projected stormwater generated by catchment (2040)*

Figure 31 tells a similar story as Figure 30 in terms of nitrogen load.

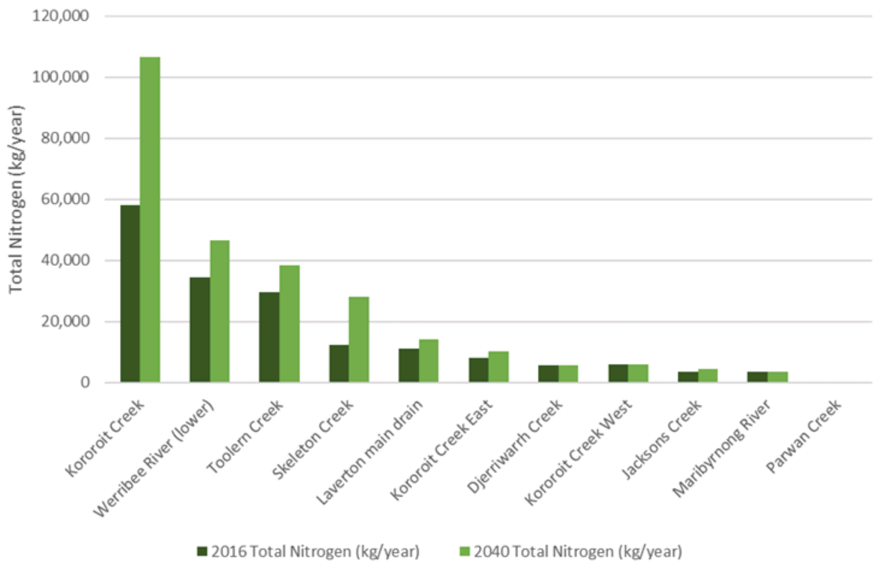


Figure 31. *Projected nitrogen generated by catchment (2040)*

3.5 Climate change and stormwater

The baseline (2016) and projected (2040) water and pollutant balance for Melton City Council are based on two rainfall gauges time series: Melbourne Airport (1971-1980) and Little River (1992-2001) as per recommendations within Melbourne Water guidelines (Melbourne Water, 2016). Monthly aerial potential evapotranspiration data is based on Melbourne Airport.

Climate change data sets were prepared to reflect anticipated changes in rainfall and evapotranspiration within the Werribee catchment at 2040 (see 2.8 above). The results indicate that in 2040 we can expect a moderate reduction in stormwater runoff due to a reduction in average rainfall and increasing evapotranspiration. The overall water balance suggests that this reduction is more than made up for by the stormwater generated from the urbanisation that is expected out to 2040. The results for each catchment, assuming 2040 levels of development, are set out in Figure 32.

The role of climate change in reducing average annual stormwater volumes (assuming other variables like imperviousness remain constant), is also linked to rainfall intensity. Higher temperatures increase the capacity of the atmosphere to retain moisture resulting in heavier downpours and increased intensity of rainfall events (Climate Council, 2017). This will impact the community through flooding. The potential flood risk due to climate change has not been modelled here. The design and location of flood mitigation and conveyance assets like retarding basins and constructed waterways is managed, often through the development process, by Melbourne Water with assets designed to protect property and residents from flood.

The assets that this report is more focussed on, and that are the direct responsibility of Council include WSUD, stormwater harvesting and stormwater infiltration assets. These assets are not designed to mitigate flooding. Therefore, while an increased risk of flooding due to climate change is real, mitigating that risk is not the focus of the plan and can be better addressed through the precinct structure plan and drainage services schemes process (managed by Melbourne Water) and also the preparation of Flood Management Plans, also in partnership with Melbourne Water.

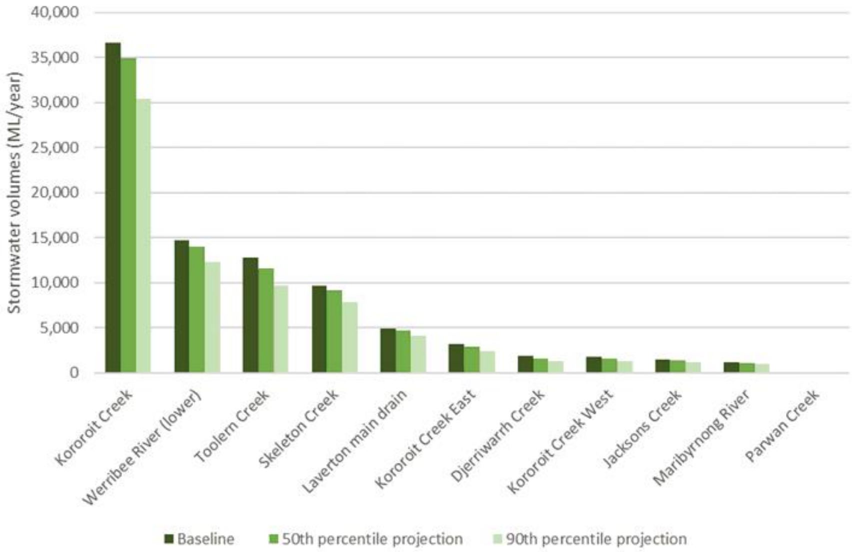


Figure 32. *Impact of climate change on stormwater volumes*

Figure 33. *Ryans Creek rehabilitation*

3.6 Water and pollutant balance summary

In summary:

- Potable water use is expected to almost triple by 2040 to 28 GL. 0.5 GL of that projected potable water use is due to Council activities.
- Per capita residential water use is between 166 and 181 litres per person per day. This may present an opportunity e.g. reducing consumption to something like 'target 155' litres per person per day, potable water consumption could be reduced by up to 5 GL per year. However, such an initiative is primarily the responsibility of the State Government and water retailers.
- There are likely to be opportunities for improved efficiency in the irrigation of open space and water use within Council buildings. Before investigating alternative water sources, it is important to know that all water is being used efficiently.
- It has been assumed that there is no growth in recycled water network. This presents an opportunity for Council to:
    - advocate for 'fit for purpose' recycled water use for the irrigation of green spaces. For example, Class B or C water is likely to be fit for irrigation while also incurring lower capital and operational costs. Access to additional recycled water in appropriate areas may also assist landowners and enterprises in rural areas.
    - Influence the nature of the Integrate Water Management plans that developers are currently required to submit to Western Water for new developments. In the absence of recycled water Council can direct developers towards activities that are consistent with the plan including stormwater and rainwater harvesting and reuse and passive tree irrigation.
- Council should investigate alternative water sources to meet their demands, particularly as an additional 33 GL per year of stormwater will be generated over time through urban development.
- This water and pollutant balance has assumed greenfield developments meet BPEM requirements. It is therefore implied that Council's infrastructure budget and efforts will focus on improving stormwater quality established catchments.
- While the water and pollutant balance doesn't deal with issues that could broadly be associated with 'liveability', the implication of the water balance is that growing volumes of poor quality stormwater and wastewater will diminish the quality of waterways and wetlands and therefore the community's enjoyment of those natural assets and perception of their value. This numerical analysis provides a sound basis for action to protect those natural assets.

4 Vision and objectives

The vision and objectives for the plan have been developed thorough a consultation process with the aim of articulating Council's aspirations for water and how it will shape the city into the future.

4.1 Vision

Melton City Council uses and manages water sustainably to enhance urban and natural assets and support community health and wellbeing.

4.2 Objectives and outcomes

The plan has three objectives:

1. Reduced reliance on potable water
2. Healthy waterways and wetlands
3. Valued landscapes that are connected and accessible.

These objectives represent the logical distillation of feedback received throughout consultation. Workshops and meetings were held with internal and external stakeholders and their water cycle issues and opportunities were discovered and organised within a 'program logic' structure (see Section 6.1). This involved categorising identified issues and opportunities with responses under intermediate and longer term 'outcomes'. The longer-term outcomes provided context for the plan's objectives, while actions were defined to achieve both intermediate and longer-term outcomes.

The outcomes that sit underneath each objective are set out in Figure 34 below. A description of the consultation undertaken is provided in Appendix B.

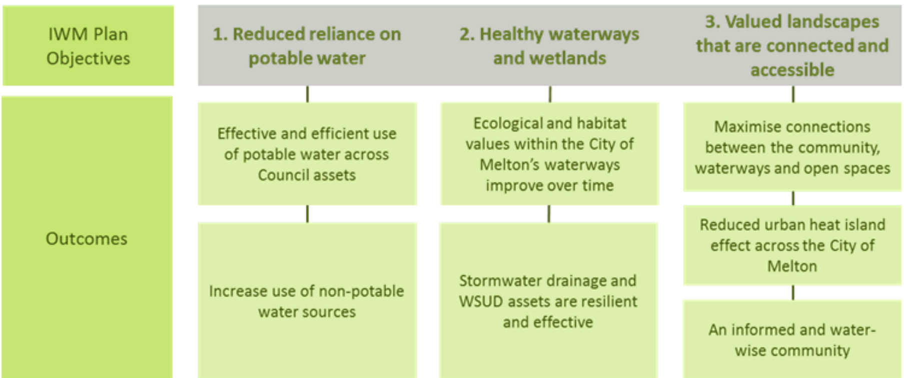


Figure 34. *Objectives and outcomes*

5 Scenarios

Implementation scenarios were analysed to understand the impact of different levels of activity and investment for Council to consider as they progress towards achieving the objectives and delivering the outcomes within the plan. Scenarios have been developed for four key areas out to 2028:

1. Water use efficiency (in open space and buildings)
2. Alternative water supply (including recycled water and stormwater)
3. Total nitrogen (as a proxy for stormwater pollutant loads), and
4. Litter (as a proxy for amenity particularly for waterways).

Three scenarios have been defined for each area.

Table 6. Scenario definitions

Scenario		Definition
1.	Baseline	2016 condition
2.	Projected	2028 – Baseline condition adjusted for population growth
3.	Scenarios	2028 – Increase in investment beyond the 'projected' scenario

5.1 Water efficiency

Water efficiency relates to both the use of potable water on open spaces (active and passive), as well as within Council buildings. These two opportunities for water efficiency have been dealt with separately below.

Open space

Under projected levels, the irrigation rate for active open space has been estimated to be 5 ML/ha/year to reflect baseline irrigation management, adjusted for the 50th percentile climate change projection (i.e. changes in rainfall and evapotranspiration). This irrigation rate applies to a warm season grass sportsground with a very high turf quality standard, with the assumption that all sportsgrounds are warm season grass and managed to this standard by 2028.

Two irrigation 'plans' have been assessed under water efficiency for open space irrigation.

Plan A – Infrastructure improvements: Under the plan, the assumption for active open space is that efficiency measures reduce the irrigation rate from 5 ML/ha/year to 4.5 ML/ha/year: a 10 % reduction. This is achieved through infrastructure improvement including improved and upgraded irrigation infrastructure, better controls and distribution uniformity (of >70%).

Plan B- Level of service: Under this 'stretch' target, further reductions are achieved by managing sportsgrounds on a ground by ground basis to achieve the desired level of service (assuming the standard varies between sportsgrounds). It is estimated that through these management practices, the average irrigation rate can be between 4.5 to 3.5 ML/ha/year. The assumption is that this is achievable with appropriate resourcing and capacity building of staff.

The outcomes of each water efficiency 'plan' are set out in Table 7 below.

Table 7. Water efficiency scenario

Scenario	Sub-category	Water efficiency savings		Comment
		Plan A	Plan B	
Baseline		0	0	2016 recycled water use plus unknown volumes of stormwater harvesting
Projected		0	0	Assumed no 'organic' growth in recycled water given Western Water's policy at the time of writing
Scenario	Active open spaces	20 ML/year	73 ML/year	Plan A is a minimum recommended reduction in demand based on reduction in projected irrigation rates from 5 ML/ha/year to 4.5 ML/ha/year through improvement of irrigation infrastructure and controls. Plan B achieves additional reduction to 3.5 ML/ha/year by matching irrigation rate to turf quality standard
	Passive open space	9 ML/year	9 ML/year	Reduction from current irrigation rate of 2.0 ML/ha/year to an average of 1.8 ML/ha/year
	Buildings	10 ML/year	10 ML/year	Based on efficiency measures in 15 priority buildings (to bring water use to 0.53 kL/sqm/year) and 5% reduction in water use at Melton Waves
Total potential water use efficiency savings		**39 ML/year**	**92 ML/year**	

5.2 Alternative water supply

Alternative water sources, including stormwater and recycled water, are used in the Council context predominantly for the irrigation of open spaces. This involves either establishing a stormwater harvesting scheme for one or more open spaces, or the extension of the recycled water network, as discussed above. When considering alternative water sources, an allowance has also been made for rainwater harvesting from Council buildings to meet non-potable demands, like irrigation of Council gardens.

An important assumption for the alternative water supply scenario is that Melton City Council commits to identifying stormwater harvesting and reuse opportunities, implementing their first alternative water supply project within three years. A new stormwater harvesting scheme is programmed every two years thereafter (to 2028 for the purposes of calculating the potable water savings). Irrigation of passive, as well as active open spaces, has also been incorporated into this scenario. A program described above and in Table 8 is estimated to yield approximately 23 ML/year in potable water use reduction.

Table 8. Alternative water supply scenario

Scenario	Sub-category	Volume	Comment
Baseline		=>1.5 ML/year	2016 recycled water use plus unknown volumes of stormwater harvesting
Projected		=>1.5 ML/year	Assumed no 'organic' growth in recycled water given Western Water's policy at the time of writing
Scenario	Active open spaces	17 ML/year	1st active open space alternative water project in 3 years, with one project every 2 years after that (out to 2026)
	Passive open space	5 ML/year	3 ha of passive open space irrigation demand met by alternative water supply
	Buildings	0.8 ML/year	Rainwater tanks meet 50% of Melton Civic Centre external water use
	Total	**23 ML/year**	Additional alternative water supply for open spaces and buildings

5.3 Total Nitrogen

The reduction in Total Nitrogen (TN) loads to receiving waterways is a proxy for a reduction in stormwater pollution more broadly. For the purposes of the Total Nitrogen scenario and the associated modelling, it is assumed that new developments will meet best practice environmental management (BPEM) pollution reduction targets. Therefore, the investment scenario is focussed more so on retrofitting existing urban areas.

The 'projected' scenario assumes the installation of two WSUD assets per year with an equivalent bioretention area of 100 m^2 installed each year. The 'investment' scenario proposes that this rate be doubled to four projects (e.g. or equivalent to 200 sqm of bioretention area per year). Melton City Council has extensive experience with these assets and therefore it is expected that this can be implemented immediately.

An element of WSUD that could further stretch this target is integrating WSUD into road renewals and through the passive irrigation of street trees. While the impact on nitrogen load of these activities has not been estimated, they will be highlighted within the action plan.

Table 9. Total nitrogen reduction

Scenario	Total TN load (kg/year)	Additional TN load reduction (kg/year)	Comments
Baseline	4,030 kg	0	2 WSUD projects per year
Projected	4,138 kg	108	2 WSUD projects per year (100 m^2 / year)
Scenario	4,245 kg	214	4 WSUD projects per year (200 m^2 / year)
	Total	**214**	

5.4 Litter

The baseline litter scenario reflects the operation of Council's 45 gross pollutant traps (GPTs), pit cleaning activities and WSUD assets. Increasing litter removal rates is seen as directly improving waterway condition and therefore liveability within the City of Melton. The implementation of WSUD has also been accounted for in the reduction of litter.

Table 10. Litter removal in 2028

Scenario	Removal method	Litter removed (tonnes / year)	Change in litter load removed (tonnes / year)	Comment
Baseline Scenario	GPT & WSUD	57.8		
	Pit cleaning	48.8		
	Total	**106.7**		
Projected Scenario	GPT & WSUD	58.4	**0.5**	100 m^2 of WSUD per year
	Pit cleaning	48.8		
	Total	**107.2**		
Investment Scenario	GPT & WSUD	68.2	**10.3**	Two additional GPTs per year 200 m^2 of WSUD per year
	Pit cleaning	48.8		
	Total	**117.0**		

5.5 Scenario summary

Figure 35 and Figure 36 describe the reduction in potable water use (to 2028) due to water efficiency measures and identifying alternative water sources. In reviewing the alternative water source scenario, it could be argued that Melton City Council pursue alternative water supplies more aggressively. The reason for the adopted scenario is based on a couple of key considerations. The first is resourcing and capacity. While Council has existing stormwater harvesting schemes, building internal capacity for additional schemes will take time and resources as Council looks to grow their stormwater harvesting portfolio. One scheme every two years (allowing for budget, design and construction) seems reasonable in that context. It is also imperative that the stormwater harvesting schemes that Council constructs yield stormwater to their full potential. The moderate rate of growth of the stormwater harvesting portfolio is aimed at ensuring that there is capacity and resources to operate and maintain those systems into the future.

The other factor is the availability of recycled water. If Western Water were to extend their network to Melton City Council's open spaces, then the level of alternative water use could be significantly increased. Therefore, Council advocating for recycled water to be provided to open spaces will be an important aspect of the IWM Plan.

Plan A water use efficiency scenario

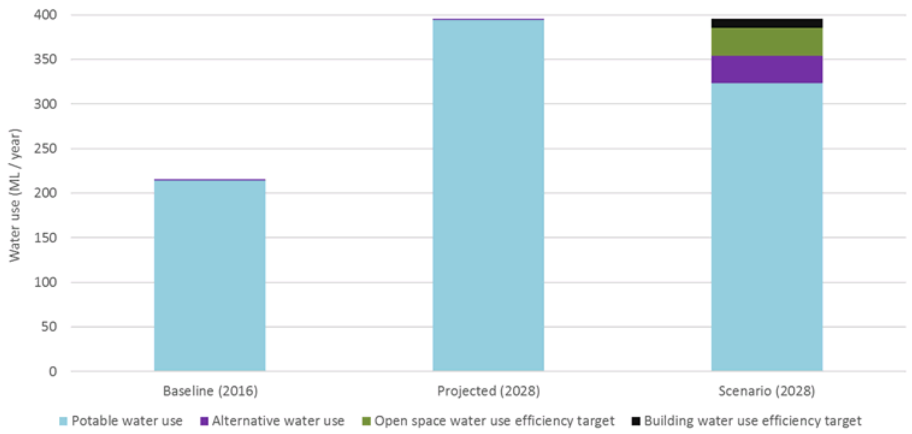


Figure 35. *Council water use scenario (including 'Plan A' water efficiency)*

Plan B water use efficiency scenario

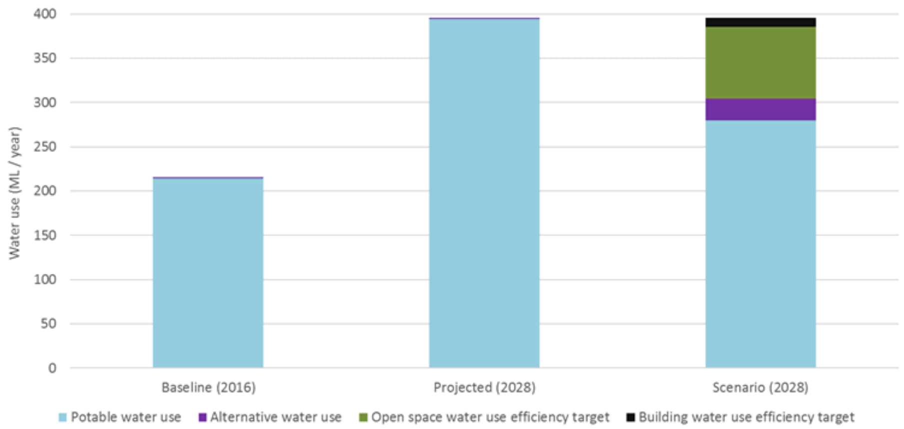


Figure 36. *Council water use scenario (including 'Plan B' water efficiency)*

As discussed above and in Melbourne Water's Healthy Waterway Strategy, litter is an important aspect of waterway health and amenity. Figure 37 illustrates the residual litter loads that will remain following the treatment described in the litter scenario. The aim will be to co-ordinate this reduction with our understanding of litter hotspots and community education, particularly linking discarding litter to waterways and ecological health.

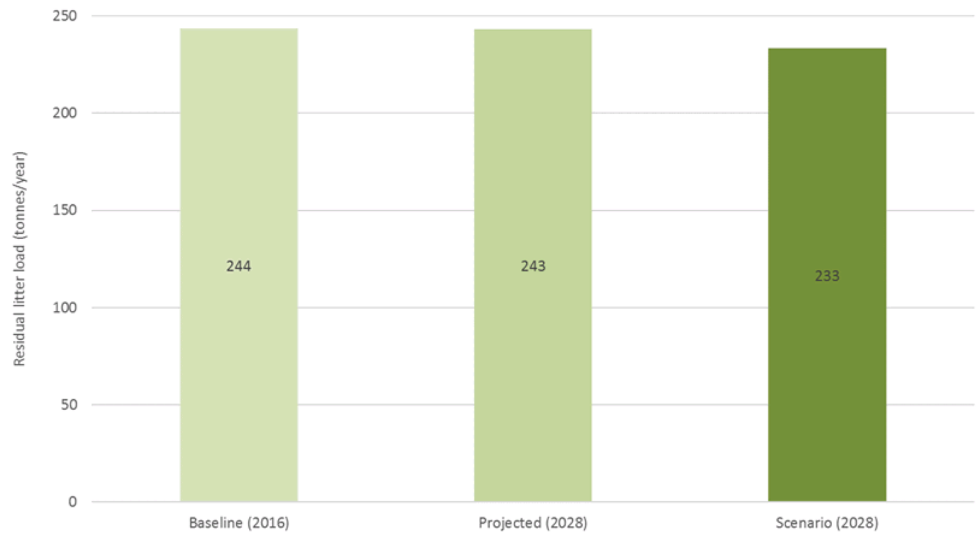


Figure 37. *Council litter reduction scenario*

5.6 Scenario cost estimate

The following table sets out the estimated capital cost of implementing each scenario at 2020 and 2028.

Scenario	Description	Baseline	Projected (2020)	Scenario (2020)	Total investment (2020)	Scenario (2028)	Total investment (2028)
1	**Water use efficiency target**						
	Efficiency measures (improved infrastructure, using technology, achieving distribution uniformity)	Existing infrastructure (assumed 70 % efficient)	Existing infrastructure (assumed 70 % efficient)	5 sportsgrounds fitted with improved irrigation infrastructure (assumed 80% efficient)	$ 550,000	16 sportsgrounds fitted with improved irrigation infrastructure (assumed 80% efficient)	$1,760,000
	Conversion of sportsgrounds to warm season grass	8.2 ha are warm season grass	6 additional sportsgrounds converted to warm season grass (2 per year)	3 additional sportsgrounds converted to warm season grass (1 per year)	$300,000	10 additional sportsgrounds converted to warm season grass	$ 1,000,000
	Resources and capacity (irrigation managers across technology, ground requirements, and water use)	Existing practice	Existing practice	Improved irrigation management at 100% of sportsgrounds (assumed 15) - allow 1 additional FTE	$100,000	Improved irrigation management at 100 % of sportsgrounds (assumed 27) - allow 3 additional FTE	$ 300,000
	Building internal efficiency measures	Existing infrastructure	Existing infrastructure	5 buildings are fitted with efficient infrastructure	$72,500	15 priority buildings + Melton Waves are fitted with efficient infrastructure	$145,000
2	**Alternate water use target**						
	Stormwater harvesting (active open spaces)	No existing asset	No new asset	1 sportsground irrigation demand is met by stormwater harvesting	$ 1,000,000	4 sportsground irrigation demand is met by stormwater harvesting	$ 4,000,000
	Stormwater harvesting (passive open spaces)	No existing asset	No new asset	No new assets by 2020	$ 0	3 ha of passive open space irrigation demand met by stormwater harvesting	$ 2,000,000
	Rainwater tanks (outdoor use)	22 existing tanks	No new asset	No new assets by 2020	$ 0	1 building outdoor irrigation demand met by rainwater tanks (Melton Civic Centre). All new Council buildings to have rainwater tanks for irrigation and toilet flushing as part of their design	$75,000
3	**Total Nitrogen (TN) reduction target**						
	Bioretention systems	38980 sqm	6 additional bioretention systems	12 additional bioretention systems	$600,000	40 additional bioretention systems	$ 2,000,000
4	**Litter reduction target**						
	GPTs	45 GPTs	No new asset	6 additional GPTs	$900,000	20 additional GPTs	$3,000,000
	Total funded works				**$3,522,500**		**$14,280,000**

Figure 38. *Utsav Malayalee Samaj undertaking waterway planting at 'The Ridge'*

6 Action Plan

The action plan for the IWM Plan will be developed to support implementation through a consultative process that incorporates the issues and opportunities identified during the workshop series and the water and pollutant balance analysis. Each of these elements contributed to the definition of three objectives that were broken down further into long term and intermediate outcomes. Investigation of various water management scenarios informed the development of specific targets and the definition of actions to achieve them.

The relationships between each stage of this process is shown in the program logic that was developed showing the link between objectives and actions (Figure 39).

6.1 Program Logic

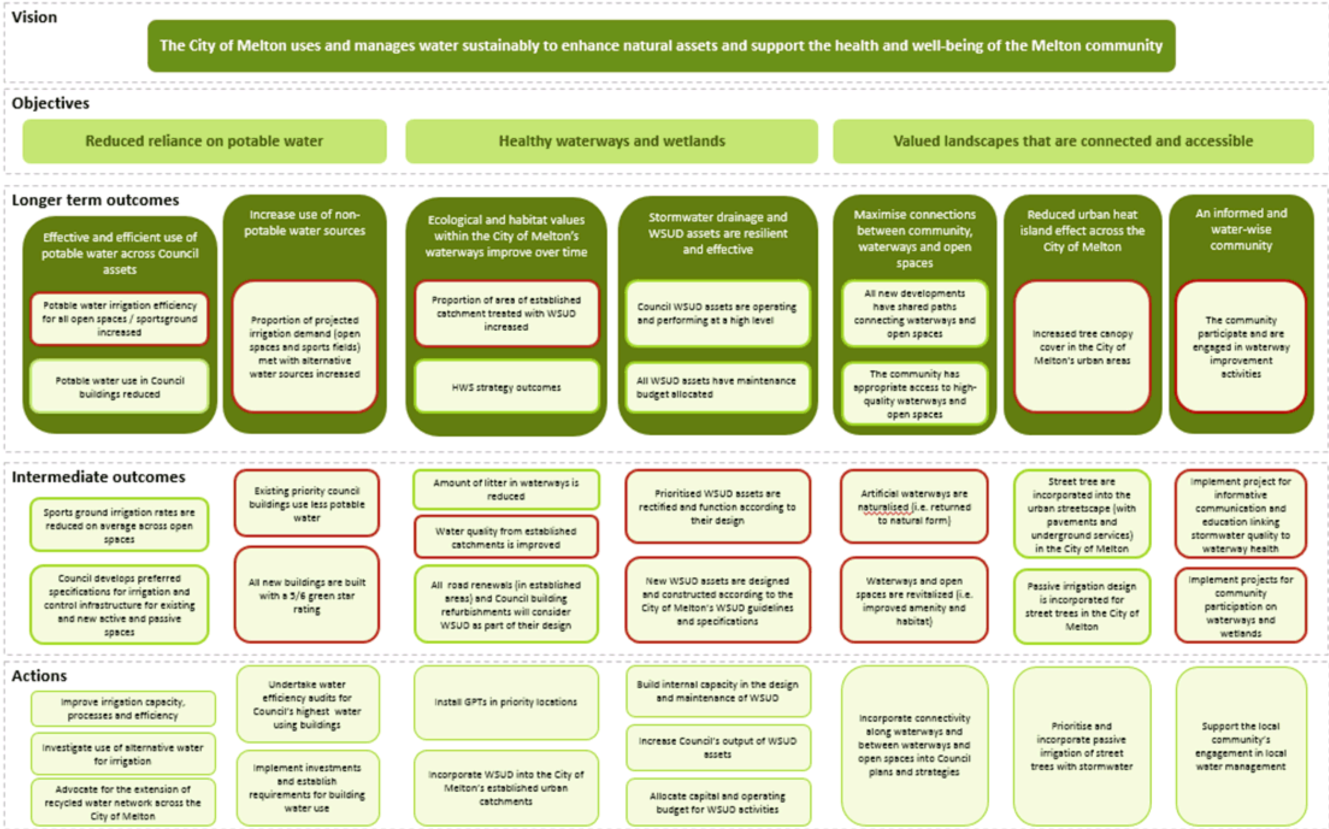


Figure 39. *Program logic linking actions to objectives*

7 Decision support tool

A decision support tool has been prepared to assist Council understand the costs and benefits of WSUD investments. The decision support tool takes inputs from MUSIC modelling (i.e. removal of nitrogen and litter) and using a linked net present value spreadsheet provides the NPV of the project and the cost per unit of removal of nitrogen and litter, as well as the levelised cost of water for comparison with other WSUD projects.

The potable water avoided, nitrogen removed, and litter removed can be accounted for to monitor progress toward our defined targets. The qualitative measure under "Asset value to community" is based on the values set out in the draft Melbourne Water's Healthy Waterways Strategy (www.MelbourneWater.com.au, 2017).

A separate spreadsheet tool has been delivered with the plan.

Decision support tool			User input
Foundational data			
Asset description		*Design parameters*	
Site name	Melton Street Wetland	Catchment area (ha)	10,000
Location	Melton Street	Treatment area (ha)	100
Asset type	Bioretention	Catchment impervious (%)	60%
Catchment size (ha)	20	Treatment to catchment ratio (%)	1.00%
Construction year	2020		
Asset performance and Value			
Performance (input from MUSIC model)		*Asset value to community (Qualitative assessment)*	
TSS (kg/yr)	5000	Community interaction and engagement	
TP (kg/yr)	9	Micro-climate and amenity	
TN (kg/yr)	50	Connectivity and recreation	
Costs			
Capital		*Operating*	
Capital cost Item 1 ($)	$0	Maintenance - Item 1 ($)	$2,000
Capital cost Item 2 ($)	$25,000	Maintenance - Item 1 (every X years)	3
Capital cost Item 3 ($)	$145,000	Maintenance - Item 2 ($)	$1,000
Capital cost Item 4 ($)	$25,000	Maintenance - Item 2(every X years)	2
Capital cost Item 5 ($)	$10,000	Maintenance - Item 3 ($)	$2,000
Capital cost Item 6 ($)	$2,567	Maintenance - Item 3 (every X years)	5
Capital cost Item 7 ($)	$0	Maintenance - Item 4 ($)	$5,000
Capital cost Item 8 ($)	$30,000	Maintenance - Item 4 (every X years)	1
		Asset reset ($)	$1,500
		Asset reset frequency (every X years)	1
CAPEX cost	**$237,567**	OPEX cost (annual)	**$8,067**
Economic Assessment			
Asset life (years)	25	Nominated Discount Rate	5.00%
NPV cost	**$68,802**		
Nitrogen abatement			
Nitrogen abatement (N) (kg/ year)	50	Melbourne Water nitrogen stormwater offset ($/kg)	**$6,645**
Cost of N abatement ($/kg)	**$4,751.34**		
Litter removal (kg/ year)	1200		
Cost of litter removal ($/kg)	**$197.97**		
Potable water - avoided cost			
Stormwater harvesting yield (kL)	6,000		
Cost of potable water at 2017 ($/kL)	$2.72		
Annual inflation	1.00%		
Levelised cost of water	**$0.90**		
Asset value to community results			
Community interaction and engagement			
Micro-climate and amenity			
Connectivity and recreation			

Figure 40. *Decision support tool (example)*

8 Monitoring, evaluation, reporting and improvement (MERI) framework

The Monitoring, Evaluation, Reporting and Improvement (MERI) framework is a conceptual model designed to support Melton City Council monitor the progress of the IWM Plan, providing a basis for learning, improvement and accountability. The framework supports the development of metrics by which to monitor and assess change in condition over time; the relative effectiveness, efficiency and appropriateness of different actions and the extent to which an action has an impact on reaching an outcome, objective or target.

A program logic approach has been adopted for the IWM Plan. Program logic illustrates how Melton City Council's IWM Plan targets have been set and how the action plan will be designed to achieve these targets as well as contribute to intermediate and longer-term outcomes. This will in turn contribute to achieving the project objectives defined through stakeholder engagement.

The program logic provides the overarching conceptual framework showing the relationships between project objectives, outcomes and actions.

Table 11. MERI definitions and relationships

Framework level	Definition
Vision	A statement of the overall vision of the Melton IWM Plan that guides the program and provides the context for setting the targets
Objectives	Overarching goals of the Melton IWM Plan that were developed through stakeholder engagement
Longer term outcomes	Tangible and measurable changes in condition in the long-term
Intermediate outcomes	Tangible and measurable changes in condition in the short-term
Immediate activities	Management actions and physical changes that lead to a change in condition
Foundational activities	Actions that inform planning, investment, prioritisation and decision-making

The MERI framework makes changes transparent so that all parties can learn, through reflection and discussion, which interventions are most appropriate, effective and efficient.

Targets
Targets for the IWM Plan are set at varying scales and timeframes. Some relate to a particular action or immediate outcome, while others link to intermediate and longer-term outcomes. Setting targets around outcomes, provides flexibility for Council to be innovative in how they deliver those outcomes, while setting targets around actions provides clarity as to what Council is to deliver.

The program logics map out how the targets for the IWM Plan have been set and the various scales and timeframes that apply.

Action plan
Actions can lead to biophysical, institutional and economic outcomes. The MERI framework supports and informs an action plan, setting out that level at which targets are set and how they should be monitored and reported on.

Monitoring
Monitoring determines whether the targets have been met. This will be achieved by monitoring asset condition or the given program performance.

- *Monitoring asset condition* describes measuring changes in the state of and trends in the condition of assets at the level of the investment and at higher levels through agreed indicators
- *Monitoring program performance* describes changes in people, organisations, institutions, practices and technologies that create an environment that is conducive to improving asset condition.

Monitoring of other outcomes will be established on a case-by-case basis.

Evaluation
The evaluation of the project is a periodic assessment of how the program, including actions, is performing against the objectives. The evaluation of the program will ask the following questions:

- *Result:* Was the target met? How, why and why not?
- *Appropriateness:* Does the action and target set link to the objectives and vision?
- *Impact:* To what extent did the actions and targets result in an improved outcome?
- *Effectiveness:* To what extent was the original condition changed?
- *Efficiency:* What cost and resources are required to implement action? What has been the value of return from investment?
- *Legacy*: Will the impacts be felt beyond the timeframe of the Plan?

Through these questions it is important to understand to identify why the desired change has not occurred.

Reporting
Reporting can occur at all levels of management, and within any timeframe depending on the intention and audience. The purpose of reporting is to communicate progress and performance on outcomes; challenges and learnings; and accountability and transparency to other agencies, the broader community and within Council.

Improvement
Improvement involves ongoing review, learning and adaptation based on critical reflection of the program including the effectiveness of actions and activities. Identified improvement actions result in amendment to actions and the plan.

MERI schedule
In finalising the IWM Plan, a MERI Plan should be developed setting out a clear schedule of deliverables:

- Proposed frequency of evaluation and reporting
- Key evaluation questions for intermediate and long-term outcomes
- Key indicators for the intermediate and long-term outcomes
- Reporting audience, public accessibility, frequency and key content.

9 References

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Berdahl P. and S. Bretz. 1997. Preliminary survey of the solar reflectance of cool roofing materials. Energy and Buildings 25:149-158.

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City of Melton (2016), Open space strategy

City of Melton (2009), MacPherson park water strategy

City of Melton (2010), Design, construction and maintenance of WSUD

City West Water (2015), Melton City Council Integrated Water Supply Plan

Climate Council (2017), Intense rainfall and flooding: The influence of climate change

DELWP (2016), Protecting Victoria's Environment – Biodiversity 2037

DELWP (2016), Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria

DEWLP (2016) Water for Victoria

DELWP (2016) Integrated Water Management Framework for Victoria

DELWP (2017) Victoria's Climate Change Adaptation Plan 2017 - 2020

Forecast i.d. City of Melton (http://forecast.id.com.au/, accessed October, November 2017)

GMA (2015), Litter Report for City of Melton

Southern Rural Water (2014), Werribee River Whole of Water Cycle Management

State of Victoria (2016), Economic Building Blocks for Victoria

Melbourne Water (2016), MUSIC modelling guidelines

Melbourne Water (2017), Healthy Waterways Strategy (https://yoursay.melbournewater.com.au, Accessed November 2017)

Victorian Planning Authority, Precinct Structure Plan (Various)

WAGA (2012), Climate Change Adaptation Action Plan 2013-30

Western Water (2017), Western irrigation network: preliminary feasibility plan

Western Water (2015), Melton and Wyndham North Integrated Water Management Analysis

WSAA (2014), Occasional Paper 30: The role of the urban water industry in contributing to liveability

Attachment A
Water and pollutant balance assumptions

Table A. Baseline scenario assumptions

Item	Breakdown	Key assumptions
Water and pollutant generation	Stormwater	MUSIC model based on: Existing land use (based on DELWP 2015 urban extent adjusted for recent Melton subdivisions) Model will account for Council and Melbourne Water existing WSUD Two large scale stormwater harvesting projects (Toolern and Caroline Springs) assuming 80% reliability of supply
	MUSIC	MUSIC model will: Use Melbourne Water recommended MUSIC rainfall templates Depending on location, use rainfall data from one of two rainfall gauges: Melbourne Airport (1971-1980) and Little River (1992-2001) (based on Melbourne Water rainfall distribution map). Use 6 min time-step rainfall data Use fraction imperviousness for different land use zones based on Melbourne Water MUSIC Guidelines 2016 Default soil parameters and pollutant concentration data will be used
	Raw water	Based on Southern Rural Water storages in conjunction with Melbourne system (Western Water and City West Water 2016 data to provide community use)
	Wastewater	Western Water and City West Water 2016 data
	Recycled water	Western Water 2016 demand (no City West Water recycled water use in Melton)
	Groundwater	Southern Rural Water 2016 extraction data (bore data)
	River diversion	Southern Rural Water 2016 diversion data (current licences)
Water use	Council: Potable / Recycled	2016 Council Water use data
	Residential Potable / Recycled	Western Water and City West Water 2016 data
	Non-residential Potable / Recycled	Western Water and City West Water 2016 data Note: non-residential data consists of agricultural / commercial / industrial water. Data provided by Western Water does not delineate between these categories.

Table B. Projected scenario assumptions

Item	Breakdown	Key assumptions
Water and pollutant generation	Stormwater	MUSIC model based on: 2040 land use (based on current PSPs that have been approved or under preparation). MUSIC parameters will be the same as baseline conditions. All Greenfield residential land development since baseline are managing stormwater to requirements set by the current BPEMG.
	MUSIC	MUSIC model will: Use Melbourne Water recommended MUSIC rainfall templates Rainfall data from one of two rainfall gauges: Melbourne Airport (1971-1980) and Little River (1992-2001) (based on Melbourne Water rainfall distribution map). 6 min time-step rainfall data Fraction imperviousness for different land use zones based on Melbourne Water MUSIC Guidelines 2016 Default soil parameters and pollutant concentration data will be used
	Climate change	Impacts of climate change based on DELWP's *Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria* for the Werribee River Basin in 2040: Changes in temperature (+1.3) PET (4.7%) Rainfall (average 619mm, 1975-2014) 50th percentile -2.7% 90 percentile -11.7% Average annual runoff (average 77mm, 1975-2014) 50th percentile -7.7% 90 percentile -28.9%
	Raw water	Based on Southern Rural Water storages in conjunction with Melbourne system. No significant change from baseline conditions, however security improved
	Wastewater generation	Projection based on population growth
	Recycled water	Based on water retailer recycled water strategy Assumed no significant growth in Class A recycled water use in urban areas (small residential demand due to smaller gardens) Potential growth in Class A recycled water use for agriculture based on current strategy
	Groundwater	No significant change to baseline condition Additional groundwater use to be considered as part of options scenarios
	River diversion	No significant change to baseline condition
Water use	Council: Potable / Stormwater / Recycled	Potable water use projection based on population growth No significant change in stormwater harvesting projects. Additional stormwater harvesting to be considered as part of options scenarios Recycled water use as per 2016
	Residential: Potable / Stormwater / Recycled	Potable water use projection based on population growth Increased water efficiency e.g. adopting target 155 litres per person per day to be considered as part of options analysis No change to baseline tank / rainwater use Recycled water use as per water retailer strategy.
	Non-residential Potable / Recycled	Potable water use projection based on land use change No significant change to baseline stormwater harvesting and reuse Recycled water use as per water retailer strategy. Expansion of recycled water network to be considered as part of options scenarios.

Attachment B
Consultation summary

The following summarises the program of workshops undertaken to inform the plan and their attendees

Table A. Consultation and engagement summary

Workshop number and title	Attendees	
1 Issues and opportunities (Internal)	Charles Cornish Manager Engineering Services Laura-Jo Mellan Manager City Design, Strategy and Environment Lawrie Conole Coordinator Environmental Services David Caligari Manager Capital Projects Troy Scoble Manager Recreation and Youth Leslie Stokes Manager Operations Voltaire David Coordinator Infrastructure Planning Matthew Hutchinson Coordinator Traffic and Design Sally Atkinson ATSI Community Engagement Officer Glenn Mulcahy Coordinator Recreation Dylan Weeks Litter Education and Prevention Officer Darren Gray Coordinator Property Services Braith Norman Coordinator Capital Projects	Diana Ho Coordinator Major Developments Wayne Krastsis Coordinator Parks Tony Herwerth Land Management Officer Kellie Mills Sustainability Officer Steve Ryan Coordinator Asset Management and GIS Katelyn Stevens Recreation Planner Nicole Willis Recreation Development Officer Marshall Kelaher Coordinator City Design Sophie Thompson Senior Strategic Planner Kate Waters Coordinator Social Planning and Well-being Kerry Walton Infrastructure Planning Engineer Rishi Viner Civil Operations Coordinator
2 Issues and opportunities (external stakeholders)	Andrew Camenzuli (Melbourne Water) Nigel Corby (City West Water) Katie Burns (DEWLP)	Rebecca Koss (Port Philip and Westernport CMA) Luke Wilson (Western Water) Southern Rural Water
3 Land development industry	Sean Pinan (Mount Atkinson) Callan Ainsaar (Stockland) Rodney Jackson (Dennis Corp) Sam Chebib (Lend Lease) Leigh Holmes (Spiire)	Jonathon Fetterplace (Dacland) Luke May (Villawood Properties) Duncan McLeallan (Moremac) Doug Vallance (Moremac) Martein Bouwmeester (SMEC)
4 Public community and environmental groups		
5 Traditional owners	Wathaurong Aboriginal Co-operative Bunurong Land Council	Wurundjeri Land Council
6 Internal (Vision and objectives)	As per workshop 1	

Attachment C
Scenario analysis detail

Water use scenario parameters

Plan timeframe (yrs)	10		10 year action plan from 2018-2028	
			2018	2028
Population Baseline	134,371	2016		
Population Projected	232,536	2028		
Baseline irrigated sportsground area	23	ha		
Projected irrigated sportsgroung area	40	ha	Based on population growth	
Projected/Scenario climate	50thpercentile			
Baseline irrigation rate (active open space)	4.57	ML/ha/year		
Based on long term average water use. This reflects current turf quality management practice (equivalent to a crop factor of 0.555)				
Projected irrigation rate (active open space)	5.00	ML/ha/year		
Baseline irrigation rate adjusted to reflect projected climate (i.e. Turf quality management same as current practice with a crop factor of 0.555)				
Scenario irrigation rate				
Turf quality management	StrongGrowth_WarmSeason			
Active open space irrigation rate	3.53	ML/ha/year	Adjusted to reflect projected climate and turf quality management	
Passive open space irrigation rate	2.0	ML/ha/year		
Efficiency measures (improved infrastructure, using technology, achieving distribution uniformity)	10%		Applicable to active and passive open spaces	
Scenario : Alternate water projects				
First active open space project within....	3	years		
Consecutive active open space projects - 1 project every X years....	2	years		
Area of active open space irrigation irrigated by alternate water supply over IWM plan timeframe	6.8	ha		
Area of passive open space irrigated by alternate water supply over IWM plan timeframe	3.0	ha		
Scenario: Building				
Internal water use efficiency	10.2	ML	Based on prioritised buildings	
Rainwater tanks - meet X % of building outdoor water use	50%		Aim for 1.5 ML/year based on Melton Civic Centre water meter Irrigation 2016 data	

Water use by scenario – open space and buildings

Overall Water Use Summary - Breakdown by water users					
Active open space irrigation	**Baseline (2016)**	**Projected (2028)**	**Scenario (2028)**	**Unit**	**Proportion**
Water use efficiency target	0	0	73	ML	
Alternative water use target	1.5	1.5	17	ML	
Target reduction in potable water use	1.5	1.5	92	ML	
Potable water use	106	200	110	ML	85%
Alternative water use	1.5	1.5	19	ML	15%
Total potable and non-potable water use	107	201	129	ML	
Passive open space irrigation					
Water use efficiency target	0	0	9	ML	
Alternative water use target	0	0	5	ML	
Target reduction in potable water use	0	0	13	ML	
Potable water use	45	86	72	ML	94%
Alternative water use	0	0	5	ML	6%
Total potable and non-potable water use	45	86	77	ML	
Buildings	**Baseline (2016)**	**Projected (2028)**	**Scenario (2028)**	**Unit**	**Proportion**
Water use efficiency target (internal only)	0	0	10	ML	
Alternative water use target (external only)	0	0	0.7	ML	
Target reduction in potable water use	0.0	0.0	11	ML	
Potable water use (Internal)	62	107	97	ML	
Potable water use (External)	1	1	0.7	ML	
Total potable water use	63	109	98	ML	99%
Alternative water use	0	0	0.7	ML	1%
Total potable and non-potable water use	63	109	98	ML	

Overall Water Use Summary					
Buildings + Open spaces	**Baseline (2016)**	**Projected (2028)**	**Scenario (2028)**	**Unit**	**Proportion**
Open space water use efficiency target	0	0	81	ML	
Open space alternative water use target	1.5	1.5	22	ML	
Building water use efficiency target	0	0	10	ML	
Building alternative water use target	0	0	0.7	ML	
Total water use efficiency target	0	0	92	ML	79%
Alternative water use	1.5	1.5	23	ML	20%
Total reduction in potable water use	1.5	1.5	116	ML	
			29%	reduction in terms of projected water use	
Potable water use	214	394	280	ML	92%
Alternative water use	1.5	1.5	24	ML	8%
Total potable and non-potable water use	216	396	304	ML	

Water use by scenario – open space and buildings (continued)

Overall Water Use Summary - Breakdown by water users					
Active open space irrigation	**Baseline (2016)**	**Projected (2028)**	**Scenario (2028)**	**Unit**	**Proportion**
Water use efficiency target	0	0	73	ML	
Alternative water use target	1.5	1.5	17	ML	
Target reduction in potable water use	1.5	1.5	92	ML	
Potable water use	106	200	110	ML	85%
Alternative water use	1.5	1.5	19	ML	15%
Total potable and non-potable water use	107	201	129	ML	
Passive open space irrigation					
Water use efficiency target	0	0	9	ML	
Alternative water use target	0	0	5	ML	
Target reduction in potable water use	0	0	13	ML	
Potable water use	45	86	72	ML	94%
Alternative water use	0	0	5	ML	6%
Total potable and non-potable water use	45	86	77	ML	
Buildings	**Baseline (2016)**	**Projected (2028)**	**Scenario (2028)**	**Unit**	**Proportion**
Water use efficiency target (internal only)	0	0	10	ML	
Alternative water use target (external only)	0	0	0.7	ML	
Target reduction in potable water use	0.0	0.0	11	ML	
Potable water use (Internal)	62	107	97	ML	
Potable water use (External)	1	1	0.7	ML	
Total potable water use	63	109	98	ML	99%
Alternative water use	0	0	0.7	ML	1%
Total potable and non-potable water use	63	109	98	ML	

Stormwater pollutant load summary

Stormwater Pollutant Reduction Summary	Baseline (2016)	Projected (2028)	Scenario (2028)	Target	
TN reduction target	4031	4138	4245	29917	kg/year
Change	4031	107	214	29917	kg/year
Litter reduction target	244	243	233	105	tonne/year
Change	244	-0.49	-10.3		tonne/year
Established developed catchment area as of 2016	857	ha			
TN load generated (kg)	66482	kg			
Gross Pollutant load generated (kg)	1167658	kg			
Best practice TN target (%)	45%				
Best practice Gross Pollutant target (%)	70%				
Best practice TN reduction (kg)	29917	kg			
Best practice Gross Pollutant redcution (kg)	817361	kg			
WSUD treatment target					
Unit residential urbanised catchment - 60 % imperviousness	10	ha			
Unit WSUD treatment (bioretention system)	365	sqm			
TN reduction target	39	kg/year			
Assumed treatment peformance for Gross Pollutant removal	50%				
Gross Pollutant reduction target	593	kg/year			
GPT treatment target					
Unit residential urbanised catchment - 60 % imperviousness	25	ha			
GPT assumed treatment peformance for Gross Pollutant removal	50%				
GPT Gross Pollutant reduction target	1550	kg/year			
Baseline					
Existing WSUD in established developed catchment as of 2016					
Bioretention system area	38980	sqm			
Baseline TN reduction	4031	kg/year			
Existing Gross Pollutant management in established developed catchment as of 2016					
Existing GPT Gross Pollutant reduction	67000	kg/year	45 GPTs as of 2016		
Pit cleaning Gross Pollutant reduction	162660	kg/year	Pit cleaning program		
WSUD Gross Pollutant reduction	125931	kg/year	38,980 sqm bioretention and swale		
Baseline Gross Pollutant removal	355591	kg/year			

Projected			
Target WSUD projects	2	/year	Each 50 sqm
WSUD treatment area	100	sqm/year	4 WSUD project per year
Additinaion TN reduction	107	kg/year	
Additional Gross Pollutant reduction	1626	kg/year	
Existing pit run Gross Pollutant removal	162660	kg/year	No change
Target GPT projects	0	per year	No additional GPT
Additional Gross Pollutant reduction	0	kg/year	
Projected TN reduction target	4138	kg/year	
Projected WSUD + GPT Gross Pollutant reduction	194,556	kg/year	
Projected Pit cleaning Gross Pollutant reduction	162,660	kg/year	
Projected Gross Pollutant reduction target	357,216	kg/year	

TN reduction target relative to best practice target	0.4%	2422	years to achieve best practice
Gross Pollutant reduction target relative to best practice target	0.4%	2841	years to achieve best practice
Scenario			
Target WSUD projects	4	/year	Each 50 sqm
WSUD treatment area	200	sqm/year	4 WSUD project per year
Additinaion TN reduction	214	kg/year	
Additional Gross Pollutant reduction	3251	kg/year	
Existing pit run Gross Pollutant removal	162660	kg/year	No change
Target GPT projects	2	per year	Additional GPTs per year
Additional Gross Pollutant reduction	31000	kg/year	
Scenario TN reduction target	4245	kg/year	
Projected WSUD + GPT Gross Pollutant reduction	227182	kg/year	
Projected Pit cleaning Gross Pollutant reduction	162660	kg/year	
Scenario Gross Pollutant reduction target	389842	kg/year	
TN reduction target relative to best practice target	0.83%	1211	years
Gross Pollutant reduction target relative to best practice target	7.4%	135	years