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Wyndham City Council

Wyndham Integrated Water Cycle Management Plan

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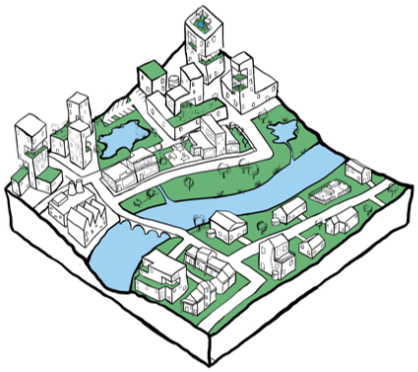
Executive Summary

Wyndham is a growing municipality that covers a diverse range of built and natural environments. The community have expressed a desire to retain the urban, rural and coastal feel of the municipality and Council's IWCM vision aims to deliver on this.



Wyndham's 2040 Vision

Wyndham is celebrated as a water sensitive city with successful urban and rural environments where Council works collaboratively with its community and stakeholders to create healthy ecosystems and liveable communities.

This vision is supported by three key objectives:

- **OBJECTIVE 1**: Create a resilient and liveable city
- **OBJECTIVE 2**: Improve the health and amenity of waterways and coastal environments
- **OBJECTIVE 3**: Improve collaboration and engagement with all stakeholders

Collectively, these objectives are designed to address the diverse elements of the water cycle and the full range of people and organisations involved in its management. Wyndham's new IWCM direction aims to deliver water services that are able to better cope with the risks of drought, flood and climate change. This will be achieved by planning for change and designing adaptable and flexible infrastructure and urban spaces. This IWCM Plan also places renewed focus on Wyndham's highly valued waterways. This includes recognition, protection and enhancement of the ecological and social values of these important natural assets. Council is also embracing the multi-disciplinary nature of IWCM through greater collaboration and engagement with all stakeholders. Whether it is in the established areas of Hoppers Crossing, the industrial estates of Laverton or the rural hinterland of Quandong, Council is dedicated to work with others to deliver improved water management.

This IWCM Plan focuses on long term actions that will bring about significant change in Wyndham by 2040. The impact of growth, climate change and Council investment have all been analysed to test the resilience of this IWCM Plan to a variety of future scenarios. The findings indicate that in terms of growth Wyndham is predicted to experience high levels of sustained urban development under all scenarios. This places greater emphasis on the need for sustained efforts to enforce existing environmental controls and ensure that the handover, documentation and maintenance of WSUD assets to Council continues to improve.

In terms of climate change, Wyndham is already experiencing a prolonged period of below average rainfall and lower rainfall this is set to become the norm under the median climate scenario. Other impacts of climate change include higher temperatures, longer dry periods and increased evapotranspiration. These predicted changes to Wyndham's environment support continued investment in urban greening initiatives to create more habitable urban spaces. These initiatives need to be designed with water in mind, alternative water supplies (e.g. wastewater or stormwater) can provide this service and avoid putting increased pressure on our valuable potable water networks.

From an investment perspective Council can make major progress towards improved stormwater management through the continued rollout of WSUD capital works. Wetlands are robust natural treatment systems that also provide great amenity for the community and will be an essential component of future projects. Council is also working to improve litter management and exploring how best to deploy other treatment and reuse technologies in response to local conditions (e.g. biofilters and stormwater harvesting). A broad range of measures is required to address the full scale of IWCM challenges in the region. Consequently, in addition to structural projects, opportunities for new roles within Council have been identified to drive IWCM solutions and enforce existing development standards across Wyndham.

A series of three road maps have been prepared as part of this IWCM Plan to guide implementation over the short term (i.e. next five years). Each road map includes a series of targets and actions designed to help Council deliver on its vision. A raft of IWCM opportunities in Wyndham have also been compiled following extensive consultation and provide a valuable knowledge base for Council to draw on.

This IWCM Plan is sits above Council's existing Water Action Plan and Stormwater Management Plan. It also has strong linkages with Council's existing documents, including the Environment and Sustainability Strategy, Open Space Strategy, Climate Change Adaptation Strategy and the Litter Reduction and Prevention Plan. It is a unifying document that designed to bring departments across Council together to collaborate better on water related projects.

CONTENTS

Glossary

Alternative water source: Water that isn't sourced from the mains drinking water supply system. This may include rainwater, stormwater, creek/river water, groundwater and recycled water.

Bioretention system (also referred to as raingarden, biofilter): A system with vegetation and layered filter media (soils and sands) that captures, retains and treats stormwater before slowly releasing it to ground or into the stormwater system.

BPEM standards: The Best Practice Environmental Management Guidelines: Stormwater (Victoria Stormwater Committee, 1999) set out objectives for stormwater management, including reductions in typical urban stormwater pollutant loads as follows: Total suspended solids (TSS): 80%, Total phosphorus (TP): 45%, Total nitrogen (TN): 45%, Litter: 70%.

Catchment: An area that drains to a given point, typically drainage is dictated by topography but may be modified by man-made structures including drains and pipes.

Directly Connected Impervious (DCI): The proportion of the impervious surface of a catchment that is connected to a stream through a conventional drainage connection (i.e. via a pipe). It is an established indicator of the likely degradation of ecological health in urban waterways due to stormwater.

Environmental water: Water managed to improve or maintain the health of rivers and wetlands – including the plants and animals that depend on them. Environmental water can mean any water in a river or wetland that provides environmental benefits, the Victorian Environmental Water Holder (VEWH) use the term to mean water available under environmental entitlements actively managed to benefit the environment.

Environmental water entitlement: A legal right to access a share of water available at a particular location or locations, subject to certain rules and conditions

Evapotranspiration: The combined processes of evaporation (i.e. the transfer of water from the land to the atmosphere) and transpiration (i.e. the transfer of water from plants to the atmosphere).

Fit for purpose water supply: The provision of water that meets but does not unnecessarily exceed the requirements of the end user (e.g. in terms of water quality).

Gross Pollutant Trap (GPT): Structures that use physical processes to trap solid waste such as litter and coarse sediment. They are commonly used as the primary treatment because they mostly remove large non-biodegradable pollutants.

Impervious surfaces: Hard surfaces that do not allow water to infiltrate to the underlying soils such as roads, roof tops, paving and car parks.

Infiltration: The process by which surface water enters the soil.

Integrated Water Cycle Management (IWCM) (also referred to as integrated water management and whole of water cycle management)**:** An approach that considers the sustainable management of all types of water in the urban water cycle. It optimises opportunities and manages risks and costs of water management by considering all aspects of the urban water cycle at multiple scales.

Lakes, ponds and dams: Natural or man-made structures used to store water while also providing some treatment function (e.g. sedimentation) and potentially some habitat value.

Litter traps: Used to capture litter in stormwater runoff, these traps use physical processes similar to gross pollutant traps but are typically simpler and smaller.

Nitrogen load: Nitrogen is an essential chemical element that is required by animals and plants. However, high levels of nitrogen contribute to eutrophication (including algal blooms) in waterways.

Non-potable water: Water that is not fit for drinking purposes but may be fit for other end uses (e.g. garden watering, toilet flushing, dust suppression).

On-Site Detention (OSD): The collection and temporary storage of stormwater within a site boundary. Once collected, stormwater is slowly released into the drainage system or allowed to seep into the surrounding soils. Detention systems are used to slow and store rainfall events to mitigate downstream flooding.

Passive irrigation: Irrigation that occurs without active intervention (i.e. not using an irrigation system). Generally refers to areas that are irrigated through stormwater flow.

Potable water: Water that is fit for drinking purposes.

Recycled water: Water, including wastewater, that has been treated to a level that makes it fit for reuse (the reuse that is suitable will depend on the level of treatment).

Runoff: Stormwater generated from rainfall. This runoff travels over land or through drainage networks (e.g. Council pipes and pits) before discharging into local waterways. Urban runoff refers to runoff from urbanised catchments with a large proportion of impervious surfaces (e.g. roofs, roads and pavements. Urban runoff is damaging to the natural environment and requires management to avoid waterway erosion and pollution.

Stormwater treatment wetland: A vegetated waterbody that is specifically designed for stormwater treatment (i.e. reduce inflow velocities, settle sediments and remove pollutants).

Swale: A vegetated channel that collects, transports, reduces, delays and treats stormwater runoff. A swale is a water sensitive alternative to a kerb and gutter system.

Stormwater: Surface water runoff from all surfaces within a catchment (e.g. roofs, driveways, roads, footpaths and vegetated areas) that occurs as a result of rainfall.

Stormwater harvesting: The process of collecting, treating and then reusing stormwater, typically stormwater is harvested to supply non-potable water demands, however the technology exists to treat stormwater to a potable (i.e. drinking) water standard.

Stormwater treatment wetland: A vegetated waterbody that is specifically designed to treat stormwater (i.e. reduce inflow velocities, settle sediments and remove pollutants).

Tree pit: An infiltration trench which is located adjacent to a tree to facilitate passive irrigation.

Urban water cycle: The urban water cycle consists of all of the water that falls on, is used within and is generated from urban settlements. This includes the rainfall on the urban area and the stormwater runoff this generates, the drinking water that is imported from local or regional reservoirs for personal and commercial use as well as the wastewater generated from these practices.

Victorian Environmental Water Holder (VEWH): The independent statutory body responsible for holding and managing Victoria's environmental water entitlements (the Water Holdings).

Warm season grasses: Grass species that require less water and are able to survive and even often thrive on sporadic summer rainfall (e.g. Couch, Buffalo and Kikuyu).

Wastewater (aka sewage): Liquid and solid waste transported in sewers or drains (includes greywater and blackwater). In the residential sector this consists predominantly of water discharged from toilets, sinks, showers, baths and the laundry.

Waterbodies: Natural or man-made structures that store water, in some cases waterbodies also provide a treatment function (e.g. sedimentation) and/or habitat value.

Water efficiency measures: Tools and techniques used to reduce the volume of water used to sustain human activity, examples instillation of fittings and appliances that reduces water usage and loss and landscaping/gardening that reduces or illuminates the need for irrigation (i.e. xeriscaping).

Water sensitive city: A water sensitive city is one that uses an approach which considers the whole water cycle and looks at the city as a catchment. It identifies where we can use alternative water sources to reduce use of the drinking water supply and help offset flooding and ensures our waterways are clean and healthy, our biodiversity is protected and that our trees and vegetation receive enough water.

Water Sensitive Urban Design (WSUD): A holistic approach to water management that integrates urban design and planning with social and physical sciences in order to deliver water services and protect aquatic environments in an urban setting.

WSUD assets: Man-made assets that are used to manage stormwater runoff (e.g. wetlands and swales)

WSUD retrofit: When a new WSUD asset is retrofitted into an existing urban area (e.g. a raingarden is constructed in an existing park, streetscape or retarding basin).

Waterways: A defined route that water travels along, including a tributary, creek, river or canal.

Wetland: An area that is permanently or seasonally saturated with water, water within a wetland may be static or flowing, fresh, brackish or saline.

1. Introduction

This Integrated Water Cycle Management (IWCM) Plan is a high level document that sits above Wyndham City Council's (WCC) existing Stormwater Management Plan and Water Action Plan. The IWCM Plan is a unifying document that clearly articulates WCC's vision and objectives for water management and brings departments across Council together to collaborate better on water related projects. The IWCM Plan identifies targets that can be used to track Council's progress towards its vision and a suite of actions designed to enhance collaboration, improve processes and guide the delivery of IWCM projects.

The IWCM Plan includes:

- An overview of Council's planned IWCM journey as determined through consultation and expressed by a vision and set of three key objectives.
- A summary of the current state of water related policy and strategy at the federal, state, regional and local level.
- An overview of the key land use, catchment, waterway and climatic conditions that impact water management across the municipality.
- An analysis of recent trends in water usage from a Council, community and agricultural perspective.
- A discussion of local litter management challenges and the identification of key litter hotspots and priority areas for action.
- A snapshot of current stormwater treatment across the municipality and planned improvements.
- Current and future water balances for the municipality that examine the import, generation, use and disposal of water from a variety of sources (e.g. potable water, rainwater, streamflow, groundwater, etc.). This includes an examination of the implications of population growth, climate change and Council investment on future conditions.
- Road maps that consist of targets and actions that can be used to track Council's progress towards its visions and objectives.
- A list of opportunities to help guide Council action and investment.

The concepts of integrated water cycle management and water sensitive cities are central to this plan. A brief introduction to these terms and their meaning in the context of Wyndham's IWCM Plan is provided below.

1.1 What is Integrated Water Cycle Management?

Integrated Water Cycle Management (IWCM) recognises the social, economic and environmental objectives of water in our communities and the shared responsibilities in delivering these objectives.

Traditionally, the urban water streams of potable water, wastewater, groundwater and stormwater have been managed separately to ensure a secure water supply, protection of human health, and asset protection (from floods). However, the ability of these isolated management systems to deliver on their services is increasingly being jeopardised, for example, through climate variability, population growth, and growing community concern on the health of their open space areas. IWCM is a response to these threats and vulnerabilities. It relates land use planning and development to water in terms of not only potable and alternative water supplies, wastewater management, stormwater management, but also its impacts on receiving waters (surface waters and groundwater), community health and longevity.

A diverse group of stakeholders are involved in the delivery of IWCM outcomes beyond WCC; these stakeholders include the general community, community groups, water utilities and state government. A collaborative process has been adopted in the development of this IWCM Plan to ensure that key project stakeholders have been involved throughout (see Attachment 5 – Record of Consultation). This ensures that the assumptions and outcomes presented in the IWCM Plan have been developed with continuous input from all of the stakeholders and sets up a strong basis to continue important collaboration into the future.

1.2 What is a Water Sensitive City?

Water sensitive cities are resilient, liveable, productive and sustainable. They adopt holistic and integrated water cycle management practices to meet a city's water and liveability needs. A water sensitive city enhances the urban hydrological cycle by:

- providing water security for economic prosperity through efficient use of diverse water resources;
- improving and protecting the health of watercourses and wetlands;
- mitigating flood risk and damage; and
- creating public spaces that harvest, clean and recycle water.

Organisational and community values also play an important role in a water sensitive city by influencing urban design decisions and water management practices.

There are six distinct developmental states that cities move through on their path toward increased water sensitivity (Figure 1). Currently, Wyndham is characterised as a Waterways City where the environmental impacts of water are starting to be being considered and receiving waterways receive some protection. With its large amount of recycled water use, Wyndham also has some elements of a Water Cycle City. However, more is needed to expand alternative water use and fully embrace sustainability. This IWCM Plan helps put in place a range of measures that will support Council as it continues to transition towards the Water Sensitive City state.

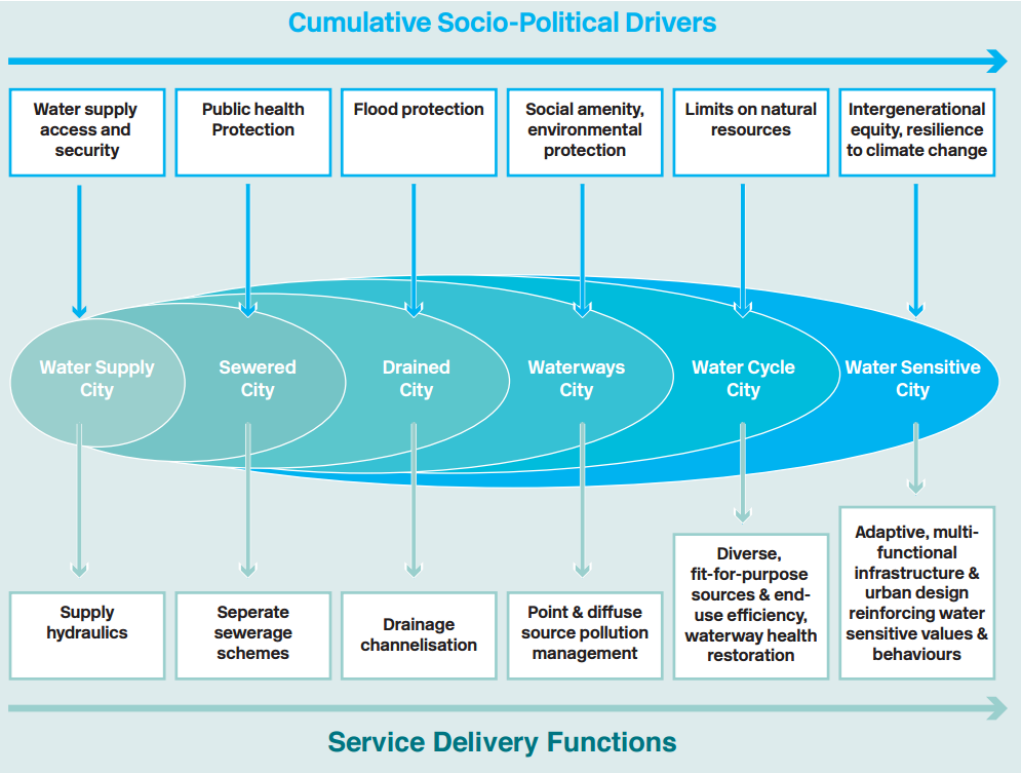
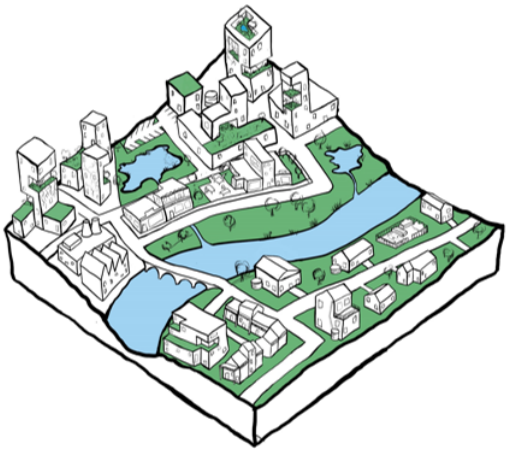


Figure 1 The Urban Water Transitions Framework (Brown, et al., 2009)

1.3 What is Council's role?

In delivering water sensitive city outcomes Council's key role and responsibilities relate to the development of planning and development standards. Council also has a critical roles to play in ensuring IWCM directly influences water sensitive city outcomes through the incorporation of best practice solutions in Council capital works and the management of Council buildings and open space networks. Council also has an important leadership role ensuring development activities across the private domain align to Council's vision and key objectives for IWCM.

2. The Vision and Objectives of this Plan



Wyndham's 2040 Vision

Wyndham is celebrated as a water sensitive city with successful urban and rural environments where Council works collaboratively with its community and stakeholders to create healthy ecosystems and liveable communities.

Wyndham City Council's IWCM vision reflects the complex mix of environments found across the municipality and the community's desire to preserve the regions urban, rural and coastal feel.

A water sensitive Wyndham will deliver a raft of benefits to the community and environment, including:

- Fit-for-purpose water usage that preserves potable water and utilises the benefits of recycled water and treated stormwater.
- Cooler greener micro-climates that reduce temperatures during heatwaves
- Improved flood protection and response.
- Multi-functional open spaces that provide a treatment, flooding, amenity and space for play.
- Cleaner and healthier waterways delivered through improved stormwater treatment and community education programs.

Three key objectives for Wyndham have been identified to help deliver on Council's vision. Each objective is presented below in Table 1.

Table 1 Wyndham's IWCM objectives

OBJECTIVE 1	
Create a resilient and liveable city	WCC aims to deliver water services that are able to cope with expected future stressors, including drought, flood and climate change. This will be achieved by planning for change and designing adaptable and flexible infrastructure and urban places. Council also aims to provide the community with spaces that meet its growing and evolving needs (e.g. aesthetics, play, thermal comfort) as well as supporting positive environmental outcomes (e.g. fit-for-purpose water supply, increased biodiversity and decreased pollution).

OBJECTIVE 2	
Improve the health and amenity of waterways and coastal environments	WCC aims to address key ecological threats to local waterways and coastal environments whilst improving the social values of these natural assets. This requires protection of existing values (e.g. marine parks and wetlands) and expanded implementation of WSUD and stormwater harvesting to counteract the negative impacts of urban development. Restoration of riparian corridors is also needed to provide channel stabilisation, temperature control and habitat. Council will also continue to advocate for local water issues, including increased environmental flows for the Werribee River.

OBJECTIVE 3	
Improve collaboration and engagement with all stakeholders	WCC recognises the multi-disciplinary nature of IWCM requires collaboration and engagement with all stakeholders. WCC aims to give the community a greater voice in water management in Wyndham, improve inter-departmental collaboration within Council and engage with government and industry stakeholders. This renewed focus on improved engagement will help build awareness of IWCM, identify capacity needs and allow for the exploration and implementation of new opportunities.

3. Contextual Review

3.1 Planning, policy and legislation

There are a variety of documents at the federal, state, regional and local level that influence the management of water. A snapshot of the key planning, policy and legislative documents that influence water management in Wyndham is provided below and summarised in Figure 2 (page 7).

- The **National Water Initiative** commits all states and territories to innovation and capacity building to create Water Sensitive Cities.
- The **State Environment Protection Policy (Waters of Victoria)** sets the framework for government agencies, businesses and the community to work together to protect and rehabilitate Victoria's surface water environments. The SEPP (WoV) states that runoff from urban and rural areas must not compromise the identified beneficial uses of receiving waters.
- Clause 56 of the **Victoria Planning Provisions** mandates integrated water cycle management and requires compliance with best practice stormwater quality treatment objectives for all residential subdivisions larger than 2 lots. Best practice stormwater quality treatment targets require an 80% reduction in suspended solids, 45% reduction in phosphorus and 45% reduction in nitrogen.

Recent developments at the state and regional level include:

- Establishment of **Greening the West** – a regional initiative with targets to double tree canopy cover in the west by 2050 and increase green space by 25% by 2030.
- Preparation of **Water for Victoria** – a new water plan which will set the strategic directions for all aspects of water management in Victoria.
- Preparation of **Plan Melbourne Refresh** – the Victorian Government's metropolitan planning strategy, guiding how Melbourne will grow and change to 2050, due for completion in 2016.
- Review of the **SEPP (WoV)** – to ensure water quality objectives reflect current science and changes to national guidelines, streamline rules for decision-makers and industry obligations, improve alignment with current government policy and programs, deliver a single SEPP that covers all waters of Victoria – due for completion in 2017.

Locally, **Wyndham's Integrated Water Cycle Management Plan** (IWCM Plan) sits within the broader context of the City Plan 2013 – 2017. It is linked to the Environment and Sustainability Strategy 2016 – 2040 and informed by other documents related to climate change, open space and street trees. The IWCM Plan sits above Wyndham City Council's (WCC) existing stormwater management and water action plans, acting as a unifying document that brings departments across Council together to collaborate better on water related projects

Key agencies and organisations involved in the management of water in the Wyndham region include WCC, the Department of Environment, Land, Water and Planning (DELWP), the Port Phillip and Westernport Catchment Management Authority (CMA), the Environment Protection Authority (EPA), City West Water (CWW), Western Water, Barwon Water and Southern Rural Water (SRW).

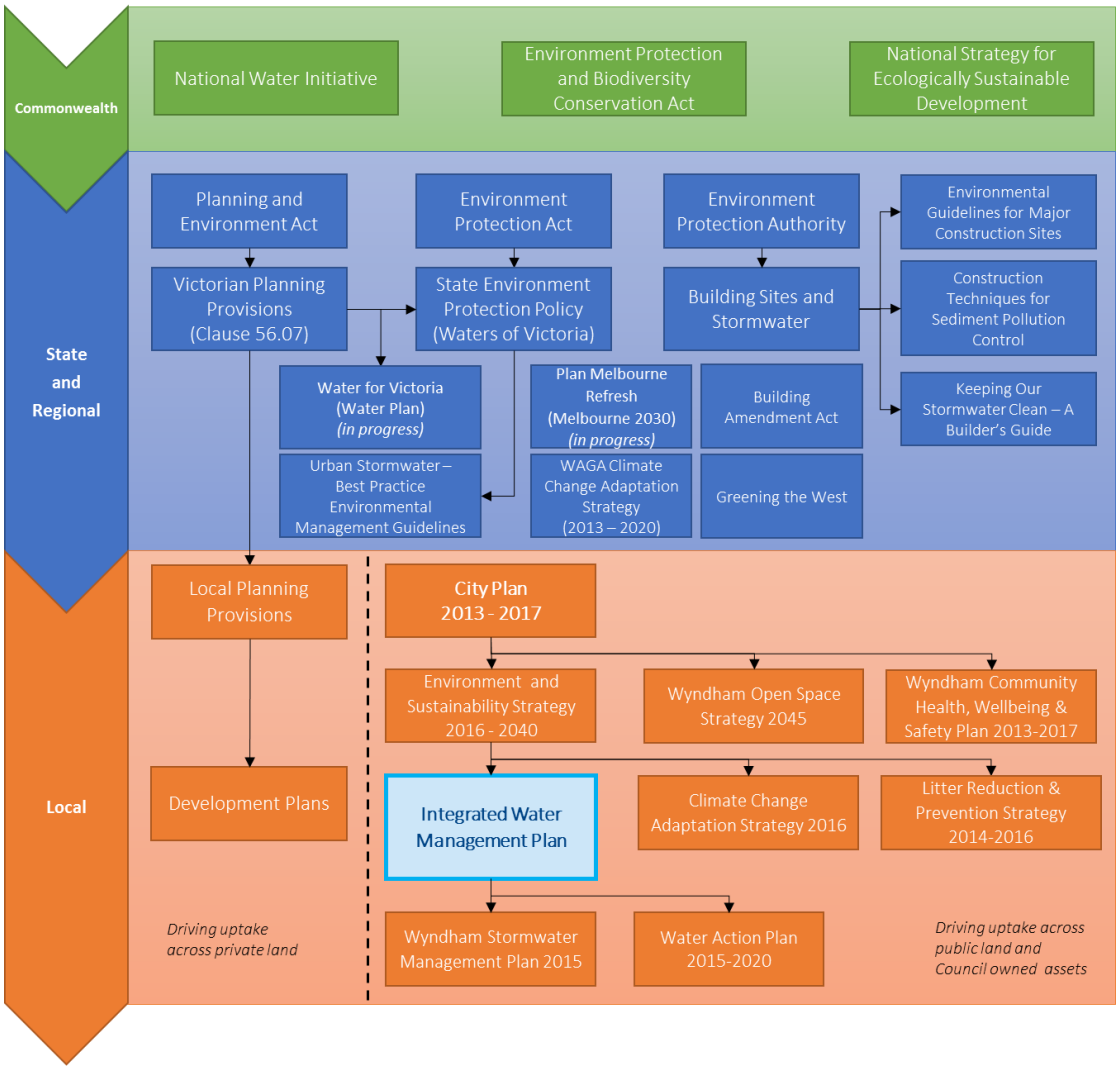


Figure 2 Key planning, policy and legislative documents

3.2 Land use

3.2.1 Current land use

The Wyndham region is characterised by six major land uses; green wedge, rural conversation, public use, urban growth, general residential, and industrial use. Significant areas to the west and north-west have a history of dry land farming and are currently zoned rural conversation or green wedge. Unique to Wyndham's south is the large public use zone used for Melbourne's Western Treatment Plant. The north-east zone features a concentration of industrial land. The oldest and most established residential and commercial areas are located in Werribee and Hoppers Crossing. Wyndham also contains significant urban growth zones, particularly in the north-west along Werribee River and north to north east in Tarneit and Truganina.

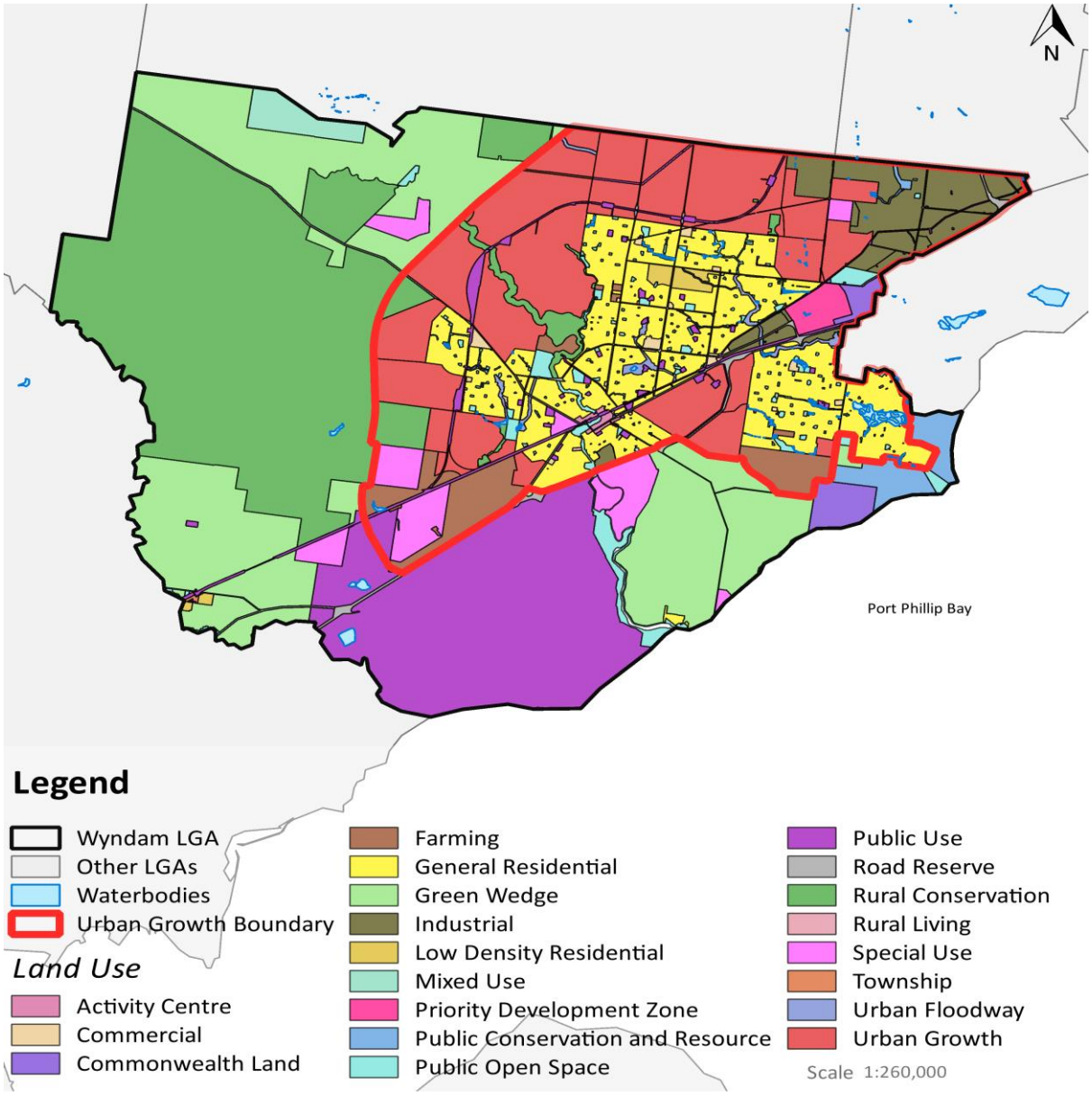


Figure 3 Current land use in Wyndham

The Werribee Irrigation District (WID) is located in Werribee South and consists of 3,000 hectares of land, of which with 2,350ha used for intensive agriculture (Figure 4). The WID has been an important agricultural centre since the early 19th century and remains a prominent asset for which Wyndham is renowned. The soils in the district are well suited to intensively irrigated agriculture and the climate is ideally suited to all year round production., consequently the value of production per hectare and production per ML are both high (SRW, 2009). Furthermore, the WID is an important feature of the local and state economy. It creates 660 jobs, generates an economic output of over $183M and supplies 85% of Victoria's cauliflower and nearly 50% of the broccoli (WCC, 2016; SRW, 2011).

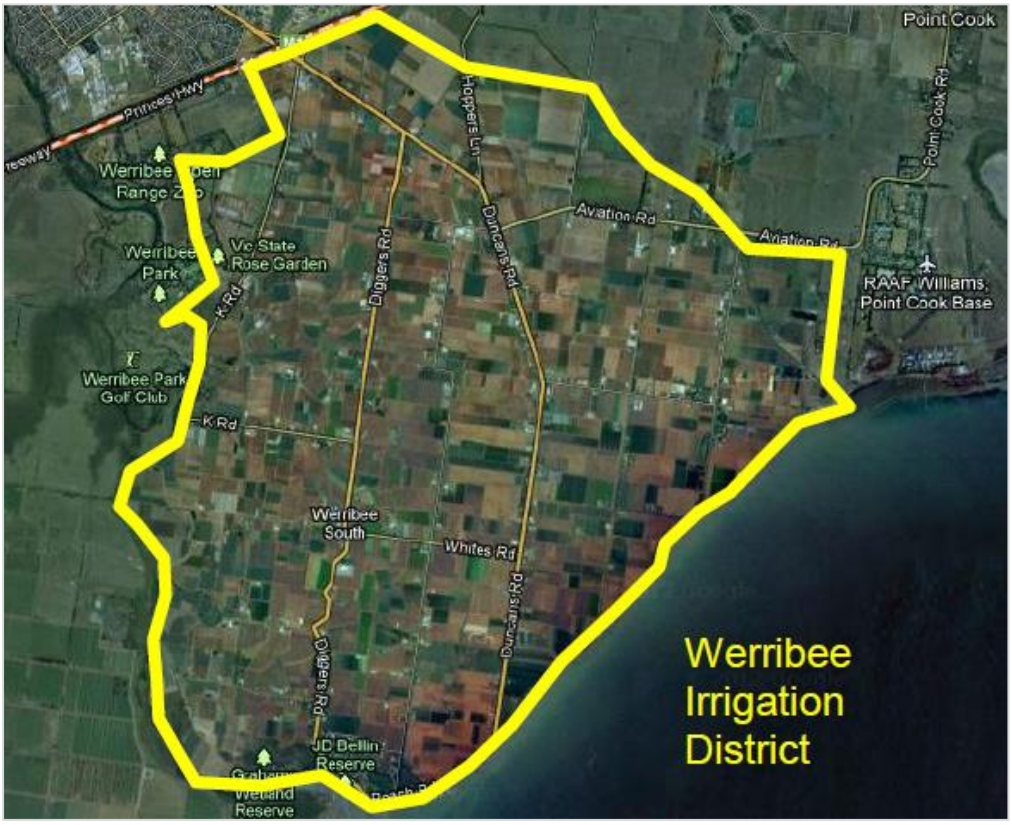


Figure 4 The Werribee Irrigation District (WID) (National Water Commission, 2016)

3.2.2 Future land use

Wyndham has already undergone substantial urbanisation and this trend is set to continue. In recent years Wyndham recorded some of the largest population growth in metropolitan Melbourne with 193 new residents a week (WCC, 2016). In 2016 Wyndham's population is estimated to be 214,098 people, this is set to almost double to 419,910 people by 2036 (forecast.id, 2016). This will make Wyndham one of the most populated local government area in Victoria.

Wyndham's large population growth will be accompanied with a rapid urbanisation as dwellings and associated infrastructure, including roads, shopping precincts and business centres, develop to cater for the new population. In the last financial year Wyndham experienced the largest growth ever

recorded in Melbourne's outer west (The Age, 2016), with more than 6500 housing lots approved and almost 9000 applications for subdivisions (Figure 5). This development is occurring across a number of areas with 17 of the municipality's 23 precinct structure plans already completed and approved.

Figure 5 Applications for subdivisions in Wyndham (The Age, 2016)

This level of urbanisation will have significant impacts on water management in Wyndham as:

- The volume of potable water used and wastewater discharged from residential and commercial areas increase substantially.
- The volume of alternative water use in residential and commercial centres increases (e.g. stormwater harvesting in Blackforest Road)
- The area of active and passive open space managed by Council grows and the drivers for alternative water use for irrigation increase.
- Rivers and streams become increasing degraded by large increases in stormwater flow volume and frequency and associated pollutant loads.

3.3 Water use

Water use in Wyndham is diverse. There are many different water supplies available (e.g. potable water, recycled water, treated stormwater, rainwater and groundwater), as well as a variety of water users (e.g. Council, residential, commercial) and water uses (e.g. health, leisure and irrigation). A brief overview of Council, community and agricultural water use in Wyndham is provided below.

3.3.1 Council water use

The irrigation of sports reserves and parks accounts for the vast majority of Wyndham City Council's water use (86%), followed by buildings (6%) and aquatic centres (3%) (WCC, 2015). From 2005/06 to 2010/11 WCCs water use declined dramatically from close to 400 ML/yr to less than 200 ML/yr (Figure 6). This reduction occurred as a result of the water restrictions that came into force during the Millennium Drought, which saw Melbourne's mains water supply reservoirs drop by almost 40%. From 2010 onwards there has been a significant rebound in Council water usage. This can be attributed to the lifting of water restrictions and the construction of several new sports reserves to cater for Wyndham's growing population. This growth in demand is increasingly being supplied by recycled water.

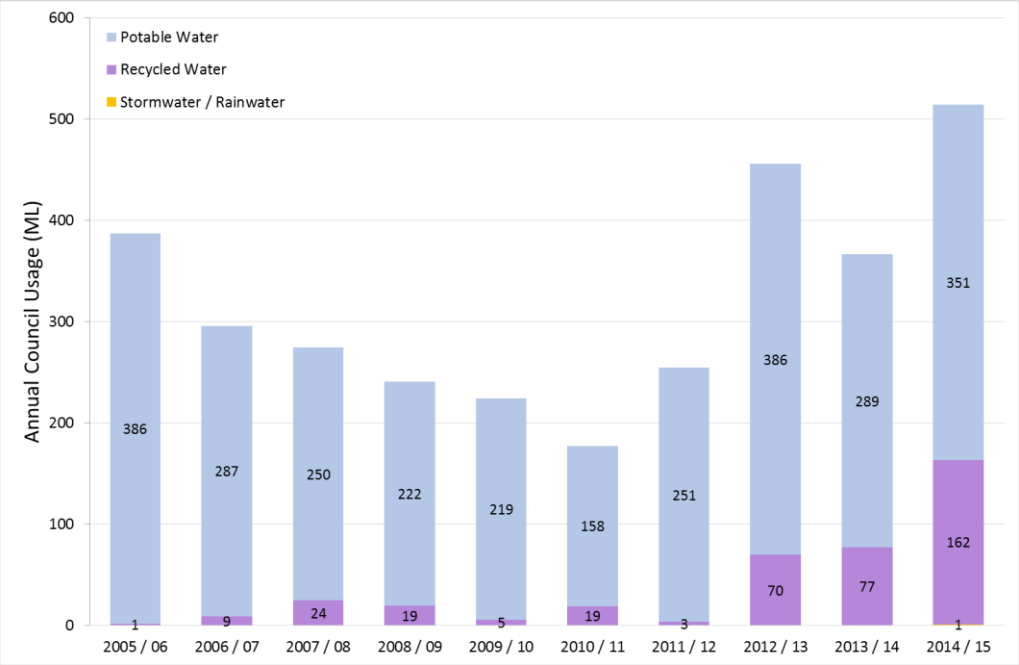


Figure 6 Annual Council water use

In face of this, WCC has still managed to reduce its consumption of water on a per resident basis relative to 2005/06 levels (Figure 7). This has been achieved through:

- The use of recycled water to irrigate several sports reserves (e.g. Saltwater, Featherbrook, Glen Orden and Mossfield Reserve).
- The installation of rainwater tanks at a number of Community Centres and Facilities including the Depot and Refuse Disposal Facility.
- A comprehensive retrofit program of water efficient fixtures and fittings for Wyndham City's buildings and facilities.

Despite these reductions, Council's average water use per resident for 2014 / 15 of 2.58 ML exceeded its recently adopted target of 2.28 ML (Figure 7). It is recommended that Council replace its current target with a target that tracks the consumption of potable water per resident. This will help focus on reductions in potable water use whilst allowing for increases in alternative water use.

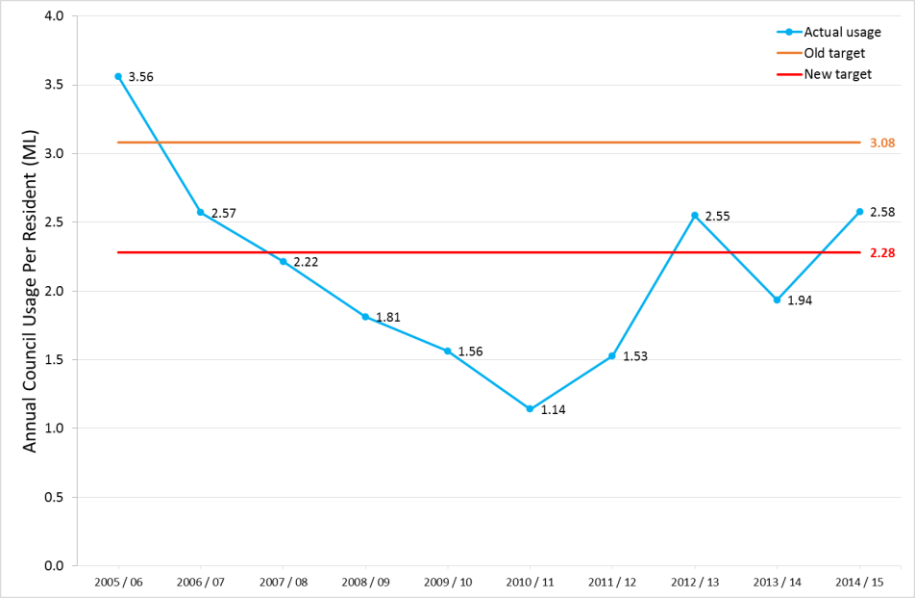


Figure 7 Annual Council water use per resident

In 2014/15, a total of 32% of Council water usage was supplied by alternative water sources (Figure 8). This allowed Council to achieve its 2020 target of meeting 30% of its water use with alternative water sources for the first time. Recycled water accounts for the vast majority of this alternative water supply, however, in recent years, Council has diversified its alternative water supply sources to include stormwater and rainwater. In 2014 / 15 stormwater and rainwater only contributed ~1ML, or 0.2 %, of Council's total water supply. However, these new supply sources, in particular stormwater, will need to increase substantially over the next few years if Council is to continue to meet its alternative water supply target. As new developments occur further away from CWWs existing recycled water network the cost to provide recycled water for irrigation will increase. This will make the investment needed to facilitate stormwater harvesting for open space irrigation increasingly economically viable.

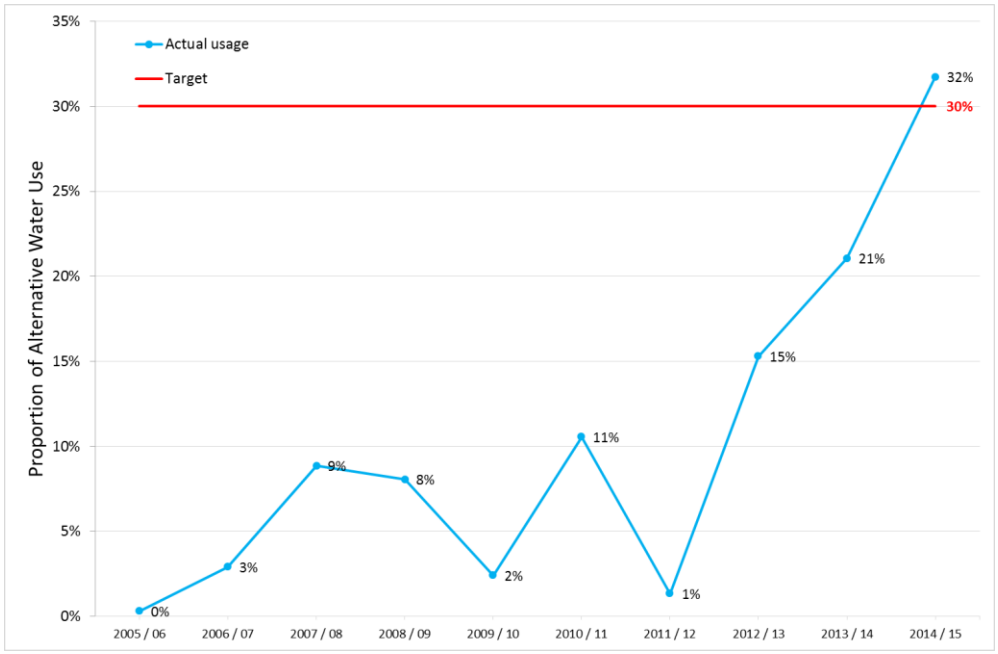


Figure 8 Alternative water use as a proportion of total Council water use

3.3.2 Community water use

In absolute terms Wyndham's community water use (i.e. residential and non-residential water use) has been steadily increasing since 2012/13 (Figure 9). Both residential and non-residential usage has increased over this period. Increases in the residential sector are largely linked to growth in Wyndham's residential population as potable usage on a per person basis has remained relatively constant since 2012/13 (ranging from 58 to 59 kL per person).

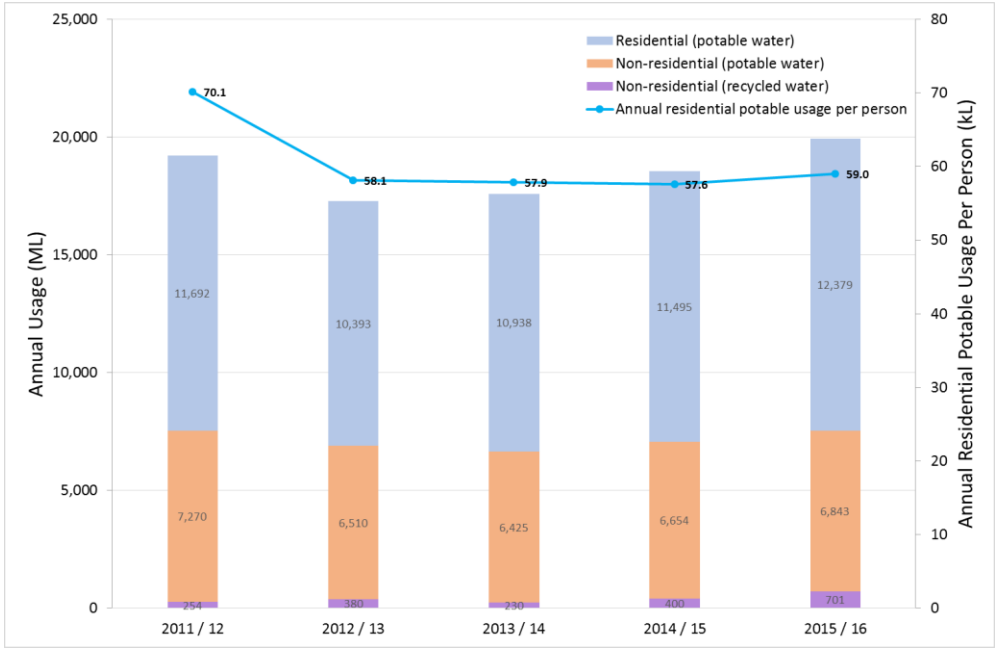


Figure 9 Community water use in Wyndham

In the residential sector there is currently no recycled water use. There are third pipe networks in place to deliver recycled water to some new residential developments, however, these networks are yet to be commissioned. In this interim period City West Water have been supplying potable water through these pipes. Consequently, recycled water use in the residential sector is expected to commence in the coming years as these come online.

In contrast, the non-residential sector has been utilising recycled water several years with a strong upwards trend (Figure 10). Over the five year period form 2011/12 to 2015/16 usage has almost tripled to 701 ML, constituting over 9% of total non-residential water use. To date, the majority of non-residential recycled water use is from the commercial rather than industrial sector, with the main uses being toilet flushing and irrigation, at shopping centres, schools and child care facilities.[1]

There is limited data on residential and non-residential alternative water usage other than recycled water. Some level of rainwater harvesting is likely across these sectors. There is also evidence of small scale water reuse, with 19% of households in Wyndham's Household Survey 2015 (WCC, 2015) indicating that they collect water from a washing machine, shower or sink to save water.

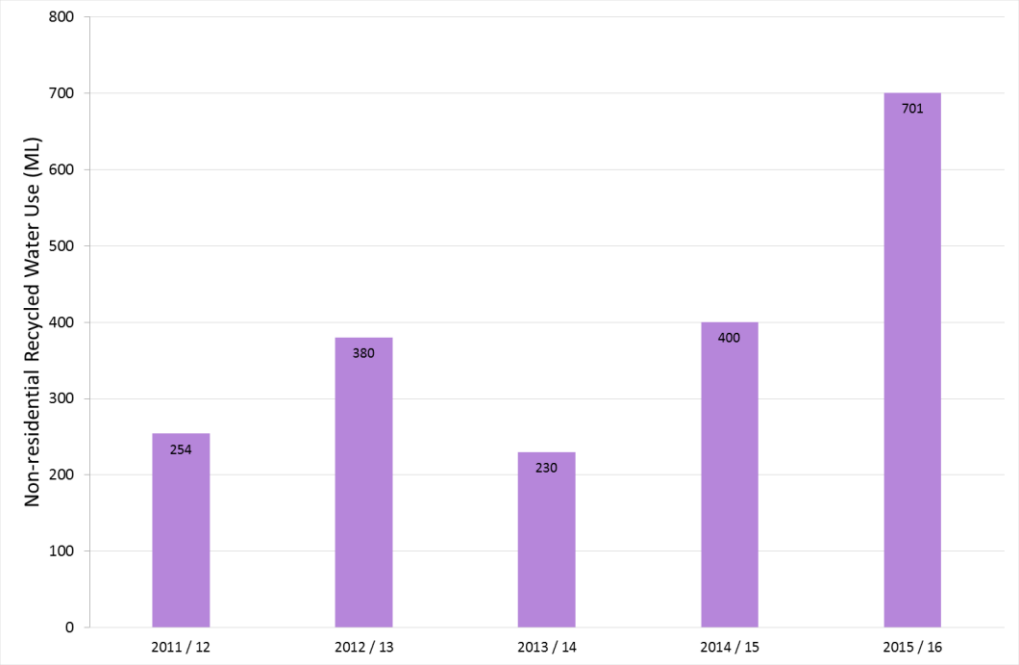


Figure 10 Non-residential recycled water use

[1] Personal communication, Des Hortan, Business Relationship Manager, Strategic Business Partnerships, CWW, 02/08/2016

3.3.3 Agricultural water use

In the 2014-15 season 15,200 ML of water entered the WID, this consisted of 4,000 ML of recycled water and 11,200 ML of river inflows (Figure 11). Only 8,000 ML of the total 15,200 ML of water supplied to the WID was delivered to Southern Rural Water customers. The difference of 7,200 ML represents system 'losses'. These losses are largely attributed to channel seepage (6,300 ML). However, there are also losses due to meter under-recording (600 ML), outfalls (230 ML) and evaporation (70 ML).

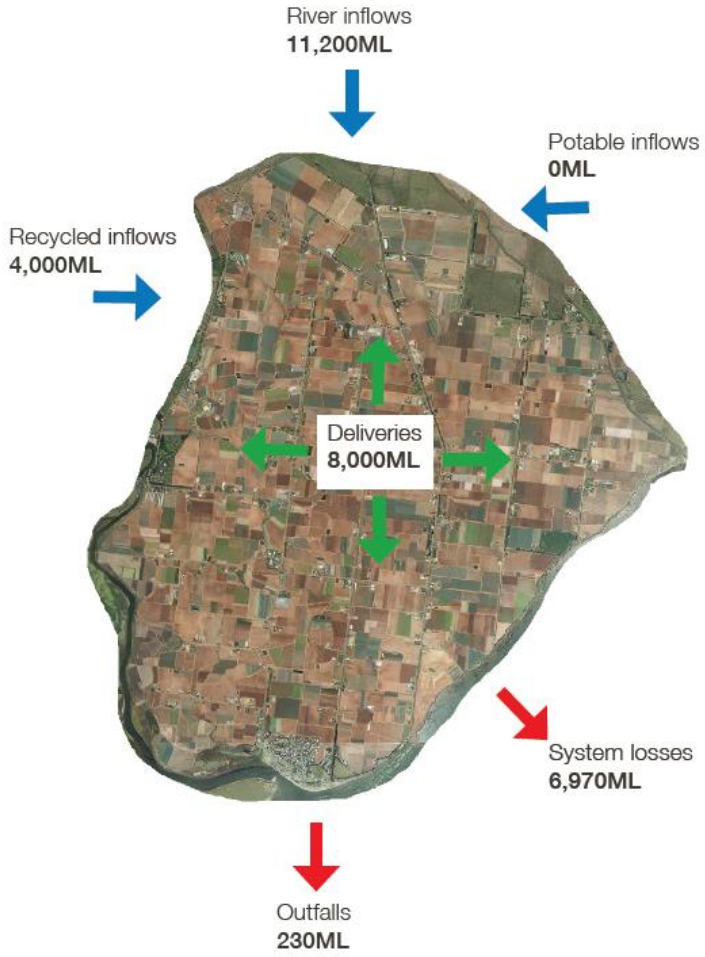


Figure 11 WID water balance for the 2014-15 season (SRW, 2015)

Southern Rural Water manages the system to reduce losses. Despite these efforts channel seepage remains a major issue. Addressing this problem requires costly channel replacements. Some channel replacements are underway, however, funding for wholescale channel replacements has yet to be secured.

The quality of recycled water delivered to the WID remains a significant issue. Recycled water has a higher salinity than surface water and although further treatment can reduce salinity, it makes the cost of supply prohibitive.

Irrigators deal with the elevated salinity of the recycled water by applying more water than crop demands, particularly during the hotter weather, to persistently leach the soil of excess salt (SRW, 2009).

Southern Rural Water has developed a business case based upon pipelining the irrigation district which has been submitted to the National Water Initiative to address this issue.

Groundwater is also used for irrigation in the WID, particularly when the surface water allocation is low (National Water Commission, 2016). The groundwater system used is known as the Werribee Delta Aquifer. The low yields and high salinity from this unconfined aquifer mean that groundwater is not always suitable for direct irrigation. Instead it needs to be mixed with surface water prior to irrigation.

The Werribee Delta Aquifer falls within the Deutgam WSPA with groundwater managed by SRW. During the Millennium Drought low surface water allocations led to increased groundwater demand. This resulted in a dramatic drop in aquifer to critically low levels with and increased salinity risks.

3.4 Catchments and waterways

The Werribee River runs through the heart of Wyndham and is the most significant waterway in the region (Figure 12). The river supports a wide array of environmental, social, economic, cultural and recreational values for the Wyndham area. The 110 km system includes a regionally significant fresh-saltwater estuary and provides for a diverse community of native flora and fauna. Popular recreational activities including fishing, bird watching, passive boating, cycling and bushwalking. Significant Indigenous cultural heritage sites have been found along the riverbank and escarpments including fish traps, artefacts and burial sites. Additionally the lower reaches of the Werribee River system provide irrigation water for the local agricultural industry.

Despite its many values, the Werribee River suffers from poor to very poor water quality and inadequate environmental flows (WCC, 2015). Negative environmental and social outcomes are associated with regular outbreaks of blue-green algae and thick blooms of the free floating fern called Azolla (*Azolla pinnata*), particular during summer periods (see Figure 13 and Figure 14 on page 18). Other known management challenges include excess nutrients and large amounts of litter.

Other important waters in the Wyndham include Lollypop Creek, Little River and Skeleton Creek. Short sections of the Kororoit Creek and Laverton Creek also flow through the municipality. These waterways are highly modified and very little remnant riparian vegetation exists in the lower sections that flow through Wyndham.

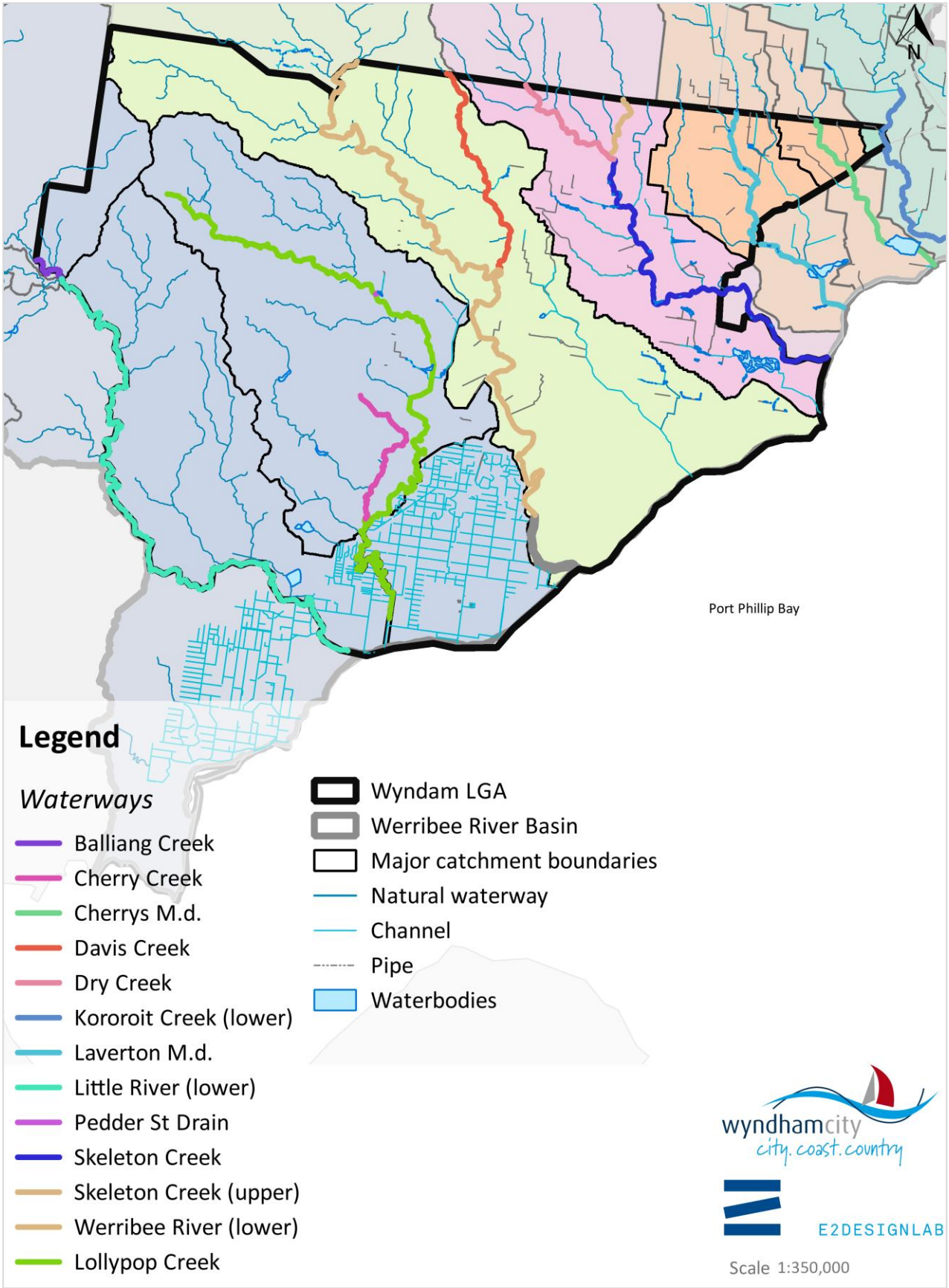


Figure 12 Wyndham's waterways

Figure 13 Azolla covering the Werribee River at Mambourin Street, Werribee. Photo courtesy John Forrester (WCC, 2015, p. 8).

Figure 14 Blue-green algal bloom in the Werribee River beneath Maltby Bypass. . Photo courtesy John Forrester (WCC, 2015, p. 9).

Land use impacts on waterways tend to accumulate over time but may occur more suddenly during periods of major land use change, such as catchment urbanisation. Many of the waterways flowing through Wyndham are left with a legacy of poor aquatic ecosystem health due to historic clearing for agriculture and more recently from the impacts of catchment urbanisation. A number of key threats impact on waterway values and include:

- Changes to natural water flows.
- Poor water quality.
- Vegetation clearing.
- Climate change.

Managing the social and amenity values of waterways is considered equally as important as managing the ecological values of a waterway. The social values of waterways encapsulate liveability values and are linked to waterway access, waterway aesthetics and quality of riparian vegetation, linkages to the open space networks across a catchment and other facilities provided (e.g. access to use the waterway, bike paths, etc.). The human amenity of remediated waterways can be largely independent of the actual ecological condition and tends to be determined by the presence of a riparian zone, visual water quality (turbidity) and presence/absence of gross pollutants.

The key factors influencing the 'social amenity' of urban waterways include:

- Community access for active and passive recreation.
- Aesthetics (including the presence of anthropogenic litter).
- Thermal comfort (micro climate influences).
- Safety.

3.5 Environmental flows

Catchment urbanisation changes the hydrology of waterways. Typically, changes to flow regimes include increased frequency of surface runoff, increased peak flows and an increase in total runoff volume. However, this is not the case for the Lower Werribee River, where the poor health rating of the waterway is attributed to low flow rates downstream of the Werribee Diversion Weir (WCC, 2015). With extensive diversions from the river to supply agriculture demands preserving environmental flows within the lower section of the waterway is now recognised as imperative to delivering improved ecological and social (including amenity and liveability) values.

The Victorian Environmental Water Holder (VEWH) is the independent statutory body responsible for holding and managing Victoria's environmental water entitlements (the Water Holdings).The VEWH works with catchment management authorities and Melbourne Water to ensure environmental water entitlements are used to achieve the best environmental outcome with the water that is available. The Werribee system is one of five systems that can receive environmental water in the Central Region of Victoria. Environmental water is held in storage and delivered to the Werribee system to meet the objectives set out in Table 2 (page 20). Detailed environmental flows and their action-specific objectives for the Werribee system can be found in Seasonal Watering Plan 2016-17 (VEWH, 2016).

Table 2 Environmental watering objectives in the Werribee System

	Maintain diverse macrophytes (large water plants) and shrubs to provide shade and food for organisms further up the food chain.
	Protect and boost native fish populations including black bream, by providing pool habitat, flows for fish to move up and downstream and encouraging fish to spawn (release eggs).
	Maintain habitat for frogs, macroinvertebrates and platypuses.
	Maintain pool water quality for fish and platypuses and inundate estuary salt marsh with brackish water.
	Move built-up silt from riffles (shallower parts of the river).

*Source: VEWH (2016, p. 49).

Management highlights and possible watering activities for 2016 include:

- Provision of an additional 1,100 ML of water available to combat recent dry conditions and help support environmental outcomes in the Werribee River system.
- Provision of flushing winter flows to the lower Werribee River. These flows haven't occurred for more than three years. The delivery of this water will support multiple environmental outcomes and improve the overall condition of the river for local community and river users.
- Maintain water quality through small fresh events, before delivering a larger flow over winter (VEWH, 2016).

Although not directly responsible for environmental flows, WCC has an important role to advocate for a shared responsibility of stakeholders (State Government, Melbourne Water and Southern Rural Water) to better manage flows within the Werribee River system and explore opportunities for the use of alternative water supplies to satisfy environmental flow requirements. The opportunity for Council to increase its advocacy for increased environmental flows was highlighted in the recent Health of the Werribee River report (2015). Council should also ensure the new growth does not further exacerbate problems in the Lower Werribee River due to altered flow regimes and poor water quality discharge in the future.

Alternative water supplies are increasingly being considered for their potential use as a source of water for environmental flows. Melbourne Water is considering the type of water appropriate for environmental flows, and what values it should support. Treated stormwater is relatively low in nutrients (compared to recycled water) and therefore is likely to support more waterway values. The use of stormwater for environmental flows will generally require the provision of storage to buffer supply (rainfall) and demand.

3.6 Groundwater

There are multiple aquifers in Wyndham, including the Werribee Delta Aquifer (WDA) and Werribee Formation Aquifer (WFA). The Werribee Delta Aquifer is the key groundwater asset in the region that is relied on by irrigators in the Werribee Irrigation District, particularly during dry spells. The WDA a shallow unconfined groundwater system that sits only 6 to 10 metres below ground level, bore yields typically range from 2 to 10 litres/second and salinity varies from 800 to 3,000 EC (SRW, 2009).

The WDA falls within the Deutgam Water Supply Protection Area (WSPA) which extends from Werribee south to the Werribee South foreshore (WID) (Figure 15). The WSPA is jointly managed by Southern Rural Water (SRW) and the Department of Environment, Land, Water and Planning (DELWP). SRW determines the groundwater allocation each year based on a consideration of groundwater level triggers, river water allocations; the availability of recycled water, and the seasonal rainfall and temperature outlook. Close management of the system is essential to mitigate the risk of saline intrusion from the estuarine reaches of Werribee River and Port Phillip Bay.

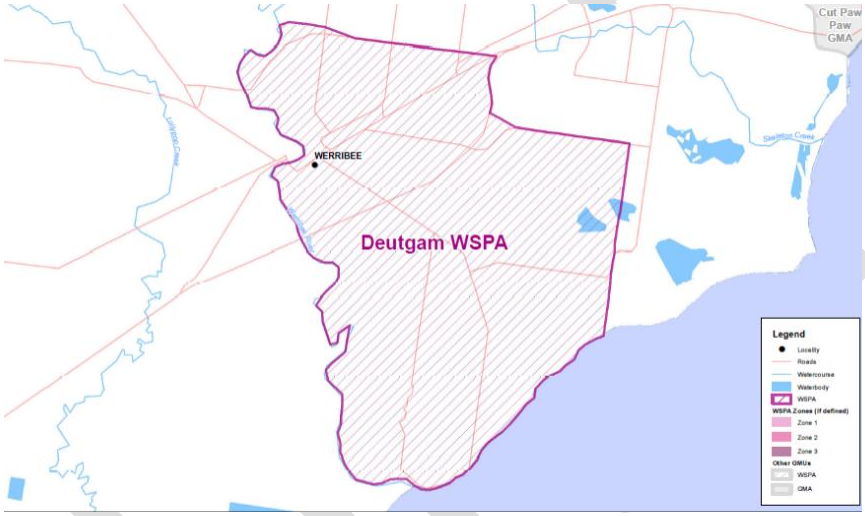


Figure 15 The Deutgam Water Supply Protection Area (SRW, 2015)

Over 95% of groundwater in the Deutgam WSPA is licensed for irrigation purposes, only a small volume is licensed for industrial or commercial purposes. In addition to licensed use people have the right to take groundwater for domestic and stock use.

Wyndham's aquifers also have the potential to support alternative water supply schemes in the region through aquifer storage and recovery (ASR). ASR involves the pumping water (e.g. recycled water or stormwater) into underground aquifers for storage. In this way ASR can offer a low cost storage opportunity that greatly increases the viability of alternative water schemes. Field testing for the aquifer located in the Werribee Formation suggests that viable injection and extraction rates are achievable. The potential for aquifer storage and recovery is being explored in Wyndham as part of the Werribee East PSP and Black Forest Road PSP.

Table 3 Deutgam WSPA statistics (SRW, 2015)

No. of licences	145

Volume of licences	4,898.6 ML
Permissible consumptive volume*	5,100 ML

* I.e. the is a cap on the amount of groundwater allocated

3.7 Litter management

Litter is an incredibly visible form of pollution that degrades Wyndham's natural environment and negatively impacts the community's enjoyment of public spaces. Environmental impacts included wildlife injury or death as a result of ingestion or entanglement, altered natural habitats as well as land and waterway contamination. In the marine environment micro plastics and other litter is transported by ocean currents and winds carry floating marine debris into whirlpools, called gyres (Healthy Waterways, 2016). For inland waterways the reduction of nutrients and sediments is a priority, however, litter management is still required to:

- Prevent drainage system blockages.
- Prevent fouling of downstream treatment assets (e.g. wetlands and biofilters).
- Preserve waterway amenity.

Figure 16 Volunteers with some of the 240 kg of litter collected at Bungies Hole on the Werribee River (Star Weekly, 2015) and Right: A platypus found in Werribee River bound in a silicon wrist band (Melbourne Water, 2014).

Negative social impacts of litter include health hazards to humans, general unsightliness, reduced community safety and neighbourhood ownership and reduced use of public places like parks and beaches (WCC, 2014). Wyndham's community currently consists of a reality high proportion of family households and is set to grow at a rapid pace. This is expected to result in increased open space use and increased litter generation. At the same time the community's expectation of the quality of open space in the municipality will likely increase. Consequently, improved liveability and amenity outcomes are also key drivers for litter management.

There are also major financial implications associated with litter management. Wyndham City spends in excess of $2 million per year on litter mitigation and cumulatively all Victorian councils spend an estimated $78 million per year on litter and street sweeping services (WCC, 2014). This significant expenditure has a direct impact on local government rates (Sustainability Victoria, 2013).

Both State and Local governments are involved in the management of litter in Victoria. Figure 17 below summarises (a) the different scales of illegal waste disposal, (b) the likely perpetrator and (c) indicates whether local or state government is responsible for clean-up and prosecution. Local government plays the primary role in litter management through provision of household waste and recycling services, public litter bins, Gross Pollutant Traps, street and beach cleaning and running targeted litter education and prevention programs. Local government also have a regulatory role in enforcing requirements for waste management activities.

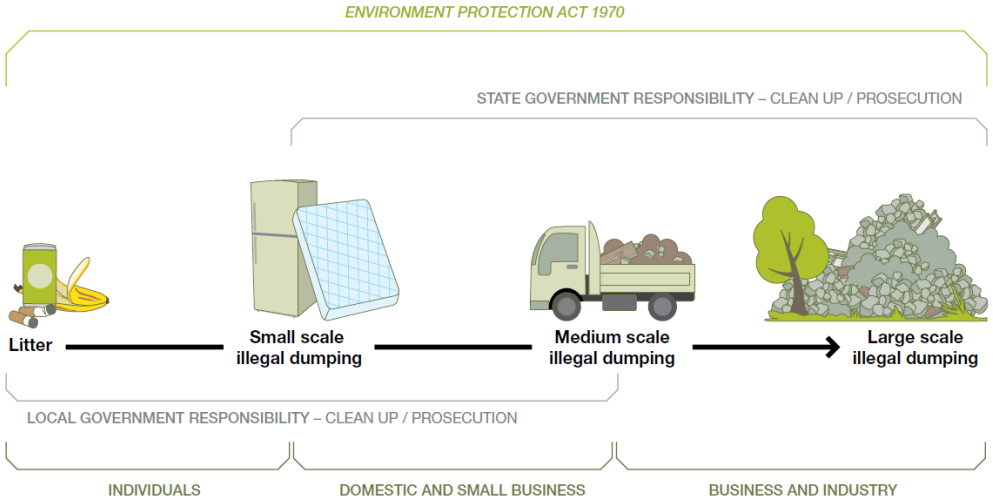


Figure 17 Acts of illegal waste disposal (Sustainability Victoria, 2013, p. 6)

WCC has recently received funding to reduce the amount of fishing related litter along both the River and foreshore in partnership with Melbourne Water and the Werribee River Association. Wyndham has also been successful in securing grant funding from the Keep Australia Beautiful National Association to install five public place recycling bins at Station Place in Werribee; to help capture bottles, cans and containers that potentially could have ended up as litter in or around the Werribee River. Other potential funding projects include installing more gross pollutant traps, purchasing/hiring floating litter traps and expanding current education programs.

3.8 Onsite Wastewater Management Plan

Onsite wastewater management of unswered properties in Victoria is a public health function which is delegated to local government. Councils act as the responsible authority for septic system plan approvals, issue of permits, setting of permit conditions, oversight of installation and the final approval of the systems use. Councils have the responsibility for the enforcement of the conditions in permits that facilitate the ongoing operation of septic tank systems.

A strategic document the Onsite Wastewater Management Plan or OWMP is to be implemented as advised by the *State Environmental Protection Policy (Waters of Victoria)* to ensure Council is meeting its obligations in managing onsite wastewater.

"municipal councils need to where relevant develop and implement a domestic wastewater management plan, in conjunction with water authorities and communities" State Environmental Protection Policy (Waters of Victoria)

The Onsite Wastewater Management Plan aims to improve the overall management of onsite wastewater in Wyndham by minimising the transport of nutrients, pathogens and other pollutants to receiving environments (ground and surface waters) to reduce the impact of wastewater from unsewered properties on the public's health and the environment.

The objectives of the OWMP are to:

- Improve Council's database management of onsite wastewater systems allowing education, maintenance, system upgrade and future planning opportunities to be explored.
- Provide communication and education to the community on system operation and best practice.
- Wastewater management in Wyndham City Council to be improved overall by taking opportunities to upgrade systems and explore the feasibility of sewer infrastructure to some areas.
- To ensure a consistent approach is taken by all stakeholders to domestic wastewater management in Wyndham City Council through regulation and education.
- Advocate for an updated sewer backlog program to be developed by the water authority which includes Wyndham City Council as part of a *Sewer management plan* as identified in the *State environmental protection policy (Waters of Victoria).*

Through the implementation of the OWMP the impact of unsewered properties on ground and surface water will be reduced as systems improve, the public are educated and sewer is provided where possible.

3.9 Stormwater management

Stormwater management is a key challenge for Wyndham. Urbanisation significantly impacts the natural water cycle by creating complex environmental changes that require careful consideration to address. Urbanisation results in an increase in impervious surfaces (e.g. roads, roof and paths), this leads to a drastic reduction in stormwater quality and results in a range of hydrologic impacts. Cumulatively these impacts significantly degrade urban streams and ecosystems. The negative impacts of urbanisation can be mitigated through the adoption of Water Sensitive Urban Design (WSUD) treatments and stormwater harvesting. The impacts of urbanisation and benefits of WSUD and stormwater harvesting on the water cycle are summarised in Figure 19 below (see p. 26).

Wyndham's waterways are already impacted by large areas of existing urban development. Each year more than 56,000 ML of runoff is generated, this transports 9,000 tonnes of total suspended solids (TSS), 20,000 kg of total phosphorus (TP) and 146,000 kg of total nitrogen (TN) into local waterways (Figure 18). As this development expands into Wyndham's substantial growth corridor runoff is predicted to increase to almost 79,000 ML/yr. This represent a 40% increase in stormwater flows and will be matched with a 45-55% increase in pollutant loads discharged across the municipality.

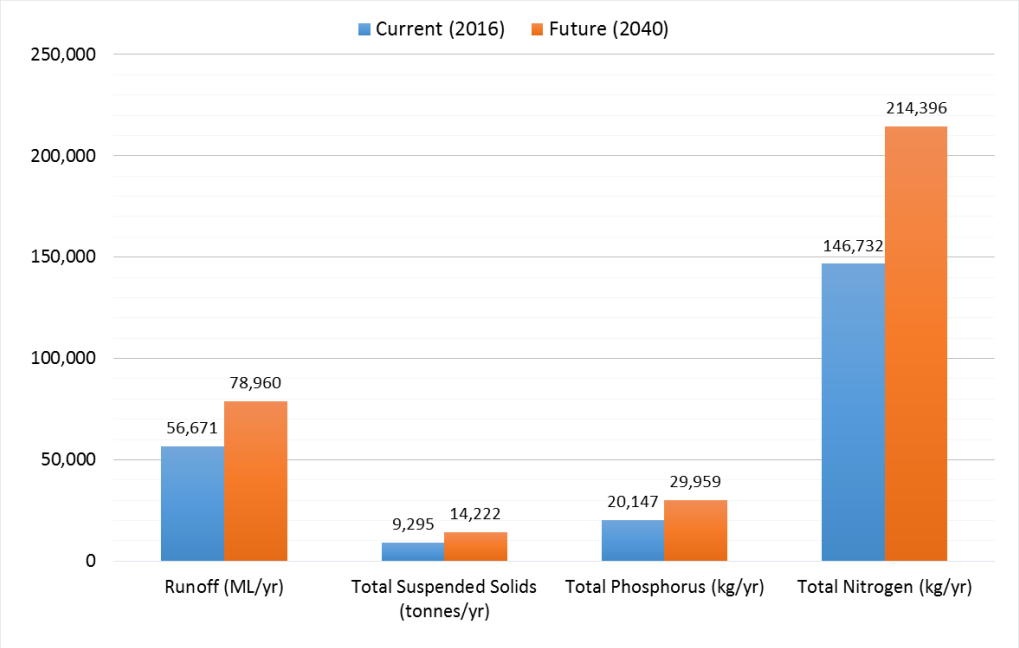


Figure 18 Increase in runoff and pollutant loads under current and future conditions

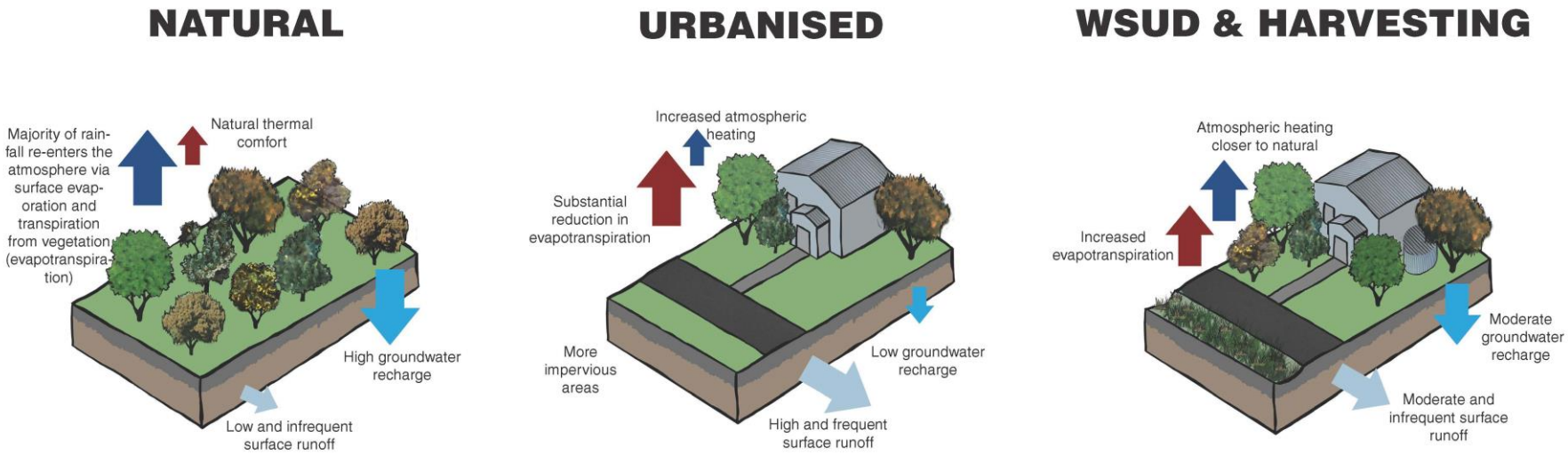


Figure 19 The impacts of urbanisation and benefits of WSUD and stormwater harvesting

Figure 20 highlights the disproportional impact that development in urban growth zones will have on total nitrogen loads. Increased runoff and pollution will occur as these areas transition from rural and agricultural land use practices, with minimal impervious areas, to highly urbanised and impervious residential and commercial developments. By 2040 the total nitrogen load from urban growth areas (87,700 kg/yr) will more than double the loads from existing residential areas (42,700 kg/yr).

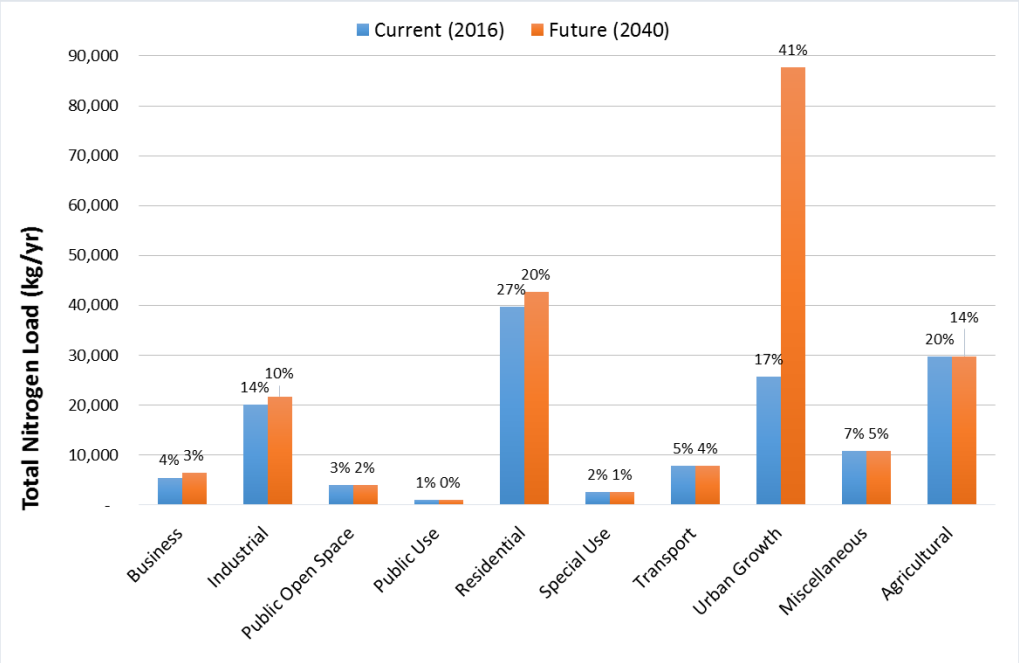


Figure 20 TN loads classified by land use under current and future conditions

The Werribee River (lower) catchment is the hardest hit by current stormwater runoff and pollutant loads. These impacts are presented in terms of nitrogen loads shown in Figure 21 (p. 28). Development of urban growth zones within the catchment will increase loads by 54% by 2040. Consequently, the Werribee River (lower) catchment will continue to be impacted by the bulk of stormwater runoff and pollutant loads into the future.

Skeleton Creek and Lollypop Creek also receive a substantial amount of the stormwater pollutants generated across Wyndham (~20% of TN loads each). Skeleton Creek is the smaller of these two catchment and impacted by a larger proportion of existing and future urban development. Laverton Main Drain and Little River (lower) catchments are the next worst impacted (~10% of TN loads each). Laverton Main Drain contains highly impervious industrial zones and will also be impacted by future development. Little River (lower) contains the township of Little River but features highly due to the size of the catchment, with the majority of pollutants generated by rural land uses. The proportion of the Balliang Creek, Cherry Main Drain and Kororoit Creek catchment contained within Wyndham are minimal and consequently, in terms of totals, do not receive a high proportion of nitrogen loads.

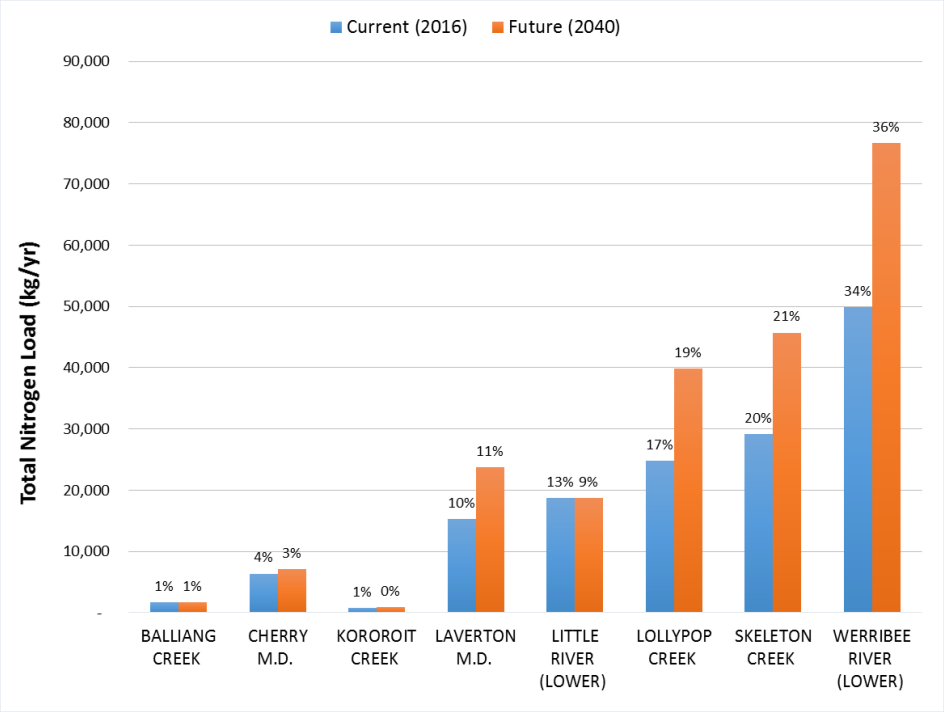


Figure 21 TN loads classified by catchment under current and future conditions

3.9.1 Existing WSUD achievements

The Best Practice Environmental Management (BPEM) Guidelines (Victorian Stormwater Committee, 1999) sets out the following objectives for removal of the typical urban annual pollutant loads:

- Total suspended solids (TSS) 80%
- Total phosphorus (TP) 45%
- Total nitrogen (TN) 45%

Numerous existing WSUD assets have been constructed across Wyndham in order to improve stormwater management across the municipality and achieve the BPEM targets in new developments (a requirement under the Victorian Planning Provisions; Clause 56.07). The majority of these assets are owned by Council (86) and Melbourne Water (63), however, there are also a range of privately owned assets (15)[2] across the municipality. The majority of Council and Melbourne Water assets are stormwater treatment wetlands. Wetlands are robust and easy to maintain treatment systems that provide a raft of benefits in addition to water quality improvements, including enhanced amenity and biodiversity. Consequently, wetlands and are the preferred WSUD treatment in Wyndham's greenfield developments (WCC, 2015).

Wyndham's current WSUD Asset Register has been assessed in order to determine the scale of treatment currently being achieved across the municipality (Table 4). This is a high level estimate

[2] This only includes private assets captured on WCC's WSUD Asset Register, there are likely more small scale WSUD treatments in the municipality (particularly rainwater tanks). The impact of these assets hasn't been estimated as part of this analysis.

based on limited data. In many cases treatment and catchment areas are unknown and it is generally uncertain to what extent systems are actually performing at their optimal levels. Modelling assumes all assets area adequately designed, constructed and regularly maintained.

Table 4 Summary of current WSUD asset performance

Asset Owner	# of Assets	Treatment Area (m2)	Pollutant Load Reductions		
			TSS (tonnes/yr)	TP (kg/yr)	TN (kg/yr)
Wyndham City Council	86	220,058	740	1,185	5,553
Melbourne Water	63	466,719	1,251	2,055	9,761
Private / Other[3]	15	63,625	152	257	1,228
Total	164	750,402	2,143	3,497	16,542

Cumulatively wetlands contribute ~70% of the current pollutant load reductions across the municipality. The remaining 30% of treatment is provided by several sediment ponds, biofilters/bioretention systems and swales located across the municipality. Melbourne Water own the larger regional scale WSUD assets, consequently, in terms of treatment area and treatment impact Melbourne Water assets provide the greatest benefits (i.e. ~60% of load reductions versus 35% for Council). In terms of meeting the BPEM targets across the entire municipality WCC, in collaboration with Melbourne Water, have made significant inroads, including a 23% reduction in TSS, 17% reduction in TP and 11% reduction in TN (Figure 16).

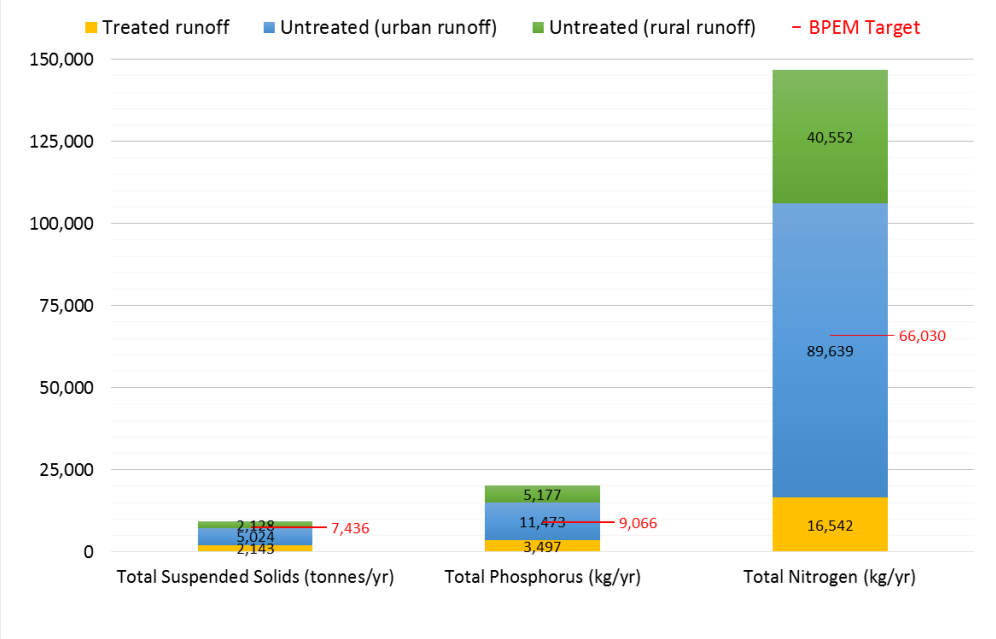


Figure 22 Untreated and treated pollutant loads for Wyndham

WCC's investment in stormwater improvements is focused in urban areas. The majority of additional loads due to new development in Wyndham should be treated to best practice in compliance with state planning provisions. Consequently, in order to significantly increase the proportion of the municipality treated to best practice Council will need to focus on retrofitting WSUD treatments into

[3] E.g. Sanctuary Lakes Clubs Ltd and the Minister for Education.

existing areas. This is typically more expensive than constructing WSUD treatments during developments as space and opportunities for cost effective WSUD are more limited. In the short term, Councils should focus be on ensuring developers handover quality designed and constructed treatment assets that meet best practice standards. It is also recommended that Council increase maintenance budgets and training to ensure adequate maintenance is provided to all current and future assets.

In rural areas WCC should continue to advocate for, and support the delivery of, improved stormwater management with the Port Phillip and Westernport Catchment Management Authority (CMA) and Southern Rural Water (SRW).

3.9.2 Planned improvements

The Wyndham Stormwater Management Plan (SWMP) 2015 provides a review of all existing systems and processes currently in place at Wyndham City Council that relate to stormwater management and Water Sensitive Urban Design (WSUD) practices. The Plan identifies the need for improved water quality, biodiversity and local fauna and flora across the municipality. Focus areas for future improvements include:

- Determining the state and location of all existing stormwater, drainage and WSUD assets.
- Improved asset management and asset maintenance.
- Improved education of the local community as well as capacity building for Council officers.

Improvements are outlined later in this document as part of 'Roadmaps' aimed at helping Council to improve outcomes in relation to current and preferred treatment systems, asset management and maintenance, planning schemes, integrated water cycle management and the Werribee Irrigation District. Projects already underway include (a) WSUD training for maintenance staff, (b) Wyndham specific MUSIC software guidelines, (c) Wyndham WSUD system design standards and standard drawings and (d) Wyndham preferred stormwater treatment systems.

At a regional level it is likely that new and broader stormwater quality treatment objectives will be introduced in the future. In particular, the release of the Victorian Governments new water plan, *Water for Victoria*, as well as the review of the State Environment Protection Policy (Waters of Victoria) and review of the State Environment Protection Policy (Groundwaters of Victoria), are expected to result in new responsibilities for water managers.

3.10 Climate

3.10.1 Rainfall

Across the entire municipality Wyndham receives on average 520 mm/yr of rainfall. Rainfall generally increases from west to east, with a low of 442 mm/yr at Mount Cottrell and a high of 570 mm/yr at the Point Cook RAAF Academy (Figure 23). The majority of existing and planned development in Wyndham lies within the 500 – 550 mm/yr rainfall band.

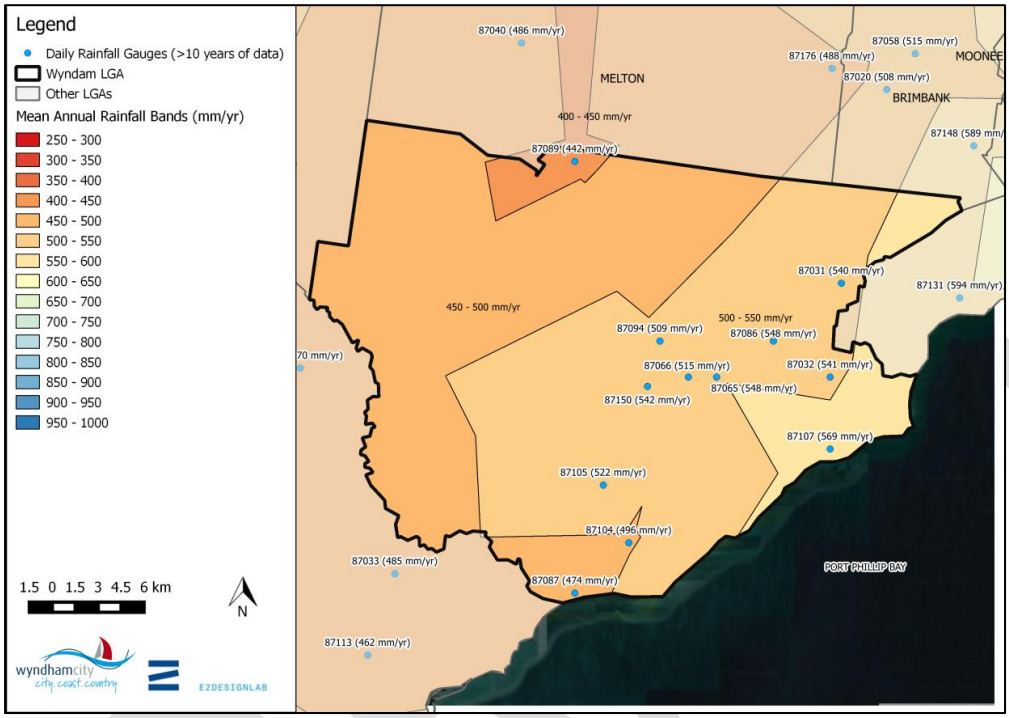


Figure 23 MAR bands and daily rainfall gauges with 10 years or more of data

Wyndham's mean annual rainfall is low relative to other parts of metropolitan Melbourne and since the mid 1990's Wyndham experienced a period of below average rainfall (Figure 24). This creates an increased driver for the uptake of alternative water sources to supplement the limited irrigation of open spaces that occurs via natural rainfall.

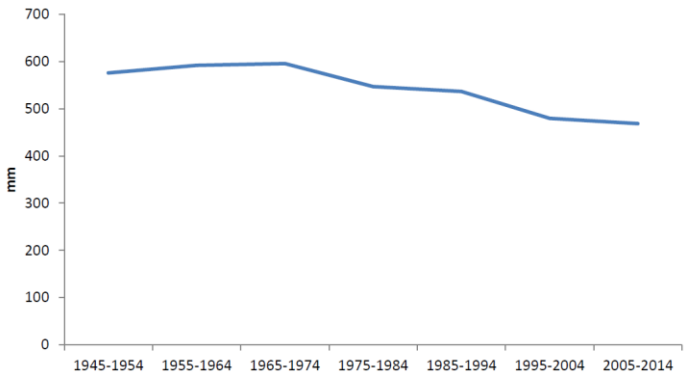


Figure 24 Wyndham annual rainfall 1945-2014 (decadal averages) (WCC, 2015)

3.10.2Temperature

In terms of temperatures, Wyndham residents are susceptible to further increases in temperature as new development replaces vegetation with heat absorbing hard surfaces such as pavements and roofs and roads. This results in a lack of shade and green space that leads to higher temperatures in urban areas (particularly at night). This phenomenon is known as the Urban Heat Island Effect. Potential urban heat risks posed to new urban growth include (Monash University and AECOM, 2013):

- Health and wellbeing impact on future residents, particularly vulnerable groups (e.g. elderly, disabled).
- Increase in living expenses due to increased reliance on air conditioning and private vehicle transport.
- Increase in social isolation, and
- Increase in urban heat impacts on surrounding areas.

The risks of increased temperatures and solar radiation can be reduced by increasing the number of irrigated open spaces, open waterbodies and trees across Wyndham. For example, thermal imagery indicates that the daytime temperature of an irrigated oval in Point Cook is approximately 12-13°C cooler than the surrounding unirrigated ground cover (Figure 25). Similarly, evaporation and transpiration ensure that waterbodies and trees are cooler than surrounding urban areas (Figure 26).

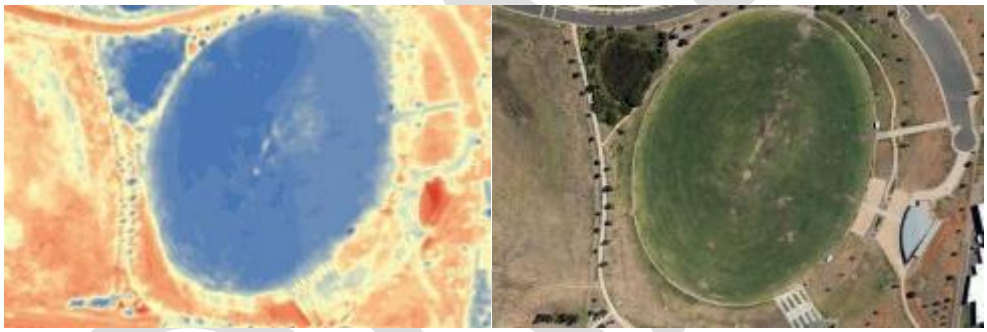


Figure 25 Comparison of irrigated (~32°,) and unirrigated ground cover (~45°C) (19 Kingsley Ave, Point Cook) (Monash University and AECOM, 2013)

Figure 26 Thermal imagery of water body (left: 64 Scrubwren Dr, Williams Landing) and tree lined street (right: 17 Wattle Grove, Point Cook) (Monash University and AECOM, 2013)

Works are already underway in Wyndham to mitigate the impact of heat across the region and improve environmental outcomes as part of the Greening the West project. Greening the West is a collaborative strategy with a focus on creating green spaces for health and wellbeing. As part of the

project tree planting is being prioritised in five major nature link regions, two of which include areas within Wyndham (Greening the West, 2016):

- The Werribee River Nature Link – plans to establish 200,000 mixed native trees along the Werribee River.
- Point Cook Coastal Park and Port Phillip Bay Western Shoreline Nature Link – plans to establish 150,000 mixed native trees along the Port Phillip Bay Western Shoreline, including at Point Cook Coastal Park, Cheetham Wetlands, Truganina Reserve, Skeleton Creek, Laverton Creek, Lower Kororoit Creek, and Hobsons Bay Coastal Trail.

WCC will be planting 30,000 trees this current planting season as part of its participation in Greening the West. Three locations have been selected for planting:

- Area 1- Floodway/Drainage reserve between Heaths Rd (Presidents Park) and Black Forest Rd, Wyndham Vale.
- Area 2 – Glen Orden Reserve and floodway behind Aquapulse through to Railway Line (Werribee - Hoppers Crossing).
- Area 3 – Floodway between Sayers Rd and Morris Rd, Hoppers Crossing.

As well as reducing temperature extremes these trees will enhances habitat, beautify the region and improve air quality.

3.11 Climate change

Climate change poses a serious threat to Wyndham, key risks for the region include:

1. Hotter summers with more days of extreme heat.
2. Sea level rise and storm surge.
3. Increased days of extreme fire danger, and
4. Lower average rainfall, but with higher, more intense storms.

These changes are expected to have broad ramifications in Wyndham, including social, economic and infrastructure impacts. As such, climate change will affect most areas of Council operations and functions. In response WCC has formalised the actions it will take to reduce its contribution to climate change and manage priority climate risks as part of the Climate Change Adaption Strategy 2012 - 2020 (WCC, 2015).

WCC has also taken action by becoming a member of the Western Alliance for Greenhouse Action (WAGA). WAGAs Climate Change Adaptation Strategy and Action Plan sets out a plan of action for WAGA and its members. The plan identifies inundation and erosion from sea level rise and storm surges as key specific risks for Wyndham given its 27.4 km long stretch of coastline. These factors will impact coastal habitats along with the other values of beaches in some locations. Wyndham does not have any existing controls in place to protect its coastline from the impacts of climate change. However, the Association of Bayside Municipalities' (ABM) is currently developing the Port Phillip Bay Adaptation Management Guide. This guide is expected to provide further details on the potential impacts of sea level rise and actions that could be taken to mitigate the associated risks.

In relation to water management the WAGA Climate Change Adaptation Strategy and Action Plan also identified the following regional priority risks:

- **Decreased water harvesting**: Declining average rainfall and extended drought periods cause reduced drain flushout events leading to drain blockages and localised flooding during extreme rainfall events.
- **Disruptions to wastewater treatment**: Increased temperatures and more frequent severe weather events increase stress on electricity networks leading to power failures and subsequent impacts on water supply and wastewater treatment.
- **Drain blockages**: Declining average rainfall and extended drought periods cause reduced drain flushout events leading to drain blockages and localised flooding during extreme rainfall events.
- **Stormwater overflow**: Severe rainfall events overwhelm stormwater systems causing overflow events, localised flooding, damage to infrastructure and environmental contamination.

Recommended actions for WAGA councils that address these risks include:

- Up-scaling water efficiency and stormwater storage and reuse projects.

- Continue focus on Water Sensitive Urban Design, and other Stormwater Reuse projects. Prioritise most vulnerable areas to inundation and risk.
- Encourage residents to install WSUD to manage stormwater onsite.
- Implement measures to reduce environmental contamination in stormwater. Use Water Sensitive Urban Design principles to slow water run-off across the landscape and utilise stormwater for reuse (e.g. swales, wetlands).
- Review maintenance regimes and maintain a drain blockage inventory of vulnerable infrastructure.
- Promote the “Snap Send Solve” (or similar) smartphone app to community to assist with early response to localised floods and blocked drains.
- Ensure adequate insurance to cover for floods, including inundation from sea level rise if relevant. Evidence suggests Victoria may face sea level rise of 1.1m by 2100 (Geoscience Australia, 2015), however, the Victorian Coastal Strategy (2008) prescribes that planning decisions need to factor in a minimum 0.8 m sea level rise by 2100 (WAGA, 2012).

These recommendations have been considered in the development of the road maps presented in IWCM Plan (see Chapter 8, p.58).

4. Existing IWCM Initiatives

In recent years WCC has invested in a number of projects that directly or indirectly support integrated water cycle management outcomes. Notable initiatives and achievements are summarised in Table 5.

Table 5 WCC's IWCM initiatives and achievements

Topic	Outcomes
Strategy	• Wyndham City Council Environment and Sustainability Strategy 2016-2040 • Wyndham City Council's Waste and Litter Strategy 2016-2040 • Wyndham's Stormwater Management Plan 2015 • Water Action Plan 2015- 2020 • Wyndham City Council's Onsite Wastewater Management Plan
Physical Assets	• Over 80 WSUD assets constructed and / or maintained • 20 sports reserves to the Class A recycled water network • Stormwater harvesting and reuse system at Saltwater Promenade Sports Reserve • 100KL of rainwater tank storage installed across 13 sites • Keep Australia Beautiful National Association funding secured to install five public place recycling bins at Station Place in Werribee
Programs	• Adoption of Planet Footprint Environmental Data Management Service • Water audits undertaken in more than 30 buildings
Advocacy	• Water for Victoria: Discussion Paper Submission • Agricultural Competiveness: White Paper Submission
Stakeholder Engagement	• More than 11,000 water efficient showerheads provided to Wyndham homes through the Showerhead Exchange Program in partnership with City West Water • Greening the West projects: E.g. Thirty thousand trees for Wyndham and Greening the Pipeline: Williams Landing parkland development (underway) • Funding secured to reduce the amount of fishing related litter along both the River and foreshore in partnership with Melbourne Water and the Werribee River Association
Investigations / Studies	• Healthier Waterways Wyndham WSUD and GPT Review 2016 • Health of the Werribee River Report 2015
Guidelines / Standards	• Guidelines and Standards Manual for the preparation of Site Environmental Management Plans

5. Water and Pollutant Balance

5.1 Baseline (2016)

Wyndham's baseline water balance provides a snapshot of human and environmental water use and disposal across the municipality (see Figure 27 and Table 6 below). It also includes an estimate of stormwater pollutant loads across Wyndham and allows for a greater understanding of the municipalities complex water cycle. The water balance highlights the large import of potable water into Wyndham which is predominantly used for residential purposes. In terms of wastewater both residential and non-residential generate large volumes which are sent to the Western Treatment Plant. Recycled water use in the Werribee Irrigation District is high, there is also moderate use by Council and the non-residential sector. Substantial volumes of groundwater is used in Wyndham, in comparison, river water use is low. Stormwater runoff is disproportionately high in Wyndham's urbanised catchments. This results in large pollutant loads entering local waterways and discharging to Port Phillip Bay.

Table 6 Wyndham's baseline water balance

			Volume in 2016 (ML/yr)
Water Use	Council	Potable	369
		Recycled Water	171
		Stormwater / Rainwater	1.0
	Residential	Potable	12,379
		Recycled Water	0
		Stormwater / Rainwater	unknown
	Non-residential	Potable	6,843
		Recycled Water	701
		Stormwater / Rainwater	unknown
		Groundwater	1,500
		River water	5
	Werribee Irrigation District	Recycled Water	4,000
	Total		25,968
Wastewater Generation	Council		130
	Residential		9,903
	Non-residential		6,789
	Total		16,822
Stormwater Runoff	Balliang Creek		813
	Cherry M.D.		2,229
	Kororoit Creek		270
	Laverton M.D.		5,461
	Little River (Lower)		7,940
	Lollypop Creek		10,115
	Skeleton Creek		10,663
	Werribee River (Lower)		19,181
	Total		56,671

Baseline (2016)
WATER AND POLLUTANT BALANCE

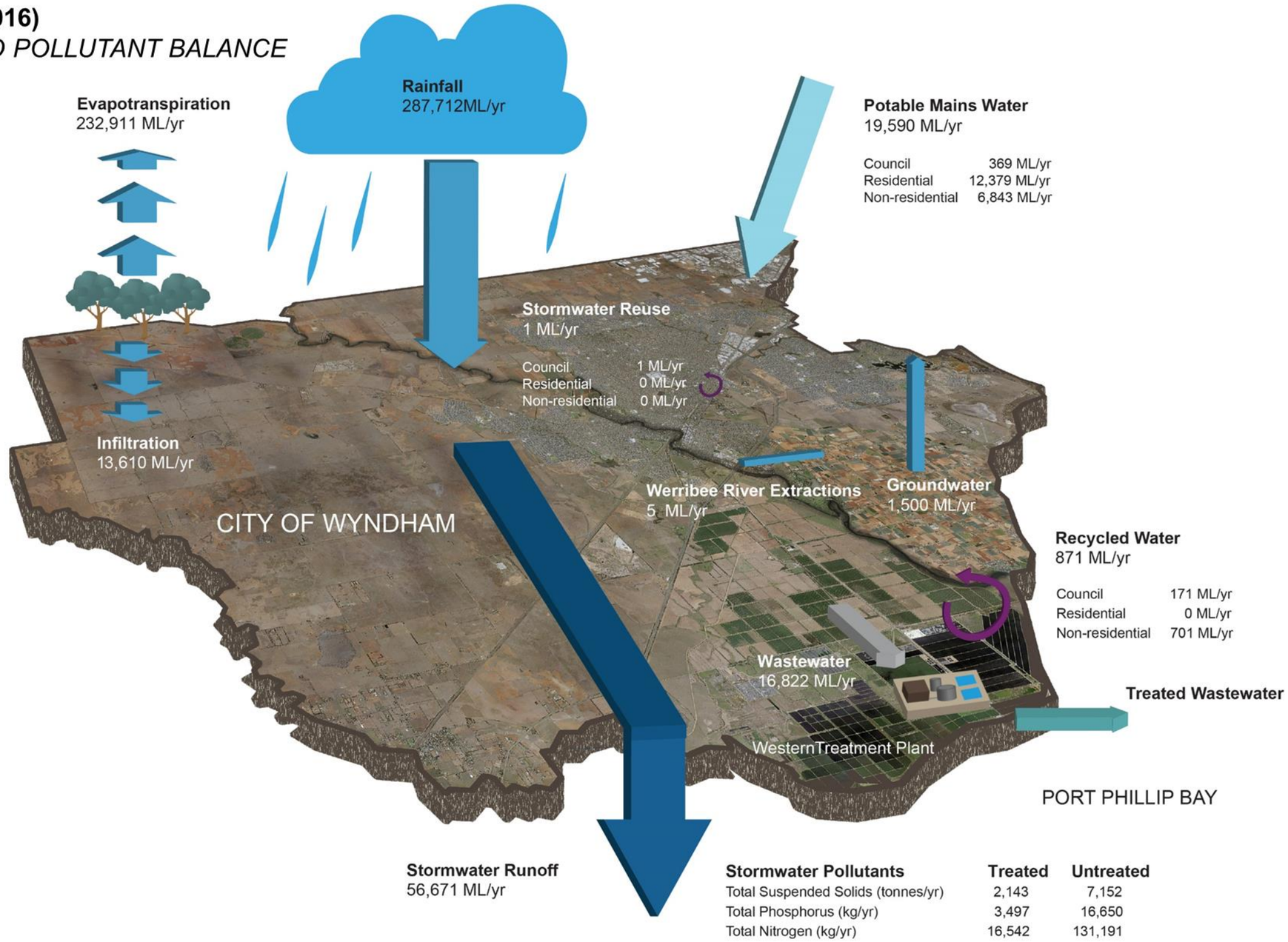


Figure 27 Wyndham's baseline water balance (year 2016)

5.2 Projected (2040)

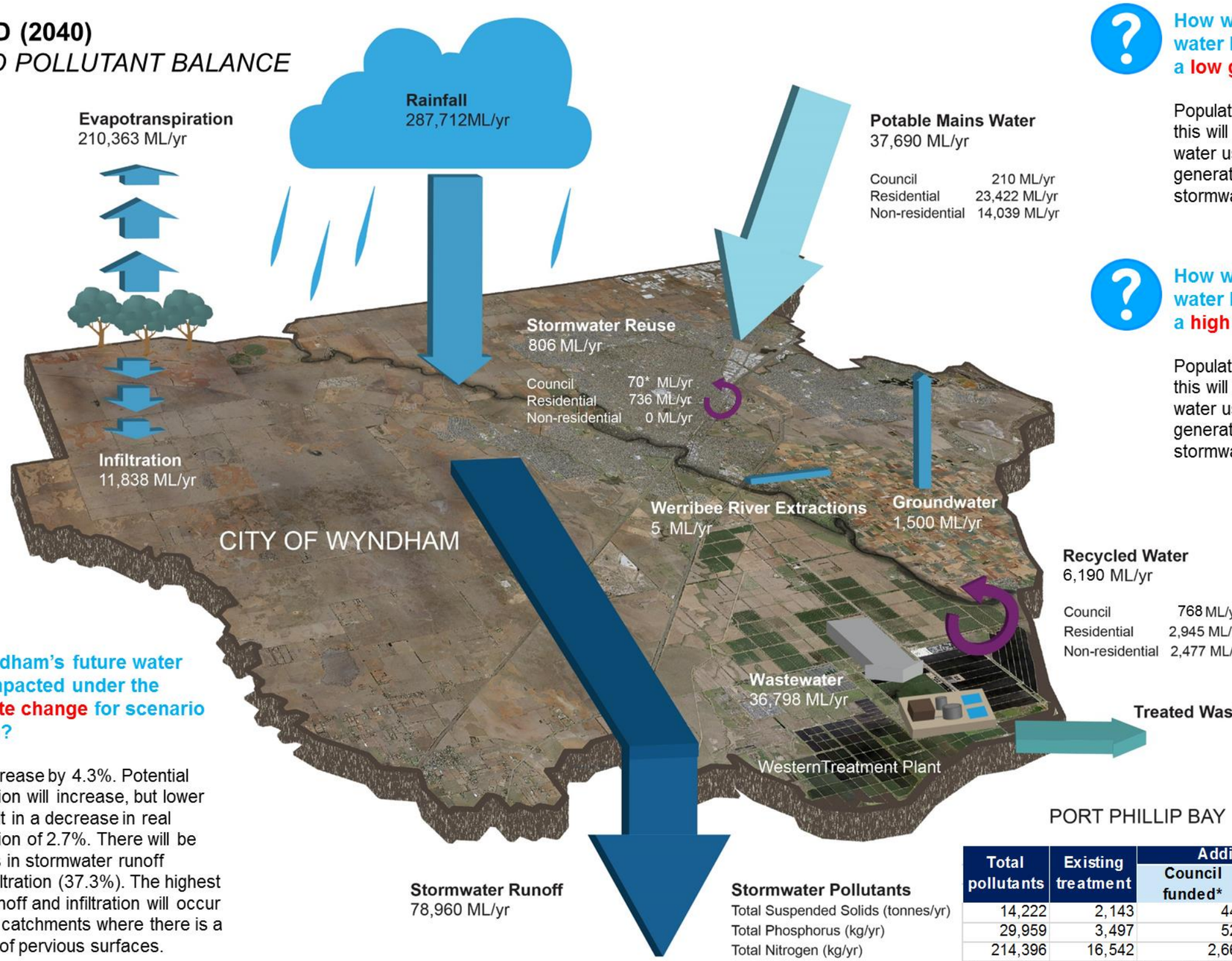
A projected water balance has been prepared for Wyndham based on expected conditions in 2040 (see Figure 28 and Table 7 below). In the projected potable water use is set to almost double due to the large growth in the residential sector. Conversely, Council potable water use is expected to decrease as it sets out to meet ambitious targets for increased alternative water use. This will lead to a continued growth in recycled water use and a sharp rise in stormwater reuse. Growth in recycled water use is also expected to occur in the residential and non-residential sectors. Large scale development across Wyndham is expected to result in a large increase in impervious surface that increase stormwater runoff and pollutants. These impacts will be felt mostly in the Laverton Main Drain, Lollypop Creek, Skeleton Creek and Werribee River (Lower) catchments.

Table 7 Wyndham's projected water balance

			Volume in 2040 (ML/yr)
Water Use	Council	Potable	210
		Recycled Water	768
		Stormwater / Rainwater	70
	Residential	Potable	23,422
		Recycled Water	2,945
		Stormwater / Rainwater	736
	Non-residential	Potable	14,039
		Recycled Water	2,477
		Stormwater / Rainwater	unknown
		Groundwater	1,500
		River water	5
	Werribee Irrigation District	Recycled Water	4,000
	Total		50,172
Wastewater Generation	Council		251
	Residential		21,682
	Non-residential		14,864
	Total		36,798
Stormwater Runoff	Balliang Creek		813
	Cherry M.D.		2,459
	Kororoit Creek		296
	Laverton M.D.		8,306
	Little River (Lower)		7,941
	Lollypop Creek		14,968
	Skeleton Creek		16,141
	Werribee River (Lower)		28,036
	Total		78,960

* Substantial efforts were made to minimise the level of uncertainty in each water balance, however, a number of assumptions and approximations were required (particularly for the projected scenario) and the outputs should be interpreted in light of these simplifications. For a detailed breakdown of data inputs and assumptions see Table 31 in Attachment 1 – Contextual Analysis (p. 111).

PROJECTED (2040)
WATER AND POLLUTANT BALANCE



Total pollutants	Existing treatment	Additional treatment		
		Council funded*	Developer funded	
			Infill*	Greenfield
14,222	2,143	447	8	3,601
29,959	3,497	525	46	4,039
214,396	16,542	2,666	670	27,931

*Based on performance scenario modelling. Council funded works based on Option B level of investment.

How will Wyndham's future water balance be impacted by a low growth scenario?

Population will decrease by 2.8%, this will lead to a drop in potable water use (2.6%), wastewater generation (2.8%) and reduced stormwater runoff (1.5%).

How will Wyndham's future water balance be impacted by a high growth scenario?

Population will increase by 1.0%, this will lead to a rise in potable water use (0.9%), wastewater generation (1.0%) and reduced stormwater runoff (0.5%).

How will Wyndham's future water balance be impacted under the median climate change for scenario for the region?

Rainfall will decrease by 4.3%. Potential evapotranspiration will increase, but lower rainfall will result in a decrease in real evapotranspiration of 2.7%. There will be large reductions in stormwater runoff (10.8%) and infiltration (37.3%). The highest reductions in runoff and infiltration will occur in undeveloped catchments where there is a high proportion of pervious surfaces.

Figure 28 Wyndham's projected water balance (year 2040)

Wyndham's projected water balance and estimates of stormwater pollutants are necessarily uncertain. The water balance will be impacted by several factors that are difficult to predict, including the level of growth / development in the region, variation in rainfall, evapotranspiration and temperature due to climate change and the level and type of investment by Council in integrated water cycle management solutions. The impact of these variables on the water and pollutant balance are summarised in Figure 28 and discussed further below.

5.2.1 Impact of growth

Recent population growth in Wyndham has been very high and this trend is forecast to continue. However, predictions of growth over such a large time frame are uncertain. Consequently the impact of low growth and high growth scenarios have been explored Table 8.

The projected water balance presented in Figure 28 is based on an expected population of 459,461 in Wyndham in 2040. Under the low growth scenario the population is expected to reach 446,607. This 2.8% reduction in population is predicted to result in similar reductions in potable water use and wastewater generation. Alternatively, under the high growth scenario the population is expected to reach 464,118. This 1.0% increase in population is predicted to result in minor changes to the water balance.

Overall this analysis indicates that Wyndham's water balance is relatively insensitive to changes in growth as all predictions for the region indicate that growth will continue to be high. This consistency in population figures allows for greater certainty in infrastructure planning. It also heightens the need for the enforcement of development controls to ensure that water and environmental protections are adhered to during this period of sustained development.

Table 8 Comparison of low and high growth scenarios

	Impacts on Wyndham's Projected Water Balance (% change relative to expected conditions)	
	Low growth*	**High growth****
Key indicator	What will happen if Wyndham's growth slows?	What will happen if Wyndham's growth increases?
Population	-2.8%	1.0%
Potable water use	-2.6%	0.9%
Wastewater generation	-2.8%	1.0%
Stormwater runoff	-1.5%	0.5%

* Based on Victoria in Future.

* Based on forecast i.d.

5.2.2 Impact of climate change

Wyndham is part of the Southern Slopes (Victoria West) natural resource management region. Climate change predictions for this region suggest that in the near future (2030) natural variability is projected to predominate over trends due to greenhouse gas emissions (CSIRO, 2016). Under high

greenhouse gas emission scenarios rainfall is expected to decrease by up to 25% in winter and 45% in spring by 2090.

The 'Baseline' (2016) and 'Projected' (2040) water balances for Wyndham are based on long term average rainfall and evapotranspiration conditions for the urban areas of Wyndham (~533 mm/yr). In order to examine the impacts of climate change in Wyndham in 2040 a 'climate change adjusted' rainfall and evapotranspiration time series has been prepared. This data set is based on the latest CSIRO projections for the 10th, 50th and 90th percentile changes in rainfall and evapotranspiration for the Southern Slopes region to 2030 (CSIRO, 2016). The data set represents the median scenario of expected climate changes to 2040. The results indicate that a reduction in rainfall of 5% and increase in evapotranspiration of 3% will result in a total runoff reduction of approximately 11% (Table 9). The largest reductions in runoff are experienced in catchments with less impervious surfaces as longer drier spells and reduced rainfall volumes in pervious catchments create dry soil conditions that decrease frequency of runoff events.

Table 9 Comparison of long term and climate change adjusted climatic conditions

		Projected (2040)		
		Long term average	**Climate change adjusted**	**Difference**
Stormwater Runoff (ML/yr)	Balliang Creek	813	594	-27%
	Cherry M.D.	2,459	2,331	-5%
	Kororoit Creek	296	279	-6%
	Laverton M.D.	8,306	7,841	-6%
	Little River (Lower)	7,941	6,034	-24%
	Lollypop Creek	14,968	13,093	-13%
	Skeleton Creek	16,141	14,966	-7%
	Werribee River (Lower)	28,036	25,283	-10%
	Total	78,960	70,419	-11%

In terms of pollutants, the predicted 11% reduction in runoff under climate change conditions translates to 6-9% reductions in annual pollutant load reductions. These reductions will benefit the environment, however, pollutant loads will continue to far exceed natural level. Consequently the reductions predicted due to climate change do not negate the need for increased stormwater treatment across the municipality.

Table 10 Comparison of long term and climate change adjusted pollutant loads

	Projected (2040)		
	Long term average	**Climate change adjusted**	**Difference**
Total Suspended Solids (tonnes/yr)	14,222	13,415	-5.7%
Total Phosphorus (kg/yr)	29,959	27,582	-7.9%
Total Nitrogen (kg/yr)	214,396	195,659	-8.7%

In terms of management responses, the variations in rainfall, evapotranspiration, runoff and pollutant loads predicted due to climate change in 2040 call for:

- Increased efforts to reduce potable water use through demand management, increased efficiency (e.g. fixtures in buildings) and increased alternative water use to account for predicted reductions in runoff.
- Greater efforts to create cool microclimates through the introduction of shade, water and vegetation into urban areas to combat predicted increases in temperature.

In terms of WSUD assets, it is unlikely that any major changes to design or maintenance will be necessary to account for changed climatic conditions due to climate change (Burge, Browne, Breen, & Wingad, 2012). One threat to consider is plant loss during extended dry periods. This risk can be mitigated in wetlands by increasing the depth of permanent pool areas and in bioretention systems by incorporating a saturated zone.

5.2.3 Litter hotspots

The Wyndham City Litter Reduction and Prevention Strategy 2014 – 2016 (WCC, 2014) sets out the City's goals for litter management and draws on the Best Practise Litter Prevention Framework of education, infrastructure and enforcement to achieve these goals. The existing strategy identifies a variety of anecdotal litter hotspots including Bungies Hole and the Leigh Street Drain as well as several roads, sporting grounds, reserves, shopping areas and new estates.

Systematic mapping of existing litter hotspot has been conducted as part of Wyndham's IWCM Plan in order to target investment in new GPTs and help engage the community in litter reduction. These existing hotspots have been identified based on bin locations, bus stops, existing activity centres, food premises, existing GPTs, land use zones, places of interest, railway stations and schools. Potential litter hotspots have also been identified based on the location of future activity centres. When taken together, the anecdotal, existing and potential litter hotspots provide a valuable snapshot of litter in Wyndham that can be periodically updated based on local knowledge and experience in litter management. Investment in new GPTs should be concentrated in areas downstream of the litter hotspots for greatest effectiveness. Furthermore, the hot spot mapping can be used as an aid to engagement, education and enforcement campaigns targeted at Wyndham's community and business groups. Litter hotspot maps for each district are provided below in Figure 30 to 33.

Figure 29: Floating litter at Guyra Court, Werribee (WCC, 2015, p. 10).

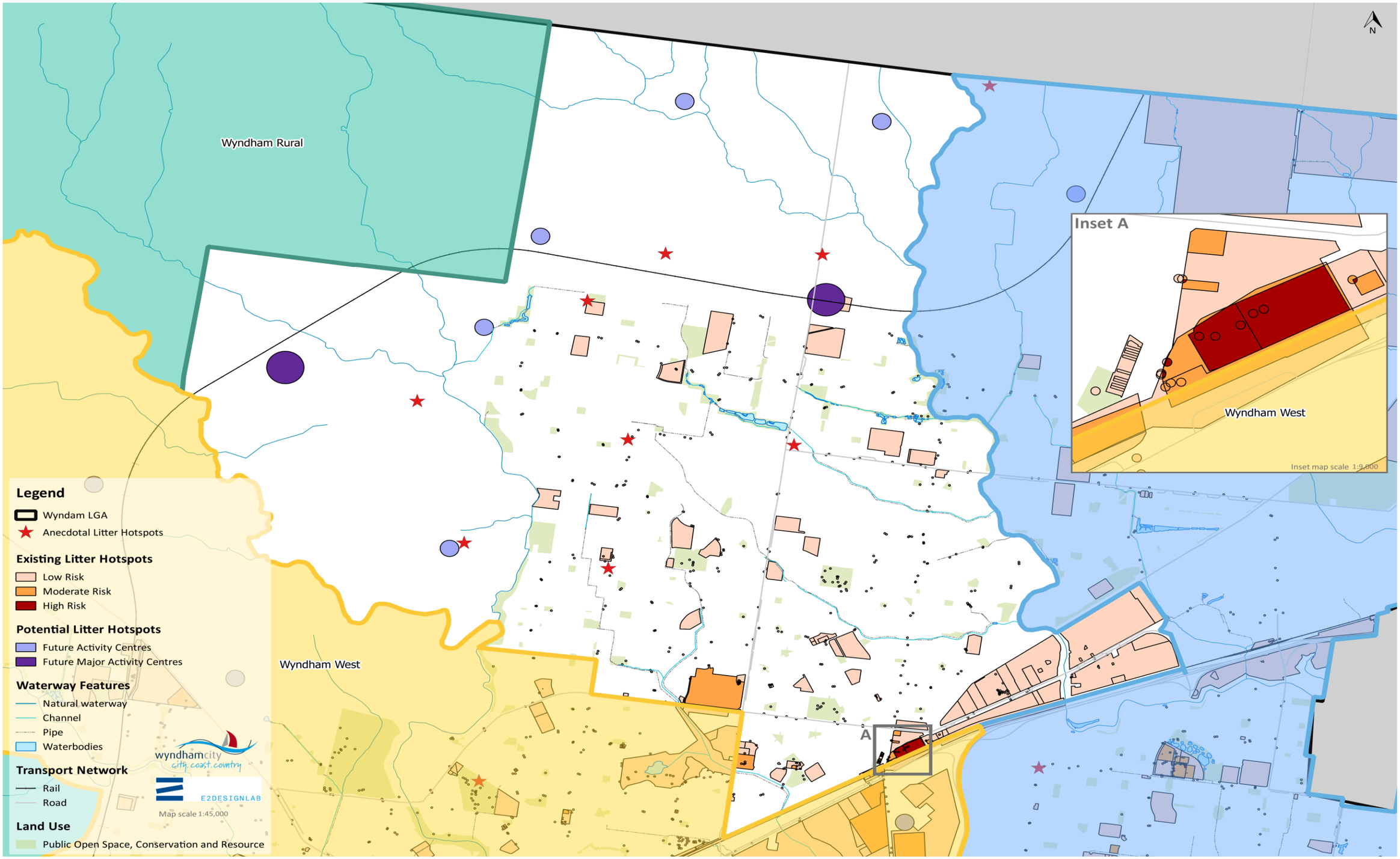


Figure 30 Wyndham Central litter hotspots

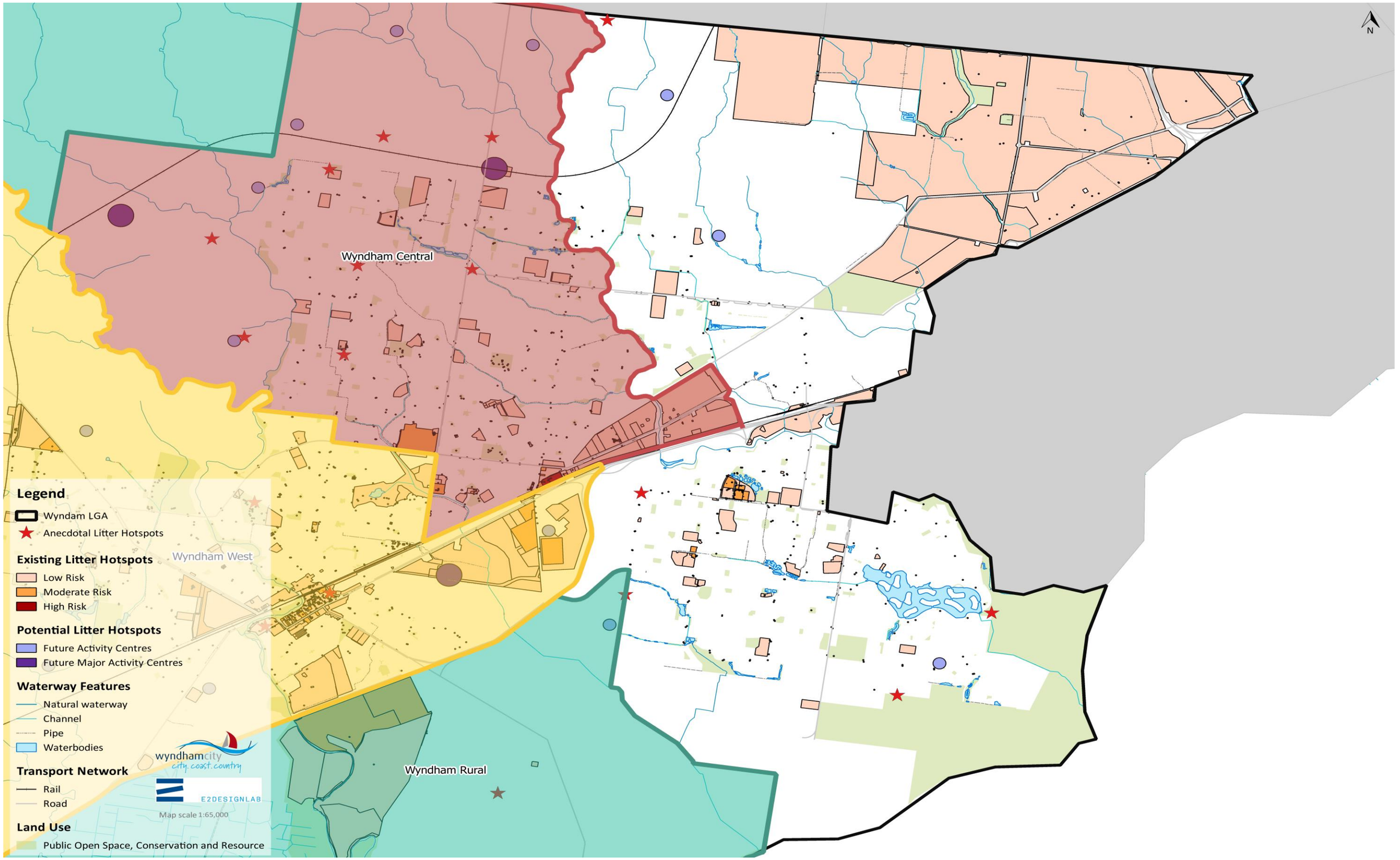


Figure 31 Wyndham East litter hotspots

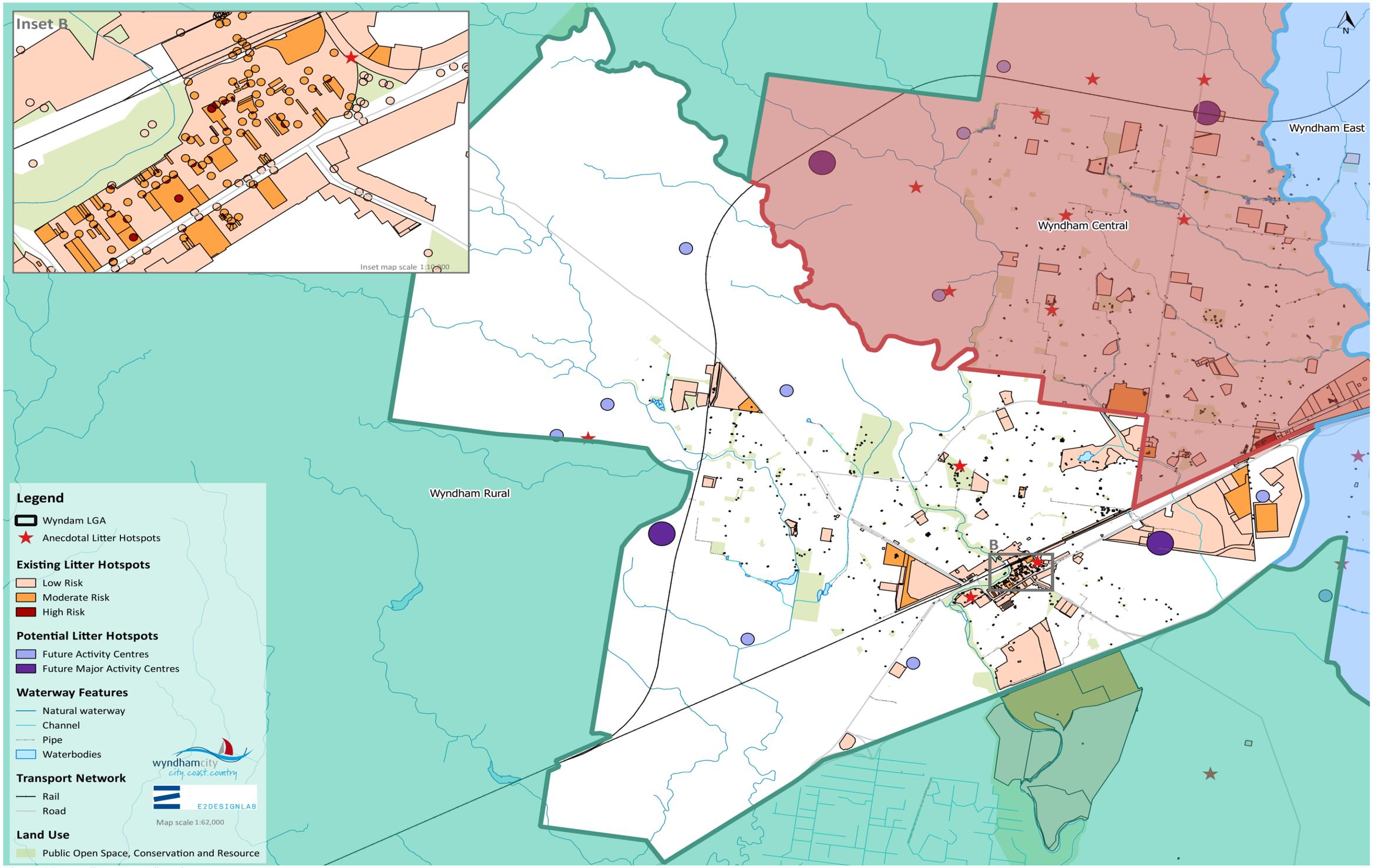


Figure 32 Wyndham West litter hotspots

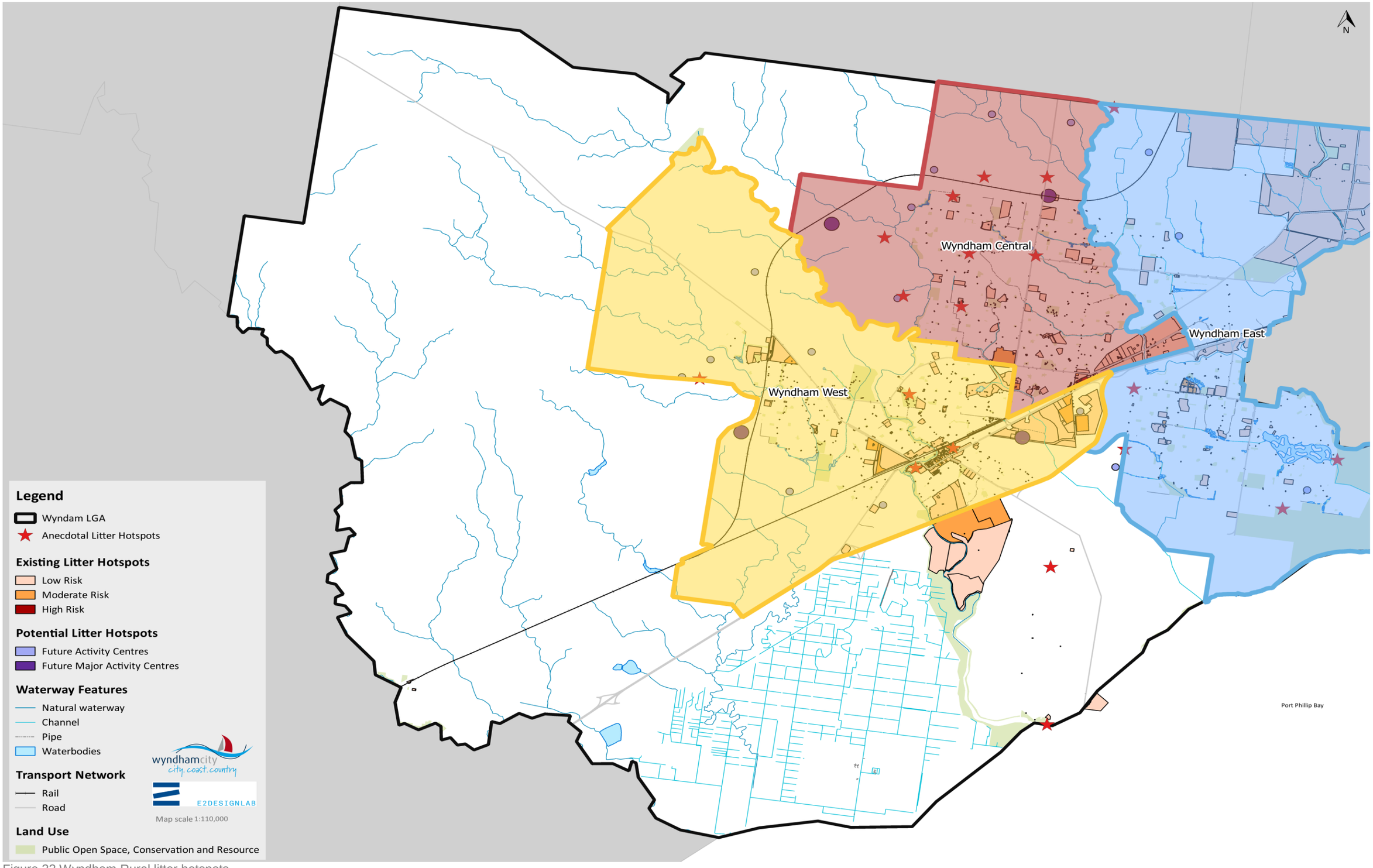


Figure 33 Wyndham Rural litter hotspots

6. Performance Scenarios

There are a range of initiatives that the WCC can employ to improve integrated water cycle management outcomes in Wyndham. Some of these initiatives will be 'non-structural' and involve the development of leadership, knowledge and effective processes. Other actions will lead to the delivery of 'structural' projects, which involve the construction of physical infrastructure and assets. As part of this IWCM Plan, the effectiveness of five structural IWCM scenarios has been assessed:

1. More wetlands or bioretention systems
2. More Gross Pollutant Traps (GPTs)
3. Stormwater harvesting for active open space irrigation
4. Stormwater harvesting for irrigation of passive recreation areas
5. Require rainwater tanks for development approval

On balance, if Wyndham is to transition to a water sensitive city it needs to invest in infrastructure that delivers multiple benefits. No one scenario can achieve this alone. Based on these findings it is recommended that as a rule-of-thumb future investment in Council WSUD capital is spread as follows:

- 45% is invested into stormwater treatment infrastructure (i.e. Scenario 1)
- 10% is invested into litter reduction infrastructure (i.e. Scenario 2)
- 45% is invested into stormwater reuse infrastructure (i.e. Scenario 3 and 4)

Scenarios 1 to 4 require Council investment in new infrastructure. This investment may be supported by external grants and funding but will require an increase in Council's capital budgets for water projects. As part of the performance scenario modelling three different levels of Council investment were explored (Table 11). The results provided Figure 34 (p.51) indicate that Council investment significantly impacts Wyndham's ability to treat all existing urban areas to best practice (i.e. treat ~47,800 kg/yr of nitrogen). Under existing levels of investment, i.e. Option A, it would take more 300 years to meet the nitrogen reduction target. Option B represents a moderate and ongoing increase in expenditure that is able to meets the best practice target in just over 200 years. Option C represents a higher level of ongoing expenditure that is able to meet the target significantly faster than Option B.

Table 11 Description of Council investment options

Funding Option		Time required to treat all existing urban areas to best practice
Option A	Investment of $200,000 per annum from 2016 onwards.	Over 300 years
Option B	Investment of $200,000 in 2016, increasing at $100,000 per annum to a maximum of $1,000,000.	207 years (i.e. by 2222)

Option C	Investment of $200,000 in 2016, increasing at $100,000 per annum to a maximum of $2,000,000.	120 years (i.e. by 2135)

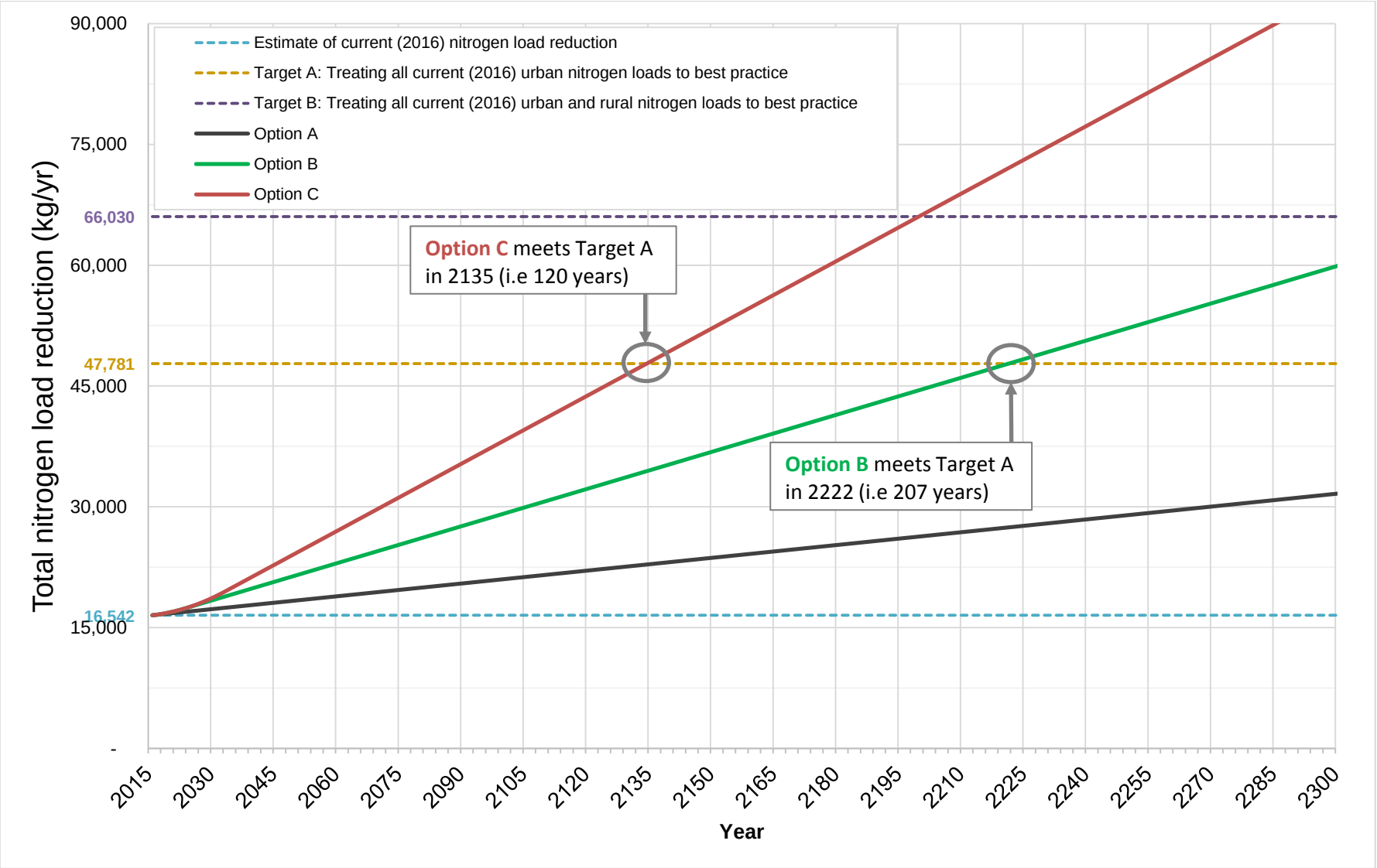


Figure 34 The impact of Council investment on nitrogen load reductions

The results show that the level of Council investment has a major impact on the achievement of long term pollution reduction targets. On balance, Option B is considered to be a realistic increase in IWCM expenditure that can deliver significantly higher pollutant load reductions and alternative water reuse by 2040. A detailed breakdown of the stormwater reuse and treatment benefits that can be delivered by this level of funding is provided below in Table 12 below (p.53).

Performance scenario 5 examines the impact Council can have on residential water use and stormwater discharge by require rainwater tanks as part of development approvals. The capital and maintenance costs of these tanks would be funded by developers not Council. However, to be successful, this scenario would require new planning processes and registers to ensure that rainwater tanks are required by Council, adequately designed and installed.

The collectively impact of all the performance scenarios has been used to inform Wyndham's projected water and pollutant balance. This analysis has also provided a strong evidence base for several of the IWCM targets presented in this plan (see Chapter 7, p.54). These targets relate to:

- Increased alternative water use by Council, including stormwater reuse, recycled water and passive watering for open space and street trees.
- Reduction in community potable water use, achieved in part by an increase in rainwater tank in new infill developments.

The performance scenario results should be considered in light of the following notes and limitations:

- WSUD capital expenditure will need to be matched by proportional increases in maintenance budgets to ensure that WSUD assets perform as intended.
- Estimates of current load reductions are based on a high level assessment of Councils' WSUD asset register.
- A strategic assessment of WSUD opportunities is needed to determine the real scale of WSUD opportunities in Wyndham.

For more details on the performance scenario modelling and results refer to Attachment 3

Table 12 Impact of Council Investment (Option B) on Wyndham's Projected Water Balance

Scenario		Funding Source	Current	Year 2020					Year 2040				
			Percentage of Existing Urban Runoff Treated to Best Practice*	Number of Additional Assets	Total Investment (2016-2020)	Annual Stormwater Reuse (ML/yr)	Additional Annual Nitrogen Reduction (kg/yr)	Percentage of Projected Urban Runoff Treated to Best Practice*	Number of Additional Assets	Total Investment (2016-2040)	Annual Stormwater Reuse (ML/yr)	Additional Annual Nitrogen Reduction (kg/yr)	Percentage of Projected Urban Runoff Treated to Best Practice*
1	More wetlands and bioretention systems	Council	**25%**	2 wetlands and 1 bioretention system	$900,000	-	199	**35%**	23 wetlands and 11 bioretention system	$9,630,000	-	2,130	**49%**
2	More gross pollutant traps (GPTs)			3.5 GPTs	$200,000	-	-		41 GPTs	$2,140,000	-	-	
3	Stormwater harvesting for active open space irrigation			1.6ha	$700,000	5.6	44		19ha	$7,490,000	59.8	468	
4	Stormwater harvesting for irrigation of passive recreation areas			0.6ha	$200,000	1.1	9		7ha	$2,140,000	11.5	93	
Subtotal - Council funded works					*$2,000,000*	*6.7*	*252*				*71.3*	*2,691*	
5	Require rainwater tanks for development approval**	Developers		1,768	$20,350,000	50.7	112		10,608	$20,350,000	303.9	670	
Total: funded works					***$22,350,000***	***57.3***	***363***			***$41,750,000***	***375.3***	***3,361***	

* I.e. progress towards Target A

** Equivalent to 442 tanks installed as part of infill development at ~$9,200 per tank (including foundations, plumbing etc.)

Note: The results presented in this table are high level estimates. The number and design of assets will vary greatly based on site context and project objectives. More details of modelling assumptions are provided in Attachment 3.

[1] Wetlands and bioretention systems assumed to each treat a 10 ha catchments with an impervious proportion of 60%.

[2] GPT based on a underground system (e.g. Rocla CDS1012) with a capacity of 300 L/s treating a 10ha catchment with an impervious proportion of 60%.

[5] Based on a wetland treating a 15 ha catchment (60% impervious) providing irrigation water for a typical 2.5 ha are of active open space (10.5 ML/yr demand, 75% annual supply reliability, 650 kL underground tank)

[4] Based on a wetland treating a 15 ha catchment (60% impervious) providing irrigation water for a typical 1.5 ha are of passive open space (3.4 ML/yr demand, 75% annual supply reliability, 200 kL underground tank)

[5] An estimated 442 rainwater tanks would be installed annually through this scenario, based on the breakdown of Council's planning permit approvals for 2015 – 2016.

7. Targets

The targets below indicate how Wyndham City Council will promote integrated water cycle management and achieve its vision of becoming a water sensitive city. Each target is categorised under one of Council's three IWM objectives and has been developed based on a consideration of:

- The water-related needs and desires of Council, community groups and external stakeholders as determined through consultation.
- Wyndham's water balance (baseline and projected) and performance scenario modelling that investigates how Council's investment, policy and staffing choices can drive change.
- Council's existing water-related skills and achievements to date.

OBJECTIVE 1: Create a resilient and liveable city		Timing	Reasoning
Target 1.1	Ensure that 100% of irrigated active open spaces are connected to an alternative water supply.	2020	Increased alternative water use and passive watering is feasible in Wyndham as: • The baseline water balance shows that Council has experience with recycled water and uptake has increased significantly in recent years. • Performance scenario modelling shows that with increased investment Council can harvest an additional 70 ML/yr of stormwater for irrigation by 2040. • The recycled water network in Wyndham will expand with development and there are also plans for local and regional stormwater harvesting (e.g. Blackforest Road). • Increased alternative water use is required for Wyndham to meet its existing targets (see Environment and Sustainability Strategy 2016 - 2040 and Water Action Plan 2015- 2020).
Target 1.2	Invest in Council projects that supply 70 ML/yr of treated stormwater by 2040. This is equivalent to treated stormwater to ~**19ha of active open space and 7ha of passive open space**.	2040	
Target 1.3	Ensure that 100% of new or replacement trees planted are either (a) passively irrigated or (b) actively irrigation from alternative water sources.	2020	
Target 1.4	Lead the community to achieve an average **water consumption of ≤155 litres per person per day** (equivalent to 56.6 kL/yr/person).	2020	This is a target that is well understood by Melbourne's community. It was introduced during the millennium drought and recently re-instigated by the state government. In Wyndham, potable water use is currently close to 160 litres per person per day, so this represents a small decrease but given recent decreases, a reasonable one.
Target 1.5	Ensure that a minimum of **300 rainwater**	2020	Performance scenario modelling indicates

	tanks for rainwater resue for rainwater reuse are installed **every year** as part of infill residential developments in existing areas.		that increased uptake of rainwater tanks for rainwater resue in infill developments (estimated at 442 per year) can help the community save ~12.7 ML/yr. This equates to a potable water saving of 50 ML/yr by 2020 and over 300 ML/yr by 2040. A target of 300 rainwater tanks for rainwater resue has been adopted as Council doesn't currently have a record of residential tanks and therefore cannot be certain how many tanks will be installed. This target should be reviewed once the register has been set-up and running for 1-2 years. This target will also help Wyndham's community meet Target 1.4.
Target 1.6	Council to support non-residential customers to source ≥15% of their total water use from alternative supplies.	2020	In recent years recycled water use in the non-residential sector has risen from 3% to 9% of total non-residential usage. This is assumed to grow to 15% by 2040 as City West Water and WCC continue to support, and advocate for, increased alternative water use.
OBJECTIVE 2: Improve the health and amenity of waterways and coastal environments		**Timing**	**Reasoning**
Target 2.1	Invest in Council projects that reduce the annual nitrogen load discharged from existing urban areas by an additional 2,691 kg/yr. This is equivalent to constructing **2 wetlands** and **1 biofilter** treating a **10 ha** residential catchments each.	2020	Wyndham's baseline water balance shows that existing WSUD assets in Wyndham remove ~ 16,500 kg/yr of nitrogen. This target requires investment in new WSUD projects that remove an additional 2,691 kg/yr. Performance scenario modelling indicates that this is feasible if Council invest in a mixture of stormwater treatment, litter reduction and stormwater reuse infrastructure. The target of 2,691 kg/yr by 2040 is based on the 'Option B' level of investment, i.e. $200,000 in 2016, increasing at $100,000 per annum to a maximum of $1,000,000. The target is set in terms of nitrogen for ease of tracking and reporting. By investing in projects that treat nitrogen Council will also be achieving reductions in flow, litter, suspended solids and phosphorus.
Target 2.2	Record 100% of WSUD assets on Council's asset management system.	2020	Deemed achievable and required to accurately track asset ownership, condition

			and performance.
Target 2.3	Ensure 100% of new water related capital works have allocated maintenance budget.	2020	Deemed achievable and required to ensure other targets are met and water infrastructure is operating as designed.
Target 2.4	Ensure 100% of existing WSUD assets are rectified and have sufficient maintenance budgets.	2020	Identified as required in the Healthier Waterways Wyndham WSUD and GPT Review 2016.
Target 2.5	Ensure that 100% of domestic wastewater generated is treated and contained within property boundaries or properties are serviced by sewer infrastructure.	2040	Deemed required due to the age and number of septic systems in operation in Wyndham City Council as identified in the Onsite Wastewater Management Plan.
Target 2.6	Install **40 new Gross Pollutant Traps** (GPTs) or equivalent	2040	Performance modelling shows that by increasing the number of GPTs Council can reduce litter by 3.7 tonnes/yr in 2020 and 43.8 tonnnes/yr in 2040 (see Table 37, Attachment 3).
OBJECTIVE 3: Improve collaboration and engagement with all stakeholders		**Timing**	**Reasoning**
Target 3. 1	Hold a minimum of four Water Sensitive Wyndham Interdepartmental Working Group meetings per year.	2017-2040	Consultation with Council staff, including workshops and interviews, indicated that improved communication and stronger collaboration is required to deliver integrated water management solutions.
Target 3.2	Hold a minimum of four community consultation, engagement and education events each year with water issues as a focus or key component. ***Sub-targets***: Directly invite the following groups to at one or more of these events: a) Aboriginal community groups, b) Culturally and Linguistically Diverse (CALD) community groups c) Young people (e.g. school groups), d) Water-related community groups and State Government organisations (to the same event).	2017-2040	Workshops with Council staff and Wyndham's community groups highlighted the need for increased collaboration between Council and the community. For Wyndham to transition to a water sensitive city its community needs to be treated as a partner in decision-making, and their meaningful involvement and empowerment should be actively pursued (CRCWSC, 2017).
Target 3.3	Identify at least one structural (e.g. wetland or alternative water supply) or non-structural (e.g. guidelines, policy, engagement) project to work on in collaboration with neighbouring councils and/or State Government water-related organisations each year.	2017-2040	By taking this step Council will be formalising and further developing its existing collaboration with external stakeholders.
Target 3.4	Provide a minimum of one workshop per year for each department involved in water	2017-2040	Council interviews indicated that training in specific areas is required (e.g. WSUD audits

	management projects.		and maintenance) and continued training is essential for staff development.

8. Road maps

A set of roadmaps have been prepared to help Council achieve its IWCM objectives and targets. Each roadmaps contains a list of short term actions (i.e. achievable over the next five years). Responsibility for coordinating the delivery of these actions rests with the Environment and Water department under the City Economy Innovation & Liveability directorate. However, a coordinated effort across multiple departments and directorates will be required to deliver on many of the targets and actions that have been identified.

Each action suggested in the road maps is accompanied by information that will support its implementation. This includes an assessment of the timing, priority, responsible directorates and departments as well as links with related targets.

Several additional actions that aren't included in the roadmaps were identified during consultation. These actions have been collated in Attachment 4 to help support the future implementation of IWCM in Wyndham.

8.1 Roadmap 1: Create a resilient and liveable city

No.	Actions	What it entails	Considerations	Timing	Priority	Responsibility	Related target(s)
1.1	**Create a Stormwater Harvesting Master plan**	- Review recycled water network and identify potential locations for stormwater harvesting for Open public spaces - Engage stakeholders in the creation of the master plan - Agree with stakeholders on how to manage alternative water supply assets - Agree on what should be irrigated and how to prioritise irrigation for all types of open space; - Consider Climate Change effect on the master plan	- Performance scenario modelling shows that with increased investment Council can harvest an additional 70 ML/yr of stormwater for irrigation by 2040. To meet this aim, Council will need to invest each year in enough projects to supply 6 ML/yr of stormwater. This is equivalent to irrigation 1 to 2 sports ovals. - Stormwater reuse projects will also help WCC meet its nitrogen reduction target (see Action 1.2). - Work with City West Water and Melbourne Water to implement alternative Water supply strategies for Wyndham.	2020	**High**	- **Coast and Water**, Assets Management, Engineering Design, Engineering Construction, Facilities and Open Space, and Vibrant City Centres Departments, Water Sensitive Wyndham Interdepartmental Working Group, and the Project Evaluation Panel	1.1, 1.2, 1.3, 1.6, 3.3
1.2	**Create a WSUD Masterplan for existing urban areas**	- Identify and prioritise existing catchments in Wyndham which require WSUD treatment - Perform MUSIC modelling for the high priority catchments - Prepare concept designs of WSUD treatments to meet best practice pollutant reduction targets - Prioritise WSUD treatments within these areas according to a set criteria defined by stakeholders - Link this plan with the Capital Works Program and find opportunities within upcoming projects - Consider Climate Change effect on the master plan - Use the Integrated Water Cycle Management Assessment and Tracking tools to develop and monitor this Masterplan.	- WCC is targeting a nitrogen reduction of 2,691 kg/yr by 2040. To meet this target WCC will need to invest each year in new stormwater treatment and reuse project that provide an additional 110 kg/yr. - The WSUD Masterplan should create a clear action plan that outlines how Council can meet its 2040 nitrogen reduction target. - The action plan should consider the costs and benefits of each project and include a budget for Council expenditure (a 5 to 10 year timeframe is suggested).	2020	**High**	- **Coast and Water**, Assets Management, Engineering Design, Engineering Construction, Facilities and Open Space, and Vibrant City Centres Departments, Water Sensitive Wyndham Interdepartmental Working Group, and the Project Evaluation Panel	2.1, 3.3
1.3	**Improve climate change risk management in regards to water assets and flooding**	- Monitor total annual budget expenditure on water use and trends over time; - Monitor total annual budget expenditure on drainage management and trends over time; - Evaluate funding, resource needs and workforce following a flood emergency and how this might change in future; - Work with MW and other Councils to model the impacts of climate change on the stormwater system and implement improvements;	- Need to separate ongoing water use from new sports fields being established (1 year high use) - Stormwater model needs to consider future scenarios specific to WCC rainfall and look at both drought and high intensity events.	2020	**High**	Coast and Water, and **Sustainability** teams	-
1.4	**Prepare and implement a City Forrest and Habitat Strategy**	- Improve urban public realm canopy cover - Standardised selection & management of tree assets suitable for Wyndham's climate and climate change - Defined tree planting program - Improve urban and rural habitat connectivity, resilience and health - Planning controls and a tree register to protect trees/habitat - Community engagement on urban forestry and valuing natural habitats - Use WSUD and other techniques to increase water availability for tree growth.	- Increase vegetation coverage - Identifying existing canopy coverage and significant habitat - Consolidate learning from previous projects (Greening the west - use of tree pits) - Keep a register of existing trees and lifespan in Wyndham - Identify opportunities near urban heat islands	2020	**High**	Environment team	1.3
1.5	**Lead a campaign to reduce water demand in Wyndham's residential and non-residential areas and increase alternative water supply**	- Track and keep a record of annual residential and non-residential water use in liaison with City West Water. - Lead by example through reducing Council water consumption and showcasing the reduction in Council's water consumption to public (use of social media) - Increase focus on water saving through running workshop as part of the Green Living Series to promote water efficient fixtures and products for households and businesses. - Provide incentives for residents and businesses to use rainwater tanks for rainwater resue. - Introduction of ESD policy into the planning scheme.	- ESD policy will aim to introduce ESD standard for new non-Council buildings. - Performance scenario modelling indicates that increased uptake of rainwater tanks for rainwater resue in infill developments (estimated at 442 per year) can help the community save ~12.7 ML/yr. This equates to a potable water saving of 50 ML/yr by 2020 and over 300 ML/yr by 2040.	2020	Medium	Coast and Water, and Sustainability teams (WCC)	1.4, 1.5, 1.6, 3.3
1.6	**Advocate towards sustainable agriculture**	- Council to keep being updated on what's happening in Werribee South through organising yearly catch up with Southern Rural Water. - Work with Southern Rural Water on managing runoff from rural areas & treating it before discharge to waterways or the coastline - Advocate for the provision of training to Werribee farmers on the efficient use of water. - Work with SRW to advocate for funding to complete the upgrade of all water supply infrastructure to the district to **improve water efficiency** - **Advocate for the long term economic and environmental benefits of existing agricultural be considered in detail prior to any rezoning of the Werribee South Irrigation District. These results should be compared with the long term economic and environmental benefits of any alternatively zoned land.**	- n/a	2040	Low	Environment and Water department (WCC) and Southern Rural Water	-
1.7	**Initiate a process for registering rainwater tanks in residential developments.**	- Start recording new rainwater tanks for new developments; - Create a voluntary register for residents to register existing rainwater tanks; - Share register between various departments;	- Performance scenario modelling indicates that increased uptake of rainwater tanks for rainwater resue in infill developments (estimated at 442 per year) can help the community save ~12.7 ML/yr. This equates to a potable water saving of 50 ML/yr by 2020 and over 300 ML/yr by 2040.	2040	Low	Coast and Water, Town Planning, Environment and Health Services, Building Services teams	1.4, 1.5

8.2 Roadmap 2: Improve the health and amenity of waterways and coastal environments

No.	Actions	What it entails	Considerations	Timing	Priority	Responsibility	Related target(s)
2.1	**Form a Coast and Water Management team**	- Form a Coast and water management team with an assigned coordinator, water engineers, water technical officer and a coastal planner. - Nominate an officer responsible for the coordination of this IWCM Plan.	- This will support the delivery of many of the targets and actions identified in this IWCM Plan.	2020	**High**	Environment and Water department	-
2.2	**Hire a Compliance Officer**	- A proactive and experienced compliance officer is required to monitor construction sites, particularly prior to heavy rainfall, and consistently enforce Council's requirements to significantly reduce sediment loads discharged to receiving environments. Benefits of a compliance officer would include significant reduction in sediment loads from construction sites and potential mitigation of rectification works for streams and WSUD assets impacted by sediment.	- The focus of this role is on major new developments. - Consider to applying for a grant from Melbourne Water to employ this officer. - Instead of funding a new position Council could train existing construction supervisors to consider sediment control during construction.	2020	**High**	Environment and Water department	-
2.3	**Increase Council initiatives in fighting litter**	- By 2020 identify and monitor five Litter Hotspot locations near waterways and implement an educational program highlighting the impacts of litter in and around these local waterways. The program will include litter audits, signage, social media campaign, raising awareness on GPT functions, review of bin infrastructure & clean up events. - Identify the source of litter found in/around highly utilised or worst performing GPTs and target education relevant to those locations - Develop a plan and budget to retrofit old side entry pits into the more effective grated side entry pits and install new GPTs.	- Target for waterways and beaches to be free from litter by 2040 as per the Waste & Litter Strategy 2016-2040	2020	**High**	**Waste Strategy** and Coast and Water teams	-

2.4	**Incorporate Integrated Water Cycle Management Objectives in Capital Projects**	- Incorporate the plan for retrofitting side entry pits with grated pits and installing new GPTs into the Capital Works Program. In the interim impose for all new infrastructure rehabilitation capital projects to retrofit all existing old pits with new grated pits.
		- Review all Landscape Capital Projects and incorporate passive watering features. .
		- Integrate WSUD and Stormwater Harvesting Masterplan into Capital Works Program.
		- Develop a standard for WSUD features in different classes of capital works projects. Incorporate WSUD features in all new Capital Projects as per the standard;
		- Use the Integrated Water Cycle Management Assessment Tool, to assess the feasibility of treating and reusing water for different type of capital projects.
			- Integrating IWCM into new capital projects is an essential step in helping WCC meet its targets to:
			  - Increase stormwater reuse to 70 ML/yr by 2040.
			  - Reduce nitrogen by 2,691 kg/yr by 2040.
			  - Waterways and beaches to be free from litter by 2040 as per the Waste & Litter Strategy 2016-2040
				2020	**High**	Coast and Water, Assets Management, **Engineering Design, Engineering Construction**, **Facilities and Open Space**, and **Vibrant City Centres Departments**, Water Sensitive Wyndham Interdepartmental Working Group, and the Capital **Project Evaluation Panel**	2.1, 2.3

2.5	**Improve developments and subdivision approval process**	- Produce standard drawings for stormwater harvesting and treatment systems. - Consider the developments of a stormwater quality contribution scheme. In the interim request stormwater treatment and/or reuse for all developments or payment into Melbourne Water's contribution scheme. - Advocate for increased recycled water use and/or stormwater harvesting for all new residential infill developments and subdivisions. Establish rainwater tanks with reuse as the 'deemed to comply' method of meeting Clause 56 requirements (VPP).	- Performance scenario modelling shows that uptake of rainwater tanks for rainwater resue in infill developments (estimated at 442 per year) can save ~12.7 ML/yr and reduce nitrogen by 28 kg/yr. In terms of potable water, this equates to a saving of 50 ML/yr by 2020 and over 300 ML/yr by 2040. In terms of nitrogen, this equates to a reduction of 110 kg/yr by 2020 and over 650 ML/yr by 2040.	2020	**High**	**Water and Coast** and **Town Planning teams**	-
2.6	**Ensure WSUD Assets Record Keeping**	- Finalisation of the Asset Corporate Register to include WSUD assets. In the interim consolidate WSUD assets for existing and new developments on GIS and in a register.	- n/a	2020	**High**	**Assets and Roads** and Coast and Water teams	2.2, 2.3, 2.4
2.7	**Review internal processes in WSUD assets approval**	- Work with Melbourne Water to establish Council's approval process for the design of WSUD assets and determine any hold points and any requirements from the developers. (Requirements can be for the developer to show Melbourne water's assets in the landscape and engineering design plans.) - Review Council's construction approval process of WSUD assets and specify hold points. - Establish a handover process for the WSUD assets from the Open Space to the Maintenance team, and specify requirements from developers such as ensuring they provide a maintenance schedule	- Review Planning referral standard conditions in line of this process - Design the process to be compatible with Council's asset management system. - Ensure planning for IWCM assets provides for adequate space for maintenance access and sediment drying areas. - Enable maintenance crews to provide early input into design and planning - Create strict protocols for handover to avoid taking on liability	2020	**High**	**Design Engineering**, Engineering Construction, Asset Management, Water and Coast, Subdivisions Urban Design and **Engineering Development** teams	2.2, 2.4
2.8	**Push for the development of a Sewer Management Plan**	- Advocate for an updated sewer backlog program to be developed by the water authority which includes Wyndham City Council as part of a Sewer Management Plan as identified in the State environmental protection policy (Waters of Victoria).	- City West Water is the key stakeholder. - Refer to the Onsite Wastewater Management Plan	2020	High	Environment and Health Services team	2.5
2.9	**Improve WSUD Inspection Process**	- Provide training for approval personnel on WSUD functions to improve inspection Process. And continue to provide training for maintenance staff on how WSUD assets operate. - Provide an inspection guideline for Council construction and maintenance staff. - Introduce a test for WSUD assets before handover to Council occurs to verify system functionality and performance (including wet weather check).	- Improve sediment management during construction phase. Focus on preventing sediment damage to WSUD assets (e.g. sacrificial layer in bio-retention)	2040	Medium	**Engineering Construction**, Asset Management, Water and Coast, **Roads** and **Parks teams** and Facilities and Assets and Roads and Open Space Departments	-
2.10	**Complete and implement the review of WSUD assets in Wyndham**	- Complete the review of the condition of all existing WSUD assets (including bio-retention Systems). Commit to and provide funding for the annual maintenance and rectification works for all WSUD assets as per the Healthier Waterways Wyndham WSUD and GPT Review 2016.	- This is essential to meet Target 2.4: Ensure 100% of existing WSUD assets are rectified and have sufficient maintenance budgets.	2020	Medium	Environment and Water, **Assets and Roads**, Vibrant City Centres, and Open Space departments (WCC)	2.4

8.3 Roadmap 3: Improve collaboration and engagement with all stakeholders

No.	Actions	What it entails	Considerations	Timing	Priority	Responsibility	Related target(s)
3.1	**Establish an Interdepartmental Working Group**	- Establish a Water Sensitive Wyndham interdepartmental working group (with representatives from different departments) to assist with implementation, evaluation and reporting of the IWCM Plan with input from community engagement initiatives. - Working group to report annually to Council and be responsible for forward planning and strategic oversight of integrated design approaches.	- n/a	2017-2040	**High**	Environment and Water, Assets and Roads, Town Planning, Urban Futures, Planning and Building, Assets and Roads, and Open Space departments (WCC).	3.1, 3.3
3.2	**Develop an IWCM Engagement Plan**	- Audit existing consultation programs to assess their effectiveness and identify where IWCM engagement can be included. - Assess equity in engagement and aim to achieve a broad reach Consider current engagement with CALD (cultural and linguistic diversity) communities and a mixture of other key groups within the community. - Create a register of interested community groups / individuals. - Present progress of the IWCM to these groups on a yearly basis, through social media, emails, workshops, activities and/or consultations in some of the actions coming out of this plan. - Organise workshops through the Green Living Series on Council's practises in water management. Open the invitation to general public and reach out for Aboriginal communities	- n/a	2017-2040	**High**	Water and Coast team (WCC)	3.2
3.3	**Share indigenous knowledge on water and integrate this knowledge into Council projects**	- Explore opportunities for sharing indigenous knowledge on water management. - For projects near waterways, work with Indigenous groups to incorporate cultural learning through designing signage and art, re-establishing indigenous vegetation and participating in the landscape design. - Identify opportunities to work with Indigenous communities on the rehabilitation of creeks and river beds.	- Use the Reconciliation Action Plan to commit the right departments to adopt these actions - Approach Aboriginal Victoria and other Aboriginal Organisations involved in water management to run workshops for Council staff.	2017-2040	**High**	Community Planning and Development, and Coast and Water team	3.2
3.4	**Advocate for the development and future implementation of external strategies that aim to protect and improve Wyndham's water resources and waterways.**	- Submission to Melbourne Water and DELWP demonstrating how water benefits the community with the aim of securing increased environmental water in the Werribee River. - Advocate to Melbourne Water and DELWP for increased flows and improved water quality in the Werribee River as part of the Werribee CBD redevelopment project. - Contribution to the State Government's review of its Regional Waterway Strategy for the Port Phillip and Western Port catchment and the future large scale, long term project for the Werribee River as one of the 36 priority waterways in the State Water Plan Strategy (Water for Victoria Discussion Paper). - Improve knowledge of the water quality along the entire length of the Werribee River with the goal of better targeting improvement works and advocacy to relevant authorities (including for the catchment outside of Wyndham). - Maintaining an awareness of water security needs for the Werribee Irrigation District and environmental water needs in the Werribee River.	- Those actions are supported by the community through the Wyndham 2040 Vision	2017-2040	**High**	Environment and Water department (WCC)	3.3
3.5	**Identify areas requiring Cultural Heritage Management Plans (CHMPs).**	- Assess Wyndham's waterways in their entirety to identify and understand areas of high Aboriginal cultural heritage value and work closely with Aboriginal Cultural Heritage Groups to consolidate heritage listed sites on Council's GIS system where appropriate.	- Leverage off existing Melbourne Water investigations - Liaise with Aboriginal Victoria	2020	Medium	Environment and Water, and Assets and Roads department	3.2
3.6	**Organise meeting with neighbouring Councils and Water Authorities**	- Initiate a collaborative group with other councils and water authorities to develop, share and improve water management strategies across the region. - Work with adjoining councils to manage catchments as a whole (e.g. City of Greater Geelong on improving outcomes for the Little River catchment and Western Water for the upper Werribee Catchment) and consider regional water management and open space opportunities (e.g. declaration of Werribee River as a linear park).	- Utilise the quarterly meetings between Council, City West Water, and Melbourne Water to discuss outcomes from the internal Water Sensitive Wyndham Interdepartmental Working Group and identify potential pilot projects. - Explore potential opportunities for Managed Aquifer Storage (e.g. Blackforest Road).	2017-2040	Medium	Water and Coast team (WCC)	3.3

9. Stakeholder Consultation

In order to shape Wyndham's IWCM journey a comprehensive series of workshops, interviews and forums was used to gain pertinent and insightful feedback, enhance collaboration and embed support for IWCM. The thoughts and feedback captured from participants during the consultation process greatly informed the development of:

- A vision for IWCM in Wyndham supported by three key objectives.
- A range of targets to track progress towards the vision.
- A list of actions and opportunities support delivery of the IWCM Plan.

The consultation with internal and external stakeholders was central to the development of Wyndham's IWCM Plan (Figure 35). Key participants in this process included Council staff, community groups, water utilities, State Government and neighbouring Councils. For more detail see Attachment 5 – Record of Consultation.

Figure 35 Overview of consultation

10. Opportunities and Pilot Projects

There are a raft of projects that can be undertaken to support Wyndham in its transition to a water sensitive city. These projects relate to a variety of sites and structures, including council buildings and infrastructure, open spaces, waterways and coastlines. The types of projects also vary from structural (e.g. stormwater treatment wetlands and water efficient fixtures) to non-structural (e.g. policy, enforcement, educational and engagement opportunities).

Broad consultation with multiple Council teams, community groups and external stakeholders (e.g. Melbourne Water, City West Water and DELWP) was conducted to identify potential IWCM opportunities across Wyndham. Opportunities were investigated in four districts across Wyndham:

- **Wyndham East** - Point Cook, Truganina, Williams Landing and Laverton North
- **Wyndham Central** - Tarneit and Hoppers Crossing
- **Wyndham West** – Werribee, Wyndham Vale and Manor Lakes
- **Wyndham Rural** - Little River, Werribee South, Mt. Cottrell, Cocoroc, Mambourin and Quandong.

These districts were identified in the Wyndham 2040 vision document (WCC, 2015) and reflect the need for small, local action to achieve big, widespread change.

In addition to the district opportunities identified during consultation a review of the municipality was conducted to identify opportunities for:

- Increased alternative water use, with a focus on existing open spaces currently irrigated with potable water.
- Increased water conservation and increased alternative water use in Council buildings.
- Improved stormwater treatment and urban greening in Council carparks.
- Improved planning for flooding and coastal inundation based on current and future conditions.

All of these opportunities in section 10.1 to 10.5 on pages 64 to 69 below.

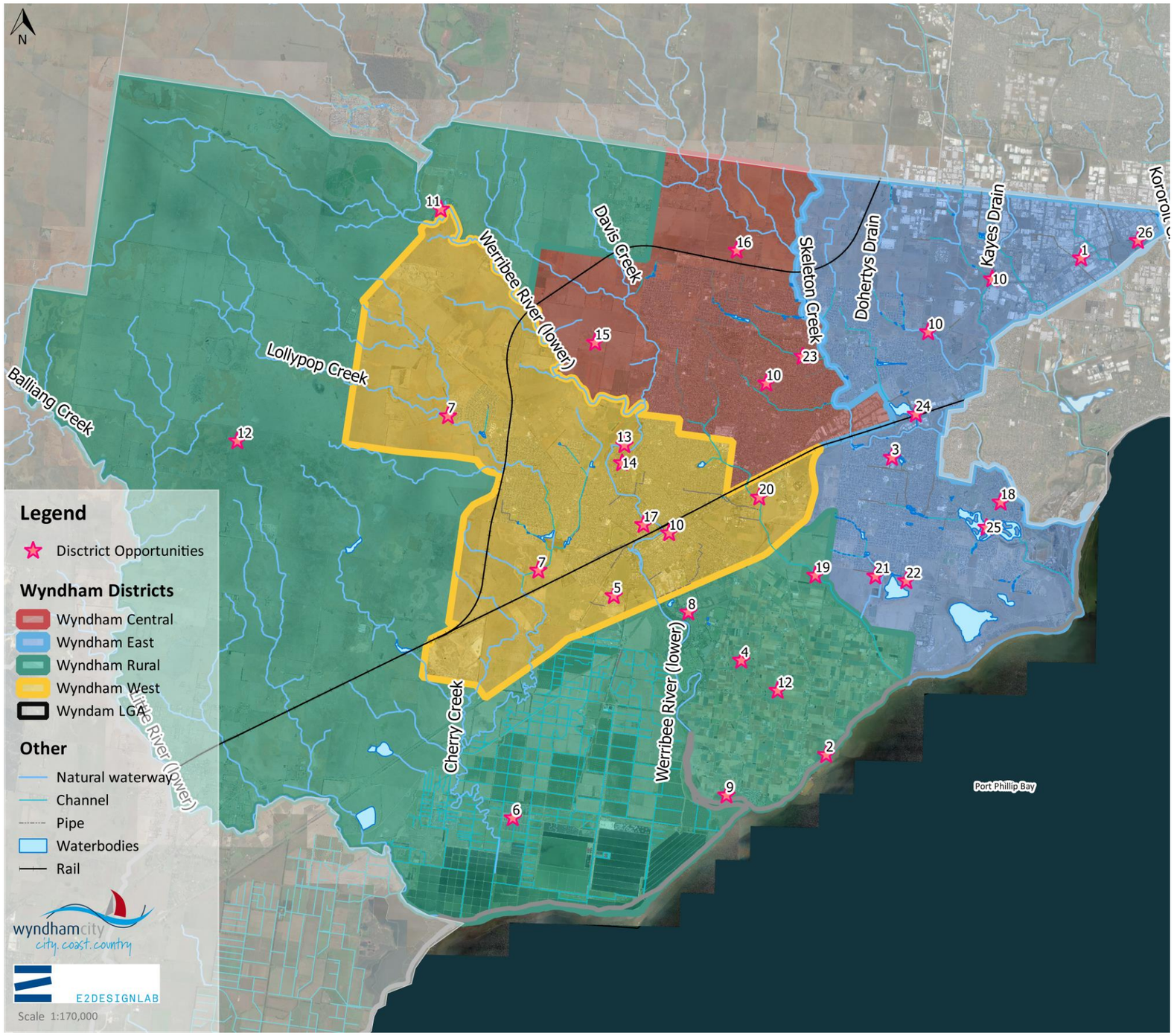


Figure 36 District opportunities identified during consultation.

10.1 District opportunities

Table 13 Details of district opportunities

ID	Opportunity	District
1	Harvest water from industrial rooftops and divert into the Melbourne Outfall Sewer (MOS) for reuse.	East
2	Increase the priority of the future Bay Trail that connects residents to coastal areas and RAMSAR sites.	Rural
3	Establish a WSUD educational program in local libraries, the Point Cook library is a potential site located next to a local wetland.	East
4	Protect and enhance the values of the Werribee South Coastline Irrigation channel that serves the Werribee South irrigation district. Investigate opportunities to recreate more natural spaces.	Rural
5	Explore alternative water harvesting opportunities in planned developments (e.g. Riverwalk Pavilion and Oval)	West
6	Promote the Western Treatment Plant as one of the world's best wastewater treatment plants and RAMSAR wetlands, encourage tourism and increased water awareness. Consider establishing a new community education centre to replace the closed site.	Rural
7	Investigate opportunities to use waterbodies in the Manor Lakes and Blackforest Road developments as the basis for multi-purpose demonstration projects.	West
8	Use Werribee Zoo as an educational and environmental tool (life cycle management, vegetation, flora, and fauna).	Rural
9	Educate land owners and visitors to Grahams Reserve of the significance of the wetland.	Rural
10	Retrofit WSUD in existing areas where existing treatment is minimal (e.g. Werribee and Hoppers Crossing). Consider opportunities in retarding basins, floodplains and along waterway outlets (e.g. along Laverton Main Drain).	West, Central and East
11	Promote Cobbledicks Ford as a tourist attraction that can be used to educate visitors and locals about Wyndham's environment and waterways.	Rural
12	Advocate for improved weed control and improved land management in rural / agricultural areas (e.g. minimise spray drift and reduced polluted runoff with fertilizers and recycled water entering waterways).	Rural
13	Develop a Werribee River Action Plan (Council's role would be one of advocacy, State Government would need to lead this with input from other partners, including Parks Vic, Melbourne Water etc.).	West, Central and Rural
14	Work with all councils and community groups in the Werribee catchment to have the Werribee River declared as a linear park to achieve greater control and consistency.	West, Central and Rural
15	Protect conservation areas, the green wedge and open spaces to avoid over development. Establish a mechanisms for policing proposed solutions.	All
16	Improve sediment control in new developments (e.g. silt barriers at the top of banks, improved enforcement).	All
17	Fix Litter issue at Bungees Hole (collaborative project involving Melbourne Water and Council).	West
18	Make knowledge on stormwater treatment and reuse techniques available to the community (include schools and sports clubs).	All
19	Create a linear park that connects the D1 drain to the bay.	All
20	Work with Melbourne Water and City West Water to investigate options to treat and reuse stormwater from the D1 Drain.	All
21	Lobby for a 700m buffer as part of the Cunningham Swamp development and investigate stormwater harvesting opportunities from the D1 drain for open space irrigation, include this in the PSP.	East
22	Investigate opportunities for improved diversion structures and increased treatment at Cunningham Swamp.	East
23	Intercept local residential and roadway catchments to recreate waterways along Sayers Drain.	Central
24	Work with Melbourne Water to ensure adequate outlet controls are in place at Laverton wetlands.	East
25	Find alternative uses for the seaweed in Sanctuary Lakes (e.g. fertiliser for the WSID)	East
26	Work with partnering organisations to pursue treatment sites identified as part of Melbourne Outfall Sewer study.	East

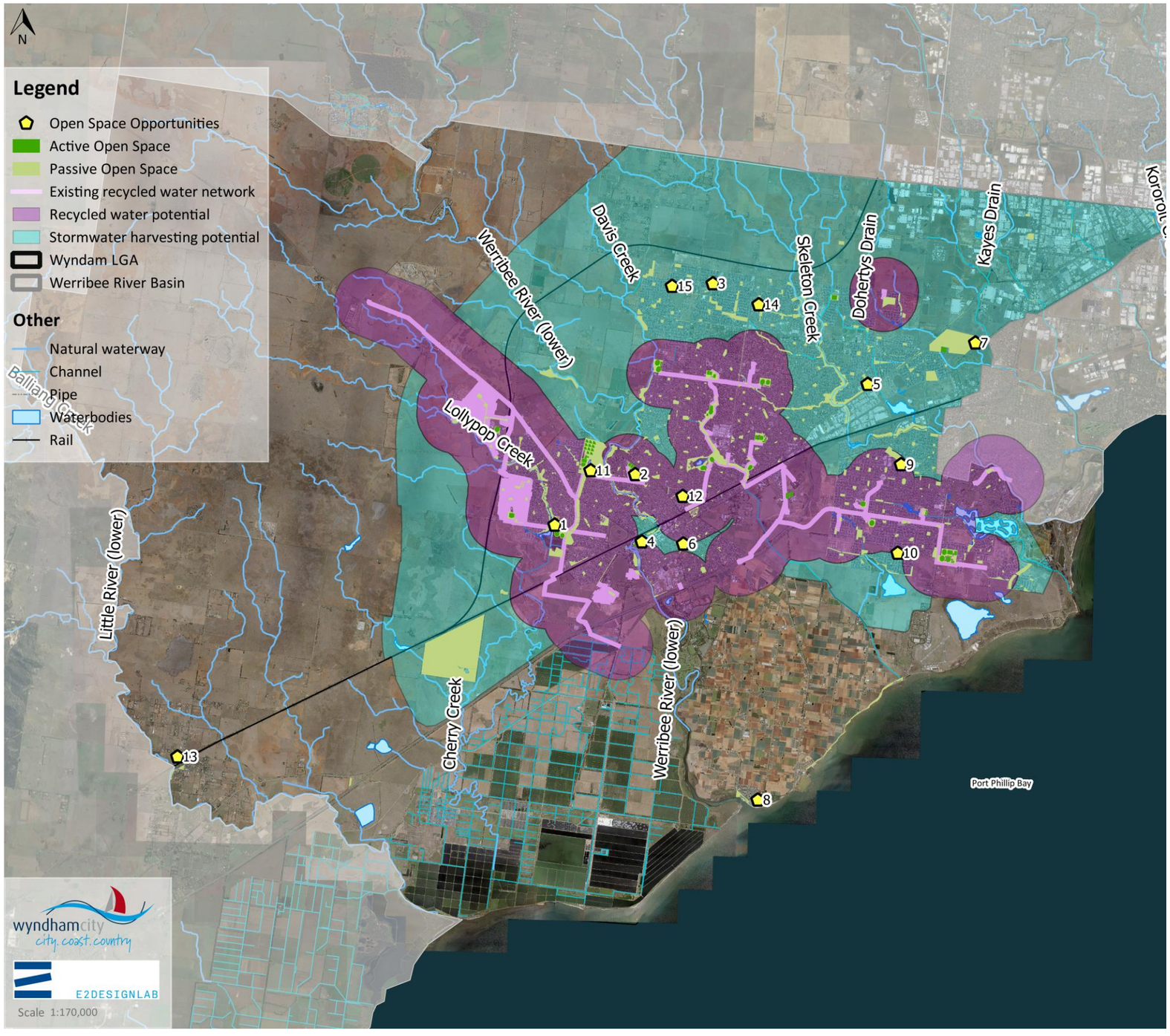


Figure 37 Opportunities for increased alternative water use across Wyndham

10.2 Alternative water use

Increased alternative water use is an important component of Wyndham's IWCM Plan as it reduces the demand for potable water and utilises water and nutrients that would otherwise damage local aquatic environments. Increaser alternative water use is already imbedded in Council's Environment and Sustainability Strategy 2016 - 2040 (WCC, 2016) and Water Action Plan (WCC, 2015).

There are several alternative water supplies available in Wyndham including recycled water, treated stormwater, river extractions and groundwater. The focus of the opportunities identified here is on recycled water and treated stormwater. It typically isn't economical to connect one site with both a recycled water and treated stormwater connection (although this may occur in some cases e.g. where stormwater is shandied with recycled water to reduce salinity). In order to help identify areas in Wyndham that are more suited to connection to a recycled water areas within 1 kilometre of existing supply mains have been mapped and shaded light purple, see Figure 37. Similarly, urban areas further than 1 kilometre from existing recycled water mains have been shaded light blue as these sites are likely to also warrant an investigation of stormwater treatment and reuse opportunities.

For Council open space irrigation is the largest water user and provides the greatest opportunity for increased alternative water uses. Opportunities for alternative water supplies at new active and passive spaces should be investigated early in the planning phases for these sites. Opportunities for alternative water supplies at existing active and passive spaces should be investigated whenever a new masterplan or site upgrade is prepared. For existing open spaces priority should be given to sites that are already irrigated with potable water as replacing this supply can lead to a cost saving for Council.

Opportunities for recycled water and stormwater use at 15 of Council's existing open spaces have been investigated. The majority of these sites are some of the highest potable water users in Wyndham. Other sites have been identified as part of consultation within Council. All 15 of the sites are mapped in Figure 37 with further details provided in Table 14 on the following page.

Table 14 Alternative water opportunities for open spaces currently irrigated with potable water

ID	Location		Opportunity		District
			Potential source (s)	Connection / site	
1	Wyndham Vale Sports Reserve (north and south)	Wyndham Vale	Recycled Water	Connect to existing recycled water main along Blackforest Road.	West
2	Galvin Park	Werribee	Recycled Water	Expand existing recycled water connection along Parklands Grove.	West
3	Goddard Street Sports Reserve	Tarneit	Stormwater	Investigate stormwater reuse options along Sayers Drain and at Reflections Wetland.	Central
4	Chirnside Park	Werribee	Recycled Water	Connect to existing recycled water main along Racecourse Road or Princes Highway (C109) and Newmarket Road.	West
			Stormwater	Investigate stormwater treatment and reuse options at local drainage outlets along Werribee River.	
5	Arndell Park Oval / Federation Boulevard Reserve	Truganina	Stormwater	Investigate stormwater treatment and reuse options at local drainage outlets along Forsyth Drain or Skeleton Creek.	East
6	Soldiers Sports Reserve	Werribee	Recycled Water	Connect to existing recycled water main along Railway Avenue or Princes Freeway.	West
			Stormwater	This site is at the top of several drainage catchments which would make stormwater reuse difficult unless it is part of another scheme.	
7	Lawrie Emmins Reserve	Laverton North	Stormwater	Investigate stormwater treatment and reuse options along Laverton Main Drain and Dohertys Drain (e.g. Malmaison Crescent Sediment Ponds or Draconis Lane wetland).	East
8	Price Reserve Sports Pavilion	Werribee South	Stormwater	Investigate stormwater treatment and reuse options at ponds along Koroneos Drive and O'connors Road.	Rural
9	Dunning Road Sports Reserve	Point Cook	Recycled Water	Connect to existing recycled water main along Boardwalk Boulevard.	East
			Stormwater	Investigate stormwater reuse options from the Boardwalk Wetland.	
10	Alamanda Sports Reserve	Point Cook	Recycled Water	Connect to existing recycled water main along Sneyedes Road.	East
			Stormwater	Investigate stormwater reuse options from Cunningham Swamp.	
11	Dog Obedience Park / Presidents Park	Wyndham Vale	Recycled Water	Expand existing connection along Heaths Road.	West
12	Conquest Drive Park	Werribee	Recycled Water	Connect to existing recycled water main along Railway Avenue.	West
13	Little River Reserve	Little River	Stormwater	Council stormwater drainage network not mapped in this area, site specific examination required to identify stormwater diversion, treatment and reuse opportunities.	Rural
14	Baden Powell Reserve Development*	Tarneit	Stormwater	Investigate stormwater treatment and reuse options from the Rose Grange Estate (Stage 23) drainage network or Seasons Estate wetland.	Central
15	Hummingbird Boulevard Reserve*	Tarneit	Stormwater	Investigate stormwater reuse options from David Creek retarding basin wetland.	Central

* Not currently irrigated with potable water

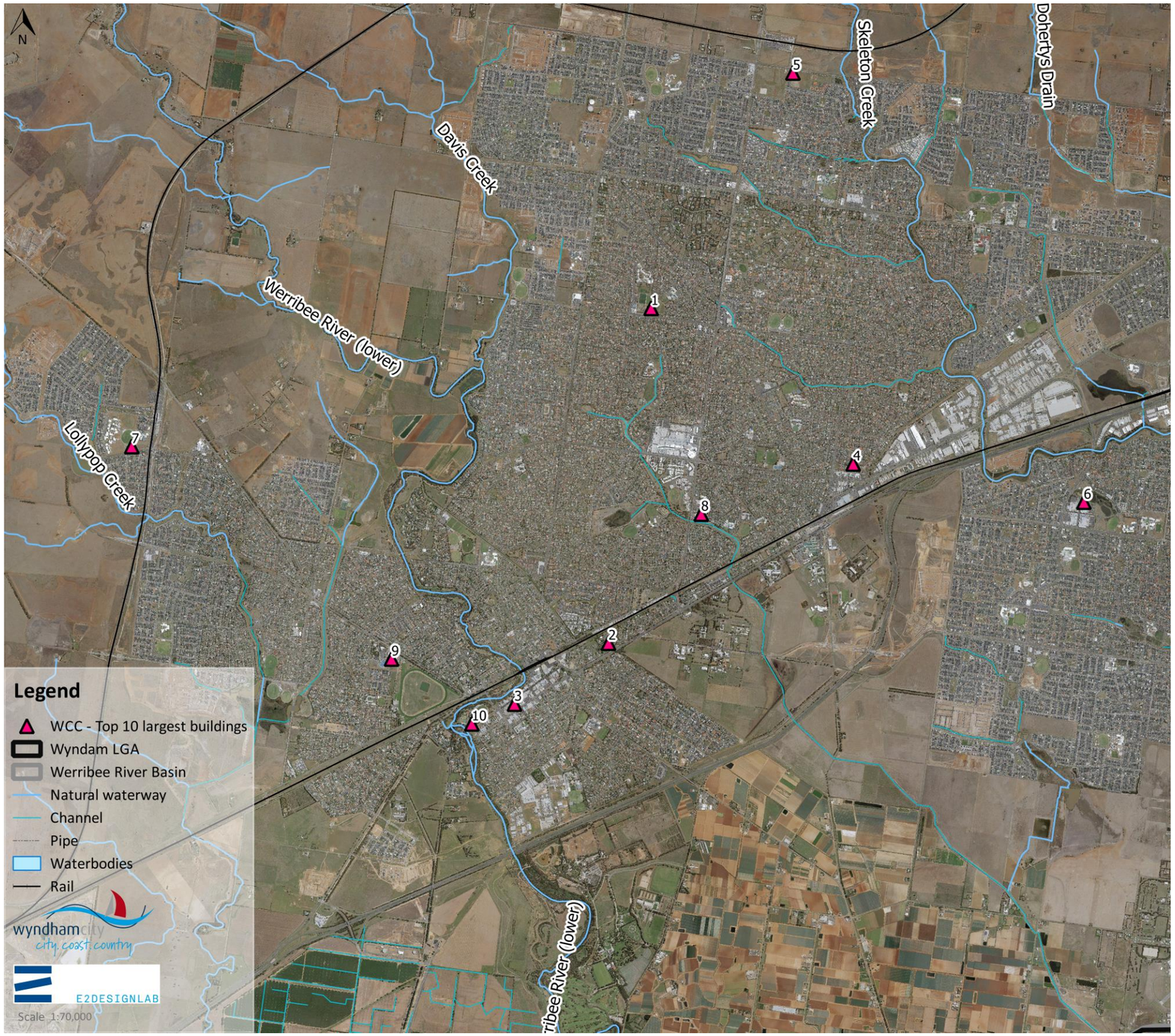


Figure 38 Wyndham City Council's top 10 largest buildings

10.3 Buildings

Council buildings and aquatic centres are some of the highest water users behind open spaces in Wyndham. In pursuit of improved water management at these sites WCC is pursuing the following goals as part of its Water Action Plan (WCC, 2015).

Building Goals

- 10% improvement in building water use efficiency by 2020 based on KL/M2/Yr.
- New council buildings are provided with rainwater tanks where an appropriate use for the water can be identified and implemented.

Aquatic Centre Goals

- Maintain aquatic centre water use levels that meet or exceed industry benchmarks.
- In 2017 review and adopt improved benchmarks if appropriate for WLEC and WOOP (after WLEC has reopened for at least 12 months).

These targets can be aided by water conservation and increased alternative water use. Recycled water, stormwater and rainwater are viable alternative water sources for many of the non-potable demands at these sites. The preferred alternative source will depend on the location and demand profile of each site. Rainwater harvesting is more viable at sites with larger roofs and larger demands are typically more cost effective. While new council buildings are the focus of the Water Action Plan goals, retrofit opportunities may also be available at some of Council's larger existing building (Table 15).

Table 15 Wyndham City Council's top 10 largest building

ID	Building	Footprint (m^2)	District
9	Eagle Stadium	15,986	West
8	AquaPulse and Encore Events Centre	10,521	Central
2	Civic Centre Offices	6,537	West
5	Tarneit Community Learning Centre	3,084	Central
7	Wyndham Vale Community Learning Centre	2,895	West
6	Point Cook Community Learning Centre	2,811	East
3	Wyndham Cultural Centre	2,730	West
10	Werribee Olympic Outdoor Pool	2,079	West
4	Central Park Community Centre	2,006	Central
1	The Grange Community Centre	1,900	Central

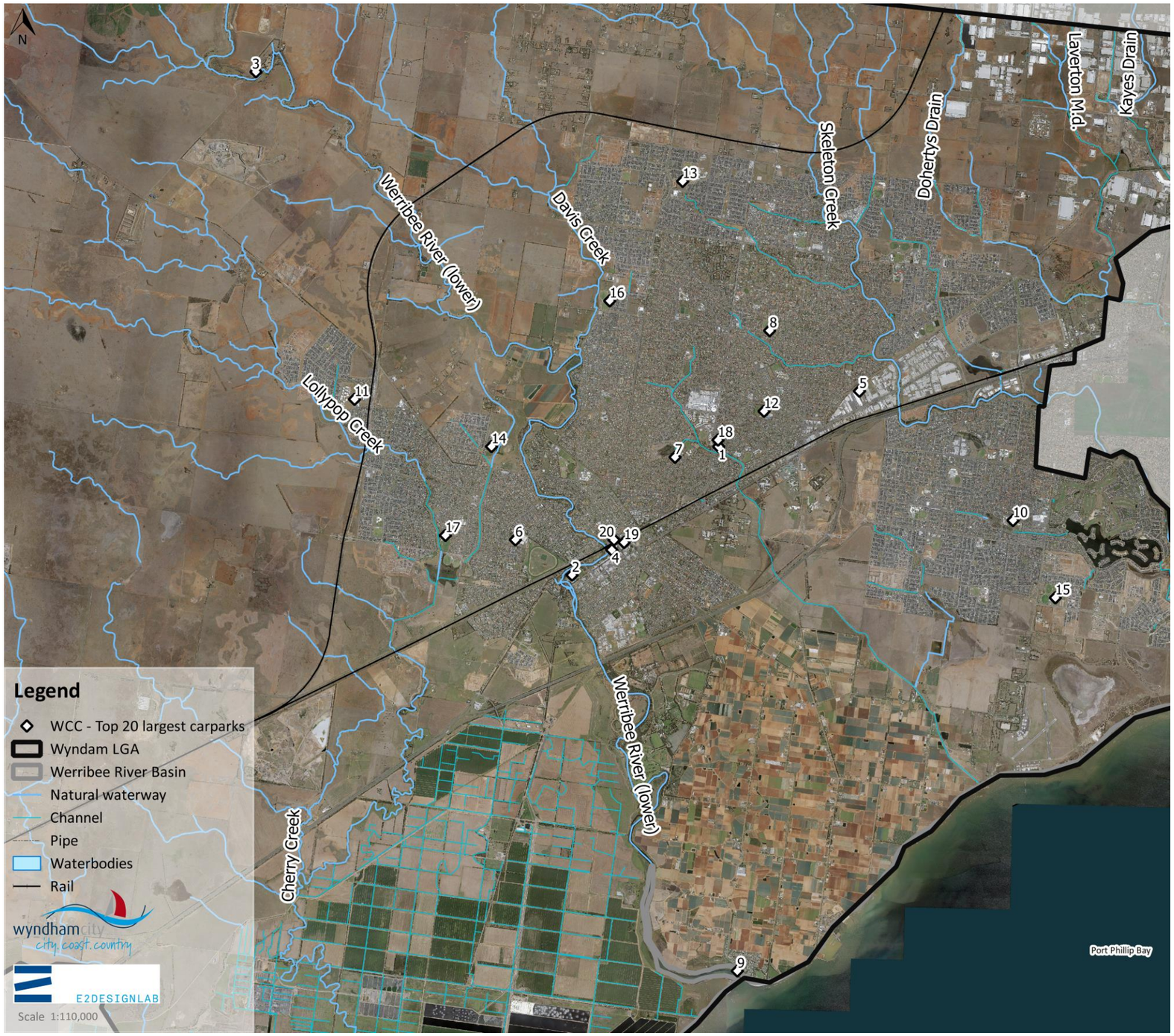


Figure 39 Wyndham City Council's top 20 largest carparks

10.4 Carparks

WCC is responsible for the management of a large number of carparks across the municipality. These areas are key assets for the community that are in regular use. However, there are many ways to improve the performance of urban carparks in terms of stormwater management and amenity. Raingardens and tree pits are examples of WSUD technologies that can be deployed in constrained sites such as carparks to treat runoff form these large impervious surfaces. These vegetated assets also improve the feel and atmosphere of otherwise sparse built environments, and help reduce heat through the provision of shade and via evapotranspiration. There are opportunities to include these WSUD features in new carpark designs or as part of upgrades to existing design. Some of Council's largest carparks consist of more than 1 ha of impervious surface and should be prioritised as part of any future retrofit/upgrade works (Table 16). Council can also continue to advocate for improved stormwater treatment and urban greening as part of private carpark design and construction.

Table 16 Wyndham City Council's top 20 largest carparks

ID	Location	Area (m^2)	District
14	Presidents Park	21,145	West
6	Eagle Stadium	17,560	West
20	Werribee Train Station	17,394	West
5	Council Depot	17,277	Central
1	Aquapulse and Encore	15,417	Central
9	James D Bellin Reserve	12,685	Rural
15	Salwater Reserve*	10,623	East
2	Chirnside Park	10,253	West
12	Mossfield Reserve	10,134	Central
7	Heathdale Glen Orden Wetlands Reserve	8,316	West
8	Hogans Road Reserve	8,285	Central
4	Comben Drive Carpark	7,289	West
11	Manor Lakes Boulevard Reserve	6,739	West
10	Jamieson Way	6,535	East
19	Woolworths Werribee Central	6,066	West
16	Wootten Road Reserve	5,756	Central
18	Youth Resource Centre	4,992	Central
17	Wyndham Vale North Reserve	4,923	West
13	Penrose Promenade Community Centre	4,596	Central
3	Cobblesdick Ford Conservation Reserve	4,580	Rural

*Already includes raingarden treatment

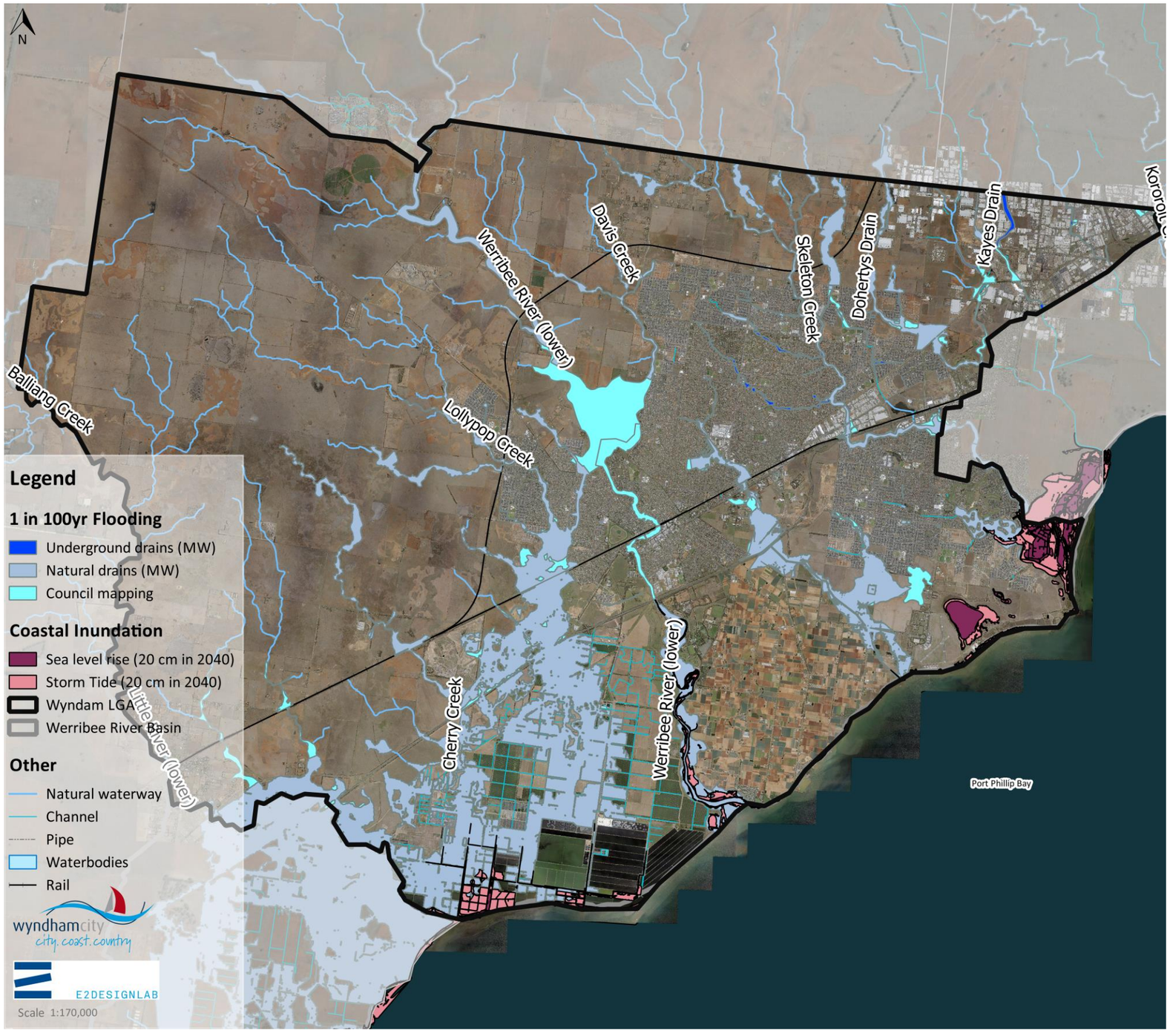


Figure 40 Land inundated by a 1 in 100yr storm and the extent of land subject to coastal inundation due to projected sea level rise from 2009 to 2040

10.5 Flooding and coastal inundation

In terms of planning for and responding to increased risks of flooding and coastal inundation WCC has the opportunity to:

- Engage and upskill residents and businesses,
- Aid planning decisions (e.g. overlays and appropriate setbacks),
- Secure appropriate insurance for flooding and inundation from sea level rise
- Target investments in infrastructure where required to protect natural and man-made assets.

The magnitude of flooding, sea level rise and storm surges are expected to continue to increase to 2040 and beyond. Consequently, there is a great need to act on these opportunities to mitigate these risks now.

WCC and Melbourne Water have mapped the extent of flooding resulting from a 1 in 100 year storm across the municipality. This relates to a storm event of such intensity, based on historical rainfall data, which has a one per cent chance of occurring in any given year (Melbourne Water, 2016). Key flood related opportunities in Wyndham, include creating multi-functional flood assets (e.g. improved access and compatible other uses during dry periods), retrofitting stormwater treatment systems into retarding basins and floodways, larger flooding offsets in new developments, improved signage and community understanding of risks.

There is a growing evidence base and tools available to support Wyndham identify and plan for inundation and erosion from sea level rise and storm surges. The Victorian Coastal Inundation Dataset models the extent of land subject to coastal inundation due to projected sea level rise from 2009 to 2040 (i.e. 20cm). The Dataset also illustrates the 1 in 100yr storm tide level in 2040 based on a 20 cm sea level rise and 6% increase in storm surge. This data illustrates the impact sea level rise on Wyndham's coastline in 2040. The largest impacts are expected around Cheetham Wetlands and the Point Cooke Marine Sanctuary (part of the Port Phillip Bay and Bellarine Peninsula Ramsar site). The RAAF Lake, Spectacle Lake, the mouth of the Werribee River and parts of the Western Treatment plant are also likely to experience impacts by 2040.

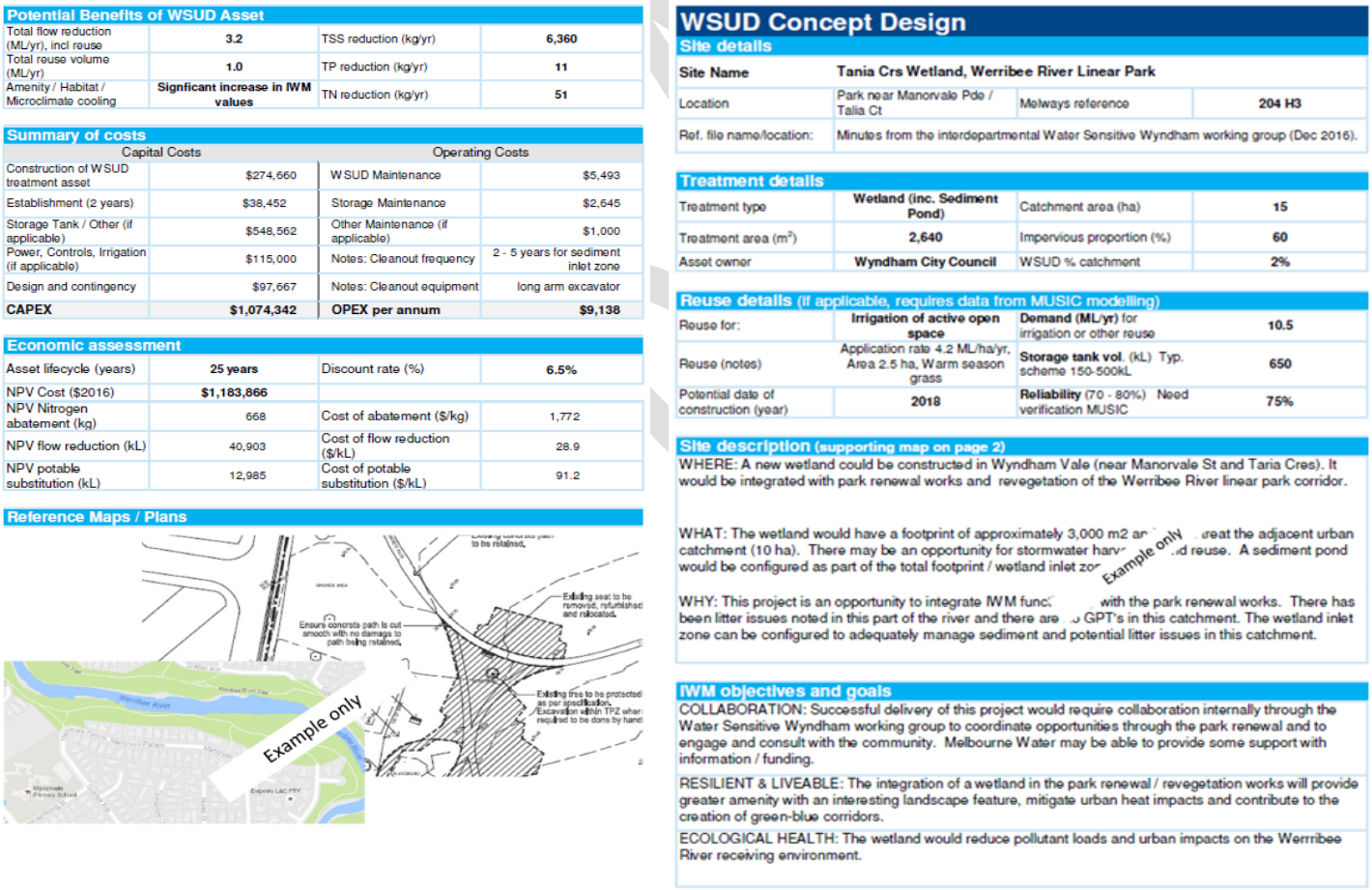
Note: The Victorian Coastal Inundation Dataset is recommended for use at a scale of approximately 1:75,000 or less detail to reflect the limitations in the modelling and the recommended catchment to regional scale of inundation assessments. The modelled extents are not suitable for assessments of potential risks at property level.

11. Monitoring and Reporting Procedures

Two excel based IWM Tools have been developed to support the implementation and tracking of Wyndham's IWM Plan.

11.1 IWCM Assessment Tool

An IWM Assessment Tool has been developed to provide WCC with an easy way to align proposed projects with Council's IWM Objectives and Vision. The tool allows Council to quickly and easily assess the potential costs and benefits (e.g. TN load reduction, flow reduction, potable water savings) of IWM opportunities (e.g. new wetlands, riparian revegetation or stormwater harvesting projects). An example of the tool outputs is provided in Figure 41. These outputs have been designed support the characterisation and communication of IWM project internally and assist with capital works and maintenance budgeting.



Potential Benefits of WSUD Asset

Total flow reduction (ML/yr), incl reuse	3.2	TSS reduction (kg/yr)	6,360
Total reuse volume (ML/yr)	1.0	TP reduction (kg/yr)	11
Amenity / Habitat / Microclimate cooling	Signficant increase in IWM values	TN reduction (kg/yr)	51

Summary of costs

Capital Costs		Operating Costs	
Construction of WSUD treatment asset	$274,660	WSUD Maintenance	$5,493
Establishment (2 years)	$38,452	Storage Maintenance	$2,645
Storage Tank / Other (if applicable)	$548,562	Other Maintenance (if applicable)	$1,000
Power, Controls, Irrigation (if applicable)	$115,000	Notes: Cleanout frequency	2 - 5 years for sediment inlet zone
Design and contingency	$97,667	Notes: Cleanout equipment	long arm excavator
CAPEX	**$1,074,342**	**OPEX per annum**	**$9,138**

Economic assessment

Asset lifecycle (years)	25 years	Discount rate (%)	6.5%
NPV Cost ($2016)	$1,183,866		
NPV Nitrogen abatement (kg)	668	Cost of abatement ($/kg)	1,772
NPV flow reduction (kL)	40,903	Cost of flow reduction ($/kL)	28.9
NPV potable substitution (kL)	12,985	Cost of potable substitution ($/kL)	91.2

Reference Maps / Plans

Example only

WSUD Concept Design

Site details

Site Name	**Tania Crs Wetland, Werribee River Linear Park**		
Location	Park near Manorvale Pde / Talia Ct	Melways reference	204 H3
Ref. file name/location:	Minutes from the interdepartmental Water Sensitive Wyndham working group (Dec 2016).		

Treatment details

Treatment type	Wetland (inc. Sediment Pond)	Catchment area (ha)	15
Treatment area (m²)	2,640	Impervious proportion (%)	60
Asset owner	Wyndham City Council	WSUD % catchment	2%

Reuse details (if applicable, requires data from MUSIC modelling)

Reuse for:	Irrigation of active open space	Demand (ML/yr) for irrigation or other reuse	10.5
Reuse (notes)	Application rate 4.2 ML/ha/yr, Area 2.5 ha, Warm season grass	Storage tank vol. (kL) Typ. scheme 150-500kL	650
Potential date of construction (year)	2018	Reliability (70 - 80%) Need verification MUSIC	75%

Site description (supporting map on page 2)

WHERE: A new wetland could be constructed in Wyndham Vale (near Manorvale St and Taria Cres). It would be integrated with park renewal works and revegetation of the Werribee River linear park corridor.

WHAT: The wetland would have a footprint of approximately 3,000 m2 ar... ...reat the adjacent urban catchment (10 ha). There may be an opportunity for stormwater harv... ...d reuse. A sediment pond would be configured as part of the total footprint / wetland inlet zo...

Example only

WHY: This project is an opportunity to integrate IWM func... with the park renewal works. There has been litter issues noted in this part of the river and there are ... GPT's in this catchment. The wetland inlet zone can be configured to adequately manage sediment and potential litter issues in this catchment.

IWM objectives and goals

COLLABORATION: Successful delivery of this project would require collaboration internally through the Water Sensitive Wyndham working group to coordinate opportunities through the park renewal and to engage and consult with the community. Melbourne Water may be able to provide some support with information / funding.

RESILIENT & LIVEABLE: The integration of a wetland in the park renewal / revegetation works will provide greater amenity with an interesting landscape feature, mitigate urban heat impacts and contribute to the creation of green-blue corridors.

ECOLOGICAL HEALTH: The wetland would reduce pollutant loads and urban impacts on the Werribee River receiving environment.

Figure 41 IWM Assessment Tool example output

11.2 IWCM Target Tracking Tool

An IWM Target Tracking Tool has been developed to provide WCC with an easy way to monitor progress toward the 2040 targets and the BPEM targets for stormwater pollutant reduction. The long term aspiration for Wyndham is the treatment of all stormwater pollutants to best practice in accordance with the Best Practice Environmental Management (BPEM) Guidelines (Victoria Stormwater Committee, 1999). This equates to typical urban annual pollutant loads reductions of 80% for total suspended solids (TSS), 45% for total phosphorus (TP), and 45% for total nitrogen (TN). To meet these targets Council, Melbourne Water, developers and other parties (e.g. private residents and state government) need to invest in stormwater treatment and reuse projects.

In pursuit of the BPEM targets Wyndham City Council have set a 2040 target for increased nitrogen reduction of 2,691 kg in existing urban areas. Council's target focuses on increasing treatment in existing urban areas as opposed to new urban developments and rural areas. This distinction is made because stormwater runoff in new developments should be treated to best practice by assets constructed by developers and the treatment of stormwater in rural areas should be led by the local Catchment Management Authority (CMA) and Southern Rural Water (SRW).

To meet the 2040 target WCC need to achieve an additional 110 kg/yr reduction in total nitrogen loads each year between 2016 and 2040 (i.e. 24 years). The IWM Target Tracking Tool allows Council to assess its progress towards this target based on Councils WSUD asset register. The tool focuses on tracking assets constructed by Council (or by Council in partnership with others) that treat runoff from existing urban catchments. Pollutant load reductions are estimated based on Council records of new treatments (including treatment type and area) and unit MUSIC models. An example of the tools output is provided in Figure 42 below.

IWCM Target Tracker

Current year: 2020

Target

This target tracker provides a snapshot of the addiitonal treatment load reductions achieved by constucting new Integrated Water Cycle Management (IWCM) and Water Sensitive Urban Design (WSUD) assets. The tool tracks the contirbution of assets constructed after 2016 (i.e. from 2017 onwards) realtive to a 2016 baseline.

The target adopted in Wydham City Council's Integrated Water Management Plan (2016) is: Reduce total nitrogen (TN) pollutant loads from stormwater runoff from existing urban areas by 2,650 kg/yr by 2040.

Wyndham's TN target corresponds to a 110 kg/yr reduction in total nitrogen loads each year between 2016 and 2040 (i.e. 24 years). This target is in addition to the best practice stormwater management requirements that new developments must conmply with to will reduce TN

Additional total nitrogen load reductions		Target
From Council assets built in 2020	0	Annual: 110 kg/yr
From Council assets built from 2017 to 2020	0	Cumulative: 440 kg/yr

WCC IWCM Assets	Baseline 2016	Built in 2020	Cumulative (built from 2017 to
Number of WSUD Assets	86	-	-
Catchment treated (ha)	1,766	-	-
Total Treatment Area (m^2)	220,058	-	-
TSS reduction (kg/yr)	16,939	-	-
TP reduction (kg/yr)	1,750	-	-
TN reduction (kg/yr)	16,500	-	-

Plot of performance

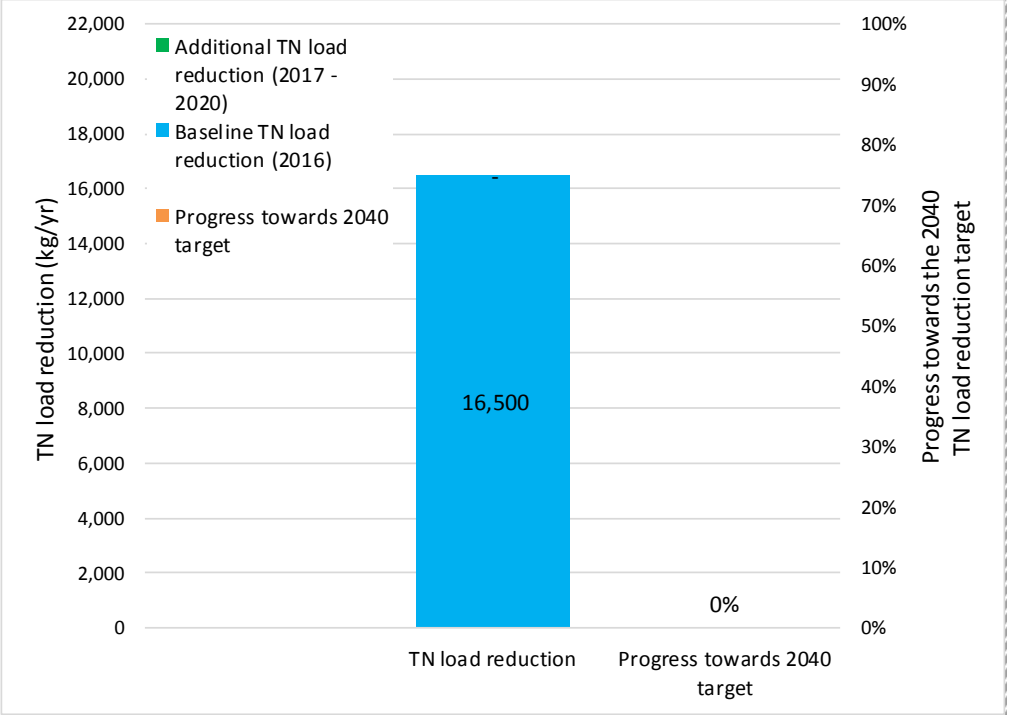


Figure 42 IWM Target Tracking Tool example output

12. References

BoM. (2016, 09 12). *Climate statistics for Australian locations*. Retrieved from Australian Government Bureau of Meteorology (BoM): http://www.bom.gov.au/jsp/ncc/cdio/cvg/av

Brown, et al. (2009). Urban water management in cities: historical, current and future regimes. *Water Science and Technology*, 847-855.

Burge, K., Browne, D., Breen, P., & Wingad, J. (2012). Water Sensitive Urban Design in a changing climate: estimating the performance of WSUD treatment measures under various climate change scenarios. *WSUD 2012: Water sensitive urban design; Building the water sensiitve community; 7th international conference on water sensitive urban design.* (pp. 119-126). Barton, ACT: Engineers Australia.

City West Water. (2016). *Lollipop Creek Sewer Pipeline Project*. Retrieved from Our Assets: http://www.citywestwater.com.au/our_assets/lollipop_creek.aspx

CRCWSC. (2017, 01 09). *Engaging communities: Empowered citizens* . Retrieved from CRC for Water Sensitive Cities: https://watersensitivecities.org.au/collaborate/collaborating-with-industry/engaging-communities/

CSIRO. (2016, 10 07). *Southern Slopes (Victoria West)*. Retrieved from Climate Change in Australia: Projections for Australia's NRM Regions: http://www.climatechangeinaustralia.gov.au/en/climate-projections/future-climate/regional-climate-change-explorer/sub-clusters/?current=SSVWC&popup=true&tooltip=true

CSIRO. (2016, 09 21). *Summary Data Explorer*. Retrieved from Climate Change in Australia: Projections for Australia's NRM Regions: http://www.climatechangeinaustralia.gov.au/en/climate-projections/explore-data/summary-data-explorer/

DELWP. (2016). *State Environment Protection Policy (Waters) Review* . Retrieved from Department of Environemnt, Land, Water and Planning (DELWP): http://delwp.vic.gov.au/water/rivers,-estuaries-and-wetlands/state-environment-protection-policy-waters-review#sthash.cm91wbCQ.dpuf

Department of Environment, Land, Water and Planning. (2014, 01 22). *Port Phillip Bay (Western Shoreline) and Bellarine Peninsula*. Retrieved from Significant Wetlands: http://www.depi.vic.gov.au/water/rivers-estuaries-and-wetlands/wetlands/significant-wetlands/port-phillip-bay-western-shoreline-and-bellarine-peninsula

Department of the Environment. (2010, 05 10). *Directory of Important Wetlands in Australia - Information sheet*. Retrieved from Australian Wetlands Database: https://www.environment.gov.au/cgi-bin/wetlands/report.pl

DEPI. (2013). *Department of Environment and Primary Industries, Index of Stream Condition: The Third Benchmark of Victorian River Condition ISC3.* East Melbourne: Department of Environment and Primary Industries.

DNRE and Parks Victoria. (2002). *Management of Victoria's Ramsar Wetlands: Strategic Direction Statement.* Melbourne: Department of Natural Resources and Environment.

Ecocreative. (2016, 08 23). *CRC for Water Sensitive Cities: a vibrant vision for Australia's cities*. Retrieved from Ecocreative: http://www.ecocreative.com.au/projects/crc-for-water-sensitive-cities-a-vibrant-vision-australias-cities/

EPA. (2012, 07 26). *Urban stormwater best practice environmental management guidelines*. Retrieved from Environment Protection Authority (EPA) Victoria : http://www.epa.vic.gov.au/business-and-industry/guidelines/water-guidance/urban-stormwater-bpemg

forecast.id. (2016, 08 16). *City of Wyndham*. Retrieved from Population Forecasts: http://forecast.id.com.au/wyndham

forecast.id. (n.d.). *City of Wyndham*. Retrieved June 2016, 15, from forecast.id: http://forecast.id.com.au/wyndham/drivers-of-population-change

Francey, M., & Catchlove, R. (2007). *Hotspots a methodology for identifying, prioritising and tackling litter in urban environments.* Melbourne.

Geoscience Australia. (2015). *Sea level rise maps*. Retrieved from OzCoasts: Australian Online Coastal Information: http://www.ozcoasts.gov.au/climate/sd_visual.jsp

Greening the West. (2016, 09 12). *1 Million Trees for Melbourne's west*. Retrieved from Greening the West: http://greeningthewest.org.au/1-million-trees-melbournes-west/

Greening the West. (2016). *About Greening the West* . Retrieved from Greening the West: http://greeningthewest.org.au/about/

Healthy Waterways. (2016). *Litter*. Retrieved from Healthy Waterways: http://healthywaterways.org/region/pressures/litter

Lloyd, S., Roberts, S., & Beck, L. (2016). *Water Sensitive Cities Benchmarking and Assessment: Moonee Valley City Council Melbourne.* Cooperative Research Centre for Water Sensitive Cities.

Melbourne Point. (2015). *Werribee River*. Retrieved from Rivers: http://www.melbournepoint.com.au/rivers/werribee-river/

Melbourne Water. (2009). *Know Your River: Werribee River.* Melbourne: Melbourne Water.

Melbourne Water. (2014, 06 20). *Tangled platypus in Werribee River a reminder of litter threat*. Retrieved from News: http://www.melbournewater.com.au/aboutus/news/pages/tangled-platypus-in-werribee-river-a-reminder-of-litter-threat.aspx

Melbourne Water. (2016, 09 20). *Overlays Explained*. Retrieved from Melbourne Water: http://www.melbournewater.com.au/planning-and-building/flood-and-planning-schemes/pages/planning-scheme-overlays.aspx

Metropolitan Planning Authority (MPA). (2016). *The State of the State Update - Vol 2.* Melbourne: Metropolitan Planning Authority (MPA).

Monash University and AECOM. (2013). *Urban Heat Island Report: City of Greater Geelong and Wyndham City Council.* City of Greater Geelong and Wyndham City Council.

National Water Commission. (2016, 08 11). *Werribee Irrigation District Groundwater Management.* Retrieved from Case Study: http://www.wetrocks.com.au/media/files/resources/national/68-Werribee_South.pdf

Profile.i.d. (2016, 08). *Dwelling type*. Retrieved from City of Wyndham: http://profile.id.com.au/wyndham/dwellings

SRW. (2009). *Western Irrigation Futures Atlas.* Southern Rural Water.

SRW. (2011). *Western Irrigation Futures Strategy.* Southern Rural Water.

SRW. (2014). *West Port Phillip Bay Groundwater Catchment Statement .* Southern Rural Water .

SRW. (2015). *Fact Sheet: WID water balance for the 2014-15 season.* Southern Rural Water.

SRW. (2015). *West Port Phillip Bay Groundwater Catchment Statement.* Southern Rural Water.

SRW. (2016). *Allocation – Deutgam (Werribee South Groundwater)*. Retrieved from Southern Rural Water: http://www.srw.com.au/customers/allocation-deutgam-werribee/

SRW. (2016, 08 16). *Port Phillip & Western Port region map*. Retrieved from Groundwater Hub of Southern Victoria : http://gwhub.srw.com.au/port-phillip-western-port-overview

SRW. (2016, 08 11). *Werribee Irrigation District*. Retrieved from Southern Rural Water: http://www.srw.com.au/water-systems/werribee/

Star Weekly. (2015, 11 18). *Tonne of trash collected at river spot since July*. Retrieved from Star Weekly: http://www.starweekly.com.au/news/litter-builds-up-as-river-traffic/

Sustainability Victoria. (2013). *The Victorian Litter Report.* Melbourne: Sustainability Victoria.

Sustainability Victoria. (2013). *Victorian Litter Strategy 2012–14, Love your Victoria.* Melbourne: Sustainability Victoria.

The Age. (2016, 07 25). *Fears for Melbourne's west as huge growth outpaces infrastructure*. Retrieved from Victoria News: http://www.theage.com.au/victoria/fears-for-melbournes-west-as-huge-growth-outpaces-infrastructure-20160724-gqcoe5.html

VEWH. (2016, 03 22). *Central Region*. Retrieved from Environmental Water: http://www.vewh.vic.gov.au/environmental-water/environmental-watering-in-your-region/central-region

VEWH. (2016). *Seasonal Watering Plan 2016-17.* Victorian Environmental Water Holder.

Victoria Stormwater Committee. (1999). *Urban Stormwater Best Practice Environmental Management Guidelines.* CSIRO.

Victorian State Government . (2016). *FAQs*. Retrieved from About the Plan Melbourne Refresh: http://refresh.planmelbourne.vic.gov.au/about/faqs#12386

WAGA. (2012). *Climate Change Adaptation Strategy: 2013-2020: Action Plan.* Western Alliance for Greenhouse Action (WAGA).

WCC. (2014). *Agricultural Competitiveness White Paper Submission - IP375 .* Wyndham City Council.

WCC. (2014). *Wyndham City Litter Reduction and Prevention Strategy 2014 – 2016 .* Melbourne: Wyndham City Council (WCC).

WCC. (2015). *Climate Change Adaption Strategy 2016 - 2020: An integrated approach to managing climmate change at Wyndham City.* Wyndham City Council .

WCC. (2015). *Community Amenity Local Law (2015).* Wyndham City Council.

WCC. (2015). *Health of the Werribee River.* Wyndham City Council.

WCC. (2015). *Water Action Plan 2015-2020.* Wyndham City Council .

WCC. (2015). *Wyndham 2040 Vision.* Wyndham City Council.

WCC. (2015). *Wyndham Household Survey 2015 District Area Results Report .* Wyndham City Council .

WCC. (2015). *Wyndham Stormwater Management Plan .* Wyndham City Council .

WCC. (2016). *Environment and Sustainability Strategy 2016 - 2040: Our Environment, Our Climate, Our Future.* Wyndham City Council .

WCC. (2016). *Snapshot of Wyndham 2016*. Retrieved from About Council: http://cms.wyndham.vic.gov.au/aboutwyndham/wyndhamcity/demographicsandpopulation/demographics/snapshot_of_wyndham_2014

WCC. (2016). *Water for Victoria Discussion Paper – Submission by Wyndham City Council.* Wyndham City Council.

WCC. (2016). *Werribee South Green Wedge Policy and Management Plan – Exhibition Version .* Wyndham City Council .

Attachment 1 – Contextual Analysis

Planning, policy and legislation

Legislative and policy context for water management occurs at the Commonwealth, State and Local Government level. These documents are supported by a number of strategies and guidelines for best practice. The state policy context is likely to change significantly over the coming years with the Department of Environment, Land, Water and Planning (DELWP) responsible for policy changes directed at better use of all water resources while driving change to improve local environments, increase liveability and deliver better water services. A summary of the legislative and policy context for water management is outlined below.

Commonwealth

The National Water Initiative (NWI) commits all states and territories to innovation and capacity building to create Water Sensitive Australian Cities (Clause 92).

The *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* is the overarching legislation for the protection of native species and enhancement of their natural habitat including the waterways and the species that they support. It provides the enforcement mechanisms for environmental controls in Victoria, including the discharge of waste, including sediment, into receiving waters.

The National Strategy for Ecologically Sustainable Development (ESD) provides strategic directions for governments' policy and decision-making in the use and management of natural resources. The Strategy facilitates a coordinated and co-operative approach to ecologically sustainable development and encourages long-term benefits for Australia over short-term gains. All states and territories adopted the strategy in 1992.

State government

The *Water Act 1989* is the overarching legislation for managing water resources in Victoria. It enables Melbourne Water to act in relation to managing waterways, drainage and stormwater. At a state level the policy and legislative instruments that provides councils with the greatest ability to influence stormwater management are:

The *Planning and Environment Act 1987* is the overarching legislation for planning the use, development and protection of land. The Victoria Planning Provisions (VPPs) are established under this Act which is the basis for all Victorian Local Government Planning Schemes. The Act allows councils to require developers to incorporate water conservation, water reuse and stormwater quality measures into developments. Clear and unambiguous planning policy mandates a number of stormwater management requirements under the Victorian Planning Provisions. They are:

- Clause 15.01 requires decision-making to be consistent with State Environment Protection Policies (Waters of Victoria and specific catchment policies).
- Clauses 15.01 and 18.09 require consideration of Urban Stormwater Best Practice Environmental Management Guidelines.
- Clause 56.07 sets out the planning requirements for urban runoff quality, potable water reduction, reused and recycled water. It mandates WSUD for all residential subdivisions.

The State Environment Protection Policies (SEPP) 2003 (Water of Victoria) established under the *Environment Protection Act 1970* and amendments in 2006 set the statutory framework for protection of waterways throughout the Port Phillip Bay catchment. . It identifies and sets out the statutory framework for protection of the beneficial uses of Victoria's waterways throughout the Port Phillip Bay catchment with Council identified as a responsible authority (EPA, 2012). Of particular relevance to stormwater management and the protection of receiving waters are:

- Responsibilities for councils (Clause 17): outlining council's role in 'protecting surface waters through a number of responsibilities, including stormwater, floodplain, drainage, and vegetation management, domestic wastewater management including septic tank approvals, local road management and land use planning.'
- Urban stormwater (Clause 46): ensuring stormwater does not impact on water quality. Specific reference to the Urban Stormwater Best Practice Management Guidelines is made.
- Unsealed roads (Clause 57): ensuring unsealed roads do not impact on stormwater runoff quality.
- On-site domestic wastewater (Clause 32): ensuring the necessary planning, approvals and monitoring occurs to minimise the transport of nutrient and pathogen and other pollutants to groundwater and surface waters.

The Urban Stormwater Best Practice Environmental Management Guidelines (Victoria Stormwater Committee, 1999) establish stormwater quality objectives to help determine the level of stormwater management necessary to meet the State Environment Protection Policy (SEPP - Waters of Victoria) objectives. The performance objectives are based on the expected improvement required to meet SEPP objectives that could be achieved by best practice treatment measures at the time (essentially wetlands). SEPP (Waters of Victoria) requires that runoff from urban and rural areas must not compromise the identified beneficial uses of the receiving waters.

Several provisions of SEPP (Waters of Victoria) specifically refer to stormwater pollution and require that measures be implemented to control its environmental impact (Victoria Stormwater Committee, 1999, p. 12). The SEPP identifies Council as an authority with a range of responsibilities. These include planning and approval of sustainable land use and urban stormwater. Council should seek to ensure that land use planning decisions consider the capability of the land to sustain the use and improve stormwater management.

In 2006, Clause 56.07-4 was introduced into the Victoria Planning Provisions (VPP) requiring integrated water cycle management (IWCM) provisions relating to residential subdivision. Compliance with the Best

Practice stormwater quality treatment objectives (BPEM) was mandated for all residential subdivisions (2 lots and greater). These targets require the following reductions in typical urban stormwater pollutants:

- 80% reduction in total suspended solids (TSS)
- 45% reduction in total phosphorus (TP)
- 45% reduction in total nitrogen (TN)

In 2009, the Bayside Planning Scheme Amendment C44 introduced Clause 22.10 – Water Sensitive Urban Design (Stormwater Management) Policy into the Bayside Planning Scheme to establish similar requirements development outside of the requirements of Clause 56.07. Similarly, in 2014 Moonee Valley Planning Scheme Amendment C108– Water Sensitive Urban Design (Stormwater Management) was introduced. Several other local governments have introduced local planning scheme amendments in line with Moonee Valley City Councils C108 (Port Phillip, Yarra, Stonnington and Melbourne). These amendments apply similar BPEM Guideline objectives to:

- New buildings
- Extensions to existing buildings which are 50 square meters in floor area or greater
- Subdivisions in a business zone.

The requirement for non-residential developments to include WSUD is not mandated by state planning (though would likely be required to comply with SEPP requirements). Currently, only Hume City Council requires WSUD in industrial developments (Amendment C134). This Policy requires compliance with the Best Practice objectives defined in the Victorian Urban Stormwater Best Practice Environmental Management (BPEM) Guidelines.

The Department of Land, Water, Environment and Planning is currently reviewing the SEPP and the Urban Stormwater Best Practice Environmental Management (BPEM) Guidelines. The SEPP review aims to ensure (DELWP, 2016):

- water quality objectives reflect current science and changes to national guidelines, community aspirations and to respond to key threats on the water environment, particularly in Gippsland Lakes;
- rules for decision-makers and industry obligations are streamlined to reflect current policy and risk-based approaches to regulation, and improve implementation and accountability;
- alignment with, and support for, delivery of current government policy and programs. For example, Murray-Darling Basin Plan, Victorian Waterway Management Strategy, and Gippsland Lakes Environmental Strategy; and
- delivery of a single SEPP that covers all waters of Victoria, including groundwater and surface water.

The BPEM review will consider refining the stormwater quality treatment objectives and potentially introducing new objectives (such as flow management objectives) and requirements for compliance.

The *Building Amendment Act 2011* refined the definition of the Building Code of Australia to include the National Construction Code Series (Volume 1, 2 and 3). This consequently introduced the requirement for all single dwellings, renovations, alterations and additions to comply with the six star standard. Six star includes a water conservation requirement and an option to install a rainwater tank or alternatively a solar hot water system. The uptake of rain water tanks reduces the volume of stormwater runoff (and pollutants) conveyed from private properties, reducing requirements for downstream treatment.

Greening the West (2016) is a collaborative strategy to improve urban green space, enhance liveability and deliver positive social outcomes for the western region of Melbourne. Urban greening improves liveability and provides many health, environmental and economic benefits. The strategy is facilitated by City West Water with a focus on creating green spaces for health and wellbeing and will be targeting the most at risk areas. Key drivers include:

- Improve physical health by creating opportunity for physical activity.
- Mitigate against climate change and reduce heat related illness.
- Improve metal health by creating healthy environments.
- Provide a more liveable environment for all the western suburbs.

The plan outlines a series of goals, targets and principals for action. Alternative water supplies and specifically the use of stormwater through harvesting from urban catchments reduces the impact on receiving waters and provides a source of water for irrigation of public urban spaces and urban greening. Targets include a 25% increase in supply of alternative water for irrigating green space by 2030, a doubling of tree canopy cover by 2050 and a 25% increase in green space by 2030.

Plan Melbourne was released in May 2014, the city planning strategy outlines measures to support jobs, improve services and transport and identifies future growth areas. The Plan Melbourne Refresh focuses on climate change, energy efficiency, housing affordability and diversity. The Refresh is required to help provide a long term viable strategy to manage Melbourne's growth, it also provides the Victorian Government with an opportunity to (Victorian State Government , 2016):

- show updated transport commitments and priorities, including the Melbourne Metro Rail Project
- show progression on Plan Melbourne initiatives and actions
- recognise new entities and governance changes, such as Infrastructure Victoria.

The Plan Melbourne Refresh consultation period has been completed, the final report and incorporation of its findings into planning schemes scheduled for 2016.

Wyndham City Council

Municipal Local Laws provide a means for Council to undertake compliance activities (such as infringement and penalty notices). In terms of water management this typically applies to Building and Work Codes of Practice for sediment and litter controls from building sites. In November 2015 Wyndham City Council's new Community Amenity Local Law (2015) came into effect. This Local Law protects the amenity of the City and the safety of all those who come to be in it. These local laws cover many aspects

of daily life such as keeping footpaths and walkways clear of clutter, managing the impact of building sites, and ensuring parks and reserves are safe and pleasant.

Local Law 43 specifically relates to the management of stormwater on building sites. It stipulates that "[w]here any building work is being carried out on any land, the owner of the land, the builder engaged to carry out building work on the land or the appointed agent must ensure that the building site is developed and managed to minimise the risks of stormwater pollution, through the contamination of run-off by chemicals, sediments, animal wastes or gross pollutants, by adopting measures to prevent:

- mud, dirt, sand, soil or stones being deposited on an abutting road or being washed into the stormwater system; and
- building clean-up, wash-down or other wastes being discharged offsite or being allowed to enter the stormwater system." (WCC, 2015, pp. 19-20)

Furthermore, Local Law 45 requires builders to ensure that during building work no refuse is deposited in or over any part of the stormwater system (WCC, 2015, p. 20).

Local Laws relevant to litter management in Wyndham include:

- 66 – Which requires owners of vacant land located in a *Business Zone, Industrial Zone* or *Residential Zone* to keep their land clear of rubbish or litter (WCC, 2015, p. 26).
- 186 – Which stipulates that a person must not deposit into any street litter bin any green waste or trade or commercial waste (WCC, 2015, p. 26).
- 194 – Which empowers Council to require an owner or occupier of land used primarily for commercial purposes to prepare a Waste Management Plan and not cause or allow any waste to be collected from the land other than in accordance with that plan (WCC, 2015, p. 59).

Implementation and enforcement of these Local Laws is subject to funding and resourcing constraints. Improved enforcements could make a significant contribution towards improved stormwater management across Wyndham's building sites. While it is difficult to quantify sediment and litter loads from building sites it is recognised that they can be a significant contributor of sediment loads, blocking drains and adversely impacting upon waterways. Given the scale of development forecast in Wyndham adequate sediment and litter control on building sites is critical to the preservation of aquatic and social waterway values.

Wyndham's City Plan 2013-17 updates the original City Plan which sets out Council's objectives and strategies to support Community Wellbeing. This includes improvements and necessary actions to four priority areas as identified by the community: transport, services, parks and recreation and city image and public safety.

The Wyndham Community Health, Wellbeing & Safety Plan 2013-2017 provides a blueprint for health and wellbeing of Wyndham. It focuses on the following five priority areas:

1. Planning and building for long-term community health and wellbeing – *A City Built for Health, Wellbeing and Safety*

2. Giving babies and children the best start in life – *A City for the Best Start in Life*
3. Being confident to move freely around Wyndham City and to feel safe and secure in our homes – *A Safe and Confident City*
4. Creating a resilient community that supports good mental health and emotional wellbeing – *An Inclusive and Resilient City*
5. Strengthening the health of our community by overcoming risk factors that contribute to preventable chronic illnesses – *An Active and Healthy City*

The plan also supports a number of key strategic documents including the City Plan and the Wyndham Planning Scheme.

Wyndham's Environment and Sustainability Strategy 2016 - 2040 (WCC, 2016) addresses the key issues for the municipality and focuses on achieving a more sustainable future. The Strategy focuses key areas related to Greenhouse gases and energy, Water Consumption, Waste, Biodiversity, Food and Food Production, Monitoring, Education, Communication and Reporting as well as Future Directions/Planning.

Climate Change Adaption Strategy 2016 – 2020 details Council's climate change risk management response. It responds to Wyndham's priority climate change risks and existing gaps, and also seeks to establish a culture of organisational learning to feed into future Council work. The following five themes are identified in the strategy:

- Managing water use and urban heat reduction
- Empowering a resilient community
- Protecting our biodiversity
- Building climate resilient infrastructure
- Establishing adaptation excellence.

The Wyndham Open Space Strategy 2045 is the key council document used to determine priorities for the planning, provision and development of open space across the municipality. It addresses the open space needs of the existing community and plans for future growth by anticipating the needs of future populations. The strategy vision is for the provision of accessible and well-connected open space network which contributes to the social interaction, health and wellbeing of Wyndham's community and protection of its natural and cultural environment now and into the future. The identification and implementation of alternative water sources for irrigation and the provision of open space corridors and adequate floodplains and stormwater buffers around waterways or wetlands or along railway corridors are important water management issues that are touched on within the strategy.

Wyndham City Council's Waste and Litter Strategy 2016-2040 sets out a long term vision for waste in Wyndham. The strategy shifts the focus from waste management to resource management by concentrating that relate to waste avoidance, reduction, reuse and recycling. The strategy also includes litter as a key topic for Wyndham and its community.

The Wyndham Stormwater Management Plan 2015 provides a review of all existing systems and processes currently in place at Wyndham City Council that relate to stormwater management and Water

Sensitive Urban Design (WSUD) practices. The plan identifies the following areas of focus for improved water quality, biodiversity and local fauna and flora:

- Determining the state and locations of all existing stormwater, drainage and WSUD assets.
- Improved asset management and asset maintenance.
- Improved education of the local community as well as capacity building for Council officers.

The Water Action Plan 2015- 2020 establishes Wyndham City's direction on water conservation and alternative water use for Council facilities and operations over the next five years. The Plan's vision is: To improve the resilience of Council's operations to drought and climate change through improved water use efficiency and use of alternative water sources. The Plan's Objectives are to:

- Maintain and improve water use efficiency of key water use areas
- Increase the use of alternative water sources across council buildings and open space

The actions developed in the plan are based on a hierarchy of avoiding and reducing water use as a first priority, followed by re-using and recycling water with the aim of minimising the use of potable water where other fit for purpose water sources are available.

WCC have also prepared a report on the Health of the Werribee River (2015) in response to growing concerns regarding the health of the Werribee River for Council and the community. The report focuses on Werribee River's lower reaches, (downstream of the Division Weir at River Bend Park Werribee to the river estuary), but also discusses some upstream factors that may contribute to the River's condition. Outcomes from the report include an action plan devised by Council officers, Melbourne Water (MW), the Werribee River Association (WRA) and a representative from the office of local Member for Werribee.

Wyndham City Council has also developed a Guidelines and Standards Manual for the preparation of Site Environmental Management Plans (SEMP). SEMPs are documents that detail the potential environmental impacts of a proposed development and the ways in which these impacts may be reduced through management strategies and site practices. Components of the guidelines relevant to Wyndham's IWCM Plan include:

- Section 6: Erosion and Sediment Control Standards
- Section 8: Waste Control Standards
- Section 9: Significant Flora and Fauna Protection Standards

Table 17 Summary of existing Council documents and their interrelation with IWCM outcomes

Document	**Document components that relate to IWCM and can be used to support the vision, objectives, target and actions identified in this Plan.**	**Recommendations for future actions (including inclusions for document updates) and general comments.**
Integrated Budget and Plan 2016/17	• Initiative #29: Implement the Stormwater Management Plan, including the development of local guidelines for use by Council and developers to model proposed water sensitive urban design drainage systems. • Initiative #30: Complete a coastal erosion assessment for Wyndham's coastline to inform the new coastal strategy to guide future land use. • Initiative #32: Implement actions from the new Environment and sustainability Strategy • Initiative #33: Commence Council's 30 year Open Space Strategy to provide a well-connected open-space network and improved access for all to adequate open-spaces. • Initiative #34: Advocate for improved water quality and security to support farming in Werribee South	Very few actions identify the role of water in delivering the broad outcome that Council are seeking to achieve. This needs to be strengthened with links explicitly identified.
Wyndham City Council Biodiversity Policy 2014	Wyndham City is committed to: • 1.1 Retain, maintain, manage and enhance biodiversity within areas of its control • 1.2 Mitigate threats to biodiversity • 1.5 Recognise that in an increasingly fragmented environment, planted and natural vegetation in urban areas play an important role in habitat connectivity between our natural reserves • 1.6 Retaining existing and reconnect fragmented biodiversity corridors where possible, including to neighbouring municipalities • 2.3 Value and protect its biodiversity and ensure habitat quality and vegetation quantity within Wyndham is maintained and enhanced where possible • 2.5 Discourage and critically assess development proposals which will disrupt ecological functions based on habitat connectivity with other natural areas and value at both landscape-scale and a localised context • 2.6 Critically assess permits to remove native vegetation with a view of achieving the best possible biodiversity outcomes and no net loss in accordance with the current native vegetation regulations • 2.8 Advocate for Wyndham's future growth, land use, land zoning and urban design to be sympathetic to existing natural areas and habitat corridors • 2.9 Strategically secure local land for conservation of local ecosystems, focussing on linking existing biodiversity sites and conserving high quality flora, fauna and ecosystems. • 3.1 Improve community understanding of biodiversity, including the importance of biodiversity at a local, regional, state and national context • 3.5 Encourage community ownership, pride and respect of conservation areas. • 4.2 Develop partnerships for regional biodiversity projects and activities to create most efficient use of resources • 4.5 Engage the community to promote a shared understanding of biodiversity values, benefits and its importance. • 5.3 Report regularly to Council and the community on the condition of Wyndham's biodiversity	The clear link between the importance of water and its relationship to support healthy vegetation are not articulated. Changes to the urban water cycle have significant impacts on biodiversity (impacts on infiltration volumes, ground water recharge etc.). Biodiversity associated with green blue assets are being increasingly recognised as important attributes that contribute to linking patches of biodiversity areas/habitats as well as their contribution to biodiversity in their own right. Wyndham City manages a number of reserves and open spaces which contain examples of Wyndham's key natural systems – grasslands, waterways, wetlands and coast. These conservation reserves and natural areas are managed across multiple departments, and many are best ecological sites within the municipal boundary. To maintain their values, Wyndham must undertake informed, dedicated and strategic biodiversity management.
Wyndham East District Plan 2015-2019	• Implement strategies to reduce illegal rubbish dumping.	Develop IWCM actions and opportunities in response to district specific objectives as identified in this plan and follow up consultation.
Wyndham West District Plan 2015-2019	• Create a greater focus on the health of our waterways in particular the Werribee River, specifically for environmental flows, litter prevention and monitoring. • Support local environment groups to look after local waterways and other natural assets.	Develop IWCM actions and opportunities in response to district specific objectives as identified in this plan and follow up consultation.
Wyndham Central District Plan 2015-2019	• Develop a Volunteering Strategy to include new ways to volunteer. • Continue to raise the profile of volunteering in Wyndham. • Deliver the Community Training Calendar to support volunteer organisations. • Create new volunteer-led programs with community. • Provide networking opportunities for people interested in volunteering and leadership.	Develop IWCM actions and opportunities in response to district specific objectives as identified in this plan and follow up consultation.
Wyndham Rural District Plan 2015-2019	• Explore the development of a fresh food hub that supports Wyndham's agricultural precinct. • Advocate for the upgrade of the water delivery system within the Werribee South Irrigation District. • Create a greater focus on the health of waterways in particular the Werribee River, specifically for environmental flows, litter prevention and monitoring	Develop IWCM actions and opportunities in response to district specific objectives as identified in this plan and follow up consultation.

Document	**Document components that relate to IWCM and can be used to support the vision, objectives, target and actions identified in this Plan.**	**Recommendations for future actions (including inclusions for document updates) and general comments.**
Wyndham City Council Environment & Sustainability Strategy 2016-2040	Short term (2020) and long term (2040) targets related to: • 1.4 Planning Controls and Growth • 1.5 Urban Ecology • 1.7 Community Engagement • 2.1 Coast • 2.2 Land Management • 2.3 Biodiversity • 2.4 Litter • 2.5 Waterways • 3.2 Integrated Water Management • 3.3 Environmentally Sustainable Design (ESD) • 3.5 Climate Change Adaptation	This is an important strategic document that set the environmental agenda for the municipality until 2040. Recommended additions include: • Refine the 2040 target of servicing 100% of Council's non-potable demands with alternative water sources. It is recommended that this target be changed to 100% of Council non-potable demands connected to an alternative water supply. This acknowledges systems will be sized economically, and stormwater harvesting schemes will typically meet 70 – 80% of demand with potable top-up accepted during prolonged dry periods. • Highlight the need for fit-for-purpose water supply as part of actions related to increase greening (e.g. passive irrigation, tree pits and alternative water supplies). • Promote the use of local rainwater / stormwater harvesting to support productive landscapes (e.g. community gardens and fruit trees) • Ensure water conservation and stormwater management on lots and as part of new developments is explicitly mentioned (e.g. link with Clause 56 VPP provisions relating to flow volumes and stormwater pollutants) • Expand assets to all WSUD assets • Explicitly link improvements in healthy functioning waterways to actions taken across catchments to reduce urban excess and stormwater pollutants entering waterways.

Climate Change Adaptation Strategy 2016-2020	New Adaptation Actions
	• Balancing water use and urban heat reduction
	  ○ 1. Trial urban heat mitigating actions within a council built carpark
	  ○ 2. Investigate benefits of urban cooling strategies
	  ○ 3. Develop a baseline of the tree canopy coverage in Wyndham
	  ○ 4. Partner with government and other agencies on a regional approach to mitigate climate change
	• Empowering a resilient community
	  ○ 5. Engaging with our community on climate change
	  ○ 6. Further embed climate change considerations in the revised Municipal Health, Wellbeing and Safety Plan
	  ○ 7. Improve the targeting of communication with the community before, during and after emergency events
	• Protecting our biodiversity
	  ○ 8. Build a series of biodiversity corridors for flora and fauna to migrate and to reconnect fragmented habitats.
	  ○ Building climate resilient infrastructure
	  ○ 9. Council vegetation corridor mapping exercise and draft rolling program for vegetation enhancement
	• Building climate resilient infrastructure
	  ○ 10. Investigate top priority buildings for opportunities and plan for increase tree plantings around buildings
	  ○ 11. Completion of an integrated water cycle management Plan
	• Adaptation excellence
	  ○ 15. Monitoring climate change and adaptation actions effectiveness
		Update action for trailing urban heat mitigating actions within council built carparks to include opportunities for passive irrigation of landscapes and multiple benefits through the inclusion of WSUD treatments.

Wyndham Stormwater Management Plan 2015	All actions in the Stormwater Management Plan are key to the delivery of IWCM and a Water Sensitive City.	Fund, monitor and report against implementation of the actions in the Stormwater Management Plan. In particular fund the IWCM officer position identified in the Stormwater Management Plan and continue to reinforce Councils endorsement of wetlands as the preferred WSUD treatment in new developments.
Wyndham City Council Water Action Plan 2015-2020	All targets and actions in the Water Action Plan are key to the delivery of IWCM and a Water Sensitive City.	Continue to monitor and report against Wyndham's water use targets in the Water Action Plan, update these targets periodically to reflect best practice. The current target for water use per residents should be updated to only include potable water use. This will help focus on reductions in potable water use whilst allowing for increases in alternative water use. Update to communicate a more nuanced approach to water management that includes potable reduction and conservation but also expands to consider the use of alternative water resources for improved liveability. Update to encourage rain/grey water harvesting and reuse on private properties.
Waste and Litter Strategy 2016-2040	• 2020 Target: Completion of an audit of all gross pollutant traps (GPT's) within the municipality, measuring the design, maintenance and source of litter for each outlet • 2020 Target: 25% reduction in litter at 15 regularly monitored locations including rural, urban, industrial, developing, waterways and coastal areas	Reconcile/consolidate these targets with the litter targets in the Wyndham City Council Environment & Sustainability Strategy 2016-2040.

Document	Document components that relate to IWCM and can be used to support the vision, objectives, target and actions identified in this Plan.	Recommendations for future actions (including inclusions for document updates) and general comments.
	• 2040 Target: Waterways and beaches to be free from litter • 2040 Target: Have functioning and well serviced litter abatement systems on all stormwater outlets across the municipality	
Site Environmental Management Plan (SEWP) Guidelines and Standards Manual	Ensure compliance with: • Section 6: Erosion and Sediment Control Standards • Section 8: Waste Control Standards • Section 9: Significant Flora and Fauna Protection Standards	Improve enforcement of these standards.
Wyndham City Council State of Environment Report 2014-15	n/a	Update reporting requirements to create strong links with the vision and objectives of this IWCM Plan. Consider broad outcomes that go beyond water conservation (e.g. improved water quality, fit-for-purpose supply, flood protection, urban greening and improved biodiversity)
Werribee South Green Wedge Policy and Management Plan - Exhibition Version 2016	Parks, Coast, Waterways and Wetlands Objectives: • To manage the effects of peripheral urban development to ensure that significant environmental assets within the precinct are not detrimentally impacted upon. • To protect and enhance sites of environmental significance on public and private land within the Green Wedges. Werribee South Coastline Objectives: • To protect, manage and enhance the identified coastal values of the Werribee South coastline. • To protect and enhance the Werribee South coastline for environmental, recreational and tourism purposes. • To protect private land and the right to farm along the Werribee South coastline. • To manage the interface and minimise conflicts between activity in public coastal areas and activity in adjoining private agricultural and domestic areas. Wetland and Waterway Further Work: • Establishment of a program to accurately and regularly monitor salinity at ground water discharge sites • Development of a comprehensive system to monitor water quality and bank condition of Green Wedge waterways and coastline, including further training for community groups • Establishing a coordinated approach to weed removal and re-vegetation along Green Wedge Waterways, including further training and support for community volunteers • Monitoring and review of environmental flow requirements of Werribee and Little Rivers • Application of best practice agricultural run-off management • Encourage the investigation of a more cost effective and sustainable application of water to irrigated crops. • Advocate for access to quality, cost effective water. Coast Management Further Work: • Development of long term strategies aimed at improving water quality in the channels and drainage lines which flow into the Bay, waterways and natural wetlands. • Investigate mechanisms to protect and enhance the Werribee South Coastal Reserve and adjoining agricultural land. • Development of a Coastal Strategy for Wyndham in conjunction with other key stakeholders. • Revegetation activities along the Werribee South coastline to stabilise ground, increase indigenous coastal vegetation coverage, provide habitat and increase amenity and recreation values • Investigation into the application of a Significant Landscape Overlay (SLO) to protect the landscape values of the Green Wedge coastline Intensive Agricultural Precinct Objectives: • To preserve agricultural areas within the Werribee South green wedge. To protect agricultural land from incompatible land uses and promote the continuation of farming and its viability within the local economy. • To broaden the range of agricultural uses possible within the area and the conditions under which diversification may take place. • To separate agricultural land uses and activities from residential, commercial, and industrial development and facilities, and where necessary, provide buffer land uses. • To provide and advocate for the provision of infrastructure and services that are sufficient to support sustainable agriculture	n/a

The Werribee Irrigation District (WID)

The WID receives its gravity-fed irrigation supply from storages at Pykes Creek, Merrimu Reservoir and Melton Reservoir. In 2004, following several years of extreme drought, the WID Recycled Water Scheme was implemented to supply Class A water from the Western Treatment Plant to irrigators. The environmental requirements for the supply and use of recycled water within the WID is regulated by the Regional Environment Improvement Plan developed by Melbourne Water and Southern Rural Water in collaboration with the Victorian EPA and other agencies. The plan includes requirements related to water quality and the monitoring and reporting of river, recycled and groundwater and soil quality.

The district is currently located within one of Melbourne's Green Wedge zones and the existing Werribee South Green Wedge Policy and Management Plan recognises and supports the continuation of irrigated agriculture in the WID precinct. Consequently, it is expected that the district will continue with agriculture production until at least 2030 (SRW, 2009). However, there are many pressures on growers in Werribee South, including the increasing cost of production, uncertainties of the security of water supply in changing climatic conditions and poor water quality (WCC, 2016).

Figure 43 Irrigation in the Werribee Irrigation District (WID) (WCC, 2016)

WCC has been meeting regularly with growers in Werribee South who have raised a number of significant concerns regarding their future sustainability (WCC, 2016). In response, Council have supported growers in the WID by advocating to the state government for the:

- Protection and enhancement of the WID.
- Simplification of the water entitlements regime.
- Modernisation of irrigation infrastructure.
- Improvement and enhancement of alternative water supplies, particularly recycled water quality and salinity.

Furthermore, Council conducted an analysis of the constraints and opportunities for improved stormwater management within the Werribee South region as part of its recent Stormwater Management Plan (WCC, 2015). The Plan includes concepts for potential Water Sensitive Urban Design (WSUD) implementation as well as road map of the features and programs required to achieve improved water quality treatment in the area.

Catchments and waterways

The Werribee River Basin

The Werribee River Basin extends from Blackwood in the north to Port Phillip Bay in the south, covering over 2715 km^2. The basin is dominated by basalt plains, with landscapes ranging from steep-sided hills and gorges to flat plains. Agriculture has become the dominant land use with forestry occurring in the upper parts of the catchment and only one-quarter of natural vegetation remaining. Wyndham City Council is located in the lower reaches of the basin, an area where future urban development presents major challenges for waterway health and careful planning is required to strike a balance between environmental, economic and social outcomes.

Local catchments, Ramsar wetlands and marine sanctuaries

Within Wyndham the Werribee River Basin splits into five primary catchments, including Little River, Werribee River, Skeleton Creek, Laverton Creek and a small portion of Kororoit Creek. These five primary catchments consist of eight major catchments and over 100 sub-catchments. All of these catchments discharge into Port Phillip Bay. The bay is a popular recreational destination, an important economic asset and a dynamic and self-sustaining ecosystem with significant environmental values.

The internationally significant Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site is located at the mouth of Little River, Lollypop Creek and Skeleton Creek. The site contains a diverse range of aquatic ecosystems, including shallow and marine waters, seasonal freshwater swamps and extensive artificial lakes (DNRE and Parks Victoria, 2002).

The site is recognised for the quality of its natural wetlands and the large numbers of waterbirds supported by both its natural and artificial wetlands. The site also provides important drought refuge for waterbirds when inland lakes and wetlands dry out and winter feeding habitat for up to 50 per cent of the global population of the nationally critically endangered Orange-bellied Parrot (Department of Environment, Land, Water and Planning, 2014).

The Port Phillip Bay and Bellarine Peninsula Ramsar Site also contains the nationally important Werribee-Avalon wetland at the mouth of Little River and Lollypop River. This wetland includes the Western Treatment Plant and is one of Australia's most important wetlands for waterbirds. This area also overlaps with the nationally important Point Cook and Laverton Saltworks wetland and the Point Cooke Marine Sanctuary at the mouth of Skeleton Creek. This stretch of coastline consists of rocky shoreline, sandy beaches and intertidal mudflats. It also contains wetlands of high value due to their ecological, recreational, scientific, educational and cultural features (Department of the Environment, 2010).

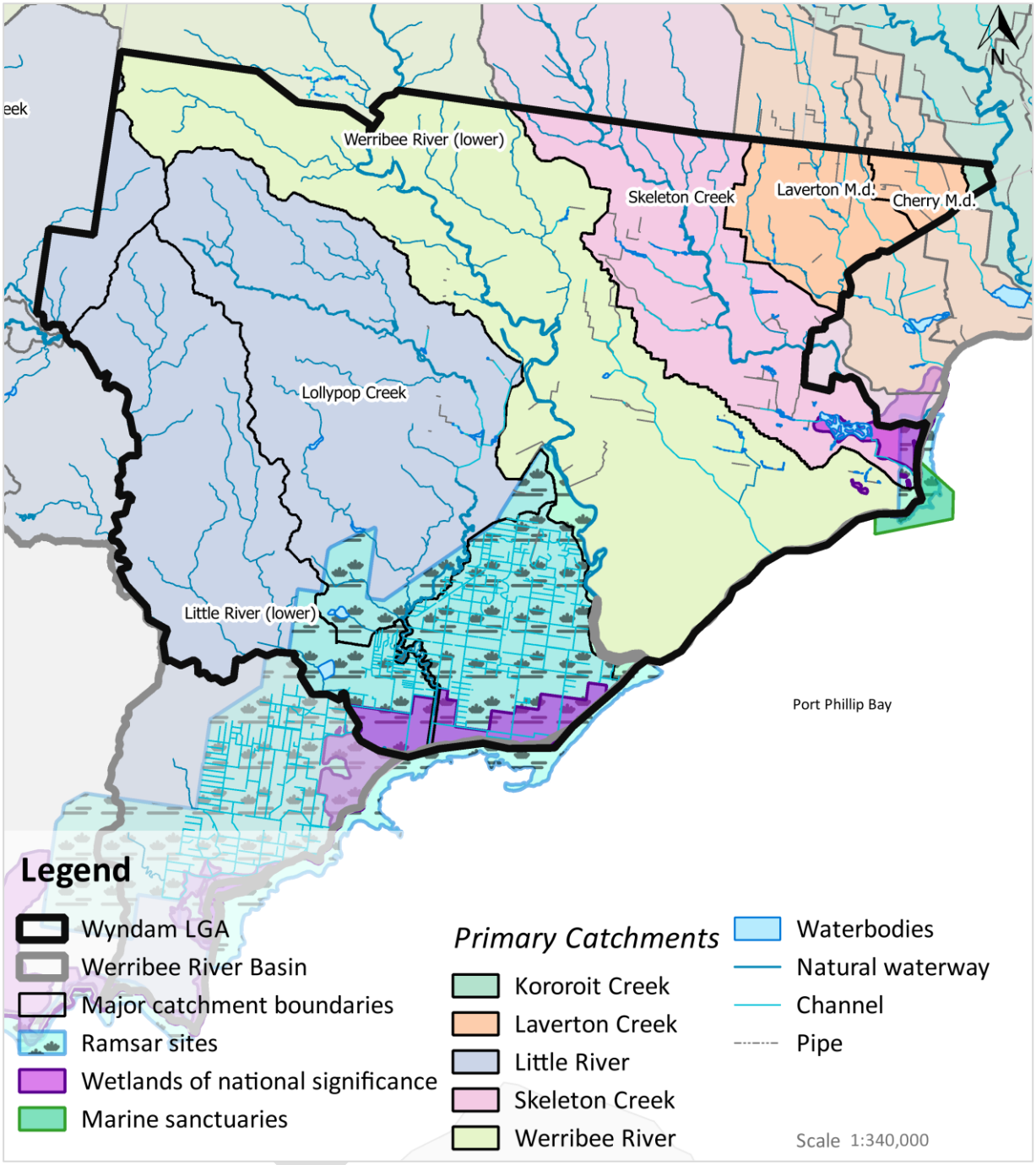


Figure 44 Wyndham's local catchments, Ramsar wetlands and marine sanctuaries

Local waterways

The Port Phillip and Westernport CMA and Melbourne Water have assessed the value of several waterways across Wyndham (Figure 46, p92). This work identifies the Werribee River as a key asset. In particular, the section of the river that runs from Mount Cottrell to Heaths Road in Werribee is of greatest value. This stretch of waterway is recognised as:

- A priority river by the Port Phillip and Westernport CMA based on a combination of environmental, social and economic values.
- A river of very high significance by Melbourne Water based on the Index of River Condition.[4]

The land within Wyndham that discharges into this stretch of the Werribee River is dominated by agricultural land uses. This creates a risk of high nutrient loads entering the waterway. However, urbanisation presents the greatest risk to waterway health as large segments of the surrounding area are flagged for urban growth.

Development in the northern part of Wyndham around the Riverdale PSP will also impact the downstream reaches of the Werribee River between Heaths Road and Port Phillip Bay. This section of waterway is still of moderate significance and contains a variety of threatened flora and fauna (Melbourne Water, 2009).

In 2015 WCC released the Health of the Werribee River report. This report showed:

- Declining platypus numbers.
- Water quality ranging from fair in the upper reaches, to very poor in the lower reaches.
- Outbreaks of Azolla weed and algae.
- Decreasing monthly water volumes, and
- 50,000 pieces of litter recorded in a recent survey.

Figure 45 Werribee River (Melbourne Point, 2015; City West Water, 2016)

[4] The Priority Rivers 2008 dataset was derived from Regional River Health Strategies (RRHS) developed by Catchment Management Authorities. The RRHSs use a tool called RiVERS to assess waterways, of which the Index of Stream Condition (ISC) is a significant information source. Given that the ISC was developed for rural rivers and creeks, it is not relevant to Melbourne Water's (MW) urban waterways. Instead, MW utilises a tool called the Index of River Condition (IRC), which was modified to account for the urban rivers and creeks in their operating area.

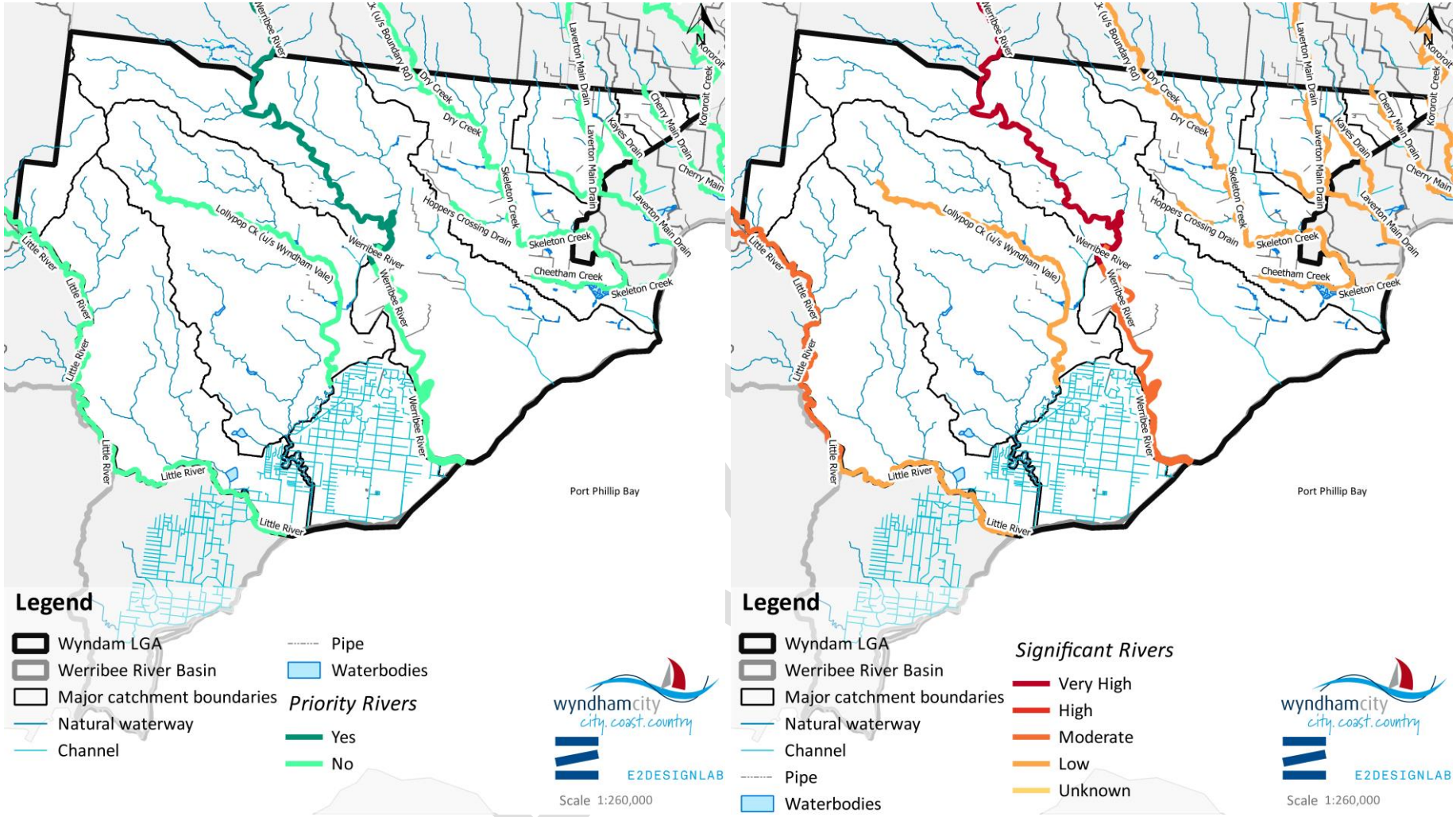


Figure 46 Priority Rivers (left) and Significant Rivers (right) in Wyndham

Little River contains stretches of waterway of moderate significance that are also impacted by surrounding agricultural land uses. These threats are unlikely to change substantially in the short term as none of this land is flagged for urban growth.

Lollypop Creek is of low significance and already impacted by urban runoff from Wyndham Vale. With over 3,800 ha scheduled for urban development, this catchment is set to undergo major transformation. This has the potential to further degrade Lollypop Creek but may also impact on the ecological function of the downstream Ramsar protected wetlands.

Skeleton Creek is of low significance, with urban development stretching from Truganina in the north to Altona Meadows and Point Cook in the south. The condition of the waterway is expected to further decline as additional development occurs in the Truganina and Tarneit North PSPs. This development will also place further pressure on the Ramsar listed sites at the mouth of Skeleton Creek.

The Laverton Creek catchment contains highly industrialised sections of Laverton Main Drain and Cherry Creek Main Drain. The waterways in these catchments are highly modified, with most reaches already piped or channelised. The Truganina Employment Precinct will be developed in this catchment, this development will be largely industrial and is likely to result in the large impervious surfaces and varied pollutants that are characteristic of the surrounding industrial areas.

Figure 47 Lollypop Creek (City West Water, 2016)

Attachment 2 – Water Balance

Rainfall

The mean annual rainfall (MAR) in Wyndham generally increases from west to east. Daily rainfall gauges with more than ten years of data show indicate a low of 442 mm/yr at Mount Cottrell and a high of 570 mm/yr at the Point Cook RAAF Academy (Figure 48). The regional MAR is 520 mm (Table 18).

Table 18 Daily rainfall gauges with more than 10 years of data

Site ID	Daily Rainfall Gauge Name	Years of Data	MAR (mm)
87089	Mount Cottrell 1	10	442
87087	Little River (Greenmeadows)	23	474
87104	Werribee Cattle Yards	25	495
87094	Werribee (Wyndham)	41	508
87066	Werribee Post Office	63	515
87105	Werribee Sewerage Farm	17	522
87031	Laverton RAAF	72	540
87032	Laverton Salines	50	541
87150	Werribee (Racecourse)	42	542
87086	Laverton Explosives	31	547
87065	Werribee Research Farm	67	548
87107	Point Cook RAFF Academy	11	569
	Regional Mean for Wyndham		**520**

For modelling purposes 6 minute rainfall data spanning ten or more years is preferred. Wyndham spans a four rainfall bands (Figure 49). However, the vast majority of existing urban development, and a substantial proportion of urban growth zones, fall within the 500 – 550 mm/yr rainfall band. The MAR in this rainfall band in Wyndham based on the 8 rainfall gauges with more than 10 years of data record is 533 mm/yr. This MAR was selected as the target mean annual rainfall for modelling. The Little River (87033) 6 minute rainfall gauge matches this MAR for the ten year period 1988 – 1997, however, there is a substantial amount of missing and accumulated data over this period (Figure 50). Consequently, the Little River time series was infilled with data from the other 6 minute rainfall gauges in the area (Table 19 and Figure 49). This resulted in rainfall data of greater quality but the same MAR (Figure 52). This 6 minute data was then compared to data from the daily rainfall gauge over the same period (Figure 52). This analysis indicates that the infilled Little River 6 minute time series rainfall gauge consistently underestimates (<5% difference) the rainfall over the period. Despite this, the infilled 6 minute Little River time series is considered to be the best rainfall data available and was selected for modelling purposes.

Table 19 6 minute rainfall gauges with more than 10 years of data

Site ID	6 Minute Rainfall Gauge Name	Site ID	6 Minute Rainfall Gauge Name
87031	Laverton RAAF	87033	Little River
87032	Laverton Salines	87105	Werribee Sewerage Farm
87104	Werribee Cattle Yards	87107	Point Cook RAAF Academy
87065	Werribee Research Farm		

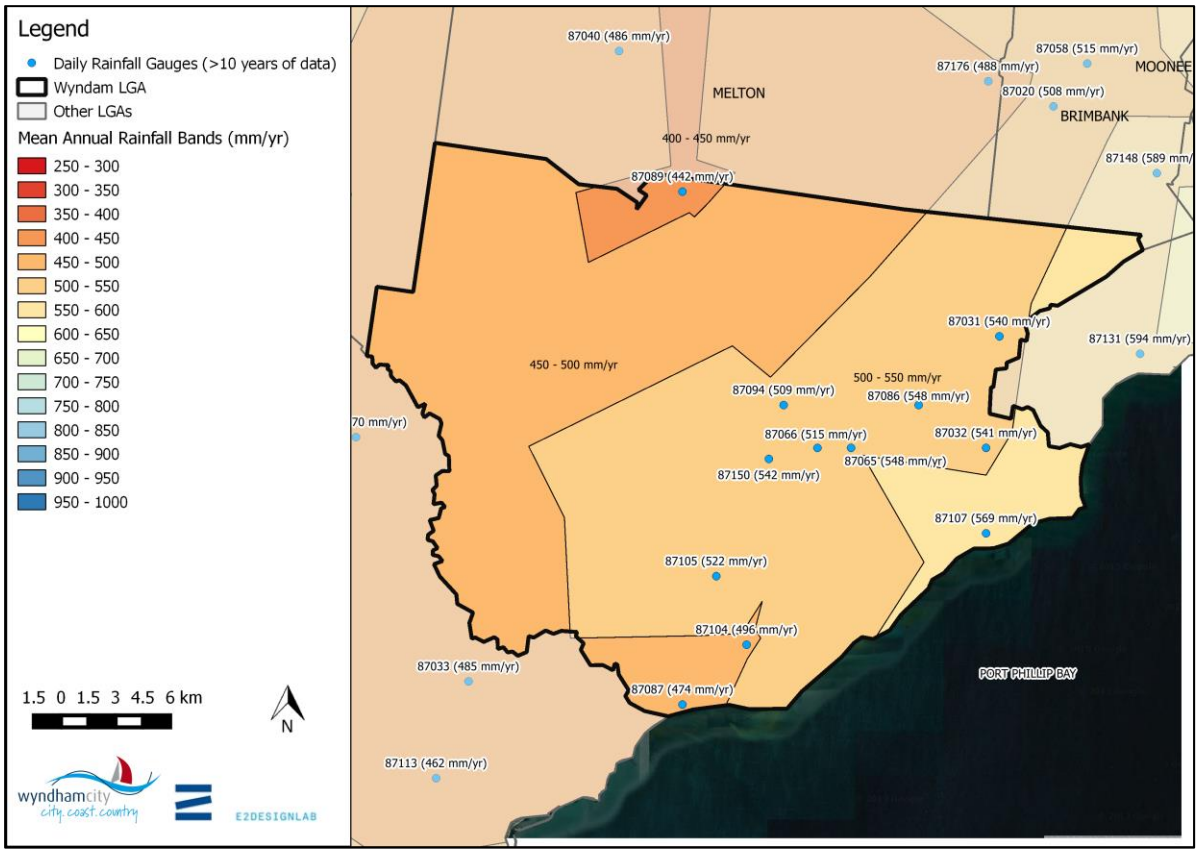


Figure 48 MAR bands and daily rainfall gauges with 10 years or more of data

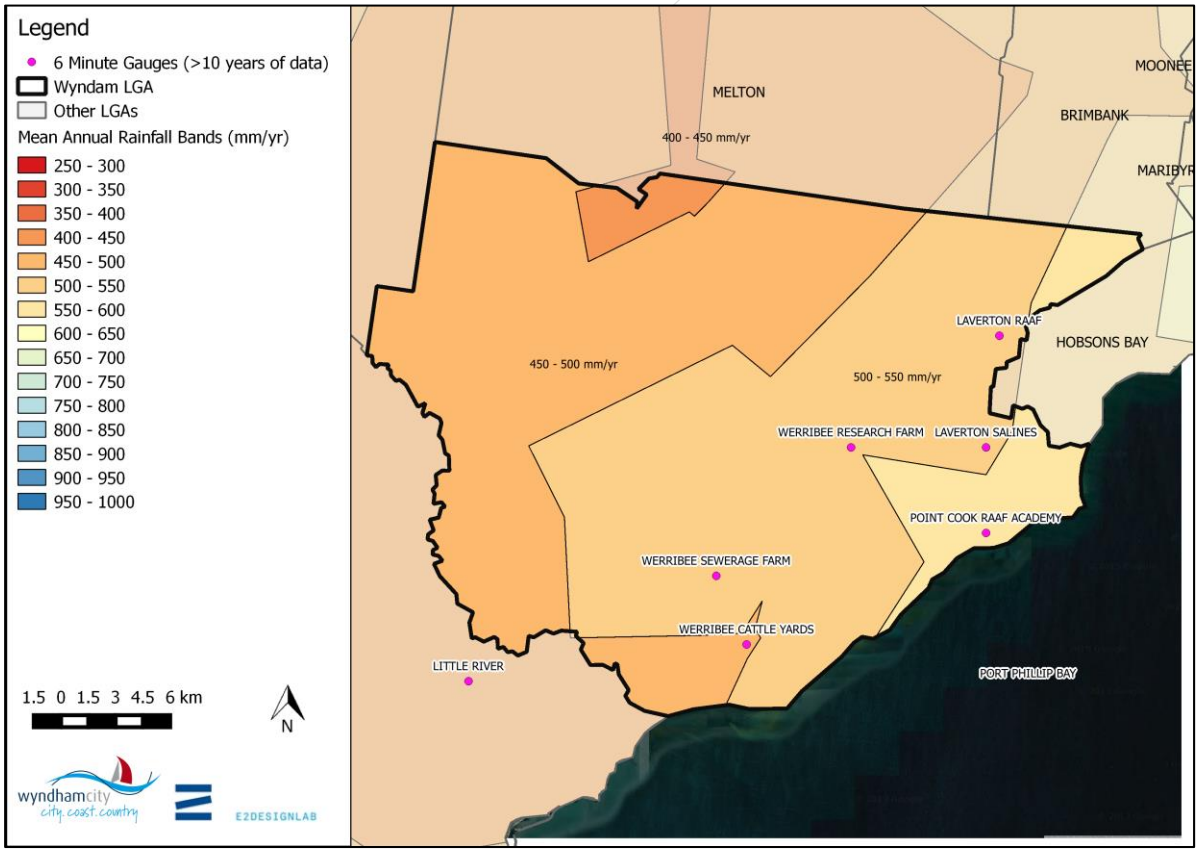


Figure 49 MAR bands and 6 minute rainfall stations with 10 years or more of data

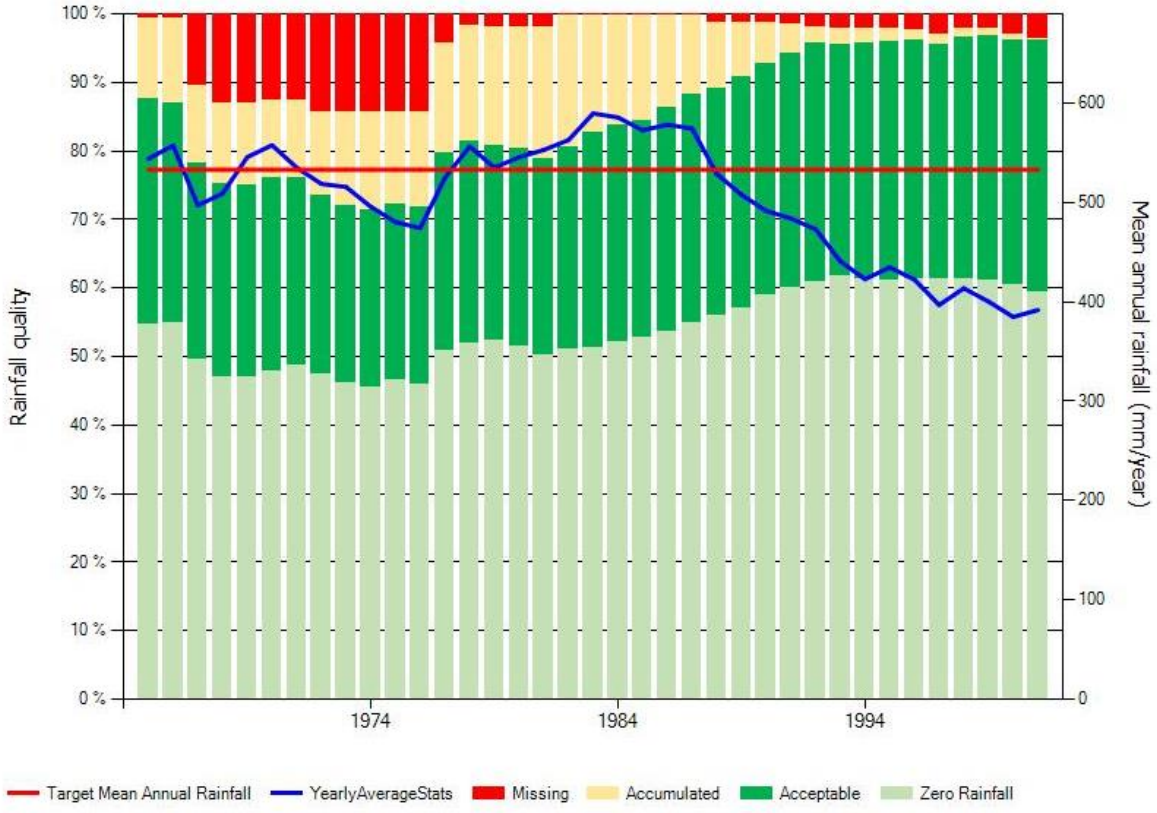


Figure 50 MAR and quality analysis for 10 year periods using the Little River 6 minute rainfall data

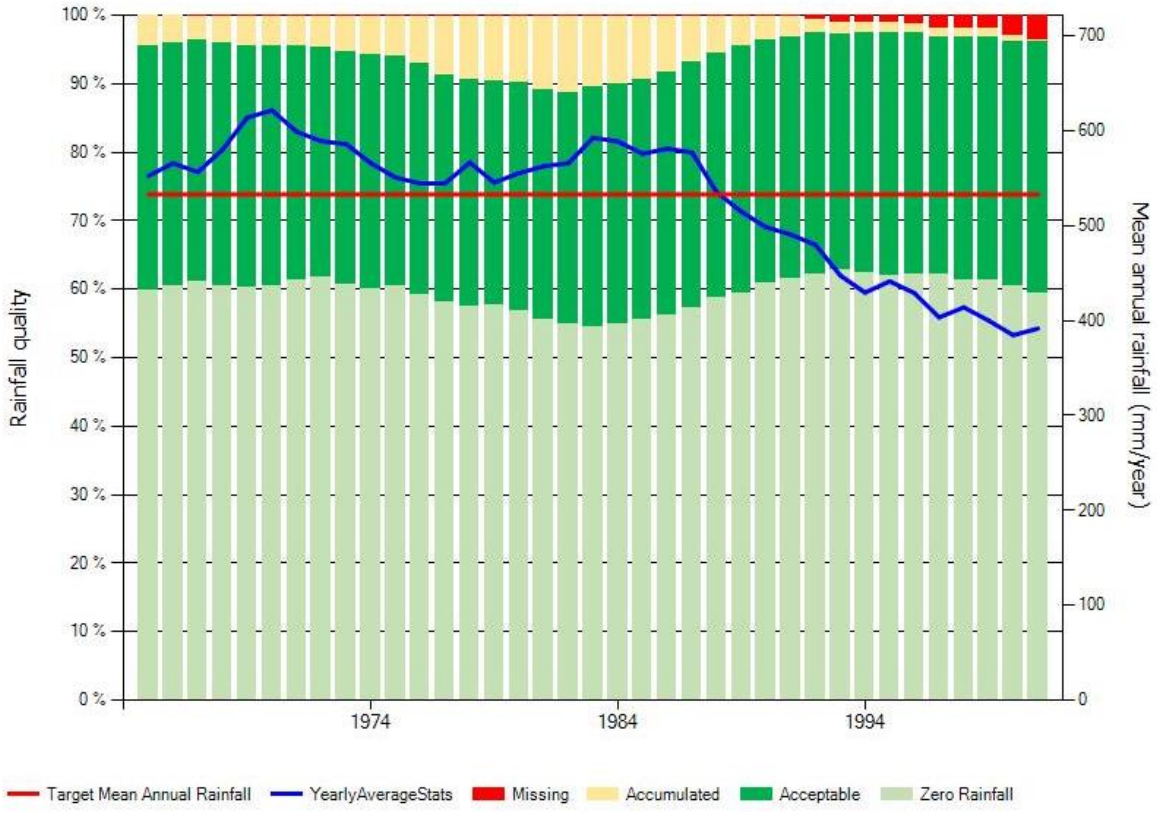


Figure 51 MAR and quality analysis for 10 year periods using the infilled Little River 6 minute rainfall data

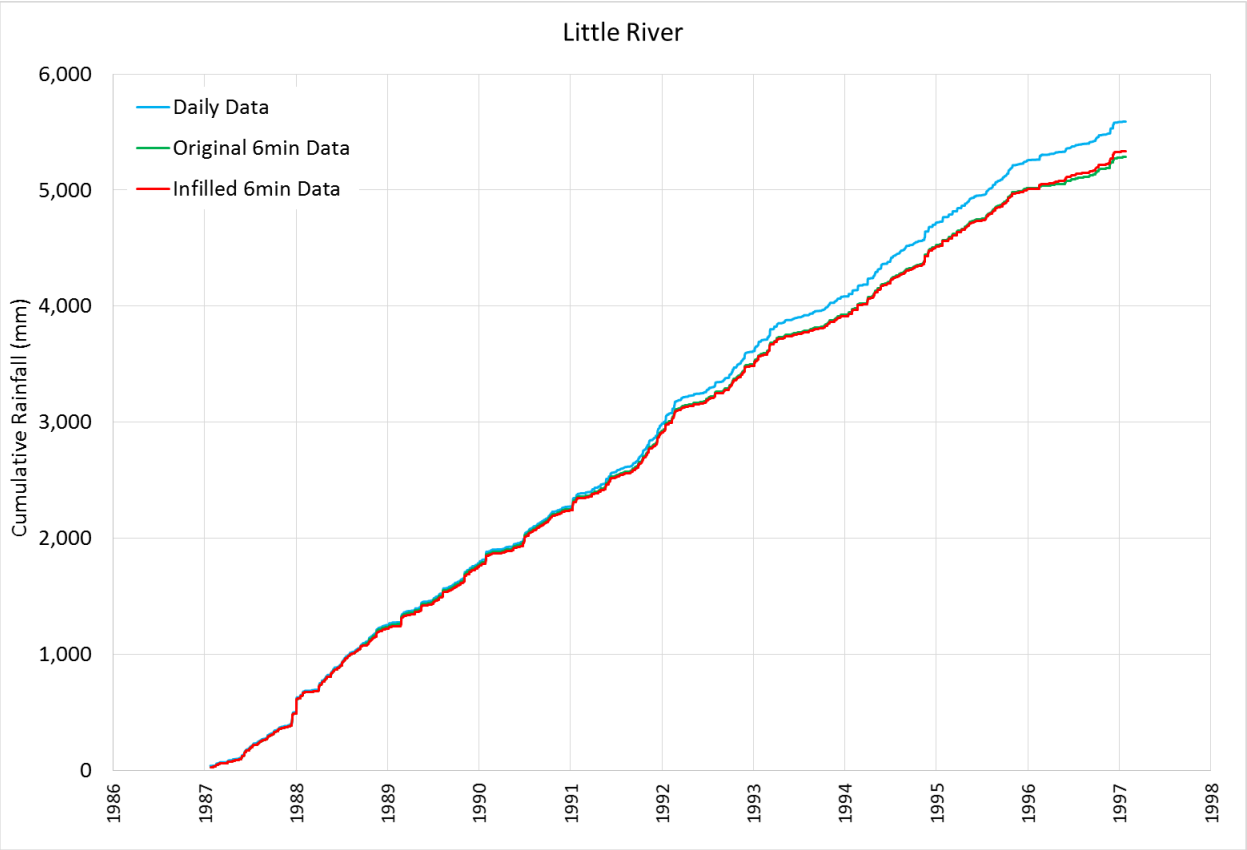


Figure 52 Comparison of cumulative rainfall from daily and 6 minute (original and infilled) rainfall records at Little River (1988 to 1997)

Climate change

MUSIC modelling used to prepare the Wyndham water balance and assess the treatment performance of existing WSUD assets is based on 6 minute rainfall data from the Little River (87033) gauge over the ten year period 1988 – 1997 and Melbourne Airport monthly aerial potential evapotranspiration. This 'baseline' data set is designed to represent the long term average climatic conditions in Wyndham based on an assessment of daily rainfall patterns over 12 gauges with 10 – 72 years of rainfall data.

Climate change is expected to alter these rainfall patterns in terms of volume, frequency and intensity. Temperatures and aerial potential evapotranspiration are also expected to increase. In order to estimate the impact of climate change in Wyndham a 'climate change adjusted' data set has been prepared. This data set is based on the latest CSIRO projections for the 10th, 50th and 90th percentile changes in annual rainfall and wet-environment potential evapotranspiration for the Southern Slopes region to 2030 (CSIRO, 2016). Representative Concentration Pathways (RCPs) are used to explore credible future options. For this analysis RCP4.5 has been adopted. Under RCP4.5 CO_2 concentrations are slightly above those of RCP6.0 until after mid-century, but emissions peak earlier (around 2040), and the CO_2 concentration reaches 540 ppm by 2100, see Figure 53.

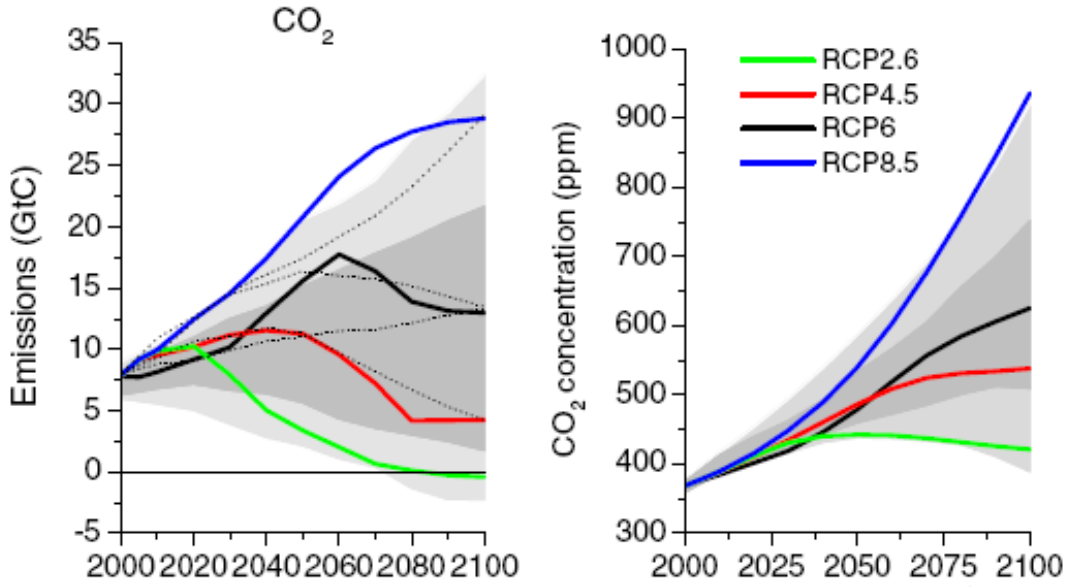


Figure 53 Emissions of CO_2 across the RCPs (left), and trends in concentrations of carbon dioxide (right). Grey area indicates the 98th and 90th percentiles (light/dark grey) of the values from the literature). The dotted lines indicate four of the SRES marker scenarios (CSIRO, 2016).

A climate change adjusted time series was generated by applying season-specific stochastically generated percentage changes to rainfall and evapotranspiration based on the procedures identified described by Burge et al. (2012). Specifically, the 6 minute rainfall data from the Little River (87033) gauge over the ten year period 1989 – 1999 and Melbourne Airport monthly aerial potential evapotranspiration data were used to represent the 1986 – 2005 baseline conditions. These files were then adjusted to generate to create a climate change adjusted hourly rainfall template for the Wyndham region based on the regions 1986 – 2005 baseline. The resulting variation in monthly rainfall, as compared to the long term average rainfall in Wyndham, is presented in Figure 54.

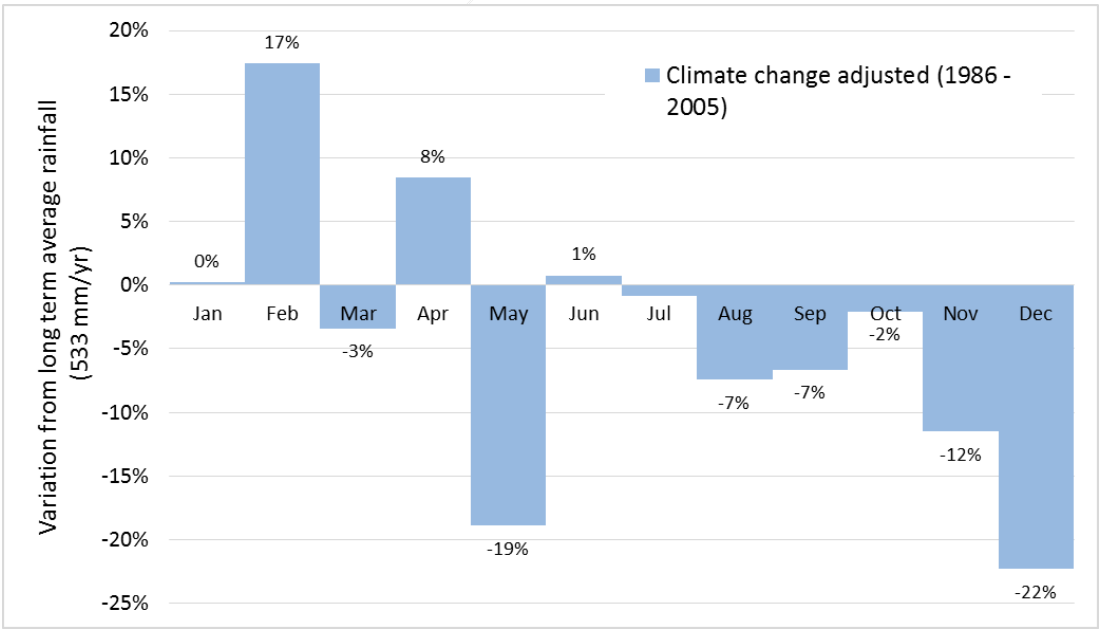


Figure 54 Comparison of rainfall under long term average and climate change conditions

Water use data

Table 20 Council water use data

Financial Year			2005 / 06	2006 / 07	2007 / 08	2008 / 09	2009 / 10	2010 / 11	2011 / 12	2012 / 13	2013 / 14	2014 / 15	2015 / 16
Council Water Use	Stormwater / Rainwater	Usage (ML)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	-
		% of total	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	-
	Recycled Water	Usage (ML)	1.2	8.6	24.3	19.4	5.4	18.7	3.4	69.7	77.2	162.2	-
		% of total	0%	3%	9%	8%	2%	11%	1%	15%	21%	32%	-
	Potable Water	Usage (ML)	386	287	250	222	219	158	251	386	289	351	-
		% of total	100 %	97%	91%	92%	98%	89%	99%	85%	79%	68%	-
	Total		387	296	274	241	224	177	254	456	366	514	-
Population			108, 795	115, 161	123, 778	133, 063	143, 405	155, 251	166, 699	178, 859	189, 063	199, 645	209, 847
Council water use per resident	Actual	Usage (ML)	3.56	2.57	2.22	1.81	1.56	1.14	1.53	2.55	1.94	2.58	-
	Target	Usage (ML)	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	2.28
Council alternative water use	Actual	Usage (ML)	1.2	8.6	24.3	19.4	5.4	18.7	3.4	69.7	77.2	163.2	-
		% of total	0%	3%	9%	8%	2%	11%	1%	15%	21%	32%	-
	Target	Usage (ML)	116	89	82	72	67	53	76	137	110	154	-
		% of total	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	-

Table 21 Community water use data – Summary all years

	Residential (ML)			Non-residential (ML)			Total (ML)	Population	Residential Potable Usage Per Person (kL)
Year	Potable water	Recycled water	Sub-Total	Potable water	Recycled water	Sub-Total			
2011 / 12	11,692	-	11,692	7,270	254	7,524	19,216	166,699	70.1
2012 / 13	10,393	-	10,393	6,510	380	6,890	17,282	178,859	58.1
2013 / 14	10,938	-	10,938	6,425	230	6,655	17,593	189,063	57.9
2014 / 15	11,495	-	11,495	6,654	400	7,055	18,550	199,645	57.6
2015 / 16	12,379	-	12,379	6,843	701	7,543	19,922	209,847	59.0

Table 22 Community water use data – Detailed breakdown for 2015/16

		Residential (ML)			Non-residential (ML)			Total (ML)
Post code	Suburb	Potable water	Recycled water	Sub-Total	Potable water	Recycled water	Sub-Total	
3024	Mambourin, Manor Lakes, Mount Cottrell, Wyndham Vale	1,304	-	1,304	124	38	162	1,466
3026	Laverton North	0.1	-	0	3,996	-	3,996	3,996
3027	Williams Landing	325	-	325	91	-	91	416
3028	Altona Meadows, Laverton, Seabrook	28	-	28	140	-	140	167
3029	Hoppers Crossing, Tarneit, Truganina	5,141	-	5,141	915	42	957	6,099
3030	Werribee, Quandong, Point Cook, Derrimut, Cocoroc	5,522	-	5,522	1,543	621	2,164	7,686
3211	Little River	59	-	59	33	-	33	91

Land use and imperviousness

Current total impervious fractions (TIFs) for Wyndham's land uses were assigned a value based on the considered 'Typical Values' outlined in Melbourne Water's (MW) 2010 MUSIC Guidelines and TIF values provide by WCC. Land uses which covered more than 1% of the municipality by area received more scrutiny. Similarly, land uses which were assigned different 'Typical Values' between the above sources also received further examination. Final value selections were adopted via visual inspections of current aerial photography. Future TIFs were also assigned to each land use to account for some future densification and development within growth areas.

Table 23. Current and future Total Imperiousness Fractions (TIFs) for land use types

						Total Fraction Impervious (TFI)			
				Area (ha)		Considered		Adopted	
Land Use	Zone Code	Planning Zone	Classification	ha	% of municipality	WCC	MW	Current	Future
Residential	GRZ1	General residential zone - schedule 1	Urban	5,699	10.5%	0.60	0.75	0.60	0.75
	LDRZ	Low density residential zone	Urban	195	0.4%	0.30	0.20	0.30	0.30
	TZ	Township zone	Urban	8	0.0%	0.55	0.55	0.40	0.50
	RLZ	Rural living zone	Urban	4	0.0%	0.20	0.20	0.20	0.20
Business	C1Z	Commercial 1 zone	Urban	136	0.3%	0.90	0.90	0.90	0.90
	C2Z	Commercial 2 zone	Urban	9	0.0%	0.90	0.90	0.90	0.90
	ACZ1	Activity centre zone - schedule 1	Urban	56	0.1%	0.80	0.85	0.80	0.80
	MUZ	Mixed use zone	Urban	448	0.8%	0.70	0.70	0.60	0.80
Industrial	IN1Z	Industrial 1 zone	Urban	47	0.1%	0.90	0.90	0.90	0.90
	IN2Z	Industrial 2 zone	Urban	1,410	2.6%	0.90	0.90	0.80	0.90
	IN3Z	Industrial 3 zone	Urban	526	1.0%	0.90	0.90	0.90	0.90
Public Use	PUZ2	Public use zone - education	Urban	76	0.1%	0.70	0.70	0.70	0.70
	PUZ3	Public use zone - health and community	Urban	15	0.0%	0.70	0.70	0.70	0.70
	PUZ5	Public use zone - cemetery/crematorium	Urban	6	0.0%	0.60	0.60	0.60	0.60
	PUZ6	Public use zone - local government	Urban	23	0.0%	0.80	0.70	0.80	0.80
	PUZ7	Public use zone - other public use	Urban	1	0.0%	0.60	0.60	0.20	0.20
Transport	PUZ4	Public use zone - transport	Urban	468	0.9%	0.70	0.70	0.70	0.70
	RDZ1	Road zone - category 1	Urban	649	1.2%	0.75	0.70	0.70	0.70
	RDZ2	Road zone - category 2	Urban	116	0.2%	0.60	0.60	0.70	0.70
Public Open Space	PPRZ	Public park and recreation zone	Urban	2,005	3.7%	0.25	0.10	0.10	0.10
	UFZ	Urban floodway zone	Urban	250	0.5%	0.25	0.00	0.05	0.05
Special Use	SUZ1	Special use zone - schedule 1	Urban	27	0.0%	0.80	0.80	0.40	0.60
	SUZ2	Special use zone - schedule 2	Urban	45	0.1%	0.10	0.10	0.10	0.10
	SUZ4	Special use zone - schedule 4	Urban	433	0.8%	0.25	0.10	0.10	0.10
	SUZ7	Special use zone - schedule 7	Urban	14	0.0%	0.25	0.05	0.05	0.05
	SUZ8	Special use zone - schedule 8	Urban	12	0.0%	0.25	0.05	0.05	0.05
	CA	Commonwealth land not controlled by planning scheme	Urban	494	0.9%	0.60	0.60	0.20	0.20
Urban Growth	PDZ1	Priority development zone - schedule 1	Urban Growth	278	0.5%	0.50	0.50	0.30	0.50
	UGZ	Urban growth zone	Urban Growth	1,030	1.9%	0.10	0.10	0.15	0.50
	UGZ1	Urban growth zone - schedule 1	Urban Growth	255	0.5%	0.10	0.10	0.40	0.50
	UGZ2	Urban growth zone - schedule 2	Urban Growth	647	1.2%	0.10	0.10	0.20	0.90
	UGZ3	Urban growth zone - schedule 3	Urban Growth	387	0.7%	0.10	0.10	0.20	0.50
	UGZ4	Urban growth zone - schedule 4	Urban Growth	92	0.2%	0.10	0.10	0.10	0.60
	UGZ5	Urban growth zone - schedule 5	Urban Growth	142	0.3%	0.10	0.10	0.15	0.60
	UGZ6	Urban growth zone - schedule 6	Urban Growth	470	0.9%	0.10	0.10	0.20	0.50
	UGZ7	Urban growth zone - schedule 7	Urban Growth	478	0.9%	0.10	0.10	0.10	0.50
	UGZ8	Urban growth zone - schedule 8	Urban Growth	482	0.9%	0.10	0.10	0.10	0.50
	UGZ9	Urban growth zone - schedule 9	Urban Growth	489	0.9%	0.10	0.10	0.10	0.50
	UGZ10	Urban growth zone - schedule 10	Urban Growth	1,016	1.9%	0.10	0.10	0.10	0.50
	UGZ11	Urban growth zone - schedule 11	Urban Growth	958	1.8%	0.10	0.10	0.10	0.50
	UGZ13	Urban growth zone - schedule 13	Urban Growth	993	1.8%	0.10	0.10	0.15	0.50
	UGZ14	Urban growth zone - schedule 14	Urban Growth	717	1.3%	0.10	0.10	0.15	0.70
	UGZ15	Urban growth zone - schedule 15	Urban Growth	44	0.1%	0.10	0.10	0.10	0.60
Agricultural	FZ	Farming zone	Non-urban	1,098	2.0%	0.10	0.10	0.05	0.05
	FZ1	Farming zone - schedule 1	Non-urban	22	0.0%	0.10	0.10	0.10	0.10
	FZ2	Farming zone - schedule 2	Non-urban	295	0.5%	0.10	0.10	0.10	0.10
	GWZ	Green wedge zone	Non-urban	9,645	17.8%	0.10	0.10	0.10	0.10
	GWAZ	Green wedge A zone	Non-urban	25	0.0%	0.10	0.10	0.10	0.10
	RCZ	Rural conservation zone	Non-urban	12,836	23.6%	0.10	0.10	0.05	0.05
Miscellaneous	PCRZ	Public conservation and resource zone	Non-urban	693	1.3%	0.25	0.10	0.05	0.05
	PUZ1	Public use zone - service and utility	Non-urban	6,956	12.8%	0.25	0.05	0.05	0.05
	SUZ3	Special use zone - schedule 3	Non-urban	64	0.1%	0.60	0.60	0.15	0.15
	SUZ6	Special use zone - schedule 6	Non-urban	947	1.7%	0.30	0.20	0.15	0.15
Other	Areas within Wyndham that do not have a planning zone attached to them (predominatley waterway). Cumulativley these areas account for a relatively small propotion of total land use so have been excluded from the water balance analysis.			77	0.1%	n/a	n/a	n/a	n/a
			Total	**54,310**	**100%**				

Stormwater flows and pollutant loads

The Model for Stormwater Improvement Conceptualisation (MUSIC) Version 6.2 was used to model the catchments and estimate stormwater flow volumes and pollutant loads.

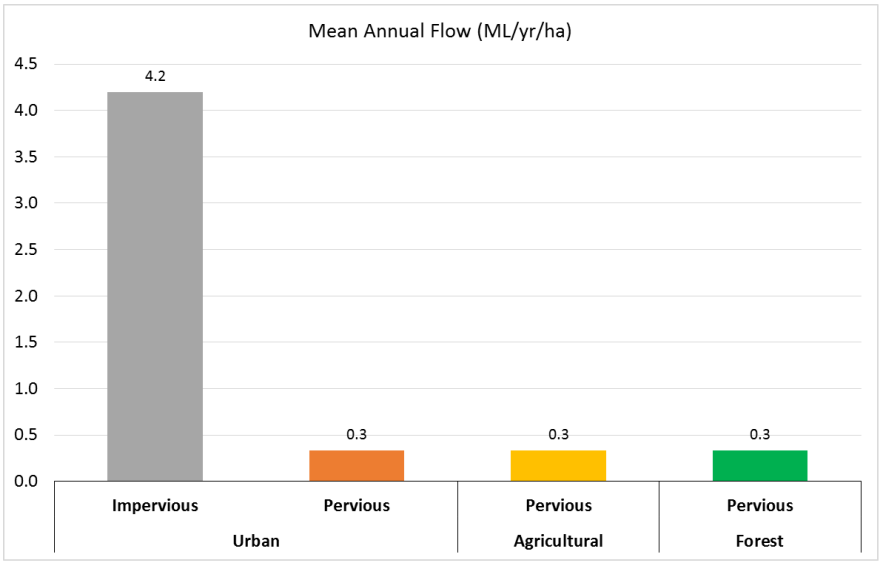
Unit models were used to determine the runoff and pollutant generation patterns across four surface types (see Table 24 below and Figure 55 on p. 102). These models were used in conjunction with the breakdown of land use within each catchment to generate stormwater runoff and pollutant loads across the municipality under for baseline (2016) and projected (2040) conditions (Table 25). A summary of all results are provided below in Figure 56 to Figure 59 (pp. 103 to 106).

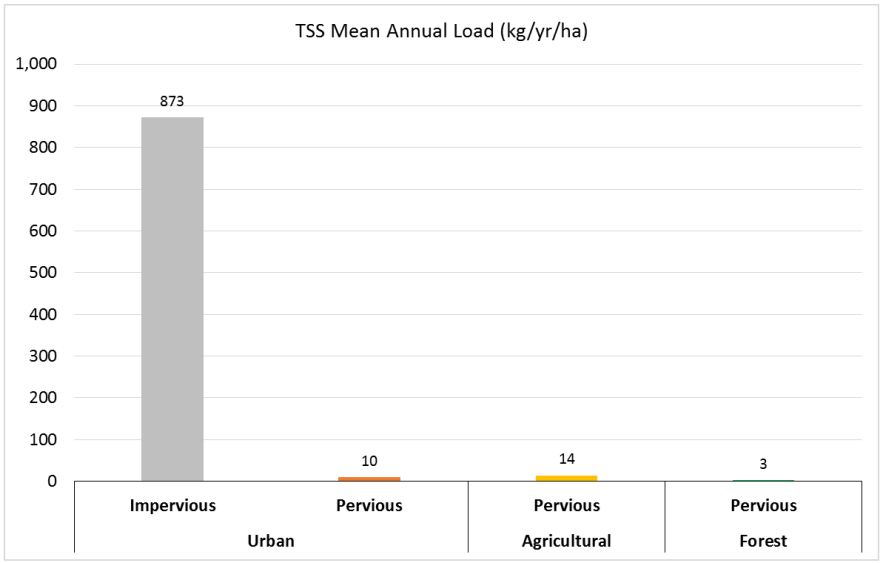
Table 24 Summary of unit model inputs

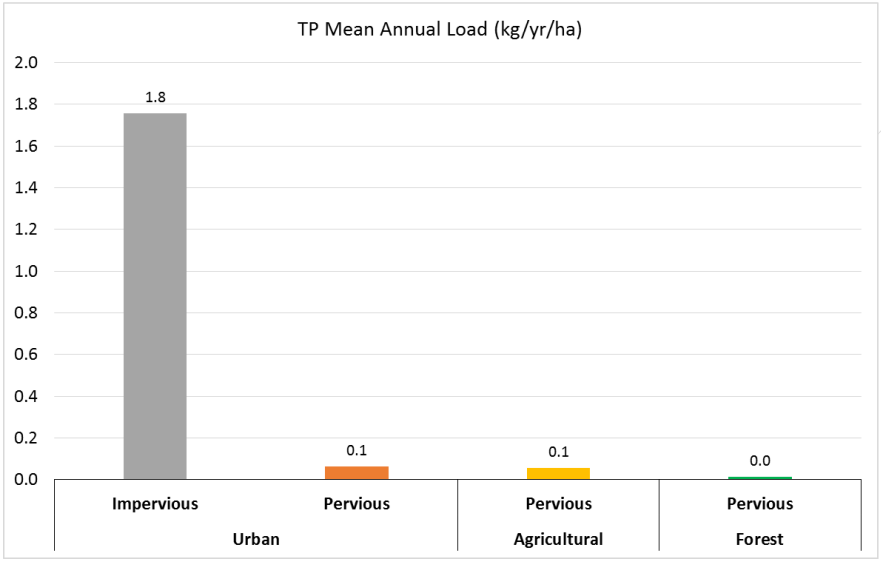
Source Node	Urban		Agricultural	Forest
Surface Type	Impervious	Pervious	Pervious	Pervious
Mean Annual Flow (ML/yr/ha)	4.20	0.33	0.33	0.33
TSS Mean Annual Load (kg/yr/ha)	872.8	10.2	14.4	3.4
TP Mean Annual Load (kg/yr/ha)	1.76	0.06	0.06	0.01
TN Mean Annual Load (kg/yr/ha)	12.08	0.74	0.52	0.13

Table 25 Source node used for each land use category

	Source Node	
	Current (2016)	Projected (2040)
Business	Urban	Urban
Industrial	Urban	Urban
Public Open Space	Urban	Urban
Public Use	Urban	Urban
Residential	Urban	Urban
Special Use	Urban	Urban
Transport	Urban	Urban
Urban Growth	Agricultural	Urban
Agricultural	Agricultural	Agricultural
Miscellaneous	Urban	Urban







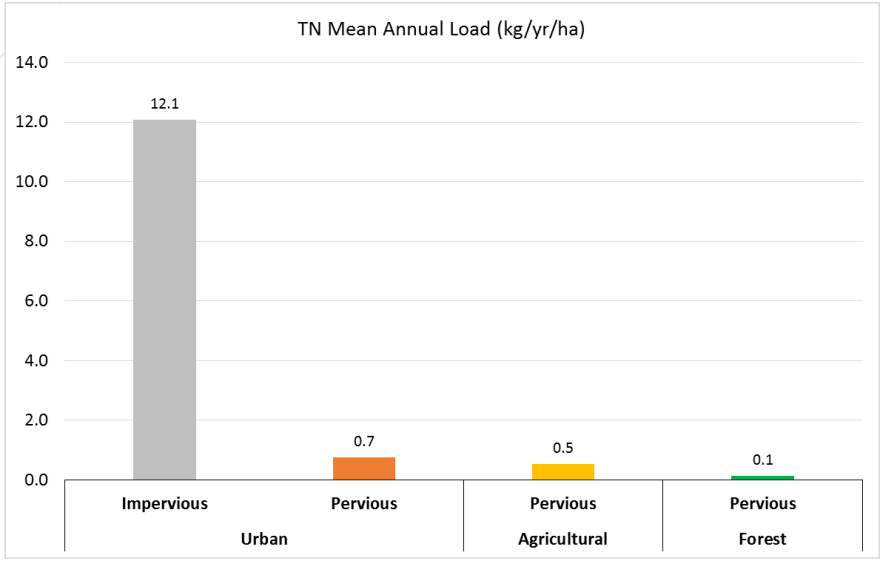


Figure 55 Unit model results

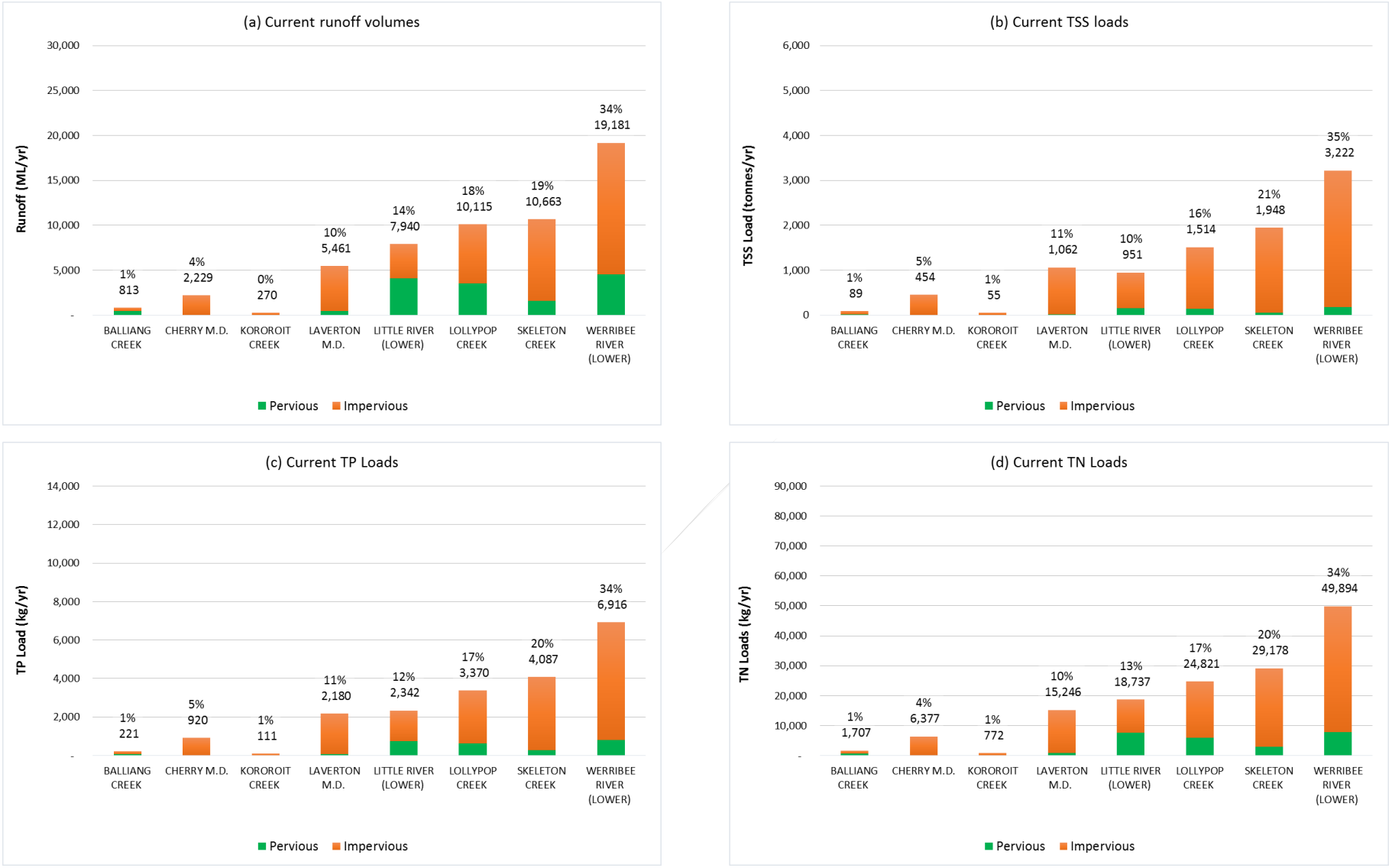


Figure 56 Breakdown of baseline (2016) stormwater flows and pollutant loads by catchment

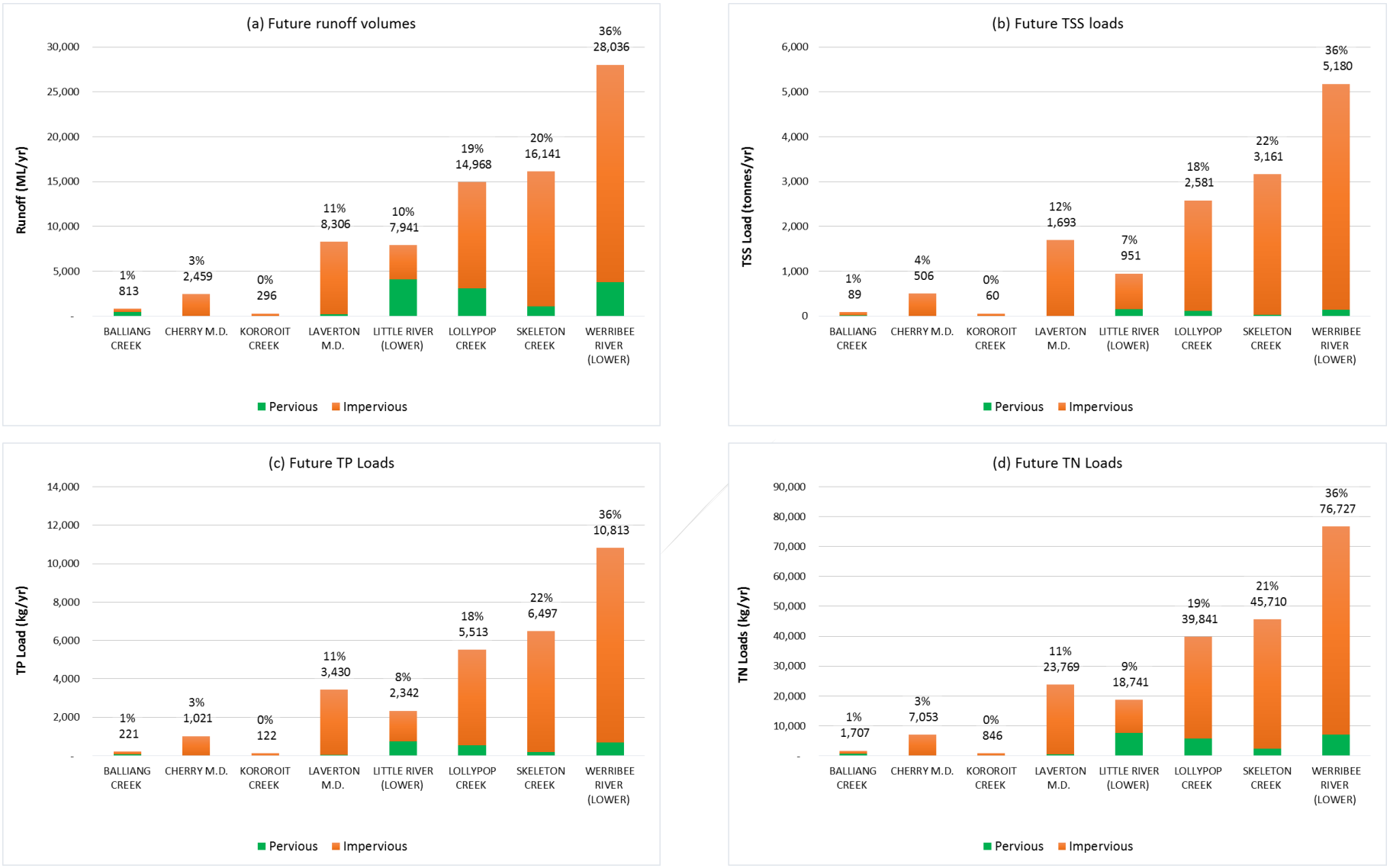


Figure 57 Breakdown of projected (2040) stormwater flows and pollutant loads by catchment

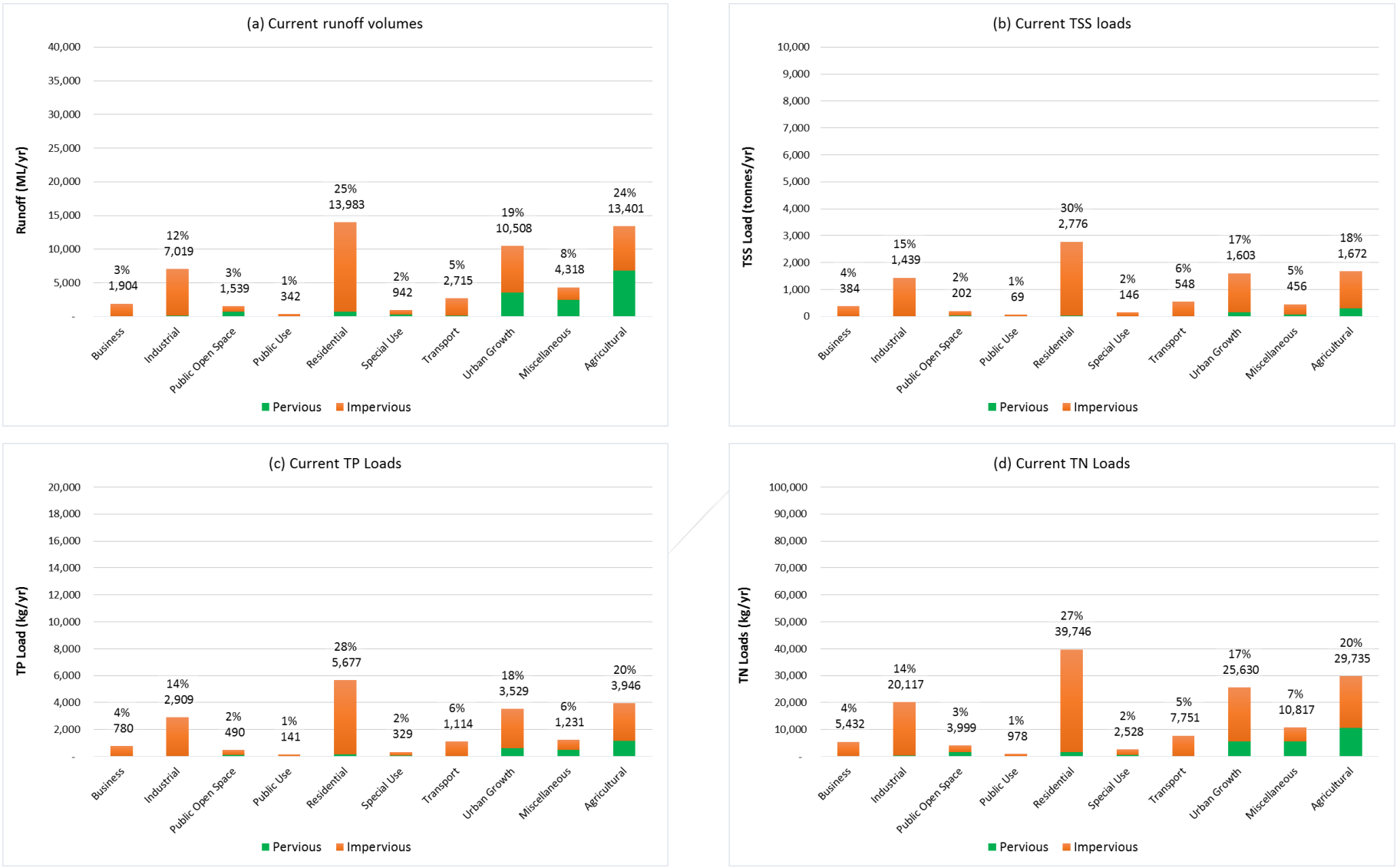


Figure 58 Breakdown of baseline (2016) stormwater flows and pollutant loads by land use

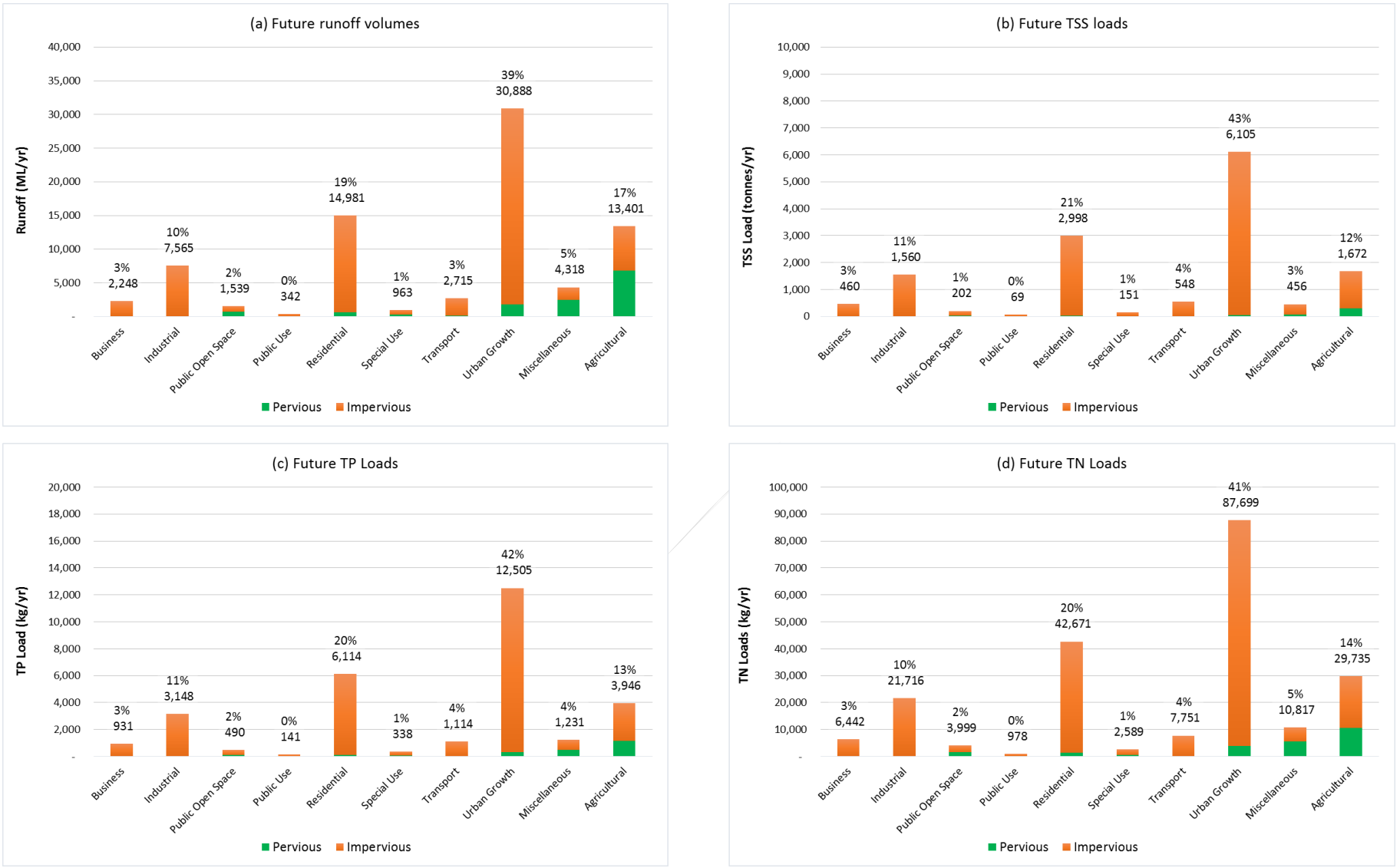


Figure 59 Breakdown of projected (2040) stormwater flows and pollutant loads by land use

Assessment of Existing WSUD Assets

A high level assessment of Council's existing WSUD assets based on their WSUD asset database. The methodology and assumptions adopted to make this assessment are documents below.

Asset type and sequence

All listed assets was categorised into one of the following ten asset types based on the asset description provided by WCC and visual inspections of aerial photography:

1. Bioretention
2. Pond
3. Sediment Pond
4. Sediment Pond, Bioretention
5. Swale
6. Swale, Bioretention
7. Swale, Sediment Pond
8. Swale, Sediment Pond, Bioretention
9. Wetland (inc. Sediment Pond)
10. Wetland (inc. Sediment Pond), Bioretention

Several assets listed on the register included multiple WSUD asset types. In order to create a consolidated list of asset types these 'combined assets' were given consistent names based the following sequence: swale, sediment pond, wetland, pond and bioretention. For example, using this approach a "Bioretention- Sediment Pond" was reclassified as a "Sediment Pond, Bioretention". All wetlands were been assumed to include a sediment pond. Assets were not assessed if they did not fit within the above-mentioned ten asset types, didn't include asset areas, didn't have sufficient information available to model their performance or were duplicates. In total only 6 assets on the register weren't assessed.

Treatment area

The majority of assets in the register contained details that allowed an estimate of treatment area to be determined. In the absence of this data the assumption outlined in Table 26 were made in order to assume a treatment area.

Table 26 Treatment area assumptions

Asset Type	Assumption
Bioretention	Width of 1 metre where width was not specified.
Sediment Pond, Bioretention	15% of total area is sediment pond, remaining area is bioretention (75%).
Swale	Length of 20 metres where length was not specified.
Swale, Bioretention	Length of 20 metres where width was not specified. Bioretention was assumed to be centred within the swale at a width of 1 metre where width was not specified.
Swale, Sediment Pond	25% of the total area is swale, remaining area is sediment pond (75%).
Swale, Sediment Pond, Bioretention	50% of total area is bioretention, remaining area is sediment pond (15%) and swale (35%).
Wetland (inc. Sediment Pond)	15% of the total area is sediment pond, remaining area is wetland (85%).
Wetland (inc. Sediment Pond), Bioretention	50% of total area is bioretention, remaining area is sediment pond (15%) and wetland (35%).

Catchment area

No catchment area data was available in the WSUD asset database. Consequently it was assumed that all assets were sized to treat a catchment (60% impervious) to best practice (i.e. 80% reduction in TSS, TP and TN loads). Unit models meeting this condition were developed for several WSUD assets and used to estimate the catchment area treated by each asset and their treatment performance (see Table 27 to Table 29).

Table 27. Summary of unit model inputs (part 1)

Parameter	Unit	Sediment Pond	Pond	Wetland	Swale
Catchment Area	ha	100	100	100.0	7.95
Impervious Fraction	-	60%	60%	60%	60%
Low Flow By-pass	m3/s	0	0	0	0
High Flow By-pass	m3/s	100	100	100	100
Extended Detention Depth	m	0.01	0.01	0.35	n/a
Inlet Pond Volume	m3	n/a	n/a	4000	n/a
Surface Area	m2	12000	18000	15600	n/a
Permanent Pool Volume	m3	12000	18000	6240	n/a
Permanent Pool Depth	m	1.0	1.0	0.40	n/a
Initial Volume	m3	6000	9000	3120	n/a
Overflow Weir Width	m	11.0	15.5	12.5	n/a
Equivalent Pipe Diameter	mm	119	140	123	n/a
Exfiltration Rate	mm/hr	0.0	0.0	0.0	3.6
Evaporative Loss as % of PET	-	75%	100%	n/a	n/a
Length	m	n/a	n/a	n/a	100
Bed Slope	%	n/a	n/a	n/a	3.0
Base Width	m	n/a	n/a	n/a	4.0
Top Width	m	n/a	n/a	n/a	6.0
Depth	m	n/a	n/a	n/a	0.30
Vegetation Height	m	n/a	n/a	n/a	0.10
Catchment Area / Surface Area	-	83	56	64	132.5

Table 28. Summary of unit model inputs (part 2)

Parameter	Unit	Bioretention
Catchment Area	ha	10
Catchment Imperviousness	-	60%
Low Flow By-pass	m3/s	0
High Flow By-pass	m3/s	100
Extended Detention Depth	m	0.25
Surface Area	of catchment area	0.3%
	m2	300
Filter Area	m2	300
Unlined Filter Media Perimeter	m	69.3
Saturated Hydraulic Conductivity	mm/hr	100
Filter Media Depth	m	0.5
TN Content of Filter Media	mg/kg	800
Orthophosphate Content of Filter Media	mg/kg	50
Exfiltration Rate	mm/hr	0
Is the Base Lined?	-	YES
Vegetation Properties	-	Effective nutrient removal plants
Overflow Weir Width	m	2
Underdrain Present	-	YES
Submerged Zone with Carbon Present?	-	NO
Submerged Zone Depth	m	0
Catchment Area / Surface Area	-	333

Table 29. Summary unit model treatment performance

		Wetland (inc. Sediment Pond)	Bioretention	Swale	Sediment pond	Pond
Catchment	Area (ha)	100	10	7.95	100	100
	Imperviousness (%)	60%	60%	60%	60%	60%
Treatment details	Treatment area (m^2)	17,600	300	600	12,000	18,000
	% of catchment	1.8%	0.3%	0.8%	1.2%	1.8%
Pollutant Load Reduction (kg/yr)	Total Suspended Solids (TSS)	42,400	4,040	3,453	42,500	42,200
	Total Phosphorus (TP)	71.7	6.1	5.12	64.2	72.2
	Total Nitrogen (TP)	343	33.5	12.9	280	337
	Gross Pollutants (kg/yr)	11,500	1,150	910	11,500	11,500
Runoff Reduction	ML/yr	21	0.3	1.1	10	20

For assets listed on the register that included multiple WSUD asset types, i.e. 'combined assets', treatment performance will be variable based on the sequence of the assets and the sizing of each asset in the treatment train. In these cases a simplified approach was adopted whereby performance was estimated based on the treatment area of a single asset in the treatment train. This asset was selected based on the following hierarchy:

1. Wetland
2. Bioretention - No infiltration
3. Sediment Pond
4. Swale
5. Pond

A summary of the current asset treatment performance, broken down by assert owner (i.e. WCC, Melbourne Water and Private / Other) is provided in Table 30 (p. 110). The accuracy of the estimate of treatment performance could be improved significantly if the WSUD asset register was modified to consistently capture:

- Treatment type
- Treatment train (i.e. the sequence of assets for 'combined assets')
- Treatment area (total area and breakdown of area for 'combined assets')
- Catchment area
- Catchment imperviousness (total and/or directly connected imperviousness)

Table 30 Summary of current asset performance

Asset Owner	Asset Type	Number of Assets	Catchment (ha)	Treatment Area (m2)						Pollutant Load Reduction (kg/yr)		
				Swale	Sediment Pond	Wetland	Pond	Bioretention	Total	TSS	TP	TN
Wyndham City Council	Bioretention	10	424	420	-	-	-	12,719	13,139	171,276	259	1,420
	Pond	1	10	-	-	-	1,750	-	1,750	4,103	7	33
	Sediment Pond	1	14	-	1,650	-	-	-	1,650	5,844	9	39
	Sediment Pond, Bioretention	1	5	-	26	-	-	149	175	2,003	3	17
	Swale	22	237	17,861	-	-	-	-	17,861	102,789	152	384
	Swale, Bioretention	16	56	7,110	-	-	-	1,692	8,802	22,786	34	189
	Swale, Sediment Pond	1	38	1,500	4,500	-	-	-	6,000	15,938	24	105
	Swale, Sediment Pond, Bioretention	1	79	1,666	714	-	-	2,380	4,760	32,051	48	266
	Wetland (inc. Sediment Pond)	33	904	-	24,888	141,034	-	-	165,922	383,322	648	3,101
	Wetland (inc. Sediment Pond), Bioretention	0	-	-	-	-	-	-	-	-	-	-
	Sub-Total	86	1,766	28,557	31,779	141,034	1,750	16,939	220,058	740,111	1,185	5,553
Melbourne Water	Bioretention	5	303	-	-	-	-	9,100	9,100	122,547	185	1,016
	Pond	0	-	-	-	-	-	-	-	-	-	-
	Sediment Pond	17	445	-	52,185	1,955	-	-	54,140	188,914	286	1,253
	Sediment Pond, Bioretention	0	-	-	-	-	-	-	-	-	-	-
	Swale	3	57	4,312	-	-	-	-	4,312	24,816	37	93
	Swale, Bioretention	0	-	-	-	-	-	-	-	-	-	-
	Swale, Sediment Pond	0	-	-	-	-	-	-	-	-	-	-
	Swale, Sediment Pond, Bioretention	0	-	-	-	-	-	-	-	-	-	-
	Wetland (inc. Sediment Pond)	37	2,145	-	59,050	334,617	-	-	393,667	909,471	1,538	7,357
	Wetland (inc. Sediment Pond), Bioretention	1	12	-	825	1,925	-	2,750	5,500	5,232	9	42
	Sub-Total	63	2,962	4,312	112,060	338,497	0	11,850	466,719	1,250,979	2,055	9,761
Private / Other	Bioretention	2	14	-	-	-	-	410	410	5,521	8	46
	Pond	5	85	-	-	-	15,285	-	15,285	35,835	61	286
	Sediment Pond	0	-	-	-	-	-	-	-	-	-	-
	Sediment Pond, Bioretention	0	-	-	-	-	-	-	-	-	-	-
	Swale	0	-	-	-	-	-	-	-	-	-	-
	Swale, Bioretention	0	-	-	-	-	-	-	-	-	-	-
	Swale, Sediment Pond	0	-	-	-	-	-	-	-	-	-	-
	Swale, Sediment Pond, Bioretention	0	-	-	-	-	-	-	-	-	-	-
	Wetland (inc. Sediment Pond)	8	261	-	7,190	40,741	-	-	47,930	110,731	187	896
	Wetland (inc. Sediment Pond), Bioretention	0	-	-	-	-	-	-	-	-	-	-
	Sub-Total	15	360	0	7,190	40,741	15,285	410	63,625	152,087	257	1,228
	Total	**164**	**5,088**	**32,869**	**151,028**	**520,271**	**17,035**	**29,199**	**750,402**	**2,143,176**	**3,497**	**16,542**

Compiled water balance data

Table 31 Compiled water balance data and assumptions

			Baseline (2016)		Projected (2040)	
			Volume (ML/yr)	Notes	Volume (ML/yr)	Notes
Water Use	Council	Potable	369	Usage per resident, stormwater/ rainwater reuse and the proportion of potable versus recycled water use were all estimated based on 2014 /15 figures accounting for increased population as predicted by Forecast i.d.	210	It is assumed that Council's water use per resident target is met, total water use is estimated based on this rate and population predictions by Forecast i.d. Alternative water use is predicted to increase based on Council's 2040 target to meet all Council non-potable demands with alternative water supplies by 2040. It is assumed that 80% of Councils total water usage is supplied by alternative water supplies. 70 ML/yr is sourced from stormwater (based on performance scenario modelling for Option B funding), the balance is supplied by recycled water.
		Recycled Water	171		768	
		Stormwater / Rainwater	1.0		70	
	Residential	Potable	12,379	Based on data provided by CWW.	23,422	Total residential water use was estimated based on 2015 / 16 rates of residential potable usage per person (59.0 kL/yr per person). Alternative water use in residential estates is expected to increase in the future as (a) recycled water is supplied to existing areas that area already connected to the recycled water network, (b) new residential areas are connected to the recycled water network, (c) new residential areas are connected to stormwater reuse schemes (e.g. Blackforest Road) and (d) greenfield and infill residential properties install rainwater tanks. Taking this into account it has been assumed that 50% of new non-potable demands are serviced with alternative water, consisting of 80% recycled water and 20 % stormwater / rainwater. Total residential water use was estimated based on the 2015 /2016 ratio of population to usage (i.e. usage ~3.6% of the total population). In recent years recycled water use in the non-residential sector has risen from 3% to 9 % of total non-residential usage. This is assumed to grow to 15% by 2040.
		Recycled Water	0		2,945	
		Stormwater / Rainwater	unknown	No data available, some rainwater use is expected due to the presence of rainwater tanks but no data is available to estimate usage.	736	
	Non-residential	Potable	6,843	Based on data provided by CWW.	14,039	
		Recycled Water	701		2,477	
		Stormwater / Rainwater	unknown	No data available, some rainwater use is expected due to the presence of rainwater tanks but no data is available to estimate usage.	unknown	No data available, some rainwater use (and potentially stormwater use) is expected but no data is available to estimate usage.
		Groundwater	1,500	Estimated based on total usage in the Deutgam WSPA in 2014/15 (1,406 ML). Annual use in the system is consistently less than 2,000 ML.	1,500	Usage assumed to remain constant.
		River water	5	Based on the total volume of water extracted the Werribee River in 2014/15.	5	Usage assumed to remain constant.
	Werribee Irrigation District	Recycled Water	4,000	Based on the WID water balance for the 2014-15 season.	4,000	Usage assumed to remain constant.
	Total		25,968	-	50,172	-
Wastewater Generation	Council		130	Estimated based on potable, recycled, stormwater and rainwater use assuming sewage discharge factors of: - Council: 24% (based on a factor of 10% for public open space irrigation (~80% of Council water use) and a factor of 80% for the remaining 20% of Council water use) - Residential: 80% - Non-residential 90%	251	Estimated based on potable, recycled, stormwater and rainwater use assuming sewage discharge factors of: - Council: 24% (based on a factor of 10% for public open space irrigation (~80% of Council water use) and a factor of 80% for the remaining 20% of Council water use) - Residential: 80% - Non-residential 90%
	Residential		9,903		21,682	
	Non-residential		6,789		14,864	
	Total		16,822	-	36,798	-
Stormwater Runoff	Balliang Creek		813	Based on assessment of current land use and MUSIC modelling.	813	Based on assessment of future land use and MUSIC modelling.
	Cherry M.D.		2,229		2,459	
	Kororoit Creek		270		296	
	Laverton M.D.		5,461		8,306	
	Little River (Lower)		7,940		7,941	
	Lollypop Creek		10,115		14,968	
	Skeleton Creek		10,663		16,141	
	Werribee River (Lower)		19,181		28,036	
	Total		56,671	-	78,960	-
Other	Rainfall		287,712	Based on MUSIC modelling.	287,712	Based on MUSIC modelling. Evapotranspiration and infiltration decrease due to the increase in impervious surfaces.
	Evapotranspiration		13,610		11,838	

Litter hotspots

A systematic methodology was adopted to identify litter hotspots (i.e. areas that generate the greatest volume of litter) using available GIS data. The methodology was based on a similar project undertaken by Melbourne Water for the lower Yarra where it was found that hotspots lie predominantly in commercial areas and in the vicinity of food markets and are influenced by transient populations (Francey & Catchlove, 2007). The methodology was also influenced by the Victorian Litter Report (Sustainability Victoria, 2013) which identified transport locations (bus and tram stops) and the public space immediately outside railway stations are the worst locations for litter on the ground. A list of the GIS layers used for the analysis and their associated litter scores are documented below in Table 32. In order to create the final hot spot maps the litter scores from multiple GIS layers were added together. For example, an isolated bin recorded a score of 3 whereas a bin in an existing major activity centre recorded a score of 6. The cumulative litter scores ranged from 1 to 13 and were used to develop three Litter Risk Categories, namely, Low Risk (1 – 4), Medium Risk (5 – 9) and High Risk (10 – 13).

Table 32 GIS layers used to identify pollutant hotspots

GIS Layer Description		Score
Transport	Bus Stops	3
	Railway station	3
Council Assets	GPTs	3
	Bins	3
Precinct	Existing Activity Centre	3
	Existing Major Activity Centre	3
Food	Asian Grocer - With Temp Control	3
	Bar (alcohol & snack foods)	3
	Canteen	3
	Canteen - School	3
	Child Care Centre	3
	Hospital Kitchen	3
	Only Fruit & Vegetable Shop	3
	Restaurant / Cafe / Hotel	3
	Supermarket	3
	Take Away / Fast Food Outlets	3
Places of Interest[1]	Sanctuary Lakes S.C.	3
	Hoppers Crossing Shopping Ctr	3
	Shopping Centre	3
	Sports & Fitness Centre	2
	Werribee Racecourse	2
	Victoria University	2
	Mercy Hospital	2
	VU Sports Complex	2
	Wyndham Harbour	2
	Open Range Zoo	2
	BP Caravan Park	2
	Werribee South Caravan Park	2
	Wyndham Leisure Centre	2
Planning Zones	C2Z	1
	PUZ2	1
	SUZ4	1
	SUZ2	1
	C1Z	1
	PUZ3	1
	IN1Z	1
	IN2Z	1
	IN3Z	1
	ACZ1	1
Education	Schools	1
Precinct[2]	Future Major Activity centre	n/a
	Future Activity centre	n/a

[1] The places of interest layer was clipped by the Existing Activity Centre layers to prevent overlap and double counting of scores.

[2] These layers were used to show the location of future activity centres that may pose a risk to litter management in the future, no score was included

Attachment 3 – Performance Scenarios

Overview

Council investment in IWCM solutions can significantly influence Wyndham's projected water and pollutant balance. In particular, Council can drive increased alternative water use to reduce the pressure on the regions potable water supplies. Increased alternative water use can also help create cooler green spaces for community play and respite. The creation of cool green spaces will be increasingly important under a future climate change scenario with reduced rainfall and increased temperatures.

Council investment in IWCM is also essential given its major role in ensuring that new developments comply with the wide range of environmental controls in place at the state and local level. The need for careful review of development applications and enforcement of development controls is particularly important in Wyndham given the high and prolonged growth forecast in the area.

Structural projects will also be important in delivering IWCM in Wyndham. Consequently the following five structural IWCM scenarios has been assessed:

1. More wetlands and bioretention systems
2. More gross pollutant traps (GPTs)
3. Stormwater harvesting for active open space irrigation
4. Stormwater harvesting for irrigation of passive recreation areas
5. Require rainwater tanks for development approval

Each scenario is described in more detail below in Table 29 (p.114).

Table 33 Performance scenario descriptions

Scenario	Description	Delivered physical opportunities
1. More wetlands or bioretention systems	This scenario investigates the benefits of investing in new wetlands and bioretention systems funded from Council's capital works budget (and potential grant funding).	• Stormwater treatment wetlands and/or bioretention systems retrofitted into existing areas as part of renewal works to maximise stormwater pollutant reduction. Works will likely focus on outfalls along waterways (e.g. Werribee River) but may also include works in streets, parks, outside Council buildings where end-of-pipe opportunities aren't available.
2. More GPTs	This scenario investigates the benefits of investing in new gross pollutant traps (GPTs) funded from Council's capital works budget (and potential grant funding).	• Gross Pollutant Traps retrofitted into existing areas to address litter and sediment issues. Works will likely focus on litter hotspots and outfalls along waterways (e.g. Werribee River).
3. Stormwater harvesting* for active open space irrigation	This scenario investigates the benefits of investing in new stormwater harvesting infrastructure for irrigation of active open space areas funded from Council's capital works budget (and potentially budgets for recreation assets).	• A harvesting scheme involves a wetland or bioretention system to treat stormwater from a local catchment, a storage tank, a pump, transfer main and infrastructure for irrigation controls (to integrate with existing irrigation network at an active recreational park). Stormwater harvesting improves water quality and delivers an alternative water source for irrigation.
4. Stormwater harvesting* for irrigation of passive recreation areas	This scenario investigates the benefits of investing in new stormwater harvesting infrastructure for irrigation of passive open space areas funded from Council's capital works budget (and potentially budgets for recreation assets).	• A harvesting scheme for passive recreation areas requires the same type of infrastructure as for active open space areas but the size and costs of the infrastructure is less as both the area irrigated and the application rate of water is reduced. Water quality improvements and enhanced amenity are delivered.
5. Require rainwater tanks for development approval	This scenario investigates the benefits associated with reuse from rainwater tanks on residential lots. Costs in this scenario would be borne by developers / property owners.	• Residential properties to install rainwater tanks plumbed to supply toilet and laundry demands as part of development approval. In 2015-16 this would have provided an alternative water source to 442 dwellings.

* Stormwater harvesting is only proposed for open spaces that do not have a recycled water supply, it is uneconomical to harvest stormwater at these locations. At sites connected with a recycled water supply WSUD works should focus on treatment only.

Assessment of costs and benefits

The costs and benefits of each performance scenario have been assessed and compared in order to understand the relative impact of each scenario.

Costs considered in the assessment include:

- Capital
- Establishment
- Maintenance

Benefits considered in the assessment in include:

- Stormwater reuse (i.e. the volume of water harvested, in some cases this reuse will also result in potable water conservation).
- Flow reduction (i.e. the volume of water 'lost' due to evapotranspiration and infiltration)
- Pollutant reductions in terms of total suspended solids (TSS), total phosphorus (TP), total nitrogen (TN) and gross pollutants (GP).

Table 34 below (p.116) shows the impact of a hypothetical investment of $1,000,000 of capital expenditure in each scenario in terms of stormwater reuse and pollutant reduction. This allows for a comparison of the benefits of each scenario based on the same upfront investment. Note that the $1,000,000 invested in scenario 5 would not be funded by Council, rather, it would be funded by private developers. The results are in present value terms and account for upfront and ongoing costs over the life of the project (i.e. 35 years, 6.5% discount rate).

Table 34 Comparison of performance scenarios

	Scenario	Stormwater reuse (ML/yr)	Flow reduction (ML/yr)	Pollutant Reduction (kg/yr)				Capital Cost	Annual Maintenance Cost	Life Cycle Cost*
				TSS	TP	TN	GP			
1	**More wetlands and bioretention systems** 2 wetlands, 4 biofilters	0.0	6.3	26,905	43	221	7,538	$1,000,000	$15,338	$1,208,141
2	**More Gross Pollutant Traps** 19 underground GPTs	0.0	0.0	61,923	8	0	20,677	$1,000,000	$43,269	$1,587,187
3	**Stormwater harvesting for active open space irrigation** 1 scheme	8.0	11.0	6,623	11	63	1,734	$1,000,000	$8,256	$1,112,037
4	**Stormwater harvesting for irrigation of passive recreation areas** 2 schemes	5.4	7.4	4,617	8	43	578	$1,000,000	$7,073	$1,095,988
5	**Require rainwater tanks for development approval** 109 tanks	3.1	3.1	82	0	7	n/a	$1,000,000	$10,860	$1,147,376

***** To allow for easy comparison across these scenarios a 'scenario budget' of $1 million dollars has been assumed (i.e. $1,000,000 invested into each scenario). This scale of investment would have a six year timeframe based on a WSUD capital works budget of $200,000 per annum. It is noted that the IWCM projects and opportunities have the potential to be funded by supporting budgets (e.g. Open Space for integration of stormwater harvesting for irrigation of passive recreation as part of park renewals / design) and grant funding may also be available (e.g. Melbourne Water Living Rivers fund).

** Net present value, 35 year lifetime, 6.5% discount rate

The cost effectiveness of each scenario is also presented in Table 35 below. This table looks at the total life cycle cost of each scenario and compares it to the benefit (e.g. kg of nitrogen treated or kL of stormwater harvested) provided. This allows for a comparison of the benefits per dollar of expenditure in each scenario to be compared. The results show that

- **Scenario 1** delivers the greatest nitrogen reduction and relatively minor flow and gross pollutant reductions.
- **Scenario 2** delivers the largest reduction in gross pollutants but does not deliver any other benefits.
- **Scenario 3** delivers the highest flow and reuse benefits as well as minor flow and gross pollutant reductions.
- **Scenario 4** is similar to scenario 3 but delivers slightly less benefits across the board as similar infrastructure is required to deliver less reuse.
- **Scenario 5** is the most expensive scenario across all of the four metrics but the costs are borne by developers rather than Council.

Table 35 The relative cost effectiveness of each performance scenario (low $ per benefit indicates greater cost effectives, as indicated by the bar charts)

		Cost effectiveness			
		Net present value, 35 year lifetime, 6.5% discount rate			
	Scenario	$/kg TN	$/kL flow reduction	$/kL reuse	$/kg gross pollutants
1	More wetlands and bioretention systems	$375	$13	n/a	$11
2	More gross pollutant traps (GPTs)	n/a	n/a	n/a	$5
3	Stormwater harvesting for active open space irrigation	$1,221	$7	$10	$44
4	Stormwater harvesting for irrigation of passive recreation areas	$1,731	$10	$14	$130
5	Require rainwater tanks for development approval	$11,482	$25	$25	n/a

It is clear from the above analysis that no one scenario can deliver all of the benefits that Wyndham is seeking to achieve as part of its IWCM Plan. Stormwater harvesting for active and passive open space irrigation (scenarios 3 and 4) delivers the strongest performance across all of the benefits considered, followed closely by additional WSUD assets focused at providing increased stormwater treatment (scenario 1). Consequently it is recommended that these scenarios are the focus of future WSUD capital expenditure. While gross pollutant traps (scenario 2) provide an efficient mechanism for reducing litter they do not provide broad benefits and should receive comparably less funding. Lot scale rainwater tanks (Scenario 5) provide a broad range of benefits and, although they are relatively expensive, the costs are funded by developers rather than Council.

The impact of funding

On balance, if Wyndham is to transition to a water sensitive city it needs to invest in infrastructure that delivers multiple benefits. No one scenario can achieve this alone. Based on these findings it is recommended that as a rule-of-thumb future investment in Council WSUD capital is spread as follows:

- 45% is invested into stormwater treatment infrastructure (i.e. Scenario 1)
- 10% is invested into litter reduction infrastructure (i.e. Scenario 2)
- 45% is invested into stormwater reuse infrastructure (i.e. Scenario 3 and 4)

Scenarios 1 to 4 all depend on Council funding. The level of funding will greatly influence Wyndham's projected (2040) Water and Pollutant Balance. As such, the impact of different levels of funding for WSUD capital works has been investigated based on the proposed breakdown of investment across each scenario. Three funding options have been considered, these are presented in Figure 60 and described below:

- **Option A** is based on an expenditure of $200,000 per annum from 2016 onwards.
- **Option B** is based on an expenditure of $200,000 in 2016, increasing at $100,000 per annum to a maximum of $1,000,000.
- **Option C** is based on an expenditure of $200,000 in 2016, increasing at $100,000 per annum to a maximum of $2,000,000.

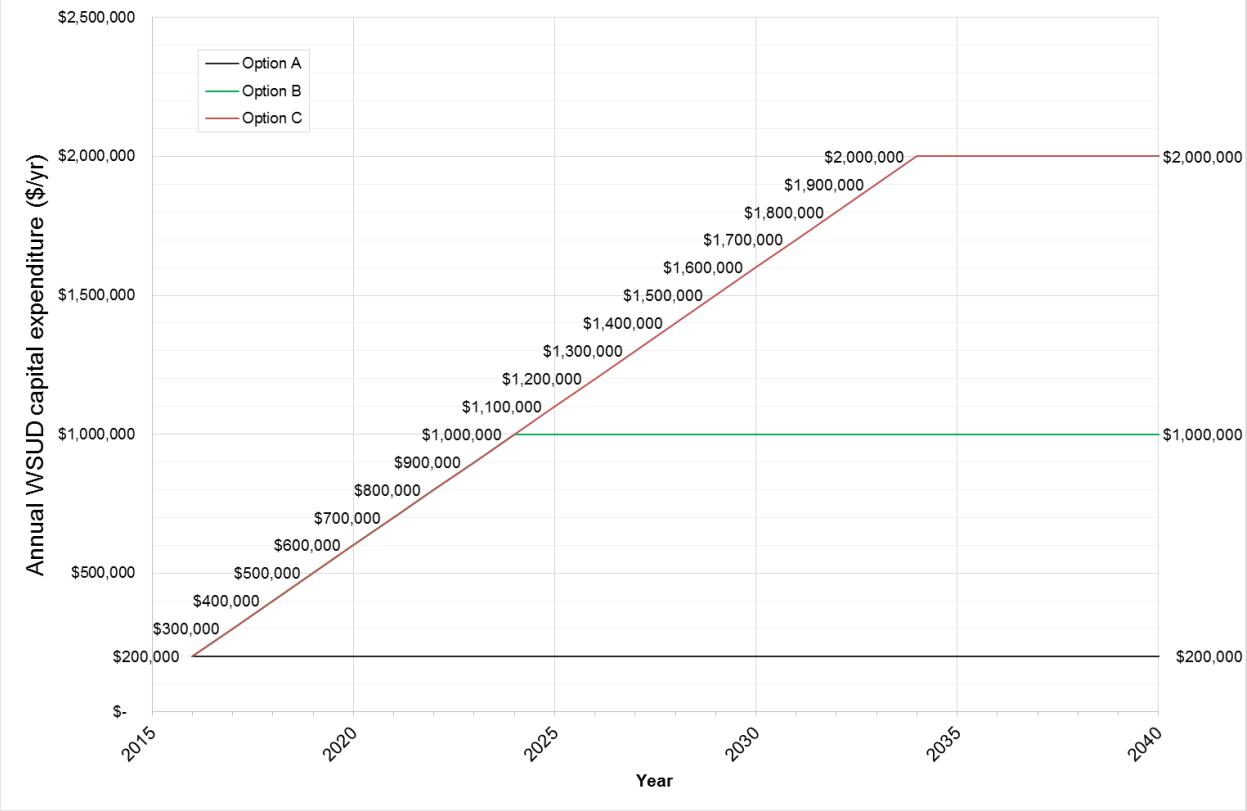


Figure 60 Potential WSUD capital expenditure options

Each option has been compared in terms of its ability to help Council meet best practice stormwater pollutant load reduction targets for nitrogen (i.e. 45% reduction). Based on current nitrogen loads across the municipality (146,732 kg/yr in 2016) this would equate to a reduction of 47,781 kg/yr to treat all urban runoff to best practice (Target A) and 66,030 kg/yr to treat all urban and rural runoff to best practice (Target B). It is recommended that Councils' investment in stormwater improvements should focus on existing urban areas (i.e. Target A). New urban areas should be treated to best practice by assets designed and constructed by developers. Council will need to fund the maintenance of these assets but will not be responsible for capital works. Rural areas should be addressed through catchment management and best practice farm management approaches. In these areas Council should continue to advocate for, and support the delivery of, improved stormwater management with the Port Phillip and Westernport Catchment Management Authority (CMA) and Southern Rural Water (SRW).

Of the funding options considered only Options B and C are able to meet Target A within the time frame of the analysis (Table 36). Option B represents a moderate and ongoing increase in expenditure and meets Target A within a 207 year period. Option C represents a higher level of ongoing expenditure and is able to meet Target A within 120 years, almost twice as fast as Option B. Option B is considered to be a realistic increase in IWCM expenditure that can deliver significantly higher pollutant load reductions and alternative water reuse by 2040. Consequently this option has been used as the basis for setting a stormwater reuse and nitrogen load reduction target for the municipality (Targets 1.2 and 2.1). A detailed breakdown of the benefits delivered by Option B level of funding in terms of stormwater reuse and total nitrogen reductions is in the body of the report Table 37 (p.120). Flow reduction, suspended solids, phosphorus and gross pollutant reductions are presented below in Table 37 (p.120).

Table 36 Summary of impact of different funding options

			Option A	Option B	Option C
Expenditure			$200,000 per annum from 2016 onwards.	$200,000 in 2016, increasing at $100,000 per annum to a maximum of $1,000,000.	$200,000 in 2016, increasing at $100,000 per annum to a maximum of $2,000,000.
Total benefits (2040)[1]	**Stormwater reuse (ML/yr)**		320	375[4]	413
	Flow reduction (ML/yr)		339	461	546
	Pollutant load reductions[3]	TSS (tonnes/yr)	109	455	697
		TP (kg/yr)	165	571	855
		TN (kg/yr)	1,274	3,336[4]	4,782
		GP (tonnes/yr)	29	130	200
Year Target A is Achieved			Not achieved by 2300	2222	2135

[1] This includes the benefits of Council funded works (i.e. scenarios 1 to 4) and developer funded works (i.e. scenario 5)

[2] Developer funded works accounts for >80% of stormwater reuse and >65% of flow reduction.

[3] Council funded works account for the majority (>80%) of pollutant load reductions.

[4] Council funded works account for 70.6 kL/yr of stormwater reuse and 2,666 kg/yr of nitrogen reduction, this has been used as the basis for setting Targets 1.2 and 2.1.

Table 37 Impact of Council investment (Option B) on Wyndham's projected water balance for flow, TSS, TP and GP reductions

Scenario		Funding Source	Year 2020 Total Investment (2017-2020)	Annual Flow Reduction (ML/yr)	Annual Suspended Solids Reduction (tonnes/yr)	Annual Phosphorus Reduction (kg/yr)	Annual Gross Pollutant Reduction (kg/yr)
1	More wetlands and bioretention systems	Council	$810,000	5.1	21.8	34.8	6.1
2	More gross pollutant traps (GPTs)		$180,000	0.0	11.1	1.4	3.7
3	Stormwater harvesting for active open space irrigation		$630,000	6.9	4.2	7.0	1.1
4	Stormwater harvesting for irrigation of passive recreation areas		$180,000	1.3	0.8	1.4	0.1
Subtotal - Council funded works			*$1,800,000*	*13.3*	*37.9*	*44.6*	*11.0*
5	Require rainwater tanks for development approval	Developers	$16,280,000	50.7	1.3	7.6	0.0
Total - Developer and Council funded works			***$18,080,000***	***64.0***	***39.3***	***52.2***	***11.0***

Scenario		Funding Source	Year 2040 Total Investment (2017-2040)	Annual Flow Reduction (ML/yr)	Annual Suspended Solids Reduction (tonnes/yr)	Annual Phosphorus Reduction (kg/yr)	Annual Gross Pollutant Reduction (kg/yr)
1	More wetlands and bioretention systems	Council	$9,540,000	59.9	256.7	410.0	71.9
2	More gross pollutant traps (GPTs)		$2,120,000	0.0	131.3	16.3	43.8
3	Stormwater harvesting for active open space irrigation		$7,420,000	81.5	49.1	82.2	12.9
4	Stormwater harvesting for irrigation of passive recreation areas		$2,120,000	15.6	9.8	16.4	1.2
Subtotal - Council funded works			*$21,200,000*	*157.0*	*446.9*	*524.9*	*129.8*
5	Require rainwater tanks for development approval	Developers	$16,280,000	303.9	8.0	45.8	0.0
Total - Developer and Council funded works			***$37,480,000***	***461.0***	***454.9***	***570.7***	***129.8***

Additional data and analysis

Scenario 1 - More wetlands and bioretention systems

Wetlands and bioretention systems filter stormwater to remove pollutants and improve water quality to protect downstream waterways. To characterise the potential benefits of retrofitting stormwater treatment wetlands and bioretention systems into Wyndham's existing streets, parks and waterway corridors a typical residential catchment has been simulated in MUSIC and wetland and bioretention systems sized to achieve best practice pollutant load reduction targets.

For a 10 ha catchment with an impervious proportion of 60%, a 1,760 m^2 wetland treatment area is needed (and an additional area around the wetland for batters, maintenance access, sediment drying etc.). The expected construction cost is $209,000, including establishment costs for the first two years of $26,000. The ongoing annual maintenance costs are $3,700 (Melbourne Water cost table from March 2016).

A 300 m^2 bioretention treatment area is required to treat stormwater runoff from a 10 ha catchment with 60% impervious proportion to achieve the same pollutant load reduction targets. The expected construction cost is $120,000, including establishment costs for the first two years of $10,920. The ongoing annual maintenance costs are $1,560 (Melbourne Water cost table from March 2016).

The table below shows the potential benefits for scenario 1 with the $1 million budget equally split between wetlands and bioretention systems. This would enable best practice targets to be achieved for a 66 ha catchment.

- Wetlands provide greater flow reduction and can provide greater amenity and habitat value.
- Bioretention systems achieve greater pollutant reduction and have a smaller footprint.

Table 38 Scenario 1 data

Scenario 1	Wetlands	Bioretention	Combined
Available budget	$500,000	$500,000	$ 1,000,000
System size(m^2) for 10 ha catchment	1,760	300	2.4 wetlands 4.2 biofilters
Capital Cost estimate per system	$209,000	$120,150	$ 1,000,000
Maintenance (following two years establishment)	$3,700 / yr	$156 - 520 / yr	$15,340 for 6.6 assets
No. of systems	2.4 wetlands	4.2 bioretention	6.6
Flow (kL/yr)	5,026	1,248	6,275
Total Suspended Solids (kg/yr)	9,890	17,020	26,900
Total Phosphorus (kg/yr)	17	26	43
Total Nitrogen (kg/yr)	83	138	221
Gross Pollutants (kg/yr)	2,750	4,790	7,540

Scenario 2 - More GPTs

Gross Pollutant Traps are effective devices for trapping litter and sediment, particularly at litter hot spots (e.g. at shopping precincts and along major roads). These devices require significant management and maintenance to ensure they continue to operate effectively. They do not provide additional landscape value in the way that a well-designed wetland or bioretention system can.

For a 10 ha catchment with an impervious proportion of 60%, a GPT with a capacity of up to 300 L/s may be required. The cost of a system of this size is expected to be $52,000 (Melbourne Water cost table from March 2016). Based on WCC maintenance of existing GPTs the expected annual maintenance cost is $2,250. This assumes the system requires clean out on average 1.5 times per year with a vacuum truck and the cost each time is $1,500.

The table below shows the potential benefits for scenario 2. For the nominal 1 million dollar budget 19 GPTs could be installed, removing sediment and litter from a catchment area of 190 ha.

Table 39 Scenario 2 data

Scenario 2	GPTs
Available budget	$1,000,000
System size(m^2) for 10 ha catchment	Underground, e.g. Rocla CDS1012
Capital Cost estimate per GPT	$52,000
Maintenance	$2,250 / yr $43,270 /yr for 19.2 GPTs
No. of systems for available budget	19.2 GPTs
Flow (ML/yr)	0
Total Suspended Solids (kg/yr)	61,900
Total Phosphorus (kg/yr)	8
Total Nitrogen (kg/yr)	0

Gross Pollutants (kg/yr)	20,680

Scenario 3 - Stormwater harvesting for active open space irrigation

A stormwater harvesting scheme associated with reuse for irrigation of an active open space recreation area can provide multiple benefits:

- Stormwater treatment and reuse – reducing pollutants discharged to the environment and providing an asset (e.g. wetland) that can improve amenity and habitat values.
- Conservation of potable water with reuse of stormwater as an alternative water source
- Increasing amenity and liveability with water available for irrigation of fields to maintain the recreational values desired by the community.

To characterise the potential benefits of providing a stormwater harvesting scheme to irrigate an active open space area in Wyndham a scheme has been modelled in MUSIC with 75% reliability to meet the irrigation demand for a typical 2.5 ha active open space area. The 10.5 ML/yr irrigation demand assumes an irrigation rate of 4.2 ML/yr/ha (for active recreation area with warm season turf). It is important to note that it is not recommended that stormwater systems be designed to be more than 70-80% reliable. Increasing reliability above this range is typically uneconomical as large increases in storage (and therefore costs) are required to supply a relatively small additional amount of water. Instead, it is recommended that Council irrigate with potable top-up during extended dry periods or cease irrigation when stormwater is not available. It is recognized that this second 'no-irrigation' option may be difficult to achieve once the local community become familiar with a set level of service / irrigation.

The system configuration includes:

- 15 ha catchment (60% impervious area)
- Diversion structure (which Melbourne Water may require to allow some low flows to bypass, the model simulated catchment baseflows bypassing).
- A wetland with an area of 2,640m^2 (wetland inlet zone 600m^3, macrophyte surface area 2,340m^2).
- A 650 kL underground tank (note that a 500 – 900 kL required for 71 – 81% reliability respectively).
- A transfer main, pump, electrical cabinet/controls and provision of power.

It is assumed that the irrigation infrastructure (including connection to a potable top-up) for the fields is separately costed.

The expected construction cost is $992,000, with ongoing annual maintenance costs for the wetland and storage tank of $8,200 (Melbourne Water cost table from March 2016).

The table below shows the potential benefits for scenario 3. For the nominal $1 million budget, 1 scheme to irrigate active open space could be constructed treating a catchment area of 15 ha.

Table 40 Scenario 3 data

Scenario 3	Stormwater Harvesting for Active Open Space Irrigation
Available budget	$1,000,000
Wetland size (m^2) for 15 ha catchment	2,640 m^2
Capital Cost estimate per system	$ 992,000
Maintenance Costs (for wetland and storage tank)	$ 8,190 / yr $ 8,260 / yr for 1.01 systems
No. of systems for available budget	1.01
Flow reduction (kL/yr)	10,990
Total Suspended Solids (kg/yr)	6,600
Total Phosphorus (kg/yr)	11
Total Nitrogen (kg/yr)	63
Gross Pollutants (kg/yr)	1,730

Scenario 4 - Stormwater harvesting for irrigation of passive recreation areas

A stormwater harvesting scheme associated with reuse for irrigation of ***passive*** open space recreation area can provide multiple benefits (in the same way as for irrigation of ***active*** open space) through stormwater treatment and reuse, conservation of potable water and increasing amenity and liveability with water available for irrigation to maintain the amenity of the passive recreation areas appreciated by the community. Providing greater amenity for passive open space areas is important given the high number of people of diverse gender, age, social interests and cultural background in Wyndham who benefit from greater amenity of passive open space areas for general recreation, social interaction and relaxation.

To characterise the potential benefits of providing a stormwater harvesting scheme to irrigate an passive open space area in Wyndham a scheme has been modelled in MUSIC with 75% reliability to meet the irrigation demand for a typical 1.5 ha passive open space area. The 3.4 ML/yr irrigation demand assumes an irrigation rate of 2.3 ML/yr/ha (for passive recreation area with warm season turf).

The system configuration includes:

- 5 ha catchment (60% impervious area). The catchment can be much smaller than for irrigation of an active open space area due to the lower irrigation demand. For a specific scheme the catchment sizes upstream of the open space area would be simulated and a suitable diversion structure proposed.
- Diversion structure (which Melbourne Water may require to allow some low flows to bypass, the model simulated catchment baseflows bypassing).
- A wetland with an area of 880m^2 (wetland inlet zone 200m^3, macrophyte surface area 780m^2).
- A 200 kL underground tank (to achieve 75% reliability in meeting irrigation demand).
- A transfer main, pump, electrical cabinet/controls and provision of power.

It is assumed that the irrigation infrastructure for the passive recreation area is separately costed. The expected construction cost is $474,000, with ongoing annual maintenance costs for the wetland and

storage tank of $3,400 (Melbourne Water cost table from March 2016). The table below shows the potential benefits for scenario 4. For the nominal $1 million budget, 2.1 schemes to irrigate passive open space could be constructed treating a catchment area of 11 ha.

Table 41 Scenario 4 data

Scenario 4	Stormwater Harvesting for Passive Open Space Irrigation
Available budget	$1,000,000
Wetland size(m^2) for 15 ha catchment	880 m^2
Capital Cost estimate per system	$ 474,000
Maintenance Costs	$ 3,350 / yr $ 7,070 / yr for 2.1 schemes
No. of systems for available budget	2.1
Flow reduction (ML/yr)	7,380
Total Suspended Solids (kg/yr)	4,600
Total Phosphorus (kg/yr)	8
Total Nitrogen (kg/yr)	43
Gross Pollutants (kg/yr)	1,210

Scenario 5 - Require rainwater tanks for development approval

Council can encourage the installation of rainwater tanks and the greater use of alternative water sources (harvested rainwater) for toilet flushing and laundry demands (as well as irrigation and even hot water demands). This scenario describes the potential benefits that could result each year from a requirement to install a rainwater tank as part of the planning permit approval process.

Residents and developers bear the costs for rainwater tanks on their properties. They benefit from reduced water usage costs and the availability of self-sufficient alternative water source. Council also benefits from the reduced volume of stormwater runoff and a reduction in stormwater pollutants.

Capital costs for this scenario are small for Council investment, but non-structure measures are critical for successful implementation in terms of:

- Providing supporting information to residents about rainwater harvesting. Ideally this would include support and access to tools for optimum sizing of rainwater tanks, factoring in roof-to-tank area, expected reuse demand and local rainfall (e.g. Melbourne Water's STORM tool).
- Providing training internally to support personnel in communicating effectively with residents and developers who will incur the additional costs associated with the installation of rainwater tanks.
- Providing information to residents about maintenance of rainwater tanks, other IWCM initiatives residents may be interested in (e.g. on lot raingardens).
- Keeping records of the rainwater tank configurations installed so that future assessment of the effectiveness of rainwater tank installation can be informed by reliable data.

Building permit approvals

An estimated 442 rainwater tanks would be installed annually through this scenario, based on the breakdown of Council's planning permit approvals for 2015 – 2016 (Table 42). It is noted that single

dwellings still make up nearly 90% of the dwellings in Wyndham (*"In 2011, there were 52,957 separate houses in the area, 5,757 medium density dwellings, and 246 high density dwellings'* (Profile.i.d., 2016)). Permits for additional dwellings include small subdivisions in existing residential neighbourhoods creating smaller separate dwellings on the existing lot and densification with multistorey dwellings. The character of typical multi-residential dwellings will influence roof-to-tank areas and the feasibility of plumbing the rainwater tank supply to toilet and laundry and other demands (e.g. irrigation).

Rainwater tank sizing needs to be conducted on a case-by-case basis using industry tools such as STORM to optimise roof-to-tank areas, plumbing to appropriate demands and suitable tank sizing.

Table 42 Council statistics, planning permit approvals for 2015 – 2016

Type	**Approvals**	
Single dwelling and residential extension	52	12%
Multi-residential: 2 dwellings	82	19%
Multi-residential: 3 - 5 dwellings	229	52%
Multi-unit: 6 - 8 dwellings	79	18%
Total	**442**	**100%**

Reuse demands

The expected reuse demands for toilet flushing and laundry are based on medium to high density dwelling data from City West Water (2015). The assumptions underpinning the simulations include:

- Toilet flushing demand, 21 L/person/day
- Laundry demand, 22.8 L/person/day

Single dwelling / duplex

- Occupancy 2.5 – 2.8 people per dwelling
- Toilet and laundry demand, 117 L / household / day
- Roof-to-tank areas 100 – 200m^2
- Tank size 3 – 5 kL with 1 kL for OSD, 2 – 4 kL active storage

Multi-residential dwellings: apartments / units

- Occupancy 2 people per dwelling (worst case average given Wyndham average is 2.9)
- Toilet demand for 4 units, 168 L / household / day (worst case: plumbed just to toilet flushing)
- Toilet and laundry demand for 4 units, 351 L / household / day
- Unit roof-to-tank area 200 – 400 m^2 for 4 units (worst case: 50 – 100 m^2 roof area per unit)
- Unit tank size 10 kL with 1 kL OSD, 9 kL active storage

Rainwater tank reliability

The reuse that occurs from rainwater tanks for a range of simulations in MUSIC are shown in Table 43. These simulations are conservative (with smaller roof areas and lower occupancy where there is uncertainty in estimates). The simulations explore the likely roof-to-tank areas, tank volumes and reuse

demands for single dwellings and for units. High reliability of supply can be achieved where the input parameters are optimised – with either a large roof-to-tank area or a large tank. Similarly increasing demands to include irrigation or hot water demands provides further benefits.

Table 43 Simulations of a range of rainwater tank reuse configurations

Type	Roof-to-tank area (m^2)	Tank Size (kL)	Reuse Demand (kL/d)	Reuse Supplied (kL/yr)	% Reliability
Small house, small roof, small tank	100	2 kL active	0.117	33	77 %
Small house, big roof, small tank	200	2 kL active	0.117	38	90 %
Small house, small roof, large tank	100	4 kL active	0.117	37	87 %
Small house, big roof, large tank	200	4 kL active	0.117	41	97 %
4 Units, small roof, 9 kl storage vol, plumbed to toilet demands only	200	9 kL active	0.168	59	96 %
4 Units, larger roof, 9 kl storage vol, plumbed to toilet demands only	400	9 kL active	0.168	61	100 %
4 Units, small roof, 9 kl active storage, toilet & laundry reuse	200	9 kL active	0.351	88	69 %
4 Units, larger roof, 9 kl active storage, toilet & laundry reuse	400	9 kL active	0.351	114	89 %
Estimated reuse for 442 dwellings					**12.664 ML/yr**

The conclusions are:

- 33 – 41 kL/yr/dwelling can be reused for typical small separate dwellings
- 59 – 114 kL/yr/ four units can be reused (15 – 29 kL/yr/unit)
- An estimated 12.7 ML of rainwater could be reused each year (based on the permit type breakdown and the reuse per dwelling ranges above. 18% dwellings with 15 kL/yr reuse, 52 % dwellings with 29 kL/yr reuse, 19% dwellings with 33 kL/yr reuse and 12% of dwellings with 41 kL/yr reuse).

The estimated 12.7 ML of rainwater reuse characterises of the benefits for scenario 5. This scenario involves a larger capital investment than the other scenarios but the costs are borne by residents or developers. The roof area treated is approximately 4.5 ha.

Table 44 Scenario 5 data

Scenario 5	Rainwater tanks required through permit approvals
Typical tank size per dwelling (kL)	2 – 4 kL active storage
Typical roof to tank area	100 – 200m^2 for houses, 50 – 100m^2 for units
Demands	Toilet and Laundry or Toilet only
No. of systems expected each year	442
Flow reduction (ML/yr)	12.7
Total Suspended Solids (kg/yr)	330
Total Phosphorus (kg/yr)	2
Total Nitrogen (kg/yr)	28
Gross Pollutants (kg/yr)	878

Attachment 4 – Additional Actions

Several additional actions were identified during consultation that support or build on the shorter term, higher priority, actions identified in the roadmaps above. These long term actions have been included in this attachment to support Wyndham's transition to a water sensitive city. These actions are based on outcomes of workshops and interviews held with Council staff and external stakeholders. The recommended actions are categorised under one of the objectives identified for this IWCM Plan and linked to relevant targets.

Roadmap 1

No.	Action	Considerations	Priority	Resources	Responsibility
1.8	**Account for cost savings and broad benefits:** Account for cost savings and broad benefits (i.e. beyond those associated with essential services) as part of the design and delivery of IWCM assets.	• Use the IWCM Assessment Tool provided in Attachment 5. • Consider potential energy-savings from reduced use of air conditioning due to shading and evapotranspiration due to the construction of green infrastructure. • Benefits that can be readily monetised included nitrogen load reductions and alternative water supply. The evidence base for quantifying increased property values is also increasing. • Potential other benefits from IWCM assets included (a) avoided heat-related morbidity and mortality, (b) cost-savings gained from avoided flooding and avoided hospital admissions, (c) increased productivity gained from avoided sick leaves, (d) improved liveability.	Medium	Staff time	Environment and Water, Assets and Roads, Planning and Building, Risk Management
1.9	**Irrigation of passive open space:** Develop a strategic plan for the irrigation of passive open spaces based on a consideration of community need (high use areas, planned park renewal works, need to reduce urban heat impacts), existing and planned recycled water networks and the potential for stormwater harvesting.	Trial sites along creek lines and identify opportunities in new growth areas.	Medium	Staff time	Environment and Water, Assets and Roads,
1.10	**Facilitate resource recovery:** At Council aquatic centres investigate and adopt best practice pool backwash management techniques.	Continue to identify and support other initiates that close the loop by: • Avoiding the use of proprietary products that are disposed of to landfill once used (e.g. some underground filtration modules). • Reusing nutrients in recycled water / stormwater by using these alternative water supplies to irrigate Council open space or productive landscapes (e.g. fruit trees or community gardens). • Supporting community green waste collection and consider initiatives to encourage composting of food scraps. • Finding alternative ways to manage sediment from WSUD assets.	Medium	New staff	Environment and Water, Assets and Roads,
1.11	**Guidelines for tree health:** Create best practice design guidelines for trees and vegetation:	Consider soil / root space for tree health and water storage, species selection (e.g. tolerant to existing and future climate conditions), integration with streetscape design, opportunities to minimise maintenance and potable water supply.	Medium	New staff and specialist advice (10k – 20k)	Environment and Water, Assets and Roads, Vibrant City Centres, Road Design
1.12	**Integrated and intelligent controls:** Use intelligent controls for irrigation and management / operation of Council assets.	• Maintain and improve efficient open space irrigation and / or building management actions as recommended in the Water Action Plan. Use technology to optimise irrigation scheduling. • Consider opportunities for intelligent control of OSD structures (e.g. talking tanks by iota). • Manage systems using appropriate resources to rapidly detect water leaks (e.g. efficient / integrated analysis of water bills). • Use integrated asset management systems to record images of asset status and link with design documents for each asset.	Medium	Staff time	Environment and Water, Vibrant City Centres
1.13	**Distributed systems**: Require rainwater tanks on infill developments, include OSD requirements and encourage reuse (e.g. toilet and garden).	Beyond infill development design and approve water management at appropriate scales (lot, streetscape, precinct, end of catchment, regional etc.) • In new developments focus on centralised treatment systems (e.g. wetlands) that are robust to changing catchment conditions and relatively easy to maintain. Use some sites/developments to test and explore alternative distributed WSUD (e.g. swales and bioretention systems) but in doing so learn from mistakes in past developments. • Explore opportunities to retrofit WSUD treatments into existing urban landscapes, end of pipe systems where river outfall possible but also works within catchments (e.g. precinct and streetscape scale) where this isn't possible.	Medium	Staff time	Environment and Water, Assets and Roads, Planning and Building, Vibrant City Centres
1.14	**Reduce energy use:** Produce study that identifies how Council water use contributes to Council's corporate greenhouse emissions and identify opportunities to support reductions in line with the targets identified in the Environment and Sustainability Strategy (2016 – 2040).	Reduce energy use related to Council water use practices by: • Consider greenhouse gas emissions as part of water projects (e.g. pumps, filtration, membranes, and disinfection systems). • Providing efficient pool heating (best practice benchmarks). • Install higher efficiency fixtures / fittings / appliances (particularly when renewal is scheduled).	Medium	New staff	Environment and Water, Planning and Building, Vibrant City Centres
1.15	**Accessible and multi-functional assets:** Allow for public access to Council water assets (including surrounding land) where appropriate and identify opportunities where new and existing assets can be multi-functional.	For example, retrofit treatment assets into retarding basins and provide an educational experience as part of waterway flood signage.	Low	Staff time and funding (variable based on projects identified)	Environment and Water, Assets and Roads, Urban Futures, Risk Management, Community Planning and Development, Sport and Recreation
1.16	**Deliver robust infrastructure:** Continue to reinforce Councils endorsement of wetlands as the preferred WSUD treatment in new	• Design and approve robust water management infrastructure. Identify issues that compromise the longevity of systems and inform planning and approval processes through best practice guidelines for design,	Low	Staff time	Environment and Water, Planning and Building and Vibrant City Centres

No.	Action	Considerations	Priority	Resources	Responsibility
	developments due to its robustness as detailed in the Stormwater Management Plan.	construction and maintenance. • Ensure access is provided for maintenance so that the systems can function effectively in the long term. • Require some flexibility in design to adapt systems to future changing catchment conditions (e.g. orifice outlet plates that can be adjusted if catchment imperviousness increases or to optimise once the hydrology of the system can be observed, additional waterway buffers to plan for increased flows due to development and / or future high intensity storms due to climate change, additional open space set aside for future storages / treatments that form part of alternative water supply networks).			
1.17	**Water related businesses and productivity:** Support existing water related businesses and facilitate new opportunities for commercial growth that supports IWCM outcomes. .	• Understand the scale of the businesses and employment connected to water related businesses based or operating in Wyndham. • Relevant business and entrepreneurs may include rainwater tank suppliers, agri-business, bush regeneration, eco-tourism, consulting, technology providers, maintenance, contractors, and reputable consultants and professionals.	Low	New staff	Environment and Water, Business Development

Roadmap 2

No.	Action	Considerations	Priority	Resources	Responsibility
2.11	**Litter management:** Provide resources to investigate where to the most suitable locations to retrofit GPTs along waterways.	• Improved litter management along waterways will help deliver on the objectives of the Waste and Litter Strategy and Environment and Sustainability Strategy. • Review and evaluate the performance of existing GPTs with a view of upgrading and/or amending maintenance regimes to further reduce litter and sediment entering the waterway (underway).	Medium	Staff time	Environment and Water, City Assets and Property, Assets and Roads
2.12	**Best practice guide to development:** Work collaboratively within Council to create a best practice guide to development that ensures liveability, resilience, waterway health and amenity are improved.	• Use this IWCM Plan to inform Council led developments and communicate Council expectations with developers • Define IWCM standards for Council led developments, greenfield, renewal and infill development. • Create mechanisms to better incorporate IWCM opportunities into development planning. • Consider developing a framework for developers in greenfield and existing suburbs to pay a 'development levy' to Council that will fund water management initiatives.	Medium	New staff	Environment and Water, Planning and Building, Urban Futures, Vibrant City Centres
2.13	**Advocacy:** Advocate to the Minister for Environment, Climate Change and Water, DELWP and the Victoria Environmental Water Holder to see if unallocated water in Lake Merrimu could be used for environmental flows. Raise at quarterly meetings with Southern Rural Water.	• Protect current 'green wedge' conservation areas from development and continue to advocate for improved protection of local areas with high ecological value. • Advocated to increase the percentage of water allocations for environmental flows and/or fund water recovery purchases	Low	Staff time	Environment and Water
2.14	**Impacts on groundwater**: Create an inventory of sites of known or suspected groundwater contamination (e.g. from old industries).	• Improve groundwater knowledge within Council and reduced impacts on this resource. • Implement a runoff limit policy to increase the level of passive infiltration in Wyndham. • Provide policy to ensure yard permeability, defining maximum proportions of lot coverage and enforcing these policies through review of permits and other approval processes. • Design parks for passive irrigation.	Low	Staff time	Environment and Water

Roadmap 3

No.	Action	Considerations	Priority	Resources	Responsibility
3.7	**Champions:** Identify IWCM champions who can drive the delivery of IWCM targets and obtain high level signoff in goal setting and resourcing needs at all levels of Council.	Ideally there will be champions from the Councillor to officer level and champions both internal and external to the interdepartmental working group.	Medium	Staff time	Environment and Water and the Water Sensitive Wyndham Interdepartmental Working Group
3.8	**Water Hub:** Develop a general Water Hub where the community can learn about and engage in local water issues (including Risk Management). Consult broadly with the community determine their needs.	• Consider housing the centre in an education centre / museum on public land around the Cheetham RAMSAR wetland. • Investigate multiple communication types (computer/web based, interactive sites, models, posters, presentations etc.) and ensure these are inclusive for CALD communities.	Medium	New staff and specialist advice (50k - doesn't include land, building, or materials)	Environment and Water, Community Planning and Development, Risk Management
3.9	**Water Literacy:** Ensure that a Council officer that is water literate and a skilled communicator participates in key community engagement events.	• Improve water literacy and understanding of water management through education, engagement and intuitive design. • Support citizen science initiatives related to water management, e.g. water quality monitoring, frog surveys and other activities. • Include engagement initiatives in the design of projects (e.g. drain stencilling, signage, arrows to show flowpaths of water in assets, litter education). • Connect with schools around local waterways, engage children to facilitate inter-generational learning (i.e. through children taking information home and sharing with family and friends).	Medium	Staff time	Environment and Water, Community Planning and Development, Risk Management
3.10	**IWCM asset coordination:** Review processes to ensure adequate internal collaboration occurs with planning, budgeting, approval, construction and handover of IWCM assets.	• Improve coordination of capital works so that WSUD and other opportunities are considered at the right time. Consider IWCM options early on in the reserve / open space design process. Use the IWM Assessment Tool to align proposed projects with Council's IWM Objectives and Vision. • Include maintenance costs in budgets for capital works to ensure funds are considered for the ongoing management. • Develop better communication and records of drainage function and design intent of assets handed over to maintenance.	Medium	New staff	Environment and Water, Planning and Building and Vibrant City Centres
3.11	**Integrated planning:** Improve the integration of water management and town planning to build future resilience:	• Consider IWCM in land use zoning (e.g. setting aside land for stormwater infiltration, storage and treatment, flood protection, productive land uses, adequate green spaces for recreation within catchments). • Respond to local issues and ensure housing is contained and separated from green space. • Engage with technical personnel within Council to inform design of multi-purpose spaces.	Medium	Staff time	Environment and Water, Planning and Building, Urban Futures, Assets and Roads, Risk Management
3.12	**Community maintenance:** Promote the "Snap Send Solve" (or similar) smartphone app to the community to assist with early response to localised floods and blocked drains (see Western Alliance for Greenhouse Action climate change adaptation recommendations).	• Engage with the community to understand and communicate with Council when maintenance issues are identified. • Provide information about maintenance of on-lot IWCM assets (e.g. City of Port Phillip raingarden, rainwater tank and porous pavement fact sheets). • Create an inventory of distributed private WSUD systems to allow for future checks.	Low	Staff time	Environment and Water, Risk Management, Vibrant City Centres, Community Planning and Development
3.13	**Engage with residents and developers on IWCM assets:** Provide information and tools about IWCM or provide links to Melbourne Water / City West Water resources (e.g. STORM tool for rainwater tank sizing, how to build a raingarden fact sheets) for developers and residents.	• Encourage IWCM opportunities on private land by providing a checklist for new buyers / residents about IWCM / WSUD. • Consider providing maintenance advice and recording the location and size of decentralised lot scale systems to inform future assessment of take up / effectiveness of various strategies in each catchment. • Investigate how developers and Council can better regulate maintenance of on lot raingardens, OSD systems, GPTs and rainwater tanks. • IWCM opportunities for residents may include water conservation and leak detection, rainwater reuse for toilet, laundry and garden demands and even hot water demands, raingardens, downpipe diversions, green roofs / walls. • Recognise the Green Star accreditation system as a key regulatory driver that will help Wyndham achieve some of its goals around water management. Council can play a role in creating broad scale change by working with developers and looking at the strategies that assist sustainability and liveability outcomes.	Low	Staff time	Environment and Water, Community Planning and Development
3.14	**Equitable access to water:** Ensure drinking fountains and toilets are available in adequate numbers in appropriate locations and provide free access (where possible) to recreational assets that support community connection to water.	• Engage with residents to identify and resolve any issues about equity in access and affordability related to water servicing and integrated infrastructure. • Understand and meet the needs of all the community (gender, age, culture, language, location) in providing water services and broader benefits from IWCM, using the Wyndham 2040 District Plans. • Represent the community appropriately in consultation with water utilities to ensure the views of the community are understood.	Low	Staff time	Environment and Water, Assets and Roads, Community Planning and Development, Sport and Recreation

Attachment 5 – Record of Consultation

The integrated water cycle management Plan has been developed in close collaboration with Council staff and other project stakeholders including Melbourne Water, City West Water, DELWP and water related community groups. Workshops and interviews were conducted throughout the project to gain valuable knowledge from the project stakeholders and to also develop the Plan together. This attachment presents the outcomes of these key collaborative events.

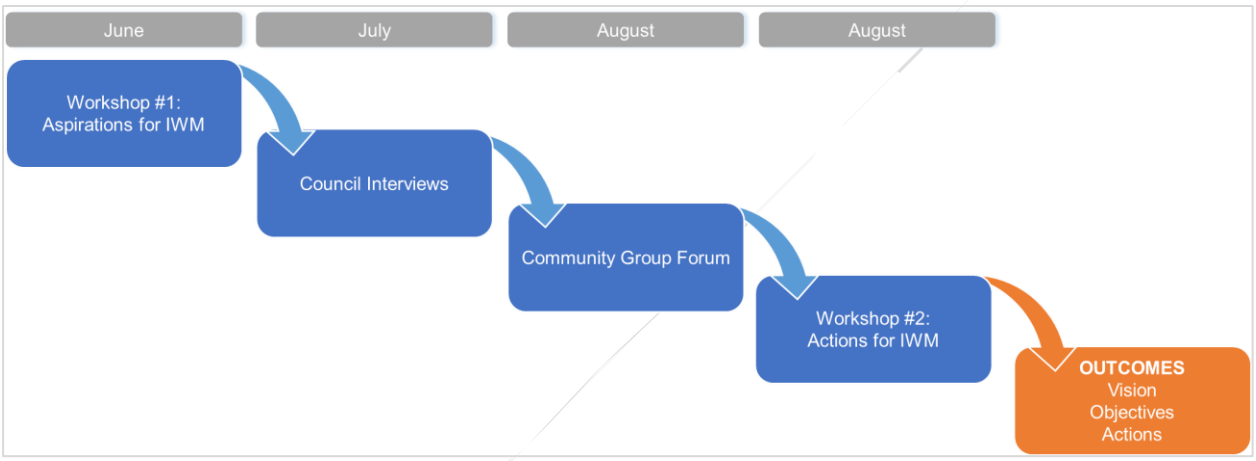


Figure 61 Overview of the consultation process

Workshop 1

Date: 23/06/2016

Record of attendance

Organisation	Invitee (Name - Role)	Attendance
Wyndham City Council	Andrew Bishop – Strategic Planner	Y
Wyndham City Council	Craig Toussaint – Place Manager	Y
Wyndham City Council	Elio Comello – Coordinator Strategic Planning	Y
Wyndham City Council	Fiona Stevenson – Team Leader Sustainability	Y
Wyndham City Council	Hayley Jarvis – Team Leader Waste Strategy	Y
Wyndham City Council	Kuan Yeoh – Senior Engineer Drainage and Water Management	Y
Wyndham City Council	Melissa Falkenberg - Manager Urban Spaces and Civil Works	Y
Wyndham City Council	Mirna El-Moslmani - Drainage Engineer Drainage and Water Management	Y
Wyndham City Council	Peter Gibbs – Team Leader Environment	Y
Wyndham City Council	Peter Gordon - Coordinator Roads	Y
Wyndham City Council	Ross Kingston – Sustainability Projects Officer	Y
Wyndham City Council	Shane Warden – Manager Facilities and Open Space	Y
Wyndham City Council	Stan Peska – Coordinator Engineering Development, Strategic Transport and Growth Infrastructure	Y
Wyndham City Council	Stephen Thorpe – Manager Assets and Roads	Y
Wyndham City Council	Susan Stanes – Coordinator Landscape, Urban Design and Civil Works	Y
E2Designlab	Celeste Morgan - Sustainability	Y
E2Designlab	Simon Roberts - integrated water cycle management Engineer	Y
Wyndham City Council	Antoniette Michail – Coordinator Engineering Development, Strategic Transport and Growth Infrastructure	N
Wyndham City Council	Clifford Eberly – Senior Research and Policy Officer	N
Wyndham City Council	Craig Dodson – Area Leader Conservation and Open Space	N
Wyndham City Council	Dayane Mardesich – Coordinator Capable Communities	N
Wyndham City Council	Georgie Hill – Coordinator Governance and Community Engagement	N
Wyndham City Council	Madeleine Veale – Community Development Officer	N
Wyndham City Council	Marc Cassanet – Coordinator Environment and Sustainability	N
Wyndham City Council	Margret Evans – Coordinator Town Planning	N
Wyndham City Council	Mark Boyle – Coordinator Parks, Open Space	N
Wyndham City Council	Martin Rowland – Team Leader Subdivisions Urban Design	N
Wyndham City Council	Steven Crimston – Emergency Management Officer	N
Wyndham City Council	Sue Hawes – Open Space Planner	N
Melbourne Water	Micah Pendergast - Stormwater Regional Coordinator - West	N

Purpose: Half day workshop to:

- Provide attendees with a summary of the background literature review and data analysis – including contextual mapping and water balance outcomes – to ensure that all attendees are aware of the different drivers and opportunities for IWCM in the municipality.
- Raise awareness across Council departments this project is occurring and establish a shared understanding of what integrated water cycle management is.
- Bring together and articulate a vision statement and objectives for integrated water cycle management in Wyndham.
- Explores issues and opportunities.

Activity 1: What are Council's IWCM Aspirations?

Attendees worked together in groups to capture Council's IWCM aspirations. Attendees were instructed to think of five future examples of what success looks like for water management in Wyndham. The following three objectives were used to stimulate conversation and categories aspirations.

Blue objectives	Green objectives	Pink objectives
To provide resources at different scales in fit-for-purpose applications that can cope with increasing pressures placed on our urban landscapes by population growth and climate change.	To create green ecological landscapes those provide multiple benefits such as heat mitigation, ecosystem health and restoration, and landscape amenity.	Where people can learn and engage in water-conscious behaviours, feel connected to their water environments and appreciate the many values of water.

The aspirations recorded under each of these objectives are presented below.

Blue Aspirations

- Increased use of storm water/grey water for private outdoor irrigation washing uses -> up to 90% by 2046
- Retain as much rainwater on site as possible.
- Rainwater tanks compulsory for residential properties over a certain size for grey water use.
- Have a proven IWCM infrastructure suited to WCC conditions and with a known whole-of-life affordability clearly identified.
- Roll out of a well-planned program of integrated water projects across the city in all new capital works.
- Improved management of WSUD/ water harvesting / irrigation assets
- Reduce unmanaged/unfiltered runoff into waterways
- To explore ideas and solution for flood mitigation in urban areas (smart technologies, community engagement etc.).
- Wyndham will have functioning and well serviced litter abatement systems on all stormwater outlets.

- Drainage, water detention, treatment, and uses are managed as an integrated Council service.
- Fit for purpose, potable water only used for drinking and showering
- A city that has secure water supply for its agriculture sector whilst encouraging sustainable water use.
- All non-potable uses are able to be serviced by alternative water sources
- Increased rain and grey water harvesting and reuse.
- Potable water replaced with stormwater/recycled water for as many applications as possible
- A city that not only reduces its water consumption but reduces its reliance on the belief that water resources are unlimited
- A city where development is set back from natural waterbodies and future (modelled) 1:100 flood levels.
- Residents of Wyndham value gardens and trees in both the private and public realm for their benefits. Gardens and trees are able to be sustained.

Green Aspirations

- Food production is viable and sustainable
- Continuous urban forest effect
- Green parks (grass & trees, local level) in most neighbourhoods for residents to use (urban comfort benefit, mental health & general well-being).
- Creating green assets that have multiple functions. I.e. Stormwater treatment systems that support vegetation growth and provide social benefits to be enjoyed by residents.
- Provide as much ‘passive’ green space as we do ‘active’ green space.
- Reduce evapotranspiration
- Wyndham to be known as a green and well vegetated municipality, rather than a dry municipality with low levels of tree canopy/vegetation.
- Green spaces in all parks, all year round (to support community well-being).
- Significant tree canopy coverage – supported through all water sources
- Greener and higher density treed public places
- More trees on residential properties and in passive open spaces. More watering required.
- Different shades of green
- Urban greening supported by alternative water
- Ability to use all recreational facilities all year round – irrigated using alternative water sources
- Water in waterways supports diverse/natural flora and fauna – improved water situation
- Healthy waterway and coastal environments
- Healthy waterways, corridors & associated green spaces (*environmental flows *Reduce pollution and sediment loads)
- Increased river/wetland/waterway health
- Urban greenery with pedestrian access
- Irrigation channel that serves Werribee South irrigation district -> opportunity to recreate more natural spaces

- Preservation of national assets – fauna & flora
- A city that supports its natural flora, fauna and habitat conservation. Acknowledging the variance of urban & rural environments.
- Recreational facilities
- Identification of correct trees and vegetation to meet existing and future climate conditions.

Pink Aspirations

- Providing policy to ensure yard permeability
- Council actively engaged and collaborating with other Councils and water authorities to improve water access/use/policies strategies
- Construction of homes that incorporate a higher level of integrated water opportunities (through local policies). Excess go back into the network?
- Densification policy to ensure housing is contained and separated from green space.
- Community engagement and awareness
- Community adopts sections of waterways (similar to adopt a highway)
- A community engaged and aware of water use and an appreciation for the importance of water
- Residents actively/consciously participate in sustainable water management at a residential / local scale.
- Clear, simple Council strategy/policies around water use and management
- Re-education policies in schools for water appreciation
- Role and value of our waterways and assets is celebrated – past and present (indigenous heritage and use included), and leveraged to create great places
- No litter – behavioural changes
- To educate communities on the importance of water use and how their actions affect the environment
- Water quality is improved to allow swimming
- Educated and engaged community about water use – right water source for purpose

Activity 2: Building on Councils Strengths #1 - What are Council's IWCM Aspirations?

Attendees worked together in three groups to identify priority tasks/issues that need to be addressed in order for Council to realise its IWCM aspirations. Participants were asked to consider tasks and issues in the following three focus areas:

- Policy and legislation
- Governance and leadership
- Practices and technology

Three tasks/issues were addressed by each group and ranked in order of priority, these are summarised below.

Policy and legislation

Group1.

1. Design guidelines
    a. WSUD assets
    b. Local conditions – climate/rainfall patterns, evapotranspiration
    c. Local modelling
    d. Above ground, large soak systems
    e. Maintainability – space excavation
    f. Litter traps
2. Fit for purpose (ethical use water)
    a. Target and values
    b. Clearly assigned roles (asset owner, service manager & monitoring)
3. Water use targets (155 Litres/pp/day)

Group 2.

1. Enforcement of building site local laws and EPA controls
2. Planning permit conditions compliance – s173 agreement across the board
3. Litter strategy

Group 3.

1. Establish WSUD standards and guidelines
2. Policy for residential rainwater tank use and infill development relating to flood mitigation (etc. water management)
3. Testing of WSUD assets before handover to Council to check they are functioning and performing as required.

Governance and leadership

Group1.

1. Council should properly resource for a water management team to oversee all water related issues
    a. Planning approvals
    b. Construction & maintenance
    c. Asset recording & strategies
    d. Strategic direction
    e. Stakeholder collaboration (water authorities)
2. Develop a clear (Council) narrative about what is “good” or supported/encouraged water use and information around how Council values water; how it benefits the community -> use this to educate Councillors, staff and the community

3. Council to lead by example to implement water efficient and/or fit for purpose use in all Council's site/facilities.

Group 2.

1. Clearly assigned roles and responsibilities for stormwater and waterway management (e.g. asset owner, service manager)
2. Council buildings and ovals lead by example in alternative water usage
3. Develop protocols for improved collaboration with relevant stakeholders

Group 3.

1. A dedicated water team (i.e. water officer)
2. Resources to pilot projects – view risks as risks, not barriers.
3. United front internally on plumbing/permits building.

Practices and technology

Group1.

1. Improve WSUD asset monitoring and maintenance procedures to best practice
2. Porous paths and roads (e.g. existing trail in Watton St.)

Group 2.

1. Keeping good records of WSUD assets and measuring their effectiveness
2. Record and analyse what is collected from GPTs and wetlands on a regular basis
3. Budget planning

Group 3.

1. Be open minded to new technologies and trail projects - learn from the experience.
2. Identify and map green assets/WSUD assets for maintenance & planning purposes
3. Improve/enhance development approval knowledge & process to meet Council's standards (requires staff training)

Council Interviews

Date: 26/07/2016

Purpose: Series of 45 minute interviews with five Council groups representing multiple divisions. Interviews were held to identify:

- Short and long term opportunities and challenges for improved integrated water cycle management across Council in general and within specific Council divisions.
- The tools or processes that need to be created or improved to help specific Council divisions overcome challenges or take opportunities.

Group 1: Asset Management and Maintenance

Record of attendance

Organisation	Invitee (Name - Role)	Attendance
Wyndham City Council	Kuan Yeoh - Senior Engineer	Y
Wyndham City Council	Mark Hammett - Operations Manager	Y
Wyndham City Council	Mirna El-Moslmani - Drainage Engineer	Y
Wyndham City Council	Peter Gordon - Coordinator Assets and Roads	Y
Wyndham City Council	Shane Walden - Facilities and Open Space (and recently open space planning)	Y
Wyndham City Council	Steven Crimston - Emergency Management Officer	Y
E2Designlab	Celeste Morgan - Sustainability	Y
E2Designlab	Simon Roberts - integrated water cycle management Engineer	Y
Wyndham City Council	Geoffrey Youla	N
Wyndham City Council	Stephen Thorpe - Manager Assets and Roads	N
Wyndham City Council	Tony Mangiardi - Co-ordinator Asset Management	N

Summary transcript

1. What are the short and long term challenges facing Council in general and your division of Council specifically?

Litter

- Litter is a big problem. Employs 8 people full time, and also affects open space. $2M out of $5M is for picking up litter/illegal dumping of cleaning budget. Community education is needed. They do have maintenance budgets which can be reviewed.

Asset Records and Maintenance

- Don't have all WSUD in asset management system – some are on GIS system. Over next 12-18 months it will be updated.
- Didn't have a maintenance for wetlands until last year – only $30,000. Only basic maintenance provided.
- Maintenance don't know what they are looking for – end up guessing. Problem is maintenance is 'vanilla' and generic for different system.

New Developments

- There is poor sediment management during construction phase. Getting better at making developers clean it out before handover, but should be avoided in the first place.
- Ongoing challenge to get space for access and sediment drying areas.
- New retarding basins aren't on the GIS system or asset management system.

Handover

- Handover process pretty smooth.
- Register of new WSUD assets from developers is not given to Council – this is a problem.
- Subdivision inspectors need some guidance on what to look for in handover.

WSUD Assets

- Swales are difficult in residential areas– access difficulties and people difficulties (e.g. drive over swale medians). The swale out the front of Council is watered.
- GHD study suggested that only one plant type will survive in Wyndham's climate. 338 mm of rain last year. In the long term – limited plant stock and potential for bioretention.
- Integration of WSUD assets into the maintenance budgets has only just begun.
- Do not like roadside swales and end of line bioretention systems.

Stormwater Harvesting

- Recycled water – take or pay contract – some sites coming up for renewal. There are concerns about reliability and difficulty in having both stormwater and recycled water. Return on investment is important – demonstrated cost-benefit.

Flooding

- Flood mapping is contentious, and an ongoing process to get them accurate.
- Hazard signage on flood retarding basins not consistent.
- Flood mapping very contentious with Melbourne Water. There is a delay in the issuing of updated flood maps following development. These are being resolved.

2. What are the short and long term opportunities for Council in general and your division of Council specifically?

Litter

- Aim for zero litter
- May want to increase GPT cleanout frequency
- Some existing areas need GPTs

WSUD and Water Quality

- Targets for heavy metals, turbidity.
- Opportunity to model for potential cleanout of WSUD assets and expected average cost.

Stormwater Harvesting

- Entering a trial with CWW on Davis Creek for a 5ML stormwater harvesting system for passive open space.
- Need to match supply and demand and prioritise water use in parks. Scoping of opportunities could be undertaken.

Flooding

- There is a need for up-to-date flood mapping.

Open Space

- Active open space receives a lot of attention, but passive open space has had none, even though it is used more. Passive open space irrigated. Trial sites along creek lines. Opportunities in new growth areas.
- Urban Heat Island is an issue that can be addressed through irrigation of passive space.

Demonstration Projects

- Identify trial sites where improved irrigation of passive open space can work.

3. Are there tools or processes that need to be created or improved to help your division overcome challenges or take opportunities?

- No specific comments – some tool / process refinement covered in the discussion of challenges.

4. General comments and questions

- Concerns expressed about the scope of the strategy. Need to get the objectives clear so that we can prioritise the right actions not anyone's pet projects (e.g. food production).
- Question: Is emergency planning is included in the strategy. Answer: it is addressed in terms of flooding and climate change risks.

Group 2: Community Engagement

Record of attendance

Organisation	Invitee (Name - Role)	Attendance
Wyndham City Council	Claire Mewing - Health Promotion Officer	Y
Wyndham City Council	Di Missen - Team Leader - Community Development	Y
Wyndham City Council	Diana Rice - Community Infrastructure Broker	Y
Wyndham City Council	Fiona Stevenson - Team Leader Sustainability	Y
Wyndham City Council	Hayley Jarvis - Team Leader Waste Strategy	Y
Wyndham City Council	Kuan Yeoh - Senior Engineer	Y
Wyndham City Council	Mirna El-Moslmani - Drainage Engineer	Y
Wyndham City Council	Peter Gibbs - Team Leader Environment	Y
E2Designlab	Celeste Morgan - Sustainability	Y
E2Designlab	Simon Roberts - integrated water cycle management Engineer	Y
Wyndham City Council	Adrian Lucas - Senior Community Engagement Officer	N
Wyndham City Council	Clifford Eberly - Senior Research and Policy Officer	N
Wyndham City Council	Dayane Mardesich - Coordinator Capable Communities	N
Wyndham City Council	Georgina Hill - Governance and City Engagement Coordinator	N
Wyndham City Council	James Simon - Community Development Officer	N
Wyndham City Council	Marc Cassanet - Coordinator Environment and Sustainability	N

Summary transcript

1. What are the short and long term challenges facing Council in general and your division of Council specifically?

Community Gardening:

- People weren't really coming to Council. For Council there is a decision as to whether to respond on a case by case basis or do we take a leadership role? E.g. is a community garden considered in a new estate in a similar manner as other infrastructure? How do you utilise land? Not enough of visible interest form the community.
- Are there resources available for community members who want to join groups? People are directed to 'my home', to replicate anything in these materials isn't worthwhile. There is a sustainable living pamphlet that is very popular.

Water Quality

- Water quality is key. That is the coast as well as the major waterways. Is there enough done around WQ monitoring? Melbourne Water yes. But perhaps there are point source outlets. There are also the irrigators that adjoin the river or coast – their runoff goes in untreated. If they are using recycled water they sign agreement with Southern Rural Water (customer service site plan) that requires that no recycled water leaves the property. But the landowners utilise all of the available space for crops, they do not treat their runoff, instead it flows onto crown land and directly into the environment. Council need Southern Rural Water on board to fix this.

Urban Greening

- Parks, trees and greening – intertwined with water in a low rainfall area: Not really captured – very general level. Country, coast, city aspect of Wyndham was a strong theme.
- Need to more communication (especially with the multi-cultural community) recreation space – local wetland or irrigated spaces.

Water Use

- Communication around water used to be simpler with target 155. Council is moving into adaptable space with heat island effect etc. Garden and open space water conservation isn't necessary the message.
- In terms of the building regulations home owners have a choice between solar and water, economically solar always add ups better.

WSUD Assets:

- WSUD treatments supported in policy but need to be careful as in some cases these need to be watered.
- Issue around separating issue of visual amenity and water quality management.

Flooding and Sea Level Rise

- Community are concerned about waterway setbacks, flooding and ESOs. Melbourne Water do 1:100 modelling, some areas may decrease and some increase when re-assessed. With climate change some flooding may go

beyond the 1:100 – are we allowing great enough setbacks from waterways? Same with coastal sea level rise.

2. What are the short and long term opportunities for Council in general and your division of Council specifically?

Community Gardens and Aquaponics:

- Interest in community gardening and aquaponics – some grants are available (tied to Environment strategy), water projects could feature in that and have funded litter watch. Currently the same groups tend to return for funding each year (e.g. Shoestring Gardening Inc.).
- Green living workshop – open to the community. Came out from feedback that the community wanted aquaponics. Two sessions were ran last year and both were booked out. Using fish and nutrients for gardening. There is one at the shoe string community garden. Opportunity to connect water supply and flushing to rainwater tanks.
- Draft community gardens policy and guidelines being prepared. Current scope is community gardens on council owned and managed land. Not school land. But there are some existing gardens in schools. Under grants would fund school garden if it was open to the community. Does the strategy discuss how the community might get an alternative water use? Yes, it definitely looks at how they access water.
- Some community centres have community gardens (Men's Shed, Irramu, Saltwater, Community education centre).

Community Groups:

- Opportunity to engage community groups.
- Groups include
    - Point Cook Open Spaces – This group was formed as a result of the building blocks program (environment themed event ran last year). The group are very motivated to clean up local waterways.
    - Werribee River Association - John Forrest River keeper will advocate for influence.
    - Friends of Skeleton Creek: Beach control groups – recently formed (part of Werribee River Association).
    - Point Cook Marine Coast Care: More active in Hobsons Bay (not contacted)
    - Western Treatment Plant Conservation advisory committee. Conservation management, don't get hands dirty but do have influence on land use and strategy. WTP RAMSAR wetland and migratory birds. Made up of experts.
- How often do Council engage with the groups? Quarterly meeting with John Forrest River keeper around litter and health. Litter watch = member of WRA, Melbourne Water, WCC, local church (beach patrol), was regular (1 x month), now they have their own funding and self-sufficient. General occurs on an ad hoc basis.

Environmental Flows:

- Main drivers are environmental flows and water quality. There is only so much Council can do in terms of flow, they can advocate for the release of more flows but whether this occurs depends on how much water is available for the environment. It is a complex issues, the water is used for multiple purposes agriculture, recreation not just environment.
- Council's relationship with Southern Rural Water is amicable. SRWs highest priority isn't environmental flows, it is replacement of irrigation channels with pipes.
- John Forest and Council meet with Southern Rural Water quarterly to discuss issues and projects. Environmental flows could easily be brought up.

Litter

- Education is more around community understanding that if you do litter it will end up in beaches and waterways -> objective to be litter free.

Agriculture:

- Opportunity to encourage farms to explore what crops they can grow that utilise less water. Contingency for drought. GW sometimes salty. Werribee River cannot always be relied on.
- The South Werribee District is managed by Southern Rural Water. There is an advisory committee (speak to Daryl Wilson and Renee). Current work is related to food policy. Elio is the coordinator. Bill Forest (Director of Agriculture) is heavily involved. Also related to conversion of open channels to pipes. Southern Rural Water and focusing on Bacchus Marsh and Werribee. Scope to support and advocate for further funding.

Community

- Leverage off the places that are local and of interest to community groups on a district by district basis. In terms of reporting this occurs annually and occurs on a district basis. Good place to put things for accountability.
- Council have listening posts form time to time. Residents can talk to councillors and council officers – this is an avenue to have direct conversations with residents. Tap into existing forums and avenues.

New Development

- The Green Star accreditation system is a key regulatory driver that would help Wyndham achieve some of its goals around water management. Because it isn't mandatory it is the industry itself, Council can play a role in working with developers to be looking at the strategies that assist sustainability. Broad scale change.

Strategies and Plans

- Council is developing a Habitat Plan over the next 12 months, this will cover native veg, waterways and wetlands. Trying to identify the critical habitat areas (Werribee River). Actions will be identified. Connecting habitats but also enhancing and improving. Not just waterway banks but also within waterways. Hoping to have community open day in later October.

Demonstration Projects

- Development site owned by Council at 1160 Sayers road. Three years ago consultant looked at future use of land. Primary objective was recreation, but then railway station and town centre and residential. Opportunity to demonstrate everything to do with water conservation. Fruit trees on natures-strips etc. Irrigating ovals, managing runoff from roads. Council would see itself as the developer. Sam and Sarup are working on the project, it hasn't been master planned yet.

3. Are there tools or processes that need to be created or improved to help your division overcome challenges or take opportunities?

New Development

- May be worth establishing best practice council development guidelines.

Litter

- Litter Hot Spots currently based on anecdotal evidence from litter crews, Melbourne Water and the community. Waterways were a key focus for the community.
- Existing schemes include the Litter Busters program for roadside litter and another program around illegal dumping.
- Council just received funding for education around reduced recreational fishing litter for Werribee South.
- Need more funding to find worst areas and then education around schools and shopping centres in those areas.

Communication

- Community want to see process improvements between waterway authorities and council. Recent works in Skeleton Creek resulted in the creek being blocked, outcome was commitment from Council to community to look at communication processes between WCC, Melbourne Water and CWW. Includes approval process, on site monitoring, surveillance of developer and coordination of construction works. Now have quarterly meetings.

4. General comments and questions

- Council already has input to external strategies and plans (e.g. Vic Water Plan, Melbourne Water about to review Healthy Waterways Strategy).
- The State Government does work closely with the irrigators.

Group 3: Engineering

Record of attendance

Organisation	Invitee (Name - Role)	Attendance
Wyndham City Council	Antoniette Michail - Engineering Development Co-ordinator	Y
Wyndham City Council	Iris Wang - Landscape Architect	Y
Wyndham City Council	Melissa Falkenberg - Manager Urban Spaces and Civil Works	Y
Wyndham City Council	Nitin Gupta - Engineering Design Coordinator	Y
Wyndham City Council	Stan Peska - Development Manager	Y
E2Designlab	Celeste Morgan - Sustainability	Y
E2Designlab	Simon Roberts - integrated water cycle management Engineer	Y
Wyndham City Council	Clifford Eberly - Senior Community Development Officer	N
Wyndham City Council	Craig Toussaint - Place Manager	N
Wyndham City Council	Dayane Mardesich - Coordinator Capable Communities	N
Wyndham City Council	Diana Rice - Community Infrastructure Broker	N
Wyndham City Council	Georgina Hill - Governance and City Engagement Coordinator	N
Wyndham City Council	Hayley Jarvis - Team Leader Waste Strategy	N
Wyndham City Council	Kuan Yeoh - Senior Engineer	N
Wyndham City Council	Mirna El-Moslmani - Drainage Engineer	N

Summary transcript

1. What are the short and long term challenges facing Council in general and your division of Council specifically?

Bioretention Systems

- There is a lack of experience in bioretention and a poor understanding of maintenance requirements.
- Guidance needed on bioretention systems.
- Case study for bioretention dos and don'ts.

Wetlands

- Council have a position that we favour wetlands but it's not an official position. Need a policy position and guidance – it needs to be endorsed and justified. Need to agree whether that is still the position.
- Wetland looks good but it takes a footprint. Always leads to an argument with developers.
- There is no testing and monitoring to demonstrate wetlands are working well.

New Development

- Developers should use engineering standards from Melbourne Water. Policy refers to old Melbourne Water rainfall figures.
- Council doesn't have a way of checking developers MUSIC models.

- Wetland treatment is co-located with waterways which has remnant vegetation – can be a clash and landscape has to mitigate the impact caused by wetland. Need better protection of landscapes and habitat during construction.
- There are some skills deficiencies in maintenance. Recently had training. Maybe construction supervisors is a gap who don't have expertise.
- Need briefing for unique systems to show new processes. Need good mentoring system for maintenance crews.
- Planning sometimes approves without drainage approval – means there is no power to hold developers to changes.

2. What are the short and long term opportunities for Council in general and your division of Council specifically?

Bioretention Systems

- Case study for bioretention dos and don'ts.
- Asset review of bioretention and challenges.

New Development

- Training and resourcing that is needed – more time to review but also expertise is needed.
- Develop internal expertise to review designs and modelling.

Demonstration Projects

- Pilot project in carpark to trial planting schemes and soils. Locate pilot projects and feed into capital works programme.

Fruit Trees

- Historically Council has said no to fruit trees and integrating community gardens, this view is changing, there may be scope to test what the maintenance requirement is. Landscape and engineering need to work with other parts of the council to explore opportunities.
- Ad hoc coordination of capital work – need principles to be added for 'consider potential for WSUD' etc.
- There are reviews of capital projects – can integrate IWCM review to this.

Collaboration

- Councillor Gibbons is the portfolio holder for environment – worth meeting with him to get support. He wants to include something on upstream contamination and what Wyndham can do to support that. May involve working closely with Melton – who don't have a WSUD coordinator. Might be things that can be shared or learnt from.
- Coordinate with neighbouring councils to look at the catchment as a whole. There is an engineering development committee for subdivisions but nothing for capital works. There is a water sensitive west group but not really defining projects.

3.	Are there tools or processes that need to be created or improved to help your division overcome challenges or take opportunities?

Handover

- Inspection officers are involved in handover of WSUD assets, Peter Gordon's team to could be included in this process.
- Engineer hands to landscape who then doesn't handover – the drainage function could have better links with asset management. Need more than planting to be checked when WSUD is handed over (soil media, engineering).

Standards

- Set standards for council led development.

Community

- Create a resilient community into the future.

4.	General comments and questions

- Resilience to future climates should be a key feature of the plan. Business cases should demonstrate response to this.
- Potential target: By 2050 all stormwater is treated to best practice. Can test capital work investments and how far this would get us towards treatment targets.
- A capital works project list should be included in the plan.

Group 4: Parks, Open Space and Landscape

Record of attendance

Organisation	Invitee (Name - Role)	Attendance
Wyndham City Council	Ben Deklepper - Tree Planter	Y
Wyndham City Council	Craig Dodson - Area leader for conservation	Y
Wyndham City Council	Mark Boyle - Coordinator Parks	Y
Wyndham City Council	Peter Grogan - Senior Landscape Architect	Y
Wyndham City Council	Ross Kingston - Sustainability	Y
Wyndham City Council	Sue Hawes - Open Space Planner	Y
Wyndham City Council	Zinta Lazdins - Landscape Architect	Y
E2Designlab	Celeste Morgan - Sustainability	Y
E2Designlab	Simon Roberts - integrated water cycle management Engineer	Y

Summary transcript

1.	What are the short and long term challenges facing Council in general and your division of Council specifically?

Open Space

- Council can influence active open space location but they have limited input on new passive as this is delivered by developers. Most developers deliver irrigation but Council turn it off.
- Normally developers will put irrigation parks during the maintenance period but following handover they will turn this off. Need to be selective on which ones to continue. Selection should consider availability of alternative water during design phase.
- Active open space, challenge that there isn't a lot of space adjacent to utilise for innovative water ideas.
- If passive irrigation increases this will change the community's expectations, how will Council bridge the gap between rainy and dry spells?
- The planning of all kinds of open space needs to be improved. Recent with PSPs have got 35+ active open spaces to come on board as well as hundreds of passive parks and encumbered land.

Stormwater Harvesting

- There are a lot of wetlands that have been located in areas that don't suit themselves to stormwater harvesting. Now CWW and Melbourne Water and trying to collocate sports grounds and these assets along waterways.
- In terms of capital works projects needs some early investigation and site investigation to see determine the feasibility of stormwater harvesting. There is a project that has funding to do exactly that. Limited to a number of

sites. Then they can start planning for and funding these projects say 5 years in advance.

- Demonstration Projects
  - CWW have come to Council with a proposal regarding a site in Truganina. Co-location of wetland to an adjacent sports reserve. CWW coordinating a proposal between the developers, there is a concept report. A business case has been presented that is attractive, at a stage but council is not ready to take it on, Council isn't against it but not ready to internalise.
  - Also had a concept presented for Davis Creek. All came back with cut the curb WSUD treatments. GHD were doing the brief for the strategy, flow chart about how council should address stormwater harvesting projects. Stumbling block is leasing agreements and responsibilities. Need council to agree to / high level endorsement of how to manage these assets and agree on what should be irrigated.
  - Issue with CWW being quite regional scale. Council is at a more localised level. Need to be reinforced as part of this strategy.

Capital Works

- Regular meeting are often held as part of capital works but often this is almost too late (but most PSPs done). As soon as reserve design process begins an IWCM review needs to be implemented. Trying to get an active open space design working group.
- Including IWCM solutions in capital works. Is there something that can be done to have rule of thumb business cases?

WSUD Maintenance and Handover

- Depot, interaction between maintenance and design staff. Historically disconnect between design intent and understanding of systems. In terms of WSUD elements definitely a lack of skill, also, during design there is no consideration of maintenance requirements.

Wetlands

- Wetlands are great for urban ecology, most people love being close to wildlife. Frog calls and mosquitos can be an issue. WCC do conduct fauna surveys quarterly. Current position is that they are drains.

Vegetation / Trees

- Concerns around inappropriate species selected for WSUD and open spaces (risk of seed migration and hybridisation if not of local providence).
- There are a lot of issues in establishing a diverse range of trees due to rainfall and soil types. Are these part of design standards? No real standards.
- In car parks, (Safeway - Hopper Crossing), the land owner could put in trees and structural soils for shading and less conflict with pavement. Safeway were up for this as large recreation with removal of trees in other area. Arborist involved to specify subgrade. Not currently occurring in council car parks.
- There are a lot of hurdles in improved tree implementation. It is most cost effective if this occurs during the development stage. In an ideal world when roads are put in there should be an allocation for tree roots. This provides a huge amount of benefit to tree health and growth.

2. What are the short and long term opportunities for Council in general and your division of Council specifically?

Open Space

- Funding and greater understanding of costs and benefits of passive open space irrigation. Explore council funded but developer delivered opportunities.
- Improve the process involved in the selection of which parks Council should continue to irrigate once handed over by developer.
- Create more storage space and recirculation networks as part of open space design (more open space for swales, ponds or even tanks).
- Design active open spaces so that runoff following irrigation is captured and reused or flows onto areas for passive irrigation (this will require early action to influence design).
- Improved efficiency of tree irrigation (utilise networks). Important to recognise the volume of soil that the tree can use and can store.
- Recently completed open space strategy. Action to selectively irrigate district level passive parks. Feedback that during summer months there are limited green spaces for respite from heat.

WSUD

- Addressing lack of knowledge of function of systems through training or workshopping.
  - Train engineering inspectors. Perhaps drainage responsibility.
- Started training last year of maintenance field operations of WSUD. Horticulture team started a WSUD team. In the past bioretention systems were recorded as gardens in the asset management system.
- By the time the assets come to council they require sediment removal (e.g. century lakes 2x in 5yrs). A lot of bio systems have to put in sacrificial layer that is reset before handover.

Trees

- Where WSUD can be used it will enable the planting of a wider range of trees and increase the benefits of the trees as these are largely dependent on the available water.

Stormwater Harvesting

- Develop a stormwater harvesting masterplan

Demonstration Projects

- Trees with structural soils in Council car parks (easiest) and road reserves, try to incorporate with WSUD / passive irrigation to diversify the types of trees that can be planted (i.e. overcome limitations of local rainfall and soil conditions). Need some expertise for this.
- Some developers are trying to do more eco or green things, if you worked with them they may be willing to do a trial looking into improved tree planting. If they could forecast the benefits in their advertising it would help. Cost is an issue.
- Harvest water that lands on the depot on the apron. Huge amount of water available.
- Cambridge reserve, district level active and local passive – looking to upgrading passive to district and integrating irrigation, also on D1 catchment – may be able to get MPA to fund. Master planning yet to start.

3. Are there tools or processes that need to be created or improved to help your division overcome challenges or take opportunities?

Open Space

- Integrated design approach for open spaces needed early on in the process before even getting into the detail design. Need design guidelines to imbed processes. Temporarily there was in interdepartmental working group on discussing water for projects. Forward planning and strategic oversight needed. Sustainability, engineer, drainage, landscape, maintenance.
- Incorporate IWCM considerations into project business case (similar to environmental sustainability requirement). For building there is an explicit set of guidelines. Other projects it is more case by case.

WSUD

- There should be an officer to oversee WSUD.

4. General comments and questions

- There were no general comments/questions.

Group 5: Strategic Planning, Statuary Planning and Enforcement

Record of attendance

Organisation	Invitee (Name - Role)	Attendance
Wyndham City Council	Dee Gomes - Planning Policy and Projects Coordinator	Y
Wyndham City Council	Elio Comello - Coordinator Strategic Planning	Y
Wyndham City Council	Kuan Yeoh - Senior Engineer	Y
Wyndham City Council	Margret Evans - Coordinator Town Planning	Y
Wyndham City Council	Mirna El-Moslmani - Drainage Engineer	Y
Wyndham City Council	Sam Freeman-Moir - Strategic Planner	Y
E2Designlab	Celeste Morgan - Sustainability	Y
E2Designlab	Simon Roberts - integrated water cycle management Engineer	Y
Wyndham City Council	Andrew Bishop - Strategic Planner	N
Wyndham City Council	Craig Toussaint - Place Manager	N
Wyndham City Council	Marc Cassanet - Environment & Sustainability Coordinator	N
Wyndham City Council	Peter McKinnon - Manager Environment & Sustainability	N

Summary transcript

1. What are the short and long term challenges facing Council in general and your division of Council

specifically?

New Developments

- What is council's position on water issues and how they want to apply it development. Hard to require when there is no policy backing. Need an agreed position so that they can ask for it from private development.
- Council has developed conditions for permits but these can be easily challenged as there is no policy back-up, this makes it easy for developers to negotiate. Some of the conditions specificity "unless approved otherwise", this allows for negotiation due to uncertainty on where treatments should be, that they should be and how they should be maintained.
- The PSP process facilitates IWCM planning, however, there are only a handful of PSPs left to be developed. An opportunity to look at past ones through review process but probably hard to change anything.
- Planners have trouble trying to include requirements from engineering that are not enforceable.
- Growling Grass Frogs along Werribee River – require clean water to be supplied. To be protected as part of PSPs.

Existing Development

- Only residential developments are required to have WSUD, but nothing to drive response for industrial or commercial.
    - BESS – has residential and commercial WSUD requirements.

Overlays

- Environmental Significance Overlays can be used for better protection / enforcement but Council would have to justify the need for it. There is an argument that precinct plans supersede ESOs and delete them.

WSUD

- Need specific solutions for Wyndham climate.

Water Use

- Leadership issue – the water action plan is in place, but people aren't doing it.

2. What are the short and long term opportunities for Council in general and your division of Council specifically?

New Developments

- Council to take leadership, provide a united front and clearly state what Council expects in terms of water management in new developments.
- Agreement about what measures are used and the flow on maintenance needs (e.g. swales are a source of disagreement at the moment).
- Supportive of including it in pre-application discussions, but there has to be certainty.
- PSPs – have had retarding basins identified with bioretention to reduce footprint – new challenge. WSUD maintenance cost is a challenge - difficulty with central swales where you have to shut down the road to maintain them – need upfront view on what council wants.

Existing Development

- Expand WSUD requirements to capture industrial and commercial premises.

Agriculture

- Council is involved in the Werribee South Irrigation District Plan – has been various submissions, and Southern Rural Water trying to upgrade rural networks. Access to water is big issues for farmers – getting water that was promised in their water supply programs.

Mechanisms

- There are other avenues to improve water outcomes other than the Planning Scheme (e.g. policy positions).
- Can transfer policy examples and then build evidence base for Wyndham to get it adopted.

Demonstration Projects

- Sayers road is an opportunity for council to take a lead.
- Consider piloting a CBD site.
- Trial a specific development and work together, and then review.

3. Are there tools or processes that need to be created or improved to help your division overcome challenges or take opportunities?

WSUD

- Need for WSUD policies and hard mechanisms/requirements.
- Case studies and business cases can help.
- Bioretention in the west study is a good reference.
- Could be better sharing with Geelong and others via water sensitive west.
- Need specific guidelines for bioretention design in the west.

4. General comments and questions

- Amenity values are important for planners and for the community. Working party in one PSP area.
- Cultural change needed. Champions needed.

Community Group Forum

Date: 02/08/2016

Purpose: Two hour workshop to:

- Understand what outcomes existing community groups want to see from Council's IWCM strategy.
- Understand the challenges and opportunities for improved integrated water cycle management in Wyndham as perceived by existing community groups.
- Identify actions that will enhance collaboration between Council, existing community groups and the community more broadly.

Record of attendance

Organisation	Invitee (Name - Role)	Attendance
Wyndham City Council	Fiona Stevenson – Team Leader Sustainability	Y
Wyndham City Council	Mirna El-Moslmani - Drainage Engineer Drainage and Water Management	Y
Wyndham City Council	Peter Gibbs – Team Leader Environment	Y
The Werribee River Association	John Forrester - Werribee Riverkeeper	Y
Sanctuary Lakes Golf Club	Ian Crews - General Manager	Y
Sanctuary Lakes Golf Club	Kevin Birtles - Club Captain	Y
Point Cook Open Spaces	Bruce Boddington	Y
Nature West	Colleen Miller - Coordinator	Y
Friends of Skeleton Creek	Denice Perry - President	Y
Friends of Skeleton Creek	John Dawes - Vice President	Y
E2Designlab	Celeste Morgan - Sustainability	Y
E2Designlab	Simon Roberts - integrated water cycle management Engineer	Y
Wyndham City Council	Hayley Jarvis – Team Leader Waste Strategy	N
Wyndham City Council	Marc Cassanet - Environment & Sustainability Coordinator	N
Truganina Landcare Group	Nanette Griffiths	N
Pinkerton Landcare and Environment Group	Daryl Akers	N
Nature West	Susie Inglis - Facilitator	N
Marine Care Point Cook	Andrew Christie	N
Little River Improvement Program	Ron Goldsmith	N
Harry Van Moorst	Western Region Environment Centre	N
Friends of Glen Orden Wetlands	Maggie McInnes	N
Envirowest	Harry van Moors	N
Corio Landcare Group	Lynette Richmond	N

Activity 1: What outcomes do you want to see in Wyndham from the IWCM Strategy?

Attendees were asked to identify outcomes they wanted to see flowing from Council's new IWCM strategy. These outcomes were loosely grouped under the strategy objectives as follows:

- Objective 1: Create a resilient and liveable city that improves the health and wellbeing of its residents
    - Provide healthy environment
    - Efficient planning
    - Identify opportunities to raise RAMSAR wetlands in rising sea levels (e.g. Cunningham Swamp)
    - One plan for water (Melbourne Water, CMA, Council, and Community Groups)
    - A state-wide litter plan with actions and regulation
    - Keeping Wyndham green
    - Provide viable water solution
    - Harvestable water supply
    - Curb and control developers
- Objective 2: Improve the health and amenity of local waterways and coastal environments
    - Healthy waterways
    - Healthy ecosystem
    - No sediments released to RAMSAR wetlands
    - Restoration of native fish and habitat
    - Habitat suitable for frogs and reptiles
    - Improved signage on all local waterways
    - More platypus
    - Protection for endangered species
    - Sustain migratory birds
    - Water quality natural water flows
    - No more damming of Skeleton Creek
    - Rename drains back to creeks
    - Good water quality for Skeleton Creek
    - Greater compliance on building regulations to stop industrial waste entering waterways
    - Don't let litter enter the stormwater
    - No plastic in the waterways / bay
    - Identify and maintain herbaceous seasonable wetlands
    - A Werribee River Management Plan
    - Council rangers to assist with creek revegetation and habitat
    - Litter traps on waterways
    - Litter
    - Protection of K Road Cliffs
- Objective 3: Encourage improved agricultural land use practices and advocate for the protection and enhancement of the Werribee South Irrigation District
    - Landscape wide management
    - Reduce water loss to irrigation channels
- Objective 4: Improve collaboration and engagement with all stakeholders
    - Good communication on water issues to local groups and residents
    - Understand community requirements
    - Community discussions with authorities, government etc.
    - Good information flow from Council and Melbourne Water to local residents and groups
    - Information to residents on litter flowing to creek and ocean (e.g. street labels)

Activity 2: What are the challenges and opportunities for water management in Wyndham?

Attendees were asked to identify the challenges and opportunities for water management in Wyndham. Responses were collected and categorised under of the six water sensitive city transition factors.

Table 45 Collated challenges and opportunities from Activity 2

1. Council leadership	2. Requirements and responsibilities	3. Communication processes
Challenges ✓ Lack of a Werribee River Management Plan ✓ Lack of prioritisation Opportunities ✓ Unified goal, unified approach ✓ Linear park proclamation for the Werribee River ✓ Become a leader in water harvesting and usage ✓ Clean water for harvesting ✓ Greater use of stormwater for maintain green space	Challenges ✓ Lack of a Werribee River Management Plan ✓ Maintaining green areas in the face of massive development ✓ Water pollution ✓ Greater urbanisation - more runoff and nutrients and pollutants ✓ Rapid urban development ✓ Over development ✓ Reptiles poached Opportunities ✓ Protect current 'green wedge' conservation areas from development.	Challenges ✓ Cooperation between groups ✓ Lobbying Melbourne Water to share vision ✓ Lack of appreciation of natural systems Opportunities ✓ Wetland information interpretative centre ✓ Education interpretive water management centre ✓ Education centre / museum in public land around Cheetham RAMSAR wetland ✓ Labels on street drain inlets (e.g. litter flows to the sea) ✓ Rename drains back to creeks ✓ Education and community help ✓ New migrant groups
4. Knowledge and skills	**5. Demonstration projects**	**6. Continuous improvement**
Challenges ✓ None identified Opportunities ✓ Utilise wider experience to provide solutions ✓ Collate water flows and quality for the area ✓ Undertake more research to reduce irrigation water usage ✓ Find better ways to store water	Challenges ✓ None identified Opportunities ✓ Frog habitat ✓ Cunningham swamp opportunities to increase habitat ✓ D1 drain – opportunity to connect Werribee to the bay ✓ Retrofit floodways in older developments (e.g. Hoppers Crossing)	Challenges ✓ Lack of knowledge about sensitive areas and protection of them. Opportunities ✓ Eco-tourism ✓ Litter control ✓ Mapping of our waterways for sensitive areas ✓ Water recycling

Figure 62 Community group representatives and council officers participating in Activity 2

Activity 3: How can Council and Community work together to have the greatest impact?

Attendees were asked to identify concrete actions that could lead to improved integrated water cycle management outcomes through collaboration. The following actions were identified:

- Develop a Werribee River Action Plan (Council's role would be one of advocacy, State Government would need to lead this with input from other partners, including Parks Vic, Melbourne Water etc.).
- Classify Werribee River as a linear park to achieve greater control and consistency (would require joint initiative across all three councils in the catchment).
- Form a catchment management group of stakeholders.
- Protect conservation areas, the green wedge and open spaces to avoid over development – this needs policing.
- Increase community support / representation within the development community
- Planning in new developments should consider greening opportunities as priority and plan for this at the outset instead of allowing hardscape infrastructure (e.g. roads and paths) to be laid down first as this means that greening and conservation has to be 'squeezed' into the areas that remain.
- There needs to be better sediment control, silt barriers in construction should go at the top of banks.
- Fix malfunctioning GPT in Bungees Hole, need management by Melbourne Water and Council.
- New community education centre (to replace the WTP one)
- Use local waterways and ecology to promote eco-tourism.
- Targeted education campaigns for construction / new residents / new generation
- Label drains 'to sea'
- Make knowledge available on stormwater harvesting techniques – especially sports clubs.
- Case studies for stormwater harvesting and water quality standard needed.
- Connect D1 drain to the bay – linear park.
- Retrofit floodways in older developments
- Habitat for growling grass frog
- Cunningham swamp, opportunity for new wetlands
- Reduce cost for recycled water for open space.

Workshop 2

Date: 03/08/2016

Purpose: Half day workshop to:

- Discuss and agree on opportunities for structural and non-structural actions.
- Discuss the current gaps in attaining desirable integrated water cycle management outcomes through delivery of the agreed actions.
- Identify actions to address the current gaps.
- Identify responsibilities for actions.

Record of attendance

Organisation	Invitee (Name - Role)	Attendance
Wyndham City Council	Andrew Bishop - Strategic Planner	Y
Wyndham City Council	Antoniette Michail - Engineering Development Co-ordinator	Y
Wyndham City Council	Fiona Stevenson – Team Leader Sustainability	Y
Wyndham City Council	Hayley Jarvis – Team Leader Waste Strategy	Y
Wyndham City Council	Kuan Yeoh – Senior Engineer Drainage and Water Management	Y
Wyndham City Council	Mirna El-Moslmani - Drainage Engineer Drainage and Water Management	Y
Wyndham City Council	Ross Kingston – Sustainability Projects Officer	Y
Wyndham City Council	Sam Freeman-Moir - Strategic Planner	Y
Wyndham City Council	Stan Peska – Coordinator Engineering Development, Strategic Transport and Growth Infrastructure	Y
Wyndham City Council	Steven Crimston - Emergency Management Officer	Y
Wyndham City Council	Trevor Prowd - Natural Environment Officer	Y
Wyndham City Council	Zinta Lazdins - Landscape Architect	Y
Melton City Council	Andrew Hepburn - Landscape Architect	Y
Melbourne Water	Micah Pendergast - Stormwater Regional Coordinator - West	Y
Department of Environment, Land, Water and Planning	Katie Burns	Y
E2Designlab	Celeste Morgan - Sustainability	Y
E2Designlab	Simon Roberts - integrated water cycle management Engineer	Y
City West Water	James O'Connor - Senior Strategic Planner	Y
City of Greater Geelong	Jarrod Gaut - Water Quality Engineer	Y
Wyndham City Council	Craig Dodson - Area Leader Conservation	N
Wyndham City Council	Iris Wang - Landscape Architect	N
Wyndham City Council	Melissa Falkenberg - Manager Urban Spaces and Civil Works	N
Wyndham City Council	Nitin Gupta - Engineering Design Coordinator	N
Wyndham City Council	Peter Gibbs – Team Leader Environment	N
Wyndham City Council	Peter Gordon - Coordinator Roads	N
Southern Rural Water	Amos Micallef, Senior Engineer, Western Irrigation Business	N
Port Phillip & Westernport Catchment Management Authority	Ian Morgans - Strategy Manager	N
Port Phillip & Westernport Catchment Management Authority	Rebecca Koss - Environmental Strategy Coordinator	N
Melton City Council	Bronwyn Richards - Principal Construction Supervisor	N
Melton City Council	Linda Bradburn - Environmental Educator	N
Melbourne Water	Sarah Watkins -Senior Planning Engineer	N
Department of Environment, Land, Water and Planning	Abby Farmer	N
City West Water	Andy Guilliano - Strategic Planner (integrated Water Cycle Management)	N
City of Greater Geelong	Peter Dohnt - Development Liaison Officer, Engineering Services	N
Brimbank City Council	Matt Aquilina - Manager Environment	N
Brimbank City Council	Ray Martin - Infrastructure Development Coordinator	N

Organisation	Invitee (Name - Role)	Attendance
Brimbank City Council	Sajeewa Seekkuge - Senior Drainage and Subdivisions Engineer	N
Wyndham City Council	Ben DeKlepper - Tree Planter	N
Wyndham City Council	Clifford Eberly - Senior Community Development Officer	N
Wyndham City Council	Craig Toussaint – Place Manager	N
Wyndham City Council	David Semmens - Manager Sport and Recreation	N
Wyndham City Council	Dayane Mardesich - Coordinator Capable Communities	N
Wyndham City Council	Dee Gomes - Planning Policy and Projects Coordinator	N
Wyndham City Council	Diana Rice - Growth Area Community Infrastructure Broker	N
Wyndham City Council	Elio Comello - Coordinator Strategic Planning	N
Wyndham City Council	Geoffrey Youla	N
Wyndham City Council	Georgie Hill - Governance and City Engagement Coordinator	N
Wyndham City Council	James Simon - Community Development Officer	N
Wyndham City Council	Madeleine Veale - Flora and Fauna Officer	N
Wyndham City Council	Marc Cassanet - Environment & Sustainability Coordinator	N
Wyndham City Council	Margret Evans -Coordinator Town Planning	N
Wyndham City Council	Mark Boyle – Coordinator Parks, Open Space	N
Wyndham City Council	Mark Hammett - Operations Manager	N
Wyndham City Council	Peter McKinnon - Manager Enviroment and Sustainablity	N
Wyndham City Council	Peter Van Til - Manager Town Planning	N
Wyndham City Council	Shane Walden - Facilities and Open Space	N
Wyndham City Council	Stephen Thorpe - Manager Assets and Roads	N
Wyndham City Council	Sue Hawes - Open Space Planner	N
Wyndham City Council	Tony Mangiardi - Co-ordinator Asset Management	N

Activity 1: How well placed is Wyndham to transition?

Attendees were asked to indicate how well they believed Wyndham City Council is positioned to transition to the aspirational city state of a 'water sensitive city'. Attendees each ranked Council's current capacity against six key transition factors. A group discussion was then held to uncover the different motivations or reasons for the variation in rankings. This exercise is intended to seed discussion and uncover common threads across Council, it should not be viewed as a comprehensive or accurate benchmark of Council's capacity to transition.

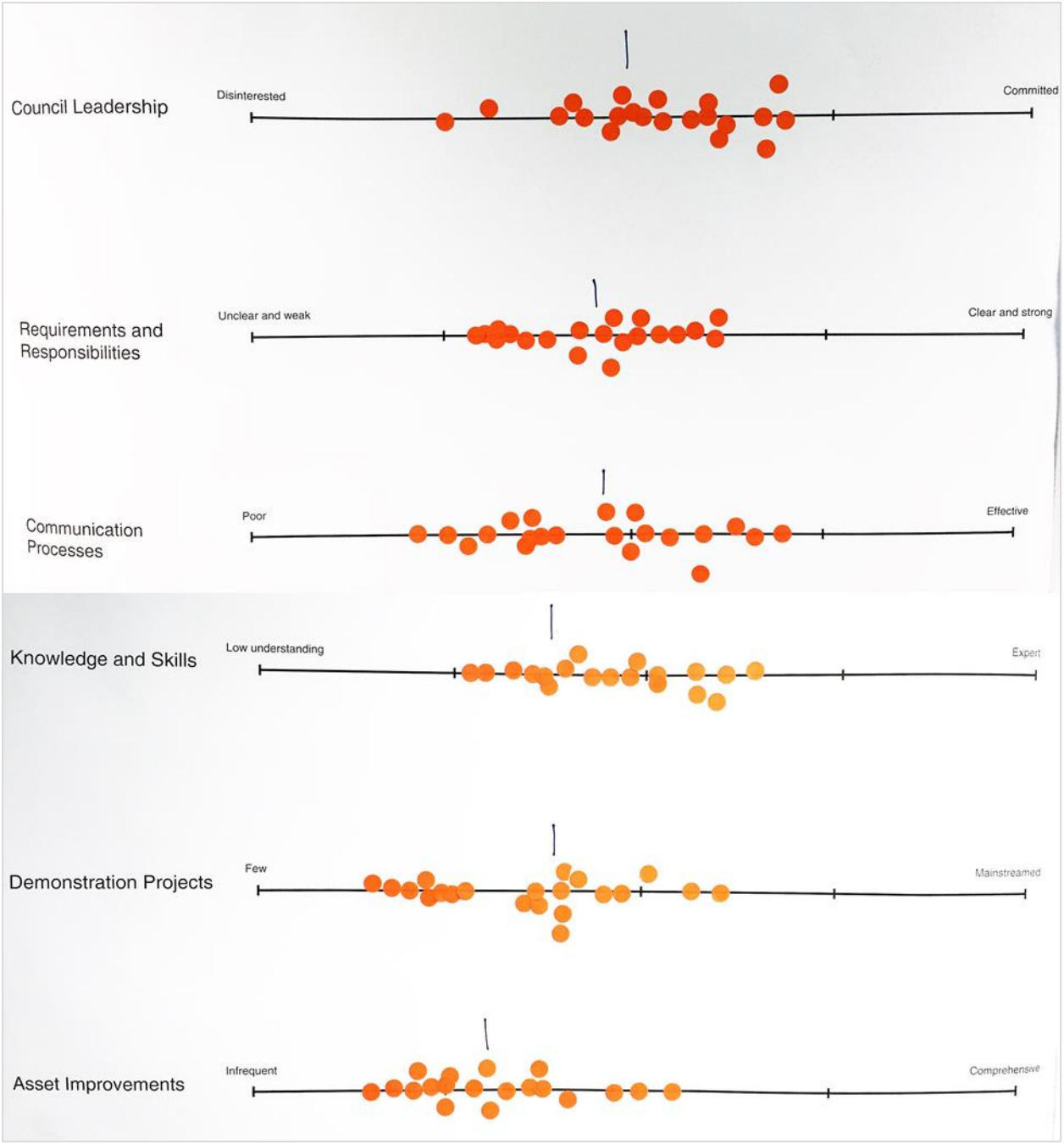


Figure 63 Transition factor rankings for Wyndham City Council

Activity 2: Prioritising and reviewing of actions across the transition factors.

Attendees were split into five groups and tasked with reviewing, adding to and prioritising a series of integrated water cycle management actions that had been categorised under the transition factors introduced in activity 1. The majority of the pre-recorded actions had been compiled from previous workshops and interviews. Each of the five groups investigated actions related to different objectives and / or focus areas, these included:

- Objective 1: Create a resilient and liveable city that improves the health and wellbeing of its residents, Focus area: Existing urban areas
- Objective 1: Create a resilient and liveable city that improves the health and wellbeing of its residents, Focus area: New development areas
- Objective 2: Improve the health and amenity of local waterways and coastal environments, Focus area: Existing urban areas
- Objective 2: Improve the health and amenity of local waterways and coastal environments, Focus area: New development areas
- Objective 3: Encourage improved agricultural land use practices and advocate for the protection and enhancement of the Werribee South Irrigation District

No group was allocated to objective 4 because improved communication and collaboration is imbedded in the six transition factors and thus inherently considered. Attendees were asked to prioritise their top 5 actions and share these with the group. The results from activity 2 are collated below in Table 46 to Table 48, pre-recorded actions are shown in black, edits / new actions in red and priority actions are bolded.

Figure 64 External stakeholders and council officers participating in Activity 2

Table 46 Activity 2 detailed feedback – Objective 1

OBJECTIVE: Create a resilient and liveable city that improves the health and wellbeing of its residents		
1. Council leadership	**2. Requirements and responsibilities**	**3. Communication processes**

Actions
 	
✓ Address Climate Change within future plans and policies.
✓ Create a greater focus on the health of our waterways in particular the Werribee River, specifically for environmental flows, litter prevention and monitoring (from District Plans).
✓ Lead with new technologies in trail projects and approaches - learn from the experience.
✓ Change the negative view surrounding water usage. Water is essential in mitigating the urban heat island effect. Using water from the appropriate source is key to this message. Engage Councillors as role models for alternative water usage.
 	
✓ ***Create a Water Leadership working group chaired by an Exec/Council member. Group is to ensure that opportunities for improved water management and better urban design opportunities are identified early as part of planning and rectification works (e.g. open space master planning, road and drainage upgrades) (e.g. WAGA for water).***
✓ ***Engage Councillors on how water can be used as a driver to improve outcomes for Wyndham's residents ($)***.
	Actions
	
	✓ Complete a coastal erosion assessment for Wyndham's coastline to inform the new coastal strategy and guide future land use.
	✓ Ensure adequate buffers around waterways and drainage easements to allow for functional use of space and mitigate the risks of larger flood peaks.
	✓ Clarify flood signage requirements for community awareness.
	✓ Make volunteering easier for Wyndham's community
	  ✓ Develop a Volunteering Strategy
	  ✓ Deliver the Community Training Calendar
	  ✓ Create new volunteer-led programs with community.
	✓ Provide policy to ensure yard permeability
	✓ Create a clear strategy to mitigate the risks of storm surges and sea level rise.
	✓ Maintain passive, drought tolerant open spaces and community spaces.
	✓ Ensure floodplains are developed for flooding.
	✓ Identify areas of responsibilities for waterways in new developments.
	✓ Use forum to work with South Rural Water to identify responsibilities and opportunities.
	✓ Stormwater trails to be matched to passive open space (not only relying on third pipe).
		Actions
		
		✓ Hold a range of free sustainability workshops for the local community. These could cover a range of topics and be more theoretical (e.g. about WSUD or IWCM) but could also (preferably) be practical (e.g. how to build a raingarden).
		✓ Engage with City West Water to bring in water education to Wyndham schools.
		✓ Advocate for communities to adopt sections of waterways (similar to adopt a highway).
		✓ Re-education policies in schools for water appreciation.
		✓ Increase awareness and reduce litter in the municipality through programs such as hosting an anti-dumping hard waste community event and promoting the addition of food scraps into green bins to reduce waste to landfill.
		✓ Internal/external communication (Melbourne Water, City West Water) to be clarified and improved for information sharing.
		✓ Communicate the risks of climate change (sea level rise, floods, heat waves etc.) to the community.

	✓ Develop non-financial incentives for recycled / stormwater uptake and usage. ✓ ***Update landscape design specifications and rewrite auditing/handover regime.*** ✓ ***Create a clear strategy for maximising alternative water use. Link to open space strategy.***	✓ ***Work with Melbourne Water to improve flood communication and planning.***
4. Knowledge and skills	**5. Demonstration projects**	**6. Continuous improvement**
Actions ✓ Conduct flood modelling for the municipality for existing and climate change conditions ✓ Conduct MUSIC modelling to assess the performance of existing and future WSUD assets under climate change ✓ Investigate how water can be used to help Council achieve its targeted increases in tree canopy cover ✓ Develop a knowledge base around how simple changes to urban design and WSUD implementation can bring about improved amenity outcomes. ✓ Internal skill base capture (sharing knowledge) and succession planning. ✓ Maintenance training to recently assigned WSUD team. ✓ ***Relevant training to Civil Engineering/Landscape/Operations once roles/responsibilities clarified.*** ✓ ***Monitor performance of assets against their design specifications.*** ✓ ***Identify appropriate trees, vegetation, soils and other purpose assets to meet existing and future climate conditions. Use to develop a local knowledge base of the area and community.***	Actions ✓ Implement a streetscape retrofit that includes green / blue elements (e.g. passively irrigated trees for treatment, amenity and cooler microclimate). Allows for new services, spaces and soil improvement. ✓ Improve public access to the Werribee South coastline. ✓ Provide resources to pilot projects (view risks as risks not as barriers) ✓ Carry out an integrated water cycle management showcasing project that delivers multiple benefits to the community ✓ ***Council buildings and ovals lead by example in alternative water usage and water efficient fixtures in Council sites and facilities*** ✓ ***Commitment to internal funding*** ✓ ***Work with the community to enhance their understanding of flooding and identify their role in flood preparedness.***	Actions ✓ Continue to work closely with communities in each district to identify their specific needs.

Table 47 Activity 2 detailed feedback – Objective 2

OBJECTIVE: Improve the health and amenity of local waterways and coastal environments		
1. Council leadership	**2. Requirements and responsibilities**	**3. Communication processes**
Actions ✓ Be open minded to new technologies and trail projects - learn from the experience. ✓ Review implementation and content in stormwater management plans. ✓ Fund an enforcement officer to ensure compliance with the Site Environmental Management Plan (SEWP) Guidelines and Standards (e.g. sediment and waste control) ✓ Fund actions identified in the stormwater management plan ✓ Leverage off other "like" LGAs to capture learnings. ✓ Identify stakeholders (*Southern Rural Water, Melbourne Water, City West Water*, catchment councils) and facilitate an annual forum. ✓ Develop funding pool for IWCM. Planning must go further than 1 year as water projects take 2-3 years of planning to get off the ground. ✓ Planning needs to have a wider focus beyond individual land parcels (esp. for stormwater harvesting on a catchment scale). ✓ ***Council needs to commit to on-going funding to implement water projects/strategy actions/maintenance.*** ✓ ***Need to implement a co-ordinated internal council (water) working group to co-ordinate large scale projects/actions across departments.***	Actions ✓ Appoint a Stormwater Engineer to coordinate all stormwater related Council activities. ✓ Set targets for pollutant load reductions as part of the IWCM strategy ✓ Formalise documentation of preferred WSUD options ✓ Generate a strategy for targeted WSUD design ✓ Formalise responsibilities for WSUD asset maintenance and develop a maintenance plan ✓ Develop a maintenance checklist for each asset ✓ Review Local Law stipulating stormwater pollution control requirements ✓ Implement a sustainable water use policy to encourage rain/grey water harvesting and reuse on private properties ✓ Introduce WSUD Compliance Guidelines for re-development and new development sites ✓ Identify WSUD sites for monitoring ✓ Establish a flow and water quality monitoring program ✓ Council needs to commit $$ to implementing strategy outcomes/recommendations to meet responsibilities to the community ✓ ***Improving WSUD asset database (including drainage pipes and outlets).*** ✓ ***Identify areas of responsibilities and fund it accordingly.*** ✓ ***Develop a framework for developers in greenfield &***	Actions ✓ Ensure the right people are consulted at the right time as part of the master planning process ✓ Develop sediment pond cleaning educational signage ✓ Update Council website to include information on WSUD, stormwater management, IWCM and applicable policies to inform developers of Wyndham's specific WSUD requirements. ✓ Initiate a collaborative group with other Councils, water authorities and community groups to develop, share and improve water management strategies across the region. ✓ Install signage near key WSUD assets ✓ Better handover processes ✓ Asset database ✓ Asset purpose and responsibilities ✓ Engage with culturally and linguistically diverse (CALD) communities through community development (e.g. around fishing and fish consumption). ✓ ***WSUD is an evolving discipline and this needs to be addressed and communicated.*** ✓ ***Connecting schools with local waterways to facilitate cross/inter-generational learning (kids take information home).*** ✓ ***Leverage off other Council's sharing the same catchment and include other authorities such as Southern Rural Water, Melbourne Water, City West***

	existing suburbs to pay a "development levy" to Council that will fund water management initiatives.	***Water.*** ✓ ***Increase connection to coastal environment by collaborating with Parks Vic and Melbourne Water. Recognise the LGAs that are responsible and advocate our work to them.***
4. Knowledge and skills	**5. Demonstration projects**	**6. Continuous improvement**
Actions ✓ Inspect bio filters to determine what is and isn't working. ✓ Identify the most pressing knowledge gaps and then fund a study to explore solutions, options include: ✓ Appropriate vegetation for the west ✓ When stormwater harvesting works best ✓ Develop MUSIC guidelines for Wyndham ✓ Develop a WSUD Technical Manual for Wyndham City Council ✓ Develop Wetland Design Guidelines ✓ Don't want to duplicate MW guidelines. Better to develop "guideline notes" of what Council accepts in terms of WSUD assets and particular differences/requirements for Council assets. ✓ ***Train council inspection and maintenance staff on WSUD purpose and function.***	Actions ✓ ***Identify 'old' practice sites as "hot spot" WSUD demonstration projects and upgrade. Use signage, school involvement etc. Photo opportunity for Councillors.*** ✓ ***Work with developers and LGAs to create case studies of what can be achieved.***	Actions ✓ **Implement the recommendations from the Wyndham Stormwater Management Plan 2015** ✓ **Continue to identify litter hotspots and increase community education and awareness** ✓ **Completing the transition of drainage data (D-SPEC) into the Asset Master to enable accurate budget forecasting.** ✓ **Continue inspections of wetlands and GPTs** ✓ **Continue WSUD training** ✓ Review the most recent developments to see what is and isn't working ✓ EPA water monitoring after heavy rainfall has ceased. Consider if it need to be reinstated.

Table 48 Activity 2 detailed feedback – Objective 3

OBJECTIVE: Encourage improved agricultural land use practices and advocate for the protection and enhancement of the WSID		
1. Council leadership	**2. Requirements and responsibilities**	**3. Communication processes**
Actions ✓ Fund actions identified in the stormwater management plan ✓ Advocate for the upgrade of the water delivery system within the Werribee South Irrigation District. ✓ **Encourage the investigation of a more cost effective and sustainable application of water to irrigated crops.** ✓ ***Advocate for access to quality, cost effective water.*** ✓ ***Advocate for increased environmental flows***	Actions ✓ **Meet with Southern Rural Water & Melbourne Water to discuss joint opportunities and define responsibilities** ✓ Establish a plan to roll out the WSUD implementation works ✓ Establish a program to accurately and regularly monitor salinity at ground water discharge sites ✓ Establish a coordinated approach to weed removal and re-vegetation along Green Wedge Waterways ✓ ***Develop a comprehensive system to monitor water quality and bank condition of green wedge waterways and coastline.***	Actions ✓ Support and educate the community in weed removal and waterway monitoring ✓ ***Continue to meet with Southern Rural Water and Melbourne Water to discuss joint opportunities and define responsibilities.*** ✓ ***Develop an WSUD education campaign for local residents***
4. Knowledge and skills	**5. Demonstration projects**	**6. Continuous improvement**
Actions ✓ Identify how the effects of peripheral urban development can be managed to ensure that significant environmental assets within the precinct are not detrimentally impacted upon. ✓ ***Encourage the investigation of a more cost effective and sustainable application of water to irrigated crops.***	Actions ✓ Conduct case study project to determine potential success of future works (refer to opportunities identified in the stormwater management plan) ✓ Explore the development of a fresh food hub that supports Wyndham's agricultural precinct.	Actions ✓ None identified.

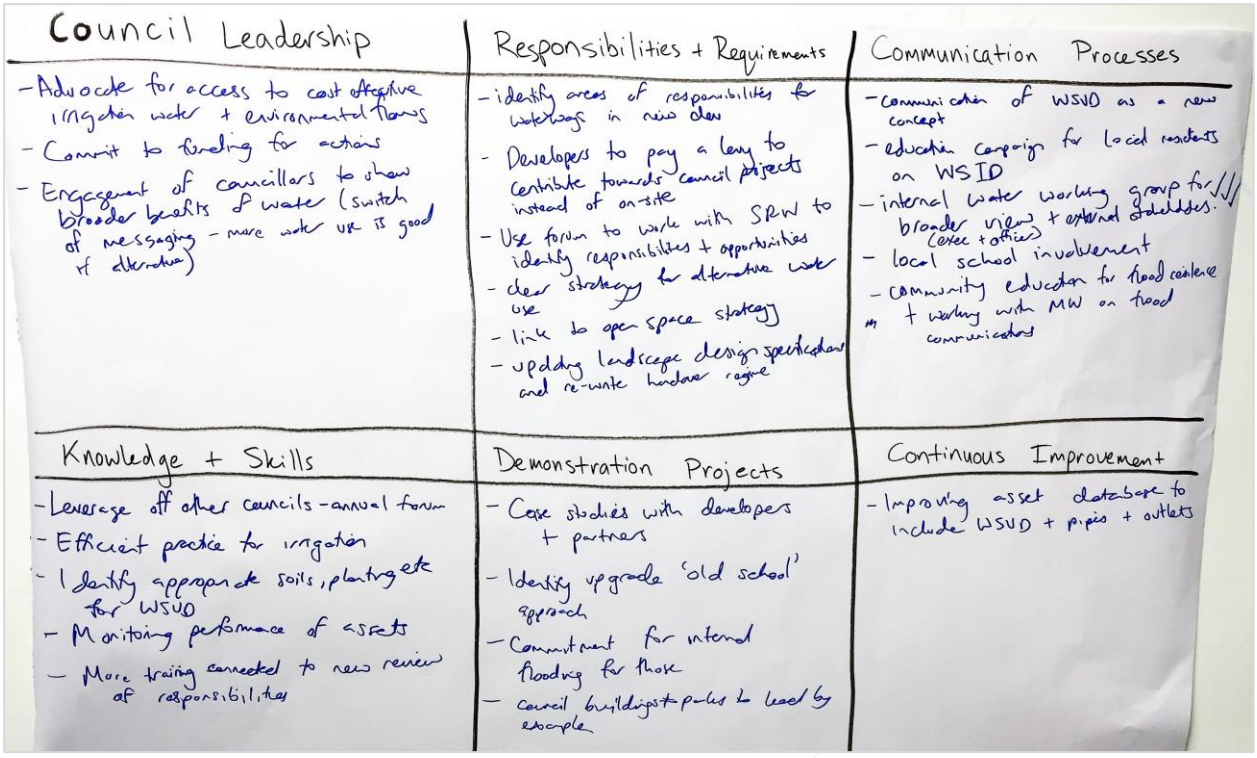


Figure 65 Summary of actions from activity 2

Activity 3: Identifying district based actions.

Attendees were split into four group, with each group representing one of the four districts identified in the Wyndham 2040 District Plans. These include Wyndham East, Wyndham Central, Wyndham West and Wyndham Rural.

Attendees were asked to identify 'structural' and 'non-structural' opportunities in their allocated district. They were also asked to consider what actions are needed to make realise these opportunities and which IWCM objective(s) the opportunity supported.

Table 49 Summary of outcomes from Activity 3

Wyndham East				
Action	**Related Objective(s)**			
	(1) Create a resilient and liveable city	(2) Healthy waterways and coastlines	(3) Agricultural land use and the WSID	(4) Improved collaboration
Water harvesting from industrial rooftops and divert the water to the MOS.	■	■		
Find alternative uses for the seaweed in Sanctuary Lakes (e.g. fertiliser for the WSID)			■	
Increase the priority of the future Bay Trail that connects residents to coastal areas and RAMSAR sites.	■			
Establish a WSUD educational program in local libraries (a potential opportunity is Point Cook library situated near local wetlands).				■
Lobby for a 700m buffer as part of the Cunningham	■	■	■	

Swamp development and investigate stormwater harvesting opportunities from the D1 drain for open space irrigation, include this in the PSP.	■	■	■	

Wyndham Central				
Action	**Related Objective(s)**			
	(1) Create a resilient and liveable city	(2) Healthy waterways and coastlines	(3) Agricultural land use and the WSID	(4) Improved collaboration
Improve / naturalise Sayers Road drainage reserve.	■	■		■
Conduct stormwater harvesting feasibility studies for Hummingbird Boulevard Pavilion and Baden Powell Reserve Development (SWMP).	■	■		
Encourage schools and community members (including new residents) to 'adopt a creek'.	■			■
Work with developers and Melbourne Water to review permeability conditions.	■	■		■

Wyndham West				
Action	**Related Objective(s)**			
	(1) Create a resilient and liveable city	(2) Healthy waterways and coastlines	(3) Agricultural land use and the WSID	(4) Improved collaboration
Opportunity to use future lakes (Blackforest and Manor Lakes) as the basis for multi-purpose demonstration projects.	■			■
Explore the use of streetscape WSUD in new developments again (learn from Wyndham Waters).	■	■	■	■
Explore water harvesting projects in planned developments (e.g. Riverwalk Pavilion and oval etc.).	■	■	■	■
Linear park along Werribee River with joint management between councils and community groups.	■	■	■	■
Retrofit WSUD in infill areas (Werribee and Hoppers Crossing) where treatment is minimal.	■	■	■	

Wyndham Rural				
Action	**Related Objective(s)**			
	(1) Create a resilient and liveable city	(2) Healthy waterways and coastlines	(3) Agricultural land use and the WSID	(4) Improved collaboration
Engage with "Friends of" groups (e.g. Werribee River) around education, habitat, working bees/volunteers.		■		■
Advocate for bike path connections (Bay Trail, Federation Trail / MOS, Werribee River Trail, Werribee River Regional Park) along key waterways (linear reserve connections). This will (a) connect rural and urban areas, (b) link nature, cultural heritage, coastal and water landscapes, and (c) delivers multiple benefits (open space, environment, and tourism, social).	■	■		■
Advocate for improved weed control and land management (includes runoff from farming areas e.g. fertilisers) methods and control (ensure minimal spray drift, and runoff).		■	■	
Focus on tourism / promotion of Melbourne Water Treatment Plant. One of the world's best wastewater treatment plants (innovative, RAMSAR wetlands).		■		■

Use Werribee Zoo as an educational and environmental tool (life cycle management, vegetation, flora, and fauna).				
Educate land owners and visitors to Grahams Reserve of the significance of the wetland.				
Promote Cobbledicks Ford (natural conservation reserve with local waterways) as a tourist attraction that can be used to educate about environment at the top the catchment.				

Addendum

Following consultation the final three objectives for Wyndham's IWCM Plan were modified to reflect the scope of Council's role in Wyndham's rural sector and align the Plan more closely with the Water Sensitive Cities Index. The outcomes captured under the objectives used during consultation were reassigned under the final three IWCM objectives adopted for the plan (Table 50).

Table 50 Summary of IWCM objectives

Objectives used during consultation	• Objective 1: Create a resilient and liveable city that improves the health and wellbeing of its residents • Objective 2: Improve the health and amenity of local waterways and coastal environments • Objective 3: Encourage improved agricultural land use practices and advocate for the protection and enhancement of the Werribee South Irrigation District • Objective 4: Improve collaboration and engagement with all stakeholders
Objectives adopted in the final IWCM Plan	• Objective 1: Create a resilient and liveable city • Objective 2: Improve the health and amenity of waterways and coastal environments • Objective 3: Improve collaboration and engagement with all stakeholders