Attachment 7

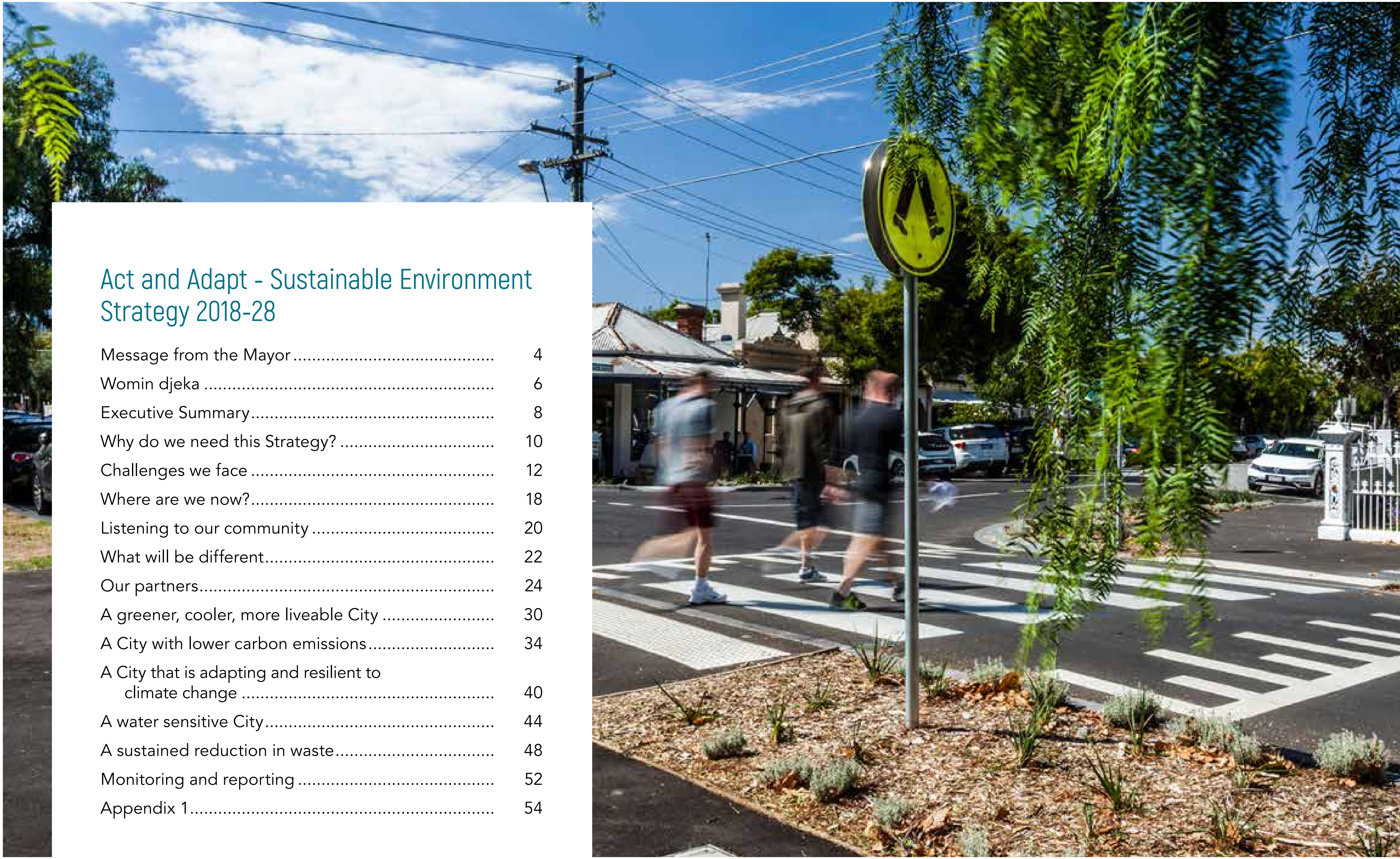
Amendment C203port (Planning Scheme Review): Background documents

Document list:

a. *Act and Adapt – Sustainable Environment Strategy 2018-28* (City of Port Phillip, 2018)
b. *Activating Laneways Strategy* (City of Port Phillip, July 2011 adopted August 2011)
c. *Art and Soul - Creative and Prosperous City Strategy 2018-22* (City of Port Phillip, 2018)
d. *Australian Rainfall and Runoff – Book 9 Runoff in Urban Areas* (Commonwealth of Australia, 2019)
e. *Car Share Policy 2016-2021* (City of Port Phillip, 2018)
f. *City of Port Phillip Biodiversity Study* (Arcadis, May 2020)
g. *City of Port Phillip Council Plan 2017-2027* (City of Port Phillip, 2017)
h. *City of Port Phillip Housing Needs Assessment and Allocations Framework* (Beverley Kliger & Associates, 2019)
i. *Compliance Guidelines for Clause 22.12 Stormwater Management* (City of Port Phillip, 2017)
j. *Don’t Waste It! - Waste Management Strategy 2018-28* (City of Port Phillip, 2018)
k. *Foreshore Management Plan 2012* (City of Port Phillip, 2012)
l. *Getting Our Community Active - Sport and Recreation Strategy 2015-2024* (City of Port Phillip, 2015)
m. *Greening Port Phillip: An urban forest approach 2010* (City of Port Phillip, 2010)
n. *Guidelines for Preparing a Waste Management Plan 2019* (City of Port Phillip, 2019)
o. *Heritage Design Guidelines* (City of Port Phillip, 2021)
p. *In Our Backyard: Growing Affordable Housing in Port Phillip 2015-2025* (City of Port Phillip, 2015)
q. *Move, Connect, Live Integrated Transport Strategy, 2018* (City of Port Phillip, 2018)
r. *Port Phillip Design Manual, 2000 (City of Port Phillip, 2000)* including:
    i. *Fishermans Bend Estate Guidelines* (City of Port Phillip, updated 2021)
    ii. *Garden City Estate Guidelines* (City of Port Phillip, updated 2021)
s. *Places for People: Public Space Strategy 2022-32* (City of Port Phillip, 2021)
t. *Recreational Boating Facilities Framework 2014* (Central Coastal Board, 2014)

Act and Adapt

Sustainable Environment Strategy 2018-28



Act and Adapt - Sustainable Environment Strategy 2018-28

We are seeking to ensure a sustainable future for the City of Port Phillip by creating a City that is greener, cooler and more liveable

Womin djeka

Council respectfully acknowledges the Yaluk-ut Weelam Clan of the Boon Wurrung.

We pay our respect to their Elders, both past and present.

We acknowledge and uphold their continuing relationship to this land and water on which we rely.

We recognise the intrinsic connection of the Traditional Owners to Country and acknowledge their contribution in the management of land, water and resources.

MESSAGE FROM THE MAYOR

Act and Adapt: Sustainable Environment Strategy 2018-28

On behalf of the Councillors, I am pleased to present Act and Adapt: Sustainable Environment Strategy 2018-28.

Council is committed to supporting a sustainable future for our City, as reflected by strategic direction three of the Council Plan - We have smart solutions for a sustainable future. This Strategy creates a framework to deliver on this commitment over the next 10 years, including key priorities such as:

- a greener, cooler more liveable City to reduce the impacts of heat and improve enjoyment of our public space
- a City with lower carbon emissions to reduce the environmental footprint of Council and community
- a City that is adapting in order to be resilient and better manage the impacts of a changing climate
- a water sensitive City that will enable Council to maintain our parks and sports fields while reducing pollutants entering the bay
- a sustained reduction in waste, adapting to changes in the industry and managing waste more efficiently.

This Strategy details actions that will deliver on these priorities, allocates budget and specifies a timeline indicating our long-term commitment to ensuring that as a community we can adapt to the pressing challenge of climate change. We are looking to do this while also enhancing our City's green spaces and foreshore, being financially responsible and reducing the broader impact we have on greenhouse gas emissions and waste.

All members of our community are custodians of our land, and we have a collective role to play in protecting its future and meeting the environmental challenges ahead. That is why we are:

- planting more trees
- harvesting water to make sure it isn't wasted
- helping to keep our bay clean
- dealing with waste in more efficient and local ways.

We are excited to present this Strategy and look forward to working with you over the next 10 years to create a more sustainable Port Phillip.

Cr Bernadene Voss
Mayor
City of Port Phillip

Council is committed to supporting a sustainable future for our City, as reflected by strategic direction three of the Council Plan - we have smart solutions for a sustainable future.

As custodians of this land, it is our responsibility to protect and enhance this land for future generations. Council values traditional knowledge and the teaching of old ways to care for the environment into the future. We look forward to partnering with all our community who are connected to this land and are proud to call it home, to ensure it thrives into the future.

WOMIN DJEKA

Womin djeka, Mar-ran biik biik. Boon Wurrung Nairm derp bordupren uther weelam. Welcome!

Welcome to my Country, the land of the great bay of the Boon Wurrung people, our beautiful home. On behalf of the Boon Wurrung, a clan of the greater Kulin nations, I welcome you to our land.

Euro Yuroke, more commonly known as St Kilda, and its surrounds, are special places that continue to carry forward the spirit of our tradition.

This land will always be protected by the creator Bundjil, who travels as an eagle, and by Waarn, who protects the waterways and travels as a crow.

As the spirit of my ancestors lives, let the wisdom and the spirit of generosity which Bundjil taught us influence the opportunities that may arise at this meeting place.

N'arweet Carolyn Briggs
Boon Wurrung Elder

Sharing the story of the land

Boon Wurrung Elder
- N'arweet Carolyn Briggs

One day - many, many years ago - there came a time of chaos and crisis.

The Boon Wurrung and the other Kulin nations were in conflict. They argued and fought. They neglected their biik (land). The murrnong (yam daisy) was neglected. Too many animals were killed and not always eaten. The gurnbak (fish) were caught during their spawning season. The iilk (eel) were not harvested. As the chaos grew, the warreeny (sea, ocean) became angry and began to rise. The wurneet (river) became flooded and eventually the whole flat plain was covered in baany (water). It threatened to flood their whole barerarerungar (country).

N'arweet Carolyn shares how the terrified people sought assistance from Bundjil, but explains how Bundjil was angry with his people, and he told them that they would have to change their ways if they wanted to save their land.

A time of chaos - Jarra Steel, 2015

The challenge of environmental sustainability is not just limited to the City of Port Phillip; it is a worldwide issue

EXECUTIVE SUMMARY

What is Act and Adapt: Sustainable Environment Strategy 2018-28?

Act and Adapt: Sustainable Environment Strategy 2018-28 outlines the City of Port Phillip's commitment to environmental sustainability for the organisation and the wider community. It establishes a pathway that will assist to transition the City to a greener, cooler more liveable City where we are all reducing our impact on the environment and are more resilient to the impacts of climate change.

This Strategy contains 47 priority actions that outline how Council will respond to strategic direction three of the Council Plan, **'We have smart solutions for a sustainable future'** and is designed to help our City thrive.

Each action can be measured against corporate and community goals in relation to the Council Plan priorities of:

- A greener, cooler and more liveable City
- A City with lower carbon emissions
- A City that is adapting and resilient to climate change
- A water sensitive City
- A sustained reduction in waste.

Actions within this Strategy will influence city planning and urban design, waste and water management, and community outreach. They also embed sustainability into Council operations and projects to ensure the City of Port Phillip is working towards a more sustainable future. This Strategy recognises that a long-term plan is required to bring about change and so has planned the delivery of the actions across the next 10 years.

Why is it important?

The City of Port Phillip is an attractive destination for residents, businesses and visitors. We have 11 kilometres of bay foreshore, beautiful tree-lined streets, and many attractive parks and open spaces that attract many native species of animals and plants

We are already Victoria's most densely populated municipality, with resident numbers projected to increase 23 per cent by 2027, to 136,300. Residential growth is compounded by worker growth, which is also set to increase by over 30,000 additional jobs in the Fishermans Bend precinct alone by 2050. Sustainably managing growth is a key challenge for the City of Port Phillip.

Managing this growth to keep the City of Port Phillip beautiful, liveable, caring, inviting, bold and real has never been more important.

Our growth challenge is compounded by the effects of a changing climate. Lower than average rainfall means our water supply is estimated to reduce by up to 11 per cent by 2020 *. Increased erosion of the foreshore due to a greater number and intensity of storm surges is expected and with most of the City only one to three metres above sea level we are vulnerable to rising sea levels.

Rising temperatures are also having an impact on our environment and heat-related health stress is acutely felt by those who are the most vulnerable in our community.

The challenge of environmental sustainability is not just limited to the City of Port Phillip; it is a worldwide issue. This Strategy not only outlines our leadership and the contribution we can make at the local level, it also underpins our commitment to the Global Covenant of Mayors for Climate and Energy, which is creating a more sustainable future for cities worldwide.

What will we achieve through this Strategy?

We are seeking to ensure a sustainable future for the City of Port Phillip by creating a City that is greener, cooler and more liveable; a City with lower carbon emissions; a City that is adapting and resilient to climate change; a City that is water sensitive with a sustained reduction in waste.

FACTS

23 %

projected increase in resident growth by 2027.

11 %

estimated reduced rainfall in 2020

14 %

of the City's greenhouse gas emissions are due to private vehicles

* CSIRO, Climate Change in Australia - Technical Report, CSIRO, Melbourne, 2007

As our City continues to grow at an unprecedented rate, we need to look at all we do, all we will need to do, and how we can best deliver value for our community.

WHY DO WE NEED THIS STRATEGY?

The City of Port Phillip aspires to be an international leader in sustainability; to be a City that builds on our success and learns from our failings in order to do better and create a better environment for all who live, work and play here.

Climate change is now affecting every country on every continent. It is affecting lives, costing people, communities and countries dearly and disrupting national economies.

The greenhouse gas emissions from human activities are driving climate change and they continue to rise. They are now at their highest levels in history. Without action, the world's average surface temperature is projected to rise over the 21st century and is likely to surpass three degrees Celsius this century - with some areas of the world expected to warm even more. The poorest and most vulnerable people are being affected the most.

Climate change is a global challenge that does not respect national borders. Emissions anywhere affect people everywhere.

Source: United Nations Sustainable Development Goal 13
https://www.un.org/sustainabledevelopment/climate-change-2/

To create a sustainable City, this Strategy drives critical actions and measures progress toward:

1. a greener, cooler and more liveable City
2. a City with lower carbon emissions
3. a City that is adapting and resilient to climate change
4. a water sensitive City
5. a sustained reduction in waste

Many other plans, policies and strategies within Council will also contribute to these outcomes.

A set of Guiding Principles were used to develop the actions in **Act and Adapt:**

- We make an impact for our community
- We prioritise fairness and equity
- We harness partnerships and collaboration
- We invest wisely to benefit our community now and tomorrow
- We adapt to change by testing, learning and monitoring

For the most part, the actions in **Act and Adapt** will be applied across the municipality. However, some actions may be delivered differently within neighbourhoods.

CHALLENGES WE FACE

Several significant long-term challenges were identified in the City's Council Plan 2017-27.

Each of these challenges provide us with opportunities to think differently about how we function as a City as we move toward a more sustainable future.

Population growth and urbanisation

As Victoria's most densely populated municipality, and with resident growth projected to increase 23 per cent by 2027 (taking our resident population to 136,300) sustainably managing growth is a key challenge for the City of Port Phillip.

To accommodate this increase in population, there is significant pressure for higher density developments. If not planned well, increased density has the potential to significantly impact on the environment, reducing tree canopy, trapping more heat in our streets, increasing concrete and stormwater runoff and placing more demand on our parks and foreshore.

Managing this growth sustainably to keep the City of Port Phillip beautiful, liveable, caring, inviting, bold and real has never been more important.

Climate change

Our sustainable growth challenge is compounded by the effects of a changing climate, one of the most pressing social challenges of our time.

Lower than average rainfall means our water supply is estimated to reduce by up to 11 per cent by 2020 and with 68 per cent of the City below three metres above sea level, we are significantly vulnerable to rising sea levels.

Increased erosion of the foreshore due to a greater number and intensity of storm surges is also a significant issue.

Rising temperatures are having an impact on our environment and heat-related health stress is acutely felt by those who are the most vulnerable in our community.

Legislation and policy

All Victorian councils must comply with legislation and policy, which is constantly under review and subject to change.

With government funding being reduced and more expectation being placed on councils to fill this gap, ensuring we can survive and thrive in a changing environment will require us to adapt and consider new ways of managing our natural environment and assets.

* Forecast.id projections

Technology

The rapid evolution of technology comes with increased demands from our community for alternative methods of service delivery.

Although challenging to keep up with the emergence of this technology, it is also an opportunity. New technology, real-time data and connectivity can help us plan our public spaces to be cooler, water our parks only when needed and let you know when an electric vehicle charging station is free.

Transport

A growing City with a road network that is at capacity and cannot be increased, requires a rethink of how more sustainable modes of transport can be used. Transport infrastructure and services can support sustainable and healthy behaviours like safe walking, bike riding and the use of public transport.

Changing economy

As changing economic conditions mean that more of our community will travel outside the municipality for work, providing more sustainable travel choices will be more important than ever.

Global challenges, local impacts

The challenge of environmental sustainability is not just limited to the City of Port Phillip; it is a worldwide issue. This Strategy outlines the contribution we can make at the local level. It is also an important part of addressing our commitment to the Global Covenant of Mayors for Climate and Energy, and the United Nations Sustainable Development Goals. Both agendas signify a global commitment to end poverty, safeguard the planet and ensure prosperity for cities worldwide.

We have the opportunity to work with governments and research organisations from all over the world to develop ways of combating these challenges on a local scale. Creating a thriving community resilient to the future impacts of climate change is a major priority for the City.

GLOBAL CHALLENGES, LOCAL IMPACTS

Health and wellbeing

- Increasing risks and discomfort for those most vulnerable in our community – people who are elderly, on a low income, living in isolation or with health conditions or impairments
- Increased strain on emergency and community support services means not everyone gets help when they need it
- Discomfort, premature death and ill health due to heat

Rising sea levels

- Damage to seaside infrastructure and property
- Increased erosion of our beaches
- Decreased quality of foreshore recreation areas and habitat

Warmer weather

- More localised hot spots where heat is trapped in concrete, asphalt and other hard surfaces
- Businesses lose income during extreme heat events
- Increased frequency of interrupted electricity supply affecting the way we live

Storm events

- Flood damage to homes, businesses and Council infrastructure
- Large clean-up costs after extreme weather events
- Insurance premiums increase
- More stormwater pollution entering the Bay after storms

Rainfall and droughts

- Our parks and gardens are drier and more expensive to maintain
- Our unique leafy character is threatened
- More frequent water restrictions

Doing things right

Inspiring our community through demonstrating environmental leadership in our own operations.

BIG OPPORTUNITIES EXIST

Changing environmental conditions will require us to think about how we deliver services to ensure we keep our residents and visitors safe. As a growing municipality, our commitment to caring for our City and to not only maintain, but enhance our local environment, is more important than ever.

Doing the right things

Understanding our current and future challenges, and evaluating our impacts to focus our investment and efforts in programs and projects that have tangible benefits for our community.

Doing things right

Inspiring our community through demonstrating environmental leadership in our own operations. Ensuring our assets and services are managed effectively and efficiently to facilitate our community to reduce their environmental impact.

Supporting Councillors and officers to become leaders in environmentally sustainable work practices.

Doing things with partners

Leveraging our strong and productive relationships with state and local governments, not-for-profit organisations, research organisations and community groups to maximise our combined impact.

Doing things differently

Embracing the rapid evolution of technology and investing in our technology systems to make it easier and cheaper for Council and the community to improve environmental outcomes.

WHERE ARE WE NOW?

From our community to our heritage buildings, we are a City of personality and character. Covering an area of 21 square kilometres, we are one of the smallest municipalities in Victoria, and we are also the most densely populated.

Half of our community live in rented accommodation. Port Phillip is also home to 19,441 businesses that collectively employ over 87,000 people.

Our proximity to Melbourne, the 11 kilometres of bay foreshore, beautiful tree-lined streets and the many attractive parks and open spaces, makes Port Phillip a popular destination for residents, businesses and tourists. As a City, we attract 2.8 million visitors a year, second only to the City of Melbourne as the most visited municipality in Victoria.

This is the community and the environment that we are committed to protecting and enhancing. This Strategy responds to the challenge of a growing population and changing environmental conditions, providing a pathway to remain the bold, liveable, caring and beautiful place we are today.

The changing climate we are already experiencing in our City brings many real challenges that demand a considered response:

1. lower than average rainfall with water supply estimated to be reduced by up to 11 per cent by 2020
2. rising temperatures, which will result in more heat-related health stress and deaths.
3. rising sea levels that will affect much of Port Phillip, which is only one to three metres above sea level
4. increased erosion of the foreshore due to an increase in the number and intensity of storm surges.

Working together

As an established municipality, opportunities to influence our urban environment to make it more resilient to these impacts can be hindered by the lack of available public space and volume of established infrastructure. However, Port Phillip is home to an engaged, committed community, which provides opportunities to unlock unique collaborative solutions.

Sustainability-focused technologies, like battery storage, bio digesters and electric vehicles, are rapidly developing, and could support Council and the community to lower emissions. Our continued investment in technology will allow us to capture and analyse large amounts of data to inform our strategic objectives and evaluate our impacts.

We have strong and productive relationships with the Victorian Government and our neighbouring councils, not-for-profit organisations and community groups. Whether it's the Melbourne Renewable Energy Project, Association of Bayside Municipalities or the Cities Power Partnership, we are able to leverage these partnerships to maximise our impact.

6.87 ha

The average Australian has an ecological footprint of 6.87 global hectares - the equivalent of a four planet lifestyle.*

Our consumption of natural resources is measured using ecological footprinting. By looking at how much energy and water we use, what type of food we eat and what we throw away, we can calculate the number of global hectares of land used to support our lifestyle.

This can then be translated into the number of planets needed if everyone on earth lived the same way.

* Global Footprint Network. (2018). National Footprint Accounts - Edition 2018. Available at: http://data.footprintnetwork.org

LISTENING TO OUR COMMUNITY

We are proud to have an engaged and committed community who are passionate about sustainability. We will need to work collaboratively with the community to meet our sustainability challenges head on and we need your help.

In preparing this Strategy we have engaged with the community through sustainability surveys, forums and focus groups to understand your concerns.

You told us you wanted:

- Greater focus on reducing our City's carbon emissions
- A proactive approach in adapting to climate change
- To get people out of their cars through better public transport connections [1]
- More information and education to support behaviour change
- Council to play a leadership role in supporting the community to take sustainability actions.

You also told us that you want actions that have real, measurable outcomes. We are committed to tracking and reporting progress through measurable indicators for each of the five outcomes.

We've listened to what you have told us and combined this with international best practice, current research and what we have already learned, to shape and inform a strategy that will guide us all to achieve our vision together.

[1] Move, Connect, Live, Council's Integrated Transport Strategy will be developed in 2018

The choices we make every day have an impact on the sustainability of our City.

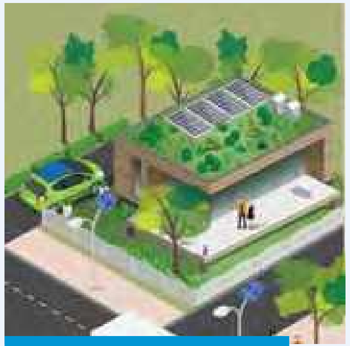
You can choose to buy less stuff, recycle, reduce the energy and water you use, take public transport, plant a tree and so much more.

WHAT WILL BE DIFFERENT

The City of Port Phillip has a vision to be a beautiful, liveable, caring, inviting, bold and real City. This vision will be realised through delivering the Council Plan.

Act and Adapt embeds change and collaborative actions across a range of council services including:

- urban design and city planning
- open space planning
- health and wellbeing
- foreshore management
- waste management
- transport
- economic development
- tourism.



Low carbon living

- Our City is a leader in zero carbon living and climate change resilience. All of Council's facilities are carbon neutral.
- Houses and apartments are cleverly designed to reduce energy use and to access power from renewable sources. Green roofs and walls reduce the urban heat island effect for all of us.

Transport

- New sustainability technology is embraced. Electric vehicles are commonplace and charge points are available for use by the community.
- A smart public transport system and safe connected walking and bicycle routes provide popular and convenient alternatives to car travel.

Partnerships

- Council is partnering with all levels of government and research organisations to ensure a collaborative approach to caring for Port Phillip and its people.

* Forecast.id projections

Working together

- Everyone works together to prepare for the extreme weather events and to keep our community safe. Services are designed to be reliable in all conditions.
- Council events are delivered without single use plastics and generate very little waste. Community and corporate events are supported to do the same.

Technology

- Smart technology and the Internet of Things help to keep our streets, parks, creeks and beaches clean. Less waste is produced. The waste that is generated is managed so that 80 per cent of it is diverted from landfill.

Urban ecology

- Healthy trees and the use of water in the landscape make our City greener and cooler.
- A diverse range of birds, insects and animals live in public spaces and on private land.

Water sensitive

- Stormwater is used to irrigate open spaces, and smart technology ensures that water isn't wasted. Water is captured in the landscape to reduce flooding and to cool the City.
- Council, the community and other stakeholders collaborate to implement cost effective solutions to reduce flooding in the Elster Creek catchment.

OUR PARTNERS

The City of Port Phillip works with key partners to deliver community focused solutions, drive regional outcomes and ensure efficient use of our resources. The initiatives outlined in this Strategy will require significant collaboration across public and community sector organisations, the private sector and our communities.

During the life of this Strategy we expect that the way we work with our partners will vary depending on the requirements of each stage of implementation. Our partners are subject to change and will evolve over time. Council values the support of our partners in helping us deliver the important initiatives in this Strategy, as we recognise we cannot achieve them alone.

Our City is affected by Federal and Victorian Government legislation and policies, the actions of neighbouring councils, the businesses and organisations that operate within our boundaries and everyone that lives, works and visits.

This context presents both opportunities and challenges for delivering the actions in this Strategy. In some instances, we will have direct control over specific actions, especially those relating to Council operations. In other cases, we will advocate to other levels of government for change and leverage opportunities to benefit our community.

Council's role

Trusted service provider
Providing high quality assets and services that are managed sustainably to ensure we minimise environmental impact and increase community resilience to the challenges of climate change.

Trusted partner and broker
Advocating to and partnering with State, Federal, and other local governments, utility providers and research organisations to drive systemic sustainability improvements in response to community needs.

Trusted advisor and agent
Working efficiently to achieve our City vision and strategic directions through delivering programs that facilitate sustainability practices in homes and businesses.

Trusted steward
Showcasing best practice sustainability practices in our own operations and trialling new ways of working to inspire our community.

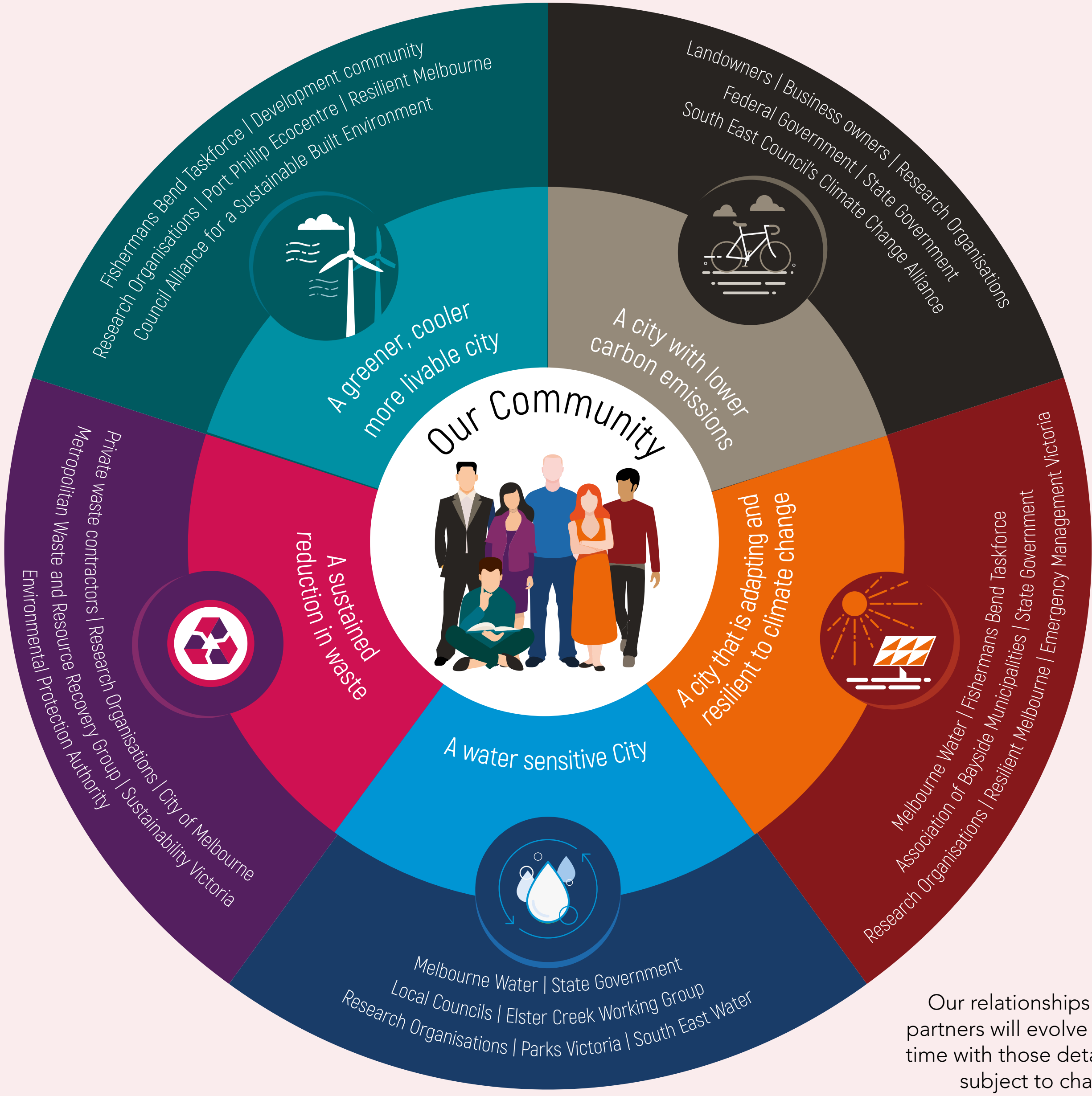
Monitoring and reporting
Monitoring and reporting against the key sustainability indicators outlined in this Strategy to develop a shared understanding of progress and to identify opportunities.

Key partners

The key to creating a sustainable Port Phillip is working with others. Our community, local and Victorian Government partners, research organisations and private industry all have a critical role to play.

Across Port Phillip there are already hundreds of organisations, businesses and individuals showing leadership, implementing solutions and making sustainability a part of everyday life. Building on our history of success, we must continue to come together and scale up our activities.

Each of us has a role in acting together to create a sustainable future.



Our relationships with partners will evolve over time with those detailed subject to change.

As a local government, Council exists within the larger government system. We are directly affected by the action or inaction that occurs in other municipalities and at the state and federal levels. Through collaboration and partnerships, we play a role in moving toward a system-wide approach to sustainability.

Partnering with the Victorian and Federal governments

- development of planning scheme amendments that deliver stronger outcomes for sustainable design, stormwater management, management of waste and action on climate change adaptation
- upgrade of sustainability assessment tools available to the public
- development of minimum mandatory standards for rental properties to improve thermal performance, ensure appropriate heating and cooling, and deliver lower energy bills
- development of minimum thermal safety standards in the planning scheme to drive improved energy efficiency and thermal safety and comfort of buildings
- access to funding that supports low income households and the energy efficiency of public housing and community housing, including support to upgrade high cost, high-energy using household fixtures such as hot water systems, heating and cooling
- addressing climate vulnerability among public housing tenants, with a particular focus on heat stress
- supporting health and wellbeing service delivery in Port Phillip, with consideration to increasing climate related health concerns such as extreme heat
- ensuring ongoing sustainable management and health of our beaches and Port Phillip Bay through regulation of Water Sensitive Urban Design to assist pollution reduction
- developing coastal adaptation responses that are sensitive to the ecological processes of Port Phillip Bay and the needs of our community
- actualising Victorian Government-run randomised onsite compliance checks for new buildings and landscapes
- progressing the development of a metropolitan organic waste processing facility
- reduction in use of balloons, plastic bags and single use plastics.

Melbourne Water and councils within Yarra and Elster Creek catchments

- collaborating to ensure a whole of catchment approach to flood prevention
- continued infrastructure upgrades to decrease flood risks locally and downstream
- continued stormwater capture and treatment to reduce the amount of pollutants entering Port Phillip Bay.

The role of residents and businesses

The choices you make every day have a massive impact on the sustainability of our municipality. You can choose to buy less stuff, recycle, reduce the energy and water you use, take public transport, plant a tree and so much more. When you do these things, you not only make a direct contribution to Port Phillip's sustainability, you also play a powerful role in influencing those around you.

The Sustainable City Community Action Plan (SCCAP), endorsed in March 2018 provides details of the programs funded by Council to support the wider community to reduce greenhouse gas emissions, waste generation and water consumption. Although the SCCAP predates Act and Adapt, it is not a duplication or contradiction. Rather, it is now included in this Strategy under Action Seven. The SCCAP includes a range of education and behaviour change initiatives as well as practical support for renters, apartment buildings, businesses and community services.

The role of landlords

More than half of our residents live in rented accommodation. Landlords hold significant power and influence over what infrastructure is installed in their properties, including air conditioning, hot water, lighting, and water systems. They also control the quality of the building shell and can decide to install things like insulation and draft proofing. The combination of these factors has a huge impact on occupant comfort, utility costs and environmental impacts.

We encourage landlords to consider upgrading tenanted properties to improve water and energy efficiency. This will not only improve liveability for tenants, it will also contribute to the appeal of the property in a rapidly changing marketplace.

Council is committed to supporting our community to become more sustainable. The **Sustainable City Community Action Plan** details exciting initiatives that Council will take over the coming years to support the community to reduce their greenhouse gas emissions, waste and water consumption.

Read more about the plan or sign up for our newsletter at:

www.sustainableportphillip.com

Building partnerships

Water Sensitive City partners

Reducing the impact of flooding in Elster Creek, particularly in Elwood, is a challenging problem. The creek runs through four council areas and is managed by Melbourne Water. Elwood is heavily impacted by the rain that falls in Glen Eira and Bayside municipalities. Council will continue to advocate for catchment-wide solutions. We rely on our government partners to help reduce the impact felt by the community.

Dumped rubbish, litter, oils and other pollutants can end up in our stormwater system and will eventually flow into the bay. This is where we rely on our community to help us create a safer, cleaner environment and a healthy bay. By partnering with the Port Phillip EcoCentre, Beach Patrol and Love Our Streets volunteers, we can educate our community about the harmful impact pollution has on our bay, encouraging greater care for our environment.

Cooler, greener more liveable City partners

The Port Phillip Planning Scheme offers significant potential to influence new developments and retrofitting of our built environment, but there are also limits to what it can achieve. We need to work with our government partners to advocate for housing that will better cope with our future environment.

Seventy-five per cent of the land in our City is privately owned. In order to create a cooler and greener City where heatwaves have less impact, we need the community's help. Opportunities to keep large trees in our environment while we face the challenge of densification and population growth is a complex problem. We must look to a range of options like green roofs, walls and facades.

Climate Adaptation partners

Council is committed to the Global Covenant of Mayors for Climate and Energy (formerly the Compact of Mayors), a global coalition of city leaders addressing climate change by pledging to cut greenhouse gas emissions and prepare for the future impacts of climate change. Our partnership with Resilient Melbourne also enables us to access and partner with researchers and other local governments to identify ways to adapt to climate change.

Get involved

Join us in creating smart solutions for a sustainable future. Come along to a workshop, join a local sustainability focused community group, visit the EcoCentre (ecocentre.com) or Council's sustainability website:

www.sustainableportphillip.com

Reducing the impact of flooding in Elster Creek, particularly in Elwood, is a challenging problem.

A greener, cooler, more liveable City

Recent highlights:

Council increased areas vegetated with Indigenous species by 2,500m^2 including plantings at Turner Reserve Port Melbourne, Elwood Canal and Head Street Reserve.

Through Council plantings in streets and parks, and community tree planting days, 4,101 trees were planted on public land in 2016-17.

In partnership with inner Melbourne councils, the City of Port Phillip developed the Growing Green Guide - a 'how to' guide for installing green walls, roofs and facades.

We live, work and play in a landscape of natural beauty, with residents and millions of visitors enjoying our beaches and lush open spaces each year.

Healthy ecosystems are vital for our City and the health of our whole community. Cities play a crucial role in connecting people to nature, and through careful planning and investment we have the ability to improve our community's quality of life.

Good planning in the past has left a legacy of beautiful and green historic parks, public and private gardens, and many tree lined streets that contribute to a mature tree canopy cover and greening across most of our neighbourhoods. There are a number of significant areas of habitat that act as biodiversity hotspots and form corridors for animals to move through our suburbs.

With increased densification, more concrete and average temperatures increasing year on year, we are finding that the City is getting hotter not only during the day, but also overnight. This is known as the urban heat island effect and it has a large impact on our community's health and wellbeing.

We will continue to deliver green and blue connections that support our local animals and an active community who enjoy a cooler, more liveable City.

We have the goal of making our whole City greener, and for that we need your help. Our key challenge is that 75 per cent of the land in the City is privately owned, so all landowners in the City hold some responsibility for creating a greener, cooler City.

Through the actions in this Strategy and the Greening Port Phillip urban forest strategy, our partnerships with the Port Phillip EcoCentre and other environmental groups, and through working with you, we are aiming to expand our urban forest, increase biodiversity corridors, increase porous surfaces and reduce the urban heat island effect across the whole of the City.

Key partners

- The community
- Resilient Melbourne
- Victorian Government
- Port Phillip EcoCentre

Key strategies

- Greening Port Phillip Strategy
- Move, Connect, Live [2]
- Water Sensitive City Plan [3]
- Climate Change Adaptation and Greenhouse Plan [4]
- Public Space Strategy [5]
- Foreshore and Hinterland Vegetation Management Plan
- Foreshore Management Plan

Measuring progress

MEASURE	2015/16	2027/28
Street canopy cover	19 %	Increase 10 %
Council's Greening Port Phillip - An Urban Forest Approach, also contains suburb-based targets that are reported against every five years.		
Canopy cover on private land	11 %	Increase 10 %

Green and blue connections use both vegetation and water to enhance public open spaces, making cities more vibrant, inviting in biodiversity and cooling the surrounding area. These spaces can be natural or highly urbanised streetscapes. Also known as Blue-Green infrastructure, this school of urban planning has been proven to have a positive impact on the liveability of a City.*

*Making Cities Liveable - http://issuu.com/ramboll/docs/bgi__new?e=4162991/34845282

[2] Council's Integrated Transport Strategy - in development
[3] To be developed in 2018/19
[4] To be developed in 2018/19
[5] In development - will replace Open Space Strategy

A greener, cooler, more liveable City

	ACTIONS	2018-2020	2021-2024	2025-2028
1	Implement the Greening Port Phillip Strategy and Street Tree Planting Program, including ongoing investment in species diversification, park trees, streetscape improvements and a stronger focus on enhancing biodiversity by planting indigenous and climate tolerant species			
2	Implement the Foreshore and Hinterland Vegetation Management Plan			
3	Develop a Biodiversity Study and Action Plan			
4	Maintain heat mapping and solar analysis data. Use data, along with Socio-Economic Index for Areas and flood data to guide project and service delivery Communicate information to the community through a web-based platform			
5	Deliver technical guidance and implement regulatory interventions to protect vegetation and increase canopy cover on private property, including green roofs, walls and facades			
6	Encourage and enforce sustainable, climate resilient buildings through the planning process by applying environmentally sustainable design planning policy guidelines and by providing clear, accessible information to the community			

Studies have shown that a well placed shade tree can significantly cool a house in summer, making it more comfortable for residents as well as reducing energy bills associated with cooling by 30 per cent*

Photo - St Kilda EarthCare and Friends of Elster Creek

* Peak Power and cooling energy savings of shade trees; Akbari et Al; Energy and buildings V25 Issue 2 1997

A City with lower carbon emissions

Recent highlights:

Council has committed to purchase all of its electricity through the Melbourne Renewable Energy Project.

Council has installed a 172 kW solar system on St Kilda Town Hall, reducing emissions by 300 tonnes and saving Council $44,000.

Council facilitated the community to install 102 solar systems on homes.

One of the most significant challenges the world faces is transitioning away from our use of fossil fuels and reducing our carbon emissions.

Council has joined with the Victorian Government and countries around the world to play our part in reducing greenhouse gas emissions, in an attempt to keep the global temperature rise to under two degrees.

To do this we must work collaboratively. Council produces only 0.6 per cent of the overall emissions in the City, and as we move towards a low carbon future we need to work with our community.

We are committed to taking real action and to supporting our community to do the same. The community can create an energy smart lifestyle by building or retrofitting houses, apartments and commercial properties with insulation and double glazing, energy efficient lighting and appliances, and by accessing renewable energy.

In 2015 at the United Nations Framework Convention on Climate Change, the international community committed to the Paris Agreement on Climate Change - to keep the rise in global temperatures to below 2°C above preindustrial levels, and to work towards limiting the rise to 1.5°C. Australia ratified this agreement on 9 November 2016.

Key partners

The community

Victorian Government

South East Councils Climate Change Alliance

Council Alliance for the Sustainable Built Environment

Key strategies

Sustainable City Community Action Plan

Climate Change Adaptation and Greenhouse Plan [11]

Move, Connect, Live [12]

Measuring progress

GREENHOUSE GAS EMISSIONS tCO2e	2016/17 BASELINE	2027/28	
Council	10,950 [6]	520	gross emissions
Council	6,464	Zero	net emissions
Community	1,700,000 [7]	Zero*	net emissions by 2050 [8]
ELECTRICITY FROM RENEWABLE SOURCES	**2016/17 BASELINE**	**2027/28**	
Council	293 kW	100 %	(includes onsite and offsite)
Community	5,100 kW	50 % (29,000 kW)	penetration [9]
ENERGY CONSUMPTION	**2016/17 BASELINE**	**2027/28**	
Energy Consumption in Council buildings [10]	8,900 MWh	7,300 MWh	

* Interim emissions to 2025 to be confirmed in late 2018

6 Gross emissions are the total emissions for City of Port Phillip, before accounting for any purchased offsets. Gross emissions include scope 1, 2 and 3 emissions. Offsets are subtracted from gross emissions to calculate Council's net emissions.
Scope 1, direct emissions: the emissions released to the atmosphere as a direct result of an activity. For example, emissions from the burning of diesel fuel in Council vehicles.
Scope 2, indirect energy emissions: the emissions released to the atmosphere from the indirect consumption of an energy commodity. For example Council using electricity produced by a coal fired power station.
Scope 3, indirect emissions: the emissions that are generated in the wider economy (other than scope 2 emissions). They occur as a consequence of Council's activities, but from sources not owned or controlled by Council. For example, the emissions released in the production of office equipment ultimately purchased by Council.

7 This figure is an estimate based on the best available data and takes into account emissions generated through energy use, transport, waste and water across the residential, commercial and industrial sectors in our municipality. It has been compiled in accordance with the Global Protocol for Community Scale Greenhouse Gas Emission Inventories. It should be noted however that due to the unavailability of publicly available data sets some of the supporting data is based on interpolation from state wide and national emissions information.

8 Aligned with Victorian State Government GHG emissions target for whole of state as per Victorian Climate Change Act 2017

9 Based on standalone and semi-detached homes as per 2016 ABS data

10 Electricity and gas consumption included. Joules of gas have been converted to an equivalent kWh

11 To be developed in 2018/19

12 Council's Integrated Transport Strategy currently under development.

A City with lower carbon emissions

	ACTIONS	2018-20	2021-24	2025-28
7	Deliver behaviour change and education programs through the Sustainable City Community Action Plan (SCCAP) and support environmental education programs in schools			
8	Review Council services to identify opportunities to reduce carbon emissions and implement changes			
9	Reduce energy use in Council buildings by investing in renewable energy, energy efficiency in Council buildings and changing our behaviour			
10	Increase the sustainability of South Melbourne Market by installing renewable energy			
11	Embed sustainability into Council's procurement and investment policies and practices, including minimum sustainability performance requirements for suppliers			
12	Introduce green lease provisions targeting tenant energy consumption, cleaning and waste management into new and renewed leases of Council buildings			
13	Transition the Council fleet to zero emissions, prioritising electric vehicles and charging stations, traditional and electric bikes, car share and low emissions vehicles			
14	Where viable, progressively convert Council buildings to fully electric power through maintenance and renewal programs			
15	Deliver an energy efficient street lighting upgrade (category V lights)			
16	Deliver a program that supports households, particularly those on a low income, to invest in sustainability retrofits, solar panels and pay back their investment through an alternative financing arrangement (SCCAP)			
17	Work with partners to drive the uptake of Environmental Upgrade Agreements for commercial and (legislation pending) residential buildings (SCCAP)			

ACTIONS		2018-20	2021-24	2025-28
18	Work with the community to determine the viability of a collective purchase of offsite renewable energy for a consortium of apartment buildings (SCCAP)			
19	Seek a partnership to test and increase uptake of solar retrofit and energy sharing platforms for apartment buildings (SCCAP)			
20	Support the community to increase the sustainability of their homes during the planning and design phases			
21	Support the uptake of electric vehicles, including installation of public charging stations and investigation of planning controls to require charging infrastructure in new developments			
22	Advocate to developers for buildings designed to achieve low energy properties and precincts above Victorian planning policy regulations Advocate to the Fishermans Bend Taskforce and Victorian Government for planning policy regulation to support their commitment to an accredited Greenstar Community in Fishermans Bend			

Melbourne Renewable Energy Project (MREP)

Council is participating in an innovative wind power project that will reduce our total emissions by 87 per cent. Everything from street lights to Council buildings will be powered by zero-emission electricity starting in 2019.

We are part of an Australian first and a model for the future - partners working together for shared sustainability and prosperity using new, market-based approaches to transform and move Australia's electricity system away from fossil fuels.

Led by the City of Melbourne, the MREP partners plan to purchase 88 GWh of electricity each year, the equivalent to powering more than 17,000 households in Melbourne annually. Because the wind farm will produce more electricity than the MREP partners need, the total emission savings will be even greater.

14 % of our City's greenhouse gas emissions are due to private vehicle use.

As a growing municipality, reducing car use is a key way to reduce our City's carbon emissions and air pollution.

Move, Connect, Live - Council's Integrated Transport Strategy (due for release 2018) contains actions that will help residents and visitors to drive less and hop on public transport, walk or ride their bikes instead.

By 2028 Council is aiming for:

48 % **by foot** of all daily trips by pedestrians

10 % **by bike** of all daily trips by bike

13 % **by public transport** of all daily trips by public transport

29 % **by car** of all daily trips by car

Reducing car use is a key way to reduce our City's overall impact on carbon emissions and air pollution.

A City that is adapting and resilient to climate change

Recent highlights:

Council joined the South East Councils Climate Change Alliance in 2016, partnering to deliver climate adaptation and carbon mitigation projects regionally.

Through our involvement in the Association of Bayside Municipalities, we joined with nine neighbouring councils to develop the Bay Blueprint. The Blueprint is a coastal adaptation planning framework that ensures councils use a consistent methodology to address coastal impacts of climate change.

Council heatmapped the City to understand where the 'hotspots' are, so we can concentrate our efforts to cool particular locations through trees, shading and water in the landscape.

Climate change is already having an impact around the world. Preparing for a different future where extreme heat events, flooding, coastal storm surges and drought are more prevalent requires commitment, innovation and collaboration.

How we respond and adapt to climate change is crucial for our community, especially the most vulnerable.

Adaptation planning is based on:

- understanding expected climatic changes
- understanding our current services and assets, and how they may cope in the future
- predicting how vulnerable our community and environment is to climate risks
- using this information to establish ways we can manage these risks and support our community to be resilient and our environment to thrive
- monitoring our response and adjusting our approach as needed.

We are getting ready for the future now, proactively preparing our assets and thinking about how we can best support our community.

We aspire to increase our resilience, ensuring changing environmental conditions won't affect Council's ability to deliver the services that support our business community and residents.

People are the heart of our City. Through the actions contained in this Strategy and partnering with community organisations, emergency services and all levels of government, we will enhance our City, maintain our reputation as Melbourne's playground and keep our community healthy and safe.

Key partners

The community

Victorian Government

South East Councils Climate Change Alliance

Emergency management organisations

Association of Bayside Municipalities

Resilient Melbourne

Key strategies

Climate Change Adaptation and Greenhouse Plan [14]

Sustainable City Community Action Plan

Greening Port Phillip Strategy

Asset Management Strategy [15]

Public Space Strategy [16]

Measuring progress

Measuring the impact our action will have on our community's resilience to climate change is difficult, as most of the benefits are dependent on an individual's perception of comfort and safety, which is different for everyone. To ensure we keep track of how the community is impacted by climate change we will monitor several indicators and use these to help us plan for improved service delivery.

These indicators are:

- number of houses impacted by extreme weather [13]
- temperature hotspots
- use of Council facilities in extreme weather.

We will also measure and report:

- actions taken to retrofit Council buildings to combat climate change.

Heatwaves

Heatwaves impact on our comfort levels, the health and safety of our community and pets, and cause significant increased demand on our electricity network.

The extreme heat experienced in Melbourne between 14 to 17 January 2014 is estimated to have cost business within the City of Melbourne approximately $37 million in lost revenue.

59% of businesses reported an impact on the comfort, motivation or morale of their workforce.

40% reported an impact on the reliability of their workforce.

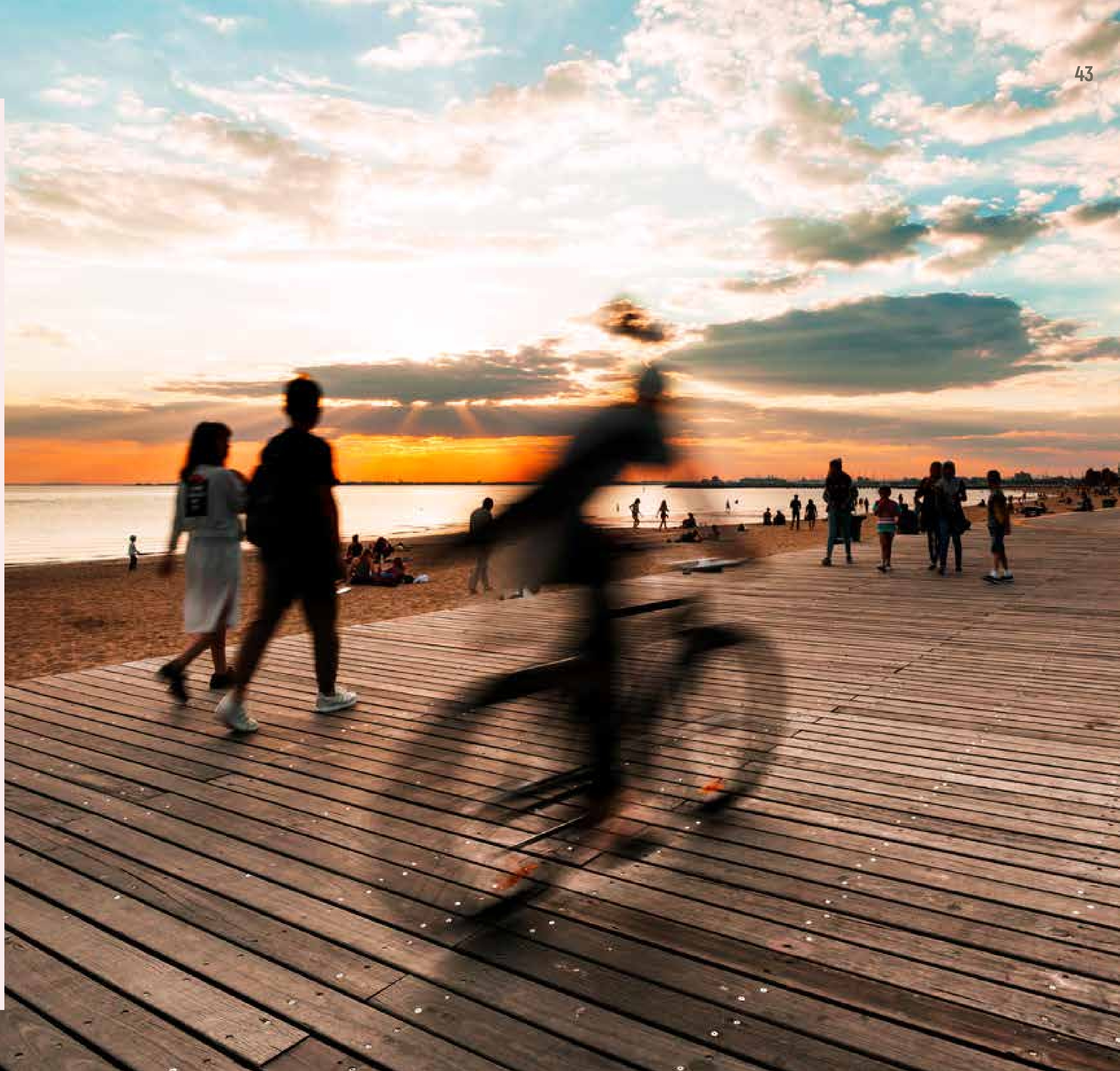
62% experienced additional operational costs such as increased use of air conditioning.

Source: A Quantitative Research Report on: 2014 Heatwave Business Impacts Social Research, Sweeny Research, 24 March 2014. Commissioned by City of Melbourne. melbourne.vic.gov.au/sitecollectiondocuments/eco-impact-of-heat-waves-on-business-2014.pdf

13 Subject to data being made available by the insurance industry
14 To be developed in 2018/19
15 Under development
16 Under development - to replace Open Space Strategy

A City that is adapting and resilient to climate change

	ACTIONS	2018-20	2021-24	2025-28
23	Create a revised Climate Adaptation and Greenhouse Plan in order to identify which tools will help the community increase their resilience to climate change, including managing the impact of heat and extreme weather			
24	Contribute to the EcoCentre redevelopment (subject to external funding). Continue to invest in EcoCentre programs that support an environmentally aware community			
25	Examine the effectiveness of establishing a Port Phillip Energy Foundation or partnering with an existing foundation to undertake advocacy, research, advisory and community engagement initiatives			
26	Conduct vulnerability assessments and financial risk modelling of Council's assets and develop minimum environmental performance standards and design guidelines for Council buildings Embed these standards into our maintenance and construction programs			
27	Assess recommendations from the state-led Coastal Hazard Vulnerability Assessment and develop an implementation strategy and action plan to help protect the City of Port Philip against sea level rise and inundation			
28	Develop concept design of blue-green infrastructure that protects against flooding and sea level rise, and enhances the natural environment			
29	Investigate alternative funding models for environmental initiatives to deliver priority projects			



Council works closely with Emergency Services Victoria and the State Emergency Service (SES) to ensure the safety of our community during storms, floods and heatwaves.

Council plays a supporting role during these times and a maintenance role after the event. During an emergency, the SES and Emergency Services Victoria are the people who respond, and should be who our community calls. The SES also provides education and support materials to ensure you can prepare for these types of weather events.

For more information visit:

http://www.portphillip.vic.gov.au/be-alert.htm

A water sensitive City

Recent highlights:

Gaining commitment from Melbourne Water and neighbouring local governments in the Elster Creek Catchment to collectively work on flooding issues.

Installing our 200th raingarden in our streetscapes to treat stormwater and remove pollutants before they enter the bay.

Commencing CCTV investigation of the City's stormwater system to assess its condition and identify opportunities for improvements.

Here in Port Phillip we have a deep connection to water. Port Phillip Bay is at our doorstep, Albert Park Lake at our core, the Yarra River to our west and Elster Creek to our east.

Creating a water sensitive City requires collaboration with Melbourne Water and South East Water to manage all aspects of the water cycle - mains water, stormwater, wastewater and groundwater - in an integrated way.

Climate change has had a significant impact on how we use urban water, and in a growing City there is increased demand being placed on our parks and open spaces.

Through treating our City as a catchment, we plan to capture water for use and work with our partners to reduce flooding.

We will not only maintain, but enhance our public spaces by using water efficiently, as well as reducing pollutants flowing into Port Phillip Bay, ensuring its health into the future.

To create a truly water sensitive City we need the community's help. Through policy changes, regulation and guidance, Council can provide support, but developers and home owners will need to take action to reduce the amount of concrete and paving on private property, ensuring that water has a chance to soak into the ground.

This will have multiple benefits, including groundwater recharge, cooling the City and reducing flooding. We may, at times, also need to disrupt parks to install water harvesting or upgrade irrigation to make them more resilient to future droughts, delivering a better long-term outcome for our community.

Key partners

- The community
- Victorian Government
- Melbourne Water
- South East Water
- Research organisations
- Neighbouring local governments

Key strategies

- A Water Sensitive City[18]
- Climate Change Adaptation and Greenhouse Plan[19]
- Sustainable City Community Action Plan
- Greening Port Phillip Strategy
- Public Space Strategy[20]

Measuring progress

MAINS WATER USE	2016/17 BASELINE	2027/28	REDUCTION
Council	238 ML/y	203 ML/y[17]	15 %
Community	178 L person per day	155 L person per day	27 %

POLLUTANTS REMOVED ANNUALLY (KG/YEAR)	TOTAL RELEASED IN CATCHMENT	REMOVED IN 2016/17	REMOVED BY 2027/28
Total suspended solids	717,035	71,369 (10 %)	192,813 (27 %)
Total phosphorous	1,880	139 (7 %)	374 (20 %)
Total nitrogen	15,009	1,033 (7 %)	2,222 (15 %)

Note: These pollutants have been identified as key pollutants that have a major role in negatively impacting the long-term health of the Bay. By targeting them, a broad range of other pollutants will also be captured, including litter, oils and heavy metals that wash off our rooftops, roads and other surfaces.

17 Goals and budgets are dependent on particular projects. If these projects do not proceed, goals will be reviewed and if needed updated.

18 To be developed in 2018/19

19 To be developed in 2018/19

20 In development

A water sensitive City

	ACTIONS	2018-20	2021-24	2025-28
30	Develop a Water Sensitive City Plan to drive an integrated approach to water management			
31	Reduce water use by renewing irrigation infrastructure and improving controls and management while maintaining highly valued green spaces			
32	Investigate and implement high value opportunities for stormwater harvesting to provide alternatives to potable water use for key Council open spaces			
33	Support plans for recycled water processing at Fishermans Bend, with water being used by residents and for irrigation of Council reserves			
34	Investigate mechanisms to require onsite stormwater detention in new developments, and technology to monitor tank levels and empty prior to storm events			
35	Implement the Elster Creek Action Plan			
36	Develop and implement a Stormwater Asset Management Plan and invest in drainage improvements			
37	Plan and deliver Water Sensitive Urban Design projects to reduce the amount of pollution entering Port Phillip Bay			
38	Complete a study of permeability potential for Council land and introduce place-based permeability targets Embed these standards into our maintenance and construction programs			
39	Update Council policy and engage with the community to achieve greater permeability on private property			

Litter and other pollutants wash into our stormwater drains when it rains. This means anything that reaches the gutter, be it litter, detergents, dog droppings or dirt and grit off the road, will flow directly into our stormwater system, Port Phillip Bay and onto our beaches.

One way Council is working to improve the quality of stormwater is through raingardens. Raingardens look like a regular garden with one major difference – they are positioned to receive rainwater from hard surfaces like roads.

Using layers of soil and gravel for filtration and planted with a combination of plants, shrubs and grasses, a raingarden reduces the amount of stormwater that would otherwise wash pollutants into the stormwater system.

This raingarden in Middle Park will remove 1.4 tonnes of dirt and 13 kg of nitrogen per year.

A sustained reduction in waste

Recent highlights:

A GaiaRecycle unit installed at the South Melbourne Market converts 360 tonnes of food waste to organic fertiliser each year.

Solar powered compaction bins installed in public spaces have increased the amount of rubbish that can be put in the bins before collection is needed.

Council is leading the standard of hard waste recycling with 70 per cent of waste being diverted from landfill. The Victorian average is 15 per cent.

The growth and increased densification of our City is placing increased pressure on waste services. This also stimulates the need for service improvements.

To respond to these changes Don't Waste It!, a new 10-year Waste Management Strategy is currently being developed.

The Strategy is a roadmap detailing how we will become a leader in municipal waste management through investment in new technologies, focused education campaigns and better planning.

In addition to our growth challenges, the waste industry in Victoria is experiencing significant stress due to the closure of multiple landfills and uncertainty within the recycling industry. These combined pressures will result in increased costs to manage waste.

Along with challenges, there are opportunities for City of Port Phillip regarding waste management. Urban renewal of Fishermans Bend within Port Phillip has caused a rethink as to where our services for waste should be located, while maintaining the high standard of services that the community expect.

The option to relocate the depot and transfer station facilities has created potential opportunities to increase the use of 'Smart Solutions' for waste management, and to seek out partners to share the new facilities to ensure full effectiveness and efficiency of waste management in the area.

Despite all the technological improvements that will be implemented, minimisation of waste is the biggest challenge we face as a Council. This is where we need your help, through:

- avoiding excess and unrecyclable packaging, like using your own coffee cup and avoiding disposable single-use plastics
- reducing waste and avoiding recycling being placed in the wrong bin, which will end up in landfill or contaminate the recycling bin
- keeping our streets and beaches litter free by using public bins, and accessing the free hard waste collection service[21].

[21] ASSIST 03 9209 6777 to book a collection.

Key partners

The community

Victorian Government

Metropolitan Waste and Resource Recovery Group

Sustainability Victoria

Key strategies

Sustainable City Community Action Plan

Don't Waste It! Waste Management Strategy [22]

Measuring progress

PERCENTAGE OF WASTE DIVERTED	2016/17 BASELINE	2027/28
Council	47 %	80 % [23]
Community (houses)	33 %	80 %
Community (multi-unit dwellings)	22 %	80 % [24]
WASTE GENERATED IN COUNCIL FACILITIES	**2016/17 BASELINE**	**2027/28**
Council	61 kg/FTE/year	4.5 kg/FTE/year

[22] To be developed in 2018

[23] Draft targets are subject to external funding partner commitments and will be confirmed in the **Don't Waste It!** Waste Management Strategy.

[24] Average of multi-unit dwellings from throughout Victoria - referenced from Sustainably Victoria

A sustained reduction in waste

	ACTIONS	2018-22	2023-28
40	Develop and implement a new Waste Management Strategy that will deliver: • a City that reduces waste • a City that maximises reuse and recycling • a City with clean streets, public spaces and foreshore areas • a City that uses new technology to process waste better and reduce environmental impacts		
41	Update waste management guidelines for apartments and implement education programs to maximise reuse and recycling		
42	Work with partners to deliver the Inner Metro Sustainability Hub (IMSH), including land acquisition planning and refining preferred site to relocate the Depot Transfer Station and potential new advanced waste treatment facility that will use new technology to process waste better and reduce environmental impacts		
43	Deliver a focused recycling program to increase waste diversion from landfill, to reduce waste and maximise reuse and recycling		
44	Pursue waste innovations, including undertaking a food diversion retrofit trial, such as insinkerators, in existing homes, to reduce waste		
45	Optimise investment in litter bins and equipment to maintain clean streets, public spaces and foreshore areas		
46	Increase investment in street cleaning and review services to maintain clean streets, public spaces and foreshore areas		
47	Deliver service innovation and collaboration though the preparation of new waste service contracts to maintain clean streets, public spaces and foreshore areas, and utilise new technology to process waste better and reduce environmental impacts		

Community having an impact

Beach Patrol

Through the power of local residents and community spirit, Beach Patrol is helping to clean the beaches of Melbourne.

Beach Patrol is a chain of volunteer community groups whose members donate an hour of their time each month to keep the beaches cleaner and safer for the greater enjoyment of all. Starting in Port Phillip in 2009 with 3206 Beach Patrol - Middle Park, there are now more than 24 groups and 2,200 people registered as volunteers keeping our beaches clean.

For more information visit:

www.beachpatrol.com.au

Port Phillip EcoCentre

The EcoCentre is leading research on litter and microplastics with several ongoing citizen science projects focused on tracking and preventing litter before it gets to the beaches of Port Philip. Beach Patrol, the Yarra Riverkeeper and local Scout groups are partnering to deliver this work.

Penguin Friendly Event project

In the Penguin Friendly Event project, Albert Park Primary School, St Kilda Primary School and the EcoCentre collaborated to create kits for landfill and litter-free fetes and festivals. Replacing single-use items with "war on waste washing up kits" prevented thousands of food, beverage and cutlery items from going in the bin - best bit is that these kits will continue to be used and build impact over time.

For more information visit:

www.ecocentre.com/penguin friendly

MEASURING AND REPORTING

Act and Adapt is a 10 year strategy. It will be reviewed every four years and updated if needed.

We will be reporting our progress each year through Council's annual report (unless otherwise stated).

OUTCOME	INDICATOR	BASELINE	2020/21	2027/28
Council goals				
A greener, cooler more liveable City	Street tree canopy cover [25]	19 %	2 % increase on baseline (19.2%)	10 % increase on baseline (21%)
A City with lower carbon emissions	GHG emissions (tCo2-e) Gross	10,950 (2016/17)	1,200	520
	GHG emissions (tCo2-e) Net	6,464 (2016/17)	Zero net	Zero net
	Electricity from renewable sources (%)	293 kW (2016/17)	100 %	100 %
	Energy consumption in Council buildings (kWh) [26 27]	8,900 MWh (2016/17)	7,200MWh	7,300MWh
A City that is adapting and resilient to climate change	Actions taken to retrofit buildings to combat climate change	Baseline and targets to be developed through Climate Adaptation and Greenhouse Action Plan		
A water sensitive City	Potable water use	238 ML/y (2016/17)	257 ML/y [28]	203 ML/y
		Pollutant reduction load (kg/year)	(percentage reduction load/year)	
	Total suspended solids	71,369	16 %	27 %
	Total phosphorous	139	12 %	20 %
	Total nitrogen	1,033	10 %	15 %
A sustained reduction in waste [29]	Percentage of waste diverted (%)	47 % (2016/17)	55 %	80 %
	Waste generated in Council facilities (t)	61 Kg/FTE/yr	TBC	4.5 Kg/FTE/yr

[25] Reported every five years

[26] Decrease in energy consumption is expected by 2020/21. Beyond this time a slight increase is forecast due to growth in Council's asset base and electrification of Council's vehicle fleet

[27] Electricity and gas consumption included. Joules of gas have been converted to an equivalent kWh

[28] The initial increase is to account for growth and increased watering and establishment of parks. Following this irrigation upgrades and efficiencies and more alternative water will result in an overall decrease towards 2027/28 targets

[29] Draft targets are subject to external funding partner commitments and will be confirmed in the **Don't Waste It!** Waste Management Strategy

OUTCOME	INDICATOR	BASELINE	2020/21	2027/28
Community goals				
A greener, cooler, more liveable City	Canopy cover on private land	11 %	2 % increase on baseline (11.2 %)	10 % increase on baseline (12.1 %)
A City with lower carbon emissions	GHG emissions (tCo2-e)	1,700,000 (2016/17)	Zero net emissions by 2050 [30] (interim emissions to 2025 to be confirmed in late 2018)	
	Electricity from renewable sources (%)	5,100 kW (2016/17)	10,400 kW (18 % penetration rate)	29,000 kW (50 % penetration rate)
A City that is adapting and resilient to climate change	Indicators to be reported on - number of houses impacted by extreme weather; temperature hotspots; use of council facilities during extreme weather.			
A water sensitive City	Potable water use	178 L person per day (2016/17)	155 L person per day	155 L person per day
A sustained reduction in waste	Houses: Percentage of waste diverted (%)	33 %	TBC	80 %
	Multi-unit dwellings: Percentage of waste diverted (%)	22 %	TBC	80 %

30 Aligned with Victorian State Government GHG emissions target for whole of state as per Victorian Climate Change Act 2017

APPENDIX 1

Actions and financial overview

STRATEGY	ACTIONS	ESTIMATED COST
A greener, cooler more liveable City	1. Implement the Greening Port Phillip Strategy and Street Tree Planting Program, including ongoing investment in species diversification, park trees, streetscape improvements and a stronger focus on biodiversity and climate tolerant species selection	$7,475,000
	2. Implement the Foreshore and Hinterland Vegetation Management Plan	
	3. Develop a Biodiversity Study and Action Plan	
	4. Maintain heat mapping and solar analysis data; use data, along with Socio-Economic Index for Areas and flood data to guide project and service delivery; communicate information to the community through a web-based platform; use data for reporting and to track intervention impact	
	5. Deliver technical guidance and implement regulatory interventions to protect vegetation and increase canopy cover on private property, including green roofs, walls and facades	
	6. Encourage and enforce sustainable, climate resilient buildings through the planning process by applying environmentally sustainable design planning policy guidelines and by providing clear, accessible information to the community	

STRATEGY	ACTIONS	ESTIMATED COST
A City with lower carbon emissions	7. Deliver behaviour change and education programs through the Sustainable City Community Action Plan and support environmental education programs in schools	$7,358,000
	8. Review Council services to implement opportunities to reduce carbon emissions and incorporate changes	
	9. Reduce energy use in Council buildings by investing in renewable energy and energy efficiency initiatives and changing our behaviour	
	10. Increase the sustainability of South Melbourne Market by installing renewable energy	
	11. Embed sustainability into Council's procurement and investment policies and practices, including minimum sustainability performance requirements for suppliers	
	12. Introduce green lease provisions targeting tenant energy consumption, cleaning and waste management into new and renewed leases of Council buildings	
	13. Transition the Council fleet to zero emissions, prioritising electric vehicles and charging stations, traditional and electric bikes, car share and low emissions vehicles	
	14. Where viable, progressively convert Council buildings to fully electric power through maintenance and renewal programs	
	15. Deliver an energy efficient street lighting upgrade (category V lights)	
	16. Deliver a program that supports households, particularly those on a low income, to invest in sustainability retrofits and solar, and pay back their investment through an alternative financing arrangement (SCCAP)	
	17. Work with partners to drive the uptake of Environmental Upgrade agreements for commercial and (legislation pending) residential buildings (SCCAP)	
	18. Work with the community to determine the viability of a collective purchase of offsite renewable energy for a consortium of apartment buildings (SCCAP)	

STRATEGY	ACTIONS	ESTIMATED COST
A City that is adapting to climate change	19. Seek a partnership to test and increase uptake of solar retrofit and energy sharing platforms for apartment buildings (SCCAP)	$3,740,000
	20. Support the community to increase the sustainability of their homes during the planning and design phases	
	21. Support the uptake of electric vehicles, including installation of public charging stations and investigation of planning controls to require charging infrastructure in new developments	
	22. Advocate to developers for buildings designed to achieve low energy properties and precincts above Victorian planning policy regulations	
	23. Advocate to the Fishermans Bend Taskforce and Victorian Government for planning policy regulation to support their commitment to an accredited Greenstar Community in Fishermans Bend	
	24. Contribute to the EcoCentre redevelopment (subject to external funding). Continue to invest in EcoCentre programs that support an environmentally aware community	
	25. Examine the effectiveness of establishing a Port Phillip Energy Foundation or partnering with an existing foundation to undertake advocacy, research, advisory and community engagement initiatives	
	26. Conduct vulnerability assessments and financial risk modelling of Council's assets and develop minimum environmental performance standards and design guidelines for Council buildings. Embed these standards into our maintenance and construction programs	
	27. Assess recommendations from the state-led Coastal Hazard Vulnerability Assessment and develop an implementation strategy and action plan to help protect the City of Port Phillip against sea level rise and inundation	
	28. Develop concept design of blue-green infrastructure that protects against flooding and sea level rise, and enhances the natural environment	
	29. Investigate alternative funding models for environmental initiatives to deliver priority projects	

STRATEGY	ACTIONS	ESTIMATED COST
A water sensitive City	30. Develop a Water Sensitive City Plan to drive an integrated approach to water management	$28,870,000
	31. Reduce water use by renewing irrigation infrastructure and improving controls and management while maintaining highly valued green spaces	
	32. Investigate and implement high value opportunities for stormwater harvesting to provide alternatives to potable water use for key Council open spaces	
	33. Support plans for recycled water processing at Fishermans Bend, with water being used by residents and for irrigation of Council reserves	
	34. Investigate mechanisms to require onsite stormwater detention in new developments, and technology to monitor tank levels and empty prior to storm events	
	35. Implement Elster Creek Action Plan	
	36. Develop and implement a Stormwater Asset Management Plan, and invest in drainage improvements	
	37. Plan and deliver Water Sensitive Urban Design projects to reduce the amount of pollution entering Port Phillip Bay	
	38. Complete a study of permeability potential for Council land, introduce place-based permeability targets. Embed these standards into our maintenance and construction programs	
	39. Update Council policy and engage with the community to achieve greater permeability on private property	

STRATEGY	ACTIONS	ESTIMATED COST
A sustained reduction in waste	40. Develop and implement a new Waste Management Strategy that will deliver: • a City that reduces waste • a City that maximises reuse and recycling • a City with clean streets, public spaces and foreshore areas • a City that uses new technology to process waste better and reduce environmental impacts	TBC in **Don't Waste It!** Waste Management Strategy
	41. Update waste management guidelines for apartments and implement education programs to maximise reuse and recycling	
	42. Work with partners to deliver the Inner Metro Sustainability Hub (IMSH) including land acquisition planning and refining preferred site to relocate the Depot Transfer station and potential new Advanced Waste Treatment facility that will use new technology to process waste better and reduce environmental impacts	
	43. Deliver a focused recycling program to increase waste diversion from landfill, to reduce waste and maximise reuse and recycling	
	44. Pursue waste innovations including undertaking a food diversion retrofit trial, such as insinkerators, in existing homes, to reduce waste	
	45. Optimise investment in litter bins and equipment to maintain clean streets, public spaces and foreshore areas	
	46. Increase investment in street cleaning and review services to maintain clean streets, public spaces and foreshore areas	
	47. Deliver service innovation and collaboration though the preparation of new waste service contracts to maintain clean streets, public spaces and foreshore areas, and utilise new technology to process waste better and reduce environmental impacts	

For more information, please contact us via:

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普通話	9679 9858	Русский	9679 9813
Polska	9679 9812	Other	9679 9814

Activating Laneways Strategy
City of Port Phillip
FINAL

July 2011

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Appendices

Activating Laneways Strategy

Laneways provide opportunities for unique public spaces. Away from the hustle and bustle of streets and main roads, lanes can offer intimate spaces for pedestrians and allow for convenient short cut routes to adjoining streets and key destinations.

The City of Port Phillip has over 42 kilometres of laneways and Rights of Way (R.O.W). The Activating Laneways Strategy seeks to identify a selection of lanes within and/or close to key areas such as Activity Centres, regionally significant open spaces and public transport networks and provide a framework to promote future activity within them.

A number of laneway classifications have been established based on their possible role and ability to accommodate levels of activation. 'Activation' can be in many forms, whether its enhancement of the public realm to improve pedestrian connectivity, promoting quality building edges to provide better engagement with the lane and/or to allow for gathering spaces and possibly events within laneways.

Classifications of lanes include:

- Destination Laneways
- Active Laneways
- Connecting Laneways
- Maintain or Enhance Laneways

Laneway designations were determined by a range of factors including, (but not limited to), their land use zoning, heritage significance, through block pedestrian access, interface sensitivities, laneway edge conditions and physical attributes.

It is acknowledged that there are a large number of laneways of varied quality within the City of Port Phillip. Many of these are located within residential areas and largely serve a functional purpose. It is likely that the majority of these lanes will experience little change and will just continue to be maintained by Council.

Given the nature of cities and that the urban environment never remains static, it is important to recognise that proposed laneway classifications are never fixed as the context of laneways may change over time. The Activating Laneways Strategy intends to be a flexible framework that provides directions for future actions and inform possibilities within laneways. While a preliminary list of laneways are identified for possible activation and/or potential upgrades, there is scope to consider other lanes if it will benefit pedestrian and bicycle movement.

Why the Strategy

Laneways traditionally provide a functional purpose i.e. for drainage, vehicle access and service areas. However it is evident through the success of other laneway revitalisation programs, encouraging activity within a selected few can have many benefits to the community.

While Council is largely responsible for the maintenance of lanes, adjoining property owners can also play a key role in realising improvements in laneway environments. Greater awareness and consideration of the opportunities available within laneways is encouraged.

The **objectives** of the Strategy are to:

- recognise the role and character of our laneways and little streets in creating a fine grain public realm
- maintain and enhance existing laneways
- facilitate and create opportunities for activation in designated laneways
- improve the walkability and permeability of the public realm.

The **purpose** of the Strategy is to:

- provide a framework for Council to manage these assets
- identify and make strategic improvements
- make regulatory amendments where necessary to achieve the objectives
- facilitate new development in line with the objectives
- foster a program of activities that enlivens the local community
- ensure the safety and well being of users and residents
- capitalise interest from adjoining property owners/new development seeking to engage with their neighbouring laneways.

What is considered a laneway/R.O.W

Laneways and Right of Ways can vary in description. However, lanes typically serve as tertiary roadways and are generally narrow in width, ranging from under 3m to over 8m wide. Most lanes usually run behind or parallel to buildings and provide important access and servicing functions.

Similarly, Right of Ways are easements that provide access to private properties. Many Right of Ways within the City of Port Phillip are unnamed and Council identifies these assets by a numbered system (eg. R1234). Lanes and street types also considered within this Strategy includes street names ending with 'Place', 'Grove', 'Close', 'Lane' or 'Little X Street' and also old nightsoil alleyways that exist within the municipality.

Relevant Strategies/Policies & Plans

The Activating Laneways Strategy seeks to build upon a suite of existing Council Strategies and Plans (Refer to Appendix 1 for summary). Currently, these documents inform and set standards as to the maintenance and heritage of laneways. They provide limited guidance on how best to capitalise on the opportunities that lanes might represent to improve community amenity. This Strategy will complement these existing policies and outline a framework to inform, manage and implement future actions within laneways.

Key strategic documents and guidelines include the following:

- Lurking in lanes (1998)
- Laneway Strategy (2003)
- Heritage kerbs, channels & laneways (2005)
- Guidelines for the Naming or Re-naming of Roads, Lanes and Reserves (2005)
- Heritage Service Practice Note 04. Laneways in Heritage Overlay Areas (2006)

This Strategy intends to work with other Council initiatives and strategies. These include:

- Council Plan 2009-2013
- Health & Wellbeing Plan
- Sustainable Asset Management Program
- Walk Plan
- Bike Plan
- Road Management Plan
- Discontinuance of Laneways Policy
- Sustainable Public Lighting Strategy
- draft Alternative Greening Strategy and Community Gardens Policy
- draft Arts and Culture Policy
- Public Art Strategy (under development)
- Strategic Activity Centre Planning Studies (i.e. structure plans, urban design frameworks)

Figure 1 shows the relationship between the Activating Laneways Strategy with other key Council policies and strategies.

Figure 1: Activating Laneways Strategy relationship with other key strategies

Laneway Investigations

While the Activating Laneway Strategy covers all lanes within the municipality, particular focus has been paid to laneways and R.O.Ws within or proximate to Activity Centres (Major and Neighbourhood centres), key regional open spaces and public transport corridors. These locations are likely to attract greater pedestrian activity and ideal to prioritise future work.

Field studies and analysis of lanes were conducted in and around key activity areas (refer to figure 2, municipal context map) including:

Major Activity Centres and environs (within existing Activity Centre study area boundary)
Clarendon Street and South Melbourne Market, South Melbourne
Bay Street, Port Melbourne
Fitzroy Street, St Kilda
Acland Street, St Kilda
Carlisle Street, Balaclava

Neighbourhood Activity Centres and environs (400m radius threshold of business/mix use zone)
Centre Avenue, Garden City
Victoria Avenue/Britport Street, Albert Park
Armstrong Street, Middle Park
Glen Huntly Road, Elwood
Ormond Road, Elwood
Glen Eira Road, Ripponlea

Key Regional Open Spaces
Port Melbourne Football Ground
Murphy Reserve, Port Melbourne
Albert Park Reserve
Foreshore & Esplanade
St Kilda Botanical Gardens

Key Regional Public Transport Corridors & Train Stations
St Kilda Road & Chapel Street
Balaclava Train Station
Ripponlea Train Station

Note: It is expected that majority of laneways/R.O.Ws outside the above listed areas will be targeted for limited change.

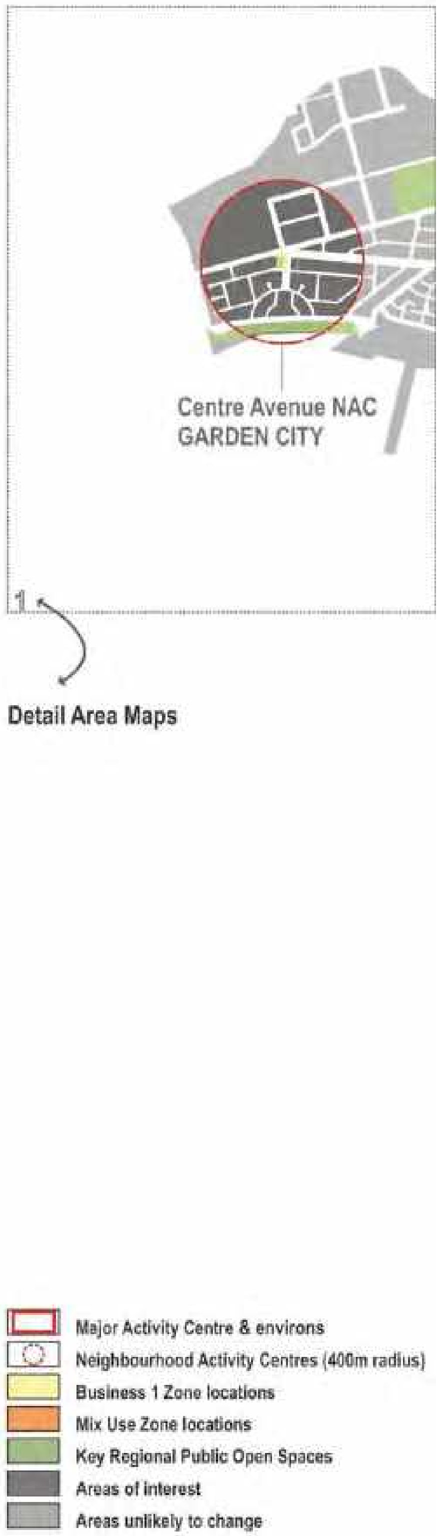


Figure 2: Municipal Context map

Figure 2: Municipal Context map (continued)

Laneway Types

Lanes and small streets were broken up into a series of types for further study based on possible future Council strategies. These types were informed by their future potential. Could they be destinations? How could we activate them? Are there some laneways that just stay as they are?

As the urban context of each laneways is highly varied, a number of questions were also considered in the process of the ranking of lanes:

- Is the lane in close walking proximity to a main (commercial) street?
- Is the lane located within commercial land use zoning including Business Zones and Mix Use Zone (MUZ)?
- Does the lanes offer through block connection and/or have possibilities for through links?
- Does the lane have adjoining commercial (private) development that can 'open' onto and positively engage with the laneway?
- Has the lane been identified in existing strategic studies including Structure Plans and Urban Design Frameworks as important links and/or opportunities for future connection?

Analysis and site inspections confirmed that the initial classifications of lanes for study largely captured the way lanes are and how they could be used across the municipality. These are:

- **Destination Laneways:** Lanes that people would travel to visit and recreate in
- **Active Laneways:** Lanes that are enlivened by businesses and residents that use them
- **Connecting Laneways:** Lanes that people use to take a short cut from A to B
- **Maintain or Enhance Laneways:** Lanes that Council will continue to maintain but might have future possibilities

These laneway types are identified in detail area plans (figures 3 – 7) and listed in Appendix 2.

Destination Laneways

Destination Laneways have the most potential to assume a more dynamic and active part of the urban fabric. These laneways would likely be the focus for capital works that improve the public realm, new development/businesses and a program of events that encourage residents and visitors to enjoy their ambience.

Currently, the City of Port Phillip has not developed any laneways of this type. There are some examples within Melbourne that offer a high quality laneway environment such as Degraves Lane [pictured] but at a very much different scale given its CBD context. *Destination Laneways* will encourage street life, passive surveillance and activity but designed to suit the urban and heritage setting of places within the City of Port Phillip.

Laneways can present different personas during the day and night. While activity is generally encouraged within *Destination* and *Active Laneway* types, the hours of activity and operation will also be heavily dependent on surrounding uses and urban context. Council will work hard with local businesses and residents to ensure potential conflicts are properly managed or minimised.

Possible *Destination Laneways* may include but not limited to (refer to figures 3-7, detail area maps for locations):

Yarra Place, R3219 & R3221, South Melbourne
(between Clarendon Street and Yarra Place)

George Lane, R3665 & R3667, St Kilda
(between Fitzroy Street and Little Grey Street)

R3405 & 3406 - 'Monarch Laneway', St Kilda
(between Acland Street and Chaucer Street leading to Woolworths Supermarket)

Recommendations/Opportunities:
> Investigate and develop future options/case studies for capital improvements by Council

> Explore potential event programming within lanes with opportunities to coincide with existing event calendar

> Explore partnerships with local businesses and develop Design and Trading guidelines

> Degraves Lane, Melbourne
City of Melbourne

Active Laneways

Active Laneways will be mostly located within commercially zoned areas and are where new development or businesses are encouraged to open onto the laneway. Given potential increase in use and pedestrian activity, these laneways may require Council to upgrade the lane to a higher level.

A number of small streets within South Melbourne including Union, Hotham and Francis Streets offer examples of private businesses taking advantage of a laneway style setting and present an attractive address towards the streetscape. While in principle, private developments adjacent to *Active Laneways* are encouraged to provide an engaging laneway interface, necessary planning, building and licensing approvals will be required from Council.

Refer to Appendix 2 for list of possible *Active Laneways* and figures 3-7, detail area maps for laneway locations.

Recommendations/Opportunities:
> Prepare Design and Trading Guidelines in consultation with community and stakeholders

> Explore case studies for laneway standards or upgrades including lighting, signage and surfaces

> Influence future strategic work (i.e. Structure Plans, UDFs etc.) with laneway aspirations

> Harper Lane, St Kilda (top)
Union Street, Sth Melbourne (middle)
Hotham Street , Sth Melbourne – Chez Drè (bottom)

Connecting Laneways

Connecting Laneways form part of a fine grain walking/bike network. They are not necessarily in centres and may need some additional work by Council to make them safe and trafficable for pedestrians and bikes, including re-paving, signage and lighting.

The Pakington Street Laneway Improvement Project is an example for potential *Connecting Laneway* outcomes. The project delivered improved pedestrian/ bike linkage from Inkerman Street (adjacent to a supermarket/mixed-use redevelopment site) to the Carlisle Street shopping centre and nearby community facilities. Laneway works included way finding signage, laneway re-surfacing, installation of public lighting and commissioning of artwork along the sides of buildings.

Council is also planning work on the Balaclava Walk Southern Link Project. It is envisaged that a continuous pedestrian/bike link and public realm enhancements is achieved from Balaclava Train Station to Ripponlea Train Station. This is timed to follow the redevelopment of the Balaclava Station by the State Government.

Council is committed to creating safe and well connected neighbourhoods that promote sustainable modes of transport.

Refer to Appendix 2 for list of possible *Connecting Laneways* and figures 3-7, detail area maps for laneway locations.

Recommendations/Opportunities:
> Align work with Council's Walk and Bike Plans

> Explore case studies for laneway standards or upgrades

> Influence future strategic work (i.e. Structure Plans, UDFs etc.) with laneway aspirations

> Pakington Lane, St Kilda

Maintain or Enhance Laneways

The overwhelming majority of Port Phillip's laneways are in residential and heritage areas and are likely to undergo little change. Nevertheless, they will continue to be maintained as per Council's existing asset management program and improved or made safe as applicable.

Many laneways within the city have heritage value and contribute to telling the story of our place. Heritage Overlay precincts cover a large area of the City of Port Phillip taking in part, or most of, all of the suburbs within the municipality. In particular most of South Melbourne, Middle Park and St Kilda are covered by Heritage Overlays. All of the precincts contain (bluestone) kerb, channels, and laneways which demonstrate the development of the area and in some cases make a strong contribution to the significance of the precinct.[1]

While these lanes will change little other than Council's ongoing maintenance, there are opportunities for adjoining properties to contribute to the overall appearance of laneways. As most people take pride and careful consideration of their property's front address to the street, the side/rear outlook to lanes are sometimes forgotten. Adjoining sites that have a laneway interface, should consider the use of complementary fencing and landscaping along the boundary (provided that it does not restrict vehicle access). The community and local residents can also play a big part in maintaining a tidy laneway by ensuring that bins are stored properly and illegal parking within lanes is avoided.

Council are also developing an Alternative Greening Port Phillip Strategy. This Strategy is devised to improve the public and private realm (where space is limited for traditional planting and landscaping) with alternative measures that enhance the aesthetic appearance of the lanescape.

Maintain or Enhance Laneways are identified in figures 3-7, detail area maps for laneway locations.

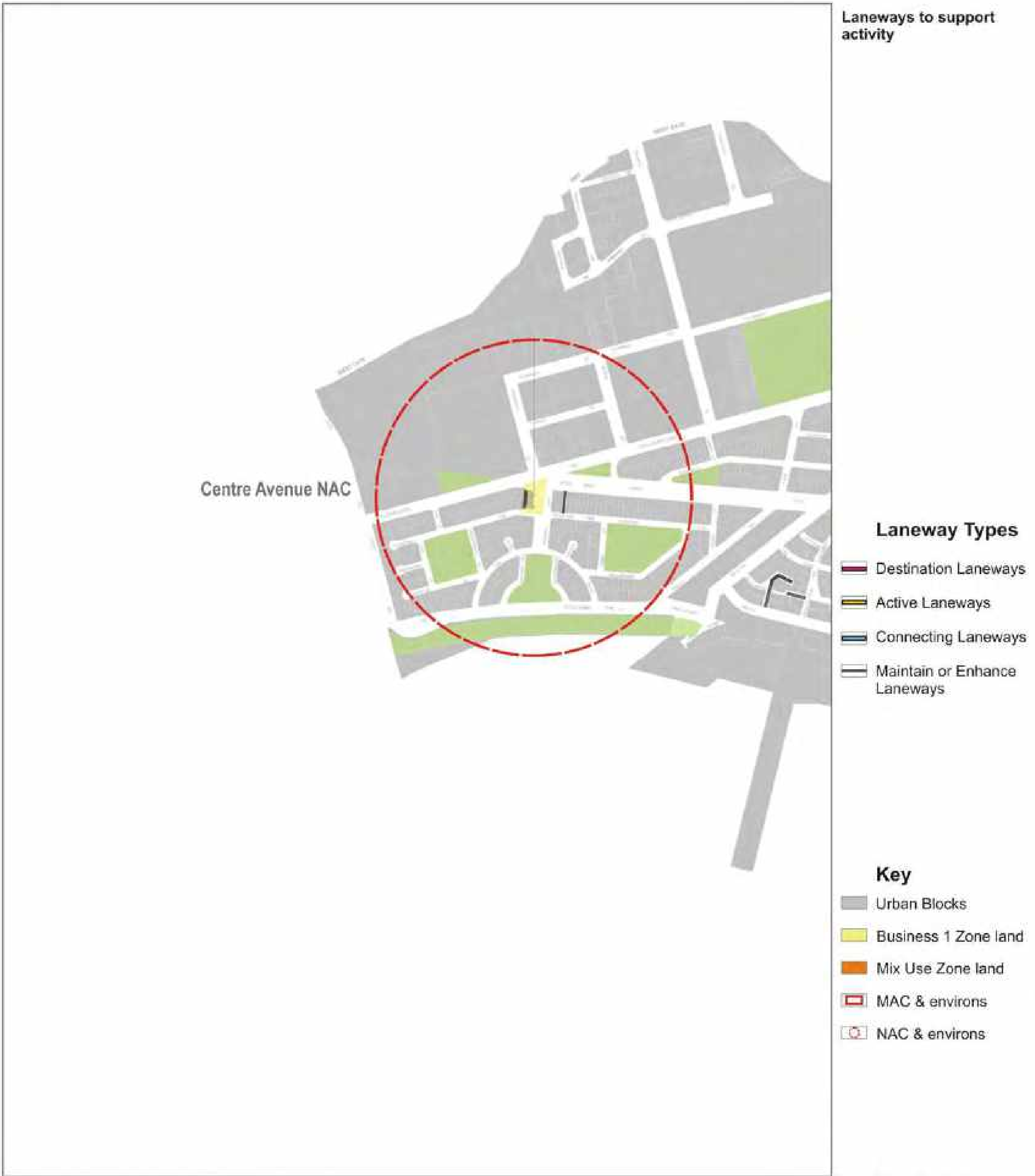
Recommendations/Opportunities:
> Align work with Council's Greening Port Phillip Strategy

> Review Council's Asset Management Program

> Complete Council laneway asset audit, updating information on the condition of lanes and land tenure

> Residential laneways, Middle Park

1 City of Port Phillip, Heritage kerbs, channels and laneways: history, significance and guidelines, City of Port Phillip, 2005, p. 8.



GARDEN CITY

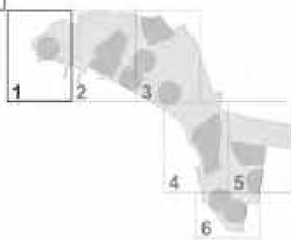


Figure 3: Detail Area Map 1

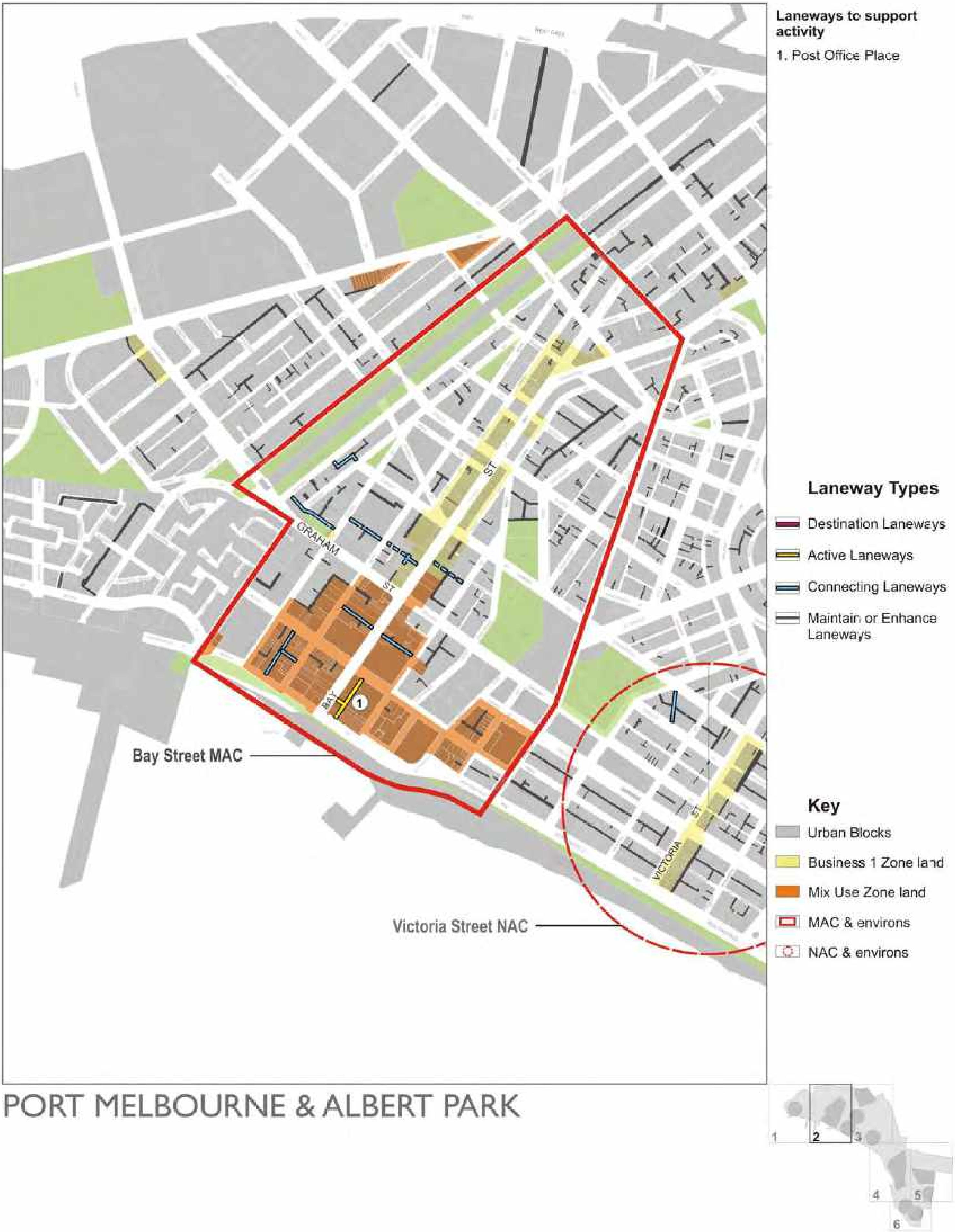


Figure 4: Detail Area Map 2

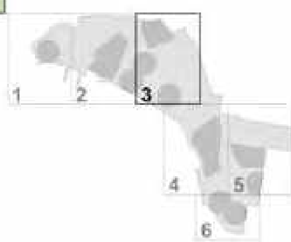


Figure 4: Detail Area Map 3

ST KILDA

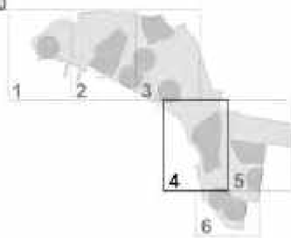


Figure 5: Detail Area Map 4

Laneways to support activity

12. R3741 (partial)

13. R3977 & 3745

14. R1535, R1519 & R1523

Laneway Types

- Destination Laneways
- Active Laneways
- Connecting Laneways
- Maintain or Enhance Laneways

Key

- Urban Blocks
- Business 1 Zone land
- Mix Use Zone land
- MAC & environs
- NAC & environs

BALACLAVA & RIPPONLEA

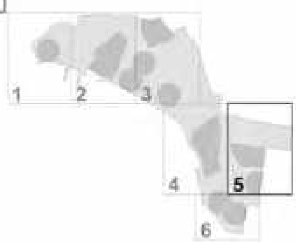


Figure 6: Detail Area Map 5

Figure 7: Detail Area Map 6

The future of City of Port Phillip's laneways

Laneways within the City of Port Phillip are often forgotten spaces. However, their gritty charm and human scale have great potential to become enticing and interesting places for residents, businesses and visitors.

The proposed laneway classifications and designations within the Strategy are by no means fixed or final. As such, the Strategy opens the prospect to re-imagining life within laneways.

The Activating Laneways Strategy seeks to deliver a range of lanes that are of high urban design quality, engaging with the community, and pedestrian friendly. This will be achieved by a number of future actions and initiatives driven by Council along with local businesses and the community.

What are the next steps

As laneways often require critical servicing and access requirements, it is important to recognise that that these functions will/may continue to exist. It is noted that future pedestrian activity within laneways may be constrained by the existing use and function of the lane, heritage and urban context or infrastructure requirements.

Prior to any significant upgrade works within laneways, further community/stakeholder consultation and detailed analysis will be undertaken to inform the extent and nature of works.

Deliverables	Actions and Opportunities	Staging	
To recognise the role and character of our laneways and little streets in creating a fine grain public realm	Prepare **Laneway Information Sheets** of selected laneways with opportunities for activation (refer to Appendix 3- sample handouts)	First Phase	✓
	Prepare a supplementary handout sheet that answers **frequently asked questions (FAQ)** and provide a general guide to the public on how to get involved and what can be done	First Phase	✓
	Develop **Design Guidelines** for private development adjacent to laneways for Council use and developer information. Possible policy development and planning scheme amendment	First Phase	
	Influence road **design standards and develop case studies** for laneway classes for Council use and community information	First Phase	
To maintain or enhance existing laneways	Identify heritage significant laneways and laneways elements critical for preservation	First Phase	✓
	Conduct **laneway and R.O.Ws audit** in conjunction with Property Service Department (Discontinuance of Laneways & R.O.Ws Policy)	On-going	✓
	Co-ordinate with Open Spaces & Sustainable Environments Unit and supplement the Alternative Greening Port Phillip Strategy	On-going	✓
	Continue existing asset management program and maintenance of laneways	On-going	
To create opportunities for activation and new development in designated laneways	Develop a **Communications Strategy** that includes community consultation and information to key stakeholders, advocating Council's vision	First Phase	
	Prepare a **conceptual designs for key laneways** and suitable for capital works and investment	First Phase	
	Prepare **Implementation Plan** outlining a co-ordinated regulatory process for Council	Second Phase	
	Investigate **initiatives to attract/promote businesses** within laneways. Advocate private development to open onto and engage with adjoining lane (where appropriate)	Second Phase	
	Support/organise social or artistic events within designated laneways. Potential to develop **event calendar** and program	Second Phase	
	Work across the organisation to improve alignment between service delivery and the implementation of the Activating Laneways Strategy	On-going	
To improve the walkability and permeability of the public realm	Implement laneway improvements to designated *Connecting, Active and Destination Laneways*. Conduct regular reviews/updates of the Strategy (every 5 years).	On-going	
	Co-ordinate works in line with existing strategic studies and asset management programs	On-going	✓

APPENDIX 1:

SUMMARY OF RELEVANT STRATEGIES AND PLANS

Council Plan 2009-2013

The proposed strategy is consistent with the Council Plan 2009-2013 by adding to the vibrancy and success of the city as a liveable and creative precinct, creating distinct and connected neighbourhoods and encouraging people to walk and cycle.

Strategic Direction 4: Enhancing Liveability

Strategy:		**Action:**
4.1.1	Maintain and build upon the unique character of the city's neighbourhoods	Prepare an Activating Laneways Strategy
4.1.2	Maintain and enhance streetscapes for improved amenity, character and sustainability	Maximise opportunity to integrate sustainable outcomes into streetscape redevelopments
4.1.7	Preserve our heritage, valuing the past and planning for the future	Continue with the heritage recognition program

Four pillars of Sustainability

1. Environmental Responsibility – The Strategy seeks to promote environmentally sensitive outcomes within both public and private laneways. While laneways traditionally serve to provide a drainage function and in many cases still do, there are opportunities to capture/reuse water runoff and enhance laneway environments through water sensitive urban design. The Strategy is also aligned with Council's Alternative Greening Strategy which seeks to identify other greening techniques that could be achieved in small streets and laneways where space is limited for conventional tree planting.

2. Economic Viability – Laneways provide a unique and interesting location for creative commercial opportunities. As seen in Melbourne's laneways, there is an emerging trend of businesses embracing intimate spaces such as laneway and arcades. The Strategy is designed to promote activation of laneways (where appropriate) through activity and built form.

3. Cultural Vitality – There are a large number of heritage significant laneways within the City of Port Phillip. Laneways provide an insight to the history and development of the city and contribute to the sense of place. They are rich in overlapping layers of social, cultural, and aesthetic values.

4. Social Equity – Laneways allow opportunities for increased 'physical' connections with surrounding streets, open spaces and destination places. As people tend to travel the shortest route possible, laneways can provide convenient short cuts to where people would like to go. Where appropriate, laneways should be made accessible to all users and be a safe and enticing environment.

Lurking in lanes, CoPP (1998)

Lurking in Lanes was a heritage exhibition undertaken by the City of Port Phillip with contributions from members of the community. It provides a detailed insight to the history of lanes based factual information retrieved from City archives and stories from the community.

While not the entire City laneways was surveyed through this research, the exhibition focused on sharing light on the history and use of laneways, the physical and social affinity with laneways and current issues that impact upon laneways today.

Heritage kerbs, channels & laneways, CoPP (2005)

Heritage kerbs, channels and laneways are Guidelines that inform the conservation and enhancement of laneways located within Heritage Overlay precincts of the City of Port Phillip.

The Guidelines identified the following types of kerb and channelling and laneways that are of cultural significance to the City of Port Phillip:

Kerb and channelling

- Bluestone kerb and channelling constructed up to the 1930s
- Concrete kerb and channel in the Fisherman's Bend Precincts only
- Bluestone pitched crossovers
- Kerb and channel furniture such as pit grates installed up to the 1930s

Laneways

- Fully pitched bluestone laneways with channel/s
- Laneways containing bluestone channels
- Laneway furniture such as manhole covers installed up to the 1930s

Heritage Service Practice Note 04. Laneways in Heritage Overlay Areas (2006)

Supplementary to Clause 22.04 Port Phillip Heritage Policy, Heritage Service Practice notes have been prepared to guide development abutting laneways within Heritage Overlay areas.

It is noted that the Activating Laneways Strategy does not seek to replace such guidelines but build upon the established objectives in dealing with laneways and narrow streets. These include:

- To conserve, enhance and recover the traditional character of laneways and narrow streets.
- To accept development that responds to the historic character of the laneway and to minimise elements that impact adversely on that character.
- To respond to the pressure for the introduction of dwellings into laneway frontages.
- To accept the place of motor vehicles in the contemporary context and to provide for them accordingly, bearing in mind that some lanes have very limited capacity.

Strategies and guidelines are provided to direct built form and presentation, wall treatments, roofing, fenestration and doors and fencing.

Laneway Strategy, CoPP (2003 – current)

The existing Laneways Strategy sought to develop a system of classifying laneways, not just on the basis of deterioration or physical condition, but also on the basis of their relative value to the community.

Sustainable Asset Management Program (current)

Capital Works & Renewal
The Laneways Strategy (2003) implemented an annual budget of $600,000 to be dedicated to laneway renewal as part of the 5 year capital works plan in order to maintain these assets.

Maintenance & Cleaning Services
The laneways of Port Phillip are cleaned four times a year. Laneways are cleaned by a combination of a small mechanical sweeper and workers with rakes and brooms.

Adjoining residents to laneways are required to cut back trees and shrubs overhanging the lane from their property.

Local law enforcement assists in the upkeep of Council laneways and responds to reports of illegal dumping, parking and activities within lanes.

Further information on Councils maintenance program can be obtained by contacting ASSIST on (03) 9209 6777.

Strategic Planning Studies

For many of the City's Activity Centres, strategic plans such as Structure Plans and Urban Design Frameworks have been prepared (or currently being developed) to guide future urban growth and town centre development. There is significant emphasise placed on increased pedestrian permeability within and around activity centres. Laneways provide opportunities for through block connections and short cuts to provide greater accessibility for both the local community and visitors.

Relevant Council policies and strategies

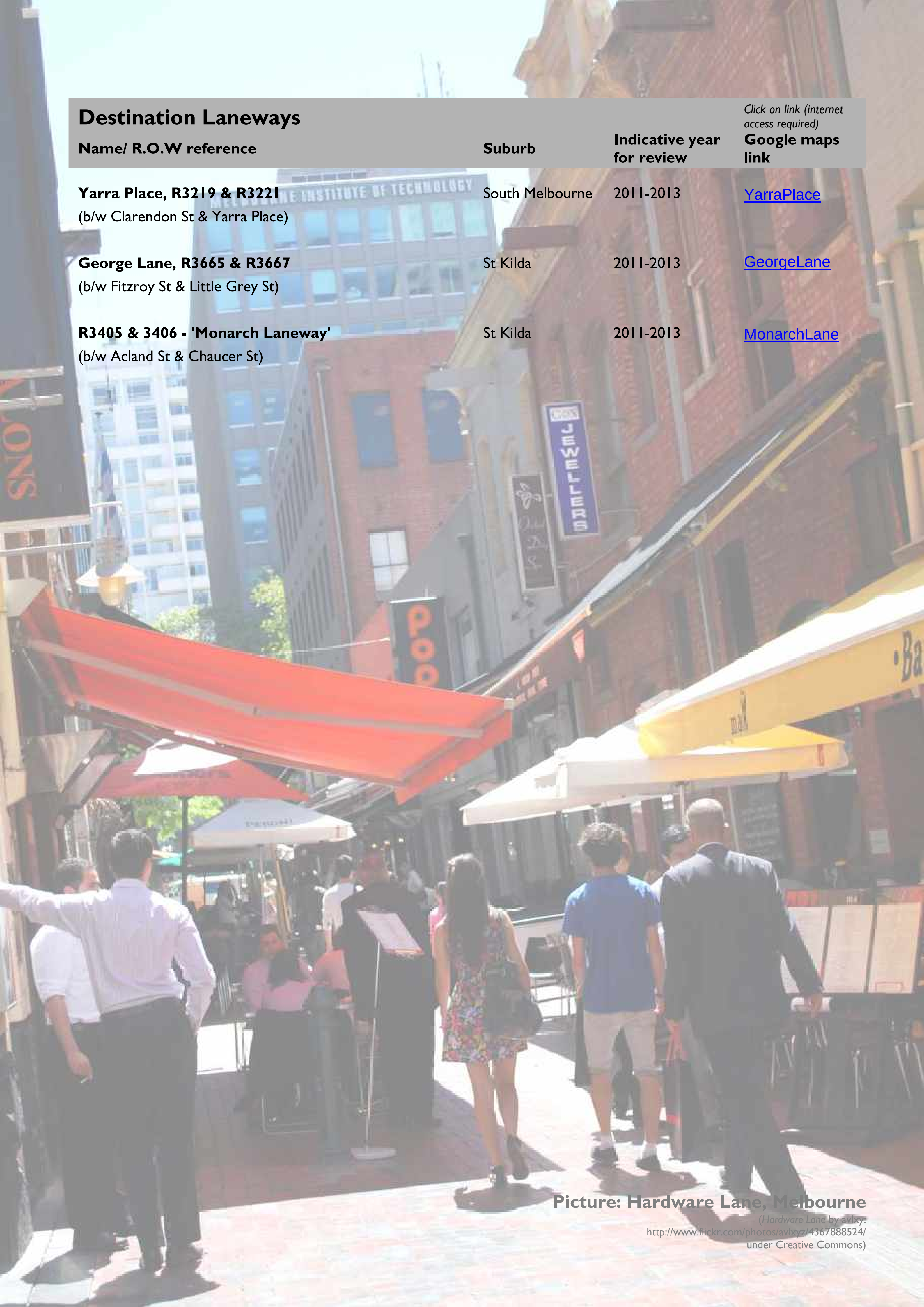
- **Walk Plan and Bike Plan**
- **Alternative Greening Strategy**
- **Discontinuance of Laneways Policy**
- **Sustainable Public Lighting Strategy**
- **Arts and Culture Policy (draft)**
- **Public Art Strategy (under development)**

APPENDIX 2:

PRELIMINARY LIST OF LANEWAYS/CLASSES

Destination Laneways

Name/ R.O.W reference	Suburb	Indicative year for review	*Click on link (internet access required)* Google maps link
Yarra Place, R3219 & R3221 (b/w Clarendon St & Yarra Place)	South Melbourne	2011-2013	YarraPlace
George Lane, R3665 & R3667 (b/w Fitzroy St & Little Grey St)	St Kilda	2011-2013	GeorgeLane
R3405 & 3406 - 'Monarch Laneway' (b/w Acland St & Chaucer St)	St Kilda	2011-2013	MonarchLane



Picture: Hardware Lane, Melbourne

(*Hardware Lane* by avlxyz: http://www.flickr.com/photos/avlxyz/4367888524/ under Creative Commons)

Active Laneways

Click on link (internet access required)

Name/ R.O.W reference	Suburb	Indicative year for review	Google maps link
Post Office Place (b/w Bay St & Dow St)	Port Melbourne	2011-2013	PostOfficePlace
Charles St (b/w Clarendon St & John St)	South Melbourne	2011-2013	CharlesStreet
Bank Place (b/w Clarendon St & Moray St)	South Melbourne	2011-2013	BankPlace
Hotham St (b/w Coventry St & Dorcas St- near Cecil St)	South Melbourne	2013-onwards	HothamStreet
Francis St (b/w Coventry St & Dorcas St- near Cecil St)	South Melbourne	2013-onwards	FrancisStreet
Union St (b/w Coventry St & Dorcas St- near Clarendon St)	South Melbourne	2013-onwards	UnionStreet
R1995 (b/w Armstrong St & Ninmo St)	Albert Park	2011-2013	R1995
Mirka Lane (b/w Inkerman St & Blanch St)	St Kilda	2011-2013	MirkaLane
R3741 (part - BIZ land) (b/w Chapel St & Camden St)	Balaclava	2011-2013	R3741
R3977 & R3745 (b/w Carlisle St & Alfred St)	Balaclava	2011-2013	R3977
R1535, R1519 & R1523 (b/w Carlisle St & Marlborough St	Balaclava	2011-2013	R1523
R1565, R1553, R1571 (part - BIZ land) (b/w Beach Avenue & Pine Avenue)	Elwood	2011-2013	R1565 R1553 R1571

Picture: Union Street, South Melbourne

Connecting Laneways

Name/ R.O.W reference	Suburb	Indicative year for review	*Click on link (internet access required)* Google maps link
Retreat Place (R2207 & R2209) (b/w Bay St & Nott St)	Port Melbourne	2011-2013	RetreatPlace
Donaldson St & R2127 (b/w Beach St & Rouse St)	Port Melbourne	2013-onwards	DonaldsonSt
R2155 (b/w Nott St & Bay St)	Port Melbourne	2013-onwards	R2155
Little Bay St (b/w Bay St & Dow St)	Port Melbourne	2013-onwards	LittleBayStreet
Bath Place (R2199 & R2201) (b/w Stokes St & Nott St)	Port Melbourne	2013-onwards	BathPlace
Barlow St (potential link to Bath Place) (b/w Nott St & Retreat Place)	Port Melbourne	2013-onwards	BarlowStreet
Adams Lane (R2165 & R2169 possible link to Bay St) (b/w Bay St & Dow St)	Port Melbourne	2013-onwards	AdamsLane
Turville Place (b/w Station St & Stokes St)	Port Melbourne	2013-onwards	TurvillePl
R2303 - R2245 & R2306 (b/w Station St & Princes/Liardet Sts)	Port Melbourne	2013-onwards	R2303
Ross Place, Roseneath Place (internal car park) (b/w Market St & York St - near Clarendon St)	South Melbourne	2013-onwards	RossPlace
Browns Lane (R3209) (b/w Market St & York St - near Cecil St)	South Melbourne	2013-onwards	BrownsLane
York Place (b/w York St & Coventry St - near Cecil St)	South Melbourne	2013-onwards	YorkPlace
Emerald Hill Place (b/w Dorcas St & Park St - near Clarendon St)	South Melbourne	2011-2013	EmeraldHillPl
Gardner Place (R2843) (b/w Cecil St & Perkins St - near Park St)	South Melbourne	2013-onwards	GardnerPlace
Tichbourne Place (b/w York St & Coventry St - near Kings Way)	South Melbourne	2013-onwards	TichbornePlace

Picture: Pakington Lane, St Kilda

Connecting Laneways (cont.)

Name/ R.O.W reference	Suburb	Indicative year for review	*Click on link (internet access required)* Google maps link
Dundas Lane (b/w Dundas Place & Victoria Avenue)	Albert Park	2013-onwards	DundasLane
Victoria Lane (b/w Dundas Lane & Victoria Avenue)	Albert Park	2013-onwards	VictoriaLane
Foote Lane (b/w Richardson St & Barrett St)	Albert park	2013-onwards	FooteLane
Canterbury Place (b/w Ninmo St & McGregor St)	Middle Park	2013-onwards	CanterburyPl
Little Grey St (R3663) (b/w Dalgety St & Fitzroy St)	St Kilda	2013-onwards	LittleGreySt
Park Lane (b/w Park St & Lock St - near Fitzroy St)	St Kilda	2013-onwards	ParkLane
R3615 (b/w Fitzroy St & Jackson St)	St Kilda	2013-onwards	R3615
R3579 (b/w Jackson St & Eildon Road)	St Kilda	2013-onwards	R3579
Alfred Place, R3487, R3485, R3543 (link to J. Talbot reserve) (b/w Robe St & Havelock St)	St Kilda	2013-onwards	AlfredPl R3487 R3485 R3543
Depot Lane (b/w Barkly St & Greeves St)	St Kilda	Completed	DepotLane
Pakington Lane (R3525, R3523 & R3453) (b/w Inkerman St & Lynott St)	St Kilda	Completed	PakingtonLane
Railway Place (walkways along rail line) (b/w Carlisle St & Nightingale St - possible extension to Ripponlea Station)	Balaclava	2013-onwards	RailwayPlace
R1435 (b/w Albion St & Maryville St)	Ripponlea	2013-onwards	R1435
R1579 (b/w Spray St & Ormond Road)	Elwood	2013-onwards	R1579

Picture: Pakington Lane, St Kilda

APPENDIX 3:

DESTINATION LANEWAYS INFORMATION SHEETS (SAMPLE)

Preliminary Information Sheets have been prepared for a number of possible destination laneways within the municipality.

Yarra Place, R3219 & R3221, South Melbourne

1. Laneway Context

	Type	Comments
1.1 Amenities	Activity Centre	Within 400m
	Public Transport	Within 400m
	Open Space	N/A
1.2 Width/ Capacity	Wide	over 8m / 1 way with parallel parking and footpaths to both sides (R3219 - 2.7m wide) (R3221 - 3.1m wide)
1.3 Through connection	Yes	Direct links to Clarendon Street
1.4 Landuse/ Zone	Business Zone	Business 1 Zone (B1Z)/ Business 3 Zone
1.5 Heritage Precinct Overlay	Yes	Heritage Overlay 3 (HO3) - land between Clarendon St/ Yarra Pl
1.6 Interface sensitivity	No	Limited sensitive interfaces
1.7 Laneway activation/ articulation	Medium	Yarra Place includes a number of activated edges and laneways are predominantly used for services
1.8 Activation opportunities	High	
1.9 Places of interest/ attraction	Yes	Direct access to/from Clarendon Street with a concentration of restaurants, cafes and bars

2. Laneway Attributes

	Type	
2.1 Laneway surface/ materials	Mixed	Yarra Place - Ashpalt, R3219 & R3221 - bluestone pitchers
2.2 General orientation	Other	Yarra Place & R3221: North - South R3219: East - West
2.3 Dedicated footpath available	Yes	To both sides of Yarra Place
2.4 Topography grade	Gentle Slope	Falling from north to south
2.5 Public lighting	Yes	Overhead lights on poles
2.6 Pedestrian access	High	Achieved from Clarendon Street and Coventry / York Streets
2.7 Vehicular access requirements	High	Yarra Street is a through access road
2.8 Existing services	Yes	Rubbish bins are informally stored within laneways

3. Propensity for Change

High

These laneway/s has a high propensity for change. Surrounding commercial uses and high connectivity with Clarendon Street make it ideal to accommodate increased activity.

The grid network of laneways offer a variety of interesting spaces that could further enhance existing/ new commercial tenancies.

4. Laneway Classification

Destination Laneways

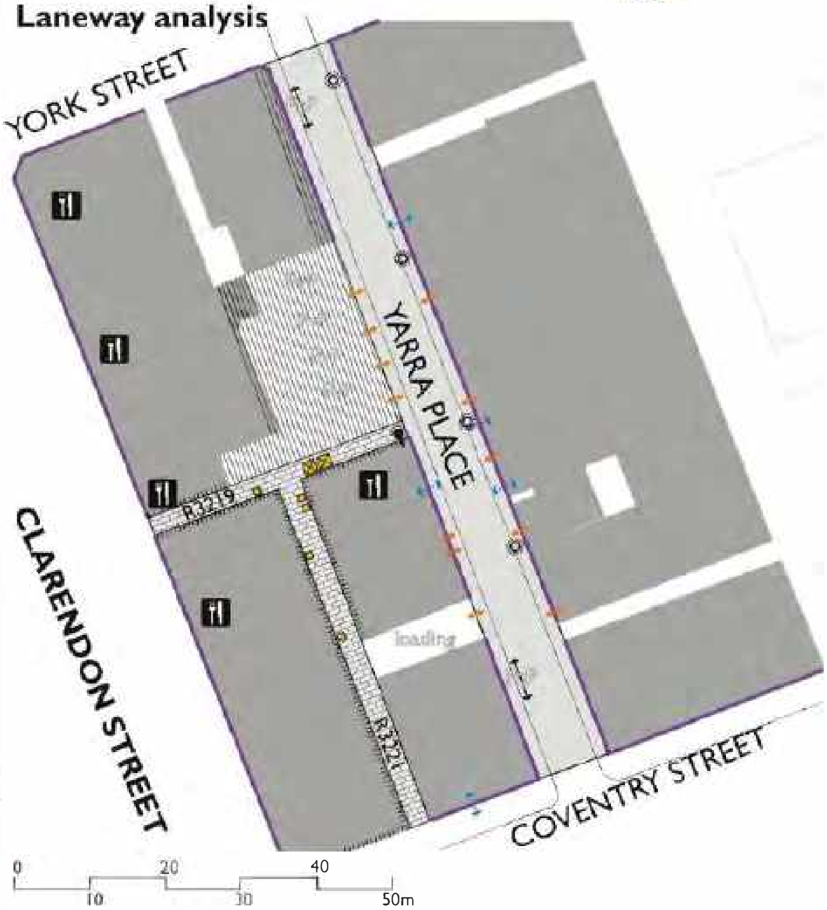
Existing Conditions


Yarra Place - 1 way with footpaths & parallel parking. Rear of shops fronting Clarendon St and warehouses


pedestrian link to Clarendon Street


R3221 - link to Coventry Street (currently bins/ refuse clutter the

Laneway analysis



- PvP private parking
- PcP public parking
- lighting - overhead on pole
- lighting - attached to building
- pedestrian entry/ access
- vehicle entry/ access
- fencing
- commercial interface
- opportunity for activation areas
- bluestone pitcher laneways
- existing restaurant/ café/ bar venues
- rubbish bins - 'dumpster'
- rubbish bins - 'wheelie'

Examples of destination laneways

George Lane, R3665 & R3667, St Kilda

1. Laneway Context

	Type	Comments
1.1 Amenities	Activity Centre	Within 400m
	Public Transport	Within 400m
	Open Space	Within 400m
1.2 Width/ Capacity	Narrow	3.4m - 3.7m wide / restricted vehicle access
1.3 Through connection	Yes	
1.4 Landuse/ Zone	Other	George Lane and R3665 - Business 1 Zone (B1Z) R3667 - Business 1 Zone (B1Z) / Residential 1 Zone (R1Z)
1.5 Heritage Precinct Overlay	Yes	Heritage Overlay 5 (HO5)
1.6 Interface sensitivity	Limited	
1.7 Laneway activation/ articulation	Low	
1.8 Activation opportunities	High	
1.9 Places of interest/ attraction	Yes	Concentration of night time venues including bars and nightclubs

2. Laneway Attributes

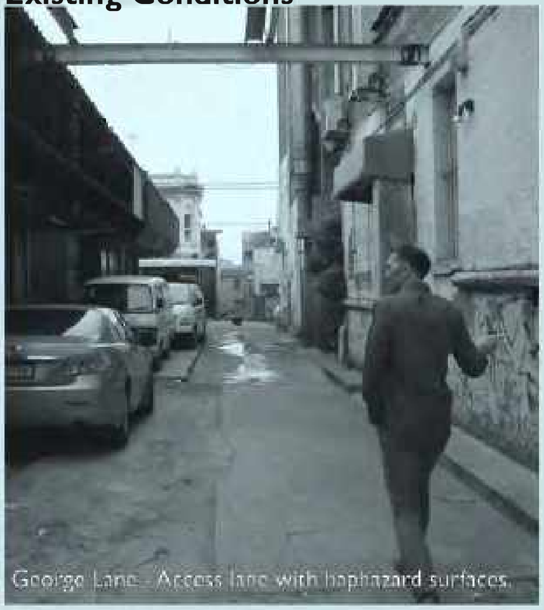
	Type	
2.1 Laneway surface/ materials	Mixed	George Lane - fragmented areas of concrete R3665 - unmade accessway R3667 - Ashpalt footpath with central bluestone channel
2.2 General orientation	Other	Series of laneways forms a 'U' shape configuration
2.3 Dedicated footpath available	No	Footpath available within R3667
2.4 Topography grade		Lanes are generally flat with the exception of R3665 which has a steep slope at northern end
2.5 Public lighting	Limited	Attached to building (within R3667 - ped link to Little Grey Street)
2.6 Pedestrian access	Medium	Poor pedestrian conditions within George Lane and R3665
2.7 Vehicular access requirements	Low	
2.8 Existing services	Yes	Access to rubbish bins required within George Lane

3. Propensity for Change — High

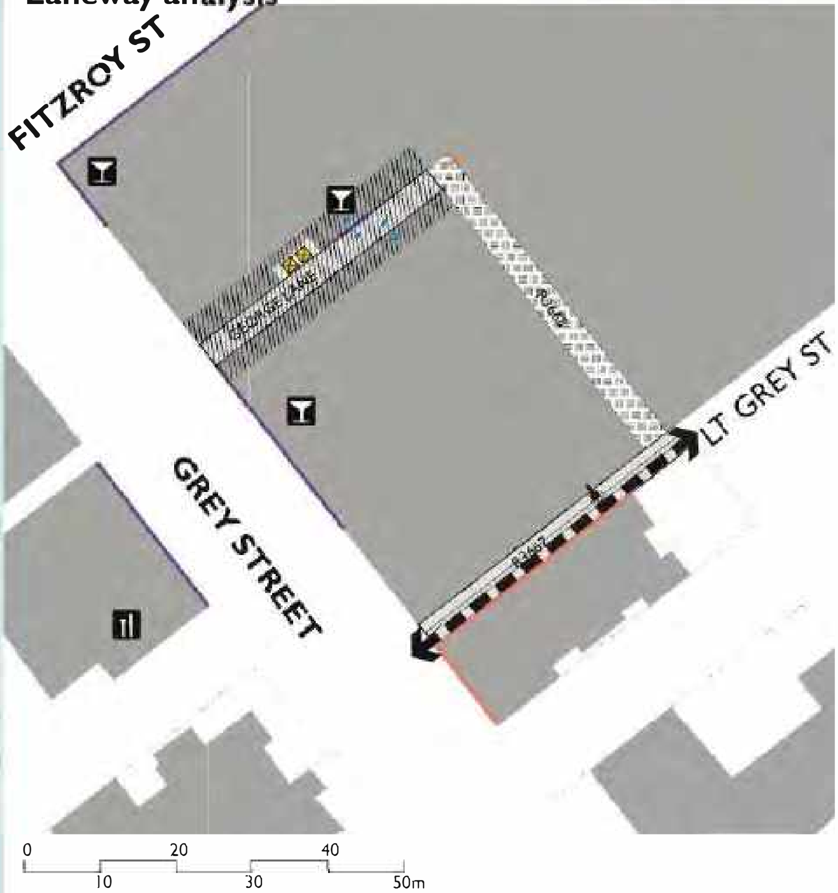
These laneways has a high propensity for change. Existing local commercial activities (including dining and night time venues) make it ideal to accommodate increased activity.
The network of laneways offer a variety of interesting spaces that could further enchance existing/ new commercial tenancies.

4. Laneway Classification — **Destination Laneways**

Existing Conditions



Laneway analysis



- private parking
- pedestrian entry/ access
- vehicle entry/ access
- bluestone wall
- established vegetation/ tree
- commercial interface
- opportunity for activation areas
- existing outdoor dining areas
- existing restaurant/ café/ bar venues
- rubbish bins - 'dumpster'
- rubbish bins - 'wheelie'

Examples of destination laneways

R3405 & R3406, St Kilda
(Acland Street - 'Monarch laneway')

1. Laneway Context

	Type	Comments
1.1 Amenities	Activity Centre	Within 400m
	Public Transport	Within 400m
	Open Space	Within 400m
1.2 Width/ Capacity	Narrow	R3405 4.0m wide / 1 vehicle accessway R3406 - 3.6m wide / 1 vehicle accessway
1.3 Through connection	Yes	Links to Acland St and Chaucer St (through woolworths carpark)
1.4 Landuse/ Zone	Business Zone	Business 1 Zone (B1Z)
1.5 Heritage Precinct Overlay	No	
1.6 Interface sensitivity	No	Limited sensitive interfaces
1.7 Laneway activation/ articulation	Low	Laneway currently utilised for pedestrian through links and services
1.8 Activation opportunities	High	
1.9 Places of interest/ attraction	Yes	Direct access to/from Acland Street and pedestrian short cut to Peanut Farm Reserve including sporting ovals

2. Laneway Attributes

	Type	
2.1 Laneway surface/ materials	Concrete	Surface is in excellent condition
2.2 General orientation	Other	R3405: East - West R3406: North - South
2.3 Dedicated footpath available	No	Laneway provides shared vehicle and pedestrian access
2.4 Topography grade	Flat	
2.5 Public lighting	Yes	Attached to buildings
2.6 Pedestrian access	High	Achieved from Acland Street and Chaucer Street
2.7 Vehicular access requirements	High	No through vehicle link. Access to refuse/ services is required during periods of the day
2.8 Existing services	Yes	Rubbish bins are informally stored within laneways

3. Propensity for Change

High

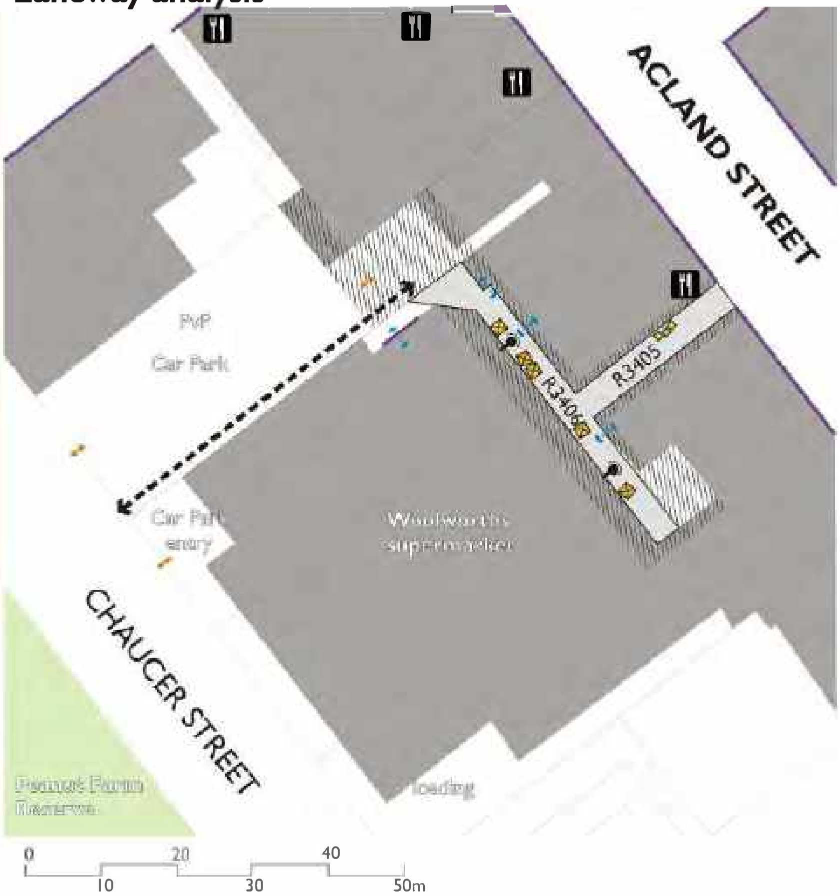
These laneway/s has a high propensity for change. Surrounding commercial uses and high connectivity with Acland Street make it an ideal to accommodate increased activity.
The laneway allows mid-block through links to surrounding public open space and is in relatively good condition, requiring minor upgrade works.

4. Laneway Classification

Destination Laneways

Open surface car park - informal pedestrian link to Acland Street / Chaucer Street

Laneway analysis



- PvP private parking
- lighting - attached to building
- pedestrian entry/ access
- vehicle entry/ access
- fencing
- enhance pedestrian link
- commercial interface
- opportunity for activation areas
- existing restaurant/ café/ bar venues
- rubbish bins - 'dumpster'
- rubbish bins - 'wheelie'

Examples of destination laneways

APPENDIX 4:

COMMUNITY CONSULTATION SUMMARY JUNE 2011

FREQUENTLY ASKED QUESTIONS

APPENDIX 4

Activating Laneways Strategy

"I think it's appropriate and timely that the CoPP is thinking about making more and better use of its laneways."

Community Feedback Summary June 2011 and Frequently Asked Questions (FAQs)

The draft Activating Laneways Strategy was made available to the public from 8 June – 22 June 2011.

Consultation on the draft Strategy was advertised in the local media and posted on the City of Port Phillip "Have Your Say" website. Copies of the document were also made available at local ASSIST centres and libraries for public viewing.

The "Have Your Say" website attracted 17 comments from the public. In general, the comments were very supportive of the Strategy and the following outlines a few common topics raised by the community.

Roles and responsibilities

What are roles and responsibilities of Council department's regarding laneways?

Simply contact Council's **ASSIST centre on 9209 6777** and be directed to the following Council Departments:

For development applications within commercial areas seeking to activate/ open onto a laneway:

- City Strategy (Places & Projects and Strategic Planning)
- City Development (Statutory Planning)

For organising community events within laneways:

- City Strategy (Places & Projects)
- Community & Health Development

For applying for art works within laneways:

- City Strategy (Places & Projects)
- Arts & Festivals

For general laneway maintenance, repair and cleaning:

- Infrastructure Maintenance Services
- Asset and Infrastructure Services
- Local Laws

For discontinuance and sale of laneways

- Property Services

"An exciting idea and turns the laneway into a valuable asset."

General laneway maintenance

While a few laneways are identified for possible improvements/upgrades, will Council forget other laneways in need of repair/ maintenance?

Council's existing **Sustainable Asset Management (SAM) program** for general laneway renewal, maintenance and cleaning will continue to remain. All lanes within the Municipality will be monitored to ensure that they are in satisfactory condition.

The Activating Laneways Strategy is set out to be a flexible framework to inform some of the possibilities within laneways. While it outlines a preliminary list of laneways ideal for activation and/or potential upgrades and improvements, there is scope for Council to consider other lanes to be included for review as the urban environments surrounding laneways frequently change.

The Strategy is planned to be reviewed every 5 years overall. In between regular updates to the laneway list which overtime seek to build a collection of high quality lanes in close proximity to Activity Centres, open spaces and public transport routes.

Nature of laneway activity

Does the Activating Laneways Strategy seek to commercialise all laneways?

The Activating Laneways Strategy does not support business/commercial activity within all lanes within the Municipality. The Strategy identifies targeted lanes that could support commercial activity subject to appropriate land use zoning, urban context and pedestrian connectivity. A large proportion of laneways are within residential areas will be maintained as per Council standards.

Design Guidelines for will be developed to inform both private development (adjacent to laneways) and public realm works (within the laneway). Such guidelines will outline preferred treatments i.e. surface/pavement type, lighting, signage etc. The guidelines are intended to ensure laneways are functional, attractive, safe and engaging for pedestrians.

Any new (private) development will still require necessary planning, building and licensing approvals from Council.

Laneway naming

What about naming the laneways?

Given the extensive number of lanes/R.O.Ws within the Municipality, Council utilises a numbered system to identify these assets.

It is possible to make an application to re-name a laneway and a naming request can be originated from the wider community or by Council officers.

"I myself am always exploring laneways (while I walk my dog). I think it is great that the Council has these previously ignored areas in mind."

Council have ***Guidelines for the Naming or Re-naming of Roads, Lanes and Reserves (2005)*** which provide detailed information/requirements for naming applications.

Community gardens within laneways

Is there potential for some residential lanes (that do not require vehicle access/traffic) to be used for community based / green initiatives like community gardens?

Council is currently developing a draft ***Community Garden Policy*** which stipulates appropriate locations, attributes and types of community gardens across the municipality.

The use of laneways for community gardens may be a possibility and will be considered by council officers on a case-by-case basis. It is important that functional issues (i.e. vehicle access, servicing, community co-operation, maintenance, responsibilities) are adequately addressed.

Graffiti within laneways

Many laneways are filled with endless graffiti. What is Council doing or what can I do to help deter graffiti?

Council is committed to controlling/ deterring graffiti within public spaces. Council initiatives include:

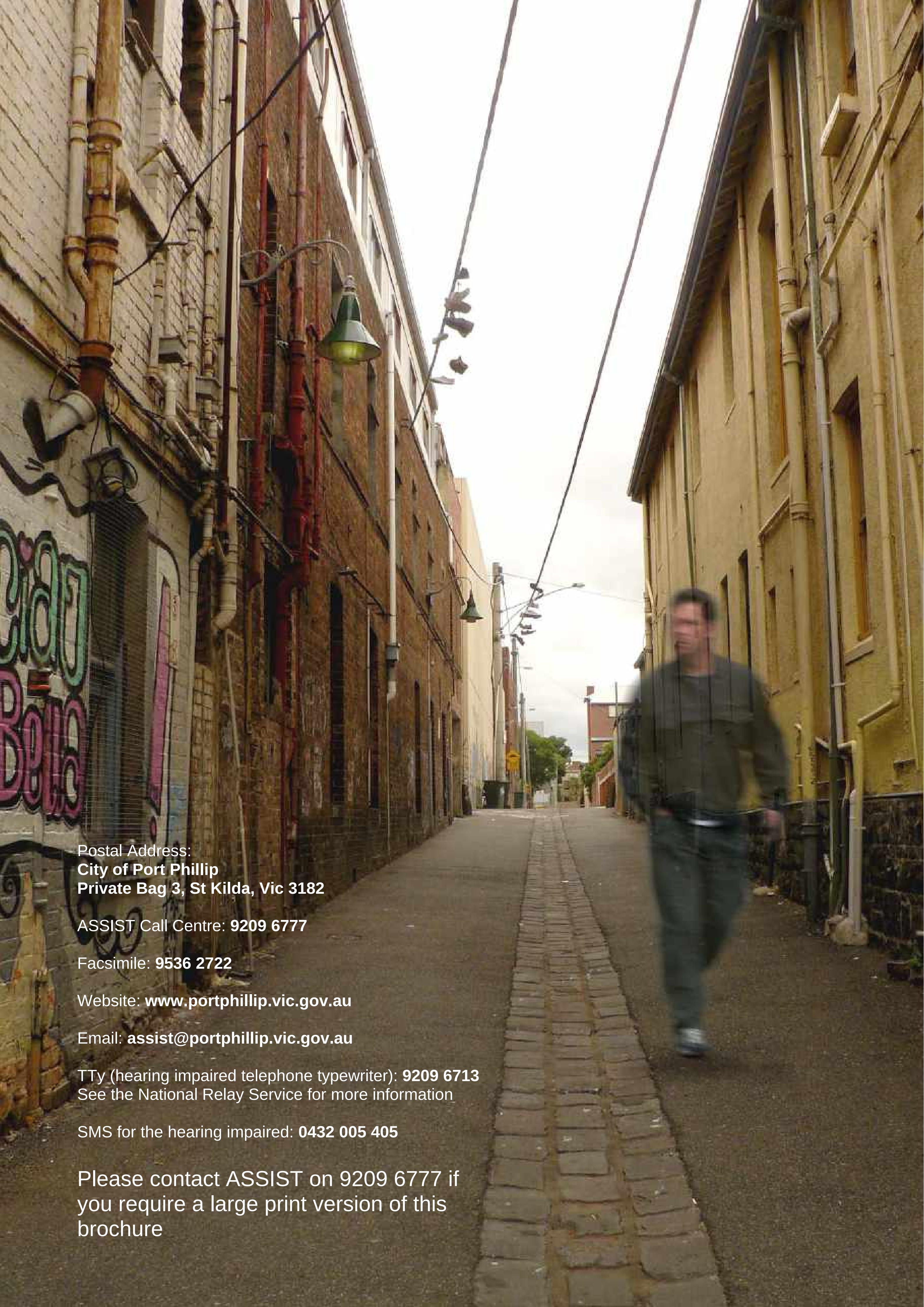
- Prompt removal of graffiti from Council owned buildings and infrastructure through a dedicated Graffiti Removal Contractor.
- Provision of FREE graffiti Kits available at all of Council Town Halls
- Provision of Councils FREE Graffiti Removal Program
- Regular letter drops to residents advising of Council's free programs
- Regular "hotspot" checks to remove graffiti from sites within the municipality where repeat offences take place
- Developing partnerships with key organisations responsible for public assets, such as transport services and utility companies to maintain a consistent approach to graffiti management
- Working with State Government and neighbouring municipalities
- Working with police to assist in detection of graffiti vandals
- Engaging with young people through community art projects

In some instances graffiti "artworks" (commissioned art projects with community/ landowner consent) are generally considered acceptable but there is a lot of community angst against graffiti "tagging".

The issue of graffiti as public art is largely a subjective matter. Council is currently developing an ***Arts and Culture Policy*** which outlines Council's Vision, Principles and Themes of public art.

Further information of what you can do to assist in reducing/ deterring graffiti can found on Council's website:

http://www.portphillip.vic.gov.au/graffiti_removal.htm



Postal Address:
City of Port Phillip
Private Bag 3, St Kilda, Vic 3182

ASSIST Call Centre: **9209 6777**

Facsimile: **9536 2722**

Website: **www.portphillip.vic.gov.au**

Email: **assist@portphillip.vic.gov.au**

TTy (hearing impaired telephone typewriter): **9209 6713**
See the National Relay Service for more information

SMS for the hearing impaired: **0432 005 405**

Please contact ASSIST on 9209 6777 if you require a large print version of this brochure

Art and Soul

Creative and Prosperous City Strategy 2018-22

Contents

Cover photo: Rawcus, Song For a Weary Throat 2017, photo Sarah Walker

Building a prosperous City that connects and grows business as well as bringing arts, culture and creative expression to everyday life and contributing to Melbourne’s liveability

Womin djeka

Council respectfully acknowledges the Yaluk-ut Weelam Clan of the Boon Wurrung.

We pay our respect to their Elders, both past and present.

We acknowledge and uphold their continuing relationship to this land and water on which we rely.

We recognise the intrinsic connection of the Traditional Owners to Country and acknowledge their contribution in the management of land, water and resources.

MESSAGE FROM THE MAYOR

The Councillors and I are pleased to release Art and Soul - Creative and Prosperous City Strategy 2018-22.

This strategy sets out our creative, cultural and economic development objectives for Port Phillip, to achieve strategic direction five in our Council Plan - We thrive by harnessing our creativity.

As our population becomes denser, older and more diverse, and with more people using our City, its creative and economic life becomes key to its future amenity. This means that Council needs to better leverage the assets and places it has, identify new clusters of job growth and creativity, and help facilitate and foster their development. Among the many initiatives that will make this happen, some of the key priorities include:

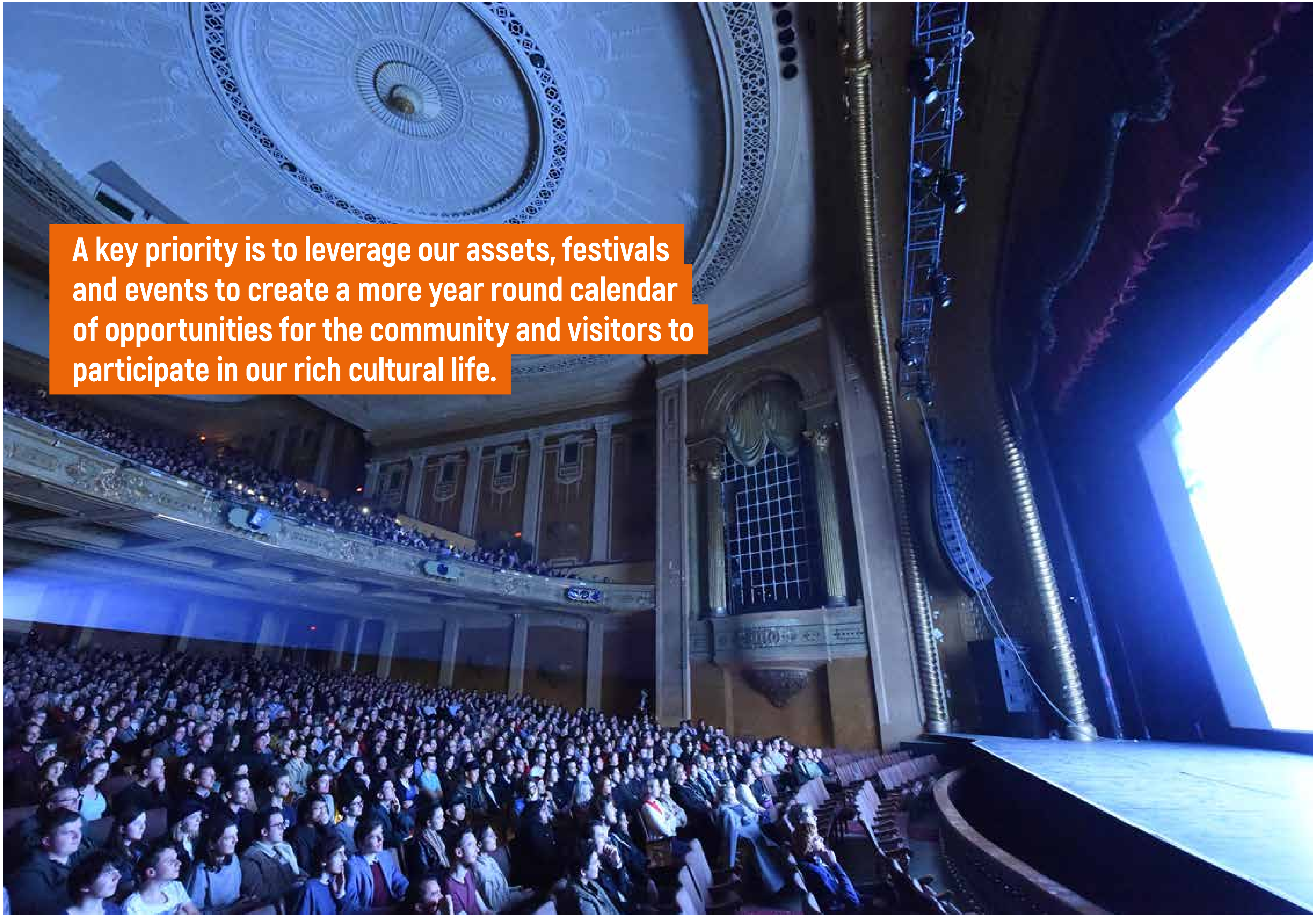
- a 'placemaking' approach that brings together residents, property owners, businesses and place users into a process that agrees a future vision and new place identity for our shopping precincts and which trials policy changes, uses temporary activation and events, and minor works to ensure these places are vibrant centres for our residents and visitors
- a comprehensive mapping of the innovation, arts and creative industries in the municipality to help Council develop ways to address affordability, diversity and availability of space for entrepreneurs, creatives and start-ups, facilitate the clustering of similar industries and leverage investment, particularly in Fishermans Bend
- leveraging our assets, festivals and events to create a more year-round calendar of opportunities across the municipality for the community and visitors to participate in our rich cultural life
- delivering a Library Action plan, Game Action plan, and Live Music plan that responds to historic and new community strengths and industries.

We look forward to working together with you to create great outcomes.

Cr Bernadene Voss
Mayor
City of Port Phillip

As our population becomes denser and more people use our City, its creative and economic life becomes key to its future amenity.

A key priority is to leverage our assets, festivals and events to create a more year round calendar of opportunities for the community and visitors to participate in our rich cultural life.



COUNCIL PLAN - OUR STRATEGIC DIRECTIONS

The Art and Soul - Creative and Prosperous City Strategy outlines the cultural change and collaborative actions required over the next four years across a range of Council services, including: arts, culture and heritage, economic development and tourism, festivals, libraries, markets, city planning and urban design, to create a thriving social, cultural and economic future for the City of Port Phillip.

ONGOING ENGAGEMENT AND REPORTING

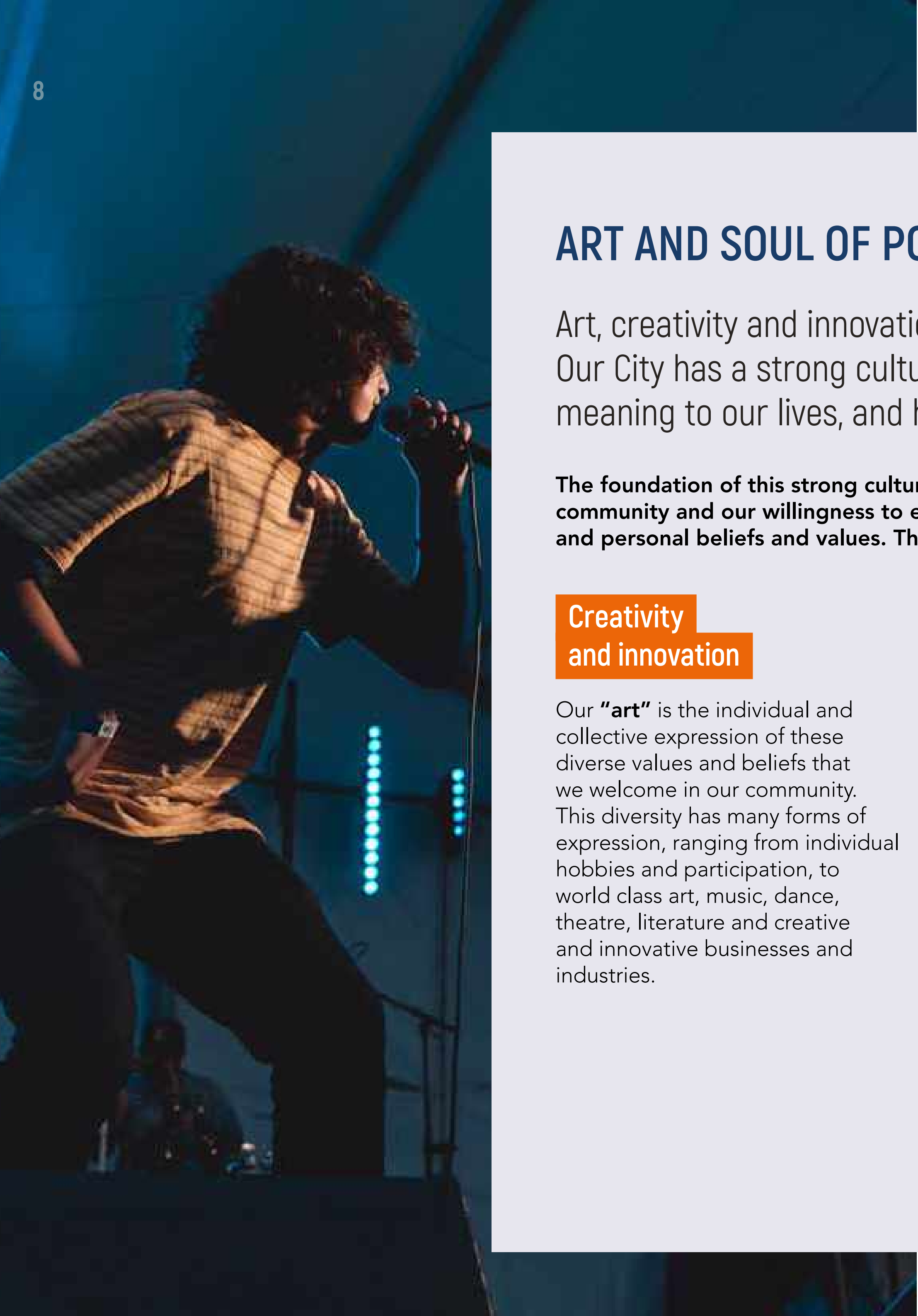
Port Phillip community

INTEGRATED COUNCIL PLAN	KEY STRATEGIES
DIRECTION 1 We embrace difference, and people belong	**Health and Wellbeing Implementation Plan**
DIRECTION 2 We are connected and it's easy to move around	**Move, Connect, Live** - Integrated Transport Strategy
DIRECTION 3 We have smart solutions for a sustainable future	**Act and Adapt** - Sustainable Environment Strategy **Don't Waste It!** - Waste Management Strategy
DIRECTION 4 We are growing and keeping our character	Public Space Strategy
DIRECTION 5 We thrive by harnessing creativity	**Art and Soul** - Creative and Prosperous City Strategy
DIRECTION 6 Our commitment to you	Organisational Strategy

Implementation

ONGOING ENGAGEMENT AND REPORTING

We hope to see an increase in the number of visitors to the City of Port Phillip; industry and business growth; a reduction in commercial vacancy rates as well as an increase in resident, business and visitor satisfaction levels.



ART AND SOUL OF PORT PHILLIP

Art, creativity and innovation are part of the DNA of Port Phillip. Our City has a strong cultural heritage that brings colour and meaning to our lives, and has shaped how our community sees itself.

The foundation of this strong cultural heritage, in the past and into the future, is our inclusiveness as a community and our willingness to embrace and welcome people with a diverse range of cultural, religious and personal beliefs and values. This is our "soul" and what makes us unique as a city and community.`

Creativity and innovation

Our **"art"** is the individual and collective expression of these diverse values and beliefs that we welcome in our community. This diversity has many forms of expression, ranging from individual hobbies and participation, to world class art, music, dance, theatre, literature and creative and innovative businesses and industries.

Creative ecosystem

Individual and collective artistic expression is supported by our **"creative ecosystem",** and we understand this to be all of the individuals, community groups, organisations and funding bodies, as well as the facilities, galleries, theatres, event spaces and venues that support **"art"** in our community.

Challenges and opportunities

As our City grows, there are many **challenges** to the "creative ecosystem" of Port Phillip and Melbourne that are described in this strategy. However, there are also great **opportunities** to leverage our unique DNA and cultural heritage by working with individuals, organisations, and new and emerging innovation industries to strengthen our creative ecosystem into the future.

Our soul, our City

Our Art and Soul Strategy describes the actions we will take, and how we will work with our community to respond to these challenges and make the most of the opportunities to deliver a creative and prosperous future for our community and the City of Port Phillip.

Our history and heritage remind us we have long been Melbourne's creative playground.

EXECUTIVE SUMMARY

What is Art and Soul - Creative and Prosperous City Strategy?

Art and Soul - Creative and Prosperous City Strategy outlines the cultural change and collaborative actions required over the next four years across a range of Council services including: arts, culture and heritage, economic development and tourism, festivals, libraries, markets, city planning and urban design, to create a thriving social, cultural and economic future for the City of Port Phillip.

Why is it important?

The City of Port Phillip has always been a bold, liveable, caring and beautiful place. Our history and heritage remind us we have long been Melbourne's creative playground. Arts, creativity and innovation are in our DNA. Our diversity and inclusiveness is our future. However, we face both challenges and opportunities from urban development and growth, which mean we need to be more considered and proactive to ensure the social, cultural and economic wellbeing of our community, and to think differently about how best to support accessibility, diversity and sustainability.

One of the important challenges we face is densification, which can create tension between competing land uses, and we see this acutely when managing the local impacts of festivals, events and live music. Gentrification, escalating land values and the rising cost of rent also present challenges for creative practitioners, art organisations, entrepreneurs and small businesses. Sustainability and consumption, the changing retail environment, the rise of the sharing economy and flexible employment models are all driving an evolution of our places and the experiences people have in our City. Meanwhile, there is also increased competition for federal and state governments and private support for arts and cultural funding, which drives demand for local government support.

Where do we want to be?

We are looking to harness the creativity of the City of Port Phillip and will seek to achieve this by creating a City of dynamic and distinctive places and precincts; building a prosperous City that connects and grows business as well as bringing arts, culture and creative expression to everyday life and contributing to Melbourne's liveability.

What will be different by 2019/20 and 2021/22 as a result of Council investing in this strategy?

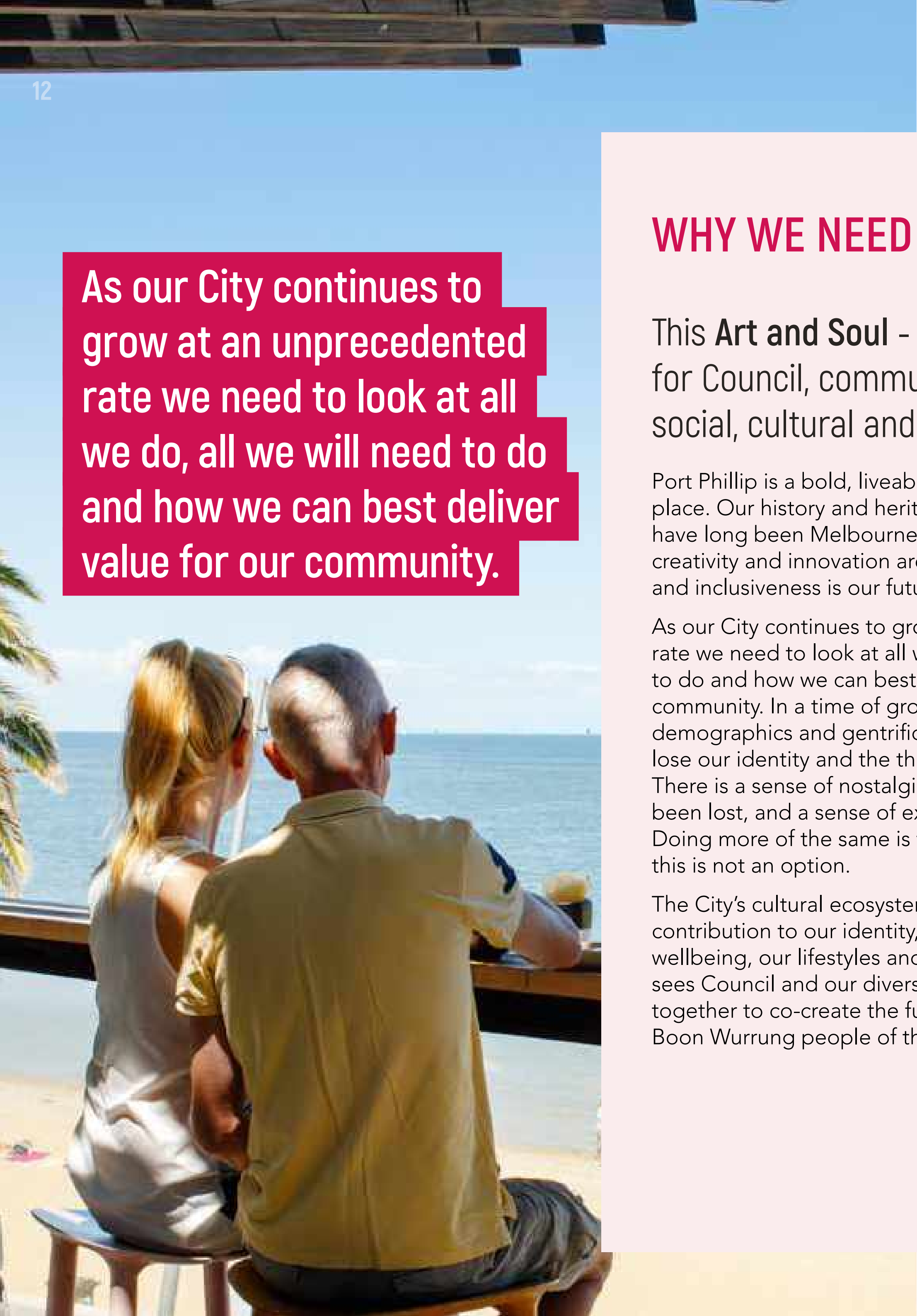
- leveraging of Council's current investments to better support creative industries
- delivery of a concentrated placemaking effort and investment, with significant activation of precincts in Fitzroy Street, Waterfront Place and Clarendon Street
- strengthening of South Melbourne and Fishermans Bend as our creative industry clusters and recognising the opportunity of other emerging clusters such as William Street in Balaclava
- increased access to a diversity of affordable spaces and funding for the local creative industries
- planning for adequate employment land across the City to facilitate local jobs and support the arts and creative industries
- delivery of a Game Action Plan, a four year plan addressing access to space and affordability, a Creative Sector Prospectus, a Live Music Action Plan and a new three year St Kilda Festival Plan.

What does success look like?

At the end of the four year strategy implementation:

- business and creatives are saying that the City of Port Phillip is the place to be to work, create and innovate
- community is saying that Council is maximising our opportunities; that we have really thought about this and have deliberately acted in a strategic and collaborative way; that the arts and creative sector is vibrant, accessible and sustainable
- Council's role has expanded, leveraging more from what we own and directly do, in addition to facilitating, brokering and co-creating with community to empower a sustained sector
- the City of Port Phillip is known as punching above our weight in contributing to the state's cultural economy.

We also hope to see an increase in the number of visitors to the City of Port Phillip, industry and business growth, a reduction in commercial vacancy rates as well as an increase in resident, business and visitor satisfaction levels. It is important to highlight that investment in this strategy alone may not be sufficient to shift these particular measures as there are a range of other external factors that may influence them. However, by tracking these measures we can reflect and adjust the strategy and try new things if the interventions don't appear to be making a significant difference.



As our City continues to grow at an unprecedented rate we need to look at all we do, all we will need to do and how we can best deliver value for our community.

WHY WE NEED THIS STRATEGY

This **Art and Soul** - Creative and Prosperous City Strategy provides a blueprint for Council, community and business to work together to create a thriving social, cultural and economic future for Port Phillip.

Port Phillip is a bold, liveable, caring and beautiful place. Our history and heritage remind us that we have long been Melbourne's creative playground. Arts, creativity and innovation are in our DNA. Our diversity and inclusiveness is our future.

As our City continues to grow at an unprecedented rate we need to look at all we do, all we will need to do and how we can best deliver value for our community. In a time of growth, densification, changing demographics and gentrification we could so easily lose our identity and the things we hold most dear. There is a sense of nostalgia about what has already been lost, and a sense of excitement about the future. Doing more of the same is the same as doing nothing - this is not an option.

The City's cultural ecosystem makes a powerful contribution to our identity, our happiness and wellbeing, our lifestyles and our economy. This strategy sees Council and our diverse community working together to co-create the future, while honouring the Boon Wurrung people of this place.

It is Council's role to facilitate and support this ecosystem, to partner, broker, promote and advocate, and to ensure that everyone in our community is empowered to share, create and participate equally in our cultural and economic prosperity. Our community's sense of belonging, its diversity, access and inclusivity are central to this strategy. We will need to fight harder to retain and reinvent this place that we love and for it to continue to be a significant contributor to Melbourne's world's most liveable city status.

The City's cultural ecosystem makes a powerful contribution to our identity, our happiness and wellbeing, our lifestyles and our economy. This strategy sees Council and our diverse community working together to co-create the future, while honouring the Boon Wurrung people of this place.

35 %

Creative industries account for around 35 % of economic activity in Port Phillip

It is essential that Council leverages more from current investment and takes a more active role; one that reimagines the way we collaborate with and support all our communities. We must recognise and create greater opportunities to connect the diverse range of participants in our creative economy, from large institutions and retailers to designers and makers, hobbyists and professionals, arts practitioners and arts organisations, consumers and audiences, micro-businesses and commercial industries - and we need to encourage this within a framework of sustainable practice.

It is equally important that Council works with its partners in the Federal and Victorian governments, and the private sector, to attract investments of metropolitan, regional and State significance, from the St Kilda Triangle to Fishermans Bend.

A creative and prosperous city is not a destination, it is journey, an iterative and dynamic process, where we can find space for everyone from all ages and backgrounds to contribute meaningfully to a shared vision. It will support the regeneration of our places and help us create bold futures.

This strategy is intrinsically connected to the Public Space Strategy, Environmental Sustainability Strategy and the Integrated Transport Strategy.

CHALLENGES WE FACE

The City of Port Phillip faces several long-term challenges that have been identified in the Council Plan 2017-27. These challenges also provide us with opportunities to think differently about how we respond to the pressures of urban development and growth.

We need to be more considered and proactive to ensure the social, cultural and economic wellbeing of our community is not only maintained but enhanced.

The challenges identified in the Council Plan all have a particular impact on this strategy

Population growth

We are already Victoria's most densely populated municipality, and resident growth is projected to increase by 23 per cent by 2027

This densification and the gentrification that comes with it creates tension between competing land uses, and we see this acutely in trying to manage the local impacts of festivals, events and live music.

Urbanisation

Equity and access to arts and culture for all members of our community are also affected by gentrification and increased competition for services.

For creative practitioners, entrepreneurs and small businesses, escalating land values and the rising cost of rent make it difficult for them to locate where they want to be, especially when the current land use trends favour residential developments (with ground floor retail) in the City's core commercial and mixed-use areas. This is especially true in Fishermans Bend, which has a diminishing supply of remaining industrial land, ageing industrial buildings, smaller land holdings and high land prices following its rezoning.

Transport and parking

The ease with which we can move around the municipality will play a part in where and how people chose to work and recreate.

Encouraging more people to work closer to home or transport, and clustering employment opportunities to respond to this will be important.

Conscious of all of these challenges, **Art and Soul** - Creative and Prosperous City Strategy will work to ensure development and opportunity is shared across the municipality and responds by creating an enabling environment for business, arts, culture, and innovation to partner easily with Council.

Technology evolution

Changes to technology and the digital environment are accelerating, sometimes with unanticipated consequences.

However, these could also be opportunities for new industries, creative expression and sustainable practice.

Economic conditions

The changing retail environment, the rise of the sharing economy and flexible employment models are driving an evolution of our places and the experiences people have in our City.

We also have to increasingly compete with other parts of Melbourne and Australia to attract the creative sector, arts, festivals and events.

Legislative and policy influence

There are increasing costs for the security of events and festivals due to changing public safety and security concerns.

Increasing competition for federal and state government, and private sector funds for the arts and creative sector is driving demand for increased local government support.

Visible cultural heritage and identity that is a mecca for creativity, the arts and live music

WHERE ARE WE NOW?

Port Phillip has an established social, cultural and economic heritage, with a proud tradition of supporting the arts, culture, tourism and events.

Our cultural life is highly regarded, and together with our strong history of diversity and inclusion, is an essential part of our City.

The City is a connected series of local, unique places; some globally famous, some nationally iconic, some local and anonymous. All play a crucial role in our community's prosperity. Port Phillip is a highly sought location to live, and St Kilda is the second most visited place in Victoria, with more than 3.4 million visitors per year. We are centrally located, with excellent transport links to most areas, and with a significant price advantage over the CBD.

Why is it important?

Council has invested in social, cultural and economic assets that will form a strong foundation for the future, including:

- unique and iconic locations, places and spaces that engage locals and attract visitors
- strong, contemporary local industries that support creativity, attract innovation and networks
- visible cultural heritage and identity that is a mecca for creativity, the arts and live music
- established and emerging creative industries that account for one-third of local economic activity and the highest percentage of employment in creative industries in Victoria
- a growing cluster of high tech and digital industries in South Melbourne
- active and ongoing Council support for creative industries and community organisations, including events and festivals, libraries, cultural facilities, galleries, arts development programs and funding, social enterprises, business development and tourism promotion.

Port Phillip is home to a highly educated, creative and diverse population, providing an opportunity to grow industries that can deliver future employment.

Fisherman's Bend is a catalytic opportunity for Port Phillip. The precinct will be the primary source of population and business growth in the City through the planned development of new higher density and mixed-use neighbourhoods. We are focused on making smart investments in infrastructure that will attract local investment and stimulate economic growth, and ensuring a genuinely mixed-use precinct that supports knowledge jobs, businesses that capitalise on proximity to the CBD, attractive residential development and supporting infrastructure such as regular public transport.

We will work with private and government partners to explore cultural and innovation hubs, and creative transitional use and reuse of spaces. We will also investigate how we might deliver Council services and facilities, like libraries, differently in the precinct to support creative, interactive and practical programs.

Creative industries make a significant contribution to our economy

Direct employment: 12,700 jobs

Indirect employment: 14,100 jobs

Creative industries account for around 35 per cent of economic activity in Port Phillip - $2.2 billion directly each year and $1.6 billion indirectly

Highest contribution from software development and interactive content

($1.2 billion directly, $700 million indirectly)

Significant contribution from architecture, design and visual arts, advertising and marketing

($850 million directly, $825 million indirectly)

Port Phillip has the highest concentration of creative industries employment in Victoria [1]

Port Phillip - 15% of total jobs

City of Melbourne - 9% of total jobs

Metropolitan and state - less than 5% of total jobs

Port Phillip accounts for nearly 15 per cent of Victorian creative industry jobs (but less than 4 per cent of total Victorian employment)

Council currently invests (2017/18) approximately $24 million in supporting arts, culture and economic development. Through mapping the creative ecosystem, we will seek to leverage this investment, particularly in places like South Melbourne, which already has one of the highest concentration of creative industries in Australia.

1 City of Port Phillip Creative Industries Economic Benefit Analysis Report 2013.

2 City of Port Phillip Council Plan 2017-27, including South Melbourne Market and resourcing.

LISTENING TO OUR COMMUNITY

We have listened to the community to help shape this strategy [3].

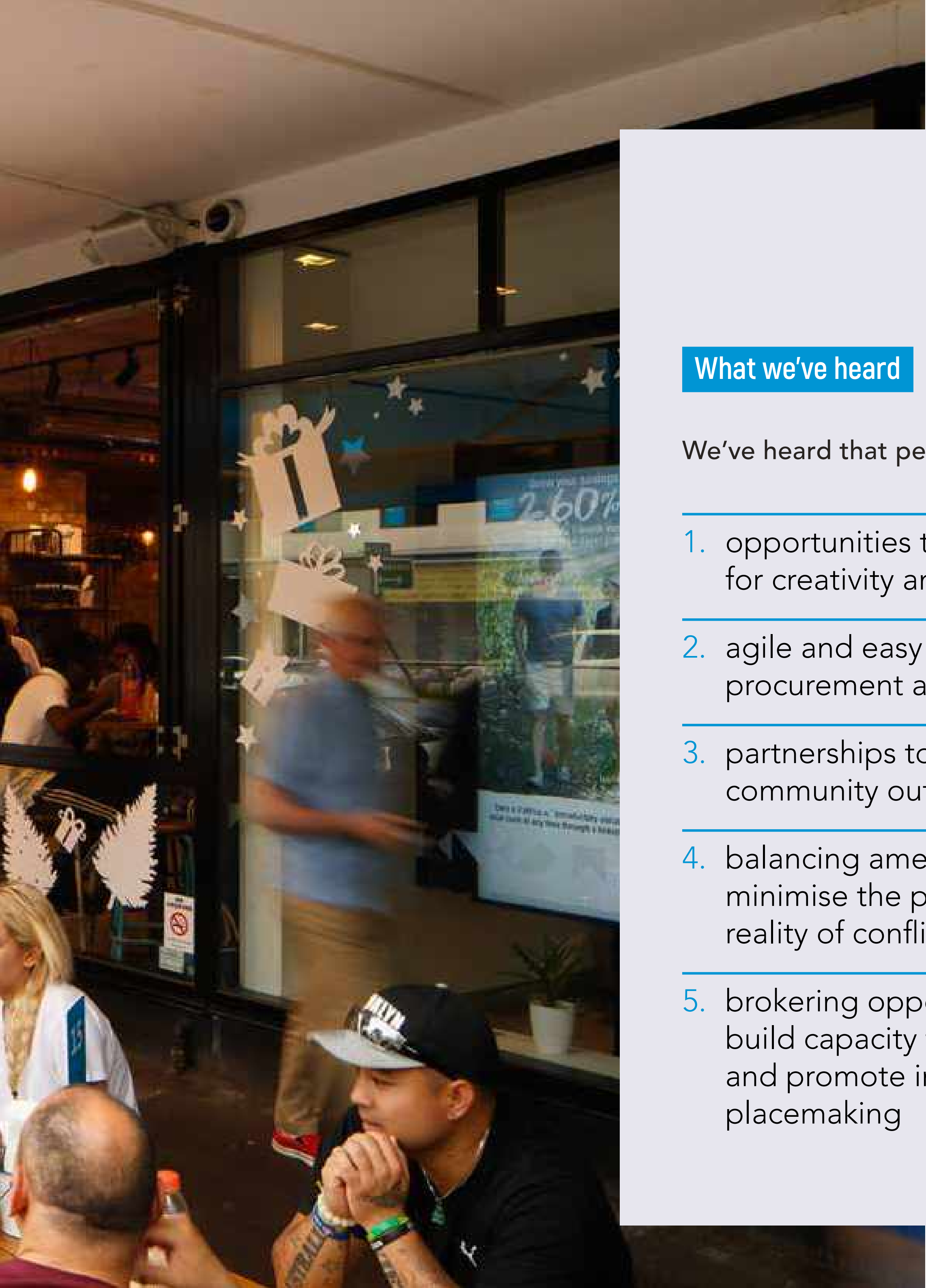
Through consultation for the 2017-27 Council Plan, The Arts Service Review Report (2016) and Creative Soundings (2017), we've listened to residents, workers, youth, students, older persons, visitors, artists, arts workers, entrepreneurs, arts organisations and centres, festivals and business. Our discussions were also informed by the technical analysis of the City of Port Phillip Economic Development Directions paper (2016), the Port Phillip City Council - 2017 Events Survey Report and the Port Phillip City Council - 2017 Events (St. Kilda Festival) Survey Report.

We have heard that our community values diverse and vibrant neighbourhood centres and the cultural and creative heritage of Port Phillip, and would like to see a better balance between activation and amenity for residents, workers and visitors.

Our community wants a more coordinated and participatory approach to supporting creative and economic activity. The creative and business sectors want clear policies to guide decision making and seamless processes for interacting with Council.

[3] Arts Service Review sector forums 2016, Economic Development Directions Paper 2016, Events Strategy, St Kilda Festival and Creative Soundings consultations 2017, Council Plan 2017-2027 consultation 2017.

Our community wants a more coordinated and participatory approach to supporting creative and economic activity.



What we've heard

We've heard that people value:

1. opportunities to develop spaces for creativity and innovation
2. agile and easy to navigate policy, procurement and permitting
3. partnerships to facilitate community outcomes
4. balancing amenity impacts to minimise the perception and reality of conflicts
5. brokering opportunities that build capacity to self-manage and promote innovative placemaking
6. ensuring accessibility, inclusivity and diversity
7. protecting and enhancing our social and cultural heritage.

Emerald Hill is home to a number of creative industries that collaborate with the community and each other to enrich and activate this cultural precinct.

In 2016, Phillip Adams Ballet Lab established their new company headquarters and studios at South Melbourne's historic Temperance Hall. This now offers international artists and local creatives an inspiring heritage space for creation, participation and engagement.

OUR PARTNERS

To achieve a creative and prosperous Port Phillip we need to work in partnership with others.

The community, state government partners, the arts and creative industry sector, and private industry all play a critical role in our success.

Our city is affected by federal and state legislation and policies, the actions of neighbouring councils, the businesses and organisations that operate within our boundaries and everyone who lives, works and visits here.

This presents both opportunities and challenges for delivering the actions in this Strategy. In some instances, we will have direct control over specific actions, especially those relating directly to Council operations. In other cases, we will advocate to other levels of government for change and leverage opportunities to benefit our community.

We will also work with organisations, businesses and individuals showing leadership to implement solutions to ensure a sustainable creative sector.

- community
- Victorian Government particularly, Creative Victoria and Tourism Victoria
- our neighbouring councils
- arts and creative sector organisations and practitioners
- live music industry
- games industry.

Photo: Space2b, Imagining Laneways, 2017

Council's role

Trusted service provider
Providing high quality assets and services that are managed sustainably to ensure we minimise environmental impact.

Trusted partner and broker
Cultivating relationships and partnerships with state, federal and other local governments, and the creative industries sector to maximise the community benefit of our activities.

Trusted advisor and agent
Working to achieve the Council Plan vision and strategic directions through delivering programs that promote the creative industries and employment.

Trusted steward
Being a sector leader through our own operations, festivals and events.

Monitoring and reporting
Monitoring and reporting against the key measures outlined in this Strategy to share our progress and identify opportunity areas for further improvement.

Council will work with the community and our partners to achieve this strategy, through:

- providing direct support for the arts, cultural and creative sectors through funding, promotion and facilities
- attracting investment from other levels of government, private and not-for-profit sectors
- trialing new policies and streamlining regulatory processes to encourage investment and activity in our City and improve local amenity
- brokering and facilitating partnerships to build a strong, resilient and sustainable ecosystem
- connecting, communicating and co-creating with our communities for place development, accessibility and sustainable activation to build future economic, cultural and social benefit.

WHAT WILL BE DIFFERENT

Our vision is

To be a City that is beautiful, liveable, caring, inviting, bold and real.

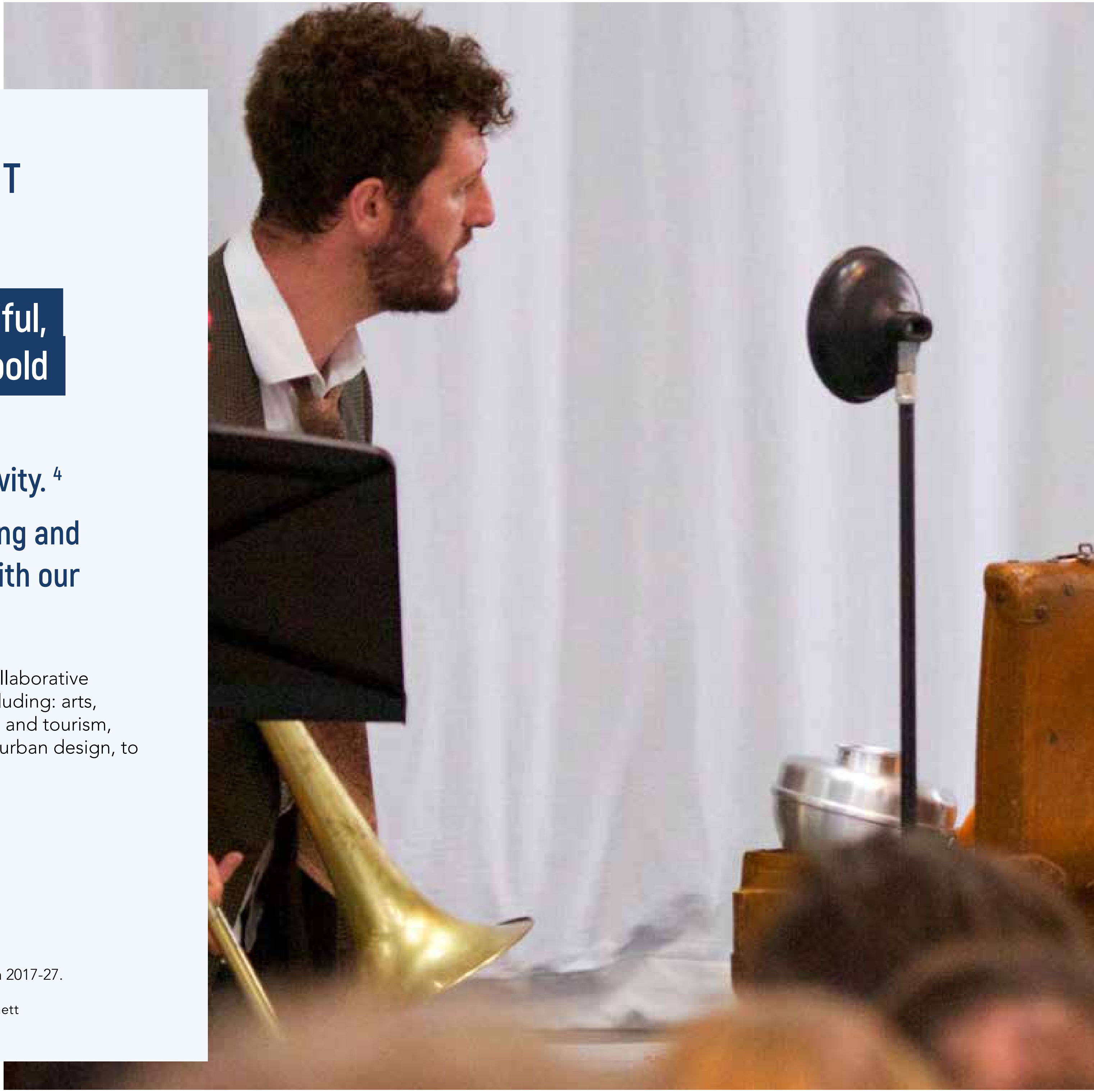
We thrive by harnessing creativity. [4]

We will realise this by facilitating and co-creating these outcomes with our community and partners.

This Strategy embeds cultural change and collaborative actions across a range of Council services including: arts, culture and heritage, economic development and tourism, festivals, libraries, markets, city planning and urban design, to deliver on these outcomes.

[4] Strategic Direction 5 - We Are Port Phillip, Council Plan 2017-27.

Photo right: Ossicle Duo, Natural order 2017, photo Greg Barnett



Outcome 1

A City of dynamic and distinctive places and precincts

Port Phillip is a City of dynamic neighbourhoods. Much more than just local shopping strips, our precincts provide opportunities to be inclusive and welcome all residents and visitors. They are key public spaces that are increasingly contested in our growing City.

The Port Phillip of the future will see enhanced prosperity for shopping precincts.

Each precinct has its own character, which is the focal point for local retail activity, entertainment, hospitality, community and cultural activities, social connection, small businesses, entrepreneurs and start-ups.

We know that the retail sector is challenged by changing shopping patterns, in particular the rise of online retail and new suburban and inner city competition.

The Port Phillip of the future will see enhanced prosperity for shopping precincts by Council working with traders and landowners to build on the unique character, vitality and retail offer of each precinct, by managing growth, protecting heritage values and creating 10-minute walking neighbourhoods.

Using a place-based approach will ensure the empowerment of communities within these precincts as we collaborate and co-create our future.

Tourism makes a particularly significant contribution to our local economy and lifestyle by providing local jobs, sustaining our vibrant hospitality sector and ensuring a reliable and regular public transport service.

A focus for Council is working with business to grow the visitor economy while maintaining the City's diversity and accessibility, and ensuring the safety and quality of life for our residents.

Port Phillip is defined by its commitment to diversity and inclusion. Our investment in the Victorian Pride Centre, to be built in Fitzroy Street, St Kilda, will deliver enduring benefits to Victoria's LGBTIQ community and to local residents, traders, artists and visitors. The Centre is expected to deliver $46 million of socioeconomic benefits to the precinct over the next 20 years, including:

- new local jobs at the Centre and during construction
- an increase in daytime trade for retailers from new staff and volunteers
- an increase in visitors, tourists and shoppers drawn to a safe and vibrant destination
- a more diverse mix of retail and other businesses for locals and visitors because of interest in and activities at the Pride Centre.

Measuring progress

OUTCOME	MEASURE	2015/16 RESULT	2018/19 TARGET	2020/21 TARGET
A City of dynamic and distinctive retail precincts and places	Residents who are satisfied that their local area has a good range of business services and local conveniences	94 %	90 %	90 %
	Visitors to the City of Port Phillip [5]	3.4 m	3.5 m	3.6 m
	Residents who are satisfied with visitor management	92 %	>90 %	>90 %

[5] Includes overnight stays, daytrip visitation (including visitors within 50km and people attending festivals).

What needs to be done and how we will do it

	ACTIONS	2018/19	2019/20	YEARS 3 AND 4
1	Work collaboratively with local place users to co-create and implement four-year plans to revitalize three priority places: Fitzroy Street, Waterfront Place and Clarendon Street			
2	Develop and implement an activation program including trials of policies that streamline Council processes to promote street activation, accessibility, a more agile response from the organisation and opportunities to try new ideas			
3	Engage and collaborate with local industry associations, trader associations, real estate agents, local communities and community organisations to co-create (and co-contribute to) place activation and governance			
4	Continue to support and renew existing special rates for marketing and development, and explore opportunities for South Melbourne			
5	Develop a strategic vision and business case for the South Melbourne Market to develop it as a place anchor, shape future investment, and plan for and deliver renewal works			
6	Leverage the opportunity of the Balaclava Station tram stop upgrade and the proposed supermarket and Marlborough Street carpark redevelopments to improve the public realm in Carlisle Street retail precinct			
7	Work with inner Melbourne councils to develop consistent and progressive approaches to better manage licensed premises and entertainment precincts			
8	Develop a process to require developers to work with Council to commission art on hoardings			

Working with business to grow the visitor economy while maintaining the City's diversity and accessibility, and ensuring the safety and quality of life for our residents

Outcome 2

A prosperous City that connects and grows business

The economic future of Port Phillip is exciting.

Competitively situated with a high growth population, centrality, and offering cheaper options than the CDB, Port Phillip is home to a unique mix of successful businesses, from start-ups and sole traders to large multinational corporations.

A strong, future-facing local economy will be nurtured by robust creative and cultural industries, where dynamic new sustainable processes, products, services and ideas are formed. Innovation and creativity drive prosperity.

There are currently more than 19,000 active businesses in our City generating over 87,000 local jobs. Sectors include knowledge-based and creative industries such as professional and scientific services, technology, health, education, arts and media, and customer and visitor-focused businesses such as retail, hospitality and accommodation.

An agile and diverse local economy provides more opportunity for our community to work locally in high quality employment, better product and service offerings, and vibrant precincts where residents can connect and feel a sense of belonging.

There are established and growing arts, creative and innovation industry clusters in South and Port Melbourne. The Game Developers Association of Australia is based in Port Phillip at The Arcade, Australia's first not-for-profit, collaborative work space specifically for developers and creative companies using gaming methodologies and technologies.

There are also other emerging arts and creative industries clusters such as Williams Street, Balaclava.

Attracting more creative enterprises, and more digital and technology entrepreneurs, small businesses and start-ups will drive further innovation and investment.

The creative industry ecosystem is a mix of creative enterprises including:

- traditional and emerging
- commercial and not-for-profit
- participatory, amateur, student and professional
- micro, bespoke and mass-appeal
- the individual artist and the peak organisation.

Measuring progress

OUTCOME	MEASURE	2015/16 RESULT	2018/19 TARGET	2020/21 TARGET
A prosperous City that connects and grows business	People employed in the top five industries as a proportion of total employment in the municipality	-	>54 %	56 %

We are committed to fostering the right conditions to sustain a thriving creative ecosystem.

One critical condition for this is access to affordable, suitable space for the creative sector. Space is at a premium in Port Phillip, and increasingly creatives are looking outside our City to find suitable development, rehearsal and presentation spaces. Temporary spaces to test ideas, innovate and activate places are also in demand from the business, cultural and creative sectors.

Council can directly influence the environment for investment and growth. Local policy, planning and regulatory frameworks influence business innovation, investment and industry growth through land use permissions, development approvals, providing appropriate supporting infrastructure, marketing local precincts, and tourism promotion.

Council's #exploreportphillip destination marketing campaign featured more than 90 local businesses and attracted more than one million engagements through Facebook in its first month.

The full digital campaign uses video and images, and targets social media influencers Broadsheet and Melbourne Girl to promote our City and reach our audience in a creative and engaging way.

What needs to be done and how we will do it

ACTIONS		2018/19	2019/20	YEARS 3 AND 4
9	Map the innovation and creative ecosystem including infrastructure assets such as buildings, creative spaces, studios, work spaces and social assets such as community groups, school communities, not for profit organisations, businesses, philanthropic and interest groups			
10	Develop and implement a four-year action plan in consultation with industry and the community, addressing affordability and the availability of diverse space for entrepreneurs and start-ups, clustering and Council's role in securing and leveraging investment opportunities, including opportunities during the transition of Fishermans Bend. The innovation and creative ecosystem mapping will provide the basis for funding these activities in years three and beyond			
11	Work with inner city councils and the Victorian Government to protect, promote and grow the local creative and innovation economy			
12	Explore a range of planning controls to protect and advance South Melbourne as a creative industries cluster and innovation district			
13	Develop a Game Action Plan that leverages existing investment and activity to position the City of Port Phillip as the games capital of Victoria			
14	Recognising the value and vibrancy they bring to the City of Port Phillip, identify, connect and regularly engage with creative clusters and emerging industries to understand and support their needs and future directions, and encourage collaboration, networking opportunities, industry experience and future employment			
15	Explore opportunities to facilitate Fishermans Bend as a creative innovation district that brings together diverse creative practitioners, entrepreneurs and businesses			

ACTIONS		2018/19	2019/20	YEARS 3 AND 4
16	Plan for adequate employment land across the City to facilitate local jobs and support creative industries			
17	Publish a Creative Sector Prospectus that will help potential investors and expanding businesses build their business plans and strengthen Port Phillip as a key player in Melbourne's creative ecosystem			
18	Develop and implement an advisory panel to connect and promote key creative clusters and strategic investment into the creative sector			
19	Develop and implement a marketing and communications plan to promote the local environment, attractions and events to locals and visitors			
20	Connect community and volunteer organisations such as the Port Melbourne Waterfront Welcomers with the broader visitor economy			

Outcome 3

Arts, culture and creative expression are part of everyday life.

Arts and culture are part of what makes our City unique.

Our inclusive definition of arts and culture includes cultural heritage, literature, contemporary art and performance, live music, digital and screen media, arts, libraries, festivals and events.

Our goal has always been to encourage diverse, inclusive participation and access to arts and culture, and we continue to have an explicit commitment to Indigenous art and its cultural celebration and participation. This includes working closely with partner organisations to deliver and enhance the outcomes from this Strategy.

According to the Australia Council's 2016 National Arts Participation Survey, arts are critical to social cohesion and reflect Australia's diversity, shape and express identity and create empathy, understanding and connection.

In 2016, the Victorian Government launched **Creative State 2016-2020**, which outlines the importance of the creative industries to the economy and to social connectedness. Artists are fundamental to the creative industries as important chroniclers and interpreters of local environments, communities and experiences.

Libraries are also an important community asset and hub that can support emerging creative industries and that make a significant contribution to the economy in their own right. Our objective is to provide an innovative, well-resourced and effectively managed library service that supports lifelong learning, builds connections and closes the digital divide.

Continuing to invest in arts and cultural participation and learning through libraries, community centres, exhibition and performance spaces, heritage programs, public art and grants will ensure the ongoing social and economic contribution that artists make to our community.

The City of Port Phillip has a dynamic music scene that could be better supported by a Live Music Action Plan incorporating all facets of the industry - from emerging to professional - and Council's role in facilitating, connecting and showcasing our City's talent.

Festivals and events have also been a cornerstone of our commitment to arts and culture. We need to ensure that they build community engagement and participation, economic development and visitation, while maintaining local liveability and amenity.

We must take all opportunities to rethink the allocation of Council resources and the use of our Council-owned assets. We need to explore greater independence in the production of our festivals and events to attract greater private and public investment, and to broaden activation across the City and the calendar year. We must also regularly review the scale, nature and impact of events to maximise the positive community benefits and minimise potential disruption.

Festivals and events have been a cornerstone of our commitment to arts and culture.

We need to ensure that they build community engagement and participation, economic development and visitation, while maintaining local liveability and amenity.

Measuring progress

OUTCOME	MEASURE	2015/16 RESULT	2018/19 TARGET	2020/21 TARGET
Arts, culture and creative expression are part of everyday life	Resident satisfaction with delivery of arts and festivals	97 %	90 %	90 %
	Residents who agree they have the opportunity to participate in affordable local community events and activities	90 %	92 %	95 %

In 2016, the Victorian Government launched **Creative State 2016-2020**, which outlines the importance of the creative industries to the economy and to social connectedness.

What needs to be done and how we will do it

	ACTIONS	2018/19	2019/20	YEARS 3 AND 4
21	Support the community to plan and produce their own festivals, events and cultural projects			
22	Develop and deliver a Live Music Action Plan, working closely with musicians, venues, events and audiences of all ages and backgrounds, to better support, facilitate, regulate and grow a dynamic live music scene, including consideration of Live N Local			
23	Implement a new, competitive multi year grants program for key arts organisations, and retain them in the City of Port Phillip and strengthen their capacity to attract funding			
24	Develop strategic partnerships with organisations whose charter addresses inclusion and diversity across the arts and creative industries, for example Arts Access and Multicultural Arts Victoria			
25	In the first year of the Strategy, engage with the current boards of Gasworks and Linden and the advisory panel for the Art and Soul Strategy (Action 18) to examine ways to better leverage Council's investment in these facilities and, following this engagement, recommend options to Council to ensure maximum access for local arts organisations, foster local arts development, attract funding from other sources, increase opportunities for community participation and promote Port Phillip as a cultural destination			
26	Protect and develop the Port Phillip City Collection by acquiring, preserving and exhibiting artworks			
27	Host a forum to engage with the community about their experience of the arts and creative sector as part of a review of the Art and Soul - Creative and Prosperous City Strategy.			

	ACTIONS	2018/19	2019/20	YEARS 3 AND 4
28	Implement the Events Strategy to achieve a balanced events calendar, attract strategic opportunities, and communicate and promote what's on, to maximise access and opportunities			
29	Review and renew the St Kilda Festival three-year plan to maximise stability for, and benefits from, the event			
30	Commit to regularly reviewing and refreshing our internal events			
31	Continue to use markets, such as the Esplanade Market, as a key activation of public space, as a local asset and visitation attraction, and opportunity for local artists and creators			
32	Update and integrate the Indigenous Arts Plan, including consideration of Yalukut Weelam Ngargee Festival			
33	Continue to invest in and maintain public art in accordance with Port Phillip City Collection Policy and Council's Public Art Guidelines			
34	Develop a Library Action Plan that contributes to a creative ecosystem and responds to current and future community needs for programming, collections and emerging technology			
35	Commence planning for the future redevelopment of St Kilda Library, considering community, Council and other service requirements			

MEASURING AND REPORTING

How will we know we have been successful?

In four years' time:

1. business and creatives are saying this is the place to be to work, create and innovate
2. community is saying that Council is maximising our opportunities; that we have really thought about this and have deliberately acted in a strategic and collaborative way
3. Council's role has expanded, leveraging more from what we own and directly do, in addition to facilitating, brokering and co-creating with community to empower a sustained sector
4. baseline measures have been established through the place work, ecosystem mapping and action plans, and an evaluation framework tracks the City's progress in each of these areas
5. the City of Port Phillip is known as punching above our weight in contributing to the state's cultural economy.

OUTCOME	MEASURE	2015/16 RESULT	2018/19 TARGET	2020/21 TARGET
A City of dynamic and distinctive retail precincts and places	Residents who are satisfied that their local area has a good range of business services and local conveniences	94 %	90 %	90 %
	Visitors to the City of Port Phillip [6]	3.4 m	3.5 m	3.6 m
	Residents who are satisfied with visitor management	92 %	>90 %	>90 %
A prosperous City that connects and grows business	People employed in the top five industries as a proportion of total employment in the municipality [7]	-	>54 %	56 %
Arts, culture and creative expression are part of everyday life	Resident satisfaction with delivery of arts and festivals	97 %	90 %	90 %
	Residents who agree they have the opportunity to participate in affordable local community events and activities	90 %	92 %	95 %

These measures do not comprehensively map progress against the actions of the Strategy. Through placemaking initiatives, CLUE data [8], creative ecosystem mapping and the development of action plans, other measures will be developed.

[6] Includes overnight stays, daytrip visitation (including visitors within 50 km and people attending festivals).

[7] In 2016/17 the top five industries in the City of Port Phillip were: Professional, scientific, technical services; construction; finance and insurance; accommodation and food services; and retail.

[8] Census Land Use Employment.

Artists are fundamental to the creative industries as important chroniclers and interpreters of local environments, communities and experiences.

APPENDIX

Actions and financial overview

STRATEGY	ACTIONS	ESTIMATED COST (OVER FOUR YEARS)
Enhance the prosperity and sociability of our shopping precincts and the South Melbourne Market by adopting a place-based approach	1. Work collaboratively with local place users to co-create and implement four-year plans to revitalize three priority places: Fitzroy Street , Waterfront Place and Clarendon Street	$1.55 m
	2. Develop and implement an activation program including trials of policies that streamline Council processes to promote street activation, accessibility, a more agile response from the organisation and opportunities to try new ideas	
	3. Engage and collaborate with local industry associations,trader associations, real estate agents, local communities and community organisations to co-create (and co-contribute to) place activation and governance	
	4. Continue to support and renew existing special rates for marketing and development and explore opportunities for South Melbourne	
	5. Develop a strategic vision and business case for the South Melbourne Market to develop it as a place anchor, shape future investment, and plan for and deliver renewal works	$0.1 m
	6. Leverage the opportunity of the proposed supermarket redevelopment, tram stop upgrade and Marlborough Street to improve the public realm in Carlisle Street retail precinct	$0.15 m
Collaborating to ensure our entertainment and local economies thrive, while ensuring safe, enjoyable places for everyone	7. Work with inner Melbourne councils to develop consistent and progressive approaches to better manage licensed premises and entertainment precincts	
	8. Develop a process to require developers to work with Council to commission art on hoardings	$0.03 m

STRATEGY	ACTIONS	ESTIMATED COST (OVER FOUR YEARS)
Foster the knowledge economy and creative industry clusters	9. Map the innovation and creative ecosystem including infrastructure assets such as buildings, creative spaces, studios, work spaces and social assets such as community groups, school communities, not for profit organisations, businesses, philanthropic and interest groups	$0.05 m
	10. Develop and implement a four-year action plan in consultation with industry and the community addressing affordability and availability of space for entrepreneurs and start-ups, clustering and Council's role in securing and leveraging investment opportunities, including opportunities during the transition of Fishermans Bend. The innovation and creative ecosystem mapping will provide the basis for funding these activities in years 3 and beyond	
	11. Work with inner city councils and the Victorian Government to protect, promote and grow the local creative and innovation economy	
	12. Explore a range of planning controls to protect and advance South Melbourne as a creative industries cluster and innovation district	
	13. Develop a Game Action Plan that leverages existing investment and activity to position the City of Port Phillip as the games capital of Victoria	$0.04 m
	14. Recognising the value and vibrancy they bring to the City of Port Phillip, identify, connect and regularly engage with creative clusters and emerging industries to understand and support their needs and future directions, and encourage collaboration, networking opportunities, industry experience and future employment	
	15. Explore opportunities to facilitate Fishermans Bend as a creative innovation district that brings together diverse creative practitioners, entrepreneurs and businesses	
	16. Plan for adequate employment land across the City to facilitate local jobs and support creative industries	
Facilitate innovation and investment that enables businesses to startup, connect and grow	17. Publish a Creative Sector Prospectus that will help potential investors and expanding businesses build their business plans and strengthen Port Phillip as a key player in Melbourne's creative ecosystem	$0.02 m
	18. Develop and implement an advisory panel to connect and promote key creative clusters and strategic investment into the creative sector	

STRATEGY	ACTIONS	ESTIMATED COST (OVER FOUR YEARS)
Promote Port Phillip as a visitor destination in a way that respects local amenity and our environment	19. Develop and implement a marketing and communications plan to promote the local environment, attractions and events to locals and visitors	
	20. Connect community and volunteer organisations such as the Port Melbourne Waterfront Welcomers with the broader visitor economy	
Promote and celebrate community participation in art, music, culture heritage and festivals	21. Support the community to plan and produce their own festivals, events and cultural projects	$0.120 m
	22. Develop and deliver a Live Music Action Plan, working closely with musicians, venues, events and audiences of all ages and backgrounds, to better support, facilitate, regulate and grow a dynamic live music scene, including consideration of Live N Local	$0.230 m
	23. Implement a new, competitive multiyear grants program for key arts organisations to meet community arts objectives, and retain them in the City of Port Phillip and strengthen their capacity to attract funding	$0.720 m
	24. Develop strategic partnerships with organisations whose charter addresses inclusion and diversity across the arts and creative industries, for example Arts Access and Multicultural Arts Victoria	
	25. In the first year of the Strategy, engage with the current boards of Gasworks and Linden, and the Art and Soul Strategy Advisory Panel (Action 18) to examine ways to better leverage Council's investment in these facilities and, following this engagement, recommend options to Council to, ensure maximum access for local arts organisations, foster local arts development, attract funding from other sources, increase opportunities for community participation and promote Port Phillip as a cultural destination	
	26. Protect and develop the Port Phillip City Collection by acquiring, preserving and exhibiting artworks	$0.12 m
	27. Host a forum to engage with the community about their experience of the arts and creative sector as part of a review of the Art and Soul - Creative and Prosperous City Strategy	

STRATEGY	ACTIONS	ESTIMATED COST (OVER FOUR YEARS)
Activate our public spaces and streets through art and cultural events	28. Implement the Events Strategy to achieve a balanced events calendar, attract strategic opportunities, and communicate, and promote what's on, to maximise access and opportunities	
	29. Review and renew the St Kilda Festival three-year plan to maximise stability for, and benefits from, the event	
	30. Commit to regularly reviewing and refreshing our internal events	
	31. Continue to use markets, such as the Esplanade Market, as a key activation of public space, as a local asset and visitation attraction, and opportunity for local artists and creators	
	32. Update and integrate the Indigenous Arts Plan, including consideration of Yalukut Weelam Ngargee Festival	$0.02 m
	33. Continue to invest and maintain public art in accordance with Port Phillip City Collection Policy and Council's Public Art Guidelines	
Modernise our library services and spaces to support inclusive, creative opportunities and learning outcomes	34. Develop a Library Action Plan that contributes to a creative ecosystem and responds to current and future community needs for programming, collections and emerging technology	$0.05 m
	35. Commence planning for the future redevelopment of St Kilda Library, considering community, accommodation and other service requirements	$0.15 m

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Australian Rainfall & Runoff

A GUIDE TO FLOOD ESTIMATION

BOOK 9 - RUNOFF IN URBAN AREAS

Australian Government

ENGINEERS AUSTRALIA

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ISBN 978-1-925848-36-6

How to reference this book:
Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia), 2019.

How to reference Book 9: Runoff in Urban Areas:
Coombes, P., and Roso, S. (Editors), 2019 Runoff in Urban Areas, Book 9 in Australian Rainfall and Runoff - A Guide to Flood Estimation, Commonwealth of Australia, © Commonwealth of Australia (Geoscience Australia), 2019.

PREFACE

Since its first publication in 1958, Australian Rainfall and Runoff (ARR) has remained one of the most influential and widely used guidelines published by Engineers Australia (EA). The 3rd edition, published in 1987, retained the same level of national and international acclaim as its predecessors.

With nationwide applicability, balancing the varied climates of Australia, the information and the approaches presented in Australian Rainfall and Runoff are essential for policy decisions and projects involving:

- infrastructure such as roads, rail, airports, bridges, dams, stormwater and sewer systems;
- town planning;
- mining;
- developing flood management plans for urban and rural communities;
- flood warnings and flood emergency management;
- operation of regulated river systems; and
- prediction of extreme flood levels.

However, many of the practices recommended in the 1987 edition of ARR have become outdated, and no longer represent industry best practice. This fact, coupled with the greater understanding of climate and flood hydrology derived from the larger data sets now available to us, has provided the primary impetus for revising these guidelines. It is hoped that this revision will lead to improved design practice, which will allow better management, policy and planning decisions to be made.

One of the major responsibilities of the National Committee on Water Engineering of Engineers Australia is the periodic revision of ARR. While the NCWE had long identified the need to update ARR it had become apparent by 2002 that even with a piecemeal approach the task could not be carried out without significant financial support. In 2008 the revision of ARR was identified as a priority in the National Adaptation Framework for Climate Change which was endorsed by the Council of Australian Governments.

In addition to the update, 21 projects were identified with the aim of filling knowledge gaps. Funding for Stages 1 and 2 of the ARR revision projects were provided by the now Department of the Environment. Stage 3 was funded by Geoscience Australia. Funding for Stages 2 and 3 of Project 1 (Development of Intensity-Frequency-Duration information across Australia) has been provided by the Bureau of Meteorology. The outcomes of the projects assisted the ARR Editorial Team with the compiling and writing of chapters in the revised ARR. Steering and Technical Committees were established to assist the ARR Editorial Team in guiding the projects to achieve desired outcomes.

Assoc Prof James Ball
ARR Editor

Mark Babister
Chair Technical Committee for
ARR Revision Projects

ARR Technical Committee:

Chair: Mark Babister
Members:
Associate Professor James Ball
Professor George Kuczera
Professor Martin Lambert
Associate Professor Rory Nathan
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Associate Editors for Book 9 - Runoff in Urban Areas

Peter Coombes
Steve Roso

Editorial assistance: Mikayla Ward

Status of this document

This document is a living document and will be regularly updated in the future.

In development of this guidance, and discussed in Book 1 of ARR 1987, it was recognised that knowledge and information availability is not fixed and that future research and applications will develop new techniques and information. This is particularly relevant in applications where techniques have been extrapolated from the region of their development to other regions and where efforts should be made to reduce large uncertainties in current estimates of design flood characteristics.

Therefore, where circumstances warrant, designers have a duty to use other procedures and design information more appropriate for their design flood problem. The Editorial team of this edition of Australian Rainfall and Runoff believe that the use of new or improved procedures should be encouraged, especially where these are more appropriate than the methods described in this publication.

Care should be taken when combining inputs derived using ARR 1987 and methods described in this document.

What is new in ARR 2019?

Geoscience Australia, on behalf of the Australian Government, asked the National Committee on Water Engineers (NCWE) - a specialist committee of Engineers Australia - to continue overseeing the technical direction of ARR. ARR's success comes from practitioners and researchers driving its development; and the NCWE is the appropriate organisation to oversee this work. The NCWE has formed a sub-committee to lead the ongoing management and development of ARR for the benefit of the Australian community and the profession. The current membership of the ARR management subcommittee includes Mark Babister, Robin Connolly, Rory Nathan and Bill Weeks.

The ARR team have been working hard on finalising ARR since it was released in 2016. The team has received a lot of feedback from industry and practitioners, ranging from substantial feedback to minor typographical errors. Much of this feedback has now been addressed. Where a decision has been made not to address the feedback, advice has been provided as to why this was the case.

A new version of ARR is now available. ARR 2019 is a result of extensive consultation and feedback from practitioners. Noteworthy updates include the completion of Book 9, reflection of current climate change practice and improvements to user experience, including the availability of the document as a PDF.

Key updates in ARR 2019

Update	ARR 2016	ARR 2019
Book 9	Available as “rough” draft	Peer reviewed and completed
Guideline formats	Epub version Web-based version	Following practitioner feedback, a pdf version of ARR 2019 is now available
User experience	Limited functionality in web-based version	Additional pdf format available
Climate change	Reflected best practice as of 2016 Climate Change policies	Updated to reflect current practice
PMF chapter	Updated from the guidance provided in 1998 to include current best practice	Minor edits and reflects differences required for use in dam studies and floodplain management
Examples		Examples included for Book 9
Figures		Updated reflecting practitioner feedback

As of May 2019, this version is considered to be final.

BOOK 9

Runoff in Urban Areas

Runoff in Urban Areas

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Chapter 1. Introduction

Peter Coombes, Steve Roso

Chapter Status	Final
Date last updated	14/5/2019

1.1. Introduction

There have been profound changes to the science and practice of urban hydrology and stormwater management since the last edition of Australian Rainfall and Runoff (ARR) published in 1987 (Pilgrim, 1987). During this period analysis methods have evolved from use of the slide rule to the computer age and beyond. The revision of ARR has aimed for an evidence based approach that incorporates 30 years of additional data, science and knowledge. This includes a move away from simple design rainfall burst event methods towards Ensemble and Monte Carlo approaches to better capture variability. There is less reliance on the rational method, more data available, new Intensity Frequency Duration (IFD) data and better flow estimates for ungauged catchments (refer to Book 3, Chapter 3).

There are new challenges and gaps in knowledge about urban hydrology that is part of an increasingly complex urban water cycle and town planning processes. The designer now aims to retain stormwater within urban landscapes, manage stormwater quality, maximize the potential of the stormwater resource and to slow flows into receiving waterways. Australian Rainfall and Runoff now employs Australian data which ensures that urban designers can better represent real local systems and address these new challenges.

Wherever possible this version of ARR provides information about the uncertainty of methods and inputs. This will better equip urban designers to understand risks in the urban environment. The Urban Book (Book 9 – Runoff in Urban Areas) has been constructed to utilise and complement the broader set of tools in ARR used to manage the water cycle. The over-arching objective of this book is to provide revised and up-to-date guidance for analysis and management of urban stormwater runoff.

1.1.1. Urban Stormwater Runoff

Urban stormwater runoff and associated stormwater management responses are part of a linked urban water cycle which includes stormwater quantity and quality, water supply, sewerage, urban form and waterways. Urban runoff has hydrologic characteristics such as flow rate and volume which differ considerably from natural and rural systems. As a result there is significant potential for impacts on natural processes and on society. These include nuisance flooding, disruption of traffic and business functions, flood disasters and damage, stream erosion, and destruction of natural waterway form and function. These water balance and linked systems issues are discussed in Book 9, Chapter 2 and Book 9, Chapter 3.

Whilst urban runoff can be a problem to be managed, it is also a potential opportunity to be exploited if viewed as an environmental resource. There are urban runoff design and investigation techniques that can be used to achieve better economic, social and environmental outcomes. The discussion of managing urban stormwater runoff in this Book also intersects with managing stormwater quality which is addressed in a number of guidelines throughout Australia such as Australian Runoff Quality. Many of these practices are introduced in this book.

1.1.2. Stormwater Management Infrastructure

Urban runoff was traditionally managed using networks of pipes and channels to convey stormwater rapidly away from urban areas. The definition of drainage has now broadened to incorporate both conveyance and management of stormwater volumes via a wider range of measures, including natural and man-made infrastructure to restore natural flood behavior where possible.

Two classes of stormwater management infrastructure are described in this book; volume management (Book 9, Chapter 4) and conveyance systems (Book 9, Chapter 5).

Volume management includes measures that can store runoff for a period of time, promote infiltration and store harvested stormwater for beneficial uses. Modern best practice aims to achieve a range of hydrologic and water quality objectives within these facilities. Volume management is a key element of stormwater management and flood control which has increased in importance and will continue to evolve into the future. Stormwater volume controls have been subject to substantial and increased research effort since 1987.

Conveyance systems allow runoff to pass through urban areas and provide connections through the catchment. Conveyance systems can be classified in different ways, for example underground versus surface and trunk versus non-trunk. The traditional description of urban stormwater management involves a minor and major event management philosophy where the minor concept involves pipe drainage networks and the major concept addresses flood events that are conveyed as surface flows. A minor versus major design concept is also still relevant in order to efficiently convey urban runoff while mitigating nuisance, damage and disaster. Regardless, the focus for conveyance should be careful management of surface flows and restoration of natural flow behaviour wherever possible.

Volume management facilities and conveyance systems are interlinked to form a network with volume management most often at discrete locations connected by more linear conveyance systems. Both conveyance and volume management can exist at multiple scales from lot scale (source control) to regional scale (end of pipe). In the context of Book 9, natural and semi-natural urban waterways are considered part of the network of conveyance and storage infrastructure.

1.1.3. Modelling

The unique characteristics of urban modelling include measurement and assessment of the hydrologic and hydraulic effect of impervious surfaces, conveyance systems and hydraulic structures including volume management facilities. Analysis of urban areas involves data intensive and complex processes. There is a need for complex computing tasks aided by software to assist with modern investigation. A wide range of computer software is available to the designer. Hand calculations are generally unsuitable for most urban applications other than basic checks and approximations.

Choice of computer software such as urban hydrology and hydraulic models depends on a number of factors including the spatial scale of the investigation area and the magnitude of the floods of interest. Book 9, Chapter 6 provides guidance on how to pick a short list of suitable models based on these factors. The aim should be to best match the selected model with the type of investigation being undertaken.

Once a suitable model has been selected, the challenge is to ensure the model is applied correctly. Book 9, Chapter 6 does not provide guidance on how to use specific modelling software and instead describes the urban modelling process in a software independent manner. Some models can be simplified and the physical resolution reduced, depending on the spatial scale of the investigation and experience of the modelling team. Urban modelling frameworks are described providing guidance for key segments of urban catchments from the behaviour of land uses within sub-catchments that flow to inlet structures, through urban stormwater networks, and into the receiving waterway.

1.1.4. Structure and Purpose of this Book

This Urban Book is a guideline rather than a standard or recipe as Australia is too diverse and the urban practice involves increasing complex combinations of solutions. A primary audience of this book includes readers from multiple disciplines and early career urban designers.

This book focusses on the entire spectrum of runoff events and potential flooding outcomes. Book 9, Chapter 2 provides an overview of the characteristics of urban hydrology. Book 9, Chapter 3 introduces some of the key concepts in urban stormwater management as part of an urban water cycle and urban systems. It is built around Book 9, Chapter 4 and Book 9, Chapter 5 which describe the key stormwater design elements of volume management and conveyance. Book 9, Chapter 6 provides guidance on urban modelling including model selection and application. Two case studies are also provided in Book 9, Chapter 6.

1.1.5. The Future

There is a need to allow changes in interpretation of the stormwater components of this book to accommodate contemporary and integrated approaches to water cycle management in urban areas, which starts with the integration of land and water planning across time horizons and spatial scales. This guidance encourages advances in urban water cycle management, and expects advances in science and professional practice over the next 30 years. There is an enabling framework of guidance in all ARR Books, which encourages and permits advanced analysis techniques and innovative designs. The guidance in ARR does not intend to hold back advances in analysis of integrated solutions.

In some jurisdictions, there has been disproportionate focus on mitigating nuisance in the minor system at the expense of a proper analysis of the major system. Replacement of the minor or major drainage approach with the relativity of mitigating nuisance or disaster may be a future innovation of stormwater management. Allowing space for a major system can help manage large events and provides flexibility for adapting stormwater management to incorporate integrated systems and better management of nuisance.

It is expected that policy frameworks will evolve to further integrate land and water management with design processes at all spatial scales from local to regional and which also applies to urban renewal and asset renewal or replacement choices. Future design methods fomakr integrated solutions are likely to include most of the variability of real rainfall events by using continuous simulation, Monte Carlo frameworks and techniques that consider complete storms, frequency of rainfall volumes and the spatial variability of events.

Good urban runoff management will only be achieved when it is integrated with the complete management of the urban water cycle and includes proper consideration of runoff quality. The guidance in the Urban Book must be linked with Australian Runoff Quality (ARQ) (Engineers Australia, 2006) and other water quality guidelines so that urban stormwater management is an integrated part of the urban water cycle and avoids duplication of infrastructure. An integrated approach to stormwater management should avoid installation of infrastructure to meet separate objectives that, in combination, create unexpected diminished performance. There is a need to consider integrated approaches for future urban water management. Integrated systems have the capacity to produce solutions that respond to multiple objectives including economic, social and environmental criteria.

This Book on Runoff in Urban Areas is part of the evolving story of stormwater management and aims to encourage innovation into the future.

1.2. References

Engineers Australia (2006), Australian Runoff Quality - a guide to Water Sensitive Urban Design, Wong, T.H.F. (Editor-in-Chief), Barton.

Pilgrim, DH (ed) (1987) Australian Rainfall and Runoff - A Guide to Flood Estimation, Institution of Engineers, Australia, Barton, ACT, 1987.

Chapter 2. Aspects of Urban Hydrology

Anthony Ladson

With contributions from the Book 9 editors (Peter Coombes and Steve Roso)

Chapter Status	Final
Date last updated	14/5/2019

2.1. The Urban Hydrologic Cycle

Hydrologic analysis for both urban and non-urban situations begins with the water cycle. In rural areas, hydrologists are concerned with catchment inputs, especially rainfall, outputs such as evaporation and runoff, and water storage. The fundamental processes are the same for urban catchments, however, development profoundly changes water storages and flows (Figure 9.2.1):

- Inputs increase as mains water is supplied to urban catchments along with rainfall.
- Less water is stored within urban catchments. Paved surfaces replace much of the landscape to diminish infiltration of rainfall into soil profiles. Hydraulically efficient conveyance networks rapidly remove surface water from urban areas.
- There are dramatic changes in quantity, quality and timing of water leaving the catchment. Runoff volumes are often substantially increased. Wastewater networks provide an alternative flow path that interacts with stormwater and groundwater. There may be less opportunities for water to evaporate if it can quickly drain from a catchment.

The change in the rate and volume of inputs, outputs and storage explains the hydrologic behaviour in urban areas: the rapid response to rainfall and increased flood magnitude and frequency that correlates with development. This chapter explores aspects of urban hydrology, the impact of development and urban stormwater conveyance networks, focussing on areas where the effect of urbanisation needs to be considered for estimation of floods.

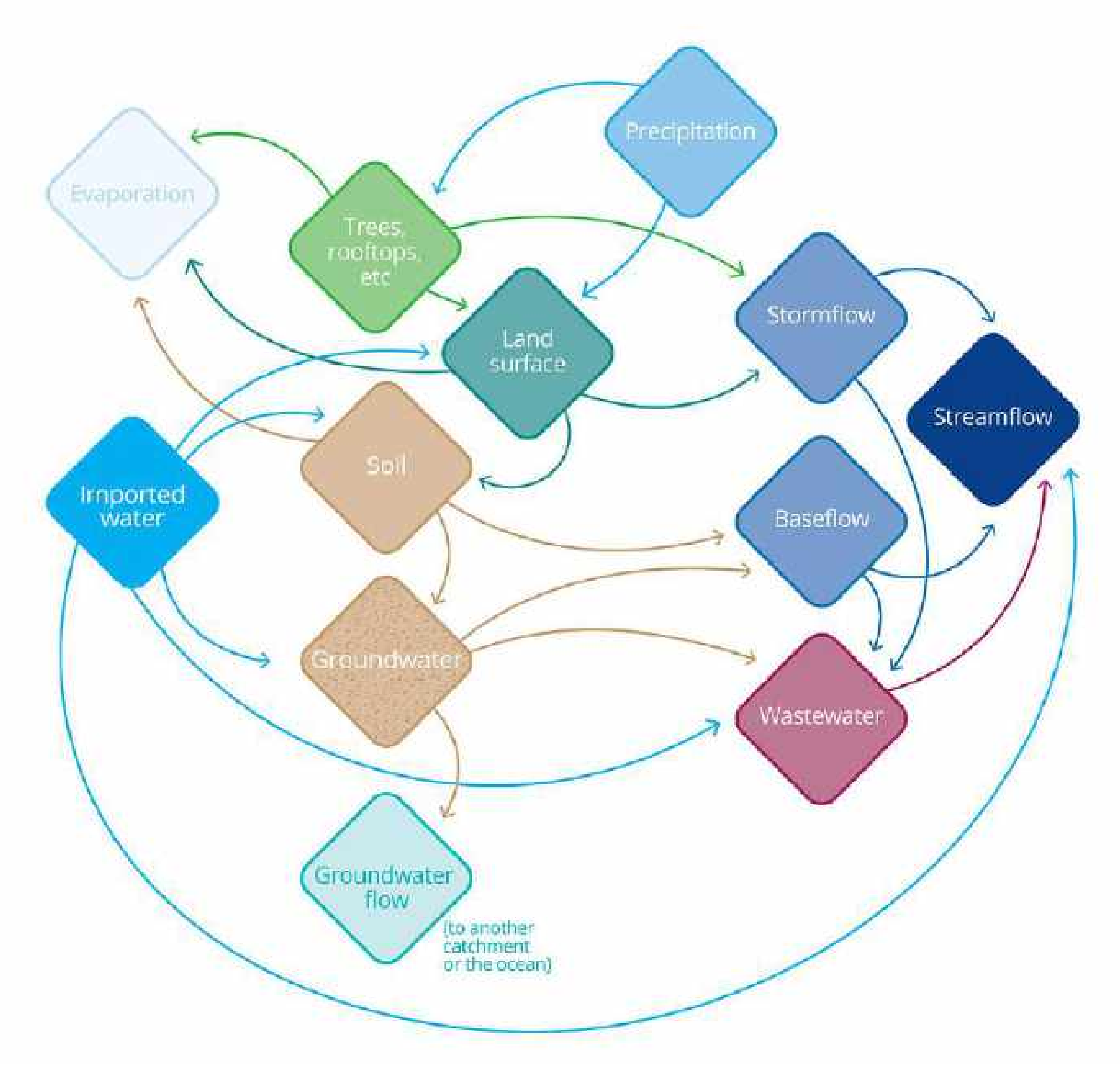

Figure 9.2.1. Simple Model of Water Inputs, Storage and Flows in an Urban Catchment

2.2. Human Impact on the Hydrologic Cycle

2.2.1. Urban Water Balance

The hydrological cycle must be considered at different temporal and spatial scales to gain an insight into urban hydrology. A water balance can identify the influence of imported water on catchment hydrology at the spatial scale of a suburb or city.

The water balance for an urban catchment, during a selected time period, can be expressed by equating the change in the amount of for water stored to the sum of catchment inputs minus the sum of catchment outputs (Mitchell et al., 2003).

$$\Delta S = (P + I) - \left(E_a + R_s + R_w\right) \qquad (9.2.1)$$

Where:

ΔS is the change in catchment storage

P is precipitation

I is imported water

E_a is actual evapotranspiration

R_s is stormwater runoff

R_w is wastewater discharge

There have been several studies of water balances in the urban areas of Australia including Canberra, Melbourne, Perth, Sydney and South-East Queensland (Table 9.2.1). Although there are substantial differences in climate of these study areas, and the number of selected examples is small, the data provides some insights.

- Wastewater leaving a catchment should be less than 59% to 86% of the amount of water imported, since imported water contributes to stormwater and evapotranspiration. This means that imported water contributes to stormwater and/or evapotranspiration. As a result, stormwater plus evaporation exceeds precipitation, according to all case studies.
- Imported water is about 30% to 39% of precipitation. This means imported water substantially increases catchment inflows.
- The volume of imported water is about the same as, or less than, wastewater plus stormwater. This suggests the potential for augmentation of water supply by some combination of rainwater harvest, stormwater harvest and wastewater reuse.

Table 9.2.1. Annual Water Balance Data from Suburbs of Australian Cities.[a]

Location	Input			Output				Wastewater /Imported Water (%)
	Rainfall (mm)	Imported Water (mm)	Imported Water as a Percentage of Rainfall (%)	Actual Evapo-transpiration (mm)	Storm Water Runoff (mm)	Waste Water Runoff (mm)	Change In Store (Misclose) (mm)[b]	
Curtin, ACT (Mitchell, et al. 2003) (1979-1996)	630	200	32%	508	203	118	1	59%
Sydney (Bell, 1972) (1962-1971)	1150	349[c]	30%	736	501	262	0	75%
Sydney (Kenway et al., 2011) (2004-2005)	952	370	39%	766	281	319	-44	86%

Location	Input			Output				Wastewater /Imported Water (%)
	Rainfall (mm)	Imported Water (mm)	Imported Water as a Percentage of Rainfall (%)	Actual Evapo-transpiration (mm)	Storm Water Runoff (mm)	Waste Water Runoff (mm)	Change In Store (Misclose) (mm)[b]	
Subiaco-Shenton Park Perth (McFarlane, 1985)	788	285 + 96[d]	36%	766	104	154	117[e]	54%
Melbourne (Kenway et al., 2011) (2004-2005)	763	237	31%	688	165	190	-43	80%
South-East Queensland (Kenway et al., 2011) (2004-2005)	1021	374	37%	814	390	179	12	49%

[a]The National Water Accounts reported by the Bureau of Meteorology (Bureau of Meteorology, 2015) contain information on water use in regions that include the urban areas of Adelaide, Canberra, Melbourne, Perth, South East Queensland and Sydney.

[b]See original studies for details

[c]Includes imported water and use of groundwater

[d]Inflow of stormwater from upstream area

[e]Adjusted for change in groundwater storage

Assessment of water balances for cities or urban regions also need to account for the spatial and temporal variation of paramaters throughout an area. For example, the spatial distribution of rainfall depth, frequency (rain days per year) and maximum temperatures are shown for the Greater Melbourne region in Figure 9.2.2, Figure 9.2.3 and Figure 9.2.4.

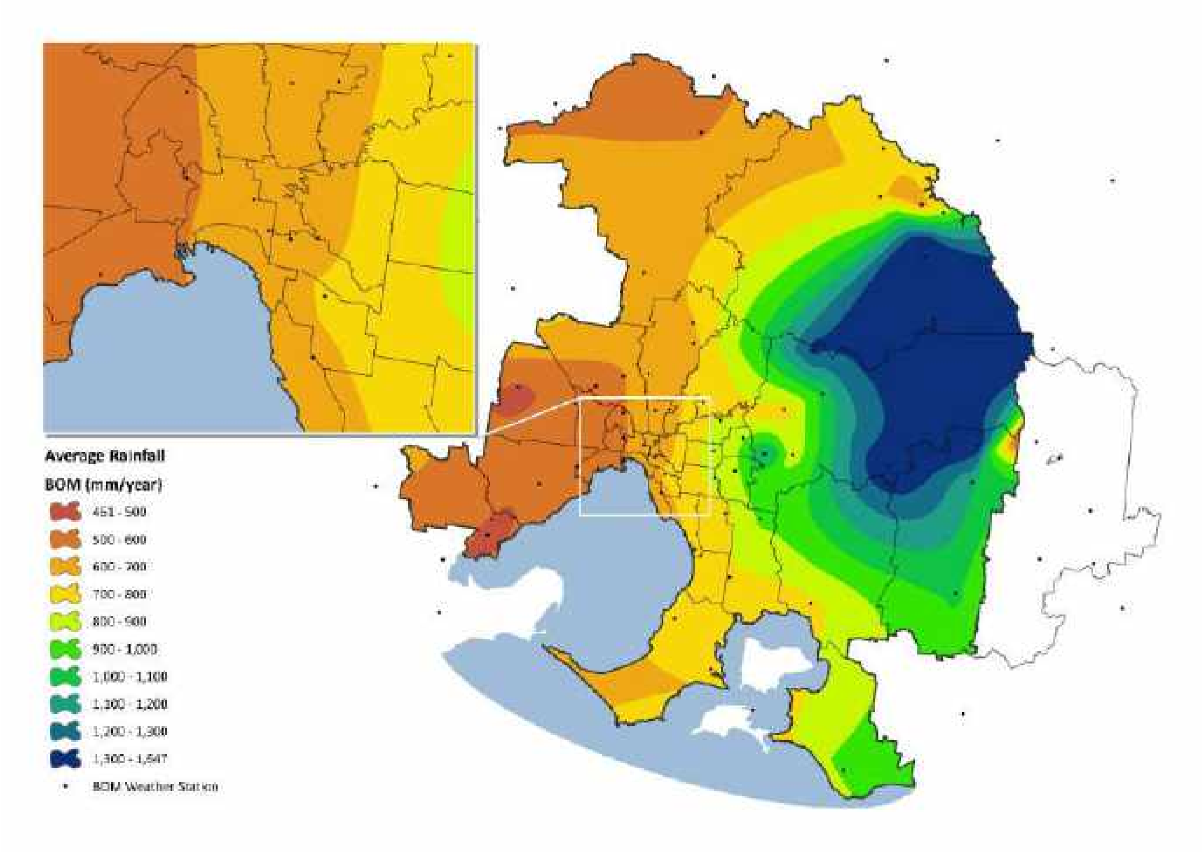

Figure 9.2.2. Spatial Distribution of Average Annual Rainfall Depths for the Greater Melbourne Region (Coombes, 2012)

Figure 9.2.2 demonstrates that average annual rainfall depths range from less than 470 mm to greater than 1640 mm across the Greater Melbourne region. The spatial distribution of rainfall will impact on the assessment of the water balance for the region and also impact on selection of stormwater management strategies. The spatial distribution of the frequency of rainfall will also impact on the determination of a water balance (Figure 9.2.3) (Walsh et al., 2012).

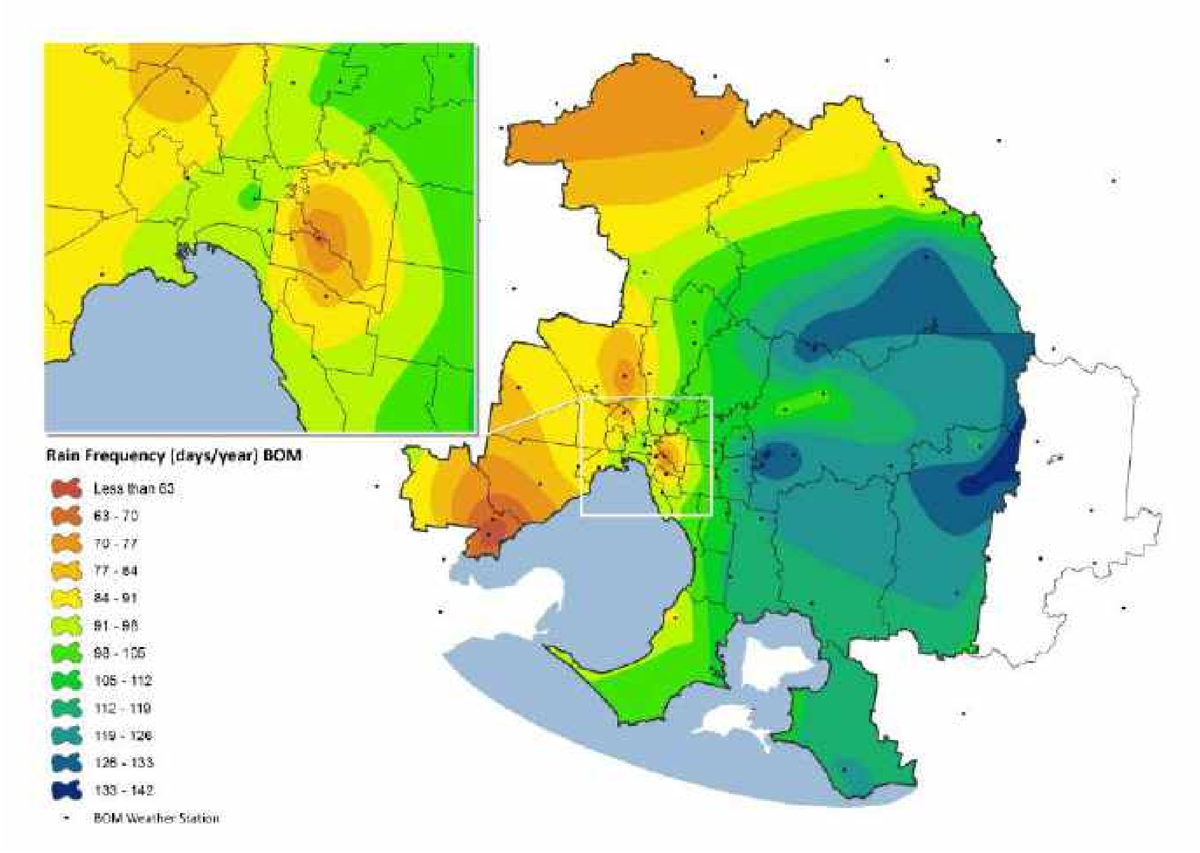

Figure 9.2.3. Spatial Distribution of Average Annual Frequency of Rainfall for the Greater Melbourne Region (Coombes, 2012)

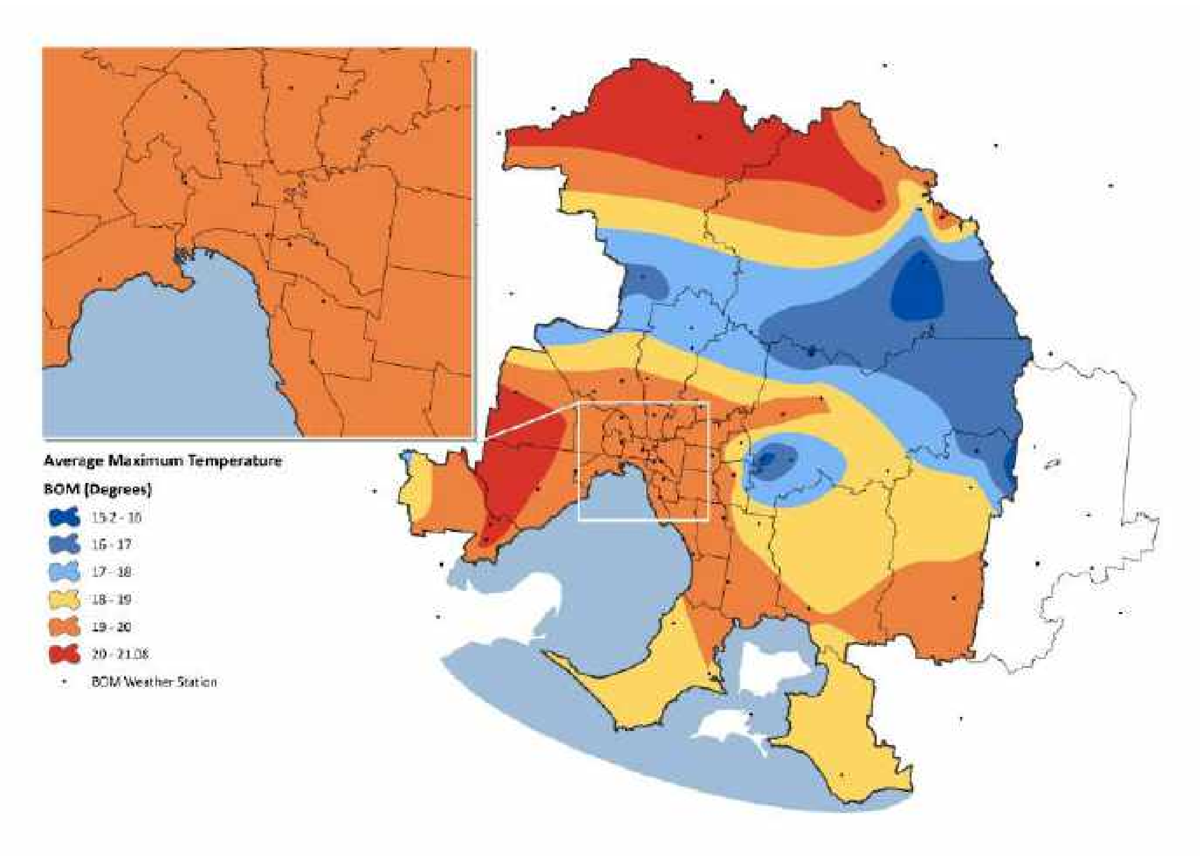

Figure 9.2.4. Spatial Distribution of Average Annual Maximum Temperatures for the Greater Melbourne Region (Coombes, 2012)

A range of recent detailed investigations that also considered the spatial and temporal variation of parameters was used to define water balances for Greater Melbourne, Greater Sydney, Greater Perth, and South-East Queensland regions. Water balances for 2013 were extracted from these studies to provide the examples presented in Table 9.2.2.

Table 9.2.2. Water Balances for Selected Regions

Region	Study	Average Annual Volume (GL)		
		Water	Wastewater	Stormwater
Greater Melbourne	Coombes & Bonacci (2012)	394	381	440[a]
Greater Sydney	Coombes & Barry (2012)	524	497	564
Greater Perth	Coombes & Lucas (2005)	249	131[b]	525
South East QLD	Coombes (2012)	278	265	470

[a]only includes stormwater runoff from urban surfaces. The total runoff volume of 650 GL/annum included open space and parks. These results are similar to the research by Walsh (2018) that estimated a total annual volume of 608 GL.

[b]there are less properties connected to centralised wastewater networks than connections to mains water supply.

Table 9.2.2 demonstrates that each region is subject to substantially greater volumes of stormwater runoff than demands for mains water. In addition, the volumes of wastewater discharges are similar to water demands. However, this result may be misleading as there are less wastewater connections (especially for Perth) than water supply connections in each region. Households in some areas are reliant on local wastewater management measures (such as septic tanks) and receive mains water supplies.

2.2.2. Lessons from a Detailed Water Balance Study at Curtin, ACT

Detailed information about an urban water balance is available for Curtin in ACT where Mitchell et al. (2003) obtained sufficient information to construct an annual water balance between January 1978 and June 1996. This study provides information on the variability in the urban water balance over time and the influence of climate (Table 9.2.3).

Table 9.2.3. Water Balance for Curtin Catchment in Canberra for the Period 1979 – 1995. (Adapted from (Mitchell et al., 2003))

Year	Rainfall (mm)	Imported Water (mm)	Actual Evapotranspiration (mm)	Stormwater Runoff (mm)	Wastewater Discharge (mm)	Change in Storage
Driest	247	269	347	74	107	-12
Average	630	200	508	203	118	1
Wettest	914	141	605	290	126	34

The average annual input and output of the catchment was about 830 mm. Approximately 24% (200 mm) of water was imported to the catchment via the supply system. Precipitation (rainfall) contributed the remaining 630 mm. Outputs included actual evapotranspiration (61%, 508 mm), stormwater runoff (24%, 203 mm) and wastewater discharge (14%, 118 mm).

The volume of imported water exceeded the volume of wastewater in all years and thus contributed to stormwater runoff, and at least in the driest years, to evapotranspiration. More water left the catchment as evapotranspiration and as stormwater runoff than was input via precipitation. In addition, in all but the driest years, wastewater and stormwater were greater than imported water, indicating the potential for harvest of suburban discharges to meet water demands. This highlighted the requirements for water imports under drought conditions.

Climate had a substantial influence on several of the water fluxes. Annual precipitation was highly variable ranging between 214 mm to 914 mm. On average, there was three times as much rainfall as water imports but in the driest year, more water was imported to the catchment than fell as rainfall. In the wettest year, imported water made up only 13% of water input. Figure 9.2.5 shows the relative amounts of precipitation and imported water for the driest, average and wettest years. The area of pie charts are proportional to total input. The proportion of imported water increases in drier years.. The proportion of imported water increases in drier years.

Considering outputs, the largest term is evapotranspiration, which represents 59% or more for each year. Although the total evapotranspiration varies between 347 mm and 605 mm for dry and wet years, the proportion of water lost as evapotranspiration is reasonably constant (59% to 66%). Figure 9.2.6 shows that relative amounts of actual evapotranspiration, stormwater and wastewater for the driest, average and wettest years (area of pie chart is proportional to total output). The proportion of stormwater increases in wetter years.. The proportion of stormwater increases during wetter years. The total volume and percentage of wastewater output does not seem to be greatly influenced by climate, as it is consistent between wet, average and dry years.

Stormwater runoff is highly reliant on climate, changing by a factor of about 4 mm from 74 mm during the driest year to 290 mm during the wettest year. Woolmington and Burgess (1983) demonstrated the direct link between garden watering and augmentation of low flows in Canberra urban streams, although this is moderated by water restrictions.

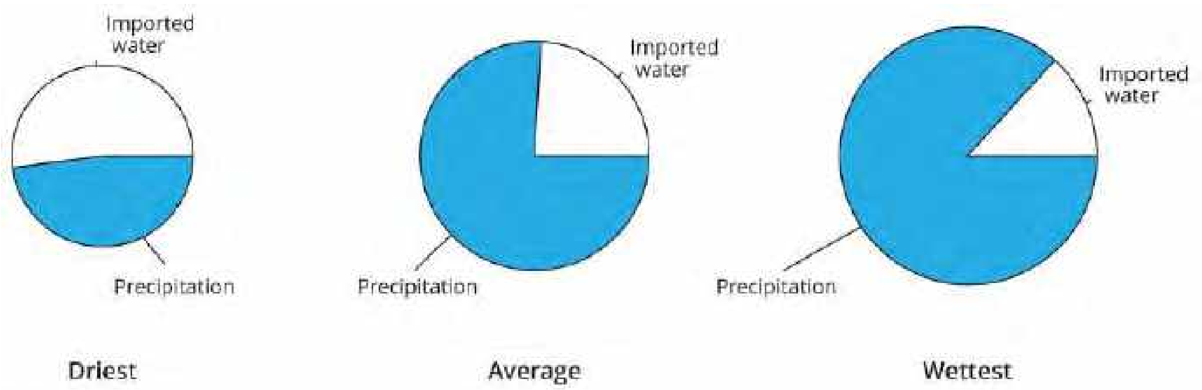

Figure 9.2.5. Total Water Input to Curtin in ACT

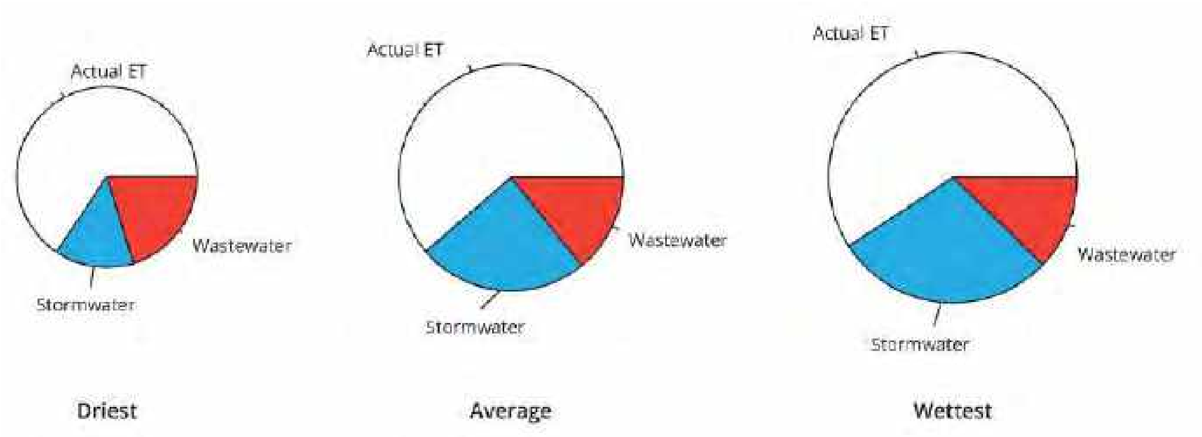

Figure 9.2.6. Total Water Output from Curtin in ACT

In summary, at the annual scale the urban water balance indicates the human impact on the hydrologic cycle. Water is imported into urban catchments and this exceeds the amount of wastewater exported, therefore there must be a net increase in outputs. Data from Curtin in the ACT shows that in dry years more than half of water inputs are via the mains supply system.

2.2.3. Implications of the Urban Water Balance: Stormwater as a Resource

Stormwater management throughout Australia was the subject of a recent Senate inquiry that recognised urban stormwater runoff as an under-utilised resource that creates significant environmental and flooding challenges (Commonwealth of Australia, 2015). Urban areas generate substantially greater stormwater runoff and pollutant loads compared to natural landscapes and are degrading our urban waterways and receiving waters. These additional flows substantially increase the discharges and overflows from sewer networks.

The volumes of stormwater runoff from urban areas exceed the water demand in many cities.

The water balance in cities include stormwater runoff, wastewater discharges and imported reticulated mains water. To illustrate this, Figure 9.2.7 presents the average annual water balance from the perspective of households in a range of Australian cities (Coombes, 2015).

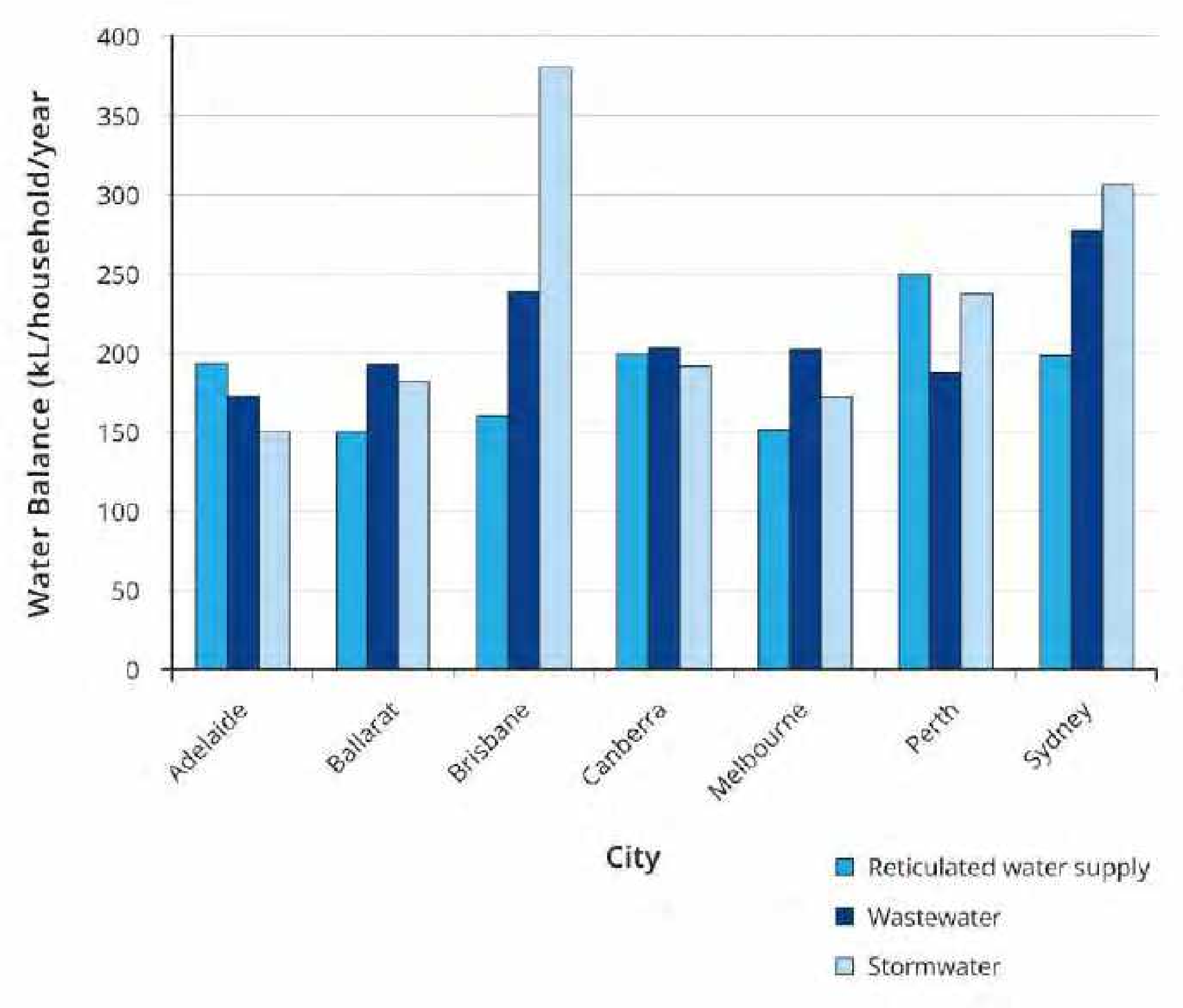

Figure 9.2.7. Average Annual Water Balances from Households in Adelaide, Ballarat, Brisbane, Canberra, Melbourne, Perth and Sydney

Figure 9.2.7 reveals how the combined volumes of stormwater runoff and wastewater discharging from households (and their properties) in each of the cities are greater than the volume of imported reticulated water supply at each location. Indeed, the average annual volumes of stormwater runoff from residential properties is similar to or greater than the average reticulated water demand from most of the properties. Improving stormwater management provides an opportunity to supplement urban water supplies as well as enhancing the amenity of urban areas and protecting the health of waterways in most cities.

The timing of water balances (rainfall, local and imported surface water supplies, groundwater, metered water use, sewage collected and stormwater runoff from urban surface) in the Ballarat Water District during recent drought is provided in Figure 9.2.8 as an example of water cycle processes (Coombes, 2015).

Figure 9.2.8. Water Cycle Processes in the Ballarat Water District from 1999 to 2012

Figure 9.2.8 indicates how the Ballarat Water District was dependent on surface water from nearby dams on local waterways [surface water (local)], until the worst of the drought in 2006. The reduced flows into local dams were supplemented using local ground water and the surface water imported from the Goulburn River (Murray-Darling Basin). Citizen's actions to reduce water use in response to water restrictions, installation of water efficient appliances and rainwater harvesting also halved the demands for utility water supply [water use (metred)] of the Ballarat Water District. The Council and the Water Authority also implemented stormwater harvesting and wastewater reuse solutions. In combination with the availability of ground water and imported surface water from the Goulburn River, these actions ensured that the City of Ballarat did not exhaust water supplies during drought. Despite rainwater and stormwater harvesting, there were still substantial stormwater runoff events suggesting that additional water was available albeit at additional cost.

The integrated action across the water cycle by the entire Ballarat community was a success from a water supply perspective that demonstrates the value of integrated solutions and understanding urban water balances. Nevertheless, this example also highlights the variable and temporal nature of urban water balances and connectivity with surrounding systems. Some of the key insights highlighted in Figure 9.2.8 are that substantial stormwater runoff events occur during drought, annual volumes of wastewater discharges were similar to water demands during water restrictions. Increases in stormwater runoff drive increases in wastewater discharges to be greater than water demands. The integrated solution for Ballarat was able to overcome the jurisdictional and institutional boundary conditions that limit opportunities for catchment based solutions in many cases.

2.2.4. Comparison of Rural and Urban Water Balances

A few studies that contrast water balances for urban and neighbouring natural catchments (Grimmond and Oke, 1986; Stephenson, 1994; Bhaskar and Welty, 2012). As expected, there is an increase in runoff, which we explore in the next section. The impact on evapotranspiration is less clear and depends on specific conditions as was apparent in the data for Curtain (Mitchell et al., 2003).

The partitioning of outflow between evaporation and stormwater runoff depends on water availability, conveyance infrastructure, storage in the catchment and the extent of irrigated parkland and gardens. There are a few examples, other than for Curtain, where this has been looked at in detail in an Australian context. In Melbourne, during a time of highly restricted water use for irrigation, Coutts et al. (2009) found that rapid stormwater runoff resulted in much reduced water availability and decreased evapotranspiration in urban areas compared to neighbouring rural sites. The result was a very dry urban landscape with energy partitioned into heating the atmosphere (which drove hot dry conditions) or into heat storage (which increased overnight temperature).

Bell (1972) suggests a similar decrease in evapotranspiration in Sydney (and consequent increase in runoff) as urbanisation increased. Recent investigations by Parker (2013) for Melbourne and by Argueso et al. (2014) for Sydney discuss a significant urban heat island effect, that is driven by increased heat storage capacity of urban structures and reduced evaporation from cities.

2.3. Aspects of Urban Stormwater Management Systems

2.3.1. Impervious Areas

An annual water balance illustrates the long term hydrologic changes caused by urbanisation. There are also substantial changes to flow events that are caused by:

- The expansion of impervious areas; and
- Efficient conveyance networks (Hollis, 1988; Schueler, 1994; Jacobson, 2011).

Urbanisation results in impervious surfaces replacing vegetated landscapes and this:

- Decreases the storage of water within soil profiles and on the ground surface and so increases the proportion of rain that runs off;
- Increases the velocity of overland flow; and
- Reduces the amount of rainfall that recharges groundwater.

Additionally, the natural stream network is augmented by conveyance networks (pipes and channels) that directly collects water from roofs and roads throughout the urban catchment. The expanded conveyance (drainage) network:

- Reduces the overland flow distance before water reaches a stream;
- Increases flow velocity because constructed drains are smoother and straighter than natural channels or overland flow paths;
- Reduces the storage of water in the channel system and on the catchment;
- Decreases the amount of water lost to evaporation because the water is quickly removed by the drainage network; and
- Means that almost all areas will contribute flow to a stream because the piped drainage network often extends to the furthest reaches the catchment.

As a result, although the exact effect of urbanisation on stream hydrology depends on the specific circumstances, there are some general comments that apply to many urban waterways in Australia. Urbanisation results in:

- Increased volumes of stormwater runoff;
- Increased frequency of high flow events;
- Increased magnitude of high flow events;
- Increased rates of change (both rising and falling limb of hydrographs);
- Increased catchment responsiveness to rainfall – more runoff events;
- Increased speed of catchment response;
- Reduced seasonality of high flows – high flow events occur year round rather than being mainly concentrated in a wet season;
- Greater variation in daily flows;
- Increased frequency of surface runoff to streams; and
- Reduced infiltration of rainfall.

Hydrologic changes caused by urbanisation occur at the same time as, and partly cause, changes to sediment loads, stream ecology and water quality (Walsh et al, 2005). Key hydrologic changes are considered in more detail in the following sections.

Increased Flow Volumes

More rainfall is converted to runoff in urban catchments from impervious surfaces and from pervious areas that are commonly compacted or irrigated by imported water (Harris and Rantz, 1964; Cordery, 1976; Hollis and Ovenden, 1988a; Hollis and Ovenden, 1988b; Hollis, 1988; Ferguson and Suckling, 1990; Boyd et al., 1994; Walsh et al., 2012; Askarizadeh et al., 2015).

Increased Flood Frequency and Magnitude

The increase in magnitude of flooding because of urbanisation has been recognised for many decades (Leopold, 1968). Urbanisation causes up to a 10-fold increase in peak flood flows in the range 4 EY to 1 EY with diminishing impacts on larger floods (Tholin and Keifer, 1959; ASCE, 1975; Espey and Winslow, 1974; Hollis, 1975; Cordery, 1976; Packman, 1981; Mein and Goyen, 1988; Ferguson and Suckling, 1990; Wong et al, 2000; Beighley and Moglen, 2002; Brath et al., 2006; Prosdocimi et al., 2015).

Increased flood magnitudes have been confirmed by analysis of paired catchment data in Australia as demonstrated by the comparison of urban Giralang and rural Gungahlin catchments in Canberra (Codner et al., 1988) as well as numerous modelling studies (Carroll, 1995). The impact of this increased flooding is substantial and makes up a large proportion of overall average annual flood damage estimates (Ronan, 2009).

Faster Flood Peaks – Flashiness

Runoff in urban streams responds more rapidly to rainfall in comparison to rural catchments and recedes more quickly. The quick response means there are more flow peaks in urban streams (Mein and Goyen, 1988; McMahon et al., 2003; Baker et al., 2004; Heejun, 2007; Walsh et al., 2012). Urbanisation was found to reduce the volume of channel storage by a factor of 30 in Canberra (Codner et al., 1988). This contributes to the rapid response of urban streams and increased flood flows.

The lag time – the time between the centre of mass of effective rainfall and the centre of mass of a flood hydrograph – decreases by 1.5 to 10 times in response to urbanisation (Packman, 1981; Bufill and Boyd, 1989).

Increased Runoff Frequency

Increased frequency of stormwater runoff is correlated with increased area of impervious surfaces. Small rainfall events of 1 to 2 mm will cause runoff from impervious surfaces (ASCE, 1975; Codner et al., 1988; Boyd et al., 1993; Walsh et al., 2012) but much more rainfall is usually required to produce runoff from grassland or forest (Hill et al., 1998; Hill et al., 2014). The frequency of stormwater runoff can increase by a factor of ten or more.

The increased responsiveness of urban landscapes to rainfall means that seasonality of flows in urban streams is different to rural streams. In many areas, rural catchments will only produce runoff after saturation of soil profiles following long periods where rainfall exceeds evapotranspiration. This result produces seasonal stream flows in many rural catchments with little runoff, when catchments are dry even when there is heavy rainfall (Western and Grayson, 2000). In urban streams, flows occur anytime there is rainfall. In temperate urban catchments, the largest urban runoff often occurs following intense thunderstorm rain during summer when, in equivalent rural catchment, there is little flow (Codner et al., 1988; Smith et al., 2013).

Changed Base Flows

The influence of urbanisation has complex impacts on groundwater and base flow in streams. Various features of urbanisation have confounding effects and their relative magnitude will determine the overall influence on base flow in streams. These features include:

- Reduced vegetation cover;
- Increases in impervious surfaces that limits infiltration and reduces evaporation of shallow groundwater;
- Infiltration from irrigation of gardens;
- Water leaking from pipes which contributes to ground water; and
- Drainage of groundwater into pipes or the gravel-filled trenches that surround pipes.

The most common response to urbanisation is that base flow in urban streams is decreased. More impervious areas means less opportunity for water to infiltrate so groundwater storage, for storage in soil profiles and discharges are reduced (Simmons and Reynolds, 1982; Lerner, 2002; Brandes et al., 2005). Less commonly, there may be increased base flow, particularly where stormwater is deliberately infiltrated (Ku et al., 1992; Al-Rashed and Sherif, 2001; Barron et al., 2013).

2.3.2. Conveyance

Urbanisation changes the processes of conveying water. The network of urban stormwater conveyance infrastructure is denser and more extensive than the natural stream system it replaces. This means that water is conveyed rapidly from both pervious and impervious surfaces throughout an urban catchment. Resistance to flows is lower in straight and smooth drainage paths of urban waterways, as compared to their natural counterparts.

The way water is conveyed from impervious areas can enhance or mitigate the influence of impervious areas. Modelling by Wong et al (2000) suggests that condition of the waterways also influences peak discharges that follow urbanisation. The largest impacts occur when urban streams are lined and made hydraulically efficient.

The importance of stormwater conveyance was confirmed in catchments with similar imperviousness but with and without conventional drainage infrastructure. This alteration of hydraulic behaviour was substantially reduced in suburbs with less efficient informal stormwater infrastructure that included roofs drained to gardens or rainwater tanks, and sealed roads which lacked curbs and drained to surrounding forest or earthen or vegetated swales (Hardy et al., 2004; Walsh et al, 2005).

Conveyance of Flood Flows

Understanding the conveyance of water in urban areas during times of overland flooding is a critical part of the analysis and design of urban stormwater management strategies. The major/minor principle requires that overland flow paths must be considered once the capacity of conveyance conduits is exceeded. This behaviour can be complex. Modelling of overland flow paths is used in many areas to guide zoning of land to control development and so reduce flood risk (Baker et al., 2005).

The catchment boundary for overland flows will often differ from boundaries of flows in conduits. This means that the behaviour of large floods may be substantially different from smaller events and has the potential to produce unexpected behaviours. An example is a suburb protected from riverine flooding by a levee. Stormwater is usually discharged under the levee into the river. If overland stormwater flooding cannot reach the river because of the levee it may, instead, back up and cause flooding. This type of unexpected and rapid flooding can be dangerous, as people are unlikely to be prepared for these types of events.

2.3.3. Receiving Environments

Many urban areas are adjacent to estuaries or bays that are the downstream boundary for water levels in streams. Coincident stormwater and estuarine flooding needs to be considered and is addressed in detail in Book 6, Chapter 5. Water authorities will often have mandated sea levels that must be used as part of the analysis flooding scenarios for planning (e.g; Melbourne Water (2012)).

Major rivers flowing through urban centres are also receivers of urban stormwater. These rivers will determine the base level to be used for modelling and additional analysis of the river system may be required to ensure flood risks are adequately considered.

The impact of urbanisation on major rivers can be contrasted with the effect on urban stormwater conveyance systems. Much of the water that is used in cities is harvested from the rivers that flow through them, for example, the Yarra River in Melbourne, the Hawkesbury-Nepean in Sydney and the Brisbane River. This results in lower flows and reduces flooding in main streams. There is a paradox here. The main rivers in urban areas have much reduced flow while in urban waterways flows are increased. For example, in Melbourne, there is about 125 km of streams and estuaries where flow has been substantially decreased by harvesting for urban water supply, and 1700 km of urban streams with substantially increased flow from urban catchments. From a citywide perspective, stormwater management needs to consider both of these impacts.

2.3.4. More Complex than Rural

Many aspects of urban flooding are more complex than similar issues in rural areas and require careful and thorough analysis. Key differences include:

- Very rapid response to rainfall;
- A greater proportion of rainfall converted to flood flow;
- Large numbers of people potentially affected by flooding;
- Development in one area adversely affecting flood risk in distant areas;
- Catchment areas than can change with the magnitude of flooding;
- Increased influence of the spatial pattern of rainfall because catchments respond to short rainfall events which are more spatial variable;
- Flooding from both riverine (fluvial) and stormwater (pluvial) overflows; and

- Floods can occur at any time of the year and may be most severe when triggered by summer thunderstorms - there is often no requirement for antecedent rainfall to wet the catchment to generate flooding.

In reviewing the components of average annual flood damage, Ronan (2009) suggested that, in general, risks from riverine flooding were reasonably well addressed but that stormwater flooding was a major issue that was yet to be adequately considered.

2.3.5. Combined and Separate Systems

The discussion in this section has generally assumed that suburbs have separate sanitary sewers and stormwater management systems. This is mostly true for Australian towns and cities. However, two areas have combined sewers – a single pipe that carries both wastewater and stormwater. These are the central area of Launceston, Tasmania and a small area in the CBD of Sydney. When the first sewers were built in Sydney, around 1857, there were five combined sewer systems: Woolloomooloo, Blackwattle Bay, Hay Street, Tank Stream and Bennelong. These discharged to Sydney Harbour. Most of these original sewers were converted to carry stormwater only following the construction of the Bondi Ocean Outfall Sewer in 1889 and wastewater was discharged in the ocean. Later developments in Sydney and elsewhere adopted separate stormwater drainage.

For an analysis of decision-making between separate and combined systems of sewerage, see Tarr (1979). For a history of urban drainage approaches, see Delleur (2003).

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Chapter 3. Philosophy of Urban Stormwater Management

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Chapter Status	Final
Date last updated	14/5/2019

3.1. Introduction

Urban stormwater management is historically described as the hydraulic design of urban drainage networks that safely conveys stormwater runoff to receiving environments. The industry's approach to urban water management in Australia has changed significantly since the establishment of centralised and separate water supply, stormwater and wastewater paradigm in the 1800s.

Urban water management evolved over time to include waterways protection, mitigation of stormwater quality, use of Water Sensitive Urban Design (WSUD), Integrated Water Cycle Management (IWCM), Water Sensitive Cities (WSC), Integrated Water Management (IWM), and many other approaches. Although these approaches are relatively new, they have wide adoption and support in legislation and policies for water management throughout Australia. Similar changes in approach to urban stormwater management in other countries include Sustainable Urban Drainage Systems (SuDS) (Bozovic et al., 2017) and Low Impact Design (LID) (USEPA, 2008). Consequently, the approach to urban stormwater management includes water supply and is based on retention and conveyance of stormwater runoff to meet multi-purpose design objectives that enhance livability of urban areas, mitigate nuisance, and avoid damage to property and loss of life.

3.2. The Journey from 1987 to 2016

Australia has experienced considerable improvement in urban water management since the 1800s, supported and underpinned by publications such as ARR (PMSEIC, 2007). Stormwater drainage in Australia evolved from combined sewers that rapidly discharged the accumulated rubbish, sewage, sullage and stormwater from streets to waterways (Armstrong, 1967; Lloyd et al., 1992). The impact on waterways and amenity of urban settlements drove the separation of sewage and stormwater infrastructure. Filling of swamps and development of contributing catchments to accommodate population growth resulted in frequent flooding of early settlements. Drainage solutions emerged to avoid stagnant water, local flooding and health impacts in urban areas. Nation building works programs during economic depressions (for example in 1890 and 1920) and following wars provided large scale drainage infrastructure throughout Australia.

The ARR 1987 guideline focused on collection and conveyance of peak stormwater flows in drainage networks. The guideline's advice on hydrologic and hydraulic analysis was consistent with the emerging computer age and hand calculation while programmable calculator and computer methods were discussed. The increasing complexity of the different methods and an associated requirement for use of computers was highlighted.

Use of statistical design rainfall bursts was recommended to calculate inflows to drainage networks and the Rational Method was described as the best known method for estimation of urban stormwater runoff. The main objective of urban drainage was to convey stormwater from streets and adjoining properties without nuisance from minor rain events, and to avoid property flooding and associated damage from major rain events (the minor/major design approach).

In contrast to the introductory comments, urban drainage was presented as a prescriptive approach using pipes to convey minor flows, with streets, open space and trunk drains used to transport major flows. Trunk drainage was described to include designs for open channels, detention and retention basins to control peak discharge, and bridges. While urban stormwater management was presented and interpreted as a drainage approach, Chapter 14 in ARR 1987 highlighted how urban drainage solutions should also:

- limit pollutants entering receiving waters;
- consider water conservation;
- integrate overall planning schemes;
- be based on measured or observed real system behaviour;
- be viewed in relation to the total urban system; and
- maximise benefits to society.

Drainage solutions solely focused on developed catchment and were mostly designed by engineers. The simplicity of methods for estimating stormwater runoff implied accuracy and certainty of design performance for many users. Urban water management further evolved in the mid-1990s to cover protection of waterways, mitigation of urban stormwater quality, WSUD (Whelans and Maunsell, 1994), IWM and IWCM (Coombes and Kuczera, 2002) approaches. Nevertheless urban stormwater runoff creates complex impacts on urban stream ecosystems and receiving waterways (Walsh et al., 2005; Paul and Meyer, 2001). Increases in runoff volumes and rates from urban areas (flow regimes) contribute to degradation of riparian ecosystems and promotes geomorphic changes within urban streams (Walsh et al., 2012). Although these approaches are relatively new, they have subsequently gained widespread adoption and support throughout Australia. To support this evolution, Engineers Australia published 'Australian Runoff Quality – A Guide To Water Sensitive Urban Design' in 2006 (Engineers Australia, 2006).

The acceptance of WSUD, IWCM and related approaches is manifested in three significant ways:

- the development of benchmark projects (e.g; Lynbrook estate (Lloyd et al, 2002), Fig Tree Place (Coombes et al., 2000) and Little Stringy Bark Creek (Walsh et al., 2015)) that provided evidence that these new approaches were successful;
- the creation of local policies and plans for integrated water management; and
- the adoption of policies for sustainable water management by state and federal governments.

Recent droughts, such as the 'millennium drought' also triggered many other changes in the urban water sector, largely associated with water conservation, harvesting, recycling and reuse (Aishett and Steinhauser, 2011).

Urban areas are complex systems that are subject to dynamic interaction of economic, social, physical and environmental processes across time and space (Forrester, 1969;

Coombes and Kuczera, 2003; Beven and Alcock, 2012). Continuous intervention is required to renew urban economic, technical and social structures to maintain human welfare and protect ecosystem services (Forrester, 1969; Meadows, 1999). Understanding these processes into the future also encounters the uncertainty created by non-stationary data that describes past processes. Design and analysis processes should include distributed approaches to account for the time based dynamics of essential data. The integrated nature of contemporary water management approaches is different to the objectives and design solutions envisaged in 1987. Urban water management is now required to consider multiple objectives (e.g. resilience, livability, sustainability and affordability) and the perspective of many disciplines. Advances in computing power, more available data and associated research also allows the analysis of increasingly complex systems to understand the trade-offs between multiple objectives (Coombes and Barry, 2014). Design of urban water management seeks to integrate land and water planning. Use of more comprehensive datasets revealed a greater range of potential outcomes that needs understanding to develop integrated solutions.

According to Argue (2017), the urban designer aims at managing the impact of urban stormwater runoff 'at source' and at multiple scales by retaining stormwater in landscapes and soil profiles, rainwater harvesting and disconnecting impervious surfaces from drainage networks (Poelsma et al., 2013). Consistent with the philosophy of source control and systems analysis, stormwater runoff is now seen as an opportunity and is valued as a resource (Clarke, 1990; Mitchell et al., 2003; McAlister et al., 2004). Modern design criteria may include analysis of the volumes, timing and frequency of stormwater runoff to determine peak flow rates, water quality and requirements to mimic natural flow regimes to protect waterway health (Walsh, 2004).

3.3. Evolving Opportunities and Challenges

Urbanisation generates dramatic changes within the natural water cycle. Impervious surfaces and directly connected drainage infrastructure decreases evapotranspiration and infiltration to soil profiles. This increases the volume and frequency of stormwater runoff and reduces baseflows; which can create flooding and affect waterway health. Drainage strategies that are reliant on conveyance can transfer additional stormwater runoff and pollutant loads generated by urban areas to other locations. The different regional scale responses within a river basin and a linked urban catchment are presented in Figure 9.3.1.

The impervious surfaces and hydraulically efficient infrastructure associated with urban catchments increases the magnitude and frequency of stormwater runoff whilse reducing the infiltration to soil profiles and subsequent baseflows in waterways. The accumulation of stormwater flows within urban catchments is highlighted. The first response at A is the (undisturbed) ecosystem upstream from urban impacts, the second response at B includes the impact of water extraction to supply the urban area (changed flow regime in rivers created by water supply) and the third response at C includes water discharges from the urban catchment (changed flow and water quality regime from both stormwater runoff and wastewater discharges) into the river basin.

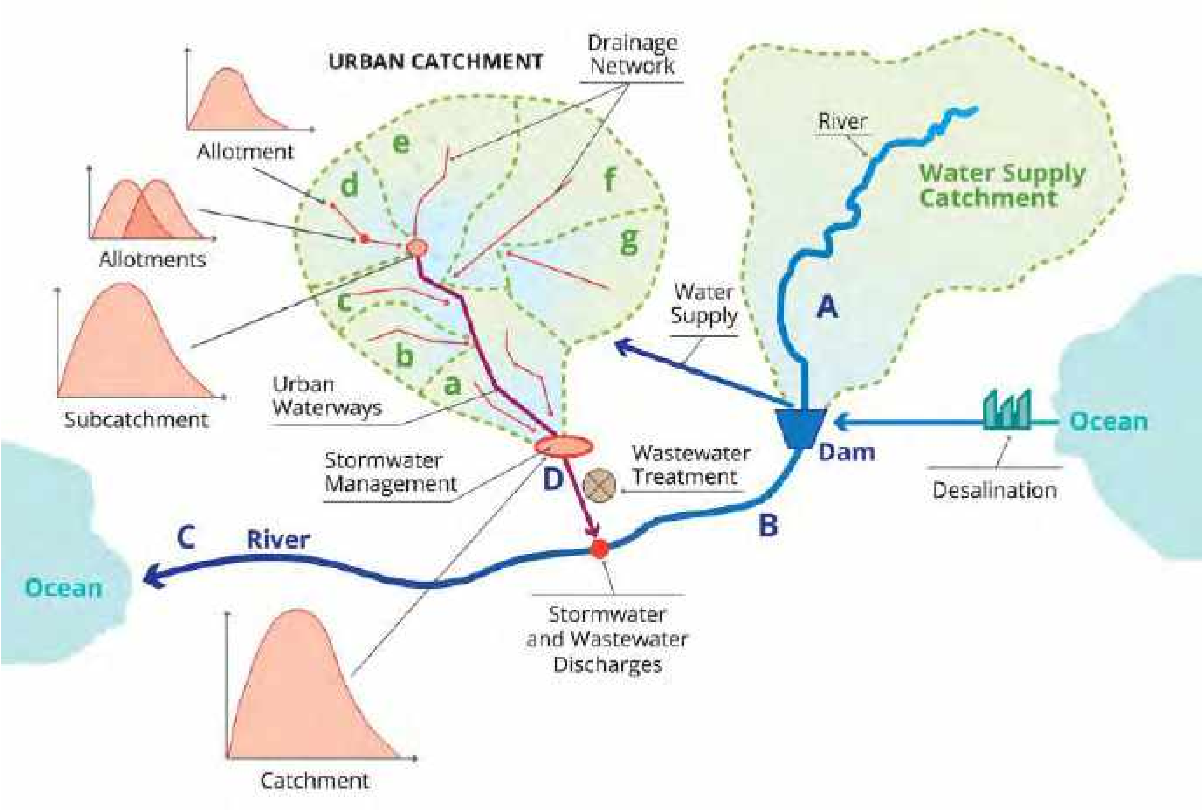

Figure 9.3.1. Schematic of Traditional Urban Catchments and Cumulative Stormwater Runoff Processes

Figure 9.3.1 demonstrates analysis and solutions at point D at the bottom of urban catchments; it can exclude understanding of impacts within the urban catchment (sub-catchments a-h) and external impacts to the river basin at B and C. Traditional analysis of urban catchments is from the perspective of rapid discharge and accumulation of stormwater via drainage networks (in sub-catchments a-h) with flow and water quality management at the bottom of the urban catchment (D) using retarding basins, constructed wetlands, and stormwater harvesting. However, the benefits for flood protection, improved stormwater quality, and protection of the health of waterways from this approach do not occur within the urban catchment upstream of point D.

Figure 9.3.1 also highlights how distributed land uses (allotments or properties) produce hydrographs of stormwater runoff into the street drainage system. This system accumulates stormwater runoff from multiple inputs, creating progressively larger volumes of stormwater runoff, which ultimately flows into urban waterways or adjoining catchments (Pezzaniti et al., 2002). This process results in significant changes in volume and timing of stormwater discharge to downstream environments.

There has been an emerging understanding that this issue can be solved by viewing urban stormwater as an opportunity to supplement urban water supplies and enhance the amenity of urban areas (Mitchell et al., 2003; Barry and Coombes, 2006; Wong, 2006). This includes development of green infrastructure and microclimates that reduce urban heat island effects. Urban catchments with impervious surfaces are substantially more efficient than conventional water supply catchments in translating rainfall into surface runoff. Rainwater and stormwater harvesting can extend supplies from regional reservoirs and the restoration of environmental flows in rivers subject to extractions for water supply (Coombes, 2007). These insights are consistent with earlier applied research by Goyen (1981) that both volumes and peak flows of stormwater runoff are required to design stormwater infrastructure, and the local property scale is the building block of cumulative rainfall runoff processes (Goyen, 2000). Reducing urban stormwater runoff volumes via harvesting and retention in upstream catchments can also decrease stormwater driven peak discharges and surcharges in wastewater infrastructure (Coombes and Barry, 2014).There has been an emerging understanding that this issue can be solved

Changes in land use, climate, increased density of urban areas and decline in hydraulic capacity of aging drainage networks can result in local flooding and damage to property. Climate change is expected to reduce annual rainfall and generate more intense rainfall events in a warming climate (PMSEIC, 2007; Wasko and Sharma, 2015). This will intensify the challenges of providing secure water supplies and mitigating urban stormwater runoff. There may also be the need to replace stormwater conveyance networks installed during post-war urban redevelopment that are nearing the end of useful life. In this situation, the capacity of an aging network or increased runoff from increasing development density can be supplemented by source control measures and integrated solutions (Barton et al., 2007). Integrated solutions and flexible approaches to design can avoid costly replacement of existing infrastructure.

Flood management issues for many urban areas are driven by runoff discharged towards waterways (overland flooding) rather than from flood flows originating at waterways (fluvial flooding). There is a need to consider more extensive range of stormwater runoff events, from frequent to rare or extreme and the associated impacts on urban environments (Weinmann, 2007). Management of these flood related impacts require integrated management of the full spectrum of flood events (Figure 9.3.2).

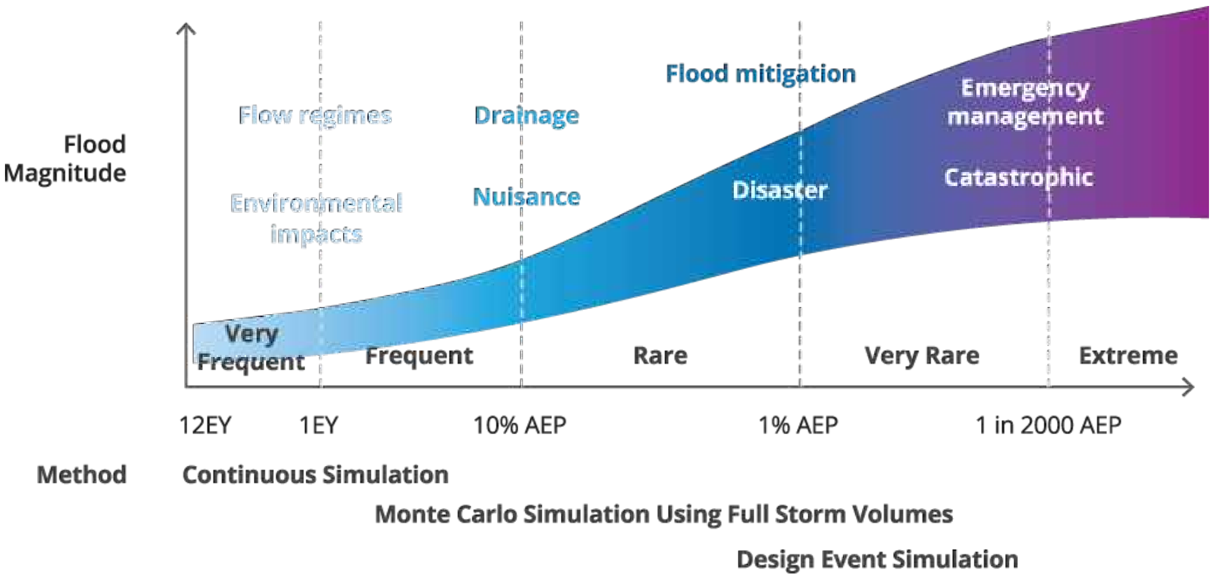

Figure 9.3.2. The Full Spectrum of Flood Events (Adapted from Weinmann (2007))

Figure 9.3.2 highlights the evolving methods of analysis, including continuous simulation and Monte Carlo simulation of full storm volumes that are likely to be required to account for the full spectrum of rainfall events as defined by Exceedance per Year (EY) or Annual Exceedance Probability (AEP). The definition of rain events is currently a mix of assumptions regarding frequency and magnitude that is clarified in this version of ARR to allow effective advice on design of stormwater management schemes. This includes development of green infrastructure and microclimates with reduction of urban heat island effects.

Strategic use of water efficiency, rainwater, stormwater and wastewater at multiple scales can supplement the performance of centralised water supply systems to provide more sustainable and affordable outcomes (Victorian Government, 2013). These integrated strategies diminish the requirement to transport water, stormwater and wastewater across regions with associated reductions in costs of extension, renewal and operation of infrastructure (Coombes and Barry, 2014). This leads to decreased requirement to augment regional water supplies and long run economic benefits. These strategies also focus on restoring more natural flow regimes in waterways and they will be beneficial in reducing remedial works in waterways and will provide reduction in size or footprint of quality treatment measures (Poelsma et al., 2013).

Current approaches to stormwater management include separate design processes and infrastructure for flooding, drainage and water quality. Jurisdictional and institutional boundary conditions are often imposed on analysis (Brown and Farrelly, 2007; Daniell et al., 2014). Integrated design includes solutions that meet multiple objectives, the catchment boundaries of each element and aims to avoid redundant infrastructure. Realisation of these benefits is dependent on integrated design approaches that account for changes in the timing and volumes of stormwater runoff, and respond to multiple objectives. Analysis of the economic benefits of integrated designs and drainage networks should be evaluated across an entire system from the perspective of whole of society. The methods and objectives for estimating urban stormwater runoff and the design of pipe drainage networks from 1987 do not include these additional considerations.

A challenge to integrated solutions is presented by engineering and economic methods of estimating performance that are reliant on average assumptions and judgements as inputs to empirical methods of estimating performance. Consequently, optimum design based on average assumptions and model approximations may not represent the actual integrated response of a project.

Educated empirical input assumptions and estimation processes can be reasonably approximated as generic processes for known historical and static problems (Kuczera et al., 2006; Weinmann, 2007). However, these processes may not replicate performance of multiple solutions within a system. For example, with respect to intersection of local water cycle solutions with town planning processes and regional infrastructure and, therefore, cannot understand or value a system that changes runoff behaviour from the smallest distributed scales (from the ‘bottom up’) (Argue, 2017; Coombes and Barry, 2014; Goyen, 2000). For example, cumulative actions at the smallest scale, such as retaining stormwater in the soil profile on each property can produce significant changes in responses throughout urban systems as shown in Figure 9.3.3.

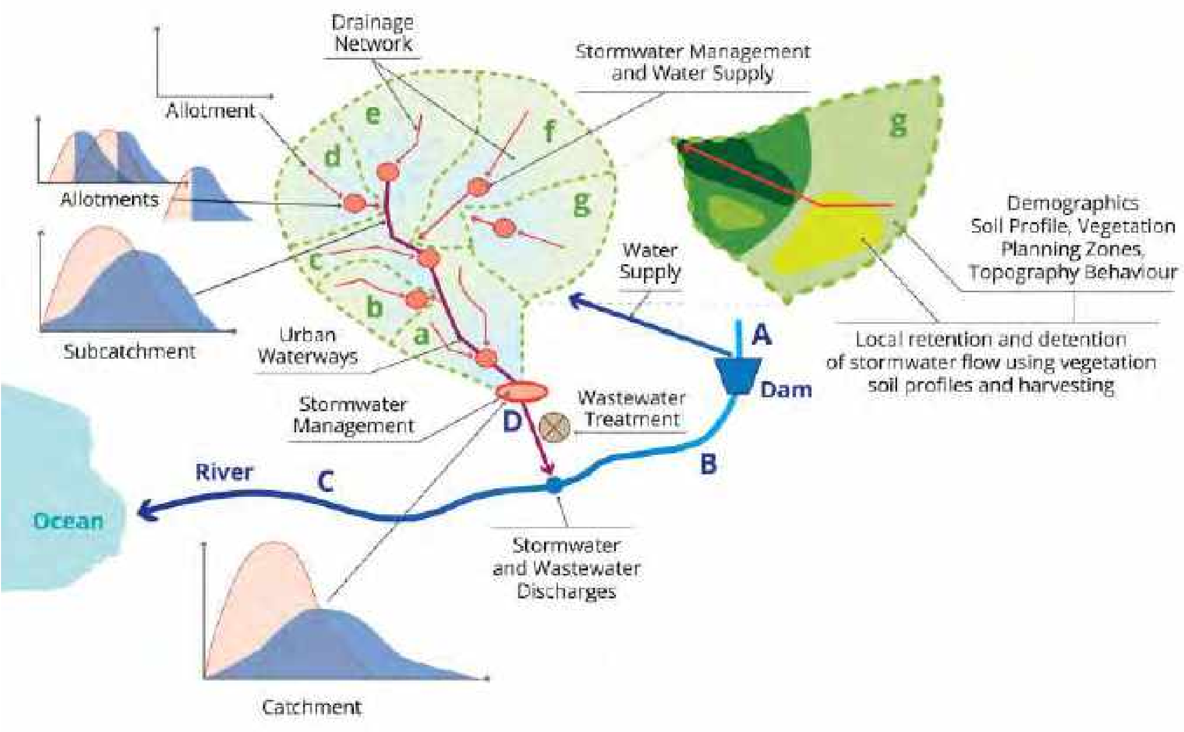

Figure 9.3.3. Cumulative Impacts of Distributed Management

It also follows that historical ‘top down’ design processes may not evaluate distributed processes because a small proportion of the available data may be simplified as whole of system average or fixed inputs (such as a runoff coefficient and average rainfall intensity). Thus, the signals of linked distributed performance (such as local volume management measures) in a system are smoothed or completely lost by partial use of data as averages and by the scale of analysis. Therefore, there is no direct mechanism to capture cascading changes in behaviours throughout a system. This can lead to competing objectives (For example: local versus regional), inappropriate solutions and information disparity such as provision of a wetland and retarding or detention basin downstream of an urban area when management is required within the urban area to protect urban amenity, stream health and avoid local flooding. This paradox can only be resolved through a broader analysis framework which recognises location based principles of proportionality and efficient intervention.

For example, consider the connectivity of contemporary water cycle networks presented in Figure 9.3.4.

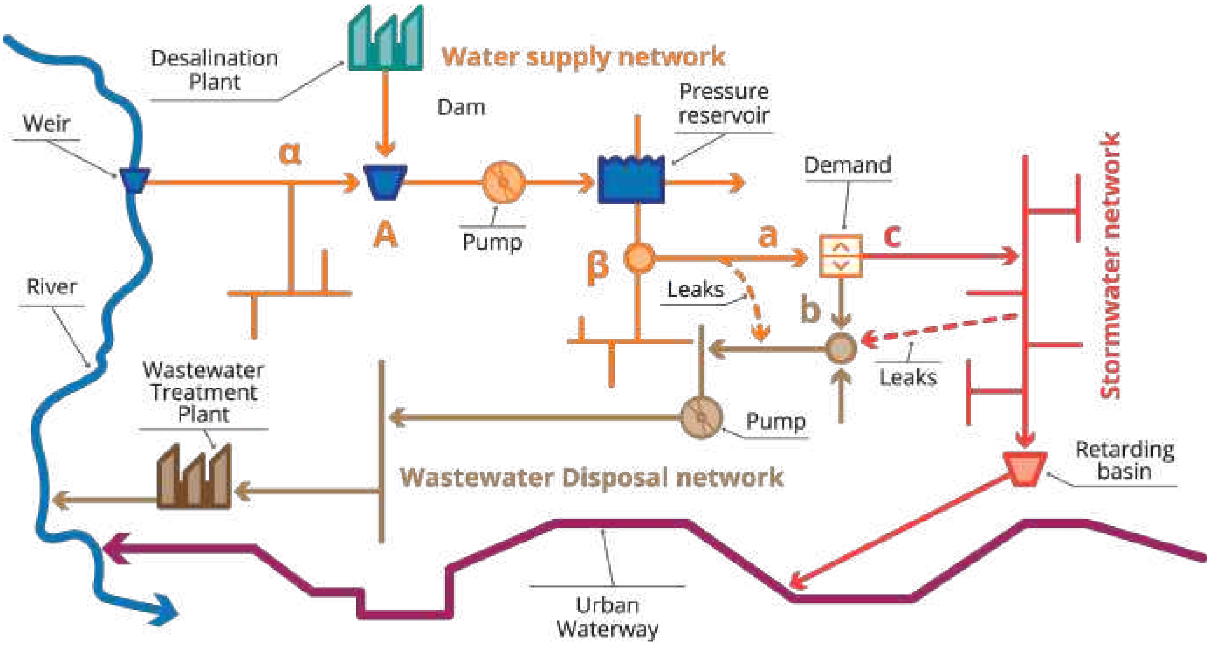

Figure 9.3.4. Schematic of the Connectivity of Urban Water Networks

Figure 9.3.4 shows that an input, or extraction at any point α or β, or an increase in water storage in a reservoir, at location A, will have some influence on flows and capacities at many other points in the system. These in turn, will translate into changes in performance and costs across the linked networks of infrastructure. Similarly, changes in behaviour (demand) at any point in the system will generate different linked impacts a, b and c on water, wastewater and stormwater networks respectively. Analysis and design of integrated solutions needs to account for the linked dynamic nature of the urban water cycle and demography. The inclusion of rainwater and stormwater harvesting, and wastewater reuse further increases the level of connectivity of urban water networks.

The historical practice for estimation of stormwater runoff rates and the design of drainage (conveyance) infrastructure is based on a methodology where all inputs, other than rainfall, are fixed variables. The fixed values of the input variables are selected to ensure that the exceedance probability of stormwater runoff is similar to that of regional rainfall statistics. However, catchments that contain cascading integrated solutions involving retention, slow drainage, harvesting of stormwater and disconnection of impervious surfaces require enhanced design methods (Kuczera et al., 2006; Wong et al, 2008; Coombes and Barry, 2008). These emerging methods for analysis and design of integrated solutions include the following considerations:

- Long sequences of rainfall that include full volumes of storm events are required to generate probabilistic designs of integrated solutions;
- Peak rainfall events may not generate peak stormwater runoff from projects with integrated solutions;
- The frequency of peak rainfall may not be equal to the frequency of peak stormwater runoff from integrated solutions;
- Stormwater runoff from urban catchments is influenced by land use planning, and the connectivity and sequencing of integrated solutions across scales;

- The probability distribution of the parameters that influence the performance of the integrated solutions (for example human behaviour, rainfall and soil processes) and the ultimate stormwater runoff behaviour are unknown for each project;

- Integrated solutions often meet multiple objectives (for example water supply, stormwater drainage, management of stormwater quality, provision of amenity and protection of waterways) and are dependent on linked interactions with surrounding infrastructure; and

- We should be mindful that the limitations of design processes are not always apparent and diligence is required to ensure that substantial problems are avoided.

In this situation, continuous simulation using historical or synthetic sequences of rainfall in a Monte Carlo framework may be required to understand the probability of stormwater runoff and the design of infrastructure (Kuczera et al., 2006; Weinmann, 2007). There are approximately 20,000 daily rainfall records with sufficient continuous rainfall records (more than 3,500) to allow continuous simulation using real or synthetic continuous rainfall records. Similarly, the designer can use ensembles of full volumes design storm event to test an integrated design solution. Assumptions and methods of analysis imposed by approval authorities in accordance with ARR 1987 can constrain the use of more appropriate analysis techniques required for better understanding the behaviour of integrated solutions. Similarly, a default requirement by approval authorities for drainage (conveyance) networks that are designed using peak storm bursts alone can limit the adoption of innovative and integrated solutions.

A combination of event based estimation techniques, directly or indirectly, may not reliably produce probabilistic design of drainage, water quality, and water or wastewater infrastructure within integrated strategies. While use of best available event based design approximations are an accepted default or deemed to comply approach for design of infrastructure, there is a need for more advanced methods for design of integrated solutions.

The absence of an integrated approach to design and planning in stormwater catchments may lead to missed opportunities and poor investment decisions, which ultimately results in higher costs with diminished social and environmental benefits (Coombes, 2005). Estimation of stormwater runoff and design of drainage (conveyance) networks for mitigation of urban flooding needs to be enhanced to provide integration with water cycle management within a systems framework.

The definition and purpose of minor or major drainage system is unclear in the context of modern approaches to water cycle management. Replacement of minor or major drainage descriptions with a definition of managing nuisance or disaster respectively, would provide a clearer focus on the relative importance of both concepts. To avoid nuisance, one may be too focused on a prescriptive drainage approach to the minor system. A well-designed major system to avoid disaster is likely to allow more opportunity for integrated solutions that will also mitigate nuisance. We also need to be cognisant that water supply and stormwater quality options can also assist in avoiding disaster and mitigating nuisance.

3.4. Urban Flooding

Urban flooding may include overland (pluvial) flooding and fluvial flooding (river and creek flows). This distinction can be important as the two types of flooding have different behaviours that may require particular analysis and management approaches.

3.4.1. Overland Flooding

Overland flooding is typically generated by short durations (minutes to hours) of intense rainfall on small catchments up to approximately 1 km^2 in area. This rainfall causes significant concentrations of surface runoff at low points and depressions throughout the urban topography. These concentrations of flows continue downslope and discharge into larger natural waterways with defined banks such as creeks, rivers or lakes where flows become fluvial in character.

Overland flooding can be responsible for significant damage. Adequate major flow paths must be provided or retained to manage these events. A stormwater management strategy is required that includes systematic identification of overland flow paths and design practices that recognise and respond to overland flood risks. Simple design practices such as slightly elevating property and floor levels above the surrounding terrain can effectively eliminate most overland flood risks.

Approaches to analysis have been developed in recent years to assist identification of overland flow paths that involve use of two dimensional hydrodynamic models where real and design rainfall events are applied throughout sub-catchments. These methods use digital terrain models of land profiles that are usually derived from LiDAR and aerial photogrammetry information. Hydrodynamic models can predict the accumulation of runoff across these surfaces and the generation of concentrated flows. Depth and velocity depth thresholds can be applied to model outputs and mapped spatially to allow identification of the most significant accumulation of flow. A map of a fluvial flow path prepared using a two dimensional hydraulic model is presented in Figure 9.3.5.

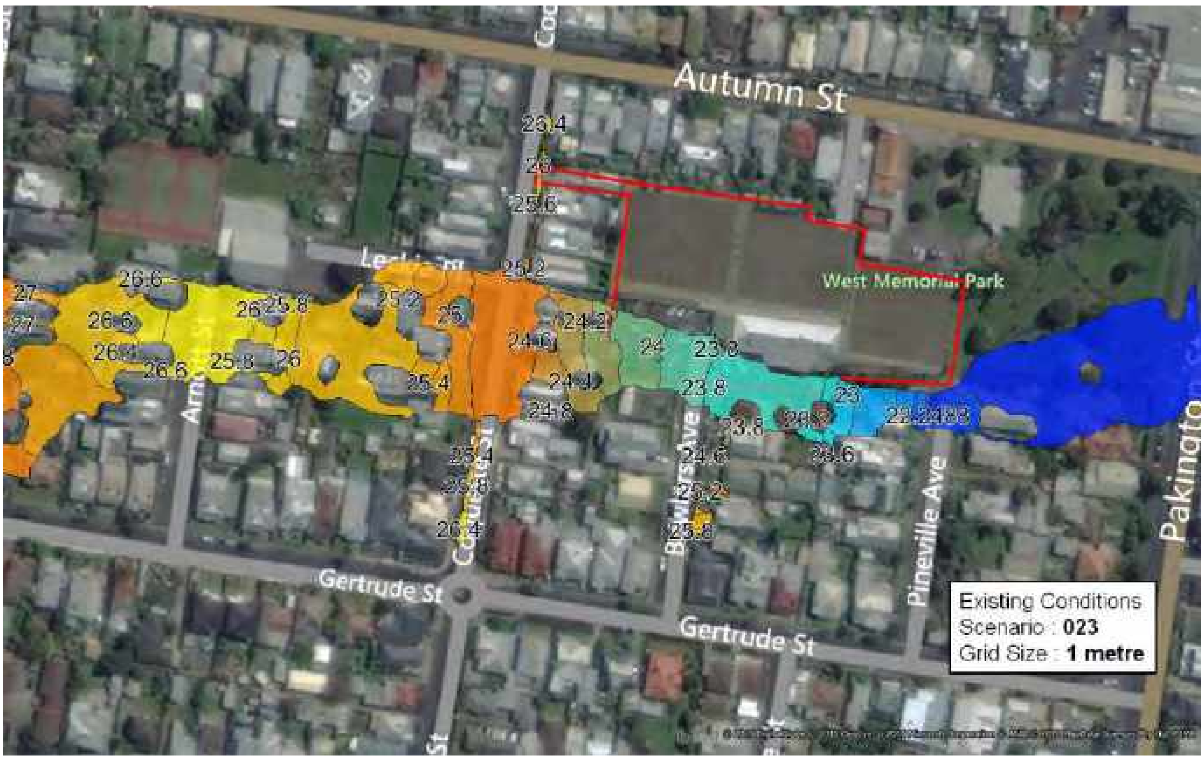

Figure 9.3.5. Example Overland Flow Path Map Generated Using a Two Dimensional Model.

This modelling approach is complex and is undertaken by a designer with suitable experience to ensure reliable outcomes. However, successful application of this method can be efficient and reveal a range of important stormwater management issues, including overland flow paths.

Approaches to analysis with less complexity may be more practical for smaller areas or simpler stormwater management strategies. This may involve the capture of detailed ground survey and inspection of the data by a suitably experienced designer to manually estimate the location of low points and likely flow paths. Simple hydrologic and hydraulic calculations (refer to Book 9, Chapter 5) could then be applied to estimate the depth and width of stormwater at regular intervals throughout overland flow paths.

Caution should always be employed when interpreting the mapping of results for stormwater flows and inundation as there may be significant uncertainties about the results caused by:

- obstructions to flow paths such as buildings and fences;
- rapidly changing flow conditions throughout a flow path;
- limitations in the accuracy of survey information; and
- limited opportunity for calibration.

The application of two dimensional modelling approach produces results that reveal hydrologic uncertainty due to use of the hydraulic model to simulate the natural physical processes of stormwater flows. These results may be in contrast to empirical or statistical relationships between rainfall and runoff that are used to estimate stormwater runoff in some traditional hydrologic modelling software.

Identification of overland flow paths allows development of stormwater management strategies. These may include:

- mapping of flooding to promote public awareness of flood risks;
- education about flood risks;
- investigation of potential upgrades to stormwater management networks; and
- building and development controls.

Flood warning emergency systems are usually inappropriate for overland flooding, as the potential warning times are too short. However, incorporation of overland flooding information with radar rainfall forecasts may assist in providing emergency management warnings.

Building and development controls should include provisions that prevent the erection of new buildings within overland flow paths or set minimum floor levels that are deemed safe. Other building controls may also require measures that minimise potential blockage and obstruction to flows within effected building envelopes. Application of these controls to particular sites may require detailed site-based flood investigations to more accurately estimate flood levels and behaviours.

A freeboard allowance above a calculated flood level is applied to determine the minimum level of infrastructure such as a habitable dwelling. Freeboard is required to account for the uncertainties that are inherent in the calculation of flooding. A typical minimum value of 0.3 m above a flood surface is suggested. However, this value can be varied to account for local factors such as the sensitivity of specific infrastructure to flood damage and expected uncertainty in estimates of flood level estimates for a site. Uncertainty about flood levels are variable and dependent on many factors including the nature of the catchment and the cross-sectional profile across the flow path.

Freeboard should not be used to protect against measurable uncertainties for example risk of blockage and climate change. If these risks are a concern for the site then they should be explicitly incorporated into the basic flood level estimates before freeboard is applied.

3.4.2. Fluvial Flooding (River and Creek Flooding)

Fluvial flooding is often referred to as river and creek flooding, and is generally caused by long durations (hours to days) of intense rainfall across large catchments. These catchments range in area from 1 km^2 to many thousands of km^2. Excess runoff from these catchments accumulates and is concentrated as flows in creeks, rivers and lakes that have natural features such as a main channel and defined banks. Stormwater escapes the main channel at locations where hydraulic capacity exceeded and caused inundation of surrounding land. This flooding can occur across vast areas of flat or low-lying terrain. The extent of flooding can be quite narrow and well defined at locations where the natural topography is incised. Fluvial flooding is generally easier to analyse than overland flooding because the channels are more readily identified and represented using computer models.

This type of flooding is natural. However, careful urban planning is required to avoid substantial damage to infrastructure and property. Fluvial flooding is recognised as one of the most significant natural hazards in Australia that is responsible for a significant proportion of economic losses and damage to property. Therefore, fluvial flooding has been the target of significant government programs for mapping of flood hazards and implementation of measures that mitigate potential economic losses and damage to property.

Fluvial flooding is a constraint to urban stormwater management that needs to be understood as it may heavily influence the type's solutions that are proposed. Numerical methods for the estimation of flood behaviour and identification of fluvial flood hazard are well established and tested. These methods are described in Book 6, Book 7 and Book 8.

The management of hazards created by fluvial flooding differs from overland flooding as the quantity of floodwaters can be much greater and therefore more difficult to control and contain using physical changes to the floodplain. It is often preferable and more cost effective to avoid these hazards using a process of careful urban planning. This is best achieved by the use of strategic plans and a suite of flood related building and development controls.

Public flood awareness mapping, flood education, flood mitigation and flood warning emergency systems become more important where development has already occurred within parts of the floodplain subject to fluvial flooding. Catchments that generate fluvial flooding are often large and the lag between rainfall and runoff can be sufficient which increases the feasibility of flood warning and emergency management strategies.

3.4.3. The Overland and Fluvial Interface

There is often an interface zone within catchments where both fluvial and overland flow paths may exist and differentiation between the two types of flowpaths becomes subjective. For example, a small gully drains through a town directly into a major creek as presented in Figure 9.3.6.

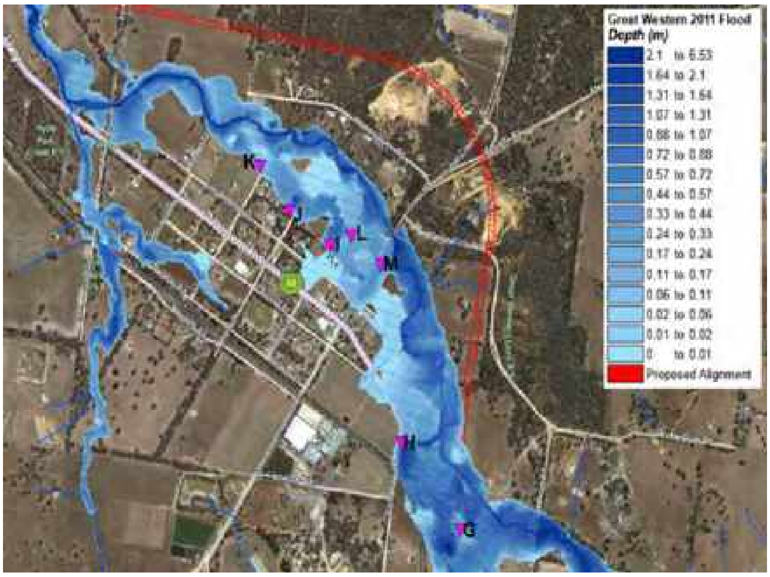

Figure 9.3.6. Example of Fluvial Flow Path with Interface with Overland Flow Path

Analysis of stormwater management strategies at the interface zone requires first principles assessment of management techniques from the perspective of both overland and fluvial flooding.

Both types of flooding can occur simultaneously. However, this is unlikely since the rainfall mechanisms that typically cause each type of flood are different. It is more likely that overland and fluvial flooding will occur at different times and possibly not during a single rainfall event. This complex behaviour can confuse attempts to communicate flood risks and implement management strategies. Confusion also arises when insurance claims are made for loss and damage because the decision to pay a claim sometimes relies upon whether the flooding was overland or fluvial in nature. In addition, the insurance industry has begun to offer fluvial flood insurance cover, which may reduce this problem in future. Nevertheless, it is important for practitioners to recognize the potential for both forms of flooding and carefully assess flood behaviour at each site and for each flood event from first principles.

3.5. Conveyance Systems

A typical stormwater (drainage) conveyance system must convey a wide range of flows within a confined corridor of land (refer to Book 9, Chapter 5). At the same time the system must meet appropriate standards of flood safety and be delivered for low life-cycle cost. This challenge is best addressed through application of a design approach referred to as a 'major and minor stormwater management system'.

A Major and Minor Stormwater Management System Has Two Parts:

- The minor system manages nuisance. This runoff is conveyed in a manner that maintains safety, minimises nuisance and damage to property. The infrastructure is also provided to avoid potential maintenance problems for example ponding and saturation of designated areas. Importantly, the minor system also includes volume management measures that aim to hold water within urban landscapes and sub-catchments (refer to Book 9, Chapter 4) – these solutions may include ponding of stormwater within a defined area. The minor system must withstand the effects of regular stormwater inundation.

- A major system primarily intended to mitigate disaster. The major system typically includes overland flow paths on roads and through open space, and trunk conveyance infrastructure. This system conveys additional stormwater runoff produced during larger less probable and rarer storm events with the intent of managing the potential for flood disaster. Overland conveyance of stormwater from large events is potentially hazardous due to the velocity and depth of flows, and must be safely contained within a defined corridor of major system flows.

3.5.1. Capacity to Manage Flooding

The overall combined capacity of the major and minor drainage system to manage flooding or inundation needs to be established for each design. This capacity is normally expressed in terms of the exceedance probability of design rainfall, creating a flood that must be contained within the conveyance or drainage system. It is common practice to set the capacity of the major system at a similar exceedance probability as the flood event used for regional flood planning (e.g. 1% AEP discharge).

However, there may be justification to deviate from this practice where a suitable risk assessment identifies the need. For example where the consequences of flooding at a particular location are high, it may be necessary to expand the overall system capacity to cater for more extreme events. This is not commonly required and this type of decision must have regard to the overall life-cycle cost and benefits that a larger capacity system may deliver.

The threshold at which the capacity of the minor system is exceeded and the major system begins to convey runoff is also a matter for consideration at the design stage or for policy makers at the time when preparing local design standards for stormwater management. The capacity of minor system is typically established to manage stormwater events ranging from 50% AEP to 5% AEP. Documentation of these standards can be found in drainage design guidelines prepared by local government and relevant state authorities. No single universally appropriate capacities of minor systems can be applied in practice.

Some factors that may influence the balance between the capacity of major and minor systems are described in Table 9.3.1. These factors may generate a number of different capacity standards for minor systems that account for different locations and jurisdictions.

Table 9.3.1. Factors Influencing the Balance between Capacities of Major and Minor Systems in Design

Factor	Description
Land availability	Sufficient land may be available for major systems to safely convey additional surface flows and reduce the proportion of flows conveyed by minor systems. The use of volume management and WSUD approaches can also change the proportion of flows assigned to minor and major systems.
Local rainfall patterns	In some areas, such as tropical northern Australia, runoff generated by frequent storms may be too large to cost effectively convey using minor systems. Major flow paths will need to be expanded accordingly to manage a proportion of these flows.
Likely level of exposure to the major flow path hazard	Major systems that are highly frequented by people or vehicles, for example in city streets or major motorways, involve greater exposure to floodwaters and corresponding risks. In these cases, it may be appropriate for a greater proportion of runoff to be conveyed in minor systems.

Factor	Description
Physical and downstream constraints	When new stormwater management systems are required for an existing urban area, it may be impractical or cost prohibitive to achieve an ideal capacity and compromise may be required.
Erosion	Natural or otherwise unlined minor systems may be subject to erosion when flow durations and or velocities are too high. If volume management options (as discussed in Book 9, Chapter 4) are not available, then lowering the capacity of the minor systems and forcing a greater proportion of flow into the major system may be one way to manage these effects.
Blockage potential	Where the capacity of minor systems is reduced by a likelihood of blockage with debris, resources should be directed towards safer and more durable surface flow paths within major systems.
Climate change	The expected future increases in short duration rainfall intensities may require appropriate design responses to increase the capacity of minor systems or change the relationship with major systems to maintain current levels of service.

3.5.2. Alignment and Configuration

The characteristics of urban form including the layout of roads, location of urban parkland and topography will influence the alignment and configuration of stormwater management networks. It is difficult to modify the stormwater management network after installation. A design process should aim for a long service life. Concept planning for major and minor stormwater management systems should therefore be undertaken carefully as an early task in the design of new urban developments.

The depth and velocity of flows along any proposed surface flow paths are considered when calculating the dimensions of stormwater conveyance corridors and must meet relevant standards for design, safety and maintenance. A design should also ensure that operation of a conveyance network during severe storms does not cause unexpected or catastrophic consequences (for example, an unintended diversion of flows into an adjoining catchment because of blockage or extreme events).

Wherever possible the width of the land corridor set aside for stormwater management should be generous to improve the constructability of the system and reduce the costs of any future renewal and maintenance activities. Opportunities for co-location of stormwater management within urban parklands should be considered. The alignments of stormwater conveyance networks typically follow natural low points to minimise earthworks. However, some re-alignment away from the natural low points may occur to account for urban form and limit conflicts with other urban infrastructure. However, the design of conveyance networks should also consider minimising damage to existing ephemeral waterways.

Alignments of major systems are often parallel to minor systems and should be continuous until intersection with a natural watercourse or receiving waters. The design should include adequate management to avoid nuisance or risks at crossings, for example roadways or footpaths.

Configuration of stormwater management strategies (including conveyance networks) will depend on the land use within and alongside the selected overland flow paths (refer to Book 9, Chapter 5). This configuration may also vary throughout a stormwater management solution. Some of the typical configurations deployed in Australian design practice are presented in Figure 9.3.7. The most common configuration (shown in Figure 9.3.7) comprises an underground conveyance (inlet structures and pipes) network (minor system) within surface flow paths on roads (major system).

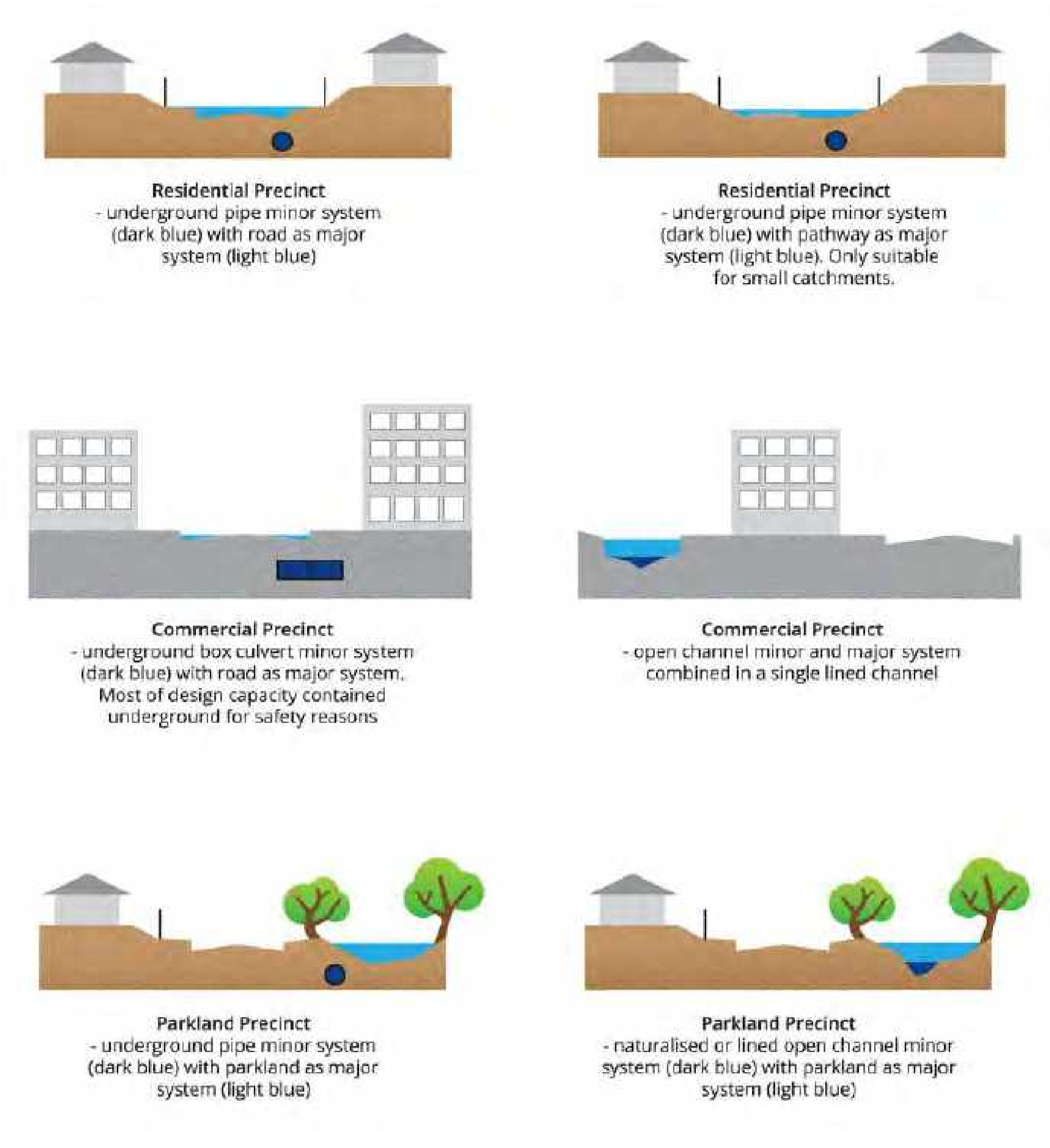

Figure 9.3.7. Typical Configurations of Major Minor Conveyance Systems Deployed in Australian Practice

The design of the major and minor systems should integrate smoothly with other urban infrastructure and manage impacts on natural environments. In particular, innovative design of urban parks can be used to achieve drainage objectives while also enhancing aesthetic and environmental outcomes.

Innovative approaches to stormwater management strategies can reduce construction costs and requirement for land area. This opportunity should be given early consideration in the concept design phase from perspective of multi-disciplinary teams.

3.5.3. Analysis

Suitable hydrologic and hydraulic calculation methods, described in Book 9, Chapter 4, Book 9, Chapter 5 and Book 9, Chapter 6, are used to estimate depths and velocities of stormwater flows with associated extents of flooding throughout major and minor systems, which facilitates the design of various components. The methods selected for analysis or design must be able to simulate the complexity of the stormwater management strategy. A design problem may include complex flow behaviours, for example parallel underground and surface flow paths, multiple inflows and the effects of storage and tail water conditions.

These methods must have the capacity to predict the hydraulic performance of the overall system and of each different component within the system for example inlet structures, pipes and channels. Hydraulic performance must be assessed using a range of storm events and configurations. Ideally, a design should be challenged by ensembles of full volume storm events to determine the critical storm duration and shape for each AEP.

The available software modelling tools can facilitate most of these complex calculations. However, emerging engineering practice and software tools aim to seamlessly handle the full range of linked hydrologic and hydraulic calculations required to account for surface flow behaviours throughout complex conveyance networks. These complex scenarios may require combinations of hydrologic models linked to hydraulic models with one dimensional conveyance network and two dimensional surface flows.

3.6. Stormwater Volume Management

3.6.1. Key Considerations

The historical practice of designing urban stormwater management has traditionally focused on peak flows and conveyance. Design standards have evolved to require comprehensive management of hydrologic changes created by urbanisation. It is now recognized that volume and regimes of stormwater runoff need to be managed (Beven and Alcock, 2012; Poelsma et al., 2013).

Typically, this is achieved through the design and installation of volume management facilities. Detailed aspects of these facilities are described in Book 9, Chapter 4, however at a philosophical level the questions that need consideration when developing a catchment-wide volume management strategy are:

What are the Volume Management Objectives for the Catchment?

Volume management objectives can include control of peak discharge, harvesting or infiltration of water and water quality treatment (refer to Book 9, Chapter 4, Section 2). These objectives are achieved using a volume management facility (either a single facility or a number of them) which can store and release runoff at different times, or even store runoff for later use.

The impact on downstream floodplains and receiving waters must be determined by assessing the catchment–wide consequences of compounding peak flow and volume discharges (increases in runoff volume and peak discharges) from different sub-catchments, as well as increased duration of flows in ephemeral aquatic ecosystems. This impact assessment will then help inform a decision about the volume management objectives to be pursued.

Phillips and Yu (2015) suggest whilst undertaking these assessments, catchment managers should also consider whether to use an ensemble of complete storms with a storm burst of around the critical duration or a storm burst only to determine the benchmark condition(s). The decision of what design to adopt can be informed through identifying the level of risk the community is willing to accept within the catchment.

Should the Objectives be Achieved in Combined Facilities?

It is preferable to provide infrastructure that meets multiple objectives. Where multiple volume objectives are sought for the catchment, it is possible to design separate volume management facilities that each target only a single objective.

For example, a facility might only manage peak discharge from a site for a single probability design flood event used for regional flood planning (e.g. 1% AEP). This might be achieved by storing a proportion of the hydrograph volume and releasing it later during the storm event through a constricted outlet. This is commonly called a detention basin or retarding basin.

Separate facilities might be required to also meet other stormwater volume objectives for example a rainwater tank for harvesting and a bio-retention basin for water quality improvement.

A more comprehensive facility might aim to achieve a peak discharge control objective alongside other volume objectives, by storing a proportion of the hydrograph volume and releasing it well after the storm event has finished, or even store it for later use (i.e. not released into the stormwater system at all). For example a constructed wetland (water quality) with an extended detention storage compartment above (peak discharge control), providing pre-treatment for a stormwater harvest facility (retention).

What is the Performance Level Sought?

For each facility and objective it is necessary to determine whether the facility must achieve a low or high level of performance.

For example, it may be sufficient to retain the hydrologic conditions equivalent to a pre-developed condition, which might be considered a low level of performance.

In some circumstances a higher level of performance might be required, for example, a return of hydrologic conditions back to a natural state.

The performance level sought will be related to the sensitivity of the downstream receiving waterway and whether the local community aspires to achieve a high performance solution.

Where should Volume Management be Achieved in the Catchment?

In some circumstances, there is opportunity to make broad strategic decisions about the distribution of these facilities across a catchment. Some typical volume management strategies that can be followed include:

- An ‘at source’ management strategy: this employs small facilities, widely distributed across the catchment, many of which will only service a small catchment or single property. Strategies of this type are most commonly part of a more comprehensive and integrated urban water strategy.
- A ‘neighbourhood scale’ management strategy: this strategy employs larger facilities that are less widely distributed than lot scale facilities but servicing larger catchments. These facilities are normally publicly managed and co-located alongside a watercourse or drainage reserve at the interface between underground and surface conveyance paths.

- A ‘regional scale’ management strategy: this strategy uses very large facilities that are located at the catchment outlet and service all properties in the watershed. These are normally publicly owned and co-located with major parkland. This is also referred to as an ‘end of pipe’ strategy.

How does Existing Urban Development Influence the Volume Strategy?

Some typical types of urbanising catchments and their associated volume strategy considerations are:

- **Future growth areas** where there is currently limited urban development (also commonly referred to as ‘Greenfields’ development). For these catchments the over-riding strategic objective commonly applied is to preserve the nature and amenity of their waterways in terms of hydrology (flow and channel geometry) and aquatic communities. This can be achieved using ‘source control’ measures applied throughout their contributing catchments. These measures include rainwater tanks, bio-retention facilities, ‘rain gardens’, infiltration trenches, ‘soakaways’ and access to aquifers where soil and geological conditions are favourable.

  Since there is often opportunity to forward plan in ‘greenfields’ catchments there may also be opportunities for comprehensive ‘neighbourhood scale’ and ‘regional scale’ placement strategies.

  Every effort should be made in these catchments to encourage 'informal' drainage, green spaces and to disconnect as much impervious surface as possible. The criterion for successful design of these systems is keeping the volume discharged from each site the same after development as before, for design flood events. Use of these practices, is referred to by Argue (2017) as a ‘regime-in-balance’ strategy. It is suggested that adoption of such a strategy can keep urban waterways operating as natural systems for many years before increased urbanisation might then require the introduction of rectification strategies such as increased channel lining.

- **Highly urbanised catchments** where the strategic objective is often to minimise the need for further modification or upgrades to conveyance networks as development and re-development continues. For these catchments land availability may constrain opportunities for wide adoption of ‘neighbourhood scale’ and ‘regional scale’ placement strategies. However volume management objectives can be achieved in a similar manner to a ‘greenfields’ catchment using ‘source control’ practices as re-development takes place. An additional opportunity, ‘roof gardens’, is provided by the presence of multi-storey and high-rise elements of this class of development.

  The objective for successful design of these systems is keeping the volume discharged from each site the same after development as before, for a design flood event. This objective is more difficult to achieve than in ‘greenfields’ catchments giving rise to the more common use of temporary on-site storages holding stormwater after flood peaks have passed. This problem can be solved by ‘slow release’, infiltration or harvesting to ensure storages are empty ahead of closely-spaced storm events. With such provisions in place, the supporting infrastructure can continue to operate successfully without enlargement.

  Prediction of Australia’s urban growth to mid-21st Century suggests that development within catchments of this type will provide the majority of new urbanisation.

- **Over-developed catchments** are a particular case of highly urbanised catchments described above, and apply to many of our older, inner-city suburbs. These catchments are characterised by frequent episodes of flash flooding and resulting community disruption.

The criterion for successful design of these systems is not just to match pre-development conditions but to go further and minimise the volume discharged from each site after re-development. This is referred to by Argue (2017) as the 'yield-minimum' strategy. The nature of re-development in an already over-developed urban catchment is frequently large-scale, for example urban renewal projects. These lend themselves to complete re-organisation of local drainage infrastructure and, hence, opportunities for less discharge during the 'design' runoff events. Every component of re-development incorporated under the 'yield-minimum' strategy moves the catchment in the direction of a balance between runoff being generated and infrastructure capacity.

Are There Other Constraints that may Influence the Strategy?

Catchment managers will also need to take into account the local landscape and soil conditions, which may limit the application of certain volume and quantity management solutions. For example, heavy clay soils may limit the application of infiltration based solutions, whereas sandy soils may promote such solutions.

Other examples of constraints that may have strategic influence are:

- sensitive riparian vegetation communities
- land ownership and development patterns, and
- different choices may be required depending on the nature of the catchment and the asset policies of the local stormwater authority.

3.6.2. Selecting a Strategy

Once the above questions have been considered it might be appropriate to establish and document a catchment-wide strategy for stormwater volume management. Such a strategy should be used to assist with the design and assessment of individual volume management proposals.

Typical catchment management strategies (as designed using bottom up or top down methods or other analyses) can include a number of different approaches which reflect the local authority's commitment to WSUD principles, as well as commitment to restore overloaded systems to balance.

Three examples of management strategies for catchment-wide volume management are provided by Argue (2017). These are consistent with the risk management framework discussed in Book 1, Chapter 5 and are defined as follows:

Yield-maximum: maximise the quantity of storm runoff captured at the end of the catchment and ensure that the floodwaters are contained within a defined floodplain. This strategy is most suitable for local authorities with a desire to have large centrally controlled systems, rather than distributed local solutions.

Regime-in-balance: maintain the harmonious and synergistic relationship that exists between continuing urban development and 'acceptable' use of the floodplain for agricultural and amenity pursuits. This strategy is most suitable for catchment or sub-catchments where development has occurred or is likely to occur and will discharge to a nearly intact or sensitive receiving environment.

Yield-minimum: improve the performance of the urban flood control infrastructure through minimisation of stormwater discharge from each development site (including redevelopment sites). This strategy is most suitable for catchment or sub-catchments with already poorly controlled urban development with a history of flood damage and ecosystem deterioration.

Large catchments, where urbanisation is actively occurring, and over an extended period, may contain precincts where a mix of these strategies might be appropriate. Notably, all strategies will benefit from urban planning that promotes rainfall infiltration, harvesting and retains natural hydrologic function.

3.7. Stormwater Offsets

Tradeable permits or offset schemes are also known as market mechanisms and are established methods within the pollution control industry, in water markets and for management of nutrient or salinity loads in river basins. These processes commonly involve financial contributions paid by a landholder for provision of pollution control works at another location, construction of an alternative mitigation scheme instead of a conventional solution in the landholders development site, or the sale of a water licence from a landholder to another landholder at another location.

Tradeable permits for pollution control are attractive as they provide opportunities for economic efficiency, flexibility and incentives for innovation (Kraemer et al., 2004; Haensch et al., 2016). The international experience with water pollution emission trading is not extensive but does include some successful examples (Shortle, 2013). Trading of pollution abatement responsibilities can cause water quality to deteriorate at different times and rates in some parts of a catchment. Therefore designing a tradeable permit or offset scheme needs to take spatial, temporal and environmental equivalence effects into account.

At the time of writing, Melbourne Water (MWC, 2018) and Queensland Healthy Waterways (Water by Design, 2014) (for example) operate stormwater quality offset schemes. These schemes involve a financial contribution paid by developers for stormwater management works to be undertaken in another location to meet catchment wide objectives for managing stormwater and protecting waterway health. These schemes respond to the assumption that regional stormwater management is more cost and time effective than distributed smaller scale solutions. These off-set schemes can be useful for urban areas subject to infill development that may have limited space for infrastructure.

There are limited examples of trading or offset schemes for management of stormwater runoff volumes or peak flows. The District of Columbia Water and Sewer Authority (for example: DCWater (2018)) provide an impervious area charge incentive program for customers to reduce effective impervious surfaces and, therefore, stormwater runoff on their properties which avoids regional works. Properties that use best management practices such as rain gardens, rainwater harvesting, green spaces and pervious paving are considered to reduce effective impervious surfaces and results in a reduced stormwater charge. Similarly, the historical on-site detention (OSD) strategies by the Upper Parramatta River Catchment Trust (for example: UPRCT (2005)) offset the need for regional stormwater basins by use of detention storages (OSD) on properties.

Use of formal stormwater off-set schemes to transfer local management of stormwater volumes and peak flows to regional facilities is not common, but these types of approaches are embodied in most developer contribution schemes for regional infrastructure. Stormwater off-set schemes for management of runoff volumes and peak flows should include the following key principles:

- Transfer of stormwater management to another location should not negatively impact on surrounding local properties at any (legal) point of discharge

- The spatial, temporal and cumulative allocation of required treatment capacity must be defined using a catchment management strategy. It is unlikely that transfer of local stormwater management requirement to a downstream regional location will be a linear or average process

- A scheme must result in the desired and measurable changes in flow (and water quality) resulting from the infrastructure and stormwater strategies within the same catchment

- The funds obtained from stormwater off-sets must be tied to measurable deliverables in the catchment

- The scheme must provide for regional infrastructure in a reasonable time period that is consistent with the timing of upstream development.

- The relative financial contributions from upstream developers must be proportional to their flow and pollutant loads that will be managed by the regional scheme

- The scheme must have the same life cycle or equivalent life cycle as the life cycle of the upstream development (e.g. short-term mitigation strategy, such as flow and erosion management, cannot be used for a long-term offset to a developed area stormwater management)

- If water quality is part of the scheme, consideration should be given to the bio-availability of pollutants removed through the different upstream and catchment wide management methods

- Clear ownership and rules about the off-set scheme should be established and risk should be mitigated through the adoption of appropriate ratios, and

- The ongoing maintenance and renewal costs associated with the regional infrastructure must be allocated to ensure the performance of the scheme does not deteriorate over time.

Stormwater off-set schemes that transfer management of stormwater volumes and peak flow to other locations have the potential for ecological impacts in local waterways or downstream receiving waters. The ultimate objectives of an off-set scheme should include performance targets that also consider secondary effects (such as impacts on local waterways) and monitoring strategies should be implemented to measure effects of strategies.

Chee (2015) highlights that there is limited evidence of success of stormwater off-set schemes and formal monitoring strategies would provide an opportunity to more critically consider the evidence of how well schemes that have been implemented and their operation. It is also emphasized that achieving equivalence in stream biodiversity and ecological function is extremely difficult.

Coker et al. (2018) argue that stormwater off-sets should not result in avoided management of stormwater runoff. They emphasize the substantial challenge of adequately considering spatial, temporal and environmental influences of off-sets, and the importance of quantifying the spatial extent of stormwater impacts from the development in question. It is highlighted that unmitigated stormwater runoff from relatively small proportions of urban areas may propagate severe impacts a long way downstream which can render the practice of offsetting within a single catchment a difficult undertaking.

3.8. Acknowledgements

This chapter benefited from the support and guidance provided by Mark Babister and Engineers Australia. The substantial contributions of the editorial panel of Andrew Allan, Andrew King, Stephen Frost, Mike Mouritz, Tony McAlister and Tony Webber in shaping this discussion are gratefully acknowledged. Additional review comments from James Ball, Bill Weeks and Christopher Walsh also assisted in clarifying the content of this paper.

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Chapter 4. Stormwater Volume Management

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Chapter Status	Final
Date last updated	14/5/2019

4.1. Introduction

Progressing from the urban stormwater philosophy discussed in Book 9, Chapter 3, this chapter provides introductory guidance on the design of 'volume management facilities'. These are discrete infrastructure measures in various forms and configurations, each of which are designed to store and release runoff volumes to manage the changes caused by urbanisation. They are linked by conveyance infrastructure (refer to Book 9, Chapter 5) to form an urban stormwater network.

This chapter focusses on the concept design phase of a volume management facility and outlines the detailed design process. Before applying the content in this chapter it is assumed that the general position of the facility within the catchment is already largely understood, and preferably informed by a catchment strategy, as discussed in Book 9, Chapter 3 and Book 9, Chapter 5.

Stormwater storages receive runoff volumes from the catchment via upstream conveyance infrastructure. The manner in which these runoff volumes are managed depends on the practice that is adopted. The storage and release of runoff changes the characteristics of the runoff hydrograph and is a fundamentally important feature of all volume management facilities.

There is considerable legacy terminology used to describe these facilities including detention (or retarding), retention, extended detention or slow release. These terms are a derivative of outlet structures and different operational strategies that change the behaviour of stormwater storages.

Stormwater storages designed in accordance with 'detention' practices include those where runoff is temporarily stored and simultaneously released via an outlet structure (Figure 9.4.1). This process typically lowers peak discharge and attenuates the hydrograph so that the average time of release is delayed. The storage volume and capacity of the outlet must be determined by catchment wide modelling to achieve target outflow peak discharges at the catchment outlet.

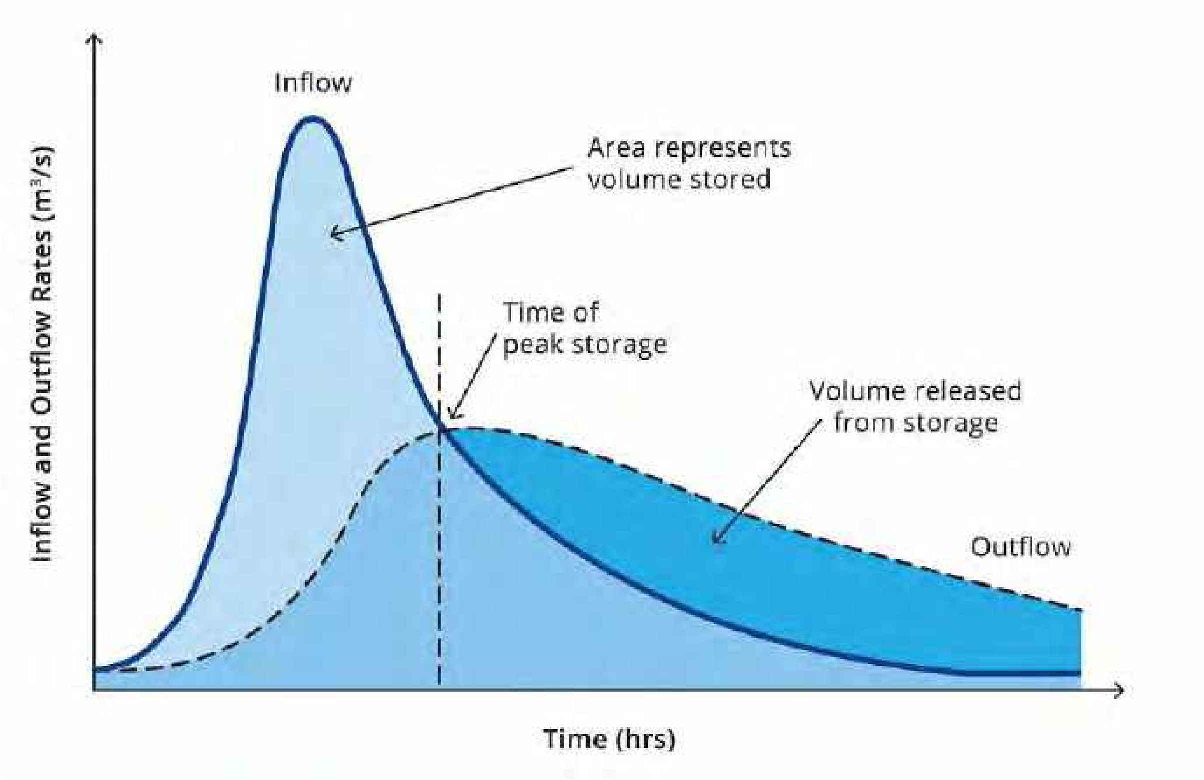

Figure 9.4.1. Typical Hydrograph Change Generated by a Temporary Storage (Without Harvesting)

Assuming the stormwater storage is empty at the beginning of a storm, the potential hydrograph change that can occur depends on:

- the outlet's discharge capacity relative to the peak discharge of the storm;
- the size of the storage basin volume relative to the total runoff volume from the storm; and
- the volume of water harvested from the storage.

As a general rule, if the storage volume is large relative to the total runoff volume, the greater the potential hydrograph attenuation that can occur. This performance also depends on the outlet capacity. A small outlet capacity relative to peak inflows will tend to favour attenuation of small storms and large storms it will overflow early, whereas a large outlet capacity will tend to favour attenuation of large storms and small storms will pass through the facility without attenuation in storage. While the storage and outlet structure are separate physical components of a volume management facility, they must be designed in an integrated manner since the capacity of the storage will effect the performance and sizing of the outlet structure and vice versa. This is a critical aspect of the design of a volume management facility with detention characteristics that requires an iterative approach to sizing.

Stormwater storages designed in accordance with 'retention' practices provide sufficient storage in the volume management facility to contain additional runoff from urban development. The volume of stored stormwater is then drawn down by infiltration, harvesting or slow release. Typical hydrographs of flows from a rural catchment and subsequent urban development of the catchment are presented in Figure 9.4.2. Inflow and outflow hydrographs which apply to a volume management facility used in a typical retention strategy, are shown in Figure 9.4.3.

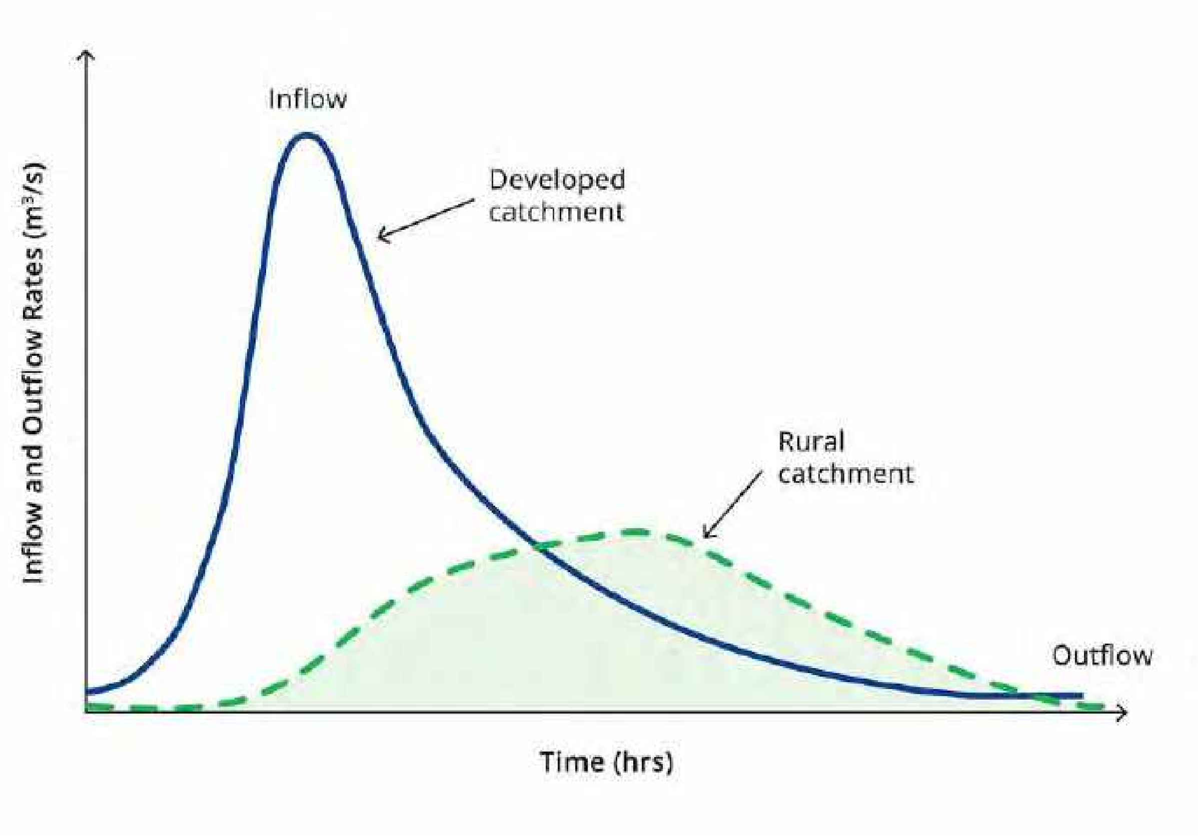

Figure 9.4.2. Rural and Developed Catchment Hydrographs

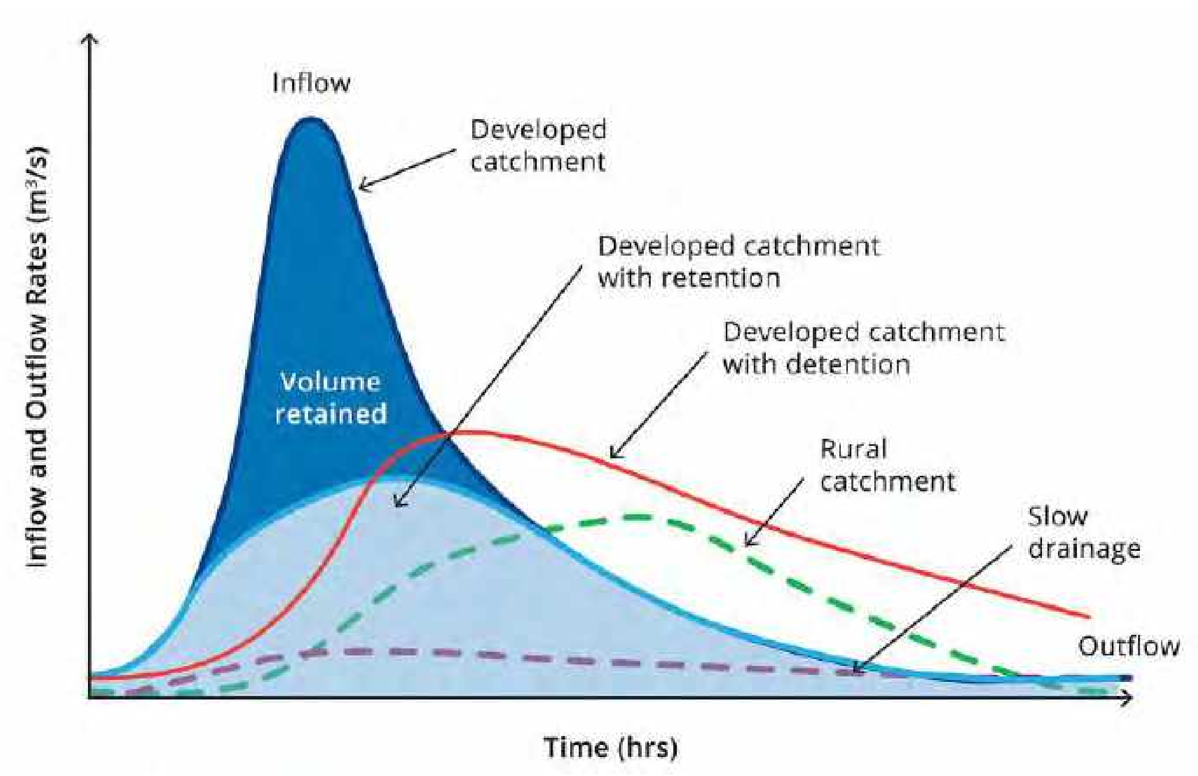

Figure 9.4.3. Developed Catchment with Retention as Compared to Detention and Slow Drainage Strategies

The hydrographs in Figure 9.4.2 represent runoff from a rural catchment and from the urban landscape developed on it. Ideal retention performance of the storage is reproduction of the rural hydrograph followed by outflow of the remaining stored runoff via slow release over a longer duration (typically greater than 24 hours). Argue (2017) outlines that it is difficult to achieve this outcome and recommends a storage volume equal to the total additional runoff expected from the development and the emptying time of volume management facility is a function of outlet infrastructure.

The outflow hydrograph resulting from this approach should be similar to that shown in Figure 9.4.3 (developed catchment with retention). A first approximation solution is likely to produce a different outflow hydrograph from the required result. Continuous simulation of the volume management facility is recommended with the aim of adjusting the design i.e. storage and outflow configuration, to produce the desired outflow hydrograph.

The concept design phase of volume management facilities commences with a thorough understanding of the volume management objectives intended for the facility (refer to Book 9, Chapter 4, Section 2). Once these objectives are defined, consideration can be given to the configuration of the facility and how its components might be sized and positioned to best meet the objectives and local site conditions (refer Book 9, Chapter 4, Section 3 and Book 9, Chapter 4, Section 4). Detailed design then follows to comprehensively define the facility to permit construction (refer to Book 9, Chapter 4, Section 5).

4.2. Volume Management Objectives

The design of a volume management facility must include objectives which are relevant to the site, the surrounding catchment and receiving waterways. A summary of the most commonly encountered volume management design objectives in Australian practice is provided in Table 9.4.1. Each objective has ‘associated benefits’ that are also listed to help distinguish the relevance of each objective to a particular site and design.

An adequate number of facilities are required within catchments to ensure that the controls will significantly affect peak discharges, volume targets and water quality targets at catchment outlets. A key aspect of the design of storage based measures is to ensure that the storages are empty or nearly empty at the commencement of a flood producing rain event. It is essential to determine the spectrum of design flood events that these facilities will manage (refer to Book 9, Chapter 3).

Table 9.4.1. Summary of Volume Management Design Objectives

Objective	Potential Associated Benefits
Control Peak Discharges This objective seeks to limit the peak flood flows and volumes discharging from a catchment to a pre-determined and acceptable level. Commonly the acceptable level is set at the natural or ‘pre-development’ condition. In some cases the acceptable level may be set below the natural condition in order to achieve a net benefit or offset an impact elsewhere. In highly developed catchments (infill development), the acceptable level may correspond to flows from the original development. These objectives may seek to change the total volume of stormwater leaving a site (retention), or delay the volume for a	• Reduced property flood damage • Reduced personal safety risks due to flooding • Reduced infrastructure damage • Reduced conveyance infrastructure

Objective	Potential Associated Benefits
short period of time (hours) (detention or retarding) which may reduce the peak of the flood hydrograph discharging from a catchment. Careful consideration of the spectrum of design flood events needs to be given and its impact on downstream receiving systems (for example stream forming flows and flood flows), which can result in 'slow release' systems. Emerging stormwater management practices seek to reduce the volume and timing of stormwater discharges from catchments. This combined approach is particularly relevant for managing stormwater runoff from increasing urban density (refer Book 9, Chapter 3). This objective is a very commonly sought outcome. It is of most relevance to urban catchments where there is a constrained floodplain downstream or sensitive ecosystem that cannot accommodate increase in peak flood discharges or volumes.	requirements (downstream)
Harvest or Infiltrate Rainwater or Stormwater This objective seeks to extract a proportion of the runoff volume from a catchment and either use this water for a consumptive purpose (i.e. consistent use to ensure draw down of storages), or infiltrate the runoff directly into local soils or subterranean aquifers (possibly for later extraction). These integrated design approaches can require interaction with soil properties, capacity of aquifers, urban form and demands of water (refer Book 9, Chapter 3). The designer should account for the elements in the design of a catchment wide strategy to ensure that adequate storage space is available in storages to achieve the objectives of the strategy. Analysis of these measures must include continuous simulation and the use of full volume storms to understand the required storage capacity for a given set of rainfall events.	• Maintain waterway stability and reduce scour • Maintain groundwater behaviour • Maintain hydrologic behaviour including natural runoff regimes • Increase volume of water stored in an aquifer • Increased availability of water for harvesting and use
Improve Water Quality This objective seeks to reduce concentrations and loads of contaminants within urban runoff to pre-determined and acceptable levels. This is achieved by: delaying some of the runoff volume for a period of time (hours to days) (detention), or storing part of the stormwater on-site (retention) and passing the retained water through treatment processes where physical, chemical and biological processes reduce contaminants in the water column. Storage of stormwater can also provide some limited water quality treatment through settlement, even where this objective is not necessarily sought.	• Maintain aquatic health • Maintain visual amenity • Improved water quality prior to discharge or prior to harvesting activities

An early design task should examine the relevance of the objectives from Table 9.4.1 for a design in the context of prior studies, investigations, catchment strategies and receiving waterbody conditions. This process allows the designer to establish a preliminary understanding of the behaviour of the site, the catchment and receiving system. Another important task is to check local stormwater authority and state government policy requirements and standards. In the absence of background studies and local authority guidance, the designer should critically assess the relevance of the above-listed objectives from first principles. The ‘associated benefits’ listed in Table 9.4.1 may assist.

Volume management initially emerged as a design consideration to control of peak discharges in catchments. This was driven by a need to manage flood impacts associated with development and an emerging understanding that the stormwater runoff behaviour of urban catchment is volume dependent. Nevertheless, the design process was driven by peak rainfall bursts rather than the full volumes of storm events. Progressively, as our understanding of urban impacts on waterways has broadened, standards have changed to the point where it is now quite common for the other volume management objectives listed in Table 9.4.1 to also be considered. Facilities that target these multiple objectives have a stronger business case and are therefore more commonly sought after in modern practice and use the full spectrum of storms to protect the downstream receiving systems.

If there are indeed multiple objectives sought for a design, it may be advantageous to design a single facility that will meet all the desired objectives. However, current stormwater management practice incorporates multiple solutions across scales to better manage risk profiles (refer Book 9, Chapter 3). Figure 9.4.4 shows how more than one design objective can be relevant to a site or a catchment, or an entire stormwater management strategy. For example, design objectives for a facility or a strategy may include:

- control peak discharges and harvest (or infiltrate) stormwater;
- control peak discharge and improve water quality;
- improve water quality and harvest (or infiltrate) stormwater; and
- control peak discharge, improve water quality and harvest (or infiltrate) stormwater.

Where possible the design process should pursue performance characteristics that target all the desired objectives. This goal is most likely to be achieved when a particular management strategy is selected as the primary objective, for example peak discharge reduction or water quality improvement, and the subsidiary objectives are incorporated by exploiting opportunities made available by the primary objective.

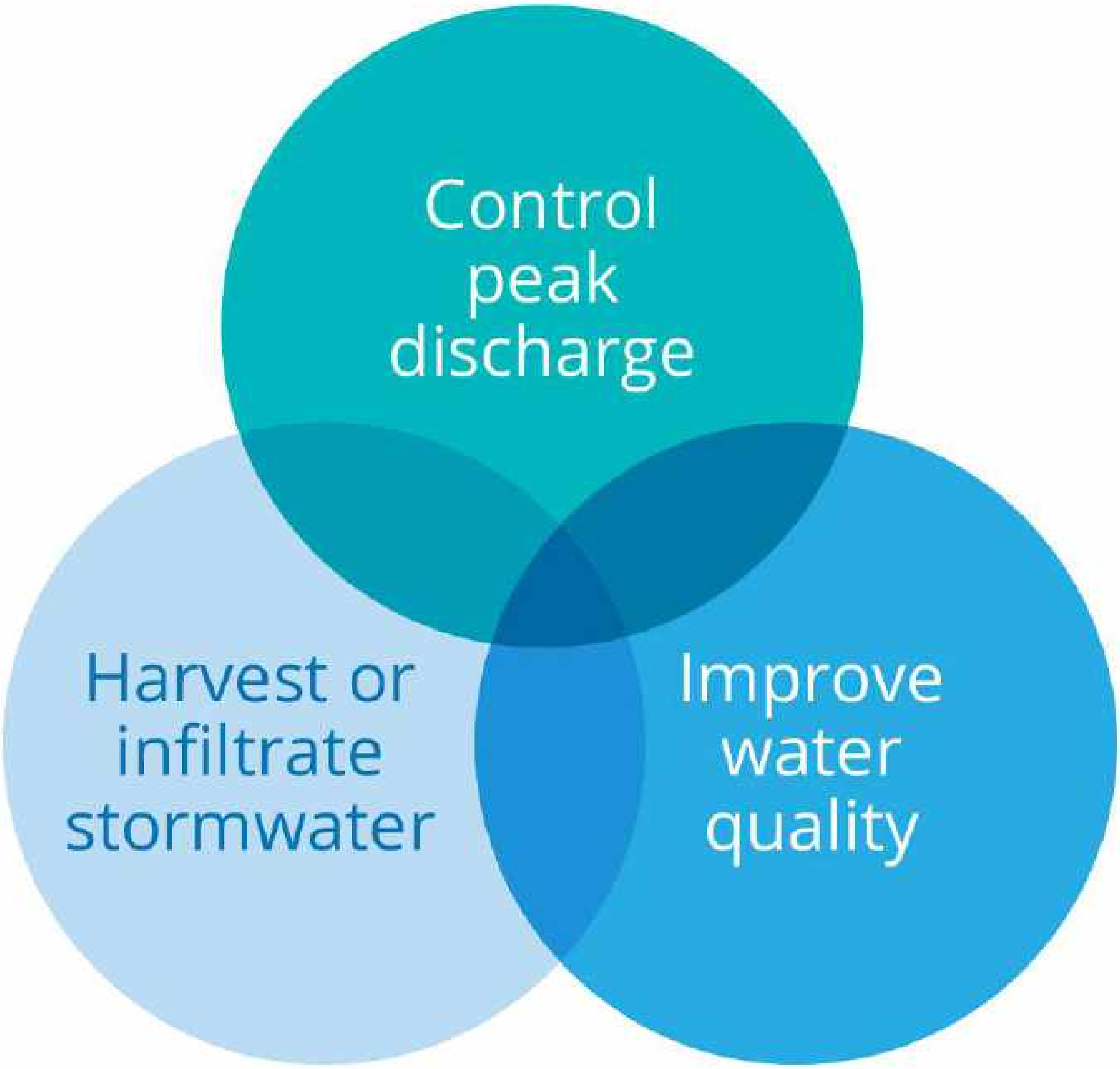

Figure 9.4.4. Potential Overlapping Volume Management Design Objectives

4.3. Components of a Volume Management Facility

4.3.1. Overview

There are up to four generic infrastructure components that are common to majority of volume management facilities; an inlet structure, storage, an outlet structure, and treatment media. These are described in Table 9.4.2.

Table 9.4.2. Volume Management Facility Components

Component	Purpose	Examples
Inlet Structure A conduit or flow path that controls the inflow into the facility and connects the	To transition flows from the upstream conveyance system into the storage device in a controlled manner (refer Book 9, Chapter 5 for	• Headwall outlet structure with riprap • Level spreader

Component	Purpose	Examples
upstream conveyance network to the storage.	more details on conveyance system outlets).	• Energy dissipator
Storage An area of land or a storage structure that contains water after rainfall occurs.	To receive and store a pre-determined volume of water for a pre-determined period of time. Partial discharge from the site and partial retention in on-site storage facilities.	• Small storages such as a On-Site Detention (OSD) tank • Large storages such as basins • 'Nested' basins • Roof gardens, rainwater tanks, bio-retention facilities, raingardens, infiltration trenches, soakaways, access to aquifers
Outlet structure A conduit or flowpath that connects the storage basin to downstream conveyance infrastructure	To control water release from the storage at a pre-determined rate and direct it to the appropriate location downstream. To control water release from the storage to a pre-determined slow release rate. Control outflow from the storage to satisfy a required emptying time criterion.	• Pipe or box culvert through an embankment (with headwall or pit entry) • Discharge control pit • Rainwater distribution system • Spillway across the top of an embankment • High overflow discharge pipe • Aquifer infiltration zone • Combinations of the above
Treatment processes A physical installation located, in-line or off-line, usually within a storage, upstream of a site, neighbourhood or regional discharge point. A material or process that removes water-borne contaminants from runoff as it passes through the storage basin.	To reduce or remove concentrations of contaminants from runoff as it passes through the device towards the outlet.	• Sediment forebay • Gross pollutant trap • Aquatic plants • Vegetated soil media • Sand, gravel or other filtration media • Storage processes including settlement, bio-reaction and natural flocculation

Each of these components can be configured and combined with the other components in different ways to meet different design objectives. The size, shape and material of each component can also be selected to respond to performance criteria and site constraints. Some components can be omitted depending on the design objectives. For example treatment processes are only required where the design seeks to improve water quality or the impacts of the storage on improving water quality need to be enhanced.

4.3.2. Common Configurations in Australian Practice

There are a large number of potential sizing and configuration options available to the designer. Changes to the relative sizes of each component (from Table 9.4.2), along with combinations of different materials and different hydraulic designs can adjust the way in which an overall facility or strategy will perform against the volume management objectives and respond to different site constraints.

The volume management facility configurations that are in common use in Australia are listed and described in Table 9.4.3. Further guidance on selecting a specific design configuration is also provided in Book 9, Chapter 4, Section 4 and Book 9, Chapter 4, Section 5

Table 9.4.3. Common Volume Management Facility Configurations in Australian Practice

Common Description	Storage Basin	Outlet Structure	Treatment Processes[a]	Typical Catchment Scale[b]
Detention Basin (Retarding Basin)	A storage basin excavated into the ground surface and partially formed by embankment on downslope side. The size of storage to be determined from catchment-wide analysis focused on the target peak flow at the catchment outlet. Normally dry.	A concrete pipe or box culvert passing through the embankment at the base level of the storage. A spillway at the top level of the storage to pass flow in excess of the culvert capacity.	Nil	Neighbourhood Precinct
On-Site Detention (OSD)	A small underground tank or surface depression. Normally dry.	A small pipe at the base level of the storage with an orifice to reduce outlet flow rates. A small weir at the top of the storage to pass flow in excess of orifice capacity (Figure 9.4.7 and Figure 9.4.8).	Nil	Lot Site
Rainwater Harvesting	Surface or underground storages capturing runoff from roof surfaces and consumed for indoor and outdoor purposes. The storage has a permanent storage volume and may have an air space above	Constant water usage (for example indoor demands) draws down storage volumes prior to rainfall events. A small pipe may link to the downstream stormwater network at the	Volume reduction processes reduce erosion of streams and reduces transport of urban pollutants.	Lot Site Neighbourhood Precinct

Common Description	Storage Basin	Outlet Structure	Treatment Processes[a]	Typical Catchment Scale[b]
	the permanent storage for stormwater detention.	top level of the permanent storage. A second pipe at the top level of the air space caters for high level overflows (Figure 9.4.9).		
Bioretention Basin	A storage basin excavated into the ground surface and partially formed by embankment on downslope side. Shallow storage over filter media. Experiences a cycle of wetting and drying.	A network of sub-soil drainage at the bottom of the filter media. Outlet pit and pipe culvert for flows that exceed the permeability of the filter. A spillway at the top level of the storage to pass flow in excess of the culvert capacity (Figure 9.4.10).	Sandy loam filter media with high permeability and suitable vegetation.	Site Neighbourhood
Constructed Wetland	A storage basin excavated into the ground surface and partially formed by embankment on downslope side. Normally wet with bathymetry designed to support healthy range of aquatic plants. Ephemeral wetlands are subject to a cycle of wetting and drying that replicate natural processes.	Outlet pit and pipe culvert. High flow bypass (directs high flows away from wetland area). A spillway at the top level of the storage to pass flow in excess of the culvert capacity (Figure 9.4.12).	Aquatic plants growing in a suitable soil substrate.	Precinct
Managed Aquifer Recharge	An infiltration zone, in the floor of a basin, with good permeable connectivity to the groundwater system or a gravel filled soakaway with aquifer access via a bore pipe.	A permeable soil layer in the floor of the basin with connectivity to an aquifer A spillway at the top level of the basin to pass flow in excess of the permeable layer (Figure 9.4.13).	Removal of stormwater volumes decreases erosion of streams and reduces transport of urban pollutants. Normally requires pre-treatment.	Neighbourhood Precinct
Infiltration System	An infiltration zone, in the floor of a drainage pit, swale, basin, trench or	A porous floor in the base of the structure with	Removed contaminants and volumes of	Lot Site

Common Description	Storage Basin	Outlet Structure	Treatment Processes[a]	Typical Catchment Scale[b]
	pavement with good permeable connectivity to the groundwater system. Overflow from a rain water tank passed into bio-retention, raingarden, gravel filled trench or soakaway, normally dry, or directly to a local aquifer	connectivity to deeper sub-soils. A spillway, pipe or channel at the top level of the structure to pass flow in excess of the permeable layer (Figure 9.4.14 and Figure 9.4.15).	stormwater from flows. This further reduces transport of pollutants.	Neighbourhood
Stormwater Harvest Pond	A large storage pond formed by excavation into the ground surface and possibly formed by embankment on downslope side.	A pump system to extract water for use. A spillway at the top level of the pond to pass flow in excess of demand.	Reduce runoff volumes diminishes erosion of streams and reduces transport of urban pollutants. Normally requires pre-treatment.	Neighbourhood Precinct

[a]Note those devices without treatment processes may still provide water treatment benefits due to the effects of temporary storage and/or harvesting of runoff.

[b]Scale definitions taken from Book 9, Chapter 6

4.4. Concept Design

4.4.1. Overview

Concept design is an important phase in the overall infrastructure delivery process. It provides early insight into the likely physical characteristics of a facility, and allows design integration with other nearby infrastructure including, for example, stormwater conveyance infrastructure, open space, roads and buildings. If an approval is required, then the concept design will form part of the evidence needed for a submission. A concept design will also be needed to establish a financial budget.

The following sub-sections outlines the concept design phase of a typical volume management facility. Four concept design tasks are described:

- Choosing the best location for the facility (Book 9, Chapter 4, Section 4)
- Choosing the best design solution, having regard to the design objectives and site variables (Book 9, Chapter 4, Section 4)
- Preliminary sizing and configuration (Book 9, Chapter 4, Section 4)
- Collaboration and integration with other relevant professional disciplines (Book 9, Chapter 4, Section 4)

While these tasks are presented in this sequence, the tasks should not necessarily be completed in this sequence nor in a linear fashion. There is often a need for iteration and concurrent completion of design tasks. For example, collaboration and a preliminary sizing may be required to inform the selection of a preferred location. Once the preferred location is determined, the preliminary sizing must be updated.

Concept design can only commence once an overall catchment strategy has been established (refer to Book 9, Chapter 3) and design objectives determined (refer to Book 9, Chapter 4, Section 2). These foundational design aspects are assumed to have been resolved prior to implementing the following guidance. In particular a decision must be made as to the general position of the facility or strategy within the catchment. For example, it should be decided prior to commencing concept design whether the facility will be constructed to service a catchment comprising a single lot, a neighbourhood, or an urban precinct that is large in scale. With this overall constraint in mind, the following concept design tasks should be considered.

4.4.2. Choose a Location

The site chosen for a volume management facility is important to the success of the design. The site will have associated site variables, such as topography, soil types, catchment characteristics and groundwater characteristics. In some circumstances, the design may need to trade off some capabilities or require special features to completely respond to these site variables, and avoid constructability and long-term performance issues.

Where there is flexibility, it is best to choose a site that presents the smallest design challenge and meets the objectives for the project. The following discussion is intended to assist in this regard.

Topography

Volume management facilities may be located on or adjacent to the lowest point in the catchment to be serviced. This maximises the catchment area to be managed. Similarly the location may also need to capture flows from upstream conveyance infrastructure. If the site cannot easily service the relevant upstream sub-catchment then performance against the design objectives may be compromised.

While catchment hydrology (refer to Book 9, Chapter 6) is an integral part of the design process, even before such calculations are undertaken, the concept design should be informed by a general appreciation of the catchment draining to the proposed facility. As a minimum, the size of the catchment area draining to the facility needs to be determined so that preliminary sizing can be undertaken.

The location chosen may need to be adequately elevated (or able to be raised using an embankment), so that hydraulic performance of the outlet structure is not adversely influenced by backwater. This is a particular consideration for facilities that have treatment processes and vegetation or where the storage is intended to be well drained.

Areas in low-lying coastal districts must also consider the effects of high-tide and possible future changes to the tide level due to sea-level rise (refer to Book 4, Chapter 4 and Book 6, Chapter 5). Frequent backwater flooding from regional flood events should also be avoided, unless its impact can be assessed and proven acceptable.

The average ground slope in the location chosen should ideally be no steeper than 5%. Steeper sites are not precluded, however they will require more careful consideration of the type and shape of storage to avoid excessive earthworks. It may also introduce the need for vertical retaining wall elements which may be undesirable if they hamper access, introduce safety risks, increase maintenance and increase longer-term facility replacement and renewal costs.

Soils

Ideally the soils in the chosen location will be suitable for construction and sufficiently deep to avoid excavation into rock.

Where an embankment is to be formed, the soil properties should allow tight compaction in layers to form a cohesive matrix and stable slope within the range of 1 in 2 to 1 in 10.

The soils used to construct any embankments or spillways should also have a very low permeability, particularly where significant volumes of water are to be stored or where long-term water storage is intended. If the soil type is not suitable then other soil materials will need to be imported for blending or replacement, or other materials considered such as clay liners.

Sites with dispersive and acid sulphate soils will require a careful selection of storage solution. If unavoidable, then the design must include appropriate management measures.

Groundwater Characteristics

Where stormwater infiltration is one of the overall design objectives, the site selected must be underlain by geologic strata that allow this infiltration to occur. Long-term groundwater behaviour in the vicinity should also be profiled, and a site selected where the elevation of the infiltration zone is not substantially below normal groundwater levels.

If infiltration is not required or desired, then a site should be chosen where the groundwater profile is unlikely to intersect the storage profile. This will simplify construction and ensure the storage can be more easily drained.

The stream baseflow, flow regimes and runoff water quality characteristics will also be relevant where water quality improvement or stormwater harvesting or infiltration objectives are targeted.

The quality of the groundwater store should also be investigated and water quality criteria for infiltration will need to be observed in accordance with local guidelines and Australian and New Zealand Environment and Conservation Council (ANZECC, 2000).

Vegetation

The selected site should not require the damage or removal of valuable trees or large stands of native vegetation. If it is determined that this cannot be avoided then special approvals may be required and a flora and fauna specialist should be engaged to assist to provide advise the design team. An environmental offset planting may be necessary.

If the facility is intended to be vegetated then an appropriate depth and quality of surface soil is required to support healthy plant growth.

4.4.3. Choosing a Design Solution

A design solution should be selected that best targets the established objectives and provides an optimum response to the constraints and variables of the site. A listing of common design solutions is provided in Table 9.4.4.

This is a basic guide aimed to provide an indicative starting point for the inexperienced urban stormwater designer and should not be interpreted as a barrier to innovative strategies or a replacement for first principles analysis. Those with experience will recognise opportunities for hybrid solutions that have broader application. For example, a hybrid facility involving a detention (retarding) basin with managed aquifer recharge (retention) and stormwater harvesting (retention) may provide a more comprehensive design solution to a volume management problem and for protection of urban waterways.

It is noted that in Table 9.4.4 there are several solution and objective combinations that are flagged as “suitable with limitations”. This means that the solution may not always perform well with respect to the relevant objective, however it can in some circumstances. For example, a particular managed aquifer recharge facility may not normally provide control of peak discharge in large floods when the water levels in the aquifer are high. However, it may still afford some benefits in small floods and greater benefits if aquifer levels are low. Some further information about these possible limitations is provided in Book 9, Chapter 4, Section 5.

Table 9.4.4. Indicative Suitability of Common Volume Management Design Solutions

Solution	Control Peak Discharge	Improve Water Quality	Harvest or Infiltrate Stormwater
Detention (Retarding) Basin (refer Book 9, Chapter 4, Section 5)	Suitable	Not suitable	Not suitable
On-Site Detention (OSD) (refer Book 9, Chapter 4, Section 5)	Suitable	Not suitable	Not suitable
Rainwater Harvesting (refer Book 9, Chapter 4, Section 5)	Suitable with limitations	Suitable	Suitable
Bioretention Basin (refer Book 9, Chapter 4, Section 5)	Suitable with limitations	Suitable	Suitable with limitations
Constructed Wetland (refer Book 9, Chapter 4, Section 5)	Suitable with limitations	Suitable	Suitable with limitations
Managed Aquifer Recharge (refer Book 9, Chapter 4, Section 5)	Suitable with limitations	Suitable with limitations	Suitable
Infiltration System (refer Book 9, Chapter 4, Section 5)	Suitable with limitations	Suitable with limitations	Suitable
Stormwater Harvest Pond (refer Book 9, Chapter 4, Section 5)	Suitable with limitations	Suitable with limitations	Suitable

4.4.4. Preliminary Sizing and Configuration

The approximate physical footprint of the structure must be understood to confirm the availability of sufficient space at the site. Where the surrounding infrastructure has yet to be planned, space requirements can be communicated early to other members of the design team.

The size of the structure is the first aspect to investigate. Ultimately the size of the structure is determined by detailed calculation and modelling, however in the very early stages of planning it may be possible to use simple hand calculations and ‘rules of thumb’.

Preliminary sizing will depend on local rainfall conditions, climate patterns and performance criteria. A value is often selected based on prior experience with the design of other nearby facilities. For example, in the case of an infiltration measure, the estimated surface area can then be combined with length and width limitations to estimate the total requirement for land area at a preliminary level of accuracy.

The shape of the facility must then be considered. The shape of the facility will be largely governed by a combination of factors including:

- Minimising and balancing earthworks – to suit the site topography and drainage and minimise the volume of earthworks relative to the volume of runoff stored. At the same time have regard to the design of adjoining infrastructure such as stormwater conveyance, roads and buildings.

- Visual and landscape objectives – there may be visual and landscape objectives sought for the facility that might influence overall shape of the facility.

- Maintenance and safety objectives – Suitable allowance should be made for maintenance access and safe batter slopes.

- Achieving suitable length to width ratios – where the facility targets water quality improvement the length to width ratio must sit within a suitable range, typically between 3:1 and 10:1.

While determining the preliminary shape of the structure, consideration should also be given to the need for any vertical wall elements, the location of outlet structures and the position and alignment of any embankments.

4.4.5. Collaboration and Integration

The best integrated outcomes for an urban design project involving stormwater are only achieved when stormwater professionals are consulted at the very beginning.

The design of a volume management facility is a task best undertaken in close collaboration with the client representative, relevant stakeholders and the overall urban design team including:

- Urban Designers;

- Local authorities including Councils and government departments;

- Civil Engineers;

- Landscape Architects;
- Environmental Engineers, Geomorphologists and Ecologists; and
- Geotechnical Engineers.

This collaboration should occur early in the design process to minimise re-work and maximise the potential for integrated outcomes. For example good opportunities exist for co-location of volume management facilities within areas that also perform recreation, landscape and environmental functions.

Since the position of volume management facilities is often tightly controlled by site topography and hydraulic constraints, it is also important that the design is undertaken in conjunction with the overall bulk earthworks and stormwater conveyance solution to yield an overall efficient and low cost design.

4.4.6. Emergence of Volume Management Research

The use of volume management measures distributed throughout urban areas to assist in the management of peak discharges at the outlets of catchments has been the topic of emerging research and practical investigations since the 1990s by an increasing number of authors and practitioners (for example Joliffe (1997), Argue and Pezzaniti (2007), Argue and Pezzaniti (2009), Argue and Pezzaniti (2010), Argue and Pezzaniti (2012), Andoh and Declerck (1999), Coombes et al. (2000), Coombes et al. (2001), Coombes et al. (2002a), Coombes et al. (2015), van der Sterren et al. (2013), van der Sterren et al. (2014)).

More recently, investigations have also focused on understanding the performance of entire linked systems of water cycle management within urban catchments that can reveal the cumulative impacts of integrated or combined strategies that better represent real systems (Coombes et al., 2002b; Coombes, 2005; Walsh et al., 2012; Coombes and Barry, 2015). These issues are discussed in Book 9, Chapter 3. This body of research and practice has evolved since the previous version of ARR 1987 (Pilgrim, 1987) and represents significant new thinking in the stormwater industry.

Many authors have established that the use of volume management at a distributed scale may not be required to provide significant reductions in peak discharges at the property scale because reducing runoff volumes at the top of catchment provide substantial reductions in peak flows throughout catchments (for example: Herrmann and Schmida (1999), Andoh and Declerck (1999), Argue and Scott (2000), Vaes and Berlamont (2001)). Argue and Scott (2000) used a large catchment scale model to conclude that distributed peak discharge control (on-site detention) and volume management (rainwater harvesting) systems produce similar hydrographs at the catchment outlet. It was acknowledged that the peak discharges on a lot scale may be larger for volume management than for flow management. However, it was found for medium to large catchments that the cumulative effect of volume reductions obliterates the effect of peak discharges at individual sites. This indicates that the cumulative effects of distributed reductions in stormwater runoff volumes can be significant at a catchment scale due to the reduction in overall volume discharged to the catchment outlet (refer to Book 9, Chapter 3). These results are consistent with the basic elements of peak flows which are volume and time. Reducing either element must reduce peak flows within the catchment.

Coombes et al. (2001), Coombes et al. (2003) also found that at the lot scale the flow management (detention) systems reduced the peak discharge at the lot scale and volume management (rainwater harvesting) provided smaller changes in peak discharges at lot scale but significantly reduced the volumes of stormwater runoff which reduced peak discharges at the street and catchment scale. It was argued that flooding is a volume driven process and peak discharges at the lot scale had little or no bearing on the floods at a catchment scale. Use of first principles processes such as continuous simulation and detailed systems analysis rather than empirical assumptions (for example antecedent conditions associated with event based analysis) has also revealed that the shape of catchment hydrographs may be significantly altered by distributed and integrated solutions within catchments (for example; Coombes and Barry (2009), Coombes (2015)). van der Sterren (2012), Burns et al. (2013) and Coombes (2015) highlight the benefits of replacing the common design requirements with treatment trains on properties and throughout urban areas to manage peak discharges and flow regimes throughout and at the outlet of urban catchments.

4.4.7. Use of Computer Models

A coupled analysis of storage basin volume and outlet capacity is necessary in order to determine the most appropriate configuration for a facility. This analysis is usually iterative. Firstly, dimensions of the storage basin and outlet are estimated and tested by numerical calculation and then progressively adjusted to achieve the design objectives. This is normally undertaken using computer models that have been developed to assist with these calculations.

The design and analysis of these facilities must include the interactions with other stormwater management facilities and urban form in the catchment and catchment behaviours. The adopted modelling approach should also use rainfall time series and resolve full hydrographs of a total duration that is relevant to the objective being analysed. For peak discharge control, this may only be minutes or hours. For water quality improvement and stormwater harvesting applications, this may be years or decades. The model must have sufficient catchment resolution and detail to adequately represent the linked hydrologic processes in the catchment. Lumped models that simplify catchment representation and behaviours should be used with caution.

The modelling approach should allow different storm scenarios to be tested since the performance of a volume management facility may be highly sensitive to the selected storm characteristics and volumes. For example, volume management facilities will have a greater impact on peak discharges under conditions where the storm burst occurs in front of a storm, rather than under conditions when the storm burst occurs towards the back of a storm, when the detention storage is already partially full.

A designer may therefore need to consider using an ensemble of complete storms with a storm burst of around the critical duration or a storm burst only to determine the benchmark condition(s) (Phillips and Yu (2015); Book 9, Chapter 6). If a design approach adopts a storm burst only approach, then for a given Annual Exceedance Probability (AEP) the peak flows are assessed for a range of storm burst durations and the storm burst duration that gives the highest peak flow is adopted as the critical storm.

If a design approach adopts an ensemble of complete storms of a given AEP, then the designer will need to determine if the benchmark condition is to be based on the 50th percentile peak flow or on a different percentile of peak flow. Preliminary testing indicates that adopting the 50th percentile is a very good indicator of the results from more complex Monte-Carlo approaches in most circumstances. Ultimately, the decision of what percentile of peak flow to adopt can be informed through identifying the level of risk the community is willing to accept within the catchment.

Once a base model is established, which includes the proposed facility, the model should be capable of iterative changes to the dimensions of the storage and the outlet structure. Using a judgement driven and iterative approach, the model is used to determine an optimised configuration that results in the required hydrologic performance for the selected range of storms.

For more detailed guidance regarding the use of computer modelling in urban stormwater design refer to Book 9, Chapter 5 and Book 9, Chapter 6.

4.5. Detailed Design Considerations

This section provides introductory level detailed design guidance for each of the most common volume management facility types, as listed in Table 9.4.3. Furthermore comprehensive design guidance reflecting local design standards should be sought from the relevant local stormwater authority. References to some useful guidelines are provided in each of the following sections.

4.5.1. Detention Basins

Detention basins, also sometimes called retarding basins, are measures which temporarily store stormwater to reduce peak discharge. Outflows are typically controlled by a low-level pipe or culvert and a high-level overflow spillway as shown in Figure 9.4.5.

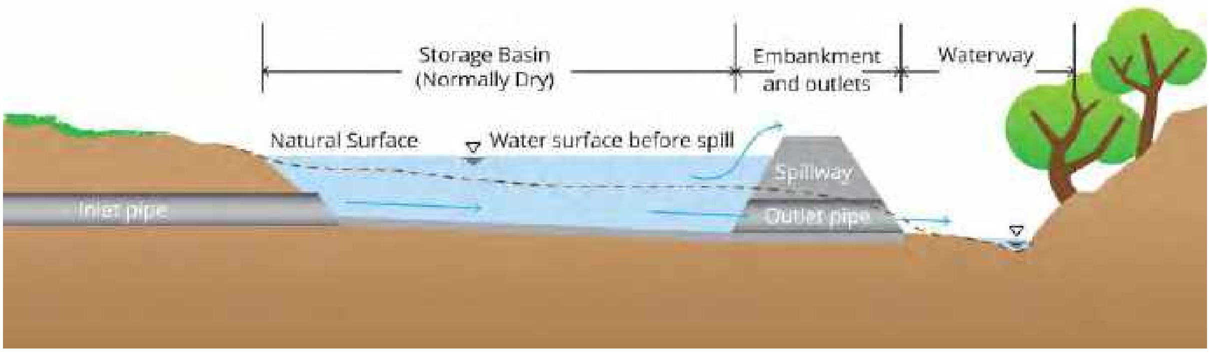

Figure 9.4.5. Detention Basin Typical Section

Detention basins can be designed to suit a range of catchment sizes. Community and regional scale basins may have considerable community benefits as areas for recreation and may be built around specific sizes and shapes of fields for sports such as football, netball and cricket. The sides of basins are usually sloping earth embankments, suitable for occasional spectator use. Basins used for passive recreation may include stands of trees (within the basin but not on any fill embankment), lawns and other vegetation.

Basins may be placed directly across a watercourse, or located off-stream, with flows in excess of a certain flow rate being diverted into them. They can be arranged in a widened section of drainage easement zoned both for recreation and drainage purposes.

Detention basins themselves are not suited to the improvement of water quality or harvesting and infiltration of stormwater. However other types of volume management facilities can be nested inside. For example a constructed wetland can be located in the floor of a large detention basin storage to also target water quality improvements.

Available Guidelines

There are many guidelines on community and regional detention including ACT Department of Urban Services (1998), Hobart City Council (2006), Department of Water, Western Australia (2007), Melbourne Water (2010), Queensland Department of Energy and Water Supply (2013). These guidelines can be readily used for designing and modelling detention systems, using the modelling and storm patterns as described in Book 9, Chapter 6.

Detailed Design Considerations

Flood Capacity

The final sizing of any basin should be completed with the aid of a computer model. The selected model must accurately simulate the hydraulic behaviour of the basin outlet, especially when a partially full pipe flow or tailwater submergence occurs (Queensland Department of Energy and Water Supply, 2013). When located in-stream, the hydraulic modelling should also represent the stream conditions and the stream flows discharging through the basin in addition to the urban areas directed to it.

Large community and regional basins can be considered dams, as they can store significant volumes of stormwater, and therefore may pose a potential threat to communities residing downstream of a basin. As a result, the design must have regard to the ANCOLD (Australian National Committee on Large Dams, 2000) guidelines. A detailed risk assessment of a storm exceeding the Dam Crest Flood should be considered in the design of a detention basin within an urban area due to the potential severe consequences of the sudden failure of a basin on any urban development located on the floodplain downstream.

Detention basins should be designed with a flood capacity to convey appropriate extreme storms safely through the basin in accordance with the Hazard Category of the basin as defined by ANCOLD, as is the case for conventional dams.

An ‘Initial Assessment’, as defined by ANCOLD’s guidelines within the ANCOLD (2000a) should be undertaken for any proposed detention basin to determine the hazard category of the structure.

Depending on the findings of the ‘Initial Assessment’ a more detailed assessment (ANCOLD, 2000b) including a Dam Break analysis for both ‘flood failure’ and ‘sunny day’ scenarios may be required.

With increasing urbanisation there are now many catchments which contain a series of detention basins. Each basin within a catchment should be investigated not only individually but also collectively within the catchment, including all basins modelled as a whole (Melbourne Water, 2010).

In addition, two further issues should be considered:

- The consequences of one basin failure cascading downstream into lower basins should be evaluated; and
- The effect of long period releases from upper basins superimposing on flows through lower basins may require a revision of the basins’ operation throughout the catchment.

Embankment Design

The embankments of detention basins should be designed using appropriate stability analysis and geotechnical design practices. Particularly, appropriate foundation treatment should be specified. For earthen embankments suitable compaction levels, vegetation cover and stabilisation should be specified and protection provided to cater for cracking or dispersive soils. Impervious zones of an earthen embankment should take the form of a centrally located ‘core’ rather than an upstream face zone to reduce the effects of drying which may lead to cracking.

If the earth fill for any embankment is taken from borrow areas, these areas should be kept as far away from the embankment(s) as practicable. Should the borrow area penetrate any alluvial sand layers or lenses, the embankment’s cut-offs should be taken to at least one metre below the estimated depth of such sand layers/lenses at the detention basin floor.

Chimney intercept filters and filter/drainage blankets should be used for all high and extreme hazard category detention basins. Such filters may also be required for lower hazard category detention basins. All earthen embankments constructed from dispersion soils must have a chimney filter and downstream filter/drain (Melbourne Water, 2010).

Suggested basin freeboard requirements for a variety of basins are provided in Table 9.4.5.

Table 9.4.5. Detention Basin Freeboard Requirements (Adapted from Queensland Department of Energy and Water Supply (2013))

Situation	AEP	Maximum Depth or Level
Basin Formed by Road Embankment		
(a)	5%	Bottom of pavement box
(b)	2%	0.3 m below edge of shoulder
Basin Formed by Railway Embankment	2%	Underside of ballast
Large Basins with Separate High Level Spillway	1%	Embankment crest with freeboard ≥1% AEP storage depth and with minimum freeboard = 0.3 m [1]

External earthen embankment slopes and their protection should take into account long term maintenance of the structure. The side slopes of a grassed earthen embankment and basin storage area should not be steeper than 1(V):4(H) to prevent bank erosion and to facilitate maintenance and mowing.

The surfaces of an earthen embankment and overflow spillway must be protected against damage by scour. The degree of protection required is subject to the calculated flow velocity.

The following treatments are recommended as a guide (NSW Government, 2004):

- $V \leq 2$ m/s a dense well-knit turf cover using for example kikuyu;
- 2 m/s $< V <$ 7 m/s a dense well-knit turf cover incorporating a turf reinforcement system; and
- $V \geq 7$ m/s hard surfacing with concrete, riprap or similar.

Practical maintenance access should be provided to the full length of the embankment and any hydraulic structures passing through it.

Basin Floor

The floor of basin shall be designed with a suitable grade that provides positive drainage to the basin outlet and to prevent water logging. Detention basins may require underdrains to positively drain the bottom of the detention facility for ease of maintenance. If there are frequent trickle flows entering the basin then a low flow channel or pipe passing through the basin should be considered.

Primary Outlets

The key function of primary outlets is to release flows from a detention basin at the designed discharge rate. Some typical primary outlets are shown in Figure 9.4.6. Book 6 details how these outlets can be hydraulically designed.

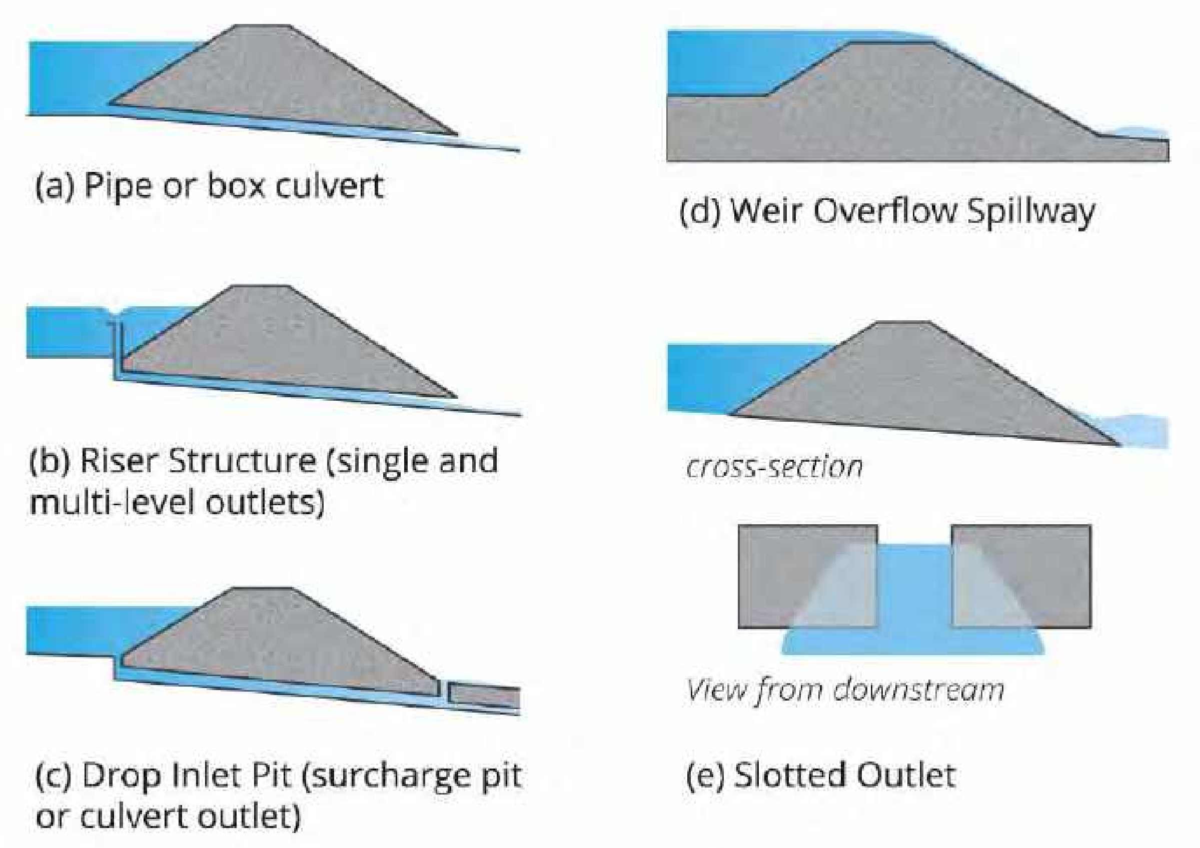

Figure 9.4.6. Typical Detention Basin Primary Outlets

Pipe or box culverts are often used as outlet structures for detention basin facilities. The design of these outlets can be for either single or multi-stage discharges. A single stage discharge system typically consists of a single culvert entrance system, which is not designed to carry emergency overflows (for example, when pipes are blocked). A multi-stage inlet typically involves the placement of a control structure at the inlet to the culvert. In particular, details on the hydraulics of rectangular weirs are given in Book 6, Chapter 3 and Book 9, Chapter 5.

Secondary Outlets

In general, the capacity of secondary outlets (typically spillways) should be based on the hazard rating of the structure as defined by the ANCOLD seven level rating system. The hazard rating defines the required ‘Fall back’ Design Flood. In some cases where the required ‘Fall back’ Design Flood is considered to be impractical, a full risk assessment of the basin may allow a lesser capacity spillway in line with ALARP (As Low As Reasonably Practicable) principles(Melbourne Water, 2010).

The design capacity of spillways should account for the possible reduced capacity of primary outlets which have the potential to become blocked during a major storm. The assessment of the possible blockage should be undertaken in accordance with the guidance provided in Book 6.

Recommendations for the design of outlet structures are provided by (ASCE, 1985) while the Design of Small Dams US Bureau of Reclamation (1987) provides procedures for the sizing and design of free overfall, ogee crest, side channel, labyrinth, chute, conduit, drop inlet (morning glory), baffled chute and culvert spillways.

Details on the hydraulics of rectangular weirs, sharp-crested rectangular weirs, broad-crested rectangular weirs, trapezoidal weirs, circular-crested weirs and compound weirs are provided in Book 6, Chapter 3.

4.5.2. On-site Detention

In many urban areas detention has been implemented, and in particular since 1975 the use of detention basins has been widespread in NSW (Institution of Engineers, Australia, 1985). However in urbanised areas the available sites for large detention basins (as described previously in Book 9, Chapter 4, Section 5) are limited or are fully utilised over time.

To avoid exacerbating what can be already substantial flooding problems in an urbanised catchment, planning and development controls are sometimes implemented at the lot scale to mitigate the impact of increased impervious surfaces. These are commonly described as On-Site Detention (OSD) as shown in Figure 9.4.7.

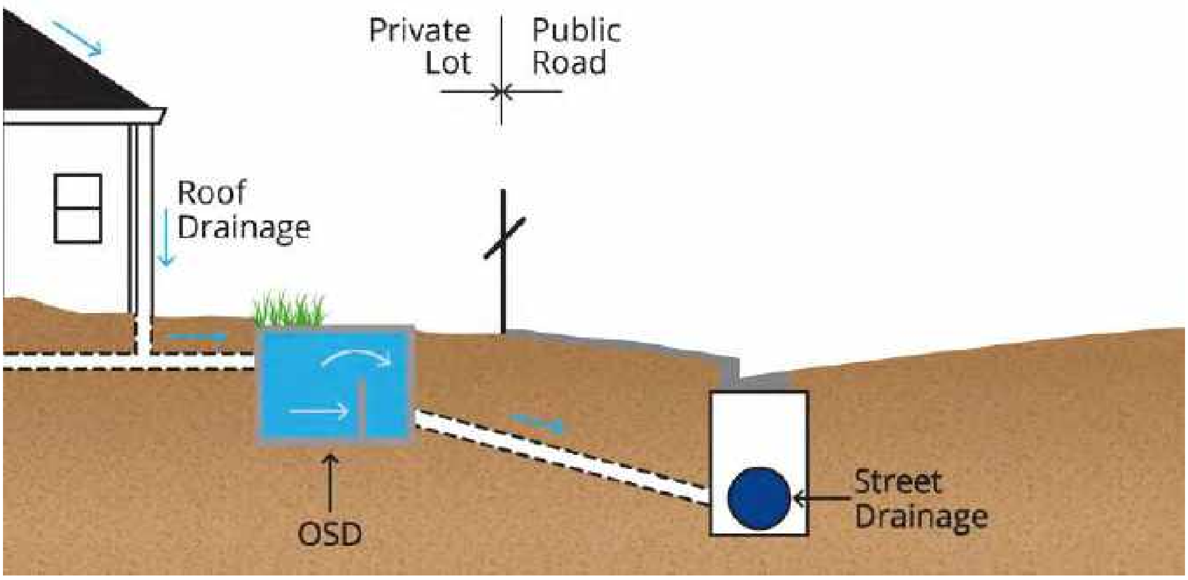

Figure 9.4.7. Typical Section Through a Below Ground On-Site Detention

In New South Wales, OSD was developed and first implemented by Ku-ring-gai Council, closely followed by Wollongong City Council (O'Loughlin et al., 1995). Since then many councils in Greater Sydney and elsewhere have implemented OSD systems. Other Councils outside of NSW have also adopted On-Site Detention, such as Hobart City Council (TAS), City of Casey (VIC), Manningham City Council (VIC), Melton Shire Council (VIC) and the City of Tea Tree (SA).

It is important to note that the imposition of OSD requirements at the lot scale is often done on the assumption that there are broader flood benefits at a catchment scale. However, in some cases there may be little or no catchment wide benefit from OSD, as the overall volume of runoff is not reduced, merely detained for a period of time. This effect is not always sufficient to influence catchment scale floods. OSD performance is also sensitive to the temporal pattern of rainfall.

Establishment of OSD policy therefore needs careful assessment at the outset using a catchment wide strategy to ensure the overall catchments to which the policy is intended to be applied are indeed suitable.

Available Guidelines

There are many guidelines on the sizing or design of OSD, for example Department of Irrigation and Drainage (2000), Upper Parramatta River Trust (2005), Hobart City Council (2006) and Derwent Estuary Program (2012). These guidelines can be readily used for designing OSD systems, using the modelling approaches outlined in Book 9, Chapter 6.

These documents can assist in the design of OSD systems, however, designers are encouraged to determine if the method identified in the guidelines are consistent and make suitable for using the contemporary flood estimation techniques identified in Book 9, Chapter 6 and the issues identified in Book 9, Chapter 3.

Detailed Design Considerations

Flood Capacity

Historically, the primary objective of OSD controls was to manage flooding in a 1% AEP event only. Further implementation and development on OSD has resulted in many authorities now requiring OSD systems to reduce the post-development flows to adopted benchmark peak discharges over a range of AEPs up to and including the 1% AEP event.

OSD discharge control requirements should be based on a catchment wide assessment. A catchment wide assessment has been typically downscaled to site control requirements, such as:

- Permissible Site Discharge (PSD) or Site Reference Discharge (SRD), which are defined as the maximum allowable discharge leaving the site (determined using catchment-based assessment of lot-based measures) with PSD giving a single discharge rates and SRD giving multiple discharge rates for different rainfall frequencies; and

- Site Storage Requirement (SSR), which is defined as the volume required for overall storage.

It should be noted that if the objective of OSD control is to manage flooding in a 1% AEP event only then typically only a single set of PSD and SSR values are defined. However, where authorities require OSD systems to perform over a range of AEPs a nest of frequency staged storages and outlets is required with multiple PSD and SSR values. An example of an OSD design is provided in Figure 9.4.8.

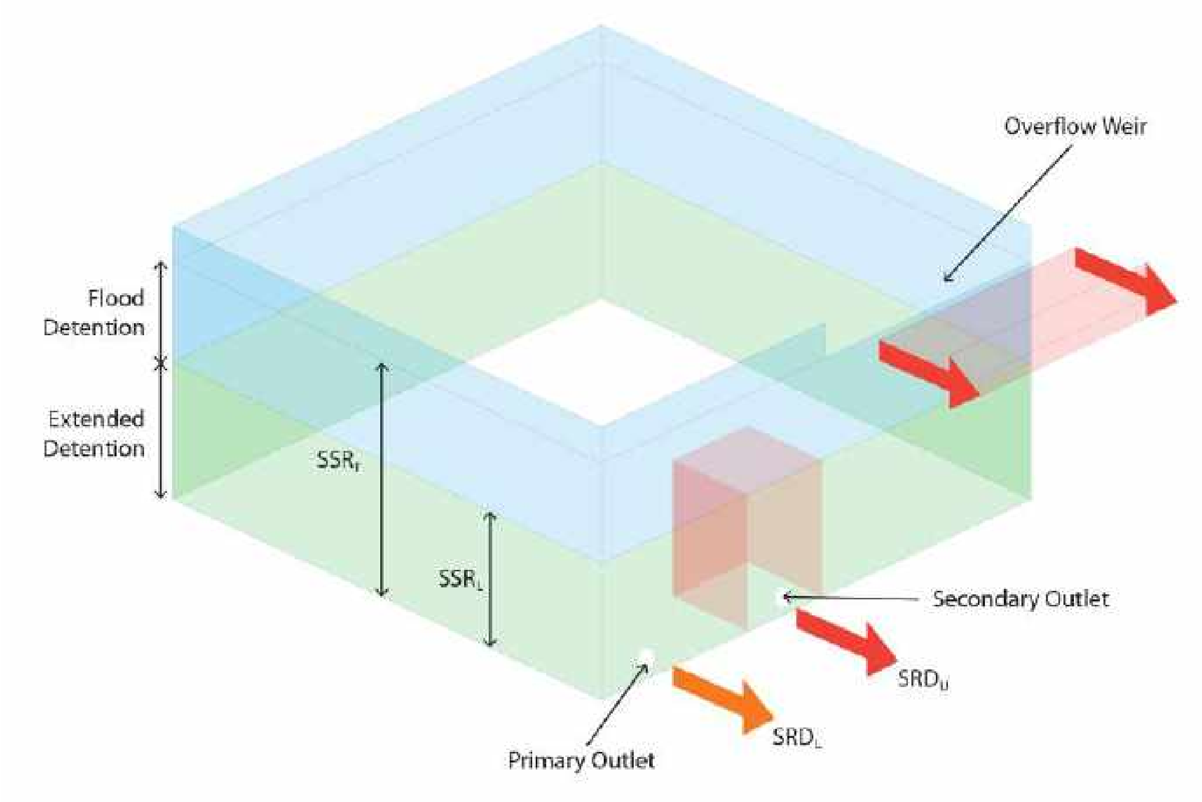

Figure 9.4.8. Frequency Staged Below Ground On-Site Detention System (adapted from Upper Parramatta River Trust (2005))

In the event that catchment wide assessments have not been conducted, one of the following site controls can be applied to enable the design of OSD systems:

1. The post-development flows of the subject site should be controlled to meet the pre-development flows for the site for a range of complete storms; or

2. Determine the capacity of the drainage system and divide by the area of lots that drain to the system. This gives an indicative estimate of the amount of the unit runoff (i.e. the PSD).

Either of these approaches are not as effective as designs based on a holistic catchment assessment, but may assist in the short term in managing nuisance flows in existing systems immediately downstream from sites.

On-Site Detention Types

OSD systems may comprise above-ground storage or underground storage or a combination of both. Above ground storage has advantages in terms of flexible configuration of site levels to achieve the required storage volume, capacity to incorporate retention through infiltration and pollutant removal landscaping features, reduced construction cost and easier maintenance. The advantages of underground storage are typically a reduced footprint in comparison to above ground storages and limitation of ponding on runoff on the surface. It is critical to select an appropriate storage type by considering the site layout, costs and effectiveness of OSD.

Above Ground On-Site Detention

OSD systems may comprise above ground storage or underground storage or a combination of both. It is critical to select an appropriate storage type by considering the site layout, costs and effectiveness of OSD.

Above ground storage has advantages in terms of flexible configuration of site levels to achieve the required storage volume, capacity to incorporate water quality treatment through infiltration and treatment media, low construction cost and potentially low maintenance.

The main types of above ground storages include landscaped storages, parking and paved storages, and rain water tanks with dedicated airspace for detention.

Where storage is not provided by a rain water tank the typical requirements listed in Table 9.4.6 should be considered.

Table 9.4.6. Above Ground On-Site Detention Storage Design Considerations

Design Aspect	Typical Considerations
Structural Adequacy	Design of surrounding embankments or retaining walls should consider structural and geotechnical aspects such as the need for reinforcement, compaction requirements and stable slopes. This includes when the storage is both full and empty.
Storage Configuration	Ponding depths shall not exceed the maximum storage depth requirements required by local standards. As an initial guide a maximum of 0.6 m is suggested for landscape areas with low pedestrian use (Department of Irrigation and Drainage, 2012). A Council may approve deeper ponding in individual cases where it is demonstrated that safety issues have been adequately addressed. For example, warning signs and or fencing should be installed where the depth exceeds0.6 m or adjacent to pedestrian traffic areas. Where ponding occurs in areas for recreational purposes (e.g. a playground) suitable velocity and depth should be selected to ensure the safety of children and the elderly. The storage volume should be increased by 20% to compensate for the potential loss of storage due to construction inaccuracies and the build-up of vegetation growth over time.
Floor Slope	The minimum ground surface slope should be 1.0%, while the desirable minimum surface slope is 1.5%.
Vegetation and Soils	Subsoil drainage around the outlet should be designed to prevent the ground becoming saturated during prolonged wet weather. Appropriate plant species for the vegetated areas should be selected that can withstand prolonged inundation and frequent wetting and drying. Any direct inflow point into a vegetated system (e.g. roof drainage or driveway runoff) should include a small energy dissipation device to reduce velocity and prevent erosion of the basin floor. Mulch utilised in the above ground storages should not be able to float and plants should be capable of withstanding frequent inundation as per the design depth and frequency.

Design Aspect	Typical Considerations
Overflow	An overflow should direct the flows to the legal point of discharge in a controlled and safe manner.
Freeboard	There should be freeboard above the stored flood level and adjacent habitable floor levels in accordance with local standards.
Safety and Access	Balustrades (fences) must comply with the Building Code of Australia (refer to Section D2.16 of the Code), while safety fences should comply with any legislated requirements for swimming pool fencing. Surface storages should be constructed so as to be easily accessible, with gentle side slopes permitting walking in or out. A maximum gradient of 1(V):4(H) (i.e. 1 vertical to 4 horizontal) should be required on at least one side to permit safe egress in an emergency. Where steep or vertical sides are unavoidable, due consideration should be given to safety aspects, such as the need for fencing or steps or a ladder, both when the storage is full and empty.
Frequency of Inundation	Frequent ponding can create maintenance problems or personal inconvenience to property owners. The initial 10%-20% of the storage should be provided in an area able to tolerate frequent inundation, e.g. a paved outdoor entertainment area, a permanent water feature, or a rock garden. Alternatively, a frequency staged storage approach should be adopted.

Below Ground Storages

Below ground storage tanks may be considered under the following conditions:

- Infeasible to construct above ground storages due to site constraints or topography; and
- Frequent inundation areas causing maintenance problems and inconvenience to the property owners or community members.

Below ground OSD storage tanks are usually made of reinforced concrete and can be pre-cast or cast in-situ to meet individual site requirements. When designing below ground tanks then typical design considerations include those listed below in Table 9.4.7.

Table 9.4.7. Below Ground On-Site Detention Storage Design Considerations (Department of Irrigation and Drainage, 2000), (Department of Irrigation and Drainage, 2012)

Design Aspect	Typical Considerations
Structural Adequacy	Storages must be structurally sound and be constructed from durable materials that are not subject to deterioration by corrosion or aggressive soil conditions. Tanks must be designed to withstand the expected live and dead loads on the structure, including external and internal hydrostatic loadings. Buoyancy should also be checked, especially for lightweight tanks, to ensure that the tank will not lift under high groundwater conditions. The soils and their impacts on concrete structure should be assessed to ensure that the correct structural specification is made.
Storage Configuration	Site geometry will dictate how the OSD system configured in plan. While a rectangular planform is typical and offers certain cost and maintenance

Design Aspect	Typical Considerations
	advantages site constraints will sometimes dictate a variation from a rectangular planform.
Floor Slope	To permit easy access to all parts of the storage for maintenance, the floor slope of the tank should be in the range 1% to 10%.
Ventilation	An important consideration for below ground storage systems is ventilation to minimise odour problems. Ventilation may be provided through the storage access opening(s) or by separate ventilation pipe risers and should be designed to prevent air from being trapped between the roof of the storage and the water surface.
Overflow	An overflow system must be provided to allow the storage to surcharge in a controlled manner if the capacity of the tank is exceeded due to a blockage of the outlet pipe or in the event of a storm with a magnitude greater than the design storm.
Freeboard	There should be freeboard above the stored flood level and adjacent habitable floor levels in accordance with local standards.
Safety and Access	A suitable amount of access hatches should be provided to enable contractors to readily adopt working in confined spaces techniques and equipment. Below-ground storage tanks should be provided with openings to allow access for maintenance. An access opening should be located directly above the outlet for cleaning when the storage tank is full and the outlet is clogged. A permanently installed ladder or step iron arrangement should be provided below each access opening if the storage is deeper than 1200 mm.
Frequency of Inundation	There should be no constraints on the frequency of inundation of the storage basin.

Below ground storage could be provided by modular system which could include one or more parallel rows of pipes connected by a common inlet and outlet chamber. The size of a modular unit is determined by the storage volume requirements, site constraints and the number of conduits or modular units which can be installed. When designing modular storage systems typical design considerations are similar to the design considerations for below ground storages as outlined above. Further guidance on conduit storage systems is provided by Department of Irrigation and Drainage (2000), Department of Irrigation and Drainage (2012).

Combined Above and Below Ground Storage

The designer of an OSD system faces a challenging task to achieve a balance between creating sufficient storages that are attractive and complementary to the architectural design, minimising personal inconvenience for property owners/residents and limiting costs.

These demands can be balanced by providing storage with a frequency staged storage approach. Under this approach, the design of OSD adopts combined storages multiple outlet approach, which can consist of an above ground storage and below ground storage. Underground storage is designed to store runoff for more frequent storm events, whilst the remainder of the required storage, up to the design storm event, is provided as above-ground storage.

This approach is likely to limit the depth of inundation and extent of area inundated in the above ground storage so that the greatest inconvenience to property owners or occupiers occurs very infrequently. It recognises that people are generally prepared to accept flooding which causes inconvenience as long as it does not cause a significant damage or does not happen too often. Conversely, the less the personal inconvenience the more frequently the inundation can be tolerated.

Outlet Structures

The outflows from OSD systems are typically controlled by orifices. Details on the hydraulics of orifices are discussed in Steward (1908); Medaugh and Johnson (1940); Lea (1942); Brater et al0. (1996); Bryant et al. (2008) and USBR (2001).

The orifice outlets should have a minimum internal diameter of at least 25 mm and need to be protected by a mesh screen to reduce the likelihood of the primary or secondary outlets being blocked by debris.

Upstream Drainage

The stormwater drainage system (including surface gradings, gutters, pipes, surface drains and overland flowpaths) for the property must:

- be able to collectively convey all runoff to the OSD system in a 1% AEP event with a duration equal to the time of concentration of the site; and
- ensure that the OSD storage is by-passed by all runoff from neighbouring properties and any part of the site not being directed to the OSD storage, for events up to and including the 1% AEP event.

Maintenance

While Councils are ultimately responsible for ensuring these systems are maintained through field inspections and enforcing the terms of any positive covenant covering OSD systems, the designer’s task is to minimise the frequency of maintenance and make the job as simple as possible (Upper Parramatta River Trust, 2005).

4.5.3. Rain Water Harvesting

Rain water harvesting at the property or lot scale has been historically used for water supply throughout Australia and for the management of stormwater runoff in cities since the 1990s. Rain water harvesting systems that provide water supply for more frequent indoor uses can reduce catchment runoff (peak flow and volumes), improve urban stormwater quality and provide a supplementary water source. The effectiveness of distributed rain water harvesting solutions for management of stormwater within and at the outlet of catchments is dependent on the number of facilities, integration with other strategies in the catchment, density of development, climate regimes, and magnitude and frequency of demand for rain water supply.

Available Guidelines

Further guidance on rain water harvesting can be found in the following documents:

- Guidance on Use of Rain water Tanks (enHealth, 2012)
- Rain water Tank Design and Installation Handbook HB 230 refer to http://www.rainwaterharvesting.org.au

- Interim Rain water Harvesting System Guidelines (NSW Department of Planning and Environment, 2015)
- Design and Operation of Rain Water Harvesting Systems refer to http://urbanwatercyclesolutions.com

Detailed Design Considerations

Modelling

Rain water harvesting systems were historically designed and considered as a stand-alone facility. This process results in assumptions that rain water harvesting systems do not contribute to the control of quantity or quality of stormwater discharges from a site or throughout a catchment. It was often argued that rain water harvesting does not provide these benefits due to the uncertainty associated with antecedent conditions of storm events (how full is the storage prior to the design storm?). Methods to determine the antecedent conditions in rain water storages prior to storm events and for design rain water harvesting systems were developed and demonstrated by Coombes et al. (2001), Coombes et al. (2002b), Hardy et al. (2004), Coombes (2005), Coombes and Barry (2007), Coombes and Barry (2009) and Coombes (2009). This applied research and monitoring has provided a design process for rain water harvesting systems that requires continuous simulation at sub-daily intervals – preferably six minute time steps to determine the dynamic airspace (drawn down of storages by water demands). This process can also determine any detention airspace requirements of rain water storages prior to given storm events for allow integration with surrounding stormwater management strategies and use in catchment models reliant on design storms. These concepts have been applied by Phillips et al. (2005) for example and can be used to address concerns about antecedent conditions in linked stormwater designs. The design process for rain water harvesting systems has been enhanced by many authors including Burns et al. (2013) and van der Sterren (2012) (for example) to also account for flow regimes to protect urban waterways.

The rain water or stormwater harvesting system should be designed using continuous simulation (as identified in Coombes and Barry (2007)) and should consider the following:

- Rainfall at the site;
- Potential magnitude and frequency of rain water use and any rate of leakage from a leaky tank;
- Roof or catchment area draining to the tank;
- Size of inlet configuration, overflow and use (e.g. can the rate of flow be discharge into the tank and out of the storage without surcharging); and
- When underground – the backflow potential from downstream systems.

Upstream Drainage

The design of rain water harvesting systems can include gutter guards, leaf diverters, first flush devices and filter socks can limit the transfer of sediment and debris into rain water storages. Mesh screens on inlets, outlets and overflow devices will exclude animals and mosquitoes and other insects from entering storages therefore minimising the risk of harmful microorganisms and disease-carrying mosquitoes entering the tanks.

Runoff that is not collected in the storage and overflows from the storage should be diverted away from storage foundations, buildings or other structures (enHealth, 2012).

Storage Location

The location of the storage infrastructure will be dependent on aesthetic and space requirements for the chosen device. The tank must also be located where sufficient roof area can be drained by gravity to the top of the tank.

If the storage system is below-ground, site soil characteristics and surface flows will need to be considered. Surface flows should be prevented from entering the tank and soil conditions are particularly important if there are salinity or acid sulphate soil concerns which would affect the integrity of the structure (Department of Water, Western Australia, 2007).

Pumps and Connections

The tanks should be connected to internal domestic demands, typically toilet flushing. Appropriate flow rates need to be maintained for the occupant and therefore the majority of rain water supply systems will require a pump to distribute water to internal and external plumbing fixtures. A pump should be sized to balance the required flow and pressure for the intended uses of the rain water from the storage while minimising energy use. Generally flows of less than 30 L/min are suitable for most residential applications (NSW Department of Planning and Environment, 2015).

Local government or State Government policy requirements may exist in regards to pumps and connections.

Outlet

Runoff that is not collected in the storage and overflows should be diverted away from storage foundations, buildings or other structures (enHealth, 2012). This water should be directed into gardens, infiltration systems or the public stormwater management network. The overflow water should not be allowed to cause nuisance to neighbouring properties or to areas of public access.

Tanks with Dedicated Airspace

The increased uptake of rain water harvesting also creates an opportunity to adopt an integrated approach to lot scale stormwater management by designing the facility to control of peak discharge and harvest runoff volume. This approach may result in rain water tanks with three outlets, one for use of rain water (e.g. connected to selected indoor plumbing or garden irrigation) down the bottom of the tank, one for orifice discharge (i.e. the OSD outlet) half way up the tank, and the third outlet is an overflow at the top of the tank (as per Figure 9.4.9) as originally proposed by Coombes et al. (2001). The dedicated airspace above the minimum level outlet provides for additional attenuation of peak discharges.

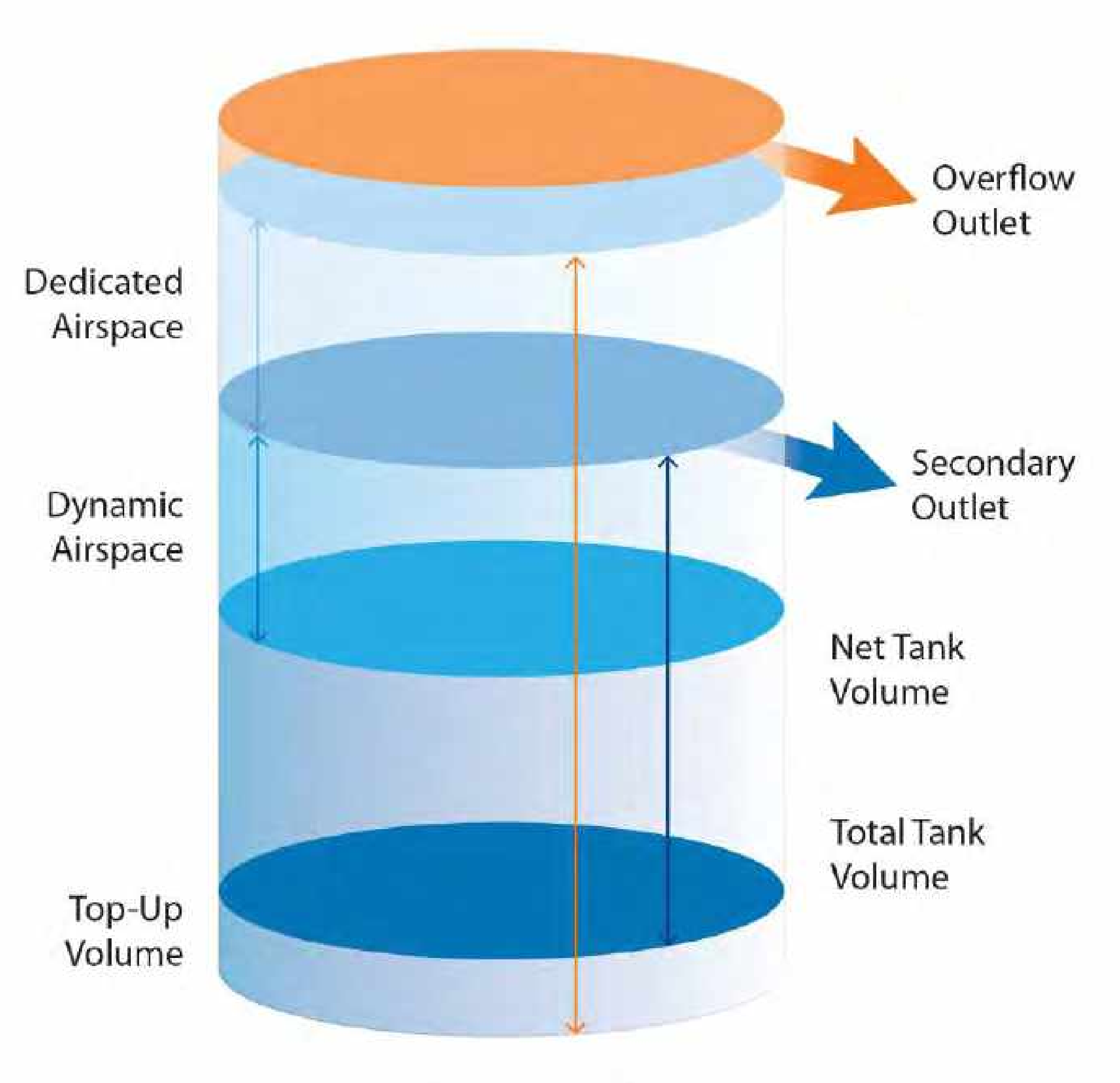

Figure 9.4.9. Rain Water Tank with Dedicated Air Space (adapted from Coombes et al. (2001))

4.5.4. Bioretention Basins

A bioretention basin is a shallow depression with a network of under-drainage and a soil-based filter media (refer to Figure 9.4.10). The filter media is vegetated with plants that tolerate periodic inundation. Stormwater is directed into the basin and percolates vertically through the soil and plant root zone providing water treatment. These facilities are sometimes also referred to as 'rain gardens'.

Bioretention basins primarily target water quality treatment objectives for small to medium catchments. In some circumstances it may also contribute to peak discharge control. Certain design types can also be used to promote the infiltration of stormwater into the groundwater system.

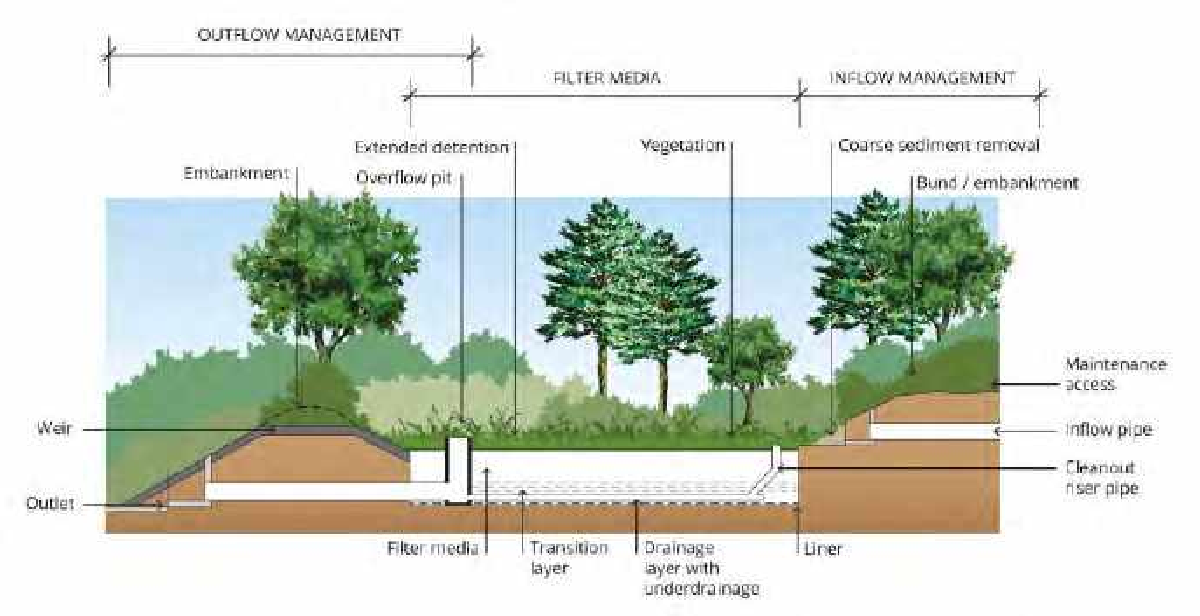

Figure 9.4.10. Components of a Bioretention Basin (Healthy Waterways by Design, 2014)

Available Guidelines

- Healthy Waterways by Design (2014) “Bioretention Technical Design Guidelines”
- Department of Water, Western Australia (2007) “Stormwater management manual for Western Australia”. Department of Water, WA, Perth, August.
- Facility for Advanced Water Biofiltration (2009) “Guidelines for Filter Media in Biofiltration Systems”

Design Considerations

Basin Layout and Sizing

The core elements of a bioretention facility including a basin with filter media, an inlet structure and an outlet structure.

In practice a typical basin filter area requirement is between 1% and 2% of the catchment it serves. However the overall size of the basin will vary depending on its catchment and the treatment performance sought.

The shape of the basin is flexible but needs to facilitate even distribution of inflows across the filter media’s surface. The shape factor should therefore ideally approach a length to width ratio of 1 (i.e. square), though rectangular layouts are acceptable and common.

An indicative maximum catchment area constraint of about 10 hectares applies since areas greater than this normally produce trickle flows which can compromise the performance of the vegetation and filter media. It also becomes more difficult to evenly distribute inflows across a large filter area and manage scour velocities. This catchment area constraint will vary depending on local climate and soils.

Designs can be scaled down to lot scale and street scale sub-catchments. These facilities are sometimes referred to as bio-pods, rain gardens and tree pits.

The basin is designed to be frequently inundated for a short period of time, however the volume temporarily stored and the release rate are not normally effective at controlling peak discharge in large floods. Hybrid design opportunities exist where the bioretention basin is nested inside a larger detention basin facility to target peak flood discharge as well as water quality.

Filter Media and Layers

The floor of the basin comprises of a carefully blended soil filter media, minimum 400 mm depth, with a prescribed hydraulic conductivity of between 100 mm and 300 mm/hr. Over time the conductivity changes as the media settles and plants establish. The plant root zone enhances the water quality treatment performance of the filter and also helps to maintain an equilibrium level of hydraulic conductivity in the media.

Beneath the filter media are a sand transition layer and then a gravel drainage layer. The sand transition layer limits progressive migration of the filter media into the drainage layer. The drainage layer includes a network of slotted pipes that collect treated stormwater for discharge. This drainage layer can be designed as a saturated sump to sustain plant growth during extended dry seasons.

Bioretention basins are normally lined with low permeability clay or a plastic membrane. It is possible to design the system without a liner to encourage infiltration into the local groundwater table, however success with this approach will heavily depend on plant choice and climate.

Inlet Structures

The inlet structure receives flow from the upstream conveyance network. Typically the inlet comprises a small headwall pipe outlet, roadside kerb and gutter or an open channel swale. For large catchments a high-flow bypass is required to limit velocities within the basin and avoid scour of plants and filter media. For large catchments a coarse sediment capture zone (sometimes referred to as a ‘sediment forebay’) is also required to capture sediment and prevent smothering of the filter media. Regular clean-out of the coarse sediment capture zone is required. Maintenance access is therefore important.

Outlet Structures

The primary outlet is the filter media underdrainage system described previously. This is collected into an outlet pit before discharge into the downstream conveyance system. The secondary outlet normally comprises of an overflow pit or weir that is engaged once the hydraulic conductivity of the filter media is exceeded. The level of the weir is normally between 0.1 m and 0.3 m above the filter surface level. For larger systems a small armoured spillway or weir may also be provided to augment outlet capacity during a large storm.

The outlet discharge level should be sufficiently elevated above local backwater and tide levels to ensure the overall facility is free-draining. Emptying time for these systems can be critical and should be checked.

Vegetation and Landscape Integration

Bioretention basins should be thickly vegetated to encourage water treatment, enhance the long-term performance of the filter media and suppress weed growth. A wide range of plant species may be suitable, but those that tolerate dry conditions, can be periodically inundated and have fibrous root systems are preferred. Native sedges, rushes, grasses, tea tree, paper bark and swamp oak have all been found to perform well. The planting scheme that is chosen should blend with the surrounding landscape and habitat.

4.5.5. Constructed Wetlands

A constructed wetland is a system of water bodies that store water and sustain a range of aquatic macrophytes and semi-aquatic plants (Figure 9.4.11 and Figure 9.4.12). Stormwater is directed into the wetland and detained for a period of approximately 48 hours. During this time, physical, chemical and biological processes result in removal of water-borne pollutants.

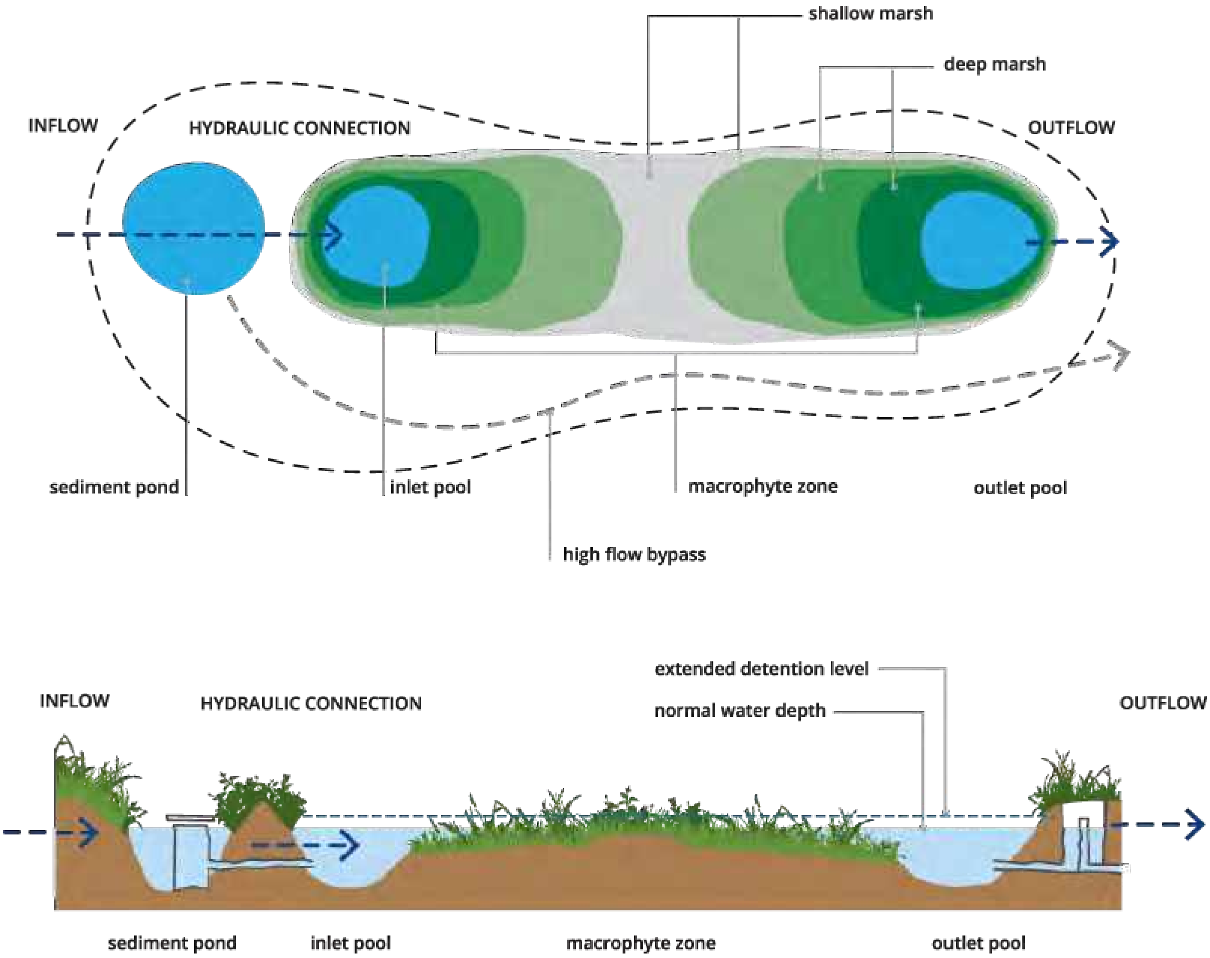

Figure 9.4.11. Schematic Layout of a Typical Constructed Wetland

Figure 9.4.12. Photo of a Typical Constructed Wetland (Source: Steve Roso)

A constructed wetland is most suitable for water quality improvement on catchments larger than approximately 10 hectares (indicative only and subject to local climate and design features). Subject to design and location it may also provide some peak discharge control. It is not directly suitable for harvesting or infiltration of stormwater as this can compromise the sustainability of vegetation. If this objective is sought a separate downstream pond facility should be provided.

Available Guidelines

- Water by Design (2017) “Wetland Technical Design Guidelines”, Brisbane Queensland
- Melbourne Water (2016) Design, construction and establishment of constructed wetlands: design manual (Final Draft), Melbourne, Victoria
- Laurenson and Kuczera (1998) “The Constructed wetlands manual” Sydney, New South Wales

Design Considerations

Inlet Pond and High Flow Bypass

The inlet pond receives stormwater inflow from the upstream conveyance system. The depth and size of the pond should be sufficient to lower flow velocities and promote settling of course sediment particles. Regular clean-out of sediment from this area is required. Reliable maintenance access for machinery should therefore be considered in the design.

The inlet zone contains drainage structures that direct low flows out of the inlet pond and into a downstream wetland area.

During a storm the wetland area fills to a depth of about 0.5 m above the normal operating level. Once this threshold is reached, high flows are directed around the wetland area via a high flow bypass. This flow split is necessary to avoid re-suspension of sediment and plant damage in the wetland area.

Wetland Area

The wetland area is designed with a range of different ponding depths up to 1.5 m, perpendicular to the flowpath. These different depth zones promote a diversity of macrophytes and semi-aquatic plants and enhance the wetlands treatment capacity. The majority of the wetland area should comprise emergent macrophytes however deeper zones are important for diversity and to sustain the ecosystem during drier periods. The overall shape of the wetland should rest within a length to width ratio of between 3 and 10. Typically the total wetland area represents about 5% of the catchment area treated however this varies depending on the climate and treatment performance that is sought.

Outlet Structure

The stormwater that is temporarily held in the wetland after rain is progressively released via a restricted outlet. A typical residence time of 48 hours is sought, however this can vary depending on the site constraints and plant selection.

A secondary outlet is also required to limit the depth of submergence over the wetland.

Vegetation and Landscape Integration

Plant selection requires specialist input to design a planting scheme suited to the hydrologic regime and climate and therefore likely to establish and maintain a thick vegetation cover. The majority of the wetland footprint should be designed to support emergent macrophytes, however deeper zones are important for diversity and to sustain the ecosystem during drier periods. Regional biodiversity guidelines should be consulted for selection of appropriate plant species.

Opportunities should also be sought to integrate the wetland into passive open space recreation and/or local natural habitat.

The wetland should be well sealed with low permeability material to ensure water retention during dry periods. The bed of the wetland should also be lined with topsoil as a growth medium for the selected plants.

The initial establishment period is critical, careful maintenance is required including weeding and replacement of losses. Progressive flooding of the wetland is also needed to avoid drowning of small plants. Predation by birds is also sometimes a challenge that needs to be managed, particularly during the establishment phase.

4.5.6. Managed Aquifer Recharge

Managed Aquifer Recharge (MAR), also known as artificial recharge, is the infiltration or injection of water into an aquifer (Environmental Protection Authority, 2005) (refer to Figure 9.4.13). The water can be withdrawn at a later date, left in the aquifer for environmental benefits, such as maintaining water levels in wetlands, or used as a barrier to prevent saltwater or other contaminants from entering the aquifer (Department of Water, Western Australia, 2007).

MAR may be used as a means of managing water from a number of sources including stormwater. The MAR schemes can range in complexity and scale from the precinct scale, through local authority infiltration systems for road runoff and public open space irrigation bores, through to the regional scale, which involves infiltration or well injection of stormwater and provision of third pipe non-potable water supply for domestic use.

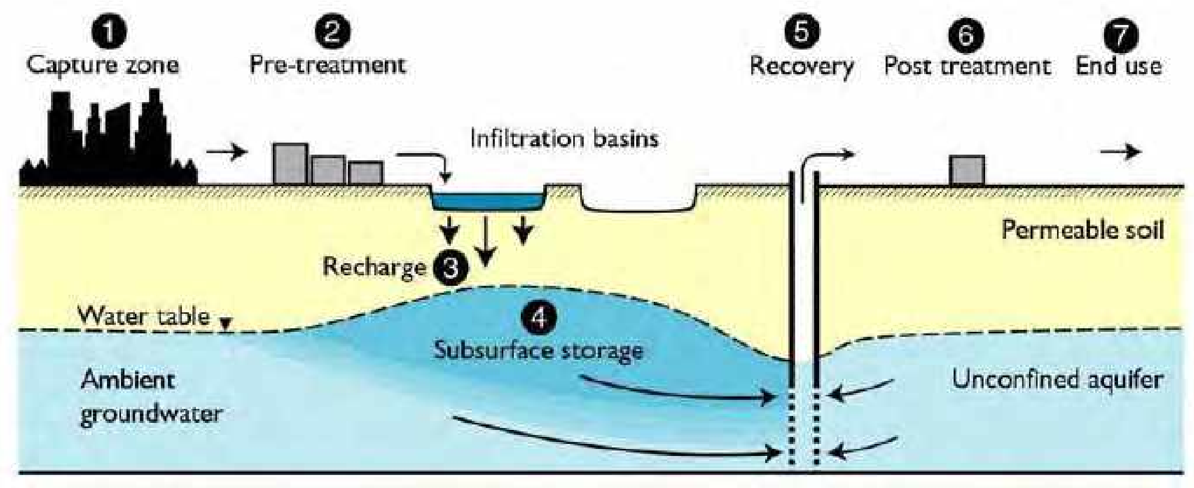

Figure 9.4.13. Example of a Managed Aquifer Recharge Scheme in an Unconfined Aquifer (Adapted from (Natural Resource Management Ministerial Council et al., 2009))

Available Guidelines

Further guidance on MAR can be found in the following documents:

- Melbourne Water (2005): WSUD: Engineering Procedures – Stormwater. Victorian Stormwater Committee, published CSIRO, Melbourne.
- Department of Water, Western Australia (2007) “Stormwater management manual for Western Australia”. Department of Water, WA, Perth, August.
- Natural Resource Management Ministerial Council et al. (2009) “Australian Guidelines for Water Recycling - Managed Aquifer Recharge - National Water Quality Management Strategy - Document No 24, Canberra.

Design Considerations

System Components

As an example, a MAR scheme for infiltration of treated stormwater into a shallow aquifer could contain the following structural elements (Melbourne Water, 2005; Department of Water, Western Australia, 2007):

- soakwells, swales or infiltration basins used to detain runoff and preferentially recharge the superficial aquifer with harvested stormwater;
- an abstraction bore to recover water from the superficial aquifer for reuse;

- a reticulation system (in the case of irrigation reuse) (will require physical separation from potable water supply);
- a water quality treatment system for recovered water depending on its intended use (e.g. removal of iron staining minerals);
- systems to monitor groundwater levels and abstraction volumes; and
- systems to monitor the quality of groundwater and recovered water.

An MAR system may also incorporate the following additional elements (Melbourne Water, 2005; Department of Water, Western Australia, 2007):

- a diversion structure from a drain;
- a control unit to stop diversions when flows are outside an acceptable range of flows or quality;
- some form of treatment for stormwater prior to injection;
- a constructed wetland, detention pond, dam or tank, part or all of which acts as a temporary storage measure (and which may also be used as a buffer storage during recovery and reuse);
- a spill or overflow structure incorporated in the constructed wetland or detention storage;
- well(s) into which the water is injected (may require extraction equipment for periodic purging);
- an equipped well to recover water from the aquifer (injection and recovery may occur in the same well);
- a treatment system for recovered water (depending on its intended use);
- sampling ports on injection and recovery lines; and
- a control system to shut down recharge in the event of unfavourable conditions.

Site Suitability

Factors to consider in evaluating the suitability of an aquifer for a MAR scheme include (Melbourne Water, 2005; Department of Water, Western Australia, 2007):

- environmental values of the aquifer including ecosystem maintenance of caves, wetlands, phyreatophytic vegetation, surface water systems and human uses (irrigation, drinking water supply);
- adverse impacts on the environment and other aquifer users (e.g. reduced pumping pressure for nearby irrigators);
- an existing and/or future drinking water source area;
- sufficient permeability and storage within the receiving aquifer;
- depth of abstraction from the aquifer;

- existing allocation of the aquifer and groundwater resource;
- existing ambient groundwater quality and contaminant concentrations;
- loss of aquifer permeability and/or infiltration due to precipitation of minerals or clogging;
- possible damage to confining layers due to pressure increases;
- higher recovery efficiencies of porous media aquifers;
- aquifer mineral dissolution, if any; and
- potential for local aquitard collapse or distortion.

4.5.7. Infiltration Systems

Infiltration systems can come in a number of different forms, each having different size and geometry but all with a common purpose to promote infiltration of stormwater. They comprise of two main components; a storage basin and an infiltration zone. They are best suited to locations where natural soils have high permeability.

These facilities assist to manage stormwater volume through infiltration of stormwater that enters the groundwater system. They may also contribute to peak discharge control where rainfall intensities are low relative to the permeability of the infiltration zone. They are not intended to provide standalone water quality treatment and should ideally be accompanied by a treatment facility to prevent groundwater contamination.

Available Guidelines

Further guidance on infiltration systems can be found in the following documents:

- Healthy Waterways by Design (2006) “Water Sensitive Urban Design Technical Design Guidelines for South-east Queensland”
- Department of Water, Western Australia (2007) “Stormwater management manual for Western Australia”. Department of Water, WA, Perth, August.
- Argue and Pezzaniti (2012) “WSUD: basic procedures for ‘source control of stormwater – a Handbook for Australian practice”

Design Considerations

System Types

There are several different types of infiltration systems that are available to the designer, each of which suit different sites and applications. These are:

- Infiltration Trenches;
- Infiltration Basins;
- Soakage Well;
- Permeable Pavement; and
- Infiltration Swales.

Each of these is described further below.

Infiltration Trenches

An infiltration trench is a trench filled with gravel or other aggregate (e.g. blue metal), lined with geotextile and covered with topsoil. Often a perforated pipe runs across the media to ensure effective distribution of the stormwater along the system. Recharge storages can also be formed using modular plastic open crates or cells which can be laid in a trench or in rectangular formation. Such systems are typically 0.5 m to 1.5 m deep, surrounded by geotextile and covered with topsoil. Stormwater discharged into these systems is often pre-treated to reduce ongoing maintenance of such systems. Systems usually have an overflow pipe for larger storm events. There are a range of products which have various weight-bearing capacities so that the surface of the system can be used for parkland or vehicle parking areas. These systems can be combined to treat a large area (Department of Water, Western Australia, 2007).

Infiltration Basins (also Known as Retention Basins)

Community and regional infiltration basins are typically installed within public open space parklands. They can consist of a natural or constructed depression designed to capture and store the stormwater runoff on the surface prior to infiltrating into the soils. Basins are best suited to sandy soils and can be planted out with a range of vegetation to blend into the local landscape. The vegetation provides some water quality treatment and the root network assists in preventing the basin floor from clogging. Pre-treatment of inflows may be required in catchments with high sediment flows (Department of Water, Western Australia, 2007).

Soakage Wells

One method for infiltration of urban runoff into suitable soils is using soakage wells (for soils with hydraulic conductivity values > 1×10^{-6} m/s). These systems are used widely in Western Australia as an at-source stormwater management control, typically in small scale residential and commercial applications, or as road side entry pits at the beginning of a stormwater system. Soakage wells can be applied in retrofitting scenarios and existing road side entry pits/gullies can be retrofitted to perform an infiltration function (Department of Water, Western Australia, 2007).

Soakage wells consist of a vertical perforated liner with stormwater entering the system via an inlet pipe at the top of the device (refer Figure 9.4.14). The base of the soakwell is open or perforated and usually covered with a geotextile. Alternatively, pervious material, such as gravel or porous pavement, can be used to form the base of the soakwell. Where source water may have a high sediment load, there should be pre-treatment, such as filtering, as soakage wells are susceptible to clogging.

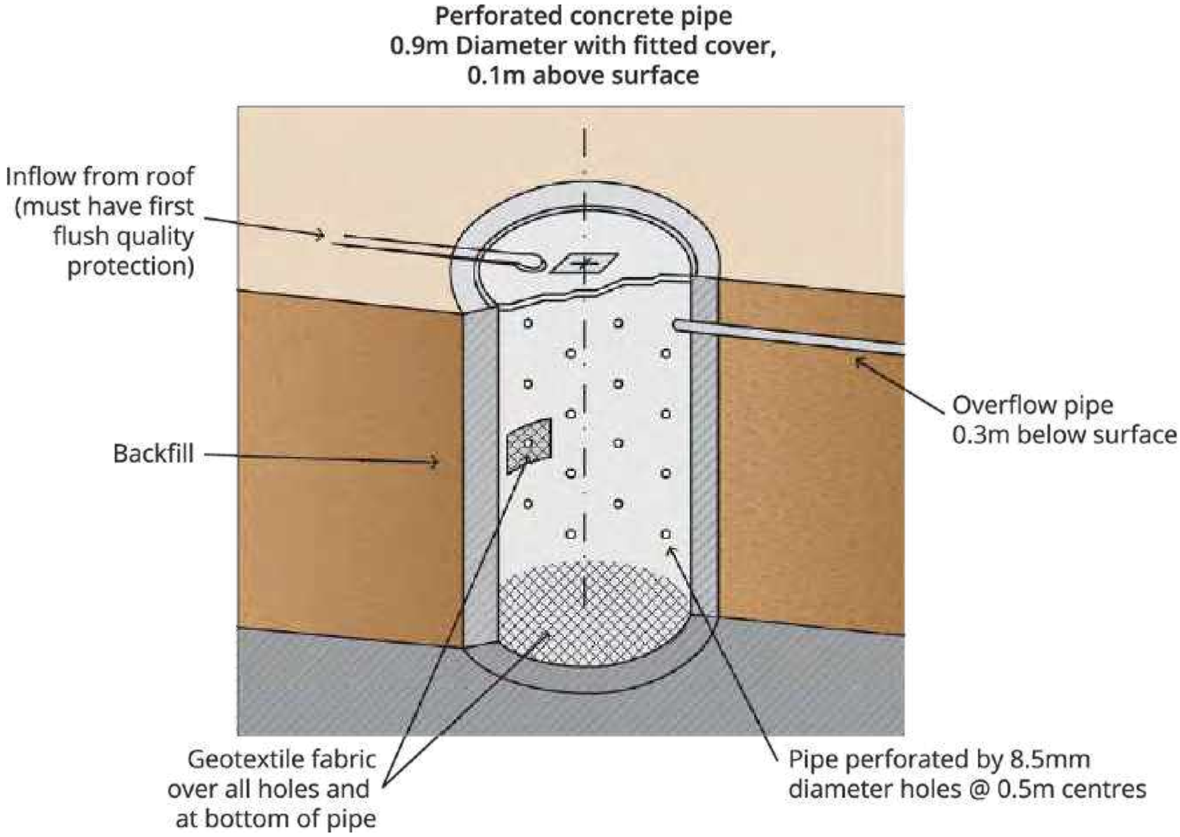

Figure 9.4.14. Leaky Well Infiltration System (adapted from Argue (2017))

Permeable Pavement

There are two types of pervious pavements that are effective in intercepting and diverting surface runoff into the host soil body:

- Permeable paving: concrete blocks incorporating slots or gravel-filled tubes providing (vertical) paths for surface flow to access gravel-filled ("leaky") storages; and
- Porous paving: grassed surface integrated with a sandy-loam and plastic ring-matrix layer laid above a substructure of sand/gravel mix placed under optimum moisture content conditions.

The abstraction capabilities of permeable paving system slots and gravel-filled tubes can be as high as 4,000 mm/h when new – a performance which can show little deterioration over time where surface sediment loads are "light" or where the supply is pre-treated. Pre-treatment in a typical urban street context would require the insertion of a simple sediment trap (2.0 m^2 capacity) immediately upstream of the paving (requiring annual clean-out). The alternative to pre-treatment is regular (five-year intervals) cleaning of the paved surface.

Grassed surface paving shows infiltration capacity of, typically, at least 100 mm/h when new and, like permeable paving, shows little deterioration over time where supply sediment loads are relatively "light". Porous paving is unsuited to the urban street context where permeable paving is used but can be relied upon for many decades of low maintenance service receiving runoff from, for example, a (conventional) paved carpark surface. "Low maintenance" in this context involves little more than regular mowing. The continued impressive performance of a porous paved surface is accounted for by the dynamic nature of the interaction – maintaining infiltration capacity - which takes place between the grass roots and the host soil.

Infiltration Swales

Infiltration swales are shallow grassed channels – typically 0.3 m to 0.5 m (maximum) deep, 5 m to 6 m wide in residential streets – with longitudinal slopes, preferably, less than 3%. They have wide application in stormwater retention systems for three main reasons:

- They can retain runoff through bed infiltration;
- They can be effective in retaining pollutants conveyed in stormwater (Breen et al., 1997; Lee et al., 2008) and
- They can fulfil a role in stormwater harvesting through soil moisture enhancement and, possibly, aquifer recharge and recovery.

The configuration of a typical infiltration swale in relation to a residential street carriageway is shown on Figure 9.4.15. This configuration includes a filter strip between the carriageway and the swale invert to provide pre-treatment and additional infiltration.

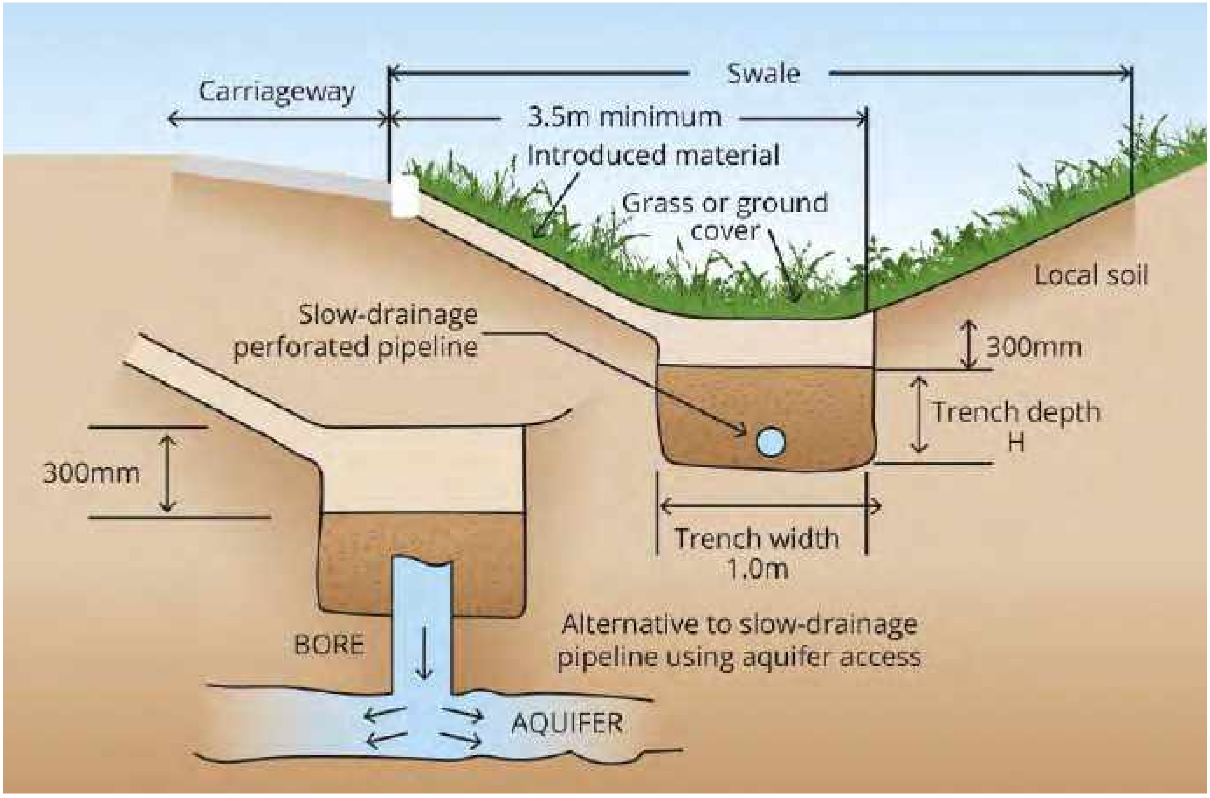

Figure 9.4.15. Main Components of an Infiltration Swale (with Filter Strip) (adapted (Argue, 2017),(Argue, 2013))

Swales only abstract flows up to a limit set by the infiltration capacity of the near-carriageway “filter strip” and channel bed. All exceedances above this capacity pass as open channel flow conveyed downstream within the boundaries of the swale. Another practice is to terminate such a swale in a “dry pond” perhaps in the vicinity of a major road intersection.

The process of abstraction is achieved through infiltration alone or by infiltration combined with sub-structure retention (gravel-filled trench or similar illustrated in Figure 9.4.7) with hydraulic disposal to aquifers (if available) or local waterways (slow-drainage) if necessary.

Site Selection

Due to their flexibility in shape, infiltration systems can be located in a relatively unusable portion of the site. However, design will need to consider clearance distances from adjacent building footings or boundaries to protect against cracking of walls and footings.

Identification of suitable sites for infiltration systems should also avoid steep terrain and areas of shallow soils overlying largely impervious rock (non-sedimentary rock and some sedimentary rock such as shale). An understanding of the seasonal and inter-annual variation of the groundwater table is also an essential element in the design of infiltration systems.

Soils

Soil types, surface geological conditions and groundwater levels determine the suitability of infiltration systems. Infiltration techniques can be implemented in a range of soil types, and are typically used in soils ranging from sands to clayey sands. While well-compacted sands are suitable these measures should not be installed in loose aeolian wind-blown sands.

Soils with lower hydraulic conductivities do not necessarily preclude the use of infiltration systems, but the size of the required system may typically become prohibitively large, or a more complex design approach may be required, such as including a slow drainage outlet system. Care should also be taken at sites with shallow soil overlying impervious bedrock, as the water stored on the bedrock will provide a stream of flow along the soil/rock interface (Department of Water, Western Australia, 2007).

Groundwater

The presence of a high groundwater table limits the potential use of infiltration systems in some areas, but does not preclude them. There are many instances of the successful application of infiltration basins on the Swan Coastal Plain where the basin base is located within 0.5 m of the average annual maximum groundwater level. The seasonal nature of local rainfall and variability in groundwater level should also be considered. Infiltration in areas with rising groundwater tables should be avoided where infiltration may accelerate the development of problems such as waterlogging and rising salinity (Department of Water, Western Australia, 2007).

Pre-treatment

In general, stormwater runoff should not be conveyed directly into an infiltration system, but the requirement for pre-treatment will depend on the catchment e.g. residential or industrial. Pre-treatment measures include the provision of leaf and roof litter guards along roof gutters, vegetated strips or swales, litter and sediment traps, sand filters and bioretention systems. To prevent infiltration systems from being clogged with sediment/litter during road and housing/building construction, temporary bunding or sediment controls need to be installed. It may also be necessary to achieve a prescribed water quality standard before stormwater can be discharged into groundwater (Department of Water, Western Australia, 2007).

Emptying Time

Emptying time is defined as the time taken to completely empty a storage associated with an infiltration system following the cessation of rainfall. This is an important design consideration as the computation procedures typically assume that the storage is empty prior to the commencement of the design storm event.

Ideally emptying time criteria should be ascertained by undertaking 'continuous simulation' modelling of a catchment (Argue, 2017) and should be conducted in accordance with Book 7 and combined with partial series analysis to determine the volume, frequency and rate of discharge from the site. In the absence of such assessments the emptying times for infiltration systems given in Table 9.4.8 are recommended in the interim.

Table 9.4.8. Interim Relationship between Annual Exceedance Proability and 'Emptying Time (Argue, 2017)

	EY			AEP (%)			
	1	0.5	0.2	10	5	2	1
Emptying Time (days)	0.5	1.0	1.5	2.0	2.5	3.0	3.5

4.5.8. Stormwater Harvest Ponds

A stormwater harvest pond comprises of a storage area to collect surface runoff for later extraction and use, often for irrigation. Ancillary infrastructure is also required for the pre and post treatment and distribution of this water.

A stormwater harvest pond is best suited to applications that target the harvesting and re-use of larger quantities of stormwater for non-potable use. Below a certain size threshold a pond may not be an economic way of storing water, in which case an alternative may be an underground tank.

A stormwater harvest pond does not directly target the improvement of water quality, however it can provide a minor contribution to this outcome in some circumstances where there is suitable irrigation demand. Similarly a stormwater harvest pond does not directly target the control of peak discharge but it may contribute to minor reductions in peak flow downstream for smaller storms.

Available Guidelines

- Healthy Waterways by Design (2009) "Stormwater Harvesting Guidelines (Draft)", Brisbane, Queensland

Design Considerations

Embankment Design

The guidance on embankment design given in Book 9, Chapter 4, Section 5 is also applicable to any dry ponds which are formed by embankments.

Configuration and Sizing

The configuration of a stormwater harvest pond is mostly influenced by physical site constraints and geotechnical limitations on batter slope. The shape of the pond does not directly affect its performance as a storage, but may affect the cost of civil construction. The most efficient shape in this regard approaches a circle or square.

The size of the pond relative to the estimated catchment yield is a balance between capital cost of construction and the reliability of supply. This sizing must be undertaken using a water balance of the site with realistic estimates of rainfall, runoff and demand.

Liners

A stormwater harvest pond requires a low permeability liner with freeboard above the normal maximum operating level. This can comprise of a non-dispersive compacted clay liner, or a synthetic membrane.

A well utilised stormwater harvest pond is not normally full and will experience significant fluctuations in water level. The liner may therefore need underdrainage to prevent excessive groundwater pressures developing on the outer wall of the membrane.

Treatment

Depending on the anticipated end-use of the stored water, the water extracted from the facility may require treatment to improve water quality to the required standard. This may involve filtration using a graded sand filter or similar.

Drainage Structures

A stormwater harvest pond requires a suitable inlet structure armoured against erosion and designed to accommodate potential inflows when the pond is fully drawn down.

The outlet structure typically comprises of an enclosed conduit or spillway, with invert set at the maximum operating level. The capacity of this spillway should be designed with the same level of consideration given to a detention basin spillway, with a capacity and freeboard matched to the level of accepted risk.

4.6. References

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Chapter 5. Stormwater Conveyance

Benjamin Kus

With contributions from the Book 9 editors (Peter Coombes and Steve Roso)

Chapter Status	Final
Date last updated	14/5/2019

5.1. Introduction

Stormwater conveyance combines hydrological and hydraulic methods to safely convey stormwater generated by rain falling on urban surfaces to an outlet. Analysis of conveyance infrastructure typically includes the hydrology of sub-catchments that transfer rainfall runoff to inlet structures feeding a network of other conveyance infrastructure including pipes, open channels, roadways and open space.

Conveyance infrastructure is one of the many tools available to the designer for urban stormwater management which is part of the process of managing the water cycle. For example a stormwater management strategy for an urban area will include a wide range of measures to manage stormwater runoff volumes and flow rates, for example on-site detention, bio-retention, rain water, stormwater harvesting and infiltration systems. These may alter the inflows to and the design of the stormwater conveyance network as shown in Figure 9.5.1. These volume management measures (as described in Book 9, Chapter 4) can operate at different scales such as source and neighbourhood controls that alter inputs to conveyance networks and regional controls that mitigate outflows from conveyance networks.

This chapter focuses on the design and analysis of stormwater conveyance networks.

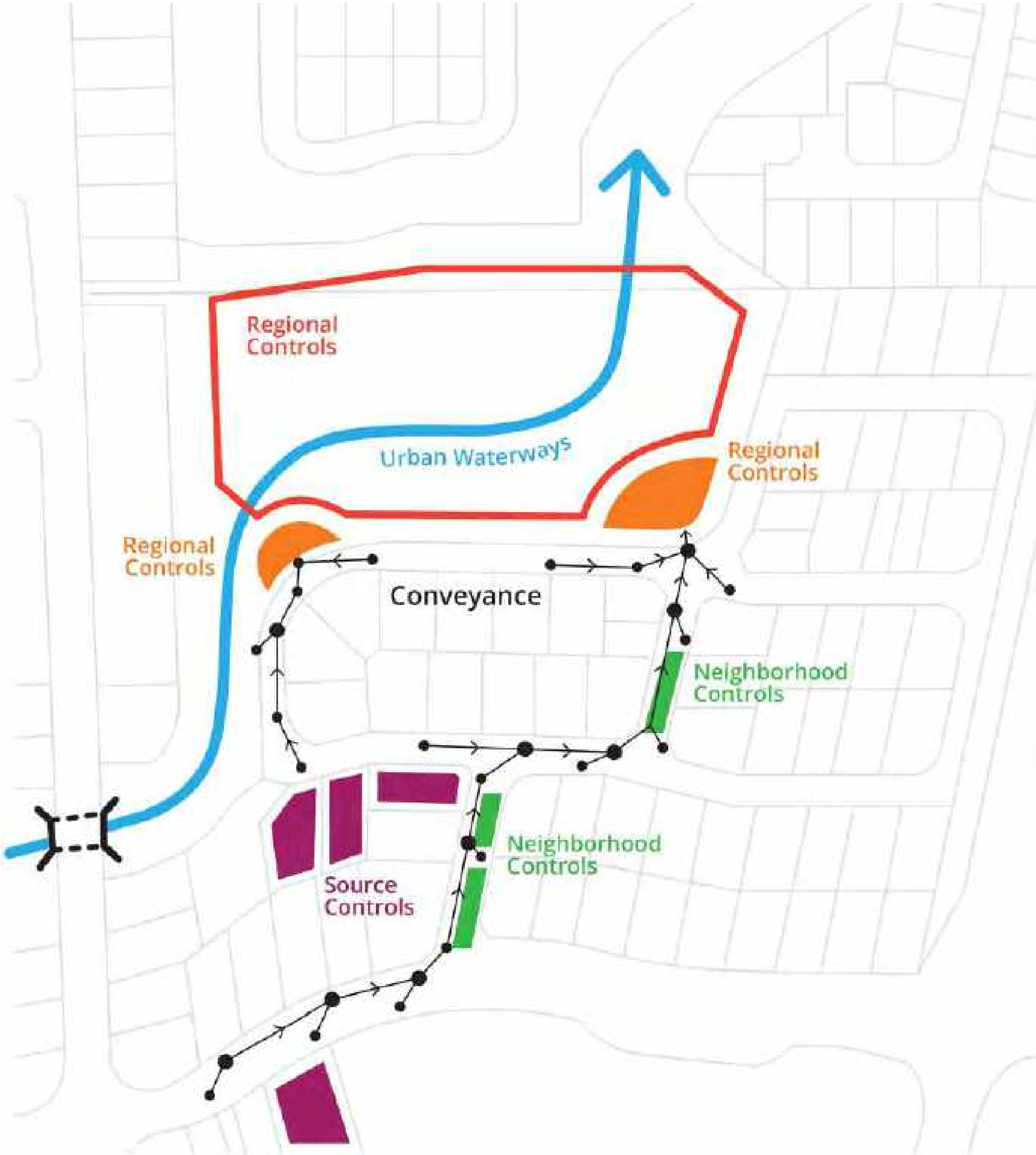


Figure 9.5.1. Stormwater Conveyance and Volume Management Within an Urban Stormwater Network

5.2. Design Philosophy and Objectives

Design of urban stormwater conveyance networks has been comprehensively addressed in guidelines within Australia and internationally. These guidelines include aspects of the design of stormwater infrastructure with different levels of detail that often concentrate on key areas of design focus (such as urban developments or main highways) or on problematic areas of concern that are specific to a locality or past events. It is generally the responsibility of the designer to select an adequate design procedure. However, the objectives and attributes of stormwater conveyance networks are often specified by the local approval authority. These authorities may base their guidance on other design specifications and guidelines such as Aus-Spec, Austroads, or the Victorian Infrastructure Design manual.

This section provides an overview of the philosophy and objectives for design of stormwater conveyance networks. The primary focus of this section is hydraulics and hydrology, and design safety requirements. Nevertheless, there are other important aspects that should be considered during the planning and design of conveyance networks. These include constructability, aesthetics, future maintenance, direct costs, long term economic factors, and the potential liability created by a conveyance network. The design should also account for the practicality of replacing conveyance infrastructure at the end of its design life.

A key hydraulic criterion is to define a conveyance network that restricts surface flows to safe limits. The primary design requirement is that stormwater depths should not be greater than a threshold value above the top of inlet pit or invert of a road gutter. This prevents inlet pits filling to the brim under design conditions which inhibits stormwater flows from entering conveyance networks. The threshold depth is typically set by the relevant approval authority and is in the order of 150 mm. Approval authorities also typically specify maximum velocities of surface flows and minimum velocities of flows in conveyance infrastructure.

In situations where surface flows are conveyed through public places, including footpaths, roads and public places, it is important to ensure that unacceptable hazards to people are not created (refer to Book 6, Chapter 7). Keeping the depth and velocity-depth attributes of surface flow within acceptable limits will minimise these hazards. When the primary purpose of a pathway is for conveyance of stormwater, it will usually be more efficient to convey flows in a dedicated watercourse that can accept higher velocity and depths of flows. These types of flow paths can be designed for dual uses (stormwater conveyance and public access) provided that the design ensures that people cannot be trapped by stormwater flows.

These limits are intended to ensure that stormwater conveyance networks operate at given levels of service without causing flooding of properties, nuisance or hazard to pedestrians and to traffic on streets. An approval authority typically specifies the design AEP of the minor and major storm events required for different land uses. Designs usually involve minor system capacity criteria for design of conveyance infrastructure and major system assumptions to ensure the urban area can safely cope with larger storm events as shown in Figure 9.5.2.

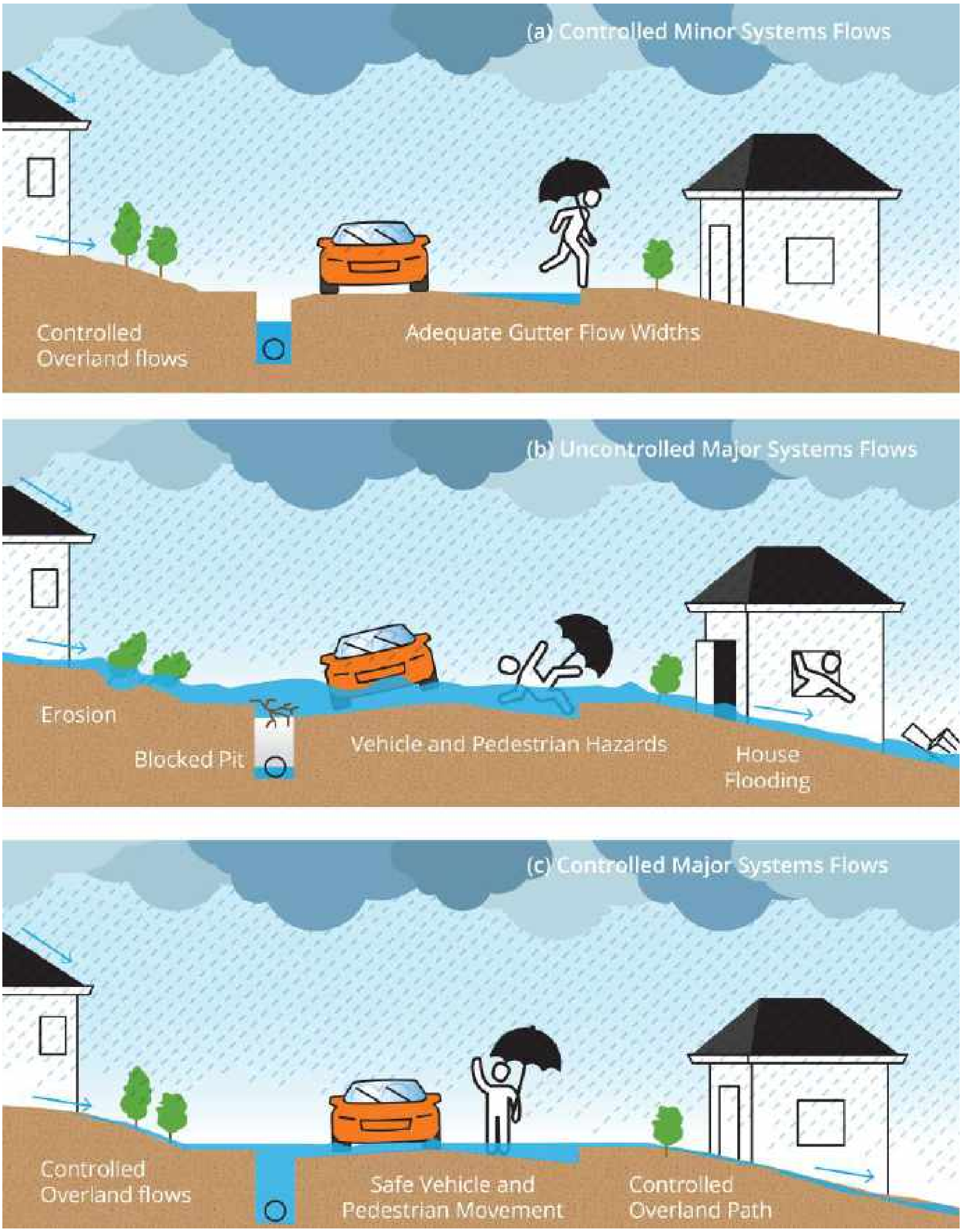


Figure 9.5.2. Minor and Major Concepts for Conveyance Networks

Figure 9.5.2 shows that the minor system is used to define the performance of the conveyance networks which include overland and bypass flows on roads, and performance of conveyance infrastructure (such as pipes and culverts). The major conveyance system includes the road profile and overland flow paths, and aims to ensure the safety of pedestrian and vehicle traffic whilst avoiding property damage and risk to life. In the absence of guidance from a consent authority, the design AEP storm events are selected to reflect the importance of a facility or urban area and the consequences of failure. Some examples are:

- Roof drainage systems: 5% AEP to 1% AEP;

- Conduit drainage systems through lots or sites: 0.5 EY to 1% AEP, depending on consequences of failure;

- Conveyance networks in streets: 0.5 EY to 5% AEP for minor flows, 2% AEP or 1% AEP for major flows (refer to Book 9, Chapter 3) (note that the street profile is part of the major conveyance network);

- Trunk conveyance networks: 1% AEP or higher, with checks on effects created by PMP storm events;

- Stormwater quality and sediment control devices: 4 EY to 1 EY but may address the full spectrum of rainfall frequencies (refer to Book 9, Chapter 3);

- On-site detention (refer to Book 9, Chapter 4): the requirements vary but should aim to improve the performance of stormwater management scheme at a sub-catchment scale; and

- Large detention basins (refer to Book 9, Chapter 4 and Book 9, Chapter 6) that may endanger lives if failure occurs: 1% AEP with checks using probable maximum precipitation (PMP) storm events.

Both design and analysis processes involve modelling the operation of a conveyance network that is subject to critical rare storm events that produce maximum flow rates for the selected AEP events. The selection of critical storm events will involve finding storm durations or particular storm patterns within ensembles or continuous sequences of rainfall that create maximum outputs for a particular location. Typically, the design of a conveyance network is shaped and sized to cater for critical storms for selected AEP events. This approach recognises that:

- It is not practical or economically feasible to design conveyance networks to be free of failure for all events. An attempt to do this would result in very large and expensive conveyance networks that would occupy a considerable land space. This would impact on the optimum provision other infrastructure services, such as water pipes and electricity conduits;

- Failures can occur in response to rare or extreme storm events or other factors such as blockages due to poor maintenance, and exacerbating circumstances such as high tide levels in coastal areas;

- A risk management approach should be adopted that accepts controlled failure;

- Ideally the acceptable level of risk should be set by community values and economic analysis, and;

- The effects of potentially rare failures should be limited by providing a ‘fail safe’ system that does not fail disastrously.

Analysis techniques should include sensitivity checks to ensure that damage and risks to lives due to failures are limited. Some failures of the network and overflows can be expected during major storm events, as shown in Figure 9.5.2, but the network should operate without causing safety hazards or large-scale property damage.

5.3. Conveyance Networks

The design or analysis process for conveyance networks requires observation of the real world situation; definition of the problem and objectives of the design; development of a conceptual model of real world behaviours; calibration using observed data; and predictions or design. A conceptual model of a conveyance network involves hydrological and hydraulic modelling including components such as inlet pits, pipes, open channels, roadways and storages. A general overview of the modelling and design process is presented in Figure 9.5.3.

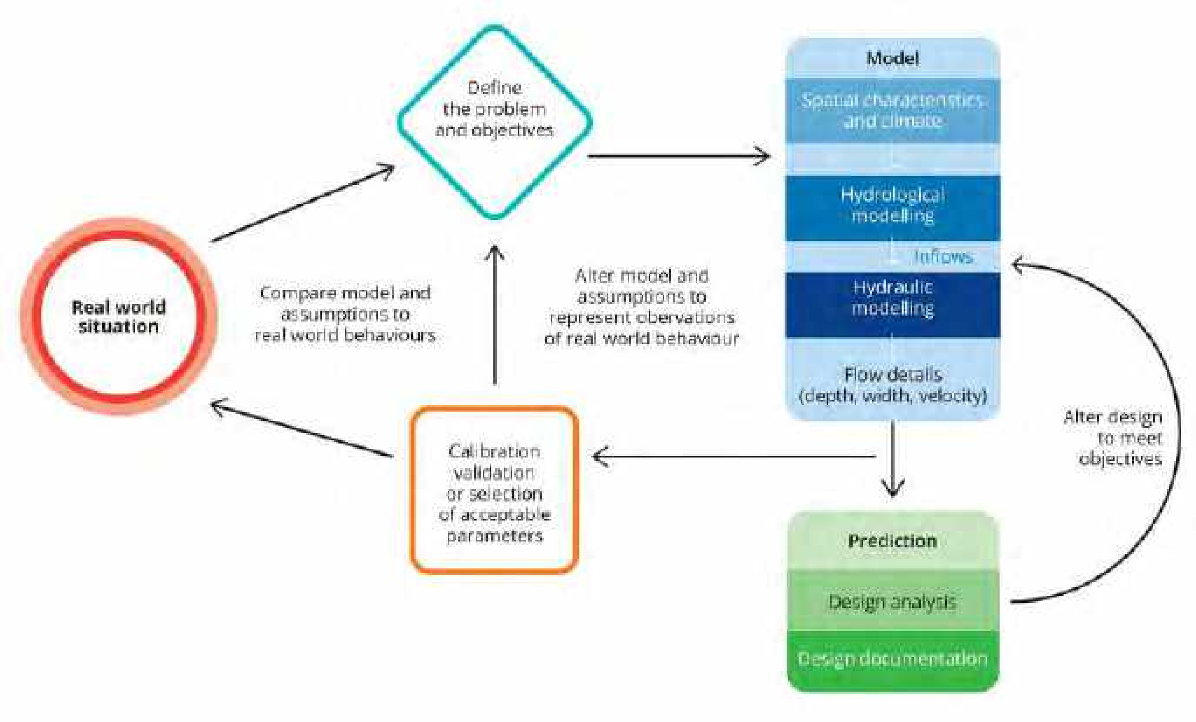


Figure 9.5.3. The Stormwater Design Process

Figure 9.5.3 shows that the stormwater design process includes hydrological modelling of rainfall runoff from urban surfaces to generate inputs to hydraulic modelling of the conveyance network. This process usually incorporates a hydrological model than translates design or real rainfall patterns into design flow rates and volumes of stormwater arriving at inlet structures within a conveyance network. A hydraulic model then converts these inflows into flow characteristics (depths, elevations, widths, velocities, and volumes) throughout the network. The design analysis then determines attributes of the conveyance infrastructure, including pipe diameters and invert levels. The steps in the conveyance design process include:

1. Define the real world situation to be modelled. This will include land use, demographics, topography, urban form, local climate, upstream and downstream conditions, and location within a river basin or waterway catchment.

2. Determine the objectives and design standards that should apply to the drainage network.

3. Locate any available rainfall runoff data that can be used to calibrate models used to design the drainage network or collate the most appropriate parameters for the catchment.

4. Choose the rainfall inputs, hydrological and hydraulic modelling methods for design or analysis:

    a. Rainfall inputs may be design storm temporal patterns of storm bursts or full volume storms, ensembles of peak burst or full storms, or long sequences of real rainfall (refer to Book 2 and ARR Data Hub).

    b. The hydrology and hydraulic models may be hand calculations but will typically be some form of computer model (refer to Book 5 and Book 7).

5. Analyse land uses, road and open space networks, and topography to develop the connectivity stormwater runoff processes throughout the catchment. This includes gathering information such as:

    a. survey and information defining topography;

    b. geotechnical and soil information;

    c. plans of the development or facility to be designed; and

    d. identifying constraints, such as easements and external drainage networks.

6. Define a model network of sub-catchments and drainage infrastructure that is an acceptable approximation of the real system.

7. Using topography, rainfall, land uses, the spatial location of other urban infrastructure and knowledge of the capacity of various drainage inlet structures, define the spacing of nodes in the conveyance network and the routing processes. The routing processes can include gutter flows, overland flows, bypass flows and pipe, culvert or channel flows. The routing processes can include gutter flows, overland flows, bypass flows and pipe or culvert or channel flows.

8. Calibrate or validate the hydrology and hydraulics of the existing catchment to any gauged data or nearby flood frequency information or accepted parameters for the area.

9. Use the model to design the capacity and spacing in inlet structures, and to size the conveyance infrastructure. This design process will be guided by the objectives and design standards that are applied to the project at Step 2. This process includes:

    a. definition of a trial layout of a drainage system made up of inlets, pipes, open channels, and storages; and

    b. using a model to define the sizes and locations of components.

10. Determine the adequacy and safety of the design for all relevant storm events.

11. Prepare plans, specifications and design reports and provide essential instructions on how to build the conveyance network.

1 Review the design, obtain approval from the required authorities and proceed with
2. construction or implementation.

Urban stormwater conveyance networks are usually a dendritic or tree-like structure that transports stormwater by gravity. Stormwater runoff is collected using inlet structures (pits) in different branches that converge at junctions along main lines and flow toward an outlet. Inlets structures located at the top of and along network branches:

- admit stormwater runoff into the conveyance infrastructure;
- provide locations where pipe diameters and directions can change;
- provide access for inspection and maintenance; and
- provide overflow points (if necessary).

Examples of underground pipe conveyance networks used in New South Wales and Queensland are provided in Figure 9.5.4.

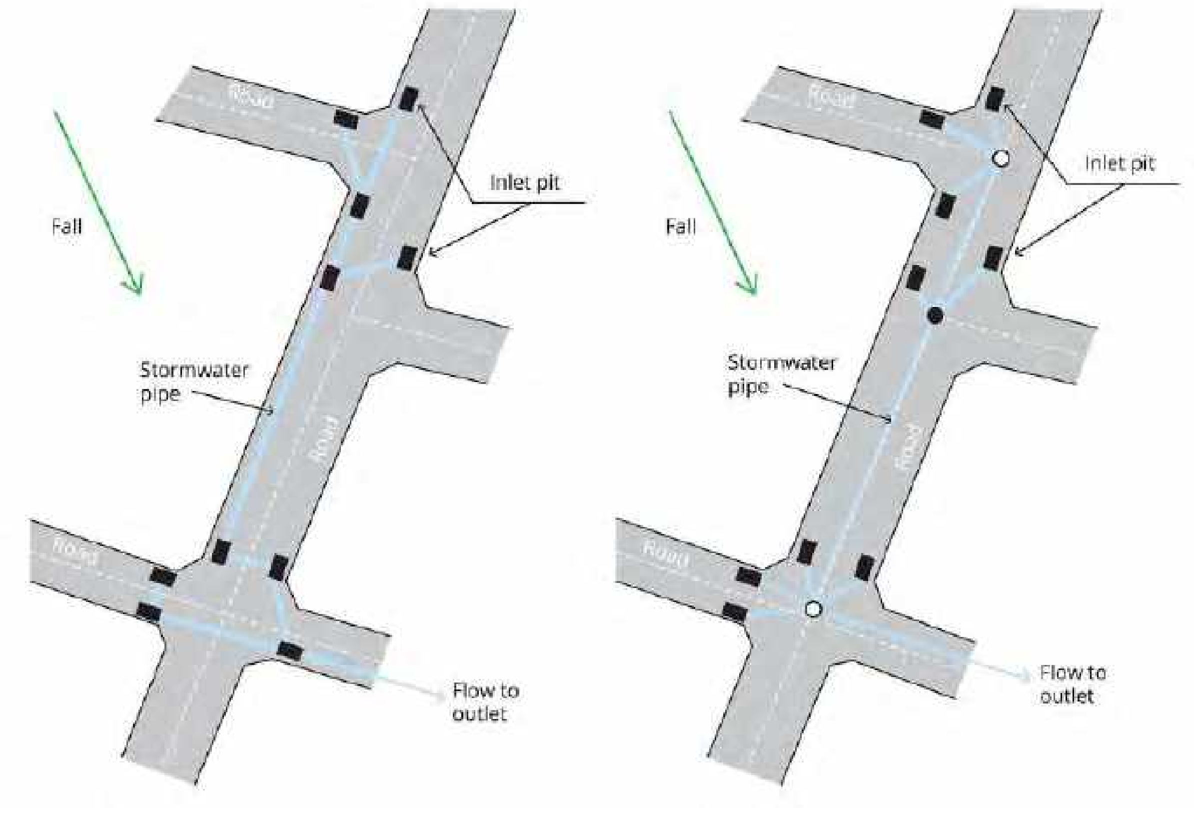


Figure 9.5.4. Examples of Configurations of Conveyance Networks in New South Wales (Left) and Queensland (Right)

Figure 9.5.4 shows different configurations of conveyance networks used in New South Wales and Queensland which highlights that a range of configurations are favoured across different jurisdictions. For example, in some Queensland jurisdictions, pipes are located under road centrelines and manholes at junctions in the conveyance network are used as collectors from inlet pits. Differences in terminology also occur across jurisdictions. For example, in New South Wales ‘kerb and gutter’ is used, while in Victoria and Queensland the term ‘kerb and channel’ is employed.

In some cases, maintenance holes, junctions or junction boxes (pits) are provided as nodes linking branches in the conveyance network. Other pits that are intended to overflow are called surcharge pits, overflow pits, or ‘bubble up’ pits. In established urban areas, looped networks may occur where additional pipes are added to provide additional conveyance capacity which can change the behaviour of the original conveyance network.

Conveyance infrastructure (for example: pipes, culverts, channels, and swales) are, mostly, constructed as straight sections with constant slope. Pipe and culvert conveyance infrastructure are available in standard dimensions supplied by the manufacturers. For example, the diameters of PVC pipes range from 90 mm to about 600 mm, and the diameters of reinforced concrete pipes start at 225 mm and increase to over 2 metres. Road authorities usually specify a minimum pipe diameter of 300 mm to 375 mm within road reserves to improve maintenance outcomes.

It is vital that conveyance networks include overland flow paths to control major stormwater runoff events. These overland flow paths should be within road profiles or through open space and pedestrian pathways. Flow paths through private property should be provided as a last resort and will require an easement (a legal instrument providing a right to drain stormwater through a property and permitting authorities to enter the site for maintenance). Overland flows directed through private property can create hazards and inhibit the development and value of the property as the required easement cannot be blocked or built upon.

Conveyance infrastructures (pipes) are designed to limit surface flows on roads to avoid nuisance to pedestrians and motorists. This process incorporates the design of roads including profiles of high locations (most often along road centrelines) and low locations (most often the inverts of gutters). The trapped low points in road networks require the provision of sag pits which will usually inform the required network of conveyance infrastructure (pipes) that can be realised by ‘joining up the dots’ between pits as shown in Figure 9.5.5.

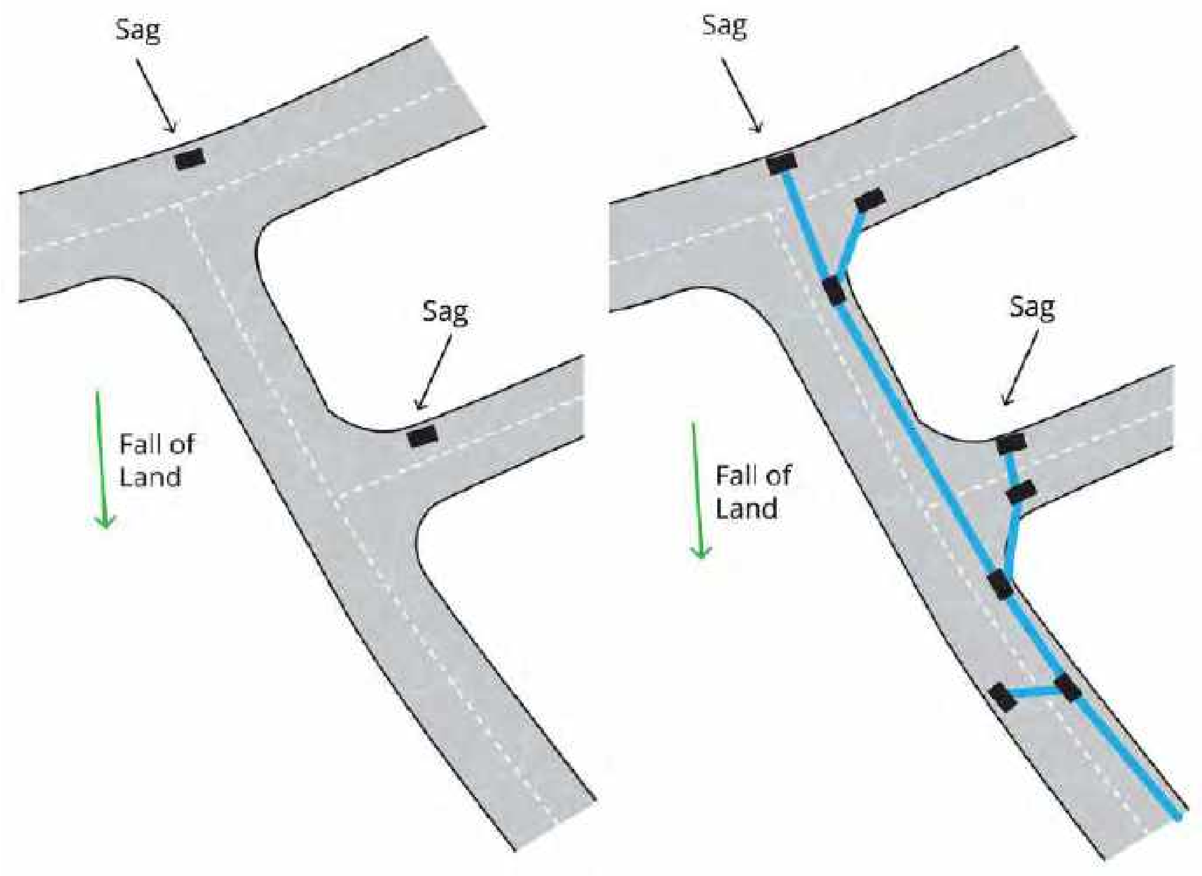


Figure 9.5.5. A Typical Configuration of a Conveyance Network

The configuration of an urban drainage network is demonstrated in a simple example of a single street in Figure 9.5.6.

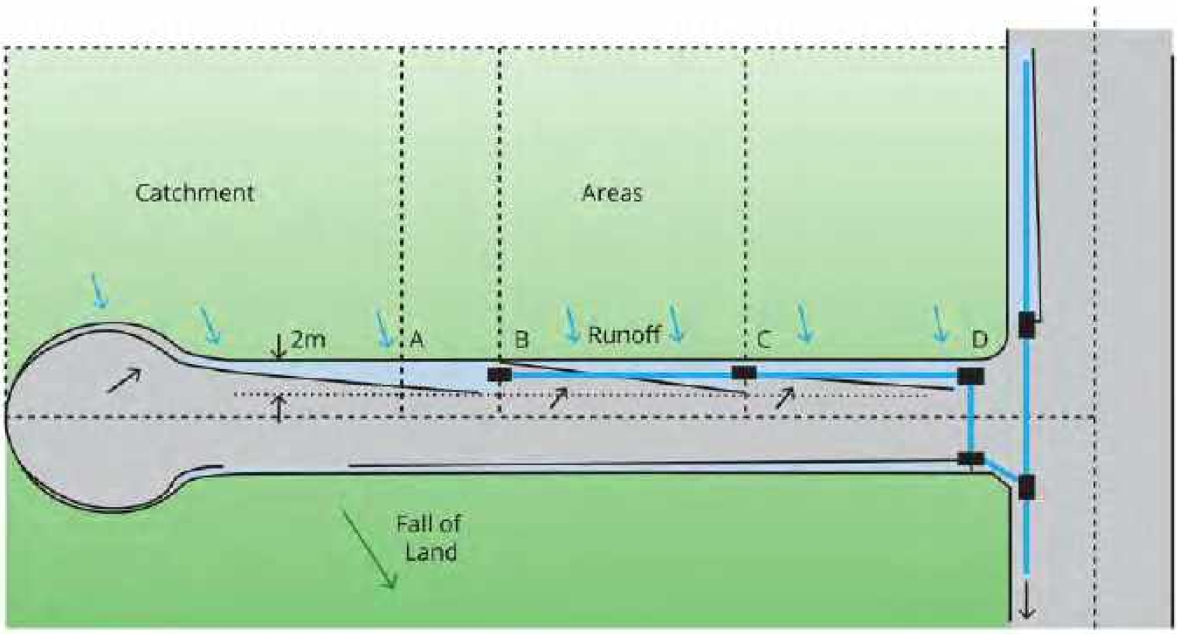


Figure 9.5.6. A Simple Example of a Stormwater Conveyance Network

Figure 9.5.6 indicates the location of inlet pits at the top of a conveyance network. The street gutters are part of the conveyance network and are utilised to transport stormwater towards inlet pits that are situated at intervals to ensure that acceptable flows are carried in road gutters. The width and depth of flows in gutters are limited to allow unimpeded access for pedestrians and vehicles. A maximum width of gutter flow of 2 m to 2.5 m with a maximum flow depth of 150 mm is generally acceptable. Local authorities typically provide guidance on these values. Locations of inlet pits to ensure adequate conveyance of stormwater may also be determined from percentages of stormwater runoff captured by each pit, and the depth of flow and the velocity-depth product of flows in the road gutter.

A designer typically prefers collecting all stormwater runoff from the upper side of the street as shown in Figure 9.5.6 with an inlet pit at Point D which avoids the need for a conveyance branch in the street. This possibility is evaluated by establishing a trial location (A) where stormwater runoff from the corresponding catchment is calculated and the corresponding width of gutter flow is estimated. The width of flows will increase along the gutter length as the areas of contributing catchments increase. A pit must be located whenever any of the criterion limits (such as flow width, depth, or velocity-depth product) are reached. Note that the design process is about limiting surface flows.

Capture of all stormwater runoff at inlet pit B reduces surface flow to zero just downstream of the pit, with surface flows increasing again along the gutter due to lateral inflows from the catchment. However, it is unlikely that on-grade pits will capture all stormwater runoff from catchment areas during minor storm events that create bypass flows downstream of the pit. This is shown at inlet pit C where the flow width increases and reduces due to the pit with a bypass, and some width of flow just downstream of the pit. The flow widths along the gutter will typically follow a saw-tooth pattern.

Figure 9.5.6 also highlights that an inlet pit must be located upstream of a tangent point at an intersection to prevent excessive surface flows at the kerb return. Bypass flows from this inlet pit are collected at inlet pit D. The other pits at the intersection are located along the path of surface overflows to collect both minor and major overflows. This configuration of inlet structures (pits) allows pedestrians to cross at street corners without being exposed to large widths of flows.

The location of inlet pits in the conveyance network may also be driven by a need to provide an inlet at a significant location, such as near a school with street crossings or at a change in road alignment. Aspects of good design practice include location of inlet pits upstream of driveways and avoidance of clashes with other services. A conveyance network also includes additional pipe connections from private property that should be incorporated in the design or analysis of the conveyance network for the street. This may include directly connected pipes from sources such as inter-allotment drainage, on-site volume management systems (such as onsite detention and rain water tanks), or major commercial developments. The first inlet pit in the conveyance network for the street may be receiving considerable pipe flow from upstream private property.

The designer needs to decide on the density of inlet pits in the conveyance network. This decision will typically be guided by the local authority. For example, the two arrangements of inlet pits at an intersection may be acceptable in two different scenarios as shown in Figure 9.5.7.

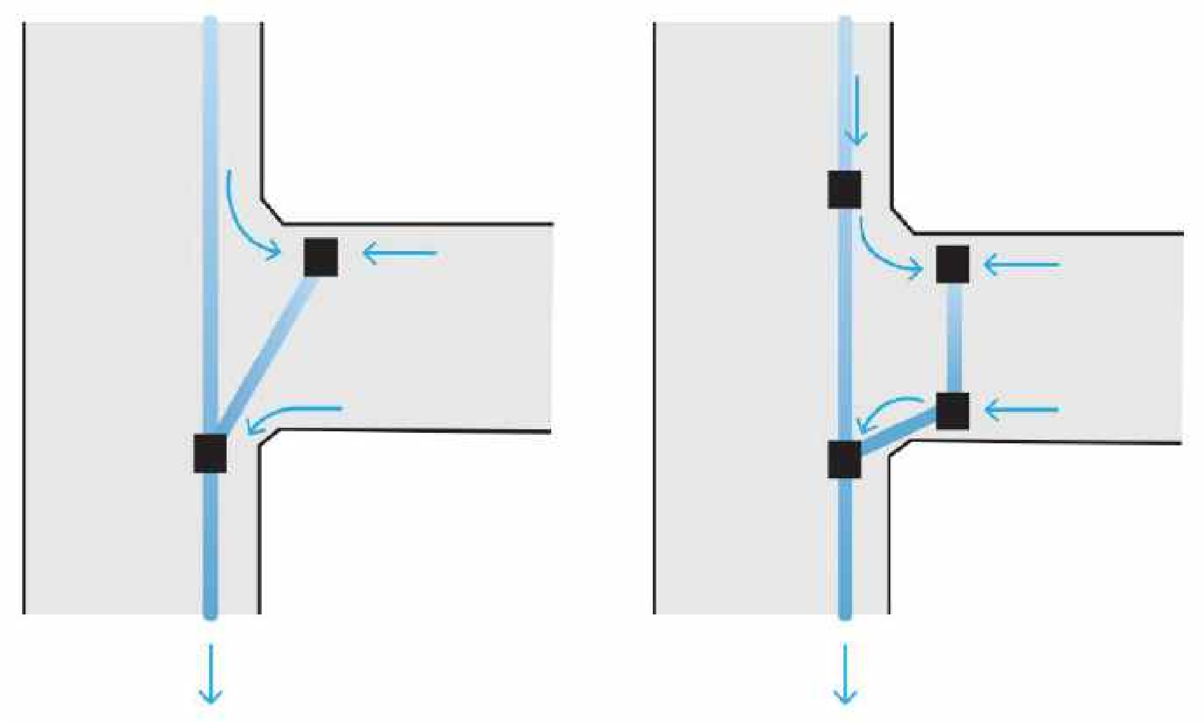


Figure 9.5.7. Example of Alternative Configurations of Inlet Pits at a Road Intersection

Figure 9.5.7 demonstrates different arrangements that may be required at an intersection that could use two or four inlet pits. The decision about the configuration of inlet pits is dependent on the magnitudes and consequences of the flows that may bypass the inlet pits. In a densely-developed area, where overflows or bypass flows may cause nuisance and damage, a greater number of inlet pits will be preferred. Fewer inlet pits can be used in a lower density development where surface flows are more easily managed and the consequences of overflows or bypass flows are small.

5.4. Design of Conveyance Networks with Computer Models

Design of urban stormwater conveyance networks has a long history in Australia. Hand calculations using the urban Rational Method was discussed in the 1958, 1977 and 1987 editions of ARR as the most utilised method for estimation of stormwater inflows to conveyance or drainage networks. There is significant ongoing concern about the reliable characterisation of the parameters (such as runoff co-efficient and time of concentration) underpinning the Rational Method due to insufficient rainfall runoff observations in urban areas (Coombes et al., 2015).

A transition into the computer age heralded the design and analysis of urban conveyance networks using computers to operate drainage software or spreadsheet manipulation that often implemented the Rational Method. The sizing of conveyance infrastructure was based on estimates of peak flows. Increases in computing power allowed greater access to software that integrated hydrology and hydraulics to more accurately analyse or design conveyance networks using hydrograph methods. Additional details about urban modelling approaches are provided in Book 9, Chapter 6.

The characteristics of contemporary urban stormwater management have evolved to be different to the objectives and design solutions for urban stormwater drainage or conveyance networks as envisaged in 1987 (Coombes, 2015). Since the 19th century, the Rational Method and hand calculations has evolved into modern rainfall runoff models (refer to Book 9, Chapter 3). The catchment area has been subdivided into sub-catchments. Average rainfall intensity derived from storm bursts has been modernised to include temporal patterns, spatial variation, relationships between different burst rainfall depths and durations, and the capture of partial areas effects. The runoff coefficient for estimation of stormwater runoff has been replaced with processes that account for the degree of urbanisation and spatial distribution of different land uses, addition of loss models to determine rainfall excess, accounting for pervious and directly or indirectly connected impervious surfaces, and inclusion of depression storages.

Rainfall runoff models have also incorporated connective components including:

- the shape of drainage networks;
- addition of drainage network conveyance, travel times and system storages;
- a separation of minor and major systems;
- response times of different components (such as roads and gutters); and
- bypasses of drainage pits and storages in sag pits.

These evolving models account for modern urban features including distributed storages such as rain water tanks, bio-retention and on-site detention; detention basins and the spatial distribution of urban features (refer to Book 9, Chapter 4). Modern design criteria include analysis of the volume, timing and frequency of stormwater runoff to determine peak flow rates, water quality and requirements. This is done to mimic natural regimes of volumetric flows to protect waterway health (Walsh, 2004; Walsh et al., 2016). Management of the volume of stormwater runoff and the frequency of runoff events from urban catchments is now seen as a key design objective to mitigate downstream flooding and protect the health of urban waterways.

Predictions of peak stormwater flows using the Rational Method may not adequately represent the fundamental processes occurring within contemporary urban catchments (Coombes et al., 2015). This concern is particularly relevant to modern stormwater management methods, such as Water Sensitive Urban Design (WSUD), that include cascading integrated solutions involving retention, slow drainage via vegetation, harvesting and reuse of stormwater and the disconnection of impervious surfaces. These distributed solutions within catchments alter runoff volume and timing in a variable manner throughout a catchment (refer to Book 9, Chapter 3). These dynamics are more likely to be revealed by advanced analysis methods. Importantly, provision of optimum designs for urban stormwater management is dependent on testing solutions across the full range of urban dynamics. The limited urban data available for characterising the parameters underpinning the urban Rational Method for average urban conditions remains a challenge.

The design procedure using computer models is typically implemented more easily and accurately than the simpler design methods. A main advantage is the ability of a computer model to rapidly perform design procedures once a system is set up and the necessary data is entered. In addition, use of computer software allows simultaneous analysis of both minor and major storm events to adequately size inlet structures and conveyance infrastructure, ensuring safe overland flow outcomes.

The procedures for design of conveyance networks have evolved from simplifying assumptions required for hand calculations, such as assuming that pipes are flowing full but not under pressure. Modern methods include more calculations and checks, and can apply unsteady flow hydraulic simulations throughout conveyance networks. These complex calculations are implemented using computers. The amount of calculations is now so large that simple numerical checks using hand calculations are not possible. However, 'sanity checks' can (and should) be made to compare results from models using simplified procedures such as estimating flowrates per unit area. These simple checks will provide estimates that are different to the results produced by computer models, however, this process should assist in avoiding gross errors.

Peak flowrates and hydrographs calculated by rainfall-runoff models are inputs to hydraulic models that determine the characteristics (elevations, depths, widths and velocities) of stormwater flows throughout catchments. Hydraulic modelling is based on physics and requires that the geometry of components of a conveyance network should be carefully defined. Key hydraulic concepts such as Continuity, Conservation of Mass, Energy, and the Bernoulli's Equation, are covered in Book 6, Chapter 2. The Friction Equations including Darcy-Weisbach, the Manning and the Colebrook-White Equations (Book 6, Chapter 2) are all important considerations for the hydraulic design of conveyance networks.

A range of hydraulic models can be used to design conveyance networks. The performance of the models can be illustrated by Hydraulic Grade Lines (HGL) and Eenergy Grade Lines (EGL, also called Total Energy Line, TEL). These grade lines are described in books on fluid mechanics and hydraulics and are useful for understanding flow phenomena.

The design of conveyance infrastructure is highly dependent on the capacity of inlet structures. Inlet structures (pits) are chosen, and then surcharges from each structure are calculated, which determines the possible cumulative surface flows throughout sub-catchments. A check is made to see whether the hydraulic characteristics of surcharges exceed performance objectives for the network (such as safety and access criteria). If the performance objectives are exceeded, the size of inlet structures needs to be increased using the next largest inlet structures and calculations proceed. During the design of inflows and associated dimensions of inlet structures, conveyance infrastructure (pipes) are also sized to ensure that the performance objectives are met. This process continues until a satisfactory level of surface flow is reached.

5.5. Inlet Structures

The performance of urban conveyance networks is dependent on the effectiveness of the inlet structures (pits) that capture stormwater runoff at regular intervals throughout the network. Relationships for the capacity of inlet structures determine the magnitudes of bypass flows and are an essential part of the design of conveyance networks. Designers should be concerned that flow widths and depths are within appropriate limits, both upstream and downstream of an inlet structure.

Designers need to consider that the effectiveness of inflow structures is impacted by the inflow of stormwater through grates or kerb inlets, and by the energy losses or pressure changes that are created by inlet structures (refer to Figure 9.5.8). Historically, pit losses were simplified as a single simple coefficient that approximates the reality of entry losses to the pit, losses within the pit and exit losses from the pit. A simple single coefficient is generally used for many different types of inlet structures.

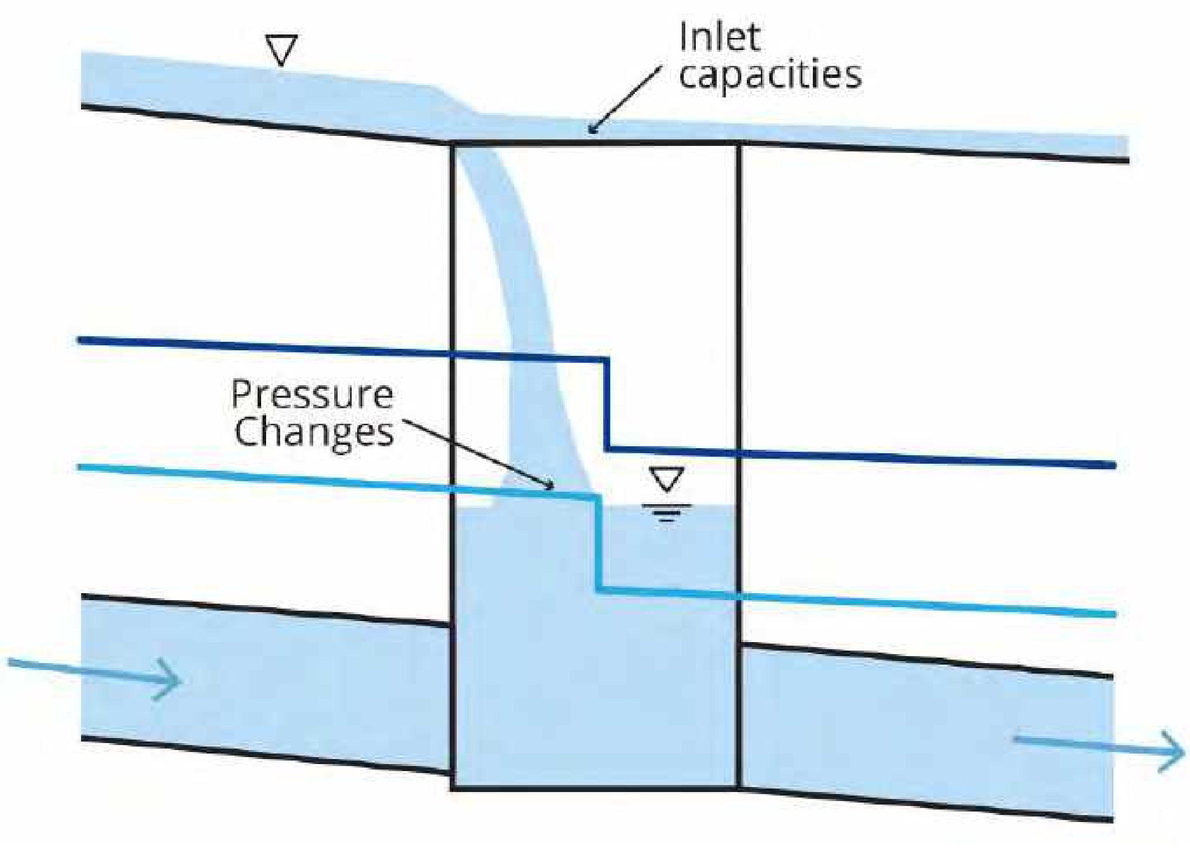


Figure 9.5.8. Idealised Hydraulic Issues Impacting on Inlet Structures

5.5.1. Types of Inlet Structures

A majority of urban stormwater runoff enters conveyance networks via inlet structures located in gutters and medians of roads. These inlet structures or drainage pits are classified by shape or configuration, and are also defined by location on a slope (on-grade pits) or in a depression (sag pits), as shown in Figure 9.5.9. On-grade and sag inlet structures are subject to different hydraulic processes. The behaviour of on-grade pits links inlet capacities to approaching flowrates and resulting bypass flows. Performance of sag pits is dependent on stormwater inflows, pipe outflows and depths of ponded water over pits which cannot escape without passing over footpaths or crowns of roads.

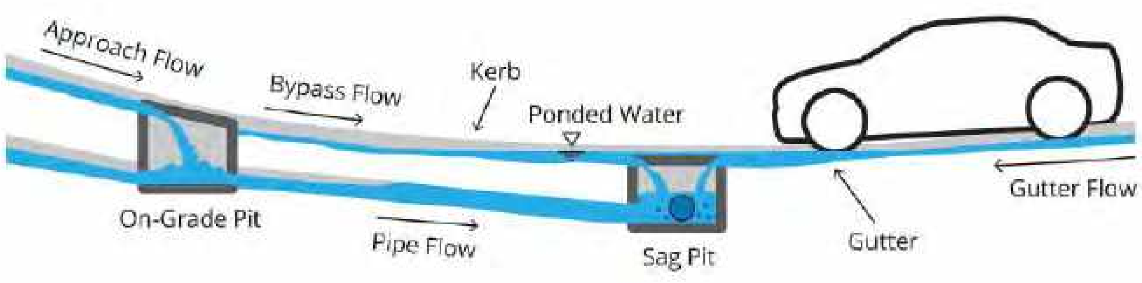


Figure 9.5.9. Basic Types of Inlet Structures

It is desirable for an inlet structure to maximise collection of stormwater runoff. However this objective must also include the safety and convenience of pedestrians, cyclists and motorists, and costs of infrastructure. Open pit structures that may provide the greatest inlet capacity are unacceptable in most environments. The design of inlet structures must not permit children to enter the pit or the conveyance network.

Grates and kerb inlet pits (also referred to as side entries or lintels) are typical inlet structures that are deployed either separately or in combination. Capacities of inlet structures can be improved by providing extensions to kerb inlets, deflectors (ribs or grooves that direct water into an inlet), depressed grates and gutters, or clusters of inlet structures that include adjacent installation of two or three standard pits. Grates and depressions of inlet structures should not be hazardous to road users, including cyclists, and their use should be avoided on busy narrow roads. Aspects of inlet structures for bicycle safety are discussed by the U.S. Federal Highway Administration (Burgi and Gober, 1977).

There is limited information on simple relationships available for the capacity of many types of inlet structures. Many investigations of pit entry capacities have utilised hydraulic models. A range of significant historical studies were published by Burgi and Gober (1977), the Australian Road Research Board (1979), NSW Department of Main Roads (1979) and Marsalek (1982). More general information about capacities of inlet structure are provided by Searcy (1969), Jens (1979), Marsalek (1982), Mills and O'Loughlin (1986), and Argue (1986).

More recent laboratory experiments have examined capacities of different inlet structures at the Manly Hydraulics Laboratory in NSW and at the University of South Australia. The relationships obtained from laboratory tests do not extend to flow rates that may occur in extreme flood events such as 1% AEP or probable maximum floods. However, these relationships are still useful for most design problems as inlet structures in urban areas are predominantly used to admit inflows from minor or more frequent events into conveyance networks.

The US Federal Highway Administration (NHI, 2013) has published the general procedure for determining inflow capacities of on-grade pits in their Hydraulic Engineering Circular No. 22 (HEC-22). The efficiency of various grate types and impacts on inlet capacities for a range of approach grades and velocities are important considerations for urban conveyance networks. In addition to grate and kerb inlets, the capacities of slotted drain inlet structures are also relevant for locations where interception of wide sheet flow is desirable and low sediment and debris is expected. The HEC-22 pit inlet procedures are a useful source of information to aid design of inlet structures.

5.5.2. Inlet Capacities

The hydraulic behaviour of on-grade and sag pits is quite different. These differences are discussed below.

Sag Inlet Pits

The capacities of sag pits are generally independent of upstream gutter slopes and are governed by weir and orifice equations which are dependent on the depth of ponding. The weir equations apply to flows that enter the pit at its edges or at the edges of bars in a grate. Alternatively orifice equations are applied when water ponds above the inlet structure at depths typically exceeding about 0.2 m. The depth of ponding increases to a threshold level and stormwater will overflow as bypass flow by passing over a ‘weir‘ such as a road crown or driveway hump or wall.

The approach and cross-fall grades of roads can affect the availability of storage volumes surrounding sag pits which can indirectly affect the overall behaviour of sag pits. These issues can be considered using hydrodynamic analysis of sag pits as small detention structures. Sag pits must have sufficient inflow capacity to accept the total inflows of stormwater runoff to avoid undesirable ponding of stormwater in intersections to limit obstruction to turning traffic, onto footpaths, into adjacent private properties or basement car parks, or over the crown of a road during a minor storm.

Basic calculations for determining approximate inlet relationships for grated sag pits were derived by Searcy (1969). However, it is preferable to utilise the HEC 22 procedures rather than the sag pit Equation (9.5.1) and Equation (9.5.2) when side entry inlet relationships are required.

For a grate,

$$Q_i = BF \times 1.66\,Pd^{1.5} \qquad \text{up to about 0.12 m of ponding } (d < 0.12) \tag{9.5.1}$$

or

$$Q_i = BF \times 0.67A(2gd)^{0.5} \qquad \text{over 0.43 m of ponding } (d > 0.43) \tag{9.5.2}$$

where

Q_i is the inlet flow rate (m^3/s),

BF is the Blockage Factor

d is the average depth of ponding (m),

P is the perimeter length of the pit excluding the section against the kerb (m) (bars can be disregarded),

A is the clear opening of the grate (m^2), i.e. total area minus area of bars, and

g is acceleration due to gravity (approximately 9.81 m/s^2).

The relationship for inlet capacity between depths of 0.12 and 0.43 is described by ARR 1987 as indefinite and Equation (9.5.1) was recommended in that situation. For an inlet structure that is not located in a depression, the following relationships are recommended:

For ponding up to 1.4 times the height of the inlet:

$$Q_i = BF \text{ x } 1.66Pd^{1.5}h \; (d \le 1.4h) \tag{9.5.3}$$

or

For ponding greater than 1.4h (d > 1.4h):

$$Q_i = BF \text{ x } 0.67A\left(2g\left(d - \frac{h}{2}\right)\right)^{0.5} (d > 1.4h) \tag{9.5.4}$$

where Q_i is the inlet flow rate (m^3/s),

h is the height of the inlet

BF is the Blockage Factor

d is the average depth of ponding (m)

L is the inlet width (m),

A is the clear opening of the grate (m^2), i.e. total area minus area of bars, and

g is acceleration due to gravity (approximately 9.81 m/s^2).

Charts of the inlet capacity of depressed kerb inlets at sag points are provided by Searcy (1969) and in (NHI, 2013).

On-Grade Inlet Pits

Calculation of relationships for inlet capacity of on-grade pits is more complex than for sag pits as several factors can change the capacity of inlets. These factors include:

- grade of the approach gutter (or channel) which will vary flow velocity;
- road cross-fall which impacts the flow width and consequently the maximum allowable flow depth at the inlet;
- roughness of the gutter and road pavement (or channel);
- efficiency of the grate; and
- entry conditions leading into the pit chamber such as gutter depressions (Figure 9.5.10) and the angle of the throat (inlet to the pit) (Figure 9.5.11).

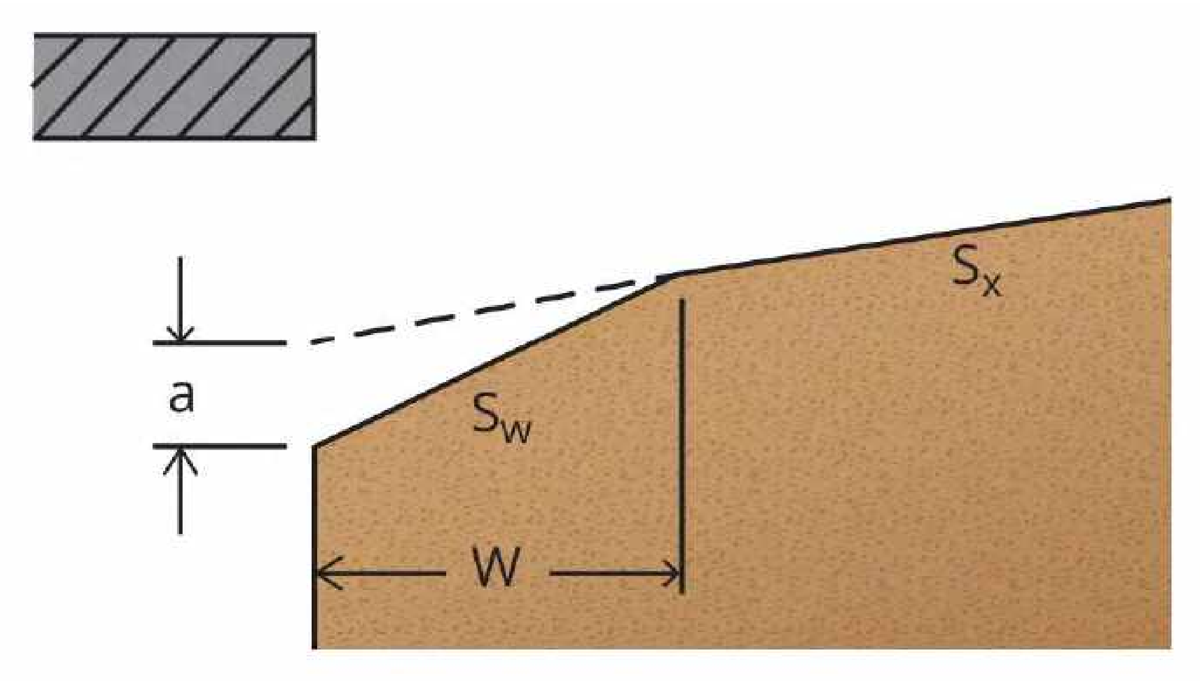


Figure 9.5.10. Kerb Inlet Gutter Depressions from HEC-22 (NHI, 2013)

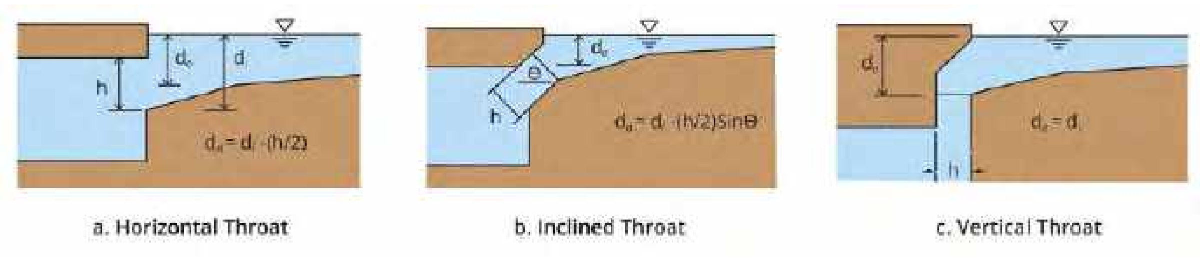


Figure 9.5.11. Kerb Inlet Throat Angles from HEC-22 (NHI, 2013)

The basic calculations to determine approximate relationships for inlet capacities of grate, side entry and combination inlets are provided by Searcy (1969). However, Equation (9.5.3) and Equation (9.5.4) should not be used in preference to HEC 22 procedures which have been hydraulically tested, and where the efficiency of various grate types is provided along with calculations for throat entry conditions. As an illustration, typical relationships for 1 m and 2 m on-grade kerb inlets are shown in Figure 9.5.12 that were derived using the HEC 22 procedures.

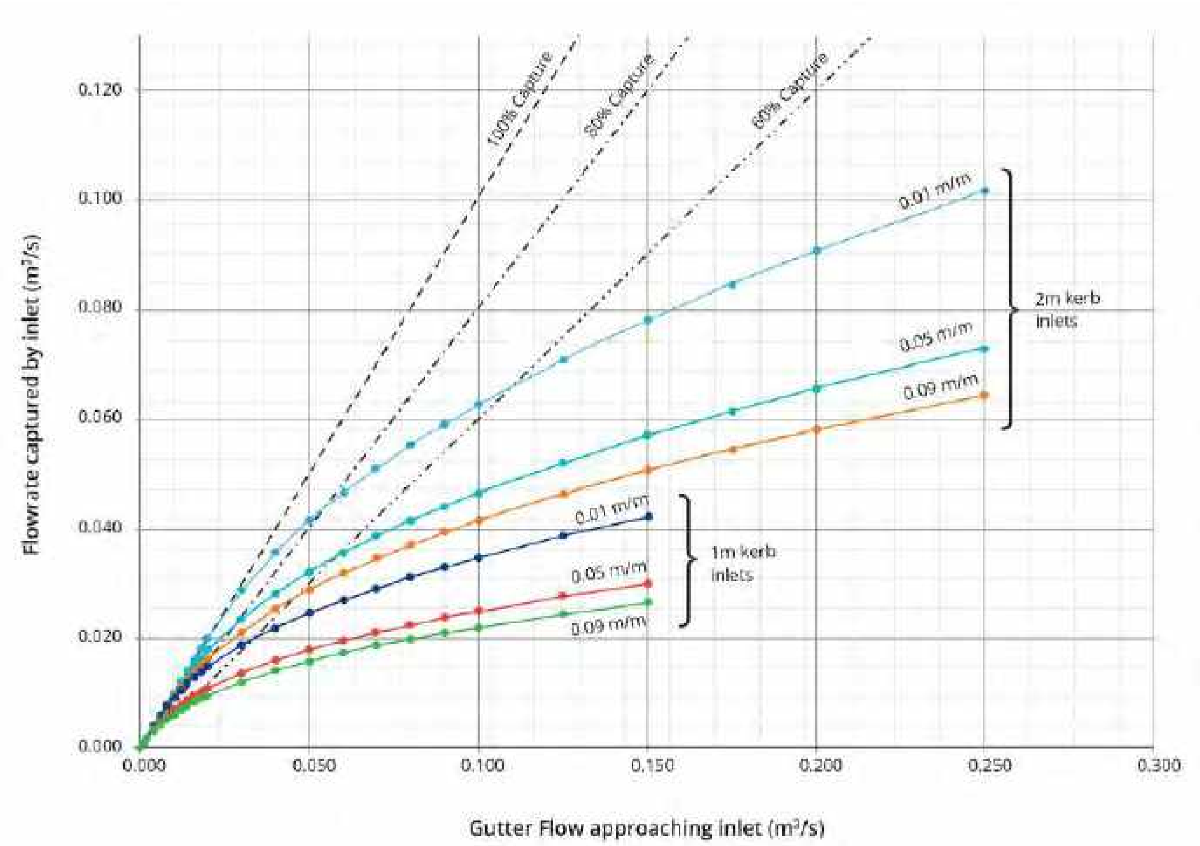


Figure 9.5.12. Inlet Capacities for On-grade Pits

Additional Information

Many different types of inlet structures are used across Australia and this chapter has only discussed some of the configurations. It is recommended that local capacity relationships, knowledge and experience, and types of inlet structures should be employed in designs for urban stormwater conveyance networks. In the absence of mandated design procedures that may be provided by a local authority, preferences should be given to local knowledge and experience, and to laboratory based methods. The designer and local authority should also accept first principles hydraulic analysis and evolving science in the selection of inlet capacities.

Additional resources available to the designer include those provided local and state authorities such as Vic Roads, the (QUDM, 2013) and from older resources including the National Capital Development Commission (1981), the Victoria Country Roads Board (1982) and the New South Wales, Department of Housing (1987).

The usual pit entry capacity relationships may not be adequate for analysis of conveyance networks subject to major rainfall events. In these situations, larger depths of surface flows, velocities and loads of debris may occur, and the inlet capacities of pits will be make for additional discussion). A blockage factor of 50% is generally applied for sag pits for minor and major systems in situations when experimental results or observations are not available. The blockage factor for on-grade pits can vary from 0% and 20% in response to local conditions. Additional advice on blockage factors is provided by Weeks et al. (2013) as shown in Table 9.5.1. Higher blockage factors are often applied for events rarer than the 1% AEP.

Table 9.5.1. Suggested Design and Severe Blockage Conditions for Inlet Pits Book 6, Chapter 6

<table>
<tr><th colspan="2" rowspan="2">Type of structure</th><th colspan="2">Blockage conditions</th></tr>
<tr><th>Design blockage</th><th>Severe blockage</th></tr>
<tr><td rowspan="3">Sag kerb inlets</td><td>Kerb inlet only</td><td>0-20%</td><td rowspan="3">100% (all cases)</td></tr>
<tr><td>Grated inlet only</td><td>0-50%</td></tr>
<tr><td>Combined inlets</td><td>Capacity of kerb opening with 100% blockage of grate</td></tr>
<tr><td rowspan="4">On grade kerb inlets</td><td>Kerb inlet only</td><td>0-20%</td><td rowspan="4">100% (all cases)</td></tr>
<tr><td>Grated inlet only (longitudinal bars)</td><td>0-40%</td></tr>
<tr><td>Grated inlet only (transverse bars)</td><td>0-50%</td></tr>
<tr><td>Combined inlets</td><td>10% blockage of combined inlet capacity on continuous grade</td></tr>
</table>

Ultimately relationships for the capacity of inlet structures determine the magnitudes of bypass flows and are an essential consideration in the design of conveyance networks. Designers must be concerned that flow widths, depths and product of depths and velocities are within appropriate limits at locations upstream and downstream of an inlet structure. These factors can be controlled by the careful location of inlet structures and by limiting bypass flows using infrastructure with sufficient inlet capacities.

5.5.3. Energy Losses

Significant pressure losses may be created by inlet structures and junctions in conveyance networks. Hydraulic losses are generally reduced when open channel flows occur in conveyance infrastructure (pipes) and benching or smooth transitioning is provided within inlet structures. Higher losses occur at inlet structures when conveyance infrastructures (pipes) are full and surcharging in response to pressure flows. These losses at pits are offset by the increased capacity of pressurised pipes and the entire pressurised conveyance network may cope with greater flow rates. Energy losses at inlet structures are expressed as a function of the velocity V_0 in the outlet or downstream pipe:

$$h_L = k.{V_0}^2/2g \tag{9.5.5}$$

Where:

h_L is the loss in metres,

k is a dimensionless energy loss coefficient, and

g is acceleration due to gravity (m/s^2).

This energy loss at the inlet structure creates a change in the total energy line (TEL) as shown in Figure 9.5.13. The associated change in the hydraulic grade line (HGL) is likely to be different in response to different pipe diameters and flow rates upstream and downstream of the structure. The position of the HGL is important to designers as it determines the location of the water surface and the degree of surcharge or overflow which may occur at that location in the conveyance network.

The change in pressure head is estimated as:

$$\Delta P/\gamma = k_u.{V_0}^2/2g \tag{9.5.6}$$

Where:

$\Delta P/\gamma$ is the pressure head change (m) relating to a change of pressure of ΔP kN / m^2 and the specific weight of water kN/m^3, and

k_u is a dimensionless coefficient of change in pressure.

A similar relationship can be applied to water levels within inlet structures which may be slightly higher than the HGL level due to the conversion of some kinetic energy to pressure energy when stormwater flows through a pit:

$$WSE = k_w.{V_0}^2/2g \tag{9.5.7}$$

Where:

WSE is the elevation of the pit water surface (m) relative to the downstream HGL elevation, and k_w is a dimensionless coefficient.

These effects are illustrated in Figure 9.5.13.

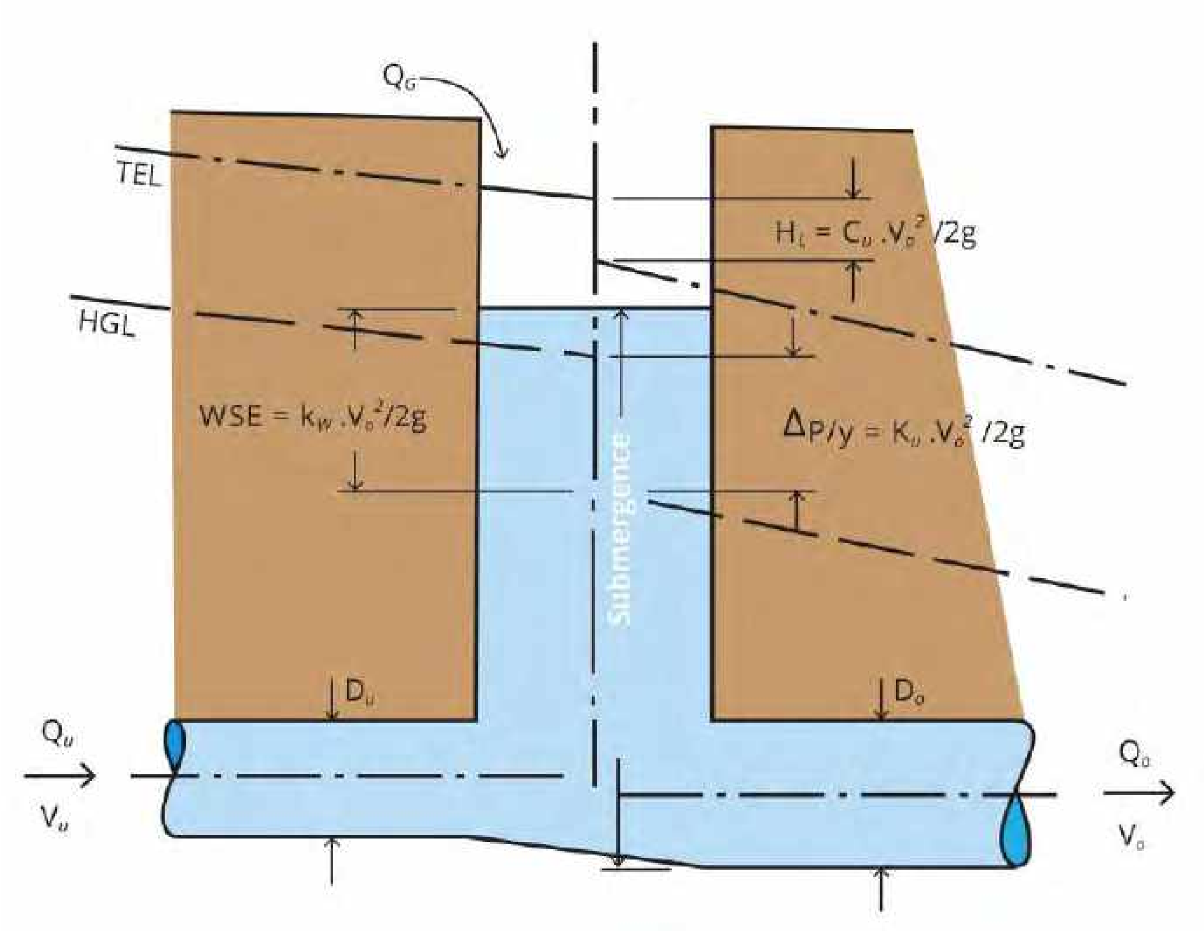


Figure 9.5.13. Idealised Grade Lines at an Inlet Structure

Where Q_o is the downstream discharge, V_o is the downstream flow velocity, D_o is the downstream pipe diameter, Q_g is the surface inflow to the pit, D_u is the upstream pipe diameter, Q_u is the upstream flow rate and Vu is the upstream flow velocity. The parameters k_u and k_w are similar for most configurations of inlet structures and the water level in a pit can be assumed to coincide with the HGL level. The arrangement of grade lines in Figure 9.5.13 is an idealised situation that assumes all changes occur at the centreline of the inlet structure. Losses actually occur across the structure and immediately downstream in the conveyance infrastructure. The convention in measurement of the performance of inlet structures is to project grade lines (measured by manometers in the upstream and downstream pipes) forwards or backwards to the pit centreline and to accept the difference as the overall loss or pressure change.

Available Methods of Determining Pressure Loss Coefficient k_u

Studies using hydraulic models can be used to derive reliable values of energy losses and pressure changes for different types of pits and junctions. A significant study by Sangster et al. (1958) dealt with pipes flowing full and produced a set of design aids for a selected configuration of inlet structures which are now called “Missouri Charts”. Hare (1980); Hare (1983) produced information on other configurations. The charts are complex and provide many possible geometric configurations of inlet structures. Careful judgement is required to select the appropriate chart for a particular configuration of a structure, and in practice, iterative calculations are required to converge to a suitable value of the pressure loss coefficient.

This iterative process can be quite time consuming for large conveyance networks. Attempts have been made to replace dependence on charts with semi-analytical methods. These range from relatively simple methods suggested by Argue (1986), Hare et al (1990) and Mills and O'Loughlin (1998) to more in-depth methods suggested by Parsell (1992) and the US FHWA HEC-22 procedure from which the algorithm described by GKY and Associates Inc (1999) and Stein et al. (1999) has been developed. The FHWA HEC-22 procedure was developed using research and laboratory efforts improving the methodologies of the 'Corrective Coefficient Energy-Loss Method' (Chang and Kilgore, 1989) and the 'Composite Energy Loss Method" Chang et al. (1994). It is also the only method which considers part-full and full pipe flow, drops in pits and other situations.

A summary paper by O'Loughlin and Stack (2002) compared the different algorithms and could not find significant differences which suggested that no single method was superior. However, the information indicated that a viable algorithm can be developed, and that further testing and development is required for the methods to acceptably match the full range of configurations of inlet structures provided by the Hare (1983). The FHWA algorithm appears to provide a significant advance in the determination of head losses and pit pressure changes in stormwater conveyance networks. Comparisons with alternative algorithms and experimental data indicated that simpler methods may provide equivalent results for losses.

Determining Pit Pressure Losses in Practice

Determining pressure changes in practice is complex due to the many possible geometric configurations of inlet structures. Geometric configurations of pits can vary according to:

- number of pipes entering pits (0, 1, 2, 3 or more);
- horizontal change of direction at the pit;
- vertical drop in the pit between inlet and outlet pipes;
- ratios of incoming and outgoing pipe diameters;
- a number of secondary factors, including slopes of pipes, shape and size of inlet structure, depths of sumps in the structure below the invert of the outgoing pipe, streamlining (or benching) of the pit and the entrance to the outlet pipe, and location of the confluence of the incoming pipes.

Variances in flows are impacted by:

- magnitudes of flow and velocity;
- ratios of grate flow entering the top of structures compared to the outflow; and
- tailwater levels.

The design calculations typically need to be repeated to achieve converging values. When designing to satisfy a freeboard requirement, revised coefficients may lead to circular alteration of pit and pipe inlet capacities which requires the designer to intervene.

Initial Estimates of k_u Before Commencing Iterative Calculations

An analysis of the hydraulic grade line of a pipe requires an estimated value of k_u at each inlet structure. Some government authorities may provide suggested values and experienced designers are likely to have developed 'rule-of-thumb' methods for determining these initial estimates of k_u. Engineers are encouraged to use these methods in hydraulic design wherever the methods have proven to be effective.

Guidance for initial estimates of k_u is provided in Figure 9.5.14 for a range of common pit configurations. These are not absolute or recommended values for final analysis of a network and are only indicative starting points of iterations required to converge to a final value. These estimations assume shallow pipes with typical minimum covers and no increases in outlet pipe diameters. Deeper inlet structures may increase values of k_u and increases in outlet pipe diameters may reduce values of k_u

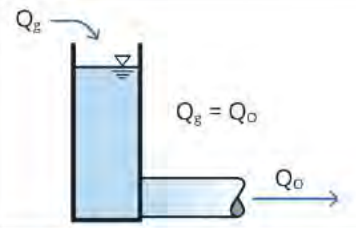
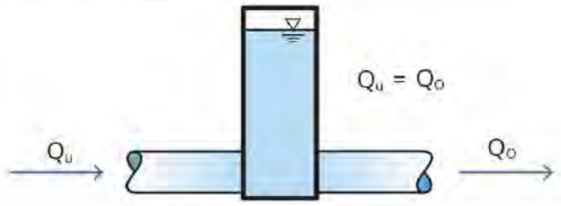
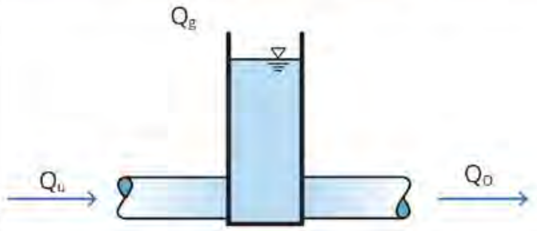
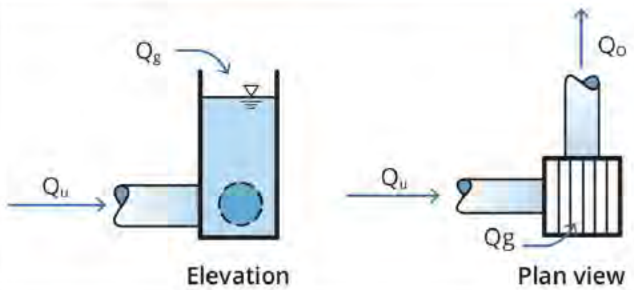
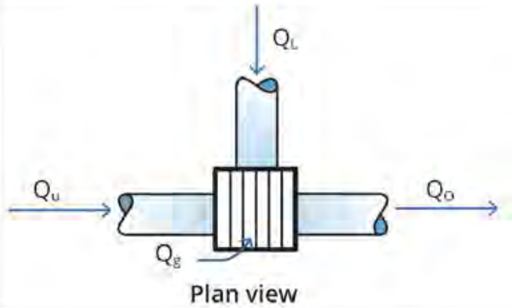
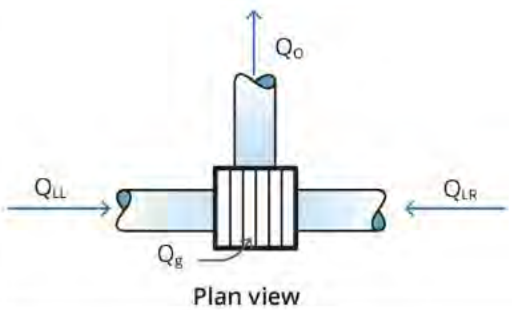
Pit Configuration	Initial k_u	Pit Sketches
First pit at the top of a line	4.0	
Well-aligned junction pit with straight through flow, no sidelines, no grate inflow	0.2	
Well-aligned pit With straight through flow, no sidelines, 50% grate inflow	1.4	
Pit with a 90° right angle direction change, no sidelines, 50% grate inflow	1.7	
Pit with a straight through flow, one or more sidelines	2.2	
Pit with a right angle direction change from two opposed inflow pipes	2.0	

Figure 9.5.14. Approximate Pressure Change Coefficients, k_u, for Inlet Structures

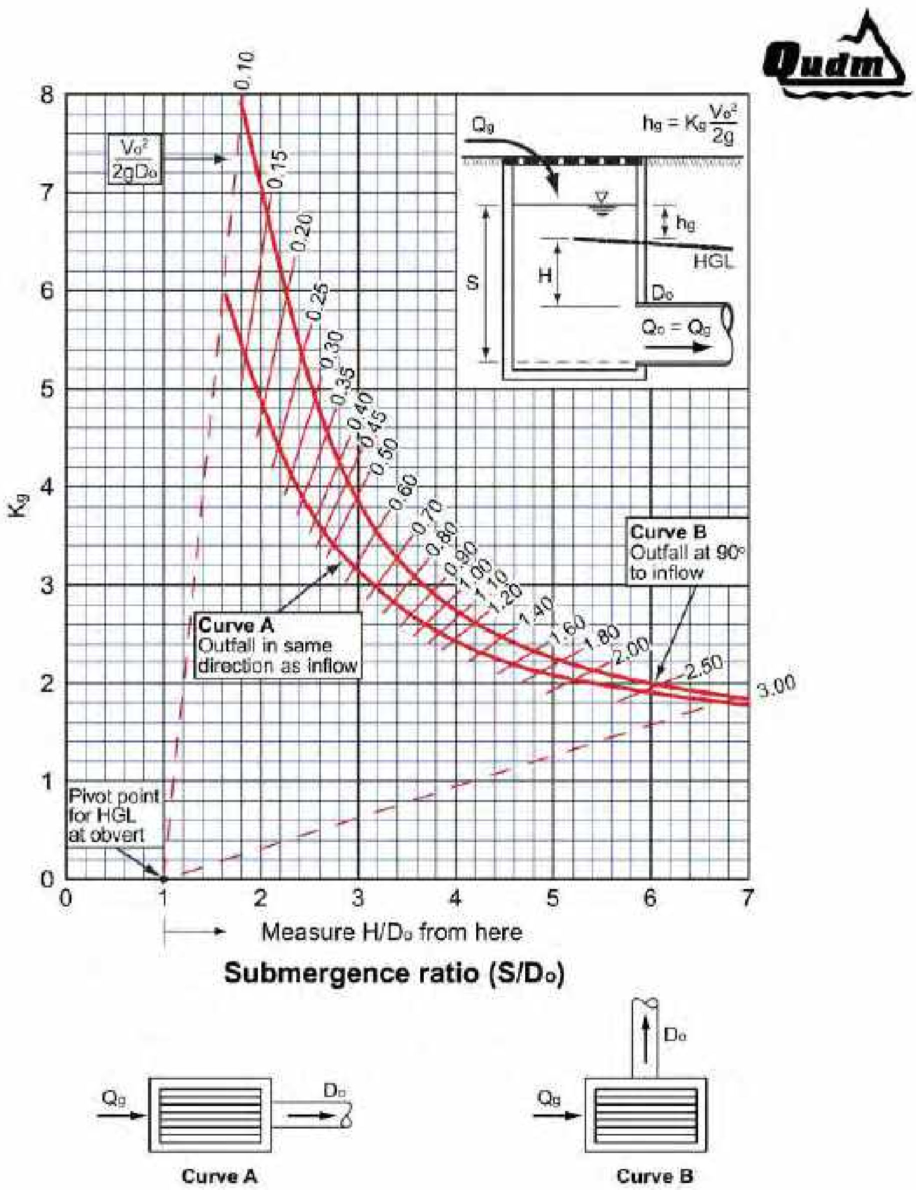
Simplified Approach

As discussed earlier, simplified design methods are available such as those presented by Mills and O'Loughlin (1998), Hare et al. (1990), and Argue (1986). Although these simpler methods may provide similar results to more complex semi-analytical methods, further laboratory research and development was recommended to account for the full range of pit configurations considered by the original Missouri Charts (Sangster et al., 1958) and by Hare (1980). Whilst simplified design methods may be considered for use during simple, non-critical pit and pipe network designs, use of Missouri Charts and Hare's results is preferred.

Recommended Approach

The Missouri Charts (Sangster et al., 1958) and the results from Hare (1980) remain widely accepted and are relevant to an estimated 85% of the possible configurations of inlet structures. The example charts presented in Figure 9.5.15 and Figure 9.5.16 are based on this information (QUDM, 2013). The first chart (Figure 9.5.15) was derived from the original Missouri Chart 2 with modification from the Department of Transport (1992) for an inlet structure with grate flow only. The pressure change coefficient k_u depends on the submergence ratio S/D_0 and iterative calculations are required.

The second example chart (Figure 9.5.16) was modified from the Missouri Chart 4 to include the results from(Hare, 1980). The inlet structure accommodates flows straight through the pit for a submergence ratio S/D_o of 2.5 and also considers inflows through grates. Here k_u depends on the ratio D_u/D_o and provides flow ratios Q_g/Q_o ranging from 0 to 0.5. A correction factor needs to be added from Table 9.5.2 when the submergence ratio S/D_o does not equal 2.5.



Pressure head change coefficients for rectangular inlet with grate flow only modified from DOT (1992)

Notes:

1. For a ***Side inlet,*** the inflow direction should be taken as the direction of flow in the kerb and channel.
2. Where the outflow direction is within 15 degrees of the direction of the direction of inflow, use ***Curve A.***
3. Where the outflow direction is greater than 15 degrees from the direction of inflow, use ***Curve B.***
4. $K_w = K_g$

Chart No. A2-3

Figure 9.5.15. Pressure Change Coefficient Chart (QUDM, 2013)

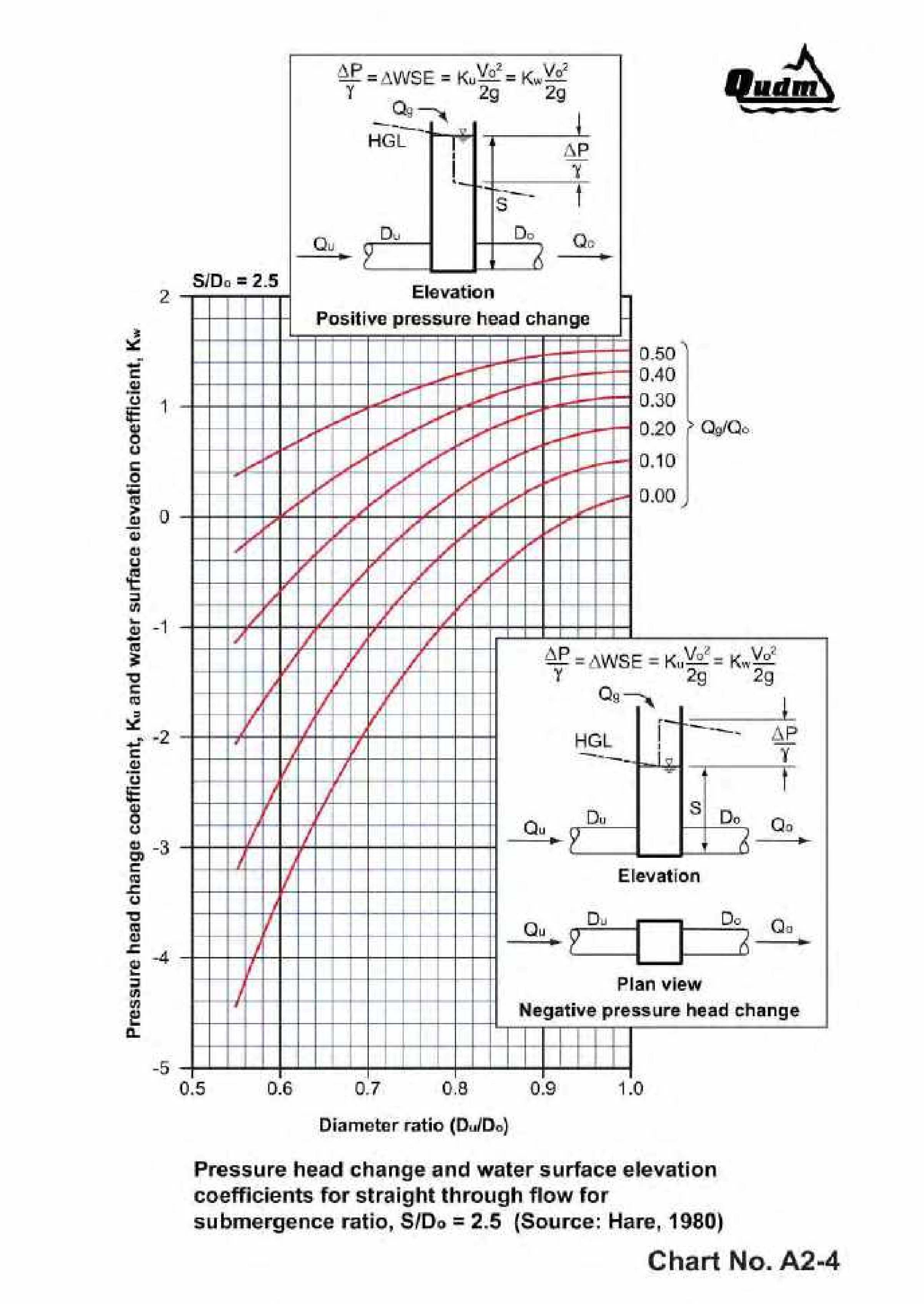


Figure 9.5.16. Pressure Change Coefficient Chart (QUDM, 2013)

Table 9.5.2. Correction Factors for k_u and k_w for Submergence Ratios (S/D_o) not Equal to 2.5 (QUDM, 2013)

S/D_o	Q_g/Q_o					
	0.00	0.10	0.20	0.30	0.40	0.50
1.5	0.00	0.11	0.22	0.33	0.44	0.55
2.0	0.00	0.04	0.08	0.12	0.16	0.20
2.5	0.00	0.00	0.00	0.00	0.00	0.00
3.0	0.00	-0.03	-0.06	-0.09	-0.12	-0.15
3.5	0.00	-0.04	-0.08	-0.12	-0.16	-0.20
4.0	0.00	-0.05	-0.10	-0.15	-0.20	-0.25

Additional influencing factors become apparent as configurations of inlet structure become more complex; such as interpolation coefficients for intermediate grate flow ratios, presence of deflectors and additional lateral or sideline pipes. The second chart (Figure 9.5.16) shows that k_u can be negative in situations where the outlet pipe is larger than the inlet pipe and “pressure recovery” occurs due to the lower downstream flow velocities than the upstream inflow velocities.

Large energy losses and pressure changes can be avoided by attention to simple rules in detailed design and construction. One principle is to ensure that jets of water emerging from inlet pipes do not impinge directly on pit walls. Wherever possible the stormwater jets from inflow should be directed into outlet pipes. Hare (1983) states that changes of flow direction should generally occur on the downstream face of pits, rather than at the upstream face or centre. Losses may be reduced by use of curved pipelines, precast bends and slope junction fittings at changes of flow direction. Typical loss factors for these fittings are:

- tee – k = 1.15 for energy loss expression $kV^2/2g$
- 90° double mitre bend – k = 0.47
- 60° double mitre bend – k = 0.25
- 45° single mitre bend – k = 0.34
- 22° single mitre bend – k = 0.12

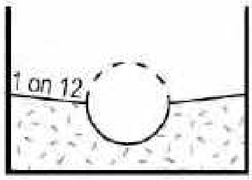
Benching

The recommended Missouri Charts do not include the effect of benching to reduce energy losses. Potential decreases in pressure change coefficients as a result of benching are provided in Figure 9.5.17, (Table 7.16.4 in QUDM (2013)).

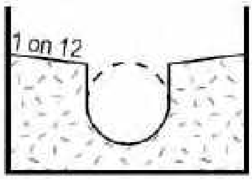
Potential decrease in pressure change coefficient as a result of benching

Access chamber type [3]	Potential decrease in pressure change coefficient (%)	
	Half-height benching [1]	Full-height benching [2]
Straight through	30	40
90° bend	20	40
Tee chamber with lateral inflow less than 50%	Nil	Nil
Tee access chamber with lateral inflow approximately 50%	Nil	10
Tee access chamber with lateral inflow approximately 100%	20	40

Notes:



Note [1]: (a) –
Half-height benching



Note [2]: (b) –
Full-height benching

Note [3]:
Results based upon testing of square pits.

Figure 9.5.17. Decrease in Pressure Change Coefficient as a Result of Benching (QUDM, 2013)

Computer Models

Various procedures have been implemented in computer software. Some unsteady flow computer programs allow for pressure losses in rather simplistic ways, such as increasing pipe friction factors to include estimated pressure losses. Other complex procedures employed by computer software include:

- iterative processes based on Missouri Charts, geometry and hydraulic results;
- semi-analytical algorithm based approaches; and
- numerical methods.

5.6. Conveyance Infrastructure

Urban conveyance networks collect rainfall runoff from urban surfaces (properties and adjacent roads) and utilise gutters, road surfaces, pipes, culverts and channels to convey stormwater to downstream infrastructure or receiving waters. This section discusses the design of conveyance infrastructure.

5.6.1. Hydraulic Models to Define Flow Characteristics

The complexity of conveyance networks requires that simple calculations based on energy gradients are often replaced by more complex procedures. Rainfall runoff is collected at multiple entry points (inlet structures) and accumulates throughout the conveyance network.

The necessary calculations combine these inflows and route them throughout a network by determining the water depths and velocities in the conveyance infrastructure. Simpler methods or models can do this for steady flows with unchanging flow rates whereas more complex models are required for unsteady and time-varying flow ates. Hydraulic grade lines (HGL) and energy grade lines (EGL) can be used to define flow depths, pressures and energies in conveyance networks as shown in Figure 9.5.18. Hydraulic models must allow for overflows when water levels exceed limits or pass over barriers. Additional information about hydraulic models is provided in Book 6 and Book 9, Chapter 6.

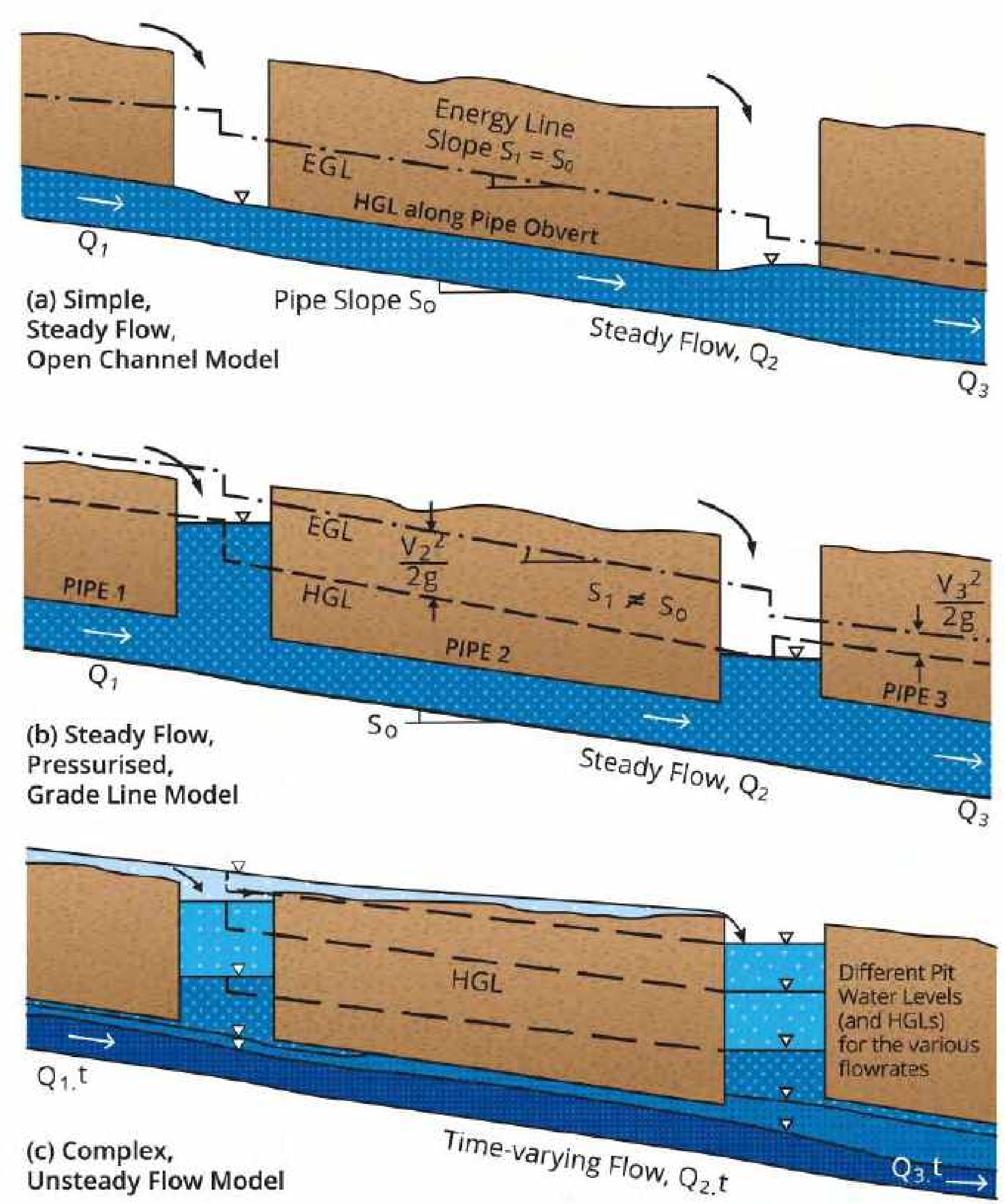


Figure 9.5.18. Schematic of Three Hydraulic Models of Conveyance Networks

Figure 9.5.18(a) demonstrates a simple model that accepts peak inflows derived from a hydrological model. It is assumed that steady flows occur in each pipe reach or link. Hydraulic grade lines are assumed to be located at the obvert (upper inside surface) of pipes and the flow condition is described as “flowing full but not under pressure”. Allowances for local losses are provided by a small drop (up to 90 mm, depending on change of flow direction) within inlet structures. The capacity of pipes can be calculated easily by applying a friction formula such as the Manning Equation and accounting for the grade of the pipe. The conveyance network is assumed to behave as a network of open channels and no allowance is made for upstream or downstream surcharges.

Figure 9.5.18(b) shows a second approach to hydraulic analysis that also assumes steady-state conditions where peak flows occur as pressure flows in pipes and the HGL is located above or along the pipe obvert. This method includes energy losses and pressure changes at inlet structures that are likely to be greater than open channel flow assumptions where water levels are below pipe obverts. Capacity of pipes is also dependent on downstream water levels which may create backwater effects on flows in pipes.

These methods accept peak flow from hydrological models and assume that peak flows occur simultaneously throughout the conveyance network. Flow rates are constant within each link and the calculated HGLs and EGLs represent upper envelopes of these flows. This process will usually estimate lower pipe capacities than unsteady flow assumptions.

Figure 9.5.18(c) presents unsteady flow processes that are created by the inflow to the conveyance network of full hydrographs typically generated in computer models and real rainfall depths and patterns. The simulations account for the changes in water levels and flow characteristics in pipes and the network throughout storm events. These processes include dynamic effects such as fast-travelling waves generated by changes in flow conditions that can create shock losses in the conveyance network. This model is applied using computers that process and solve finite difference computations. A steady flow system is assumed to be independent of time and only requires one set of calculations. However calculations in computer models of unsteady flows are repeated for many time steps and pipe reaches are divided into several sections during the calculation processes.

All three hydraulic models can be utilised for design and analysis. The first and simplest method can be used for design of small networks where downstream conditions may ultimately be varied to account for the actual behaviour of the conveyance network. These adjustments may not be possible for design of a fixed conveyance network, and the estimated capacities and impacts of conveyance network may be incorrect.

The assumed steady-state flows and a connected hydraulic grade line throughout a network of the second method is more suitable for basic design and analysis tasks. This method is likely to provide more efficient designs as it more closely reproduces real hydraulic behaviour and allows for surcharging of pits and pressure flows. This process may be used as a checking procedure by working backwards from the receiving water level towards the top of the catchment.

This model was presented by ARR 1987 (Pilgrim, 1987) as the preferred hand calculation method for hydraulic design of simple pipe networks. Calculations typically involve two iterations for a conveyance network. The first iteration commences at the top of the catchment, accumulating the flows arriving at each inlet structure, and allows for possible bypass flows at pits. The calculated flows through the conveyance network are used to determine the sizes of pipes and the invert levels at their ends whilst ensuring that HGLs do not rise above a limit, usually 0.15 m below the surface level of inlet structures. This design procedure involves a series of trials with increasing pipe sizes selected from the commercially available diameters. The smallest commercially available pipe diameters that meet the design requirements are typically selected.

The iteration of the calculations commence at the outlet using a set tailwater level and project the HGLs upward towards the top of the catchment by considering the HGL slope due to pipe friction and the local pressure changes at each inlet structure. The previously calculated flow rates, pipe diameters and water levels in pits can be used in design charts such as the Missouri and Hare charts to determine local pressure changes at pits (refer to Book 9, Chapter 5, Section 5). When the upstream process of calculations reaches an inlet structure with two or more pipe branches, the calculations progress separately and upstream in each branch.

This projection process can be employed for part-full pipe flows, and for pressurised and full-pipe flows. However, the straight water surface profiles assumed for part-full flows will not be exact. A more accurate procedure is to project water surfaces upstream using the gradually-varied flow methods commonly called backwater curve computations.

Some designers of conveyance networks are still using the simple, steady flow procedures. However the unsteady flow models produce more realistic behaviours in response to hydrographs and flow volumes that are essential for analysis volume sensitive systems that include volume management facilities (refer to Book 9, Chapter 4). Modelling using unsteady hydraulic (and hydrology) assumptions is the preferred method for detailed analysis of conveyance networks that need to respond to strict constraints and where realistic modelling of network behaviour is needed. This approach is also essential for analysis of existing conveyance networks to replicate an existing deficit in performance or to reproduce a known flooding problem. There are many software products currently available that can be utilised for these types of analysis and design (refer to Book 9, Chapter 6).

5.6.2. Overland Flow

Conveyance networks receive and include overland flows. Overland flow is conveyed as sheet flow across land surfaces or in an overland flow path within a channel or swale. Sheet flow is typically produced when rainfall exceeds the volume of depression storages and infiltration capacity of a catchment resulting in overland flows travelling towards a receiving watercourse or an inlet structure in a conveyance network. Overland flows can also be escaping floodwater when the capacity of a conveyance network or watercourse is exceeded.

Overland flow paths typically convey stormwater when the capacity of the minor system conveyance network is exceeded as bypass flows between inlet structures along a kerb and gutter in a street, along swales in rural or grassed areas, or sometimes undesirably through private property. Calculations for overland flows are similar to open channels in that they can be defined as a number of different channel sections with constant cross-sections and slopes. However a key difference between overland flow paths and open channels is that overland flow paths are typically limited to shallower flow depths to meet safe design criteria. Open channels typically convey stormwater at greater depths and flow rates.

Urban stormwater management may combine buffer strips or vegetated swales or bioretention with overland flow paths as cost effective methods to facilitate attenuation of flows and removal of pollutants.

Limitations of Depth and Width of Overland Flows

The depths, widths and velocities of overland flows should be limited to meet objectives for safety and erosion. A range of conditions may be applied when a cross-section of a road is to be used to convey major and minor flows and the limiting factor is deemed to be the most restrictive criteria. These criteria include risks to pedestrians, particularly children, and the importance of the road for transport purposes. The following conditions should apply when guidance from a consent authority is not available:

- The depth of stormwater flows at the kerb (d_g) should be limited to the lower side of a street to prevent uncontrolled overflows from entering properties. For streets with 150 mm high kerbs and a footpath with a substantial slope towards the gutter, a suitable limiting depth may be 200 mm or to the height of a water-excluding hump on a property driveway plus an appropriate freeboard. In addition a maximum width of flow should not be exceeded in the carriageway. Greater depths may be tolerated where a street is significantly lower than the land on both sides and in tropical areas with greater intensity rainfalls. A suitable freeboard should apply to floor levels of habitable rooms in properties adjoining the road.

- The product of depth and velocity (d_g.V), with V being the average velocity in the gutter, should not exceed 0.4 m^2/s for safety of pedestrians, 0.3 m^2/s for stability of parked vehicles (depending on size), or as directed by the consent authority (refer to Book 6, Chapter 7).

- Depths of stormwater flows should not exceed the height of the crown of the road during minor storms or where flows are to be contained on one side of a street. This includes locations that include ponding of stormwater such as at sag pits. Depending on the importance of the road (local, collector, arterial) and the importance of access, limits on width of flow of 2 to 2.5 m are typical.

- Widths of flows may be limited to allow clear lanes in the centre of a road for passage of vehicles. Flow depths should not exceed the height of the crown of a road by more than 50 mm for major overland flow paths not considered part of the trunk drainage system and in new development areas.

Dimensions of Flow

The Manning Equation can be used to calculate flows in trapezoidal style overland flow paths. Sheet flow is commonly estimated using a version of the kinematic wave equation for flow distances up to 130 m and then sheet flows are then concentrated into some form of gully or defined overland flow path (NHI, 2013).

Equations for road gutters can be extended to calculate flows along full road cross-sections during major events. For a given flow rate, the normal depth corresponding to steady, established flow can be found by simple iterative calculations using a friction formula such as the Manning Equation. Although these assumptions may not be entirely valid, the errors involved may be generally acceptable.

Design charts of the flow capacities of roadway cross-sections can be prepared using Equation (9.5.8). Allowable zones are defined by various limiting conditions and criteria as shown by the example in Figure 9.5.19.

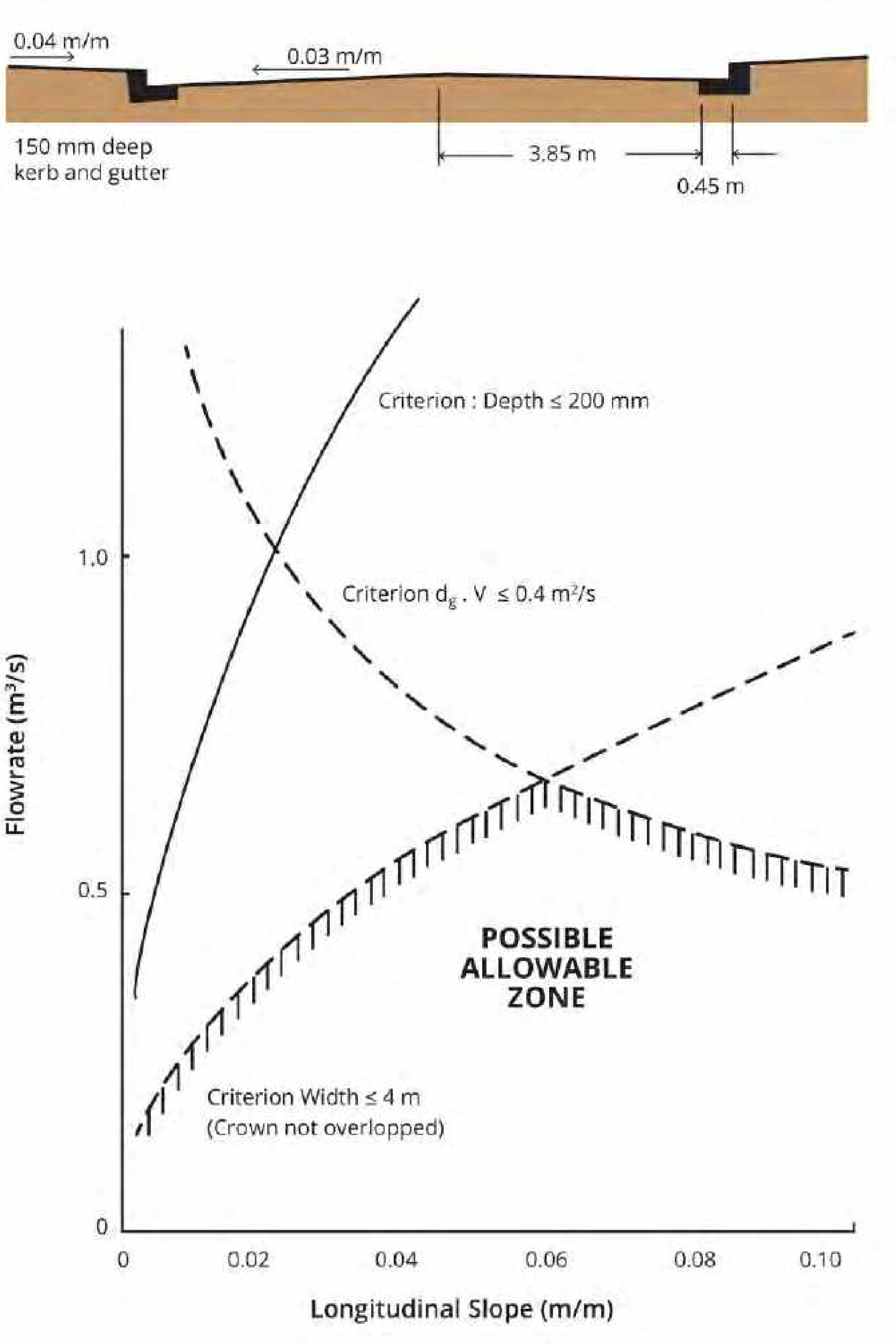


Figure 9.5.19. Flow Capacity Chart for One Side of an 8 m Carriageway with 3% Cross-fall

Gutter and Roadway Flow Equation

The following general equation developed by the U.S. Bureau of Public Roads (Searcy, 1969) is recommended to determine flows in streets. With reference to Figure 9.5.20(a), the equation is:

$$Q = Q_{ABC} - Q_{DBF} - Q_{DEF} - Q_{GEH} = 0.375F \left[\left(Z_g/n_g\right).\left(d_g^{8/3} - d_p^{8/3}\right) + \left(Z_p/n_p\right).\left(d_p^{8/3} - d_c^{8/3}\right)\right].S_0^{1/2} \tag{9.5.8}$$

where Q (m^3/s) is the total flow rate which is estimated by dividing the section as shown in Figure 9.5.20(a) and applying the equation by Izzard (1946) for a triangular channel with a single cross-fall:

$$Q = 0.375Fd^{8/3}S_0^{1/2}Z/n \tag{9.5.9}$$

Where:

F is a flow correction factor,

Z_g and Z_p are the reciprocals of the gutter and pavement cross-slopes (m/m),

n_g and n_p are the corresponding Manning's roughness coefficients,

d_g and d_p are the greatest gutter and pavement depths (m),

d_c is the depth of water on the road crown, and

S_o is the longitudinal slope (m/m).

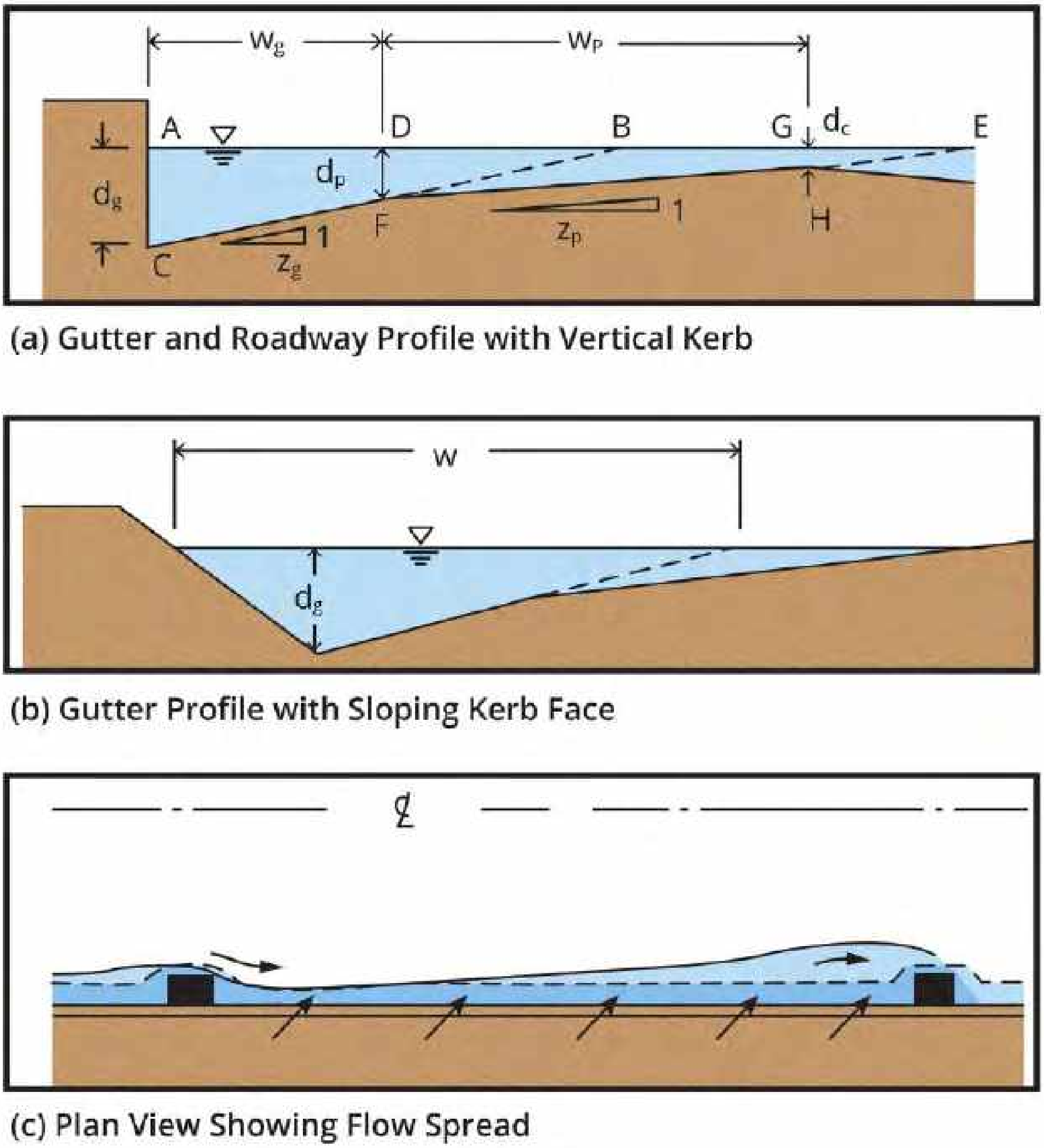


Figure 9.5.20. Gutter Flow Characteristics.

Equation (9.5.8) can be applied in simplified form when flows are contained in a gutter or on one side of a road. Clarke et al. (1981) estimated values for F of about 0.9 for simple triangular channels and 0.8 for gutter sections of the type shown in Figure 9.5.20(a). These assumptions may be used in the absence of more precise information. Typical values of Manning's n are 0.012 for concrete, 0.014 for asphalt, 0.018 for flush seal and 0.025 for stone pitchers (Dowd et al., 1980).

Consider the face of the kerb to be vertical in situations where the face of a kerb is relatively steep. Equation (9.5.8) can be applied to “lay-back” kerbs with sloping faces by assuming that zg is equal to w/dg as defined in Figure 9.5.20(b).

Open channel flow equations, such as the Manning Equation, can also be used to determine flows in lined gutters or unlined drains or swales.

Flow depths and widths for a specified flow rate can be determined using Equation (9.5.8). Velocities are estimated by dividing the flow rate by the corresponding flow area. Travel times for stormwater conveyance can be derived by dividing gutter length by flow velocity. Distributed lateral inflows as shown in Figure 9.5.20(c) can generate flow rates and characteristics such as width, depth and velocity that vary along a gutter. In this situation the average flow velocity occurs at about 60% of the distance along the gutter towards the inlet structure. Gutter flow calculations that use of the total flow arriving an inlet structure will overestimate velocities impacting on the structure.

Other Considerations

Gutter flow times depend on flow rates and it is necessary to specify a time in order to estimate a flow rate. A set of iterative calculations are required. In these calculations, a velocity or time is assumed, and a flow rate calculated. Then a check is undertaken to determine whether the total time of flow in the overland and gutter flow paths agrees with the original assumption.

A precise calculation of gutter flows must allow for concentrated inflows such as bypass flows from an upstream pit at the upper end of the gutter or an outflow from a large site at some point along the gutter. A representative design flow rate must be estimated to permit calculation of the average velocity and travel time.

Parked vehicles and driveways may interrupt and widen surface flows. The limited experimental evidence available suggests that these effects are localised. Allowance for this effect may be needed for streets where close parking of vehicles is likely but specific allowance does not appear necessary at other locations. The design process should account for possible future alterations to gutter and road profiles including resurfacing of roads. Effects of possible pit blockages must be assessed at locations where overflows may cause significant damage.

Aquaplaning or hydroplaning is also an important consideration, especially for highway drainage. This occurs when the tyre's inability to shed water from the contact patch is exceeded, resulting in a layer of water building between the tyre and road surface leading to a loss of traction that prevents the vehicle from responding to control inputs. Although aquaplaning is dependent on other geometric factors of road design, adequate sizing and placement of inlet structures and cross culvert drainage systems is also a significant factor in reducing the risk of sheet flow occurring on roads. For guidance on aquaplaning, or highway drainage in general, refer to sources such as Austroads (Austroads, 2013), road transport authority guidelines for each state and territory, the FHWA or UK Highway Agency.

It is also important to consider the longevity of an overland flow path and this is especially relevant for flow paths through private property. Blockages are likely to occur due to lack of maintenance, or by post construction modifications such as from garden beds and mulch, or by modifications designed to enclose domestic pets.

It is often necessary to locate structures within minor overland flow paths including property fencing, sound-control barriers and above ground services. When designing overland flow paths that may contain these types of structures it is important to consider the potential for flows to be redirected by these barriers.

5.6.3. The Hydraulic Grade Line (HGL) and Energy Grade Line (EGL)

The hydraulic (HGL) and energy grade line (EGL) concepts are derived from the Bernoulli Equation and assist with the analysis of complex flow problems. The HGL is determined by plotting the relationship for pressure head P/γ and height above an arbitrary datum z at key locations in a conveyance network using the following equation:

$$HGL = P/\gamma + z \tag{9.5.10}$$

Where P is pressure and γ is specific density of water.

Similarly, the EGL adds the velocity head $V^2/2g$ to the HGL to provide a relationship for EGL that can be derived at key locations in the conveyance network:

$$EGL = V^2/2g + P/\gamma + z \tag{9.5.11}$$

Where V is the average velocity in a conduit and g is gravity.

The vertical distance to point (such as the centre of a conduit) below the HGL represents the pressure head or pressure energy at a point. Negative heads or partial vacuums may occur at siphons and the conduit is above the HGL. The HGL coincides with the water surface for open channel flows, except at points such as brinks of weirs where non-hydrostatic conditions prevail. Water rises to the level of the HGL in an inlet structure (pit) that acts as a vertical riser.

The EGL is located above the HGL and represents the total energy (velocity + pressure + potential) available to the flow that is expressed as a height (metres) equivalent to flow energy per unit weight in joules (or newton-metres) per newton.

Grade lines typically slope downwards in the direction of flow in conveyance networks and slope represents energy losses due to pipe friction. The HGL and EGL are parallel for steady flows. The grade lines generally have a different slope to the pipe in closed conduits under pressure (with the HGL above the pipe). The grade-lines are parallel to open channels that are subject to steady and uniform flows since the friction loss equals the potential energy loss represented by the slope of the conduit.

Changes in the shape or direction of conduits create turbulence and local losses that are represented as sharp drops in EGLs. Significant energy losses are typically assumed to act at the centre of inlet structures in analysis of conveyance networks. The HGL is also assumed to change at the centre of inlet structures as illustrated in Figure 9.5.21. These assumptions differ from the actual location of losses at the entry and exit of inlet structures (pits).

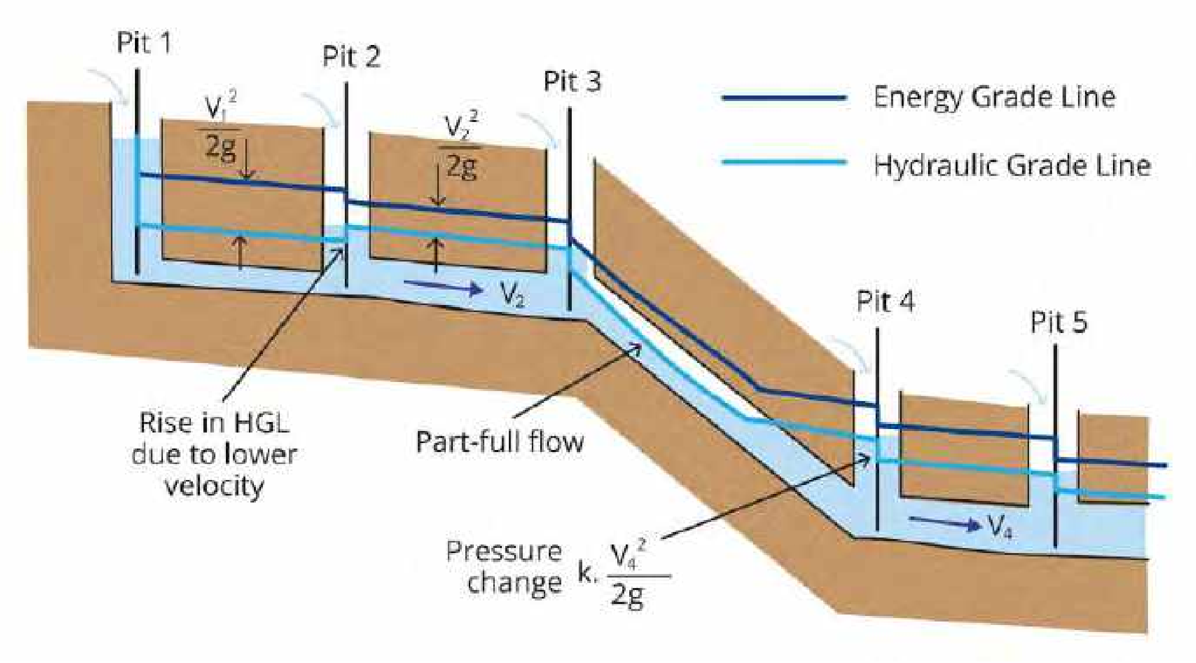


Figure 9.5.21. Flow Behaviour in a Surcharged Pipe System Showing Energy Grade Lines and Hydraulic Grade Lines

5.6.4. Flows Through Conveyance Networks

Local Losses

Changes in the shape or direction of conduits can create turbulence and local losses that are represented as sharp drops in the EGL. Losses occur at entrances and exits to pits, pipe bends, and at contractions, expansions, junctions, and valves in conveyance networks. Except for expansions and contractions of conduits, these losses have the following relationship:

$$h = k\,.\frac{V^2}{2g} \tag{9.5.12}$$

where h is the loss in m, and k is a loss coefficient multiplied by the velocity head of the downstream flow.

The loss factor k is dependent on the geometry of entrances to a conduit. A square-edged entrance will usually have a factor of k_e = 0.5 and for a rounded entrance the factor is approximately 0.2. The factor at a pipe exit k_{exit} is usually 1.0 as it is assumed the entire kinetic energy of flows will be lost as the pipe discharges into a larger body of water or atmosphere.

The losses at bends depend on the radius of the bend and have a typical value of k_b = 0.5. Contractions in conduits (decreases in pipe diameter) are subject to low levels of losses with a typical factor k_c of 0.05. Expansions in conduits (increases in diameter) generate higher losses h_L that are dependent on the upstream V_u and downstream V_d velocities:

$$h_L = K_{\exp}\,.\frac{(V_u - V_d)^2}{2g} \tag{9.5.13}$$

where k_{exp} is about 1.0 for abrupt pipe expansions.

Valves have variable loss factors which can become very large as the valve closes.

Full Flows in Conduits

The estimation of flow rates through conveyance networks that are flowing full is made by relating the available energy or head to the losses as expressed by the velocity head. The following calculation shows how flowrates can be determined from the available head and the assumed energy losses along a 300 mm pipe discharging from a reservoir as shown in Figure 9.5.22.

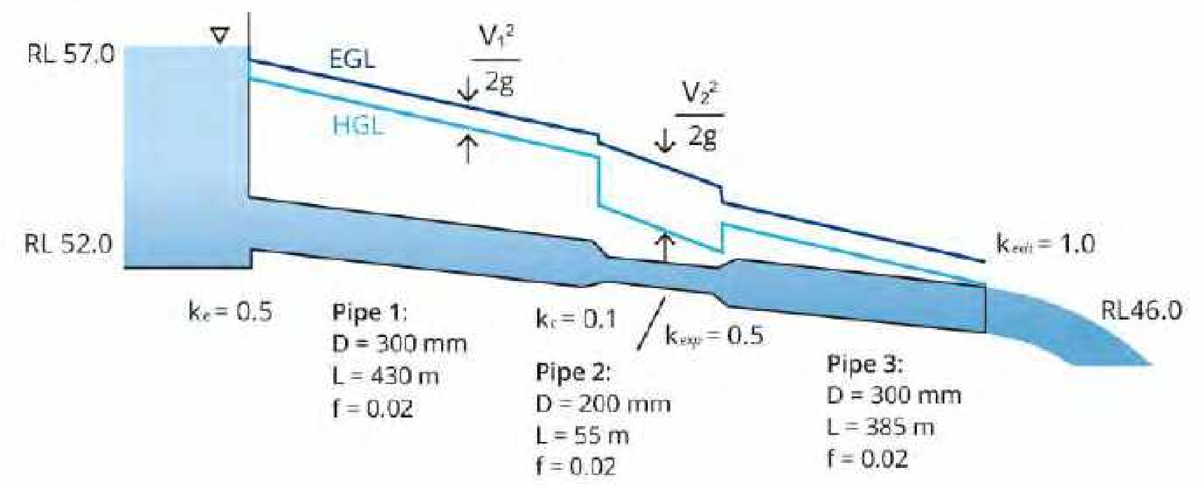


Figure 9.5.22. Example of Full Flows in a Pipe

The pipe diameter reduces from 300 mm to 200 mm at the middle of the pipe branch. The energy loss at the following expansion is assumed to be 0.5 times the velocity head in the downstream pipe and all friction values (f) in the Darcy-Weisbach Equation are set at 0.02.

The water level in the reservoir is 57.0 m above a height datum and the total head available is 57.0 - 46.0 = 11.0 m. The various losses are all functions of the velocity heads in the pipes. Since $V_3 = V_1$ and $V_2 = V_1 . \frac{A_1}{A_2} = V_1 . \left(\frac{D_1}{D_2}\right)^2$, the sum of the losses will be:

$$\left(k_e + \left(f . \frac{L}{D}\right)_1 + k_c + \left(f . \frac{L}{D}\right)_2 . \left(\frac{D_2}{D_1}\right)^4 + k_{\text{exp}} + \left(f . \frac{L}{D}\right)_3 + k_{exit}\right)\frac{{V_1}^2}{2g} = 11 \text{ m} \qquad (9.5.14)$$

$$\left(0.5 + \left(0.02.\frac{430}{0.3}\right) + 0.1 + \left(0.02.\frac{55}{0.2}\right).\left(\frac{0.3}{0.2}\right)^4 + 0.5 + \left(0.02.\frac{385}{0.3}\right) + 1.0\right)\frac{{V_1}^2}{2g}$$
$$= 11 \text{ m} \qquad (9.5.15)$$

Thus,

$$
\begin{aligned}
&84.28 \cdot \frac{{V_1}^2}{2g} = 11 \text{ m},\\
&V_1 = \left(\frac{11.0 \times 19.60}{84.28}\right)^{0.5}\\
&= 1.60 \text{ m/s and}\\
&Q = V_1 A_1\\
&= \pi/4 \cdot (0.3)^2 \cdot 1.60\\
&= 0.113 \text{ m}^3/\text{s}
\end{aligned}
\qquad (9.5.16)
$$

The Manning Equation can also be used with friction losses expressed by $\left(2g\, n^2 \frac{L}{R^{4/3}}\right) \text{x} \frac{V^2}{2g}$ since slope of the energy gradeline is S = h^f/L.

Equations using conservation of mass, energy and momentum can be constructed to describe the state of an entire conveyance network that includes multiple pipes and inlet structures. These equations are solved to provide information about the pressures and velocities throughout a conveyance network which can be visualised as EGLs and HGLs. More complex partial differential equations are required to cope with unsteady flows that change with time.

Conduits Flowing Partially Full

Conduits that are flowing partially full in stormwater conveyance networks can exhibit complex behaviours. A maximum flow capacity is achieved when conduits are operating at less than full flows. However it is not good practice to design conduits with partial flows as disturbances may eliminate free surfaces in conduits and cause a transition to pressurized full flows that may lead to surcharges.

This assumes that flows in conduits are open channel flows with atmospheric pressure at the surface. Submergence at the entrance and tailwater levels affecting the outlet of conduits generates further complications. In addition, large air bubbles and air pockets can occur in conduits that operate in partially full conditions resulting in pressures that can be above or below atmospheric pressure. The theory of open channel hydraulics is addressed in Book 6.

Complex Procedures

A more complex and correct procedure for analysis of conveyance networks is to apply partial differential equations of unsteady flow varying in space (the distance along a conduit) x and time t that is defined as steps or intervals. These numerical models divide river, channel or pipe reaches into segments and define the transfer of mass and momentum between adjacent segments using the *Saint Venant Equations* for conservation of mass and momentum in unsteady flows as described in Book 6, Chapter 2. The equations must be solved iteratively using finite difference or finite element models and matrix calculations that may require longer computing times.

These more complex calculation processes are quite different from water surface projection methods such as the ‘standard step’ procedure. Nevertheless the same outputs are produced such the HGL levels at points along a conduit and at different times during a flow event. The equations allow for pipe friction and local losses, and also incorporate pressure changes at inlet pits and junctions.

Modelling of urban conveyance networks is typically carried out using a range of computer software packages that provide different levels of rigour or precision which involve trade-offs between speed and accuracy. However the designer should be aware of other important considerations such as stability. Unlikely high or low pressures, water levels, and flow rates are generated when iterative calculations become unstable. The usual way of achieving stable results with a computer model is to choose a shorter time step or adjustment of factors affecting the relative time steps in space and time. Small errors in volumes or flows (typically < 1%) can be accepted in order to achieve faster running times.

Priessmann Slot

Methods of analysis must allow for flows that change from partially full to full conduit flows and back again. Modelling procedures that account for unsteady flow regimes employ the Priessmann Slot assumption. This mixed flow problem is simplified by the addition of a hypothetical slot in the pipe which allows the depth of flow to exceed the pipe diameter and provides pressurized flow effects (Yen, 1986; Butler, 2004). The width of the slot must not be too wide to significantly impact on continuity and should be determined to ensure that the gravity wave speed equals the pressure wave speed.

The hypothetical slot allows the analysis of the conveyance network to be treated as an open channel flow problem. However, a limitation of this approach is that it cannot accurately simulate the formation and impact of air pockets or negative pressures results from shocks.

Outlet Structures

Regardless of whether flow within the conduit is full or part full, suitable transition is required at the end of a conveyance conduit, where flow discharges to the receiving environment. The transition structure, or outlet structure should accommodate potential for high velocity and/or turbulent flow. This can be achieved through armouring of the surface using material such as rock or concrete, along with gradual transition of geometry from that of the conduit, to that of the receiving channel or basin. Energy dissipation and/or flow dispersion can be achieved at the same time using appropriate outlet structure design. This is particularly necessary where stormwater settlement processes are expected in a receiving basin structure such as a bio-retention basin or constructed wetland.

The outlet structure may also represent an opportunity for removal of gross-pollutants prior to stormwater passing into a receiving channel or structure. This can be achieved using various forms of screens, baskets and mechanical filters. The impact of these structures, whether clear, partially blocked or fully blocked on the hydraulic performance of the conveyance infrastructure needs careful assessment at the design stage.

5.6.5. Culverts

The simplest conveyance network is a single-pipe culvert which is a common component of highway and railway networks that is located wherever an embankment crosses a waterway or drainage path. These transport crossings may only involve a single pipe (or multiple parallel pipes). However, the hydraulic calculations can be complicated. Culvert hydraulics are comprehensively described by Normann et al. (2005). The treatment of culvert hydraulics (or headwalls) is divided by two flow conditions:

1. Inlet controls – dependent on the orifice effect at the culvert entrance; and
2. Outlet controls – dependent on full, pressurised flow conditions through the pipe or on high tailwater levels.

Multiple culverts may be connected by pits or junctions in a similar manner as a large conveyance network (refer to Book 9, Chapter 5, Section 6)

Inlet Control

Inlet conditions for culverts are created by the vena contracta effects shown in Figure 9.5.23.

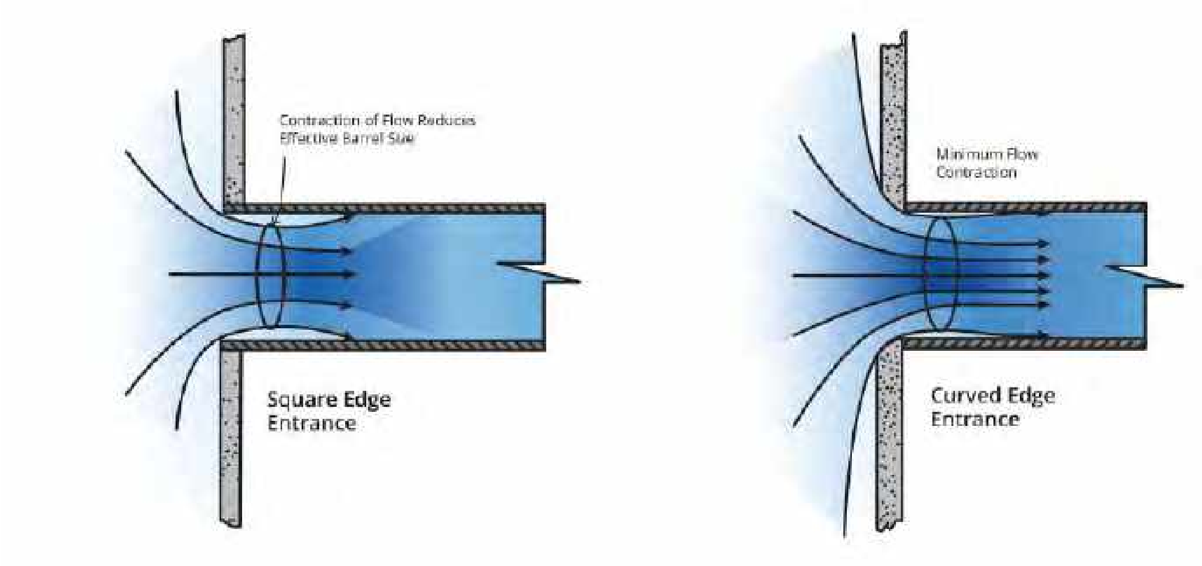


Figure 9.5.23. Vena Contracta or Contraction at a Culvert Entrance

The streamlines of flows entering a culvert cannot turn abruptly and the curvature of flows continues into the culvert creating a jet with a diameter less than that of the culvert. This process reduces the available cross-sectional area of flows and the overall flow rate. The ratio between the jet and the pipe diameters is 0.6 for a square-edged entrance. Values for other entrance types are shown in Figure 9.5.24.

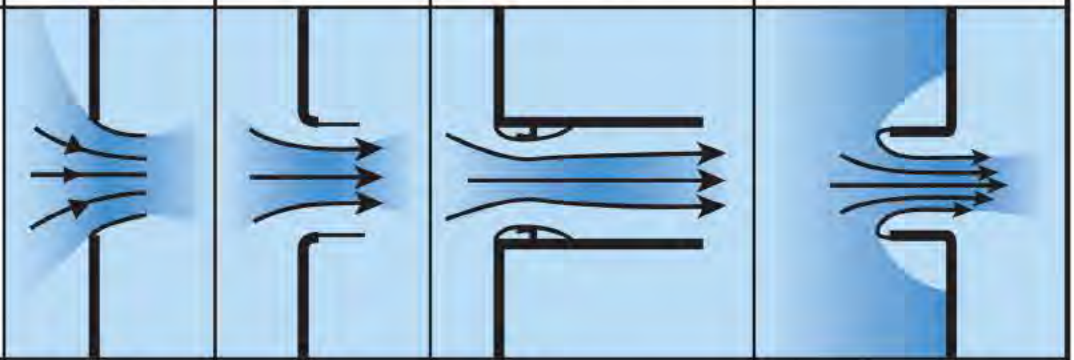
Orifices and their Nominal Coefficients				
	Sharp edged	Rounded	Short tube	Borda
				
C	0.61	0.98	0.80	0.51
C_c	0.62	1.00	1.00	0.52
C_u	0.98	0.98	0.80	0.98

Figure 9.5.24. Orifice Coefficients (Vennard and Street, 1982)

The correction coefficient for the reduced area is C_c and C_u is the factor for the velocity being less that the theoretical value of $V = \sqrt{2gh}$ where h is the pressure head on the orifice (m) and g is the acceleration due to gravity (m/s^2). The overall correction coefficient is $C = C_c.C_u$.

The general case of inlet control is presented in Figure 9.5.25 where it is observed that the culvert barrel has a greater capacity than the entrance as it is flowing partially full. As indicated, Figure 9.5.24 shows that the capacity of the culvert can be improved by modifying the entrance by rounding sharp edges and changing the streamlines. These improvements may be useful in situations when additional capacity is required.

The general equation governing orifice flow for a circular pipe is:

$$Q = VA = C\left(\frac{\pi D^2}{4}\right)(2gh)^{0.5} \tag{9.5.17}$$

where C is the correction factor (dimensionless),

D is the pipe diameter (mm),

h is the head on the orifice, usually taken from the upstream water surface to the centre of the orifice (m), and

g is gravitational acceleration (9.81 m/s^2).

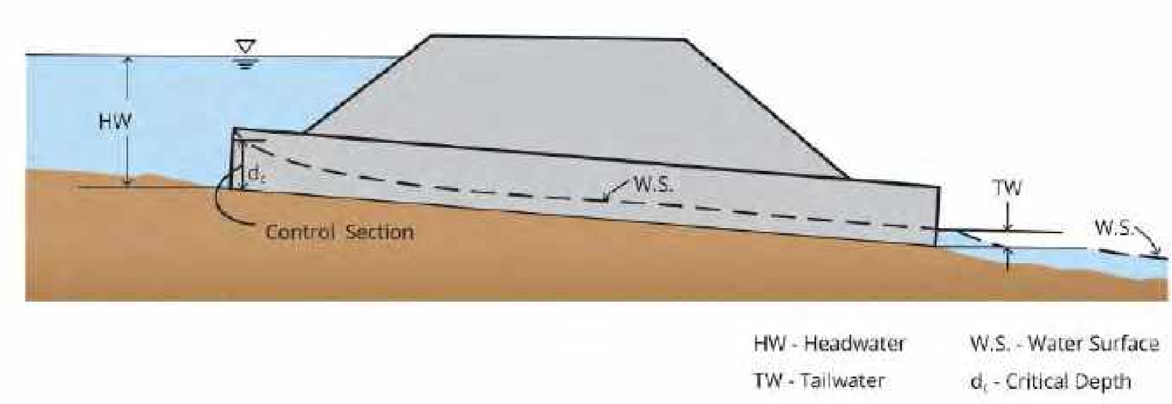


Figure 9.5.25. Example of Inlet Control (U.S. Department of Transport, 2005)

The hydraulics is more complicated when the entrance to the culvert is not completely submerged. This may involve three different states depending on the headwater height above the invert HW and the culvert diameter or height D:

- Partially full flow for HW < 0.8D is a weir type flow as water pours into the pipe;
- Partially full flow with 0.8 < HW < 1.2D is similar to weir flow; and
- Fully submerged inlet flow for HW > 1.2D is an orifice flow.

The stated limits of 0.8D and 1.2D are approximate. These three zones lead to the behaviour demonstrated in Figure 9.5.26 where the inlet control relationship changes depending on the headwater elevation. It is also possible to have two different flow rates at the same water elevation which depends on whether the culvert is operating as an inlet or outlet controlled system. These states can also depend on whether flows are increasing or decreasing.

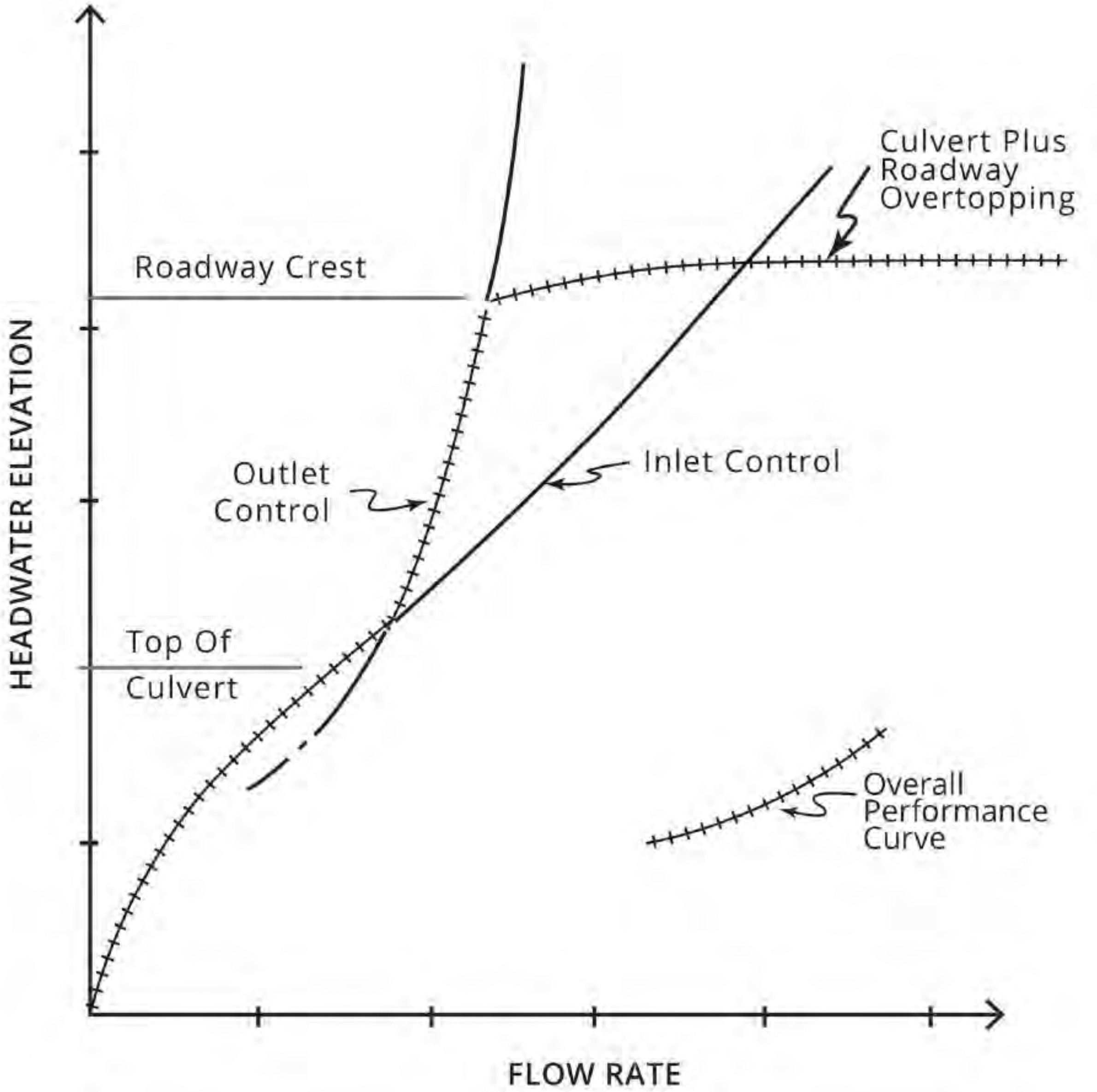


Figure 9.5.26. Inlet Control versus Elevation of Headwaters (U.S. Department of Transport, 2005)

A range of design aids are generally available in the form of nomographs used to calculate headwater levels for various situations involving circular, box and other types of culverts. A better approach is to use computer software to model culvert hydraulics.

Outlet Controls

Outlet control occurs when a culvert is not capable of conveying as much flow as the inlet can accept. The controlling section is generally at the culvert exit where subcritical or pressurised flow conditions are occurring or further downstream of the culvert due to tailwater conditions. Two outlet-controlled situations are provided in Figure 9.5.27. The difference between upstream headwater and the tailwater levels drives the flows through the culvert. Energy losses are added and equated to the available head.

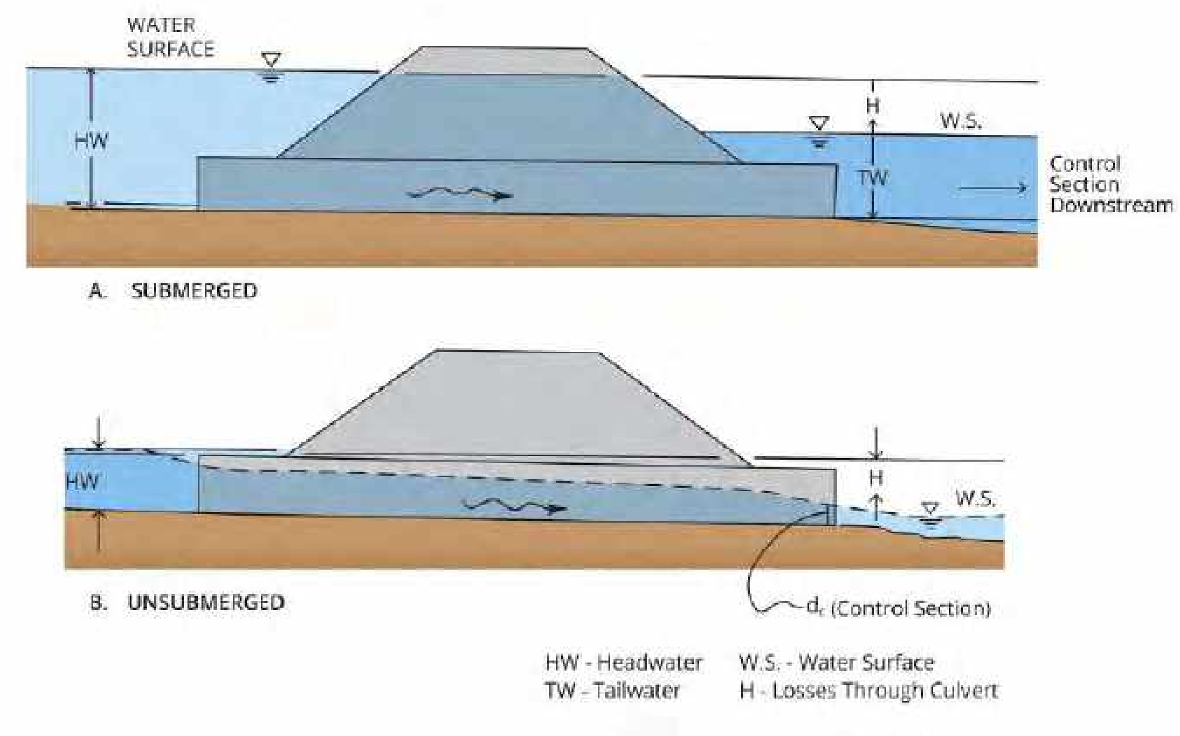


Figure 9.5.27. Example of Outlet Control Situations (U.S. Department of Transport, 2005)

These calculations involve backwards projection of the HGL that commences at the tailwater level if this submerges the outlet. Different computer models make various assumptions for free outfalls. It is assumed that the level will be half way between the pipe obvert and the critical depth, and it is necessary to determine that critical depth from nomographs or equations. However other computer models assume that it is the lower of (a) the critical depth and (b) the normal depth.

A weir equation is applied to allow for overtopping of road embankments:

$$Q = C_w L_w H^{1.5} \qquad (9.5.18)$$

where C_w is a weir coefficient, depending on the weir shape (Figure 9.5.28),

L_w is the width or length of the weir perpendicular to the direction of flow, and

h is the height of water above the weir crest (m).

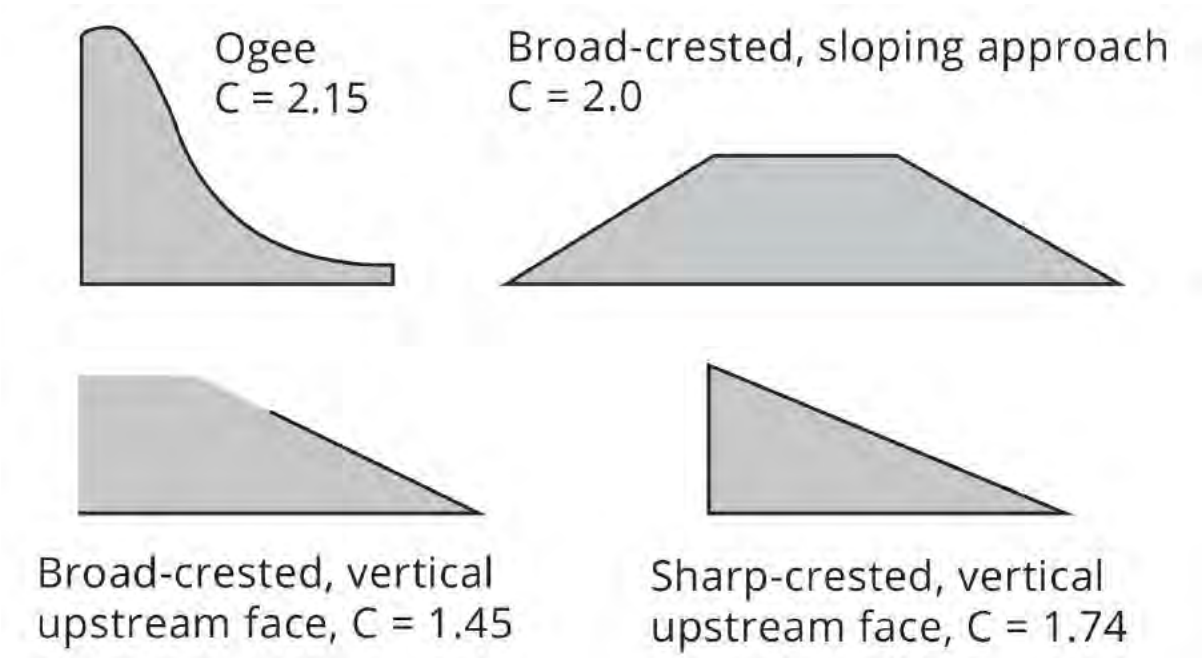


Figure 9.5.28. Shapes of Weir Crests (Laurenson et al., 2010)

Culvert and overflow weir outflows can be combined into a composite relationship as shown in Figure 9.5.26. This calculation should account for inlet and outlet controls and usually the most conservative relationship that provides the lowest flow rate for a given depth is accepted.

The real behaviour of a culvert is more complex and involves a phenomenon called 'priming'. As upstream water levels rise, culverts tend to remain under inlet control until they run full. As upstream water levels decline, culverts tend to remain at full flows in an outlet control configuration until there is a sudden reversion to inlet control and decline in headwater level.

Since culverts are often used as outlets for detention basins and conveyance networks. The relationships presented above can be applied to specify the elevation and discharge relationships needed for routing of flows through volume management facilities.

5.7. References

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Chapter 6. Modelling Approaches

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The authors collaborated with Mikayla Ward and Sophia Buchanan to produce the Brownfield and Greenfield case studies.

Chapter Status	Final
Date last updated	14/5/2019

6.1. Introduction

Urban stormwater management responds to an increasing number of performance objectives including to mitigate property damage, avoid risks to human life, enhance the amenity of urban settlements, and protect surrounding environments (refer to Book 9, Chapter 3, Section 3 and Book 9, Chapter 5, Section 2). This involves consideration of the full spectrum of rain events, from frequent to rare (refer to Book 9, Chapter 3), from the perspective of flooding, water quality, provision of infrastructure, protection of environments, and enhancing amenity of urban areas. The assessment of urban stormwater behaviour, performance against objectives and associated design tasks, involves complex analytical problems that are better resolved using a computer-based model system.

A computer model involves use of software or a complex spreadsheet. Compared with hand calculation, computer models permit rapid numerical calculation across large spatial and temporal domains, while facilitating testing of multiple suites of parameters and inputs (refer Book 9, Chapter 3, Section 4). This in turn allows the model to be calibrated to best represent the real world conditions that are under assessment. Models can be a useful tool to assist our thinking, and can be readily documented and reviewed, ultimately leading to better assessments and design outcomes.

Reliable estimates are nevertheless conditional upon best practice application of the computer model. It is important to remember that models are only tools to guide our thinking about design and management. The purpose of this chapter is to provide guidance on the selection and application of modelling approaches within urban catchments, having regard to the techniques described in other books of ARR. The chapter is structured as follows:

- Book 9, Chapter 6, Section 2 describes tasks that are characteristic of urban modelling.
- Book 9, Chapter 6, Section 3 discusses current trends in urban modelling. This may assist with planning a long-term strategy for technology adoption, research, and training. A general description of the types of computer models commonly applied in urban stormwater practice is provided as an aid for model selection.
- Book 9, Chapter 6, Section 4 provides a framework for application of computer models to urban stormwater catchments. This discussion includes guidance for each segment of the catchment, from the watershed, through the urban stormwater network, and into the receiving waterway.

This chapter is not intended to duplicate content in other chapters. Where relevant detail is available elsewhere, references to other books and chapters are provided.

In the context of this chapter, an ‘urban model’ can be defined as a conceptual or computer-based modelling system that performs hydrologic, hydraulic, water balance, or water quality calculations, across a catchment significantly disturbed by urban development and associated infrastructure. This modelling system may operate across all the significant scales of urban areas from allotment to neighbourhood to precinct to region. Urban infrastructure of most direct relevance includes increased impervious surfaces, modification to natural conveyance areas (e.g. pits, pipes, and open channels), and volume management infrastructure (e.g. rainwater tanks, bioretention, and basins).

Emerging urban stormwater analysis and solutions are based on a systems approach that incorporates multiple linked scales (Book 9, Chapter 3). The USEPA (2008) highlights that past practice of designing individual items of stormwater infrastructure at a single centralised scale has been inadequate for managing urban flooding and water quality in waterways. Stormwater management needs to be designed as a system that integrates structural and non-structural attributes of design with site characteristics and performance objectives.

More recently, the USEPA (2008) established that green infrastructure solutions distributed at multiple scales throughout urban catchments partially disconnected impervious surfaces. They also contributed to improved stormwater quality and avoided flood damages (Atkins, 2015). These insights are consistent with earlier Australian applied research finding that both the peak flows and volumes of stormwater runoff are required for the design of stormwater infrastructure (Goyen, 1981), and the local scale was the basic building block of cumulative urban rainfall runoff processes (Goyen, 2000).

Many methods for modelling stormwater runoff are based on regional scale assumptions and processes. However, inclusion of local scale processes in analysis improves knowledge of within catchment outcomes and whole of catchment responses.

It is suggested that a catchment with less than 10 percent impervious surfaces, or with less than 10 percent of the natural conveyance areas modified, would not be considered an ‘urban catchment’. In which case, the advice in this chapter may have less relevance. However, each catchment is different, some natural or rural catchments contain sub-catchments that are urbanised (for example, in semi-urban areas). The relevance of this chapter to a specific modelling investigation needs to be determined by the reader through application of judgement and experience.

6.2. Urban Modelling Tasks

Typical urban modelling tasks are introduced in this section to establish context for subsequent discussion. In particular this section focusses on those modelling tasks that are not typically required when modelling rural and natural catchments. This section should be read in conjunction with Book 5, Book 6 and Book 7 where the reader can find information about modelling tasks and assumptions that are common across all catchment types (i.e. urban, semi-rural, rural, and natural).

There are some important differences between modelling of urban catchments compared with modelling other types of catchments. Urban areas can include:

- A larger proportion of impervious surfaces (refer Book 9, Chapter 6, Section 2).
- Stormwater conveyance infrastructure. This includes a network of inlet structures and non-natural flow paths that provide for greater concentrations and velocities of flow (refer Book 9, Chapter 6, Section 2).
- Numerous hydraulic structures. This includes infrastructure for waterway crossings, temporary storage of volume, water harvesting and treatment of runoff (refer Book 9, Chapter 6, Section 2, Book 9, Chapter 6, Section 2 and Book 9, Chapter 6, Section 2).

- A greater variety of land uses at different scales with different connectivity to catchment outlets (refer Book 9, Chapter 6, Section 4).

The density of land uses and associated infrastructure within an urban catchment also changes with time. The urban modelling process must therefore consider the information needs of the stakeholder and ensure the temporal scenarios being modelled are relevant.

There are also differences relating to the availability and use of model input data. Modelling in urban areas has intensive requirements related to representation of urban form, land uses, and stormwater infrastructure. Therefore, collection and collation of input data can become a significant component of the overall urban modelling task (refer Book 9, Chapter 6, Section 2).

6.2.1. Impervious Surface Estimation

One of the defining characteristics of an urban catchment is the presence of impervious surfaces such as roads, buildings, footpaths, and driveways. These surfaces have an associated reduced infiltration loss and decreased lag in hydrologic response in comparison to pervious surfaces (i.e. landscaping, lawns, open space) or natural catchments. Book 4, Chapter 2, Section 7 provides further discussion of the effects of impervious cover on runoff from urban areas.

Hydrologic modelling of urban areas requires an estimate of the proportion of impervious surfaces across each catchment and sub-catchment to be modelled. As described in Book 5, there are two main types of impervious surfaces that exist within urban areas:

1. Impervious areas which are directly connected to the conveyance network or urban waterway – referred to as Directly Connected Impervious Areas (DCIA).

2. Impervious areas which are indirectly connected to the conveyance network, typically where impervious surface runoff flows over pervious surfaces before reaching the conveyance network (e.g. a roof that discharges onto a lawn). These are referred to as Indirectly Connected Impervious Areas (ICIA). Alternatively, the responses of these impervious surfaces are disconnected from sub-catchment outlets by volume management measures (refer Book 9, Chapter 4).

These two configurations of impervious surfaces provide different hydrologic responses with Directly Connected Impervious Areas contributing to runoff more quickly than Indirectly Connected Impervious Areas (refer Book 5, Chapter 3, Section 4).

For large urban catchments, isolating the separate hydrologic effects of these two types of impervious surfaces is challenging. Book 5, Chapter 3, Section 4 instead describes a concept referred to as Effective Impervious Area (EIA) that encompasses the combined hydrologic effect of both directly and indirectly connected impervious areas. The estimated EIA value for a catchment is calculated and then applied to hydrologic calculations using the adopted modelling software.

The approach described in Book 5, Chapter 3, Section 4 involves estimation of EIA via linear regression of site stream flow gauge and rainfall data. In situations where there is insufficient available data to allow this technique to be used, the ratio of EIA to Total Impervious Area (TIA) has been established for a collection of gauged catchments that allows EIA to be estimated based on an estimate of TIA (Refer Book 5, Chapter 3, Section 4).

TIA is a measurable catchment feature that is typically estimated using GIS methods (refer Book 5, Chapter 3, Section 4). The selection of a technique for estimation of TIA will depend on catchment scale, data availability, accuracy requirements, and whether the catchment scenario being investigated relates to an existing or future condition.

From Book 5 the recommended ratio of EIA/TIA for the majority of urban catchments sits within the range of 50% and 70%. For example, if the TIA for an urban catchment was measured to be say 55% then the EIA for that same catchment would be somewhere between 27.5% and 38.5% of the total catchment area.

However, when the EIA approach is used, it is important that the characteristics of the catchment under investigation are compared to those of the catchments that have been used to establish the recommended EIA/TIA ratio. Different catchments have different stormwater management standards and land use patterns that may alter the overall degree of connectivity between impervious surfaces and the drainage network serving the catchment. Where there is higher connectivity, the EIA is also expected to be higher.

For some catchment investigations where there is strong connectivity between the impervious surfaces and the downstream drainage system, the measured TIA value may be the more suitable impervious surface value to be used for hydrologic modelling purposes. For example, the analysis of a sealed carpark surface, where the entire impervious area is directly connected to surface inlets, is more appropriately undertaken using a TIA estimate.

Also, where the scale of the catchment is small, for example an individual parcel of land or a small development site, the use of TIA values in conjunction with a sub-catchment definition that reflects actual stormwater connectivity may be more appropriate. To avoid over estimation, designers should only use TIA for small scale catchments when they are satisfied that all the impervious flow is directly connected. The effect of any volume management infrastructure should also be explicitly reflected in these model simulations.

Consideration also needs to be given to the overall need for accuracy when deriving estimates of impervious cover. The majority of techniques applied by designers typically under or over-estimate actual impervious cover by between 10 and 20 percent (Roso et al., 2006).

Predicted peak discharges and runoff volumes are sensitive to error in impervious cover when modelling low rainfall events with both event based and continuous simulation models. Roso et al. (2006) observed that a difference in impervious surfaces of +/- 10 percent from actual conditions, can result in typical errors of 13% in peak discharge and 25% in runoff volume. These errors decrease in situations where rainfall depths are higher and infiltration losses less significant.

It is also noted that where a catchment has significant impervious cover, the variability of runoff is reduced in comparison to a similar pervious catchment since infiltration losses have less influence.

Additional discussion of configurations of impervious surfaces is provided in Book 9, Chapter 6, Section 4. Local observations or information about connectivity of impervious surfaces should be applied in models wherever possible.

6.2.2. Conveyance Infrastructure

Urban areas typically contain a significant amount of stormwater conveyance infrastructure, including numerous stormwater inlet structures feeding a network of other conveyance infrastructure such as street gutters, pipes, open channels, roadways, and overland flow paths through open spaces. These are linked together to form a continuous and distributed network from source to receiving waterway (refer Book 9, Chapter 5).

While natural waterway conveyance is increasingly sought as a design objective for new urban areas, traditionally urban drainage systems have been designed to transfer runoff quickly and within a minimum corridor, often partly underground. This containment of flows within conduits that have artificial linings and unnatural slope leads to faster average flow velocity, greater volume, and significantly altered flood hydrographs compared to those from comparably sized rural and natural catchments.

In order to accurately represent the hydrologic and hydraulic behaviour of an urban area, the influence of conveyance infrastructure on routing and flow behaviour should be included within the adopted urban flood model. For most applications, the model should be capable of describing the effect of conveyance infrastructure on flow characteristics such as flow depth, velocity, direction, surface level, and the hydraulic grade line showing hydraulic losses including their position and size. Other important information includes the split of flow between the minor and major flow path, maximum flow widths in gutters, maximum allowable flow velocity in pipes, the location and direction of any diversions and breakouts, and the extent of property inundation.

The effect of conveyance infrastructure on these flood characteristics varies across the different types of urban flood models.

Some models reflect the performance of conveyance infrastructure explicitly, which requires that the designer input a detailed physical definition of conduits and their hydraulic characteristics. The typical data that must be collected and input to these models include:

- Conduit type;
- cross-sectional dimensions (e.g. pipe diameter, channel width and depth, profile);
- length;
- slope, or sufficient elevation data to allow slope to be calculated using length; and
- hydraulic parameters (e.g. mannings ‘n’, viscosity).

This information must be gathered for each relevant piece of conveyance infrastructure that is part of the network being investigated. In some cases, this data may be readily accessible in an asset database. In other circumstances this data may require collection via ground survey. When data cannot be obtained due to inaccessible structures, assumptions regarding the network geometry may be required.

A schematic representation of the overall conveyance network, including connectivity between inlets, conduits, and junctions is then constructed within the model.

These models can be data intensive, but they also have potential to provide detailed and accurate descriptions of flood behaviours.

Depending on the type of user interface and pre-processor associated with the adopted model software, some of these data requirements may be automatically harvested from other raw input data. For example, a three dimensional surface model may be used to establish roadside gutter profile and slope automatically. Even so, some information will be required such as in this case the plan position of the roadside gutter.

For large urban areas, particularly those that have become densely developed over a long period of time, the task of collecting and collating all the dimensions of all conveyance infrastructure can be a major undertaking. Further complexity and effort arises since each inlet structure has a potential hydrologic sub-catchment that must be defined and input to the model. It is also possible that the size of the sub-catchment may change as flow rate increases. An exception is a rainfall-on-grid model approach where sub-catchment definition may not be required, but even still, substantial effort is required to ensure each inlet structure is capturing a realistic amount of runoff.

In some cases the burden of this infrastructure definition task can be reduced through use of simplified models and assumptions that do not explicitly model the performance of all conveyance infrastructure items. For example, the capacity of underground drainage may be an assumed proportion of the total runoff hydrograph or in some cases totally ignored. This approach can be acceptable if the capacity of the underground system is small relative to the size of floods being investigated. In this case the model construction may instead focus on a more accurate definition of surface-based conveyance infrastructure and overland flow paths.

Other models can provide flood estimates using an even more implicit description of conveyance infrastructure. For example, rating curves and stage hydrographs may be used for selected locations in conjunction with run-off routing hydrologic estimates. In this case less physical data needs to be collected.

Any decision to simplify the description of conveyance infrastructure within a model needs to be made recognising the accuracy requirements of the investigation and the risks associated with any limitations that may be introduced. It is important that the impacts of simplifying models and associated assumptions are fully understood. This is further discussed in Book 9, Chapter 6, Section 3.

6.2.3. Waterway Crossings

Waterway crossings are urban infrastructure for the purpose of allowing access across a natural or man-made waterway. The most commonly encountered waterway crossings comprise of causeways, culverts and bridges that are constructed as part of a vehicular, rail or pedestrian transport system.

Waterway crossings can have considerable hydraulic impact for floods within the range where the crossing structure causes the cross-sectional area of the waterway to be substantially reduced. In these circumstances additional energy is required to pass flow through and/or over the structure causing increased pressure head upstream of the crossing (afflux). Afflux is flow dependant and will change across the range of potential flood discharges. This afflux can cause a significant storage volume to be engaged upstream of embankments which can therefore also heavily influence downstream flood behaviour.

A comprehensive description of hydraulic behaviour at waterway crossings and other hydraulic structures is found in Book 6, Chapter 3.

As well as causing afflux locally around the structure, the hydraulic behaviour associated with waterway crossings can also have an impact on:

- Floodplain storage and hydrograph attenuation;
- tail water levels for upstream drainage;
- cross-catchment diversion of flow; and
- bed scour and local stream morphology.

These impacts are not necessarily confined to those that are in the immediate vicinity of the investigation site or study area and may impact areas upstream or downstream. A comprehensive urban flood investigation should therefore consider the impact of each existing or proposed waterway crossing in the catchment (and adjoining catchment in the case of cross-catchment diversion) and whether they could have an impact on local flood behaviour.

Once the relevant waterway crossings have been identified, the urban modelling task is then to suitably define the crossing structure within the model. This will normally include the physical dimensions and shape of the waterway opening beneath the crossing deck and any obstruction caused by associated railings, embankments, and utility services. Models may also assist with identifying locations where bed shear stress increases are likely and the design of scour protection measures (refer to Book 6, Chapter 3).

Consideration also needs to be given to blockage potential of the overall structure and which blockage scenarios may be required in order to fully describe potential flood behaviour. Book 6, Chapter 6 provides further detail regarding blockage considerations.

As with conveyance infrastructure, some types of urban models may estimate the flood behaviour impacts of the waterway crossing in an implicit manner through use of rating curves and stage hydrographs. The impact of any such simplifications and assumptions on model accuracy needs to be considered when selecting an appropriate model platform for the investigation.

6.2.4. Volume Management Infrastructure

Volume management infrastructure comprises of discrete facilities, primarily for the purpose of controlling peak discharge and volume. They can be located at almost any point within a drainage network and are linked by conveyance infrastructure and/or natural waterways. A comprehensive description of typical volume management infrastructure facilities is found in Book 6, Chapter 4.

The hydrologic and hydraulic impact of these facilities can be significant and will vary according to the design of the facility and size of the flood. For the urban designer, the task associated with this infrastructure is the physical description and schematisation of the facility within the model. This will normally include:

- Storage characteristics and how the volume stored varies with depth; and
- outlet characteristics and how the outlet influence depth and volume of water stored in the facility

The way this model task is completed will depend on the type of model being used, but most commonly involves entering a form of definition table describing storage volume with depth along with details regarding the physical dimensions and elevations of the outlet structure.

Depending on the intended purpose of the urban modelling task, consideration should also be given to antecedent conditions, whether the storage is partly utilised prior to the onset of the storm burst and whether there is potential for blockage of the outlet structure at some point in time and to what extent.

The hydrologic and hydraulic impact of a volume management facility may be distant from its physical location (upstream or downstream). The designer must consider inclusion of all volume management facilities that could potentially impact the investigation site. Also, as proposed storage volumes increase, the critical storm duration and pattern may correspondingly change, necessitating the inclusion of additional rainfall scenarios into the suite of model tests.

6.2.5. Water Quality Treatment Performance

An increasingly common urban modelling task is the assessment of the water quality treatment performance associated with a water treatment facility such as those described in Book 9, Chapter 4.

The facilities that perform this function are often co-located or are an integral part of a volume management infrastructure facility. Where this is indeed the case then similar model inputs are required such as the basin storage and outlet characteristics. However, a different model platform may be necessary since the treatment process targets smaller storms and occurs over longer time periods. For example, event based hydrologic models may not be a suitable basis for these assessments. Instead a continuous simulation-based model would be more suitable.

In addition, further information is required to define the treatment characteristics of the facility. These are mostly based on empirical relationships that simply associate the performance of the facility with its size or alternatively retention curves that relate inflow and outflow concentrations of pollutants. The pollutants of most interest are gross pollutants, nutrients (Total Nitrogen and Total Phosphorus), and Total Suspended Solids.

6.2.6. Data Collection and Collation

A well organised data collection and collation process is essential in the modelling process. It not only ensures that the modelling is fit for purpose, but it documents the sources of data and how the data was interpreted and used in the model. Models often evolve as improvements are made or processes are changed to better represent different components. This task is much simpler if a good data management process has been used.

It is important that the data management system properly documents the source of the data, the format, and the date of acquisition. Book 1, Chapter 4 provides comprehensive advice on the use of data. A key challenge in urban catchments is that many urban drainage components cannot be put directly into a model but need to be schematised. Examples include converting a basin drawing into a stage storage table or representing a complex pit system. It is important that the data management system properly documents this process so the interpretation and schematisation is properly documented and can be reviewed or refined later. While data can be classified in many ways, there are three broad types of data:

- Model inputs such as rainfall and temporal patterns that change between events;
- model components such as pipes, storages, terrain information and land use data; and
- observed data such as observed peak flood levels and flows

The digital age has changed many aspects of data collection with data often being easier to find but often the original data sources are unclear with merged data sets representing the largest part of this problem. This same problem exists in the model development process where many data sets are interpreted and merged. While most urban catchments are ungauged recent observed flood data can often be found on social media and older historical flood information can be found in scanned historical records and newspapers.

6.3. Model Selection

There is a wide range of conceptual modelling approaches, software platforms and systems available to the urban designer. Each platform has different capabilities and strengths. It is not the role of this Guideline to recommend specific conceptual modelling approaches, software packages or prescribed flood estimation methods. However, the guidance contained in this chapter does seek to classify the available options into categories and highlight the current strengths and weaknesses of each to support a decision on the adoption of an appropriate platform or estimation procedure for the task at hand. The authors are mindful that the science and practice of urban stormwater management will continue to evolve, and new models and data will become available. The guidance in this chapter should not be perceived to be excluding new and innovative approaches.

6.3.1. Overall Trends in Urban Modelling

The last 30 years has seen fundamental changes in the way urban stormwater assessment and design tasks are undertaken. It is reasonable to assume that similar change will occur over the next 30 years. Recognising that the decision to adopt a specific urban catchment model platform can have significant implications for personal research and training, this section provides introductory level discussion about these trends. It is expected this will support more informed choices related to adoption of a model platform, either for a specific investigation project or for a longer-term strategic assessment program.

6.3.1.1. Computing Power

In response to the overall computing requirements of society, urban modelling designers now have access to faster computers with enormous numerical computation capability. This has arisen through improvements to computer processors (CPUs) including 64-bit computing and multi-core processing. More recently the use of Graphics Processing Units (GPUs) has led to further substantial processing improvements. New opportunities are also arising with the advent of high-performance computing services, including on the cloud. The transition from hand calculations to widespread availability of computing power to assist in designs is a major change in stormwater management practice since ARR 1987 (Book 9, Chapter 3, Section 3).

As these computing advances have occurred, urban modelling software platforms have been adapted to harness some of the available computational speed increases. This permits the modelling designer to consider:

- Increasing the physical size of the model domain. For example, model a larger urban catchment;
- increasing the spatial and temporal resolution of the model to allow for finer grained numerical calculations that account for location and connectivity of different land uses;
- longer time-series of rainfall;
- a greater number of catchment scenarios;
- tighter integration of hydrologic and hydraulic computation;
- more model iterations to support improved calibration and sensitivity analysis; and

- less conceptualisation and closer alignment to complex physical processes.

It can be expected that computational capabilities will continue to increase into the future and that urban modelling software platforms will continue to be refined and improved to harness more of the available capacity.

Currently, computing power is such that it is reasonable to expect that most urban hydrologic model simulations, even relatively complex ones, can be undertaken within seconds or minutes. It can therefore be assumed that pure hydrologic investigations are already unconstrained by computing power regardless of the choice of model platform.

Computing power is still somewhat of a constraint for hydraulic simulations. Some of the more complex finer resolution or larger domain hydraulic model simulations can take hours or days per simulation. This may constrain the design of an urban hydraulic modelling investigation and also means that due care must be taken when selecting a hydraulic model platform. A hydraulic platform and method should be chosen that has computational efficiency to match the problem at hand. Models with very long run times should be carefully managed as they usually preclude comprehensive testing, checking or calibration.

The future will permit very large multi-catchment spatial domains to be modelled at the finest level of temporal and spatial resolution necessary, with sufficient speed to allow simultaneous and exhaustive exploration of hydrologic and hydraulic scenarios.

This trend may outpace our ability to improve the underlying science and gather sufficient quality input data, and to respond with more informed design and management solutions. Consideration will also need to be given to whether the ultimate outcomes of investigations are improved by aggressively pursuing the full capabilities of available computing power.

In other words, at some point in the future, further improvements to computing power may cease to provide any material value to urban modelling designers. Substantial further research and data collection, for a range of urban catchment scales, is necessary to ensure theory is able to keep pace with computing power.

6.3.1.2. Alignment to Physical Hydrologic and Hydraulic Processes

The underlying methods that are applied using computer-based models have experienced a trend away from conceptual and simplified deterministic techniques to methods that more closely align with the actual physical processes that are occurring.

Some examples of this trend are:

- A move away from isolated storm bursts with a single pattern, towards consideration of pre-burst rainfall and more complete storm bursts including an ensemble of equally likely but different temporal patterns. This leads to more robust design and resolves some of the issues that arise when trying to maintain probability neutrality between rainfall and flood (refer Book 3 and Book 5). The future will see this trend continue with designs becoming increasingly based on complete storms and continuous recorded or synthetic rainfall sequences.

- The use of direct rainfall, also referred to as ‘rainfall-on-grid’ approaches which attempts to explicitly resolve the accumulation of runoff progressively down the catchment, removing the need to pre-identify flow paths and sub-catchments. This is a useful way to ensure flow paths are not inadvertently omitted from an investigation. With further research and software development this approach may in time also eliminate the need for hydrologic models to undertake surface routing. At this stage however, there is inadequate evidence that a direct rainfall approach should be relied upon for this purpose with many parameters being scale and approach dependent (refer Book 5).

- The hydraulic models applied in practice have increasingly changed from one-dimensional to two-dimensional representations of the floodplain surface. This allows a more realistic definition of potential flow paths which in turn improves the representation of flood behaviour (refer Book 5 and Book 7).

With continuation of this trend it can be anticipated that model platforms will eventually converge on more accurate representations of rainfall runoff and flood processes, requiring different model inputs, parameters, and application techniques. Again, this will only occur with adequate research and software development effort and data collection for a range of urban catchment scales.

6.3.1.3. Statistical Approaches

There has been increasing awareness and understanding of the need to consider the joint probability of model assumptions and physical processes (Kuczera et al., 2006). This has given rise to techniques such as Monte-Carlo sampling and ensembles of rainfall patterns to reduce potential probability distortions and gain better appreciation of model uncertainty (Book 3). For simple urban models or where the design objectives have limited sensitivity to model results these approaches may not be warranted.

These approaches should be considered where better appreciation of natural variability and uncertainty is required. This may include sensitive urban areas, a major waterway crossing, large flood mitigation proposal or hydrologic design of regional scale water quality infrastructure.

Machine learning algorithms are also being used for the prediction of stream flow using statistical information drawn from historic rainfall and stream gauge data, providing an alternative approach to hydrologic modelling.

6.3.1.4. Accumulation of Longer Periods of Recorded Data

With the passage of time, longer periods of recorded data have become available to allow refinements of design rainfall, losses, and more informed model calibration (Book 2, Chapter 3, Section 4). Over time this will allow a better understanding of model performance and uncertainty, particularly within those catchments where data has been recorded. There will be diminishing situations where models are left uncalibrated for the want of historic data.

6.3.1.5. The Internet and Spatial Information Systems

Since the 1987 version of ARR, the internet has emerged to become a ubiquitous part of life. The internet provides urban modelling designers a new potentially more effective method for:

- Accessing and disseminating research, including international practice;
- gathering model input data;
- processing of simulations (using cloud processing technology); and
- storing and communicating information arising from model investigations.

Furthermore, modelling software platforms that have traditionally been tied to a single computer, are now able to be offered as internet-based services. Into the future other new applications will be found for the internet that cannot be fully anticipated at this time but will likely support further improvements in the application of urban models.

In parallel to the internet, an associated trend that has also emerged is a deeper interest and reliance on Geographical Information Systems (GIS). These systems are used for the storage, handling and display of physical catchment data, catchment parameters and infrastructure data.

Spatial information systems have become an important support technology for the application of urban models, with most platforms leveraging these tools for pre-processing and post-processing of data, storage of data, data display, data enhancement and the preparation of information products for stakeholders.

6.3.1.6. Information Needs of the End User

The information needs of the end user have become more complex. A greater number of aspects are of interest. For example, the extent, depth, and level of floodwaters are now typically supplemented by velocity, combinations of velocity and depth (hazard), volume and timing. Enhanced datasets are also now prepared such as risk and planning controls. These results are often required at many additional locations distributed across urban catchments rather than at selected locations at the bottom of catchments.

Urban modelling designers should consider how the model software platforms they use can be used to accommodate these growing information needs.

6.3.2. Types of Urban Models

Notwithstanding the potential future trends in urban modelling described above, today’s industry designers already have a greater array of model platforms and estimation options than available in the past. However, each option differs in the quality of spatial representation they are capable of achieving, as well as the capability with which they can represent different physical flood processes. Accordingly, some models or methods may or may not be suitable for a specific urban modelling task.

Some of the more common types of models and methods are listed in Table 9.6.1. For each type, a generic classification of its capability is also provided. This is a snapshot in time of the capability of these models and will change with time. This classification is based on the examples in Table 9.6.2. A subsequent section describes the performance of these models at different spatial scales.

Table 9.6.1. Common Types of Urban Models

Focus	Urban Model Type	Estimation Capabilities (also refer Table 9.6.2)				Example Model Platforms (where relevant)
		Runoff Generation and Surface Routing	Channel and Storage Routing	Structure Hydraulics	Other specific capabilities or limitations	
Hydrology	Rational Method	Limited	None	None	Peak flow only – scalar quantity, single lumped catchment, requires 'Time of Concentration' assumption, only suitable for small catchments. It has best capabilities where there is no storage present.	RATHGL, PCdrain
Hydrology	Time Area Method, Extended Rational Method	Moderate	None	None	Suitable for small catchments only. Can be extended as a collection of linked sub-catchments.	ILSAX, DRAINS
Hydrology	Runoff Routing	Strong	Moderate	Limited	Full event hydrograph, empirically derived lag parameters, non-linear routing capabilities. Structure hydraulics can be moderately capable for discrete structures but not for continuous conveyance networks.	RORB, RAFTS, WBNM, URBS, HEC-HMS
Hydrology	Continuous Simulation	Strong	Moderate	Limited	Continuous multi-year runoff sequence, comprehensive infiltration loss models. Limited capability for rare to very rare floods unless utilised with replicates of conditioned synthetic continuous rainfall (such as DRIP)	XP-RAFTS, MUSIC, PURRS, Systems Framework
Hydrology and Hydraulics	Hydrology coupled to 1D hydraulic model	Moderate	Moderate	Strong	Not always emulating full capability of the underlying hydrologic model	DRAINS, PCdrain, XP-SWMM

Focus	Urban Model Type	Estimation Capabilities (also refer Table 9.6.2)				Example Model Platforms (where relevant)
		Runoff Generation and Surface Routing	Channel and Storage Routing	Structure Hydraulics	Other specific capabilities or limitations	
Hydrology and Hydraulics	Direct Rainfall (‘rainfall-on-grid’)	Limited	Moderate	Strong	Does not require pre-defined flow paths. Sensitive to topographic data pre-processing and surface roughness assumptions. Not suitable for ‘greenfield’ subdivision drainage design.	TUFLOW, MIKE21, SOBEK, ANUGA
Hydrology and Hydraulics	Runoff routing coupled to two-dimensional hydraulic model	Moderate	Strong	Strong	Requires pre-defined understanding of flow paths in order to establish initial model. Requires input and output procedure between two model software packages.	RAFTS with MIKE21, WBNM with TUFLOW, XP STORM with TUFLOW, DRAINS with TUFLOW
Hydraulics	One-dimensional hydraulic model	None	Moderate	Strong	Simple channel or pipe behaviour only. Limited where complex flood storages exist.	HEC-RAS, MIKE11, SOBEK
Hydraulics	Two-dimensional hydraulic model	None	Strong	Strong	Complex flow behaviour including breakout and diversion. Flow transitions and hydraulic jumps. Principally surface flow.	TUFLOW, SOBEK, ANUGA, MIKE21, HEC-RAS 2D, RMA, RiverFlow2D
Hydraulics	Pipe network models	None	Moderate	Strong	Specialist models for underground drainage networks, storage routing performance best where flow is contained within the minor system.	SWMM, XP-STORM, DRAINS, PC drain, MIKE URBAN

Focus	Urban Model Type	Estimation Capabilities (also refer Table 9.6.2)				Example Model Platforms (where relevant)
		Runoff Generation and Surface Routing	Channel and Storage Routing	Structure Hydraulics	Other specific capabilities or limitations	
Water Quality	Water quality model	Moderate	Limited	Limited	Additional capabilities related to pollutant generation and removal. Hydraulic capabilities can be extended by coupling to 1D hydraulic model. Runoff generation less suited to event based flood estimates.	MUSIC, EPA-SWMM

Table 9.6.2. Generic Classification of Model Estimation Capability

Flood process	Limited Capability	Moderate Capability	Moderate Capability
Runoff generation and surface routing	Average intensity or burst Cursory treatment of infiltration losses Surface characteristics not fully represented	More complete storm Infiltration losses Surface characteristics partially represented	Full storm or rainfall sequence Infiltration losses Spatial distribution of rainfall Surface characteristics well represented (including surface wave speed)
Channel and storage routing	Channel characteristics not represented No explicit calculation of flood storage and its attenuation effects	Channel characteristics partially represented Storage behaviour partially represented including attenuation effects and spatial influences	Channel characteristics and flood wave speed well represented Storage behaviour well described including complex hydraulic behaviour and attenuation effects

Flood process	Limited Capability	Moderate Capability	Moderate Capability
Structure hydraulics	Basic hydraulic structures only Rating tables Manning's formula for open channels.	Small range of hydraulic structures Basic topographic representation	Wide range of hydraulic structures Resolves shallow water equations (1D or 2D or both)

When selecting a particular model or technique, the designer should in the first instance look to match the estimation capabilities of the model, whether they be 'limited', 'moderate' or 'strong', with the nature of urban modelling problem that is being investigated.

For example, if channel routing and structure hydraulics are not aspects of the problem that need to be investigated, then the model selected need not have any capabilities in these areas. Equally, if it is expected that a particular problem will require significant capabilities in (for example,) runoff generation, then a model with 'strong' capabilities in this area should be considered.

Where the estimation capabilities are identified in Table 9.6.1 as 'limited', significant caution must be adopted. As a minimum they should be applied by, or under the direct guidance of, a designer who fully understands the limitations of these approaches. The tolerance for error in the results should be considered and if greater accuracy is required then an alternative more capable model platform applied.

As always, the level of experience of the designer is a significant factor. Someone with significant experience and familiarity with a specific model may be able to extend its capabilities to a level that achieves an acceptable level of estimation accuracy that is beyond its normal capabilities if deployed by an average or less advanced user.

6.3.3. Model Scale

Urban models are constructed at different spatial scales depending on the size of the overall catchment to be analysed and the nature of the performance objectives being sought. Typically the smallest catchment a designer will consider is that of a single small parcel of land with a single dwelling. The type of model assessments that are normally undertaken at this scale include model calculations to assist with design of internal drainage systems and small volume management facilities (e.g. rainwater tanks and OSD).

At the other end of the spectrum of potential scale, an urban model may be constructed to represent all the stormwater catchments spanning an entire suburb or even a small city. These larger models are often used for the purpose of regional flood mapping, establishing flood levels for development purposes or the design of large-scale stormwater and road crossing infrastructure.

When evaluating which type of model to adopt for a particular urban modelling project, the spatial scale of interest is an important factor to consider since some particular models may not be capable of competently representing all the complexity that is encountered at the scale of interest.

Consider four example spatial scales with each physical footprint increasing by an approximate order of magnitude as shown in Table 9.6.3 below.

Table 9.6.3. Typical Urban Model Scales

Lot	Site	Neighbourhood	Precinct
A small parcel of land with 1 or 2 buildings.	A large parcel of land with multiple buildings. Sometimes a small number of 'lots' combined.	Many parcels of land each with at least one building. Many 'lots' and potentially some multi-building complexes.	Hundreds of parcels of land each with at least one building. A large number of 'lots' and multi-building complexes combined. Several neighbourhoods.
e.g. single detached dwelling or duplex up to 1,000m^2 in area	e.g. large townhouse complex covering an area up to 1 hectare	e.g. a residential subdivision stage or a neighbourhood covering an area up to 10 hectares	e.g. a small suburb covering an area of 100 hectares

As a model's spatial scale increases from 'lot' through to 'precinct' the more likely that the catchment being modelled will contain a greater range of features of relevance to stormwater behaviour such as:

- Public roads acting as overland flowpaths
- A larger variety of different land uses and associated connectivity
- Large capacity conveyance infrastructure
- Large basins and volume management infrastructure
- Urban waterways
- Urban waterway crossings

In conjunction with this increase in the number of stormwater features, it follows that the potential number of rainfall runoff processes encountered in a larger scale model will also increase. In this context flood generation processes include damaging floods as well as much smaller floods that are relevant to yield and water quality assessment.

Table 9.6.4 below provides a list of the flood generation processes encountered at each of the four spatial scales described above. This listing is non-exhaustive and only provided to demonstrate that there is a larger number of potential flood generation processes that can be expected to occur as spatial scale increases from 'lot' scale to 'precinct' scale (growing from approximately 8 to 32 in the example listing provided in Table 9.6.4).

Some degree of simplification of these flood generation processes normally occurs when preparing an urban flood model. The flood generation processes listed in Table 9.6.4 have different levels of importance and influence when trying to decide whether any simplifications are possible. Each process has been indicated in Table 9.6.4 by one of two different symbols as follows:

A very important flood generation process. A model constructed at this scale should have the capability to competently address this flood process.	1

A flood generation process that is less important. This process may be omitted or simplified if accuracy of model estimates is not critical	2

Further discussion regarding model simplification is included in Book 9, Chapter 6, Section 3.

Table 9.6.4. Example Flood Generation Processes at Different Model Spatial Scales

Example Flood Generation Processes	Lot	Site	Neighbourhood	Precinct
Overland flow routing across surface of lot	2	2	2	2
Conveyance capacity of roof gutters and downpipes	2	2	2	2
Routing through internal underground drainage	2	2	2	2
Runoff generation from impervious surfaces within lot (e.g. roof)	1	1	2	2
Runoff generation from pervious surfaces within lot (e.g. garden)	1	1	2	2
Conveyance capacity of internal underground drainage	1	1	2	2
Routing through temporary and/or permanent storage connected to dwelling (source control)	1	1	2	2
Storage outlet behaviour including use of stored water for internal and external private demand (source control)	1	1	2	2
Overland flow routing between multiple lots		2	2	2
Routing through open surface drains and driveways		2	2	2
Routing through inter-allotment drainage		2	2	2
Runoff generation from impervious surfaces within common areas (e.g. common driveway)		1	2	2
Runoff generation from pervious surfaces within common areas (e.g. landscape areas)		1	2	2
Conveyance capacity of open surface drains and driveways		1	2	2
Conveyance capacity of inter-allotment drainage		1	2	2
Capacity of inlets to the internal underground system and potential bypass		1	2	2
Routing through temporary and/or permanent storage within common area (source control)		1	2	2
Storage outlet behaviour including use of stored water for external demand within common areas (source control)		1	2	2

Example Flood Generation Processes	Lot	Site	Neighbourhood	Precinct
Overland flow routing across the sub-catchment surface			2	2
Routing through roadside gutters and table drains			2	2
Routing through underground drainage and trunk drainage			1	2
Routing through major overland flow paths			1	2
Conveyance capacity of roadside gutters and table drains			1	2
Runoff generation from impervious surfaces (neighbourhood scale)			1	2
Runoff generation from pervious surfaces (neighbourhood scale)			1	2
Capacity of inlets to the road drainage system and potential bypass			1	2
Capacity of inlets to the trunk underground drainage system and potential bypass			1	2
Conveyance capacity of underground drainage and trunk drainage			1	2
Conveyance capacity of major overland flow paths			1	2
Routing through temporary and/or permanent storage within public areas (neighbourhood control)			1	2
Storage outlet behaviour including use of stored water for external demand within public areas (neighbourhood control)			1	2
Runoff generation from impervious surfaces (precinct scale)				1
Runoff generation from pervious surfaces (precinct scale)				1
Routing through large open channels and urban waterways				1
Conveyance capacity of large open channels and urban waterways				1
Performance of culverts and bridges including impact of blockage and diversion				1
Routing through temporary and/or permanent storage within public areas (regional control)				1
Storage outlet behaviour including use of stored water for external demand within public areas (regional control)				1

2. Opportunity for model simplification (refer Book 9, Chapter 6, Section 3)

Most model platforms have some limitations on which processes they can represent. A decision will be required at the commencement of model preparation as to whether the selected model and the available data are capable of achieving the required level of accuracy and reliability.

As a result of the expected increase in the number of flood generation processes with scale, if a catchment investigation requires investigation across a large spatial scale, then the designer can expect that a model or method with ‘strong’ estimation capabilities across multiple flood process areas will be necessary (refer Table 9.6.1 and Table 9.6.2).

For example, the Rational Method, with ‘limited’ runoff generation and surface routing capabilities, is not likely to be suitable for a ‘precinct’ scale estimate of peak flow as it cannot adequately simulate the array of flood processes that are encountered, even in the simplest of catchments. However, it may be suitable at a ‘lot’ scale in circumstances where storage routing is not critical.

If volume management infrastructure forms part of a solution, or if an understanding of potential impacts on downstream flooding are required, then a ‘strong’ hydrologic estimation method such as a runoff-routing model should be used. For most urban modelling at this point in time, a runoff-routing model coupled to a two-dimensional hydraulic model or pipe network model will provide the strongest estimation capabilities across a wide range of model scales.

The resolution of model inputs and boundary conditions also needs to be considered. There is little value in developing a high-resolution model with coarse lumped inflows or considering the performance of a complex system using a single temporal pattern.

6.3.4. Flood Magnitude

The capability of each type of model also varies with magnitude of the flood being considered. For the smallest of floods, including frequent storms and runoff events, the model’s capabilities should include consideration of infiltration losses including for some applications the recovery of soil moisture profiles during inter-event periods and baseflow. The importance of this capability may change depending on the level of impervious cover within the catchment, becoming decreasingly important as impervious cover increases.

These capabilities are principally the domain of runoff-routing and continuous simulation models. Other processes that effect total runoff volume such as harvesting and use of rainwater may also be important considerations for smaller flood magnitudes. Figure 9.6.1 indicates the likely range of effectiveness for the different types of hydrologic models against flood magnitude on x-scale and model scale on y–scale.

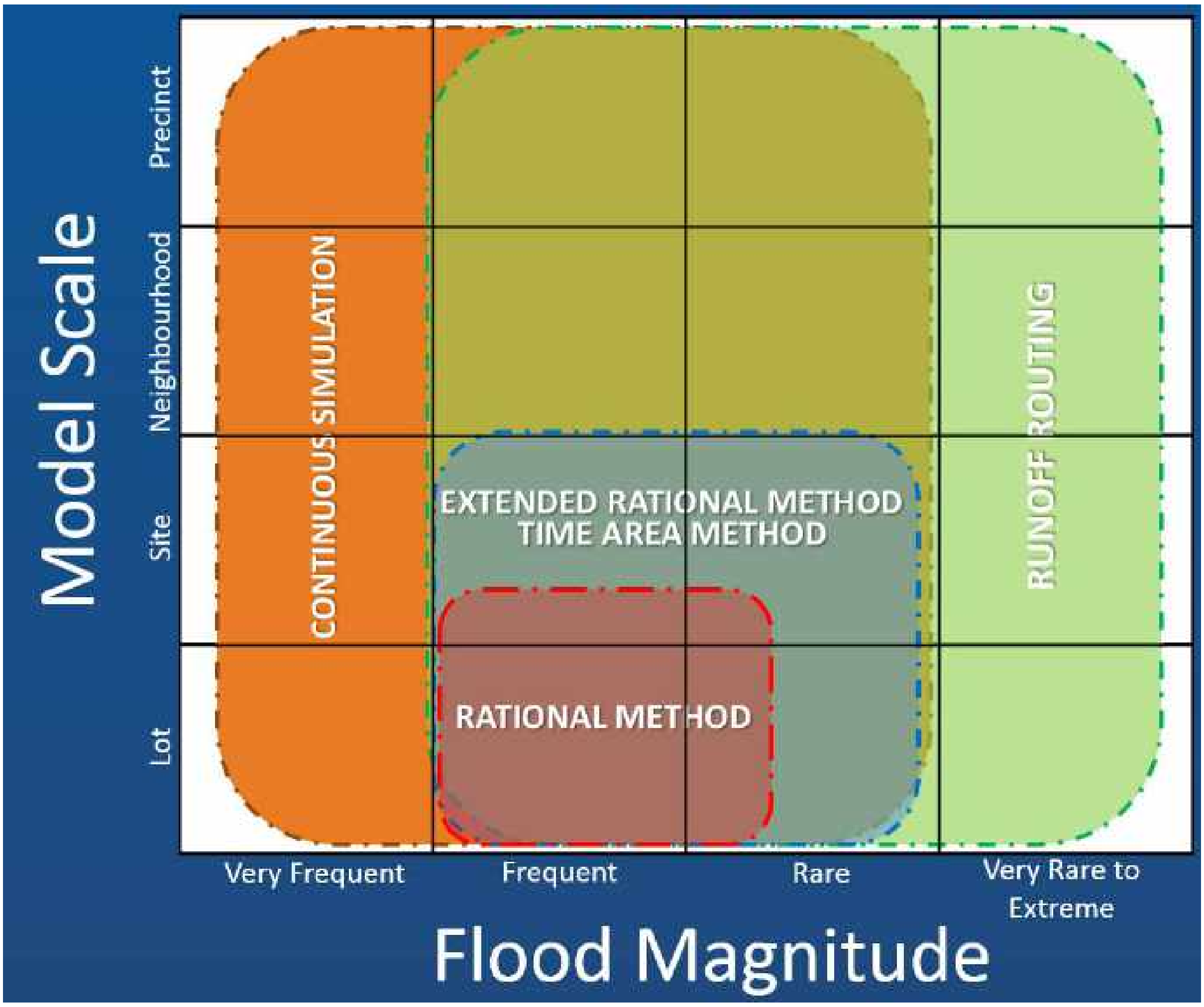

Figure 9.6.1. Types of Urban Hydrologic Models and their Likely Application Range

As the magnitude of flooding that is of interest increases, different hydrologic model requirements emerge since the importance of antecedent soil moisture and rainfall diminish. Typically, runoff-routing models applied using discrete rainfall bursts or more complete storms would be used.

For the companion hydraulic calculations during small floods, and where flooding is confined to the pipe network or a simple channel, a pipe network model and/or 1D channel hydraulic model will normally be adequate. Even some hydrologic model packages have the capability to undertake basic hydraulic calculations.

For hydraulic calculations associated with large floods that exceed the normal capacity of a channel, or where substantial overland flows develop, a 2D hydraulic model may have more utility since the likelihood of complex flow patterns increases.

Further detailed information regarding hydraulic models is included in Book 6, Chapter 4.

6.3.5. Choosing a Model

A stepwise process is suggested below to assist with identifying the types of models that may be suitable for a specific urban modelling problem. Consideration of each step in the flowchart shown in Figure 9.6.2 will help to progressively reduce the number of candidate model types that may apply.

Figure 9.6.2. Stepwise Flowchart for Selecting an Urban Stormwater Model

Where there are multiple options arising from this process, the simplest model, capable of the necessary calculations should be favoured. Other model selection criteria include, availability of sufficient input data and parameter research, output data capabilities, availability of other required functionality (e.g. water quality calculation), cost, and designer familiarity with the model. A hydraulic model involves a more explicit representation of flow routing and how storage is represented in the catchment. Generally, a hydraulic model will be required where there is a need to understand both flow and flood levels. one-dimensional pipe and channel models only provide this information at key locations but are well suited to 'greenfields' subdivision design, while a two-dimensional model provides a detailed spatial representation of surface stormwater processes and may be more suited to brownfields investigations.

6.3.6. Model Simplification

In conjunction with selecting a type of model that has the necessary estimation capabilities and is well suited to the model scale of interest and associated smaller scale influences, consideration must also be given to the degree of model simplification that might be appropriate.

When modelling at small spatial scales it is simpler to closely represent each flood process and its associated physical features and drainage connections explicitly. As spatial scale increases it is sometimes possible to adopt some model simplifications to manage data requirements and the general complexity of the modelling task. For example, when building a ‘precinct’ scale model it may be possible to omit or simplify ‘lot’ scale processes. However, models should not be simplified unless that consequences of spatial averaging, deterministic assumptions and judgements is well understood. Where simplification is undertaken, efforts should be made to fully understand the impacts of simplification and limits on validity of the model outputs. For example, by comparison of results against a more detailed sub-model or results generated by an alternative model.

Experience and careful judgement are required when choosing to omit or simplify those processes that are suggested as being less important. In general, the omission or simplification of such a process should only occur when the investigation does not demand highly reliable estimates, for example, for preliminary sizing of structures or where flood risks are low. Table 9.6.4 indicates those flood generation processes that may be less important and therefore could be considered as an opportunity for simplification at each different spatial scale.

6.3.7. Model Resolution

Closely related to consideration of model simplification is the interrelated consideration of model resolution. Resolution can in this context have multiple aspects.

Firstly there is spatial resolution of the model. For a hydrologic model this will relate to the minimum size of sub-catchments. For a hydraulic model this will relate to the density of sampling of the ground surface.

The adopted spatial resolution of a model will govern the density of reporting locations i.e. where model results are output by the model software. It may also influence model accuracy. Through experience a designer will develop an understanding of the optimum model spatial resolution for each type of model and to what degree spatial simplification can be tolerated.

Then there is the temporal resolution of the model and the ability to extract output time series that are fit for purpose. For example, the temporal resolution necessary for regional water supply planning may be lower than required for calculation of stormwater harvest yield from a small catchment. In this case a degree of temporal simplification to daily or monthly data may be acceptable for a regional water supply planning task.

Again, through experience a designer will develop an understanding of the optimum model temporal resolution and to what degree temporal simplification can be tolerated.

6.4. Application to Urban Modelling

Stormwater management is subject to ongoing evolution and change. There has been substantial change to the practice and science of stormwater management since 1987 as discussed in Book 9, Chapter 3. This version of ARR combines 30 years of additional data with evolving science and professional capability to accommodate changes in professional and community aspirations. This process has provided a range of new methods, data and resources that can assist the designer to address the local challenges of managing stormwater runoff in urban areas.

Drainage networks (also discussed in Book 9, Chapter 5) are now considered to be part of more comprehensive stormwater management approaches (refer Book 9, Chapter 3) that respond to multiple water cycle objectives including protecting waterways, mitigating flood risks, provision of water resources, managing the quality of stormwater runoff and enhancing the amenity of urban areas. These approaches respond to a need to manage urban water balances (discussed in Book 9, Chapter 2) and to also incorporate a range of storage measures (refer Book 9, Chapter 4) that aim to manage flooding, stormwater quality and provide additional water resources.

This section provides a framework for application of modelling approaches to urban stormwater catchments. The framework provides guidance for key segments of catchments from the behaviour of land uses within sub-catchments that flow to inlet structures, through urban stormwater networks, and into the receiving waterway.

A range of approaches are now available to determine the configuration of measures in a linked stormwater management system than may include a conveyance network, volume management strategies and non-structural measures. These methods can range from simple procedures to detailed computer modelling. The application of new rainfall data and methods to modelling approaches is discussed with reference to the different approaches to the design of stormwater management measures and systems.

6.4.1. Urban Modelling Frameworks

An increasing range of modelling frameworks and approaches are available to urban designers (refer Figure 9.6.1). The urban stormwater design process, as outlined in Book 9, Chapter 5, Section 3 (refer Figure 9.5.3), should be modified to respond to the characteristics of a particular project. Selection of a modelling framework will depend on the purpose of the analysis, scale and complexity of the project, availability of data and the consequences of failure, and includes:

- Hydrological models that translate rainfall into stormwater runoff and evaluate behaviour of storages;
- hydraulic models that evaluate or design the transfer of stormwater flows through networks of infrastructure and across land surfaces;
- hydrology models that include simple pipe hydraulics or one-dimensional hydraulic models;
- linked hydrology and hydraulic models that include detailed two-dimensional surface flows with hydrodynamic conveyance networks;
- rainfall-on-grid models;
- continuous simulation of rainfall runoff and physical processes to evaluate behaviour of integrated solutions and account for antecedent conditions, water quality and associated performance issues; and
- approximate empirical relationships or peak runoff assumptions used to design and evaluate components of urban catchments.

We should be mindful that all models are an approximation of reality that can be used to enhance our understanding about the likely stormwater behaviours for particular urban scenarios. The different hydrological and hydraulic models can be classified by their outputs of peak flowrates, hydrographs, flood depths or continuous sequences of stormwater runoff. These models can also be distinguished by the methods used to route rainfall runoff towards inlet structures in urban conveyance networks or stormwater volume management measures. Models can also be described by different spatial detail such as lumped, semi-distributed or distributed inputs (Figure 4.2.5, Book 4, Chapter 2, Section 6). Lumped catchment models approximate the behaviour of the catchment using single average inputs and assumptions. Semi-distributed models employ a range of sub-catchments with different attributes and assumptions. In contrast, spatially explicit details are included in distributed models – this detail may include the range of different land uses and properties in an urban model or a grid of equal size and shape used throughout the model. An emerging type of distributed hydrology and hydraulic model is the direct rainfall or rainfall-on-grid methods (refer Book 6, Chapter 4, Section 7).

Empirical relationships can be utilised to determine peak flows from small catchments and are applied to the design of roof gutters, downpipes, and infrastructure to manage stormwater runoff from properties in accordance with standards such as AS/NZS 3500.3. These approximate methods include nominal “deemed to comply” infrastructure specifications or generally require information about catchment area and slope, and utilise assumed runoff coefficients, time of concentration and design rainfall intensity in a lumped catchment design process.

The probabilistic or the urban Rational Method is a more detailed approximate method that is utilised to generate peak flowrates for use in the design of pipe networks within small properties and for small sub-catchments. This framework of analysis differs from simple empirical relationships by including equivalent or effective impervious areas, accumulation of flow rates and the areas of different land uses. The method uses rainfall intensity derived from Intensity Frequency Duration (IFD) data, assumed runoff coefficients and time of concentration to derive stormwater peak flows.

The design approach associated with urban Rational Method is often based on lumped sub-catchment inputs to inlet structures which require the resolution of partial area effects on the timing of cumulative peak discharges throughout a conveyance network. A lumped sub-catchment process combines all land uses, including the area of pervious and impervious surfaces (full area), with an estimated time of concentration to derive peak flows at the outlet of a sub-catchment which is the inlet to a conveyance network. A partial area effect is, for example, where the runoff from impervious surfaces (partial area) arrives at the outlet before runoff from pervious surfaces reach the outlet at less than the full area travel time. These methods may be used to analyse the capacity of individual pipes or peak flows from small catchments but cannot simulate actual flow behaviour throughout conveyance networks and urban stormwater management systems (Pilgrim, 1987).

The simple nature of the urban Rational Method cannot account for the complexity of contemporary urban catchments and modern stormwater management approaches, the temporal and spatial variability of storm events, and variations in antecedent or between storm event processes. Approximate methods, such as Rational Method, should only be applied within a catchment where more detailed analysis of rainfall runoff observations have defined the parameters (for example, runoff coefficient and time of concentration) for use in the method (Phillips et al., 2014; Coombes et al., 2015a). However, Goyen (2000) established that derivation of runoff parameters at the regional scale or bottom of a catchment may not necessarily describe local processes in sub-catchments. Local information is also needed to determine urban runoff parameters.

Runoff or hydrograph routing methods are commonly associated with computer models that include internal processes that incorporate different land uses with separate pervious and impervious surfaces. The process includes depression storages and losses with lag times to generate separate hydrographs of runoff for each land surface. These runoff routing methods typically employ event based rainfall inputs (Book 4, Chapter 3, Section 2) of selected Annual Exceedance Probability (AEP) and duration of peak burst rainfall (refer to Book 9, Chapter 6, Section 4). An objective of this process is to achieve probability neutrality between rainfall inputs and generated runoff for urban catchments.

These runoff routing methods may utilise single or multiple design storms and associated temporal patterns to determine regimes of excess rainfall that is then routed through hydraulic models that range from simple pipe hydraulics to full two-dimensional hydrodynamic processes. A key limitation of event based modelling approaches is the need for assumptions about joint probability of antecedent conditions (such as soil moisture and available storage in volume management solutions) and the characteristics of storm events (Kuczera et al., 2006). In addition, event based methods have traditionally only simulated runoff from burst rainfall and have not considered that runoff is also generated by pre-burst and post-burst rainfall (refer to Book 9, Chapter 6, Section 4). The magnitude of rainfall runoff in urban catchment may be under-estimated by event based processes unless pre-burst rainfall is also counted in rainfall event based models.

The limitations of rainfall event based models, and dramatic increases in the capacity and utilisation of computers has fostered the use of continuous simulation (Book 4, Chapter 3, Section 3 and Book 9, Chapter 3) models that can account for continuous physical, conceptual and statistical processes in urban catchments. These methods have traditionally utilised real or synthetically generated rainfall sequences to understand the yield from water supply catchments and the behaviour of water and wastewater distribution networks. These methods are also used to estimate the behaviour of stormwater quality solutions in urban catchments (Fletcher et al., 2001). However, continuous simulation can also be employed to account for the interactions between climate processes, human interventions or behaviours and stormwater runoff from urban catchments (Coombes and Barry, 2015). Pluviograph rainfall records with intervals of less than an hour (often 6 minute intervals) are used in continuous simulation of rainfall runoff from urban catchments.

The continuous simulation method involves simulation of a rainfall runoff model over a time period of sufficient length to account for all of the important interactions between rainfall and catchment processes to produce an urban flood frequency analysis. Sufficient lengths of observed rainfall are usually not available to provide adequate information about rare runoff events and synthetic rainfall sequences are often required for continuous simulation models (Book 4, Chapter 3, Section 3; Book 2, Chapter 7,). Use of continuous simulation with synthetic rainfall inputs may require calibration of the rainfall model and the continuous runoff routing model (Book 4, Chapter 3, Section 3). However, all models require calibration and verification.

An alternative use of continuous simulation is to derive the probability distribution of initial conditions prior to storm events such soil moisture storage, and available storage in rainwater tanks and bioretention facilities (Coombes and Barry, 2008a; Hardy et al., 2004). These probability distributions of initial conditions are then utilised in event based runoff routing models to determine runoff from urban catchments. Note that these types of probabilistic inputs are associated with complete storm events and will need to be applied in event based models using complete storm events or combinations of pre-burst and burst rainfall.

Direct rainfall or rainfall-on-grid models combine hydrological and hydraulic processes to generate rainfall runoff and hydraulic routing in a single model. Rainfall is applied to each grid in a two-dimensional hydraulic model to generate overland flows and discharges in conduits (Book 6, Chapter 4, Section 7). This method can provide more realistic representation of catchment storages and surface runoff processes including cross catchment flows. A fine grid of good quality topographic, losses and roughness data is required, and topography information will need to be edited to include key infrastructure such as street gutters, hydraulic structure, conveyance networks and road crowns (Hall, 2015). Rainfall-on-grid models should be calibrated to local historical spatial flood levels or flow data. Use of regional rainfall runoff parameters is not suitable for direct rainfall methods that are driven by local processes.

There may also be a need to vary roughness parameters (such as Manning's n) with flow depth (for example, Zahidi et al. (2017); Khrapov et al. (2015); Muglera et al. (2011)) and carefully assign loss parameters in each grid (Babister and Barton, 2012). The results at local and sub-catchment scales may be unexpected as all flow paths are identified. The method is subject to a range of potential challenges including mathematical instabilities, unrealistic flows and large errors created by losses, variable roughness, long runtimes and shallow flow depths. These powerful direct rain methods are subject to ongoing research and model results should be interpreted with caution. It is imperative that designers check that catchment response with an alternative model and volume of runoff is consistent with loss model used (refer to Book 9, Chapter 6, Section 4). If a rainfall excess model is used this represents the volume of runoff that appears at the catchment outlet not rainfall applied to the model so depression storage needs to factored into losses.

6.4.2. Choice of Rainfall

Most hydrology and hydraulic models require rainfall inputs to estimate stormwater runoff and associated flood responses. The investigations underpinning the this guideline incorporated 30 years of additional data and science (Book 2, Chapter 1) to develop improved design rainfall frameworks. There was also a need to incorporate climate change processes into design rainfall frameworks (Book 2, Chapter 2, Section 4). Design rainfalls are simpler and different to real or observed rainfall. More advanced design rainfalls that assume storm bursts and spatial uniform temporal patterns cannot capture that actual variability of observed rainfall. This insight motivated a change in practice from simple average rainfall intensity or single rainfall burst approaches to ensemble and Monte Carlo methods to better capture the natural variability of rainfall.

The design of stormwater infrastructure and understanding of runoff for urban areas involves decisions at multiple scales. This insight can be combined with ensembles of design rainfall patterns to determine the appropriate rainfall inputs as shown (for example) by the Box and Whisker plot of peak runoff (discharge) to the catchment outlet in Figure 9.6.3.

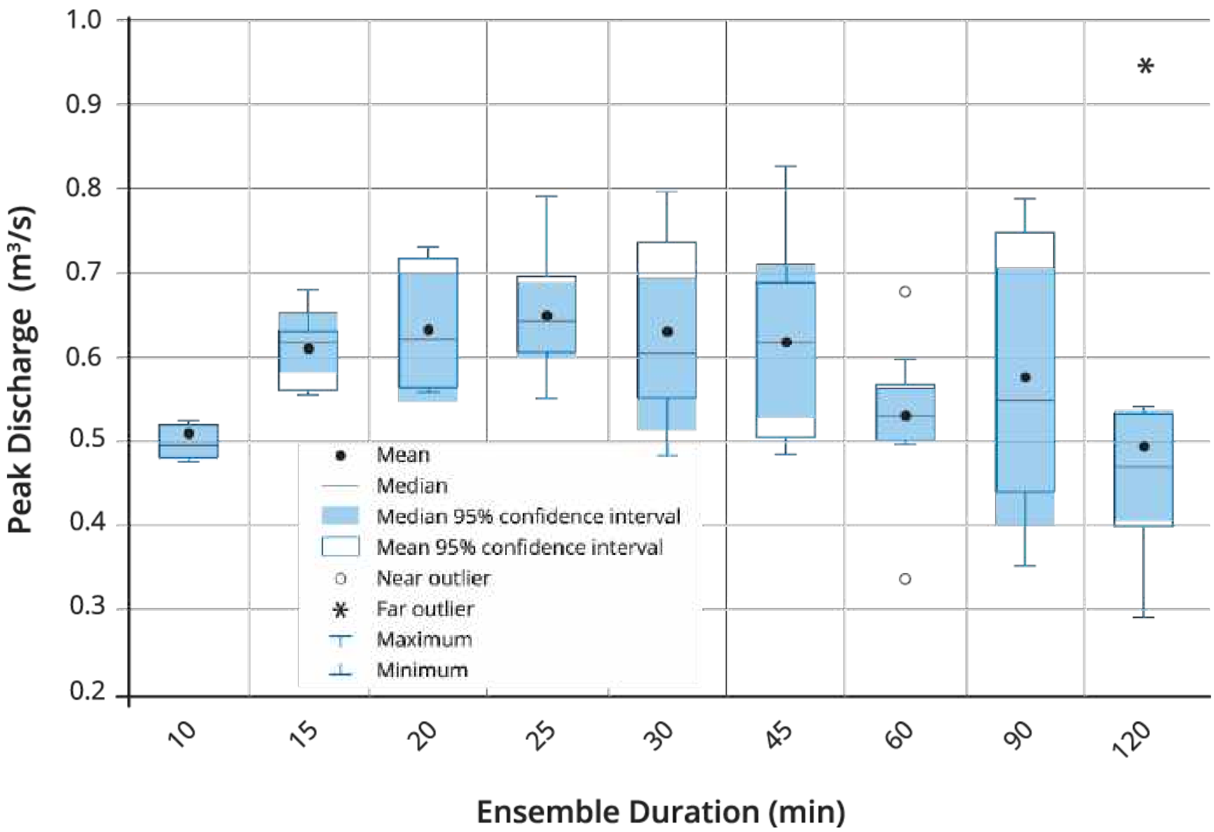

Figure 9.6.3. Example of a Box and Whisker Plot of Peak Stormwater Runoff Utilised to Select the Critical Storm Burst Ensemble and Other Design Information

Figure 9.6.3 indicates highest average and median peak discharge is generated by the ensemble of 10 storm bursts of 25 minute duration at the catchment outlet. A small number of higher values of peak runoff also occur in the 45 minute (maximum value) and 120 minute (far outlier value) durations which could be used to test the potential maximum hazard of surface flows. Conveyance infrastructure within the catchment should be designed using ensembles of storms with durations up to and including 25 minutes to account for impacts of smaller duration storms upstream of the outlet. Different design ensembles may apply in situations that incorporate within catchment storage solutions and at different locations in the urban catchment.

This improved approach to design rainfall inputs to models is particularly important for urban catchments that are significantly different to rural catchments because they generate runoff from majority of rainfall as shown in Figure 9.6.4.

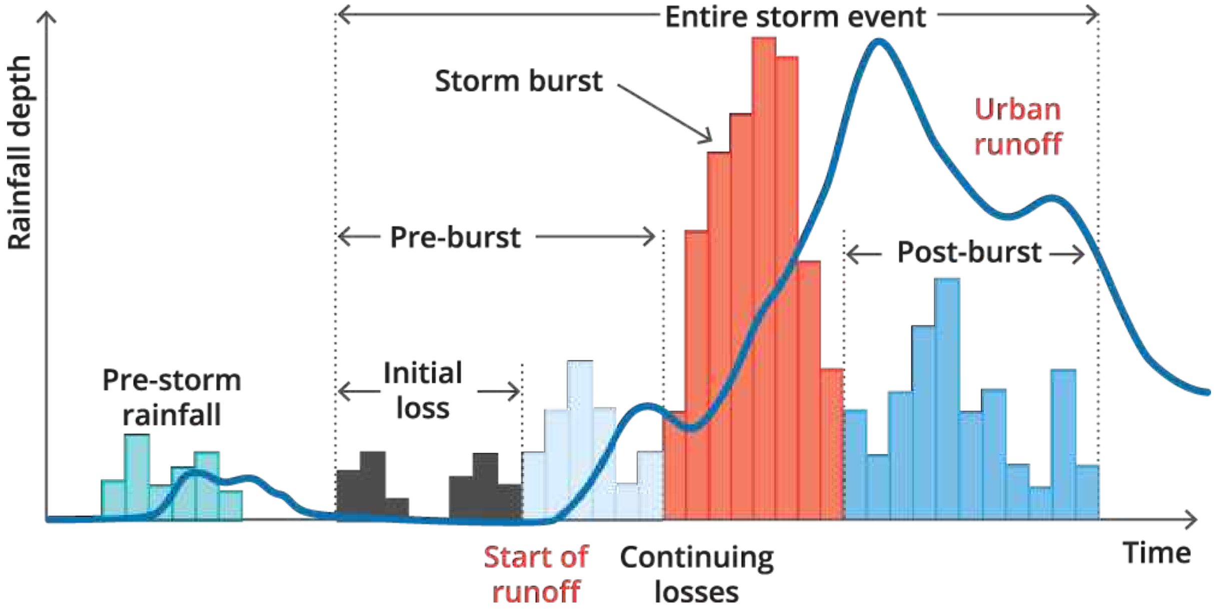

Figure 9.6.4. Rainfall Runoff Processes in Urban Catchments

Figure 9.6.4 demonstrates that urban runoff can be generated by pre-burst, burst and post-burst proportions of complete storms (entire storm event). There are many different configurations of pre-burst, burst and post-burst rainfall in real rainfall events that should be considered in analysis of urban hydrology. Urban designs based on a single burst pattern of rainfall or peak rainfall assumptions can overlook substantial runoff rates and volumes which may adversely impact on the performance of inlet structures in conveyance networks, volume management measures, roads and overland flow paths (Coombes et al., 2015b).

A range of updated rainfall products are available from the ARR Data Hub (Babister et al, 2016), including new spatially distributed IFD, Areal Reduction factors (ARF), design temporal patterns for burst rainfall, hydrological losses, and pre-burst rainfall – as summarised in Table 9.6.5.

Table 9.6.5. Summary of Updated Design Rainfall Processes

Input	ARR 1987	Pre Update	ARR 2016
IFD	Paper maps	BoM web page	Updated BoM web page. Book 2, Chapter 3.
ARF	Figure 2.7 from US data	FORGE work (except NSW)	New equations derived using Australian data. Book 2, Chapter 4.
Temporal patterns	Single temporal pattern of design burst rainfall based on Average Variability Method (AVM)	AVM, filtered for embedded burst	Ensemble of real storms. Book 2, Chapter 5.
Spatial pattern	Centroid	Spatially distributed IFD	Spatially distributed IFD

Input	ARR 1987	Pre Update	ARR 2016
Climate change			Factors available from Book 1, Chapter 6 and the ARR Data Hub.
Losses	State based advice, sometimes based on data	Calibrated in the hydrologic Model.	Calibrated losses. Uncalibrated models use losses available from Book 5, Chapter 5 and the ARR Data Hub.
Pre-burst	Allegedly incorporated into advice	Mixed	Estimates provided on ARR Data Hub. Use 60 minute pre-burst rainfall with burst rainfall ensembles of durations less than 60 minutes

The different rainfall inputs to hydrology and hydraulic models are discussed in Book 2. The updated IFD design rainfall data is available from the BoM website. Derivation of the IFD data using the additional rainfall records is outlined in Book 2, Chapter 3, Section 4 and the application of the updated IFD design rainfalls is presented in Book 2, Chapter 3, Section 9.

ARF are available from the ARR Data Hub and is discussed in Book 2, Chapter 4. Design rainfalls (IFD) only apply at a point in a catchment. When estimates of rainfall runoff are required for catchments with areas greater than 10 km^2, the design rainfall intensities at a point are not representative of the areal average rainfall intensity for the entire catchment. The ARF is the ratio between the design values of areal average rainfall and point rainfall, for same duration and Annual Exceedance Probability (AEP). Application of ARF is outlined in Book 2, Chapter 4, Section 3.

Most runoff-routing methods utilise design temporal patterns to determine the timing of rainfall falling on catchment and generate hydrographs of runoff. The traditional use of a single average temporal pattern has been found to be inadequate for hydrological analysis due to the variability of natural rainfall patterns (Book 2, Chapter 5) and of the characteristics of urban catchments (Book 9, Chapter 3). The application of design temporal patterns as outlined in Book 2, Chapter 5, Section 9. Ensembles of design temporal patterns that are more likely to capture these natural and human variabilities are available from the ARR Data Hub. It is noted that two different ensemble patterns are provided, point rainfall patterns for catchments with areas up to 75 km^2 and areal rainfall patterns for catchments with areas greater than 75 km^2.

Climate change has the potential to alter the frequency and severity of rainfall events, storm surge and floods by altering rainfall IFD relationships, rainfall temporal patterns, continuous rainfall sequences, antecedent conditions and baseflow regimes (Book 1, Chapter 6; Book 2, Chapter 2, Section 4). Interim climate change factors are presented as changes in average temperature and associated percentage increases in rainfall intensity for selected global climate models (GCM) in the ARR Data Hub. These values should be applied in the context of the risk decision tree processes provided in Book 1, Chapter 6, Section 3. These interim values are subject to continuing research and evolving science.

The ARR Data Hub provides regional rural losses for complete storms and pre-burst rainfall. In urban areas, the median values of local losses should be utilised wherever possible. The average initial losses from urban impervious surfaces is less than 1 mm (Book 4, Chapter 2, Section 7) and ranges from 1 mm to 4 mm for urban effective impervious areas (Book 5, Chapter 3, Section 4). In most cases, storm burst loss is equal to median storm loss less pre-burst rainfall.

Rural and regional loss assumptions should not be a default assumption for urban areas and a hierarchy for selecting urban losses is highlighted as follows:

- Use local losses based on GIS investigations, local knowledge and observations. Losses derived at a regional scale are not local losses- use local losses in small scale models. Note that a well-constructed model with adequate spatial scale should account for effective impervious area and connectivity effects

- Regional losses (Book 5, Chapter 3, Section 4 and Book 5, Chapter 3, Section 5): Impervious area losses: IL: <1 mm, CL: 0 mm/hr; Effective Impervious Area: IL: 1-2 mm, CL: 0 mm/hr; Pervious area ≈ rural losses

- Rural losses: Urban losses are some proportion of rural losses

Continuous simulation of rainfall runoff processes is aided by the increased availability of continuous (also known as pluviograph or instantaneous) rainfall from the Australian Bureau of Meteorology (BOM). However, as discussed in Book 9, Chapter 6, Section 4, longer synthetic continuous rainfall records are usually required to understand the impacts of rarer runoff events. Development and availability of synthetic continuous rainfall sequences are discussed in Book 2, Chapter 7. Additional discussion of synthetic continuous rainfall records that incorporate regional layers (surfaces) of spatial observed climate observations is also provided by Coombes and Barry (2015) and Coombes and Barry (2018). This guideline also provides software to generate multi-site continuous synthetic rainfall (Multi-site Rainfall Simulator) at http://arr.ga.gov.au/.

Radar rainfall (refer Cecinati et al. (2017)) can be used to interpolate between point rainfall observations for use in hydrology and 2D hydraulic models. There have been many studies that have developed methods to correct errors in radar rainfall but some residual errors are intrinsic to radar rainfall that should be resolved by spatial and temporal comparison to point rainfall observations.

6.4.3. Runoff From Properties

Stormwater runoff from roofs and properties, at the lot scale, is the basic building block of urban stormwater catchment behaviour ((Goyen and O'Loughlin, 1999a; Stephens and Kuczera, 1999) and Book 9, Chapter 3). Runoff from properties involves a complex interaction of roofs, yards, paved areas, gardens, and adjoining roads and footpaths as shown for a residential property in Figure 9.6.5.

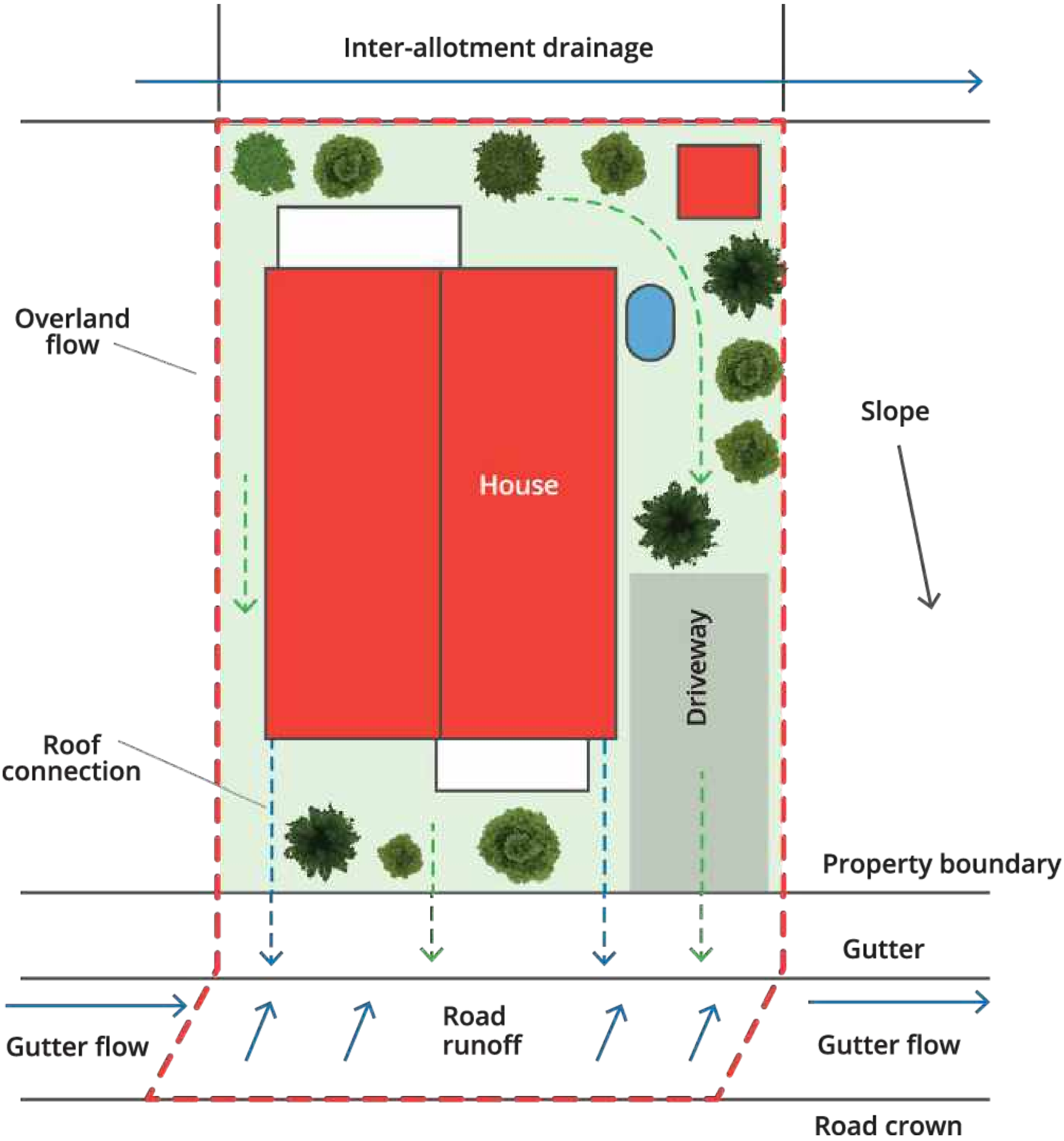

Figure 9.6.5. Stormwater Runoff from Roofs and Properties – Lot Scale Effects

Figure 9.6.5 demonstrates the pathways of stormwater runoff from different surfaces within a property. These runoff processes are dominated by directly connected impervious surfaces, indirectly connected surfaces and pervious surfaces. Rain falling on impervious roof surfaces flow into roof gutter storages which discharge via downpipes into pipes connected to the street gutter or pipe network. Runoff from impervious driveway surfaces and adjacent road surfaces discharge to street gutters. These impervious surfaces facilitate highly efficient translation of rainfall into runoff, are subject to small depression storage losses, and are mostly directly connected to street gutters. Rain falling on pervious yard areas is partially retained in depression storages and infiltrates into soil profiles prior to generation of runoff from residual rainfall. These types of pervious surfaces are relatively inefficient at generating runoff and are often indirectly connected to street gutters or pipe networks. Urban properties can also include impervious areas that discharge stormwater to pervious surfaces or storages (for example, rainwater tanks, onsite detention and raingardens) that partially disconnect these surfaces from street gutters.

Runoff from impervious surfaces may also arrive at street gutters more rapidly than runoff from pervious surfaces. In many situations, pervious surfaces may not generate runoff for frequent rainfall events. These runoff behaviours are influenced by the configuration of property assets (including building form), topography and stormwater management measures. In situations where allotments slope away from roads, runoff from roofs and impervious surfaces may be directed to an inter-allotment conveyance (easement drainage) network. Local authorities will often specify locations of stormwater discharges from properties – this is known as a legal discharge point. Subsoil drains are sometimes used on properties to lower water tables around buildings or in waterlogged areas and discharge stormwater from properties.

Property scale influences are fundamental to urban stormwater runoff. However, there has been limited testing at this scale (Stephens and Kuczera, 1999), and designs of roof and property drainage are not clearly defined (Jones et al., 1999). A major challenge for simulation of urban stormwater runoff is the behaviour of individual properties and accumulation of these property behaviours throughout urban catchments (Goyen (2000), Coombes (2015); Book 9, Chapter 3). The cumulative impacts of properties on the behaviour of catchments are defined by the timing, volume and rate of stormwater runoff from each property. The runoff behaviour of properties can also be altered by a range of onsite stormwater management approaches including disconnection of roof downpipes from street gutters, raingardens, landscaping, rainwater tanks, infiltration measures, onsite detention and green spaces (refer Book 9, Chapter 3 and Book 9, Chapter 4). Local authorities can apply restrictions on the flow rate, quantity and quality of stormwater that discharges from a property to encourage onsite management of stormwater to avoid or reduce downstream impacts (Chocat et al., 2001; Patouillard and Forest, 2011; Walsh et al., 2012; Everard and McInnes, 2013).

Calibration or verification of urban stormwater modelling frameworks at the catchment scale does not imply that the sub-catchment or local behaviours in models are also correctly described (Goyen and O'Loughlin, 1999a; Stephens and Kuczera, 1999; Kuczera et al., 2006; Coombes, 2015). Attention to local detail in stormwater design is required to ensure that potentially overlooked local processes do not generate local failures or excessive infrastructure or unexpected downstream consequences. The problems generated by approximated local behaviours can become worse in areas subject to increasing urban density and infill development. Kemp and Myers (2015), for example, found that increases in urban density of 18% generated 16% increase in runoff volumes and a 300% increase in expected flood damages for 20% AEP storm events.

Simple methods for design of roof gutters, downpipes and property drainage are provided in Australian Standards (for example, AS/NZS 3500.3), by suppliers of roofing materials, government authorities and the Plumbing Code of Australia. These approaches include nominal and general methods. Nominal methods apply to single dwellings on properties with land areas up to 1,000 m^2 by providing “deemed to comply” specifications of infrastructure (configuration, minimum pipe sizes, depth of cover over pipes and slopes).

Design calculations are provided for more complex land uses and larger properties. These guidelines highlight the need to avoid ponding against buildings, flows into buildings and management of overland flows from adjoining properties. Large residential, commercial and industrial properties and car parks include more complex and dendritic stormwater management systems (for example Figure 9.6.6).

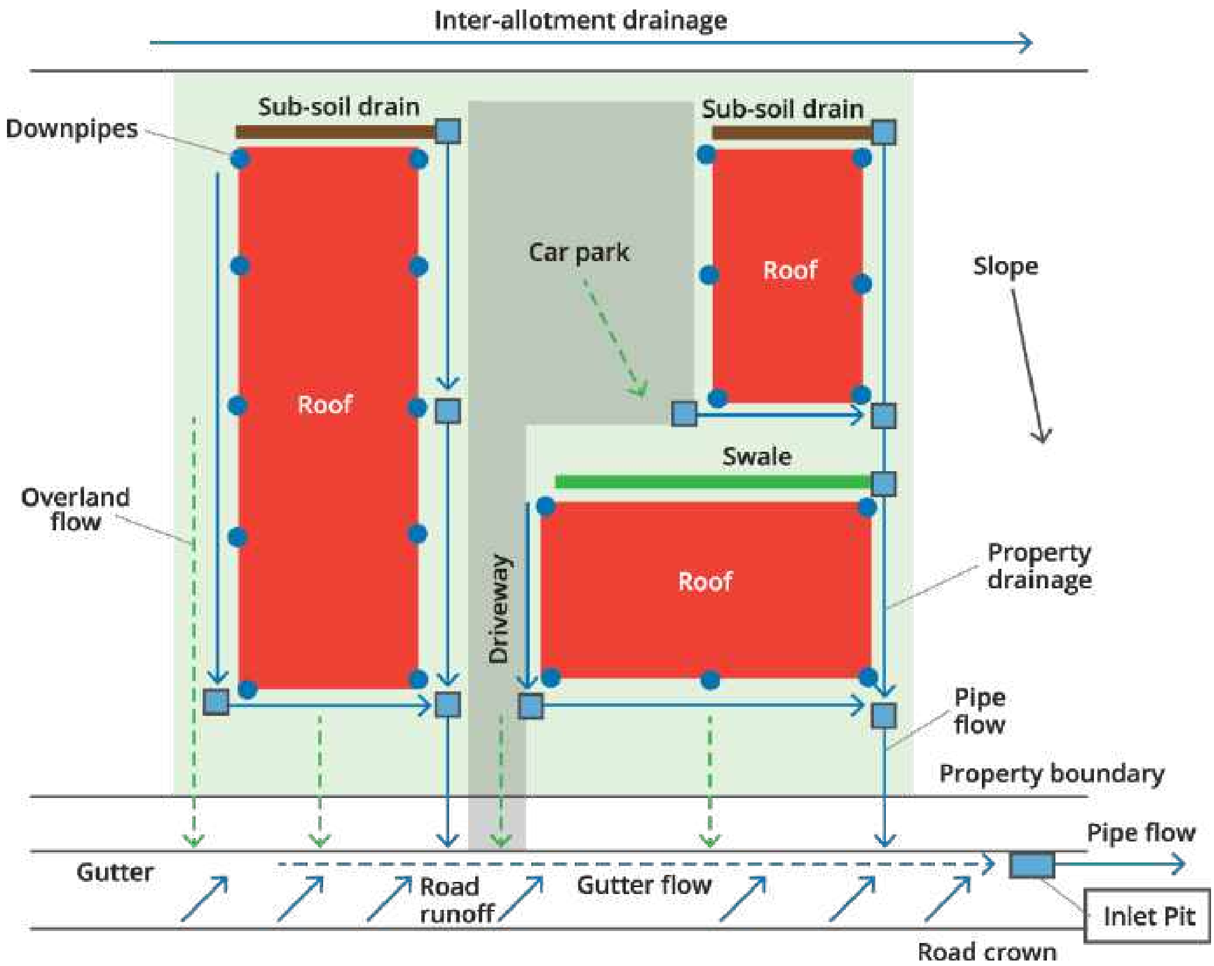

Figure 9.6.6. Stormwater Management System for Larger Properties with Complex Land Uses

Figure 9.6.6 shows that stormwater management schemes within properties may combine multiple pathways of stormwater runoff from different surfaces that have variable levels of connection to the street gutter or inlet pit in the street conveyance network. The performance of these networks may be affected by in-pipe attenuation effects, volume management measures, and substantial variations in the timing and magnitude of runoff to sub-catchment outlets. These outflows from properties are surface flows, or direct inflows to pipe networks in streets or inter-allotment conveyance networks.

Approximate or general design methods are based in rules derived from simple Rational Method assumptions and utilise catchment areas (roofs, paved surfaces and gardens), proportions of imperviousness, slopes, assumed times of concentration with associated average rainfall intensities and runoff coefficients to generate maximum or peak flow rates. A five minute time of concentration and associated rainfall intensity was commonly assumed in design processes for roof and property drainage. Performance standards for roofs have been defined by choice of rainfall intensity of a 5% AEP for roof gutters and of a 1% AEP for box gutters. Design of conveyance networks within properties aim to avoid surcharges and overland flows for 1 EY in low density areas and up to 5% AEP for important land uses (such as hospitals and aged care facilities) that may be vulnerable to greater risk or inconvenience. The volume, pattern and timing of stormwater runoff are not considered in these approaches which may lead to under-performance of stormwater management measures included unexpected surface flows on properties.

Field measurements suggest that travel time to street gutters from residential properties is two minutes or less (Stephens and Kuczera, 1999; Coombes, 2002). The assumption of five minute time of concentration in ARR 1987 (Pilgrim, 1987) was based on the lowest available time interval of IFD rainfall at the time. Revised IFDs available from the BoM provide values for rainfall intensity that commence at a one minute duration which permits use of finer detail in design and to account for shorter flow times to outlets. Observations by Stephens and Kuczera (1999), Goyen (2000) and Coombes (2002) indicate that initial losses from roof gutter systems range from 0 mm to 1 mm and continuing losses range from 0% for metal roofs to 20% for dry tile roofs. Average depression storage losses of impervious surfaces can range from 1 mm to 10 mm and average losses from pervious surfaces range from 2 mm to 20 mm.

Goyen and O'Loughlin (1999b) highlighted that spatial and temporal patterns of rainfall losses and their magnitude have significant impacts on peak stormwater runoff. Larger scale and more general estimates of losses are provided in Book 3, Chapter 3. Wherever possible, local information on losses should be incorporated in analysis of stormwater runoff and associated designs of infrastructure.

More detailed hydrograph routing methods may be required for larger properties with complex land uses to design infrastructure for given performance standards, and to understand the behaviour of the stormwater management system. The need to manage inflows of groundwater and surface runoff to basements on some properties will also require volume based analysis to understand the extent of flooding and to design pump out infrastructure. Argue (2004) provides a range of simple methods for including volumes in the small scale design processes that are known as “regime in balance” and accounting for “emptying times” of storages.

Stormwater management strategies for larger or more complex properties should be designed or analysed using event based hydrograph routing methods that utilise storm burst patterns and pre-burst rainfall as inputs. The pre-burst rainfall, rainfall intensities and patterns of storm bursts for a given location can be downloaded from the ARR Data Hub http://data.arr-software.org/ and included in models of stormwater runoff. These rainfall inputs are provided in most proprietary software packages.

This modelling process includes details of different surfaces within sub-catchments that influence stormwater runoff to inlet structures within the property stormwater management network. The analysis should include the characteristics of pervious and impervious surfaces – such as initial and continuing losses, sub-catchment areas, slopes and details of overland flow paths. This approach is similar to the design and analysis process for public stormwater conveyance (street drainage) networks.

Use of ensembles of storm burst rainfall will ensure that the stormwater management system for a property is tested by a range of equally likely storm patterns and volumes of rainfall. This will permit a more complete understanding of potential surface flow paths within the property and in the adjacent street gutter, and the impacts on downstream infrastructure. However, use of complete storms or inclusion of pre-burst rainfall with the burst rainfall patterns will assist with defining the likely magnitude of overland flow behaviours at the property. Initial losses in the analysis may need to be set to zero if the magnitude of pre-burst rainfall is greater than the capacity of depression storages on the property. At some locations, the residual pre-burst rainfall may also contribute to additional runoff and overland flows within the property. These approaches can be combined in a range of computer modelling packages.

The ability of peak flow or event based models to describe runoff behaviours are limited in situations where the joint probability of antecedent conditions and storm events is not well defined (refer to Book 4, Chapter 3, Section 3) and there are continuous responses to complete storm events. These limitations apply to stormwater strategies that include volume storage measures, rainwater or stormwater harvesting, and water quality solutions.

In these situations, continuous simulation using real local rainfall or synthetic rainfall sequences can be utilised to test the continuous interactions between key components of the stormwater management. The results from continuous simulation can be directly interrogated to understand key performance criteria such as annual average reduction in water demand, stormwater runoff and nitrogen loads created by rainwater harvesting and raingardens. Alternatively, continuous simulation can provide distributions of available storage in volume management measures (such as rainwater tanks, infiltration measures and bioretention devices) or soil profiles prior to storm events versus frequency of storm events that can be used in event based analysis (Coombes and Barry, 2008b; Hardy et al., 2004) as shown, for example, in Figure 9.6.7.

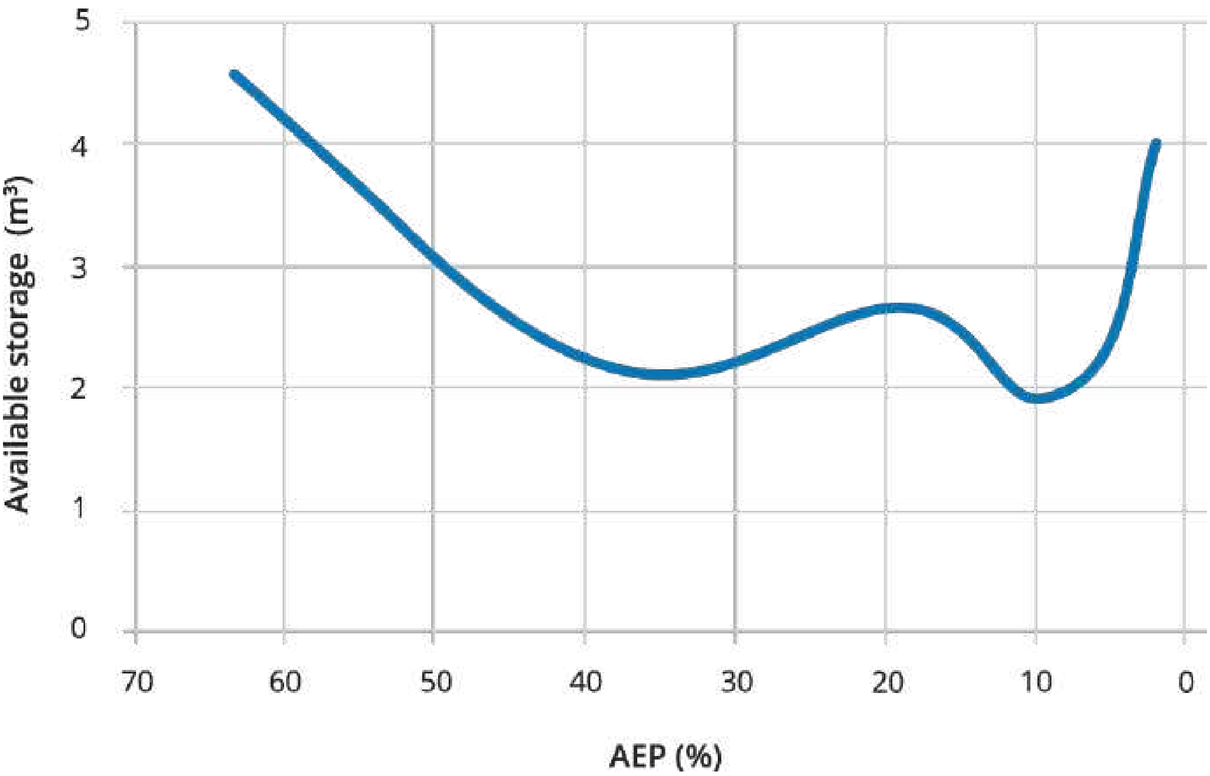

Figure 9.6.7. Example Distribution of Available Storage Prior to Storm Events versus Annual Exceedance Probability (AEP) of Storm Events

Figure 9.6.7 (for example,) demonstrates the average retention storage available in rainwater tank (capacity of 5 m^3 collecting runoff from a 100 m^2 roof area and supplying household indoor and outdoor uses) prior to storm events of a given AEP that was derived using continuous simulation. This type of information can be used in event based models to determine stormwater peak flows and runoff volumes. These results will vary significantly with different land uses, building form and throughout Australia.

6.4.4. Sub-Catchment Runoff to Inlet Structures

Sub-catchments define an urban area that discharges stormwater runoff to an inlet structure within a stormwater management network. There is further discussion of conveyance networks in Book 9, Chapter 5, Section 1 to Book 9, Chapter 5, Section 3 and of inlet structures in Book 9, Chapter 5, Section 5. The configuration and characteristics of the urban area within a sub-catchment will define the hydrological response that produces stormwater inflows to a stormwater network. These surface flows define the performance of an inlet structure as inflows to a conveyance network and as surface bypass flows. An example of a simple urban sub-catchment is provided in Figure 9.6.8.

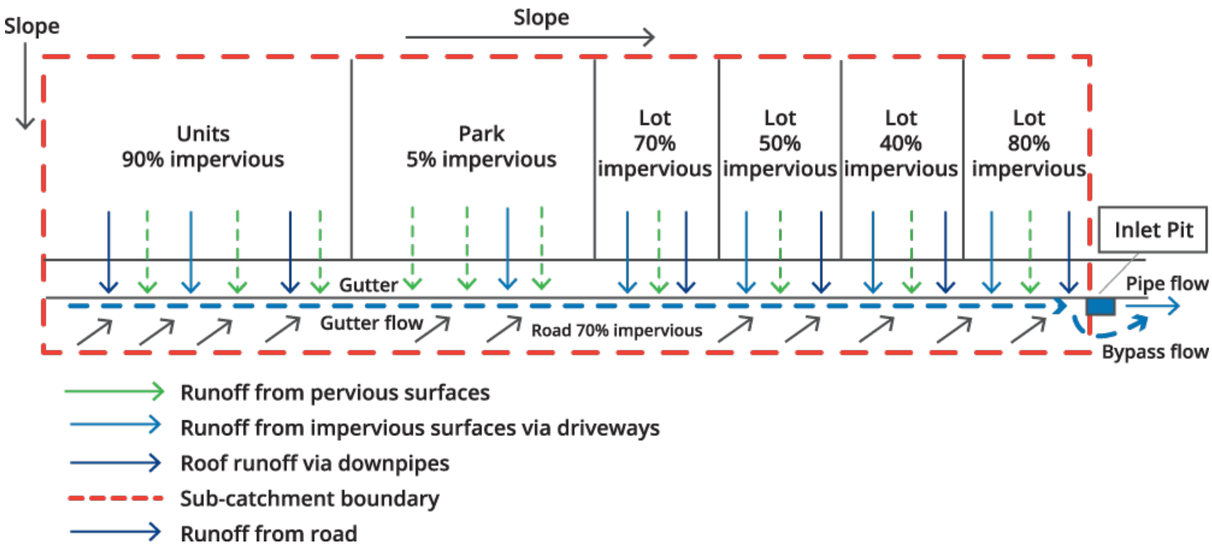

Figure 9.6.8. Example of a Simple Urban Stormwater Sub-Catchment

Figure 9.6.8 highlights that an urban sub-catchment may contain a range of different land uses, including (for example) unit and detached residential dwellings on properties, a park and part of a road. These land uses incorporate different surfaces, including roofs, paved areas (impervious), garden and grassed areas (pervious) that produce different regimes of stormwater runoff.

The behaviour of the sub-catchment surfaces can be estimated using lumped catchment approximations which are based on sub-catchment area, the total impervious area (TIA) and a travel time (or time of concentration) for a critical rainfall duration to the inlet structure (refer Book 5, Chapter 2, Section 2 and Book 9, Chapter 5, Section 5). For example, a sub-catchment area of 4,250 m^2 with an impervious proportion of 56% and time of concentration which depends on rainfall intensity, slope and distance to inlet structure. In the absence of other data, these types of approximations could be used in simple calculations or in computer models. However, it is preferable to construct analysis of urban sub-catchments using local details which can be sourced from site inspection, survey plans and inquiry using GIS.

Impervious or pervious surfaces can be directly connected or disconnected to inlet structures in conveyance networks. These surfaces may be also distant from the inlet structure or near the inlet. Thus the level of connectedness and distance of impervious areas from inlet structures should also be considered in analysis of stormwater runoff in urban areas. In addition, the analysis should account for surfaces that discharge to inlets via rapid conveyance mechanisms, such as street gutters, and for other surfaces that may discharge to inlets via slower conveyance processes such as across pervious surfaces (green spaces) or via storages.

An urban sub-catchment often includes depression storages, and a mosaic of different surfaces, runoff rates, storages and cumulative connectivity. The order of actions in the connectivity of different types of surfaces with storages to the inlet can dramatically change travel times and peak flows. Roofs may discharge via pipes to street gutters that facilitate rapid transfer of runoff volume to inlets. Runoff from road surfaces to the gutter may arrive at a similar or earlier time (refer Figure 9.6.8).

It is unlikely that lumped catchment approximations will provide reliable estimates of stormwater runoff from urban sub-catchments that include a range of different land uses and catchment storages with variable connectivity to inlets. Use of lumped catchment with TIA approximations may generate over-estimations of stormwater peak flows. Distributed methods of analysis may be more appropriate for ungauged catchments, where there are storages within catchments or for analysis using more robust runoff routing in computer models.

Urban sub-catchments include Directly Connected Impervious Areas (DCIA), Indirectly Connected Impervious Areas (ICIA) and pervious areas as described in Book 5, Chapter 3, Section 4. Limited regional investigations suggest that a combination of these effects produced Effective Impervious Areas (EIA) which are 55%-65% of the TIA of urban sub-catchments. Estimates of indirectly connected areas are further impacted by interactions between impervious and pervious areas, by storage in sub-catchments with Water Sensitive Urban Design (WSUD) measures and are influenced by Antecedent soil Moisture Conditions (AMC).

Other impervious surfaces may discharge via driveways to the street gutter which produces a different time for stormwater runoff to reach the inlet structure. Pervious surfaces also discharge to the street gutter, partially via impervious surfaces, to the inlet. Thus the timing of the arrival of runoff volumes to the inlet is dependent on these many different configurations and characteristics within the sub-catchment. So the performance of the inlet structure and the magnitude of surface bypass flows are dramatically affected by these considerations. These complex processes can be better described by semi-distributed (link-node) and distributed (grid) computer models (Book 5, Chapter 2, Section 4; Book 6, Chapter 4, Section 7) that explicitly combine these details with pre-burst rainfall and ensembles on burst rainfall patterns.

Regional analysis of a small number of urban catchments provides estimated initial losses of 1 – 3 mm for EIA and 20 – 30 mm for indirectly connected areas in sub-catchments (Book 5, Chapter 3, Section 5). Estimated median continuing losses were 2.5 mm/hour in South East Australia and 1 – 4 mm/hour elsewhere. These event based regional values should only be used in the absence of local data. It is essential that assumptions about losses in stormwater models are based on assessment of local conditions. The magnitude of losses is also impacted by AMC which is altered by garden watering in urban areas and by available storage in volume management measures throughout the sub-catchment. It is unlikely that event based models can fully account for these effects. Sensitivity checks, Monte Carlo processes and continuous simulation can be utilised to include the variation in AMC and available storage within urban sub-catchments.

Urban drainage was historically designed using peak flows derived using peak rainfall intensity or peak rainfall bursts in accordance with the assumption that peak flowrates only affect conveyance infrastructure. Many urban drainage networks are operating below anticipated service levels due to a range of impacts including increased density of urban areas. Analysis by Coombes et al. (2015a) indicates that the absence of stormwater runoff volumes in design processes based on peak runoff assumptions may partially explain under-performance of some urban drainage networks. The performance of inlet structures and therefore drainage networks can also be affected by the volume of stormwater arriving at the structure, variations in rainfall temporal patterns and by pre-burst rainfall that was not included in the design process. The uncounted volumes of stormwater runoff in peak flow and storm burst assumptions can become additional and unexpected overland or bypass flows in urban systems.

6.4.5. From the Inlet to the Outlet

Rainfall runoff from sub-catchments accumulates as inflows to conveyance networks or as surface flows throughout urban catchments that discharge towards an outlet (Book 9, Chapter 5). A network of conveyance infrastructure may incorporate pipes, open channels, roadways and open space. These networks often include water quality, volume management and flow control infrastructure (refer to Book 9, Chapter 4) that are incorporated in sub-catchment scale processes (such as source and neighbourhood controls: see Figure 9.5.1) or as regional controls at the outlet.

Analysis and design of stormwater management and flooding in urban areas was historically based on separate hydrology and hydraulic processes, and is focused at the network scale. A key objective of these processes was determination of flows in conveyance infrastructure such as pipes and open channels to avoid surcharges and bypass flows at inlets (refer to Book 9, Chapter 5, Section 5) to avoid nuisance, property damage and risk to life (refer to Book 9, Chapter 5, Section 2 and Book 6, Chapter 7). These urban conveyance networks include significant surface flows, usually along roads and through open spaces, from sub-catchments into and throughout conveyance networks. These flows from sub-catchments to inlets and within conveyance networks were determined as a hydrological process as an input to hydraulic models of conveyance networks (see Book 9, Chapter 5, Section 6and Book 5, Chapter 2).

The conveyance network is a framework of sub-catchment inputs. Urban stormwater design typically employed pipe network hydraulic models that utilise peak inflows or hydrographs as inputs (refer to Figure 9.5.18). More advanced one-dimensional models were also available that can be applied to simulation of conveyance networks (refer to Book 6, Chapter 4, Section 6; Book 5, Chapter 6 and Book 9, Chapter 5).

Overland or surface flows are a key consideration in analysis and design of urban stormwater management infrastructure. The dominant urban hydraulic response to rare rainfall events (such as 1% AEP) is often overland flows on roads and across open space. Emerging methods of analysis and design of urban stormwater involve combined hydrology and hydraulic models to better understand surface flows throughout urban catchments. These methods include coupled one and two-dimensional models, and direct rainfall (rainfall-on-grid) models. Book 6, Chapter 4, Section 7, and Babister and Barton (2012) provide detailed discussion about these approaches.

The flowrates, depth and area of surface flows in urban catchments are highly sensitive to different temporal patterns and volumes of rainfall (Babister and Barton, 2012). Similarly, Goyen (1981), Goyen (2000) and Coombes et al. (2015a) found that the performance of conveyance infrastructure also varies with temporal patterns and volumes of rainfall. It is recommended that ensembles of ten temporal patterns of design rainfall are used for investigation of the hydrology and hydraulic processes in urban areas. The separation of hydrologic and hydraulic routing is often blurred in analysis of urban areas which fosters complicated decisions around the use of hydrologic inputs and their interaction with hydraulic models. An overview of the difference approaches to rainfall inputs provided by this guideline is compared to ARR 1987 approach in Figure 9.6.9.

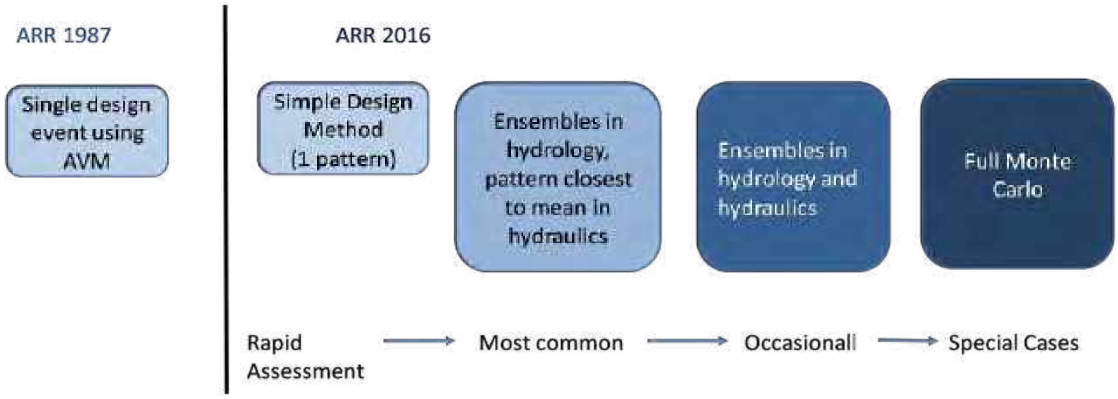

Figure 9.6.9. Changes in Design Modelling Techniques for Urban Areas

Figure 9.6.9 highlights that this guideline provides ensembles of 10 temporal patterns for each region that is a departure from the single event process supported by ARR 1987. These rainfall inputs can be used in hydrology and hydraulic modelling as required for different design and assessment tasks (refer to Book 2, Chapter 4 for further detail). The rapid assessment approach is not recommended for design of urban conveyance networks and the Monte Carlo processes can be used in special cases. It is expected that rainfall ensembles in hydrologic simulations, and in hydrologic and hydraulic simulations would be commonly utilised in urban conveyance networks. The process of using rainfall ensembles in hydrology is outlined in Figure 9.6.10.

Figure 9.6.10 shows that the inputs to analysis of the conveyance network include IFD information from the BOM, ensembles of rainfall temporal patterns, regional losses, pre-burst rainfall and Areal reduction factors from the ARR Data Hub. Wherever possible, local losses derived in accordance with Book 9, Chapter 6, Section 4 and Book 9, Chapter 6, Section 4 should be used in preference to regional losses for urban areas. These inputs are used in a hydrology model to generate ensembles of peak flows throughout the urban catchment for various storm durations and the required quantiles or AEPs of storm events. Mean peak flows are derived for key locations in the catchment and the rainfall temporal pattern that produces peak flows closest to the mean peak flows are utilised in the hydraulic model. This approach may be better suited to models with longer run times as considerable time can be expended determining critical durations in both hydrology and hydraulic models.

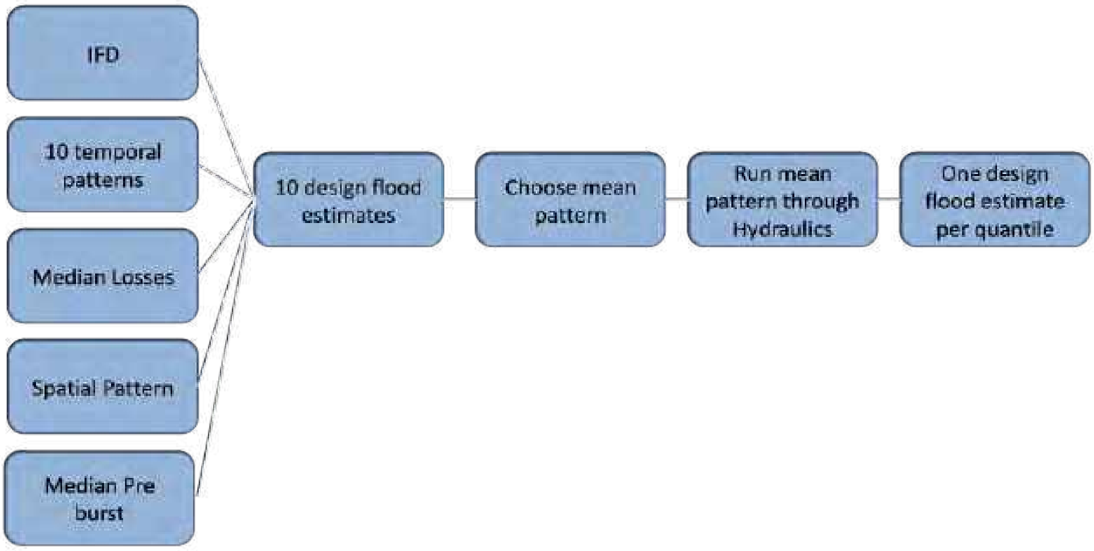

Figure 9.6.10. Design Process that Utilises Rainfall Ensembles in Hydrology to Select the Rainfall Pattern Closest to Mean Peak Flows for use in Hydraulic Analysis

The processes outlined in Figure 9.6.10 produce a single estimate of flood depth for each selected quantile or AEP. It is important to highlight that the critical rainfall duration and temporal pattern estimated using the hydrology model is likely to be different to the critical rainfall and temporal pattern relevant to the hydraulic simulations. These differences between critical hydrology and hydraulic inputs can have substantial impacts on the design of infrastructure and understanding of surface flows.

In situations where the hydraulic impacts of the design processes are significant, rainfall ensembles can be used in the hydrologic and hydraulic simulations as outlined in Figure 9.6.11.

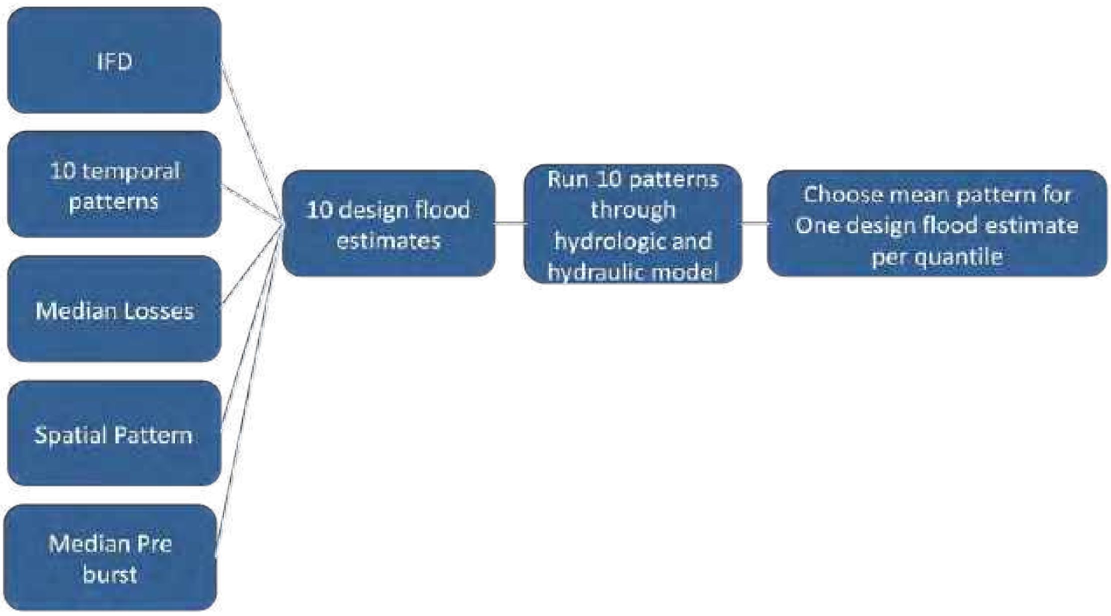

Figure 9.6.11. Design Process that Utilises Rainfall Ensembles in Hydrology and Hydraulic Simulations to Select the Mean Pattern for Analysis of Flooding

Figure 9.6.11 outlines that process for utilising ensembles of rainfall patterns in hydrology and hydraulic models. This process is better suited to situations where there are shorter model run times, critical flooding considerations and for coupled hydrology and hydraulic models. The processes outlined in Figure 9.6.10 and Figure 9.6.11 may also need to be applied to understand critical rainfall durations and patterns at key internal locations within catchments.

A brownfield case study based on the Woolloomooloo catchment in Sydney demonstrates the use of ensemble temporal patterns of rainfall and effects on the performance of hydraulic models used for design or assessment of conveyance networks (see Ward et al. (2018)). The catchment area is approximately 1.6 km^2 and has been heavily urbanised with limited open spaces or pervious areas. The catchment is also characterized by undulating terrain and contains known depression storages. The catchment drains to the harbour through a pit and pipe network, with the streets acting as overland flow paths (Figure 9.6.12).

Figure 9.6.12. The Woolloomooloo Catchment in Sydney

This guideline supports a number of modelling techniques and Table 9.6.1 and Table 9.6.2 provide guidance on selection of modelling approaches. Use of coupled 1D/2D and direct rainfall models were necessary to understand within catchment surface flows and flooding. The potentially short model run times and need to understand local flooding supports use of rainfall ensembles in both hydrology and hydraulics models. This study combined a well-known hydrology model with a popular 2D and 1D hydraulic model that relies on second order finite-difference schemes to simulate the hydrodynamics of floodplains and waterways.

This case study discusses three modelling options that were designed to account for within catchment overland flows and flooding:

- Use of a hydrology model to generate overland flows from small sub-catchments for use in a coupled 1D/2D hydraulic model. Individual properties, roofs and small area land surfaces were assigned as sub-catchments (refer to Book 9, Chapter 6, Section 4) in the hydrologic model to capture the rainfall concentration phase of stormwater runoff into the hydraulic model. This approach is necessary to understand within catchment flooding.

- A concentrated direct rainfall model where rainfall is applied to polygons of different land surfaces separated by perviousness and connectivity to the hydraulic 1D/2D model. These concentrated land surfaces also account for rainfall losses.

- Direct rainfall-on-grid where rainfall, after accounting for initial and continuing losses, was applied to all active grid cells. A fixed grid of $2m^2$ was employed in the hydraulic model.

Direct rainfall methods are known to trap volumes of rainfall in depressions and in areas with high roughness throughout 2D hydraulic models. The value of a carefully constructed direct rainfall model is the ability to identify sub-catchment flow paths, contributing areas and storage. However, the designer must ensure that catchment storages or initial losses are not doubled counted in simulations by the addition of regional loss assumptions. Given that there is a paucity of research into the accuracy of direct rainfall models, it is recommended that results of direct rainfall methods are compared with traditional methods by examination of the characteristics of hydrograph produced by both methods (Babister and Barton, 2012). A suitable method of representing buildings and good quality topography data is also required to produce accurate urban stormwater runoff behaviours. A mass balance or volume error check is also recommended.

The historical process of determining rainfall loss parameters using ARR 1987 assumptions, including soil type and antecedent moisture content parameters (AMC) from the ILSAX model, is provided in Table 9.6.6 for comparison.

Table 9.6.6. ARR 1987 Rainfall Loss Parameters

Parameter	Value
Paved Area Depression Storage (Initial Loss)	1.0 mm
Grassed Area Depression Storage (Initial Loss)	5.0 mm
SOIL TYPE	3
Slow infiltration rates. This parameter, in conjunction with the AMC, determines the continuing loss	
AMC	3
Description	Rather wet
Total Rainfall in 5 Days Preceding the Storm	12.5 to 25mm

This guideline provides a range of up-to-date parameters for use in analysis. The catchment is located within the East Coast South temporal pattern region. Temporal patterns for the East Coast South region and Intensity Frequency Duration (IFD) rainfall depths were downloaded from the ARR Data Hub website. This information is combined to construct ensembles of 10 rainfall patterns for the required flood quantiles (AEP). This case study focuses on the 1% AEP storm. The initial and continuing storm losses of 28 mm and 1.6 mm/hour for rural areas, and median pre-burst rainfall of 1.1 mm associated with a one hour 1% AEP storm event can also be downloaded from the ARR Data Hub.

It is recommended that varied rainfall losses are applied to different types of surfaces in the catchment. These surfaces include urban pervious areas such as parks, and impervious areas such as roads, median strips and building roofs. The identified impervious areas were split up into Effective Impervious Area (EIA) and Indirectly Connected Impervious Area (ICIA).

Effective Impervious Area represents the portion of a catchment area that has an impervious response. Due to the highly urbanised nature of the catchment this portion was identified as 75% of the total impervious area. The remaining area that is not classified as Effective Impervious Area is Indirectly Connected Impervious Area (25%). Building roofs were identified separately as Indirectly Connected Impervious Area as the down pipes were not assumed to directly discharge into the storm water pipes. The information from the ARR Data Hub is modified by loss values for urban catchments that are provided in Book 5, Chapter 3 and in Book 9, Chapter 6, Section 4 as summarised in Table 9.6.7.

Table 9.6.7. ARR 2016 Rainfall Loss Parameters for Urban Areas

Urban Area	Storm Initial Loss (mm)	Continuing Loss (mm/hr)
Effective Impervious Area	1 – 2 mm	0
Indirectly Connected Area	60 to 80% of rural catchment losses	For south eastern Australia, a typical value of 2.5mm/h, with a range of 1 to 3 mm/h, would be appropriate. This value should be adjusted based on engineering judgement and reviewing the catchment characteristics such as soil types, interaction of indirectly connected impervious areas with pervious areas. For other areas, adopt a range of 1 to 4 mm/h.
Urban Pervious Area	Traditionally, designers have adopted similar loss values for these areas as for those they would adopt in rural areas.	

In event based modelling approaches, it is important to subtract pre-burst rainfall from local losses associated with impervious and pervious surfaces as follows:

Burst initial loss = Storm initial losses – Pre-burst rainfall (for Burst initialloss ≥ 0)

For example, the burst initial loss for effective impervious area is 1.5 – 1.1 = 0.4 mm. The adopted burst losses for the urban surfaces are presented in Table 9.6.8. Note that in a situation where pre-burst rainfall is greater than the storm initial losses, the residual pre-burst rainfall should be included in the analysis.

Table 9.6.8. Adopted ARR 2016 Rainfall Loss Parameters

Urban Surface	Burst Initial Loss (mm)	Continuing Loss (mm/hr)
Effective Impervious Area	0.4	0
Indirectly Connected Area	16.1	1.6

Urban Surface	Burst Initial Loss (mm)	Continuing Loss (mm/hr)
Urban Pervious Area	26.9	1.6

Hydraulic and associated flood behaviour is influenced by the hydraulic resistance due to topography and urban form. The selection of appropriate roughness coefficients is critical to the success of this approach (see Book 6, Chapter 4). Depth varying Manning's "n" roughness parameters were selected for each land use to account for shallow overland flow depths across urban surfaces. Some hydraulic modelling packages provide this capability in accordance with emerging research into depth varying roughness (for example, Zahidi et al. (2017), Khrapov et al. (2015), Muglera et al. (2011)).

Analysis of the performance of urban conveyance networks is critically dependent on potential blockage of inlet structures (Book 6, Chapter 6; Book 9, Chapter 5, Section 5) and the need to address safety design criteria (see Book 6, Chapter 7; Book 9, Chapter 5, Section 3). Assessment of potential blockage of inlet structures should also consider data from local authorities about maintenance programs and local flooding (Weeks et al., 2013). The assumed blockage factors for inlet pits subject to runoff from 1% AEP rainfall events were derived from Book 9, Chapter 5, Section 5, from local government historical records, and maintenance programs (see Table 6.6.1), from Weeks et al. (2013) and are presented in Table 9.6.9.

Table 9.6.9. Assumed Capacity of Inlet Pits for 1% AEP Rain Events

Sag Inlet Pit	
Kerb Inlet	80%
Grated Inlet	50%
Combination	Assume Grate 100% blocked
On-grade Inlet Pit	
Kerb Inlet	80%
Grated Inlet	60%
Combination	90%

The critical rainfall duration for the catchment was derived using the ensembles of rainfall temporal patterns in the combined hydrology and 2D hydraulic model to reveal the highest mean and median flood elevations at key locations as shown for in Figure 9.6.13.

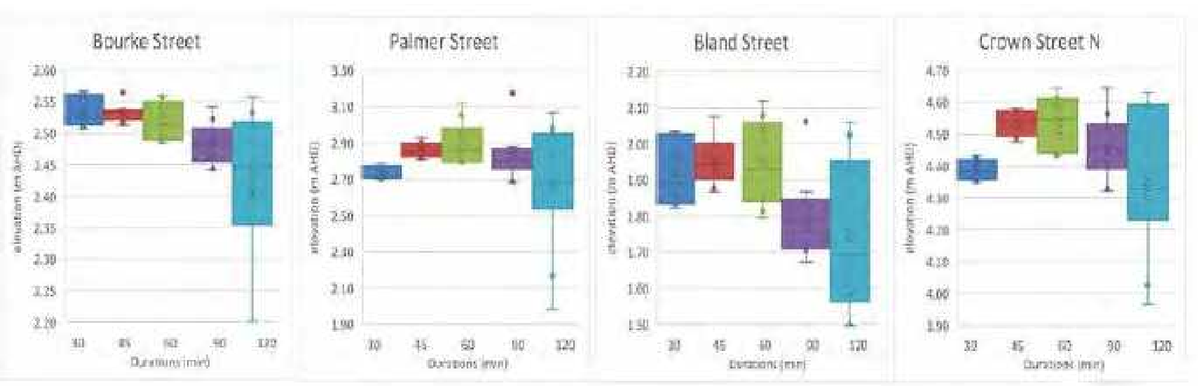

Figure 9.6.13. Use of Ensembles of Storm Bursts (1% AEP) in the Hydraulic Model to Select Critical Duration

Figure 9.6.13 reveals that the use of ensembles of rainfall in the hydraulic model indicates that different critical rainfall durations apply throughout the catchment. The results from Figure 9.6.13 were used with consideration of the characteristics of the catchment to select the critical storm duration of 60 minutes. The impact on stormwater runoff from using the single storm burst pattern from ARR 1987 is compared to use of an ensemble of ten storm burst patterns (1% AEP) from this guideline for part of the Wooloomooloo catchment in Figure 9.6.14. This graph presents ten hydrographs of stormwater runoff in the trunk drainage system at Bourke Street confluence.

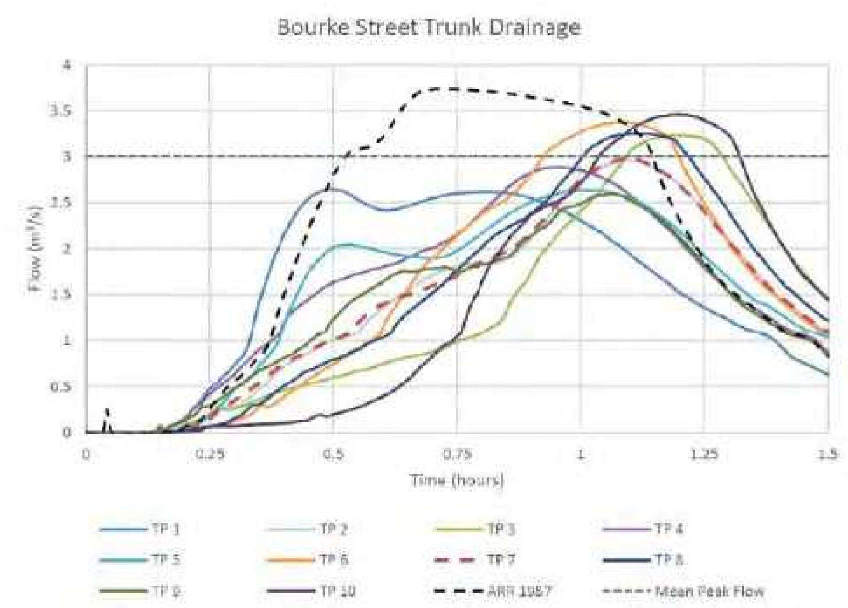

Figure 9.6.14. Example of Runoff from ARR 1987 Single Storm Burst and Ensembles of Storm Bursts from this guideline (1% AEP)

Figure 9.6.14 demonstrates that a single pattern of burst rainfall from ARR 1987 produces a different hydrograph shape, volume and peak runoff at the catchment outlet to the ensemble of storm burst patterns from this guideline. This difference is driven by the 30 years of additional data and science available to this guideline that has allowed the derivations of more spatially relevant rainfall and temporal patterns. The variability of the equally likely storm burst patterns from the ARR ensembles facilitates testing of catchment characteristics for generation of maximum runoff.

The direct rainfall method applies rainfall directly to all grid cells and the scale of routing is at every 2 m by 2 m grid cell. In this approach the depth of flow is shallow and rainfall can get stuck on the model grid. To maintain the area of rainfall applied to the grid, the buildings were nulled (removed) from the actual grid and rainfall was scaled up to account for the lost building areas.

The concentrated direct rainfall method applied rainfall to polygons of different local surfaces such as buildings and parks. This process permits the specification of the area, initial and continuing losses that are applied to each land use polygon. Separate attributes are applied to roofs to account for the different connectivity to concentrated stormwater flows.

A manual volume check should be undertaken on all direct rainfall model configurations. The volume of water leaving the model through the downstream boundary should be equal to the amount of water that was applied (via direct rainfall and inflows across external boundaries), less losses and storages within the model. The upper portion of the catchment (area of 52.8

Ha) was assessed to maximize the volume of water that drains from the catchment at the last time step. The characteristics of the upper catchment are shown in Table 9.6.10.

Table 9.6.10. Characteristics of the Upper Catchment used in the Volume Check

Type	Catchment Area (m^2)	IL (mm)	CL (mm/hr)
100% Pervious	22,508	26.9	1.6
100% Impervious	102,607	0.4	0.0
EIA	133,909	0.4	0.0
ICIA	34,549	16.14	1.6
ICIA (Buildings)	234,630	16.14	1.6
AVERAGE LOSS		**11.4**	**0.9**
TOTAL (m^2)	**528,202**		

The model run was extended to allow all stormwater to drain from the catchment by extrapolating the outflow curve towards zero. Inflow volume was calculated as the cumulative depth of rainfall less initial and continuing losses multiplied by the area of the catchment. Flows extracted from the hydraulic model 1D results can also be converted into volumes. A flow line along the upstream catchment divide together with outflow boundaries were used in the 2D hydraulic model to also account for the volume of overland flows leaving the catchment. These results can be presented as a cumulative depth graph or as a pie chart (refer to Figure 9.6.15)

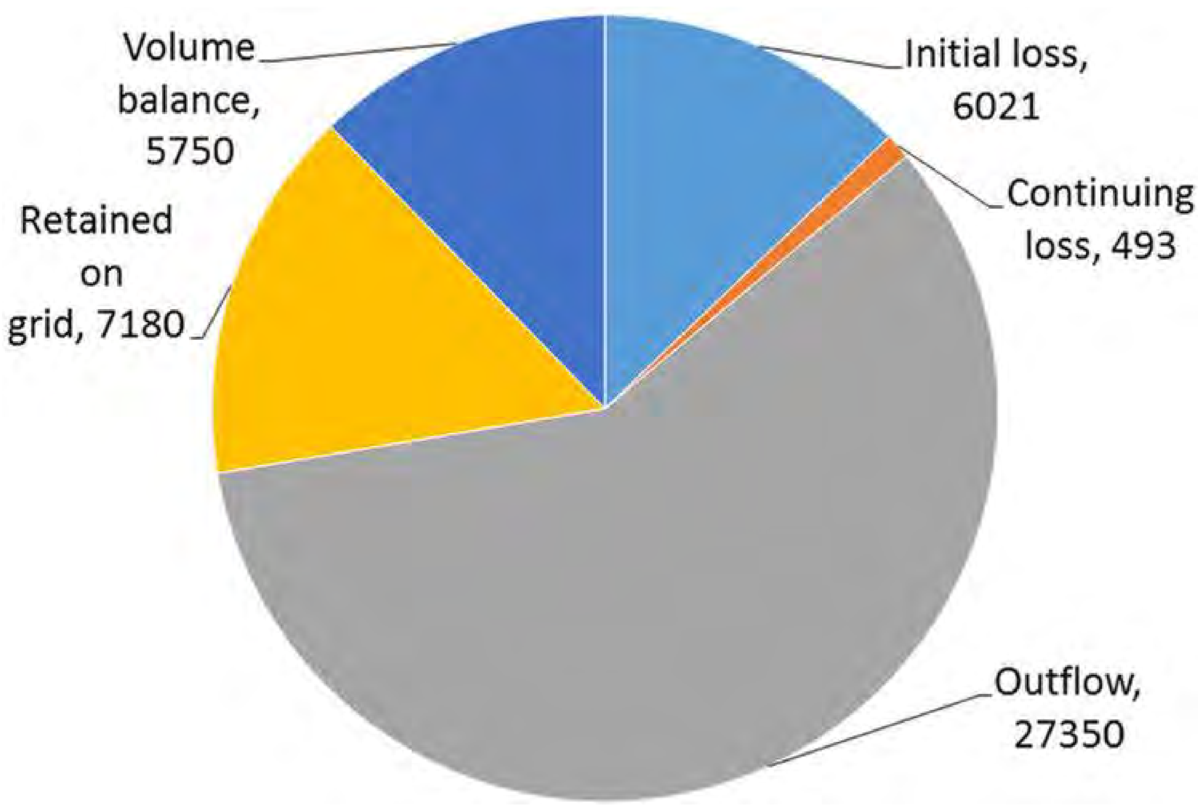

Figure 9.6.15. Upper Catchment Volume Check for Direct Rainfall Model (Prior to Corrections)

Figure 9.6.15 shows 5,750 m^3 (14%) of rainfall was retained in the model (11 mm) which is described as the volume balance. An acceptable error or additional retention of stormwater is less than 5% which indicates a need to reduce initial losses used in the direct rain model. Accounting for volumes of depression storage in the catchment topography by decreasing initial rainfall losses will increase in overall pipe and overland outflows. These results indicate that the catchment topography includes depression storages that capture 23.1 mm of rainfall. The results from coupled hydrology and 1D/2D hydraulic model with traditional loss assumptions revealed rainfall losses of 24.3 mm. The concentrated direct rainfall and direct rainfall methods can also be evaluated using sensitivity testing of initial conditions as follows:

- No accounting for rainfall lost to depression storage;
- Accounting for depression storage loss by reducing the initial loss. Apply direct rainfall with initial loss, less the average depth on grid;
- Accounting for depression storage using a restart file, which reapplied the conditions from the last time step to the model. Direct rainfall applied with the initial conditions adopted from the final time step of the initial simulation.

The outflow depths in the standard direct rainfall simulations changed from 52 mm to 61 mm by using a restart file and in the standard direct rainfall simulations changed from 52 mm to 56 mm by reducing the assumed initial losses in the models.

The hydrograph outputs of overland flows at selected locations (refer to Figure 9.6.12) at Riley Street near the park (top pane) and at Crown Street North (bottom pane) are shown in Figure 9.6.16. It is clear that overland flow is under-represented in the uncorrected direct rainfall models as compared to traditional coupled 1D/2D models.

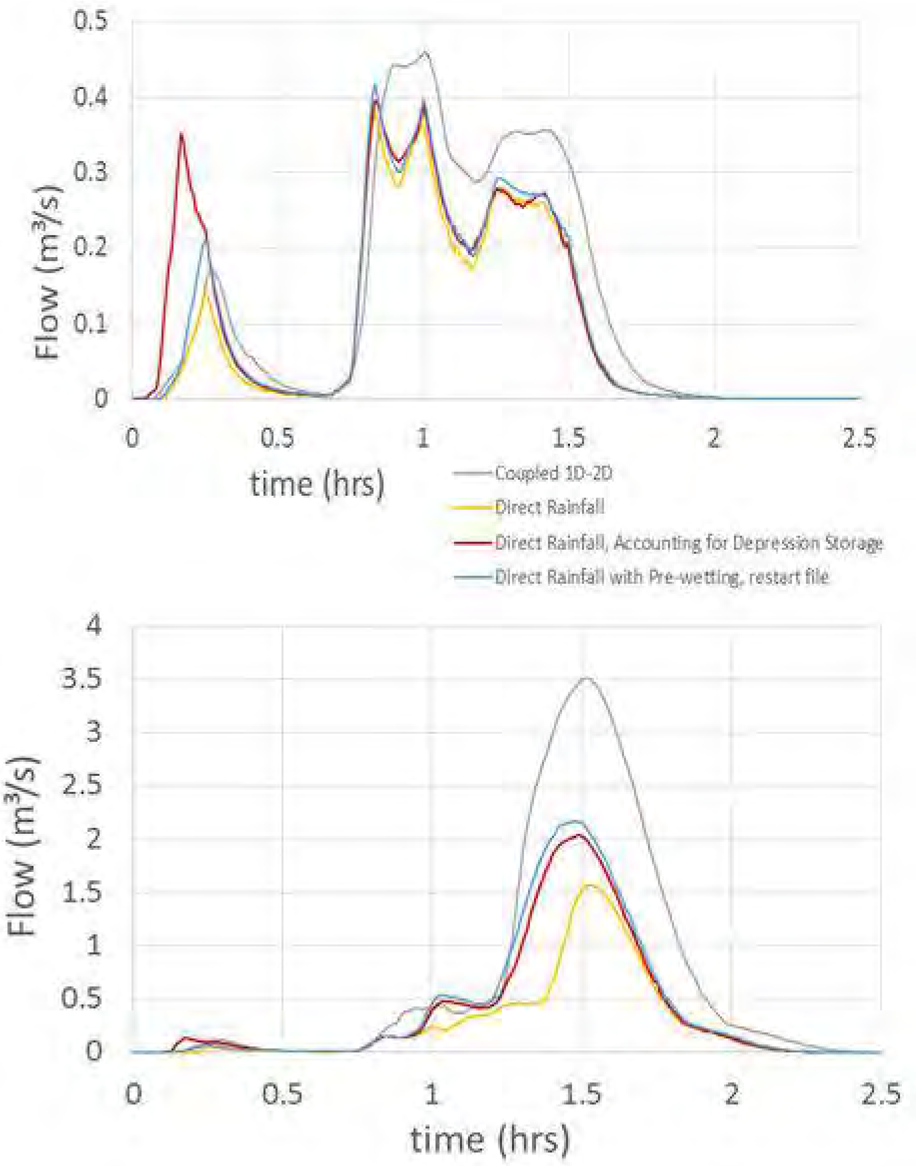

Figure 9.6.16. Comparison of Treatment of Initial Conditions in Overland Flows Generated by Coupled Direct Rainfall Models Near the Top of the Catchment (Top Pane: Riley Street) and Near the Bottom of the Catchment

Figure 9.6.16 demonstrates that the uncorrected direct rainfall models produce variable under-estimation of surface flows, as compared to a traditional coupled 1D/2D model, that is dependent on location and attributes of sub-catchments. Techniques that account for depression storage or pre-wetting of the catchment surfaces using restart files can improve the comparative performance of direct rainfall models. However, the residual differences in surface flows highlight that 2D models and in particular direct rainfall models should also be verified using historical records of local flood depths. Surface flows are a significant proportion of the responses from urban catchment as shown in Figure 9.6.17.

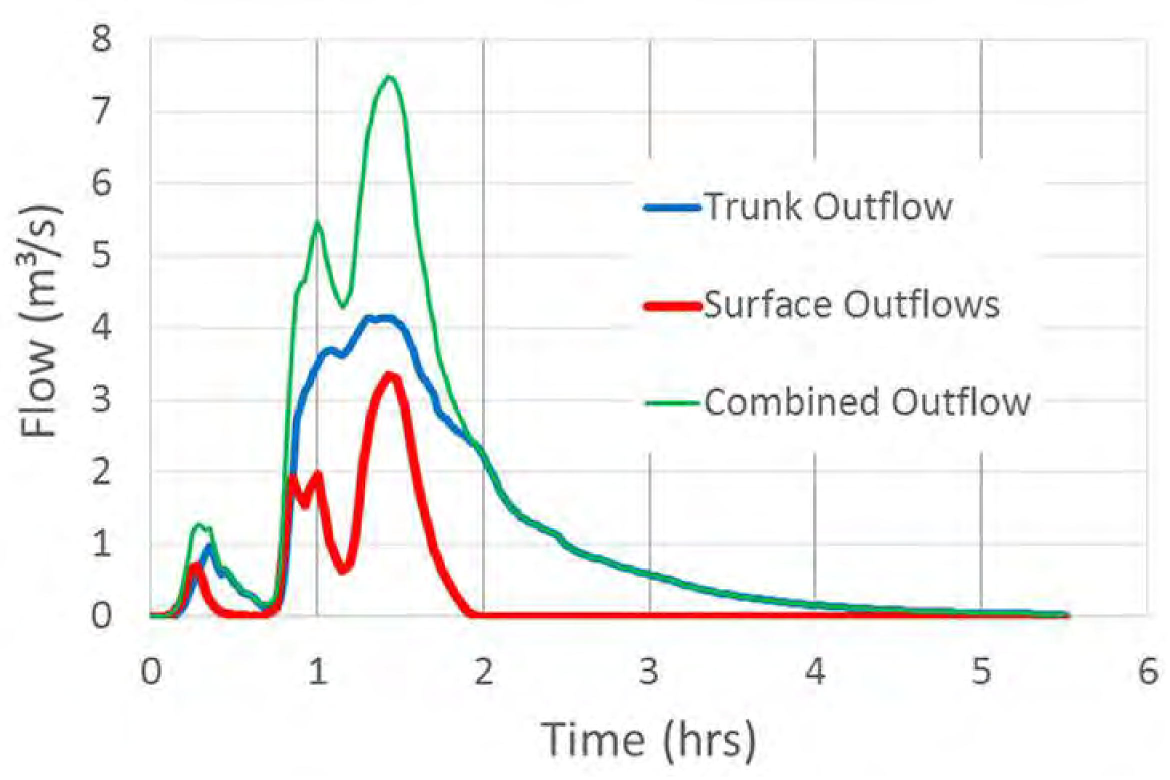

Figure 9.6.17. Outflow Hydrographs Catchment Showing the Significance of Surface Flows

This case study demonstrates practical application of the ARR ensemble temporal patterns on an urban catchment that is dominated by overland flow. The pattern that best represents the mean response has been selected based on flood elevation rather than flow. It is clear from the results of this analysis that a volume check of direct rainfall approaches should be undertaken in accordance with recommendations of Babister and Barton (2012) and the results should be verified using historical records of spatial flooding. A significant amount the rainfall excess is not generating runoff because rainfall is trapped on the terrain grid. This trapped rainfall excess represents an effective overestimation of the catchment loses with associated underestimation of surface flow and should be factored into the losses so that the correct amount of rainfall excess is generated. This can be carried out by either pre-wetting parts of the catchment or adjusting the assumed initial losses or a combination of both.

6.4.6. Downstream

Outflows from urban sub-catchments and conveyance networks interact with regional storage controls and water quality measures (refer to Book 9, Chapter 4 and Book 9, Chapter 5), discharge to urban waterways (See Book 9, Chapter 2and Book 9, Chapter 3) and to receiving waters such as estuaries, rivers, bays and oceans. The methods outlined in Book 6, Chapter 5 may need to be applied to interactions of rainfall and storm surge processes in estuaries, bays and oceans to account for combined impacts on urban flooding.

The complexity of urban areas also fosters the need to consider the joint probability of the different factors such intersection of urban runoff with regional flows in rivers or water levels in regional storages and water quality measures, which may be correlated or independent of each other. Methods to account for joint probability are provided in Book 4, Chapter 4. The urban designer should also consider climate change impacts on urban flooding as outlined in Book 8, Chapter 7, Section 7 and Book 1, Chapter 6.

The connectivity between design of urban conveyance and a volume management facility, setting the rural base case for design targets, application of climate change and assessment of downstream impacts on a sensitive waterways is combined in a greenfield example (Coombes and Barry, 2018). This conceptual design example is located near Ballarat in Victoria and includes an objective of no increase in peak flows in the downstream natural waterway to mitigate impacts of the urban development on erosion of the stream. The pre-development catchment is shown in Figure 9.6.18 and the proposed development is presented in Figure 9.6.19.

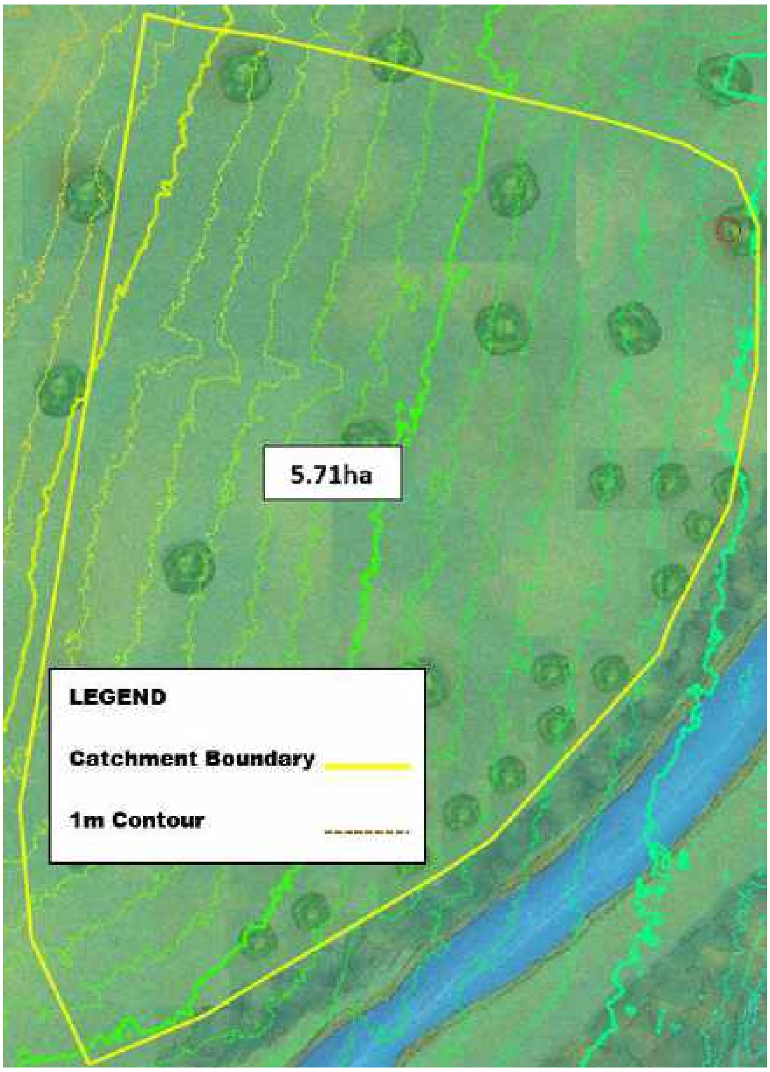

Figure 9.6.18. Catchment prior to development

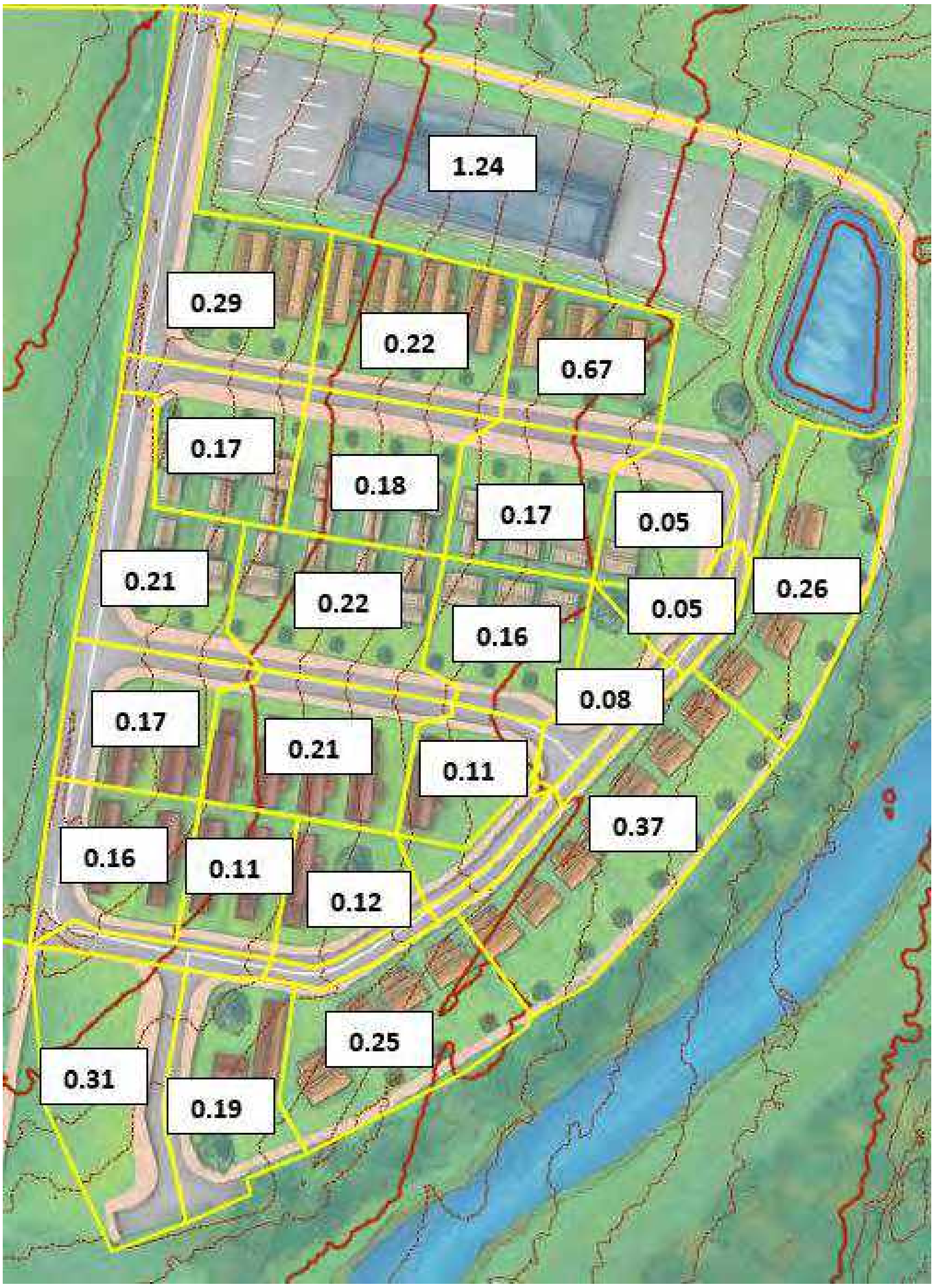

Figure 9.6.19. Developed Catchment

An estimate of pre-development peak flows was required to set the design peak flow targets for the proposed urban development. The Regional Flood Frequency Estimation Model (RFFE) available from http://rffe.arr-software.org/ was utilised to estimate rural peak flows with uncertainty as shown in Figure 9.6.20 which is based on gauged flows from multiple regional gauges (Figure 9.6.21). The use and limitations of the RFFE is described in Book 3, Chapter 3. Whilst the example catchment size is less than the currently recommended minimum and the RFFE is subject to improvement, this process provides a good starting point for defining the rural flow target. The rural flows from the RFFE might also be combined with statistical analysis of observed flows in a nearby catchment using FLIKE (refer to Book 3, Chapter 2, Section 8) to improve regional flow estimates. These improved regional peak flow results from the nearby catchment can be used to calibrate a hydrology model and the parameters transferred to the design catchment as explained by Coombes et al. (2016). Patil and Stieglitz (2012), for example, outline methods of transferring parameters from gauged catchments to ungauged catchments.

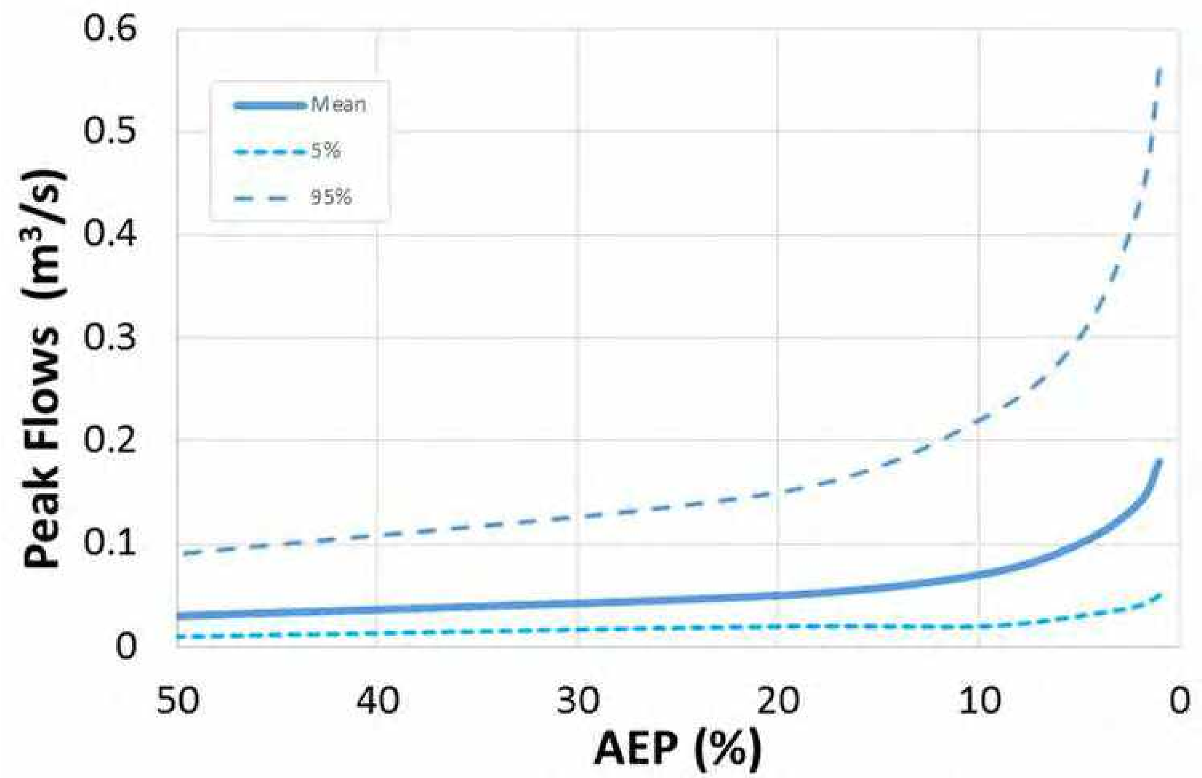

Figure 9.6.20. Estimated Rural Peak Flows using the RFFE

Figure 9.6.21. Regional Flow Gauges used in the RFFE Estimate of Rural Peak Flows

The next step in the design process involved selecting the project location in the ARR Data Hub and downloading hydrology and rainfall information, including local design rainfall IFD and ensembles of temporal patterns. Most proprietary models will download this information and set up the ensembles of rainfall inputs. Estimated regional rural losses for initial losses (IL) of 25 mm and continuing losses (CL) of 4.3 mm/hr were also downloaded from the ARR Data Hub.

A model with combined hydrology and hydraulic capacity was used with initial estimates of IL = 25 mm and CL = 4.3 mm/hr, design burst rainfall ensembles and pre-burst rainfall to estimate local rural losses that were calibrated to rural flows sourced from the RFFE as shown in Figure 9.6.22. The critical duration was found to be 1.5 hours as defined by highest mean peak flows for 50%, 10% and 1% AEP events as shown in Figure 9.6.23, Figure 9.6.24 and Figure 9.6.25. Median pre-burst rainfall for 90 minute storm durations were also selected from the ARR Data Hub for 50% AEP: 4.1 mm; 10% AEP: 3.3 mm and 1% AEP: 1.1 mm. The pre-burst rainfall was included in the hydrology model and spread over the hour prior to burst rainfall and the calibration processes aimed to find values of IL and CL that produced simulated rural peak flows that were similar to RFFE peak flows for the 10% AEP events. This process enabled an estimate of local rural initial losses of 16 mm and continuing loss of 5 mm/hr for an assumed Mannings roughness coefficient (n = 0.075).

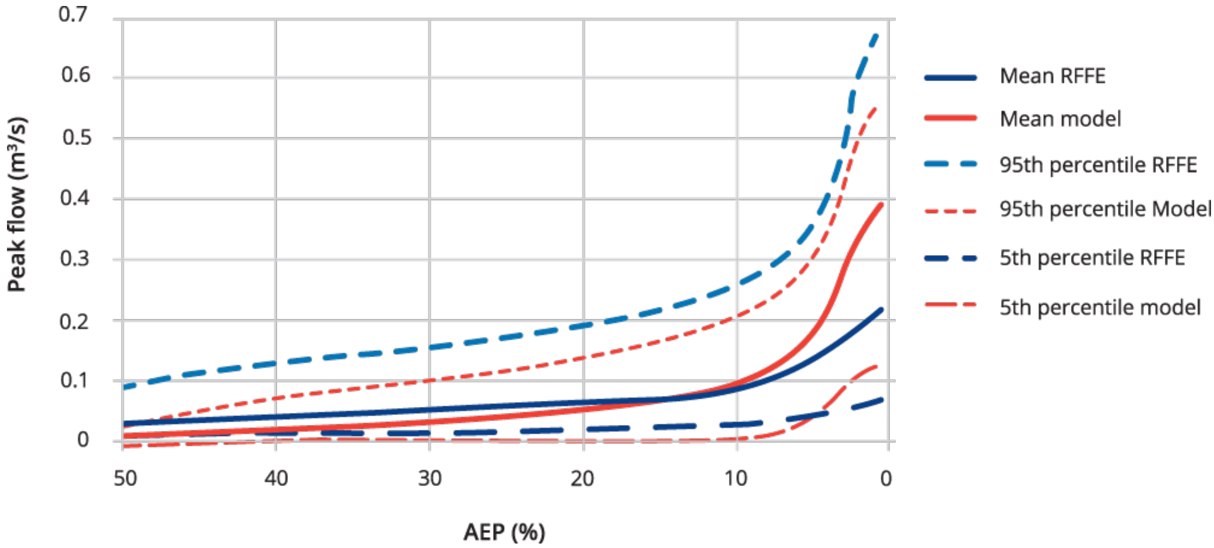

Figure 9.6.22. Calibration of Rural Flows to RFFE Flow Estimates

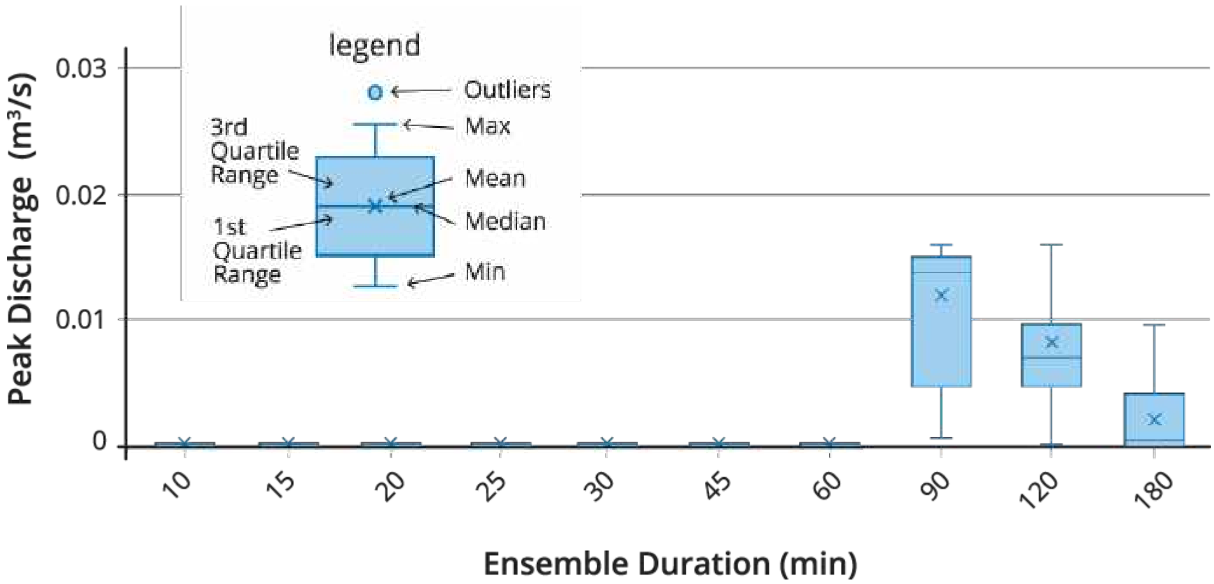

Figure 9.6.23. Pre-Development Peaks Flows for 50% AEP Events

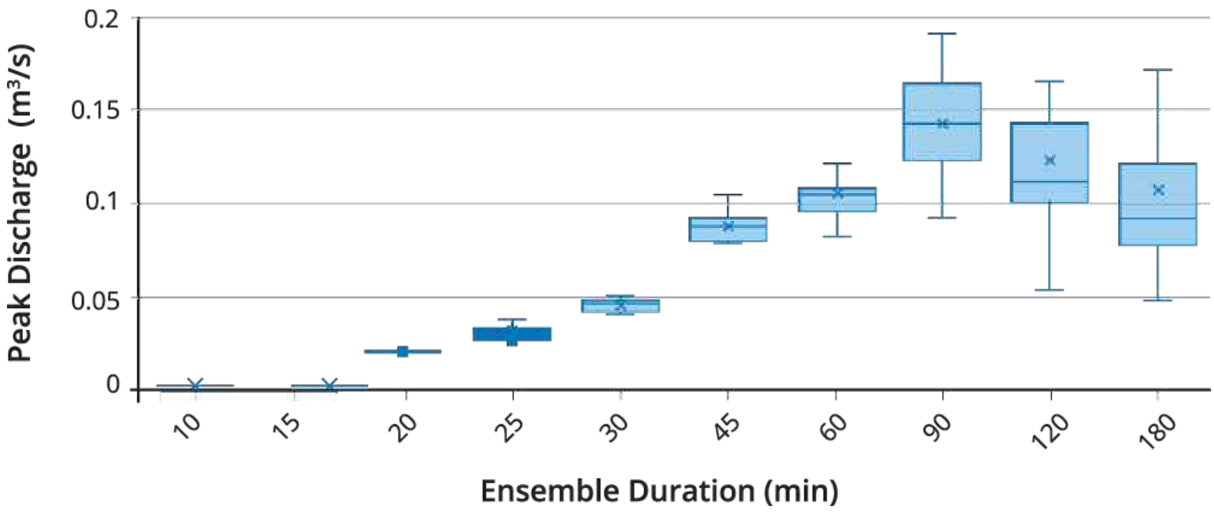

Figure 9.6.24. Pre-Development Peak Flows for 10% AEP Events

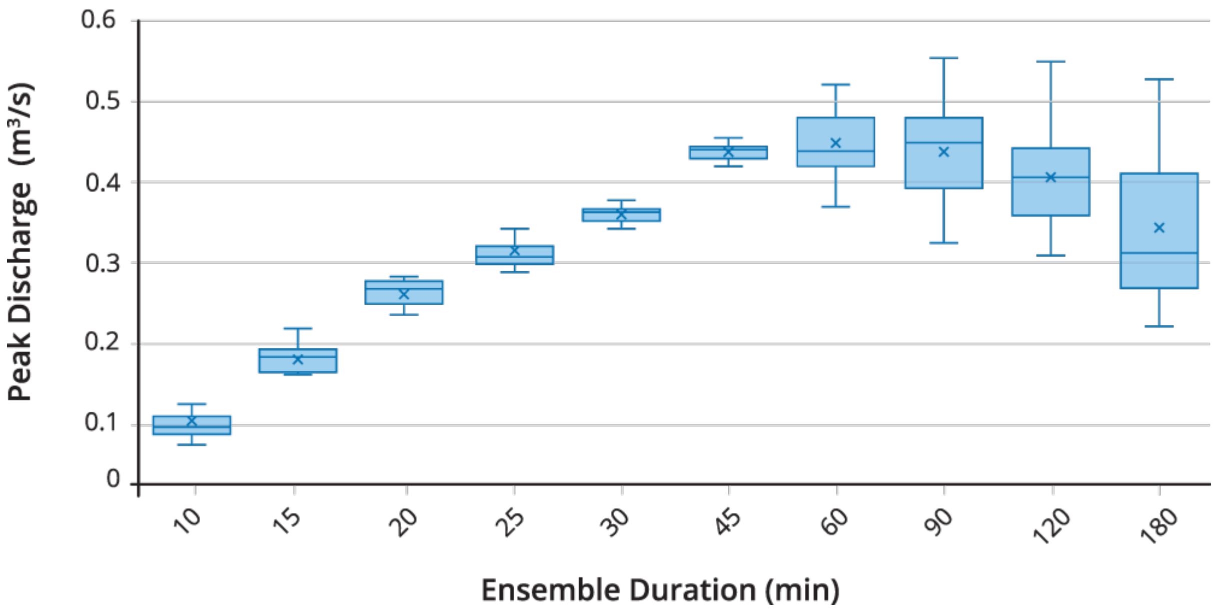

Figure 9.6.25. Pre-Development Peak flows for 1% AEP Events

The mean maximum pre-development peak flows for the 50%, 10% and 1% AEP were found to be 0.011 m^3/s, 0.14 m^3/s and 0.45 m^3/s respectively. These values were used as the peak flow targets for the urban development. The altered land surfaces (impervious and pervious areas of roads and properties) associated with the urban development was included in the hydrology model. The loss values for the urban catchment from Book 5, Chapter 3 and Book 9, Chapter 6, Section 4 were assigned as follows:

- Effective Impervious Area: IL =1.5 mm, CL = 0 mm/hr
- Pervious Area = rural losses

Indirectly connected impervious area assumptions were not required because the spatial detail of land uses with associated connectivity were included in the hydrology/hydraulics model. The hydrology of the urban catchment was simulated for all design rainfall ensembles to determine a critical duration of 10 minutes for the 10% AEP flows relevant to the design of pit and pipe conveyance infrastructure (refer to Book 9, Chapter 5). These simulations were completed prior to design of infrastructure to determine the relevant critical duration and design storm for use in the design process. Pre-burst rainfall for a one hour duration was selected from the ARR Data Hub (50% AEP: 2.2 mm, 10% AEP: 2.2 mm, 1% AEP: 0.8 mm) for use with the 10 minute duration design rainfall ensembles relevant to the design of the pit and pipe conveyance infrastructure. The pre-burst rainfall was distributed across an hour prior to the burst rainfall.

The hydrographs from the simulation using ensembles of 10% AEP design burst rainfall with pre-burst rainfall was examined to select the design storm closest to mean peak flow for design of conveyance infrastructure as shown in Figure 9.6.26. Urban peak flows from all design rainfall durations for 50%, 10% and 1% AEP events are presented in Figure 9.6.27, Figure 9.6.28 and Figure 9.6.29 respectively.

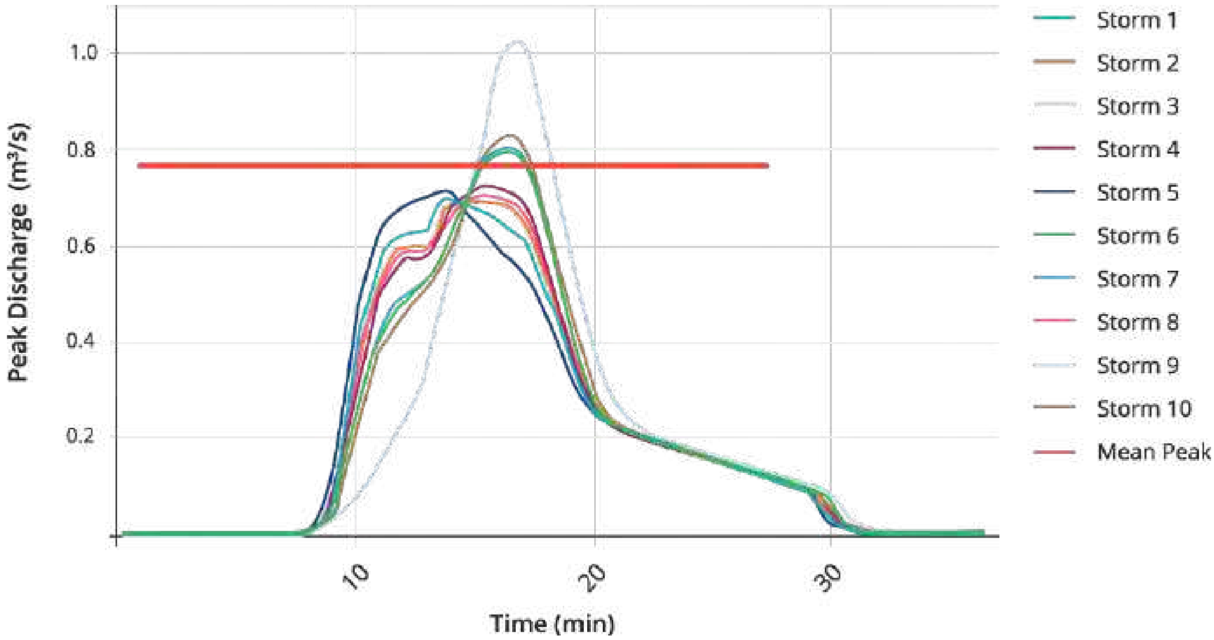

Figure 9.6.26. Selection of the 10% AEP Design Storm for Preliminary Infrastructure Design

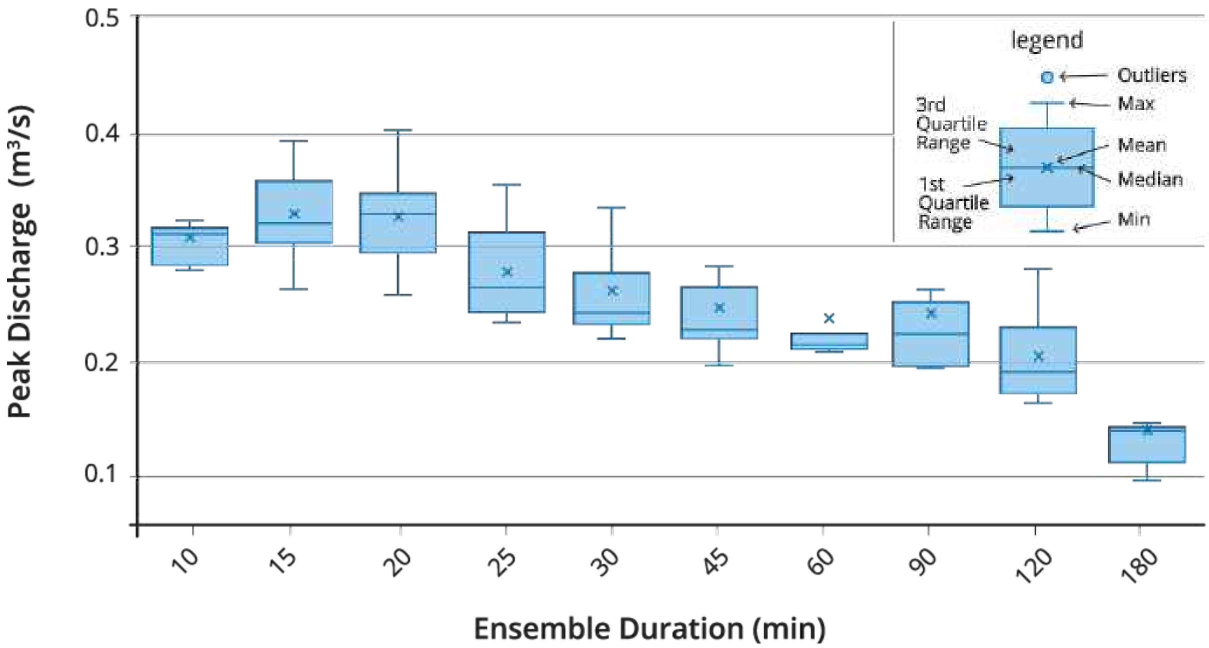

Figure 9.6.27. Development Peak Flows for 50% AEP Events

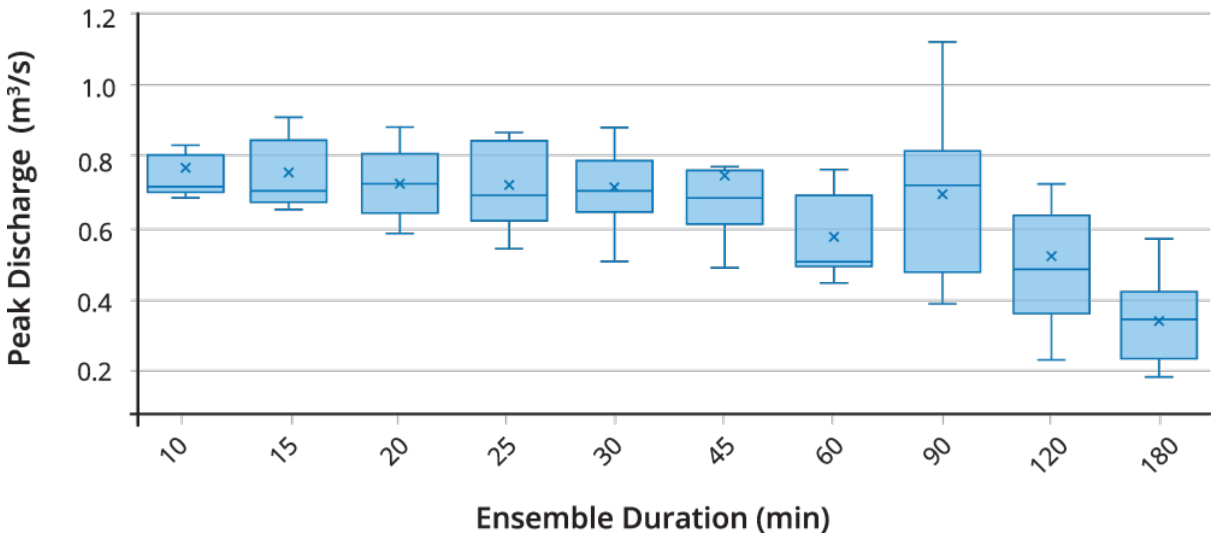

Figure 9.6.28. Development Peaks Flows for 10% AEP Events

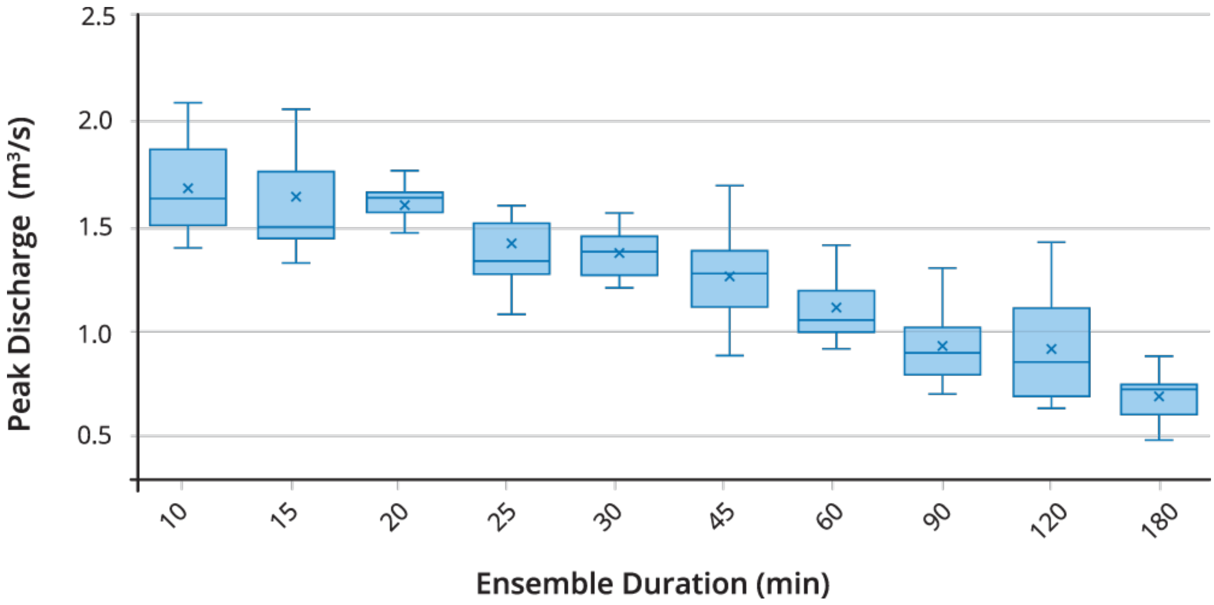

Figure 9.6.29. Development Peak Flows for 1% AEP Events

The preliminary design of the conveyance network (Book 9, Chapter 5) shown in Figure 9.6.30 was sized using storm 7 (Figure 9.6.26) for the 10% AEP event with a design pre-burst rainfall of 2.2 mm. Inlet pit relationships from Book 9, Chapter 5, Section 5 were applied to the design process. Pit inlet capacities for on grade pits (Figure 9.5.12) and sag pits (Equation (9.5.1) to Equation (9.5.4)) were derived using Book 9, Chapter 5, Section 5. Design blockage of on grade and sag pits was derived from Table 9.5.2 and pit energy losses were defined using Book 9, Chapter 5, Section 5.

A hydrology/hydraulics model was use to sized pipes in the conveyance network with objectives of maintaining 150 mm freeboard to grates of inlet pits and less than two metre flow width on roads. The design of the conveyance network was then checked using ensembles for 10% AEP design storm events with pre-burst rainfall for 10, 15, 20 and 30 minute durations.

The safety of surface flows were also checked by simulating the performance of the conveyance network using design rainfall ensembles for 1% AEP burst events with pre-burst rainfall for 10, 15, 20 and 30 minute durations. In accordance with Book 9, Chapter 3, Section 4 and Book 9, Chapter 5, Section 6 (also see Book 7, Chapter 6), the design aimed to limit surface water depths to less than 200 mm and less than 50 mm at road crowns. These objectives also included limiting depth velocity product to less than 0.4 and aimed for freeboard to floor levels of greater than 300 mm.

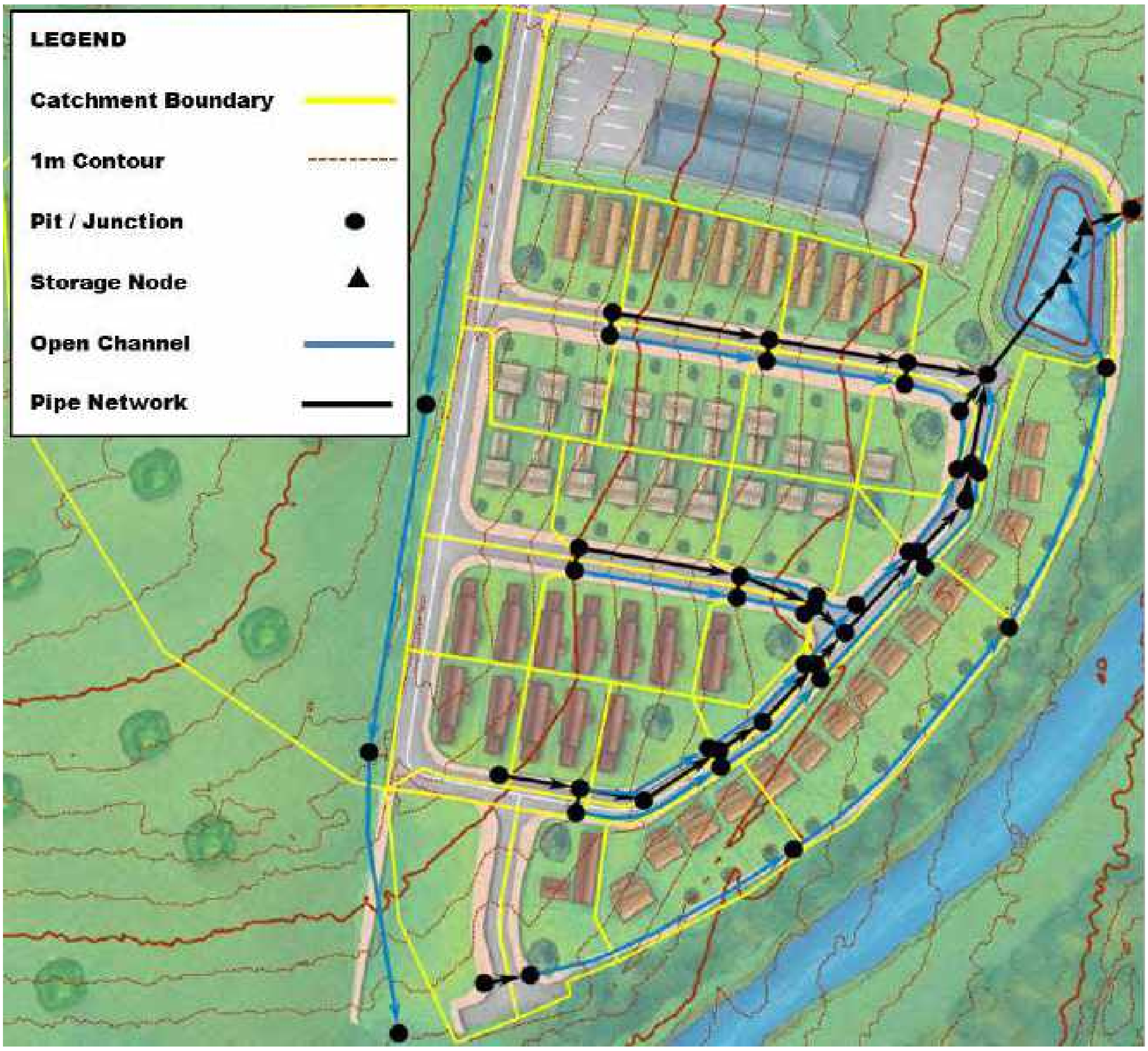

Figure 9.6.30. Overview of the Planned Conveyance Network in the Urban Development

A storage basin was then designed to manage flooding and impacts on downstream waterway (refer to Book 9, Chapter 4) by mitigating the 50%, 10%, 1% AEP peak flows to meet the rural target defined above. Storage volume and outflow arrangements were utilised to achieve this (refer to Figure 9.6.31). The design of the basin included a freeboard of 300 mm from 1% AEP maximum depth and an emergency spillway designed for full blockage of 1% AEP rainfall events (refer to Book 6, Chapter 6 for blockage discussions).

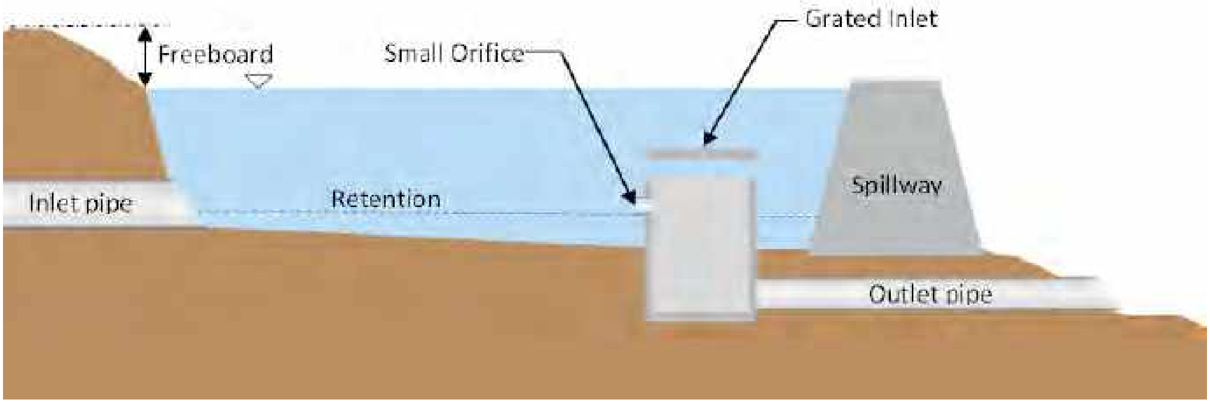

Figure 9.6.31. Overview of the Planned Storage Basin Below the Urban Development

A trial basin design was undertaken using the hydrology/hydraulics models and ensembles of 1.5 hour duration design rainfall with pre-burst rainfall. The design of the basin was then tested and modified using ensembles of design rainfall with pre-burst rainfall for all durations to ensure the rural peak flow targets were met and the maximum basin depth was not exceeded. The final results for peak flows discharging from the development via the basin are shown in Figure 9.6.32, Figure 9.6.33 and Figure 9.6.34 for 50%, 10% and 1% AEP rainfall events. Water levels in the basin for all 1% AEP rainfall durations are provided in Figure 9.6.35.

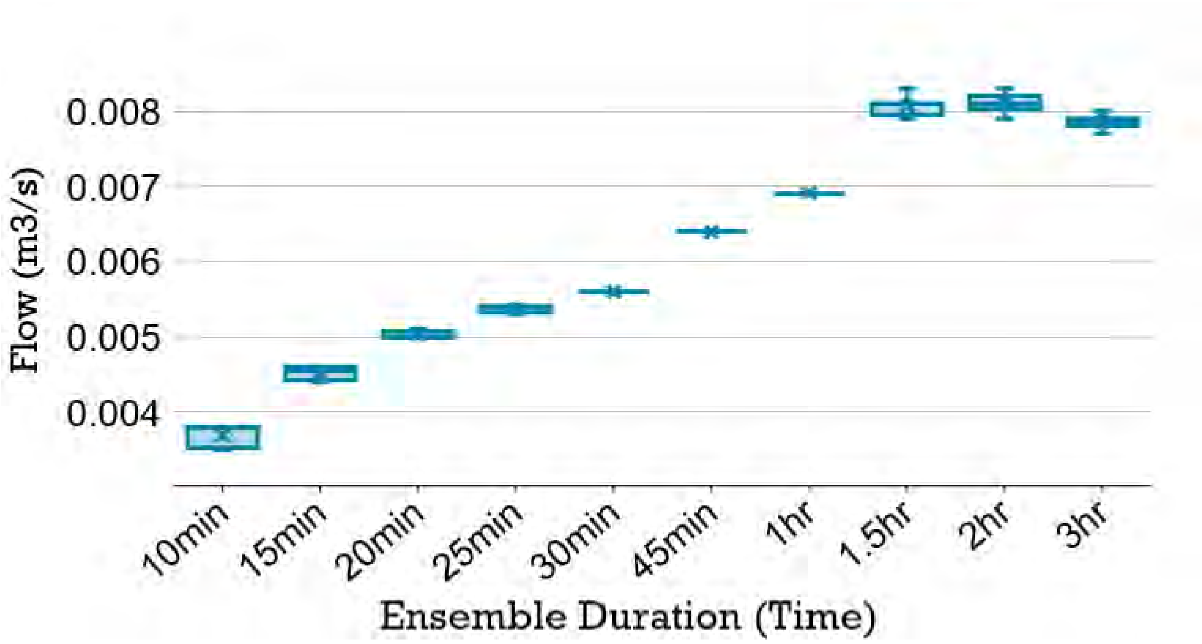

Figure 9.6.32. Peak flows from the Basin for 50% AEP Events

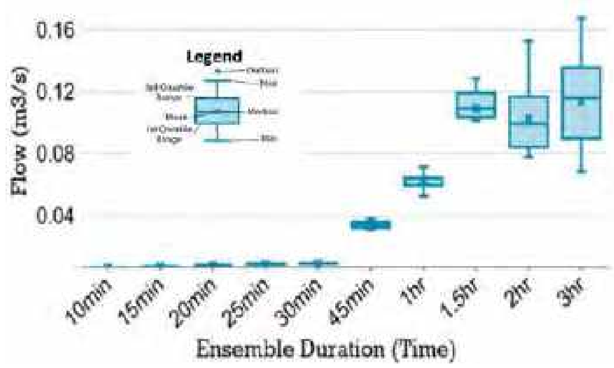

Figure 9.6.33. Peak Flows from the Basin for 10% AEP Events

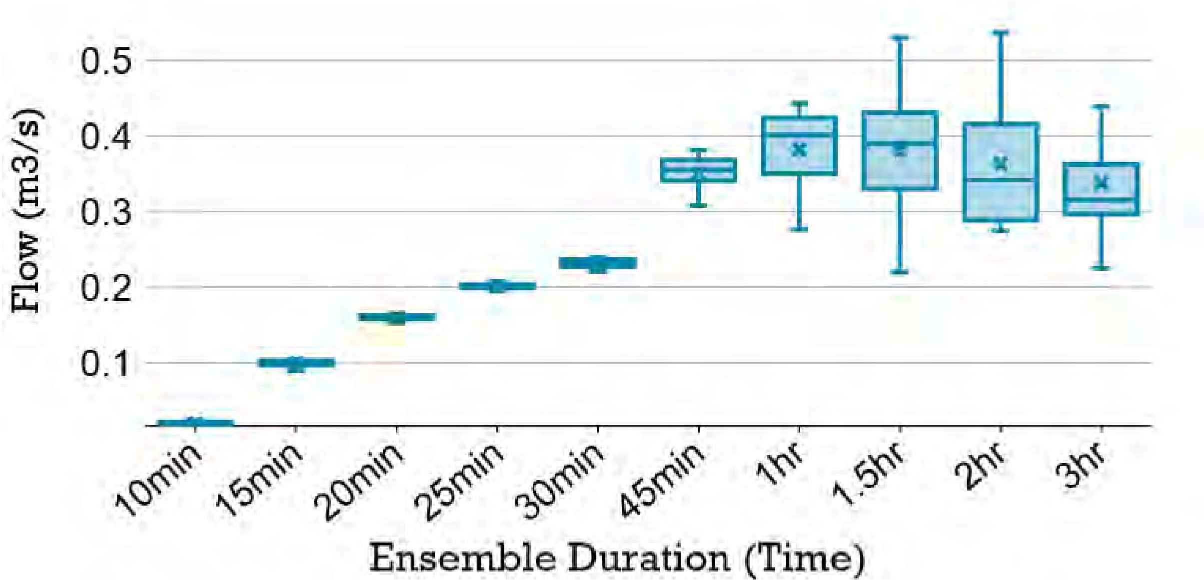

Figure 9.6.34. Peak Flows from the Basin for 1% AEP Events

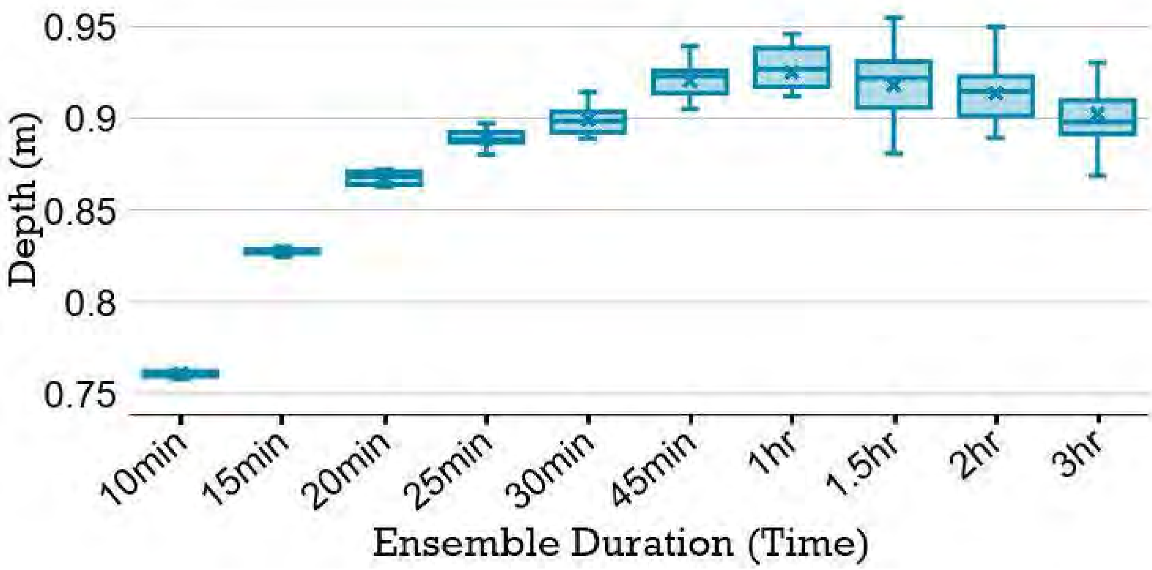

Figure 9.6.35. Peak Water Levels the Basin for 1% AEP Events

Figure 9.6.32 to Figure 9.6.34 show that the mean peak flows from the basin were less than the rural flows with critical durations ranging from one to three hours. A one hour critical duration of peak water levels in the basin was also observed from the analysis (refer to Figure 9.6.35). These result highlight that critical durations of stormwater runoff can vary throughout catchments and across different types of the infrastructure.

The design of the conveyance and storage infrastructure was evaluated for climate change impacts using the methods outlined in Book 1, Chapter 6 and Book 8, Chapter 7, Section 7. A design life for the infrastructure and consequence level for climate change impacts was selected. A design life of 100 years was assumed for the basin with medium consequences of failure due to impacts on the waterway and surrounding rural properties.

This assessment was utilised to extract data from ARR Data Hub for the RCP 8.5 value for 2090 which indicated an expected 16.1% increase in peak rainfall[1]. This expected increase in peak flows was used to alter the increase in peak rainfall. This expected increase in peak flows was used to alter the increase in peak rainfall (Please note the Data hub value for Ballarat has changed as of May 2019 to 16.3% to reflect changes to the predicted temperatures from Climate Change Australia). This expected increase in peak flows was used to alter the relevant design rainfall ensembles and the hydrology/hydraulic model was rerun to test the impact of climate change on peak water levels in the basin and on roads. Designers should also utilise emerging research to incorporate that most up to date climate change assessments. For example, Wasko and Sharma (2015) outline greater potential for increased rainfall intensities in urban areas.

The impact of applying the expected 2090 climate change effects on design rainfall on peak water levels in the basin and at a critical location on the road is shown in Figure 9.6.36. Increases in peak water depths are experienced in the basin and on the road. The increased runoff into the basin is managed by the emergency spillway and peak water levels are acceptable. However, peak water levels on the road exceed the design objectives and the designer should highlight this situation to the consent authority for further consideration.

[1]Please note the Data hub value for Ballarat has changed as of May 2019 to 16.3%. This reflects changes to the predicted temperatures from Climate Change Australia

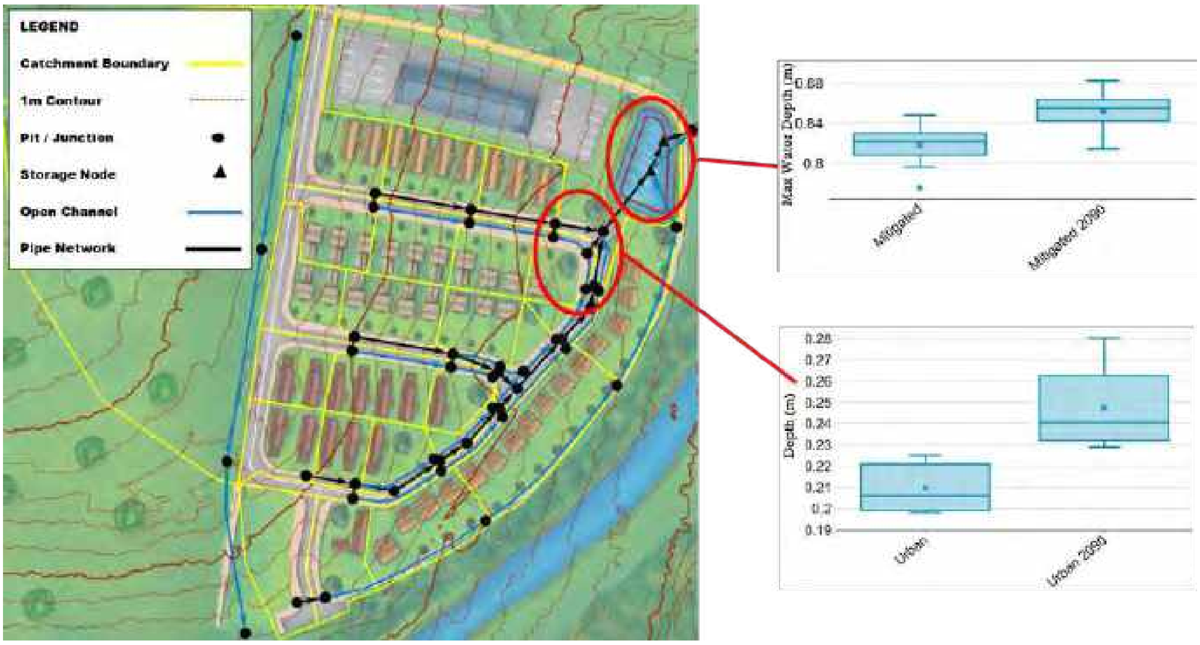

Figure 9.6.36. Peak Water Levels in the Basin and on Roads for 1% AEP Events Subject to Climate Change

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<tr><td>Approved by:</td><td>Council</td></tr>
<tr><td>Review Date</td><td>December 2018</td></tr>
<tr><td rowspan="2">Responsible Officers: Kathleen Kemp
Sustainable Transport Planner,
Karen Roache
Shared Transport Services Officer</td><td>Expiry Date</td><td>26/07/21</td></tr>
<tr><td>Version No</td><td>2</td></tr>
<tr><td>Authorising Officer: Peter Smith</td><td colspan="2">Chief Executive Officer</td></tr>
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1. PURPOSE

The purpose of this policy is to:

1.1 Define the benefits of car share to members, the local community and Council;

1.2 Encourage the expansion of car share across the municipality between 2016 and 2021;

1.3 Provide clear targets for expanding the number of car share vehicles and members in the City of Port Phillip by 2021 to reduce the number of privately owned vehicles and create a shift to sustainable travel choices, in order to realise community benefits;

1.4 Outlines the rationale for any applicable car share fees and charges;

1.5 Articulate the criteria for the preferred location for on-street car share bays.

1.6 Provide a clear basis for Council procedures in how Council officers increase the number of car share vehicles and the coverage across the municipality.

2. SCOPE

2.1 The operation of Car Share on the road network within the municipality, including expanding the network of vehicles and any changes to on-street parking controls.

2.2 Supporting the provision of car share vehicles within appropriately located and designed developments through the application of the Port Phillip Planning Scheme.

2.3 This policy only applies to commercial Car Share Providers. Peer-to-peer car share schemes are excluded from this policy except for the purposes of promotion and reporting.

2.4 This policy does not apply to any agreement between Car Share providers and a third party entered into for the purposes of providing a car share vehicle within privately owned property.

3. REFERENCES

3.1 Car Share delivers on key objectives from the "Vibrant" and "Healthy" sections of the Council Plan. Specifically it addresses the following three focus areas:

- 4.4 Ensure people can travel with ease using a range of convenient, safe, accessible and sustainable travel choices, and particularly actions to:
  - Plan for, and respond to, the changing transport needs of a high density community.
  - Minimise the impacts of motor vehicles on the liveability of our City.
- 4.2 Ensure growth is well planned and managed for the future
- 2.2 Support our community to achieve improved health and wellbeing
- Council's *Sustainable Transport Strategy* which sets Council's vision for a connected and liveable city where residents, visitors and workers can live and travel without needing to own a car by improving the convenience, safety, accessibility and range of sustainable travel choices across the municipality. The policy supports the Strategy by supporting the realisation of the following:
  - o Council's commitment to achieve an aspirational 50% reduction in community greenhouse gas emissions per person by 2020 (based on 2006 levels) as articulated in the Toward Zero Environmental Strategy.
  - o Supporting outcome: Motor Vehicles – Smarter with Less

    Reduced vehicle usage and ownership by providing for sustainable modes of travel, car share schemes and encouraging the uptake of more efficient vehicle technologies and driver behaviour.
  - o Council has committed to encourage households and businesses to use car share schemes.

3.2 The *Port Phillip Planning Scheme*, Clause 52.06 - Car Parking.

3.3 Council's *Sustainable Transport Policy and Parking Rates 2007*.

3.4 The *Local Government Act 1989,* Clause 1 of Schedule 11.

4. DEFINITIONS

4.1 Car share providers (CSP) are approved by Council to apply for car share bays and provide vehicles for their members to use.

4.2 On-street car share bays refer to dedicated parking spaces located on local and arterial roads, which are occupied by a vehicle provided and managed by the respective Car Share Provider.

4.3 Off-street car share bays refer to parking spaces in off-street car parks, residential or commercial buildings or properties.

5. COUNCIL POLICY

5.1 Benefits of Car Share to the City of Port Phillip

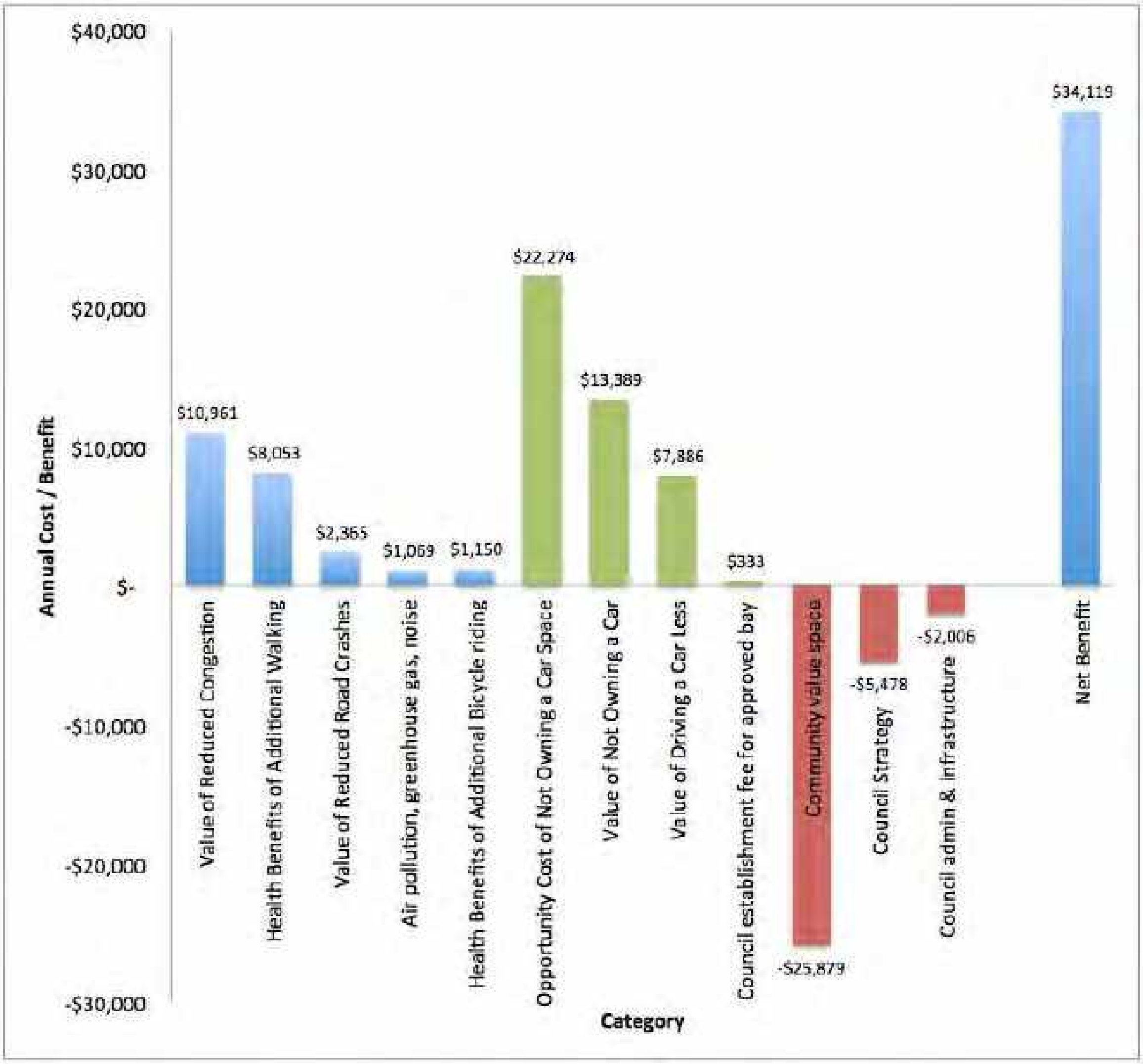
5.1.1 A network of easily reached and distributed car share vehicles provides benefits to the member (user), local residents (non-users) and the broader community. As such, the expansion in the 'network coverage' and number of car share vehicles across the municipality is encouraged, as it generates the following benefits:

- Lowering private vehicle ownership levels;
- Reducing local parking pressures and improving parking availability around the car share vehicle location (Research shows that one Car Share Vehicle replaces an average of 10 privately owned vehicles);
- Supporting shifts towards more walking, bike riding and public transport trips, by being a complementary travel choice;
- Residents and businesses who become car share members save money, by avoiding the cost of car ownership.
- Generates a number of secondary benefits and opportunities. This includes social equity as people can access a vehicle without owning a vehicle, increased physical activity, greater local expenditure and better environmental performance through less vehicle emissions and local amenity.

5.1.2 Independent research by Phillip Boyle & Associates indicates that investment in Car Share by Council delivers a Cost Benefit Ratio of $2.43 for every $1 spent, as shown in **Figure 1.**

Figure 1 Annual Benefit and Cost of each Car Share Vehicle in the City of Port Phillip

Public Benefit **Private Benefit** **Public Cost**



5.2 Target for the number of car share spaces and membership in 2021

5.2.1 Council seeks to realise a network of 330 car share vehicles (both on and off-street) across the municipality by 2021. Expansion targets for car share are based upon reducing the level of private vehicle ownership within the municipality. Current trends in growth are that if not addressed a further 2,904 vehicles will added to the already 51,927 privately owned vehicles located within the City of Port Phillip between 2016 and 2021.

5.2.2 The target of 330 car share vehicles by 2021 is intended to stabilise car ownership levels at 2015 levels (52,000 privately owned vehicles). Assuming incremental expansion of on-street car share vehicles then this could follow the pattern shown in **Table 1**.

Table 1: Proposed annual expansion of car share vehicles to reach 2021 target.

Financial Year	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Number of car share vehicles in service	103	147	191	235	282	330
Number of new car share bays created per annum	44	44	44	47	48	

5.2.3 Council reserves the right to amend the target upwards, as part of a mid-policy review to be completed by December 2018. Amending the target upwards will be based upon the levels of car share utilisation, membership per vehicle and the benefits of car share quantified through monitoring and reporting data supplied by the Car Share Providers to Council, in order to affect greater reductions in private vehicle ownership to pre-2016 levels.

5.2.4 Council will work with car share operators to promote car share and increase membership in car share schemes to 10% of the resident population.

5.3 Fees and charges

5.3.1 Council seeks cost neutrality in providing on-street car share bays, managing the implementation of the policy and monitoring performance and reporting. In determining appropriate establishment fees and any annual charges, Council takes into consideration the following factors:

- Administration and management costs;
- Officer time dedicated to the expansion of the network of car share bays;
- The value of car spaces for residents;
- Demand for on-street car share bays; and
- The direct community benefits of car share.

5.4 Siting and location criteria for on-street car share bays

5.4.1 Council's Sustainable Transport Strategy provides four guiding principles which help to inform the general locations and more specific siting criteria for the placement of new on-street car share bays shown in **Table 3** and **Figure 2** shows the Hierarchy of Parking Need from Council's Sustainable Transport Strategy.

5.4.2 Council officers and CSPs will follow these criteria in determining the ideal placement of car share bays and thus vehicles to maximise the vehicle use and as a result, the benefits of car share to our local community and members.

Table 3: Location and siting criteria for determining car share bay placement.

Sustainable Transport Strategy Guiding Principles	Criteria for Determining Car Share Bay Placement
1. ***Ensure Priority*** – The Council will give preference to, and right of way to sustainable transport modes in terms of allocating time, space and facilities, guided by Council's Road User Hierarchy.	**Location Criteria:** **Parking Hierarchy** • Follows the hierarchy of parking need in determining the location, based on parking controls nearby. **Convenient** • Place cars outside residential or commercial properties. • Place cars where users request them or where demand is demonstrated. •
	Siting Criteria: **Favourable Context** • Near activity and community hubs, areas of high employment, residential densities or low vehicle ownership.
2. ***Increased Integration*** – The Council will strive to achieve a City where places are interlinked through walking, bike riding and public transport routes that are efficient, direct, attractive and competitive.	**Location Criteria:** **Transport Integration** • Place near tram or bus stops or train stations. • Place on arterials and "exits" to communities.
	Siting Criteria: **Effective Catchment** • Put cars within 300m of each other to provide 'coverage'. • Put cars at intersections to maximise access catchment. **Efficiency**

	• Uses spaces which are no longer required and can be re-purposed (loading zones, taxi zones, and residential disabled parking bays). • Locations where works have created new space (redundant cross-overs removed, street furniture relocated). • Authorise 'small bays for small cars'.
3. ***Improve Safety and Accessibility*** – Council will work to provide conditions which allow people of all abilities to feel safer using our streets and sustainable transport options.	**Location Criteria:** **Safety** • Orientated so it does not block sightlines from access ways, crossovers or pedestrian crossing points (formal and informal). • Provides clearances from service covers, drainage pits and conduits. **Mobility impaired** • Preserves DDA accessibility such as dropped kerbs, circulation space next to disabled parking spaces, tram and bus stops.
	Siting Criteria: • Minimum setback from vehicle crossovers and intersections is maintained.
4. ***Raise Profile*** – The Council will strive to raise the profile of walking, bike riding and public transport along with the benefits of these transport modes through provision of information, facilities and active promotion to drive change in travel behaviour.	**Location Criteria:** **Visibility** • Ideally bays are at the beginning or end of a row of parking. • A proportion of bays close to shopping strip, major attractors or areas of high pedestrian traffic. • The choice of vehicle (sedan, wagon, van) must reflect the ground floor use of adjacent buildings and the surrounding streetscape to ensure it does not obscure or be out of scale within the locations context. **Promotion and Awareness** • Communicates the benefits of car share on lowering parking demand and cost saving for people becoming members. • Clearly communicates the purpose of the car share bay.

Figure 2: Council's Hierarchy of Parking Need

5.5 Supporting the Provision of Car Share Vehicles within New Developments

5.5.1 Council supports the provision of car share vehicles within new developments to not only reduce the need for car parking and car ownership for the specific development, and lessen the impact of this on the locality, but also to supplement the on-street network of car share in the locality of the new development.

5.5.2 Within new developments the provision of a car share scheme operated by a Car share Provider is supported by Council along with a reduction in the number of car parking spaces provided on-site. This will be considered in conjunction with Council's *Sustainable Transport Policy and Parking Rates 2007* and the *Port Phillip Planning Scheme* (Provision 52.06 – Car parking).

5.5.3 Public access is required to be provided to the car share vehicle within each new development. This necessitates careful design and location of car share bays within new developments to ensure easy access to the car share vehicle and make it convenient to use. Guidance on the location and design of the car share bay within new developments is included within **Attachment 7**.

5.6 Car Share as a Travel Choice for Our Community '

5.6.1 Council recognises that Car Share is a travel choice or 'service' for the local community. In order to be a viable travel choice and alternative to private vehicle ownership Council seeks to create a network of car share vehicles that provide municipality-wide coverage.

5.6.2 The proposed distribution of car share vehicles, across each Sustainable Transport Planning Precinct between now and 2021is shown in **Figure 3.**

5.6.3 Further details on how Council will guide the creation a network of car share vehicles is included in **Attachment 8.**

Figure 3: Distribution of current and proposed car share vehicles by precinct

5.7 Roles and Responsibilities

5.7.1 Car Share Providers (CSP) are responsible for providing documents to become qualified, as outlined in **Attachment 1** and providing vehicles, membership and levels of service that meet requirements, providing quarterly and annual reports and maintaining vehicles as outlined in **Attachment 2.**

5.7.2 Council is responsible for approval of car share applications, consulting adjacent properties, installation of car share bays and promoting the benefits of car share as outlined in **Attachment 3** with the Application Process for New On-Street Car Share Bays outlined in **Attachment 4** and the City of Port Phillip Car Share Enforcement Procedure described in **Attachment 5**.

5.7.3 Developers and Body Corporates are responsible for meeting the requirements of the planning scheme, planning permits and ensuring that the operation of the development continues to comply with the planning permit and conditions relating to the car share vehicle and bay within the development.

6. CAR SHARE PROCEDURES

The relevant procedures for implementing the City of Port Phillip Car Share Policy 2016 – 2021 are detailed in the supporting document and set out within the following attachments:

Attachment 1 - Car Share Provider (CSP) Qualification Criteria

Attachment 2 - Obligations of Car Share Providers

Attachment 3 - Obligations of Council

Attachment 4 - Application Process for New On-Street Car Share Bays

Attachment 5 – City of Port Phillip Car Share Enforcement Procedure

Attachment 6 – Car Share Bay Application Form (September 2015)

Attachment 7 – Location and Design Criteria for Car Share Vehicles within New Developments

Attachment 8 – Council's Approach to Expanding Car Share

Attachment 1: Car Share Provider (CSP) Qualification Criteria

1.1 Only CSPs that are considered suitable can apply for car share bays within the City of Port Phillip. To determine whether a CSP is qualified they must demonstrate their compliance to criteria detailed below.

1.2 Insurance:

1.2.1 The CSP will need to hold a current Public Liability Policy of Insurance for the sum of

10 million dollars. The CSP must provide the Council with a certificate of currency in respect of the insurance/s referred to above.

1.3 Car Share Vehicle Requirements:

1.3.1 Providers must supply a range of vehicles based on an assessment of local needs, encompassing passenger vehicles, vans and utility vehicles.

1.3.2 There is to be no third party advertising placed on car share vehicles unless by prior agreement for a specific purpose such as to offset the costs of wheelchair accessible vehicles. The CSP's branding must be readily distinguishable for enforcement purposes.

1.3.3 All passenger vehicles must have a minimum 4 star ANCAP safety rating. Average emissions for passenger vehicle fleets of 160 grams of carbon dioxide equivalent emissions per kilometre in 2018, reducing by 5 grams per kilometre annually until 2021.

1.3.4 In the case of vans or utility vehicles, the operator must demonstrate that the vehicle is a high environmental performer for its class.

1.3.5 The vehicle must not be a caravan, box trailer and must not exceed 4.5 tonnes gross weight.

1.4 Car Share Membership Requirements:

1.4.1 There are to be no restrictions to membership based on the age of car share members.

As defined in VicRoads' Traffic Management Note No. 28[1]:

- A car share vehicle is for the exclusive use of car share members
- A member of a car share scheme is a person who has fulfilled membership requirements with a CSP
- Vehicles are available to car share members only. There are to be no casual memberships made available as is the case with hire car companies.

1.5 Minimum Level of Service:

1.5.1 Car share vehicles will be available for a minimum booking period of one hour.

1.5.2 CSPs must ensure that no on-street space remains empty for a period greater than five consecutive days, unless by prior written agreement.

1.5.3 A CSP must ensure vehicles can be booked via both an Internet and telephone

[1] VicRoads Traffic Management Note No. 28 – Guidelines for the Implementation of Car-Share Parking, November 2009.

booking service available 24 hours a day, 7 days a week.

1.5.4 The CSP must provide a customer support service during business hours seven days a week.

1.5.5 The CSP must be capable of demonstrating they comply with the obligations set out in Section **Attachment 2** of this policy.

Attachment 2: Obligations of Car Share Providers

2.1 Promotion

Each Car Share Provider is solely responsible for the promotion of their service to prospective and existing members. Council will continue to promote the concept of car sharing as a travel choice that complements walking, bike riding and public transport travel and an alternative to a privately owned vehicle.

2.2 Reporting:

2.2.1 Council requires CSPs to collect usage information on their individual car share vehicles and bay locations as well as general membership characteristics for reporting purposes.

2.2.1 CSPs will agree to report quarterly in a standardized spread sheet on the following characteristics, at a minimum, for each on-street and off-street vehicle e.g.:

- Total number of hours booked per month
- Total number of trips per month
- Utilisation rate per month (number of hours the vehicle is booked per month/time vehicle is available per month)
- Total distance travelled per month
- Average trip distance per month
- Number of trips over 50km per month
- Number of trips undertaken on weekdays per month
- Number of trips undertaken on weekends per month.
- Average emissions of passenger vehicle fleet.

2.2.2 CSPs will agree to report quarterly on the following characteristics, at a minimum, on their members e.g.:

- Membership numbers per month
- Percentage growth in membership by month
- Breakdown of members by private or corporate membership (if applicable) by month
- Geographical location of members within the City of Port Phillip by postcode.

2.2.3 In addition to submitting quarterly reports, CSPs will agree Council can request a report at any time on the usage characteristics of any one bay if required.

2.2.4 CSPs will agree to conduct an annual survey of Port Phillip members' travel habits and car ownership levels. Questions will be provided by the Sustainable Transport team.

2.3 Maintaining Car Share Locations:

2.3.1 The CSP must supply a vehicle to the approved bay within ten working days of installation (or by prior written agreement) as per the terms of the Agreement.

2.3.2 Council's Transport Safety Engineering team is responsible for maintaining signage and line marking of the car share bay, however the CSP must ensure that:

- In the course of maintaining or cleaning car share vehicles, no refuse shall be disposed onto the street
- No existing or approved structures, fixtures or fittings shall be altered or added to without written approval of the delegate
- Any approved fixtures, such as information panels, are kept in good condition and the information they contain is kept up to date by the CSP.

2.4 Enforcement Procedure:

2.4.1 Demand for on-street parking in the City of Port Phillip is high. CSPs need to adhere to, and inform their members of, the enforcement procedure set out in **Attachment 5** should a car share bay be illegally occupied by a non-car share vehicle.

2.5 Allowing Access to Car Share Bays:

2.5.1 The CSP will grant Council access to the bay for necessary activities such as line marking, road works, festivals or events. Council will aim to provide advanced notice to the CSP in these situations.

2.6 Failure to Meet Obligations:

2.6.1 Ability to terminate an agreement is as per Council's Register of Delegations.

2.6.2 Council can suspend the CSP's right to use one or more of the allocated car share spaces if they fail to meet any of the obligations listed above and can choose to reallocate bays to another CSP.

Attachment 3: Obligations of Council

3.1 The individual responsibilities of each Council work unit are outlined below:

3.1.1 Car Share Officer is responsible for:

- Assessment and approval of car share bay applications using the siting and location criteria (jointly with Transport Safety Engineering).
- Informing Councillors of the Car Share Bay locations which are being considered
- Consulting properties immediately adjacent to proposed bay locations to ascertain whether they have any legitimate concerns or objections.
- Ensuring CSPs are set up as Debtors on Council's financial system
- Informing Procurement via an Invoice Request Form to invoice CSPs for the required number of approved car share bays.
- Informing the Sustainable Transport team of the proposed make and model of car share vehicles to be supplied by CSPs for approval
- Informing the Sustainable Transport team with the locations of new bays once they have been implemented.
- Updating the map of car share bays within the municipality on Council's website twice a year.
- Informing Parking and Enforcement of the location of new bays once they are Implemented.
- Serving as the point of contact for CSPs regarding applications for car share bays and invoicing for new car share bays..

3.1.2 Transport Safety Engineering is responsible for:

- Assessment and approval of car share bay applications using the siting and location criteria (jointly with Car Share Officer).
- Providing referral advice to Statutory Planning about the suitability of proposed off-street car share spaces.
- Arranging contractors to install new bays (signage and line marking) and to refresh signage and line marking of existing bays as deemed necessary by the Coordinator of Transport Safety Engineering
- Serving as the point of contact for CSPs regarding maintenance of existing car share bays.

3.1.3 Sustainable Transport is responsible for:

- Overseeing the CSP qualification process
- Working the Contracts, Procurement and Fleet area to develop a suitable contract with car share providers
- Approving the make and model of car share vehicles to be supplied by CSPs
- Monitoring performance of car share bays based on reports received from operators
- Designing an annual survey of car share member travel habits to provide to CSPs

- Recommending to Council appropriate fees and charges and ensuring that this is included in the Car Share Application Form.
- Working with City Strategy to progress the inclusion of car share provision, location and design requirements in the planning scheme, requisite research and planning scheme amendment preparation. This will include determining the ideal approach and mechanisms to facilitate greater car share provision within developments.
- Using Council's communication channels to:
    - Show that car share vehicles are readily available in the City of Port Phillip and help residents identify the locations and providers that are most convenient for them.
    - Encourage residents and businesses to join and use car share services.
    - Promote car sharing as a travel choice that complements walking, bike riding and public transport travel and an alternative to a privately owned vehicle.
    - Increase the awareness of decision-makers including Councillors and Council officers, and the broader community of the benefits to the local community and ease of use of car share.
- Updating the schedule of bays in the CSP's Contract of Agreement

3.1.4 Parking Enforcement is responsible for:

- Maintaining the policy and procedure for the enforcement of car share bays
- Serving as the point of contact for CSPs regarding enforcement of car share bays
- Responding to requests to issue parking infringement notices to non-car share vehicles parked in car share bays.

3.1.5 Statutory Planning is responsible for:

- Seek the inclusion of car share bays that are well located and designed in new developments to enable convenient access and ease of use within planning applications and providing information about car share to developers during pre-application meetings.
- Ensuring that planning permits include installation of off-street car share bays where appropriate.

3.1.6 ASSIST is responsible for:

- Taking general enquiries from the community about the car sharing
- Serving as the point of contact for CSPs if a car share bay is found to be illegally

  occupied by a non-car share vehicle. The ASSIST Centre will then transfer the call from the CSP to the Parking Enforcement team.

Attachment 4: Application Process for New On-Street Car Share Bays

4.1 Council reserves its rights to determine the number of available car share bays prior to the application process.

4.2 Applications for new car share bays will be accepted generally twice per year and Council will provide six weeks' notice of the dates.

4.3 Council will advise how many bays are available to be applied for prior to the start of the application process.

4.4 Qualified CSP are encouraged to nominate at least one additional location and prioritise their applications so that if a proposed location is deemed unsuitable another can be considered.

4.5 Qualifying CSPs must follow the process outlined below to apply for new bays:

4.5.1 Step 1: Submitting the Application

- The CSP must complete an application form for each bay they wish to apply for and submit it to Council's Car Share Officer for approval.

4.5.2 Step 2 Assessment of Applications:

As part of their application, CSPs will have to demonstrate the demand for a car share bay at their chosen location. To demonstrate the demand for a bay CSPs can refer to:

- The number of existing car share members or potential new members living/working nearby
- Utilisation rates of existing car share vehicles located nearby
- Potential demand based on an assessment of relevant demographics e.g. household size, age of population etc.
- Number of requests from existing car share members or registrations of interest from potential new members.

4.5.3 CSPs must consider Council's Siting and Location Criteria including the Hierarchy of Parking Need when applying for new bay locations. The hierarchy prioritises safety and sustainability while aiming to accommodate the parking needs of residents, businesses and visitors.

4.5.4 Consideration will be given to applications for pods with multiple vehicles if sufficient demand can be demonstrated based on the number of members and/or high usage of existing car share vehicles in the vicinity of the proposed location.

4.5.5 In general, applications for new car share bays will not be considered where parking or stopping is prohibited by Road Rules Victoria, such as in clearways, at the location of bus stops.

4.5.6 Each application will be assessed on its own merits in conjunction with Council policy.

4.6 Step 2: Application Assessment

4.6.1 Council's Car Share Officer will assess the application and the suitability of the proposed car share bay location and will provide fortnightly updates to CSP of progress on the application.

4.6.2 If required, the Car Share Officer will undertake consultation with properties immediately adjacent to the proposed bay location and will inform Councillors of locations prior to consultation.

4.6.3 Where the proposed location is deemed unsuitable by the Transport Safety Engineering team or where the consultation is unsuccessful, an effort will be made to find an alternative location for the bay nearby.

4.7 Step 3: Payment of Establishment Fee and any annual fees

4.7.1 Transport Safety Engineering will require payment of the establishment fee for each approved car share bay location. An invoice will be issued to the CSP payable within **30 days** by electronic funds transfer. If payment is not received in 30 days the allocation of the bay allocation will be cancelled.

4.7.2 Any annual frees will be levied on 1 July for each financial year and must be paid in full before any new car share bays are installed.

4.8 Step 4: Bay Installation

4.8.1 Once payment has been received, Transport Safety Engineering will engage a contractor to implement signage and line marking for the required number of bays.

4.8.2 Council will endeavour to implement signage and line marking of the car share bay **within six to eight weeks** of receiving payment, subject to the contractor's availability and weather conditions.

4.9 Step 5: Updating Council Records

Once the bays have been installed, the Car Share Officer will update the list of locations on the Council website and inform the Sustainable Transport team of the new locations for addition to the schedule of bays in the CSP's Contract of Agreement.

4.10 Duration of Agreement:

4.10.1 The duration of the agreement will last for a period of **five years** after which time it will come under review by Council.

4.10.2 Council reserves the right to take back bays at any time if necessary and will give the CSP a minimum of **one month's notice** in writing should the situation arise. Council will attempt to relocate the car share bay in question at no cost to the CSP.

4.10.3 The CSP may terminate the agreement upon giving the required amount of notice to Council as defined in the terms of the Agreement.

4.10.4 Council's Transport Safety Engineering team will consult the properties immediately adjacent to the proposed bay location in writing, if applicable, to ascertain whether the occupiers have any legitimate objections. Providing there are none, Traffic and Parking Design will install the appropriate signs and line marking according to the timeframes specified.

4.11 Removing or Relocating installed car share bays

4.11.1 Council reserves the right to remove an existing Car Share Bay at any time. In this event Council will advise the CSP of its intention and cover the costs involved. The CSP will have the opportunity to nominate a new bay for installation which will follow the standard application process.

4.11.2 If a CSP wants to remove a car share bay and another CSP does not want to utilise the bay, the CSP will be liable for the cost of removing the car share bay.

Attachment 5: City of Port Phillip Car Share Enforcement Procedure

5.1 Demand for on-street parking in the City of Port Phillip is high. Providers need to adhere to, and inform their members of, the following procedure should they find a car share bay to be illegally occupied by a non-car share vehicle:

5.2 Step 1: CSP Notification of an Illegally Parked Vehicle

- Members must immediately inform the CSP if a non-car share vehicle is parked in the car share bay and provide them with the offending vehicle's registration details.
- Members should then park the car share vehicle legally. As close as possible to its designated bay observing clearways, disabled bays and timed restrictions, and inform the CSP of its whereabouts. The car share vehicle will be exempt from paid parking charges.

5.3 Step 2: Council Notification of an Illegally Parked Vehicle

- The CSP is to notify Council's Parking Enforcement team, via the ASSIST Centre's general contact number within 1 hour of being notified, and provide them with the location of the offending vehicle and its registration details as well as the location of where the car share vehicle was parked. The CSP must advise the member to park the vehicle within the City of Port Phillip boundaries or for car share vehicles that are located within private car parks, the vehicle should be parked within the same private car park

5.4 Step 3: Infringement of Illegally Parked Vehicle

- Parking Enforcement will respond to requests to infringe illegally parked vehicles subject to the response times listed in the Parking Enforcement Procedure.

5.5 Step 4: Returning the Car Share Vehicle to the Car Share Bay

- The CSP must ensure that the car share vehicle is returned to the car share bay within 12 hours of notification by Council.

Attachment 6: **Application Form for On-Street Car Share Bays (March 2016)**

Applications must be lodged with Port Phillip City Council (**Council**) Transport Safety Engineering team via email at *transport@portphillip.vic.gov.au* by 15 April 2016. Council reserves the right to refuse any incomplete applications, or ask for further information where required. By submitting an application, the Applicant agrees to comply with the terms and conditions of the On-Street Car Share Scheme Agreement.

All enquiries regarding the application should be addressed to Council at *transport@portphillip.vic.gov.au* or (03) 9209 6239.

1. Applicant's Details

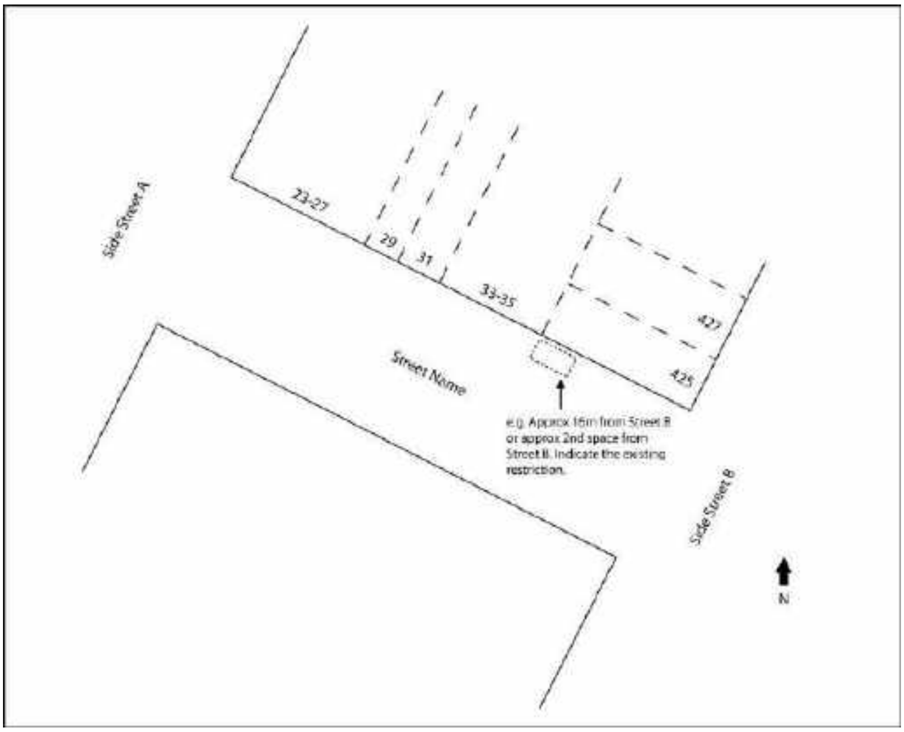
Company name:	
Company address:	
ABN:	
Contact Person:	
Phone number:	
Fax number:	
Email:	

2. Proposed Car Share Bay Location2

Please provide the following:

- Street address
- Aerial view of showing location of proposed bay.
- Street view clearly showing proposed bay.
- Existing parking restrictions at the proposed bay location
- Land use abutting the proposed bay location
- Proximity to nearest car share vehicle(s)
- Proximity to public transport stops or train stations (if applicable)

Figure 1: Aerial view for Proposed Car Share Bay (example only)



If more than 1 location is requested, please attach **additional** pages as required- Please ensure each bay is in order of preference.

Does the Applicant propose to install an information panel at the location[3]:

☐ No

☐ Yes, please provide details of the dimensions of the information panel (height, width, depth) and proposed content.

3. Basis for Demand[4]

• Number of existing car share members within a 500m radius	
• Number of potential new members within a 500m radius	
• Utilisation rates of existing car share vehicles within a 500m radius expressed as a ratio of car to members	
• Other indicators of estimated demand: e.g. household size, age of population, growth in monthly membership etc.	

4. Proposed Car Share Vehicle At Location

Vehicle 1	**Vehicle 2 (Alternate)**
Proposed make(s):	Proposed make(s):
Proposed model(s):	Proposed model(s):
ANCAP safety rating: *stars*	ANCAP safety rating: *stars*
Carbon emissions per vehicle: *grams/km*	Carbon emissions per vehicle: *grams/km*

5. Payment of Application Fee

3 Council does not support the attachment of brochure holders or other temporary fixtures to signposts.
4 Applicant should provide as much details as possible and where appropriate, supply references.

Based on the information provided in the application, Council will determine the suitability of the proposed car share bay location and will undertake consultation if required.

Council may in its discretion reject any application. In that event, Council may propose an alternative location for the Applicant.

If the Applicant is successful, the Applicant must pay Council a $1,000 bay establishment fee (**Fee**) by electronic funds transfer within 30 days of notification. If the Fee is not paid by the deadline, Council may reject the application. Council may in its discretion, amend the Fee.

6. PRIVACY NOTICE

The *Privacy Act 1988 (Cth)* makes provisions for collecting, storing using and disclosing personal information, which has implications for the way in which Council handles personal information in its possession or control.

Council will only use the Applicant's personal information for the purposes provided to it. Council does not share the Applicant's information with other organisations, or other persons without the Applicant's permission unless it is reasonably necessary for the purpose or when Council is required or authorised by law to do so.

THE APPLICANT CERTIFIES that all information provided under this application and the attached supporting documentation is true and correct and AGREES to the Terms and Conditions of the Car Share Scheme.

Executed for and on behalf of ____ by its Authorised Representative:

Signed: …………………………………….. Name: ……..……………………………

Position: …………………………………….. Date: ………………………………………

Attachment 7 – Car share Bays in New Developments - Location and Design Guidance

7.1 The below criteria provide guidance to the location and design of car share bays within new developments:

- ✓ The car share space must be accessible 24 hours a day, seven days a week by any member of the car share provider, and by employees or contractors of the car share operator in order to clean, detail or service the car.
- ✓ A highly visible location from the street
  - o for buildings with car parks in the front setback, in the front set back of the site adjacent to visitor car spaces.
  - o for buildings with car parks at the rear, at the rear of the site adjacent to visitor car spaces or loading facilities.
- ✓ Ideally in front of boom gates
- ✓ In the first level of a multi-storey car park (be it ground level, the first level up or first level down)
- ✓ In a separate location to where other, assigned / subdivided car spaces are provided
- ✓ Where security arrangements are not required or are simple to follow (and where customers can use the same mechanism that they use to get into the vehicle)
- ✓ In a well-lit part of the site
- ✓ a short distance from an entry point, lift or staircase
- ✓ In a standard car space where manoeuvring in and out of the space is limited to no more than three movements
- ✓ On common property managed by the Owners' Corporation
- ✓ Minimum height clearance of 2.2 m to allow a cleaning van to enter, manoeuver and exit.

- ✓ Mobile data and GPS reception
- ✓ Markings for exclusive use of the car share vehicle

Attachment 8 – Council's Approach to Expanding Car Share

8.1 Council intends for the expansion of the network of car share vehicles to grow outward from the existing vehicle locations into other parts of the municipality to achieve coverage across the City of Port Phillip. Into the future expansion of car share will be considered through an area approach.

8.2 Council may request that new car share bays will be located in specific parts of the municipality.

8.3 An analysis of the capacity for expansion of the Car Share network in different areas was completed and considered the following factors:

- population forecasts;
- journey to work data;
- current car ownership levels;
- household incomes; and
- levels of parking demand across the municipality.

8.4 The proposed distribution across the Sustainable Transport Planning Precincts is detailed within **Table 1** below.

CITY OF PORT PHILLIP

Table 1 Proposed distribution of car share vehicles by Sustainable Transport Planning Precinct							
Precinct Number	**Sustainable Transport Planning Precinct**	**On-road car parking spaces** (Based on Car Parking Capacity Study 2014)	**Proposed Car Share Vehicles by 2021 to meet target of 330 by 2021**	**Current number**	**Additional proposed by 2021**	**Car Share Bays as a Proportion of on-road car parking spaces**	**Comments on capacity for future growth of car share**
1	Fishermans Bend	2,590	35	0	35	1.4%	Ensure planning requirements apply
2	Port Melbourne	9,435	55	13	42	0.6%	Expand strongly
3	South Melbourne	5,660	28	10	18	0.5%	Limited expansion
4	Albert Park	6,324	27	5	22	0.4%	Expand
5	St Kilda Road	1,456	15	4	11	1.0%	Expand strongly (particularly off street)
6	St Kilda	4,505	32	22	10	0.7%	Limited expansion
7	Middle Park & St Kilda West	6,941	30	4	26	0.4%	Expand
8	St Kilda East	4,642	37	4	33	0.8%	Expand
9	Balaclava and Ripponlea	3,398	23	9	14	0.7%	Expand especially near apartments
10	Elwood	5,616	48	8	40	0.9%	Expand especially near apartments
	Total	**50,567**	**330**	**79**	**152**	**0.7%**	

CITY OF PORT PHILLIP BIODIVERSITY STUDY

07 MAY 2020

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BIODIVERSITY STUDY

City of Port Phillip Biodiversity Study and Action Plan

Client: City of Port Phillip

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Approver	Camilla Freestone
Project No	10036163
Date	7/05/2020
Revision Text	Version 2 (Final)

This report has been prepared for City of Port Phillip in accordance with the terms and conditions of appointment for City of Port Phillip Biodiversity Study and Action Plan dated 28 August 2019. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

Cover photo: Coast Banksia *Banksia integrifolia*, by Renae Walton.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
01	16/03/2020	First draft	F Sutton, N Roberts, R Gration	C. Freestone
02	07/05/2020	Final addressing comments received from CoPP	N Roberts	F Sutton

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ACKNOWLEDGEMENTS

The Authors would like to thank the following people for their contributions in preparing this City of Port Phillip Biodiversity Study:

- Renae Walton, City of Port Phillip
- Matt Dell, dellbotany
- Gio Fitzpatrick, local naturalist
- April Seymore, Reiko Yamada and Neil Blake, Port Phillip EcoCenter
- Boon Wurrung Foundation
- Tara Shokouhi, Ryan MacManus, Lawrence Hill, Camilla Freestone, Nina Incerti Zapedowski, Arcadis

SUMMARY

Background

Arcadis was commissioned by the City of Port Phillip to undertake a Biodiversity Study and Action Plan project. This has comprised three parts:

- A thorough desktop review of ecological data available electronically and authoring of an associated Background Research Discussion Paper (Discussion Paper) to present the findings and identify ecological knowledge gaps that could be filled with further survey work.
- A Biodiversity Study (this report) to present the findings of field surveys undertaken in response to the findings of the Discussion Paper.
- Preparation of a Biodiversity Action Plan to promote, protect and enhance biodiversity values within the municipality.

The Discussion Paper identified the flora and fauna field survey priorities necessary to improve the knowledge of, and documentation consistency for, ecological values across the municipality. This formed the basis of site and survey type selection for this Biodiversity Study, which included the following:

Study site location	Vegetation mapping	Floristic quadrat establishment	Fauna surveys
Port Melbourne Foreshore (Sandridge Beach and First Point)	✓	✓	
St Kilda West Beach	✓	✓	
Port Melbourne Light Rail*	✓		
Elwood Coastline			
MO Moran Reserve	✓	✓	
Point Ormond/Elwood Teatree	✓	✓	✓ (1)
Elwood Foreshore and Reserve	✓	✓	✓ (1)
Elwood Canal Linear Reserve	✓		✓ (1, 2, 3)
Alma Park East	✓		
Canterbury Road Urban Forest			✓ (1)
St Kilda Breakwater			✓ (3,4)
St Kilda Botanical Gardens			✓ (2)

1 = Fauna habitat and microbat surveys

2 = Amphibians

3 = Reptiles

4 = Rakali (Water-rat)

*Refers to the parkland reserves either side of the light rail between Boundary Street and Graham Street, Port Melbourne.

Field surveys were used to identify and assess the natural values of the study area. The Ecological Vegetation Classes (EVCs) present at each site were identified and divided into zones based on variations in vegetation quality. Planted indigenous vegetation was included in assessments where it resembled an EVC. Where indigenous amenity plantings bore little resemblance to remnant vegetation they were mapped as separate 'plantings' zones.

A range of fauna survey methods were deployed using passive (sound recorders) and active methods. The studies concentrated on mammals—specifically microbats and Rakali—frogs and reptiles. A shorebird count was added to the surveys based on discussions with local naturalist, Gio Fitzpatrick. The targeted fauna surveys were as follows:

1. Canterbury Road Urban Forest – Bat survey
2. St Kilda Botanical Gardens – Bat and frog survey
3. Elwood Canal / Elster Creek – Bat, frog and reptile survey
4. Point Ormond Reserve – Bat survey
5. St Kilda Breakwater – Rakali survey
6. St Kilda Spit (a tidal sandbar artefact of the breakwater construction at St Kilda West Beach) – Shorebird / wader survey.

Results

Vegetation values

This study identified and mapped nine EVCs across the six study sites where vegetation surveys were conducted. They are:

- EVC 2: Coast Banksia Woodland (Coast Banksia dominated foreshore woodland, inland of Coastal Dune Scrub)
- EVC 3: Damp Sands Herb-rich Woodland (Eucalypt dominated woodland of inland areas with sandy-loamsoils)
- EVC 10: Estuarine Wetland (Sea Rush dominated plantings in drainage wetlands along the coast)
- EVC 160: Coastal Dune Scrub (Commonly salt-pruned and wind-swept scrub occurring on the primary dunes)
- EVC 175: Grassy Woodland (River Red-gum and Yellow Box dominated woodland of inland reserves)
- EVC 311: Berm Grassy Shrubland (Coast Saltbush dominated shrubland on breakwater groynes and berms)
- EVC 821: Tall Marsh (Common Reed dominated vegetation in an artificial wetland)
- EVC 879: Coastal Dune Grassland (Hairy Spinifex dominated grassland on the foredunes)
- EVC 914: Estuarine Flats Grassland (Grassland vegetation occupying moist depressions on primary dunes).

A total of 30 condition zones (Zone IDs) were identified across the six sites, including two zones defined as planted and not assigned to an EVC.

Of the 28 Zone IDs assessed against EVC benchmarks for condition, most were scored between 30% and 50% of pre-European condition. The highest condition score was 55%, which was for an area of Coastal Dune Grassland at Port Melbourne Foreshore. There were several areas of vegetation mapped that scored less than 20% for condition. These areas were all non-coastal, woodland vegetation and were often predominantly planted for utility and sometimes completely lacked understory, or in other cases lacked canopy. The condition scores of such sites are expected to increase as plantings mature, especially if understory enrichment plantings are continued and weeds are controlled.

Six permanent vegetation monitoring quadrats were established in four coastal EVCs at the targeted sites as indicated in the above table. Stakes, photographic records and location data were used to allow these quadrats to be accurately relocated in future years for monitoring purposes.

Two species classified as rare in Victoria were recorded, all or most of which appear to have been planted. Namely, Marsh Saltbush *Atriplex paludosa* subsp. *paludosa* and Coast Wirilda *Acacia uncifolia.*

Fauna values

Five microbat species were identified from their call features and, three species call complexes. A species call complex is where the characteristic call features used for identification are not present and the call could be of more than one species. The species and call complexes identified were as follows:

1. Chocolate Wattled Bat – *Chalinolobus morio*
2. Gould's Wattled Bat – *Chalinolobus gouldii*
3. Large Forest Bat – *Vespadelus darlingtoni*
4. Little Forest Bat – *Vespadelus vulturnus*
5. White-striped Freetail Bat – *Austronomus australis*

The three call complexes recorded were:

1. Forest bat complex – *Vespadelus* sp.
2. Long-eared bat complex – *Nyctophilus* sp.
3. Freetail / Gould's wattled bat complex – *Ozimops* / *Chalinolobus* sp.

Two species of frogs were recorded at the St Kilda Botanical Gardens, namely Peron's Tree Frog *Litoria peronii* and Southern Brown Tree Frog *Litoria ewingii.* Neither of these species are typically associated with urbanised environments.

Two species of shorebird were observed at the St Kilda Spit: Black-winged Stilt *Himantopus himantopus* and Red-necked Stint *Calidris ruficollis*. Two Chestnut Teal *Anas castanea* and four Nankeen Night Heron *Nycticorax caledonicus* were also observed whilst surveying for shorebirds and waders.

Twenty Rakali *Hydromys chrysogaster* were observed on the St Kilda Breakwater during the survey period with a further two observed coincidently when leaving the study site.

Significant Tree mapping

Aerial photography was analysed to predict the potential occurrence of Significant Trees on private property, as defined in the City of Port Phillip's Local Law (trees or palms with a trunk circumference of ≥ 150 cm measured 1 m from the base).

This analysis revealed that potential Significant Trees were more commonly located in the southern portions of the municipality, compared to the north, primarily in residential areas compared to industrial areas. The highest concentration of private properties with a high likelihood of containing Significant Trees were centred in Elwood (155 parcels) and St Kilda (115 parcels). St Kilda and St Kilda East contained the highest concentration of properties determined to have a Moderate likelihood, with 214 parcels and 147 parcels, respectively.

A comparison of different mechanisms available to protect Significant Trees and other ecological values is provided herein.

Recommendations

Further survey work is recommended at a number of sites not included in this Biodiversity Study, along with 10 yearly monitoring of the ecological values within the sites assessed and development of a Vegetation and Fauna Habitat Management Plan. These recommendations are incorporated and built upon in the City of Port Phillip Biodiversity Action Plan also being prepared as part of this project.

1 INTRODUCTION

The City of Port Phillip is a highly urbanised Council located near the heart of Melbourne with over 11 km of frontage onto Port Phillip Bay. The ecological values of the municipality are highly modified and have been subject to various levels of survey over the years, from extensive repeated bird surveys, NatureSpot monitoring to collect data on all lifeforms (from vertebrate animals and vascular plants to invertebrates, bryophytes and fungi), through to a near absence of ecological survey in some areas.

Arcadis was commissioned by the City of Port Phillip to undertake a Biodiversity Study and Action Plan project. This included a thorough desktop review of all ecological data available electronically and preparation of a Background Research Discussion Paper (Arcadis 2020; herein referred to as the Discussion Paper) to present the findings and identify ecological knowledge gaps that could be filled with further survey work. This Biodiversity Study is the second phase of the project to present the findings of field surveys undertaken in response to the findings of the Discussion Paper. The final stage is preparation of a Biodiversity Action Plan to promote, protect and enhance biodiversity values within the municipality. Through the project, consultation with important stakeholders has been undertaken, including Council departments, natural resource management contractors, the Boon Wurrung Foundation, environmental organisations and local naturalists in the community.

The Discussion Paper identifies an abundance of bird surveys across the municipality, while other ecological surveys have been generally lacking or undertaken on an ad hoc basis. To improve the knowledge of, and documentation consistency for, ecological values across the municipality, it was recommended that further surveys be undertaken as follows:

- Sandridge Foreshore and First Point: vegetation mapping and floristic quadrat
- St Kilda West Beach: vegetation mapping and floristic quadrat
- MO Moran Reserve: vegetation mapping
- Point Ormond: vegetation mapping, floristic quadrat, fauna habitat, microbat survey
- Elwood Teatree: vegetation mapping
- Elwood Foreshore and Reserve: vegetation mapping, floristic quadrat
- Port Melbourne Light Rail: vegetation mapping
- Elwood Canal Linear Reserve, Elster Creek: vegetation mapping, microbat, amphibian and reptile surveys
- Alma Park East: vegetation mapping
- Canterbury Forest – Middle Park: fauna habitat and microbat survey
- St Kilda Breakwater: fauna habitat, reptile and Rakali survey
- St Kilda Botanical Gardens: fauna habitat, microbat and amphibian survey.

This Biodiversity Study documents the findings of these field surveys and will be used to inform the Biodiversity Action Plan.

This study also includes the results of aerial photography analysis to predict potential occurrence of Significant Trees as defined in the City of Port Phillip's Local Law. Recommendations are made regarding potential planning mechanisms available to protect these trees and other biodiversity values.

1.1 Study area

The City of Port Phillip is 20.62 km^2 and lies within the Port Phillip and Westernport Catchment Management Authority region and Gippsland Plain bioregion. Most of the municipality is used for residential, business and industrial purposes, which have resulted in removal of most native vegetation and fauna habitat, and extensive modification of what little remains.

Situated on a 'sandbelt', the underlying geology primarily consists of coastal dunes from the Quaternary period or older (Cenozoic period) dunes that have formed into consolidated siliclastic rocks. There are also smaller areas of Quaternary alluvium along the banks of the Yarra River, Cenozoic volcanic rocks to the north of Albert Park Lake and a small outcrop of Silurian sedimentary rock (mudstone, siltstone, sandstone and conglomerate) (GeoScience 2020).

The average annual rainfall for the nearest weather station (Essendon Airport, approximately 11 km north-west of the municipality) between 1991 and 2020 was 503.6 mm, most of which falls in November (and December), and the least falling in March. The warmest month is January with an average daily maximum of 27.5ºC while the coldest is July with an average daily maximum of 13.9ºC (BOM 2020).

Climate projections released for Victoria and the Greater Melbourne region by CSIRO and DELWP (Clarke et al 2019a, b) indicate that the climate will continue to warm. For Melbourne, the climate could be more like the current climate of Wangaratta by the 2050s, with:

- Maximum and minimum daily temperatures continuing to increase over this century (very high confidence)
- Rainfall continuing to be very variable over time, with a long-term projection of continued decline in winter and spring (medium to high confidence), and autumn (low to medium confidence), but with some chance of little change, and
- Increased intensity of extreme rainfall events, but these will remain very variable in space and time.

The foreshore reserves provide a narrow corridor of habitat along most of the coastal boundary of the municipality, while the internal reserve system comprises a suite of parks and reserves with varying levels of habitat and connectivity.

Six study sites were selected for flora surveys and six for fauna surveys as follows (illustrated in Figure 1);

Flora surveys

- Port Melbourne Foreshore (Sandridge Foreshore and First Point)
- St Kilda West Beach
- Elwood Coastline (MO Moran Reserve, Point Ormond, Elwood Teatree, Elwood Foreshore Reserve)
- Port Melbourne Light Rail
- Elwood Canal Linear Reserve
- Alma Park East

Fauna surveys

- Canterbury Road Urban Forest – Bat survey
- St Kilda Botanical Gardens – Bat and frog survey
- Elwood Canal / Elster Creek – Bat, frog and reptile survey
- Point Ormond Reserve – Bat survey
- St Kilda Breakwater – Rakali survey
- St Kilda Spit (a tidal sandbar artefact of the breakwater construction at St Kilda West Beach) – Shorebird / wader survey.

Figure 1. The sites selected for flora and/or fauna survey as part of this City of Port Phillip Biodiversity Study.

2 METHODS

2.1 Desktop review

In addition to the thorough desktop review completed as part of the Discussion Paper (Arcadis 2020), the following databases and literature were also reviewed:

- Department of Environment, Land, Water and Planning (DELWP) NatureKit interactive map for Ecological Vegetation Class (EVC) mapping/modelling of the area (both extant and pre-1750) (DELWP 2020a), and EVC Benchmarks (DELWP 2020b)
- Planning Schemes Online (DELWP 2020c)
- Relevant GIS data and aerial photography
- Relevant publications, legislation, government policies and strategies.

2.2 Field survey

2.2.1 Vegetation and flora surveys

2.2.1.1 Vegetation mapping

The vegetation field surveys were conducted by two botanists between 5 December 2019 and 22 January 2020 at the following sites:

- Port Melbourne Foreshore (Sandridge Foreshore and First Point area)
- St Kilda West Beach
- Elwood coastline (including MO Moran Reserve, Point Ormond Reserve, Elwood Teatree, Elwood Park and Elwood Foreshore Reserve)
- Port Melbourne Light Rail corridor (including Cook Reserve, Smith Reserve, Turner Reserve, Hester Reserve, Fennell Reserve, Page Reserve, Gill Reserve, Howe Reserve and Walter Reserve)
- Elwood Canal Linear Reserve, Elster Creek
- Alma Park East (east of the railway line).

Vegetation field survey site locations are shown in Figure 1.

The sites were surveyed on foot to map native vegetation communities and record vascular plant species within them. All indigenous and naturalised vascular flora were identified to species level where adequate features were present to do so. Planted non-indigenous species were noted when they occurred within a native vegetation patch but a definitive list of cultivated species at each site was not created.

Within each site, native vegetation was mapped as either a ‘patch’ or ‘scattered tree’ as per the definitions specified in the Victorian *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP 2017):

- Patch
  - An area of vegetation where at least 25% of the total perennial understorey plant cover is native
  - Any area with three or more native canopy trees where the where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy, or
  - Any mapped wetland included in the Current wetlands map, available in DELWP systems and tools.
- Scattered tree
  - A native canopy tree that does not form part of a patch.

Native vegetation was assigned an EVC with reference to DELWP's EVC modelling (DELWP 2020a) and EVC benchmarks (DELWP 2020b). Vegetation Quality Assessments were completed for patches of native vegetation following the Vegetation Quality Assessment Manual (DSE 2004).

Vegetation that was exclusively planted, apparently within the past five years, was not assigned to an EVC but instead mapped as a recent indigenous or mixed planting. More mature plantings were often indistinguishable from naturally colonised or remnant vegetation and were therefore treated as such. Indigenous enhancement plantings within mature patches were also assessed as part of the remnant.

2.2.1.2 Floristic quadrats

Six permanent quadrats were established across the study area to provide a reference for changes in floristic assemblages over time. They were established in areas of representative remnant vegetation where stakes could be easily disguised from tracks when necessary. Garden beds and more highly modified areas of vegetation were avoided.

As patches of remnant vegetation within the sites are generally quite small and/or narrow, 10 m x 10 m quadrats were determined to be the most suitable size. Each quadrat was aligned in a (true) north-south orientation and marked with a permanent wooden stake with a pink spray painted top in the north-west corner. The stake was photographed *in situ* from an angle that showed any nearby landscape or vegetation feature that would facilitate finding it again in future years.

At each 10 m x 10 m quadrat (100 m^2), the following data were collected:

- GPS coordinates at the location of the stake
- Two photos of the quadrat taken from just behind the stake in the north-west corner (one facing east-south-east, the other south-south-east) to encompass the entire quadrat within the photo-point.
- EVC: Where possible, quadrats were positioned within a single EVC.
- Native and exotic vascular plant species occurring within or overhanging the quadrat, with the following data recorded:
  - Cover, estimated as <1%, 1–5%, 5–10%, 10–15% and so on in 5% intervals to 95–100%
  - Distribution classed as Localised, Scattered or Widespread
  - Recruitment, assessed for all indigenous woody species only, with the definition of a recruit being "*an immature woody plant that contains no evidence of flowering or fruiting material*" (DSE 2004).
- Cover of the following attributes occurring with the quadrat (estimated as <1%, 1–5%, 5–10%, 10–15% and so on in 5% intervals to 95–100%):
  - Non-vascular plants (mosses, liverworts) and lichens
  - Bare ground
  - Rock
  - Organic litter and logs.

2.2.2 Fauna surveys

A range of fauna surveys were deployed using both passive and active methods. Birds have been extensively studied across the municipality by various organisations and individuals. It is for this reason that surveys for the current project concentrated on mammals, specifically microbats and Rakali, amphibians and reptiles. Gio Fitzpatrick, a local field naturalist, raised the significance of the St Kilda Spit for Red-necked Stint at St Kilda Spit with a recent observation. Gio has observed up to 200 birds feeding at St Kilda Spit. Red-necked Stint are a listed migratory species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999). Subsequently a shorebird / wader count was added to the surveys undertaken. A total of six survey locations were selected based on a stakeholder workshop held on 12 November 2020. The locations and survey types were as follows:

1. Canterbury Forest – Bat survey
2. St Kilda Botanical Gardens – Bat and frog survey
3. Elwood Canal / Elster Creek – Bat and frog survey
4. Point Ormond Reserve – Bat survey
5. St Kilda Breakwater – Rakali survey
6. St Kilda Spit – Shorebird / wader survey.

Where the results were inconclusive or limited, further advice was sought from Gio Fitzpatrick.

Details are provided in Figure 1 where the relevant surveys were undertaken.

2.2.2.1 Bat detector survey

Four Anabat Express (Titley Electronics™) bat detectors were strategically placed in habitat likely to maximise recording bat calls. The detectors were set-up where bats were likely to commute (flyway) to their foraging areas and / or where foraging was likely to occur.

For the reasons outlined above, a detector was setup on the municipal boundary of City of Port Phillip and Elsternwick Park in the adjoining Bayside City Council as opposed to within the Elwood Canal area. This location was less channelised, and there was mature native overstorey and aquatic vegetation present.

The bat detectors were deployed for a period varying from 7 to10 days and comprised a total of 34 detector nights. Due to equipment failure at the St Kilda and Elster Creek sites in January 2020, the surveys were repeated in February 2020. Weather conditions were considered suitable for bat activity for the majority of the survey period (refer to Section 4.2.6).

The bat detectors were deployed at the following four sites:

1. Canterbury Forest; 16–25 January 2020
2. St Kilda Botanical Gardens; 9–15 February 2020
3. Elster Creek; 9–15 February 2020
4. Point Ormond Reserve; 16–25 January 2020

Analysis of bat calls was undertaken using AnalookW Ver. 4.4a software. A filter was used in the AnalookW software to delete files without bat calls e.g. insect noise.

Refer to Appendix A for photographs showing the placement of bat detectors and adjacent habitat, and Appendix B for field survey location maps.

2.2.2.2 Amphibian recorder survey

Two Song Meter SM4 acoustic recorders (Wildlife Acoustics™) were deployed to record frog calls in conjunction with bat detectors deployed in January 2020. Weather conditions, as described in Section 4.2.6 below, were considered conducive to frog call activity on 16, 21, 23 January 2020. Song Meters were deployed for 10 days at two sites for a total of 20 detector nights:

1. St Kilda Botanical Gardens; 16–25 January 2020
2. Elwood Canal / Elster Creek; 16–25 January 2020.

Call analysis was undertaken using Kaleidoscope Vers. 4.3.2 sound analysis software.

Refer to Appendix A for photographs showing the detector placement and adjacent habitat, and Appendix B for field survey location maps.

2.2.2.3 Active reptile Search

A search was undertaken on both sides of the Elwood Canal. Areas targeted were where native and exotic vegetation, woody debris or leaf litter was present. The search was undertaken over a period of approximately 2 hours (1.10 PM–3.05 PM) covering a distance of approximately 3.5 km. Weather conditions were conducive to reptile activity, refer to Section 4.2.6.

Refer to Appendix A for an indicative representation of the habitat searched adjacent to the Elwood Canal, and Appendix B for field survey location maps.

2.2.2.4 Active Rakali survey

A standardised survey methodology was developed to undertake annual monitoring by Earthcare volunteers. The Rakali survey was undertaken on the 10 March 2020. The survey was undertaken at dusk by two fieldworkers over a period of 75 minutes. The survey method was non-invasive, trialling the use of binoculars and headlamp by one field worker as the primary method. The 2nd fieldworker used a near-infrared night scope to compare the effectiveness of the use of binoculars and headlamp. The survey was conducted on a night conducive to activity, i.e. calm water and little to no wind.

Refer to Appendix A for photographs showing Rakali habitat surveyed, and Appendix B for field survey location maps.

2.2.2.5 St Kilda Spit Shorebird / Wader survey

A shorebird survey was undertaken at St Kilda Spit on the 10 March 2020 at dusk. A Nikon 90 mm spotting scope was used to count the number of stint and identify other migratory species which occupy the St Kilda Spit.

Refer to Appendix A for photographs showing shorebird habitat surveyed, and Appendix B for field survey location maps.

2.2.2.6 Habitat Assessment

A habitat assessment was undertaken to gain a general overview of site conditions and suitability to support fauna. The assessment sheet records information on the vegetation, (i.e. canopy, understorey and ground cover), canopy health, recruitment, disturbance history, feeding and nesting resources, tree hollows, presence of leaf litter, woody debris and rocks. Habitat assessments were undertaken at the following sites on the given dates:

1. St Kilda Botanical Gardens – 1 February 2020
2. Canterbury Road Urban Forest – 1 February 2020
3. Elwood Canal / Elster Creek – 1 February 2020
4. Point Ormond Reserve – 1 February 2020
5. St Kilda Breakwater – 10 March 2020
6. St Kilda Spit – 10 March 2020.

2.3 Significant Trees - mapping potential occurrence

According to the City of Port Phillip (2020), *a Significant Tree means a tree or palm on private land:*

- *With a trunk circumference of 150 centimetres or greater measured 1 metre from the base;*
- *A multi-stemmed tree where the circumference of its exterior stems equals or is greater than 1.5 metres when measured 1 metre from its base; or*
- *If the tree has been removed, a trunk circumference of 150 centimetres or greater measured at its base.*

Using the Department of Transport aerial imagery taken on 13 of October 2018, provided by the City of Port Phillip, Arcadis visually analysed and mapped the potential occurrence of Significant Trees and palms on private land. As the presence of Significant Trees on public land, including roads and parks, is thought to be relatively well understood, public land was not included in this analysis.

Each property parcel was assigned to one of the following likelihood categories:

- High likelihood – Contains one or more clearly visible larger tree canopies or palm trees that may fit the definition of a Significant Tree
- Moderate likelihood – Tree canopies difficult to distinguish but property contains treed or shrubby vegetation that may include Significant Trees
- Low likelihood – All other properties that don't appear to contain Significant Trees
- Other – Properties that have a Significant Tree registered on their property, however no potentially Significant Trees were visible during the assessment of the aerial imagery.

The list of addresses for existing registered Significant Trees, provided by the City of Port Phillip, was geocoded and used as a point of reference for the visual assessment of canopy sizes. As there is potential for existing Significant Trees to have been lopped or felled, these properties were also categorised into the High, Moderate or Other likelihood categories.

2.4 Nomenclature, taxonomy and conservation status

Plant taxonomy and the use of common names follow the online Victorian Biodiversity Atlas (DELWP 2020d), VicFlora (VicFlora 2020), or the Australian Plant Census (Council of Heads of Australasian Herbaria 2020). For fauna, common names are generally used in the text.

Where an asterisk (*) precedes a plant or animal name, it is used to indicate those which are not indigenous to Victoria. A hash (#) is used to denote a Victorian indigenous plant species that is generally accepted as not indigenous i.e. outside of its natural range where recorded within the study area.

The conservation status of species was determined using DELWP's advisory lists (DEPI 2014, DSE 2013, DSE 2009) and separately for listings under the Commonwealth EPBC Act and Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act).

The FFG Act has recently undergone an amendment that will result in revised conservation statuses and transfer of advisory listed species to the FFG Act. As such the current advisory lists are expected to be outdated by approximately June 2020.

2.5 Limitations

As with all flora surveys, the seasonality of some species can be a limitation for the field survey as they can be easily overlooked if inconspicuous during the survey period or identified to genus level only if fertile material is absent. One notable limitation of this nature was the ability to confidently identify Australian Salt-grass *Distichlis distichophylla*, Salt Couch *Sporobolus virginicus*, Prickly Couch *Zoysia macrantha* and to a lesser degree Couch **Cynodon dactylon* var *dactylon* in the absence of fertile material – all four of which are known to occur along the City of Port Phillip foreshore. However, these limitations are unlikely to alter the major findings regarding the quality and significance of the vegetation.

Whilst the fauna surveys were undertaken during known activity periods of the target species, presence is contingent on a range of factors including the availability of suitable habitat, detectability, climatic conditions and levels of disturbance (human and domestic animals) at the time of the surveys. For these reasons where an animal is observed, species presence can be confirmed.

The GIS analysis of properties for presence of Significant Trees was based on the size of tree canopies, so should be viewed as indicative only. Ground truthing of these trees will be required. In addition, large trees that were dead or lacked foliage in the aerial imagery were unlikely to have been detected. It should be noted that the October 2019 aerial imagery used did show foliage on deciduous trees so these should not have been overlooked, therefore the impact of this limitation is not expected to be significant.

3 FLORA VALUES

3.1 Vegetation descriptions

Nine Ecological Vegetation Classes (EVCs) were observed within the six sites. Remnant vegetation within the six sites exists in a highly modified landscape of roads, residential buildings, sports fields, industrial and other infrastructure. Furthermore, there has been significant modification and engineering of natural watercourses (e.g. Elwood Canal) and some sections of shoreline (e.g. construction of sea walls, breakwater groynes and concrete coastal walkways and bike paths). In many cases the native vegetation patches have probably re-colonised or been planted after areas have been cleared and modified for past or current uses.

Recent indigenous plantings were commonly observed. If such plantings were within (or fringing) an existing patch of mature vegetation they were included as part of the floristic diversity of that patch. Two additional non-EVC assigned categories of vegetation were mapped:

- Indigenous grassy and low shrub plantings
- Indigenous plantings and colonisers with a non-native canopy.

These two categories have some functional biodiversity values but cannot be meaningfully categorised into an EVC.

Each of the EVCs and planted vegetation types observed are described below in order of EVC number:

- EVC 2: Coast Banksia Woodland (Coast Banksia dominated foreshore woodland, inland of the Coastal Dune Scrub)
- EVC 3: Damp Sands Herb-rich Woodland (Eucalypt dominated woodland of inland areas with sandy-loamy soils)
- EVC 10: Estuarine Wetland (Sea Rush dominated plantings in drainage wetlands along the coast)
- EVC 160: Coastal Dune Scrub (Commonly salt-pruned and wind-swept scrub occurring on the primary dunes)
- EVC 175: Grassy Woodland (River Red-gum and Yellow Box dominated woodland of inland reserves)
- EVC 311: Berm Grassy Shrubland (Coast Saltbush dominated shrubland on breakwater groynes and berms)
- EVC 821: Tall Marsh (Common Reed dominated vegetation in an artificial wetland)
- EVC 879: Coastal Dune Grassland (Hairy Spinifex dominated grassland on the foredunes)
- EVC 914: Estuarine Flats Grassland (Grassland vegetation occupying moist depressions on primary dunes)
- Planted vegetation

The conservation status for the EVC within the Gippsland Plain Bioregion appears in the heading in brackets after the EVC name below. Italicised text under each heading is from the EVC Benchmark (DELWP 2020b).

3.1.1 EVC 2: Coast Banksia Woodland (Vulnerable)

> *Restricted to near coastal localities on secondary or tertiary dunes behind Coastal Dune Scrub. Usually dominated by a woodland overstorey of Coast Banksia* Banksia integrifolia *to 15 m tall over a medium shrub layer. The understorey consists of a number of herbs and sedges, including scramblers.*

Coast Banksia Woodland would have formerly occurred in a mosaic with Coastal Dune Scrub (EVC 160) along the entire City of Port Phillip foreshore, associated with recent dune deposits (DELPW 2020a). At the time of the field surveys there was a very small patch at St Kilda West Beach and two almost contiguous larger patches at the Elwood Coastline. The structure was a variable woodland 5–15 m tall, with either a shrubby or grassy understorey (Plate 1).

Coast Banksia trees were common in the canopy of this EVC (Plate 1), generally in moderate to good health, with some trees showing limb decline, canopy decline or death. It is understood that many Coast Banksia trees along the foreshore have been planted over previous months, years and decades and the success of these plantings in more recent times has generally been poor.

In some areas of this EVC, Coast Banksias were absent or extremely sparse. These patches were distinguished from adjacent Coastal Dune Scrub on the basis of having taller canopy species (typically greater than c. 5 m) and occupying sites somewhat sheltered from strong coastal winds and saltspray. Where this was the case, canopy dominants were Drooping Sheoak *Allocasuarina verticillata* and/or (less often) Coast Tea-tree *Leptospermum laevigatum*. Emergent Coast Manna Gum *Eucalyptus viminalis* subsp. *pryoriana* and Swamp Gum *Eucalyptus ovata* were also occasionally present in the canopy (the later typically occurring in wetter swales).

Common shrubs in the mid-layer (1–5 m) included Sweet Bursaria *Bursaria spinosa*, Common Boobialla *Myoporum insulare* and Seaberry Saltbush *Rhagodia candolleana* subsp. *candolleana*. Indigenous grasses and other graminoids were more abundant where the shrub layer was sparse. Common species include Prickly Spear-grass *Austrostipa stipoides*, Coast Spear-grass *Austrostipa flavescens,* Sandhill Sword-sedge *Lepidosperma concavum* and Small-flower Flax-lily *Dianella brevicaulis*.

Almost all large old specimens of Coast Banksia *Banksia integrifolia* observed in this study were in Elwood Park, clustered around buildings and amenities (e.g. around Elwood Tennis Club, behind the Sailing Club). Highly fragmented examples of this EVC were seen in other parts of this parkland, including fringing recreation and carpark spaces (Plate 1). These generally narrow patches often had a planted understorey of indigenous shrubs and grasses.

The main weeds occurring in this vegetation type in the study area were Panic Veldt-grass * *Ehrharta erecta* var. *erecta* and a suite of common annual herbaceous weeds such as Common Sow Thistle *Sonchus oleraceus* and Fumatory *Fumaria* species.

Plate 1. Various representations of Coast Banksia Woodland at Elwood Coastline

3.1.2 EVC 3: Damp Sands Herb-rich Woodland (Vulnerable)

> *A low, grassy or bracken-dominated eucalypt forest or open woodland to 15 m tall with a large shrub layer and ground layer rich in herbs, grasses, and orchids. Occurs mainly on flat or undulating areas on moderately fertile, relatively well-drained, deep sandy or loamy topsoils over heavier subsoils (duplex soils).*

Damp Sands Herb-rich Woodland would have formerly occurred extensively in City of Port Phillip, inland from the coastal dune systems. Patches of this vegetation type were observed in the Port Melbourne Light Rail Reserve and adjacent to the Elwood Canal (Plate 2).

Canopy dominants in this woodland were Coast Manna Gum *Eucalyptus viminalis* subsp. *pryoriana*, Yellow Box *Eucalyptus melliodora* and River Red Gum *Eucalyptus camaldulensis*, most of which have been planted. The tall shrubby and understorey tree mid-layer included Black Sheoak *Allocasuarina littoralis*, Drooping Sheoak *Allocasuarina verticillata*, Lightwood *Acacia implexa* and Sweet Bursaria *Bursaria spinosa*.

Very little remnant ground layer vegetation remained but in many places there have been indigenous plantings established that are consistent with this EVC. In some cases, such plantings have been made in park garden beds that have a largely exotic canopy (e.g. Port Melbourne Light Rail Reserves). Common understorey species (in most cases planted) were small-medium shrubs (e.g. Coastal Daisy Bush *Olearia axillaris*, Hop Goodenia *Goodenia ovata*, Common Correa *Correa reflexa* and Prickly Wattle *Acacia paradoxa*), and grasses and graminoids (e.g. Spiny Headed Mat-rush *Lomandra longifolia*, Black-anther Flax-lily *Dianella revoluta* and Coastal Spear-grass *Austrodanthonia flavescens*).

Revegetation and amenity plantings have increased the diversity of many patches of this EVC, with easily cultivated and robust plants being most commonly used. The notable lack of Bracken *Pteridium esculentum*, which is typically common in this EVC, is likely a result of historic clearing and difficulties surrounding its propagation. Some patches of this EVC have a mown exotic lawn understorey and/or mulched ground and lack any indigenous understorey.

Weeds are mainly annual grasses and herbs typical of disturbed areas.

Plate 2. Damp Sands Herb Rich Woodland at the Port Melbourne Light Rail and Elwood Canal sites.

3.1.3 EVC 10 Estuarine Wetland (Least Concern)

> *Grows on anaerobic peat-rich muds on the edges of estuarine waterbodies such as creeks, rivers and lagoons with intermediate salinity conditions. Vegetation is determined by fluctuating salinity, which varies in time from occasionally fresh to brackish or occasionally saline according to river flood and marine tide events. Dominated by graminoids and halophytic herbs and often fringed by a tall scrub layer of Swamp Paperbark* Melaleuca ericifolia *at the landward edge.*

In the study area examples of Estuarine Wetland were seen in the Elwood Foreshore area (Plate 3). They occurred in water sensitive urban design drainage wetlands where the vegetation had been planted. The dominant species observed were Sea Rush *Juncus krausii* and Knobby Club Rush *Ficinia nodosa* which are representative of this EVC. Both of these species had expanded their cover naturally since planting occurred.

Other species fringing the Rush-dominated vegetation were Swamp Paperbark *Melaleuca ericifolia*, Spiny-headed Mat-rush *Lomandra longifolia* subsp. *longifolia*, Coast Tussock-grass *Poa poiformis* and Black-anther Flax-lily *Dianella revoluta*.

Few weeds were seen in this vegetation type, and the ground layer commonly included a layer of rocks or river pebbles to minimise erosion and provide amenity value.

Plate 3. Estuarine Wetland planted into a constructed wetland at Elwood Foreshore.

3.1.4 EVC 160: Coastal Dune Scrub (Depleted)

> *Closed scrub to 5 m tall with occasional emergents occurring on secondary dunes along ocean and bay beaches and lake shores. Occupies siliceous and calcareous sands that are subject to high levels of saltspray and continuous disturbance from onshore winds.*

The pre-1750 EVC mapping of the study area shows this EVC to have existed in a mosaic with Coast Banksia Woodland and this was supported by field observations. Coastal Dune Grassland was typically present where wind and salt-spray would stunt the shrubby canopy and limit Coast Banksia establishment. Due to salt-pruning of foliage from salt-laden winds, the Coastal Dune Scrub vegetation observed was commonly stunted, growing 1–3 m tall, or occasionally up to c. 5 m tall (Plate 4).

Coastal Dune Scrub is typically characterised by the dominance of Coast Tea-tree *Leptospermum laevigatum*, however within the study area other shrubs were frequently dominants, including Drooping Sheoak *Allocasuarina verticillata*, Black She-oak *Allocasuarina littoralis,* Coast Wattle *Acacia longifolia* var. *sophorae* and Common Boobialla *Myoporum insulare.* The understorey was dominated by the shrub Seaberry Saltbush *Rhagodia candolleana* and the scrambler/climber Bower Spinach *Tetragonia implexicoma*, with a sparse ground layer of sand-tolerant graminoids such as Prickly Spear-grass *Austrostipa stipoides* and Small-flower Flax-lily *Dianella brevicaulis*.

Many of these patches have been significantly modified by past plantings, including in some cases non-indigenous shrubs and trees in the canopy in the MO Moran Reserve and Point Ormond Reserve (e.g. Bushy Yate *Eucalyptus lehmannii,* Showy Honey-myrtle *Melaleuca nesophila* and Giant Honey-myrtle *Melaleuca armillaris* subsp*. armillaris*).

Recent plantings at the fringes of some patches include herbs, grasses and woody species. Plantings such as those extending native vegetation patches in the MO Moran Reserve had a high diversity, including species not typical of the Coastal Dune Scrub EVC but likely to have occurred in the area in other EVCs (such as Coast Banksia Woodland and Damp Sands Herb-rich Woodland). In other areas, such as near the toilet block on the Elwood foreshore, tussock-dominated plantings have been made, with woody species interspersed. The graminoids included Prickly Spear-grass *Austrostipa stipoides*, Chaffy Saw-sedge *Gahnia filum*, Knobby Club-sedge *Ficinia nodosa* and Pale Flax-lily *Dianella longifolia*.

Weeds generally associated with disturbance were common (e.g. Prostrate Knotweed *Polygonum aviculare*, Mallow *Malva* species, Sweet Melilot *Melilotus indicus*), often associated with the prolific network of authorized and unauthorized tracks.

Plate 4. Coastal Dune Scrub in the Elwood Foreshore Reserve

3.1.5 EVC 175: Grassy Woodland (Endangered)

> *A variable open eucalypt woodland to 15 m tall or occasionally Sheoak woodland to 10 m tall over a diverse ground layer of grasses and herbs. The shrub component is usually sparse. It occurs on sites with moderate fertility on gentle slopes or undulating hills on a range of geologies.*

Grassy Woodland was the former vegetation type of the Alma Park area (Plate 5). Numerous healthy remnant eucalypt trees were observed to persist in the northern part of the parkland, east of the railway line, including large old trees (River Red-gum *Eucalyptus camaldulensis* and Yellow Box *Eucalyptus melliodora*). Mostly these trees have a mown lawn of exotic-grasses underneath their canopy. Several of the canopy eucalypts occur within long-established garden beds with a planted indigenous understorey of shrubs and ground-layer species, along with other Australian native species that are not indigenous to the City of Port Phillip. Shrub and subcanopy tree species in this garden bed included Sweet Bursaria *Bursaria spinosa* and Lightwood *Acacia implexa*. The ground-layer was heavily mulched with commonly planted species including graminoids such as Spiny-Headed Mat-rush *Lomandra longifolia* subsp. *longifolia*, Kangaroo Grass *Themeda triandra* and Black-anther Flax-lily *Dianella revoluta*.

Along the railway easement, a more natural albeit modified representation of Grassy Woodland exists with more naturally recruiting indigenous species. Eucalypts were present in low numbers, with most of the vegetation consisting of patches of recruiting midstorey and understorey species. These include understorey trees and shrubs such as Black Wattle *Acacia mearnsii*, Lightwood *Acacia implexa*, Blackwood *Acacia melanoxylon*, Forest Burgan *Kunzea* sp. (Upright form), and ground layer graminoids such as Kangaroo Grass, Spear Grasses *Austrostipa* spp., Spiny-Headed Mat-rush, Common Wheat-grass *Anthosachne scabra*.

Weeds were uncommon in the garden bed areas that had been heavily mulched, and common in the more natural representations along the railway easement. They primarily consisted of perennial grasses such as Couch *Cynodon dactylon* var. *dactylon* and Prairie Grass *Bromus catharticus*.

Plate 5. Grassy Woodland at Alma Park dominated by River Red-gums Eucalyptus camaldulensis *or regenerating Wattles* Acacia *sp. and other indigenous species.*

3.1.6 EVC 311: Berm Grassy Shrubland (Endangered)

Low shrubland to 1.5 m tall occurring in sheltered coastal areas where sand deposits have formed as a result of low energy wave action. Contains a number of halophytic species over a ground layer of grasses and herbs.

Berm Grassy Shrubland was observed as small patches associated with breakwaters, groynes or sea walls where these structures trap sediments. There was also a narrow band of this EVC along rocky sections of the Elwood coastline (Plate 6).

Species diversity is generally low in the loose sandy and rocky environment that this EVC occupies. It is dominated by the shrub Coast Saltbush *Atriplex cinerea*, to approximately 1 m tall. Common though sparse species also included Prickly Spear-grass *Austrostipa stipoides*, Seaberry Saltbush *Rhagodia candolleana*, Rounded noon-flower *Disphyma crassifolium* subsp. *clavellatum* and Karkalla *Carpobrotus rossii*.

Where this EVC occurs along the walking and cycling paths in Elwood it has generally been enriched with plantings. Species especially prominent in planted areas are Prickly Spear-grass *Austrostipa stipoides*, Coast Tussock-grass *Poa poiformis*, Coast Daisy-bush *Olearia axillaris* and Cushion Bush *Leucophyta brownii*.

Some areas had a dense cover of the invasive Couch **Cynodon dactylon* var. *dactylon*. Other weeds observed with a patchy occurrence included Sow Thistle **Sonchus oleraceus*, Annual Yellow Sweetclover **Melilotus indicus*, Prairie Grass **Bromus catharticus* and Fleabane **Erigeron* sp.

Plate 6. Berm Grassy Shrubland on a rock groyne at Sandridge Foreshore Reserve and along the foreshore at Elwood Coastline.

3.1.7 EVC 821: Tall Marsh[1]

Occurs on Quaternary sedimentary geology of mainly estuarine sands, soils are peaty, silty clays, and average annual rainfall is approximately 600 mm. It requires shallow water (to 1 m deep) and low current-scour, and can only tolerate very low levels of salinity. Closed to open grassland/sedgeland to 2-3 m tall, dominated by Common Reed and Cumbungi. Small aquatic and semi-aquatic species occur amongst the reeds.

A small planted wetland near the playground in Alma Park is dominated by wetland vegetation that resembles Tall Marsh (Plate 7). Dominant species included Common Reed *Phragmites australis* in the deepest parts of the wetland, Poong'ort *Carex tereticaulis*, Tall Sedge *Carex appressa* and Pale Rush *Juncus pallidus* around the wet margins and Spiny-headed Mat-rush *Lomandra longifolia* around the riparian perimeter. There was a small amount of water in this wetland at the time of the field visit, with the margins of the wetland revealing exposed mud.

Plate 7. Landscaped wetland at Alma Park resembling Tall Marsh

3.1.8 EVC 879: Coastal Dune Grassland (Depleted)

Consists of grasses and halophytes (succulents) that colonise the foredunes of ocean beaches. Soils are siliceous sands that have a very low humus content.

Coastal Dune Grassland was observed in the study area on sandy beach fringes that were not subjected to beach-cleaning or sand nourishment machinery. The largest patch of this EVC was observed at Sandridge Reserve, where it occupies a strip on the low foredunes adjacent the sandy beach (Plate 8). The dominant species was primarily Hairy Spinifex *Spinifex sericeus*, though a substantial area is dominated by Strand Sedge *Carex pumila*. These species send out horizontal runners (rhizomes and/or stolons) that bind the sand. Other species commonly observed (especially where the sand has stabilised) included Karkalla *Carpobrotus rossii*, Rounded noon-flower *Disphyma crassifolium* subsp. *clavellatum* and Knobby Club-sedge *Ficinia nodosa*.

Weed cover was generally low in this EVC in the study area. Annual grasses and Sea Rocket **Cakile maritima* were the more abundant weeds, though generally they were uncommon. The only documented Victorian occurrence of the herbaceous weed Cut-leaf Evening-primrose **Oenothera laciniata* subsp. *laciniate* occurs in this EVC at Sandridge Reserve.

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[1] DELWP has not yet assigned a Bioregional Conservation Status (BCS) for Tall Marsh in the Gippsland Plain.

Plate 8. Coastal Dune Grassland dominated by Hairy Spinifex Spinifex sericea *(left) and Strand Sedge* Carex pumila *(right), Port Melbourne Foreshore*

3.1.9 EVC 914: Estuarine Flats Grassland (Endangered)

Closed to open grassland to 1.5 m tall with occasional shrubs occurring on estuarine flats often associated with current or old beach berms or sand sheets that are occasionally inundated by high tides. Occupies areas on marginally higher ground inland from Coastal Saltmarsh.

Estuarine Flats Grassland remnants were observed at Sandridge Foreshore in Port Melbourne and St Kilda West Beach (Plate 9). Small modified examples were also observed along the bike and pedestrian paths at MO Moran Reserve. It is associated with swale areas behind low foredunes (as seen at St Kilda West Beach) as well as lower areas behind Berm Grassy Shrubland (as in the aforementioned bike path area). This grassy/sedgy vegetation was dominated by Australian Salt-grass *Distichlis distichophylla*, Knobby Club-rush *Ficinia nodosa*, Sea Rush *Juncus kraussii* subsp. *australiensis*. Also common were Hairy Spinifex *Spinifex sericeus* and Small-flower Flax-lily *Dianella brevicaulis*. Species more typical of adjacent woody EVCs were also observed as young or stunted shrubs, including Common Boobialla *Myoporum insulare* and Coast Banksia *Banksia integrifolia*.

Grassy weeds were common in this EVC in the study area, especially the perennial Couch *Cynodon dactylon* var. *dactylon* and the annual Great Brome *Bromus diandrus*.

Plate 9. Estuarine Flats Grassland at Port Melbourne Foreshore (left) and St Kilda West beach (right).

3.1.10 Planted vegetation

Indigenous species have been planted extensively in many of the study sites. In most cases these plantings enrich or extend a patch of native vegetation that has been assigned to one of the EVCs already described. Small patches of planted vegetation that had garden-like appearance or otherwise lacked sufficient resemblance to an EVC were classified as (Plate 10):

- **Plantings – grassy and low shrubs:** Tufted grasses, sedges and lilies were generally dominant, sometimes interplanted with low shrubs such as Cushion Bush *Leucophyta brownii* and Coast Saltbush *Atriplex cinerea*.
- **Plantings – indigenous species under exotic canopy**: Generally these areas had a well-established exotic canopy (e.g. Norfolk Island Pine or Norfolk Island Hibiscus) with indigenous understorey amenity plantings including those from the 'grassy and low shrubs' category and/or hardy low shrubs such as Seaberry Salt Bush *Rhagodia candolleana* and Coast Saltbush *Atriplex cinerea*.

Plate 10. Planted vegetation – grassy and low shrubs at Port Melbourne Foreshore (left) and Elwood Coastline (middle), and Plantings – indigenous species under exotic canopy at Elwood Coastline (right).

3.2 Site vegetation values

During the vegetation field surveys, 214 plant species were recorded within the nine observed EVCs and 30 quality zones across the six study sites. This included 130 (60%) indigenous species, 79 exotic species and 5 native Victorian native species that are outside their natural range in the City of Port Phillip (Appendix A). Two of the indigenous species (Coast Wattle and Coast Tea-tree) are regarded as indigenous when in coastal environments, however, are considered outside their natural range when occurring further inland away from the coastal vegetation communities.

Thirty zones of vegetation were identified across the six flora surveys sites, comprising the EVCs and planted native vegetation described in Section 3.121. Most vegetation assessed as part of this study was determined to be between 30% and 50% of pre-European condition (Table 1). The results of the Vegetation Quality Assessments undertaken consider landscape components (i.e. how much native vegetation is within the surrounding landscape). It is worthy of note that these components consistently reduced the overall pre-European habitat quality score of all Zones assessed and this aspect is unlikely to change given the highly urbanised landscape within and adjoining the municipality.

Table 1. Total native vegetation area within each habitat score range across the six sites assessed as part of the flora surveys.

Note, three additional zones were assessed as native amenity plantings that did not adequately resemble an EVC to warrant a vegetation quality assessment.

Habitat Score Range	Number of zones (Zone IDs)	Area of Vegetation (ha)
10–19% pre-European condition	5	1.19
20–29% pre-European condition	2	0.63
30–39% pre-European condition	10	4.95
40–49% pre-European condition	8	10.42
50–59% pre-European condition	2	1.30
TOTAL	**27**	**18.49**

The following sections provide an overview for the indigenous vegetation identified at each site (presented in alphabetical order by site name). This includes brief description of each EVC, a table presenting the Vegetation Quality Assessment scores, a graph illustrating the proportion of native vegetation within each quality score range, and a figure illustrating the distribution and extent of indigenous vegetation.

3.2.1 Alma Park East

3.2.1.1 Vegetation values

Alma Park East is a recreation space predominately comprising amenity plantings, exotic trees, lawns and walking paths. Native vegetation comprises two EVCs presenting as patches of vegetation and a Scattered Tree.

Grassy Woodland (EVC 175): Two zones were recorded for this EVC. Within Alma Park the Grassy Woodland vegetation largely comprised a remnant River Red-gum *Eucalyptus camaldulensis* canopy over manicured lawns or garden beds (Zone ID 28, 26% pre-European condition). Over the fence in the adjoining escarpment of the railway easement the Grassy Woodland vegetation comprised a small suite of naturally recruiting tree and shrub species over a predominantly weedy ground layer with occasional patches of native grasses and graminoids (Zone 26, 18% pre-European condition). One Scattered Tree (River Red-gum) was also recorded.

Tall Marsh (EVC 821): The landscaped constructed wetland to the south of the park comprised indigenous species consistent with the Tall March EVC, such as Common Reed *Phragmites australis*, Poong'ort *Carex tereticaulis* and Tall Sedge *Carex appressa*. This vegetation had a score of 17% pre-European condition.

Plate 11. Grassy Woodland Vegetation at Alma Park, comprising remnant and planted River Red-gums over lawns and garden beds (above), and regenerating Wattles and other indigenous species along the adjoining railway line (below)

Table 2. Summary of the Vegetation Quality Assessment for the three quality zones identified at Alma Park East, St Kilda.

Key:

EVC	Ecological Vegetation Class
GW	Grassy Woodland
TM	Tall Marsh
GP	Gippsland Plain
EN	Classified as endangered in the Gippsland Plain Bioregion
LC	Classified as least concern in the Gippsland Plain Bioregion
VQA	Vegetation Quality Assessment, based on the Habitat Hectares condition method (DSE 2004)

Zone ID			26	27	28
Bioregion			GP	GP	GP
EVC Number: Name			175: GW	821: TM	175: GW
EVC Bioregional Conservation Status (BCS)			EN	LC	EN
Score		Max			
Site Condition	Large Trees	10	0	-	10
	Canopy Cover	5	3	-	3
	Lack of Weeds	15	0	7	2
	Understorey	25	5	15	5
	Recruitment	10	6	6	0
	Organic Matter	5	4	4	4
	Logs	5	0	-	2
Site Score	**Total Site Score**	**75**	**18**	**32**	**26**
	Max Site Score		75	55	75
	Adjusted Site Score		**18**	**44**	**26**
Landscape Context	Patch Size	10	1	1	1
	Neighbourhood	10	0	0	0
	Distance to Core	5	0	0	0
VQA Condition Score		100%	**19%**	**45%**	**17%**
Number of Large Trees			0	-	7
Area (ha)			**0.564**	**0.075**	**0.480**

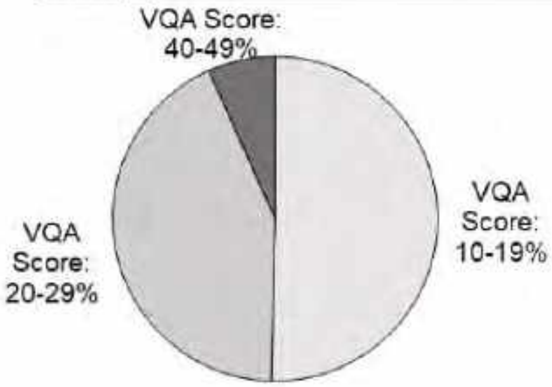

*Figure 2. Proportional area of vegetation assessed within each habitat score (%) category, Alma Park East, St Kilda, January 2020. Note that the percentages represent **condition categories**, the graph is a visual representation of the contribution of each category to the **total area** (hectares) of mapped vegetation at this site.*

Figure 3. Vegetation values within the Alma Park East site.

3.2.2 Elwood Canal Linear Reserve

3.2.2.1 Vegetation values

The vegetation along the Elwood Canal site included some mature indigenous eucalypts and other indigenous trees, over a predominantly planted indigenous ground layer. Some exotic canopy trees and plantings also existed, sometimes associated with encroaching gardens from adjoining residents.

All areas that resembled remnant indigenous vegetation resembled a single EVC but were assessed as four distinct condition zones.

Damp Sands Herb-rich Woodland (EVC 3): The highest quality zone (Zone ID 16) comprised an indigenous canopy, midstorey and moderately diverse groundlayer of robust species, most of which appeared to have been planted. The condition in this zone was 39% pre-European condition, which was the highest at this site. The main canopy species were Coast Manna-gum *Eucalyptus viminalis* subsp. *pryoriana* and River Red-gum, *Eucalyptus camaldulensis*. A sub-canopy of Lightwood *Acacia implexa*, Drooping Sheoak *Allocasuarina verticillata* and other shrubs was present in some areas.

One patch of vegetation (Zone ID 17) had moderate diversity of indigenous understorey species (both planted and colonised) under a canopy of exotic trees (primarily Desert Ash *Fraxinus angustifolia*). This patch achieved a condition score of 13% pre-European condition.

Near the eastern end of the reserve, on the northern side of the canal, there were several mature Silver-leaf Stringybark *Eucalyptus cephalocarpa* with a patchy understorey dominated by Spiny-headed Mat-rush *Lomandra longifolia* subsp. *longifolia* (Zone ID 18). This patch scored 20% pre-European condition notably due to poor understorey diversity and lack of recruitment. The trees were approaching the size to be considered Large Old Trees.

On the southern side of the canal a large proportion of the indigenous understorey vegetation had a non-indigenous canopy (e.g. Sugar Gum **Eucalyptus cladocalyx).* These patches were assessed as a different zone (Zone ID 19) and scored 13% for condition. Along the edge of the reserve where private properties have access to the reserve there were multiple incursions of exotic garden species into this zone.

There were also several young planted Scattered Trees that were not part of the above zones, but still represent a component of the Damp Sand Herb-rich Woodland EVC.

3.2.2.2 Significant flora

Two Victorian Rare species (DEPI 2014) were recorded at this site in Damp Sands Herb-rich Woodland: Marsh Saltbush *Atriplex paludosa* subsp. *paludosa* and Wirilda *Acacia unifolia*. It is expected that both were planted.

Plate 12. Restored Damp Sands Herb-rich Woodland at Elwood Canal

Table 3. Summary of the Vegetation Quality Assessment for the four quality zones identified at Elwood Canal Linear Reserve, Elwood.

Key:
EVC Ecological Vegetation Class
DSHRW Damp Sands Herb-rich Woodland
GP Gippsland Plain
EN Classified as endangered in the Gippsland Plain Bioregion
VQA Vegetation Quality Assessment, based on the Habitat Hectares condition method (DSE 2004)

Zone ID			**16**	**17**	**18**	**19**
Bioregion			GP	GP	GP	GP
EVC Number: Name			3:DSHRW	3:DSHRW	3:DSHRW	3:DSHRW
EVC Bioregional Conservation Status (BCS)			EN	EN	EN	EN
Score		Max				
Site Condition	Large Trees	10	0	0	0	0
	Canopy Cover	5	5	0	5	0
	Lack of Weeds	15	9	0	4	2
	Understorey	25	15	5	5	5
	Recruitment	10	3	3	0	1
	Organic Matter	5	5	4	5	4
	Logs	5	0	0	0	0
Site Score	**Total Site Score**	**75**	**37**	**12**	**19**	**12**
	Max Site Score		75	75	75	75
	Adjusted Site Score		**37**	**12**	**19**	**12**
Landscape Context	Patch Size	10	2	1	1	1
	Neighbourhood	10	0	0	0	0
	Distance to Core	5	0	0	0	0
VQA Condition Score		100%	**39%**	**13%**	**20%**	**13%**
Number of Large Old Trees			0	0	0	0
Area (ha)			**0.672**	**0.054**	**0.092**	**0.022**

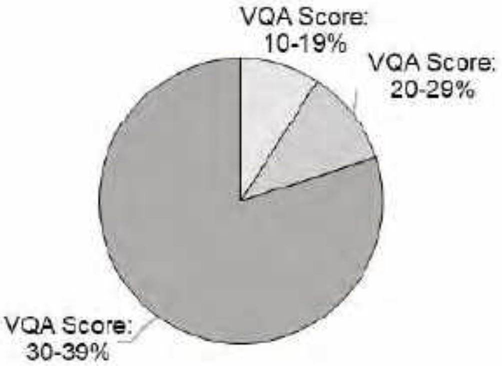

Figure 4. Proportional area of vegetation assessed within each habitat score (%) category, Elwood Canal Linear Reserve, Elwood. Note that the percentages represent ***condition categories****, the graph is a visual representation of the contribution of each category to the* ***total area*** *(hectares) of mapped vegetation at this site.*

Figure 5. Vegetation values within the Elwood Canal Linear Reserve.

3.2.3 Elwood Coastline

3.2.3.1 Vegetation values

The stretch of coastline between the St Kilda Marina and the southern edge of the City of Port Phillip coastline contained five EVCs within reserves and recreation spaces.

Coast Banksia Woodland (EVC 2): Occupied sites generally somewhat sheltered from salt-spray and wind. The distribution of mature Coast Banksia *Banksia integrifolia* was uneven along the Elwood coastline. Most mature Coast Banksia trees occurred in or near Elwood Park (especially behind the Angling Club and Elwood Baths). All examples of Large Old Trees (i.e. Banksia greater than 50 cm diameter at breast height according to the EVC benchmark) were clustered around the Tennis Club area, sometimes very close to car parking areas. Coast Banksia was sparse from the canopy in the Elwood Teatree Reserve (near Point Ormond) however the canopy height is consistently taller than the adjacent areas of Coastal Dune Scrub. The EVC condition score was 45% pre-European levels.

Estuarine Wetland (EVC 10): There were three small examples of this vegetation type along the Elwood Coastline (Zone ID 25). Two are just south west of Lady Foster Kindergarten, around small constructed drainage area. The third was a somewhat larger landscaped drainage feature to the south of Wallie Watson Oval. These wetlands, which are dominated by Sea Rush *Juncus kraussii* subsp. *australiensis* and Knobby Club-sedge *Ficinia nodosa*, had moderate species diversity for the vegetation type but lacked recruitment beyond the planting that was done at the time of their creation. They scored 44% of pre-European condition.

Coastal Dune Scrub (EVC 160): This EVC was represented by two condition zones along the Elwood coastline. The first (Zone ID 22) comprised clumps of native shrubby vegetation in the MO Moran Reserve and Point Ormond where understorey species diversity was relatively high (due largely to enhancement plantings) but canopy shrubs were sometimes not indigenous. The second zone of this EVC (Zone ID 23) was the more-or-less contiguous stretch of vegetation between the Elwood Teatree and Elwood Foreshore Reserve. The vegetation graded into Coast Banksia Woodland at both ends of this stretch. There were many areas where the shrubby canopy (especially the Drooping Sheoak, which were generally taller than the rest of the shrubs present) appeared senescent, damaged or in poor health. Overall, both condition zones scored similarly: 45% and 46% of pre-European condition respectively.

Berm Grassy Shrubland (EVC 311): This EVC, dominated by Coast Saltbush *Atriplex cinerea* hugged the coastline, generally occupying a narrow band between the rocky shore or sea wall and the bike or pedestrian sealed path. There was also a small patch of this vegetation type on the rocky groyne next to the Elwood Boat Ramp. The condition was 46% pre-European levels.

Estuarine Flats Grassland (EVC 914): In the MO Moran Reserve a narrow band of vegetation adjacent the bike path (inland from the Berm Grassy Shrubland along the coastline) resembles this EVC. Dominant species include plantings of Knobby Club-sedge *Ficinia nodosa* and Cushion Bush *Leucophyta brownii*, and some naturally recruiting such as Australian Salt-grass *Distichlis distichophylla*. Although likely to be largely of planted origin, the species diversity and presence of colonising indigenous coastal grasses gave this zone resemblance to Estuarine Flats Grassland and scored 32% pre-European condition.

Plantings: Two planted vegetation zones (amenity plantings with indigenous species) were identified and mapped at this site. The first (Zone ID 30) included grassy plantings, typically dominated by tussock forming coastal grasses and lilies such as Prickly Spear-grass *Austrostipa stipoides* and Small-flower Flax-lily *Dianella brevicaulis*. Low shrubs such as Cushion Bush *Leucophyton brownii* and (when further from the coast) Hop Goodenia *Goodenia ovata* also occurred. The second type of plantings allocated a zone (Zone ID 29) comprised an exotic canopy, of Norfolk Island Hibiscus **Lagunaria patersonia* interspersed with indigenous Drooping Sheoak *Allocasuarina verticillata* trees over a predominantly Seaberry Saltbush *Rhagodia candolleana* understorey.

3.2.3.2 Significant flora

Marsh Saltbush *Atriplex paludosa* subsp. *paludosa* (rare in Victoria, DEPI 2014) was observed in four of the EVCs along the Elwood Coastline: Coast Banksia Woodland, Coastal Dune Scrub, Estuarine Flats Grassland and Berm Grassy Shrubland. It is expected that many of the observed plants were planted however some may have colonised or be remnant.

Plate 13. Darker green Coastal Dune Scrub and silvery Berm Grassy Shrubland vegetation at Elwood Coastline

Plate 14. Coastal Dune Scrub that has been salt-pruned at Elwood Coastline.

Table 4. Summary of the Vegetation Quality Assessment for the eight quality zones identified at the Elwood Coastline site, Elwood.

Key:
EVC Ecological Vegetation Class
BGS Berm Grassy Shrubland
EFG Estuarine Flats Grassland
CDS Coastal Dune Scrub
CBW Coast Banksia Woodland
EW Estuarine Wetland
GP Gippsland Plain
EN Classified as endangered in the Gippsland Plain Bioregion
VU Classified as vulnerable in the Gippsland Plain Bioregion
DP Classified as depleted in the Gippsland Plain Bioregion
LC Classified as least concern in the Gippsland Plain Bioregion
VQA Vegetation Quality Assessment, based on the Habitat Hectares condition method (DSE 2004)

Zone ID			20	21	22	23	24	25	29	30
Bioregion			GP	GP	GP	GP	GP	GP	GP	GP
EVC Number: Name			311: BGS	914: EFG	160: CDS	160: CDS	2: CBW	10: EW	Planting	Planting
EVC BCS			EN	EN	DP	DP	LC	VU	NA	NA
Score		Max								
Site Condition	Large Trees	10	-	-	-	-	6	-	-	-
	Canopy Cover	5	-	-	-	-	3	-	-	-
	Lack of Weeds	15	7	4	9	7	7	13	-	-
	Understorey	25	15	15	15	15	15	15	-	-
	Recruitment	10	6	0	5	5	5	0	-	-
	Organic Matter	5	5	4	3	5	5	3	-	-
	Logs	5	-	-	-	-	4	-	-	-
Site Score	**Total Site Score**	**75**	**33**	**23**	**32**	**32**	**45**	**31**	-	-
	Max Site Score		55	55	55	55	75	55	-	-
	Adjusted Site Score		**45**	**31**	**44**	**44**	**45**	**42**	-	-
Landscape Context	Patch Size	10	1	1	1	2	2	2	-	-
	Neighbourhood	10	0	0	0	0	0	0	-	-
	Distance to Core	5	0	0	0	0	0	0	-	-
VQA Condition Score		**100%**	**46%**	**32%**	**45%**	**46%**	**47%**	**44%**	**NA**	**NA**
Number of Large Trees			0	0	0	0	9	0	0	0
Area (ha)			**1.189**	**0.175**	**1.567**	**2.013**	**3.231**	**0.080**	**0.406**	**0.153**

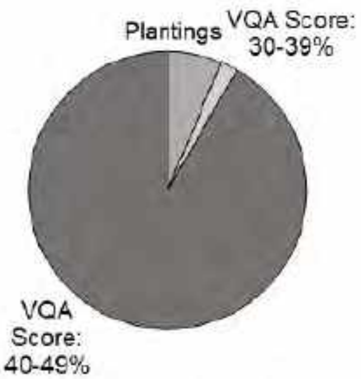

Figure 6. Proportional area of vegetation assessed within each habitat score (%) category, Elwood Coastline, Elwood. Note that the percentages represent ***condition categories****, the graph is a visual representation of the contribution of each category to the* ***total area*** *(hectares) of mapped vegetation at this site.*

Elwood Coastline

Figure 7. Vegetation values within the Elwood Coastline site. Map 1/3

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Figure 8. Vegetation values within the Elwood Coastline site. Map 2/3

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Figure 9. Vegetation values within the Elwood Coastline site. Map 3/3

3.2.4 Port Melbourne Foreshore

3.2.4.1 Vegetation values

Four EVCs comprising six quality zones were recorded within the Port Melbourne Foreshore site, along with some narrow strips of low-growing amenity plantings.

Coastal Dune Scrub (EVC 160): The vegetation classified as Coastal Dune Scrub appears to largely be planted with a combination of indigenous species and occasional exotic species. A small number of planted Coast Banksia *Banksia integrifolia* trees are present, giving resemblance to Coast Banksia Woodland EVC, however given their scarcity it was determined that Coastal Dune Scrub was the most appropriate EVC. Zone ID 5 resembled a more natural albeit modified vegetation structure achieving a quality score of 35% of pre-European condition, while Zone ID 7 was more representative of mulched planted garden beds with few weeds and scored 42% pre-European condition.

Berm Grassy Shrubland (EVC 311): Occurs on the breakwater groynes and primary dune where Coast Saltbush *Atriplex cinerea* has opportunistically colonised the sediments within and adjoining the basal boulders. Vegetation in this Zone scored 35% of pre-European condition.

Coastal Dune Grassland (EVC 879): Occurs on the foredune with two distinct zones of quality – some areas are moderately diverse (Zone ID 3; 55% of pre-European Condition) while others are very species poor (Zone ID 1; 34% of pre-European condition). Hairy Spinifex *Spinifex sericea* and Strand Sedge *Carex pumila* bind and stabilise the foredune sands, with the notably large Strand Sedge population being considered quite significant.

Estuarine Flats Grassland (EVC 914): At the western end of the site, this EVC was located in a swale accumulating additional moisture behind the primary dune. The small area contained a small suite of species and was quite weedy, scoring 29% of pre-European condition.

Plantings: Along some of the footpaths were narrow strips of indigenous amenity plantings, primarily consisting of low growing shrubs and graminoids such as Cushion Bush *Leucophyta brownii*, Prickly Spear-grass *Austrostipa stipoides*, Coast Tussock-grass *Poa poiformis*, Spiny-headed Mat-rush *Lomandra longifolia* and Small-flower Flax-lily *Dianella brevicaulis*.

3.2.4.2 Significant flora

The Victorian rare species Marsh Saltbush *Atriplex paludosa* subsp. *paludosa* (DEPI 2014) was observed in the Coastal Dune Scrub at Port Melbourne Foreshore. It is expected that these were planted.

Plate 15. Vegetation at Port Melbourne Foreshore comprising Coastal Dune Grassland dominated by Strand Sedge Carex pumila *(foreground) and Hairy Spinifex* Spinifex sericea *(left) and Coast Dune Scrub (background left).*

Table 5. Summary of the Vegetation Quality Assessment for the seven quality zones identified at Port Melbourne Foreshore, Port Melbourne.

Key:
EVC Ecological Vegetation Class
CDG Coastal Dune Grassland
BGS Berm Grassy Shrubland
EFG Estuarine Flats Grassland
CDS Coastal Dune Scrub
GP Gippsland Plain
EN Classified as endangered in the Gippsland Plain Bioregion
DP Classified as depleted in the Gippsland Plain Bioregion
NA Not Applicable
VQA Vegetation Quality Assessment, based on the Habitat Hectares condition method (DSE 2004)

Zone ID			1	2	3	4	5	6	7
Bioregion			GP	GP	GP	GP	GP	GP	GP
EVC Number: Name			879: CDG	311: BGS	879: CDG	914: EFG	160: CDS	Planting	160: CDS
EVC Bioregional Conservation Status (BCS)			DP	EN	DP	EN	DP	NA	DP
Score		Max							
Site Condition	Large Trees	10	-	-	-	-	-	-	-
	Canopy Cover	5	-	-	-	-	-	-	-
	Lack of Weeds	15	13	7	13	7	4	-	13
	Understorey	25	5	10	15	5	15	-	15
	Recruitment	10	1	3	6	3	3	-	0
	Organic Matter	5	5	5	5	5	3	-	2
	Logs	5	-	-	-	-	-	-	-
Site Score	**Total Site Score**	**75**	**24**	**25**	**39**	**20**	**25**	-	**30**
	Max Site Score		55	55	55	55	55	-	55
	Adjusted Site Score		**33**	**34**	**53**	**27**	**34**	-	**41**
Landscape Context	Patch Size	10	1	1	2	2	1	-	1
	Neighbourhood	10	0	0	0	0	0	-	1
	Distance to Core	5	0	0	0	0	0	-	0
VQA Condition Score		**100%**	**34%**	**35%**	**55%**	**29%**	**35%**	**NA**	**42%**
Number of Large Trees			-	-	-	-	-	-	-
Area (ha)			**0.049**	**0.174**	**0.849**	**0.061**	**1.520**	**0.605**	**1.542**

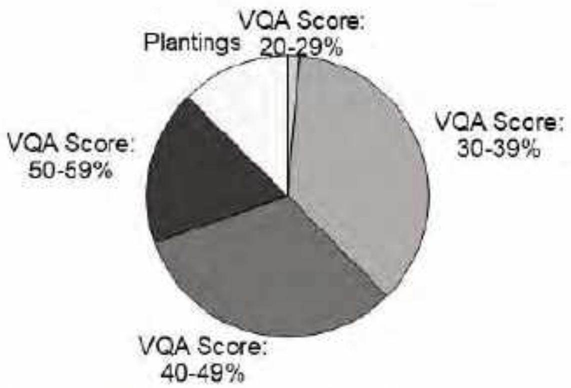

Figure 10. Proportional area of vegetation assessed within each habitat score (%) category, Port Melbourne Foreshore, Port Melbourne. Note that the percentages represent ***condition categories****, the graph is a visual representation of the contribution of each category to the* ***total area*** *(hectares) of mapped vegetation at this site.*

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Figure 11. Vegetation values within the Port Melbourne Foreshore site. Map 1/2

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Figure 12. Vegetation values within the Port Melbourne Foreshore site. Map 2/2

3.2.5 Port Melbourne Light Rail Corridor

3.2.5.1 Vegetation values

The parkland reserves along both sides of the Port Melbourne Light Rail contained a mix of exotic and indigenous vegetation, as well as mown grassy recreation areas, bike paths, walking tracks and children's playgrounds. Two Large Old Trees[2] were observed on the western side of the light rail, which was also the side where most mature indigenous plantings were seen. Although planted, these areas, as well as some more recent plantings on the eastern side, resembled native vegetation and were assessed as such. A single EVC was represented, however condition was variable.

Damp Sands Herb-rich Woodland (EVC 3): There were four condition zones identified.

The patch with the highest condition (43% pre-European condition), occupied the largest area of native vegetation at this site, which was a strip along the north western side of the light rail reserve (Zone ID 12). This zone had a healthy canopy and tall shrubby subcanopy of eucalypts, Drooping Sheoak *Allocasuarina verticillata*, Sweet Bursaria *Bursaria spinosa* and other tall shrubs, plus a range of graminoids and herbs (both planted and colonising) in the ground layer.

A zone which comprised mainly a canopy of mixed eucalypts over mown lawn of exotic grass or mulched areas supressing grass around trees (Zone ID 13) scored 19% pre-European condition. The majority of trees were still quite young and had been planted.

A planted area on the eastern side of the light rail (Zone ID 14) had a predominately exotic canopy but a moderately species-rich indigenous understorey of recent plantings. This area had a condition score of 33% pre-European condition.

There was also indigenous vegetation within the fenced light rail easement (Zone ID 15). The indigenous species here (mostly large shrubs and small trees) are presumed to have naturally colonised. Species included young River Red-gum *Eucalyptus camaldulensis* and Lightwood *Acacia implexa*. This vegetation did not comprise the enrichment plantings and mulch of some of the other zones. It scored 30% of pre-European condition.

Plate 16. Restored Damp Sands Herb-rich Woodland along the Port Melbourne Light Rail

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[2] A Large Old Tree (LOT) is an indigenous tree with a diameter at breast height (dbh) equal to or greater than that specified in the relevant EVC benchmark. For example, the benchmark for Damp Sands Herb-rich Woodland specifies a LOT is 70cm dhb or above (DELWP 2020b).

Table 6. Summary of the Vegetation Quality Assessment for the four quality zones identified at Port Melbourne Light Rail Corridor, Port Melbourne.

Key:
EVC Ecological Vegetation Class
DSHRW Damp Sands Herb-rich Woodland
GP Gippsland Plain
EN Classified as endangered in the Gippsland Plain Bioregion
VQA Vegetation Quality Assessment, based on the Habitat Hectares condition method (DSE 2004)

Zone ID			12	13	14	15
Bioregion			GP	GP	GP	GP
EVC Number: Name			3:DSHRW	3:DSHRW	3:DSHRW	3:DSHRW
EVC Bioregional Conservation Status (BCS)			EN	EN	EN	EN
Score		Max				
Site Condition	Large Trees	10	3	3	0	0
	Canopy Cover	5	5	3	0	5
	Lack of Weeds	15	13	4	15	11
	Understorey	25	15	5	15	5
	Recruitment	10	3	0	0	1
	Organic Matter	5	3	3	2	5
	Logs	5	0	0	0	2
Site Score	**Total Site Score**	**75**	**42**	**18**	**32**	**29**
	Max Site Score		75	75	75	75
	Adjusted Site Score		**42**	**18**	**32**	**29**
Landscape Context	Patch Size	10	1	1	1	1
	Neighbourhood	10	0	0	0	0
	Distance to Core	5	0	0	0	0
VQA Condition Score		**100%**	**43%**	**19%**	**33%**	**30%**
Number of Large Trees			1	1	0	0
Area (ha)			**0.722**	**0.552**	**0.515**	**0.161**

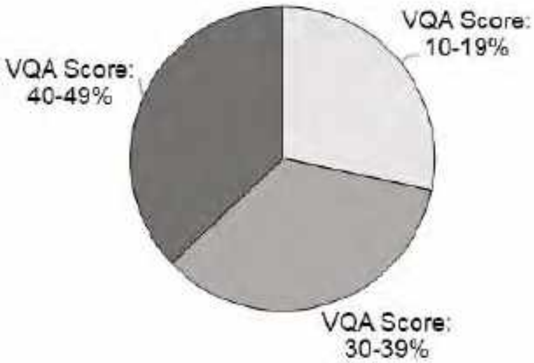

Figure 13. Proportional area of vegetation assessed within each habitat score (%) category, Port Melbourne Light Rail Corridor, Port Melbourne. Note that the percentages represent ***condition categories****, the graph is a visual representation of the contribution of each category to the* ***total area*** *(hectares) of mapped vegetation at this site.*

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Figure 14. Vegetation values within the Port Melbourne Light Rail Corridor.

3.2.6 St Kilda West Beach

3.2.6.1 Vegetation values

There were four EVC observed in the two patches of remnant native vegetation at St Kilda West Beach.

Coast Banksia Woodland (EVC 2): This occurred on the higher ground or more sheltered areas in both the eastern and western patch. Some remnant Coast Banksia *Banksia integrifolia* and other shrubs (e.g. Drooping Sheoak *Allocasuarina verticillata*, Coast Tea-tree *Leptospermum laevigatum*) were present. The predominately grassy understorey was mostly likely planted and had a relatively low species diversity. It scored 32% pre-European condition.

Berm Grassy Shrubland (EVC 311): This was confined to the area around the drainage line/canal to the east of this site. Coast Saltbush *Atriplex cinerea* dominated this EVC with a small amount of other native and exotic species on the groundlayer. Weeds and lack of recruitment resulted in a lower condition score of 38% of pre-European condition.

Coastal Dune Grassland (EVC 879): Occupies the foredunes and dominated by Hairy Spinifex *Spinifex sericea*, which was stabilising the loose sand at the perimeter of the vegetation patches. It was assessed as 54% the pre-European condition, which represented the highest condition score for this site.

Estuarine Flats Grassland (EVC 914): This vegetation occupied the swale area encircled by boardwalks in the eastern vegetation patch at this site. This area was waterlogged in places and supported a range of predominantly grasses and graminoids tolerant of both salinity and periodic inundation. The soil had a high proportion of broken shells in the surface layer and may be an Aboriginal midden (further investigation required). Species diversity was moderate for this vegetation type however the presence of high threat weeds including Spiny Rush **Juncus acutus* subsp. *acutus* and Couch **Cynodon dactylon* var. *dactylon* contributed to a low-moderate condition score of 35% of pre-European condition.

Plate 17. Estuarine Flats Grassland at St Kilda West Beach

Table 7. Summary of the Vegetation Quality Assessment for the four quality zones identified at St Kilda West Beach, St Kilda.

Key:
EVC Ecological Vegetation Class
BGS Berm Grassy Shrubland
CBW Coast Banksia Woodland
CDG Coastal Dune Grassland
EFG Estuarine Flats Grassland
GP Gippsland Plain
EN Classified as endangered in the Gippsland Plain Bioregion
DP Classified as depleted in the Gippsland Plain Bioregion
LC Classified as least concern in the Gippsland Plain Bioregion
VQA Vegetation Quality Assessment, based on the Habitat Hectares condition method (DSE 2004)

Zone ID			**8**	**9**	**10**	**11**
Bioregion			GP	GP	GP	GP
EVC Number: Name			2: CBW	311: BGS	879: CDG	914: EFG
EVC Bioregional Conservation Status (BCS)			LC	EN	DP	EN
Score		Max				
Site Condition	Large Trees	10	4	-	-	-
	Canopy Cover	5	0	-	-	-
	Lack of Weeds	15	7	7	11	4
	Understorey	25	10	15	15	10
	Recruitment	10	5	0	3	6
	Organic Matter	5	5	5	5	5
	Logs	5	0	-	-	-
Site Score	**Total Site Score**	**75**	**31**	**27**	**34**	**25**
	Max Site Score		75	55	55	55
	Adjusted Site Score		**31**	**37**	**46**	**34**
Landscape Context	Patch Size	10	1	1	1	1
	Neighbourhood	10	0	0	0	0
	Distance to Core	5	0	0	6	0
VQA Condition Score		100%	**32%**	**38%**	**53%**	**35%**
Number of Large Trees			1	-	-	-
Area (ha)			**1.056**	**0.090**	**0.453**	**0.537**

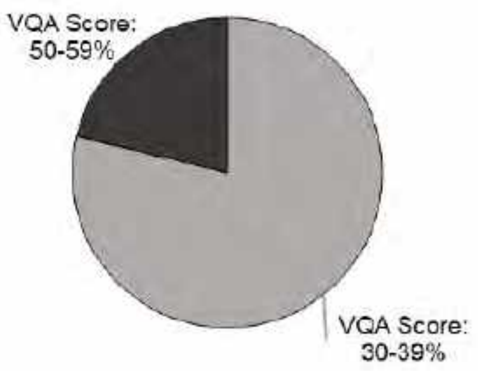

Figure 15. Proportional area of vegetation assessed within each habitat score (%) category, St Kilda West Beach, St Kilda. Note that the percentages represent ***condition categories****, the graph is a visual representation of the contribution of each category to the* ***total area*** *(hectares) of mapped vegetation at this site.*

Figure 16. Vegetation values within the St Kilda West Beach site.

3.3 Floristic quadrats

Six quadrats were completed for the project, all of which are located in larger remnants of native vegetation along the City of Port Phillip's foreshore. Due to the highly modified, narrow and planted nature of most areas of native vegetation within inland reserves, no locations were deemed suitable for floristic quadrats.

Table 8 summarises the EVC, number of species and dominant species (native or exotic) in each quadrat, with full details and photos provided in Appendix D.

*Table 8. Summary of data collected from the six floristic quadrats completed in areas of remnant vegetation located along the City of Port Phillip coastline (refer to Appendix D for full details). An asterisk * before a species name indicates it is exotic. Dominate species are listed in alphabetical order, not order of dominance.*

Quad. #	Site	EVC	No. Species			Dominant species	
			Total no.	No. Native (%)	No. Exotic (%)	Scientific name	Common name
1	Elwood Coastline	Coastal Dune Scrub	18	10 (56%)	8 (44%)	*Acacia longifolia subsp. sophorae*	Coast Wattle
						Myoporum insulare	Common Boobialla
						Rhagodia candolleana subsp. candolleana	Seaberry Saltbush
						Tetragonia implexicoma	Bower Spinach
2	Elwood Coastline	Coast Banksia Woodland	14	12 (86%)	2 (14%)	*Allocasuarina verticillata*	Drooping Sheoak
						Bursaria spinosa subsp. *spinosa*	Sweet Bursaria
						Eucalyptus ovata	Swamp Gum
						Rhagodia candolleana subsp. *candolleana*	Seaberry Saltbush
						Tetragonia implexicoma	Bower Spinach
3	Elwood Coastline	Coast Banksia Woodland	11	10 (91%)	1 (9%)	*Allocasuarina verticillata*	Drooping Sheoak
						**Ehrharta erecta* var. *erecta*	Panic Veldt-grass
						Rhagodia candolleana subsp. *candolleana*	Seaberry Saltbush
						Tetragonia implexicoma	Bower Spinach
4	St Kilda West Beach	Estuarine Flats Grassland	13	9 (69%)	4 (31%)	*Ficinia nodosa*	Knobby Club-sedge
						Distichlis distichophylla	Australian Salt-grass
						Austrostipa stipoides	Prickly Spear-grass
						**Cynodon dactylon* var. *dactylon*	Couch
5	Port Melbourne Foreshore	Coastal Dune Grassland	11	6 (55%)	5 (45%)	**Bromus diandrus*	Great Brome
						**Ehrharta erecta* var. *erecta*	Panic Veldt-grass
						Spinifex sericeus	Hairy Spinifex
6	Port Melbourne Foreshore	Coastal Dune Grassland	17	11 (65%)	6 (35%)	**Bromus diandrus*	Great Brome
						**Cynodon dactylon* var. *dactylon*	Couch
						Spinifex sericeus	Hairy Spinifex

4 FAUNA HABITAT

4.1 Habitat descriptions

The study sites varied from coastal and freshwater habitat to modified terrestrial habitat. All the study areas have been modified to varying degrees. Modification can have beneficial outcomes, as is the case with the St Kilda Breakwater. Whilst the St Kilda Breakwater is not a natural feature it provides excellent habitat for Rakali (a native water-rat) and nesting for Little Penguins. Further to this the Breakwater has created the tidal sand bar on the St Kilda Spit where migratory shorebirds roost of an evening. Conversely the highly modified Elwood Canal has limited ability to improve water quality within the creek and entering Port Phillip Bay, and there is very little native vegetation that has not been revegetated.

Except for the St Kilda Botanical Gardens, the sites were linear with distances to the core varying from 5 m to 200 m. The distance to the core impacts on how fauna use a site due to the influence of 'edge effect' which is "the effect of an abrupt transition between two quite different adjoining ecological communities on the numbers and kinds of organisms in the marginal habitat" (Meriam Webster, 2020).

Edge effects influence how fauna interact within the landscape and whether the habitat provides the required resources for a species to persist. In an urban environment, the edge effect is not a transition of an adjoining ecological community, it is typically the result of infrastructure e.g. roads, housing, commercial building, open space and lighting. Edge effects have varying degrees of influence depending on the species. Other external influences include how humans interact with the area e.g. tree clearing, dogs off leads, etc.

An overview of the fauna habitat observed at each study area is provided below.

4.1.1 St Kilda Botanical Gardens

The St Kilda Botanical Gardens consists of a modified terrestrial and freshwater aquatic habitat approximately 7.6 ha in area. The garden has both mature introduced (e.g. Date Palm and Moreton Bay Fig) and native canopy trees and a diversity of introduced understorey and ground flora.

The native section consists of a range of introduced native canopy trees and, native midstorey (Blackwood *Acacia melanoxylon*, Black Wattle *Acacia mearnsii* and Coast Pomaderris *Pomaderris paniculosa* subsp. *paralia*) and ground flora (Tussock Grasses *Poa* species, Spiny-headed Mat-rush *Lomandra longifolia* and Berry Saltbush *Atriplex semibaccata*). There were many habitat trees (Lemon-scented Gum *Corymbia citriodora*, Spotted Gum *Corymbia maculata*, Sugar Gum *Eucalyptus cladocalyx* and Moreton Bay Fig *Ficus macrophylla*) providing food resources but only a few tree hollows were observed. Nest boxes have been placed throughout the gardens to supplement the lack of tree hollows. There is a scarcity of woody debris and / rocks in the garden beds.

The aquatic habitat is approximately 1000 m^2 and consists of a concrete pond with a fountain and small constructed wetland dominated by planted native aquatic species (Cumbungi *Typha* species, Sedges *Carex* species and Rushes *Juncus* species) and several introduced species.

4.1.2 Canterbury Road Urban Forest

The '*Urban Forest*' is a linear revegetated area providing approximately 1.6 ha of terrestrial habitat. The site was established approximately 15-years ago. The forest consists of non-provenance native canopy trees, (Box and Ironbark eucalypts) and, native mid-storey (Gold-dust Wattle *Acacia acinacea*, Hedge Wattle *Acacia paradoxa* and Correa *Correa* species) and ground flora (Berry Saltbush *Atriplex semibaccata*). There was a lack of woody debris and rocks to provide habitat for insects and skinks. The *Urban Forest* is self-sustaining and relatively weed free. Whilst the forest provides food resources for insectivorous and nectivorous birds, it lacks roosts for hollow dependant species.

4.1.3 Elwood Canal / Elster Creek

The Elwood Canal and Elster Creek study area is approximately 4.5 ha. The revegetation at the mouth of Elwood Canal to Marine Parade, replicating the Estuarine Wetlands EVC, is well advanced and provides habitat for a range of birds and reptiles. The tidal zone of the canal supports habitat for a range of fish and foraging for herons and egrets.

It is highly modified with the creek being channelised from Glen Huntly Road to St Kilda Street. There is little in the way of remnant vegetation with the exception of several River Red Gums. Introduced Sugar Gums are the most prevalent canopy species confined to the eastern section.

Revegetation along the Elwood Canal and Elster Creek from Marine Parade to St Kilda Road is in the early stages of establishment (restored Damp Sands Herb-rich Woodland) and provides habitat for common bird species, skinks and microbats. There were few tree hollows observed however this has been supplemented by nest boxes. There was a lack of woody debris and rocks providing habitat for insects and skinks. Kikuyu grass was dominant on the escarpment and riparian zones.

There was a strong odour coming from the water in Elster Creek from above the tidal zone through to St Kilda Street, which suggests that it is of limited suitability for water dependant birds and frogs.

4.1.4 Point Ormond Reserve

The vegetation within Point Ormond Reserve is a linear remnant coastal vegetation community (Coast Banksia Woodland) linking with Elwood Foreshore creating an area of approximately 7 ha. It is one of the largest, if not the largest intact remnant vegetation community in the City of Port Phillip. With the exception of some illegal clearing of the canopy, the reserve is both floristically and structurally diverse (e.g. canopy trees and shrubs, understorey and ground flora). Unlike the other study areas, there is extensive ground cover and woody debris. The Melaleucas (e.g. Swamp Paperbark *Melaleuca ericifolia*; Moonah *Melaleuca lanceolata*) and Coast Banksia *Banksia integrifolia* trees provide habitat for a wide range of fauna species.

4.1.5 St Kilda Breakwater

Although the St Kilda Breakwater is human constructed infrastructure built from basalt rocks to provide safe mooring for boats, the breakwater provides important habitat for a variety of species including birds, mammals, reptiles, fish and crustaceans. The gaps between the boulders provides safe nesting from predators for Little Penguins and Rakali (native water-rat) and supports prey for the Rakali as well as cormorants and other waterbirds. The breakwater covers an area of approximately 2.5 ha.

4.1.6 St Kilda Spit

The St Kilda Spit is an artefact of the construction of the breakwater at St Kilda West Beach. It consists of a tidal sandbar and Coastal Dune Grassland on the shoreline. The Spit provides roosting habitat (Gio Fitzpatrick, pers comm, 25 February 2020) of an evening for migratory waders and feeding resources for other coastal waterbirds, e.g. Red-necked Stint, Pied Oyster Catcher *Haematopus longirostris*, Black-winged Stilt and Red-necked *Avocet Recurvirostra novaehollandiae*. The Spit covers an area of approximately 15 ha.

Refer to fauna habitat assessment sheets in Appendix E.

4.2 Fauna survey results

4.2.1 Bat detector surveys

Bat activity and diversity was greatest in the larger areas where there is a range vegetation, presence of understory and trees of older age classes that provide natural roosts, or where roosts are supplemented by nest boxes.

St Kilda Botanical Gardens had the highest levels of bat activity and species diversity. This is attributed to the diversity of vegetation (both native and non-native), areas suitable for foraging, proximity to water and roost availability. The impacts of edge effects are likely to be less due to the size and shape of the gardens.

A total of five microbat species were identified from their call features and, three species call complexes. A species call complex is where the characteristic call features used for identification are not present and the call could be of more than one species. The species and call complexes identified were as follows:

1. Chocolate Wattled Bat – *Chalinolobus morio*
2. Gould's Wattled Bat – *Chalinolobus gouldii*
3. Large Forest Bat – *Vespadelus darlingtoni*
4. Little Forest Bat – *Vespadelus vulturnus*
5. White-striped Freetail Bat – *Austronomus australis*

The three call complexes recorded were:

1. Forest bat complex – *Vespadelus* sp.
2. Long-eared bat complex – *Nyctophilus* sp.
3. Freetail / Gould's wattled bat complex- *Ozimops / Chalinolobus* sp.

Refer to Appendix F for call images indicative of species identified.

St Kilda Botanical Gardens

The *Gardens* had second highest species diversity. Four species were identified from their distinctive call features along with one call complex. Call activity averaged 380 bat call files per night, the highest activity of any site.

Gould's Wattled Bat was recorded on each of the five-nights the detectors were deployed, Large Forest Bat and White-striped Freetail Bat were recorded on four nights and Little Forest Bat on 1 night. The Long-eared bat call complex, most likely Lesser Long-eared Bat, was recorded on two nights (refer to Table 9 below).

Table 9. Bat call activity at St Kilda Botanical Gardens

Key: ✓ Present

Site Name: St Kilda Botanical Gardens	11/2/20	12/2/20	13/2/20	14/2/20	15/2/20	Total
Number of files	427	419	372	297	387	1902
Identified to species level	4	1	3	3	3	
Gould's Wattled Bat	✓	✓	✓	✓	✓	
Large Forest Bat	✓		✓	✓	✓	
Little Forest Bat	✓					
White-striped Freetail Bat	✓		✓	✓	✓	
Identified to call complex		1	1			
Long-eared Bat		✓	✓			

Plate 18. Bat detector deployed on Spotted Gum directed to an area considered foraging habitat

Plate 19. Bat foraging habitat located adjacent to bat detector.

Canterbury Forest

Bat activity and species diversity at Canterbury Forest was the lowest of any of the sites, with only one bat call recorded. Gould's Wattled Bat was recorded at the site, this is the most common species recorded in urban areas.

The lack of bat activity is attributed to the small area of the reserve, its linear landscape structure, isolation from remnant vegetation and significant edge effects with light rail and a major road immediately adjacent. The vegetation is also relatively young, and the canopy trees lack roosts. Of interest is electrical activity from the light rail which was recorded by the bat detectors. It is possible that the electrical activity interferes with echolocation and bats avoid the area. Refer to Table 10 for results.

Table 10. Bat call activity at Canterbury Forest

Key: ✓ Present

Species: Date	17/1/20	18/1/20	Total
Number of files	19	1	20
Identified to species level		1	
Gould's Wattled Bat		✓	

Elwood Canal / Elster Creek

Bat activity was confined to three of the five nights of deployment. Two species were recorded, Gould's Wattled Bat and Chocolate Wattled Bat and one call complex, Long-eared species. Chocolate Wattled Bat was not recorded at any of the other sites. Notwithstanding the linear shape of the study area and the majority of the vegetation having been re-established, the detectors were placed where bat activity was expected.

There was an average of 11.6 calls per night, which is lower than anticipated (refer to Table 11 for nightly results). In comparison, the St Kilda Botanical Gardens averaged 380 calls per night over the same survey period.

Table 11. Bat call activity at Elwood Canal / Elster Creek

Key: ✓ Present

Species: Date	11/2/20	12/2/20	13/2/20	Total
Number of files	5	19	11	35
Identified to species level	1	2	1	
Chocolate Wattled Bat		✓		
Gould's Wattled Bat	✓	✓	✓	
Identified to call complex	1			
Long-eared Bat	✓			

Plate 20. Elster Creek bat detector on River Red Gum

Plate 21. Elster Creek bat foraging habitat adjacent to detector.

Point Ormond Reserve

Bat activity was recorded on each of the eleven nights of detector deployment averaging nineteen calls per night. Three species were recorded, Gould's Wattled Bat, Little Forest Bat and White-striped Freetail Bat, all common in urban areas. One call complex was recorded, Gould's Wattled Bat / Freetail species complex. Refer to Table 12 for nightly activity results.

The nightly bat activity levels were as anticipated given the type of vegetation community present, i.e. Coast Banksia Woodland and Coastal Dune Scrub. Although linear in shape, the distance to the core is greater (40 m–80 m) than Canterbury Forest and Elwood Canal / Elster Creek (5 m–10 m) and forms one of the largest remnant patches of vegetation in the municipality.

Table 12. Bat call activity at Point Ormond Reserve

Key: ✓ Present

Site Name: Port Ormond	16/1/20	17/1/20	18/1/20	19/1/20	20/1/20	21/1/20	22/1/20	23/1/20	24/1/20	25/1/20	26/1/20	Total
Number of files	3	22	33	45	5	46	3	8	21	22	2	210
Identified to species level												
Gould's Wattled Bat	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Little Forest Bat	✓	✓	✓	✓		✓			✓			
White-striped Freetail Bat		✓	✓			✓			✓			
Identified to call complex												
Gould's Wattled Bat / Ozimops sp						✓						

Plate 22. Point Ormond Reserve bat detector placed on Drooping Sheoak

Plate 23. Bat foraging habitat located adjacent to bat detector

4.2.2 Amphibian recorder surveys

St Kilda Botanical Gardens

The SongMeter SM4™ recorder was set up adjacent to the constructed wetland and pond at St Kilda Botanical Gardens. Two species were recorded, Peron's Tree Frog and Southern Brown Tree Frog. Both species are not usually found in such a highly urbanised area close to the CBD.

Peron's Tree Frog is a more recent occurrence believed to have been introduced during remedial works in the constructed wetland. Common Froglet and Marsh Frogs have been recorded in the past but have not been heard for a number of years (Gio Fitzpatrick, pers comm, 10 February 2020).

Table 13. St Kilda Botanical Gardens SongMeter SM4 frog survey

IN FILE	DURATION	Fmin Hz	Fmean Hz	Fmax Hz	DATE	TIME	MANUAL ID
S4A02566_20200126_220000.wav	2.024062	1,000.00	1,823.08	2,437.50	26/01/2020	22:00	Peron's Tree Frog
S4A02566_20200126_000000.wav	1.917812	875.00	1,934.63	3,250.00	26/01/2020	0:00	Peron's Tree Frog
S4A02566_20200123_000000.wav	2.44375	937.50	2,006.90	3,062.50	23/01/2020	0:00	Peron's Tree Frog
S4A02566_20200119_220000.wav	2.125	1,500.00	2,113.94	3,000.00	19/01/2020	22:00	Peron's Tree Frog
S4A02566_20200126_220000.wav	2.109062	1,375.00	2,048.55	2,875.00	26/01/2020	22:00	Peron's Tree Frog
S4A02566_20200123_040000.wav	3.1875	2,062.50	2,347.48	2,812.50	23/01/2020	4:00	Southern Brown Tree Frog
S4A02566_20200122_030000.wav	2.523438	2,125.00	2,482.14	2,812.50	22/01/2020	3:00	Southern Brown Tree Frog

Plate 24. SongMeter placed on palm tree between pond and constructed wetland

Plate 25. Constructed wetland located adjacent to recorder

Elwood Canal / Elster Creek

The SongMeter SM4™ recorder was set up adjacent to the Elster Creek where riparian and aquatic vegetation was present. No frogs were recorded over the 11 days of deployment. This was an unexpected result given that Southern Brown Tree Frog and Striped Marsh Frog have been recorded in Elster Creek in Elsternwick Park. However, as previously noted, the water quality appears to be compromised for much of the canal and creek above the tidal zone.

Plate 26. SongMeter placed on River Red Gum

Plate 27. Riparian and aquatic habitat located adjacent to recorder

4.2.3 Elwood Canal / Elster Creek active reptile search

The active reptile survey failed to record the presence of any reptiles although Weasel Skink and Garden Skink have previously been observed within the canal and adjacent houses (Gio, Fitzpatrick, pers comm, 10, February 2020). The revegetated areas would benefit by the placement of woody debris and rocks to provide ground layer protection for skinks and their prey.

Plate 28. Elwood Canal / Elster Creek indicative skink habitat

4.2.4 Active Rakali survey

The survey was completed during ideal weather conditions (refer to table 17). Twenty Rakali were observed, during the 75-minute survey period, two more Rakali were observed when leaving the study site. It is of interest that nineteen of the twenty observations were on the protected northern side of the *Breakwater*. The surface of the water was calmer, water depth is less (easier foraging), and there are natural sandy banks on the water's edge for exiting and feeding.

A literature search failed to find any studies that provide information regarding the current population densities at study sites in Victoria. A Rakali community study in Western Australia in 2014-2015 (Trocini, S. et al 2015), reported 234 sightings over a four-month period. The report notes that there was anecdotal evidence of localised declines and extinctions in the Perth Metropolitan Region. If a similar trend is occurring across Melbourne, the population of Rakali at the *Breakwater* are of significance. The *Breakwater* appears to be one of the only known strongholds for Rakali in Melbourne.

Plate 29. St Kilda Breakwater

4.2.5 St Kilda Spit Shorebird / wader survey

Dog activity was at its peak between 7pm and dusk and no shorebirds or waders were observed. Once dog activity ceased post dusk, two species of shorebirds were observed feeding at the Spit, namely Black-winged Stilt (3) and Red-necked Stint (7). Four Nankeen Night Heron, two of which were foraging, and two Chestnut Teals were also observed.

Up to two hundred Red-necked Stint have previously been observed feeding at the Spit. Other species regularly seen are Pied Oyster Catcher, Red-necked Avocet and Nankeen Night Heron (Gio Fitzpatrick, pers comm, 25 February 2020).

The Spit's suitability post dusk might not be only due to dog activity during daylight. A study by Dwyer et al (2013) found benefits with an overspill of lighting from an industrial area adjacent to a foraging area of the Common Redshank. Other studies referred to in their report support their conclusions that visual foraging is more productive than tactile foraging and provides a beneficial food intake for feeding intertidal birds. Dwyer et al (2013) are of the opinion that artificial lighting has a beneficial outcome for common redshank. It's possible that the overflow of lighting from Marine Parade provides similar benefits. Birds may be preferentially flying to the Spit post dusk to supplement their daytime feeding.

Plate 30. Low tide at St Kilda Spit

4.2.6 Weather Conditions

Surveys were conducted to coincide with the seasonal and weather conditions preferred by the target species. The tables below provide the weather conditions for each of the surveys.

Table 14. Canterbury Forest, Point Ormond bat survey, St Kilda Botanical Gardens and Elster Creek frog surveys

Date	Rainfall (mm)	3pm Temp (°C)	3pm Relative Humidity (%)	3pm cloud cover	3pm wind direction	3pm wind speed (km/h)	3pm Air Pressure (hPa)
16/01/2020	31.2	17.3	65	7	S	33	1012.3
17/01/2020	0.8	23.8	50	7	SSW	20	1009.6
18/01/2020	0	26.9	47	7	S	26	1005.7
19/01/2020	0	27.6	47	3	S	26	1002.4
20/01/2020	0.2	18.8	80	8	S	31	1003.5
21/01/2020	25.2	22.6	42	1	SSW	11	1007.9
22/01/2020	0	31	20	7	NNW	56	998.6
23/01/2020	18	20.2	47	7	W	43	998.9
24/01/2020	0.6	21.2	40	7	WNW	11	1012.1
25/01/2020	0	26.9	36	1	S	20	1012.2

Table 15. St Kilda Botanical Gardens and Elster Creek bat survey

Date	Rainfall (mm)	3pm Temp (°C)	3pm Relative Humidity (%)	3pm cloud cover	3pm Wind Direction	3pm Wind Speed (km/h)	3pm Air Pressure (hPa)
9/02/2020	0	26.5	44	7	E	35	1014.9
10/02/2020	0.8	25.8	58	7	SE	15	1008.2
11/02/2020	0	27.2	54	7	SSW	20	1008.1
12/02/2020	0.4	24	74	6	S	26	1013
13/02/2020	0.2	30.3	45	2	SE	9	1009.8
14/02/2020	0	22.1	86	7	WSW	39	1006.1
15/02/2020	11.2	17.3	98	8	SSW	22	1011.3

Table 16. Elwood Canal reptile survey

Date	Rainfall (mm)	9am Temp (°C)	3pm Temp (°C)	Cloud cover	Ave wind speed (km/h)	Air Pressure (hPa)
11/02/2020	0	20.5	27	7	14	1009.2

Table 17. St Kilda Breakwater Rakali and St Kilda Spit shorebird survey

Date	Rainfall (mm)	3pm Temp (°C)	3pm Relative Humidity (%)	3pm cloud cover (oktas)	3pm wind direction	3pm wind speed (km/h)	3pm Air Pressure (hPa)
10/03/2020	0	20.5	63	0	SW	17	1019.4

5 SIGNIFICANT TREES

5.1 Significant Tree mapping

According to the City of Port Phillip (2020), *a Significant Tree means a tree or palm on private land:*

- *With a trunk circumference of 150 centimetres or greater measured 1 metre from the base;*
- *A multi-stemmed tree where the circumference of its exterior stems equals or is greater than 1.5 metres when measured 1 metre from its base; or*
- *If the tree has been removed, a trunk circumference of 150 centimetres or greater measured at its base.*

Properties potentially containing Significant Tress were mapped using aerial photography for private property across the City of Port Phillip. The methods undertaken for this analysis are provided in Section 2.3.

The highest concentration of private properties with a high likelihood of containing Significant Trees were centred in Elwood (155 parcels) and St Kilda (115 parcels). St Kilda and St Kilda East contained the highest concentration of properties determined to have a Moderate likelihood, with 214 parcels and 147 parcels, respectively.

Potential Significant Trees were more commonly located in the southern portions of the municipality, compared to the north, primarily in residential areas compared to industrial areas. Of all 1265 private property parcels potentially containing Significant Trees:

- Approximately 94% fall within residential zones
  - 41% of those have a High likelihood
  - 59% of those have a Moderate likelihood
- Approximately 3.4% fall within the commercial zones
  - 59% of those have a High likelihood
  - 41% of those have a High likelihood
- 2.6% are within other zones.

Three large industrial parcels in Port Melbourne that have registered Significant Trees were placed into the ‘Other’ category as potentially Significant Trees could not be seen in the aerial imagery.

Table 18 provides a suburb break down of the number of properties in the High, Moderate or Other likelihood categories, with all other properties falling in the Low likelihood category. The distributions of these are depicted in Figure 17.

Table 18. Suburb breakdown of the number of properties in the High, Moderate or Other likelihood of containing Significant Trees categories.

Suburb	High Likelihood	Moderate Likelihood	Other
Elwood	155	83	0
St Kilda	123	214	0
St Kilda East	49	147	0
Port Melbourne	48	54	3
South Melbourne	27	62	0
Balaclava	25	50	0
Albert Park	24	87	0
St Kilda West	16	19	0
Melbourne	18	9	0
Ripponlea	8	12	0
Middle Park	4	24	0
Windsor	3	0	0
Southbank	1	0	0
TOTAL	**501**	**761**	**3**

Figure 17. Likelihood of private properties to contain Significant Trees based on aerial photo interpretation.

5.2 Provisions for the protection of Significant Trees and environmental values

A comparison of the potential benefits and limitations of different Planning Scheme and Local Law mechanisms that could be used to protect Significant Trees and other environmental values is provided in Table 19

Table 19. Potential mechanisms available to increase the protection of Significant Trees and other environmental values within the Port Phillip municipality.

Mechanism	Potential benefits	Potential limitations	Comments
Planning scheme			
Vegetation Protection Overlay (VPO)	Can apply to remnant and exotic/planted vegetation. Protection can be for biodiversity, amenity, landscape and heritage values – can be adapted to cover specific trees or areas of vegetation, or provide blanket coverage over wider areas. Protects vegetation that could otherwise be permitted for removal under exemptions of Clause 52.17 Native Vegetation. Can include offsets (e.g. compensation plantings) or application of additional mitigation measures (land management plans) if the vegetation is permitted to be removed.	Only triggers a planning permit for the removal or lopping of vegetation. Buildings and works that would not require a permit but may indirectly impact vegetation (e.g. a Tree Protection Zone), would not be controlled by the VPO. If used to protect Significant Trees – trees would need to be mapped which can be costly and incomplete for areas of private land that cannot be accessed. Alternatively, blanket application can be applied where sufficient justification can be provided (e.g. Banyule and Monash Planning Schemes). Introduction of new overlay schedules (or changes to the existing schedules) requires a planning scheme amendment, which can be lengthy process, including the preparation of amendment documents, and in some circumstances supporting documentation, public exhibition and a planning panel.	There is only one VPO schedule in Port Phillip planning scheme – it affects a significant English Oak tree on one property in St Kilda. Given the limitations of the VPO, the need for a VPO should be viewed in context of whether a VPO would be beneficial above the already existing Local Law relating to Significant Trees and other overlay options. Depending how a VPO is used to protect Significant Trees, the trees may need to be mapped or the VPO applied to extensive areas (as is the case in Banyule and Monash Planning Schemes, for example). Mapping trees is a cost to factor in but there are significant benefits to council decision-makers in having this data on hand.
Environmental Significance Overlay (ESO)	Protects areas supporting important biodiversity/environmental values and is the preferred overlay for achieving biodiversity outcomes (DELWP 2017).	Specifically applies to the protection of biodiversity and/or environmental values (e.g. waterways and coastal environs). Amenity values are not	Four ESO schedules currently in use for Port Phillip – Light Rail, Corroboee Tree, West Beach Natural History Reserve and Port Melbourne Environs. There may be additional opportunities to protect notable biodiversity and environmental values (e.g. habitat for

Mechanism	Potential benefits	Potential limitations	Comments
	Broader application than a VPO, including permit for development or other works, and impacts to significant habitat or other environmental values not associated with vegetation. Protects vegetation (including non-remnant vegetation) that could otherwise be permitted for removal under exemptions of Clause 52.17 Native Vegetation. Can include offsets (e.g. compensation plantings) and/or application of additional mitigation measures (land management plans) if the vegetation is permitted to be removed and/or works approved.	considered in this overlay. Introduction of new overlay schedules (or changes to the existing schedules) requires a planning scheme amendment, which can be lengthy process, including the preparation of amendment documents, and in some circumstances supporting documentation, public exhibition and a planning panel.	Rakali, areas of native vegetation, coastal areas and areas along waterways) outside of these areas through the use of additional ESO schedules. Much of these areas will be on public land and the benefits of this would need to be weighed up with the resources required for a planning scheme amendment.
Other overlays affecting trees and landscapes: • Significant Landscape Overlay (SLO) • Neighbour-hood Character Overlay (NCO) • Heritage Overlay (HO)	Can consider aesthetic, landscape, cultural and natural heritage values. Can include provisions for removal of vegetation and building and works. Protects vegetation (including non-remnant vegetation) that could otherwise be permitted for removal under exemptions of Clause 52.17 Native Vegetation.	Not to be used to protect biodiversity values only, although Significant Trees are not determined on their biodiversity values, rather their size. Introduction of new overlay schedules (or changes to the existing schedules) requires a planning scheme amendment, which can be lengthy process, including the preparation of amendment documents, and in some circumstances supporting documentation, public exhibition and a planning panel.	There is no Significant Landscape Overlay currently within the Port Phillip Planning Scheme. Inclusion of a new overlay requires a Planning Scheme Amendment and is an onerous process, as is developing new schedules or amendments to existing schedules to existing overlays. However an SLO may be useful along coastal areas to protect the landscape features. A NCO currently applies to properties within the Beacon Cove area. Additional NCOs could be developed to increase the coverage of this overlay for tree protection. However, given the extensive coverage of the Heritage Overlay in Port Phillip, inclusion of more NCO schedules to cover additional areas may not be necessary. Instead, there may be opportunities to include tree controls that would protect Significant Trees within alternative overlays, including for works proposed within the vicinity of the tree. The use of HOs has been effective for Significant Tree protection in other municipalities such as Banyule and Casey where individual properties that are recognised for heritage values are covered by a HO, and some individual trees outside the HO properties are also covered by a HO, or in some cases an ESO. The HO schedules include provision for tree controls for the majorities of properties covered, and apply to the entire property, not just the heritage place (e.g. building) listed. However, any additional controls would require a planning scheme amendment and heritage justification.

Mechanism	Potential benefits	Potential limitations	Comments
Local Law			
Significant Trees	Additional mechanism to planning scheme controls, that allows for the protection of Significant Trees within a municipality. A permit under the local law can be triggered if pruning, removal or works within the vicinity of a Significant Tree, is proposed. Can apply to native and non-native trees. Significance can be based on size (diameter or circumference of trunk) and/or other attributes. If based on size, then location of individual trees does not need to be mapped. Does not require a planning amendment.	Landowners are often not aware of local laws in relation to protection of trees and requirements for permits. Typically applies to trees and not other vegetation. May require amending Local Law.	Port Phillip already has Significant Trees (based on tree size) within its Local Law. There are opportunities to strengthen this policy to include a list and map of high priority trees for retention based on identified criteria, and also for the inclusion of a permit for works within the vicinity of Significant Trees. Local Laws expire after 10 years if they are not amended prior and this provides a good opportunity to review Local Laws and consider whether changes are required. Other example Local Laws include City of Bayside's Local Law No. 2 'Neighbourhood Amenity", City of Boroondara's "Tree Protection" Local Law and Brimbank City Council's proposed Municipal Tree Policy (in preparation).

The best options for increasing protection of Significant Trees (regardless of their environmental values) needs to be viewed in the context of the values of the tree being protected, the location of the values (distribution and tenure of land), and the resources required to achieve the required outcome. For example, significant changes via a planning scheme amendment can be expensive, time consuming and onerous. This needs to be weighed up with the benefit of the changes and whether this will significantly improve the protection of the values being considered. Consideration should also be given to avoiding obtaining multiple provisions where the objective can be achieved with one provision (e.g. a Vegetation Protection Overlay (VPO) for Significant Trees and Local Law for Significant Trees). On this basis, the following are recommended for Port Phillip:

1. Review the Significant Tree requirements in the Port Phillip Local Law and consider increasing the protection measures associated with Significant Trees with new measures to be adopted once the current local law expires in August 2023. The current measures include all trees above a nominated size on private land. Consideration should be given to:
    a. Protecting Significant Trees from impacts not associated with pruning or removal by including the requirement for a permit when works or development are undertaken within a nominated distance from the tree trunk.
    b. Developing a registry and mapping the location of high retention value trees which are to be given a very high priority for retention when works or development are proposed (similar to Significant Trees within Boroondara's Local Law). Criteria would need to be developed to determine how the trees will be identified, and then assessed and mapped by an arborist. A system for nominating specific trees by the public could also be considered. Affected property owners would need to be notified. The registry could be reviewed every ten years when the Local Law is renewed. This would also allow additional trees to be included, and the health and condition of existing trees to be reassessed and removed from the registry if they no longer fulfilled the criteria.
2. Council to determine if additional planning controls are required in the planning scheme to protect Significant Trees (regardless of their environmental values) or vegetation / biodiversity values. The majority of the most significant vegetation (excluding Significant Trees) and biodiversity values for the municipality are located on public land and managed by public authorities. Implications of an overlay for future works or development on public land should be considered, as well as measures already in place

under existing planning provisions (zones and overlays, such as the Heritage Overlay). If additional planning controls are deemed necessary:

a. Developing a new Environmental Significance Overlay or Vegetation Protection Overlay, or amending the existing Heritage Overlay to include more tree controls will be a costly and time-consuming exercise (some more than others). Significant Trees will need to be identified and assessed for their relevant value (e.g. heritage value, environmental or amenity value). Each of these overlay options have limitations in their effectiveness at protecting all Significant Trees. For example, ESOs are typically used for protecting the most significant biodiversity values of a municipality and do not consider amenity values and VPOs do not trigger permits for buildings and works that may indirectly impact a tree. A detailed investigation into these options would be required and Port Phillip would need to weight up the pros and cons of each option as outlined in Table 19.

b. Based on the opportunities and limitations of the overlays considered above in Table 19**Error! Reference source not found.**, the existing Heritage Overlay may provide an opportunity to include Significant Trees within the planning scheme. While some of the current schedules within the Port Phillip Heritage Overlay include tree controls, there is opportunity to include tree controls to more of the schedules (i.e. a planning permit required to remove, lop, or undertaken works within the vicinity of a Significant Trees). This would require the trees and vegetation within each property to be considered for their heritage value. There is quite an overlap between private properties that have a moderate to high likelihood of supporting a Significant Tree (Figure 17) and those affected by the Heritage Overlay. While there would be some duplication in permit requirements for works associated with Significant Trees, this would allow a planning permit to consider, (1) the implications of the proposed works on the heritage place, including Significant Trees (e.g. measures taken to protect Significant Trees during works), and (2) how the new development takes into account the health, appearance and setting of the tree.

As a priority, it will likely be most simple and quite effective (i.e. to cover general values in relation to Significant Trees such as landscape amenity and biodiversity) to include a Significant Trees requirement into Local Law. This will also provide a mechanism to address potential indirect impacts of works and development on the trees. So that the public are aware of the requirements of obtaining a Local Law permit before works are undertaken, a public consultation and awareness campaign is recommended.

Being a mapped planning mechanism, the application and implications of an overlays are more readily identified. A Vegetation Protection Overlay applied to large tracts of land would trigger a permit for direct impacts to Significant Trees (e.g. lopping, felling) and other vegetation, however indirect impacts to Tree Protection Zones during works would not. In such cases, the use of another planning overlay is recommended for Significant Trees when a specific objective is being achieved and/or when values are particularly significant (e.g. biodiversity, heritage). This would likely require the trees to be assessed and mapped as part of the Planning Scheme Amendment process. For example, Significant Trees could be protected in the existing Heritage Overlay if they are in the context of the heritage place being protected, such as trees that are very old and form part of the history of the property. Alternatively, large remnant indigenous trees could be protected for their biodiversity values under an Environmental Significance Overlay.

It is common in other Melbourne metropolitan municipalities (e.g. Banyule, Monash, Casey, Whitehorse to name a few) to protect Significant Trees via several different planning approaches including different areas of the landscape covered by Environmental Significance Overlay, Vegetation Protection Overlay, Significant Landscape Overlays and/or Heritage Overlays, while others only use a Local Law (e.g. Bayside). This would be more effective at protecting Significant Trees and other vegetation; however it will be a costly and time consuming process that must also be considered.

If it is determined that additional overlays on public land are not necessary, protocols could be developed to ensure adjoining significant vegetation on public land is protected, particularly when new development or other works are proposed.

The introduction of new planning controls will require consideration by City of Port Phillip to determine the most appropriate mechanism for protecting Significant Trees, vegetation and habitat (e.g. Rakali habitat at St Kilda Breakwater). Depending on the pathway(s) pursued, planning investigations and on-ground evaluation of identified values and species vegetation will be required. The Significant Tree mapping undertaken as part of this study can provide a valuable contribution to refining investigation areas. Regardless of the planning mechanism chosen, community consultation and engagement will be essential.

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APPENDIX A – FAUNA EQUIPMENT DEPLOYMENT AND HABITAT CHARACTERISTICS

Bat Detectors

ID	Site Photographs – Bat Detectors	Comments
IMG_20200117_112528		Canterbury Forest bat detector
IMG_20200117_112226		Canterbury Forest bat flyway. Overstorey of non-provenance native species

ID	Site Photographs – Bat Detectors	Comments
IMG_1152		St Kilda Botanical Gardens bat detector
IMG_1150		St Kilda Botanical Gardens bat foraging habitat adjacent to detector
IMG_1154		Elster Creek bat detector

ID	Site Photographs – Bat Detectors	Comments
IMG_20200201_095542		Elster Creek bat foraging habitat adjacent to detector. Mixture of River Red Gum and Sugar Gum overstorey with Typha within Elster Creek
IMG_1084		Point Ormond Reserve bat detector
IMG_20200201_100715		Point Ormond Reserve foraging bat habitat adjacent to detector. One of the few areas of relatively intact remnant vegetation.

Song Meter Frog Recorders

ID	Site Photographs – Song Meters frog recorders	Comments
IMG_1079		St Kilda Botanical Gardens Song Meter frog recorder
IMG_20200201_093449		St Kilda Botanical Gardens frog habitat adjacent to recorder
IMG_1082		Elster Creek Song Meter frog recorder

ID	Site Photographs – Song Meters frog recorders	Comments
IMG_1156		Elster Creek frog habitat adjacent to recorder

Reptile Search Habitat

ID	Site Photographs – Reptile Search Habitat	Comments
IMG_20200211_132126		Elwood Canal indicative skink habitat

ID	Site Photographs – Reptile Search Habitat	Comments
IMG_20200211_132310		Elwood Canal indicative skink habitat
IMG_20200211_142029		Elwood Canal indicative skink habitat

Rakali Survey Habitat

ID	Site Photographs – Rakali Survey Habitat	Comments
IMG_20200211_145758		St Kilda Breakwater search area
IMG_20200211_145625		St Kilda Breakwater with basalt boulders providing roosting and feeding stations.

Shorebird survey

ID	Site Photographs – Shorebird Survey	Comments
IMG_1229		St Kilda Spit survey area

APPENDIX B – FAUNA SURVEY FIELD MAPS

Canterbury Forest

Fauna surveying

Elster Creek

Fauna surveying

Elster Creek

Fauna surveying

City of Port Phillip City of Port Phillip Biodiversity Study

Point Ormond

Fauna surveying

Created by : RM
QA by : LH

City of Port Phillip City of Port Phillip Biodiversity Study

St Kilda Botanical Gardens

Fauna surveying

St Kilda Breakwater

Fauna surveying

City of Port Phillip City of Port Phillip Biodiversity Study

St Kilda Spit

Fauna surveying

APPENDIX C – PLANT SPECIES RECORDED DURING THE FIELD SURVEYS

Key:

*	Exotic species
#	Victorian native species that are non-indigenous to the City of Port Phillip
(#)	Indigenous species that can naturalise outside their natural range and are considered non-indigenous in areas away from the coast
EPBC	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FFG	Victorian *Flora and Fauna Guarantee Act 1988*
VROT	Victorian Rare or threatened species in Victoria (DEPI 2014)
cr	Classified as Critically Endangered in Victoria
en	Classified as Endangered in Victoria
vu	Classified as Vulnerable in Victoria
nt	Classified as Near Threatened in Victoria
dd	Classified as Data Deficient in Victoria

EPBC	FFG	VROT		*Taxon Name*	Taxon Common Name	Number of zones recorded
				Acacia acinacea s.l.	Gold-dust Wattle	1
			*	*Acacia baileyana*	Cootamundra Wattle	3
				Acacia dealbata	Silver Wattle	1
			#	*Acacia floribunda*	White Sallow-wattle	1
				Acacia implexa	Lightwood	6
			#	*Acacia longifolia* subsp. *longifolia*	Sallow Wattle	1
			(#)	*Acacia longifolia* subsp. *sophorae*	Coast Wattle	9
				Acacia mearnsii	Black Wattle	6
				Acacia melanoxylon	Blackwood	6
				Acacia paradoxa	Hedge Wattle	8
				Acacia spp.	Wattle	1
				Acacia stricta	Hop Wattle	1
				Acacia suaveolens	Sweet Wattle	1
		r		*Acacia uncifolia*	Coast Wirilda	1
				Acaena novae-zelandiae	Bidgee-widgee	1
				Actites megalocarpus	Dune Thistle	1
			.	*Allocasuarina diminuta* subsp. *diminuta*	Waxy Sheoak	2
				Allocasuarina littoralis	Black Sheoak	8
				Allocasuarina paradoxa	Green Sheoak	1
				Allocasuarina verticillata	Drooping Sheoak	12
			*	*Aloe maculata*	Common Soap Aloe	2
				Alyxia buxifolia	Sea Box	6
				Anthosachne scabra s.l.	Common Wheat-grass	2
			*	*Araujia sericifera*	White Bladder-flower	2
				Atriplex cinerea	Coast Saltbush	15
		r		*Atriplex paludosa* subsp. *paludosa*	Marsh Saltbush	6
				Atriplex semibaccata	Berry Saltbush	2
				Austrostipa bigeniculata	Kneed Spear-grass	3
				Austrostipa flavescens	Coast Spear-grass	9
				Austrostipa scabra	Rough Spear-grass	2
				Austrostipa spp.	Spear Grass	1
				Austrostipa stipoides	Prickly Spear-grass	14
			*	*Avena barbata*	Bearded Oat	1
			*	*Avena fatua*	Wild Oat	2
			*	*Avena* spp.	Oat	3

EPBC	FFG	VROT		*Taxon Name*	Taxon Common Name	Number of zones recorded
				Banksia integrifolia subsp. *integrifolia*	Coast Banksia	13
				Banksia marginata	Silver Banksia	1
				Banksia serrata	Saw Banksia	1
				Banksia spp.	Banksia	1
			*	*Billardiera fusiformis*	Bluebell Creeper	1
				Bossiaea cinerea	Showy Bossiaea	1
			*	*Brassica fruticulosa*	Twiggy Turnip	2
			*	*Briza maxima*	Large Quaking-grass	1
			*	*Bromus catharticus*	Prairie Grass	8
			*	*Bromus diandrus*	Great Brome	11
			*	*Bromus hordeaceus*	Soft Brome	2
				Bursaria spinosa	Sweet Bursaria	8
			*	*Cakile maritima* subsp. *maritima*	Sea Rocket	5
				Callistemon sieberi	River Bottlebrush	1
				Carex appressa	Tall Sedge	2
				Carex pumila	Strand Sedge	2
				Carex spp.	Sedge	1
				Carex tereticaulis	Poong'ort	1
			*	*Carpobrotus edulis*	Hottentot Fig	1
				Carpobrotus rossii	Karkalla	8
				Cassinia sifton	Sifton Bush	3
				Cassytha melantha	Coarse Dodder-laurel	1
			*	*Cenchrus clandestinus*	Kikuyu	5
				Chrysocephalum apiculatum s.l.	Common Everlasting	3
				Chrysocephalum apiculatum subsp. *apiculatum*	Common Everlasting	1
				Chrysocephalum semipapposum subsp. semipapposum	Clustered Everlasting	1
				Clematis microphylla s.l.	Small-leaved Clematis	6
				Coprosma quadrifida	Prickly Currant-bush	1
			*	*Coprosma repens*	Mirror Bush	1
				Correa alba var. *alba*	White Correa	11
			*	*Correa baeuerlenii*	Chef's Cap Correa	1
				Correa reflexa	Common Correa	2
				Correa reflexa var. *reflexa*	Common Correa	2
		v	#	*Corymbia maculata*	Spotted Gum	1
				Crassula spp.	Crassula	1
			*	*Cynodon dactylon* var. *dactylon*	Couch	12
			*	*Cyperus eragrostis*	Drain Flat-sedge	1
			*	*Delairea odorata*	Cape Ivy	1
				Dianella brevicaulis	Small-flower Flax-lily	19
				Dianella longifolia s.l.	Pale Flax-lily	7
				Dianella revoluta s.l.	Black-anther Flax-lily	7
				Dichelachne crinita	Long-hair Plume-grass	2
				Dichelachne spp.	Plume Grass	1
				Dichondra repens	Kidney-weed	1
			*	*Dipogon lignosus*	Common Dipogon	1
				Disphyma crassifolium subsp. *clavellatum*	Rounded Noon-flower	9
				Distichlis distichophylla	Australian Salt-grass	6

EPBC	FFG	VROT		Taxon Name	Taxon Common Name	Number of zones recorded
				Distichlis distichophylla/Sporobolus virginicus	Australian Salt-grass/Salt Couch species aggregate	2
				Duma florulenta	Tangled Lignum	2
			*	*Ehrharta erecta* var. *erecta*	Panic Veldt-grass	12
			*	*Ehrharta longiflora*	Annual Veldt-grass	5
				Einadia nutans subsp. *nutans* (s.s.)	Nodding Saltbush	3
				Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	2
				Enchylaena tomentosa var. *tomentosa* (prostrate form)	Ruby Saltbush (prostrate southern form)	2
				Epilobium hirtigerum	Hairy Willow-herb	1
			*	*Erigeron* spp.	Fleabane	8
				Eucalyptus camaldulensis	River Red-gum	7
				Eucalyptus cephalocarpa s.l.	Silver-leaf Stringybark	2
			*	*Eucalyptus cladocalyx*	Sugar Gum	1
			*	*Eucalyptus lehmannii*	Bushy Yate	1
				Eucalyptus leucoxylon	Yellow Gum	1
				Eucalyptus melliodora	Yellow Box	5
				Eucalyptus ovata	Swamp Gum	4
				Eucalyptus polyanthemos	Red Box	1
		r		*Eucalyptus sideroxylon* subsp. *sideroxylon*	Mugga	2
				Eucalyptus spp.	Eucalypt	3
				Eucalyptus viminalis	Manna Gum	1
				Eucalyptus viminalis subsp. *pryoriana*	Coast Manna-gum	6
			*	*Euphorbia paralias*	Sea Spurge	1
				Eutaxia microphylla	Common Eutaxia	2
				Ficinia nodosa	Knobby Club-sedge	14
			*	*Fraxinus angustifolia*	Desert Ash	2
				Gahnia filum	Chaffy Saw-sedge	4
				Gahnia sieberiana	Red-fruit Saw-sedge	2
			*	*Galenia pubescens* var. *pubescens*	Galenia	7
				Geranium spp.	Crane's Bill	1
				Goodenia ovata	Hop Goodenia	8
			*	*Hakea drupacea*	Sweet Hakea	2
				Hardenbergia violacea	Purple Coral-pea	3
			*	*Hedera helix*	English Ivy	2
				Helichrysum luteoalbum	Jersey Cudweed	7
			*	*Hordeum marinum*		4
			*	*Hypochaeris radicata*	Flatweed	4
				Imperata cylindrica	Blady Grass	1
				Indigofera australis subsp. *australis*	Austral Indigo	3
			*	*Juncus acutus* subsp. *acutus*	Spiny Rush	2
				Juncus kraussii subsp. *australiensis*	Sea Rush	6
				Juncus pallidus	Pale Rush	2
				Kennedia prostrata	Running Postman	1
				Kunzea sp. (Upright form)	Forest Burgan	3
			*	*Lactuca serriola*	Prickly Lettuce	4
			*	*Lagunaria patersonia* subsp. *patersonia*	Pyramid Tree	1
			*	*Lagurus ovatus*	Hare's-tail Grass	3
				Lasiopetalum baueri	Slender Velvet-bush	7

EPBC	FFG	VROT		Taxon Name	Taxon Common Name	Number of zones recorded
			*	*Lepidium africanum*	Common Peppercress	2
				Lepidosperma concavum	Sandhill Sword-sedge	5
				Leptospermum continentale	Prickly Tea-tree	1
			(#)	*Leptospermum laevigatum*	Coast Tea-tree	8
				Leptospermum lanigerum	Woolly Tea-tree	1
				Leucophyta brownii	Cushion Bush	9
				Leucopogon parviflorus	Coast Beard-heath	1
				Linum marginale	Native Flax	2
			*	*Lolium rigidum*	Wimmera Rye-grass	2
				Lomandra longifolia	Spiny-headed Mat-rush	4
				Lomandra longifolia subsp. *longifolia*	Spiny-headed Mat-rush	10
			*	*Lysimachia arvensis*	Pimpernel	2
				Malva spp.	Mallow	2
			*	*Medicago polymorpha*	Burr Medic	4
		r	#	*Melaleuca armillaris subsp. armillaris*	Giant Honey-myrtle	3
				Melaleuca ericifolia	Swamp Paperbark	4
				Melaleuca lanceolata	Moonah	3
			*	*Melaleuca nesophila*	Showy Honey-myrtle	1
			*	*Melilotus indicus*	Sweet Melilot	5
				Muehlenbeckia australis	Climbing Lignum	1
				Myoporum insulare	Common Boobialla	10
			*	*Myoporum laetum*	Ngaio	1
				Myoporum parvifolium	Creeping Myoporum	5
				Myoporum petiolatum	Sticky Boobialla	1
			*	*Oenothera laciniata* subsp. *laciniata*	Cut-leaf Evening-primrose	1
				Olearia axillaris	Coast Daisy-Bush	9
				Olearia glutinosa	Sticky Daisy-bush	4
				Olearia lirata	Snowy Daisy-bush	2
				Olearia ramulosa	Twiggy Daisy-bush	5
				Ozothamnus ferrugineus	Tree Everlasting	1
			*	*Parapholis incurva*	Coast Barb-grass	3
			*	*Paraserianthes lophantha* subsp. *lophantha*	Cape Wattle	1
				Pelargonium australe	Austral Stork's-bill	6
				Phragmites australis	Common Reed	3
			*	*Phytolacca octandra*	Red-ink Weed	1
			*	*Pinus radiata*	Radiata Pine	1
			*	*Pittosporum crassifolium*	Karo	1
			*	*Plantago coronopus*	Buck's-horn Plantain	3
			*	*Plantago lanceolata*	Ribwort	2
			*	*Poa annua*	Annual Meadow-grass	1
				Poa labillardierei var. *labillardierei*	Common Tussock-grass	4
				Poa poiformis	Coast Tussock-grass	9
				Poa sieberiana	Grey Tussock-grass	1
			*	*Polygonum aviculare* s.l.	Prostrate Knotweed	2
				Pomaderris paniculosa subsp. *paralia*	Coast Pomaderris	3
				Portulaca oleracea	Common Purslane	1
				Rhagodia candolleana subsp. *candolleana*	Seaberry Saltbush	16
				Ricinocarpos pinifolius	Wedding Bush	1

EPBC	FFG	VROT		Taxon Name	Taxon Common Name	Number of zones recorded
			*	*Romulea rosea*	Onion Grass	2
				Rumex spp.	Dock	1
				Rytidosperma caespitosum	Common Wallaby-grass	4
				Rytidosperma fulvum	Copper-awned Wallaby-grass	1
				Rytidosperma geniculatum	Kneed Wallaby-grass	1
				Rytidosperma pilosum	Velvet Wallaby-grass	1
				Rytidosperma racemosum var. *racemosum*	Slender Wallaby-grass	2
			*	*Schinus molle*	Pepper Tree	5
			*	*Scolymus hispanicus*	Golden Thistle	2
				Senecio pinnatifolius var. *lanceolatus*	Lance-leaf Groundsel	1
				Senecio quadridentatus	Cotton Fireweed	1
				Solanum laciniatum	Large Kangaroo Apple	4
			*	*Solanum nigrum* s.l.	Black Nightshade	1
			*	*Sonchus asper* s.l.	Rough Sow-thistle	1
			*	*Sonchus oleraceus*	Common Sow-thistle	20
				Spinifex sericeus	Hairy Spinifex	10
			*	*Stellaria media*	Chickweed	1
				Selliera radicans	Shiny Swamp-mat	1
			*	*Stenotaphrum secundatum*	Buffalo Grass	1
				Suaeda australis	Austral Seablite	3
			*	*Symphyotrichum subulatum*	Aster-weed	1
				Tetragonia implexicoma	Bower Spinach	10
				Tetragonia tetragonioides	New Zealand Spinach	1
				Themeda triandra	Kangaroo Grass	2
			*	*Thinopyrum junceiforme*	Sea Wheat-grass	2
				Tortula muralis	Common Wall-moss	1
				Trachymene composita	Parsnip Trachymene	1
			*	*Trifolium arvense* var. *arvense*	Hare's-foot Clover	1
				Triquetrella papillata	Common Twine-moss	1
			*	*Vicia* spp.	Vetch	2
			*	*Viola odorata*	Common Violet	1
			*	*Vulpia fasciculata*	Dune Fescue	2
			*	*Vulpia* spp.	Fescue	6
				Wahlenbergia communis s.l.	Tufted Bluebell	3
				Wahlenbergia multicaulis	Branching Bluebell	1
			*	*Watsonia* spp.	Watsonia	1
				Xerochrysum viscosum	Shiny Everlasting	2

APPENDIX D – FLORISTIC QUADRAT DATA

Key:

EVC Ecological Vegetation Class
* Exotic taxon

Quadrat 1	
Ecological Vegetation Class	160: Coastal Dune Scrub
Site	Elwood Coastline
Coordinates	144.9809985, -37.8856016
Date	23/01/2020
Recorder	NR & FS
Habitat Attribute Type	**Cover**
Non-vascular plants and lichens	<1%
Bare ground	1-5%
Rock	0%
Litter	55-60%

Taxon name	Taxon common name	Cover	Distribution	Recruiting
Acacia longifolia subsp. *sophorae*	Coast Wattle	10–15%	Scattered	
Acacia paradoxa	Hedge Wattle	<1%	Localised	
Allocasuarina verticillata	Drooping Sheoak	<1%	Localised	✓
**Bromus hordeaceus*	Soft Brome	1-5%	Scattered	
Clematis microphylla var. *microphylla* spp. agg.	Small-leaved Clematis	<1%	Localised	
Dianella brevicaulis	Small-flower Flax-lily	<1%	Localised	
**Ehrharta erecta* var. *erecta*	Panic Veldt-grass	1-5%	Scattered	
**Galenia pubescens* var. *pubescens*	Galenia	<1%	Localised	
**Hypochaeris radicata*	Flatweed	<1%	Localised	
**Melilotus indicus*	Sweet Melilot	<1%	Localised	
Muehlenbeckia australis	Climbing Lignum	1–5%	Scattered	
Myoporum insulare	Common Boobialla	15–20%	Scattered	✓
**Plantago coronopus*	Buck's-horn Plantain	1–5%	Scattered	
Rhagodia candolleana subsp. *candolleana*	Seaberry Saltbush	40–45%	Widespread	✓
**Romulea rosea*	Onion Grass	<1%	Localised	
**Sonchus oleraceus*	Common Sow-thistle	<1%	Localised	
Tetragonia implexicoma	Bower Spinach	15–20%	Scattered	
**Vulpia fasciculata*	Dune Fescue	<1%	Localised	

Notes: Small track runs through the quadrat. Some Drooping Sheoak have snapped trunks and are dead or lying flat. Canopy 1.8m. Dominant species Seaberry Saltbush and Common Boobialla.

a. 

b. 

c. 

Figure 18. Photo-points for Quadrat 1 (a) looking east-south-east along the northern boundary, (b) looking south-south-east along the western boundary, and (c) photo of the stake in situ*.*

Quadrat 2				
EVC	2: Coast Banksia Woodland			
Site	Elwood Coastline			
Coordinates	144.9825306, -37.8864296			
Date	23/01/2020			
Recorder	NR & FS			
Habitat Attribute Type	**Cover**			
Non-vascular and lichens	<1%			
Bare ground	1-5%			
Rock	0%			
Litter	75-80%			
Taxon name	**Taxon common name**	**Cover**	**Distribution**	**Recruiting**
Acacia paradoxa	Hedge Wattle	1–5%	Localised	✓
Allocasuarina verticillata	Drooping Sheoak	15–20%	Scattered	
Bursaria spinosa subsp. *spinosa*	Sweet Bursaria	10–15%	Localised	
**Ehrharta erecta* var. *erecta*	Panic Veldt-grass	1–5%	Scattered	
Eucalyptus ovata	Swamp Gum	5–10%	Scattered	
Eucalyptus viminalis subsp. *pryoriana*	Coast Manna-gum	<1%	Localised	
**Fraxinus angustifolia*	Desert Ash	<1%	Localised	
Goodenia ovata	Hop Goodenia	5–10%	Scattered	
Lasiopetalum baueri	Slender Velvet-bush	<1%	Localised	
Lomandra longifolia subsp. *longifolia*	Spiny-headed Mat-rush	<1%	Localised	
Muehlenbeckia australis	Climbing Lignum	1–5%	Scattered	✓
Olearia glutinosa	Sticky Daisy-bush	<1%	Localised	
Rhagodia candolleana subsp. *candolleana*	Seaberry Saltbush	75–80%	Widespread	✓
Tetragonia implexicoma	Bower Spinach	10–15%	Widespread	

Notes: c. 7 m tall canopy of Drooping Sheoak, Swamp Gum and Coast Manna Gum. Dense shrub layer approx. 4 m tall (Sweet Bursaria and Hedge Wattle). Small track through the quadrat. Sheoaks in poor health.

a. 

b. 

Figure 19. Photo-points for Quadrat 2 (a) looking east-south-east along the northern boundary, (b) looking south-south-east along the western boundary.

Quadrat 3				
EVC	2: Coast Banksia Woodland			
Site	Elwood Coastline			
Coordinates	144.9772278, -37.8817861			
Date	23/01/2020			
Recorder	NR & FS			
Habitat Attribute Type	**Cover**			
Non-vascular and lichens	<1%			
Bare ground	1-5%			
Rock	<1%			
Litter	70-75%			
Litter	75-80%	**Cover**	**Distribution**	**Recruiting**
Acacia longifolia subsp. *sophorae*	Coast Wattle	1–5%	Localised	
Allocasuarina verticillata	Drooping Sheoak	20–25%	Widespread	
Alyxia buxifolia	Sea Box	1–5%	Localised	
Banksia integrifolia subsp. *integrifolia*	Coast Banksia	1–5%	Localised	
Clematis microphylla var. *microphylla* spp. agg.	Small-leaved Clematis	<1%	Localised	
**Ehrharta erecta* var. *erecta*	Panic Veldt-grass	5–10%	Scattered	
Eucalyptus viminalis subsp. *pryoriana*	Coast Manna-gum	1–5%	Localised	
Myoporum insulare	Common Boobialla	1–5%	Localised	✓
Pomaderris paniculosa subsp. *paralia*	Coast Pomaderris	1–5%	Localised	
Rhagodia candolleana subsp. *candolleana*	Seaberry Saltbush	75–80%	Widespread	✓
Tetragonia implexicoma	Bower Spinach	5–10%	Scattered	

a. 

b. 

c. 

Figure 20. Photo-points for Quadrat 3 (a) looking east-south-east along the northern boundary, (b) looking south-south-east along the western boundary, and (c) photo of the stake in situ*.*

Quadrat 4				
EVC	10: Estuarine Flats Grassland			
Site	St Kilda West Beach			
Coordinates	144.968307, -37.8589115			
Date	23/01/2020			
Recorder	NR & FS			
Habitat Attribute Type	**Cover**			
Non-vascular and lichens	0%			
Bare ground	<1%			
Rock	0%			
Litter	5-10%			
Taxon name	**Taxon common name**	**Cover**	**Distribution**	**Recruiting**
Actites megalocarpus	Dune Thistle	<1%	Localised	
Austrostipa stipoides	Prickly Spear-grass	10–15%	Scattered	
Banksia integrifolia subsp. *integrifolia*	Coast Banksia	<1%	Localised	✓
**Cynodon dactylon* var. *dactylon*	Couch	10–15%	Scattered	
Dianella brevicaulis	Small-flower Flax-lily	1–5%	Localised	
Distichlis distichophylla/Sporobolus virginicus	Australian Salt-grass/Salt Couch species aggregate	35–40%	Widespread	
Ficinia nodosa	Knobby Club-sedge	50–55%	Widespread	
Helichrysum adenophorum	Branched Everlasting	<1%	Localised	
**Hypochaeris radicata*	Flatweed	<1%	Localised	
**Juncus acutus* subsp. *acutus*	Spiny Rush	<1%	Localised	
Juncus kraussii subsp. *australiensis*	Sea Rush	1–5%	Scattered	
Selliera radicans	Shiny Swamp-mat	1–5%	Scattered	
**Sonchus oleraceus*	Common Sow-thistle	<1%	Scattered	


a.


b.


c.

Figure 21. Photo-points for Quadrat 4 (a) looking east-south-east along the northern boundary, (b) looking south-south-east along the western boundary, and (c) photo of the stake in situ*.*

Quadrat 5				
EVC	879:Coastal Dune Grassland			
Site	Port Melbourne Foreshore			
Coordinates	144.915366, -37.8404189			
Date	23/01/2020			
Recorder	NR & FS			
Habitat Attribute Type	**Cover**			
Non-vascular and lichens	0%			
Bare ground	0%			
Rock	1-5%			
Litter	25-30%			
Taxon name	**Taxon common name**	**Cover**	**Distribution**	**Recruiting**
Acacia longifolia subsp. *sophorae*	Coast Wattle	<1%	Localised	✓
Austrostipa stipoides	Prickly Spear-grass	<1%	Localised	
**Bromus diandrus*	Great Brome	5–10%	Widespread	
Dianella brevicaulis	Small-flower Flax-lily	<1%	Localised	
Distichlis distichophylla/Sporobolus virginicus	Australian Salt-grass/Salt Couch species aggregate	<1%	Localised	
**Ehrharta erecta* var. *erecta*	Panic Veldt-grass	1–5%	Scattered	
**Lagurus ovatus*	Hare's-tail Grass	<1%	Localised	
Poa poiformis	Coast Tussock-grass	<1%	Localised	
**Sonchus oleraceus*	Common Sow-thistle	<1%	Localised	
Spinifex sericeus	Hairy Spinifex	85–90%	Widespread	
**Vulpia muralis*	Wall Fescue	<1%	Localised	

a. 

b. 

c. 

Figure 22. Photo-points for Quadrat 5 (a) looking east-south-east along the northern boundary, (b) looking south-south-east along the western boundary, and (c) photo of the stake in situ*.*

Quadrat 6				
EVC	879: Coastal Dune Grassland			
Site	Port Melbourne Foreshore			
Coordinates	144.913693, -37.841432			
Date	23/01/2020			
Recorder	NR & FS			
Habitat Attribute Type	**Cover**			
Non-vascular and lichens	<1%			
Bare ground	<1%			
Rock	10-15%			
Litter	10-15%			
Taxon name	**Taxon common name**	**Cover**	**Distribution**	**Recruiting**
Acacia longifolia subsp. *sophorae*	Coast Wattle	<1%	Localised	✓
Allocasuarina verticillata	Drooping Sheoak	<1%	Localised	✓
Atriplex cinerea	Coast Saltbush	1–5%	Scattered	✓
**Bromus diandrus*	Great Brome	10–15%	Widespread	
**Cynodon dactylon* var. *dactylon*	Couch	15–20%	Widespread	
Distichlis distichophylla/Sporobolus virginicus	Australian Salt-grass/Salt Couch species aggregate	1–5%	Scattered	
Ehrharta erecta var. *erecta*	Panic Veldt-grass	<1%	Localised	
Ficinia nodosa	Knobby Club-sedge	<1%	Localised	
**Hypochaeris radicata*	Flatweed	<1%	Localised	
**Lactuca serriola*	Prickly Lettuce	<1%	Localised	
Laphangium luteoalbum	Jersey Cudweed	<1%	Localised	
Lepidosperma gladiatum	Coast Sword-sedge	1–5%	Localised	
**Oenothera laciniata* subsp. *laciniata*	Cut-leaf Evening-primrose	1–5%	Scattered	
Rhagodia candolleana subsp. *candolleana*	Seaberry Saltbush	1–5%	Localised	
**Sonchus oleraceus*	Common Sow-thistle	<1%	Scattered	
Spinifex sericeus	Hairy Spinifex	40–45%	Widespread	
Wahlenbergia multicaulis	Branching Bluebell	<1%	Localised	

a. b. c.

Figure 23. Photo-points for Quadrat 6 (a) looking east-south-east along the northern boundary, (b) looking south-south-east along the western boundary, and (c) photo of the stake in situ

APPENDIX E – FAUNA HABITAT ASSESSMENT SHEETS

SITE DETAILS: St Kilda Botanical Gardens	
LAND TENURE: Public	**EVC:** N/A
TOPOGRAPHIC POSITION: N/A	
SIZE OF AREA (ha): 7.6ha	**DISTANCE TO CORE (m):** 120-150

DATE:	1/02/2020		**RECORDERS NAME: Rob Gration**		
DATUM	AGD66		GDA94	☑	
Photo	☑		**WPT**	☑	
GPS	S:		E:		Alt:

DISTURBANCE HISTORY			
	Severity	Legend	Last event
Fire	0	0 = none	
Clearing / logging	0	1 = light	
Grazing	0	2 = mod	
Weeds	1	3 = severe	
Mistletoe	0	N/A = Not applic	
Other			
SOIL TYPE			
Clay	Loam	Sand	Organic

WEATHER CONDITIONS							
Day	Temp max / min	Air Pressure	Relative humidity	Wind velocity	Moon	Cloud / Lux	Rain
1							
2							
3							
4							
5							
6							
7							

VEGETATION (spechts) Trees 5 > 30 meters			
70 - 100 %	30 - 70 %	10 - 30 %	< 10 %
Closed Forest	Open Forest	Woodland	Open Woodland
Dominant Species Present		**Canopy Health %**	**Ave Dia**
Spotted Gum		95	100-120cm
Sugar Gum		95	70-80cm
Recruitment	Nil	Some	Extensive

WEATHER LEGEND	
Wind	0 = calm. 1 = leaves rustle. 2 = branches moving. 3 = strong
Moon	0 = none. 1 = 1/4 moon. 2 = 1/2 moon. 3 = 3/4 moon. 4 = full moon
Cloud	0 = none. 1 = partial. 2 = complete
Rain	0 = none. 1 = drizzle. 2 = rain. 3 = heavy rain. 4 = thunder storms

PROXIMITY TO WATER (klm)							
< 0.1	0.1 - 0.5	0.5 - 1	1 - 2	2 - 5	5 - 10	> 10	
☑							

VEGETATION (spetchts) Understory % Cover			
70 - 100 %	30 - 70 %	10 - 30 %	< 10 %
Dominant Species Present		**Recruitment**	**Ave Height**
Pomedaris			12-1.5cm
Black Wattle			3-4m
Balckwood			3-4m

Habitat trees (Alive)	**Tree hollows**	% Cover Ground Flora		Litter (cm)	No of Logs	Rocks Present	% Cover
		Nil		Nil	Nil	Yes	
10	2	1-5		1~2	1~2	No	☑
		5~10		3~5	3~5	Weed Cover %	
Stags	*Hollow (dia)*	10~20		>5	5~10	1-5	☑
	10cm	20~50	☑		>10	6-10	
		>50				>10	

City of Port Phillip City of Port Phillip Biodiversity Study

SITE DETAILS: Canterbury Forest			
LAND TENURE: Public	**EVC:** N/A		
TOPOGRAPHIC POSITION: N/A			
SIZE OF AREA (ha): 1.6 approx.	**DISTANCE TO CORE (m):** 10		

DATE: 1/02/2020			**RECORDERS NAME:** Rob Gration		
DATUM	AGD66		GDA94	☑	
Photo	☑		**WPT**	☑	
GPS	S:		E:		Alt:

DISTURBANCE HISTORY

	Severity	Legend	Last event
Fire	0	0 = none	
Clearing / logging	0	1 = light	
Grazing	0	2 = mod	
Weeds	1	3 = severe	
Mistletoe	0	N/A = Not applic	
Other			

SOIL TYPE

Clay	Loam	Sand	Organic

WEATHER CONDITIONS

Day	Temp max / min	Air Pressure	Relative humidity	Wind velocity	Moon	Cloud / Lux	Rain
1							
2							
3							
4							
5							
6							
7							

VEGETATION (spechts) Trees 5 > 30 meters

70 - 100 %	30 - 70 %	10 - 30 %	< 10 %
Closed Forest	Open Forest	Woodland	Open Woodland

Dominant Species Present	**Canopy Health %**	**Ave Dia**
Box sp	95-100	60cm
Red Ironbark	95-101	20cm

Recruitment	Nil	Some	Extensive

WEATHER LEGEND

Wind	0 = calm. 1 = leaves rustle. 2 = branches moving. 3 = strong
Moon	0 = none. 1 = 1/4 moon. 2 = 1/2 moon. 3 = 3/4 moon. 4 = full moon
Cloud	0 = none. 1 = partial. 2 = complete
Rain	0 = none. 1 = drizzle. 2 = rain. 3 = heavy rain. 4 = thunder storms

PROXIMITY TO WATER (klm)

< 0.1	0.1 - 0.5	0.5 - 1	1 - 2	2 - 5	5 - 10	> 10
	☑					

VEGETATION (spetchts) Understory % Cover

70 - 100 %	30 - 70 %	10 - 30 %	< 10 %
	☑		

Dominant Species Present	**Recruitment**	**Ave Height**
Gold-dust Wattle		120cm
Hedge Wattle		120cm

Habitat trees (Alive)	**Tree hollows**	% Cover Ground Flora		Litter (cm)	No of Logs	Rocks Present	% Cover
		Nil		Nil	Nil	Yes	< 5
8	N/A	1-5	☑	1~2	1~2	No	
		5~10		3~5	3~5	Weed Cover %	
Stags	*Hollow (dia)*	10~20		>5	5~10	1-5	☑
		20~50			>10	6-10	
		>50				>10	

SITE DETAILS: Elwood Canal / Elster Creek	
LAND TENURE: Public	**EVC:** Damp Sands Herb-rich Woodland
TOPOGRAPHIC POSITION: riparian / escarpment	
SIZE OF AREA (ha): 5 approx.	**DISTANCE TO CORE (m):** 5-10

DATE: 1/02/2020			**RECORDERS NAME:** Rob Gration		
DATUM	AGD66		GDA94	☑	
Photo	☑		**WPT**	☑	
GPS	S:		E:		Alt:

DISTURBANCE HISTORY

	Severity	Legend	Last event
Fire		0 = none	
Clearing / logging		1 = light	
Grazing		2 = mod	
Weeds		3 = severe	
Mistletoe		N/A = Not applic	
Other	2	Urban disturbance	On-going

SOIL TYPE

Clay	Loam	Sand	Organic

WEATHER CONDITIONS

Day	Temp max / min	Air Pressure	Relative humidity	Wind velocity	Moon	Cloud / Lux	Rain
1							
2							
3							
4							
5							
6							
7							

VEGETATION (spechts) Trees 5 > 30 meters

70 - 100 %	30 - 70 %	10 - 30 %	< 10 %
Closed Forest	Open Forest	Woodland	Open Woodland
Dominant Species Present		**Canopy Health %**	**Ave Dia**
River Red Gum		95	60-80cm
Sheok sp		95	20-30cm
Sugar Gum		95	80-120cm
Recruitment	Nil	Some	Extensive

WEATHER LEGEND

Wind	0 = calm. 1 = leaves rustle. 2 = branches moving. 3 = strong
Moon	0 = none. 1 = 1/4 moon. 2 = 1/2 moon. 3 = 3/4 moon. 4 = full moon
Cloud	0 = none. 1 = partial. 2 = complete
Rain	0 = none. 1 = drizzle. 2 = rain. 3 = heavy rain. 4 = thunder storms

PROXIMITY TO WATER (klm)

< 0.1	0.1 - 0.5	0.5 - 1	1 - 2	2 - 5	5 - 10	> 10	
☑							

VEGETATION (spetchts) Understory % Cover

70 - 100 %	30 - 70 %	10 - 30 %	< 10 %
Dominant Species Present		**Recruitment**	**Ave Height**
Bansia			25-40cm
Correa			80-150cm

Habitat trees (Alive)	**Tree hollows**	% Cover Ground Flora		Litter (cm)	No of Logs	Rocks Present	% Cover
		Nil		Nil	Nil	Yes	
7		1-5		1~2	1~2	No	☑
		5~10	☑	3~5	3~5	Weed Cover %	
Stags	*Hollow (dia)*	10~20		>5	5~10	1-5	
		20~50			>10	6-10	
		>50				>10	☑

SITE DETAILS: Point Ormond	
LAND TENURE: Public	**EVC:** Coastal Dune Scrub
TOPOGRAPHIC POSITION: Coastal Foreshore	
SIZE OF AREA (ha): 8 approx.	**DISTANCE TO CORE (m):** 40-80

DATE: 1/02/2020			**RECORDERS NAME:** Rob Gration		
DATUM	AGD66		GDA94	☑	
Photo	☑		**WPT**	☑	
GPS	S:		E:		Alt:

DISTURBANCE HISTORY			
	Severity	Legend	Last event
Fire	0	0 = none	
Clearing / logging	0	1 = light	
Grazing	0	2 = mod	
Weeds	1	3 = severe	
Mistletoe	0	N/A = Not applic	
Other	2	Human disturbance	On-going
SOIL TYPE			
Clay	Loam	Sand	Organic

WEATHER CONDITIONS							
Day	Temp max / min	Air Pressure	Relative humidity	Wind velocity	Moon	Cloud / Lux	Rain
1							
2							
3							
4							
5							
6							
7							

VEGETATION (spechts) Trees 5 > 30 meters			
70 - 100 %	30 - 70 %	10 - 30 %	< 10 %
Closed Forest	Open Forest	Woodland	Open Woodland
Dominant Species Present		**Canopy Health %**	**Ave Dia**
Coast Tea-tree		95	12-20cm
Sheok sp		95	12-20cm
Banksia		95	12-15cm
Recruitment	Nil	Some	Extensive

WEATHER LEGEND	
Wind	0 = calm. 1 = leaves rustle. 2 = branches moving. 3 = strong
Moon	0 = none. 1 = 1/4 moon. 2 = 1/2 moon. 3 = 3/4 moon. 4 = full moon
Cloud	0 = none. 1 = partial. 2 = complete
Rain	0 = none. 1 = drizzle. 2 = rain. 3 = heavy rain. 4 = thunder storms

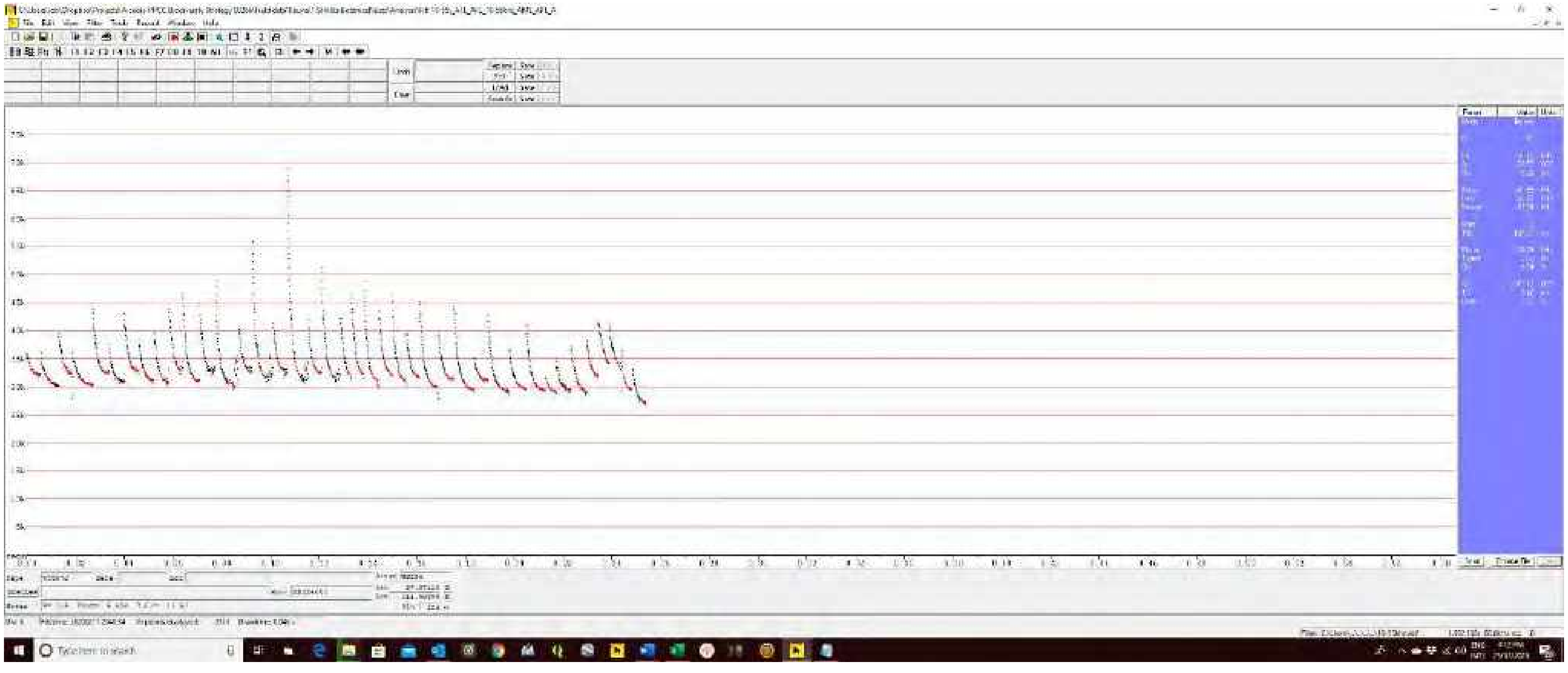
PROXIMITY TO WATER (klm)							
< 0.1	0.1 - 0.5	0.5 - 1	1 - 2	2 - 5	5 - 10	> 10	
	☑						

VEGETATION (spetchts) Understory % Cover			
70 - 100 %	30 - 70 %	10 - 30 %	< 10 %
Dominant Species Present	**Recruitment**		**Ave Height**
Coast wattle			1.2-1.5m
Salt Bush			50cm

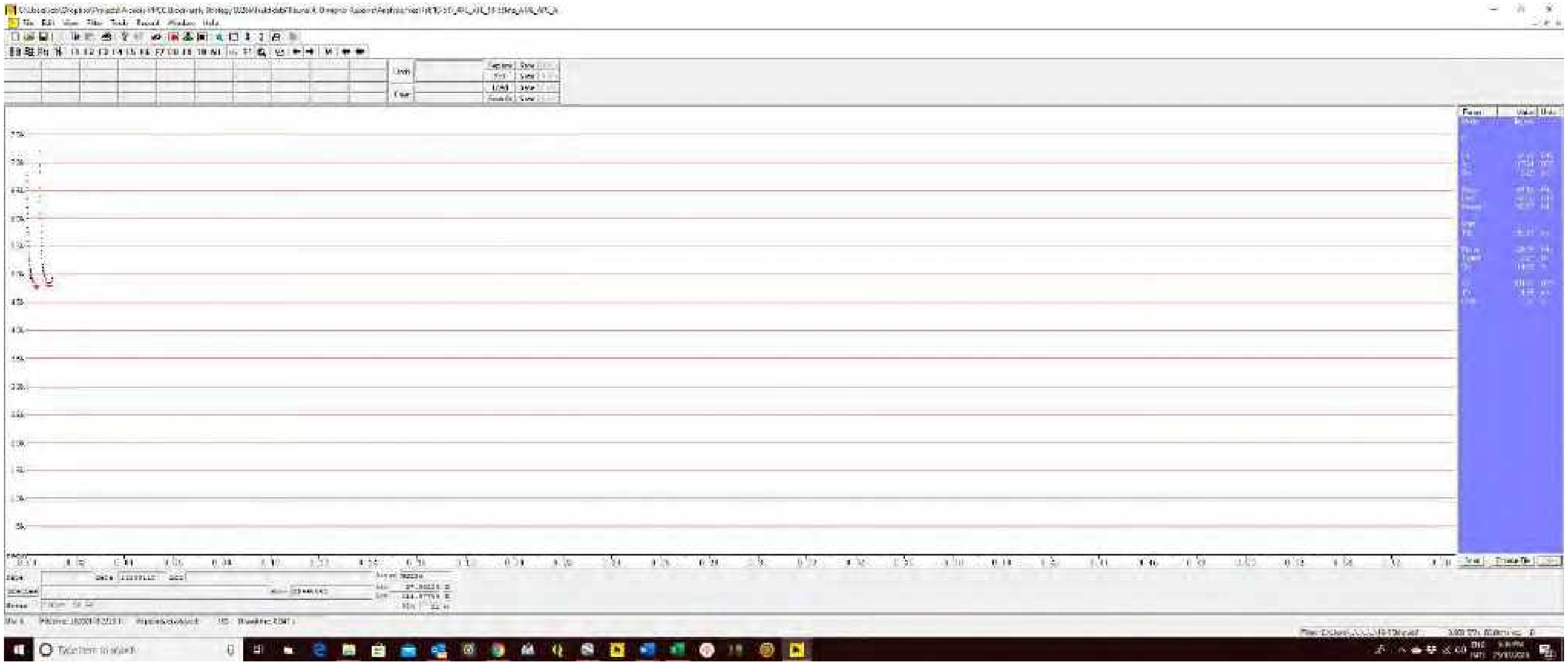
Habitat trees (Alive)	**Tree hollows**	% Cover Ground Flora		Litter (cm)	No of Logs	Rocks Present	% Cover
		Nil		Nil	Nil	Yes	
>10		1-5		1~2	1~2	No	☑
		5~10	☑	3~5	3~5	Weed Cover %	
Stags	*Hollow (dia)*	10~20		>5	5~10	1-5	☑
		20~50			>10	6-10	
		>50				>10	

APPENDIX F – BAT CALL IMAGES

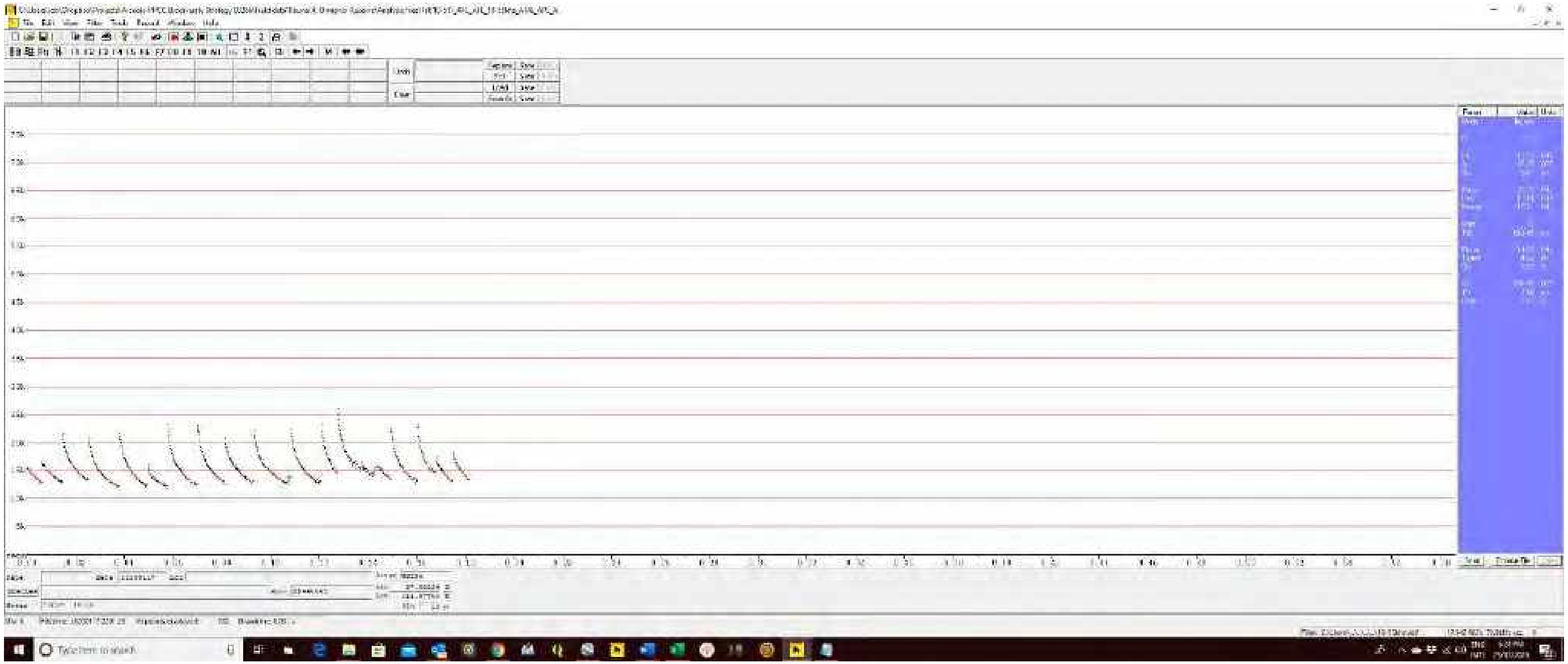
Gould's Wattled Bat



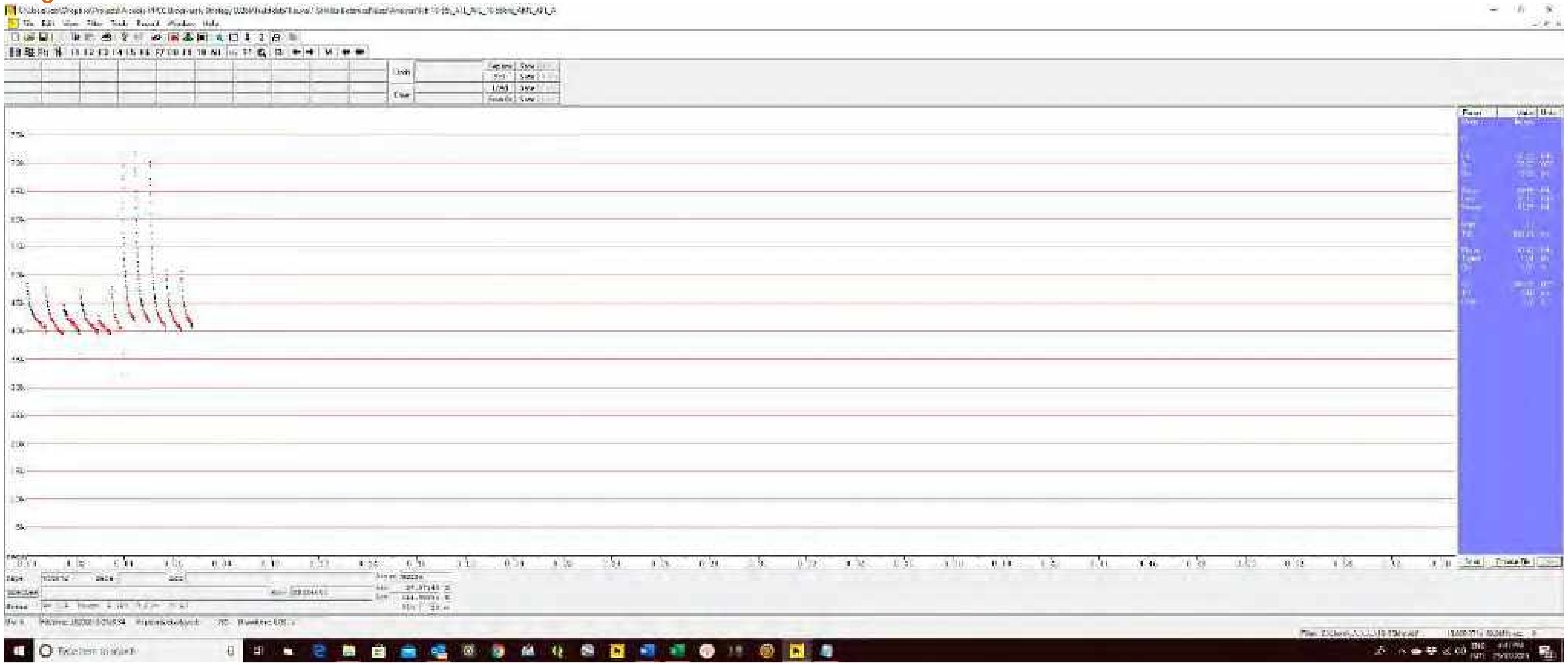
Little Forest Bat



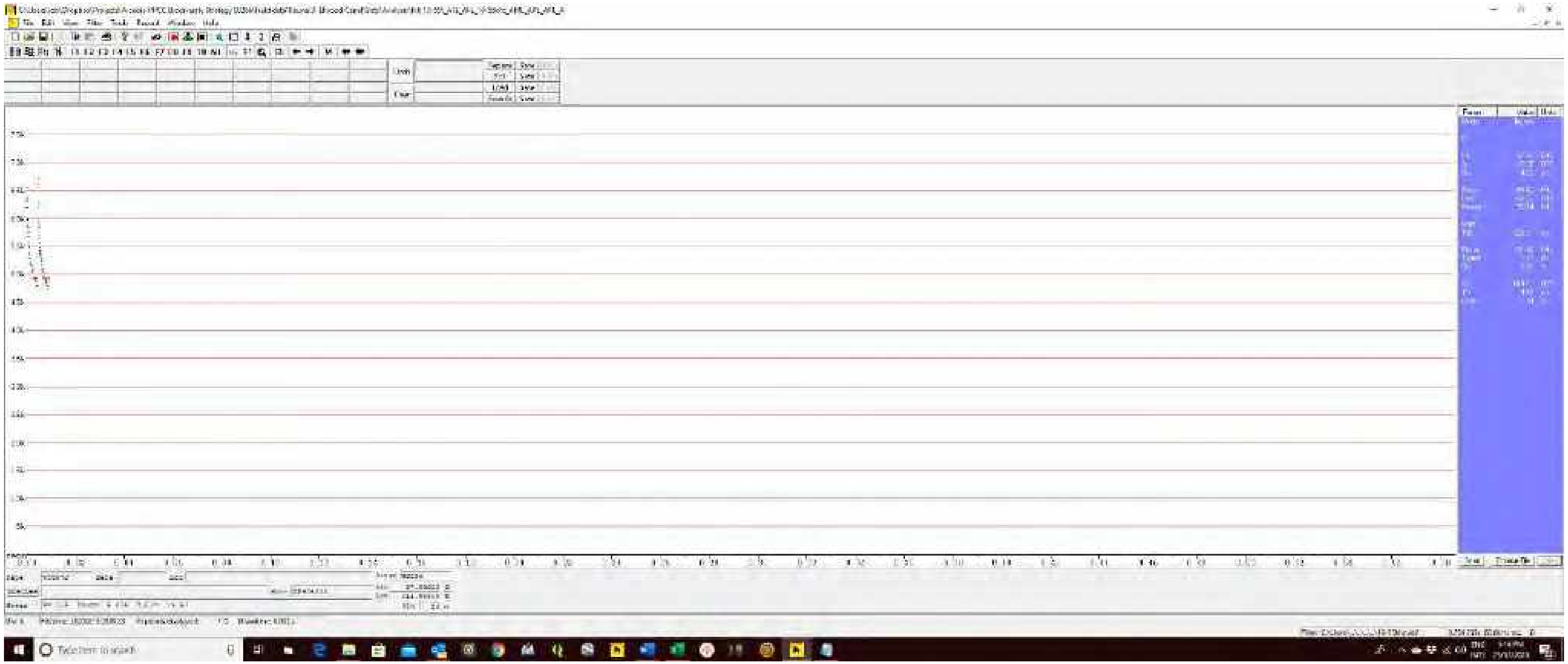
White-striped Freetail Bat



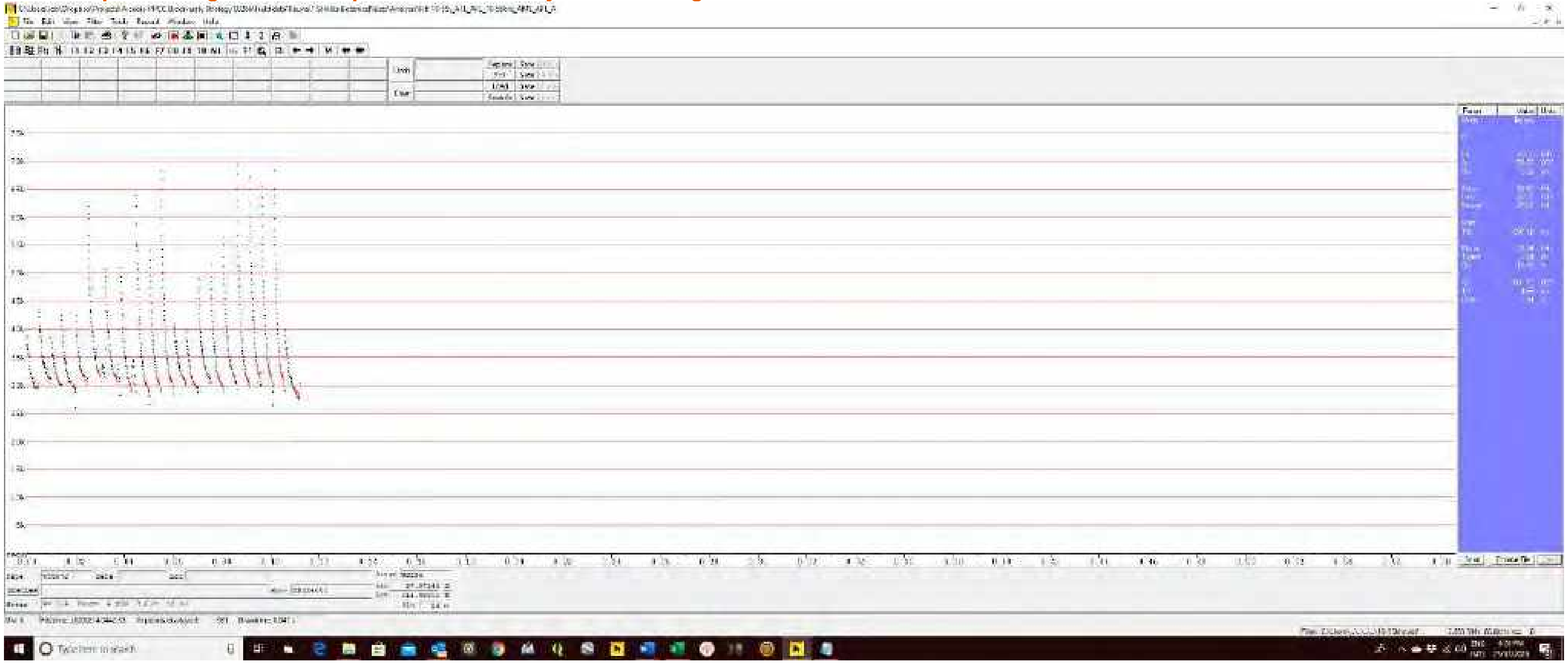
Large Forest Bat



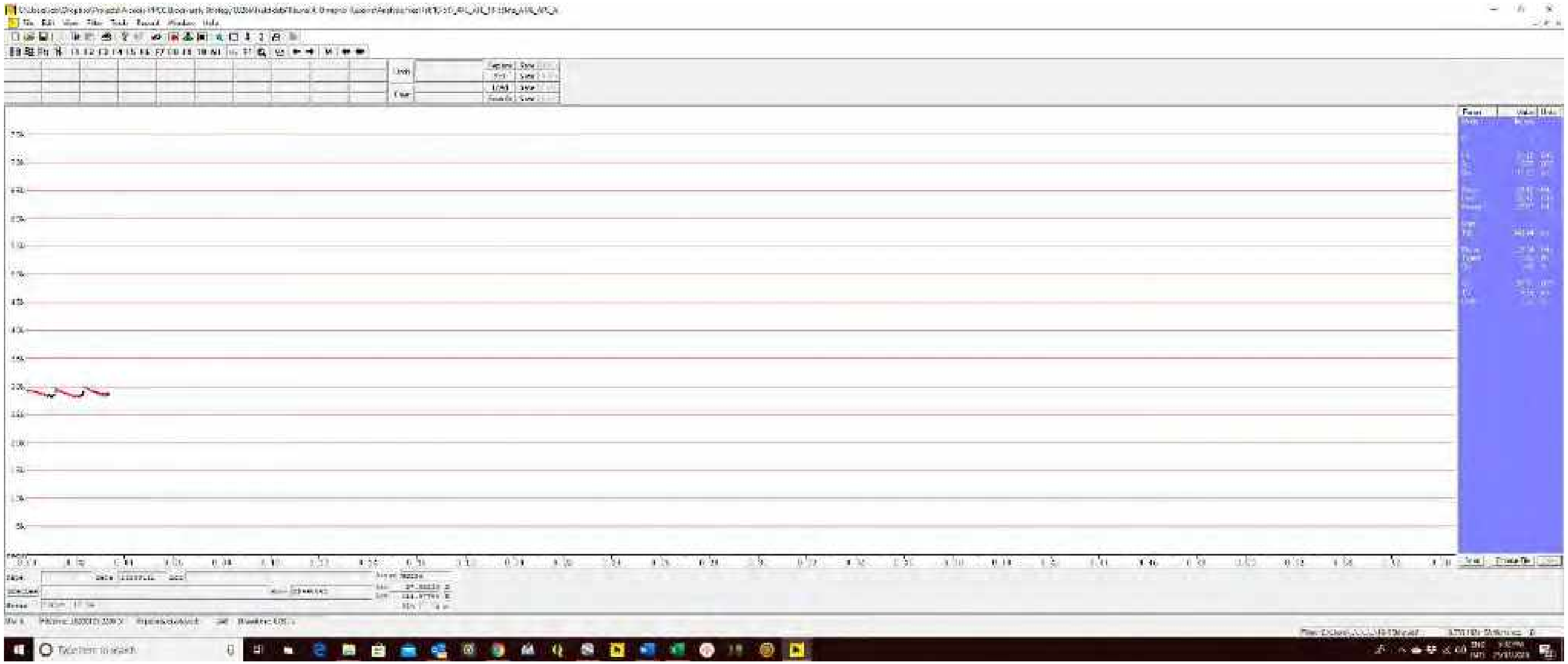
Chocolate Wattled Bat



Call complex- Long-eared bat species- Most likely Lesser Long-eared bat

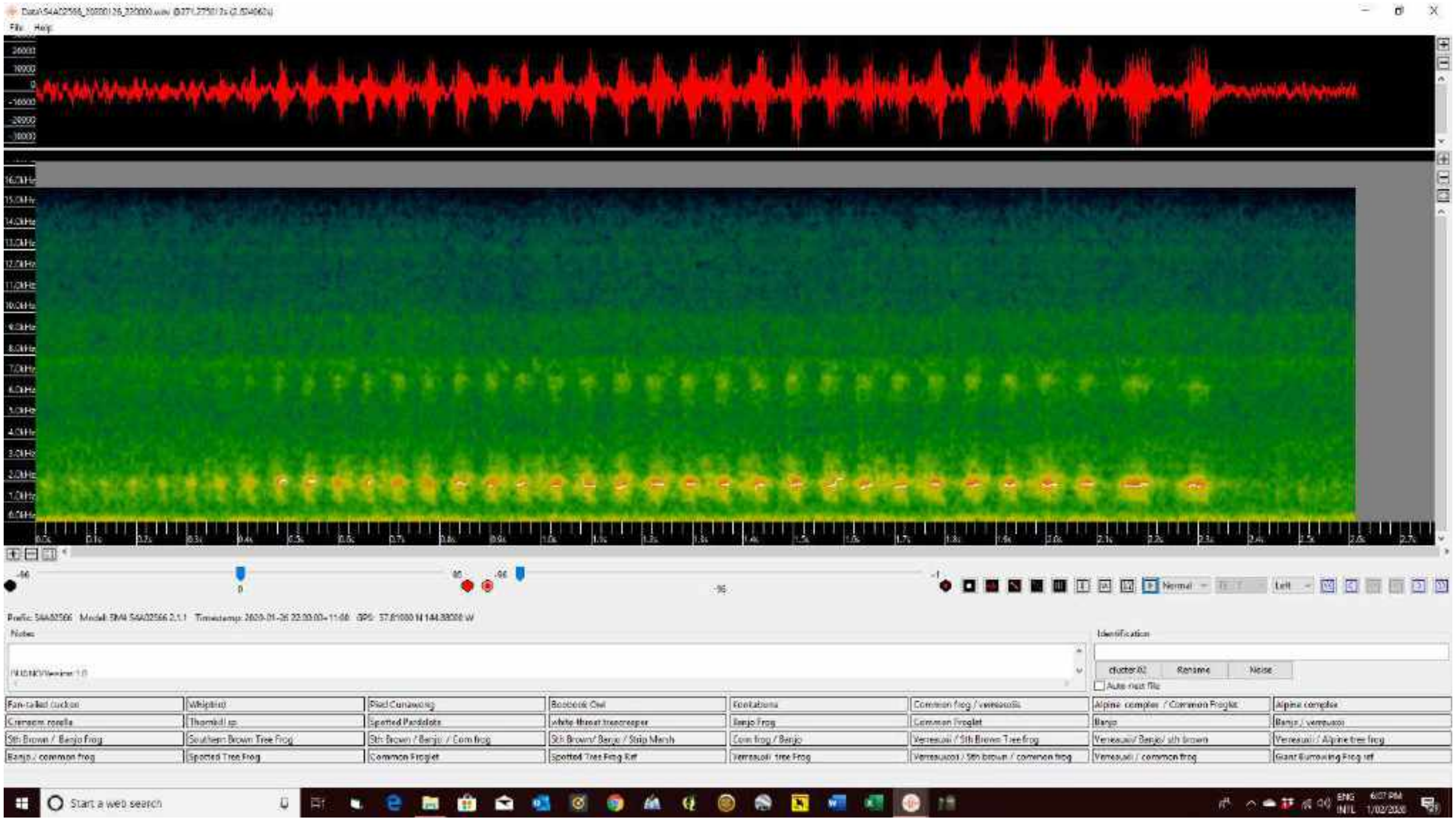


Call complex -Gould's Wattled Bat / Freetail Bat species

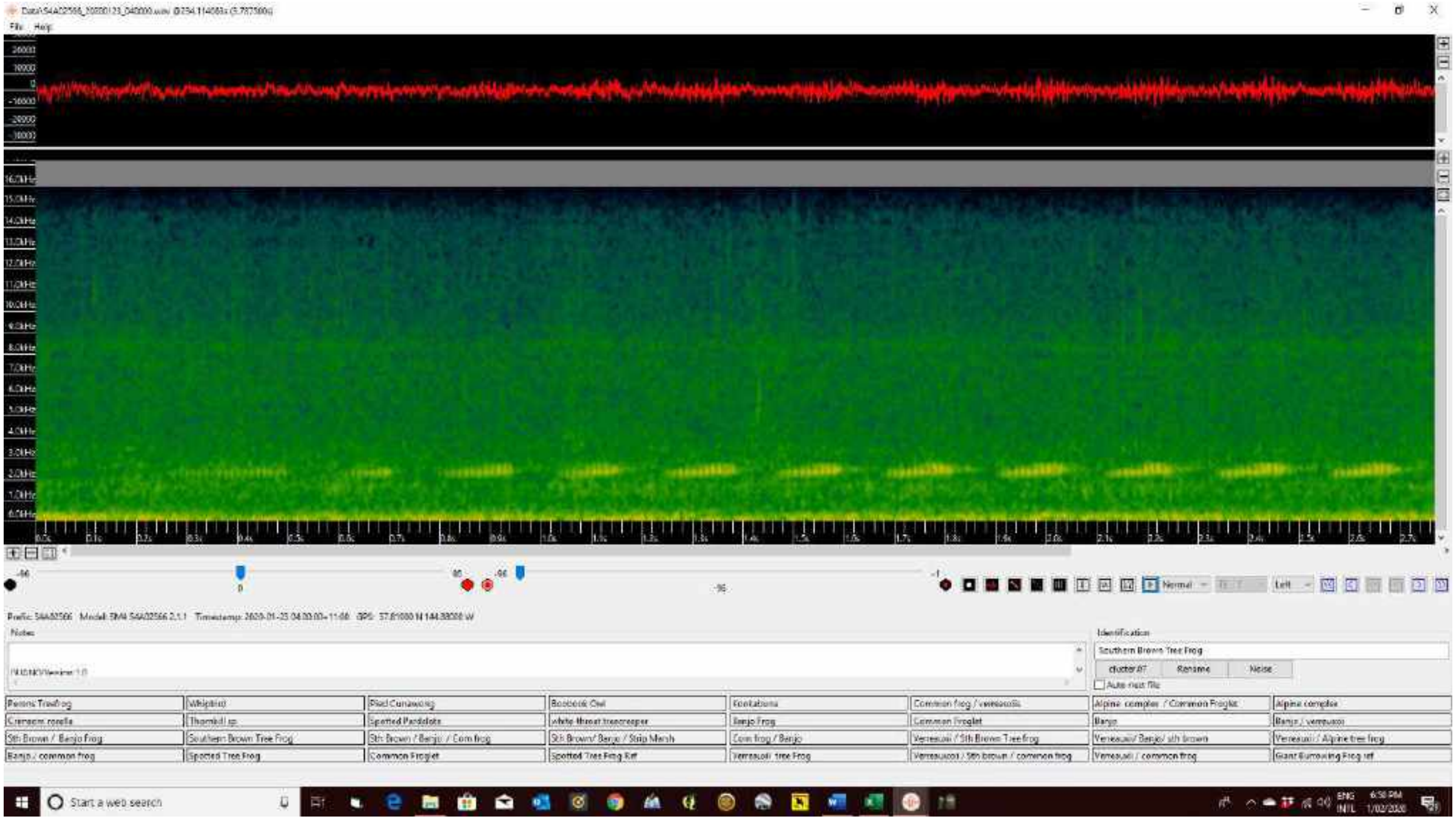


APPENDIX G – FROG CALL IMAGES

Peron's Tree Frog



Southern Brown Tree Frog



ARCADIS

Design & Consultancy
for natural and
built assets

We are Port Phillip
Council Plan 2017-27

Council respectfully acknowledged the Yalukut Weelam Clan of the Boon Wurrung.

We pay our respects to their Elders, both past and present.

We acknowledge and uphold their continuing relationship to this land.

Contents

City Of Port Phillip Councillors

The City of Port Phillip has three wards, each represented by three elected councillors.

The Councillors were elected to the City of Port Phillip for a four year term on 22 October 2016. The Mayor, Councillor Bernadene Voss, was elected by the Councillors on 10 November 2016.

Councillors are responsible for setting the strategic direction for the City, representing the local community in their decision making, developing policy, setting service standards, and monitoring performance.

Map showing wards and photos of each councillor.

Mayor's message

The Councillors and I are pleased to release the City of Port Phillip Council Plan 2017-2027.

This plan is the first of its kind for Port Phillip, as it sets out our long-term vision for the City and the outcomes we want to see over the next 10 years.

Our plan does what no other plan in Victoria does. It clearly links all Council activities and spending with the outcomes we seek for a liveable, inviting and caring City.

It makes a long-term commitment to improve and protect the health and wellbeing of our people and our places.

I am proud to lead a team of councillors who are committed to acting and making decisions in the long-term interests of Port Phillip. We are a diverse group. Our differences are a strength when it comes to making decisions that reflect the needs and desires of our communities.

This plan represents what this Council stands for. It not only delivers for today but sets us up to effectively address the challenges to come. Through this plan, we are continuing to build a City where people belong and our many cultures and differences are welcomed. We are creating a City that is connected and accessible for everyone and, in the face of growth, we are seeking to retain and celebrate the character and heritage of Port Phillip.

This plan will deliver a step change in the way we approach some of our most pressing challenges. Over the next four years we will work towards revolutionising the way we manage waste. We will invest in innovative water harvesting, work with our community to reduce greenhouse gas emissions, and ensure we are adapting to the ever present impacts of a changing climate.

Providing more transport choices and managing parking will also be a key focus as our City grows.

We will work hard with our partners in the Victorian Government to ensure Fishermans Bend is a unique, liveable and welcoming part of the City that we can be proud of.

Building partnerships will be at the heart of our approach to improving our services and ensuring they meet the needs and demands of our changing communities.

This Council is committed to strong governance and financial management that ensures value for money and a sustainable long-term financial outlook. When preparing this plan, we carefully considered the evidence and benefits before committing to spending.

Careful planning, while still investing in the things that matter, means we have achieved a small surplus of $371,000 and kept the 2017/18 rate increase at two per cent, in line with the Victorian Government rate cap.

Taking a prudent approach to our budget means we are able to invest in improving existing core services and assets for current residents, as well as being well positioned to respond to future challenges.

This plan delivers a significant investment in the basics that matter most to our community and keep our City running. For example, we are increasing our commitment to keeping our streets and villages clean, maintaining our trees and parks, and ensuring community and recreation facilities are fit for purpose and can be used by more people, more often.

We are investing to substantially improve community outcomes, including delivery of our affordable housing strategy and our contribution to the Ferrars Street Education and Community Precinct.

We are also investing in the unique places in our City that are drawcards for residents and visitors, such as enhancing our beautiful foreshore and ensuring the South Melbourne Market remains the best market in the Victoria.

Bigger than ever community engagement has informed this plan. We received more than 2,000 pieces of feedback and 125 submissions to the draft plan, which helped shape our priorities.

Our Council has started to build a great relationship with the community and we look forward to continuing this during our term.

Message from the CEO

We are Port Phillip, Council Plan 2017-2027 is an exciting new chapter in the City of Port Phillip’s history.

For the first time, the Council Plan has been integrated with our 10-year financial plan, annual budget and our health and wellbeing plan. This integrated, long-term approach represents a significant shift in the way we plan for our people and places, and ensures that everything we do – our projects, services, people and spending is linked to Council’s strategic direction for the City.

Our newly elected Council of nine members representing three wards, is embarking on an ambitious program through this plan. This plan signals an intention to invest in services and projects that ensure Port Phillip remains the bold, liveable, caring and beautiful place residents and visitors know and love.

This plan will commit the organisation to one of our largest ever capital programs, at $42.5 million in 2017/18. We have achieved this significant level of investment, and an increase in some service levels, while still remaining within the Victorian Government’s cap on rate increases. Our approach to maximising organisational efficiencies has enabled this. Over the last two years we have saved $7 million without reducing services, and we have forecast to save a further $1.6 million in the next year. Working closely with the Councillors to prudently budget over the long-term, we have also been able to reduce the impact of the rates cap gap over the next 10 years while keeping pace with the needs of our rapidly growing community.

Successfully delivering this plan will require a commitment to modernising the organisation so we can continuously improve and deliver best value to our community. We are deeply committed to being an efficient and effective organisation that is responsive to our diverse community and easy to work with.

I am very proud to lead a professional organisation that is driven by its commitment to put the community at the heart of everything we do. I look forward to working alongside the Council and the community to put this plan into action.

About this plan

This plan sets out what we want to achieve for the City of Port Phillip by 2027, and how we will support the current and future health and wellbeing of the City and our people.

This plan delivers on our Victorian local government planning obligations under the Local Government Act 1989 and the Public Health and Wellbeing Act 2008. These obligations determine how we plan for community needs and aspirations over the long, medium and short term, and hold ourselves accountable.

This single, integrated plan delivers our council plan, municipal public health and wellbeing plan, strategic resource plan, 10-year financial outlook, and annual budget.

This plan is supported by the Port Phillip Planning Scheme and detailed strategies and delivery plans that will help deliver our vision and the outcomes we are committed to. Within the organisation, department and individual employee plans are also aligned to support the delivery of the Council Plan.

Figure 1: Integrated planning and delivery framework

We are committed to a continuous cycle of planning, implementing, reporting and review to ensure we deliver the best outcomes for the community. This plan will be reviewed, updated and improved every year. In particular, we will improve over time the way we measure our performance and how we plan, report and engage at the neighbourhood level.

We will regularly report on our progress towards achieving the outcomes of this plan, our financial performance and project delivery. These reports, and our annual reports, are available online at www.portphillip.vic.gov.au.

Figure 2: Engaging and reporting on the Council Plan

Partners to our plan

Local government plays a key role in protecting and enhancing liveability and the wellbeing of our current and future communities. We are well positioned to directly influence vital factors like transport and land use planning, housing, protection of the natural environment and mitigating impacts of climate change, fostering local connections, social development and safety.

This plan sets out how we, and agencies working in Port Phillip, will work together to improve community outcomes.

We will partner with other levels of government, community, not-for-profit and business organisations, service providers and residents, to develop, implement and evaluate projects, programs and policies that deliver our vision and improve the health and wellbeing of our people and places.

Section 1: Port Phillip Today and Tomorrow

Our city and our people

The Yalukut Weelam clan of the Boon Wurrung are the first people of the City of Port Phillip, with a continued strong connection to the land. Yalukut Weelam means ‘river home’ or ‘people of the river’ reflecting the original prevalence of wetlands between the Yarra River and the foreshore – a landscape that has altered vastly since European settlement.

Port Phillip is one of the oldest areas of European settlement in Melbourne, known and treasured by many for its urban village feel and artistic expression. It is a city of neighbourhoods, each with its own character, defined by heritage buildings, strip shopping precincts and tree-lined streets.

Port Phillip is one of the smallest municipalities in Victoria, only 21 square kilometres, and the most densely populated with more than twice the population density of the metropolitan Melbourne average.

Port Phillip is a popular inner city area of Melbourne, attracting more than 2.8 million visitors[1] each year, making it one of the most visited places in metropolitan Melbourne, second only to the central business district. The foreshore that stretches over 11 kilometres, and vast public open spaces, make the City highly desirable to residents and visitors.

As we look to 2050, we know that the world will be different. Our physical environment will be more volatile and hostile, technology will continue to rapidly evolve and our urban environment will be more dynamic as information becomes more readily available at all times. Our public places and spaces will significantly change and evolve as residential and mixed use development continues and density increases. Significant population growth is expected over the next 40 years, particularly in the Fishermans Bend renewal area on the northern edge of the City, and in established neighbourhoods like St Kilda Road and South Melbourne.

This plan is shaped by our desire to celebrate our history, protect our character, and encourage inclusion and creativity, while planning for the future of a dynamic and evolving City.

General statistics about the City of Port Phillip

Population (forecast 2017) is 110,967 people

Age profile:

[1] *Source: Tourism Research Australia Data (March 2016). Note: Excludes local (Melbourne) visitors.*

12% are aged between 0 and 17 years

36% are aged between 18 and 34 years

45% are aged between 35 and 69 years

7% are aged 70 years or more

Household type:

40% are singles

28% are couples without children

20% are families with children

12% are other household types

Country of birth:

31% were born overseas:

6% in the United Kingdom

3% in New Zealand

2% in India

Language spoken at home:

20% of residents speak a language other than English

Top 3 languages spoken at home:

3% of residents speak Greek

1.5% of residents speak Russian

1.5% of residents speak Mandarin

Transport:

26% of residents use public transport to get to work

73% of residents own one or more cars

13% of residents rode bikes and 73% walked as recent modes of transport

Housing:

50% of households rent

41% of households own their own home

8% of households live in social or public housing

Income:

31% of households have a total weekly household income of greater than $2,500.

Our health and wellbeing

Integrating health and wellbeing into the Council Plan

Working at the interface with community, local government is well-positioned to directly influence conditions that enable positive health and wellbeing. We have a legislative responsibility under the Victorian Public Health and Wellbeing Act 2008 to prepare a Municipal Public Health and Wellbeing Plan every four years.

To recognise the important role Council plays in supporting health and wellbeing, we have integrated the planning, implementation and evaluation requirements of the Municipal Public Health and Wellbeing Plan into this Council Plan. Integrating our plans in this way ensures we are working to protect, improve and promote public health and wellbeing in everything we do.

Socio-economic factors, and the natural and built environment impact on health. By working collaboratively with other levels of government, service providers, business and community we can reduce inequalities and optimise the conditions in which people can be healthy. In this way, we hope to provide coordinated, robust and appropriate responses, including:

- supporting the delivery of an integrated transport network that connects people and places
- designing infrastructure that creates a greener, cooler and more liveable city
- advocating for and facilitating partnerships to support delivery of diverse, affordable housing
- developing policies and programs that strengthen the community to prevent crime, injury and ill-health, and foster positive social and health change.

The six strategic directions of this plan have been informed and guided by analysing population health data, community consultation and stakeholder feedback, reviewing international, national, state and local research and policy, and the Victorian Public Health and Wellbeing Plan 2015-2019. This ensures we play our role in achieving the State vision of *“a Victoria free of the avoidable burden of disease and injury, so that all Victorians can enjoy the highest attainable standards of health, wellbeing, and participation at every age”*.

Understanding health

We have embedded the World Health Organisation definition of health in this plan. That is, *“a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity”*.

To support this holistic view of health and wellbeing we need to understand what influences health outcomes. Influences include biological factors and the conditions in which people are born, grow, live, work, play and age – known as the social determinants of health. The Social Model of Health diagram shows this best, with individuals at the centre. This model guides our efforts and those of our partners to promote conditions that support people to be healthy.

We know that there will always be differences in health status in our community. These differences do not happen by chance. They follow social patterns and a trajectory by which an individual's overall health tends to improve at each step up the economic and social hierarchy. That is why we have a role in working to reduce health and wellbeing inequalities, by committing to prevention and early intervention across the life course and by embedding health equity and social justice principles in everything we do.

Understanding health

Inside circle

- Age
- Gender
- Ethnicity
- Ability

Individual Lifestyle Factors

- Diet
- Exercise
- Smoking
- Alcohol
- Illicit substances

Social and Community Networks

- Social participation
- Family
- Friendships

Living and Working Conditions

- Income
- Education
- Housing
- Health services
- Safety
- Transport
- Agriculture and food production
- Water and sanitation

General Socio-Economic, Cultural and Environmental Conditions

- Political landscape
- Built environment
- Social justice
- Health equity

Port Phillip's health profile

- 7% currently smoke
- 6% eat enough fruit and vegetables

- 59% get enough physical activity
- 38% are pre-obese or obese
- 53% have at least one chronic disease
- rate of sexually transmissible infections is nearly four times state average
- each person spends $50 per week on alcohol and $297 on pokies annually
- 44% at risk of alcohol-related harm each month and 69% lifetime risk
- rate of criminal offences is nearly 1.5 times state average
- 96% feel safe walking alone during the day and 65% at night
- 1,023 family violence incidents per 100,000 people
- 31% experienced anxiety or depression in their lifetime
- 43% excellent/very good health status (self-reported)

Victorians' health and wellbeing is high by international standards and significant gains have been made in recent years. The health and wellbeing of the Port Phillip community is similarly relatively high.

Available data shows that we are similar to the Victorian average in terms of general wellbeing, life satisfaction, day time safety, resilience, levels of psychological distress, participation in health screening activities (for example, blood pressure check), neighbourhood cohesion, social trust, willingness to intervene in a situation of family violence, and fruit, vegetable and water consumption.

Our community has some more favourable outcomes than the Victorian average, such as levels of physical activity and obesity, smoking rates, income and socioeconomic indicators, and some chronic diseases. Port Phillip also has higher than average levels of gender equity awareness, which contributes to lower rates of family violence. Our efforts in these aspects of health and wellbeing must continue to maintain these positive outcomes.

However, we also experience less favourable outcomes. Areas of concern include use of alcohol and illicit drugs, crime, sedentary work behaviours, housing affordability, people experiencing homelessness, and sexually transmissible infections.

Favourable health outcomes	Unfavourable health outcomes
• Almost two-thirds of Port Phillip residents feel safe walking alone in their local area after dark, which is significantly more than the state average. • The percentage of people who do not meet physical activity guidelines is the lowest in the state. • Port Phillip residents eat significantly more serves of vegetables per day than the state average. • The rate of reported obesity is the lowest in the state. • Significantly lower smoking rate than the state average. • The percentage of people who believe multiculturalism makes life better is among the highest in the state. • The median household income is among the highest in the state and the percentage of people with income less than $400 per week is the lowest in the state. • The percentages of households with mortgage stress and rental stress are among the lowest in the state. • The percentage of social housing is among the highest in the state. • Use of public transport to get to work is the highest in the state. • The percentage of people reporting arthritis is the lowest in the state, and the percentages reporting type two diabetes and high blood pressure are among the lowest. • Kindergarten fee subsidy rate is the lowest in the state. • Infant breastfeeding rates are among the highest in the state. • The percentage of children with speech or language problems at school entry is among the lowest in the state.	• The rate of criminal offences is among the highest in the state. • Significantly higher levels of time spent sitting on a usual work day than state average. • Significantly greater number of residents identified as being at risk of short-term harm from alcohol, and the number of people identified as being at *very* high risk of short-term harm is the highest in state. • Significantly greater number of residents who agree that getting drunk every now and then is okay. • Significantly higher rates of alcohol related ambulance attendances, hospitalisation, emergency department presentations and assault, including the highest rate of male alcohol-related hospitalisations in the state. • Significantly higher rate of pharmaceutical related ambulance attendances. • Significantly higher rates of illicit drug related ambulance attendances (in particular for amphetamines, meth-amphetamines and ecstasy) and the highest hospitalisation rate in the state. • The percentage of people who feel they are able to get help from neighbours is among the lowest in the state. • The median weekly rent for a three-bedroom home is the highest in the state and the median house price is among the highest in the state. • The estimated rate of homeless people per 1,000 population is the highest in the state. • Significantly higher rates of sexually transmissible infections.

This plan seeks to understand the complexities of these outcomes, and identify how we can work together with our partners to improve our health and wellbeing.

Our challenges

We have identified seven significant, long-term challenges facing our City, that we have considered when developing this long-term plan:

- Climate Change

- Population growth
- Urbanisation
- Transport and parking
- Legislative and policy influence
- Changing economic conditions
- Rapid evolution of technology.

How we respond to these challenges impacts the liveability of our City, and the health of our community and has shaped this plan and the services we provide.

Climate change

Port Phillip is already experiencing the impacts of climate change, including temperature increases (of between 1.2 and 1.4 degrees since 1950), lower than average rainfall (a decrease of between 100 and 200 millimetres since 1950), more flooding, sea level rise (of between 0.08 to 0.17 metres above the 2005 level), and a notable increase in the number of days over 35 degrees[2].

Our City is Melbourne's playground. The beach lifestyle and coastal activities are very attractive and important to the health and enjoyment of residents and visitors. However, Port Phillip is built on reclaimed land to the south and north. Much of the City is only one to three metres above sea level and coastal areas are exposed to the impacts of climate change, especially flooding and erosion. Port Phillip is located at the bottom of the Elster Creek and Yarra River catchments, requiring a regional 'whole-of catchment' partnership approach to enable both proactive and emergency flood management responses.

We can expect increased flooding of coastal properties and public amenities, storm damage to infrastructure, beach erosion, decreased water quality and security of water supply, reduced summer outdoor activities and hotter urban spaces. Changing environmental conditions may challenge some members of our community to stay healthy and safe. For example, those experiencing health or housing crises will be more vulnerable to periods of extreme heat or cold.

This will have an impact on Council services. Assets may be unable to provide the same level of service to the community. In particular, drainage (currently beyond capacity) and Council facilities may become cost-prohibitive to operate if they are not developed to the required sustainable design standards.

Greenhouse gas emissions reduction is one important way to address climate change and avoid dangerous temperature increases. Ninety-nine per cent of Port Phillip emissions are community generated, and these are increasing as our City grows and reliance on car travel continues.

[2] Climate Ready Victoria: Greater Melbourne, November 2015, State of Victoria Department of Environment, Land, Water and Planning.

Population growth

Port Phillip's population is expected to grow to more than 167,870[3] people by 2041, a significant 51 per cent increase from the 2017 estimate of 110,967 people. Over the life of this plan, our population is expected to grow by 23 per cent to 136,300[4].

Our worker population will also rise dramatically. Fishermans Bend is expected to cater for 60,000 jobs by 2050, with just over half of these jobs (33,715) projected to be within Port Phillip. Adjacent municipalities are also expected to grow significantly. The population of the City of Melbourne is projected to double over the next 30 years.

Growth will not be uniform across our City. The St Kilda Road, Sandridge/Wirraway and Montague neighbourhoods are projected to grow significantly. Other established neighbourhoods will experience lower population growth.

In 2041, the population will continue to be highly mobile and dominated by 25-39 year olds, but with an increasing number of older people. The forecast median age for the Fishermans Bend suburbs (Montague, Sandridge/Wirraway) is 29, 30 and 34 years of age respectively. Our community will likely be more diverse, as the number of people born overseas grows. More than two-thirds of our households will be single person or couples without children.

Population growth and associated demographic and socio-economic shifts will increase demand for all Council services and amenities. Health inequities and wealth disparity may be exacerbated if people find it difficult to access programs, services and amenities that support health and wellbeing. Coupled with the increasing cost of providing services, increasing demand will stretch services and infrastructure. Achieving a balance between the economic benefits of tourism and thriving entertainment and shopping precincts, and minimising social harm and protecting residential amenity may become more challenging.

Transport and parking

Integrated transport infrastructure and services support healthy behaviours including safe walking, bike riding and use of public transport, and enjoyment of entertainment precincts, parks and open spaces.

Road network congestion will continue to be an issue as our population grows. The road network for cars is at capacity and cannot be increased. The Victorian Government is prioritising more efficient and sustainable modes like trams, walking and bike riding. So we can expect that, in real terms, road network capacity for private cars is likely to remain static or decrease over time.

Managing on-street car parking for different users – residents, workers and visitors – is also an ongoing challenge. In many parts of the City, demand for parking outstrips supply, and decisions will need to be made about how to best allocate this scarce resource.

Managing congestion as our City grows will only be possible by supporting people to travel by non-car modes. This will require ongoing investment in walking and bike riding infrastructure, behaviour change initiatives, and partnerships with the Victorian Government to deliver 'place and movement' projects that invest in our public spaces and increase public transport service levels, capacity and accessibility.

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[3] Forecast.id projections.
[4] Forecast.id projections.

Traffic and parking congestion has a significant impact on our environment and health, and compromises the liveability of our City. Without safe and accessible transport, some people will be constrained in their ability to stay connected and participate in important aspects of community life, like work, exercise, visiting friends and family, and accessing services and programs.

Increases in car trips cannot easily be accommodated, especially during peak travel times. It is expected that there will be a continuing shift to public transport, walking and bike riding, where these alternatives are safe, direct and convenient.

It will be important to ensure our public spaces are places for people, accessible by walking and riding a bike, and offer opportunities to be healthy. Learning from European cities, early planning for high capacity bike parking across the City will be required, with the new Domain station presenting a significant opportunity.

Urbanisation

Population growth will drive an increase in urban density. Fishermans Bend will make a significant contribution to housing growth, with new high density neighbourhoods. The density of established areas across the City will also increase, with the St Kilda/St Kilda West and St Kilda Road neighbourhoods accounting for more than half of the projected housing growth outside Fishermans Bend over the next 20 years. We will see more medium to high density residential development and continued pressure to convert commercial areas to residential use. If not carefully managed, this could pose a threat to neighbourhood character and heritage.

Compact cities enable more people to be connected to the things they need to be healthy, like public transport, employment, education and services. However, urban environments increase exposure to pollution and traffic accidents, and reduce access to nature and green open spaces. Maintaining liveability in a higher density city will take concerted effort.

Demand for inner city housing increases price, and can constrain socio-economic and demographic diversity. Higher density, mixed use development means that we are fast becoming a 24 hour city. The ever growing night time economy, and social issues like drug and alcohol abuse and family violence, become more visible and intensified in urban areas.

With increasing density and vertical living, more people will use our parks, villages, roads and footpaths, beaches and public transport. Improving travel choices and access to high frequency public transport will ensure liveability for residents, workers and visitors. Our public spaces and waterfront will need to be welcoming to all and cater for different and increased use as they become residents' 'backyards'.

Our neighbourhoods will need to be safe and walkable, with good access to shops and flexible community spaces, and have a balance of residential and business use so we can reap the benefits of a vibrant 'mixed use' city and support healthy, active and connected communities.

Housing affordability will continue to be a concern. Housing costs in Port Phillip are twice the Melbourne average and most low and moderate income households find buying a home and private rentals increasingly unaffordable.

Rapid evolution of technology

The world is becoming more connected. People, businesses and governments are increasingly moving online to connect, deliver and access services, obtain information and perform activities like shopping and working. Technology is also changing the way our residents work. Around one in every 12 workers works from home.

We can expect increasing demand for council services to be delivered online, and for engagement through social media and other digital means. We will need to respond to this demand and think about how we operate and support people to connect with Council, particularly those who have limited online access and/or digital literacy. The digital shift will reshape how we deliver services and engage our community in decision making.

Technological advances also present opportunities for Council to consider new methods of service delivery, such as electronic parking management, that have the potential to offer efficiencies and improved community outcomes. New technologies will enable our workforce to be more mobile and deliver services that support community health and wellbeing where, when and how they want them.

Legislative and policy influence

All Victorian councils operate in a complex legislative and policy environment that includes 75 Acts of Parliament and 28 Regulations. The key Act (the Local Government Act 1989) is under review.

Government funding is being reduced or withdrawn from several sectors, placing additional expectation on local government to fill the gap. This trend of government cost shifting, along with increased compliance, will likely continue. Large-scale sector reforms will exacerbate this challenge, requiring service model changes that may impact on those in our community with the most complex needs.

In addition, the cap on rate increases means local government's ability to control revenue is constrained. As a result, we are experiencing increased strain on our financial sustainability. The cap on rate increases is forecast to impact our bottom line by $35 million over the next 10 years if we don't make changes to the way we operate. Difficult decisions will need to be made about our services, investments and assets to ensure the health and wellbeing of our people and places within these fiscal constraints.

Changing economic conditions

Port Phillip's economy was close to $12 billion in 2015[5], contributing 4.2 per cent of the greater Melbourne economy. Our economy grew significantly in the early 2000s, and slowed over the last 10 years, but we experienced 2.9 per cent growth in GRP[6] between 2013 and 2015[7].

In recent years we have experienced some growth in the number of businesses and jobs - particularly in construction, manufacturing and some services. We have a higher than average proportion of professional, scientific and technical services (23.6 per cent compared to 9.1 per cent in Victoria), arts and recreation services (2.8 per cent compared to 1.6 per cent) and information media and telecommunications (4 per cent compared to 2.2 per cent). The South Melbourne precinct has one of the highest concentrations of creative industries in Australia. Despite this, 75 per cent of our working population leave the area for work.

The Port Phillip neighbourhoods of Fishermans Bend are currently home to over 750 businesses and approximately 12,000 workers[8]. The transition of Fishermans Bend to a mixed use community will have a significant impact on the number and type of businesses and jobs in that area.

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[5] Economy.id, City of Port Phillip Economic Profile.
[6] Gross Regional Product (GRP) is the market value of all final goods and services produced within an area in a period of time.
[7] Economy.id, City of Port Phillip Economic Profile.
[8] Economy.id, City of Port Phillip Economic Profile.

Our people can expect to spend more time travelling to work outside of the City. We may also continue to experience a change in the nature of our business community as high rental prices put pressure on smaller businesses.

Socio-economic factors have a significant impact on health and wellbeing. The spectrum of people considered vulnerable is widening due to increased costs of living, rental and property costs, social exclusion and health inequity. More than 8,000 residents are living in housing stress and 2,500 residents are on the public housing waiting list (excluding local community housing waiting lists). In the last two years, we have seen an increase of 104 per cent in the number of calls received about people sleeping rough in public places. We expect to observe ever-increasing vulnerability in our community.

Our vision

We are beautiful, liveable, caring, inviting, bold and real

Our strategic directions

We will deliver the vision for Port Phillip through six directions. The plan is structured around these directions and the outcomes for the health and wellbeing of our people and places that we want to see by 2027.

How this plan responds to our community

The table that follows shows how this plan responds to our identified emerging health issues and the Victorian Public Health and Wellbeing Plan 2015-19.

There are four emerging health issues for Port Phillip. We determined these by analysing population health data and identifying priorities, and then assessing what impact we can have on the issue.

1. Housing and homelessness.
2. Social inclusion and diversity.
   Including social network and mental health (prevalence of and lifestyle risk factors).
3. Safety.
   Including crime, alcohol, illicit and pharmaceutical drugs and family violence.
4. Access to information and services.
   Including health services, maternal and child health, sexual and reproductive health, preventative action, health status, and prevalence of illness and disease.

Outcomes by 2027	Emerging health issues that will be addressed	State health priorities that will be addressed
Strategic direction 1: We embrace difference, and people belong		
1.1 A safe and active community with strong social connections	Social inclusion and diversity Safety	Reducing harmful alcohol and drug use Preventing violence and injury
1.2 An increase in affordable housing	Housing and homelessness	Improving mental health
1.3 Access to services that support the health and wellbeing of our growing community	Access to information and services	All
1.4 Community diversity is valued and celebrated	Social inclusion and diversity	Improving mental health
Strategic direction 2: We are connected and it's easy to move around		
2.1 An integrated transport network that connects people and places 2.2 Demand for parking and car travel is moderated as our City grows 2.3 Our streets and places are designed for people	Access to information and services Social inclusion and diversity Safety	Healthier eating and active living Preventing violence and injury
Strategic direction 3: We have smart solutions for a sustainable future		
3.1 A greener, cooler and more liveable City 3.2 A City with lower carbon emissions 3.3 A City that is adapting and resilient to climate change 3.4 A water sensitive City 3.5 A sustained reduction in waste	Access to information and services Housing and homelessness	Healthier eating and active living Improving mental health
Strategic direction 4: We are growing and keeping our character		

Outcomes by 2027	Emerging health issues that will be addressed	State health priorities that will be addressed
4.1 Liveability in a high density City 4.2 A City of diverse and distinctive neighbourhoods and places	Housing and homelessness Access to information and services Social inclusion and diversity Safety	Healthier eating and active living Improving mental health Reducing harmful alcohol and drug use
Strategic direction 5: We thrive by harnessing creativity		
5.1 A City of dynamic and distinctive retail precincts 5.2 A prosperous City that connects and grows business 5.3 A City where arts, culture and creative expression is part of everyday life	Access to information and services Safety Social inclusion and diversity	Reducing harmful alcohol and drug use Preventing violence and injury Improving mental health
Strategic direction 6: Our commitment to you		
6.1 A financially sustainable, high performing, well governed organisation that puts the community first	Social inclusion and diversity Access to information and services	All

How the community helped shape this plan

Your views and aspirations for the City have been important contributions to this plan.

During February 2017, we ran a comprehensive community engagement program asking for your feedback on how to tackle some of the challenges we face and what you value most about the City.

Community engagement was widely promoted through a range of channels, including Council and library websites, social media, advertisements in local newspapers, and email updates to community networks. Postcards were distributed in town halls, libraries, shopping precincts, markets, childcare centres, community centres and other sites across the City. Community ideas and feedback was captured through:

- community surveys
- an avatar survey identifying community personas
- pop-up conversations between the community and Councillors

- targeted focus groups
- stakeholder meetings
- online discussion forums
- special focus workshops to explore particularly significant challenges like transport, parking and managing waste.

Tailored conversations and activities ensured that a range of groups were involved (including some that are typically harder to reach), such as Indigenous, culturally and linguistically diverse, older people, faith-based communities, youth and children. We used several methods, including facilitated focus group conversations, interpreters to assist with completing the community surveys, and translated feedback forms in Greek, Polish and Russian. A large print survey was provided to community members on request, to ensure the engagement was accessible and everyone had an opportunity to contribute their ideas.

We engaged community researchers to conduct surveys that were inclusive of all members of our community, to extend our reach to people who do not typically engage with Council. Community researchers are graduates of the *Voices of the South Side* program that provides public speaking, advocacy, research, communication and teamwork skills to people who live in social and public housing in Port Phillip.

Survey questions and prompts emphasised the central role that local government plays in creating communities and environments in which people can thrive. We know we have influence over some of the most powerful contributors to health and wellbeing, like employment, social support, land-use planning, transport and access to cultural activities, so we are ideally placed to have a profound impact on the quality of life of our community.

We received more than 2,000 pieces of feedback, and reached 450 people through the tailored engagement with harder to reach groups in our community. 125 groups and individuals made a submission to the draft Plan when it was released in April.

Community engagement and consultation to help develop this plan is just one thread of an ongoing conversation about how to support the health and wellbeing of our community. We are committed to monitoring social change and participating in research to understand emerging trends based on evidence, working with community and other partners to innovate and advocating to meet community needs. We will do this by working with the Port Phillip Health and Wellbeing Alliance, Youth Advisory Committee, Older Persons Consultative Committee, Access Network, Multicultural Forum and Multifaith Network to develop policy, services and infrastructure that best meet diverse community needs.

The table that follows shows the key themes from our community engagement and consultation. This plan responds by reinforcing the attributes of our City that our community values most and planning for the City they want to see in 10 years' time.

What our communities value	How this plan responds
Supportive City for all There is a desire to support all people in the community, including those who are most vulnerable and from diverse backgrounds, and to invest in supporting healthy living and community wellbeing for people of all ages, abilities and life stages. Council's role in developing community capacity was emphasised.	We embrace difference, and people belong (Direction 1) The plan identifies priorities that will deliver: An active and well connected community, with access to services that enhance health and wellbeing. An increase in affordable housing, services targeted at supporting community members experiencing vulnerability, and programs and events that celebrate and are inclusive of our diverse cultural communities.

What our communities value	How this plan responds
	Highlights of the plan include: Major upgrades to sporting and community facilities, investing in delivering new affordable housing projects by partnering with housing organisations, and ensuring our services meet the needs of our rapidly growing community.
Transport choice and parking management Improving transport, traffic management and parking management is one of the City's greatest challenges. Our community wants a city that makes it easier and more enjoyable to walk, bike ride or use public transport. There are wide ranging views about how to manage parking.	We are connected and it's easy to move around (Direction 2) The plan identifies priorities that will deliver: A transport network offering real travel choices, an improved framework for managing our limited parking supply, and streets that are designed for healthy people, not cars. Highlights of the plan include: Developing an Integrated Transport Strategy, investing in improving pedestrian safety and the continuity of our bike routes, and advocacy to address gaps in the public transport network, including a high frequency tram connection to Fishermans Bend.
Creating a sustainable city and managing climate change Reducing greenhouse gas emissions and managing a changing climate are considered key challenges. Ensuring an environmentally sustainable City is considered important.	We have smart solutions for a sustainable future (Direction 3) The plan identifies priorities that will deliver: A cooler city through greening our buildings and streets. A city that has reduced waste going to landfill and increased the use of renewable energy sources. A city and community that has adapted for climate change and reduced the risk of flooding. Highlights of the plan include: Developing a Sustainable City Community Action Plan and a new Sustainability Strategy Beyond 2020. Investing in stormwater harvesting, solar energy, waste service innovation and the EcoCentre.

What our communities value	How this plan responds
Sense of place and community Our communities value the places where they live, including beaches, parks and gardens. Clean, safe, and inviting streets, spaces and amenities are important to our community now and in the future. Protecting heritage and iconic buildings is also considered important. Developing our neighbourhoods in a balanced way How our neighbourhoods can provide for growth, and maintain character is considered a challenge for the City.	We are growing and keeping our character (Direction 4) The plan identifies priorities that will deliver: Liveability as the City grows and urban density increases, by ensuring high quality buildings contribute to safe, lively streets, and enhanced public spaces to cater for increased demand. Protection of the City's valued heritage places and 10-minute neighbourhoods to reinforce the sense of place. Highlights of the plan include: Reviewing planning policy to effectively manage urban growth, strengthening heritage controls and developing a new Public Spaces Strategy. Working in partnership with the Victorian Government to develop a robust planning framework and precinct plans for Fishermans Bend to ensure a world class renewal area.
Creativity and diversity of the City The culture and vibrancy of Port Phillip is highly regarded and considered part of what makes the City unique. Balancing activation with protecting local amenity Supporting businesses and activating shopping strips is seen as an opportunity. Events, festivals and attractions that bring people to the City need to be managed in a way that protects local amenity.	We thrive by harnessing creativity (Direction 5) The plan identifies priorities that will deliver: A city where arts, culture and creative expression is part of everyday life, our creative industries cluster has grown, and thriving retail centres are a focal point for local communities and business. Highlights of the plan include: Investing in retail precincts to improve accessibility and facilitating renewal. Developing a Creative and Prosperous City Strategy and transforming our libraries as creative and learning spaces.

A full summary of the feedback received is available at www.portphillip.vic.gov.au/haveyoursay.

Strategic direction 1: We embrace difference, and people belong.

What we want to see by 2027

1.1 A safe and active community with strong social connections

1.2 An increase in affordable housing

1.3 Access to services that support the health and wellbeing of our growing community

1.4 Community diversity is valued and celebrated

How we will measure progress

Outcome indicators	2014/15 result	2015/16 result	2017/18 target	2020/21 target	2026/27 target
Residents that agree Port Phillip is a welcoming and supportive community for everyone	96%	93%	>95%	>95%	>95%
Social housing as a percentage of housing stock (Average 92 new dwellings per year required to maintain performance)	7.2%	7.2%	7.2%	7.2%	7.2%
Wellbeing index (VicHealth Indicators Survey self-reported index, available every four years)	n/a	77.5	n/a	>77.5	>77.5

By 2027 we want to see:

1.1 A safe and active community with strong social connections

We will work towards this outcome by:	Our priorities for the next four years:
A Providing access to flexible, multi-purpose facilities that support participation in community life through sport, recreation and life-long learning. B Supporting programs that create social connections and strengthen community networks. C Building community capacity by harnessing the knowledge, expertise and spirit within our community.	• Plan and deliver a long-term program of sports field and pavilion upgrades to enhance capacity and broaden community participation in sport and recreation. • Redevelop the South Melbourne Life Saving Club to provide contemporary clubhouse facilities and public amenities. • Invest in a long-term program of community facility upgrades to ensure they are fit for purpose and meet current and future community needs. • Establish outdoor gyms and fitness stations in open space and continue to upgrade recreation reserves and skate parks to facilitate an active, healthy community.

We will work towards this outcome by:	Our priorities for the next four years:
	• Deliver community strengthening programs that harness community knowledge and expertise to support leadership, learning and volunteering, improve safety and foster positive social and health outcomes. • Implement a whole of Council and community approach to preventing and responding to family violence. • Collaborate with partners to understand and minimise the harms associated with alcohol and drug use. • Provide funding to groups and organisations that support local networks, encourage community participation and support access and inclusion.

1.2 An increase in affordable housing

We will work towards this outcome by:	Our priorities for the next four years:
A Pursuing new, sustainable funding streams to significantly increase the supply of social housing. B Establishing and facilitating partnerships to support diverse and innovative new affordable housing projects, and reduce the risk of homelessness.	• Implement In Our Backyard – Growing Affordable Housing in Port Phillip 2015-2025 to increase the supply and diversity of affordable housing aligned to priority local needs – low income families, older people, key workers, and single people at greatest risk of homelessness. • Continue to implement the Homelessness Action Strategy 2015-2020 and provide support for people experiencing homelessness to access suitable housing. • Use Council property assets (land and air space contributions) and cash contributions to facilitate delivery of new community housing units by local housing organisations, including progressing development of 46-58 Marlborough Street, Balaclava. • Work with the Victorian Government and local community housing organisations to optimise benefits from existing social housing sites, through increased yield, quality and housing type, aligned to local needs. • Facilitate partnerships between the community housing, private and philanthropic sectors that fund and deliver new housing projects, including in Fishermans Bend.

1.3 Access to services that support the health and wellbeing of our growing community

We will work towards this outcome by:	Our priorities for the next four years:
A Facilitating access to relevant services that cater for all ages and life stages.	• Deliver new community spaces as part of the integrated Ferrars Street Education and Community Precinct at Fishermans Bend.

We will work towards this outcome by:	Our priorities for the next four years:
B Supporting co-located and integrated services, and shared use arrangements, to improve access for all. C Exploring partnerships and innovative ways of delivering services.	• Implement outcomes from reviewing Council's role in aged care and disability support services, in the context of national sector reforms and with the aim of facilitating continued access to relevant, quality services. • Complete the review of children's services to determine Council's future role in early childhood education and care. • Explore new models of providing services and advocate to ensure the right mix and level of services to improve access and health equity for our communities. • Implement improvements to maternal and child health services and family support services that respond to growing and changing demands. • Investigate the feasibility of a dedicated youth space, including through potential partnership arrangements. • Collaborate with partners and service providers to undertake neighbourhood planning and delivery of community infrastructure, services, programs and outreach that promote health and social inclusion and are aligned to community needs. • Provide funding to community organisations and service providers to ensure access to relevant services and programs.

1.4 Community diversity is valued and celebrated

We will work towards this outcome by:	Our priorities for the next four years:
A Supporting programs and events that engage, honour and are inclusive of our diverse social and cultural communities. B Targeting services and building community capacity to support vulnerable members of our community, emphasising prevention and early intervention. C Protecting and promoting Aboriginal culture and heritage, and continuing	• Establish the Pride Centre in St Kilda. • Work with the Port Phillip Health and Wellbeing Alliance, Youth Advisory Committee, Older Persons Consultative Committee, Access Network, Multicultural Forum and Multifaith Network to develop policy, services and infrastructure that best meet diverse community needs. • Ongoing delivery of programs and events that celebrate our diverse communities, including multicultural and multifaith events, senior events, and the Pride March. • Review the Port Phillip Social Justice Charter. • Retain Council's Access and Ageing Department Rainbow Tick accreditation to ensure LGBTIQ inclusive service delivery.

We will work towards this outcome by:	Our priorities for the next four years:
reconciliation with our Indigenous community.	• Develop and implement our second Reconciliation Action Plan 2017-2019, including the Aboriginal and Torres Strait Islander employment policy, and update the Aboriginal and Torres Strait Islander Arts Plan.

This direction is supported by:

Instrument	Description
Advocacy priorities	Advocate to the Victorian Government: • for an affordable housing target in Fishermans Bend • to introduce 'Inclusionary Zoning' to deliver affordable and social housing through private sector development • for improved public and social housing, and better standards for boarding and rooming houses, to improve safety, amenity and privacy of residents • to improve access to education and additional schools in Port Phillip. Advocate to the Federal Government for funded support and tax reform that addresses housing affordability.
Engagement and partnership priorities	Ongoing collaboration with partners to the Health and Wellbeing Alliance. Suai Covalima Timor Leste Partnership. Work in partnership with Victoria Police, the community and local service agencies to improve community safety. Work with new and current partners to monitor and respond to health and social change through research and evidence-based policy. Work with academic partners to undertake place-based evaluations of health outcomes. Work with inner Melbourne councils to collaborate on regional sport and recreational planning and delivery.
Strategies / plans. These are mapped to the direction they primarily contribute to. Some strategies, plans and policies will contribute to multiple directions.	Childcare Policy 2006 Disability Policy 2011 Family, Youth and Children Collaborative Practice Framework 2016 Family, Youth and Children Strategy 2014-2019 Friends of Suai Strategic Plan 2010-2020 Homelessness Action Strategy 2015-2020

Instrument	Description
	In Our Backyard – Growing Affordable Housing in Port Phillip 2015-2025
	Middle Years Commitment and Action Plan 2014-2019
	Protocol for Assisting People Who Sleep Rough 2012
	Reconciliation Action Plan 2017 *(under development)*
	Social Justice Charter 2011
	Sport and Recreation Strategy and Implementation Plan 2015-2024
	Youth Commitment and Action Plan 2014-2019

Key projects that will be underway by 2027:

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
Affordable housing and homelessness	In Our Backyard Strategy Implementation. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*	$210,000	Partner	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Ageing and accessibility	Aged Care Transition Service Review	$183,000	Deliver	Finish	n/a	n/a	n/a	n/a
Children	Children's Centres Improvement Program	$3,800,000	Deliver	Start	Ongoing	Ongoing	Ongoing	Ongoing
	Bubup Nairm Non Compliance Works	$990,000	Deliver	Finish	n/a	n/a	n/a	n/a
	Children's Services Review Implementation	$210,000	Deliver	Finish				
Community programs and facilities	Ferrars Street Education and Community Precinct Community Facilities and Netball Courts. This is a major initiative that will be reported on in Council's Annual Report,	$2,995,000	Fund	Finish	n/a	n/a	n/a	n/a

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
	pursuant to section 131 of the *Local Government Act 1989*.							
	Community Facilities Upgrade Program – Liardet Street Community Centre	$560,000	Deliver	Finish	n/a	n/a	n/a	n/a
	Community Facilities Upgrade Program – South Melbourne Community Centre	$590,000	Deliver	Finish	n/a	n/a	n/a	n/a
	Pride Centre Implementation	$20,000	Partner	Start	Ongoing	Finish	n/a	n/a
Families and young people	Adventure Playgrounds Upgrade	$700,000	Deliver	n/a	n/a	n/a	Start	Finish
Recreation	JL Murphy Reserve Pavilion Upgrade. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$2,472,000	Deliver	Start	Finish	n/a	n/a	n/a
	Peanut Farm Reserve Sports Pavilion Upgrade. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$2,815,000	Deliver	Ongoing	Finish	n/a	n/a	n/a
	South Melbourne Life Saving Club Redevelopment. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$6,350,000	Deliver	Start	Ongoing	Finish	n/a	n/a
	North Port Oval Upgrade	$2,950,000	Deliver	n/a	Start	Ongoing	Finish	n/a
	Sports Playing Field Renewal Program	$800,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
	Julier Reserve Pavilion Upgrade	$240,000	Deliver	n/a	n/a	Start	Ongoing	Finish
	Lagoon Reserve Sport Field Upgrade	$100,000	Deliver	n/a	n/a	n/a	Start	Finish
	Recreation Reserves Facilities Renewals Program	$1,135,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

Services that contribute to this direction

Service category and description	Expenditure type	2017/18	2018/19	2019/20	2020/21
Affordable housing and homelessness - support people at risk of or experiencing homelessness through direct services and facilitating an increasing supply of affordable housing through research and advocacy, contributing property and funding for community housing projects, and facilitating affordable housing developments by the public, private and community sectors.	Operating expenditure Capital expenditure	$1,479,490 $0	$1,446,325 $0	$1,484,787 $0	$1,548,791 $0
Ageing and accessibility – facilitate independence and promote social connectedness for older people and those living with a disability by providing in-home support services, social inclusion programs, funding for community groups and service providers, assessing clients to determine their needs, and consulting with community committees and networks. Note: this service may change over the next four years in response to national sector reforms.	Operating expenditure Capital expenditure	$10,317,495 $76,176	$10,488,905 $121,032	$10,856,657 $119,808	$11,337,449 $89,496
Children – help families achieve their full potential by providing, funding and advocating for high quality, affordable early childhood education and care, maternal and child health services, playgroups and toy libraries. Note: this service may change over the next four years to reflect changing demand and service models.	Operating expenditure Capital expenditure	$17,180,054 $1,565,392	$17,485,509 $1,190,344	$18,097,687 $1,389,936	$18,897,691 $1,379,832

Service category and description	Expenditure type	2017/18	2018/19	2019/20	2020/21
Community programs and facilities – support inclusion for all people in our diverse community regardless of age, ethnicity, gender identity, sexuality, faith or socio-economic status, by working with community organisations, multicultural and multifaith networks, and through planning, programs, grants and facilities. The operating expenditure figure for 2017/18 includes one-off funding for the Ferrars Street Education and Community Precinct and Pride Centre.	Operating expenditure Capital expenditure	$16,182,392 $1,162,696	$4,365,020 $150,172	$4,517,817 $139,968	$4,717,956 $384,916
Families and young people – support for families and young people through case management services for vulnerable families, middle years services and programs for young people aged 8 to 11 years, and programs and projects for young people aged 12 to 25 years who live, work, study or recreate in Port Phillip.	Operating expenditure Capital expenditure	$4,128,338 $0	$4,271,231 $0	$4,419,112 $0	$4,905,461 $700,000
Recreation – support our community to remain active and healthy through programs, support and funding for local sports and recreation clubs and providers, providing quality sports facilities, and partnering with other organisations to facilitate health and wellbeing outcomes.	Operating expenditure Capital expenditure	$1,829,060 $3,130,000	$1,885,692 $7,127,000	$1,944,294 $4,880,000	$2,021,566 $1,920,000

Performance measures

Service	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
Affordable housing and homelessness	Number of new social housing units facilitated	No score	4,114 (total baseline)	No score	4,482
Ageing and accessibility	Resident satisfaction with services that support older people and people living with disabilities	94%	93%	>94%	95%
Children / Families and young people	Proportion of state regulated family, youth and children's services that meet or exceed national quality and accreditation standards	100%	100%	100%	100%

Service	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
	Participation in first maternal and child health home visit. This measure is required under the Local Government Performance Reporting Framework. The greater than 100 per cent result is due to a greater number of visits than birth notifications, because some babies born late in the financial year received their first visit in the next financial year.	104.4%	103.9%	100%	100%
	Infant enrolment in maternal and child health services. This measure is required under the Local Government Performance Reporting Framework.	99.8%	99.8%	100%	100%
	Cost of maternal and child health service. This measure is required under the Local Government Performance Reporting Framework.	$72.65	$73.37	<$75	<$80
	Participation in maternal and child health services. This measure is required under the Local Government Performance Reporting Framework.	83.6%	84.2%	>85%	>88%
	Participation by Aboriginal children in maternal and child health services. This measure is required under the Local Government Performance Reporting Framework.	69.1%	87.2%	>85%	>88%
	Resident satisfaction with services that support families, youth and children	95%	97%	>95%	>95%
Community programs and facilities	Resident perception regarding whether City of Port Phillip services contribute to the overall health and wellbeing of the community	Data unavailable	66% (result is from November 2016)	67%	68%
	Visits per capita to community facilities	1.9	1.7	>1.9	>2

Service	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
Recreation	Community rating of Council's recreational facility performance (index)	n/a	76	>75	>80
	Participation per capita in sport and recreation across formal and informal activities	n/a	Baseline to be set	1% increase on baseline	5% increase on baseline

Service information

Service statistics	Result	Assets	Result
Organisations receiving community grants	50	Maternal and child health centres	7
Council facility bookings	11,700	Council and community managed childcare centres	12
Sports club members	20,000	Community centres	15
Older persons referred for housing support	350	Sports club buildings	20
Number of contacts made by young people (12-25 years) with youth services and programs	26,359		
Hours of family support services provided	2,500		
Visits to adventure playgrounds by middle years young people (8-11 years)	21,187		
Children receiving maternal and child health support	5,138		
Active home care clients	1,973		
Community bus passengers	33,150		
Playgroups	70		

Major financial contributions *(annual value of $30,000 or more)*	**Value**	**Major contracts** *(annualised 2017/18 value of $150,000 or more)*	**Annualised value 2017/18**
Childcare subsidies (community managed centres)	$884,000	Sports field maintenance	$534,000
Port Phillip Community Group	$611,000	Childcare and community centre grounds maintenance	$186,000
Childcare subsidies (council managed centres)	$707,000		
Community housing contribution	$500,000		
Community and neighbourhood grants	$303,000		
Food services and social support grants	$208,000		
Youth services	$163,000		
Kindergarten grants	$123,000		
Town hall hire subsidy	$110,000		
Port Melbourne Neighbourhood House	$109,000		
Star Health	$102,000		
South Port Legal Service	$58,000		
Friends of Suai	$48,000		
South Port Day Links	$47,000		
Melbourne City Mission	$38,000		
Sacred Heart Mission	$33,000		

Major financial contributions *(annual value of $30,000 or more)*	**Value**	**Major contracts** *(annualised 2017/18 value of $150,000 or more)*	**Annualised value 2017/18**
New Hope Foundation	$32,000		
Melbourne Sports and Aquatic Centre	$30,000		

Major leases on council assets		**Market rental (Estimate. Unless otherwise noted, market rent is the rating valuation calculated as five per cent of the Capital Improvement Value of the property.)**	**Rent per year (excluding GST)**
Ada A'Beckett Childrens Centre	2 Batman Road, Port Melbourne	$340,000	$104
Albert Park Kindergarten	18 Dundas Place, Albert Park	$102,500	$104
Bubup Womindjeka Family and Childrens Centre	85 Liardet Street, Port Melbourne	$385,000	$104
Clarendon Childrens Centre	404-412 Clarendon Street, South Melbourne	$105,000	$104
Eildon Road Childrens Centre	17 Eildon Road, St Kilda	$127,500	$104
Lady Forster Kindergarten	63B Ormond Esplanade, Elwood	$185,000	$104
Lillian Cannam Kindergarten	97 Eastern Road, South Melbourne	$155,000	$104
Napier Street Aged Care	179 Napier Street, South Melbourne	$483,000 (market rent determined by valuation report)	$0

Major leases on council assets		Market rental (Estimate. Unless otherwise noted, market rent is the rating valuation calculated as five per cent of the Capital Improvement Value of the property.)	Rent per year (excluding GST)
Poets Grove Family and Childrens Centre	18 Poets Grove, Elwood	$185,000	$104
Port Melbourne Football Club North Port		$210,000 (market rent determined by valuation report)	$9,805
South Melbourne Child Care	5-11 Carter Street, Albert Park	$125,000	$104
South Port Community Residential Home	18-30 Richardson Street, Albert Park	$100,000 (ground rent only at market rates)	$1
St Kilda Life Saving Club		$420,000 (market rent determined by valuation report)	$1,000
The Elwood Childrens Centre	446 Tennyson Street, Elwood	$100,000	$104

Total budget for 2017/18

$57.1 million

How is it spent?

Operating - $51,116,830

Capital - $5,934,264

How is it funded?

Rates - $18,123,423

Fees and charges including parking - $20,713,590

Other income - $18,214,081 including $10.7 million of reserves for the Pride Centre and the Ferrars Street Education and Community Precinct community facilities.

Strategic direction 2: We are connected and it's easy to move around.

What we want to see by 2027

2.1 An integrated transport network that connects people and places

2.2 Demand for parking and car travel is moderated as our City grows

2.3 Our streets and places are designed for people

How we will measure progress

Outcome indicators	2014/15 result	2015/16 result	2017/18 target	2020/21 target	2027 target
Residents reporting choosing sustainable transport options to travel to work	57%	57%	58%	60%	65%
Number of fatal and serious traffic collisions involving all road users	93	97	<127	<119	To be determined as part of the Integrated Transport Strategy
Number of schools participating in Ride 2 School Month and Walk to School Day	8	10	12	14	16

By 2027 we want to see:

2.1 An integrated transport network that connects people and places

We will work towards this outcome by:	Our priorities for the next four years:
A Advocating for investment in public transport to address network gaps, increase capacity, and improve connections between modes. B Improving the connectivity, safety and amenity of walking and bike riding networks. C Influencing truck movements to facilitate business and manage local amenity impacts.	• Develop and deliver an Integrated Transport Strategy, including network plans for all modes and intermodal connections. • Implement walking projects that create safe, high amenity walking routes and reduce barriers to people walking across arterial roads. • Improve the attractiveness of bike riding as part of delivering Council's bike network. • Deliver the Beach Street separated queuing lane to reduce traffic delays associated with cruise ship arrivals. • Plan for and deliver Kerferd Road safety and streetscape improvements to enhance walking and bike riding (*subject to State funding*). • Work with Public Transport Victoria on the Balaclava Station interchange and Carlisle Street tram stop upgrade. • Ongoing program of renewals and improvements to laneways, roads, footpaths and street signage.

2.2 Demand for parking and car travel is moderated as our City grows

We will work towards this outcome by:	Our priorities for the next four years:
A Engaging with the community using a neighbourhood based approach, to encourage active and sustainable travel. B Reducing reliance on cars, by directing housing and employment growth to areas with the best access to public transport and shops. C Managing parking demand through technology, policy and pricing.	• Develop a Parking Management Plan as part of the Integrated Transport Strategy, and develop new policies for paid parking, on-street permits and parking provision rates for new development. • Investigate Council's car parks for future development opportunities that deliver increased community benefit. • Implement clever parking initiatives that help manage parking supply and turnover, and improve customer experience. • Expand the on-street network of car share vehicles, and encourage provision in new developments. • Improve local community travel choices, especially by schools, by investing in infrastructure and behaviour change programs.

We will work towards this outcome by:	Our priorities for the next four years:
	• Integrate land use and transport planning through a review of the Municipal Strategic Statement.

2.3 Our streets and places are designed for people

We will work towards this outcome by:	Our priorities for the next four years:
A Prioritising walking, bike riding and public transport when designing roads and allocating resources. B Pursuing universal accessibility for people with disabilities, children and older people.	• Implement blackspot safety improvements at high collision locations *(subject to external funding)*. • Work with partners on the St Kilda Junction safety upgrade and St Kilda Road safety improvement study to facilitate walking, bike riding and use of public transport. • Work with Public Transport Victoria to deliver a pipeline of place and movement projects, with fully integrated urban design and increased public transport service benefits for our communities. • Complete the streetscape and intersection upgrade of Wellington Street to improve safety and amenity. • Review and implement the City of Port Phillip Access Plan to support universal access, and implement accessibility improvements to council buildings, streets and public spaces, including the beach. • Work with partners on the design and implementation of the Domain Station and precinct to prioritise walking, bike riding and public transport services. • Progressively review and upgrade disabled parking spaces in commercial areas to meet updated Australian Standards.

This direction is supported by:

Instrument	Description
Advocacy priorities	Advocate to the Victorian Government: • to maximise community benefit from Melbourne Metro public transport and precinct works including the Park Street tram link and all associated tram stop upgrades • to maximise community benefit from Public Transport Victoria’s tram stop upgrade program • for the Shrine to Bay Boulevard, landscape and bike network connection • to expedite funding and delivery of the St Kilda Road safety improvement project to provide for convenient, safe and continuous walking and bike riding

Instrument	Description
	• for early implementation of strategic cycling corridors (continuous buffered and protected bike lanes), light rail and smart bus routes to and around Fishermans Bend • for Balaclava Walk (Nightingale Street to Ripponlea Station). Advocate to VicRoads to confine truck travel to select routes through the City, including an extension of the truck curfew on Beaconsfield Parade and Beach Street.
Engagement and partnership priorities	Lead collaboration with inner Melbourne councils to secure funding for the inner metro strategic cycling corridor network. Partner with inner city councils to advocate for a consistent wayfinding strategy for pedestrians and public transport users.
Strategies / plans. These are mapped to the direction they primarily contribute to. Some strategies, plans and policies will contribute to multiple directions.	Access Plan 2013-2018 Bike Plan: Pedal Power 2011-2020 Car Share Policy 2016-2021 Parking Permit Policy 2001 Public Transport Advocacy Statement 2009 Road Management Plan 2013 Safer Streets 2013-2020: The Road User Safety Strategy Sustainable Transport and Parking Rates Policy 2007 Sustainable Transport Precinct Plans Sustainable Transport Strategy: A Connected and Liveable City 2014 Walk Plan 2011-2020

Key projects that will be underway by 2027

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
Transport and parking management	Integrated Transport Strategy Development. This is a major initiative that will contribute to Transforming Transport and Parking. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*	$150,000	Deliver	Finish	n/a	n/a	n/a	n/a

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
	Beach Street Separated Queuing Lane Implementation. This is a major initiative that will contribute to Transforming Transport and Parking. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*	$519,000	Deliver	Finish	n/a	n/a	n/a	n/a
	Kerferd Road Safety Improvements *(subject to external funding)*. This is a major initiative that will contribute to Transforming Transport and Parking. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*	$1,950,000	Deliver	Start	Finish	n/a	n/a	n/a
	Kerferd Road Streetscape Upgrade *(subject to the safety improvements project proceeding, an approved business case and external funding)*. This is a major initiative that will contribute to Transforming Transport and Parking. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*	$2,200,000	Deliver	Start	Ongoing	Finish	n/a	n/a
	Wellington Street Upgrade – Intersection Redevelopment	$600,000	Deliver	n/a	Start & Finish	n/a	n/a	n/a
	Blackspot Safety Improvements *(subject to external funding)*	$2,106,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Parking Technology Renewal and Upgrade Program	$2,600,000	Deliver	Start	Ongoing	Ongoing	Ongoing	Ongoing
	Walk Plan and Bike Plan Implementation. This is a major initiative that will contribute to Transforming Transport and Parking. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*	$4,040,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
	St Kilda Junction Safety Upgrade	$500,000	Deliver	n/a	Start & Finish	n/a	n/a	n/a
	Street Signage and Furniture Renewal Program	$1,440,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Footpath Renewal Program	$3,050,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Kerb and Gutter Renewal Program	$3,535,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Laneway Renewal and Upgrade Programs	$1,970,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Public Space Accessibility Improvement Program	$1,400,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Road Renewal Program	$14,580,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Melbourne Metro Tunnel Project Support – Domain Station	$500,000	Partner	Start	n/a	n/a	n/a	n/a
	Safer Streets Infrastructure Improvement Program	$200,000	Deliver	Finish				

Services that contribute to this direction

Service category and description	Expenditure type	2017/18	2018/19	2019/20	2020/21
Transport and parking management – provide and maintain a safe transport network, develop transport and road safety strategy and policy, measure the impact of education programs, improve the range of travel modes, and manage parking policy, on-street parking controls and enforcement.	Operating expenditure Capital expenditure	$20,965,335 $9,725,000	$20,496,704 $12,875,000	$21,198,485 $9,870,000	$22,137,578 $8,870,000

Performance measures

Service	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
Transport and parking management	Resident satisfaction with transport planning policy, safety and design	-	91% (result is from November 2016)	>90%	>90%
	Resident satisfaction with parking management	77%	79%	80%	80%
	Resident satisfaction with resident parking permits	-	74% (result is from November 2016)	75%	75%
	Sealed local road requests. This measure is required under the Local Government Performance Reporting Framework.	59	52	<60	<60
	Satisfaction with sealed local roads	73	70	>70	>70
	Cost of sealed local road reconstruction. This measure is required under the Local Government Performance Reporting Framework.	$170.70	$156.51	<$160	<$164
	Cost of sealed local road resealing. This measure is required under the Local Government Performance Reporting Framework.	$40.27	$43.03	<$50	<$60
	Sealed local roads below the intervention level. This measure is required under the Local Government Performance Reporting Framework.	97%	97%	97%	97%

Service information

Service statistics	Result	Assets	Result
Parking infringement notices	158,000	Bike network (lanes and paths)	59km
Parking permits	31,000	Roads	265km
Requests for infringement reviews	17,000	Footpaths	414km
Infringements lodged with the Infringements Court	28,000	Parking machines	489

Major contracts	**Annualised value 2017/18**
Civil infrastructure and maintenance	$8.9m
Parking administration services	$2.0m
Parking machine maintenance	$975,000
Street lighting electricity	$639,000
Vehicle towing	$509,000

Total budget for 2017/18

$30.7 million

How is it spent?

Operating - $20,965,335

Capital - $9,725,000

How is it funded?

Rates - $22,932,177

Fees and charges including parking - $6,129,732

Other income - $1,628,426.

Strategic direction 3: We have smart solutions for a sustainable future.

What we want to see by 2027

3.1 A greener, cooler and more liveable City
3.2 A City with lower carbon emissions
3.3 A City that is adapting and resilient to climate change
3.4 A water sensitive City
3.5 A sustained reduction in waste

How we will measure progress

Outcome indicators	2014/15 result	2015/16 result	2017/18 target	2020/21 target	2026/27 target
Total canopy cover	Data unavailable	19%	20%	22%	29%
Council's greenhouse gas emissions	43% reduction (On 1996/97 emissions, which was 16,333 tonnes)	60% reduction	71% reduction	100% reduction	Zero net emissions
Council's potable water use (ML)	209	258	211.5	155	155

Outcome indicators	2014/15 result	2015/16 result	2017/18 target	2020/21 target	2026/27 target
Kerbside collection waste diverted from landfill. This measure is required under the Local Government Performance Reporting Framework.	35%	34%	35%	>35%	Target to be set through the Waste Management Plan
Municipal-wide greenhouse gas emissions	n/a	n/a	Baseline to be established by 2017/18	Target to be set once baseline known, through the Sustainability Strategy Beyond 2020	Target to be set once baseline known, through the Sustainability Strategy Beyond 2020

By 2027 we want to see:

3.1 A greener, cooler and more liveable City

We will work towards this outcome by:	Our priorities for the next four years:
A Increasing canopy cover and diversity of tree species across our streets and open spaces. B Facilitating the greening of our built environment, through green roofs, walls and facades.	• Promote green buildings by applying environmentally sustainable design planning policy and guidelines. • Develop a heat management plan to help cool the City and reduce the impact on health. • Implement and review progress on the Greening Port Phillip Plan – An Urban Forest Approach, including implementing the street tree planting program 2017-2022 and ongoing investment in park trees and streetscape improvements, including in Fishermans Bend. • Investigate opportunities to protect vegetation and increase canopy cover on private property. • Complete an Ecological Biodiversity Study, in partnership with the EcoCentre and local experts.

3.2 A City with lower carbon emissions

We will work towards this outcome by:	Our priorities for the next four years:
A Reducing Council energy consumption and greenhouse gas emissions. B Facilitating a reduction in community greenhouse gas emissions by partnering with the community and private sector. C Promoting sustainable and low energy precinct infrastructure, including in Fishermans Bend.	• Develop a sustainability strategy for beyond 2020, including considering United Nations sustainability goals and targets and baselining municipal-wide greenhouse gas emissions. • Invest in renewable energy and energy efficiency measures in Council buildings and in the Melbourne Renewable Energy Project, a group purchasing model to drive investment in renewable energy. • Develop and implement a Sustainable City Community Action Plan and deliver behaviour change and education programs for the community and business. • Contribute to the EcoCentre redevelopment and continue to invest in EcoCentre programs that support an environmentally aware community. • Develop guidelines that enable increased uptake of environmentally sustainable design features, including roof top solar, in heritage areas. • Examine the effectiveness of establishing a Port Phillip energy foundation, or partnering with an existing foundation, to undertake advocacy, research, advisory and community engagement initiatives. • Embed sustainability into Council’s procurement, fleet and investment policies and practices and investigate opportunities to install electric car charging stations.

3.3 A City that is adapting to climate change

We will work towards this outcome by:	Our priorities for the next four years:
A Increasing community resilience to the impacts of climate change. B Requiring development to adapt to and positively influence the local climate. C Managing and reducing the impacts of flooding and sea level rise.	• Develop tools to help the community understand and adapt to the impacts of climate change. • Work with partners to develop a bay-wide coastal hazard assessment and advocate for a planning scheme tool to identify and manage coastal inundation. • Work with partners to develop a long-term action plan for the Elster Creek catchment to mitigate flooding. • Develop and implement a framework to increase Council asset resilience to the impacts of climate change.

3.4 A water sensitive City

We will work towards this outcome by:	Our priorities for the next four years:
A Reducing potable water consumption by encouraging more efficient water use and establishing alternative water sources. B Improving the quality of water entering Port Phillip Bay and increasing ground permeability.	• Undertake integrated water management planning, including partnering with Melbourne Water and others to review and implement relevant plans. • Plan and deliver water sensitive urban design interventions to reduce contaminants in water entering Port Phillip Bay. • Investigate and implement *(subject to viability)* stormwater harvesting and flood mitigation works at key locations. • Implement irrigation upgrades at key sports fields and parks to optimise water use. • Increase the permeability of ground surfaces across public streets and spaces, and work with the community to achieve greater permeability on private property. • Collaborate with the Cooperative Research Centre for Water Sensitive Cities. • Develop a Stormwater Asset Management Plan and continue to invest in drainage improvements. • Develop a Stormwater Management Policy and Guidelines to require onsite stormwater detention for new developments.

3.5 A sustained reduction in waste

We will work towards this outcome by:	Our priorities for the next four years:
A Reducing waste and maximising recycling and diversion from landfill through service innovation and facilitating community action. B Managing waste collection to improve amenity and achieve cleaner streets, public spaces and foreshore areas.	• Develop and implement a new municipal Waste and Resource Recovery Strategy including an implementation plan to divert organic waste from landfill. • Increase investment in street cleaning, litter bins and equipment to improve amenity and responsiveness and investigate opportunities for further improvements to service delivery. • Work with the Metropolitan Waste and Resource Recovery Group to develop a business case to establish an inner metropolitan organic waste management service. • Pursue waste innovations in Fishermans Bend. • Update waste management guidelines for apartment developments and implement education programs.

This direction is supported by:

Instrument	Description
Advocacy priorities	Advocate for and promote reduced use of balloons, plastic bags and single use plastics. Advocate to the Victorian Government for sustainability targets in Fishermans Bend. Advocate for innovative sustainable infrastructure solutions for water reuse, energy and climate resilience, and partner to deliver advanced waste treatment and resource recovery.
Engagement and partnership priorities	Collaborate with the South East Councils Climate Change Alliance and the Council Alliance for Sustainable and Built Environment. Work with partners to improve catchment management. Work with the Association of Bayside Municipalities to coordinate, cooperate and advocate to ensure sustainable management and health of Port Phillip Bay. Work with inner Melbourne councils on an Urban Forest and Biodiversity Strategy for the inner region. Work with inner Melbourne councils on an innovative waste management strategy for the inner region. Work with Parks Victoria and City of Melbourne to determine the viability of stormwater harvesting at Albert Park Lake.
Strategies / plans. These are mapped to the direction they primarily contribute to. Some strategies, plans and policies will contribute to multiple directions.	Climate Adaptation Plan 2010 Foreshore and Hinterland Vegetation Management Plan 2015 Greenhouse Plan 2011 Greening Port Phillip, An Urban Forest Approach 2010 Graffiti Management Plan 2013-2018 Public Toilet Plan 2013-2023 Stormwater Management Plan 2010 Sustainable Design Strategy 2013 Sustainable Public Lighting Strategy for Streets and Open Space 2011-2016 Toward Zero Sustainable Environment Strategy 2007 Water Plan 2010 Water Sensitive Urban Design Guidelines 2009

Key projects that will be underway by 2027

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
Amenity	Stormwater Management Program. This is a major initiative that will contribute to Transforming Water Management. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*	$5,200,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Plant and Equipment (Depot) Renewal Program	$350,000	Deliver	n/a	Start	Ongoing	Ongoing	Ongoing
	Clean Streets Service Review	$100,000	Deliver		Start and Finish			
Sustainability	Water Sensitive Urban Design Program. This is a major initiative that will contribute to Transforming Water Management. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$1,800,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Albert Park Stormwater Harvesting Development (subject to confirming viability). This is a major initiative that will contribute to Transforming Water Management. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$4,250,000	Partner	Start	Ongoing	Ongoing	Finish	n/a
	Alma Park Stormwater Harvesting Development. This is a major initiative that will contribute to Transforming Water Management. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$1,150,000	Deliver	Start	Ongoing	Finish	n/a	n/a

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
	Baseline of Municipal Greenhouse Gas Emissions Development. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$150,000	Deliver	Start and Finish	n/a	n/a	n/a	n/a
	Sustainability Strategy Beyond 2020 Review. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$150,000	Deliver	Finish	n/a	n/a	n/a	n/a
	Sustainable City Community Action Plan Implementation	$300,000	Deliver	Start				
	South Melbourne Market Solar Installation	$690,000	Deliver	Start	Finish	n/a	n/a	n/a
	Energy Efficiency and Solar Program. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$1,960,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Street and Park Tree Improvements Program	$2,160,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	EcoCentre Redevelopment (subject to funding)	$3,300,000	Partner	Start	Ongoing	Ongoing	Finish	n/a
Waste reduction	Waste and Resource Recovery Strategy Development. This is a major initiative that will contribute to Transforming Waste Management. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*	$95,000	Deliver	Finish	n/a	n/a	n/a	n/a
	Litter Bin Renewal and Expansion Program	$1,630,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

Services that contribute to this direction

Service category and description	Expenditure type	2017/18	2018/19	2019/20	2020/21
Amenity – manage waste collection, clean streets, beaches, foreshore, roads, footpaths, medians, trade commercial areas, public toilets and barbecues, maintain Council buildings and assets, respond to graffiti complaints and remove graffiti.	Operating expenditure Capital expenditure	$16,442,776 $3,498,570	$17,120,072 $3,147,865	$17,616,894 $3,236,560	$18,124,202 $2,956,595
Sustainability – reduce Council and community impact on the environment and coordinate long-term approaches to climate adaptation through policy and tools to achieve environmental sustainability outcomes, behaviour change programs, community outreach, advice and support, partnership programs, advocacy, and by embedding sustainability into Council operations and projects.	Operating expenditure Capital expenditure	$3,418,275 $1,639,348	$3,212,476 $3,527,086	$3,105,246 $6,159,984	$3,204,267 $3,157,458
Waste reduction – reduce waste going to landfill through kerbside and public place recycling, hard waste and green waste collection, operating the Resource Recovery Centre, waste and environment education, and support for the EcoCentre.	Operating expenditure Capital expenditure	$3,897,818 $0	$3,860,448 $0	$3,928,261 $0	$4,015,606 $0

Performance measures

Service	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
Amenity	Resident satisfaction with street cleaning	89%	89%	>90%	>90%
	Street cleaning audit compliance	85%	95%	>95%	>95%
Sustainability	New trees planted per year	1,305	1,466	1,055	1,055
	Resident satisfaction with making Port Phillip more environmentally sustainable	91%	91%	>90%	>90%

Service	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
	Eligible applications that addressed sustainable design issues and received a planning permit	78%	78%	87%	100%
	Mega litres of water use from alternative sources	Data unavailable	1.68	15	138
	Total suspended solids removed from stormwater (tonnes)	Data unavailable	38.9	47.3	109.43
	Investments in fossil-free institutions	28%	49%	60-80%	60-80%
Waste	Council waste production	62.2 tonnes	53.4 tonnes	50 tonnes	10.64 tonnes
	Resident satisfaction with waste and recycling collections	95%	92%	90%	90%
	Kerbside bin collections missed. This measure is required under the Local Government Performance Reporting Framework.	5.6	2.7	<2.5	<2.5
	Direct cost of kerbside garbage bin collection service. This measure is required under the Local Government Performance Reporting Framework.	$75.10	$72.89	<$80	<$85
	Direct cost of kerbside recycling collection. This measure is required under the Local Government Performance Reporting Framework.	$32.00	$33.93	<$36	<$40
	Kerbside garbage requests (per 1,000 households). This measure is required under the Local Government Performance Reporting Framework.	48.64	33.57	<35	<35

Service information

Service statistics	Result	Assets	Result
Number of time recycling bins are emptied	1.8 million	Drain pipes	11,900 km
People participating in Council-run sustainability programs	7,500	Drainage pits	10,400
Number of time waste bins are emptied	2 million	Street and park litter bins	1,212
Hard waste and green waste collections	15,600	Street trees	31,042
Customer request responses	6,720	Park trees	12,852

Financial contributions	**Value 2017/18**	**Major contracts**	**Annualised value 2017/18**
EcoCentre contribution and funding for education programs	$200,000	Regional landfill	$1.7m
		Residential kerbside waste collection	$1.5m
		Residential kerbside recycling collection	$1.5m
		Hard waste and dumped rubbish collection	$1.5m
		Drainage maintenance	$966,000
		Mobile waste and recycling bins	$179,000

Total budget for 2017/18

$28.9 million

How is it spent?

Operating - $23,758,869

Capital - $5,137,918

How is it funded?

Rates - $22,492,539$

Fees and charges including parking - $4,732,108

Other income - $1,672,139

Strategic direction 4: We are growing and keeping our character.

What we want to see by 2027

4.1 Liveability in a high density City

4.2 A City of diverse and distinctive neighbourhoods and places

How we will measure progress

Outcome indicators	2014/15 result	2015/16 result	2017/18 target	2020/21 target	2027 target
Residents who feel a sense of safety and security in Port Phillip	85%	85%	85%	>87%	>90%
Residents who are proud of, connected to and enjoy living in their neighbourhood	97%	96%	95%	>95%	>95%
Residents who agree the local area is vibrant, accessible and engaging	97%	96%	95%	>95%	>95%
Planning decisions upheld by VCAT. This measure is required under the Local Government Performance Reporting Framework.	71%	71%	>70%	>70%	>70%

By 2027 we want to see:

4.1 Liveability in a high density City

We will work towards this outcome by:	Our priorities for the next four years:
A Requiring well-designed buildings that contribute to safe, lively, high amenity places. B Designing, activating and managing public spaces that are safe and inviting places for people to enjoy. C Extending, connecting and diversifying our open space network to cater for increased demand.	• Partner with the Victorian Government to ensure the Fishermans Bend Framework and precinct plans maximise outcomes for current and future Port Phillip residents, including employment, housing choice, quality public space and community facilities, and early delivery of fast, frequent public transport. • Deliver open space and streetscape works in Fishermans Bend, particularly in the Montague Precinct and at the Ferrars Street Education and Community Precinct. • Work with the Victorian Government to effectively manage soil contamination and management on open space sites, including at Gasworks Arts Park. • Review and update the Port Phillip Planning Scheme and Municipal Strategic Statement to ensure an effective framework of local policy and controls to manage growth and support healthy communities. • Implement planning scheme amendments to strengthen design and development controls in areas undergoing significant change. • Develop a new public space strategy. • Review Council’s design and technical standards for streets and public spaces. • Deliver the Design and Development Awards, to showcase and promote design excellence in Port Phillip. • Invest in improving parks, playgrounds and street and public space lighting. • Continue to improve community safety by evaluating CCTV, undertaking community safety audits and implementing crime prevention through environmental design guidelines. • Continue to maintain a high standard of amenity, ensure compliance with planning requirements and local laws, and support public health and safety through service improvements and mobile technology. • Review Council’s local law to manage and improve community amenity. • Review Council’s Domestic Animal Management Plan, which promotes animal welfare and responsible pet ownership.

4.2 A City of diverse and distinctive neighbourhoods and places

We will work towards this outcome by:	Our priorities for the next four years:
A Planning for *10 minute walking neighbourhoods* that give locals access to shops, community spaces and a strong sense of place. B Protecting heritage places that represent our historic, social, cultural and architectural identity. C Ensuring new development integrates with, respects and contributes to the unique heritage, character and beauty of our neighbourhoods. D Enhancing the environmental and recreational qualities of the foreshore.	• Effectively manage the St Kilda Marina lease process, including developing design guidelines through stakeholder and community engagement. • Advocate for and partner to develop a vision and plan for St Kilda Junction. • Develop an urban design framework for the St Kilda Road North - Domain Station precinct and surrounds. • Continued delivery of place-based planning and coordinated development and advocacy using a precinct management approach in Balaclava, Domain, Port Melbourne Waterfront and Fitzroy Street, St Kilda. • Develop design guidelines for key foreshore destinations including the St Kilda Triangle and Port Melbourne Waterfront. • Implement a program to strengthen heritage controls including assessing sites of cultural and social significance and implementing the review of Heritage Overlay 6 (East St Kilda) through the planning scheme. • Review the Housing Strategy to ensure new residential development is well located and respects the character and heritage of established neighbourhoods. • Review the Heritage Policy in the Planning Scheme to improve guidance on retention and adaptive reuse of the City's heritage fabric. • Reflect and interpret the City's history by installing plaques, memorials and monuments. • Upgrade the foreshore including vegetation projects and maritime infrastructure renewals.

This direction is supported by:

Instrument	Description
Advocacy priorities	Advocate to the Victorian Government for: • measures to mitigate the amenity impact of Melbourne Metro construction, including minimising the loss of trees • early delivery of high frequency public transport links to Fishermans Bend • a sustainable funding and financing strategy to fund the timely delivery of local infrastructure at Fisherman Bend

Instrument	Description
	• community consultation for a replacement recreational structure that meets safety obligations, to recognise the cultural and heritage significance of Brookes Jetty • the redevelopment of St Kilda Pier.
Engagement and partnership priorities	Engage with our communities and advocate for positive planning outcomes for Fishermans Bend, including walkability. Work with Parks Victoria on key projects, including use of Port Phillip Bay and Albert Park.
Strategies / plans. These are mapped to the direction they primarily contribute to. Some strategies, plans and policies will contribute to multiple directions.	Activating Laneways Strategy 2011 City of Port Phillip Housing Strategy 2007-2017 City of Port Phillip Activity Centre Strategy 2006 Domestic Animal Management Plan 2012-2016 Fishermans Bend Planning and Economic Development Strategy Foreshore Management Plan 2012 Inner Melbourne Action Plan 2015-2025 Management plans for: Catani Gardens and Southern Foreshore, Elwood Foreshore and Recreation reserves, JL Murphy Reserve, and Marina Reserve Masterplans for: Albert Park College Precinct, Balaclava Station, Emerald Hill Precinct, St Kilda Triangle Monuments and Memorials Guidelines Municipal Emergency Management Plan Open Space Strategy and Implementation Plan Framework 2009 Open Space Water Management Plan 2010 Playspace Strategy 2011 Port Melbourne Waterfront Activation Plan Port Phillip Heritage Review 2000 (Version 18) Port Phillip Local Law No.1 (Community Amenity) 2013 Port Phillip Planning Scheme

Instrument	Description
	Precinct structure plans and urban design frameworks for: activity centres (Bay Street, Carlisle Street, South Melbourne Central and Ormond Road Elwood) and growth precincts (Montague Precinct, St Kilda Road South, St Kilda Road North, St Kilda Foreshore and Port Melbourne Waterfront)
	Port Phillip City Collection Policy 2017
	Soil Contamination Management Policy
	St Kilda Botanical Gardens Future Directions Plan 2009

Key projects that will be underway by 2027

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
City planning and urban design	Fishermans Bend Managing Growth Program. This is a major initiative that will contribute to Transforming Fishermans Bend. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*	$365,000	Partner	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Planning Scheme Amendments Program	$1,000,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Precinct management: Domain, Balaclava, Port Melbourne Waterfront and Fitzroy Street.	$1,327,500	Deliver	Ongoing	Ongoing	Finish	n/a	n/a
Development approvals and compliance	Statutory Planning Service Review	$100,000	Deliver	Finish				
Public space	Public Spaces Strategy Development. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$120,000	Deliver	Start	Ongoing	Finish	n/a	n/a
	Ferrars Street Education and Community Precinct – Construction of Montague Park. This is a major initiative that will contribute to Transforming	$8,290,000	Deliver	Start	Ongoing	Ongoing	Finish	n/a

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
	Fishermans Bend. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*							
	Ferrars Street Education and Community Precinct – Streetscape Upgrade. This is a major initiative that will contribute to Transforming Fishermans Bend. Major initiatives will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989.*	$3,768,000	Partner	Ongoing	Finish	n/a	n/a	n/a
	Gasworks Arts Park Contamination Management Plan and Reinstatement. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$4,660,000	Partner	Start	Ongoing	Ongoing	Finish	n/a
	St Kilda Marina New Lease. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$200,000	Deliver	Start	Finish	n/a	n/a	n/a
	Foreshore Assets Renewal and Upgrade Program	$1,485,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Maritime Infrastructure Renewal Program	$3,300,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Parks and Playground Renewal and Upgrade Program	$3,960,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Parks Furniture and Pathway Renewal Program	$1,400,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Public Space Lighting Renewal and Upgrade Program	$2,200,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Public Space Lighting Expansion Program	$600,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

Services that contribute to this direction

Service category and description	Expenditure type	2017/18	2018/19	2019/20	2020/21
City planning and urban design - direct and manage changes in land use, the built environment and the public realm to maximise community benefit through place-based urban strategy and projects, land-use policies, reviewing and amending the Port Phillip Planning Scheme and Municipal Strategic Statement, precinct management to coordinate development in key areas, working to enhance the public realm and protect buildings of architectural, cultural or historical interest through urban design and heritage advice, and contributing to state planning policy and regulation.	Operating expenditure Capital expenditure	$5,442,216 $288,088	$4,771,463 $60,516	$4,758,152 $59,904	$4,825,665 $44,748
Development approvals and compliance - regulate how land is developed, used and occupied safely by providing advice and education, processing planning applications and supporting community participation in the planning process, issuing and enforcing permits for activity in and around building sites, investigating and enforcing land use and development issues, protecting our assets, roads and footpaths, carrying out building and site inspections and assessments.	Operating expenditure Capital expenditure	$8,552,518 $0	$8,749,977 $0	$9,057,908 $0	$9,459,173 $0
Health services - support public health by monitoring registered food premises, accommodation properties, registered hairdressers, tattooists, beauty parlours, and water quality in public swimming pools and spas, providing for immunisation and syringe disposal, and investigating public health nuisance complaints.	Operating expenditure Capital expenditure	$1,885,914 $0	$1,952,155 $0	$2,020,7250 $0	$2,110,243 $0
Local laws and animal management – ensure community safety by enforcing local laws (use, occupation and behaviour on Council land, commercial activities, illegal advertising, dumped rubbish and illegal camping), monitoring building site activity and protecting Council assets, responding to complaints about breaches of the Domestic Animals Act 1995, and encouraging responsible pet ownership through education and registration.	Operating expenditure Capital expenditure	$2,200,728 $0	$2,278,032 $0	$2,358,052 $0	$2,462,513 $0
Municipal emergency management – ensure our community is safe in the event of an emergency, and supported to recover from such events.	Operating expenditure	$550,506 $0	$569,598 $0	$589,353 $0	$615,461 $0

Service category and description	Expenditure type	2017/18	2018/19	2019/20	2020/21
	Capital expenditure				
Public space – improve our network of accessible parks and open spaces including foreshore, playgrounds, gardens, reserves, sports fields and streetscapes by planning and delivering improvements, ongoing maintenance and management, and activation through permitted recreation, cultural and community activities and events.	Operating expenditure Capital expenditure	$16,496,022 $8,961,740	$16,993,308 $4,460,430	$17,428,840 $7,424,920	$17,885,055 $11,182,290
Note: These services ensure we deliver on our responsibilities under the Planning and Environment Act 1978, Building Act 2006, Domestic Animals Act 1995, Emergency Management Act 1986, State Food Act 1984, Public Health and Wellbeing Act 2008, Tobacco Act 1987 and Council's local law.					

Performance measures

Service	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
Development approvals and compliance	Days taken to decide planning applications. This measure is required under the Local Government Performance Reporting Framework.	67	75	<75	<75
	Planning applications decided within 60 days. This measure is required under the Local Government Performance Reporting Framework.	63%	58%	>60%	>60%
	Cost of statutory planning service. This measure is required under the Local Government Performance Reporting Framework.	$1,367	$1,725	<$2,200	<$2,500
	Resident satisfaction with Council's planning services	77%	79%	>80%	>80%
Health services	Children fully vaccinated in municipality	95%	98%	99%	99%
	All critical and most major non-compliance notifications about food premises followed up on the due date. This measure is required under the Local Government Performance Reporting Framework.	96%	99%	95%	95%

Service	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
	Days between receipt and first response actions for all food complaints. This measure is required under the Local Government Performance Reporting Framework.	1.8	1.8	<2 days	<2 days
	Food premises receiving annual assessment or audit. This measure is required under the Local Government Performance Reporting Framework.		100%	100%	100%
	Cost of food safety service	$690	$548	<$562	<$603
Local laws and animal management	Animal management prosecutions. This measure is required under the Local Government Performance Reporting Framework.	4	5	<10	<10
	Days between receipt and first response actions for all animal management requests. This measure is required under the Local Government Performance Reporting Framework.	1	1	<2	<2
	Animals reclaimed. This measure is required under the Local Government Performance Reporting Framework.	55%	59%	>55%	>55%
	Cost of animal management service. This measure is required under the Local Government Performance Reporting Framework.	$74.30	$75.10	<$76	<$80
Public space	Resident satisfaction with parks and open space	96%	94%	>90%	>90%
	Resident satisfaction with beach cleaning	94%	92%	>90%	>90%
	Contract delivered to standard for parks and open space	99%	95%	95%	95%
	Public space community requests resolved on time	76%	86%	85%	90%

Service information

Service statistics	Result	Assets	Result
New planning permit applications processed	1,550+	Historical and heritage sites	31
Building permits, and report and consent applications processed	500	Playgrounds and sports fields	75
Proactive inspections to improve planning compliance	200	Immunisation centres	6
Permits issued for footpath trading, construction related street occupation and skip bins	6,000	Reserves and gardens	176 ha
Attendances at VCAT to advocate for Council policies and decisions	100		
Playground inspections	3,692		
Events permitted	350		
M^2 of beach cleaned (weekly)	238,000		
Customer requests responded to	4,300		
Animal management requests	1,350		
Pet registrations	8,300		
Square metres of graffiti removed	23,000		
Premise and property inspections	2,100		
Vaccinated school children	2,000		
Public health nuisance investigations	400		

Financial contributions	Value	Major contracts	Annualised value 2017/18
Inner Melbourne Action Plan	$95,000	Parks and open space maintenance	$4.6m
Contribution to State Emergency Services *(part-funded by the State government)*	$32,000	Tree maintenance	$4.0m
		Cleaning public facilities	$1.8m
		Street furniture	$651,000
		Natural heritage area maintenance	$252,000

Total budget for 2017/18

$44.4 million

How is it spent?

Operating - $35,127,903

Capital - $9,249,828

How is it funded?

Rates - $21,882,756

Fees and charges including parking - $15,206,128

Other income - $7,288,848 including $7.8 million of open space contributions.

Strategic direction 5: We thrive by harnessing creativity.

What we want to see by 2027

5.1 A City of dynamic and distinctive retail precincts

5.2 A prosperous City that connects and grows business

5.3 A City where arts, culture and creative expression is part of everyday life

How we will measure progress

Outcome indicators	2014/15 result	2015/16 result	2017/18 target	2020/21 target	2027 target
People employed in the Top 5 industries as a proportion of total employment in the municipality	54%	No score	>54%	56%	60%
Visitors to the City of Port Phillip excluding visitors from within 50 km and people attending festivals	1.6 million	1.7 million	1.8 million	1.9 million	2.4 million
Residents who agree they have the opportunity to participate in affordable local community events and activities	92%	90%	92%	95%	>95%
Residents who agree Port Phillip has a culture of creativity	95%	90%	95%	>95%	>95%

By 2027 we want to see:

5.1 A City of dynamic and distinctive retail precincts

We will work towards this outcome by:	Our priorities for the next four years:
A Enhancing the prosperity of our shopping precincts and the South Melbourne Market by working with traders and land owners to build on the unique character, vitality and retail offer of each precinct. B Collaborating to ensure our entertainment and local economies	• Adopt a place-based precinct management approach to coordinate development, activation and advocacy. • Pursue improvements to the Carlisle Street retail precinct, including planning for redevelopment of the supermarket precinct to enhance the retail offer and surrounding street spaces. • Develop a strategic plan for the St Kilda precinct, including a strategy to revitalise Fitzroy Street. • Review footpath trading policies to promote street activity and accessibility.

We will work towards this outcome by:	Our priorities for the next four years:
thrive, while ensuring safe, enjoyable places for everyone.	• Continue to collect special rates to support traders and fund the promotion, marketing and development of retail precincts. • Develop a strategic business case for the South Melbourne Market to shape the future direction and investment, and plan for and deliver renewal works. • Work with inner Melbourne councils to develop approaches to better manage licenced premises and entertainment precincts.

5.2 A prosperous City that connects and grows business

We will work towards this outcome by:	Our priorities for the next four years:
A Fostering the knowledge economy and creative industry clusters. B Facilitating innovation and investment that enables businesses to start-up, connect and grow. C Partnering to promote Port Phillip as a visitor destination in a way that respects local amenity.	• Develop a Creative and Prosperous City Strategy that features all elements of our City’s economy. • Facilitate networking events, training and development programs for local businesses. • Deliver a Business Awards program to recognise and promote exemplary local businesses. • Ongoing support for local industry associations, including visitor and volunteer groups like the Port Melbourne Waterfront Welcomers. • Work with inner Melbourne councils on strategies to protect, promote and grow inner Melbourne’s creative and knowledge economy and boost local employment.

5.3 A City where arts, culture and creative expression are part of everyday life

We will work towards this outcome by:	Our priorities for the next four years:
A Promoting and celebrating community creativity and participation in art, music, culture, heritage and festivals. B Activating our public spaces and streets through local cultural events and urban art. C Transforming our library services and spaces to support inclusive, creative opportunities and learning outcomes.	• Invest in our key arts and culture venues, including continuing to fund the operation of Gasworks Arts Park and Linden Gallery. • Implement the Events Strategy through event attraction and communications. • Support early stage entrepreneurs in the creative industries by reinventing a library space and working with partners to identify and unlock creative spaces. • Deliver improvements to library branches and the library collection, including planning for redeveloping the St Kilda Library. • Improve and expand the City collection by acquiring artworks.

We will work towards this outcome by:	Our priorities for the next four years:
	• Deliver and facilitate a program of festivals that celebrate local culture and talent. • Provide grants, funding and spaces for arts and cultural organisations and service providers to ensure access for everyone to relevant services and programs.

This direction is supported by:

Instrument	Description
Advocacy priorities	Advocate for Victorian Government funding to support City of Port Phillip festivals. Advocate to Creative Victoria to resource and support the reinvention of libraries to help increase the impact of creative industries at a local level.
Engagement and partnership priorities	Working with creative practitioners to create opportunities for industry experience, collaboration and innovation.
Strategies / plans. These are mapped to the direction they primarily contribute to. Some strategies, plans and policies will contribute to multiple directions.	Aboriginal and Torres Islander Arts Strategy 2014-2017 Arts and Culture Policy 2011 Community Grants Subsidies and Donations Policy 2014-2017 Events Strategy 2015-2017 Outdoor Events Policy 2014 Port Phillip City Collection Policy 2017 South Melbourne Market Strategic Plan 2015-2020 St Kilda Esplanade Market Strategic Plan 2016-2020 St Kilda Festival Strategy and Multi-Year Operational Plan 2016-2018

Key projects that will be underway by 2027

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
Arts, culture and heritage	Creative and Prosperous City Strategy Development. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$50,000	Deliver	Finish	n/a	n/a	n/a	n/a
	Linden Gallery Upgrade. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$1,675,000	Deliver	Finish	n/a	n/a	n/a	n/a
Libraries	Balaclava Precinct Program – St Kilda Library Redevelopment Strategy	No funding allocated in the next four years	Deliver	n/a	n/a	n/a	n/a	Start
	Library Purchases	$3,140,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Markets	South Melbourne Market Building Compliance	$2,175,000	Deliver	Ongoing	Ongoing	Ongoing	End	n/a
	South Melbourne Market Renewal Program	$800,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

Services that contribute to this direction

Service category and description	Expenditure type	2017/18	2018/19	2019/20	2020/21
Arts, culture and heritage - promote community participation and engagement in arts, culture and heritage and foster development of the City's creative people and culture through programs, services, spaces and funding for artists and arts organisations.	Operating expenditure Capital expenditure	$2,894,584 $2,693,088	$2,942,370 $980,516	$3,044,537 $89,904	$3,178,701 $74,748

Service category and description	Expenditure type	2017/18	2018/19	2019/20	2020/21
Economic development and tourism - support our business community to be successful by developing economic strategies, supporting economic activity centres and villages, collaborating with businesses and associations, facilitating training and development for business owners, facilitating special rate schemes for trader groups and attracting investment in growth sectors and urban renewal areas.	Operating expenditure Capital expenditure	$1,763,860 $0	$1,965,344 $0	$1,774,624 $0	$1,650,646 $0
Festivals - deliver accessible and inclusive festivals that celebrate creativity, provide opportunities for artists, traders and business, and meet the needs and aspirations of the community.	Operating expenditure Capital expenditure	$4,568,271 $0	$4,528,754 $0	$4,685,482 $0	$4,893,049 $0
Libraries - provide branch-based, online and in-home library and information services, including access to technology, flexible, safe and welcoming community spaces, literacy and life-long learning programs and events.	Operating expenditure Capital expenditure	$5,096,544 $785,000	$5,227,516 $785,000	$5,561,763 $785,000	$5,801,504 $785,000
Markets – operate and promote the South Melbourne and St Kilda Esplanade markets, and support and permit local markets (for example, Gasworks, Veg Out, Hank Marvin).	Operating expenditure Capital expenditure	$5,419,112 $1,000,000	$5,481,456 $825,000	$5,670,079 $825,000	$5,921,169 $825,000

Performance measures

Outcome	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
Arts, culture and heritage / Festivals	Resident satisfaction with delivering arts and festivals	95%	97%	90%	90%

Outcome	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
Economic development and tourism	Residents who agree their local area has a good range of business services and local conveniences	94%	94%	90%	90%
	Resident satisfaction with visitor management	n/a	92% (result is from November 2016)	>90%	>90%
Libraries	Active library members in the community. This measure is required under the Local Government Performance Reporting Framework.	20%	19.4%	20%	21%
	Number of collection items purchased in the last five years (standard of library collection). This measure is required under the Local Government Performance Reporting Framework.	46%	47%	48%	50%
	Cost per capita of library service. This measure is required under the Local Government Performance Reporting Framework.	$5.76	$6.13	<$7	<$8
	Visits to library per capita	6.5	6.5	6.5	7.0
	Rate of turnover for physical items (loans per item). This measure is required under the Local Government Performance Reporting Framework.	4.8	4.8	5	5.5
Markets	Residents who agree South Melbourne Market is a significant benefit to residents	98%	99%	90%	90%

Service information

Service statistics	Result	Assets	Result
Visitors to council-owned arts facilities	115,000	Library branches	5
Grants to arts and culture projects and events	34	Library books	206,749

Service statistics	Result
Visitors to South Melbourne Market	4.7 million
Attendees at the St Kilda Festival	440,000
Attendees at the St Kilda Film Festival	13,000
Attendees at Indigenous arts program events	12,000
Attendees at Yalukit Wilum Ngargee	8,000
Attendees at Live N Local	10,000
Number of active businesses	18,000
Number of local jobs	86,000
Registered ABNs in Port Phillip	60,000
Library visits	670,000
Online sessions at libraries	250,000
Loans from the library collection	1.0 million
Public programs hosted at libraries	445
Public internet access bookings	90,000
Number of participants at major events	225,500

Assets	Result
Value of Council-owned art works	$16.8 million
Arts facilities	4
Value of South Melbourne Market	$20.2 million

Financial contributions	Value 2017/18	Major contracts	Annualised value 2017/18
Gasworks Arts Park management and programming	$560,000	St Kilda Festival	$1.7m
St Kilda Film Festival	$307,000	South Melbourne Market cleaning	$980,000
Linden Gallery management and programming	$257,000		
Cultural Development Fund (grants)	$137,000		
Local Festivals Fund (grants)	$135,000		
Indigenous Arts	$111,000		
Live N Local	$93,000		
Pride March	$50,000		
Emerald Hill Cultural Precinct Program *(2017/18 only)*	$40,000		
Red Stitch Actors Theatre *(2017/18 only)*	$30,000		
Theatre Works *(2017/18 only)*	$30,000		

Major leases on council assets		Market rental (Estimate determined by valuation report)	Rent per year (excluding GST)
ANAM	South Melbourne Town Hall *(proposed)*	$450,000	$1,000. (In addition, ANAM contributes $120,000 per annum as a capital contribution to renewing the building)
Gasworks Arts Inc	Gasworks Arts Park	$566,000	$104

Major leases on council assets		Market rental (Estimate determined by valuation report)	Rent per year (excluding GST)
Linden New Art	26 Acland Street, St Kilda	$220,000	$104

Total budget for 2017/18

$24.2 million

How is it spent?

Operating - $19,742,371

Capital - $4,478,088

How is it funded?

Rates - $11,037,112

Fees and charges including parking - $5,171,343

Other income - $8,012,004 including $5.6 million of markets rental and hire income.

Strategic direction 6: Our commitment to you.

What we want to see by 2027

6.1 A financially sustainable, high performing, well governed organisation that puts the community first

How we will measure progress

Outcome indicators	2014/15 result	2015/16 result	2017/18 target	2020/21 target	2027 target
Satisfaction with community consultation and engagement (index). This measure is	61	62	>60	>65	>70

Outcome indicators	2014/15 result	2015/16 result	2017/18 target	2020/21 target	2027 target
required under the Local Government Performance Reporting Framework.					
Proportion of residents who have participated in community engagement activities. This measure is required under the Local Government Performance Reporting Framework. This is a new measure. Baseline will be set in 2017/18.	No data	No data	Baseline to be set	Baseline to be set	Baseline to be set
Satisfaction with the overall performance of Council (index)	68	64	>65	>70	>70
Overall financial sustainability risk rating (as measured against the VAGO Financial Sustainability Risk Framework)	Low	Low	Low	Low	Low
Efficiency savings as a percentage of operating expense (excluding depreciation)	1.2%	1.8%	1%	1.5%	1.5%

By 2027 we want to see:

6.1 A financially sustainable, high performing, well-governed organisation that puts the community first

We will work towards this outcome by:	Our priorities for the next four years:
A Improving customer experience and technology and being more innovative. B Improving community engagement, advocacy, transparency and governance. C Inspiring leadership, a capable workforce and culture of high performance and safety.	• Develop and implement a Customer Experience Improvement Plan and Information and Communications Technology Strategy. • Be the partner of choice for other councils and organisations to work with, to enable improved customer experience, productivity and innovation. • Be catalysts for greater community action, including by opening up more of our data to the public

We will work towards this outcome by:	Our priorities for the next four years:
D Ensuring sustainable financial and asset management and effective project delivery.	• Develop and implement a Community Engagement Policy and a plan for deeper community participation in Council planning and budgeting activities. • Develop and implement an advocacy strategy to advance Council and community priorities. • Improve our enterprise planning, performance, risk and compliance frameworks. • Deliver the Council Election 2020. • Improve record-keeping, including digitising historical records. • Upgrade the organisation's financial and asset management systems, processes and practices. • Invest in improving the condition, functionality, capacity and sustainability of council assets. • Continue to build organisational capability and maturity in project management. • Review our rating strategy, property policy and investment policy. • Review the organisation's People and Culture Strategy and develop a workforce plan. • Improve the organisation's health and safety practices.

This direction is supported by:

Instrument	Description
Advocacy priorities	Advocate to the Victorian Government for access to Fishermans Bend development contributions to support delivery of community infrastructure.
Engagement and partnership priorities	Work with the Municipal Association of Victoria (MAV) to advocate for a cost-shift index to be applied to the Victorian Government cap on rates increases. Work with other councils, the MAV, and organisations on opportunities to drive efficiency and service improvements through collaborative procurement, process and system improvement, and where relevant, service delivery.
Strategies / plans. These are mapped to the direction they primarily contribute	Asset management plans *(under review)* Asset Management Policy 2017 and Strategy *(under development)* City of Port Phillip Security Camera Footage Policy 2012

Instrument	Description
to. Some strategies, plans and policies will contribute to multiple directions.	Civic Recognition and Support Strategy Councillor Code of Conduct (including Councillor Support and Expense Reimbursement Policy 2016) Employee Code of Conduct Property Policy 2009 Risk Management Policy 2017

Key projects that will be underway by 2027

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
Asset management	South Melbourne Town Hall Lifts Upgrade	$1,400,000	Deliver	Start	Finish	n/a	n/a	n/a
	Building Renewal and Upgrade Program. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.	$11,630,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Building Safety and Accessibility Program	$6,810,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Staff Accommodation Plan Development	$200,000	Deliver	Finish	n/a	n/a	n/a	n/a
	Council Fleet Renewal Program	$5,646,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Governance and engagement	Integrated Council Plan and Budget Community Engagement	$845,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Technology, transformation and customer experience	Business Enablement and Innovation Fund	$800,000	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
	Improvement in Technology and Customer Experience. Includes Core Application Renewal and Upgrade Program and Core Business Technology Infrastructure Renewal and Upgrade	$15,092,000 million	Deliver	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

Service	Project	Cost (4-year projection)	Council's role	2017/18	2018/19	2019/20	2020/21	2021-27
	Program. This is a major initiative that will be reported on in Council's Annual Report, pursuant to section 131 of the *Local Government Act 1989*.							
	Online Communications Improvement Program	$621,000	Deliver	n/a	Start	Finish	n/a	n/a

Services that contribute to this direction

Service category and description	Expenditure type	2017/18	2018/19	2019/20	2020/21
Asset management – ensure effective management of our assets and property.	Operating expenditure Capital expenditure	$4,579,287 $3,502,696	$4,533,126 $4,570,172	$4,692,372 $5,069,968	$5,050,244 $7,714,916
Finance and project management – maintain financial sustainability by ensuring effective management and control of our financial resources and ensuring Council's projects deliver best value.	Operating expenditure Capital expenditure	$8,278,721 $49,726	$8,503,227 $79,007	$8,808,343 $78,208	$9,193,454 $58,421
Governance and engagement – enable good governance by supporting Councillors to make well-informed decisions, managing freedom of information, maintaining records, ensuring robust planning, reporting and risk management, and facilitating inclusive engagement with our community to support decision making.	Operating expenditure Capital expenditure	$9,521,737 $25,392	$9,721,154 $383,844	$10,056,956 $317,436	$10,740,835 $154,832
People, culture and capability – ensure our employees are supported to deliver our services, have access to development opportunities, and work in a safe and healthy environment.	Operating expenditure Capital expenditure	$3,933,402 $12,696	$3,643,302 $20,172	$3,770,494 $19,968	$3,937,527 $14,916

Service category and description	Expenditure type	2017/18	2018/19	2019/20	2020/21
Technology, transformation and customer experience – enable efficient and effective service delivery to our community through best practice information and communication technologies, clever information management, continuous improvement of the community's experience of Council, and ensuring our community are informed about available services and their queries and requests are responded to.	Operating expenditure Capital expenditure	$3,112,090 $4,354,392	$3,212,658 $3,640,344	$3,516,702 $3,639,936	$3,454,772 $3,629,832
Note: These services ensures Council delivers on its requirements under the Local Government Act 1989, the Local Government Performance Reporting Framework, and employment and occupational health and safety regulations.					

Performance measures

Outcome	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
Asset management	Asset management maturity	883	883	>1,000	Under development
	Asset renewal as a percentage of depreciation. This measure is required under the Local Government Performance Reporting Framework. Council uses VAGO asset renewal / upgrade to depreciation as a key measure of financial sustainability.	73%	72%	78%	84%
Finance and project management	Average residential rate per residential property assessment. This measure is required under the Local Government Performance Reporting Framework.	$1,359	$1,434	$1,513	$1,625
	Expenditure per property assessment. This measure is required under the Local Government Performance Reporting Framework.	$2,623	$2,620	$2,952	$2,840
	Working capital. This measure is required under the Local Government Performance Reporting Framework.	221%	243%	202%	194%

Outcome	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
	Unrestricted cash. This measure is required under the Local Government Performance Reporting Framework.	94.9%	104%	95%	103%
	Loans and borrowing compared to rate revenue. This measure is required under the Local Government Performance Reporting Framework.	8.5%	8.0%	7.4%	6.5%
	Adjusted underlying result. This measure is required under the Local Government Performance Reporting Framework.	(0.6)%	1.0%	(9.3)%	4.5%
	Rates concentration. This measure is required under the Local Government Performance Reporting Framework.	60.2%	61.3%	60.2%	60.3%
	Rates revenue compared to property values. This measure is required under the Local Government Performance Reporting Framework.	0.22%	0.23%	0.19%	0.19%
	Rates collection rate	98%	98%	98%	98%
	Return on financial investments	2.86%	2.88%	2.28%	50 basis points above the 90 day BBSW swap rate
	Percentage of priority projects on track	77%	68%	80%	80%
	Project management maturity score	16.8	18.1	>21	>21
Governance and engagement	Council decisions closed to public. This measure is required under the Local Government Performance Reporting Framework.	2%	7%	<10%	<10%
	Councillor attendance rate at Council meetings. This measure is required under the Local Government Performance Reporting Framework.	92%	92%	>90%	>90%

Outcome	Measure	Result 2014/15	Result 2015/16	Target 2017/18	Target 2020/21
	Direct cost of delivering Council's governance service per Councillor. This measure is required under the Local Government Performance Reporting Framework.	$55,333	$59,459	<$60,000	<$65,000
	Material legislative breaches	4	9	0	0
	Audit actions completed on time	73%	93%	>90%	>90%
	Community satisfaction with advocacy (index)	59	59	60	62
	Community satisfaction with Council decisions (index)	60	59	60	62
People, culture and capability	Staff engagement score	71%	74%	>74%	>74%
	Staff alignment score	52%	59%	>59%	>59%
	Staff turnover. This measure is required under the Local Government Performance Reporting Framework.	10%	10.4%	10%	10%
	Total recordable injury frequency rate per million work hours	22.2	19.4	14.5	9.5
Technology, transformation and customer experience	Community time saved (days)	3,685	19,054	10,000	12,000
	Staff time saved (hours)	1,242	3,401	5,000	3,000
	Operating efficiencies	$2 million	$3 million	$2 million	$2.6 million
	Community satisfaction with customer service (index)	73	71	>70	>70
	Calls answered within 30 seconds	75%	78%	>80%	>80%
	Requests resolved within agreed timeframe	89%	91%	>90%	>90%
	Percentage of residents that agree the website is easy to use and navigate through the sections you want	92%	87%	90%	90%

Service information

Service statistics	Result	Assets	Result
Customers interactions	206,802	Council corporate fleet cars	123
Twitter followers (total)	5,450	Computers	826
Rates invoices	175,000	Mobile phones	614
Leases and licences managed (total)	170		
Building maintenance requests processed	5,100+		
Rateable residential properties (total)	61,952		
Rateable commercial / industrial properties (total)	7,877		

Financial contributions	**Value**	**Major contracts**	**Annualised value 2017/18**
Councillor committee donations and neighbourhood contributions	$35,000	Insurance services *Note: actual expenditure is allocated to relevant services*	$1.2m
		Recruitment services	$875,000
		Electricity	$806,000
		Valuation services	$709,000
		Security services *Note: actual expenditure is allocated to relevant services*	$584,000
		Microsoft licensing agreements	$576,000

Financial contributions	Value	Major contracts	Annualised value 2017/18
		Procurement panel (recruitment and training)	$493,000
		Banking and bill payment services	$489,000
		After hours customer service	$480,000
		Printing services *Note: actual expenditure is allocated to relevant services*	$423,000
		Internet network services	$391,000
		Stationary and associated services	$300,000
		Internal audit and core assurance services	$213,000
		Mechanical maintenance services	$200,000
		Local area network infrastructure	$192,000
		Divercity newsletter	$192,000
		Electronic security services	$176,000

Major leases on council assets		Market rental (Estimate, unless otherwise stated determined by the valuation report)	Rent per year (excluding GST)
Access Arts Victoria	222 Bank Street, South Melbourne	$235,000	$59,702
Brewsters	Ground floor, 147 Liardet Street, Port Melbourne	$211,993	Equals market rental estimate

Major leases on council assets		Market rental (Estimate, unless otherwise stated determined by the valuation report)	Rent per year (excluding GST)
Café Watersedge	11 Waterfront Place, Port Melbourne	$309,000 (Market rent is Net Annual Value – a rating calculation for market rent undertaken every two years for rating purposes and used where a valuation report is not available)	$62,535
Palais Theatre Live Nation	14 Lower Esplanade, St Kilda	$875,000	Equals market rental estimate
Redside	9 Waterfront Place, Port Melbourne	$371,500 (Market rent is Net Annual Value – a rating calculation for market rent undertaken every two years for rating purposes and used where a valuation report is not available)	$41,797
Sails on the Bay	15 Elwood Foreshore, Elwood	$207,126	Equals market rental estimate
Schiavello Group	13 Waterfront Place, Port Melbourne	$422,500 (Market rent is Net Annual Value – a rating calculation for market rent undertaken every two years for rating purposes and used where a valuation report is not available)	$61,742
Shorething Donovans	36 Jacka Boulevard, St Kilda	$291,490	Equals market rental estimate
St Kilda Sea Baths Car Park	8 Jacka Boulevard, St Kilda	$225,000	Equals market rental estimate
St Kilda Marina	42A Marine Parade, St Kilda	$1,152,000 (Market rent is Net Annual Value – a rating calculation for market rent undertaken every two years for rating purposes and used where a valuation report is not available)	$157,310
Stokegroup	30 Jacka Boulevard, St Kilda	$490,000	$461,491 (The Stokehouse lease allows for initial discounts related to the fire reinstatement and business

Major leases on council assets		Market rental (Estimate, unless otherwise stated determined by the valuation report)	Rent per year (excluding GST)
			re-establishment reflecting direct investment by the Stokehouse operators)
The Vineyard	71A Acland Street, St Kilda	$245,000 (Market rental estimate is currently contested)	$202,591
West Beach Bathing Pavilion	330 Beaconsfield Parade, St Kilda West	$358,000	$0 (Percentage of turnover above threshold amount is currently under review)

Total budget for 2017/18

$37.4 million

How is it spent?

Operating - $29,425,236

Capital - $7,944,902

How is it funded?

Rates - $24,300,994

Fees and charges including parking - $5,084,155

Other income - $7,984,990

Delivering our strategic directions

Four-year budget at a glance

Strategic direction	Total spend 2017-2021 ($m)	Value per $100 of rates
We embrace difference, and people belong	Operating - $175,800,000 Capital - $25,500,000	$13
We are connected and it's easy to move around	Operating - $84,800,000 Capital - $41,300,000	$20
We have smart solutions for a sustainable future	Operating - $97,900,000 Capital - $27,300,000	$20
We are growing and keeping our character	Operating - $144,000,000 Capital - $32,500,000	$17
We thrive by harnessing creativity	Operating - $82,100,000 Capital - $10,500,000	$8
Our commitment to you	Operating - $122,300,000 Capital - $37,300,000	$22
Note: our commitment includes funding for some major capital works that contribute to all directions and cannot be readily allocated.		

Our financial strategy

Our financial strategy provides clear direction on the allocation, management and use of financial resources. It aims to ensure that Council stays financially sustainable while maintaining assets and services, responding to growth, and delivering on our priorities.

The financial strategy is embedded in our 10-year Financial Plan and throughout this plan. It sets the parameters within which Council agrees to operate to maintain acceptable financial outcomes over the short, medium and long term.

The 10-year Financial Plan is in Section 3.

Addressing the rates cap challenge

Over the next 10 years, we will face many challenges that require strong financial leadership and creative solutions to overcome them. Key among these challenges will be rates capping. Without action, the Financial Plan forecasts a cumulative $35 million funding gap due to rate capping.

We closely monitor the affordability of services, and recognise ongoing community concerns about the financial impost of rates and the cost of other essential services. As such, we are not planning to apply for a rate increase above the rates cap over the life of the Financial Plan.

We plan to balance the budget and close the rates cap gap by adjusting the following strategic levers.

Delivering efficiency and cost savings

The community's expectations for better value service delivery are of primary concern to Council. We have identified permanent operational savings of $2.0 million in Budget 2017/18. This adds to the $7.0 million of savings delivered in the last three budgets.

Over the period of the financial plan, we will target the delivery of efficiency savings equivalent to one per cent of operating expenditure (less depreciation) per annum for the first three years and 1.5 per cent per annum thereafter. This is expected to reduce our cost base by a cumulative $22.5 million over the 10-year period.

Key initiatives to deliver these savings include a service review program to better define service requirements and target support, a commitment to better practice procurement and asset management, the sale of surplus properties, and investment in business process and system improvement.

Appropriate use of borrowings and reserves

We will consider borrowings for property acquisitions, large capital works or operating projects that provide intergenerational community benefit, and initiatives that deliver sufficient revenue streams to service the debt. Borrowings will not be used to fund ongoing operations.

The financial plan includes refinancing a $7.5 million loan due to mature in 2021/22 on interest only terms. It is expected that this will release $5.3 million in cash over the 10-year period while maintaining very low debt levels.

We maintain general reserves at levels sufficient to ensure operational liquidity. Reserves may be built up over time to part-fund large capital works or appropriate operating projects where this is considered more efficient than the use of debt.

The financial plan includes using general reserves as an internal source of borrowing for projects that will benefit future generations such as the Ferrars Street Education and Community Precinct works ($9.8 million). We will continue to use open space contributions for investment in parks and foreshore open space assets.

The financial plan also includes a progressive build-up of the Palais Theatre Reserve funded from significantly increased rental returns following the successful leasing process last year to ensure funds are available to maintain the theatre over the long term.

Our investment in the Pride Centre will be part funded from the Strategic Property Reserve (built up from sale of surplus assets) and general reserves.

Careful management and prioritisation of expenditure

We undertake a rigorous and robust budget setting process each year, including a line by line review of operating budgets and proposed projects to ensure alignment with strategic priorities and best value. Performance is monitored closely throughout the year with forecasts updated monthly.

In addition to the disciplined budget setting and expenditure monitoring, the strategy in the financial plan provides $4.2 million per annum for operating projects. This represents a minor reduction compared to historical expenditure levels, resulting in cumulative savings of $2.0 million over the 10-year period.

Our focus on improved asset management sees investment prioritised on assets most in need of intervention rather than those in relatively good condition. This translates to an increase in spending on buildings, drainage and technology over the 10-year period of the plan, partially offset by reducing road and footpath renewal budgets.

Setting fair and appropriate user charges

The annual budget process includes a thorough review of user charges to ensure they remain affordable, fair, and appropriate. We believe that those who directly benefit from and/or cause expenditure should make an appropriate contribution to the service balanced by the capacity of people to pay.

The financial plan links increases in Council user charges to the rates cap plus 0.25 percentage points from 2018/19. This is forecast to contribute a cumulative $1.7 million towards the rates cap gap. The application and impact of this policy setting will be reviewed annually to ensure affordability and fairness.

Rates assistance

We recognise the impact municipal rates and other charges have on the financially disadvantaged groups of the community. In addition to our commitment to keeping rates affordable, we offer assistance packages:

- A pensioner rebate that will increase by 2.6 per cent to $160 in 2017/18. The City of Port Phillip is one of very few councils that offers this scheme.
- An option for self-funded retirees to defer their rates indefinitely at five per cent for the 2017/18 financial year (half the official penalty interest rate set by the Victorian Government).
- Providing a 50 per cent waiver of the general rate for housing accommodation that provides reduced rentals for elderly persons of limited means.
- Freezing animal management fees for pensioners at 2014/15 levels.

- Support for residents and ratepayers experiencing hardship through rate deferments and payment arrangements.

Financial risks

- The financial plan assumes rates capping based on the Essential Services Commission (ESC) recommended methodology. Since its introduction, the Minister for Local Government has prescribed rate increases lower than the ESC recommendation. Every 0.1 per cent lower than the ESC methodology equates to a $119,000 reduction per annum in revenue.
- The financial plan achieves financial sustainability over the next 10 years. Beyond this period, sustainability will be tested particularly if other financial risks materialise.
- A more subdued property development market may result in rates revenue growing at a lower rate than the 1.3 per cent per annum financial plan assumption. Every 0.1 per cent reduction in growth equates to a $119,000 reduction in revenue.
- Parking revenue, which is our second largest revenue source, is historically volatile and can be impacted by the macro-economic environment. A 1.0 per cent reduction in revenue from parking fees and fines equates to a $300,000 per annum reduction in revenue.
- There may be a large funding gap between the infrastructure desired in Fishermans Bend and what is able to be funded. A failure to appropriately budget for the costs of running and looking after new assets in Fishermans Bend is also a risk.
- The possibility of a future unfunded defined benefits superannuation call.
- Future reductions in funding from other levels of Government or increases in cost shifting.
- A major, unexpected, asset renewal/upgrade challenge.

Notwithstanding these risks, our sound financial position with low levels of borrowing and healthy reserves balance enable us to respond to these financial risks in the 10-year period if they arise. If necessary, we can also apply to the ESC for an above rates cap increase.

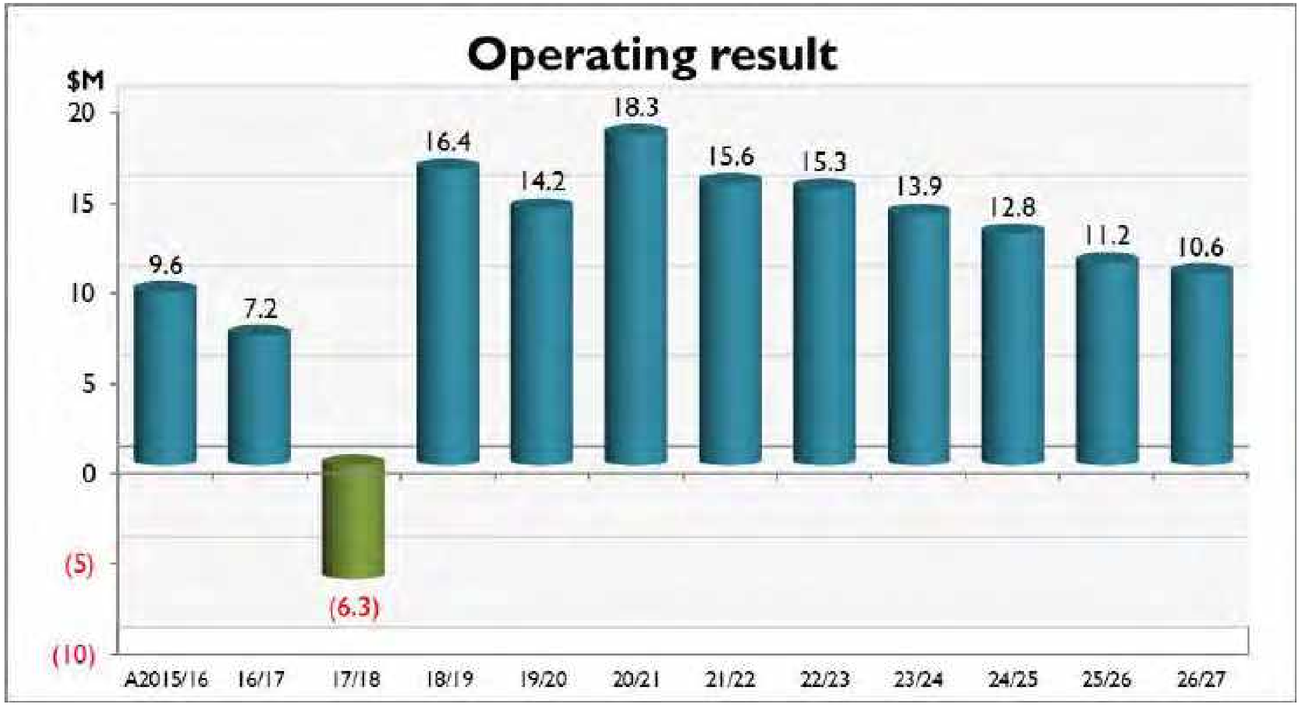
Monitoring our financial sustainability

We use the Victorian Auditor General's (VAGO) financial sustainability indicators to monitor our financial sustainability. Our financial strategy is designed to ensure an overall low risk rating over the period of the plan unless we can demonstrate it is prudent not to (i.e. for one-off abnormal transactions that do not have an enduring impact). We are forecasting that we will achieve an overall risk rating of low throughout the 10-year period, as shown in the table below.

		Forecast	Budget	Projections								
Indicator	**Indicator Targets**	**2016/17**	**2017/18**	**18/19**	**19/20**	**20/21**	**21/22**	**22/23**	**23/24**	**24/25**	**25/26**	**26/27**
Net Result %	Greater than 0%	5.9%	(3.0%)	7.5%	6.4%	7.9%	6.6%	6.3%	5.5%	4.9%	4.2%	3.8%
Working Capital	Working Capital Ratio >100%	227%	202%	213%	217%	194%	235%	240%	242%	241%	234%	224%
Internal Financing	Net cashflow from operations to net capital expenditure >100%	112%	78%	117%	110%	120%	112%	113%	110%	106%	102%	99%
Indebtedness	Indebtedness ratio <40%	6.0%	5.8%	5.6%	5.5%	1.8%	5.2%	5.1%	5.0%	4.9%	4.8%	4.7%
Capital Replacement	Capital to depreciation >150%	156%	148%	159%	159%	157%	156%	153%	151%	150%	150%	151%
Infrastructure Renewal Gap	Renewal & upgrade to depreciation >100%	117%	122%	126%	123%	119%	123%	121%	119%	119%	119%	119%
Overall Financial Sustainable Risk Rating		Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Financial summary

Operating result



Achieving an operating surplus is a key component of our financial strategy. It provides capacity to renew our $2.6 billion portfolio of community assets, meet debt repayment obligations, and manage the impact of financial risks materialising.

There are three significant one-off items in 2017/18 totalling $19.4 million:

- Pride Centre contributions (cash and property)
- Ferrars Street precinct works
- relinquishing a Committee of Management property of crown land located at 62-74 Pickles Street, South Melbourne.

These items do not detrimentally impact our objective of financial sustainability, as a large component has no cash impact and/or represents reclassification to operations from the capital portfolio. If the result is adjusted for these items, we would achieve an operating surplus of $13.1 million.

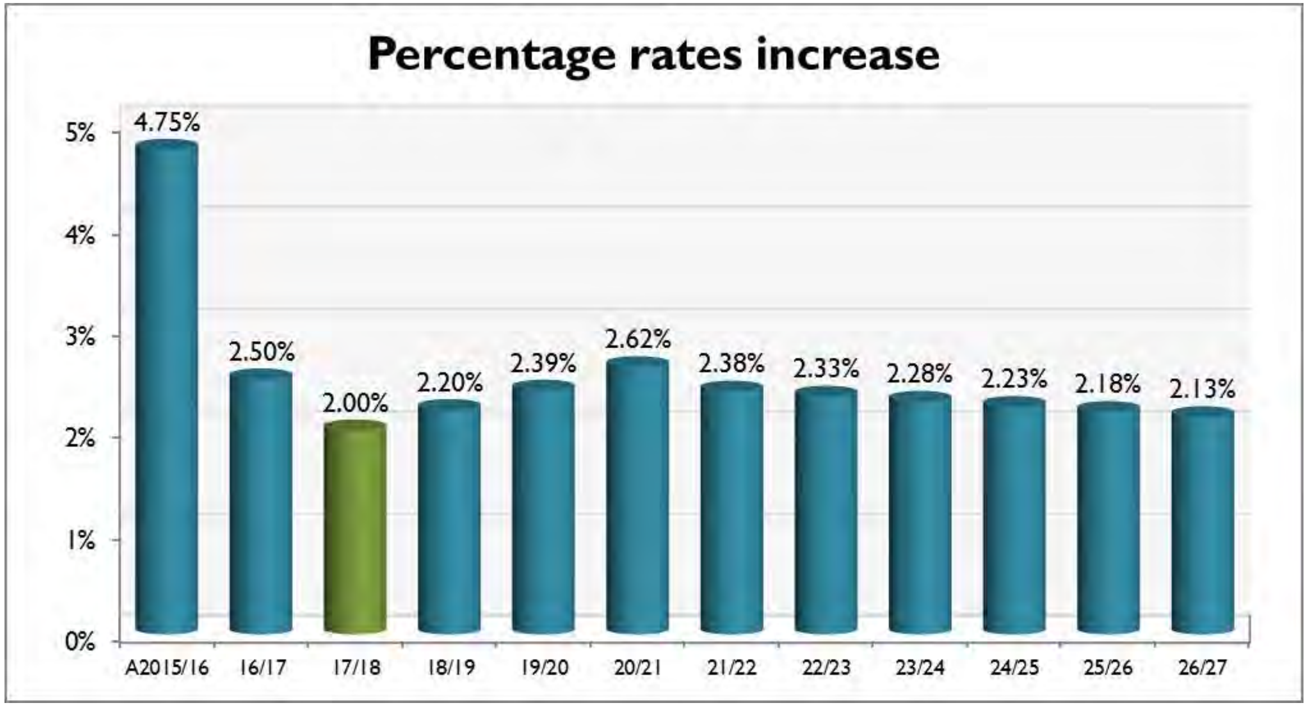
The decline in operating surplus in the outer years is primarily the impact of the projected 3.8 per cent per annum increase in depreciation expense, the result of our commitment to invest in new and upgraded capital assets over the financial plan.

Underlying result

The adjusted underlying result excludes capital related revenue (grants and open space contributions). Reasons for the movement in the underlying result are consistent with the operating result.

Rates percentage increase

Budget 2017/18, which funds a $42.5 million capital program and maintains existing service levels, includes a 2.0 per cent rates increase, consistent with the Victorian Government cap. This has been achieved through a continued strong focus on prudent financial management, careful prioritisation and commitment to productivity and efficiency ($9 million identified over the last four budgets). Future rates increases are based on forward projections of inflation and the ESC methodology for setting the rates cap.



Operating expenditure

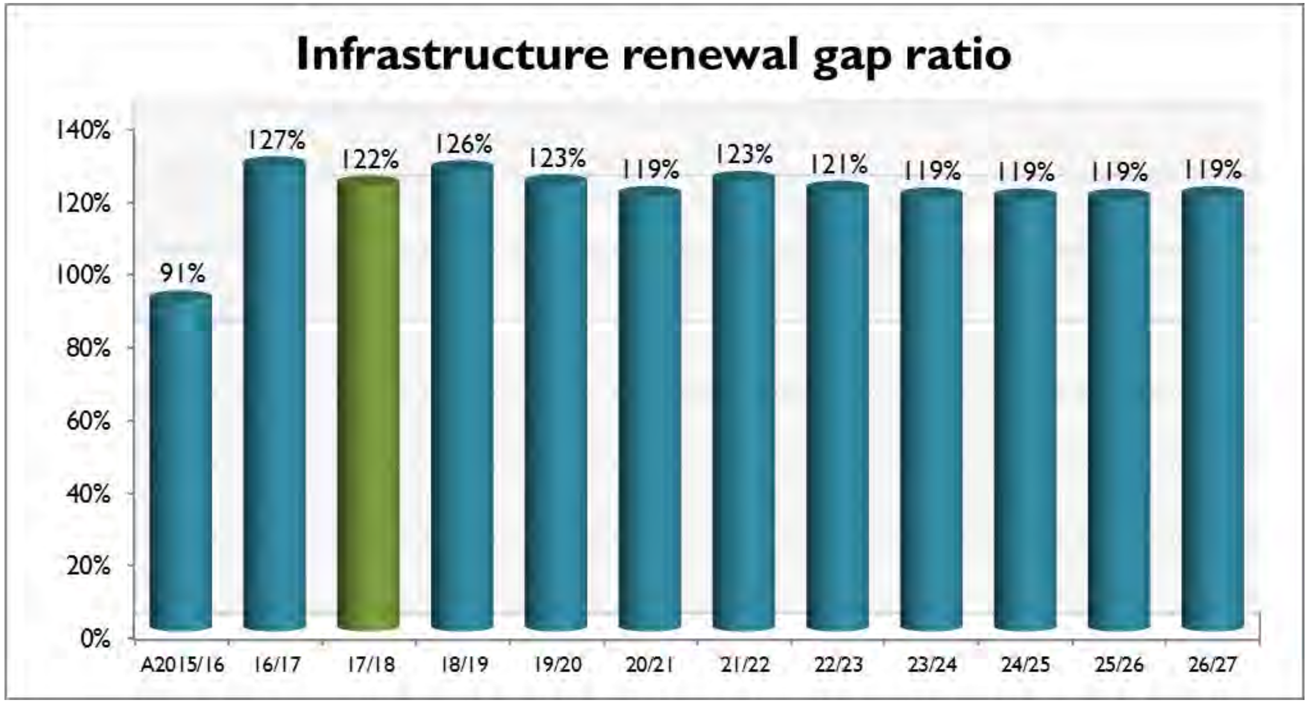
The $28.2 million increase in operating expenditure in 2017/18 has been impacted by increases in non-cash depreciation expenses of $3.2 million, a $5.3 million provision for Ferrars Street Education and Community Precinct works, one-off cash and property contributions of $10.5 million for the Pride Centre, and a non-cash asset write-off of $3.6 million for the relinquished Committee of Management property of crown land located at 62-74 Pickles Street, South Melbourne. If these items are removed, the 2017/18 adjusted operating expenditure is $196.7 million, a $5.6 million or 2.9 per cent increase compared to 2016/17.

The small but steady growth in operating expenditure in future years is largely driven by inflation (around 2-2.3 per cent per annum), service demand increases associated with population growth (around 1.3 per cent per annum), and the operating expenditure impact of new and improved assets (for example depreciation increase of 3.8 per cent per annum). This is partially offset by our commitment to efficiency and cost savings (1.0-1.5 per cent per annum).

Infrastructure renewal gap

This graph shows the asset renewal and upgrade budget over the financial plan compared to depreciation.

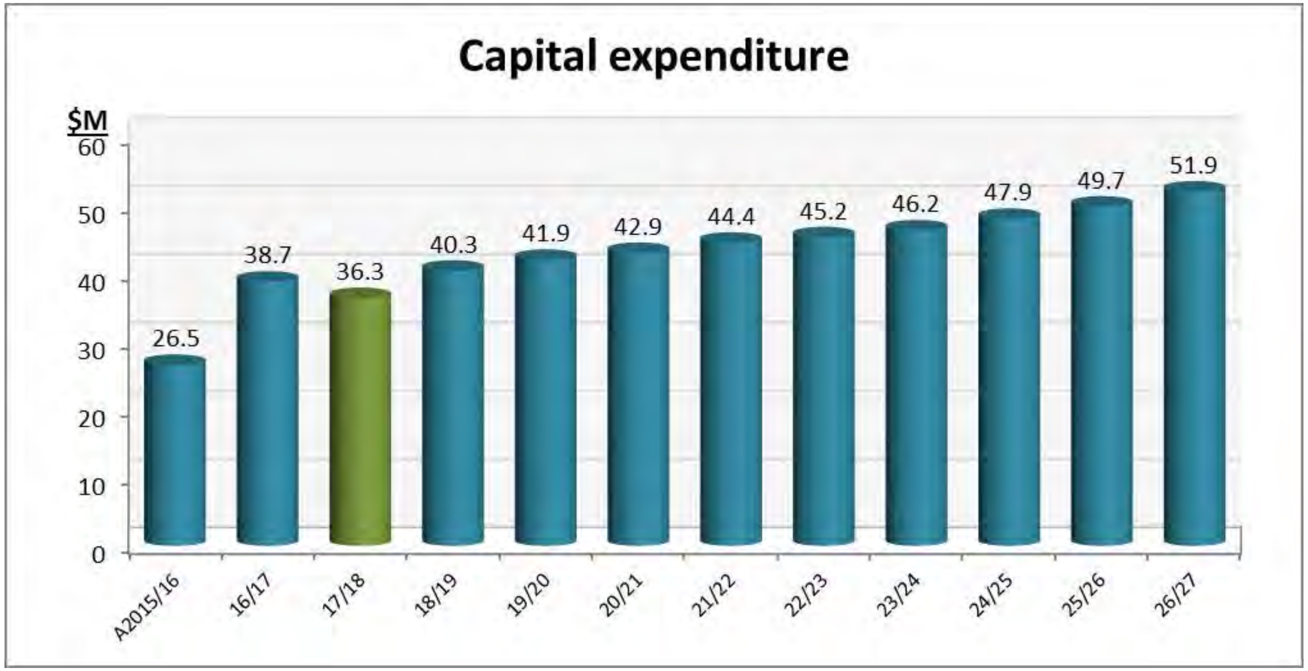
The forecast in 2016/17 includes a significant one-off contribution towards the Palais Theatre restoration. Over the 10-year period, we intend to stay above 100 per cent, which shows our commitment to maintaining and upgrading our existing assets.



Capital expenditure

Capital works expenditure in 2017/18 is expected to be $36.3 million, out of a total $42.5 million capital program. The $6.2 million gap represents the component of the capital program budget expected to be treated as operating expenditure, such as community engagement and feasibility studies.

Over the period of the financial plan, we provide for appropriate levels of capital expenditure to ensure existing assets are maintained and improved, while investing in growth driven assets. Over the 10-year period, we plan for our total capital expenditure to be greater than 150 per cent of depreciation expenditure.



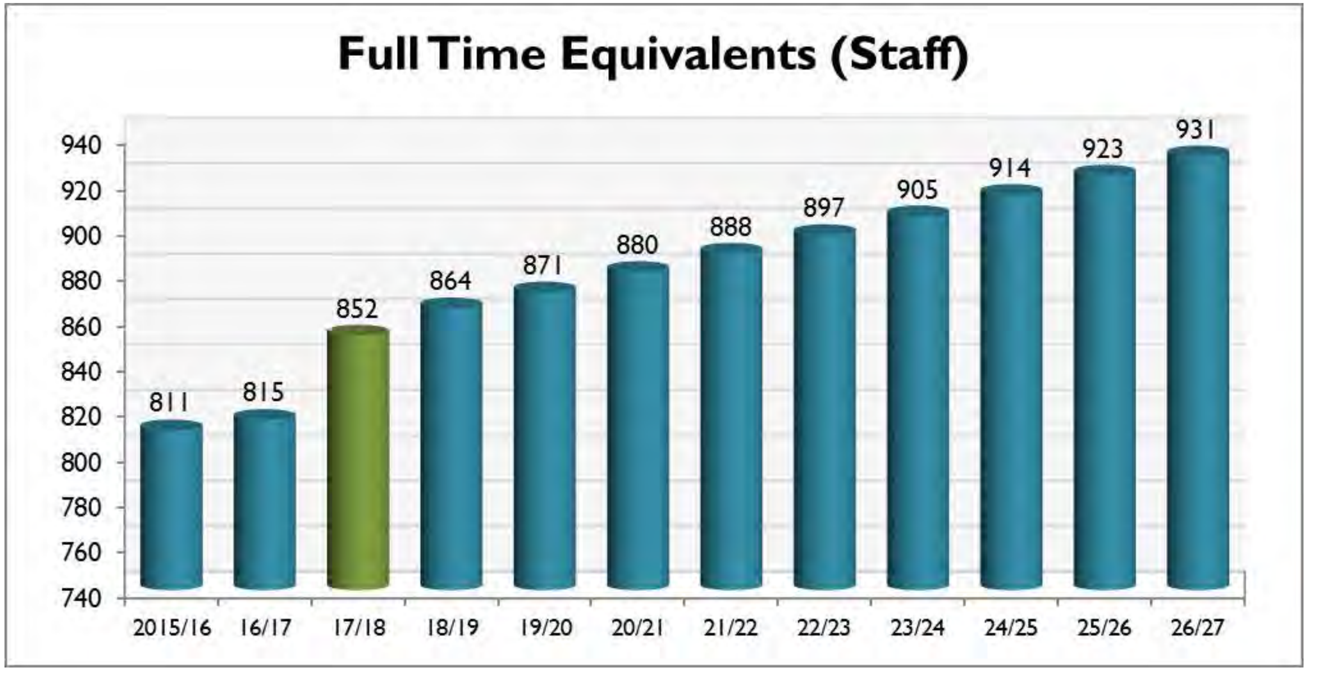
Council staff

Council employees are our most valued resources, enabling the delivery of a broad range of services. While we constrained employee growth to 4.6 full time equivalents (FTE) in Budget 2016/17, in Budget 2017/18 we are proposing a 37 FTE increase based on 47 new positions partially offset through the disestablishment of 10 existing FTE positions. The key drivers for this increase include:

- 14.1 FTE to support delivery of the project portfolio including 3.4 externally funded positions for the Melbourne Metro Rail Authority
- 5.3 FTE in response to population and resultant service growth – primarily the Fishermans Bend Children's and Community Centre
- 8 FTE to support increased service levels for street cleaning – a priority identified through community complaints and engagement
- 8 FTE to support risk mitigation and legislative compliance including ensuring our buildings and the South Melbourne Market are safe.

Over the last two financial years, the increase in FTE is equivalent to 2.6 per cent per annum.

Over the life of the financial plan, the growth in FTEs is expected to increase by 1.3 per cent in line with projected population growth.



Rates expenditure allocation

This chart shows how rates revenue is spent across our services, for every $100 we spend.

Service category	Proportion of rates spent on service (for every $100 we spend)
Transport and parking management	$19.60
Amenity	$12.90
Public space	$12.00
Governance and engagement	$6.30
Technology, transformation and customer experience	$5.30
Sustainability	$4.70
Asset management	$4.60

Service category	Proportion of rates spent on service (for every $100 we spend)
Families and young people	$4.10
Community programs and facilities	$3.50
City planning and urban design	$3.30
Libraries	$3.30
Finance and project management	$2.90
Arts, culture and heritage	$2.50
People, culture and capability	$2.50
Waste reduction	$2.20
Festivals	$2.10
Recreation	$2.10
Children	$1.80
Ageing and accessibility	$1.20
Economic development and tourism	$1.20
Affordable housing and homelessness	$1.00
Local laws and animal management	$0.90
Health services	$0.60
Development approvals and compliance	$0.30
Municipal emergency management	$0.30
Markets	($1.20)
Total	$100.00

Note: some services receive substantial funding from other sources, such as government grants, fees and charges.

Section 2: Our neighbourhoods

Our neighbourhoods at a glance

People who live in Port Phillip tend to experience the City at a neighbourhood level. Strong communities of interest exist in local areas, and people relate closely with the distinctive characteristics of their own neighbourhood.

We have nine defined neighbourhoods, each with distinct character and attributes. Two of these are emerging neighbourhoods in Fishermans Bend.

We deliver services and projects in our each of our neighbourhoods, and each place is home to community infrastructure that enables us to provide services locally, city-wide and regionally.

Neighbourhood	Forecast population in 2017	Forecast population in 2027	Change
Elwood / Ripponlea	16,618	17,268	3.9%
Balaclava / St Kilda East	17,638	18,700	6.0%
St Kilda / St Kilda West	24,826	28,472	14.7%
St Kilda Road	12,241	17,675	44.4%
Albert Park / Middle Park	11,974	11,908	-0.6%
South Melbourne	10,263	12,133	18.2%
Port Melbourne	17,006	17,172	1.0%
Sandridge / Wirraway	307	5,385	1654.1%
Montague	92	7,032	7543.5%
Port Phillip	110,967	136,301	22.8%
Neighbourhood boundaries do not correspond directly with suburb boundaries. All population estimates and forecasts are sourced from Forecast.id (based on the 2011 Census), updated in January 2017.			

We are Elwood / Ripponlea

Encompassing the suburb of Ripponlea and most of the suburb of Elwood, the neighbourhood is known for its leafy streets and suburban character. Visitors and locals are drawn to the beach and the cafés and restaurants in local shopping strips. Ripponlea Station offers good accessibility to central Melbourne.

Pull out fact

- 28.5 per cent of residents are families.

Our people

- 16,618 people are estimated to live here in 2017. By 2027, the population is forecast to grow by 3.9 per cent to 17,268.
- There is a higher proportion of young people (0-17 years) and 35-49 year olds than the City average, reflecting the greater proportion of family households. There is a smaller proportion of older people.
- While the majority of people live in medium and high-density housing, a greater proportion live in separate housing (20 per cent) than the City of Port Phillip average (14.5 per cent).
- 16 per cent of people speak a language other than English at home, compared with the City average of 19.7 per cent, with Greek, Italian and Russian the most common.

History

Point Ormond was an important source of seafood for the Boon Wurrung people, with evidence of an Aboriginal shell midden found in 1974. The original red, brown and yellow sandstone of this area is likely to have been a source of ochre for body paint used in performance. In 1894, a Ngargee was witnessed at the site that is now Ripponlea mansion.

Development of the area dates from the 1850s. Substantial growth started in the early 1900s, continuing into the interwar period. Significant development occurred during the post-war years. The population was relatively stable during the 1990s and then increased slightly from 2001, largely a result of new apartment developments in the area. Elwood was originally swampland until the development of Elwood Canal, which enabled residential development.

Servicing the community

The Elwood / Ripponlea neighbourhood is home to a range of amenities and facilities.

- Ripponlea neighbourhood activity centre
- Elwood neighbourhood activity centre (Glen Huntly / Ormond roads)
- Tennyson Street neighbourhood activity centre
- Lady Forster Kindergarten
- Poets Grove Family and Children’s Centre
- Burnett Gray Centre (Elwood playgroups)

- Elwood Angling Club
- Elwood Life Saving Club
- Elwood St Kilda Neighbourhood Learning centre (including Poets Grove community garden and toy library)
- Elwood Park
- Elwood Beach
- Point Ormond
- Elwood Canal
- Clarke Reserve
- Moran Reserve

Investment in Elwood / Ripponlea this year (2017/18)

- Elwood Park carpark bollard removal
- Elwood Playspace design (funded from open space reserves)
- Elster Creek catchment governance and advocacy
- Elwood public space wall replacement
- Point Ormond and Brighton Road medians sign replacement
- Point Ormond bollard removal and installation
- Point Ormond Kiosk public space and landscaping
- Point Ormond Reserve and Elwood Carnival site shade sail replacement
- Point Ormond, Elwood Tea Tree and Elwood Foreshore revegetation
- Raised zebra crossings at Broadway / Milton Street roundabout (part of the Blackspot Safety Improvements Program and subject to external funding)
- Sails on the Bay building renewals
- Wave St footpath renewal

We are Balaclava / St Kilda East

Encompassing the suburb of Balaclava and part of St Kilda East and St Kilda, this neighbourhood has diverse housing types and population. Primarily a residential neighbourhood, the Carlisle Street activity centre, Balaclava station and Alma Park are key features. The cafes and restaurants on Carlisle Street are popular with locals and visitors.

Pull out fact

- 41.7% of residents are aged 20-34 years.

Our people

- 17,638 people are estimated to live here in 2017. By 2027 the population is projected to grow by 6.0 per cent to 18,700.
- There is a prominent Jewish community in the neighbourhood.
- There is a high proportion of young workers and smaller proportions of parents, young families and older people compared to the rest of the City.
- The majority of people live in medium and high-density housing (81.2 per cent).
- 23.9 per cent of people speak a language other than English at home (higher than the City average of 19.7 per cent).
- Russian (3.1 per cent), Greek (2.1 per cent) and Hebrew (1.6 per cent) are the most common languages spoken at home other than English.

History

Houses in Balaclava / St Kilda East includes larger houses and cottages from the Victorian, Edwardian and interwar eras, and a significant number of flats from the 1960s and 1970s, and more recent contemporary apartments.

Balaclava was named after the battlefield in the Crimean War (1853-1856) and has related street names like Nightingale, Inkerman, Raglan and Sebastopol.

Servicing the community

The Balaclava / St Kilda East neighbourhood is home to a range of amenities and facilities.

- Carlisle Street activity centre
- Inkerman Street local activity centre
- St Kilda Town Hall
- Bubup Nairm Family and Children's Centre
- The Avenue Children's Centre
- St Kilda and Balaclava Kindergarten
- St Kilda Library
- Alma Road Community House (including maternal child health services and Te Arai community garden)
- St Kilda community garden
- Alma Park Reserve
- Hewison Reserve
- Te Arai Reserve
- William Street Reserve
- Pakington Street Reserve

Investment in Balaclava / St Kilda East this year (2017/18)

- Alexandra Street / Alma Road intersection median closure (part of the Blackspot Safety Improvements program and subject to external funding)
- Alma Park stormwater harvesting
- Balaclava Precinct management
- Bubup Nairm non compliance works

- Carlisle Street public toilet improvements
- Charles Street and Glen Eira Avenue footpath renewals
- Elm Grove, Camden Street and Alma Road laneway renewals
- Hewison Reserve irrigation upgrades (funded from open space reserves)
- Inkerman Street intersection upgrades for bike riders (walk and bike plan implementation)
- Marlborough St affordable housing project
- St Kilda Town Hall renewals and security improvements
- Wando Grove road renewals
- Work with PTV on the Carlisle St tram stop upgrade and Balaclava Station interchange

We are St Kilda / St Kilda West

Encompassing the suburbs of St Kilda West (east of Cowderoy Street), most of St Kilda and a small part of Elwood, the neighbourhood is attractive to residents and visitors for its iconic retail strips, significant open spaces and the foreshore.

St Kilda attracts over 2.2 million visitors[1] every year as it is home to many of Melbourne's famous attractions including Luna Park, the Palais Theatre and St Kilda Beach. It also hosts large events including the St Kilda Festival and Pride March.

Pull out fact

- More than 50% of residents rent their home.

Our people

- 24,826 people are estimated to live here in 2017. By 2027, the population is projected to grow by 4.7 per cent to 28,472.
- There is a smaller proportion of young people (under 17 years) when compared to the City average but a higher proportion of people aged 18 to 34 years, reflecting the prominence of young couples, singles and group households.
- The majority of people live in medium to high-density housing (90.1 per cent).
- Over half the dwellings are being rented (higher than the City average) and just under half of the residents live alone.
- 16.2 per cent of people speak a language other than English at home, with Russian and Greek the most common.

History

Albert Park Reserve was once a rich willam or camp for the Yalukut Weelam, with miams (huts) built alongside today's Albert Park Lake. The Ngargee (Corroboree) Tree located in the south-east corner of Albert Park is the last remaining corroboree tree in Melbourne, and also the site of the ceremonial dance circle and Ngargee grasslands that are a current day focus for cultural and reconciliation activities.

European development dates from the 1840s, spurred by the opening of the railway line. St Kilda grew in the late 1880s, continuing into the early 1900s. Expansion continued during the interwar period and the 1940s, including the construction of many flats and apartments. Significant development occurred during the 1950s and 1960s, due mainly to high-density development.

Servicing the community

The St Kilda / St Kilda West neighbourhood is home to a range of amenities, facilities and significant events.

- Fitzroy Street activity centre
- Acland Street activity centre
- St Kilda Road South precinct
- St Kilda Triangle
- Betty Day Community Centre
- Cora Graves Community Centre
- Peanut Farm Reserve Pavilion
- St Kilda Adventure Playground
- Shakespeare Grove and Veg Out
- St Kilda Life Saving Club
- Port Phillip EcoCentre
- Eildon Road Children's Centre
- North St Kilda Children's Centre
- Elwood Children's Centre
- St Kilda Festival
- St Kilda Film Festival
- Esplanade Market
- Linden New Art
- Theatreworks
- Shakespeare Grove Artist Studios
- Palais Theatre
- Luna Park (asset not owned / managed by council)
- Astor Theatre (asset not owned / managed by council)
- National Theatre (asset not owned / managed by council)
- St Kilda Sea Baths (asset not owned / managed by council)
- St Kilda Botanical Gardens
- Catani Gardens
- St Kilda Marina
- O'Donnell Gardens
- Church Street Reserve
- Crimea Street Reserve
- Cummings Reserve
- H R Johnson Reserve
- Jacoby Reserve
- Jim Duggan Reserve
- Renfrey Reserve
- Talbot Reserve
- Waterloo Reserve

Investment in St Kilda / St Kilda West this year (2017/18)

- Barkly Street laneway renewals
- Betty Day Community Centre renewals and solar installation
- Carlo Catani Wall improvements
- Crimea Street reserve upgrade design (funded from open space reserves)
- Donovans roof renewal
- EcoCentre redevelopment contribution
- Fitzroy Street, Seabaths and the Slopes public toilet improvements
- Fitzroy Street precinct management
- Herbert Street footpath renewal
- Herbert Street and Dickens Street road renewals
- Jim Duggan Reserve and Church Square Reserve bollard removal and installation
- Linden Gallery roof and balcony upgrade
- Peanut Farm Reserve sports pavilion upgrade, floodlighting design (funded from open space reserves), soil contamination management, irrigation and grass replacement
- Replace litter bins at Catani Gardens, Fitzroy and Acland streets, and St Kilda Promenade
- Replace Newton Court gates and fences at Dalgety Street Reserve
- Replace seats at Luna Park and Jacoby Reserve
- Replace signs at Church Square Reserve, Brighton Road and St Kilda Road medians
- St Kilda Life Saving Club beach shower, landscaping and access improvements
- St Kilda Botanical Gardens brick path edging
- St Kilda Marina lease
- St Kilda Road South urban design and land use framework implementation plan
- Work with PTV on Fitzroy Street / Grey Street tram stop reinstatement

We are St Kilda Road

Encompassing parts of the suburbs of Melbourne and Windsor, and parts of Albert Park and South Melbourne, the St Kilda Road neighbourhood is unique in the City because of its mix of offices and high-rise residential development. It is our fastest growing neighbourhood.

St Kilda Road is a significant employment area with over 20,000 people working in the neighbourhood. The planned Domain Station for the Melbourne Metro will enhance access to the area. The neighbourhood includes and adjoins significant open spaces and recreational facilities.

Pull out fact

- Population is forecast to grow by 44.4 per cent by 2027.

Our people

- 12,241 people are estimated to live here in 2017, growing to 17,675 in 2027.
- There are a higher proportion of people aged between 18 to 34 years than the City average and a much smaller proportion of parents and young families.
- Almost 97 per cent of residents live in high density housing, with a high proportion of private renters.
- Significantly more people were born overseas (46.5 per cent) than the City average (31 per cent), with origins including China, the United Kingdom, Indonesia and India.

History

St Kilda Road is regarded as Melbourne's iconic 'urban boulevard'. Development of the area dates from the 1860s, with a number of heritage mansions still remaining. Rapid residential apartment development has taken place from the early 1990s, replacing former office space.

The population more than doubled between 1991 and 2001 and growth continues, with development of residential apartment towers now focused in the area north of Albert Road.

Servicing the community

The St Kilda Road neighbourhood is home to a range of amenities and facilities.

- St Kilda Road North precinct
- Domain interchange
- Bowen Crescent Reserve
- Albert Road Reserve
- Albert Park, Golf Course and Lake (asset not owned / managed by council)
- Albert Reserve tennis, lacrosse and cricket facilities (asset not owned / managed by council)

Investment in St Kilda Road this year (2017/18)

- Domain precinct management
- South African War Memorial conservation
- St Kilda Road safety improvement study
- Work with Victorian Government on the Melbourne Metro Tunnel Project / Domain Station

We are Albert Park / Middle Park

Encompassing the suburb of Middle Park, part of the suburb of Albert Park and part of St Kilda West, this neighbourhood is one of the oldest parts of the City with significant heritage areas featuring wide tree-lined streets and houses from the Victorian and Edwardian eras. Primarily a residential area, visitors are also drawn to the beach, local shopping strips and recreational facilities in Albert Park.

Pull out fact

- 22 per cent of people speak a language other than English at home.

Our people

- 11,974 people are estimated to live here in 2017. The population is forecast to decline very slightly to 11,908 by 2027 due to limited housing growth and a reduction in household size (as families mature).
- There are a higher proportion of pre-schoolers and people at post-retirement age than the City average and a significantly smaller proportion of young people starting out in the workforce.
- While almost half of residents live in medium density housing, a significantly higher proportion live in separate housing (30.9 per cent) than the City average of 14.5 per cent.
- Greek and Italian are the most common languages other than English that are spoken at home.

History

The coastline of Port Phillip Bay was a focal point for the Boon Wurrung, who travelled annually down the coast returning to Port Phillip in warmer weather. The Canterbury Road Urban Forest still retains surviving plants of the woodlands and wetlands of the former Albert Park Lagoon, which was the traditional home to the Yalukut Weelam clan.

European development dates from the 1850s, spurred by the opening of the railway line. Expansion continued during the interwar period and the 1940s, and significant development occurred during the 1960s. The population was relatively stable between 1991 and 2006, and increased slightly between 2006 and 2011.

Servicing the community

The Albert Park / Middle Park neighbourhood is home to a range of amenities and facilities.

- Bridport Street / Victoria Avenue neighbourhood activity centre
- Armstrong Street neighbourhood activity centre
- Albert Park Preschool and Maternal Child Health
- Middle Park Kindergarten
- South Melbourne Childcare Cooperative
- Albert Park Library
- Mary Kehoe Community Centre (including Mary and Basil community garden)
- Middle Park Community Centre (including library, toy library, maternal and child health and civic kindergarten)
- South Melbourne Life Saving Club
- Albert Park Yachting and Angling Club
- Albert Park and Middle Park beaches
- Albert Park Reserve (asset not owned / managed by council)
- Ashworth Street Reserve
- Danks Street Playspace
- Gasworks Arts Park
- Frank and Mary Crean Reserve
- Little Finlay Reserve
- Little Page Reserve
- Neville Street Reserve
- Moubray Street Pop Up Park

Investment in Albert Park / Middle Park this year (2017/18)

- Investigating with partners Albert Park stormwater harvesting
- Gasworks Arts Park contamination management and planning for theatre seat replacement
- Sandbar building roof renewal works
- South Melbourne Life Saving Club and public amenities redevelopment planning and design
- Smith Street road renewal
- Station Pier to Kerferd Rd Pier foreshore lighting replacement (funded from open space reserves)

We are South Melbourne

Encompassing most of the suburb of South Melbourne and part of Albert Park, the neighbourhood is one of Melbourne’s original suburbs. The South Melbourne activity centre, including Clarendon Street and the South Melbourne Market, attracts a local and regional visitors. Significant established business precincts, predominantly east of Clarendon Street, offer a location for small and medium size firms close to central Melbourne.

Pull out fact

- 17.8 per cent of people live in social housing.

Our people

10,263 people are estimated to live here in 2017. The population will grow by 18.2 per cent to 12,133 by 2027.

Compared to the City average, there is a higher proportion of people aged over 70 years and a lower proportion of residents aged between 18 to 34 years.

Residents live in a mix of medium density (45.9 per cent), separate house (25.0 per cent) and high-density (26.4 per cent) housing, with a higher than average proportion of family households.

The neighbourhood has a much greater proportion of people living in social housing than the City average of 4.8 per cent.

History

South Melbourne, or Nerre nerre minum, was home to the Yalukut Weelam clan of the Boon Wurrung. The higher ground of Emerald Hill (now the site of the South Melbourne Town Hall) was used as a place to engage in ceremonies.

Development dates from the 1850s, following establishment of a tent city for gold seekers. There was rapid growth in the 1870s and 1880s, and significant development occurred a century later, including construction of high-rise public housing estates. The population has increased gradually from the early 1990s, a result of contemporary apartment developments.

Servicing the community

The South Melbourne neighbourhood is home to a range of amenities and facilities.

- South Melbourne Central activity centre (Clarendon Street, South Melbourne Market and surrounding business precincts)
- South Melbourne Town Hall and Community Hub
- South Melbourne Market
- Emerald Hill Library and Heritage Centre
- South Melbourne Community Centre/Trugo Club
- South Melbourne Hellenic RSL
- Melbourne Sports and Aquatic Centre (asset not owned / managed by council)
- Napier Street Aged Care (asset not owned / managed by council)
- CASPA Care Residential Care
- Clarendon Children’s Centre
- Clarendon Family Centre (including maternal and child health and toy library)
- Coventry Children’s Centre
- Lillian Cannam Kindergarten
- Pickles Street Learning (Youth Education) Centre
- Skinners Adventure Playground
- Sol Green Community Centre
- St Vincent Gardens
- Sol Green Reserve

- Lyell / Iffla Reserve
- Eastern Reserve
- Ludwig Stamer Reserve
- Emerald Hill Place
- Howe Crescent Reserve

Investment in South Melbourne this year (2017/18)

- Dorcas Street / Moray Street roundabout raised zebra crossings and Coventry Street / Tope Street intersection kerb extensions (part of the Blackspot Safety Improvements Program and subject to external funding)
- Emerald Hill Reserve sign replacement
- Ferrars Place and Ferrars Street footpath renewals
- Frank and Mary Crean Reserve seats and picnic table replacement
- Kerferd Road safety improvements planning (subject to funding)
- Park Street / Mountain Street / Nelson Road roundabout safety improvements (walk and bike plan implementation)
- Sol Green Reserve irrigation upgrades (funded from open space reserves)
- South Melbourne Community Centre renewals
- South Melbourne Market building compliance, renewal and stall changeover refit works
- South Melbourne Market solar energy design
- South Melbourne Market strategic business case
- South Melbourne Town Hall lift upgrades

We are Port Melbourne

Encompassing most of the suburb of Port Melbourne, this neighbourhood is a gateway to Melbourne via Station Pier. The Waterfront precinct brings a large number of visitors to the neighbourhood and beyond, attracted to the foreshore and beaches and the retail and commercial strip along Bay Street. Traditional residential heritage precincts contrast with the distinctive areas of Garden City, Beacon Cove and contemporary apartment development in the Port Melbourne mixed use area. The neighbourhood is also home to the Port Phillip Specialist School for children with disabilities.

Pull out fact

- The population is forecast to grow by 4.2 per cent by 2027.

Our people

- 17,006 people are estimated to live here in 2017, growing to 17,728 by 2027.
- Compared to the City average, there is a larger proportion of families with young children and people at post-retirement age (70+ years).
- There is a smaller proportion of renters than the City average (43.9 per cent compared with 50.1 per cent)
- There is a larger proportion of people living in social housing (8.0 per cent compared to the City average of 4.8 per cent).

History

The Port Melbourne lagoon was an original feature of this neighbourhood and a well-known Aboriginal site. The lagoon was filled in from the 1890s to create Lagoon Reserve and Edwards Park.

Port Melbourne is one of the oldest neighbourhoods in the City, with housing dating from the Victorian and Edwardian eras. Major exceptions are the historic Garden City estates developed in the 1930s and 1940s, and the more recent Beacon Cove development adjacent to Station Pier. Beacon Cove and significant redevelopment of former industrial sites for residential apartments (southern end of Bay Street) have seen the population double over the last few decades.

Servicing the community

The Port Melbourne neighbourhood is home to a range of amenities and facilities.

- Bay Street major activity centre
- Garden City neighbourhood activity centre
- Port Melbourne Waterfront precinct
- Ada Mary A'Beckett Children's Centre
- Clark Street Children's Centre
- Bubup Womindjeka Family and Children's Centre
- Port Melbourne Library
- Fishermans Bend Community Centre (and community garden)
- Liardet Street Community Centre
- Port Melbourne Community Centre / Trugo Club
- Port Melbourne Community Room
- Port Melbourne Cricket Ground
- Port Melbourne Tennis Club
- Port Melbourne Life Saving Club
- Port Melbourne Bowls Club
- Port Melbourne Yacht Club
- Sandridge Community Centre / Trugo Club
- Sandridge Life Saving Club
- Buckingham Reserve
- Crichton Reserve
- Cyril Letts Reserve
- Edwards Park
- Fred Jackson Reserve
- Lagoon Reserve
- Garden City Reserve
- Morris Reserve
- R F Julier Reserve
- Sangster Reserve

- Walter Reserve
- Perce White Reserve (asset not owned / managed by council)
- Port Melbourne Town Hall (including toy library)

Investment in Port Melbourne this year (2017/18)

- Bay Street Coles public toilet improvements
- Beach Street separated queuing lane works
- Beacon Cove and Cyril Letts Reserve irrigation upgrades (funded from open space reserves)
- Beacon Cove maritime infrastructure works (funded from open space reserves)
- Crichton Reserve renewal and upgrade (funded from open space reserves)
- Elder Smith Reserve bollard removal and installation
- Garden City Reserve unisex accessible public toilet including change table delivery
- George Walter Reserve irrigation upgrades and sign replacements (funded from open space reserves)
- Heath Street, Poolman Street, Spring Street and Stokes Street road renewals
- Ingles Street signalisation
- Liardet Street Community Centre renewals
- Page Reserve bollard, fence and gate replacements
- Port Melbourne Community Centre and Trugo Club minor works
- Port Melbourne Light Rail and Station St shared path improvements (walk and bike plan implementation)
- Port Melbourne Waterfront precinct management
- Sandridge Community Centre and Trugo Club public toilet and kitchen facilities upgrades
- Solar installation at Liardet Street offices and Port Melbourne Town Hall
- Spring Street footpath renewal

We are Montague

Montague is an emerging neighbourhood in Fishermans Bend. Montague is bound by the West Gate Freeway to the north, the St Kilda Light Rail Line (Route 96) to the east, City Road to the south, and Boundary Street to the west.

As part of Fishermans Bend, Montague is envisaged to feature high-density tower development to the north, and finer grain lower-rise development to the south that will respect heritage buildings and adjoining established neighbourhoods.

The area

- Montague is currently a significant employment area featuring a range of businesses, including cafes and a major cluster of creative industries. It is also home to significant cultural and built heritage that further contribute to the neighbourhood's distinct character.
- There are very few current residents (approximately 92 in 2017). By 2027, it is projected that 7,032 people will reside in Montague and 14,053 residents by 2041.
- The Montague Continuing Education Centre provides services to young persons with mild intellectual disabilities. Montague has strong links to the CBD with established light rail routes.

History

Montague contains a mix of nineteenth and early twentieth century low scale residential, commercial and industrial buildings, including some early historic sites related to the growth of Melbourne's port and earliest worker suburbs. Examples include 'corner' hotels such as Wayside Inn, Talbot Inn, Golden Fleece Hotel, Victorian shops and dwellings along City Road and Montague Street, and notable industrial buildings like the former Dunlop factory and Laycock & Sons Woollen Mills.

Servicing the community

The Montague neighbourhood will be home amenities and facilities currently under development.

- Ferrars Street Education and Community Precinct (under construction)
- Community hub (proposed community hub co-located at the Montague Continuing Education Centre)
- Montague Park (soon to be developed at the corner of Buckhurst and Ferrars Street)

Investment in Montague this year (2017/18)

- Depot accommodation renewal
- Ferrars Street Education and Community precinct community facilities, netball courts, open space, streetscape and program management

We are Sandridge / Wirraway

Sandridge / Wirraway will transform over the next 30 years as the Fishermans Bend renewal area develops.

Sandridge / Wirraway is bound by the West Gate Freeway to the north, Williamstown Road to the south, Todd Road to the west and Johnson Street to the east.

By 2051, it is anticipated the neighbourhood will host more than 20,000 jobs, primarily in the Sandridge suburb, as a result of its premium office and commercial location and proposed transport connections with the CBD across the Yarra River. The suburb of Wirraway is envisaged as a family friendly inner city neighbourhood offering a diverse choice of housing.

The area

- There are very few current residents (approximately 307 in 2017). By 2027, it is projected that 5,385 people will reside in Sandridge / Wirraway and 22,745 residents by 2041.
- This neighbourhood adjoins the Fisherman Bend employment precinct (within the City of Melbourne), which is home to 12,500 existing jobs. North Port Oval and its historic grandstand is an anchor for the local community. JL Murphy Reserve is a major green space in Fishermans Bend, with a focus on active recreation, organised sports and leisure activities.

History

The Sandridge area, named after the high ridges of sand created by wind, originally contained extensive wetlands that were rich hunting and gathering grounds for the Boon Wurrung people.

Formerly part of the neighbourhood of Port Melbourne, this primarily industrial area has been home to several prominent historical Australian aircraft design and automotive manufacturing companies, including the former Rootes/Chrysler factory. ‘The Block’ residential development at 164 Ingles Street is an example of retention and reuse of an important heritage building that will convey the place’s history to the future Fishermans Bend community. The building was the office of John Kitchen and Sons P/L, the largest soap making firm in Australia. The building also has architectural significance as an exceptionally imposing commercial building in the Classical Revival style from the interwar period.

Servicing the community

The Sandridge / Wirraway neighbourhood is home to a range of amenities and facilities.

- North Port Oval Reserve and Pavilion
- JL Murphy Reserve (including Dig-In Community Garden)
- Council Depot and Resource Recovery Centre

Investment in Sandridge / Wirraway this year (2017/18)

- Floodlighting renewals at Aanenson Oval at J.L Murphy Reserve (funded from open space reserves)
- JL Murphy Reserve pavilion upgrade planning and design

Section 3: Finances and performance

Our 10-Year Financial Plan

Overview and context

Financial sustainability is a key objective for Council, as a sound financial base is required to continue to deliver valued services to the community. The 10-Year Financial Plan supports Council to achieve financial sustainability, particularly in the face of the significant challenge posed by rates capping. The financial plan also provides the context within which the Council formulates the Council Plan, including our Strategic Resource Plan and Budget and enables the Council to plan for the financial impacts of growth.

The Financial Plan demonstrates the long-term financial implications of Council's revenue and expenditure projections. The Financial Plan is prepared and revised annually to reflect our changing operating environment, including considering information gathered internally and the significant external factors that impact on Council at any point in time.

Key outcomes of the financial plan: identifying the impact of rates capping

We recognise the community concern about the affordability of Council services, with rates and other essential services forming an increasing share of average household expenditure. The community's expectation for better value in service delivery has been reflected in our decision making. We continue to implement initiatives to ensure that our services are delivered in the most efficient and effective manner possible. This includes a successful drive for efficiency savings. Permanent operational savings of $2 million for Budget 2017/18 have been identified, in addition to the $7 million of savings identified for in Budgets 2014/15 and 2016/17.

The Victorian Government has also responded to community affordability concerns by capping rate increases from 2016/17. This plan demonstrates the significant impact that rate capping will have on our financial position and the use of financial levers to ensure financial sustainability.

The level of the rates cap in 2018/19 and beyond is still highly uncertain. The Essential Services Commission (ESC), Victoria's independent economic regulator, recommended that the rates cap be set a level that reflects movements in the consumer price index (CPI) and the wage price index (WPI), as wages form a significant proportion of council's costs.

For 2017/18 the ESC recommended a 2.35 per cent rate cap based on its formula. However, this was not accepted by the Minister of Local Government, and instead a cap of 2.0 per cent based solely on CPI was applied.

In the two years since rate capping was introduced, the Minister has linked the cap to CPI instead of the ESC recommendation. It is likely that future rate caps could be lower than CPI, which poses a risk to our financial sustainability.

The Financial Plan assumes a rate cap based on the ESC recommended methodology. The impact of rates capping is quantified as an accumulated challenge of $35 million over ten years. This represents a major challenge for us (and the sector as a whole) that will require fundamental changes to the way we operate. Our approach to managing this challenge is outlined below.

Rates capping challenge

Rates cap consistent with the ESC methodology	2017/18	2018/19	2019/20	2020/21	2026/27
Rate increase	2.00%	2.20%	2.39%	2.62%	2.13%
Accumulated rates capping challenge ($m)	($0.0)	($1.6)	($3.3)	($5.9)	($35.0)

Initiatives to improve our efficiency and effectiveness will position us favourably to manage this challenge. However, the medium to long-term magnitude of rate capping will require fundamental review of the sustainability of our operations.

A 'business as usual' approach will not be sufficient to meet the rates capping challenge. We will need to consider:

- opportunities to further reduce our cost base without impacting service levels (such as efficiencies identified through process, procurement, and project planning and delivery improvements)
- ensuring that user fees and charges reflect the benefit that individual community members receive (that is, rates funding is not unreasonably subsidising services that provide private benefit)
- service delivery options, including changes to the way services are targeted and delivered and consideration of service level reductions in areas of lower strategic priority
- applying to the ESC for rate increases above CPI, where those increases are justifiable to the community
- a prudent and fiscally responsible approach towards the use of new debt for strategic property acquisitions, funding community capital works or operating projects that will provide intergenerational community benefit, and initiatives that deliver revenue streams to repay debt
- using reserves where appropriate to invest in one-off new or improved assets where this is considered more efficient than the use of debt.

Other aspects of the financial plan, such as expenditure and other revenue are currently based on business as usual planning. See the *Financial statements* section for details.

Growth in Port Phillip

We are facing a period of significant growth, much of which through development in Fishermans Bend. Current planning projections provide for a possible population increase of 120,000 people in the next 40 years, over 100 per cent of our current population. We are continuing to invest in planning for growth in the municipality, including Fishermans Bend, to ensure that service outcomes meet the expectations of current and future generations.

We are working closely with the Victorian Government to deliver a package of work in the Montague precinct of Fishermans Bend, where development is occurring first. This plan includes financial outcomes from works agreed with the Victorian Government and known proposals only.

The Victorian Government is currently preparing a Developer Contributions Plan for Fishermans Bend that will outline future investment needs and funding sources. This is not expected to be complete until later in 2017. Due to the uncertainty of the future investment profile, no further investment has been incorporated in this plan, beyond the immediate proposal for the Montague Precinct. We will update our financial planning for Fishermans Bend as new information becomes available.

Climate change and renewing community assets

We own and control a wide range of assets from land and buildings to roads, drains, footpaths and open space. The total value of our fixed assets is $2.6 billion and is largely the product of investment by prior generations of residents. Consistent with the trend across the local government sector, we are facing escalating costs to maintain and renew our ageing asset base.

Much of the City is only one to three metres above sea level and therefore vulnerable to the impacts of climate change. Flooding of coastal properties and public amenities, storm damage to infrastructure and beach erosion are examples of climate change impacts. To mitigate against the impacts of climate change, upgrades and renewal of assets will need to be designed and built to suit. This means additional costs. This plan reflects increasing renewals expenditure due to an expanding asset base, and cost escalation for delivering renewals and mitigating against the impacts of climate change.

A major focus is continued improvements to our asset planning and management capability. Insufficient investment in asset renewal will result in assets deteriorating much faster than necessary, adding cost in the long run and potentially compromising service levels.

Impacts of State and Commonwealth Government legislation and policy

The transfer of responsibilities and costs from other levels of government has been well documented and continues to be a significant issue. Types of ‘cost shifting’ and additional taxes include:

- direct removal of funding, such as the freeze in indexation of grants commission funding and the cessation of $250,000 funding for adventure playgrounds
- indirect impact of government policies that formally or informally transfer service responsibility, for example we currently allocate resources to support social housing ($500,000), a public policy area that in many respects should be the responsibility of State and Commonwealth governments
- introduction of the congestion levy, which is being partly funded by a contribution of rates revenue to mitigate the significant negative impact on visitation and trade in the areas where the levy applies (in addition to an increase in parking fees)
- additional capital expenditure required to ensure our buildings are compliant with the Disability Discrimination Act and Building Code.

Financial outcomes

Our decision-making reflects principles of sound financial management, to ensure our finances remain prudent and sustainable.

This plan assesses our financial performance using key financial indicators. See the *Measuring performance* section for details.

Cash surplus/deficit – This is a measure of the cash inflows from all sources of revenue and the cash outflows for all expenditure (capital and operating expenditure). The Financial Plan presents a balanced budget over the 10-year planning horizon. However, it is important to note that we will have to make significant financial savings to meet the rate capping challenge (quantified as $35 million over 10 years).

Borrowings – No further investment is included in this plan beyond the immediate proposal for the Montague precinct, due to the uncertainty of the future investment profile. It is likely that investing for growth will require the prudent use of borrowing. We have the capacity to borrow up to $68 million and still achieve a low risk rating in accordance with VAGO's financial sustainability risk assessment. The Financial Plan assumes refinancing of existing loans $7.5 million in 2021/22 for a further 10-year interest only terms.

Working capital – This is a measure of current assets to current liabilities in determining our ability to pay existing liabilities that fall within the next 12 months. The Financial Plan expects this measure to stay above 100 per cent, peaking at 242 per cent and dipping to a low of 194 per cent.

Infrastructure renewal gap – This measures spending on existing assets through renewal and upgrade compared to depreciation. A ratio of 100 per cent or higher indicates that spending on existing assets is moving at a faster rate than the rate of asset deterioration. The Financial Plan forecasts for significant investment in existing assets over the next 10 years, achieving a renewal gap ratio between 112 per cent and 126 per cent. This recognises that in the past two years, we have been below 100 per cent and the need for upgrades driven by safety (The Building Code of Australia under the *Building Act 1975*) and accessibility (*Disability Discrimination Act 1992*).

Financial sustainability

Despite being in a very strong financial position, rates capping presents a significant threat to our financial sustainability. To manage this challenge, we continue to consider the principles of sound financial management prescribed in the *Local Government Act 1989*:

- prudently manage financial risks related to debt, assets and liabilities
- provide reasonable stability in the level of the rates burden
- consider the financial impacts of Council decisions on future generations
- provide full, accurate and timely disclosure of financial information.

We use the Victorian Auditor General Office (VAGO) financial indicators to measure financial sustainability risk. Our strategy is to ensure we achieve an overall low risk rating. As demonstrated below, the VAGO financial indicators over the financial plan show we are financially sustainable.

		Forecast	Budget	Projections								
Indicator	**Indicator Targets**	**2016/17**	**2017/18**	**18/19**	**19/20**	**20/21**	**21/22**	**22/23**	**23/24**	**24/25**	**25/26**	**26/27**
Net Result %	Greater than 0%	5.9%	(3.0%)	7.5%	6.4%	7.9%	6.6%	6.3%	5.5%	4.9%	4.2%	3.8%
Working Capital	Working Capital Ratio >100%	227%	202%	213%	217%	194%	235%	240%	242%	241%	234%	224%
Internal Financing	Net cashflow from operations to net capital expenditure >100%	112%	78%	117%	110%	120%	112%	113%	110%	106%	102%	99%
Indebtedness	Indebtedness ratio <40%	6.0%	5.8%	5.6%	5.5%	1.8%	5.2%	5.1%	5.0%	4.9%	4.8%	4.7%
Capital Replacement	Capital to depreciation >150%	156%	148%	159%	159%	157%	156%	153%	151%	150%	150%	151%
Infrastructure Renewal Gap	Renewal & upgrade to depreciation >100%	117%	122%	126%	123%	119%	123%	121%	119%	119%	119%	119%
Overall Financial Sustainable Risk Rating		Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

We also use our own principles to support financial sustainability, which aim to ensure continued operating viability, sustainable funding of assets and the ability to absorb the impact of unexpected budget shocks.

Financial principle	Measures
1. Council will have fair, affordable and stable revenue and financing mechanisms.	1. Funding is prioritised towards achieving Council strategies and priorities and in accordance with key policies.
	2. The distribution of costs and revenues to be fair and reasonable with a level of consistency in treatment.
	3. The capacity of people to pay will be considered in determining the appropriate mix of funding mechanisms.
	4. Where benefits from an investment are to be enjoyed by future generations, those future generations should contribute to the cost.

Financial principle	Measures
	5. Those who directly benefit from or cause expenditure will make a contribution towards funding it.
	6. Funding mechanisms will be transparent, practical to implement and not involve unreasonable transaction costs.
	7. Growth in universal services will be funded through growth in rates and the broader revenue base associated with growth.
	8. Rate revenue will remain at a stable percentage of total underlying revenue (target between 60 per cent and 65 per cent of total underlying revenue) and other revenue will be strengthened over the medium term to reduce reliance on rate revenue.
2. Council will have an ongoing sustainable and balanced budget, and ideally a small cash surplus.	9. Expenditure on operating activities will be in line with, or lower than, income from operating activities, producing a surplus. Any surplus achieved will be used to repay debt or carried over to subsequent years.
	10. Net cash outflow from operational, capital and financing activities will be in line with, or lower than, cash inflow from operational activities, producing a cash surplus. A positive cash surplus balance any budgeted year is targeted.
	11. Net cash flow from operations is to generate sufficient cash to fund capital works over the long term. Internal financing ratio to be greater than 100 per cent.
3. Council's asset base will be maintained, enhanced and expanded.	12. The total pool of assets will increase in value each year – excluding the effect of any revaluation adjustments and sale of assets of lower strategic value.
	13. Capital expenditure compared to depreciation is to be greater or equal to 150 per cent over a medium to long term planning horizon.
	14. Assets will be managed in accordance with community need, optimum utilisation and long-term efficiency.
	15. Capital expenditure on existing assets (asset renewals and upgrades) will be higher than depreciation over a medium to long term planning horizon.
4. Capital will be managed in the most efficient manner possible.	16. General reserves will be maintained at levels sufficient to ensure operational liquidity. Working Capital Liquidity Ratio (current assets compared to current liabilities) is to be at least 100 per cent.
	17. Council will consider borrowings for property acquisitions, large capital works or operating projects that provide inter-generational community benefit, and initiatives that deliver sufficient revenue streams to service the debt.
	18. Prudent use of debt shall be subject to achieving: o indebtedness ratio (Non-current liabilities compared to own source revenue) below 40 per cent

Financial principle	Measures
	o loans and borrowings compared to rates below 70 per cent o loans and borrowing repayments compared to rates below 20 per cent.
	19. Reserves may be built up over time to enable part funding of periodic large capital expenditure items where this is considered more efficient than the use of debt.
5. Council will proactively develop and lead an efficient and effective organisational culture.	20. In order to deliver better value to our growing community, we will support developing policy and practice in the workplace to increase organisational innovation, effectiveness and efficiency.
	21. The organisation will target delivery of productivity and efficiency savings of greater than one per cent of operating expenditure less depreciation per annum.

In addition to our principles of sound financial management, financial decision-making is guided by key strategies.

Use of rate revenue

Our main revenue source is assessment rates on properties in the municipality. Our rating strategy is supported by the following principles:

- Local government rates are levied in accordance with a ratepayer’s capacity to pay as measured by the Net Annual Value (NAV) of property owned within the municipality. Rates levied are therefore directly proportional to the NAV of individual properties. Other measures such as concessions, deferral of rate payments and other discounts to fees and charges will be applied to address equity and access issues.
- Universal services are funded from the broadest forms of income - rates and parking revenue.
- Fees for subsidised services provided by Council in a market, such as childcare and aged care, will be based on a clearly articulated policy position. To achieve equitable outcomes, these services will be funded through a mix of user charges, government grants and rates.
- Specific individual regulatory services such as, but not limited to, animal licences, parking permits and planning permits will be funded, where possible, through user charges (some may be set by statute) and otherwise through rates.
- Special rates are levied against retail tenants in various shopping precincts and this rate income is then distributed to centralised trader associations to spend on improving the shopping strip for the benefit of all traders.
- Rate concessions are available for recreational land and pensioners. We are one of only a few councils that provide a pensioner rate rebate in addition to the Victorian Government pensioner rate rebate.
- Self-funded retirees are entitled to request a deferral of their rates indefinitely at a discounted interest rate. Persons experiencing financial hardship may also, subject to application and financial assessment, access this benefit.

Use of borrowings

Our borrowings strategy is supported by the following principles:

- Borrowings will not be used to fund ongoing operations.
- A prudent and fiscally responsible approach will be applied in considering any proposals for new debt to deliver our objectives.
- Where debt is increased, the servicing costs ideally need to be funded from future revenue streams or cost savings that can be expected from the investment of the funds raised.
- Borrowings are also appropriate for the purpose of funding large non-recurrent capital works or operating projects that can be expected to provide benefits to future generations.
- Debt will be managed as part of an efficient capital management policy and repaid when it is prudent to do so.

Infrastructure and asset management

Our infrastructure and asset management strategy is supported by the following principles:

- We are committed to spending what is required to renew and enhance our asset base to ensure ongoing fitness for use. The capital budget takes into account expected asset deterioration, increased asset utilisation (capacity requirements) and technology development.
- Renewal of existing assets is generally funded from the depreciation expense that is provided each year. This needs to be applied to the different asset portfolios (drainage, roads, buildings and land improvements) to ensure consistency across the entire network of assets that we manage.
- Maintaining capital expenditure at levels that will replenish existing assets is a higher priority than reducing debt and investing in new assets, as asset funding shortfalls will transfer the liability to future generations.
- Asset acquisitions and capital works projects are funded from rate revenue, reserves, sale of existing assets, government grants or external borrowings.
- Our investment and asset management strategies, purchasing arrangements and other financial tools should encourage environmental responsibility.

Financial resource planning assumptions and risks

Financial assumptions

- The Financial Plan is updated annually following a review of internal financial results and changes in the external environment. Following this, scenario analysis is performed to test key assumptions and to prepare a ten year forecast that best represents our expected financial performance given those assumptions.

- The financial information used for 2017/18 (the base year) is based on the February 2017 forecast. The revenue and expenditure associated with growth has been separated from all other activities for the purposes of this Financial Plan. The assumptions associated with growth are included in the *Planning for growth* section.
- A detailed explanation of planning assumptions is provided below.

Item	2017/18	2018/19	2019/20	2020/21	2026/27
Consumer Price Index (CPI)	2.10%	2.10%	2.10%	2.30%	2.30%
Based on the most recent forecast from the Deloitte Access Economic Business Outlook for the Victorian Consumer Price Index.					
Rates cap – base case (ESC recommended methodology)	2.00%	2.20%	2.39%	2.62%	2.13%
There remains some uncertainty as to the level of the rates cap in future years. For the purposes of the financial plan, Council has used forecasts from the Deloitte Access Economic Business Outlook for the Consumer Price Index and Wage Price Index.					
Growth in the rate base	1.3% per annum based on latest population growth data from Profile ID and Fisherman's Bend Taskforce.				
Parking revenue	Parking fees is linked to the CPI plus 0.25 percentage points per annum from 2018/19 and fines by 2.0% per annum.				
User fees and charges	User fees and charges is linked to the CPI plus 0.25 percentage points per annum from 2018/19.				
Open space contributions	Remains constant at $4.1 million per annum plus forecast contributions from Fisherman's Bend.				
Government grants	Operating grants increased by CPI. Capital grants are based on identified funding. The out-years set at $1.3 million.				
Interest received	2.10%	2.50%	2.50%	3.60%	3.60%
Based on the Deloitte Access Economic Business Outlook forecast for the 90 day bank bill rate plus 50 basis points.					
Employee costs	2..00%	2.00%	2.30%	2.30%	2.30%
Employee benefits to increase as per latest EBA 2.0% for 2017/18 and 2018/19. The out-years are linked to CPI.					
Contract services, professional services, materials and other expenditure	Increased by CPI or contractual agreements.				

Item	2017/18	2018/19	2019/20	2020/21	2026/27
Utility costs	Based on forecasts from Australian Energy Market Operators, utility costs are expected to be higher than CPI at 3.28% per annum.				
Service growth	The cost of service growth is equivalent to the increase in rates revenue attributable to increase in the rates base (that is, it is assumed that the benefit of new assessments is wholly offset by the cost to service them).				
Depreciation	Depreciation has been increased as a product of new assets being created consistent with the planned capital program.				
Operating projects	Total operating projects to be capped to $4.2 million from 2018/19 and increases by annual CPI.				
Capital projects	Capital projects consistent with the detailed planned over the Strategic Resource Plan. Annual capital project budgets will target renewal gap ratio greater than 100% and capital replacement ratio greater than 150%.				
Borrowings	Assumes refinancing of $7.5 million due to mature in 2021/22 for a further 10-year interest only terms. We will review borrowings when reviewing and developing the Council Plan and Budget. The prudent use of borrowing is to be consistent with our principles of smoothing out major financial shocks, inter-generational significant projects and for growth related capital projects.				
Reserves	The use of reserves remains consistent with past practice. This includes the following assumptions: • open space receipts and out-goings are equivalent (each year) • sustainable transport reserve receipts and out-goings are equivalent (each year) • a debt repayment reserve is used to accumulate the capital necessary to retire council debt.				

Financial risks

Our most significant financial risk is the impact of rates capping. The Financial Plan assumes rate capping based on the ESC recommended methodology. Since its introduction, the Minister for Local Government has prescribed rates lower than the ESC recommendation. Every 0.1 per cent lower than the ESC methodology equates to a $119,000 reduction per annum in revenue. Our approach for managing this risk is outlined above.

Other financial risks include:

- More subdued property development, which may result in the rates revenue base growing at a lower rate than the current 1.3 per cent growth assumption, (every 0.1 per cent reduction in growth equates to a $119,000 revenue loss).
- Lower than expected parking revenue, our second largest revenue source. Parking revenue is historically volatile and is impacted by the macro-economic environment (a 1.0 per cent reduction in revenue from parking fees and fines equates to a $300,000 revenue loss).
- Uncertainty regarding Fishermans Bend. There may be a large funding gap between the infrastructure desired and that able to be funded. A failure to appropriately budget for the costs of running and looking after new assets in Fishermans Bend is also a risk.

- The possibility of a future unfunded defined benefits superannuation call occurring.
- Future reductions in funding from other levels of government or increases in cost shifting.
- A major, unexpected, asset renewal issue.

Our sound financial position with low levels of borrowing and healthy reserves balance, enable us to respond to these financial risks in the ten-year period. If necessary, we can also apply to the ESC for an above rates cap increase.

Planning for growth

In November 2014, the State Government's Metropolitan Planning Authority prepared a Draft Fishermans Bend Urban Renewal Area Developer Contributions Plan (DCP) which outlines approximately $376 million of local infrastructure and open space investment (in 2013 dollar terms). Infrastructure investment in Fishermans Bend will be funded through revenue associated with the DCP Levy, open space contributions, and direct State and local government funding.

Development in Fishermans Bend will create unprecedented financial challenges as we manage making significant investment ahead of future revenue streams. Work is underway to model the financial impact on Council, but uncertainty remains regarding the timing and extent of infrastructure funding that we will provide.

We are working closely with the Victorian Government to deliver works in the Montague precinct, including:

- community facilities and netball courts in a joint development, with a primary school at Ferrars Street, South Melbourne expected to be open in early 2018
- acquisition of land for open space on Buckhurst Street, South Melbourne adjacent to the Ferrars Street community centre.

Further proposed capital investment includes:

- streetscape works to make the Ferrars Street school safe and accessible
- remediation and improvement works for the acquired land to make it fit for open space use.

Non-financial resources

Council culture

To strengthen the delivery of the Council Plan, we have developed a *Community First* organisational strategy. All activities are viewed through the community's eyes, ensuring delivery of the best possible services, projects and outcomes for the community.

Council staff

Our employees are a valuable resource. We have a diverse workforce of committed individuals with an extensive range of skills and experience. We aspire to be an employer of choice and to operate collectively as one organisation focused on achieving the Council Plan objectives. To enable this, we are committed to professional development, mentoring, open communication and maintaining a safe and respectful working environment.

In response the financial challenges we face, a significant investment has been made in building the capability of staff, including to:

- manage and prioritise projects with the support of new processes and systems
- focus on identify and realise efficiency savings
- achieve better service and financial outcomes through continuous process improvement initiatives
- perform detailed service reviews with an objective of improving overall value
- make more informed asset management decisions
- leverage technology to improve customer service
- undertake long-term planning and performance measurement.

Financial statements

This section presents our Financial Statements and Statement of Human Resources. Budget information for 2017/18 to 2020/21 has been extracted from the Strategic Resource Plan.

This section includes the following budgeted financial statements in accordance with the Local Government Act 1989 and the Local Government Model Financial Report:

- Comprehensive income statement
- Income statement converted to cash
- Balance sheet
- Statement of changes in equity
- Statement of cash flows
- Statement of capital works
- Capital projects 2017/18
- Summary of capital works expenditure 2017-21
- 2017-27 capital program
- Budget 2017/18 operating projects
- Schedule of reserve movements
- Statement of human resources
- Summary of planned human resources
- Grants – operating
- Grants – capital
- Statement of borrowings

Comprehensive income statement

	Notes	Forecasts 2016/17 $'000	Budget 2017/18 $'000	Projections 2018/19 $'000	2019/20 $'000	2020/21 $'000	2021/22 $'000	2022/23 $'000	2023/24 $'000	2024/25 $'000	2025/26 $'000	2026/27 $'000
Income												
Rates and charges		117,201	120,769	125,205	130,038	135,350	140,545	145,862	151,300	156,859	162,536	168,330
Statutory fees and fines:												
• Parking fines		17,992	18,637	19,010	19,390	19,778	20,174	20,577	20,989	21,409	21,837	22,274
• Other statutory fees and fines		3,991	4,073	4,159	4,246	4,344	4,444	4,546	4,651	4,758	4,867	4,979
User fees:												
• Parking fees		16,230	16,296	16,695	17,358	17,856	18,326	18,799	19,275	19,753	20,233	20,715
• Other user fees		17,708	18,031	19,273	19,782	20,058	20,587	21,119	21,657	22,194	22,735	23,277
Grants - operating		11,473	9,421	10,444	10,663	10,908	11,159	11,416	11,679	11,948	12,223	12,504
Grants - capital		2,534	4,460	4,585	1,400	3,400	1,300	1,300	1,300	1,300	1,300	1,300
Contributions - monetary	1	8,167	7,830	4,488	4,773	4,884	5,063	5,131	5,252	5,331	5,373	5,405
Other income		13,123	13,406	14,288	14,332	16,024	15,602	16,246	16,232	16,910	16,535	16,961
Total Income		**208,419**	**212,923**	**218,147**	**221,982**	**232,602**	**237,200**	**244,996**	**252,335**	**260,462**	**267,639**	**275,745**
Expenses												
Employee costs		83,863	88,637	91,636	94,457	97,856	101,810	105,925	110,209	114,668	119,308	123,622
Materials and services	2	74,399	77,074	69,191	71,206	72,998	74,993	77,401	80,413	83,611	86,246	89,060
Bad and doubtful debts		3,399	3,478	3,478	3,478	3,549	3,621	3,694	3,769	3,845	3,923	4,002
Depreciation and amortisation		22,457	24,430	25,360	26,318	27,358	28,432	29,541	30,686	31,868	33,088	34,348
Borrowing costs		458	460	490	520	550	583	714	744	774	804	834
Other expenses	3	9,730	17,445	8,861	9,047	9,255	9,468	9,686	9,909	10,137	10,370	10,609
Net (gain)/loss on disposal of property, infrastructure, plant and equipment	4	1,886	7,736	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715
Total Expenses		**196,192**	**219,260**	**201,731**	**207,742**	**214,280**	**221,622**	**229,677**	**238,444**	**247,618**	**256,454**	**265,190**
Operating Surplus/(Deficit) for the year	**5**	**12,227**	**(6,337)**	**16,416**	**14,240**	**18,322**	**15,578**	**15,319**	**13,891**	**12,844**	**11,185**	**10,555**

Notes

- Contributions – monetary – The Budget 2017/18 includes $3.3 million from the Development Contribution Plan (DCP) for Fishermans Bend Ferrars St Precinct works. Due to the uncertainty of planned works in Fishermans Bend, no further DCP are included in future years.
- Materials and services – The Budget 2017/18 includes $5.3 million of Ferrars St Precinct project works that will not be added to Council's asset as they are for building demolition, soil remediation and contributions for the community centre which will be on a 30 year lease.
- Other expenses – The Budget 2017/18 includes a one-off $8.95 million Council cash contribution for the Victoria Pride Centre to be situated in St Kilda.
- Net loss from disposal of property, infrastructure, plant and equipment – The Budget 2017/18 includes a property transfer as a part of Council's contribution to the Victoria Pride Centre ($1.56 million) and a Committee of Management property to be relinquished ($3.56 million).
- Operating Surplus for the year – An operating deficit is expected in the Budget 2017/18 as the items identified under notes 2 to 4 totalling $19.4 million. Excluding these items would result in an operating surplus of $13.1 million.

Income statement converted to cash

	Notes	Forecasts 2016/17 $'000	Budget 2017/18 $'000	Projections 2018/19 $'000	2019/20 $'000	2020/21 $'000	2021/22 $'000	2022/23 $'000	2023/24 $'000	2024/25 $'000	2025/26 $'000	2026/27 $'000
Operating Surplus/ (Deficit) for the year		**12,227**	**(6,337)**	**16,416**	**14,240**	**18,322**	**15,578**	**15,319**	**13,891**	**12,844**	**11,185**	**10,555**
Adjustments for non-cash operating items:												
• Add back depreciation		22,457	24,430	25,360	26,318	27,358	28,432	29,541	30,686	31,868	33,088	34,348
• Add back written-down value of asset disposals		6,451	9,246	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
• Add back balance sheet work in progress reallocated to operating		1,200	1,200	1,225	1,251	1,280	1,309	1,339	1,370	1,402	1,434	1,467
Adjustments for investing items:												
• Less capital expenditure (deferrals funded from reserves)		(35,104)	(36,273)	(40,343)	(41,921)	(42,862)	(44,439)	(45,162)	(46,201)	(47,865)	(49,665)	(51,856)
• Less capital expenditure deferrals to next financial year		-	-	-	-	-	-	-	-	-	-	-
Adjustments for financing items:												
• Less Loan Repayments		-	-	-	-	-	(7,500)	-	-	-	-	-
• Less Lease Repayments		(500)	(700)	(670)	(640)	(610)	(580)	(550)	(520)	(490)	(460)	(430)
• Add New Borrowings		-	-	-	-	-	7,500	-	-	-	-	-
Adjustments for reserve movements:												
• Statutory Reserve Drawdown/ (Replenish)		(4,201)	(2,205)	(1,255)	(470)	(770)	-	-	-	-	-	-
• Discretionary Reserve Drawdown/ (Replenish)		(5,054)	10,120	(3,883)	(1,858)	(5,631)	(3,355)	(3,402)	(2,300)	(799)	1,351	2,949
Cash Surplus/(Deficit) for the Year		**(1,733)**	**(519)**	**(151)**	**(80)**	**87**	**(55)**	**86**	**(74)**	**(40)**	**(67)**	**34**
Opening Balance - Cash Surplus		2,623	890	371	221	141	227	173	259	184	144	77
Closing Cash Surplus Balance		**890**	**371**	**221**	**141**	**227**	**173**	**259**	**184**	**144**	**77**	**110**

Balance sheet

	Notes	Forecast 2016/17 $'000	Budget 2017/18 $'000	Projections 2018/19 $'000	2019/20 $'000	2020/21 $'000	2021/22 $'000	2022/23 $'000	2023/24 $'000	2024/25 $'000	2025/26 $'000	2026/27 $'000
ASSETS												
Current assets												
Cash and cash equivalents		64,415	56,900	62,799	65,980	73,613	78,092	82,794	86,271	88,320	88,231	86,685
Trade and other receivables		11,718	11,747	11,776	11,805	11,835	11,865	11,895	11,925	11,955	11,985	12,015
Other financial assets		4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Non current assets classified as held for sale		-	-	-	-	-	-	-	-	-	-	-
Other assets		1,847	1,852	1,857	1,862	1,867	1,872	1,877	1,882	1,887	1,892	1,897
Total current assets		**81,980**	**74,499**	**80,432**	**83,647**	**91,315**	**95,829**	**100,566**	**104,078**	**106,162**	**106,108**	**104,597**
Non-current assets												
Investments in associates and joint ventures		356	356	356	356	356	356	356	356	356	356	356
Other financial assets		235	235	235	235	235	235	235	235	235	235	235
Property, infrastructure, plant and equipment		2,668,683	2,670,737	2,783,591	2,795,540	2,913,873	2,926,108	3,049,766	3,061,388	3,190,893	3,203,453	3,340,217
Total non-current assets		**2,669,274**	**2,671,328**	**2,784,182**	**2,796,131**	**2,914,464**	**2,926,699**	**3,050,357**	**3,061,979**	**3,191,484**	**3,204,044**	**3,340,808**
TOTAL ASSETS		**2,751,254**	**2,745,827**	**2,864,614**	**2,879,778**	**3,005,779**	**3,022,528**	**3,150,923**	**3,166,057**	**3,297,646**	**3,310,152**	**3,445,405**
LIABILITIES												
Current liabilities												
Trade and other payables		17,455	17,891	18,338	18,796	19,266	19,748	20,242	20,748	21,267	21,799	22,344
Trust funds and deposits		5,115	5,243	5,374	5,508	5,646	5,787	5,932	6,080	6,232	6,388	6,548
Provisions		12,621	12,937	13,235	13,539	14,003	14,483	14,979	15,492	16,023	16,572	17,140
Interest-bearing loans and borrowings		860	830	800	770	8,240	710	680	650	620	590	560
Total current liabilities		**36,051**	**36,901**	**37,747**	**38,613**	**47,155**	**40,728**	**41,833**	**42,970**	**44,142**	**45,349**	**46,592**
Non-current liabilities												
Provisions		2,930	3,003	3,072	3,143	3,251	3,362	3,477	3,596	3,719	3,846	3,978
Interest-bearing loans and borrowings		8,170	8,157	8,144	8,131	618	8,105	8,092	8,079	8,066	8,053	8,040
Total non current liabilities		**11,100**	**11,160**	**11,216**	**11,274**	**3,869**	**11,467**	**11,569**	**11,675**	**11,785**	**11,899**	**12,018**
TOTAL LIABILITIES		**47,151**	**48,061**	**48,963**	**49,887**	**51,024**	**52,195**	**53,402**	**54,645**	**55,927**	**57,248**	**58,610**
NET ASSETS		**2,704,103**	**2,697,766**	**2,815,651**	**2,829,891**	**2,954,755**	**2,970,333**	**3,097,521**	**3,111,412**	**3,241,719**	**3,252,904**	**3,386,795**
EQUITY												
Accumulated surplus		633,332	634,910	646,187	658,100	670,020	682,243	694,161	705,752	717,797	730,333	743,837
Asset revaluation reserve		2,029,373	2,029,373	2,130,842	2,130,842	2,237,384	2,237,384	2,349,253	2,349,253	2,466,716	2,466,716	2,590,052
Other reserves		41,398	33,483	38,621	40,950	47,351	50,705	54,107	56,407	57,206	55,855	52,906
TOTAL EQUITY		**2,704,103**	**2,697,766**	**2,815,651**	**2,829,891**	**2,954,755**	**2,970,333**	**3,097,521**	**3,111,412**	**3,241,719**	**3,252,904**	**3,386,795**

Statement of changes in equity

	Total $'000	Accumulated Surplus $'000	Revaluation Reserve $'000	Other Reserves $'000
2018				
Balance at beginning of the financial year	**2,704,103**	633,332	2,029,373	41,398
Comprehensive result	**(6,337)**	(6,337)	-	-
Net asset revaluation increment(decrement)	**-**	-	-	-
Transfer to other reserves	**-**	(11,627)	-	11,627
Transfer from other reserves	-	19,542	-	(19,542)
Balance at end of the financial year	**2,697,766**	**634,910**	**2,029,373**	**33,483**
2019				
Balance at beginning of the financial year	**2,697,766**	634,910	2,029,373	33,483
Comprehensive result	**16,416**	16,416	-	-
Net asset revaluation increment(decrement)	**101,469**	-	101,469	-
Transfer to other reserves	**-**	(11,955)	-	11,955
Transfer from other reserves	**-**	6,817	-	(6,817)
Balance at end of the financial year	**2,815,651**	**646,187**	**2,130,842**	**38,621**
2020				
Balance at beginning of the financial year	**2,815,651**	646,187	2,130,842	38,621
Comprehensive result	**14,240**	14,240	-	-
Net asset revaluation increment(decrement)	**-**	-	-	-
Transfer to other reserves	**-**	(11,108)	-	11,108
Transfer from other reserves	**-**	8,780	-	(8,780)
Balance at end of the financial year	**2,829,891**	**658,100**	**2,130,842**	**40,950**
2021				
Balance at beginning of the financial year	**2,829,891**	658,100	2,130,842	40,950
Comprehensive result	**18,322**	18,322	-	-
Net asset revaluation increment(decrement)	**106,542**	-	106,542	-
Transfer to other reserves	**-**	(15,781)	-	15,781
Transfer from other reserves	**-**	9,380	-	(9,380)
Balance at end of the financial year	**2,954,755**	**670,020**	**2,237,384**	**47,351**

	Total $'000	Accumulated Surplus $'000	Revaluation Reserve $'000	Other Reserves $'000
2022				
Balance at beginning of the financial year	**2,954,755**	670,020	2,237,384	47,351
Comprehensive result	**15,578**	15,578	-	-
Net asset revaluation increment(decrement)	**-**	-	-	-
Transfer to other reserves	**-**	(10,568)	-	10,568
Transfer from other reserves	**-**	7,213	-	(7,213)
Balance at end of the financial year	**2,970,333**	**682,243**	**2,237,384**	**50,705**
2023				
Balance at beginning of the financial year	**2,970,333**	682,243	2,237,384	50,705
Comprehensive result	**15,319**	15,319	-	-
Net asset revaluation increment(decrement)	**111,869**	-	111,869	-
Transfer to other reserves	**-**	(10,683)	-	10,683
Transfer from other reserves	**-**	7,281	-	(7,281)
Balance at end of the financial year	**3,097,521**	**694,161**	**2,349,253**	**54,107**
2024				
Balance at beginning of the financial year	**3,097,521**	694,161	2,349,253	54,107
Comprehensive result	**13,891**	13,891	-	-
Net asset revaluation increment(decrement)	**-**	-	-	-
Transfer to other reserves	**-**	(9,702)	-	9,702
Transfer from other reserves	**-**	7,402	-	(7,402)
Balance at end of the financial year	**3,111,412**	**705,752**	**2,349,253**	**56,407**
2025				
Balance at beginning of the financial year	**3,111,412**	705,752	2,349,253	56,407
Comprehensive result	**12,844**	12,844	-	-
Net asset revaluation increment(decrement)	**117,463**	-	117,463	-
Transfer to other reserves	**-**	(8,480)	-	8,480
Transfer from other reserves	**-**	7,681	-	(7,681)
Balance at end of the financial year	**3,241,719**	**717,797**	**2,466,716**	**57,206**

	Total $'000	Accumulated Surplus $'000	Revaluation Reserve $'000	Other Reserves $'000
2026				
Balance at beginning of the financial year	**3,241,719**	717,797	2,466,716	57,206
Comprehensive result	**11,185**	11,185	-	-
Net asset revaluation increment(decrement)	**-**	-	-	-
Transfer to other reserves	**-**	(8,572)	-	8,572
Transfer from other reserves	**-**	9,923	-	(9,923)
Balance at end of the financial year	**3,252,904**	**730,333**	**2,466,716**	**55,855**
2027				
Balance at beginning of the financial year	**3,252,904**	730,333	2,466,716	55,855
Comprehensive result	**10,555**	10,555	-	-
Net asset revaluation increment(decrement)	**123,336**	-	123,336	-
Transfer to other reserves	**-**	(8,655)	-	8,655
Transfer from other reserves	**-**	11,605	-	(11,605)
Balance at end of the financial year	**3,386,795**	**743,837**	**2,590,052**	**52,906**

Statement of cash flows

		Forecasts	Budget	Projections								
		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
	Notes	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Cash flows from operating activities												
Rates and charges		117,201	120,769	125,205	130,038	135,350	140,545	145,862	151,300	156,859	162,536	168,330
Statutory fees and fines												
• Parking fines		14,682	15,248	15,621	16,001	16,318	16,642	16,972	17,309	17,653	18,003	18,361
• Other statutory fees and fines		3,989	4,071	4,157	4,244	4,342	4,442	4,544	4,649	4,756	4,865	4,977
User fees												
• Parking fees		16,222	16,288	16,687	17,350	17,848	18,318	18,791	19,267	19,745	20,225	20,707
• Other user fees		17,600	17,923	19,165	19,674	19,949	20,478	21,010	21,548	22,085	22,626	23,168
Grants - operating		11,473	9,421	10,444	10,663	10,908	11,159	11,416	11,679	11,948	12,223	12,504
Grants - capital		2,534	4,460	4,585	1,400	3,400	1,300	1,300	1,300	1,300	1,300	1,300
Contributions - monetary		8,167	7,830	4,488	4,773	4,884	5,063	5,131	5,252	5,331	5,373	5,405
Other receipts		13,118	13,401	14,283	14,327	16,019	15,597	16,241	16,227	16,905	16,530	16,956
Net trust funds taken/(repaid)		125	128	131	134	138	141	145	148	152	156	160
Employee costs		(83,301)	(88,248)	(91,269)	(94,082)	(97,284)	(101,219)	(105,314)	(109,577)	(114,014)	(118,632)	(122,922)
Materials and services		(72,773)	(75,438)	(67,519)	(69,497)	(71,248)	(73,202)	(75,568)	(78,537)	(81,690)	(84,280)	(87,048)
Other payments	1	(9,730)	(17,445)	(8,861)	(9,047)	(9,255)	(9,468)	(9,686)	(9,909)	(10,137)	(10,370)	(10,609)
Net cash provided by operating activities		**39,307**	**28,408**	**47,117**	**45,977**	**51,370**	**49,796**	**50,843**	**50,657**	**50,893**	**50,555**	**51,289**
Cash flows from investing activities												
Payments for property, infrastructure, plant and equipment	2	(35,104)	(36,273)	(40,343)	(41,921)	(42,862)	(44,439)	(45,162)	(46,201)	(47,865)	(49,665)	(51,856)
Proceeds from the sale of property, infrastructure, plant and equipment		4,565	1,510	285	285	285	285	285	285	285	285	285
Payments for investments		-	-	-	-	-	-	-	-	-	-	-
Proceeds from sale of investments		-	-	-	-	-	-	-	-	-	-	-
Net cash used in investing activities		**(30,539)**	**(34,763)**	**(40,058)**	**(41,636)**	**(42,577)**	**(44,154)**	**(44,877)**	**(45,916)**	**(47,580)**	**(49,380)**	**(51,571)**
Cash flows from financing activities												
Finance costs		(458)	(460)	(490)	(520)	(550)	(583)	(714)	(744)	(774)	(804)	(834)
Proceeds from borrowings	3	-	-	-	-	-	7,500	-	-	-	-	-
Repayment of borrowings	3	(500)	(700)	(670)	(640)	(610)	(8,080)	(550)	(520)	(490)	(460)	(430)
Net cash provided by / (used in) financing activities		**(958)**	**(1,160)**	**(1,160)**	**(1,160)**	**(1,160)**	**(1,163)**	**(1,264)**	**(1,264)**	**(1,264)**	**(1,264)**	**(1,264)**
Net increase (decrease) in cash and cash equivalents		**7,810**	**(7,515)**	**5,899**	**3,181**	**7,633**	**4,479**	**4,702**	**3,477**	**2,049**	**(89)**	**(1,546)**
Cash and cash equivalents at beginning of year		56,605	64,415	56,900	62,799	65,980	73,613	78,092	82,794	86,271	88,320	88,231
Cash & cash equivalents at end of year		**64,415**	**56,900**	**62,799**	**65,980**	**73,613**	**78,092**	**82,794**	**86,271**	**88,320**	**88,231**	**86,685**

Notes to Statement of Cash Flows:

1. Other payments – Budget 2017/18 includes a one-off $8.95 million Council cash contribution for the Victoria Pride Centre to be situated in St Kilda.
2. Payments for property, infrastructure, plant and equipment – The dip in Budget 2017/18 is due to the $5.3 million of Ferrars Street precinct projects that will not be added to Council's asset base as they are for building demolition, soil remediation and a contribution for the community centre that provides us access over a 30-year lease.
3. Proceeds from borrowings and repayment of borrowings – Council has $7.5 million of borrowing which is expected to mature in 2021/22 financial year. Council plans to refinance this loan for a further 10 years on interest only terms.

Statement of capital works

		Forecast	Budget	Projections								
		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
	Notes	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Property												
Building improvements		9,408	13,153	13,711	12,545	12,392	12,177	12,157	12,437	13,023	13,523	14,284
Total buildings		**9,408**	**13,153**	**13,711**	**12,545**	**12,392**	**12,177**	**12,157**	**12,437**	**13,023**	**13,523**	**14,284**
Total property		**9,408**	**13,153**	**13,711**	**12,545**	**12,392**	**12,177**	**12,157**	**12,437**	**13,023**	**13,523**	**14,284**
Plant and equipment												
Plant, machinery and equipment		495	590	1,174	625	640	655	670	685	701	717	733
Fixtures, fittings and furniture		85	35	337	-	-	50	51	52	53	54	55
Computers and telecommunications		3,129	3,202	2,744	2,811	2,821	3,186	3,259	3,334	3,411	3,489	3,569
Heritage and artworks		39	30	31	31	32	33	34	35	36	37	38
Library books		814	785	801	818	837	856	876	896	917	938	960
Motor vehicles		751	1,058	1,716	1,735	1,326	1,356	1,387	1,419	1,452	1,485	1,519
Total plant and equipment		**5,313**	**5,700**	**6,804**	**6,021**	**5,655**	**6,136**	**6,277**	**6,421**	**6,570**	**6,720**	**6,874**
Infrastructure												
Roads		4,728	6,130	6,800	6,004	6,142	6,284	6,429	6,577	6,728	6,883	7,041
Footpaths and cycleways		2,750	1,685	3,221	1,668	1,706	2,045	2,092	2,140	2,189	2,239	2,290
Drainage		1,370	1,420	3,012	4,170	3,093	3,604	3,687	3,772	3,859	3,948	4,039
Parks, open space and streetscapes		10,699	7,925	6,529	11,242	13,597	13,909	14,229	14,556	15,191	16,040	17,009
Other infrastructure		836	260	265	271	277	284	291	298	305	312	319
Total infrastructure		**20,383**	**17,420**	**19,828**	**23,355**	**24,815**	**26,126**	**26,728**	**27,343**	**28,272**	**29,422**	**30,698**
Total capital works expenditure		**35,104**	**36,273**	**40,343**	**41,921**	**42,862**	**44,439**	**45,162**	**46,201**	**47,865**	**49,665**	**51,856**
Represented by:												
New asset expenditure		8,284	1,568	2,313	3,230	3,815	3,111	3,161	3,234	3,351	3,477	3,630
Asset renewal expenditure		20,907	20,444	22,769	22,959	22,975	24,441	24,839	25,411	26,326	27,316	28,521
Asset expansion expenditure		548	4,847	5,972	6,444	6,406	6,221	6,323	6,468	6,701	6,953	7,260
Asset upgrade expenditure		5,365	9,414	9,289	9,288	9,666	10,665	10,839	11,088	11,488	11,920	12,445
Total capital works expenditure		**35,104**	**36,273**	**40,343**	**41,921**	**42,862**	**44,439**	**45,162**	**46,201**	**47,865**	**49,665**	**51,856**

Budget 2017/18 Capital Projects

Capital Works Area	Operating Cost $'000	Capital Cost $'000	Project Cost $'000	Asset expenditure types: Operating $'000	New $'000	Renewal $'000	Upgrade $'000	Expansion $'000	Funding sources: Grants & Contribns $'000	Reserves $'000	Council Cash $'000	Borrowings $'000
PROPERTY												
BUILDINGS												
Bubup Nairm Non Compliance Works	0	500	**500**	0	0	125	375	0	0	0	500	0
Building Renewal and Upgrade Program	220	1,960	**2,180**	220	0	1,568	392	0	0	0	2,180	0
Building Renewal and Upgrade Program - Children's Centres	0	150	**150**	0	0	120	30	0	0	150	0	0
Building Safety and Accessibility Program	130	1,180	**1,310**	130	0	708	354	118	0	0	1,310	0
Children's Centres Improvement Program	200	200	**400**	200	0	100	100	0	0	400	0	0
Liardet St Community Centre Upgrade	0	560	**560**	0	0	280	140	140	0	0	560	0
South Melb Community Centre Upgrade	0	590	**590**	0	0	413	89	89	0	0	590	0
Depot Accommodation Renewal	0	250	**250**	0	0	250	0	0	0	0	250	0
EcoCentre Redevelopment	100	100	**200**	100	0	50	50	0	0	0	200	0
Energy Efficiency and Solar Program	0	460	**460**	0	0	0	230	230	0	0	460	0
JL Murphy Reserve Pavilion Upgrade	100	200	**300**	100	0	60	140	0	300	0	0	0
Linden Gallery Upgrade	0	1,675	**1,675**	0	0	670	1,005	0	0	0	1,675	0
Peanut Farm Reserve Sports Pavilion Upgrade	230	2,085	**2,315**	230	0	521	209	1,355	300	500	1,515	0
Public Toilet Plan Implementation Program	50	75	**125**	50	0	60	15	0	0	0	125	0
South Melb Life Saving Club Redevelopment	100	100	**200**	100	0	0	100	0	0	0	200	0
South Melb Market Building Compliance	50	450	**500**	50	0	270	180	0	0	0	500	0
South Melb Market Renewal Program	0	200	**200**	0	0	180	20	0	0	0	200	0
South Melb Market Solar Installation	0	173	**173**	0	0	0	0	173	0	0	173	0
South Melb Market Stall Changeover Refits	0	125	**125**	0	0	75	50	0	0	0	125	0
South Melb Town Hall Lifts Upgrade	0	840	**840**	0	0	756	84	0	0	0	840	0
TOTAL BUILDINGS	1,180	11,873	**13,053**	1,180	0	6,206	3,562	2,105	600	1,050	11,403	0
LEASEHOLD IMPROVEMENTS	0	0	**0**	0	0	0	0	0	0	0	0	0
HERITAGE BUILDINGS	0	0	**0**	0	0	0	0	0	0	0	0	0
TOTAL PROPERTY	1,180	11,873	**13,053**	1,180	0	6,206	3,562	2,105	600	1,050	11,403	0

Capital Works Area	Operating Cost $'000	Capital Cost $'000	Project Cost $'000	Asset expenditure types: Operating $'000	New $'000	Renewal $'000	Upgrade $'000	Expansion $'000	Funding sources: Grants & Contribns $'000	Reserves $'000	Council Cash $'000	Borrowings $'000
PLANT AND EQUIPMENT												
PLANT, MACHINERY AND EQUIPMENT												
Parking Technology Renewal And Upgrade Program	200	400	**600**	200	20	340	40	0	0	0	600	0
Street Cleaning Vehicle and Equipment Purchase	0	190	**190**	0	190	0	0	0	0	0	190	0
TOTAL PLANT, MACHINERY & EQUIPMENT	200	590	**790**	200	210	340	40	0	0	0	790	0
FIXTURES, FITTINGS AND FURNITURE												
Gasworks Theatre Seats Replacement	0	35	**35**	0	0	35	0	0	0	0	35	0
TOTAL FIXTURES, FITTINGS AND FURNITURE	0	35	**35**	0	0	35	0	0	0	0	35	0
COMPUTERS AND TELECOMMUNICATIONS												
Core Application Renewal and Upgrade Program	750	1,750	**2,500**	750	0	1,050	700	0	0	0	2,500	0
Core IT Infrastructure Renewal and Upgrade Program	377	1,158	**1,535**	377	0	695	463	0	0	0	1,535	0
TOTAL COMPUTERS & TELECOMMUNICATIONS	1,127	2,908	**4,035**	1,127	0	1,745	1,163	0	0	0	4,035	0
HERITAGE PLANT AND EQUIPMENT												
Art Acquisition	0	30	**30**	0	0	0	0	30	0	0	30	0
TOTAL HERITAGE PLANT AND EQUIPMENT	0	30	**30**	0	0	0	0	30	0	0	30	0
LIBRARY BOOKS												
Library Purchases	0	785	**785**	0	0	628	0	157	0	0	785	0
TOTAL LIBRARY BOOKS	0	785	**785**	0	0	628	0	157	0	0	785	0
MOTOR VEHICLES												
Council Fleet Renewal Program	0	1,058	**1,058**	0	0	1,058	0	0	0	0	1,058	0
TOTAL MOTOR VEHICLES	0	1,058	**1,058**	0	0	1,058	0	0	0	0	1,058	0
TOTAL PLANT AND EQUIPMENT	1,327	5,406	**6,733**	1,327	210	3,806	1,203	187	0	0	6,733	0

Capital Works Area	Operating Cost $'000	Capital Cost $'000	Project Cost $'000	Asset expenditure types: Operating $'000	New $'000	Renewal $'000	Upgrade $'000	Expansion $'000	Funding sources: Grants & Contribns $'000	Reserves $'000	Council Cash $'000	Borrowings $'000
INFRASTRUCTURE												
ROADS												
Beach St Separated Queuing Lane Implementation	50	469	**519**	50	94	117	117	141	0	0	519	0
Blackspot Safety Improvements	0	906	**906**	0	181	317	227	181	906	0	0	0
Kerb and Gutter Renewal Program	0	550	**550**	0	0	468	83	0	0	0	550	0
Laneway Renewal Program	0	260	**260**	0	0	260	0	0	0	0	260	0
Major Civil Roads Planning and Design	0	200	**200**	0	0	110	60	30	0	0	200	0
Road Renewal Program	0	3,645	**3,645**	0	0	2,552	911	182	389	0	3,256	0
Safer Street Infrastructure Improvement Program	100	100	**200**	100	0	50	50	0	0	200	0	0
TOTAL ROADS	150	6,130	**6,280**	150	275	3,873	1,448	534	1,295	200	4,785	0
BRIDGES	0	0	**0**	0	0	0	0	0	0	0	0	0
FOOTPATHS AND CYCLEWAYS												
Footpath Renewal Program	0	700	**700**	0	0	700	0	0	0	0	700	0
Kerferd Road Safety Improvements	50	145	**195**	50	0	94	51	0	195	0	0	0
Walk Plan and Bike Plan Implementation	200	840	**1,040**	200	0	0	420	420	200	840	0	0
TOTAL FOOTPATHS AND CYCLEWAYS	250	1,685	**1,935**	250	0	794	471	420	395	840	700	0
DRAINAGE												
Albert Park Stormwater Harvesting Development	0	50	**50**	0	0	0	0	50	0	0	50	0
Alma Park Stormwater Harvesting Development	50	50	**100**	50	0	0	0	50	0	0	100	0
Stormwater Management Program	280	1,020	**1,300**	280	0	816	102	102	0	0	1,300	0
Water Sensitive Urban Design Program	0	300	**300**	0	0	0	0	300	0	0	300	0
TOTAL DRAINAGE	330	1,420	**1,750**	330	0	816	102	502	0	0	1,750	0
PARKS, OPEN SPACE AND STREETSCAPES												
Carlisle St Upgrade - Balaclava Station Interchange	0	50	**50**	0	0	0	50	0	0	0	50	0
Carlo Catani Wall Structural Rectification	0	450	**450**	0	0	450	0	0	0	0	450	0
Elwood Public Space Wall Replacement	0	302	**302**	0	0	302	0	0	0	0	302	0
Fitzroy St / Grey St Tram Stop Reinstatement	50	150	**200**	50	0	90	60	0	0	0	200	0
Foreshore Assets Renewal and Upgrade Program	50	435	**485**	50	0	261	174	0	0	350	135	0
FSECP - Construction of Montague Park	1,790	500	**2,290**	1,790	500	0	0	0	3,330	0	(1,040)	0
FSECP - Streetscape Upgrade	500	2,138	**2,638**	500	321	321	855	641	2,170	468	0	0
Kerferd Road Streetscape Upgrade	50	150	**200**	50	0	98	53	0	0	0	200	0
Litter Bin Renewal and Expansion Program	0	490	**490**	0	0	392	49	49	0	0	490	0

Capital Works Area	Operating Cost $'000	Capital Cost $'000	Project Cost $'000	Asset expenditure types: Operating $'000	New $'000	Renewal $'000	Upgrade $'000	Expansion $'000	Funding sources: Grants & Contribns $'000	Reserves $'000	Council Cash $'000	Borrowings $'000
Maritime Infrastructure Renewal Program	50	600	**650**	50	180	420	0	0	0	0	650	0
Open Space Irrigation Renewal and Upgrade Program	50	200	**250**	50	0	160	40	0	0	250	0	0
Outdoor Fitness Station Program	0	75	**75**	0	75	0	0	0	0	75	0	0
Parks and Playground Renewal and Upgrade Program	200	790	**990**	200	0	553	119	119	0	660	330	0
Parks Furniture and Pathway Renewal	20	330	**350**	20	0	330	0	0	0	100	250	0
Public Space Accessibility Improvement Program	50	300	**350**	50	0	0	180	120	0	350	0	0
Public Space Lighting Expansion Program	0	150	**150**	0	0	0	0	150	0	150	0	0
Public Space Lighting Renewal and Upgrade Program	0	400	**400**	0	0	320	80	0	0	80	320	0
Recreation Reserves Facilities Renewal Program	50	170	**220**	50	0	170	0	0	0	220	0	0
Sports Field Lighting Expansion	0	20	**20**	0	0	0	0	20	0	20	0	0
TOTAL PARKS, OPEN SPACE & STREETSCAPES	2,860	7,700	**10,560**	2,860	1,076	3,866	1,659	1,099	5,500	2,723	2,337	0
OFF STREET CAR PARKS	0	0	**0**	0	0	0	0	0	0	0	0	0
OTHER INFRASTRUCTURE												
Street Signage and Furniture Renewal Program	100	260	**360**	100	0	260	0	0	0	0	360	0
TOTAL OTHER INFRASTRUCTURE	100	260	**360**	100	0	260	0	0	0	0	360	0
TOTAL INFRASTRUCTURE	3,690	17,195	**20,885**	3,690	1,351	9,610	3,679	2,555	7,190	3,763	9,932	0
TOTAL CAPITAL WORKS 2017/18	6,197	34,474	**40,671**	6,197	1,561	19,622	8,445	4,847	7,790	4,813	28,068	0

Works Deferred From 2016/17

Capital Works Area	Operating Cost $'000	Capital Cost $'000	Project Cost $'000	Asset expenditure types: Operating $'000	New $'000	Renewal $'000	Upgrade $'000	Expansion $'000	Funding sources: Grants & Contribns $'000	Reserves $'000	Council Cash $'000	Borrowings $'000
PROPERTY												
BUILDINGS												
Bubup Nairm Non Compliance Works	0	490	**490**	0	0	123	368	0	0	490	0	0
Public Toilet Plan Implementation Program	0	440	**440**	0	0	88	352	0	0	440	0	0
South Melbourne Market Building Compliance	0	175	**175**	0	0	175	0	0	0	175	0	0
EcoCentre Relocatable Buildings	0	100	**100**	0	0	50	50	0	0	100	0	0
Gaswork Building Upgrade	0	75	**75**	0	8	8	60	0	0	75	0	0
TOTAL BUILDINGS	0	1,280	**1,280**	0	8	443	830	0	0	1,280	0	0
TOTAL PROPERTY	0	1,280	**1,280**	0	8	443	830	0	0	1,280	0	0
PLANT AND EQUIPMENT												
COMPUTERS AND TELECOMMUNICATIONS												
Core IT Infrastructure Renewal and Upgrade Program	0	257	**257**	0	0	154	103	0	0	257	0	0
Valuation System Replacement	0	37	**37**	0	0	0	37	0	0	37	0	0
TOTAL COMPUTERS & TELECOMMUNICATIONS	0	294	**294**	0	0	154	140	0	0	294	0	0
TOTAL PLANT AND EQUIPMENT	0	294	**294**	0	0	154	140	0	0	294	0	0
INFRASTRUCTURE												
PARKS, OPEN SPACE AND STREETSCAPES												
Carlo Catani Wall Structural Rectification	0	225	**225**	0	0	225	0	0	0	225	0	0
TOTAL PARKS, OPEN SPACE & STREETSCAPES	0	225	**225**	0	0	225	0	0	0	225	0	0
TOTAL INFRASTRUCTURE	0	225	**225**	0	0	225	0	0	0	225	0	0
TOTAL CAPITAL WORKS 2017/18	0	1,799	**1,799**	0	8	822	969	0	0	1,799	0	0
Summary:												
Property	1,180	13,153	**14,333**	1,180	8	6,649	4,392	2,105	600	2,330	11,403	0
Plant & Equipment	1,327	5,700	**7,027**	1,327	210	3,960	1,343	187	0	294	6,733	0
Infrastructure	3,690	17,420	**21,110**	3,690	1,351	9,835	3,679	2,555	7,190	3,988	9,932	0
Total Capital Works Inc Deferrals	6,197	36,273	**42,470**	6,197	1,568	20,444	9,414	4,847	7,790	6,612	28,068	0

Summary of Capital Works Expenditure 2017-21

Capital Works 2017/18	Operating Cost $'000	Capital Cost $'000	Project Cost $'000	Asset expenditure types					Funding sources			
				Operating $'000	New $'000	Renewal $'000	Upgrade $'000	Expansion $'000	Grants & Contribns $'000	Reserves $'000	Council Cash $'000	Borrowings $'000
Property												
Land	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Land improvements	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Buildings	**1,180**	**13,153**	**14,333**	1,180	8	6,649	4,392	2,105	600	2,330	11,403	0
Leasehold Improvements	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Heritage buildings	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Total property	**1,180**	**13,153**	**14,333**	1,180	8	6,649	4,392	2,105	600	2,330	11,403	0
Plant and equipment												
Plant, machinery and equipment	**200**	**590**	**790**	200	210	340	40	0	0	0	790	0
Fixtures, fittings and furniture	**0**	**35**	**35**	0	0	35	0	0	0	0	35	0
Computers and telecommunications	**1,127**	**3,202**	**4,329**	1,127	0	1,899	1,303	0	0	294	4,035	0
Heritage plant and equipment	**0**	**30**	**30**	0	0	0	0	30	0	0	30	0
Library books	**0**	**785**	**785**	0	0	628	0	157	0	0	785	0
Motor vehicles	**0**	**1,058**	**1,058**	0	0	1,058	0	0	0	0	1,058	0
Total plant and equipment	**1,327**	**5,700**	**7,027**	1,327	210	3,960	1,343	187	0	294	6,733	0
Infrastructure												
Roads	**150**	**6,130**	**6,280**	150	275	3,873	1,448	534	1,295	200	4,785	0
Bridges	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Footpaths and cycleways	**250**	**1,685**	**1,935**	250	0	794	471	420	395	840	700	0
Drainage	**330**	**1,420**	**1,750**	330	0	816	102	502	0	0	1,750	0
Parks, open space and streetscapes	**2,860**	**7,925**	**10,785**	2,860	1,076	4,091	1,659	1,099	5,500	2,948	2,337	0
Off street car parks	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Other infrastructure	**100**	**260**	**360**	100	0	260	0	0	0	0	360	0
Total infrastructure	**3,690**	**17,420**	**21,110**	3,690	1,351	9,835	3,679	2,555	7,190	3,988	9,932	0
TOTAL capital works expenditure 2017/18	**6,197**	**36,273**	**42,470**	6,197	1,568	20,444	9,414	4,847	7,790	6,612	28,068	0

Capital Works 2018/19	Operating Cost $'000	Capital Cost $'000	Project Cost $'000	Asset expenditure types: Operating $'000	New $'000	Renewal $'000	Upgrade $'000	Expansion $'000	Funding sources: Grants & Contribns $'000	Reserves $'000	Council Cash $'000	Borrowings $'000
Property												
Land	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Land improvements	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Buildings	**1,175**	**13,711**	**14,886**	1,175	0	7,167	4,113	2,431	1,600	1,563	11,723	0
Leasehold Improvements	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Heritage buildings	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Total property	**1,175**	**13,711**	**14,886**	1,175	0	7,167	4,113	2,431	1,600	1,563	11,723	0
Plant and equipment												
Plant, machinery and equipment	**0**	**1,174**	**1,174**	0	418	677	80	0	0	0	1,174	0
Fixtures, fittings and furniture	**0**	**337**	**337**	0	0	337	0	0	0	0	337	0
Computers and telecommunications	**1,255**	**2,744**	**3,999**	1,255	0	1,647	1,098	0	0	0	3,999	0
Heritage plant and equipment	**0**	**31**	**31**	0	0	0	0	31	0	0	31	0
Library books	**0**	**801**	**801**	0	0	641	0	160	0	0	801	0
Motor vehicles	**0**	**1,716**	**1,716**	0	0	1,716	0	0	0	0	1,716	0
Total plant and equipment	**1,255**	**6,804**	**8,059**	1,255	418	5,018	1,177	191	0	0	8,059	0
Infrastructure												
Roads	**200**	**6,800**	**7,000**	200	305	4,297	1,606	593	400	0	6,600	0
Bridges	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Footpaths and cycleways	**350**	**3,221**	**3,571**	350	0	1,565	919	737	1,755	800	1,016	0
Drainage	**500**	**3,012**	**3,512**	500	0	1,731	216	1,065	0	0	3,512	0
Parks, open space and streetscapes	**850**	**6,529**	**7,379**	850	1,590	2,726	1,257	956	830	3,590	2,959	0
Off street car parks	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Other infrastructure	**100**	**265**	**365**	100	0	265	0	0	0	0	365	0
Total infrastructure	**2,000**	**19,828**	**21,828**	2,000	1,895	10,584	3,998	3,351	2,985	4,390	14,453	0
TOTAL capital works expenditure 2018/19	**4,430**	**40,343**	**44,773**	4,430	2,313	22,769	9,289	5,972	4,585	5,953	34,235	0

Capital Works 2019/20	Operating Cost $'000	Capital Cost $'000	Project Cost $'000	Asset expenditure types: Operating $'000	New $'000	Renewal $'000	Upgrade $'000	Expansion $'000	Funding sources: Grants & Contribns $'000	Reserves $'000	Council Cash $'000	Borrowings $'000
Property												
Land	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Land improvements	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Buildings	**1,160**	**12,545**	**13,705**	1,160	0	6,558	3,764	2,224	1,000	1,350	11,355	0
Leasehold Improvements	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Heritage buildings	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Total property	**1,160**	**12,545**	**13,705**	1,160	0	6,558	3,764	2,224	1,000	1,350	11,355	0
Plant and equipment												
Plant, machinery and equipment	**0**	**625**	**625**	0	223	360	42	0	0	0	625	0
Fixtures, fittings and furniture	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Computers and telecommunications	**1,180**	**2,811**	**3,991**	1,180	0	1,687	1,125	0	0	0	3,991	0
Heritage plant and equipment	**0**	**31**	**31**	0	0	0	0	31	0	0	31	0
Library books	**0**	**818**	**818**	0	0	655	0	164	0	0	818	0
Motor vehicles	**0**	**1,735**	**1,735**	0	0	1,735	0	0	0	0	1,735	0
Total plant and equipment	**1,180**	**6,021**	**7,201**	1,180	223	4,436	1,167	195	0	0	7,201	0
Infrastructure												
Roads	**0**	**6,004**	**6,004**	0	269	3,794	1,418	523	400	0	5,604	0
Bridges	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Footpaths and cycleways	**200**	**1,668**	**1,868**	200	0	811	476	382	0	800	1,068	0
Drainage	**200**	**4,170**	**4,370**	200	0	2,396	300	1,474	0	0	4,370	0
Parks, open space and streetscapes	**1,050**	**11,242**	**12,292**	1,050	2,738	4,694	2,165	1,646	0	6,590	5,702	0
Off street car parks	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Other infrastructure	**100**	**271**	**371**	100	0	271	0	0	0	0	371	0
Total infrastructure	**1,550**	**23,355**	**24,905**	1,550	3,007	11,965	4,358	4,025	400	7,390	17,115	0
TOTAL capital works expenditure 2019/20	**3,890**	**41,921**	**45,811**	3,890	3,230	22,959	9,288	6,444	1,400	8,740	35,671	0

Capital Works 2020/21	Operating Cost $'000	Capital Cost $'000	Project Cost $'000	Asset expenditure types: Operating $'000	New $'000	Renewal $'000	Upgrade $'000	Expansion $'000	Funding sources: Grants & Contribns $'000	Reserves $'000	Council Cash $'000	Borrowings $'000
Property												
Land	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Land improvements	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Buildings	**1,065**	**12,392**	**13,457**	1,065	0	6,477	3,718	2,197	0	1,350	12,107	0
Leasehold Improvements	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Heritage buildings	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Total property	**1,065**	**12,392**	**13,457**	1,065	0	6,477	3,718	2,197	0	1,350	12,107	0
Plant and equipment												
Plant, machinery and equipment	**0**	**640**	**640**	0	228	369	43	0	0	0	640	0
Fixtures, fittings and furniture	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Computers and telecommunications	**1,080**	**2,821**	**3,901**	1,080	0	1,692	1,128	0	0	0	3,901	0
Heritage plant and equipment	**0**	**32**	**32**	0	0	0	0	32	0	0	32	0
Library books	**0**	**837**	**837**	0	0	670	0	167	0	0	837	0
Motor vehicles	**0**	**1,326**	**1,326**	0	0	1,326	0	0	0	0	1,326	0
Total plant and equipment	**1,080**	**5,655**	**6,735**	1,080	228	4,056	1,172	199	0	0	6,735	0
Infrastructure												
Roads	**0**	**6,142**	**6,142**	0	276	3,881	1,450	535	400	0	5,742	0
Bridges	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Footpaths and cycleways	**200**	**1,706**	**1,906**	200	0	829	487	391	0	800	1,106	0
Drainage	**100**	**3,093**	**3,193**	100	0	1,777	222	1,093	0	0	3,193	0
Parks, open space and streetscapes	**1,205**	**13,597**	**14,802**	1,205	3,311	5,676	2,618	1,991	3,000	7,190	4,612	0
Off street car parks	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0
Other infrastructure	**100**	**277**	**377**	100	0	277	0	0	0	0	377	0
Total infrastructure	**1,605**	**24,815**	**26,420**	1,605	3,587	12,441	4,777	4,010	3,400	7,990	15,030	0
TOTAL capital works expenditure 2020/21	**3,750**	**42,862**	**46,612**	3,750	3,815	22,975	9,666	6,406	3,400	9,340	33,872	0

2017-27 capital program

Strategic direction/ service category	Project Name	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Strategic Direction 1: We embrace difference and people belong											
Children	Bubup Nairm Non Compliance Works	990,000	0	0	0	0	0	0	0	0	0
	Children's Centre Minor Capital Works	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
	Children's Centres Improvement Program	400,000	1,000,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Community programs and facilities	Community Facilities Upgrade Program	0	130,000	120,000	370,000	370,000	370,000	370,000	370,000	370,000	370,000
	Liardet St Community Centre Upgrade	560,000	0	0	0	0	0	0	0	0	0
	South Melb Community Centre Upgrade	590,000	0	0	0	0	0	0	0	0	0
Families and young people	Adventure Playgrounds Upgrade	0	0	0	700,000	1,000,000	1,000,000	0	0	0	0
Recreation	Informal Sport and Recreation Infrastructure	0	25,000	100,000	100,000	100,000	100,000	100,000	0	0	0
	JL Murphy Reserve Pavilion Upgrade	300,000	2,172,000	0	0	0	0	0	0	0	0
	Julier Reserve Pavilion Upgrade	0	0	50,000	190,000	1,900,000	0	0	0	0	0
	Lagoon Reserve Sport Field Upgrade	0	0	0	100,000	2,000,000	0	0	0	0	0
	Northport Oval Upgrade	0	200,000	1,750,000	1,000,000	0	0	0	0	0	0
	Outdoor Fitness Station Program	75,000	75,000	75,000	75,000	0	0	0	0	0	0
	Peanut Farm Reserve Sports Pavilion Upgrade	2,315,000	500,000	0	0	0	0	0	0	0	0
	Recreation Reserves Facilities Renewal Program	220,000	305,000	305,000	305,000	305,000	305,000	305,000	305,000	305,000	305,000
	South Melb Life Saving Club Redevelopment	200,000	3,700,000	2,450,000	0	0	0	0	0	0	0
	Sports Fields Lighting Expansion	20,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
	Lagoon Reserve Pavilion Upgrade	0	0	0	0	50,000	190,000	1,900,000	0	0	0
	Sports Fields Upgrade Program	0	0	0	0	0	1,000,000	1,000,000	0	0	0
		5,820,000	**8,407,000**	**6,350,000**	**4,340,000**	**7,225,000**	**4,465,000**	**5,175,000**	**2,175,000**	**2,175,000**	**2,175,000**

Strategic direction/ service category	Project Name	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Strategic Direction 2: We are connected and it's easy to move around											
Transport and parking	Beach St Separated Queuing Lane Implementation	519,000	0	0	0	0	0	0	0	0	0
	Blackspot Safety Improvements	906,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000
	Footpath Renewal Program	700,000	750,000	800,000	800,000	800,000	800,000	800,000	800,000	800,000	800,000
	Kerb and Gutter Renewal Program	550,000	995,000	995,000	995,000	995,000	995,000	995,000	995,000	995,000	995,000
	Kerferd Road Safety Improvements	195,000	1,755,000	0	0	0	0	0	0	0	0
	Kerferd Road Streetscape Upgrade	200,000	1,000,000	1,000,000	0	0	0	0	0	0	0
	Laneway Renewal Program	260,000	260,000	260,000	260,000	260,000	260,000	260,000	260,000	260,000	260,000
	Laneway Upgrade Program	0	310,000	310,000	310,000	310,000	310,000	0	0	0	0
	Major Civil Roads Planning and Design	200,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
	Parking Technology Renewal And Upgrade Program	600,000	800,000	600,000	600,000	400,000	400,000	400,000	400,000	400,000	400,000
	Public Space Accessibility Improvement Program	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000
	Road Renewal Program	3,645,000	3,645,000	3,645,000	3,645,000	3,645,000	3,645,000	3,645,000	3,645,000	3,645,000	3,645,000
	Safer Street Infrastructure Improvement Program	200,000	0	0	0	0	0	0	0	0	0
	St Kilda Junction Safety Upgrade	0	500,000	0	0	0	0	0	0	0	0
	Street Signage and Furniture Renewal Program	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
	Walk Plan and Bike Plan Implementation	1,040,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
	Wellington Street Upgrade - Intersection Redevelopment	0	600,000	0	0	0	0	0	0	0	0
		9,725,000	**12,875,000**	**9,870,000**	**8,870,000**	**8,670,000**	**8,670,000**	**8,360,000**	**8,360,000**	**8,360,000**	**8,360,000**

Strategic direction/ service category	Project Name	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Strategic Direction 3: We have smart solutions for a sustainable future											
Amenity	Depot Accommodation Renewal	250,000	0	0	0	0	0	0	0	0	0
	Litter Bin Renewal and Expansion Program	490,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000
	Plant And Equipment (Depot) Renewal Program	0	350,000	0	0	350,000	350,000	350,000	350,000	350,000	350,000
	Public Toilet Plan Implementation Program	565,000	0	450,000	450,000	450,000	450,000	450,000	450,000	450,000	450,000
	Stormwater Management Program	1,300,000	1,300,000	1,300,000	1,300,000	1,300,000	1,300,000	1,300,000	1,300,000	1,300,000	1,300,000
	Street Cleaning Vehicle and Equipment Purchase	190,000	0	0	0	0	0	0	0	0	0
Sustainability	Albert Park Stormwater Harvesting Development	50,000	1,000,000	2,100,000	1,100,000	0	0	0	0	0	0
	Alma Park Stormwater Harvesting Development	100,000	850,000	200,000	0	0	0	0	0	0	0
	EcoCentre Redevelopment	200,000	0	2,400,000	600,000	0	0	0	0	0	0
	EcoCentre Relocatable Buildings	100,000	0	0	0	0	0	0	0	0	0
	Energy Efficiency and Solar Program	460,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
	Open Space Irrigation Renewal and Upgrade Program	250,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000
	South Melb Market Solar Installation	173,000	517,000	0	0	0	0	0	0	0	0
	Water Sensitive Urban Design Program	300,000	300,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000
		4,428,000	**5,547,000**	**8,280,000**	**5,280,000**	**3,930,000**	**3,930,000**	**3,930,000**	**3,930,000**	**3,930,000**	**3,930,000**

Strategic direction/ service category	Project Name	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Strategic Direction 4: We are growing but keeping our character											
City planning and urban design	Carlisle St Upgrade - Balaclava Station Interchange	50,000	0	0	0	0	0	0	0	0	0
	Fitzroy St / Grey St Tram Stop Reinstatement	200,000	0	0	0	0	0	0	0	0	0
Public space	Carlo Catani Wall Structural Rectification	675,000	0	0	0	0	0	0	0	0	0
	Elwood Public Space Wall Replacement	302,000	0	0	0	0	0	0	0	0	0
	Foreshore Assets Renewal and Upgrade Program	485,000	0	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
	FSECP - Construction of Montague Park	2,290,000	0	0	6,000,000	0	0	0	0	0	0
	FSECP - Streetscape Upgrade	2,638,000	1,130,000	0	0	0	0	0	0	0	0
	Gasworks Arts Park Reinstatement	0	485,000	3,000,000	1,000,000	0	0	0	0	0	0
	Graham Street Skate Park Upgrade	0	15,000	385,000	0	0	0	0	0	0	0
	JL Murphy Playspace Upgrade	0	40,000	400,000	0	0	0	0	0	0	0
	Maritime Infrastructure Renewal Program	650,000	650,000	1,000,000	1,000,000	650,000	650,000	650,000	650,000	650,000	650,000
	Parks and Playground Renewal and Upgrade Program	990,000	990,000	990,000	990,000	990,000	990,000	990,000	990,000	990,000	990,000
	Parks Furniture and Pathway Renewal Program	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000
	Public Space Lighting Expansion Program	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
	Public Space Lighting Renewal and Upgrade Program	400,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000
		9,180,000	**4,410,000**	**7,375,000**	**10,590,000**	**3,240,000**	**3,240,000**	**3,240,000**	**3,240,000**	**3,240,000**	**3,240,000**

Strategic direction/ service category	Project Name	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Strategic Direction 5: We thrive by harnessing creativity											
Arts, culture and heritage	Art Acquisition	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
	Gasworks Building Upgrade	75,000	0	0	0	0	0	0	0	0	0
	Gasworks Theatre Seats Replacement	35,000	330,000	0	0	0	0	0	0	0	0
	Linden Gallery Upgrade	1,675,000	0	0	0	0	0	0	0	0	0
	South Melb Town Hall Lifts Upgrade	840,000	560,000	0	0	0	0	0	0	0	0
Libraries	Library Purchases	785,000	785,000	785,000	785,000	785,000	785,000	785,000	785,000	785,000	785,000
	St Kilda Library Redevelopment	0	0	0	0	2,500,000	5,000,000	2,500,000	0	0	0
Markets	South Melb Market Building Compliance	675,000	500,000	500,000	500,000	0	0	0	0	0	0
	South Melb Market Renewal Program	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
	South Melb Market Stall Changeover Refits	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000
		4,440,000	**2,530,000**	**1,640,000**	**1,640,000**	**3,640,000**	**6,140,000**	**3,640,000**	**1,140,000**	**1,140,000**	**1,140,000**

Strategic direction/ service category	Project Name	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Strategic Direction 6: Our commitment to you											
Asset management	Building Renewal and Upgrade Program	2,180,000	3,050,000	3,050,000	3,350,000	3,350,000	3,350,000	3,350,000	3,350,000	3,350,000	3,350,000
	Building Safety and Accessibility Program	1,310,000	1,500,000	2,000,000	2,000,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000
Financial and project management	Council Fleet Renewal Program	1,058,000	1,681,000	1,664,000	1,243,000	1,231,000	1,031,000	1,751,000	1,507,000	1,441,000	1,076,000
Governance and engagement	Councillor Equipment and Accommodation Renewal	0	0	0	125,000	0	0	0	125,000	0	0
	Online Communications Improvement Program	0	343,500	277,500	0	0	0	0	0	0	0
Technology, transformation and customer experience	Core Application Renewal and Upgrade Program	2,500,000	2,500,000	2,500,000	2,500,000	2,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
	Core IT Infrastructure Renewal and Upgrade Program	1,792,000	1,100,000	1,100,000	1,100,000	1,000,000	1,000,000	900,000	900,000	800,000	800,000
	Valuation Software Replacement	37,000	0	0	0	0	0	0	0	0	0
		8,877,000	**10,174,500**	**10,591,500**	**10,318,000**	**9,081,000**	**7,881,000**	**8,501,000**	**8,382,000**	**8,091,000**	**7,726,000**

Other capital expenditure	Project Name	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Budget capacity			-	-	2,905,000	8,506,179	9,775,402	11,345,386	17,595,514	18,603,106	19,984,463
Indexation for inflation		-	829,500	1,704,500	2,669,000	3,646,821	4,563,598	5,509,614	6,545,486	7,625,894	8,800,537
Grand total		**42,470,000**	**44,773,000**	**45,811,000**	**46,612,000**	**47,939,000**	**48,665,000**	**49,701,000**	**51,368,000**	**53,165,000**	**55,356,000**

Budget 2017/18 operating projects

Strategic direction/ service category	Project Name	2017/18
Strategic Direction 1: We embrace difference and people belong		
Affordable housing and	Balaclava Precinct Program - Marlborough St Affordable Housing	50,000
homelessness	In Our Backyard Strategy Implementation	80,000
Ageing and accessibility	Aged Care Transition Service Review	183,880
Children	Children's Services Review Implementation	210,000
	Maternal and Child Health - System Implementation	76,000
Community programs and	FSECP - Community Facilities And Netball Courts	2,995,000
facilities	Pride Centre Implementation	20,000
Recreation	Sports Playing Field Renewal Program	200,000
		3,814,880
Strategic Direction 2: We are connected and it's easy to move around		
Transport and parking	Acland Street Upgrade - Traffic Studies	87,166
	Fines Reform Act Implementation	60,000
	Integrated Transport Strategy Development	150,000
	Melbourne Metro Tunnel Project Support - Domain Station	500,000
	Parking Efficiency and Integration Program	300,000
	Post Office Place and Albert Park College Safe Access Investigation	50,000
		1,147,166
Strategic Direction 3: We have smart solutions for a sustainable future		
Sustainability	Baseline of Municipal Greenhouse Gas Emissions Development	150,000
	Community Carbon Cops Program Delivery	30,000
	Elster Creek Flood Response Advocacy	52,000
	Energy Performance Contracting	110,000
	Park Tree Improvement Program	40,000
	Street Tree Improvement Program	500,000
	Sustainability Strategy Beyond 2020 Review	150,000
	Sustainable City Community Action Plan Implementation	300,000
Waste reduction	Council Depot Waste Management and ResourceRecovery Services Futu	65,000
	Waste and Resource Recovery Strategy Development	95,000
	Waste Futures Program	142,000
		1,634,000

Strategic direction/ service category	Project Name	2017/18
Strategic Direction 4: We are growing but keeping our character		
City planning and urban design	Balaclava Precinct Program - Carlisle St Tram Stop Upgrade	200,000
	Domain Precinct Management	147,000
	Fishermans Bend Managing Growth Program	365,000
	FSECP - Program Management	220,000
	Heritage Plaques Installation	20,000
	Heritage Program Development and Implementation	50,000
	Memorials and Monuments Renewal Program	50,000
	Planning Scheme Amendments Program	250,000
	Port Melbourne Waterfront Precinct Management	96,000
	Port Phillip Planning Scheme Statutory 4 Year Review and Revised LPPF :	40,000
	St Kilda Road South UDLUF - Implementation Plan	23,000
Development compliance	Statutory Planning Service Review	100,000
Public space	Foreshore Vegetation Upgrade Program	100,000
	Gasworks Arts Park Contamination Management Plan	50,000
	Public Spaces Strategy Development	50,000
	Soil Contamination Management Program	380,000
	St Kilda Marina New Lease	150,000
		2,291,000

Strategic direction/ service category	Project Name	2017/18
Strategic Direction 5: We thrive by harnessing creativity		
Arts, culture and heritage	Creative and Prosperous City Strategy Development	50,000
Economic development	Balaclava Precinct Program - Precinct Management	192,000
and tourism	Fitzroy St Precinct Management	96,000
Festivals	Events Strategy Communications Plan Implementation	60,000
	Queens Baton Relay Event	131,000
Libraries	Smart Space - Creative Spaces In Libraries	47,000
Markets	South Melb Market Strategic Business Case	120,000
		696,000
Strategic Direction 6: Our commitment to you		
Asset management	Staff Accommodation Plan Development	200,000
Financial and project mana	Capital Projects Quality Management Operations Manual	70,000
Governance and	Integrated Council Plan and Budget Community Engagement	150,000
engagement	Risk and Compliance Management Solution	125,000
People and culture	Employee Lifecycle Process Improvements	105,000
	Health and Safety Improvement Project	100,000
	Learning Management System and eLearning	208,000
Technology, transformation and customer experience	Business Enablement and Innovation Fund	200,000
		1,158,000
		10,741,046

Schedule of cash-backed reserve movements

Cash Backed Reserves	Notes	1 July 2016	2016/17			2017/18			2018/19			2019/20		
		Opening Balance $'000	Replenish Reserves $'000	Reserves Drawdown $'000	Closing balance $'000	Replenish Reserves $'000	Reserves Drawdown $'000	Closing balance $'000	Replenish Reserves $'000	Reserves Drawdown $'000	Closing balance $'000	Replenish Reserves $'000	Reserves Drawdown $'000	Closing balance $'000
Statutory Reserves														
Open Space Contributions (Resort & Recreation Levy)														
• *Open Space Contributions excluding FBURA*		*12,411*	*7,842*	*(3,658)*	*16,595*	*4,500*	*(2,295)*	*18,800*	*4,100*	*(2,845)*	*20,055*	*4,100*	*(3,630)*	*20,525*
• *Fishermans Bend Urban Renewal Area (FBURA)*		-	-	-	-	-	-	-	-	-	-	-	-	-
Total Open Space Contributions (Resort & Recreation Levy)		12,411	7,842	(3,658)	16,595	4,500	(2,295)	18,800	4,100	(2,845)	20,055	4,100	(3,630)	20,525
• Car Parking Reserve		1,794	-	-	1,794	-	-	1,794	-	-	1,794	-	-	1,794
• Developer Contributions - Port Melbourne		146	17	-	163	-	-	163	-	-	163	-	-	163
• Trust Funds and Deposits	1	4,990	125	-	5,115	128	-	5,243	131	-	5,374	134	-	5,508
Total Statutory Reserves		**19,341**	**7,984**	**(3,658)**	**23,667**	**4,628**	**(2,295)**	**26,000**	**4,231**	**(2,845)**	**27,386**	**4,234**	**(3,630)**	**27,990**
Non-Statutory Reserves														
Contractual Reserves														
• Child Care Infrastructure		3,852	791	-	4,643	845	(550)	4,938	866	(1,150)	4,654	889	(1,350)	4,193
• Middle Park Beach Nourishment		1,183	30	-	1,213	25	-	1,238	31	-	1,269	32	-	1,301
• Tied Grants		1,351	2,626	(1,351)	2,626	748	(2,600)	774	-	(774)	-	-	-	-
• Project Deferrals		7,640	1,844	(7,640)	1,844	-	(1,844)	-	-	-	-	-	-	-
Total Contractual Reserves		**14,026**	**5,291**	**(8,991)**	**10,326**	**1,618**	**(4,994)**	**6,950**	**897**	**(1,924)**	**5,923**	**921**	**(1,350)**	**5,494**
Strategic Reserves														
• Palais Theatre		-	106	(1,250)	(1,144)	855	-	(289)	873	-	584	892	-	1,477
• Strategic Property Fund		390	4,980	-	5,370	1,215	(3,900)	2,685	140	-	2,825	140	-	2,965
• In Our Backyard (Affordable Housing)		500	500	-	1,000	-	-	1,000	-	-	1,000	-	-	1,000
• Other		8,767	4,500	(2,839)	10,428	885	(4,890)	6,423	875	(1,748)	5,550	800	(3,800)	2,550
Total Strategic Reserves		**9,657**	**10,086**	**(4,089)**	**15,654**	**2,955**	**(8,790)**	**9,819**	**1,888**	**(1,748)**	**9,959**	**1,832**	**(3,800)**	**7,992**
General Reserves														
• Debt Redemption		576	-	(576)	-	-	-	-	-	-	-	-	-	-
• Internal Borrowing - FBURA Ferrars St		(4,600)	308	(3,108)	(7,400)	-	(3,463)	(10,863)	670	(300)	(10,493)	955	-	(9,538)
• Internal Borrowing - Other incl (Vision Super Liability, Fleet and projects)		(1,867)	1,867	-	-	-	-	-	-	-	-	-	-	-
• Asset Renewal Fund (including Smart Technology Fund)	2	-	4,266	-	4,266	1,904	-	6,170	1,000	-	7,170	1,000	-	8,170
• Rates Cap Challenge	3	-	-	-	-	650	-	650	3,400	-	4,050	2,300	-	6,350
Total General Reserves		**(5,891)**	**6,441**	**(3,684)**	**(3,134)**	**2,554**	**(3,463)**	**(4,043)**	**5,070**	**(300)**	**727**	**4,255**	**-**	**4,982**
Total Non-Statutory Reserves		**17,792**	**21,818**	**(16,764)**	**22,846**	**7,127**	**(17,247)**	**12,726**	**7,855**	**(3,972)**	**16,609**	**7,008**	**(5,150)**	**18,468**
Total Cash-backed Reserves		**37,133**	**29,802**	**(20,422)**	**46,513**	**11,755**	**(19,542)**	**38,726**	**12,086**	**(6,817)**	**43,995**	**11,242**	**(8,780)**	**46,458**

Cash Backed Reserves	Notes	2020/21 Replenish Reserves $'000	2020/21 Reserves Drawdown $'000	2020/21 Closing balance $'000	2021/22 Replenish Reserves $'000	2021/22 Reserves Drawdown $'000	2021/22 Closing balance $'000	2022/23 Replenish Reserves $'000	2022/23 Reserves Drawdown $'000	2022/23 Closing balance $'000	2023/24 Replenish Reserves $'000	2023/24 Reserves Drawdown $'000	2023/24 Closing balance $'000
Statutory Reserves													
Open Space Contributions (Resort & Recreation Levy)													
• *Open Space Contributions excluding FBURA*		*4,100*	*(3,330)*	*21,295*	*4,100*	*(4,100)*	*21,295*	*4,100*	*(4,100)*	*21,295*	*4,100*	*(4,100)*	*21,295*
• *Fishermans Bend Urban Renewal Area (FBURA)*		-	-	-	-	-	-	-	-	-	-	-	-
Total Open Space Contributions (Resort & Recreation Levy)		4,100	(3,330)	21,295	4,100	(4,100)	21,295	4,100	(4,100)	21,295	4,100	(4,100)	21,295
• Car Parking Reserve		-	-	1,794	-	-	1,794	-	-	1,794	-	-	1,794
• Developer Contributions - Port Melbourne		-	-	163	-	-	163	-	-	163	-	-	163
• Trust Funds and Deposits	1	138	-	5,646	141	-	5,787	145	-	5,932	148	-	6,080
Total Statutory Reserves		**4,238**	**(3,330)**	**28,898**	**4,241**	**(4,100)**	**29,039**	**4,245**	**(4,100)**	**29,184**	**4,248**	**(4,100)**	**29,332**
Non-Statutory Reserves													
Contractual Reserves													
• Child Care Infrastructure		915	(1,350)	3,758	939	(1,350)	3,347	963	(1,350)	2,960	987	(1,350)	2,597
• Middle Park Beach Nourishment		47	-	1,348	49	-	1,397	50	-	1,447	52	-	1,499
• Tied Grants		-	-	-	-	-	-	-	-	-	-	-	-
• Project Deferrals		-	-	-	-	-	-	-	-	-	-	-	-
Total Contractual Reserves		**962**	**(1,350)**	**5,106**	**988**	**(1,350)**	**4,744**	**1,013**	**(1,350)**	**4,407**	**1,039**	**(1,350)**	**4,096**
Strategic Reserves													
• Palais Theatre		913	-	2,390	935	-	3,324	957	-	4,281	979	-	5,260
• Strategic Property Fund		140	-	3,105	-	-	3,105	-	-	3,105	-	-	3,105
• In Our Backyard (Affordable Housing)		-	-	1,000	-	-	1,000	-	-	1,000	-	-	1,000
• Other		800	(1,700)	1,650	800	(800)	1,650	800	(800)	1,650	800	(800)	1,650
Total Strategic Reserves		**1,853**	**(1,700)**	**8,145**	**1,735**	**(800)**	**9,079**	**1,757**	**(800)**	**10,036**	**1,779**	**(800)**	**11,015**
General Reserves													
• Debt Redemption		-	-	-	-	-	-	-	-	-	-	-	-
• Internal Borrowing - FBURA Ferrars St		1,066	(3,000)	(11,472)	1,245	(963)	(11,190)	1,313	(1,031)	(10,908)	1,434	(1,152)	(10,626)
• Internal Borrowing - Other incl (Vision Super Liability, Fleet and projects)		-	-	-	-	-	-	-	-	-	-	-	-
• Asset Renewal Fund (including Smart Technology Fund)	2	-	-	8,170	-	-	8,170	-	-	8,170	-	-	8,170
• Rates Cap Challenge	3	7,800	-	14,150	2,500	-	16,650	2,500	-	19,150	1,350	-	20,500
Total General Reserves		**8,866**	**(3,000)**	**10,848**	**3,745**	**(963)**	**13,630**	**3,813**	**(1,031)**	**16,412**	**2,784**	**(1,152)**	**18,044**
Total Non-Statutory Reserves		**11,681**	**(6,050)**	**24,099**	**6,468**	**(3,113)**	**27,453**	**6,583**	**(3,181)**	**30,855**	**5,602**	**(3,302)**	**33,155**
Total Cash-backed Reserves		**15,919**	**(9,380)**	**52,997**	**10,709**	**(7,213)**	**56,492**	**10,828**	**(7,281)**	**60,039**	**9,850**	**(7,402)**	**62,487**

Cash Backed Reserves	Notes	2024/25 Replenish Reserves $'000	2024/25 Reserves Drawdown $'000	2024/25 Closing balance $'000	2025/26 Replenish Reserves $'000	2025/26 Reserves Drawdown $'000	2025/26 Closing balance $'000	2026/27 Replenish Reserves $'000	2026/27 Reserves Drawdown $'000	2026/27 Closing balance $'000
Statutory Reserves										
Open Space Contributions (Resort & Recreation Levy)										
• *Open Space Contributions excluding FBURA*		*4,100*	*(4,100)*	*21,295*	*4,100*	*(4,100)*	*21,295*	*4,100*	*(4,100)*	*21,295*
• *Fishermans Bend Urban Renewal Area (FBURA)*		-	-	-	-	-	-	-	-	-
Total Open Space Contributions (Resort & Recreation Levy)		4,100	(4,100)	21,295	4,100	(4,100)	21,295	4,100	(4,100)	21,295
• Car Parking Reserve		-	-	1,794	-	-	1,794	-	-	1,794
• Developer Contributions - Port Melbourne		-	-	163	-	-	163	-	-	163
• Trust Funds and Deposits	1	152	-	6,232	156	-	6,388	160	-	6,548
Total Statutory Reserves		**4,252**	**(4,100)**	**29,484**	**4,256**	**(4,100)**	**29,640**	**4,260**	**(4,100)**	**29,800**
Non-Statutory Reserves										
Contractual Reserves										
• Child Care Infrastructure		1,011	(1,350)	2,258	1,036	(1,350)	1,944	1,061	(1,350)	1,655
• Middle Park Beach Nourishment		54	-	1,553	56	-	1,609	58	-	1,667
• Tied Grants		-	-	-	-	-	-	-	-	-
• Project Deferrals		-	-	-	-	-	-	-	-	-
Total Contractual Reserves		**1,065**	**(1,350)**	**3,811**	**1,092**	**(1,350)**	**3,553**	**1,119**	**(1,350)**	**3,322**
Strategic Reserves										
• Palais Theatre		1,002	-	6,262	1,025	-	7,287	1,050	-	8,337
• Strategic Property Fund		-	-	3,105	-	-	3,105	-	-	3,105
• In Our Backyard (Affordable Housing)		-	-	1,000	-	-	1,000	-	-	1,000
• Other		800	(800)	1,650	800	(800)	1,650	800	(800)	1,650
Total Strategic Reserves		**1,802**	**(800)**	**12,017**	**1,825**	**(800)**	**13,042**	**1,850**	**(800)**	**14,092**
General Reserves										
• Debt Redemption		-	-	-	-	-	-	-	-	-
• Internal Borrowing - FBURA Ferrars St		1,513	(1,231)	(10,344)	1,555	(1,273)	(10,062)	1,587	(1,305)	(9,780)
• Internal Borrowing - Other incl (Vision Super Liability, Fleet and projects)		-	-	-	-	-	-	-	-	-
• Asset Renewal Fund (including Smart Technology Fund)	2	-	-	8,170	-	-	8,170	-	-	8,170
• Rates Cap Challenge	3	-	(200)	20,300	-	(2,400)	17,900	-	(4,050)	13,850
Total General Reserves		**1,513**	**(1,431)**	**18,126**	**1,555**	**(3,673)**	**16,008**	**1,587**	**(5,355)**	**12,240**
Total Non-Statutory Reserves		**4,380**	**(3,581)**	**33,954**	**4,472**	**(5,823)**	**32,603**	**4,555**	**(7,505)**	**29,654**
Total Cash-backed Reserves		**8,632**	**(7,681)**	**63,438**	**8,728**	**(9,923)**	**62,243**	**8,815**	**(11,605)**	**59,454**

Notes to Reserves:

1. Trust Funds and Deposits – Deposits and contract retentions are held in trust by Council as a form of surety for transactions with Council. These are also represented as liabilities in the balance sheet.
2. Asset Renewal Fund (including Smart Technology Fund) – For funding of future asset renewals and projects related to Smart Technology.

3. Rates Cap Challenge – Over the life of the 10-year financial plan, Council is expected to face a rates cap challenge as outline in the financial strategy. This reserve serves to quarantine the cash surpluses in the former years to fund the cash deficits in the latter years of the Financial Plan.

Statement of human resources

	Forecast	Budget	Projections								
	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Staff expenditure											
Employee costs - operating	83,863	88,637	91,636	94,457	97,856	101,810	105,925	110,209	114,668	119,308	123,622
Employee costs - capital	1,472	1,516	1,551	1,587	1,728	1,773	1,819	1,867	2,015	2,068	2,122
Total staff expenditure	**85,335**	**90,153**	**93,187**	**96,044**	**99,584**	**103,583**	**107,745**	**112,076**	**116,683**	**121,376**	**125,744**
	EFT	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**
Staff numbers											
Employees	828	852	864	871	880	888	897	905	914	923	931
Total staff numbers	**828**	**852**	**864**	**871**	**880**	**888**	**897**	**905**	**914**	**923**	**931**

Summary of planned human resources

	Forecast	Budget	Projections								
	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Staff expenditure											
Chief Executive Officer	3,282	3,545	3,687	3,810	3,951	4,098	4,250	4,408	4,572	4,742	4,918
Community Development	27,105	27,072	28,178	29,132	30,228	31,366	32,546	33,772	35,043	36,363	37,731
Infrastructure & Amenity	18,315	20,093	20,917	21,628	22,444	23,291	24,171	25,084	26,031	27,013	28,033
Organisational Performance	17,062	17,428	17,950	18,440	19,005	19,587	20,189	20,809	21,449	22,109	22,791
Place Strategy & Development	11,438	12,685	13,159	13,576	14,056	14,553	15,069	15,603	16,156	16,729	17,324
Total permanent operating staff expenditure	**77,202**	**80,823**	**83,891**	**86,585**	**89,682**	**92,894**	**96,224**	**99,675**	**103,251**	**106,957**	**110,797**
Casual labour	1,465	1,447	1,480	1,515	1,554	1,594	1,636	1,679	1,722	1,767	1,813
Other labour (agency staff, maternity leave, FBT)	5,196	6,367	6,265	6,358	6,619	7,321	8,065	8,856	9,694	10,584	11,012
Capital employee costs	1,472	1,516	1,551	1,587	1,728	1,773	1,819	1,867	2,015	2,068	2,122
Total staff expenditure	**85,335**	**90,153**	**93,187**	**96,044**	**99,584**	**103,583**	**107,745**	**112,076**	**116,683**	**121,376**	**125,744**

	Forecast	Budget	Projections								
	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Staff numbers	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**	**EFT**
Chief Executive Officer											
• Full Time	22	23	24	24	24	25	25	26	26	26	27
• Part Time	4	5	5	5	5	5	5	5	5	5	5
Total Chief Executive Officer	26	28	29	29	29	30	30	30	31	31	32
Community Development											
• Full Time	172	176	178	180	182	184	184	185	186	188	190
• Part Time	141	141	144	145	146	147	150	153	155	156	158
Total Community Development	314	317	322	325	328	332	335	338	341	345	348
Infrastructure & Amenity											
• Full Time	175	189	193	195	198	200	202	205	207	210	212
• Part Time	23	23	23	23	23	23	23	23	23	23	23
Total Infrastructure & Amenity	199	213	216	218	221	223	226	228	230	233	235
Organisational Performance											
• Full Time	128	129	131	131	132	133	134	134	135	136	137
• Part Time	24	24	24	24	24	24	24	24	24	24	24
Total Organisational Performance	152	153	155	155	156	157	158	159	159	160	161
Place Strategy & Development											
• Full Time	101	102	104	105	106	108	109	110	112	113	115
• Part Time	5	6	6	5	5	5	5	5	5	5	5
Total Place Strategy & Development	106	108	110	110	112	113	114	116	117	118	120
Casual and other	16	16	16	16	16	16	16	16	16	16	16
Capital Employees	14	17	17	17	18	18	18	18	19	19	19
Total staff numbers	**828**	**852**	**864**	**871**	**880**	**888**	**897**	**905**	**914**	**923**	**931**

Grants – operating

Operating Grant Funding Types and Source	Budget 2016/17 $'000	Forecast 2016/17 $'000	Budget 2017/18 $'000	Variance $'000
Recurrent - Commonwealth Government				
Victoria Grants Commission	2,548	3,856	1,291	(2,565)
Immunisation	19	19	19	0
Recreation	24	0	0	0
Community Health	0	287	292	5
General home care	0	2,276	2,731	455
Recurrent - State Government				
Community Health	572	286	304	18
Family and Children	654	654	716	62
General home care	3,702	1,545	1,095	(449)
Libraries	612	682	683	1
Maternal & Child Health	659	744	755	11
Recreation	534	520	526	6
School crossing supervisors	94	94	91	(3)
Street & Beach Cleaning	285	285	291	6
Sustainability	10	10	0	(10)
Total recurrent grants	**9,713**	**11,257**	**8,793**	**(2,464)**
Non-recurrent - Commonwealth Government				
Family and Children	9	0	9	9
Recreation	33	33	34	1
Non-recurrent - State Government				
Family and Children	5	84	35	(49)
Recreation	0	50	50	0
Transport	0	0	500	500
Sustainability	0	49	0	(49)
Total non-recurrent grants	**47**	**216**	**628**	**412**
Total operating grants	**9,760**	**11,473**	**9,421**	**(2,052)**

Grants – capital

Capital Grant Funding Types and Source	Budget 2016/17 $'000	Forecast 2016/17 $'000	Budget 2017/18 $'000	Variance $'000
Recurrent - Commonwealth Government				
Roads	0	449	389	(60)
Total recurrent grants	**0**	**449**	**389**	**(60)**
Non-recurrent - Commonwealth Government				
Roads	0	0	906	906
Non-recurrent - State Government				
Buildings	645	1,645	600	(1,045)
Footpaths and Cycleways	66	66	200	134
Parks, Open Space and Streetscape	0	0	2,170	2,170
Plant and Equipment	0	246	0	(246)
Roads	165	128	195	67
Total non-recurrent grants	**876**	**2,085**	**4,071**	**1,986**
Total capital grants	**876**	**2,534**	**4,460**	**1,926**

Statement of borrowings

	Forecast 2016/17 $'000	Budget 2017/18 $'000
Total amount to be borrowed as at 30 June of the prior year	9,073	9,030
Total amount to be borrowed	457	657
Total amount projected to be redeemed	(500)	(700)
Total amount proposed to be borrowed as at 30 June	**9,030**	**8,987**

Measuring performance

Our directions in this Council Plan outline outcome and service measures to monitor progress. Under the *Local Government Act 1989* and *Local Government (Planning and Reporting) Regulations 2014* there are prescribed indicators for local government in Victoria. The prescribed service performance indicators are reflected in *Section 2: Our future focus*. Additionally there are prescribed sustainable capacity and financial performance indicators. These measures provide insight into the effectiveness of our financial management and our capacity to meet the needs of our community in the future.

Sustainable capacity indicators

The prescribed sustainable capacity indicators provide information that highlights our capacity to meet the needs of our communities and absorb foreseeable changes and unexpected shocks into the future.

Indicator / measure	Results 2014/15	Results 2015/16	Budget 2017/18	Projection 2020/21
Population				
Expenses per head of municipal population [Total expenses / Municipal population]	$1,701.51	$1,737.12	$1,862.25	$1,742.52
Infrastructure per head of municipal population [Value of infrastructure / Municipal population]	$5,516.95	$5,528.54	$5,553.30	$5,589.35
Population density per length of road [Municipal population / Kilometres of local roads]	364.05	396.77	420.69	449.58
Own-source revenue				
Own-source revenue per head of municipal population [Own-source revenue / Municipal population]	$1,573.38	$1,668.41	$1,683.43	$1,758.11

Indicator / measure	Results 2014/15	Results 2015/16	Budget 2017/18	Projection 2020/21
Recurrent grants				
Recurrent grants per head of municipal population [Recurrent grants / Municipal population]	$111.46	$85.52	$82.94	$89.86
Disadvantage				
Relative Socio-Economic Disadvantage [Index of Relative Socio-Economic Disadvantage by decile]	10.00	10.00	10.00	10.00

Definitions

- “adjusted underlying revenue” means total income other than:
  - non-recurrent grants used to fund capital expenditure; and
  - non-monetary asset contributions; and
- contributions to fund capital expenditure from sources other than those referred to above
- “infrastructure” means non-current property, plant and equipment excluding land
- “local road” means a sealed or unsealed road for which the council is the responsible road authority under the Road Management Act 2004
- “population” means the resident population estimated by council
- “own-source revenue” means adjusted underlying revenue other than revenue that is not under the control of council (including government grants)
- “relative socio-economic disadvantage”, in relation to a municipality, means the relative socio-economic disadvantage, expressed as a decile for the relevant financial year, of the area in which the municipality is located according to the Index of Relative Socio-Economic Disadvantage (Catalogue Number 2033.0.55.001) of SEIFA
- “SEIFA” means the Socio-Economic Indexes for Areas published from time to time by the Australian Bureau of Statistics on its Internet website
- “unrestricted cash” means all cash and cash equivalents other than restricted cash.

Service performance indicators

All service performance measures and indicators are included under *Section 2: Our future focus*.

Financial performance indicators

The prescribed financial performance indicators provide information that help monitor the effectiveness of our financial management.

Indicator	Measure	Forecast 2016/17	Budget 2017/18	Projections 18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	Trend
Operating Position													
Adjusted underlying result	Adjusted underlying surplus (deficit) / Adjusted underlying revenue	0.8%	(9.3%)	3.5%	3.7%	4.5%	4.0%	3.7%	3.0%	2.4%	1.7%	1.4%	↓
Liquidity													
Working Capital	Current assets / current liabilities	227.4%	201.9%	213.1%	216.6%	193.6%	235.3%	240.4%	242.2%	240.5%	234.0%	224.5%	↑
Unrestricted cash	Unrestricted cash / current liabilities	124.1%	94.6%	104.4%	108.7%	103.3%	130.3%	137.7%	141.8%	142.3%	138.0%	130.7%	↑
Obligations													
Loans and borrowings	Interest bearing loans and borrowings / rate revenue	7.7%	7.4%	7.1%	6.8%	6.5%	6.3%	6.0%	5.8%	5.5%	5.3%	5.1%	↑
Loans and borrowings	Interest and principal repayments / rate revenue	0.8%	1.0%	0.9%	0.9%	0.9%	6.2%	0.9%	0.8%	0.8%	0.8%	0.8%	↑
Indebtedness	Non-current liabilities / own source revenue	6.0%	5.8%	5.6%	5.5%	1.8%	5.2%	5.1%	5.0%	4.9%	4.8%	4.7%	↑
Asset renewal	Asset renewal expenditure / depreciation	93.1%	83.7%	89.8%	87.2%	84.0%	86.0%	84.1%	82.8%	82.6%	82.6%	83.0%	→

Indicator	Measure	Forecast 2016/17	Budget 2017/18	Projections 18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	Trend
Stability													
Rates concentration	Rate revenue / adjusted underlying revenue	59.3%	60.2%	59.9%	60.3%	60.3%	60.9%	61.1%	61.6%	61.8%	62.3%	62.6%	⇩
Rates effort	Rate revenue / property values (CIV)	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	⇨
Efficiency													
Expenditure level	Total expenditure / no. of assessments	2,757	2,952	2,742	2,788	2,840	2,901	2,969	3,045	3,122	3,194	3,261	⇩
Expenditure level	Specific purpose grants expended / Specific purpose grants received	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	⇨
Revenue level	Residential rate revenue / No. of residential assessments	1,484	1,513	1,547	1,584	1,625	1,664	1,703	1,741	1,780	1,819	1,858	⇧
Workforce turnover	No. of resignations & terminations / average no. of staff	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	⇨

Key to Forecast Trends:

⇧ Forecast improvement in Council's financial performance/ financial position indicator

⇨ Forecasts that Council's financial performance/ financial position will be steady

⇩ Forecast deterioration in Council's financial performance/ financial position indicator

Notes to indicators:

- ***Adjusted underlying result*** – An indicator of the sustainable operating result required to enable Council to continue to provide core services and meet its objectives. Deterioration in financial performance is expected over the period primarily impacted by the projected 3.8% per annum increase in depreciation expense as a result of Council’s commitment to invest in capital assets for service delivery.
- ***Working Capital*** – The proportion of current liabilities represented by current assets. Working capital is forecast to remain steady or slightly improve at an acceptable level over the period.
- ***Debt compared to rates*** – Trend indicates Council’s reducing reliance on debt against its annual rate revenue. Council has the capacity to use debt to respond to financial risks over the period.
- ***Asset renewal*** – This percentage indicates the extent of Council’s renewals against its depreciation charge (an indication of the decline in value of its existing capital assets). A percentage greater than 100 indicates Council is maintaining its existing assets, while a percentage less than 100 means its assets are deteriorating faster than they are being renewed and future capital expenditure will be required to renew assets.
- ***Rates concentration*** – Reflects extent of reliance on rate revenues to fund all of Council’s on-going services. Trend indicates Council will become more reliant on rate revenue to all other sources.

Linking our initiatives to strategies and plans

This Council Plan is our primary planning document. It outlines the priorities that guide decision-making and the initiatives that will achieve our strategic objectives. Council has also adopted plans and strategies to support the delivery of the Council Plan, by providing detail about how specific policy objectives will be achieved.

The *Local Government Act 1989* stipulates that the Strategic Resource Plan 'must take into account services and initiatives contained in any plan adopted by the Council'. We undertake a disciplined annual budget process to ensure that future organisational resources are allocated in a way that best delivers on the Council Plan. All resource allocation decisions are made with reference to Council Plan priorities and objectives.

The table below shows the significant strategies, policies, plans and guidelines, the specific projects and initiatives that are linked to those documents, and the amount funded in this Council Plan. The figures show projects identified to take place between 2017/18 and 2020/21 and support for other agencies through grants or funding deeds. The allocation of resources is often guided by multiple Council Plan objectives and/or strategies. The resources identified below are cash allocations (that is, both capital and operating, project and recurrent investments) and may be funded from multiple sources, including external sources such as grants.

Some strategies, policies and plans do not have specific project funding attached. Rather, activity to achieve the objectives of those strategies, policies and plans is funded through service budgets and equivalent full-time staff (EFT). Service budgets and EFT information is provided in section 1 of this plan.

Consistent with legislative obligations and best practice, we review our Council Plan priorities and resource allocation annually. Estimates for 2018/19 and beyond represent current planning assumptions and should be considered provisional. These investments will be subject to evaluation and prioritisation in the relevant budget year.

Planning instrument, description and specific resources allocated for the following four years				
Strategic Direction 1: We embrace difference, and people belong				
Childcare Policy 2006	Ensures Council's commitment to funding childcare with short and long term strategies to retain and increase childcare places and financial support for low to middle income families. Funding is for subsidies to third parties to provide childcare services.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$1,718,794	$1,655,422	$1,688,531	$1,722,301

Planning instrument, description and specific resources allocated for the following four years				
Disability Policy	Describes Council's commitment to people living with disability and provides a leadership platform on which to base decisions regarding actions and advocacy that at times may reach beyond its legislative requirements. This policy is delivered primarily through the budget and activity of the *Ageing and accessibility* service. Funding for asset upgrades to meet Disability Discrimination Act requirements also contribute to meeting the objectives of this policy.			
Family, Youth and Children Collaborative Practice Framework	Outlines how collaborative practices will be supported, enhanced and embedded into service culture and delivery to achieve the desired goals. Funding is for a third party to provide family, youth and children services.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$102,318	$104,364	$106,452	$108,581
Family Youth and Children Strategy 2014–2019	Guides development and implementation of policies and plans and drives service delivery and planning for children, middle years, youth and families. Funding is for our contribution to the community facilities and netball courts at Ferrars Street, building upgrade works at children centres, and service reviews.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$4,821,000	$1,150,000	$1,350,000	$1,350,000
Friends of Suai Strategic Plan 2010–2020	Strengthens capability and involvement in the Covalima community, practices good governance and management in our Friendship, and builds community awareness and our knowledge of Friendship between our Communities.			

Planning instrument, description and specific resources allocated for the following four years				
	Funding is for our contribution to Friends of Suai.			
Funding year and amount	2017/18 $48,000	2018/19 $48,000	2019/20 $48,000	2020/21 $48,000
Homelessness Action Strategy 2015–2020	Seeks to reduce the risks associated with homelessness through the development of agreed actions, continuing council's role as a leader, advocate, planner, facilitator and service provider. This strategy is delivered primarily through the budgets and activities of the *Affordable housing and homelessness* and *Community programs and facilities* services.			
In Our Backyard – Growing Affordable Housing in Port Phillip 2015–2025	Sets out a broad vision for housing and residential development in Port Phillip and makes recommendations regarding the future management of housing and residential development in the City. Funding is for an annual cash contribution to an affordable housing reserve to support new projects and an expression of interest for making Council land in Marlborough Street ready for release to the community housing development market.			
Funding year and amount	2017/18 $630,000	2018/19 $550,000	2019/20 $540,000	2020/21 $540,000
Middle Years Commitment and Action Plan 2014–2019	Provides a framework for Council, the community and our key partners to enable middle years young people to be happy, healthy and have their voices heard. Funding is for upgrading council-owned Adventure Playgrounds.			
Funding year and amount	2017/18 $0	2018/19 $0	2019/20 $0	2020/21 $700,000

Planning instrument, description and specific resources allocated for the following four years				
Protocol for Assisting People Who Sleep Rough 2012	Helps ensure that people experiencing primary homelessness are treated appropriately and are offered relevant support services. This protocol is delivered primarily through the budget and activity of the *Affordable housing and homelessness* service.			
Reconciliation Action Plan 2017 (under development)	Explores employment opportunities, builds awareness and understanding and enhances cultural and economic development for local Aborigines and Torres Strait Islanders. This plan is delivered primarily through the budget and activity of the *Community programs and facilities* service.			
Social Justice Charter 2011	The Charter sets a goal for the community to work together in pursuit of the common good, while protecting and promoting the rights of all members of the community. Funding is for establishing the Pride Centre in St Kilda and funding third parties to provide access and ageing services. The Social Justice Charter is also delivered through the budget and activity of the *Community programs and facilities* service.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$855,326	$852,033	$869,073	$886,455
Sport and Recreation Strategy 2015–2024	Supports the planning and provision of recreation and sport facilities and services to the local community. Funding is for redeveloping the South Melbourne Life Saving Club, upgrading Peanut Farm and JL Murphy pavilions, renewing and upgrading sports playing fields and lighting.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$3,330,000	$7,327,000	$5,080,000	$2,120,000

Planning instrument, description and specific resources allocated for the following four years				
Youth Commitment and Action Plan 2014–2019	Outlines how Council will bring our vision to fruition and meet our commitments. Funding is for funding deeds to third parties to provide youth services.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$234,900	$239,598	$244,390	$249,278
Other initiatives not specifically aligned to a strategy	Funding is for upgrading the South Melbourne and Liardet Street, Port Melbourne community centres and reviewing Council's role in aged care and disability support services.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$1,333,880	$130,000	$120,000	$370,000
Strategic Direction 2: We are connected and it's easy to move around				
Access Plan 2013–2018	Represents a 'whole of organisation' approach to addressing access and inclusion. It reflects the need for all areas of Council to work together in a coordinated manner to improve access for all. Funding is for public space accessibility improvements.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$350,000	$350,000	$350,000	$350,000
Bike Plan: Pedal Power 2011-2020 and Walk Plan 2011-2020	These plans are about making Port Phillip better for bike riding and walking by carefully planning our infrastructure so riding and walking is convenient, safe, efficient and enjoyable. Funding is for implementing the Walk and Bike plans.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21

Planning instrument, description and specific resources allocated for the following four years				
	$1,040,000	$1,000,000	$1,000,000	$1,000,000
Car Share Policy 2016-2021	Defines the benefits of car share to members, the local community and Council and encourages the expansion of car share across the municipality. This policy is delivered primarily through the budget and activity of the *Transport and parking management* service.			
Parking Permit Policy 2001	Provides guidelines for residents, visitors, members of community service organisations, disabled residents, trade persons and businesses for eligibility of parking permits. This policy is delivered primarily through the budget and activity of the *Transport and parking management* service.			
Public Transport Advocacy Statement 2009	Provides guidance on those matters that Council will advocate regarding bus, tram and train travel. This commitment is delivered primarily through the budget and activity of the *Transport and parking management* service.			
Road Management Plan	Outlines our road management responsibilities, lists the road assets and details the standards of service, maintenance and construction for roads within the City. Funding is for renewing roads and kerbs, footpaths and laneways.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$5,355,000	$5,800,000	$5,850,000	$5,850,000
Safer Streets 2013-2020: The Road User Safety Strategy	Sets out the goals for eliminating fatalities and reducing the risk of injury on our roads so that people of all ages and abilities can travel on our road network safely and that vulnerable road users have confidence to travel freely in the City.			

Planning instrument, description and specific resources allocated for the following four years				
	Funding is for implementing blackspot safety improvements at high collision locations, deliver the Beach Street separated queuing lane to reduce traffic delays associated with cruise ship arrivals, and plan for and deliver Kerferd Road safety improvements to enhance walking and bike riding.			
Funding year and amount	2017/18 $2,157,166	2018/19 $4,255,000	2019/20 $1,400,000	2020/21 $400,000
Sustainable Transport Strategy: A Connected and Liveable City	Supports our vision for a connected and liveable city where residents, visitors and workers can live and travel car free by improving the convenience, safety, accessibility and range of sustainable travel choices across the municipality. Funding is to maximise community benefit from Melbourne Metro public transport and precinct works including the Park Street tram link and all associated tram stop upgrades implement and Implement clever parking initiatives that help manage parking supply and turnover, and improve customer experience.			
Funding year and amount	2017/18 $1,460,000	2018/19 $800,000	2019/20 $600,000	2020/21 $600,000
Other initiatives not specifically aligned to a strategy	Funding is for development of the Integrated Transport Strategy			
Funding year and amount	2017/18 $150,000	2018/19 $0	2019/20 $0	2020/21 $0
Strategic Direction 3: We have smart solutions for a sustainable future				
Climate Adaptation Plan 2010	Targets Council operations and policy in the areas of built form, public space, coastal management and protection, drainage and flooding management, managing heat stress and heat island			

Planning instrument, description and specific resources allocated for the following four years				
	effects, and supporting local emergency management. It is a key plan to guide change in some vital Council operational areas, in order to progressively develop a more climate adept city. Funding is a contribution to the EcoCentre redevelopment (subject to third party funding), and develop and implement a Sustainable City Community Action Plan.			
Funding year and amount	2017/18 $682,000	2018/19 $383,000	2019/20 $2,730,000	2020/21 $930,000
Foreshore and Hinterland Vegetation Management Plan 2015	Provides guidance for the future use, development and management of the Port Phillip foreshore. Funding is for ongoing investment in upgrading the foreshore including vegetation projects.			
Funding year and amount	2017/18 $100,000	2018/19 $150,000	2019/20 $150,000	2020/21 $150,000
Graffiti Management Plan 2013-2018	Provides direction for the removal and management of graffiti across the city, implementation community focussed programs that contribute to minimising graffiti, and provision of opportunities for people to participate in more legitimate forms of public art. This plan is delivered through the budget and activity of the *Amenity* service.			
Greenhouse Plan 2011	Assists Council to address emissions reduction actions in greenhouse gas emissions, urban design and development, transport, zero waste, purchasing and procurement, and climate change. Funding is for developing a baseline of municipal greenhouse gas emission and investing in energy efficiency measures (for example, solar implementation) in Council buildings.			

Planning instrument, description and specific resources allocated for the following four years				
Funding year and amount	2017/18 $893,000	2018/19 $1,147,000	2019/20 $500,000	2020/21 $500,000
Greening Port Phillip, An Urban Forest Approach 2010	Supports a healthy and diverse urban forest that uses innovative greening solutions to enhance the community's daily experience, ensuring environmental, economic, cultural and social sustainability for future generations. Funding is for street tree and park tree improvement programs.			
Funding year and amount	2017/18 $540,000	2018/19 $540,000	2019/20 $540,000	2020/21 $540,000
Open Space Water Management Plan	Reflects the principles of the Water Plan 2010 and creates an implementation framework from which actions can be developed and prioritised. Funding is for implementing irrigation upgrades to key sports fields and parks to optimise water use.			
Funding year and amount	2017/18 $250,000	2018/19 $350,000	2019/20 $350,000	2020/21 $350,000
Public Toilet Plan 2013–2023	Supports clean, safe, accessible public toilets to all local residents and visitors to the municipality. Funding is for improving safety and amenity of public toilets. Funding for the upgrade of the South Melbourne Life Saving Club in 2018/19 includes the toilet facilities and is located under the Sport and Recreation Strategy.			
Funding year and amount	2017/18 $565,000	2018/19 $0	2019/20 $450,000	2020/21 $450,000

Planning instrument, description and specific resources allocated for the following four years				
Storm Water Management Plan	Provides direction for the environmental management of stormwater and presents an integrated approach to stormwater management, which maintains the traditional function of preventing adverse flooding, but also places emphasis on improving water quality and environmental amenity of stormwater systems. Funding is for developing a Stormwater Asset Management Plan, a Stormwater Management Policy, guidelines to require on-site stormwater detention for new developments and continuing to invest in drainage.			
Funding year and amount	2017/18 $1,300,000	2018/19 $1,300,000	2019/20 $1,300,000	2020/21 $1,300,000
Sustainable Design Strategy 2013	Sets out how Council will achieve sustainable design outcomes through the planning scheme and incorporates best practice sustainability design standards for Council buildings, provides an assessment framework that directly supports the proposed Amendment C97 Environmentally Efficient Design (EED) Local Planning Policy. This strategy is delivered primarily through the budgets and activity of the *City planning and urban design and Sustainability* services.			
Sustainable Public Lighting Strategy for Streets and Open Space 2011–2016	Provides the framework for achieving our zero net Council emissions by 2020 goal by providing direction for improvement where it is needed. Funding is for renewal, upgrade and expansion of public space lighting.			
Funding year and amount	2017/18 $550,000	2018/19 $750,000	2019/20 $750,000	2020/21 $750,000

Planning instrument, description and specific resources allocated for the following four years				
Towards Zero – Sustainable Environment 2007	Provides the community with a clear statement of the key sustainability challenges faced by the City and the policy and strategy directions that needed to be pursued over the next 5-10 years. In addition, it sets targets for the community and Council, and the framework for measuring progress against our sustainability challenges. Funding is for commencing a review of sustainability strategy beyond 2020 and contributions to the Port Phillip EcoCentre including education programs.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$350,000	$203,040	$206,138	$209,294
Water Plan 2010	Identifies different water sources that can be used to make the city more liveable. Funding is for working with third parties on the viability of stormwater harvesting at Albert Park Lake and Alma Park.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$150,000	$1,850,000	$2,300,000	$1,100,000
Water Sensitive Urban Design Guidelines	Provides a range of measures that are designed to avoid, or at least minimise, the environmental impacts of urbanisation in terms of the demand for water and the potential pollution threat to natural water bodies. Funding is for planning and delivering water sensitive urban design interventions to reduce contaminants in water entering Port Phillip Bay.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$300,000	$300,000	$600,000	$600,000

Planning instrument, description and specific resources allocated for the following four years				
Other initiatives not specifically aligned to a strategy	Funding is for developing and implementing a new municipal Waste Management and Resource Recovery Plan, and investment in waste management and street cleaning infrastructure, including litter bins and other equipment.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$1,232,000	$972,000	$463,000	$380,000
Strategic Direction 4: We are growing but keeping our character				
Activating Laneways Strategy	Identifies a selection of lanes within and/or close to key areas such as Activity Centres, regionally significant open spaces and public transport networks, and provides a framework to promote future activity within them. Funding is for the Laneway Upgrade Program.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$0	$310,000	$310,000	$310,000
City of Port Phillip Housing Strategy 2007-2017	Sets out a broad vision for housing and residential development in Port Phillip and makes recommendations regarding the future management of housing and residential development in the City. This strategy is delivered primarily through the budgets and activity of the *City planning and urban design and Affordable housing and homelessness* services.			
City of Port Phillip Activity Centre Strategy 2006	Provide a holistic understanding of the complex role and function of activity centres and the contribution that they can make to creating sustainable local communities and is in response to *Melbourne 2030: Planning for Sustainable Growth*			

Planning instrument, description and specific resources allocated for the following four years				
	This strategy is delivered primarily through the budget and activity of the *City planning and urban design* service.			
Domestic Animal Management Plan 2012-2016	Aims to provide harmonious and responsible pet ownership across the City of Port Phillip focusing on the registration of pets, effective control of dogs within public areas, pet residential management, pet microchipping and de-sexing and the encouragement of owners to pick up dog poo. This plan is delivered primarily through the budget and activity of the *Local laws and animal management* service.			
Fishermans Bend Planning & Economic Development Strategy	Guides the continued transition of Fishermans Bend from a traditional industrial area into a diverse, inner city business and employment precinct. Funding is for the Ferrars Street Education and Community Precinct Montague Park and streetscape upgrade projects.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$5,513,000	$1,130,000	$0	$6,000,000
Foreshore Management Plan 2012	Guides how to protect, maintain and manage the City's coastline. It provides strategic directions to address unsustainable impacts on the Port Phillip coast and community. Funding is for renewing foreshore and maritime assets.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$1,135,000	$650,000	$1,500,000	$1,500,000
Inner Melbourne Action Plan	Sets out 11 regional strategies and 57 actions to make the Inner Melbourne Region more liveable. Funding is for our contribution to the Inner Melbourne Action Plan.			

Planning instrument, description and specific resources allocated for the following four years				
Funding year and amount	2017/18 $95,000	2018/19 $95,000	2019/20 $95,000	2020/21 $95,000
Management plans for: Catani Gardens and Southern Foreshore, Elwood Foreshore and Recreation reserves, JL Murphy Reserve, and Marina Reserve	Funding is for Carlo Catani wall structural rectification and the Elwood public space wall replacement			
Funding year and amount	2017/18 $977,000	2018/19 $0	2019/20 $0	2020/21 $0
Masterplans for: Albert Park College Precinct, Balaclava Station, Emerald Hill Precinct, St Kilda Triangle	Funding is for working with Public Transport Victoria on upgrading the Balaclava Station interchange on Carlisle Street.			
Funding year and amount	2017/18 $50,000	2018/19 $0	2019/20 $0	2020/21 $0
Memorials and Monuments Policy	Guides management of existing memorials and decision-making for new memorials. Funding is for the memorials and monuments renewal program and heritage plaques.			
Funding year and amount	2017/18 $70,000	2018/19 $70,000	2019/20 $70,000	2020/21 $70,000
Municipal Emergency Management Plan	Outlines how the Port Phillip City Council will Implement measures to prevent (or reduce) the causes (or effects) of emergencies, manage the use of municipal resources in response to emergencies, manage support (that may be provided) to or from			

Planning instrument, description and specific resources allocated for the following four years				
	adjoining municipalities, assist the affected community to recover following an emergency and complement other local, regional and state planning arrangements. Funding is for our contribution to State Emergency Services.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$32,000	$32,640	$33,293	$33,959
Open Space Strategy and Implementation Plan Framework 2009	Guides delivery of a city where public open spaces define the City's character and respond to its people's need for places to rest, recreate and be inspired. Funding is to renew park and street furniture and signage.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$710,000	$710,000	$710,000	$1,265,000
Playspace Strategy 2011	Sets the vision, policy context and framework for future development of play spaces and prioritises play spaces for upgrade and renewal. Funding is to renew and upgrade parks and playgrounds, including the playspace at JL Murphy and Graham Street Skate Park.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$990,000	$1,045,000	$1,775,000	$990,000
Port Melbourne Waterfront Activation Plan	Defines short term actions and identifies longer term strategies and is guide for the delivery of them by Council, business and the community to activate the Port Melbourne Waterfront. This plan is delivered primarily through the budget and activity of the *City planning and urban design* service.			

Planning instrument, description and specific resources allocated for the following four years				
Port Phillip Heritage Review 2000 (Version 18)	Includes completion of additional assessments of places and areas of heritage significance since the gazetting of the original review in 2000. Funding is developing and implementing the Heritage Program.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$50,000	$50,000	$50,000	$50,000
Port Phillip Local Law No.1 (Community Amenity) 2013	Manages the uses and activities on roads and Council land, and manages, regulates and controls certain uses and activities. The local law is delivered primarily through the budgets and activity of the *Health services* and *Local laws and animal management* services.			
Port Phillip Planning Scheme	Provides a clear and consistent framework within which decisions about the use and development of land can be made. Expresses state, regional, local and community expectations for areas and land uses. Provides for the implementation of State, regional and local policies affecting land use and development. Funding is for reviewing and updating the Port Phillip Planning Scheme, including the Municipal Strategic Statement, to ensure an effective framework of local policy and controls to manage growth and implementing planning scheme amendments that strengthen design and development controls in areas undergoing significant change.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$290,000	$250,000	$250,000	$250,000
Precinct structure plans and urban design	Funding is for precinct management to ensure coordination of development, projects and advocacy, including for Domain and Port			

Planning instrument, description and specific resources allocated for the following four years				
frameworks for: activity centres (Bay Street, Carlisle Street, South Melbourne Central and Ormond Road Elwood) and growth precincts (Montague Precinct, St Kilda Road South, St Kilda Road North, St Kilda Foreshore and Port Melbourne Waterfront)	Melbourne Waterfront and design works to support upgraded tram stops in Fitzroy St and Carlisle St.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$816,000	$330,000	$121,500	$0
Soil Contamination Management Policy	Outlines our approach to assessing and managing potentially contaminated land that we own or manage. Funding is for working with the Victorian Government to effectively manage soil contamination on open space sites, including at Gasworks Arts Park.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$505,000	$915,000	$3,380,000	$1,380,000
St Kilda Botanical Gardens Future Directions Plan	Examines botanic function and cultural heritage of the Gardens and provides a number of improvement recommendations. This plan is delivered primarily through the budget and activity of the *Public space* service.			
Other initiatives not specifically assigned to a strategy	Funding is for developing a Public Spaces strategy, a Statutory Planning service review and Design and Development Awards.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$170,000	$70,000	$40,000	$20,000

Planning instrument, description and specific resources allocated for the following four years				
Strategic Direction 5: We thrive by harnessing creativity				
Aboriginal and Torres Islander Arts Strategy 2014-2017	Ensures resources are available for the annual Aboriginal and Torres Strait Islander arts calendar. Funding is for the Yalukit Willum Ngargee festival and Indigenous Arts program.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$106,230	$108,886	$111,608	$114,398
Arts and Culture Policy 2011	Articulates our commitment to supporting a culturally vibrant city and outlines principles and objectives for arts and cultural services, programs and facilities. Funding supports the management and operation of Gasworks and Linden Gallery and other arts organisations including 2017/18 funding only for Red Stitch, Theatre Works and the Emerald Hill Cultural Precinct program, the Cultural Development Fund, and replacing the Gasworks Theatre seats.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$2,764,403	$1,365,128	$1,048,555	$1,062,184
Community Grants Subsidies and Donations Policy	Sets direction for transparent and effective administration of community grants programs, subsidy schemes and donations. Funding is for supporting community facilities, community projects and village impact grants.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$442,675	$442,675	$442,675	$442,675

Planning instrument, description and specific resources allocated for the following four years				
Events Strategy 2015–2017	Plans, attracts and directs events to ensure our city is welcoming, healthy, safe and vibrant for all. Funding is for the St Kilda Film Festival, grants for Local Festivals, contributions to Pride March, Live N Local and other events.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$756,496	$585,499	$596,136	$607,031
Outdoor Events Policy 2010	Provides a framework through which the City of Port Phillip manages externally produced events in public space. It includes assessment and approval of direct applications, and the principles of attracting events to the municipality. This policy is delivered primarily through the budget and activity of the Public space service.			
Port Phillip City Collection Policy 2017	Articulates the context and principles for the Port Phillip City Collection. It is the guiding document for collection management and key decision-making relating to the Collection, outlining the requirements around collection development through acquisition, documentation, conservation and access. Funding is for the arts acquisition program.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$30,000	$30,000	$30,000	$30,000
South Melbourne Market Strategic Plan 2015–2020	Five-year strategic planning for managing the South Melbourne Market to achieve its goals over the next five years. Funding is for renewal and building compliance works, fit-out of stalls and to develop a strategic business case.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21

Planning instrument, description and specific resources allocated for the following four years				
	$1,120,000	$825,000	$825,000	$825,000
St Kilda Esplanade Market Strategic Plan 2016-2020	Reinforces the Market's identity as a makers' market, and sets out three key priorities: to continue to make the Market a 'market of choice' for stallholders and visitors; to ensure a positive market experience through improving amenities and infrastructure over time; and to increase visitor numbers and Market profile through marketing and communications. This plan is delivered primarily through the budget and activity of the *Markets* service.			
St Kilda Festival Strategy and Multi-Year Operational Plan 2016-2018	A three year action plan to reinforce the Festival as Australia's largest free music festival, a unique and iconic Melbourne event showcasing Australian bands Funding is for the St Kilda Festival.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$1,449,823	$1,485,942	$1,523,091	$1,561,168
Other initiatives not specifically assigned to a strategy	Funding is for developing a Creative and Prosperous City strategy, library purchases, and precinct management for Balaclava and Fitzroy Street.			
Funding year and amount	2017/18	2018/19	2019/20	2020/21
	$1,370,000	$1,423,000	$1,329,000	$1,135,000
Strategic Direction 6: Our commitment to you				
Asset Management Plans (under review) and Asset Management Policy and	Council's asset management is complex and impacts on nearly all areas of Council responsibilities. Renewals are capital works that are required to ensure that Council intervenes in an optimal manner			

Planning instrument, description and specific resources allocated for the following four years				
Strategy (under development)	to protect and renew infrastructure assets. This supports on-going service and financial sustainability. Funding is for asset renewals that are not allocated to other identified strategies or plans such as renewal of buildings, IT infrastructure and applications and Council's fleet. Also included is works building safety works on community assets, works on South Melbourne Town Hall lifts, development of a staff accommodation plan and development of a business technology strategic plan and asset management strategy.			
Funding year and amount	2017/18 $10,112,000	2018/19 $10,734,500	2019/20 $10,791,500	2020/21 $12,818,000
City of Port Phillip Security Camera Footage Policy 2012	Sets policy and processes for the retention, release and return of City of Port Phillip security footage. This policy is delivered primarily through the budget and activity of the *Governance and engagement* service.			
Civic Recognition and Support Strategy	This strategy is delivered primarily through the budget and activity of the *Governance and engagement* service.			
Councillor Code of Conduct (including Councillor Support and Expense Reimbursement Policy 2016)	Develops behavioural principles for elected representatives around conducting Council business. This policy is delivered primarily through the budget and activity of the *Governance and engagement* service.			
Leasing and Licencing Policy (under development)	This policy is delivered primarily through the budget and activity of the *Asset management* service.			
Other initiatives not specifically assigned to a strategy	Funding is for community engagement to support the annual review of the Council Plan and continuous improvement initiatives.			

Planning instrument, description and specific resources allocated for the following four years				
Funding year and amount	2017/18 $763,000	2018/19 $350,000	2019/20 $350,000	2020/21 $595,000

Rates and charges

This section presents information which the Act and the Regulations require to be disclosed in the Council’s annual budget.

It also contains information on Council's past and foreshadowed rating levels along with Council's rating structure and the impact of changes in property valuations. This section should be read in conjunction with Council’s Rating Strategy which is available on Council’s website.

Rating context

In developing the Strategic Resource Plan, rates and charges are identified as the main source of revenue, accounting for over 56 per cent of the total revenue received by Council annually. Planning for future rate increases has historically been an important component of the Strategic Resource Planning process. The State Government have introduced the *Fair Go Rates System (FGRS)* which sets out the maximum amount councils may increase rates in a year. For 2017/18 the FGRS cap has been set at 2.0 per cent. The cap applies to both general rates and municipal charges and is calculated on the basis of council's average rates and charges.

The level of required rates and charges has been considered in this context, with reference to Council's other sources of income and the planned expenditure on services and works to be undertaken for the Port Phillip community.

Council recognises the rising community concern regarding the affordability of Council services, with rates and other essential services forming an increasing share of average household expenditure.

The community's expectation for better value in Council service delivery has been reflected in Council's decision making. Council has recently launched a number of initiatives to ensure that its services are delivered in the most efficient and effective manner possible. These initiatives include a successful drive for efficiency savings, resulting in permanent operational savings of $7 million (to date) with a further $2.0 million expected in 2017/18. These initiatives have been supported by improved capability in Council planning, process improvement and project management.

In order to achieve Council's objectives while maintaining services levels and a strong capital expenditure program, the average general rate will increase by 2.0 per cent in line with the rate cap. This will raise total rates and charges for 2017/18 of $120.77 million, including supplementary rates of $935,880.

Current year rates and charges

Council had already endorsed the 10-Year Financial Outlook at its meeting on 13 December 2016 and agreed not to apply to the independent economic regulator for a variation to the rates cap in 2017/18. In endorsing the 10-Year Financial Outlook, Council noted the approach to meeting the significant challenge of rates capping. More specifically identifying:

- opportunities to further reduce Council's cost base without impacting service levels (such as efficiencies identified through improvements in processes, procurement and project planning and delivery)
- opportunities to ensure that user fees and charges reflect the benefit that individual community members receive (that is, rates funding is not unreasonably subsidising services that provide private benefit)

- service delivery options, including changes to the way services are currently delivered and consideration of service level changes in areas of lower strategic priority
- appropriate use of borrowings and reserves.

These measures have enabled Council to maintain service levels and a strong capital expenditure program, and limit the rate increase to 2.0 per cent in 2017/18 in line with the rate cap set by the Victorian Government.

This table sets out future proposed increases in rates and charges and the total rates to be raised, based on the forecast financial position of Council as at 30 June 2017.

Year	General Rate Increase %	Total Rates Raised $'000
2016/17	2.50	117,201
2017/18	2.00	120,769
2018/19	2.20	125,205
2019/20	2.39	130,038
2020/21	2.62	135,350

Rating structure

Council has established a rating structure which is comprised of two key elements:

- Property values, form the central basis of rating under the *Local Government Act 1989*
- A user pays component to reflect usage of discretionary waste services (large bins) provided by Council.

Striking a proper balance between these elements provides equity in the distribution of the rate burden across residents.

The Port Phillip rating system is based on Net Annual Value (NAV). Municipalities which have a relatively large commercial property base (for example, inner city councils) have tended to remain on NAV due to the fact that it offers protection to residential ratepayers through an in built differential.

Port Phillip is one of only a few councils in Victoria continuing to use the NAV rating system. Under NAV rating, property rates are determined in accordance with the rental yield and this is always assessed as being five per cent of the Capital Improved Value (CIV) for residential properties and at a higher rate (typically seven to nine per cent) for commercial and industrial properties. Council's that use CIV rating typically have differential rates in place for commercial and industrial properties; this is not necessary under NAV rating which has an in built differential.

Council provides for rate concessions for recreational land. Under the Cultural and Recreational Lands Act 1963, provision is made for a Council to grant a rating concession to any 'recreational lands' which meet the test of being rateable land under the Act. There are 27 recreational properties in Port Phillip that are rated under the Cultural and Recreational Lands Act and rate concessions ranging from 25 per cent to 85 per cent are provided.

This table summarises the rates to be determined for the 2017/18 year. A more detailed analysis of the rates to be raised is contained in “Declaration of Rates and Charges” section.

Rate type	How applied	2016/17	2017/18	Change
General rates	Cents/$ NAV	3.8517	3.9287	2%
Municipal charge	$/ property	Nil	Nil	Nil
Annual garbage charge - non-rateable properties	$/ property	$260	$260	Nil
240 Litre bin - annual service charge	$/ property	$120	$120	Nil

Council has adopted a formal *Rating Strategy* that contains expanded information on Council's rating structure and the reasons behind its choices in applying the rating mechanisms it has used.

Differential rates

The City of Port Phillip uses the Net Annual Value (NAV) system for determining the distribution of rates across the municipality.

Section 161 (1) of the Local Government Act 1989 only allows for differential rates to be applied by councils that use the Capital Improved Value (CIV) system for valuing land. While councils using other rating systems may raise limited differential rates under Section 161A of the Local Government Act 1989 this may only be applied between the following land categories farm land, urban farm land and residential properties which does not apply to Port Phillip which is an inner metropolitan council. The other option available under this provision is a differential between different wards which is also not appropriate.

Declaration of rates and charges 2017/18

The rate in the dollar to be levied as general rates under section 158 of the Act for each type or class of land compared with the previous financial year

Type or class of land	2016/17 cents/$NAV	2017/18 cents/$NAV	Change
General rate for rateable properties	3.8517	3.9287	2.00%

The estimated total amount to be raised by general rates in relation to each type or class of land, and the estimated total amount to be raised by general rates, compared with the previous financial year

Type or class of land	2016/17 ($)	2017/18 ($)	Change
Residential	91,990,829	94,720,216	2.97%
Commercial	19,638,796	20,288,811	3.31%
Industrial	5,087,730	4,924,783	(3.20%)
Total amount to be raised by general rates	**116,717,355**	**119,933,810**	**2.76%**

The number of assessments in relation to each type or class of land, and the total number of assessments, compared with the previous financial year

Type or class of land	2016/17	2017/18	Change
Residential	61,952	62,588	1.03%
Commercial	6,851	6,900	0.72%
Industrial	999	995	(0.40%)
Total number of assessments	**69,802**	**70,483**	

- The basis of valuation to be used is the Net Annual Value (NAV)

The estimated total value of each type or class of land, and the estimated total value of land, compared with the previous financial year

Type or class of land	2016/17 ($)	2017/18 ($)	Change
Residential	2,388,317,600	2,410,981,150	0.95%
Commercial	509,873,450	516,425,550	1.29%
Industrial	132,090,500	125,354,000	(5.10%)
Total value of land	**3,030,281,550**	**3,052,760,700**	**0.74%**

The municipal charge under section 159 of the Act compared with the previous financial year

Type of Charge	Per Rateable Property 2016/17 ($)	Per Rateable Property 2017/18 ($)	Change
Municipal	0	0	0.00%

The estimated total amount to be raised by municipal charges compared with the previous financial year

Type of Charge	2016/17 ($)	2017/18 ($)	Change
Municipal	0	0	0.00%

The rate or unit amount to be levied for each type of service rate or charge under section 162 of the Act compared with the previous financial year

Type of Charge	Per Rateable Property 2016/17 ($)	Per Rateable Property 2017/18 ($)	Change
Annual Garbage Charge for non-rateable tenements	260	260	0.00%
240 Litre Bin - Annual Service Charge	120	120	0.00%
80 Litre Bin – Annual Rebate	(30)	(30)	0.00%

The estimated total amount to be raised by each type of service rate or charge, and the estimated total amount to be raised by service rates and charges, compared with the previous financial year

Type of Charge	2016/17 ($)	2017/18 ($)	Change
Annual Garbage Charge for non-rateable tenements	22,880	22,880	0.00%
240 Litre Bin - Annual Service Charge	238,330	241,320	1.25%
Total Service charge excluding rebates	**261,210**	**264,200**	**1.14%**
80 Litre Bin – Annual Rebate	(74,880)	(74,880)	0.00%
Total additional service charges (waste collection)	**186,330**	**189,320**	**1.60%**

The estimated total amount to be raised by all rates and charges compared with the previous financial year

Type of Charge	2016/17 ($)	2017/18 ($)	Change
General Rates	116,717,355	119,933,810	2.76%
Municipal Charge	0	0	0.00%
Supplementary Rates and Charges	591,000	935,900	58.36%
Rate rebates and adjustments (including penalty interest)	(340,000)	(329,662)	(3.04%)
Cultural and Recreational Charges	46,672	39,863	(14.59%)
Additional service charges (Waste collection)	186,330	189,320	1.60%
Total Rates and Charges	**117,201,357**	**120,769,231**	**3.04%**

Any significant changes that may affect the estimated amounts to be raised by rates and charges

There are no known significant changes which may affect the estimated amounts to be raised by rates and charges. However, the total amount to be raised by rates and charges may be affected by:

- The making of supplementary valuations (2017/18: budgeted $935,900 and 2016/17: estimated $700,000)
- The variation of returned levels of value (e.g. valuation appeals)
- Changes of use of land such that rateable land becomes non-rateable land and vice versa; and
- Changes of use of land such that residential land becomes business land and vice versa.

Fair Go Rates System Compliance

City of Port Phillip is fully compliant with the State Government's Fair Go Rates System.

Base Average Rates (2016/17)	$1,668.25
Maximum Rate Increase (set by the State Government)	2.00%
Capped Average Rates (2017/18)	$1,701.62
Maximum General Rates and Municipal Charges Revenue	$119,935,282
Budgeted General Rates and Municipal Charges Revenue	$119,933,810

Fees and charges

Ensuring we recover costs through fair and appropriate user charges

In most cases, our fees and charges for 2017/18 will increase by 2.5 per cent. There will be variances when minor rounding equates to a larger percentage. There is one exception where we believe a larger increase is fair and reasonable:

- an increase of 3.73 per cent to long day care fees (an increase from $120.50 to $125 per day) and a $134.80 per day fee to apply to non- residents of City of Port Phillip who intend to use the facilities at the Ferrars Street Early Learning Centre (opens in 2018).
- The general increase in long day care fees maintains Council's contribution to the service at current levels and is in accordance with the rising costs of direct care in regulated services. Council's fees for long day care aligns midway with other service providers in the municipality and neighbouring councils.

Following a review of parking machine charges for the Fitzroy Street area and Waterfront Place, Council has agreed to reduce the hourly and maximum/all day charges to:

Fees from 1 July 2017 to 30 June 2019	1 April to 30 Sept Fee Incl. GST	1 Oct to 31 March Fee Incl. GST
Station Pier & Waterfront Place – per hour	$1.80	$3.80
Station Pier & Waterfront Place – max. / per day	$8.50	$12.60
Fitzroy Street, Pattison Street & St Kilda West (excluding Beaconsfield Parade) – per hour	$1.80	$3.80
Fitzroy Street, Pattison Street & St Kilda West (excluding Beaconsfield Parade) – max. / per day	$8.50	$12.60

Discounted kerbside trading permits will continue in 2017/18 for Acland and Fitzroy streets.

There will be some new fees in 2017/18 to help manage demand and prevent cross-subsidisation of services by ratepayers. This approach is consistent with community feedback, which supported increasing user charges for some services:

- varying fees based on a sliding scale for a "refundable noise bond" for Open Space and Recreation events
- event related parking on reserve fee of $95.

This following sections present the fees and charges of a statutory and non-statutory nature which are proposed to be charged in respect to various goods and services during 2017/18.

Statutory fees may change during the financial year in accordance with updated State Government legislation and regulation.

Strategic direction: We embrace difference, and people belong

Ageing and accessibility

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Planned activity groups		
Planned activity group - quarter day activities for older people and people with disabilities	$5.35	$5.60
Planned activity group - half day activities for older people and people with disabilities - this includes water leisure activities	$9.30	$9.60
Planned activity group - full day activities for older people and people with disabilities	$14.65	$15.00
Planned activity group - package	$84.50	$86.60
Shopping Group (July-December)	$2.00	$3.80
Shopping Group (January-June)	$3.80	$5.60
Cooking Group (July-December)	$1.50	$3.80
Cooking Group (January-June)	$3.80	$5.60
Personal, respite and home care		
Personal Care - Base	$6.00	$6.20
Personal Care - Medium	$14.25	$14.60
Personal Care - Max	$38.85	$39.80
Personal Care - Package	$50.80	$52.20
Respite Care - Base Fee	$4.25	$4.40

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Respite Care - Medium Fee	$7.25	$7.40
Respite Care - Max Fee	$35.80	$36.60
Respite Care - Package	$50.80	$52.20
Home Care - Base Fee	$7.85	$8.00
Home Care - Med Fee	$18.55	$19.00
Home Care - Max Fee	$34.35	$35.20
Home Care - Package	$50.80	$52.20
Property Maintenance - Base Fee	$11.50	$11.80
Property Maintenance - Med Fee	$18.10	$18.60
Property Maintenance - Max Fee	$48.25	$49.40
Property Maintenance - Package	$68.40	$70.20
Food services		
Food Services	$8.80	$9.00
Food Services - Package	$10.20	$10.40
Food Services - Package - Meal only (itemised fees)	n/a	$7.20
Centre-based meal - 3 courses	$6.00	$6.20
Centre-based meal - 2 courses	$4.50	$4.60

Children

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Long day care		
Long Day Care daily fee	$120.50	$125.00
Long Day Care daily fee – non-resident at Ferrars St Early Learning Centre	-	$134.80

Community programs and facilities

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Community connect-community facilities		
Community groups Type 1 Based within Port Phillip	$12.20	$12.50
Community groups Type 2 operate from outside Port Phillip	$18.00	$18.50
Semi Commercial Hirers	$42.70	$43.70
Private Hire	$60.60	$62.00
Public Liability Insurance	$28.50	$30.00
Security Deposit - Standard	$100.00	$100.00
Security Deposit - Specific	$500.00	$500.00
Community transport bus hire		
Cleaning charge on hire buses	$52.50	$53.80
Cora Graves - hall hire		
Semi-Commercial Use	$42.70	$43.70
Casual Hire	$60.60	$62.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Community connect-community facilities		
Community groups Type 1 Based within Port Phillip	$12.20	$12.50
Community groups Type 2 operate from outside Port Phillip	$18.00	$18.50
Semi Commercial Hirers	$42.70	$43.70
Private Hire	$60.60	$62.00
Public Liability Insurance	$28.50	$30.00
Security Deposit - Standard	$100.00	$100.00
Security Deposit - Specific	$500.00	$500.00
Community Groups	$12.20	$12.50

Families and young people

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Hire fees for St Kilda Adventure Playground		
Party Hire: Non-resident	$200.00	$200.00
Party Hire: Resident	$125.00	$135.00
Party Hire: Resident Concession	$50.00	$50.00
Party Hire: Program member	$0.00	$25.00
Party Hire: Non-resident Concession	$110.00	$110.00
Hire: Community groups based within Port Phillip	$12.20	$12.50
Hire: Community groups operate from outside Port Phillip	$18.00	$18.50
Hire: Semi Commercial Hirers	$42.70	$43.70

Recreation

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Commercial Recreation Activities - New Licences & Permits (Statutory Fees)		
Commercial Recreation Activity (beach and water activities) - Annual Licence Fee	$281.00	$297.00
Commercial Recreation Activity (beach based activities) - Annual Licence Fee	$281.00	$297.00
Commercial Recreation Activity (launch of craft only) - Annual Licence Fee	$540.00	$554.00
Commercial Recreational Activity - Kite boarding - Annual Licence Fee	$1,900.00	$1,948.00
Commercial Recreational Activity - Skydiving - Annual Licence Fee	$165,000.00	$169,000.00
Commercial Recreation Activity (all activities) - Participant Fee Adult	$2.70	$2.40
Commercial Recreation Activity (all activities) - Participant Fee Child	$1.75	$1.60
Personal Training (1 to 15 participants) - Annual Licence Fee	$281.00	$297.00
Sports Ground and Facilities Bookings		
Sports ground casual booking (community per day)	$128.00	$131.00
Sports ground casual booking (corporate per day)	$185.00	$190.00
Sports ground casual booking (high & private schools per term)	$60.00	$62.00
Pavilion hire casual (community & school groups)	$95.00	$97.00
Pavilion hire casual (corporate groups)	$172.00	$176.00
Pavilion Hire casual - Elwood Pavilion (corporate groups)	$345.00	$354.00
North Port Oval casual hire	$475.00	$487.00
Casual use - Refundable Security Deposit	$500.00	$500.00
Sports club use - Refundable Security Deposit	$500.00	$500.00

Strategic direction: We are connected and it’s easy to move around

Transport and parking management

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Infrastructure maintenance		
Road Reinstatement - Refundable Deposit	$1,000.00	$1,000.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
South Melbourne Market		
Parking - Market Days Car Parking on market days is free for the first two hours, then 2-3 hrs $6; 3-4 hrs $12; 4-5hrs $40, 5hrs+ $65		
Parking - Non Market Days Car Parking on roof non Market Days (Mon, Tues, Thurs) $9 all day	$12.00	$13.00
Parking permits		
Resident parking permit. Concession Card holders are entitled to obtain one Residential permit free of charge and subsequent permits at half price.	$77.00	$79.00
Combined parking permit (resident/foreshore). Concession Card holders are entitled to obtain one Combined permit free of charge and subsequent permits at half price.	$113.00	$116.00
Party parking permit (for two days and one night)	$5.00	$5.10
Visitor parking permit (annual). Concession Card holders are entitled to obtain one Visitor permit free of charge and subsequent permits at half price.	$103.00	$106.00
Foreshore parking permit. Concession Card holders are entitled to obtain one Foreshore permit free of charge and subsequent permits at half price.	$55.00	$57.00
Foreshore Club Parking permit. Concession Card holders are only entitled to obtain one Foreshore Club permit at half price. No first permit free for this permit type.	$95.00	$97.00
The concessions apply to holders of one of the following cards: • Pensioner Concession Card – issued by Centrelink, Department of Human Services or Department of Veterans' Affairs • Health Care Card issued by Centrelink or Department of Human Services • Commonwealth Seniors Health Card issued by Department of Human Services • Department of Veterans' Affairs Gold Card – War Widow or Totally and Permanently Incapacitated		
Tradesman parking permit (per week)	$50.00	$51.00
Temporary parking permit - Admin fee	$85.00	$87.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Unrestricted bay	$6.00	$6.20
Non-metered restricted time parking per bay	$37.00	$38.00
All Day parking ticket or meter parking per bay	$21.00	$22.00
Time restricted paid parking per bay	$33.00	$34.00
Permit reissue - Admin fee	$20.00	$20.00
Parking machine charges		
Foreshore area (tourist and excluding Waterfront Place and Station Pier) - per day	$12.30	$12.60
Foreshore area (tourist and excluding Waterfront Place and Station Pier) - per hour	$5.10	$5.20
Station Pier & Waterfront Place – maximum / per day (1 July - 30 September and 1 April - 30 June)	$12.30	$8.50
Station Pier & Waterfront Place – maximum / per day (1 October - 31 March)	$12.30	$12.60
Station Pier & Waterfront Place – per hour (1 July - 30 September and 1 April - 30 June)	$5.10	$1.80
Station Pier & Waterfront Place – per hour (1 October - 31 March)	$5.10	$3.80
St Kilda Road - North of the junction (commercial) - per hour	$3.70	$3.80
Fitzroy Street Area, including Pattison Street and St Kilda West and excluding Beaconsfield Parade (tourist/retail) – maximum / per day (1 July - 30 September and 1 April - 30 June)	$12.30	$8.50
Fitzroy Street area, including Pattison Street and St Kilda West and excluding Beaconsfield Parade (tourist/retail) – maximum / per day (1 October - 31 March)	$12.30	$12.60
Fitzroy Street area, including Pattison Street and St Kilda West and excluding Beaconsfield Parade (tourist/retail) - per hour (1 July - 30 September and 1 April - 30 June)	$3.70	$1.80
Fitzroy Street area, including Pattison Street and St Kilda West and excluding Beaconsfield Parade (tourist/retail) – per hour (1 October - 31 March)	$3.70	$3.80
South Melbourne East - North East of Kingsway (commercial) - per hour	$3.70	$3.80
South Melbourne South - Albert Road area (commercial) - per day	$11.80	$12.00
South Melbourne South - Albert Road area (commercial) - per hour	$3.70	$3.80

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
South Melbourne Central - North of Park and Ferrars Street (industrial) - per day	$8.30	$8.50
South Melbourne Central - North of Park and Ferrars Street (industrial) - per hour	$1.70	$1.80
South Melbourne Central - Clarendon Street Retail Precinct - per day	$8.30	$8.50
South Melbourne Central - Clarendon Street Retail Precinct - per hour	$1.70	$1.80
South Melbourne West - South West of Ferrars Street (Industrial) - per day	$8.30	$8.50
South Melbourne West - South West of Ferrars Street (Industrial) - per hour	$1.70	$1.80
St Kilda Road - South of St Kilda Junction (commercial / retail) - per day	$6.30	$6.50
St Kilda Road - South of St Kilda Junction (commercial / retail) - per hour	$1.70	$1.80
Parking enforcement		
Vehicle Clearway Release Fee	$405.00	$415.00
Vehicle Transfer from Nationwide Towing to Manheim	$720.00	$720.00
Daily vehicle storage fee after 48 hours (new fee)	$18.00	$18.50
Unregistered and abandoned vehicle release fee (new fee)	$405.00	$415.00
Parking fines		
Penalty Fines - class 1	$78.00	$80.00
Penalty Fines - class 2	$93.00	$95.00
Penalty Fines - class 3	$154.00	$158.00
Penalty Reminder Notice	$25.00	$23.00
Lodgement fee	$54.50	$70.00

Strategic direction: We have smart solutions for a sustainable future

Amenity

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
City Permits – community amenity		
Works zone - application fee	$99.50	$102.00
Works zone permit for 3 or less months: Parking in front of construction site for workers' private vehicles for 3 months or less. Up to 4 bays or the width of the site (whichever is the lesser)	$1,258.00	$1,289.45
Works zone permit for 6 months Parking in front of construction site for workers' private vehicles for 6 months. Up to 4 bays or the width of the site (whichever is the lesser)	$2,245.00	$2,301.00
Works zone permit for 9 months Parking in front of construction site for workers' private vehicles for 9 months. Up to 4 bays or the width of the site (whichever is the lesser)	$2,940.00	$3,013.50
Works zone permit for 12 months Parking in front of construction site for workers' private vehicles for 12 months. Up to 4 bays or the width of the site (whichever is the lesser)	$3,655.00	$3,746.40
Work Zone permit extensions: An extension to the permit allowing parking in front of construction site for workers' private vehicles.	$844.00	$865.10
Work Zone permit (additional parking bays, in excess of four) Additional parking bays for workers' private vehicles in front of a construction site.	$257.00	$263.40
Work Zone Signage installations and removal	$378.00	$387.45
Advertising Signs (Real Estate Agents) application fee Application fee for the permit to allow small Auctions signs to be placed in residential streets at the time of auctions or open for inspections only.	$99.50	$102.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Advertising Signs (Real Estate Agents) permit fee Annual permit for small Auctions signs to be placed in residential streets at the time of auctions or open for inspections only.	$645.00	$661.10
City Permits – itinerant trading		
Charity Bins application fee for permit to place a charity clothing bin on council land.	$99.50	$102.00
Charity Bins permit fee to place a charity clothing bin on council land.	$64.00	$65.60
Charity Bins Permit Renewal Fee	$99.50	$102.00
Commercial Waste Bins application fee to apply for permit to store waste bins for commercial premises on council land e.g. for cafes (not skip bins).	$99.50	$102.00
Commercial Waste Bins permit fee to store waste bins for commercial premises on council land e.g. for cafes (not skip bins).	$64.00	$65.60
Commercial Waste Bins - 120 litre bin	$64.00	$65.60
Commercial Waste Bins - 240 litre bin	$92.50	$94.80
Commercial Waste Bins - up to 1200 litres	$369.00	$378.20
Non-motorised trading permit fee (including pedicabs & horse drawn carts)	$2,369.00	$2,428.20
City Permits – occupying the road for works:		
Asset Protection permit and deposit for protection of council land and assets to cover costs for any damage associated with development works at a construction site.	$218.80	$224.25
Out of Hours permit - application fee or development work undertaken outside approved hours under the Local Law: 7am-6pm M-F, 9am-3pm Sat. No works on Sunday or public holidays.	$99.50	$102.00
Out of Hours Permit - permit fee per day for development work undertaken outside approved hours under the Local Law: 7am-6pm M-F, 9am-3pm Sat. No works on Sunday or public holidays.	$363.00	$372.00
Road Opening Permit - application fee to excavate council land for the purposes of water, electricity, telecommunications etc. for private contractors. Under legislation, service authorities are not required to obtain permits.	$99.50	$102.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Road Opening Permit - permit fee to excavate council land for the purposes of water, electricity, telecommunications etc. for private contractors. Under legislation, service authorities are not required to obtain permits.	$109.50	$112.25
Vehicle Crossing - application fee for permit to construct or repair a private driveway to council specifications.	$120.00	$123.00
Vehicle Crossing - permit fee to construct or repair a private driveway to council specifications (paid once assessment of application determines that a permit is okay to be issued).	$163.00	$167.00
Street Occupation Permits - application fee to apply for a permit to occupy council land for works or storage of associated building materials.	$99.50	$102.00
Street Occupation Permits - permit fee to occupy council land for works or storage of associated building materials.	$119.00	$122.00
Street Occupation Permits - (plus $2 ground / $1 head gantry per square meter per day) For street occupation permits, an additional $2 per square meter of ground level surface taken up per week or $1 per square metre per day for overhead gantry (for example, air space)	Plus $2.10 ground / $1.10 head gantry per sq. meter per day	Plus $2.10 ground / $1.10 head gantry per sq. meter per day
Road Closure Permit - application fee for permit to close off one lane of traffic or to close the whole road subject to Traffic Management Plan approval.	$99.50	$102.00
Road Closure Permit - fee per day with road opening to close off one lane of traffic or to close the whole road subject to Traffic Management Plan approval.	$125.00	$128.10
Road Closure Permit - fee per day for other closures	$208.50	$213.70
Skip Bin Permit - application fee to apply for a permit to store a refuse/skip bin on council land.	$26.20	$26.85
Skip Bin Permit - per day for permit to store a refuse/skip bin on council land.	$18.00	$18.45
Skip Bin Permit - per week to store a refuse/skip bin on council land.	$86.80	$88.95
Shipping Container or Portable Storage Containers - up to 6 meter; per day rate.	$123.50	$126.60
Shipping Container or Portable Storage Containers - greater than 6 meter; per day rate.	$205.50	$210.65

Waste reduction

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Waste Management Operations		
Sale of worm farms	$75.00	$77.00
Sale of compost bins	$42.00	$43.00
Resource Recovery Centre Fees (Car Boot)	$20.00	$21.00
Resource Recovery Centre Fees (Station Wagon, Utility)	$39.00	$40.00
Resource Recovery Centre Fees (Small Trailer)	$53.00	$55.00
Resource Recovery Centre Fees (Large Trailer)	$98.00	$101.00
Resource Recovery Centre Fees (Contractors m^3)	$86.00	$88.00
Resource Recovery Centre Fees - Non Resident (Car Boot)	$27.00	$28.00
Resource Recovery Centre Fees - Non Resident (Station Wagon, Utility)	$50.00	$52.00
Resource Recovery Centre Fees - Non Resident (Small Trailer)	$65.00	$67.00
Resource Recovery Centre Fees - Non Resident (Large Trailer)	$108.00	$111.00

Strategic direction: We are growing and keeping our character

City planning and urban design

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Planning Scheme Amendment Fees		
Stage 1 - a) considering a request to amend a planning scheme; and b) taking action required by Division 1 of	$2,871.60	$2,871.60

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Part 3 of the Act; and c) considering any submissions which do not seek a change to the amendment; and d) if applicable, abandoning the amendment		
Stage 2 - **Up to and including 10 submissions which seek a change to an amendment:** e) considering submissions and, where necessary, referring the submissions to a panel; and f) providing assistance to a panel in accordance with section 158 of the Act; and g) making a submission to the panel in accordance with section 24(b) of the Act; and h) considering the report of the panel in accordance with section 27 of the Act; and i) after considering submissions and the report of the panel, abandoning the amendment in accordance with section 28 of the Act (if applicable)	$14,232.70	$14,232.70
Stage 2 - **11 to (and including) 20 submissions which seek a change to an amendment:** e) considering submissions and, where necessary, referring the submissions to a panel; and f) providing assistance to a panel in accordance with section 158 of the Act; and g) making a submission to the panel in accordance with section 24(b) of the Act; and h) considering the report of the panel in accordance with section 27 of the Act; and i) after considering submissions and the report of the panel, abandoning the amendment in accordance with section 28 of the Act (if applicable)	$28,437.60	$28,437.60
Stage 2 - **Submissions that exceed 20 submissions which seek a change to an amendment:** e) considering submissions and, where necessary, referring the submissions to a panel; and f) providing assistance to a panel in accordance with section 158 of the Act; and g) making a submission to the panel in accordance with section 24(b) of the Act; and h) considering the report of the panel in accordance with section 27 of the Act; and i) after considering submissions and the report of the panel, abandoning the amendment in accordance with section 28 of the Act (if applicable)	$38,014.40	$38,014.40
Stage 3 - a) adopting the amendment or part of the amendment in accordance with section 29 of the Act; and b) submitting the amendment for approval by the Minister in accordance with section 31 of the Act; and c) giving the notice of the approval of the amendment required by section 36(2) of the Act.	$453.10	$453.10

Development approvals and compliance

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Building control fees		
Legal Point of Discharge – for Stormwater and provide information for the Building Surveyor	$60.90	$60.90
Property enquiry (Form 2.10) 326/1 – to obtain property information relating to Building Permits and Notices & Orders outstanding ordinarily sought by Solicitors	$48.60	$48.60
Property enquiry (Form 2.10) 326/1 - plus $40 fast track fee – (as above) Additional fee for fast turnaround	$88.60	$88.60
Flood level certificate 326/2 – to obtain property information relating to Flooding	$48.60	$48.60
Flood level certificate 326/2 - plus $40 fast track fee – (as above) Additional fee for fast turnaround	$88.60	$88.60
Property enquiry - 326/3 – to obtain inspecting approval dates ordinarily sought by an Owner or Mortgagee	$48.60	$48.60
Lodgement fee from Private Building Surveyors – commercial – associated with lodgement of Building Permit for Commercial properties ordinarily lodged by the private Building Surveyor	$36.40	$36.40
Lodgement fee from Private Building Surveyors – residential – associated with lodgement of Building Permit for Residential properties ordinarily lodged by the private Building Surveyor	$36.40	$36.40
Government building levy (Calculated as % of value of work) – calculated as % of value of work. Fee associated with Building Permits and paid to the Building Commission as a levy	0.128% & 0.034%	0.128% & 0.034%
Report and Consent Fee – Rescode – associated with siting non-compliance relation to Building Permits	$256.90	$256.90
Report and Consent Fee – Hoarding – associated with precautions over the street alignment in relation to Permits (i.e. Hoarding, scaffold etc.)	$256.90	$256.90
Report ONLY - Rescode and Hoarding – associated with precautions over the street alignment in relation to Permits (i.e. Hoarding, scaffold etc.)	$513.80	$513.80
POPE -Place of public entertainment - Small (NEW) – associated with precautions over the street alignment in relation to Permits (i.e. Hoarding, scaffold etc.)	$550.00	$550.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
POPE -Place of public entertainment – Medium (NEW) – associated with precautions over the street alignment in relation to Permits (i.e. Hoarding, scaffold etc.)	$1,000.00	$1,000.00
POPE -Place of public entertainment – Large (NEW) – associated with precautions over the street alignment in relation to Permits (i.e. Hoarding, scaffold etc.)	$1,500.00	$1,500.00
Siting Approval - Up to 5 Structures (NEW) – associated with precautions over the street alignment in relation to Permits (i.e. Hoarding, scaffold etc.)	$350.00	$350.00
Siting Approval - Between 6 and 10 Structures (NEW) – associated with precautions over the street alignment in relation to Permits (i.e. Hoarding, scaffold etc.)	$550.00	$550.00
Siting Approval - Greater than 10 Structures (NEW) – associated with precautions over the street alignment in relation to Permits (i.e. Hoarding, scaffold etc.)	$1,000.00	$1,000.00
Fire Safety Determination - Small Building – associated with inspection of smaller buildings to provide assessment of fire safety	$539.75	$553.20
Fire Safety Determination - Medium Building – associated with inspection of medium buildings to provide assessment of fire safety	$1,619.29	$1,659.75
Fire Safety Determination - Large Building – associated with inspection of larger buildings to provide assessment of fire safety	$2,698.78	$2,766.25
Building permits (internal)		
Demolish detached dwelling	$1,104.36	$1,131.95
Demolish attached dwelling	$1,327.84	$1,361.00
Demolish outbuildings	$665.00	$681.60
Swimming pools (includes barrier to AS 1926)	$1,818.26	$1,863.70
Fences	$663.77	$680.35
Carports/garages <20,000	$885.19	$907.30
Carports/garages >20,000	$1,106.64	$1,134.30
Alterations and additions to a dwelling <100,000	$1,327.84	$1,361.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Alterations and additions to a dwelling 100,000-200,000	$1,548.03	$1,586.70
Alterations and additions to a dwelling 200,000-300,000	$1,846.01	$1,892.15
Alterations and additions to a dwelling >300,000	$2,210.67	$2,265.90
New dwellings <250,000	$2,359.86	$2,418.85
New dwellings 250,000-500,000	$2,801.38	$2,871.40
New dwellings >500,000	$3,243.82	$3,324.90
Multiple dwellings (2)	$4,423.90	$4,534.50
Multiple dwellings (3)	$5,160.62	$5,289.60
Multiple dwellings (4)	$5,897.85	$6,045.30
Amendment to building permits issued	$516.01	$528.90
Extension of time to building permits issued	$516.01	$528.90
Shop fit outs <100,000	$1,179.88	$1,209.35
Shop fit outs 100,000-200,000	$1,401.20	$1,436.20
Shop fit outs >200,000	$1,621.91	$1,662.45
Internal alterations to class 2 apartments	$1,106.93	$1,134.60
Extension of time- Class 1 or 10	$307.53	$315.20
Extension of time- Class 2-9	$442.34	$453.40
Lapsed Permit Renewal (Class 1 or 10)	$614.19	$629.50
Lapsed Permit Renewal (Class 2 - 9) Minimum Fee	$767.54	$786.70
Class 2, 3, 4, 5, 6, 7 & 9 Alterations, additions and new buildings		
Up to $40,000	$805.56	$825.70

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
$40,000 - $100,000	$ value x (1.749%)	$ value x (1.749%)
$100,001 - $500,000	$ value x (1.523%)	$ value x (1.523%)
$500,001 - $2 million	$ value x (0.617%)	$ value x (0.617%)
>$2 - $10 million	$ value x (0.3284%)	$ value x (0.3284%)
>$10 - $20 million	$ value x (0.219%)	$ value x (0.219%)
>$20 – $30 million	$ value x (0.215%)	$ value x (0.215%)
>$30 – $40 million	$ value x (0.1965%)	$ value x (0.1965%)
>$40 – $50 million	$ value x (0.2048%)	$ value x (0.2048%)
>$50 million	$ value x (0.1872%)	$ value x (0.1872%)
Building control fees		
Install SOLAR PANELS for Residents and Industry	$0.00	$0.00
Use Only (includes Liquor Licence & Car Park Waiver) – to apply for a planning permit to change the use of the land only	$1,240.70	$1,240.70
Single Dwelling (up to $2,000,000) - use and/or develop a single dwelling per lot, and undertake development ancillary to a single dwelling per lot (other than a class 8 permit or a permit to subdivide or consolidate land):-		
Less than $10,000	$188.20	$188.20
More than $10,001 less than $100,000	$592.50	$592.50

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
More than $10,000 less than $500,000	$1,212.80	$1,212.80
More than $500,000 less than $1,000,000	$1,310.40	$1,310.40
More than $1,000,000 less than $2,000,000 (more than $2,000,000 see Class12,13,14 & 15)	$1,407.90	$1,407.90

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
VicSmart Application		
$10,000 or Less	$188.20	$188.20
More than $10,000	$404.30	$404.30
Subdivide or consolidate land	$188.20	$188.20
Development (including single dwellings > $2,000,000)		
Less than $100,000 (other than a class 2, class 3, class 7 or class 8 or a permit to subdivide or consolidate land)	$1,080.40	$1,080.40
$100,000 to $1,000,000 (other than a class 4, class 5, or class 8 or a permit to subdivide or consolidate land)	$1,456.70	$1,456.70
$1,000,001 to $5,000,000 (including a single dwelling per lot) (other than a class 6 or class 8 or a permit to subdivide or consolidate land.	$3,213.20	$3,213.20
$5,000,001 to $15,000,000 (including a single dwelling per lot) (other than a class 8 or a permit to subdivide or consolidate land) if the estimated cost of development is.	$8,189.90	$8,189.90
Class - Statutory Planning Fees - Applications for Permits Regulation 9		
$15,000,000 to $50,000,000 (including a single dwelling per lot) (other than a class 8 or a permit to subdivide or consolidate land)	$24,151.10	$24,151.10
$50,000,001 plus (including a single dwelling per lot) (other than a class 8 or a permit to subdivide or consolidate land). For the first 12 months, fee for a Class 15 will be charged at %50 - i.e. $27,141.20"	$54,282.40	$54,282.40
Subdivision		
Subdivide an existing building (other than a class 9 permit)	$1,240.70	$1,240.70
Two lot subdivision (other than a class 9 or class 16 permit)	$1,240.70	$1,240.70
Realignment of a common boundary or consolidate lots (other than a class 9 permit)	$1,240.70	$1,240.70
Subdivide land (other than a class 9, class 16, class 17 or class 18 permit)	$1240.70 per 100"	$1,240.70

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
• create, vary or remove a restriction within the meaning of the Subdivision Act 1988; or • create or remove a right of way; or • create, vary or remove an easement other than a right of way; or • vary/ remove a condition in the nature of an easement (other than right of way) in a Crown grant.	$1,240.70	$1,240.70
A Permit not otherwise provided for in the Regulations	$1,240.70	$1,240.70
Other Statutory Planning Fees		
S57A (a) Amend a (new) application after notice has been given (section 57A(3)(a)) is 40% of the application fee for that class of permit.	40% of Application Fee (and may incl. (c)	40% of Application Fee (and may incl. (c)
S57A (b) Amend a Sec.72 application after notice has been given (section 57A(3)(a)) is 40% of the application fee for that class of permit set out in the Table at Regulation 11 and any additional fee under (c) below.	40% of Application Fee + (c)	40% of Application Fee + (c)
S57A – If amending the application changes the class of application (c) Application to amend an Application for a (new) permit after notice has been given or Application to amend an application for S.72 changes to the class of that permit to a new class having a higher application fee set: additional fee being the difference between the original fee and the amended class fee.	Difference between original fee and new class $	Difference between original fee and new class $
Certificate of Compliance	$306.70	$306.70
Where the Planning Scheme specifies that a matter must be done "to the satisfaction of the responsible authority" (including car parking consent)	$306.70	$306.70
For an agreement, or to amend or end an agreement, under Section 173 of the Act	$620.30	$620.30
Class - Statutory Planning Fees – Amendments to Permits S.72 Regulation 11		
Class 1 - Amendment to a permit to change the use allowed by the permit or allow a new use.	$1,240.70	$1,240.70

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Class 2 - Amendment to a permit (other than a permit for a single dwelling per lot or to use and develop a single dwelling per lot or to undertake development ancillary to a single dwelling per lot) to change the statement (preamble) of what the permit allows or to change any or all of the conditions which apply to the permit.	$1,240.70	$1,240.70
Single Dwelling (to $2,000,000) - Amendment to a permit for a single dwelling per lot or use and develop a single dwelling per lot and undertake development ancillary to a single dwelling per lot (other than a class 8 permit or a permit to subdivide or consolidate land):-		
Class 3 - (Class 2) less than $10,000.	$188.20	$188.20
Class 4 - (Class 3) more than $10,000 less than $100,000	$592.50	$592.50
Class 5 - (Class 4) more than $100,000 less than $500,000	$1,212.80	$1,212.80
Class 6 - (Class 5 & 6) more than $500,000 less than $2,000,000	$1,310.40	$1,310.40
VicSmart Applications		
Class 7 - (Class 7) Less than $10,000	$188.20	$188.20
Class 8 - (Class 8) more than $10,000	$404.30	$404.30
Class 9 - (Class 9) to subdivide or consolidate land	$188.20	$188.20
Development (including single dwellings > more than $2,000,000)		
Class 10 - (Class 10) Less than $100,000 - amend a permit to develop land (other than a class 2, class 3, class 7 or class 8 or a permit to subdivide or consolidate land)	$1,080.40	$1,080.40
Class 11 - (Class 11) $100,001 to $1,000,000 - amend a permit to develop land (other than a class 4, class 5, or class 8 or a permit to subdivide or consolidate land)	$1,456.70	$1,456.70
Class 12 - (Class 12,13,14 or 15) More than $1,000,001 - amend a permit to develop land (other than a class 6 or class 8 or a permit to subdivide or consolidate land)	$3,213.20	$3,213.20
Subdivision		
Class 13 - (Class 16) to subdivide and existing building (other than a class 9 permit)	$1,240.70	$1,240.70
Class 14 - (Class 17) to subdivide land into 2 lots (other than a class 9 or class 16 permit)	$1,240.70	$1,240.70

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Class 15 - (Class 18) To effect a realignment of a common boundary between lots or consolidate 2 or more lots (other than a class 9 permit)	$1,240.70	$1,240.70
Class 16 - (Class 19) Subdivide land (other than a class 9, class 16, class 17 or class 18 permit)	$1,240.7 per 100	$1,240.7 per 100
Class 17 - (Class 20) Amendment to an application to: a) create, vary or remove a restriction within the meaning of the Subdivision Act 1988; or b) create or remove a right of way; or c) create, vary or remove an easement other than a right of way; or d) vary or remove a condition in the nature of an easement (other than right of way) in a Crown grant	$1,240.70	$1,240.70
Class 18 - (Class21) Amendments to an application for a permit not otherwise provided for in the Regulations	$1,240.70	$1,240.70
Port Phillip Planning & Administration Fees		
Secondary consent - Fee for amending Endorsed Plans	$130.20	$133.45
Certification - Endorsement of Plans of Subdivision	$164.50	$164.50
Fast Track Fee – for minor planning applications (such as painting of heritage buildings and minor works applications) that are able to be processed without advertising or the need for external referrals	$123.00	$126.05
Car parking consent – for determining satisfactory car parking where no Planning Permit is required	$130.00	$133.25
Advertising – Board – per advertising sign when planning permit applications are required to be advertised	$76.00	$77.90
Advertising – Letter – per letter when planning permit applications are required to be advertised	$11.00	$11.30
Planning Confirmation – for response to requests for Planning information	$174.00	$178.35
Copy of Planning Register – for a copy of the planning register	$76.00	$77.90
Form A Report & Consent Request – for Report and Consent on Proposed Demolition	$64.10	$64.10
Extension of Time		

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
1 dwelling	$574.50	$588.85
2-9 dwellings	$693.40	$710.75
10 or more dwellings	$920.00	$943.00
Subdivisions	$574.50	$588.85
Commercial/industrial	$846.00	$867.15
Planning File Search		
Form A Report & Consent Request (Building Survey)	$55.55	$55.55
Residential lodged from 2008 onwards	$57.00	$58.40
Residential lodged during or prior to 2008	$106.00	$108.65
Residential Property Information Request	$100.00	$102.50
Commercial Applications - Lodged from 2008 onwards	$92.25	$94.55
Commercial Applications - Lodged prior 2008	$315.70	$323.55
Commercial Property Information Request	$315.70	$323.55
Scanning / Photocopying Fee - per sheet / page		
A4	$1.35	$1.40
A3	$2.25	$2.30
A2	$4.95	$5.10
A1 & AO	$7.60	$7.80

Health services

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Food Act Registration & Renewal of Registration Fees - High Risk Class 1 Permits. Initial registration fees decrease on a pro-rata basis by 1/4 every 3 months throughout the annual registration period		
Medium	$272.00	$279.00
Large	$368.00	$377.00
Food Act Registration & Renewal of Registration Fees - Class 2 regular (predominantly) commercial premises - open most days of the week or mobile or temporary premises operating regularly (most weekends, large events). Initial registration fees decrease on a pro-rata basis quarterly		
Small	$272.00	$279.00
Medium	$550.00	$564.00
Large	$778.00	$797.00
Food Act Registration & Renewal of Registration Fees - Class 3 regular (predominantly) commercial premises - open most days of the week or mobile or temporary premises operating regularly (most weekends, large events). Initial registration fees decrease on a pro-rata basis quarterly		
Small	$164.00	$168.00
Medium	$272.00	$279.00
Large	$368.00	$377.00
Food services		
Food Act Registration & Renewal of Registration Fees - Supermarkets. Initial registration fees decrease on a pro-rata basis quarterly		
Small	$550.00	$564.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Medium	$778.00	$797.00
Large	$1,215.00	$1,245.00
Food Act Registration & Renewal of Registration Fees - Class 2 Community Groups & Clubs. Initial registration fees decrease on a pro-rata basis quarterly		
Small	$69.00	$71.00
Regular	$142.00	$146.00
Large	$550.00	$564.00
Food Act Registration & Renewal of Registration Fees - Class 3 Community Groups & Clubs. Initial registration fees decrease on a pro-rata basis quarterly		
Small	$59.00	$60.00
Regular	$119.00	$122.00
Large	$272.00	$279.00
Mobile or temporary premises associated with a permanent fixed premises		
Class 3	$119.00	$122.00
Class 2	$142.00	$146.00
Commercial mobile or temporary premises(Large Scale)-Operating regularly state-wide		
Class 3	$272.00	$279.00
Class 2	$550.00	$564.00
Commercial mobile or temporary premises - operating regularly State-wide		
Class 3	$164.00	$168.00
Class 2	$272.00	$279.00
Commercial mobile or temporary premises - operating occasionally, seasonally or equivalent		
Class 3	$119.00	$122.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Class 2	$142.00	$146.00
Commercial mobile or temporary premises - single event or day registration		
Class 3	$59.00	$60.00
Class 2	$69.00	$71.00
Community group, sporting club, school or other not for profit - mobile or temporary premises - operating occasionally, seasonally or up to 12 months		
Class 3	$59.00	$60.00
Class 2	$69.00	$71.00
Community group, sporting club, school or other not for profit - mobile or temporary premises - single event or day registration (festivals)		
Class 2 & 3	$0.00	$0.00
Food Act Registration Late Fees		
Registration late fee (Class 1)	$32.00	$33.00
Registration late fee (Class 2 and 3)	$92.00	$94.00
Transfer of Registration Fees (Food Act)		
Class 1 & 3	$124.00	$127.00
Class 2	$183.00	$188.00
Plan Approval Fee		
Class 1 & 3	$124.00	$127.00
Class 2	$183.00	$188.00
Transfer Inspection Report fees (Food Act)		
Class 1 & 3	$124.00	$127.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Class 2	$183.00	$188.00
Registered Charities		
Class 1,2 & 3	$0.00	$0.00
Personal services premises		
Public Health & Wellbeing Act Fee - Personal services premises. Hairdresser & low-risk beauty parlour fee is full amount and is a one-off single payment with no requirement to renew registration annually. For skin penetration, colonic irrigation, higher risk beauty parlour and hairdressers with additional beauty treatments, the initial registration fees decrease on a pro-rata basis by 1/4 every 3 months throughout the annual registration period and must be renewed annually		
Registration Fee	$147.00	$151.00
Registration Late Fee	$61.00	$63.00
Plan Approval Fee	$56.00	$57.00
Transfer of registration fees	$74.00	$76.00
Transfer Inspection Report fees	$74.00	$76.00
Prescribed accommodation		
Prescribed Accommodation - Residential Accommodation / Rooming House / Youth Hostel / Student Dormitory / Hotel / Motel Registration Fees		
1 - 10 residents	$207.00	$212.00
11 - 20 residents	$388.00	$398.00
21 - 40 residents	$578.00	$592.00
41 - 60 residents	$944.00	$968.00
61 - 80 residents	$1,576.00	$1,615.00
80+ residents	$1,946.00	$1,995.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Registration Late Fee		
Registration Late Fee	$62.00	$64.00
Plan Approval Fee		
Category 1 (1-20 residents)	$92.00	$94.00
Category 2 (21-60 residents)	$124.00	$127.00
Category 3 (61+ residents)	$183.00	$188.00
Transfer of registration fees (Public Health & Wellbeing Act)		
Category 1 (1-20 residents)	$124.00	$127.00
Category 2 (21-60 residents)	$246.00	$252.00
Category 3 (61+ residents)	$368.00	$377.00
Transfer Inspection Report fees (Public Health & Wellbeing Act)		
Category 1 (1-20 residents)	$124.00	$127.00
Category 2 (21-60 residents)	$246.00	$252.00
Category 3 (61+ residents)	$368.00	$377.00

Local laws and animal management

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Animal Management		
Domestic Animal Business	$255.00	$262.00
Dog		

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Animal Management		
Permit for multiple dogs per residence (one off payment)	$64.00	$66.00
Restricted breed dog - includes any declared, menacing, dangerous dogs	$250.00	$256.00
Maximum fee pensioner	$92.00	$92.00
Minimum fee pensioner	$30.50	$30.50
Maximum fee non- pensioner	$195.00	$200.00
Minimum fee non- pensioner	$65.00	$67.00
Reclaim fees	$158.00	$162.00
Rebate for Assist Dogs (on production of required documentation)	-$65.00	-$67.00
Cat		
Minimum fee non- pensioner	$34.00	$35.00
Minimum fee pensioner	$15.50	$15.50
Maximum fee pensioner	$47.50	$47.50
Maximum fee non- pensioner	$100.00	$102.00
Reclaim fees	$82.00	$84.00
Local law reclaim fee		
Reclaim fee - impounded goods, for any goods, materials impounded by council that are released to the owner e.g. shopping trolleys	$150.00	$154.00
Local law permit fees		
Significant Trees - application fee to apply for permit to remove or prune a significant tree on private land.	$99.50	$102.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Animal Management		
Significant Trees - permit fee to remove or prune a significant tree on private land.	$64.00	$65.60
General Local Laws Permit Fee	$173.50	$200.00

Public space

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Events		
Event and promotion application fee	$85.00	$88.00
Busking Fee - 6 months 9am - 9pm	$67.00	$70.00
Street Stall Permit/Collection	$60.00	$62.00
Temporary signage fee - up to 14 days only	$142.00	$145.00
Commercial Promotions		
Product Promotions - roving, no structures (per hour)	$305.00	$312.00
Product Promotions - with structures or vehicles (per hour) - St Kilda Precinct	$462.00	$475.00
Product Promotions - with structures or vehicles (per hour) - Outside St Kilda Precinct	$360.00	$370.00
Product Promotions - per day fee for an eight hour day	$2,700.00	$2,770.00
Product Promotions - per day fee for an eight hour day package. (Min three days)	$2,250.00	$2,306.00
Distributing Promotional Flyers - for Port Phillip businesses (per hour)	$20.00	$20.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Distributing Promotional Flyers - for Port Phillip businesses (full day/ 8 hours)	$100.00	$100.00
Commercial Event or Promotion - site fee per day		
Unique site (up to 5000 participants)	$6,165.00	$6,170.00
Combined use of South Beach Reserve and St Kilda Foreshore (up to 5000 participants)	$7,300.00	$7,300.00
Small events	$270.00	$280.00
Intermediate events	$0.00	$650.00
Medium events	$1,215.00	$1,245.00
Large events	$2,450.00	$2,515.00
Major event	$6,165.00	$6,170.00
High risk/high impact event	$6,000 - $25,000	$6,000 - $25,000
St Kilda peak season (December - February)	$6,000 - $25,000	$6,000 - $25,000
Bump in and bump out fee - weekends per day	$616.00	$630.00
Bump in and bump out fee - weekdays per day	$460.00	$470.00
Refundable Security Bond per site	$500.00 - $50,000.00	$500.00 – $50,000.00
Refundable Noise Bond	$0.00	$5,000.00 – $20,000.00
On-Road Events		
Combination Events (Reserve and Road use) ; flat fee 0 - 2000 registered participants inclusive	$10,000.00	$10,000.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Combination Events (Reserve and Road use) for events with over 2000 registered participant s, additional fee per registered participant 2001+	$5.00	$5.05
Traffic management costs (per hour)	$105.00	$110.00
Parking on Reserve fee		$95.00
On-Road Only (per participant) - minimum charge 2000 participants	$1.35	$1.50
Community Event (single site per day)		
Community Event (single site per day)	10% of event fee	10% of event fee
Markets		
Outdoor Markets (per session)	$620.00	$635.00
Grand Prix		
Grand Prix stallholders - 3m x 3m site	$600.00	$615.00
Grand Prix stallholders (units sq. m)	$1.35	$1.40
Grand Prix roving permits (per user)	$416.00	$430.00

Strategic direction: We thrive by harnessing our creativity

Arts, Culture and Heritage

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Heritage		
Curatorial Services (heritage image reproduction service - digital image delivery by email or CD)	$36.50	$36.50
Filming permits		
Filming Permits (motion pictures & related photography (first day)	$841.00	$862.00
Filming Permits (motion pictures & related photography (second day)	$510.00	$525.00
Filming Permits (motion pictures & related photography (third and subsequent days)	$175.00	$180.00
Filming Permits (motion pictures & related photography (community / cultural benefit))	$175.00	$180.00
Filming Permits (motion pictures, half day)	$510.00	$525.00
Filming Permits (service fee - low budget)	$48.00	$50.00
Filming Permits (service fee - no budget)	$20.00	$20.00
Photography permits		
Photography Permit (commercial stills photography (first day)	$393.00	$400.00
Photography Permit (commercial stills photography second & subsequent days)	$175.00	$180.00

Economic development and tourism

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
City Permits – footpath trading		
Occupancy Permits – Tables – to place a table on the footpath (annual cost per item).		
Acland Street	$79.00	$79.00
Fitzroy Street	$79.00	$79.00
Standard	$79.00	$79.00
Discount	$45.00	$45.00
Footpath occupancy permits- Chairs – to place a chair on the footpath (annual cost per item).		
Acland Street	$117.00	$117.00
Fitzroy Street	$117.00	$117.00
Standard	$117.00	$117.00
Discount	$70.00	$70.00
Footpath occupancy permits- Glass Screens – Tables – to place a table within a glass screen on the footpath (annual cost per item).		
Fitzroy Street	$106.00	$106.00
Standard	$106.00	$106.00
Discount	$61.00	$61.00
Footpath occupancy permits- Glass Screens – Chairs – to place a chair within a glass screen on the footpath (annual cost per item).		
Fitzroy Street	$158.00	$158.00
Standard	$158.00	$158.00
Discount	$95.00	$95.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Footpath occupancy permits- various		
Footpath occupancy permits - Advertising signs 1 per property only	$314.00	$314.00
Footpath occupancy permits - Display of goods	$375.00	$375.00
Footpath occupancy permits - Planters per premises with outdoor furniture	$108.00	$108.00
Footpath occupancy permits - Screens per premises with outdoor furniture	$191.00	$191.00
Footpath occupancy permits - Outdoor heaters	$126.00	$126.00
Renewal Fee	$72.00	$72.00
New Applications Fee	$120.00	$120.00
Transfers	$120.00	$120.00
Glass Screen Application Fees	$250.00	$250.00
Temporary Permits		
Temporary Application Fee	$68.00	$68.00
Temp - Marketing & Promotion activity (daily charge) to a max of $305	$74.00	$74.00
Advertising signs application fee	$68.00	$68.00
Advertising signs per day (with a max of $255)	$40.00	$40.00
Extended Trading - Outdoor seating		
Extended Trading application fee	$68.00	$68.00
Extension of current situation $10m2 Min of $200	$223.00	$223.00
Marque enclosing outdoor seating $15m2 Min of $200	$223.00	$223.00
Marque - once off yearly sales $110/day max $550	$119.00	$119.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Mobile Food Vans		
Mobile Food Vans Permit	$2,173.00	$2,173.00
Mobile Food Vehicle Application Fee	$70.00	$70.00

Festivals

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
St Kilda Festival		
SKF Road trading (non-alcohol per m2)	$9.60	$10.00
SKF Road Trading (with alcohol per m2)	$25.50	$26.00
SKF Itinerant Market Stall (high pedestrian zone)	$315.00	$322.00
SKF Itinerant Market Stall (regular zone)	$163.00	$167.00
SKF All Food Vending Areas (under 15 m2)	$75.00	$77.00
SKF All Food Vending Areas (over 15 m2)	$115.50	$118.00
SKF Trading Application Fee	$30.00	$31.00
St Kilda Film Festival call for entry fee - early bird rate	$35.00	$35.00
St Kilda Film Festival call for entry fee - standard rate	$39.00	$39.00
St Kilda Festival call for entry fee	$33.00	$33.00
Cost Recovery (infrastructure and power hire)	n/a	Cost Recovery

Libraries

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Local History - microfiche reader printer copies	$0.20	$0.20
Internet/PC copy charge	$0.20	$0.20
Black and white photocopy charges - A4	$0.20	$0.20
Black and white photocopy charges - A3	$0.20	$0.20
Colour Photocopy Charges	$1.00	$1.00
Inter Library Loans	$2.00	$2.00

Markets

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Esplanade market		
Esplanade Market (3 monthly permits) 2.4 metre size site	$620.00	$620.00
Esplanade Market (6 monthly permits) 2.4 metre size site	$1,133.00	$1,133.00
Esplanade Market (12 monthly permits) 2.4 metre size site	$2,112.00	$2,112.00
Esplanade Market (casual permits) 2.4 metre size site	$77.00	$77.00
Esplanade Market (3 monthly permits) 3.1 metre size site	$682.00	$682.00
Esplanade Market (6 monthly permits) 3.1 metre size site	$1,246.00	$1,246.00
Esplanade Market (12 monthly permits) 3.1 metre size site	$2,323.00	$2,323.00
Esplanade Market (casual permits) 3.1 metre size site	$85.00	$85.00
Administration fee - new stallholders	$30.00	$30.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Late fee on invoice payment - permanent stallholders	$30.00	$30.00
Late fee on invoice payment - casual stallholders	$10.00	$10.00
Ready to eat food - Casual stalls 3m site	$169.00	$169.00
Ready to eat food - Casual stalls oversize site	$231.00	$231.00
Ready to eat food - Quarterly Permits- for 3 months. (January-March, April-June, July-September, October-December)	$1,364.00	$1,364.00
Coffee Vendor - Quarterly Permits- for 3 months. (January-March, April-June, July-September, October-December)	$956.00	$956.00
Coffee Vendor - Half yearly Permits- for 6 months (January-June, July-December)	$1,746.00	$1,746.00
Coffee Vendor - Annual Permits - for 12 months (July-June)	$3,255.00	$3,255.00
Coffee Vendor - Casual Fee	$115.50	$115.50

Strategic direction: Our commitment to you

Financial and project management

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Rates		
Land Information Certificates	$24.80	$25.40
Urgent Land Information Certificates	$90.80	$93.10
Reprint of prior years' Rates notice	$11.00	$11.30
Financial management		

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Dishonoured Cheques	$42.90	$44.00

Governance and engagement

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Freedom of Information		
Freedom of Information requests (excluding photocopying charges)	$27.90	$27.90
Minor Foreshore and Parks Weddings & Events		
St Kilda Botanical Gardens, Catani Gardens and St Vincent Gardens - Community, Wedding Ceremony, Private Function (1hr permit)	$400.00 (3hr min)	$137.00
St Kilda Botanical Gardens, Catani Gardens and St Vincent Gardens - Commercial Function (1hr permit)	$755.00 (3hr min)	$258.00
General Gardens (non-heritage) - Community, Wedding Ceremony, Private Function (1hr permit)	$250.00 (3hr min)	$86.00
General Gardens (non-heritage) - Commercial Function (1hr permit)	$665.00 (3hr min)	$228.00
Additional Structures 3 x 3mt or larger (rides, jumping castles, etc. please allow for additional set up/pack down times)	$200.00 (3 hr min)	$205.00
Hall hire		
St Kilda Town Hall – Auditorium Full (incl. kitchen)		
Commercial Mon-Thurs. whole day	$2,220.00	$2,276.00
Commercial Fri - Sun whole day	$4,370.00	$4,480.00
Community Mon-Thurs. Whole day	$946.00	$970.00
Community Fri-Sun whole day	$1,576.00	$1,616.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
After Hours Hourly Rate Commercial (before 8am or after 1am)	$282.00	$290.00
After Hours Hourly Rate Community (before 8am or after 1am)	$158.00	$162.00
Port Melbourne Town Hall – Auditorium (incl. kitchen)		
Commercial Mon-Thurs. whole day	$1,330.00	$1,364.00
Commercial Fri - Sun whole day	$1,670.00	$1,712.00
Community Mon-Thurs. Whole day	$568.00	$583.00
Community Fri-Sun whole day	$694.00	$712.00
After Hours Hourly Rate Commercial (before 8am or after 1am)	$101.00	$104.00
After Hours Hourly Rate Community (before 8am or after 1am)	$32.00	$33.00
South Melbourne Town Hall – Auditorium (incl. kitchen)		
Commercial Mon-Thurs. whole day	$1,368.00	$1,403.00
Commercial Fri - Sun whole day	$1,828.00	$1,874.00
Community Mon-Thurs. Whole day	$694.00	$712.00
Community Fri-Sun whole day	$820.00	$841.00
After hours Hourly Rate Commercial (before 8am, after 1am)	$169.00	$174.00
After Hours Hourly Rate Community (before 8am, after 1am)	$95.00	$98.00
Meeting rooms		
St Kilda Town Hall – Nairm		
Commercial per hour	$90.00	$93.00
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$44.00	$46.00
Community per hour (non-peak)	$11.50	$12.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
St Kilda Town Hall – Gunuwarra		
Commercial per hour	$113.00	$116.00
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$44.00	$46.00
Community per hour (non-peak)	$11.50	$12.00
St Kilda Town Hall – Wominjeka Reception		
Commercial per hour	$113.00	$116.00
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$44.00	$46.00
Community per hour (non-peak)	$11.50	$12.00
St Kilda Town Hall – Council Chamber		
Commercial per hour	$168.00	$173.00
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$81.00	$84.00
Community per hour (non-peak)	$11.50	$12.00
St Kilda Town Hall – St Kilda		
Commercial per hour	$90.00	$93.00
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$44.00	$46.00
Community per hour (non-peak)	$11.50	$12.00
St Kilda Town Hall – Ngargee		
Commercial per hour	$113.00	$116.00
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$44.00	$46.00
Community per hour (non-peak)	$11.50	$12.00
St Kilda Town Hall – Yalukit		
Commercial per hour	$113.00	$116.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$44.00	$46.00
Community per hour (non-peak)	$11.50	$12.00
St Kilda Town Hall – Training		
Commercial per hour	$113.00	$116.00
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$44.00	$46.00
Community per hour (non-peak)	$11.50	$12.00
St Kilda Town Hall – Port Melbourne room		
Commercial per hour	$90.00	$93.00
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$44.00	$46.00
Community per hour (non-peak)	$11.50	$12.00
Port Melbourne Town Hall meeting rooms		
Mayors Room - Commercial per hour	$90.00	$93.00
Mayors Room - Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$44.00	$46.00
Community per hour (non-peak)	$11.50	$12.00
Council Chamber - Commercial per hour	$113.00	$116.00
Council Chamber - Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$65.00	$67.00
Community per hour (non-peak)	$11.50	$12.00
South Melbourne Town Hall meeting rooms		
Commercial per hour	$168.00	$173.00
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$81.00	$84.00
Community per hour (non-peak)	$11.50	$12.00

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Council Chamber		
Commercial per hour	$168.00	$173.00
Community per hour (peak 9am - 5pm Mon-Fri & Weekends)	$81.00	$84.00
Community per hour (non-peak)	$11.50	$12.00
Staff labour		
Duty Officer Fees - (Mon - Thurs.)	$39.00	$39.00
Duty Officer Fees - (Fri, Sat & Sun)	$61.00	$68.00
Duty Officer Fees - (Public Holidays)	$78.00	$83.00
Security Officer Fees - (Mon - Thurs.)	$46.50	$48.00
Security Officer Fees - (Fri, Sat, Sun & PH)	$78.00	$80.00
Public Liability Fee	$28.50	$30.00
Bond - Commercial	$3,000.00	$3,075.00
Bond - Community	$1,000.00	$1,025.00

Technology, transformation and customer experience

Description	2016/17 Fee (incl. GST)	2017/18 Fee (incl. GST)
Geospatial Information Systems		
GIS hourly rate for further work	$64.00	$65.60

Glossary

Term	Definition
Act	Local Government Act 1989
Accounting Standards	Australian accounting standards are set by the Australian Accounting Standards Board (AASB) and have the force of law for Corporations law entities under s296 of the *Corporations Act* 2001. They must also be applied to all other general purpose financial reports of reporting entities in the public and private sectors.
Adjusted underlying revenue	The adjusted underlying revenue means total income other than non-recurrent grants used to fund capital expenditure, non-monetary asset contributions and contributions to fund capital expenditure from sources other than grants and non-monetary contributions.
Adjusted underlying surplus (or deficit)	The adjusted underlying surplus (or deficit) means adjusted underlying revenue less total expenditure. It is a measure of financial sustainability of the Council which excludes the masking of the net surplus (or deficit) by capital-related revenue.
Annual budget	Plan under Section 127 of the Act setting out the services to be provided and initiatives to be undertaken over the next 12 months and the funding and other resources required.
Annual report	The annual report prepared by Council under sections 131, 132 and 133 of the Act. The annual report to the community contains a report of operations and audited financial and performance statements.
Annual reporting requirements	Annual reporting requirements include the financial reporting requirements of the Act, Accounting Standards and other mandatory professional reporting requirements.
Asset expansion expenditure	Expenditure that extends the capacity of an existing asset to provide benefits to new users at the same standard as is provided to beneficiaries.
Asset renewal expenditure	Expenditure on an existing asset or on replacing and existing asset that returns the service capability of the asset to its original capability.
Asset upgrade expenditure	Expenditure that: (a) enhances an existing asset to provide a higher level of service or (b) increases the life of the asset beyond its original life.

Term	Definition
Borrowing strategy	A borrowing strategy is the process by which the Council's current external funding requirements can be identified, existing funding arrangements managed and future requirements monitored.
Balance sheet	The balance sheet shows the expected net current asset, net non-current asset and net asset positions in the forthcoming year compared to the forecast actual in the current year. The balance sheet should be prepared in accordance with the requirements of AASB101 Presentation of Financial Statements and the Local Government Model Financial Report.
Comprehensive income statement	The comprehensive income statement shows the expected operating result in the forthcoming year compared to the forecast actual result in the current year. The income statement should be prepared in accordance with the requirements of AASB101 Presentation of Financial Statements and the Local Government Model Financial Report.
Financial Statements	Sections 126(2)(a), 127(2)(a) and / or 131(1)(b) of the Act require the following documents to include financial statements: - Strategic Resource Plan - Budget - Annual Report The financial statements to be included in the Budget include: - Comprehensive Income Statement - Balance Sheet - Statement of Changes in Equity - Statement of Cash Flows - Statement of Capital Works The financial statements must be in the form set out in the Local Government Model Financial Report.
Statement of capital works	The statement of capital works show the expected internal and external funding for capital works expenditure and the total proposed capital works expenditure for the forthcoming year with a comparison with forecast actual for the current year. The statement of capital works should be prepared in accordance with Regulation 9 of the Local Government (Planning and Reporting) Regulations 2014.
Statement of cash flows	The statement of cash flows shows the expected net cash inflows and outflows in the forthcoming year in the form of a reconciliation between the opening and closing balances of total cash and investments for the year. Comparison is made to the current year's expected inflows and outflows. The cash flow statement should be prepared in accordance with the requirements of AASB 107 Statement of Cash Flows and the Local Government Model Financial Report.

Term	Definition
Statement of changes in equity	The statement of changes in equity shows the expected movement in Accumulated Surplus and reserves for the year. The statement of changes in equity should be prepared in accordance with the requirements of AASB 101 Presentation of Financial Statements and the Local Government Model Financial Report.
Budget preparation requirement	Under the Act, a Council is required to prepare and adopt an annual budget by 30 June each year. The Local Government Amendment (Performance Reporting and Accountability) Bill 2013 amends the date the budget must be adopted to 30 June each year - refer section 11(1) of the Bill. This amends section 130 (3) of the Act.
Capital expenditure	Capital expenditure is relatively large (material) expenditure that produces economic benefits expected to last for more than 12 months. A pre-determined 'threshold' may be used which indicates the level of expenditure deemed to be material in accordance with Council's policy. Capital expenditure includes renewal, expansion and upgrade. Where capital projects involve a combination of renewal, expansion and upgrade expenditures, the total project cost needs to be allocated accordingly.
Capital works program	A detailed list of capital works expenditure that will be undertaken during the 2016/17 financial year. Regulation 10 requires that the budget contains a detailed list of capital works expenditure and sets out how that information is to be disclosed by reference to asset categories, asset expenditure type and funding sources.
Carry forward capital works	Carry forward capital works are those that are incomplete in the current budget year and will be completed in the following budget year.
Council Plan	Means a Council Plan prepared by Council under Section 125 of the Local Government Act 1989. This document sets out the strategic objectives of the Council and strategies for achieving the objectives as part of the overall strategic planning framework.
Department of Environment, Land, Water and Planning (DELWP)	Local Government Victoria is part of the Department of Environment, Land, Water and Planning (DELWP).
Discretionary reserves	Discretionary reserves are funds earmarked by Council for various purposes.
External influences in the preparation of a budget	Matters arising from third party actions over which Council has little or no control e.g. Change in legislation.

Term	Definition
Financial sustainability	A key outcome of the strategic resource plan. Longer term planning is essential in ensuring that a Council remains financially sustainable in the long term.
Financing activities	Financing activities means those activities which relate to changing the size and composition of the financial structure of the entity, including equity and borrowings not falling within the definition of cash.
Four way budgeting methodology *(Strategic Resource Plan)*	The linking of the income statement, balance sheet, cash flow statement and capital works statement to produce forecast financial statements based on assumptions about future movements in key revenues, expenses, assets and liabilities.
Infrastructure	Non-current property, plant and equipment excluding land.
Infrastructure strategy	An infrastructure strategy is the process by which current infrastructure and ongoing maintenance requirements can be identified, budgeted capital works implemented and future developments monitored. The key objective of an infrastructure strategy is to maintain or preserve Council's existing assets at desired condition levels. If sufficient funds are not allocated to asset preservation then Council's investment in those assets will reduce, along with the capacity to deliver services to the community.
Internal influences in the preparation of the budget	Matters arising from Council actions over which there is some element of control (e.g. approval of unbudgeted capital expenditure).
Investing activities	Investing activities means those activities which relate to acquisition and disposal of non-current assets, including property, plant and equipment and other productive assets, and investments not falling within the definition of cash.
Key assumptions	When preparing a balance sheet of financial position, key assumptions upon which the statement has been based should be disclosed in the budget to assist the reader when comparing movements in assets, liabilities and equity between budget years.
Legislative framework	The Act, Regulations and other laws and statutes which set a Council's governance, planning and reporting requirements.
Local Government Model Financial Report	Local Government Model Financial Report published by the Department from time to time including on the Department's Internet website.

Term	Definition
Local Government (Planning and Reporting) Regulations 2014	Regulations, made under Section 243 of the Act prescribe: (a) The content and preparation of the financial statements of a Council (b) The performance indicators and measures to be included in a budget, revised budget and annual report of a Council (c) The information to be included in a Council Plan, Strategic Resource Plan, budget, revised budget and annual report.
New asset expenditure	Expenditure that creates a new asset that provides a service that does not currently exist.
Non-financial resources	Means the resources other than financial resources required to deliver the services and initiatives in the budget.
Non-recurrent grants	Means a grant obtained on the condition that it be expended in a specified manner and is not expected to be received again during the period covered by a Council's Strategic Resource Plan.
Operating activities	Operating activities means those activities that relate to the provision of goods and services.
Operating expenditure	Operating expenditure is defined as consumptions or losses of future economic benefits, in the form of reductions in assets or increases in liabilities; and that result in a decrease in equity during the reporting period.
Operating performance (Impact of current year on 2016/17 budget)	This statement shows the expected operating result as compared to the budget result in the current year separating operating and capital components of revenue and expenditure.
Operating revenue	Operating revenue is defined as inflows or other enhancements or savings in outflows of future economic benefits in the form of increases in assets or reductions in liabilities and that result in an increase in equity during the reporting period.
Own-source revenue	Means adjusted underlying revenue other than revenue that is not under the control of Council (including government grants).
Performance statement	Means a statement including the results of the prescribed service outcome indicators, financial performance indicators and sustainable capacity indicators for the financial year and included in the annual report.
Rate structure (Rating information)	Site value (SV), capital improved value (CIV) or net annual value (NAV) are the main bases upon which rates will be levied. These should be detailed in the budget statement.

Term	Definition
Rating strategy	A rating strategy is the process by which the Council's rate structure is established and how the total income generated through rates and charges is allocated across properties in the municipality. Decisions regarding the quantum or rate levels and increases from year to year are made as part of Council's long term financial planning processes and with consideration of Council's other sources of income and the planned expenditure on services and works to be undertaken for its community.
Recurrent grant	A grant other than a non-recurrent grant.
Regulations	Local Government (Planning and Reporting) Regulations 2014.
Restricted cash	Cash and cash equivalents, within the meaning of AAS, that are not available for use other than a purpose for which it is restricted, and includes cash to be used to fund capital works expenditure from the previous financial year.
Revised budget	The revised budget prepared by a Council under Section 128 of the Act. Section 128 of the Act permits a Council to prepare a revised budget if circumstances arise which cause a material change in the budget and which affects the financial operations and position of the Council.
Road Management Act	The purpose of this Act which operates from 1 July 2004 is to reform the law relating to road management in Victoria and to make relating amendments to certain Acts, including the Local Government Act 1989
Services, Initiatives and Major Initiatives	Section 127 of the Act requires a budget to contain a description of the services and initiatives to be funded by the budget, along with a statement as to how they will contribute to the achievement of the Council's strategic objectives as specified in the Council Plan. The budget must also include major initiatives, being initiatives identified by the Council as priorities to be undertaken during the financial year. The services delivered by Council means assistance, support, advice and other actions undertaken by a council for the benefit of the local community. Initiatives means actions that are once-off in nature and/or lead to improvements in service. Major initiatives means significant initiatives that will directly contribute to the achievement of the council plan during the current year and have major focus in the budget.
Statement of Capital Works	Means a statement which shows all capital expenditure of a council in relation to non-current assets and asset expenditure type prepared in accordance with the model statement of capital works in the Local Government Model Financial Report.

<table>
<tr><th>Term</th><th>Definition</th></tr>
<tr><td>Statement of Human Resources</td><td>Means a statement which shows all Council staff expenditure and the number of full time equivalent Council staff.</td></tr>
<tr><td>Statutory reserves</td><td>Statutory reserves are funds set aside for specified statutory purposes in accordance with various legislative requirements. These reserves are not available for other purposes.</td></tr>
<tr><td>Strategic Resource Plan (SRP)</td><td>Section 125(2)(d) of the Act requires that a Council must prepare and approve a Council Plan that must include a strategic resource plan containing matters specified in Section 126.

Section 126 of the Act states that:
• the strategic resource plan is the plan of the resources required to achieve the council plan strategic objectives
• the strategic resource plan must include the financial statements describing the financial resources in respect of at least the next four financial years
• the strategic resource plan must take into account services and initiatives contained in any plan adopted by council and if the council proposes to adopt a plan to provide services or take initiatives, the resources required must be consistent with the strategic resource plan
• Council must review their strategic resource plan during the preparation of the council plan
• Council must adopt the strategic resource plan not later than 30 June each year and a copy must be available for public inspection at the council office and internet website.

In preparing the strategic resource plan, councils should comply with the principles of sound financial management (Section 136) as prescribed in the Act being to:
• prudently manage financial risks relating to debt, assets and liabilities
• provide reasonable stability in the level of rate burden
• consider the financial effects of council decisions on future generations
• provide full, accurate and timely disclosure of financial information.

In addition to Section 126 of the Act parts 2 and 3 of the Regulations also prescribe further details in relation to the preparation of the strategic resource plan</td></tr>
<tr><td>Unrestricted cash</td><td>Unrestricted cash represents all cash and cash equivalents other than restricted cash.</td></tr>
</table>

Term	Definition
Valuations of Land Act 1960	The Valuations of Land Act 1960 requires a Council to revalue all rateable properties every two years. Valuations of Land Act- Section 11