

Report to the Future Melbourne (Environment) Committee

Agenda item 6.6

Draft Elizabeth Street Catchment Integrated Water Cycle Management Plan

18 November 2014

Presenter: Ian Shears, Manager Urban Landscapes

Purpose and background

1. The purpose of this report is to seek the Future Melbourne Committee's endorsement of the draft Elizabeth Street Catchment Integrated Water Cycle Management Plan (Attachment 2) for community consultation.
2. The 305 hectare Elizabeth Street catchment sits entirely within the City of Melbourne and is categorised as the highest level of flood rating (extreme) by Melbourne Water.
3. The development of an Elizabeth Street Catchment Integrated Water Cycle Management Plan (IWCMP) is an initiative of Council's 2014-15 Annual Plan, is an action in Total Watermark – City as a Catchment 2014, and forms a key component of the funding agreement between the City of Melbourne and the Office of Living Victoria.

Key issues

4. Key objectives of the draft plan include reducing flooding in the Elizabeth Street catchment from extreme to high, improving management of water use, reducing storm water runoff, increasing open space, soil permeability and moisture, increasing canopy cover and improving vegetation health through availability of alternative water sources. Addressing these issues will meet the storm water quality, water use and flood management targets for Melbourne Water, the Office of Living Victoria and City West Water.
5. The draft plan adopts previously endorsed targets from Total Watermark, the Urban Forest Strategy and the Open Space Strategy. New targets are proposed to reduce storm water run-off and increase permeability. These will be achieved by expanding open spaces, increasing soil moisture and improving vegetation health.
6. Key stakeholders to be engaged include Melbourne Water, City West Water, the Office of Living Victoria and major landowners in the catchment including the University of Melbourne and RMIT. This will primarily consist of targeted individual engagement with each organisation.

Recommendation from management

7. That the Future Melbourne Committee:
 - 7.1. endorses the draft Elizabeth Street Catchment Integrated Water Cycle Management Plan for community engagement from November 2014 to February 2015
 - 7.2. notes that a further report will be presented to the Future Melbourne Committee on the results of public consultation and consequent revisions to the draft Elizabeth Street Catchment Integrated Water Cycle Management Plan
 - 7.3. authorises the Director City Design to make any further minor editorial changes to the draft Elizabeth Street Catchment Integrated Water Cycle Management Plan prior to community engagement.

Attachments:

1. Supporting Attachment
2. Elizabeth Street Catchment Integrated Water Cycle Management Plan

Supporting Attachment

Legal

1. There are no Legal implications in adopting this report.

Finance

2. There are no financial implications in adopting this draft report. Costs to prepare the Elizabeth Street Catchment Integrated Water Cycle Management Plan will be met from current budgets. The final plan will have a list of actions and projects to be implemented. These will be considered in the context of the ten year council budget.

Conflict of interest

3. No member of Council staff, or other person engaged under a contract, involved in advising on or preparing this report has declared a direct or indirect interest in relation to the matter of the report.

Stakeholder consultation

4. In preparation for writing this report, the City of Melbourne's Parks and Gardens Advisory Committee was engaged in the development of the plan. Feedback was obtained from The Office of Living Victoria as well as Council's Engineering Services, Sustainability and Parks Services branches.
5. Key stakeholder will be engaged within the catchment including Melbourne Water, City West Water, The University of Melbourne and RMIT. Selected businesses, resident groups and community groups will also be engaged. Techniques will include targeted sessions with specific organisations and individuals and the draft will be available for comment via Participate Melbourne.

Relation to Council policy

6. The Elizabeth Street Catchment Integrated Water Cycle Management Plan is an action in the year two Council Plan. It is also an action in Total Watermark – City as a Catchment and progresses actions from the Open Space Strategy, Urban Forest Strategy and City North Structure Plan.

Environmental sustainability

7. When the actions in the final plan are implemented, council and the community will;
 - Benefit from using water more efficiently.
 - Have increased access to alternative water sources.
 - Experience reduced flooding impact.
 - Have mitigated impacts of urban heating.
 - Have additional public open space and urban forest outcomes.

**DRAFT 1 -
21/10/14**



INTEGRATED WATER CYCLE MANAGEMENT PLAN

- FOR THE ELIZABETH ST CATCHMENT -



CITY OF MELBOURNE



AN ECO CITY

We provide solid foundations for the sustainability of Melbourne's communities. We embrace the unfamiliar if it helps us achieve our ambitions. We continue to encourage our community to take positive actions and we lead by example locally, nationally and globally.

DRAFT 1 - 21/10/14

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Overview

The Elizabeth Street Catchment Integrated Water Cycle Management Draft Plan is a strategy for sustainable water management within the 305-hectare Elizabeth Street Catchment.

The Catchment sits entirely within the municipality of Melbourne. It starts at College Crescent in Carlton and finishes where the Elizabeth Street drain joins the Yarra River below Flinders Street Station.

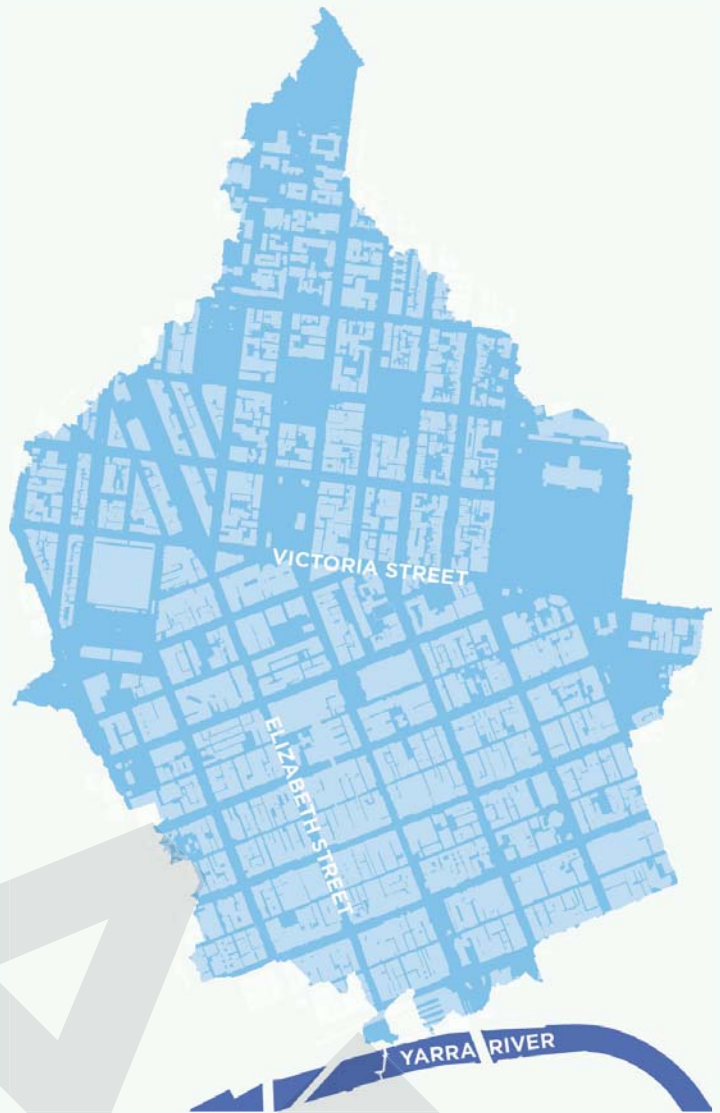
The Elizabeth Street Catchment is categorised by Melbourne Water as being at extreme flood risk – the highest level. Our Draft Plan includes an approach to reduce this flood risk. It also includes ways to use alternative water sources to irrigate existing and future parks and open spaces.

As one of the biggest water users in the municipality and as the manager of stormwater on roads, parks and open space within the city, the City of Melbourne has a leadership role to play in water cycle management.

The Draft Plan involves all the elements of the water cycle that the City of Melbourne can influence – water consumption, rainwater, stormwater, wastewater and groundwater management.

It is part of a much bigger program of work we are undertaking for Melbourne to become one of the world's most sustainable cities. We know that a successful future depends on understanding the risks that climate change poses, reducing our impact and becoming more resilient.

The City of Melbourne practices integrated water cycle management. This is the coordinated management of all components of the water cycle including water consumption, rainwater, stormwater, wastewater and groundwater, to secure a range of benefits for the wider catchment.



Objectives

1. To reduce the Catchment's Melbourne Water flood rating from Extreme to High
2. To increase open space, soil moisture and areas of unsealed soil in Elizabeth Street Catchment
3. To mimic the natural water cycle by retaining more rainwater in the upper section of the catchment and reducing stormwater runoff
4. To improve the health of existing vegetation through irrigation from alternative water sources

Targets

To meet our objectives, we will strive to achieve the targets outlined below. These targets have previously been set in the City of Melbourne's Total Watermark - City as a Catchment Update 2014, our Urban Forest Strategy and our Open Space Strategy. The Office of Living Water has set the targets on water use and stormwater capture for the whole of metropolitan Melbourne.

Flooding

- 1:20 Average Recurrence Interval (ARI) (or equivalent) flow capacity of all council drains within the catchment.

Open space

- Increase the provision of open space in the Catchment in line with the Open Space Strategy and the City North Structure Plan

Canopy cover

- Increase canopy cover to 40% across the Catchment by 2040

2018 targets Alternative water use

- 8% of all municipal water use sourced from alternative water sources
 - 30% of all council water use sourced from alternative water sources

2030 targets Alternative water use

- 20% all municipal water use sourced from alternative water sources
 - 50% of all council water use sourced from alternative water sources

What are alternative water sources?

Alternative water sources are non-drinking water sources. This can include reusing rain or stormwater, or recycled wastewater - sewerage, blackwater or greywater.

Water Quality

- 20% reduction in Total Nitrogen contributed to the waterways from the municipality of Melbourne's catchment (baseline year 2000).

Water Quality

- 30% reduction in Total Nitrogen contributed to the waterways from the municipality of Melbourne's catchment (baseline year 2000).

Water use

- 45% reduction in water use by 2050 (baseline year 2000)

Stormwater capture

- 40% reduction in stormwater runoff by 2050 (baseline year 2000)

Unsealed soil

- 40% of the Elizabeth Street Catchment's soil surface is unsealed by 2030 (baseline year 2014)

What is sealed soil?

Sealed soil refers to paving, roads and buildings covering the soil, preventing air and water from getting in. Unsealed, or permeable soil includes soil that has no asphalt, concrete or paving on it, whether it be bare earth, or soil covered by grass or other vegetation. Permeable paving is an approximate of unsealed soil, as it allows water and air to permeate through paved surfaces, including road surfaces. Green roofs are one of the methods used to offset the effect of creating a sealed surface. Although water cannot reach the ground under a building, a new layer of soil is being provided on the rooftop that can hold some water.

What's in the Draft Plan?

The Draft Plan outlines the amount of open space available, projects in the pipeline, our targets in detail and the quantum of work needed to meet the targets.

It includes details on completed blackwater recycling, rainwater and stormwater harvesting projects that have been implemented over the past decade, and case studies of successful projects that have been implemented in the Elizabeth Street Catchment.

There are many options and ways of meeting our objectives of reducing flooding, mimicking the natural water cycle, increasing areas of unsealed soil, open space and soil moisture and improving vegetation quality. The Draft Plan outlines key opportunities and possible projects we could implement.

Next steps

We have developed this Draft Plan to discuss with our stakeholders and the community, to hear their advice, opinions and expertise on the best way to meet our objectives. A three-month consultation period will be held from mid November 2014 – mid February 2015. This will help us to finalise the

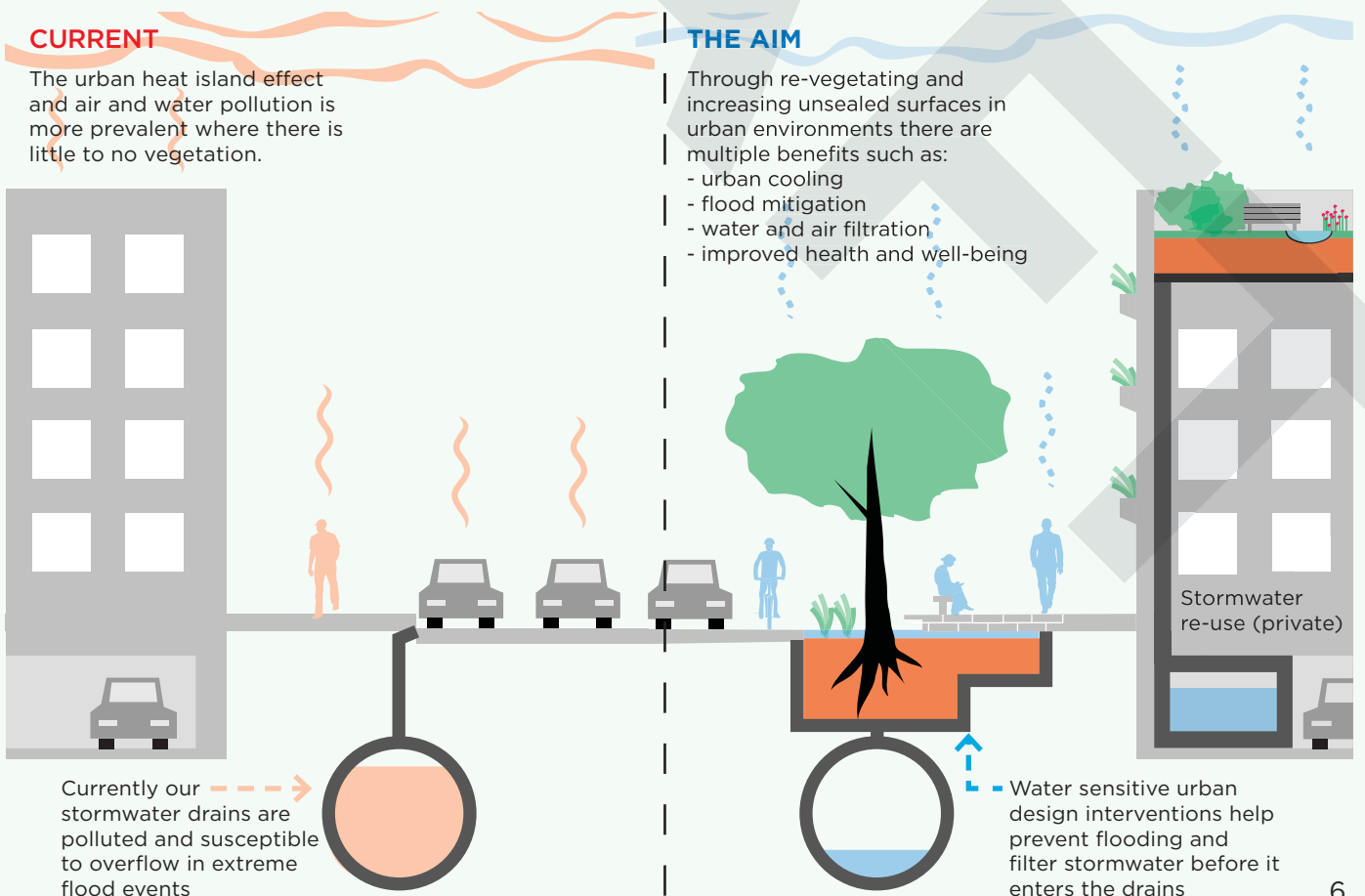
Plan, and to determine which projects will get us to the targets in the most efficient and effective way.

It will also help us understand what is happening in the private realm including plans for future development in the Catchment, so we can integrate those initiatives into this Plan.

We will be looking at all aspects of the Catchment, including open space provision, road renewal programs, the drainage network capacity, flooding, irrigation demands and public and private plans for water storage and reuse. In addition to the input from the consultation process, we will also undertake detailed feasibility modelling of the proposed projects. An action program of short-term and longer-term projects will then be finalised, with implementation beginning in 2015.

Consultation will take place at various levels, including engaging with peak groups and industry associations of many of the stakeholders listed below.

We want as much input as possible, to ensure the best possible outcome for Elizabeth Street Catchment, and to create a plan for the community to embrace and contribute towards.



Whose water is it to manage?

The Elizabeth Street Catchment is highly urbanised which means it has a variety of land uses, owners and stakeholders. This complexity is challenging, but also provides opportunity for collaboration across the community to meet our objectives of reducing flooding, re-naturalising the Catchment, increasing open space, permeability and soil moisture and improving vegetation quality.

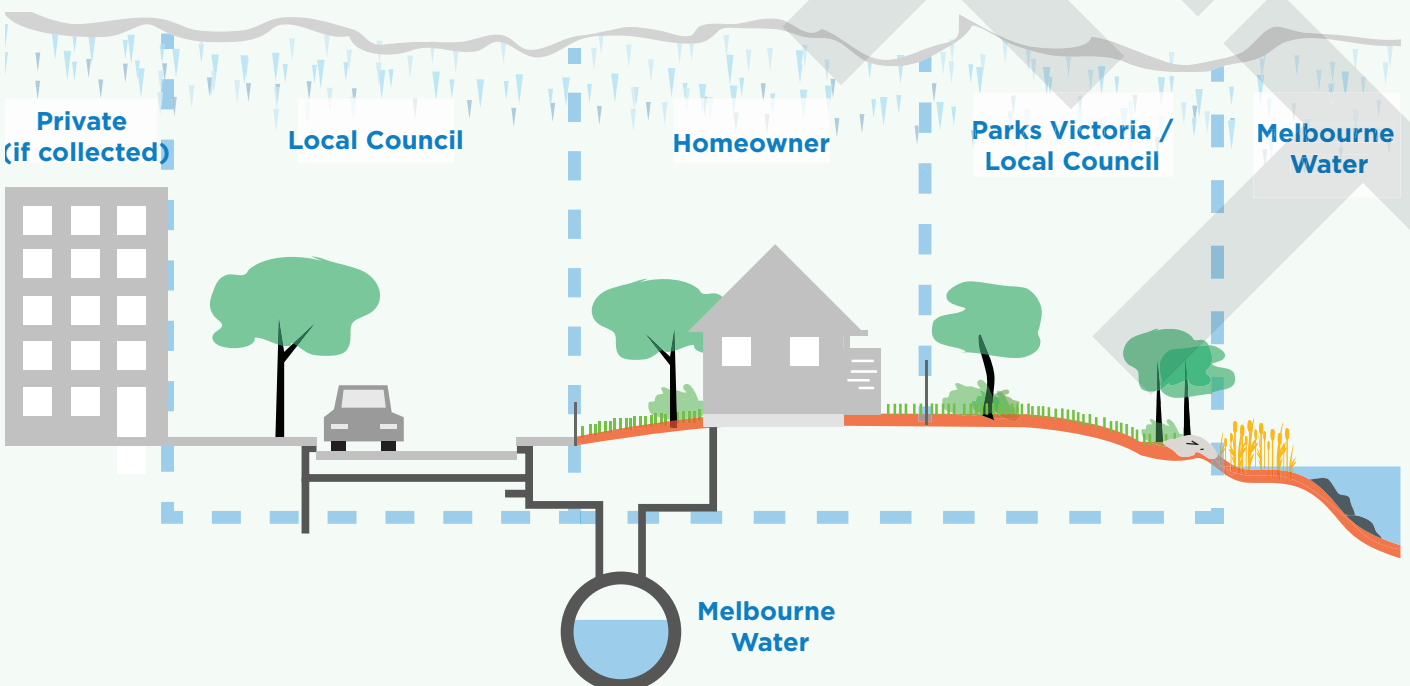
The City of Melbourne is one of the biggest water users in the municipality. A large portion of this water is used for irrigation of our public parks, gardens and vegetation. We are responsible for drainage and implementing alternative water supply projects. The City of Melbourne is also the planning authority for applications less than 25,000m² of floor area, so we can regulate how water is managed in new buildings on private property. We have a key role to play in the Elizabeth Street Catchment.

The Victorian Government's Office of Living Victoria drives change within the water sector, across both metropolitan Melbourne and Victoria. Its role includes increasing collaboration between the different agencies that manage our catchments and waterways.

We will deliver this Draft Plan and the

subsequent projects and program of work in partnership with Office of Living Victoria. Melbourne Water is the main drain manager in the Catchment, and City West Water is water retailer. The City of Melbourne will work closely with both organisations to achieve our objectives for the Catchment.

Below: Water is managed by a range of different people depending on location



Stakeholder	Impact of flooding and role in Catchment
Office of Living Victoria	Funding partner and developer of whole-of-water strategy across Victoria
Residents	Access to property and vehicles during flood events, potential damage to property
Businesses in the Catchment including Melbourne Central shopping centre	Access to businesses and shopping centres during flood events, potential damage to assets
Community including commuters and office workers	Access to offices, public transport, shopping and open spaces
The University of Melbourne	Major landholder in the catchment. Renovating or constructing new buildings. Student access, property damage
RMIT University	Major landholder in the catchment. Renovating or constructing new buildings. Student access, property damage
Queen Victoria Market	Elizabeth Street flooding hinders access to the market. Master Plan underway.
Melbourne Water	Main drain manager - drainage assets not performing effectively in Elizabeth Street due to water volume coming from upper Elizabeth Street Catchment.
City West Water	Responsible for water and wastewater services to end customers in the Catchment
Vic Roads	Road manager - traffic disruption in roads subject to flooding
Yarra Trams	Public transport delivery - trams disruption in roads subject to flooding
Metro Trains	Flooding impact on Flinders Street and Melbourne Central Station
Public Transport Victoria	Impact on public transport network and infrastructure
Bus Association of Victoria	Flooding impact on bus operations
Citywide	Asset management and renewal within Catchment
Developers including Grocon and Lendlease	Impact on current and future developments

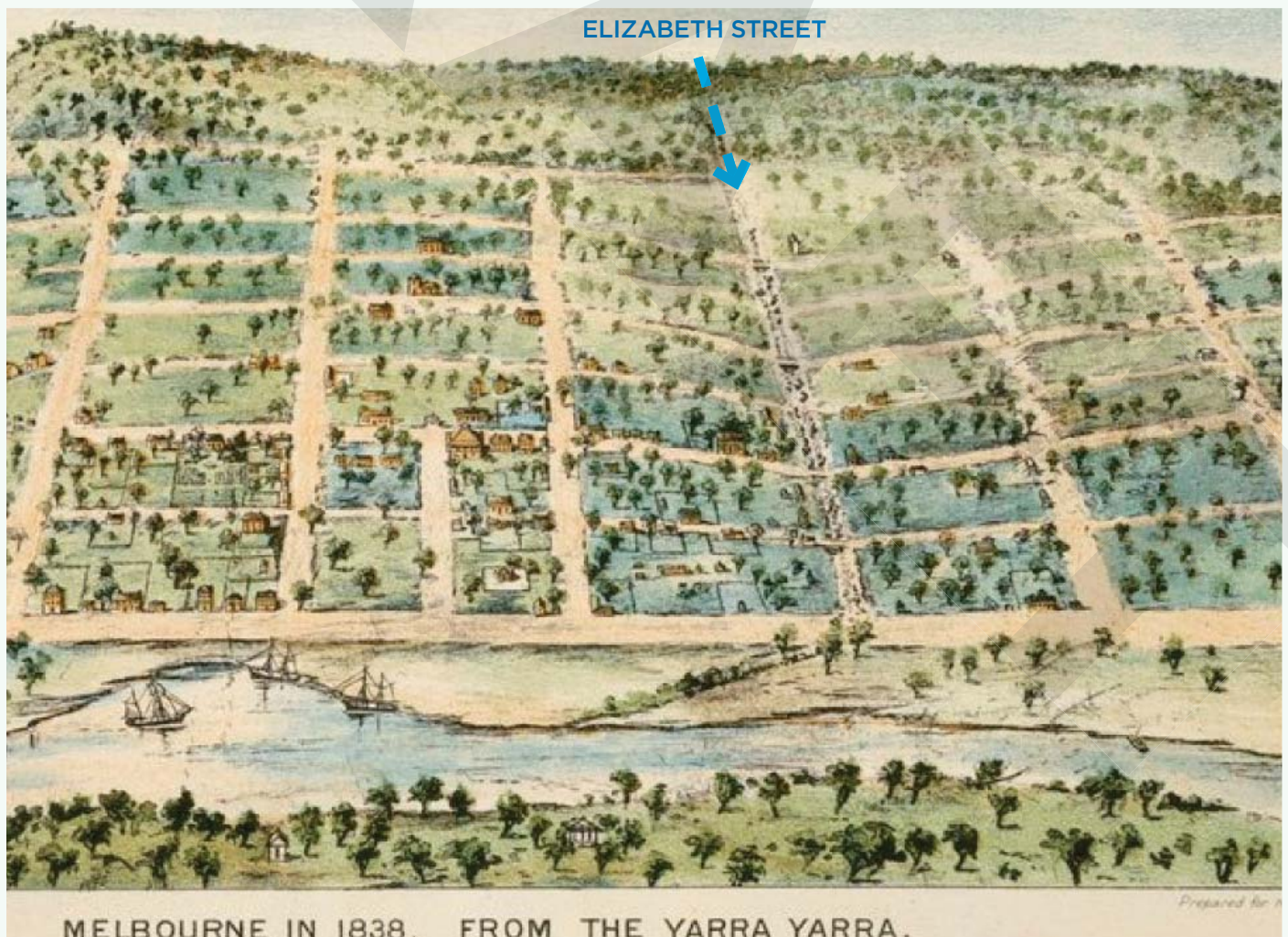
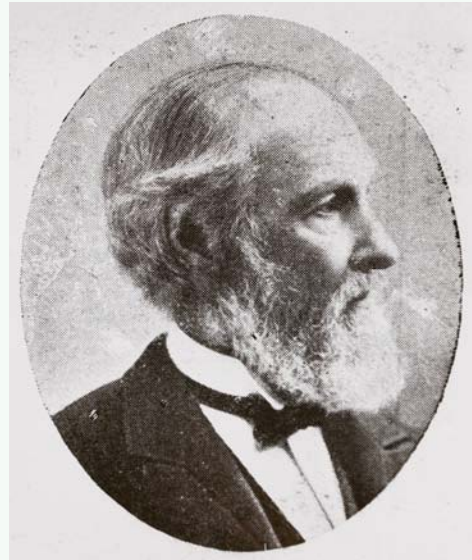
Historical context

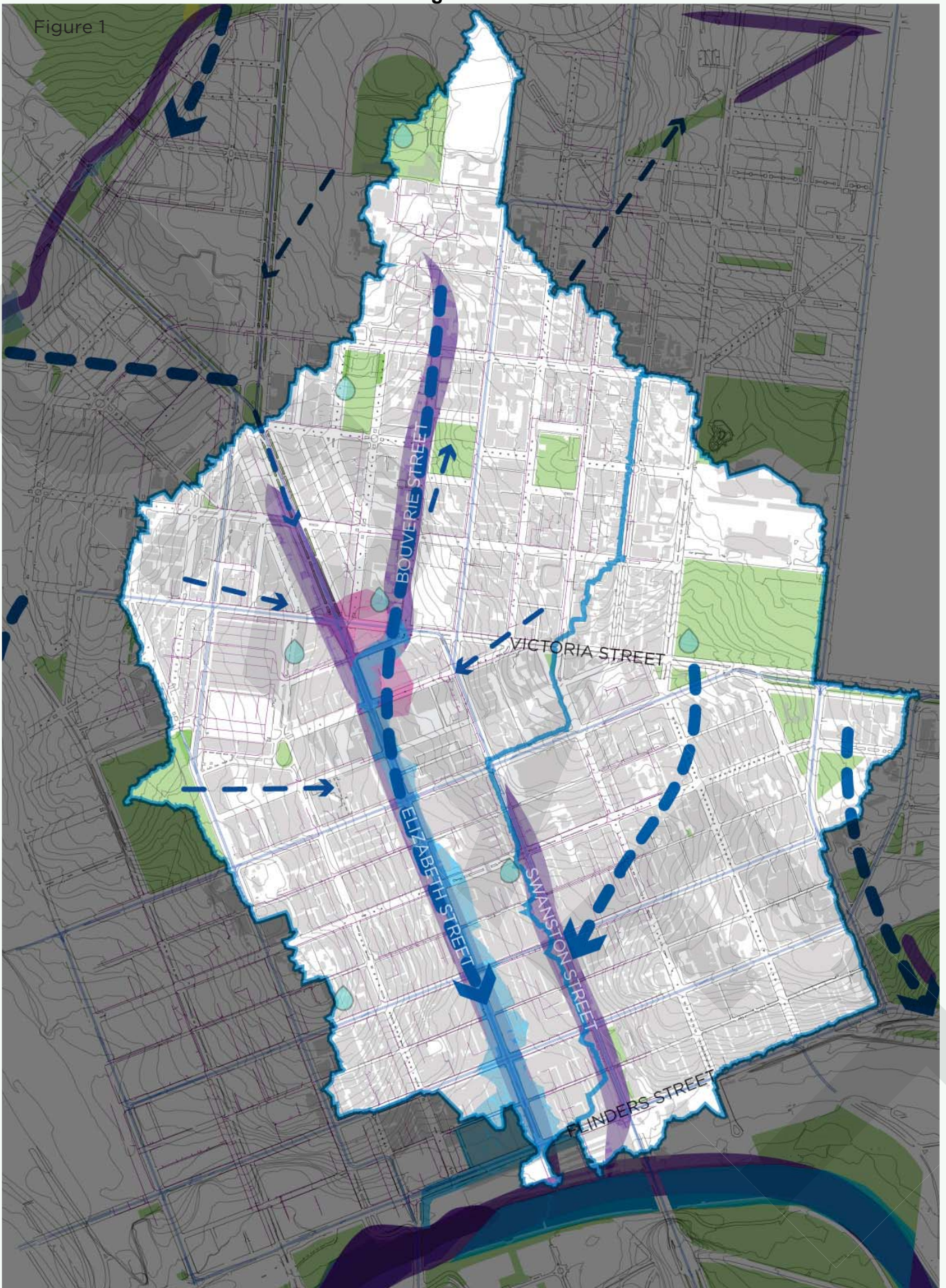
The area now known as Elizabeth Street was originally a creek that fed into the Yarra River. "Williams Creek", as it was originally called, was piped underground when the street was built, but the area is still a natural low point and drainage line. As such, it has always been an area susceptible to flooding.

William Westgarth (pictured), who was the first member of Melbourne City Council and the founder and first president of the Melbourne Chamber of Commerce, stated in his personal reflections:










"Melbourne missed a great chance in filling up with a street (Elizabeth) this troublesome, and, as a street, unhealthy hollow. Dr Howitt used to tell me he never could cure a patient, resident there, who had become seriously unwell. A reservation of the natural grass and gum-trees between Queen and Swanston streets would have redeemed Melbourne up to the first rank of urban scenic effect, and the riotous Williams (Creek) might, with entire usefulness, have subsided into a succession of ornamental lakes and fish ponds."

- William Westgarth, 1842





THE ELIZABETH STREET CATCHMENT

- | | | | | | |
|---|----------------------|---|--------------------------|--|-------------------------|
|  | Buildings |  | Key water flow direction |  | Contours |
|  | Flood prone area |  | Catchment boundary |  | Historical watercourses |
|  | Existing green space |  | Existing re-use stations |  | Swamp conditions |

Key challenges

We face several major challenges in meeting our objectives of reducing flooding, increasing open space, soil moisture and unsealed soil and improving vegetation quality in the Elizabeth Street Catchment.

Climate change

Without significant international movement to decrease emissions in the next few years we are predicted to experience a temperature increase of between 2°C – 6.2°C by 2100 (Climate Commission, 2013), which exceeds what is now commonly accepted as the threshold for dangerous climate change, a 2°C increase.

By 2030 Melbourne is predicted to be significantly affected by warmer temperatures and heatwaves, lower rainfall, intense storm events and flash flooding (CSIRO 2007). By 2070 we are predicted to be experiencing more than double the number of heatwaves, a more than 10 per cent reduction in rainfall and a significant increase in extreme storm events. These climate changes will affect the Elizabeth Street Catchment as well as the broader municipality.

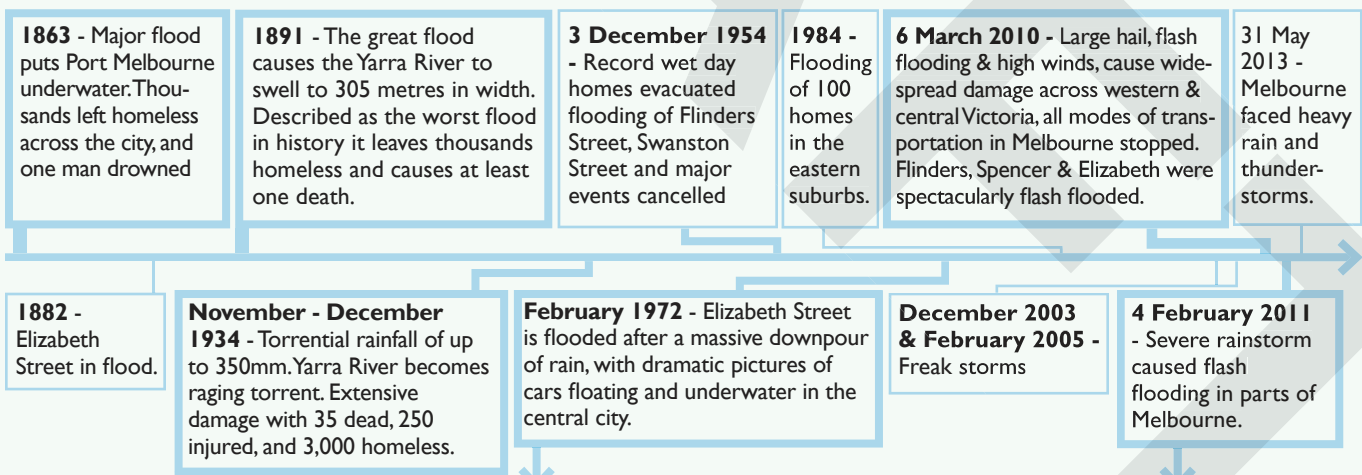
Flash flooding

Rapid climate change is resulting in less but more intense bursts of rainfall, leading to an increase in flash flooding. Elizabeth Street Catchment is a natural low point and drainage line and is subject to inundation. The Catchment includes both the Elizabeth Street drainage network and the Swanston Street drainage network. This is because when the Swanston Street drain is over capacity and water is flowing along the roads, water from Swanston Street runs downhill to Elizabeth Street.

As a busy inner city street, thousands of people are affected when it floods. Flooding within this catchment affects the trams that use Elizabeth Street along with other vehicles. Pedestrians are also affected by floodwater making footpaths dangerous and sometimes impassable. The properties lining Elizabeth Street are also subject to inundation.

Small flooding events can cause damage to property and transport disruptions. Major flooding can result in damage to businesses and residences, stranding of residents and employees, business disruptions, environmental damage due to inundation of sewage or contaminated sites, transport disruptions, injuries and fatalities. The impacts of flooding have huge economic costs. In the late 2000s, the average direct annual damage cost of all forms of flooding across Victoria - excluding potential climate change impacts - was estimated to be approximately \$450 million.

SIGNIFICANT FLOOD HISTORY



Key challenges

Maintaining our Urban Forest

Melbourne's tree population is vast and is a defining part of Melbourne and of Elizabeth Street. But more than a decade of drought, severe water restrictions and periods of extreme heat, combined with an ageing tree stock, have put our trees under immense stress and many are now in a state of accelerated decline. As a result, we expect to lose 27 per cent of the city's current tree population in the next decade and 44 per cent in the next 20 years.

Heatwaves

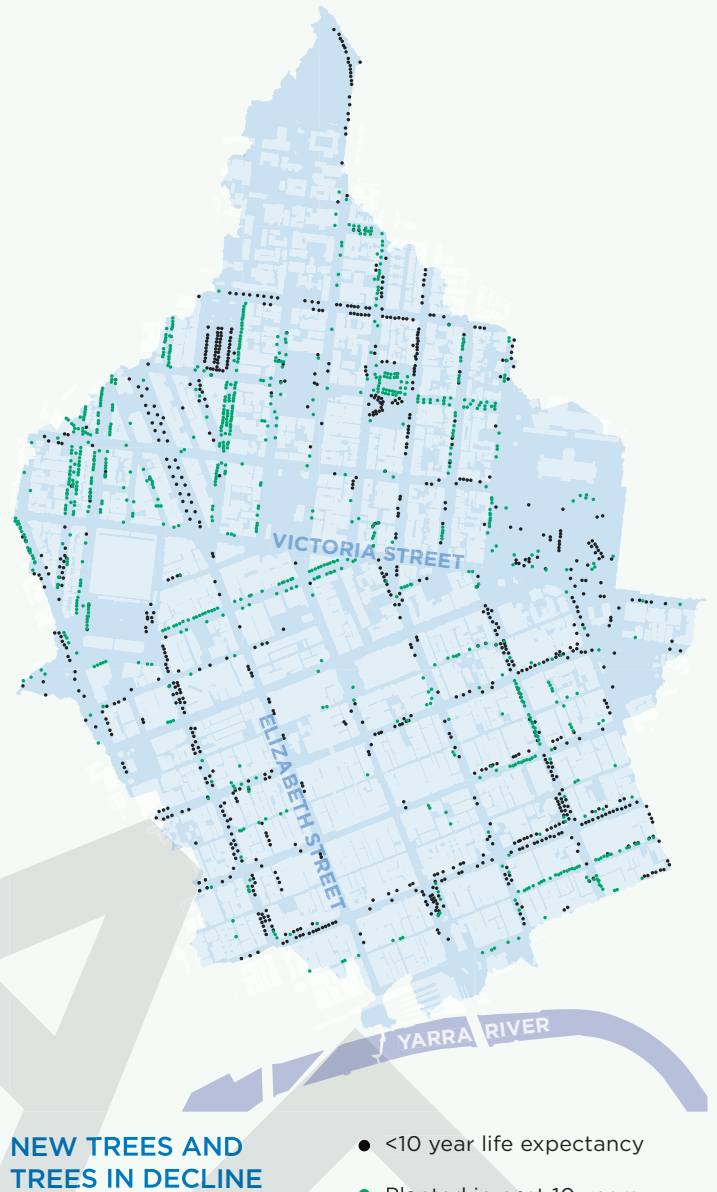
The frequency and intensity of heatwaves is expected to increase, and with it the economic impacts of such events on businesses. The extreme heat experienced in Melbourne between 14 and 17 January in 2013 is estimated to have cost businesses in the municipality \$37 million in lost revenue. The risk of extreme heat to human health is also a serious concern.

During the Black Saturday fires in 2009, the deaths of the 173 people who died directly from the fires were widely reported. Less well known however, were the 374 deaths in Victoria that resulted from the five-day heat wave preceding Black Saturday. Due to the Catchment's highly urbanised nature, combined with the high daily visitation, heatwave effects will be particularly noticeable in the Elizabeth Street Catchment.

Population growth, urbanisation and open space

By 2030, the municipality of Melbourne's current population of approximately 100,000 is predicted to more than double. Our worker and visitor populations are also increasing rapidly, with 1.2 million daily visitors projected by 2030, up from 800,000 daily in 2013.

Demographically the city has also changed. An apartment building boom has meant that 93 per cent of new homes built between 2006 and 2012 were apartments. Our 2012 Structure Plan states that by 2040, there will be more than 10,000 new people living in the Elizabeth Street Catchment. This higher density living and working places additional demand on our city's existing open spaces - the publicly owned land used for recreation, including major sporting venues, public parks, gardens, reserves, waterways and forecourts.



Integrated water cycle management in a city

The City of Melbourne practices integrated water cycle management. This is the coordinated management of all components of the water cycle including water consumption, rainwater, stormwater, wastewater and groundwater, to secure a range of benefits for the wider catchment.

Undertaking this integrated management in a city or urban water catchment presents very different challenges than managing catchments in more natural, less built environments.

Unsealed or permeable soil surfaces in a natural landscape allow water to infiltrate into soil slowly and be used by vegetation. In built urban environments such as Melbourne, there are large areas of sealed soil such as under roads and buildings where water is unable to

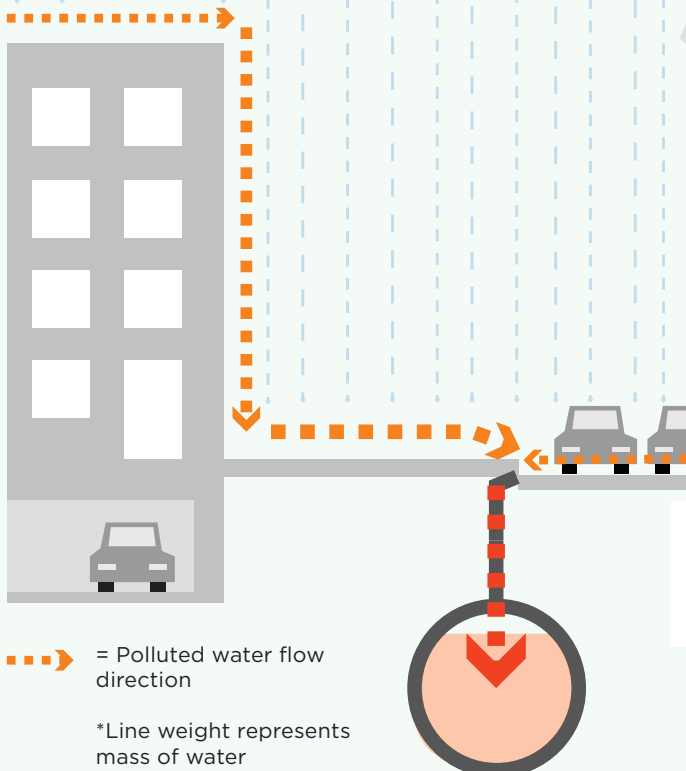
penetrate, and quickly runs off into drains. During this process, water collects all forms of urban pollutants, including oil, plastics, nutrients (including nitrogen), metals, and rubbish, and then carries them into our rivers.

Urban soils also do not act the same as a natural ecosystem. Due to being sealed or covered over, urban soils can be compacted and lacking in nutrients and soil organisms. This prohibits soils from being able to capture and hold water, and also stops groundwater infiltration. Low soil water holding capacity and sealed surfaces can contribute to a loss of biodiversity and an increase in the urban heat island effect. They can also stop groundwater infiltration.

This all accumulates to create a significant change in natural hydrological cycle. The aim of water management within an urban context is to restore the natural water cycle rhythm, to slow water down, allow for groundwater infiltration and regeneration, and to allow evapotranspiration and subsequently urban cooling to occur.

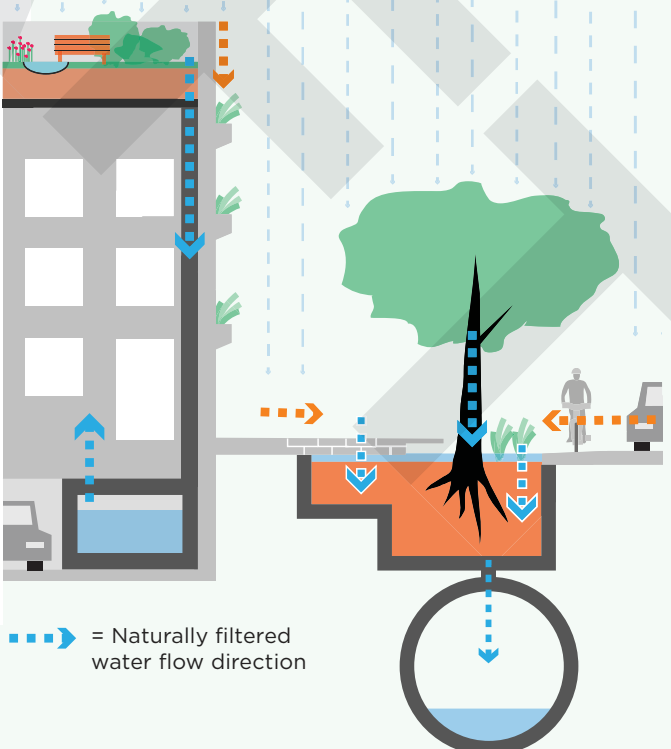
STANDARD URBAN FORM

A depiction of a highly impermeable urban form, one that offers no opportunities for vegetation, or for water to infiltrate soils.



INTEGRATED URBAN FORM

Green roofs, street trees and rainwater gardens have significant impacts in filtering and slowing stormwater runoff, whilst also providing cleaner and cooler air.



Integrated water cycle management in a city

In Melbourne, the volume of stormwater runoff from our rainfall is greater than the amount we actually use from our dams. This volume of water is more than enough to provide both an alternative supply for non-drinking purposes and a healthy flow to our waterways and bays.

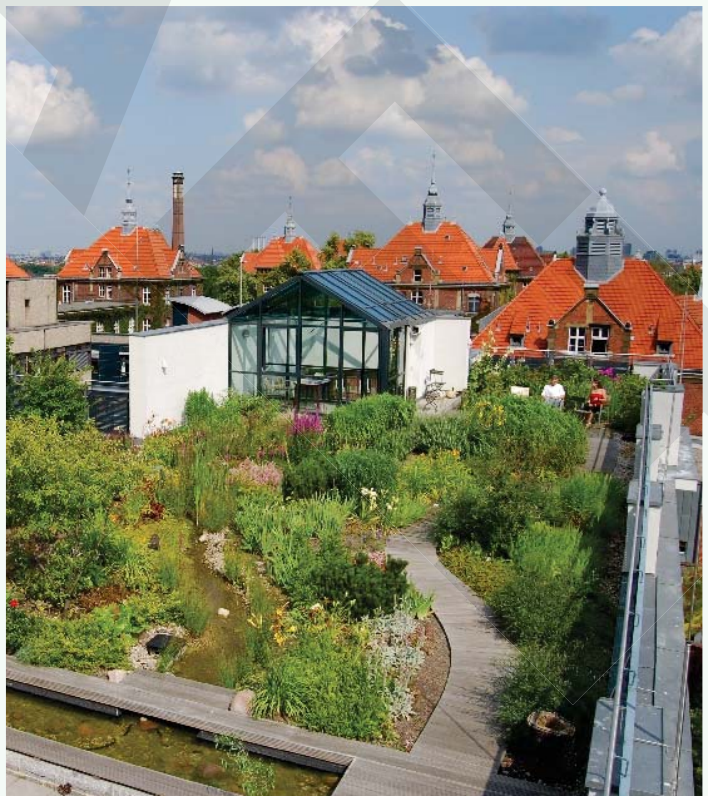
We need to value and use Melbourne's rainfall to minimise water price increases, improve the health of waterways and bays, reduce urban flooding, enhance liveability, self-sufficiency, amenity, and build Melbourne's expertise in integrated water cycle management.

BERLIN'S URBAN GREENING CAMPAIGN

In Berlin, Germany, demand from the community led the city administration to implement an Urban Greening Campaign. It was intended to improve urban biodiversity and increase surface permeability - unsealed soil - in densely populated areas of Berlin. However it also provided welcome side effects for the city's water systems. The campaign indirectly affected the city's water management strategies by reducing hydraulic stress on drains and improving the replenishment of groundwater. The green roofs and other green infrastructure introduced through the campaign was key to providing Berlin's urban landscape with multiple benefits, such as water purification, delaying runoff and increasing urban biodiversity.

Did you know?

Berlin has a closed-water-cycle, meaning that 100% of their water is sourced from within Berlin's boundaries



Green roof Wiegmann Clinic in Berlin - Image source: Optigreen

Case studies

Across the municipality of Melbourne, major landholders and the City of Melbourne have implemented numerous innovative and successful interventions including using alternative water to irrigate parks and gardens. Examples are permeable pavements, stormwater harvesting tanks, black water recycling and raingarden tree pits.

The case studies are examples of what has been implemented in the Elizabeth Street Catchment to reduce flooding, increase open space, soiled moisture and areas of unsealed soil and to improve vegetation quality.

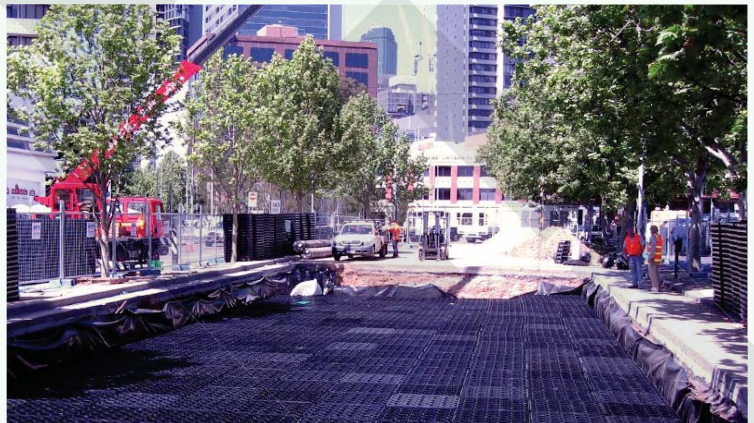
Royal Exhibition Building/Museum stormwater harvesting tanks - 2011

An underground tank was installed to store rainwater captured from the extensive roof of the Royal Exhibition Building, and from surrounding paved areas. The completed tank is 23m x 23m wide and 2.6m high. It has a storage capacity of 1.35 million litres. The system is expected to supply 6.4 million litres of alternative water for reuse in the toilets, fountains, lakes, and irrigation of the garden beds and trees, in accordance with Museum Victoria's commitment to sustainable management practices.



Queen Victoria Market tanks - 2006

Rainwater is piped, collected and stored in a 600,000 litre underground tank. This provides a new water source for the Queen Street public toilets and saves the Queen Victoria Market from using five million litres of drinking water annually. In addition, the decreased stormwater discharge from Queen Victoria Market has reduced pressure on nearby drainage infrastructure that has a history of flooding, and reduced the stormwater pollutant load in the Yarra River and Port Philip Bay.



The University of Melbourne Economics Building - 2010

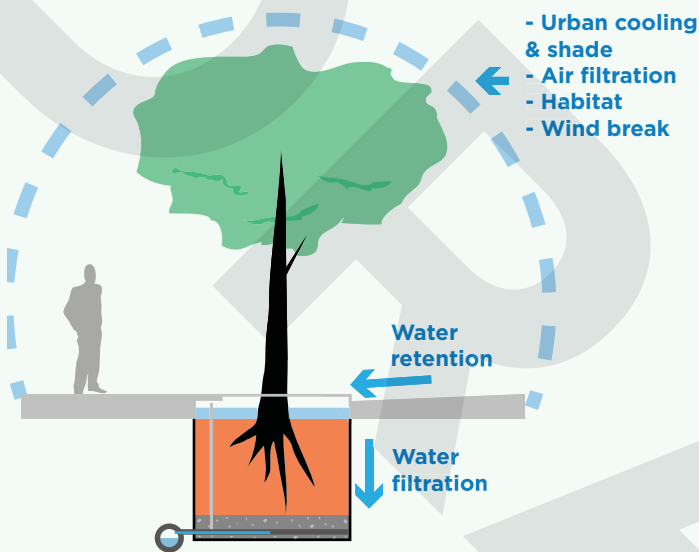
When constructing its Economics Building in Berkeley Street Carlton, the University of Melbourne included the installation of a blackwater recycling system. It is capable of treating 30,000 litres of sewerage per day. Being a student building, the main use of water is for toilet flushing. By using recycled water, it is expected that water use will be reduced by more than 80 per cent.



Little Bourke Street Raingarden tree pits - 2006

In Little Bourke Street, the City of Melbourne installed the first of many raingarden tree pits to be utilised across greater Melbourne. Raingarden tree pits are designed so that stormwater is captured from the gutter and directed to the base of the tree in the footpath. Sediment and litter is captured on top of the soil, while the tree roots and soil microorganisms remove any dissolved nutrients. The tree benefits as excess

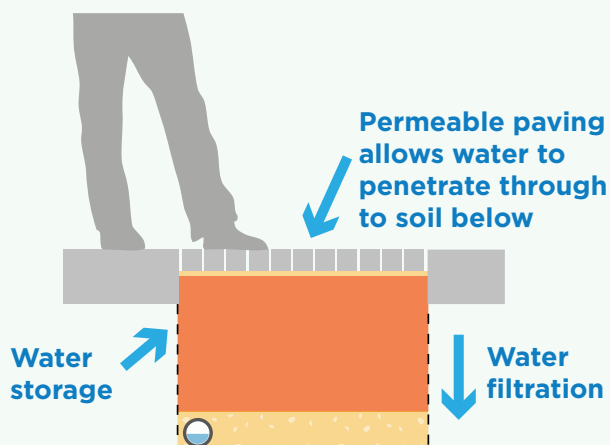
moisture drains away via the underground drain, the tree has a source of water, and any larger flows bypass the inlet grate to enter the standard drainage system. This intervention is only possible for new tree plantings because we can't create a pit around an existing tree without harming the roots.



Collins Street permeable paving (unsealed soil) project - 2013

In this new intervention being piloted in Collins Street, the City of Melbourne laid a permeable strip of bluestone footpath next to standard bluestone paving which is laid on 150mm of concrete. This provided the existing trees with access to moisture from stormwater runoff. We are also using a similar intervention in asphalt footpaths and parking lanes where we utilise a

“no-fines” asphalt mix. This allows water to flow through to the structural soil below where it is directly utilised by the trees, or to infiltrate the surrounding soil for later use. The project is an example of ‘unsealing soil,’ as the underlying soil now has access to air and water.



Progress to date

The City of Melbourne, private landowners and building owners have already completed a number of successful blackwater recycling and stormwater and rainwater harvesting works within the Elizabeth Street Catchment during the past decade – many of which are included below. The Draft Plan will build upon these projects.

Location	System type	Storage size (kL) or equivalent	Catchment area (Hectares)	Completion date	Projected benefits (Megalitres)		Total Nitrogen Stormwater pollutant load reduction (kg)	Project owner
					Alternative water source used	Stormwater flow reduction		
Lt Bourke St - Elizabeth to Queen	Raingarden tree pits	0.56	0.083	2006		0.2	0.098	City of Melbourne
Davison Place	Raingarden	1.6	0.055	2006		0.2	0.46	City of Melbourne
Lt Collins St - Spring to Exhibition	Raingarden tree pits	1.04	0.223	2007		0.4	1.51	City of Melbourne
Victoria St - Corner of Elizabeth	Infiltration Tree Pits	2.88	0.15	2012		0.23	0.6	City of Melbourne
Collins St (Eliz-Queen) permeable bluestone	Permeable Paving, infiltration and structural soil	0.54	0.17	2013		0.787	1.9	City of Melbourne
Queen Vic market Queen St (Franklin - Therry Sts)	Underground tank, Toilet reuse	600	1.43	2006	5.0	5.0	11.6	City of Melbourne
CH2 Building 240 Lt Collins St	Sewer mining, water recycling			2006				City of Melbourne
60L Building 60 Leicester St Carlton	Rainwater for potable reuse including sterilisation, Blackwater recycled for irrigation and toilet flushing	20		2002	0.5	1	1.4	Private
500 Bourke St	Rainwater harvesting system, water efficient fixtures	91		2009	36	36	1	Private
Building A, University of Melbourne	Rainwater tanks for toilet flushing	300			10	10	1.2	University of Melbourne
Faculty of Economics and Commerce Building, 198 Berkley St	Rainwater tanks, Blackwater recycled for toilets and cooling water, 32kl/day			2010	32	10	1.2	University of Melbourne
Urban workshop 50 Lonsdale St	Blackwater reuse, efficient fixtures			2006	0.5		1	DHS - Lease
Southern Cross West Tower 111 Bourke St	Blackwater recycling			2012	0.2			Private
Royal Exhibition Building - Museum Rathdowne St, Western forecourt	Rainwater tanks used for irrigation and toilets	1500	1.9	2011	6.4	6.4	18.5	State Govt (Museum)
200 Victoria street	Underground Rainwater tanks	200		2010	4	4	1	EPA
120-136 Collins St	Rainwater tanks used for garden	8		1991	0.2	0.2	0.7	Private

Targets in detail

The targets we have chosen include technical terms and information that are explained in detail in the table below. Our targets are listed in order of priority, and achieving higher-listed targets will also help achieve the lower-listed targets.

Flooding

- 1:20 Average Recurrence Interval (ARI) (or equivalent) flow capacity of all council drains within the catchment.

This target will reduce damage caused by floods, but will not totally eliminate flooding. Floods are a normal part of the water cycle, and we will always have some level of flooding. Climate change modelling for Melbourne predicts heavy rain events will occur more often.

Average Recurrence Interval (ARI) is the predicted time between two similar types of flood events occurring at a particular place. 1:20 ARI means that the event should only happen once in 20 years, or in probability terms there's a 5 per cent chance of the event occurring. 1:100 means it should only happen once in 100 years. Our current planning standards require our ground floor to be above the 1:100 year flood height. However our roads and footpaths - and sometimes parks, reserves and even backyards - are designed to carry this water.

Our drains are designed to handle the more frequent flood events, generally to a 1:5 ARI. In the central city, this standard is being increased to cope with a 1:20 ARI event. But many of our drains are over 100 years old and are currently under the 1:20 ARI standard. This plan includes an analysis of the drainage network and areas for improvement.

Open space

- Increase the provision of open space in the Catchment

Increasing open space will increase the amount of unsealed soil or the permeability of the Catchment. This will allow more water to be absorbed, decreasing stormwater runoff. Open spaces can also serve to temporarily contain floodwaters in larger events. Plans to achieve this increase are outlined in the City of Melbourne's Open Space Strategy and the City North Structure Plan.

Canopy cover

- Increase canopy cover to 40% across the Catchment by 2040

This will mitigate urban heat by providing shade over roads, footpaths and buildings. The canopy also intercepts rainfall, thus mitigating runoff. The evapotranspiration of water as it moves through vegetation and evaporates off foliage aids in cooling during the summer months.

Achieving this target is outlined in the City of Melbourne's Urban Forest Strategy and Carlton and Central City Urban Forest Precinct Plans.

**2018 targets
Alternative water use**

**2030 targets
Alternative water use**

- 4. • 8% of all municipal water use sourced from alternative water sources
- 30% of all council water use sourced from alternative water sources

- 20% all municipal water use sourced from alternative water sources
- 50% of all council water use sourced from alternative water sources

Achieving these targets will require an increase in non-drinking water sources. This can include reusing rain or stormwater, or recycled wastewater - sewerage, blackwater or greywater. The capture, treatment and reuse of rainwater and stormwater have the added benefit of helping to reduce the impact of flooding. It also helps to improve the quality and reduce the quantity of stormwater running into our creeks and rivers. Storage can include smaller - 5,000-20,000 litre - rainwater tanks on household lots as well as larger stormwater harvesting from our drains and road network.

Recycling wastewater decreases flows in the sewers, reducing the need to upgrade sewer pipes and treatment plants in the future. An analysis of the volumes of alternative water use required to meet these targets is included in this plan. This target is outlined in our Total Watermark - City as a Catchment strategy updated 2014.

Water use

- 6. 45% reduction in potable water use by 2050 (baseline year 2000)

This target will be achieved by the provision of alternative water sources and by water efficiency measures in buildings, businesses and open space irrigation.

This is an Office of Living Victoria target for metropolitan Melbourne.

Stormwater capture

- 7. 40% reduction in stormwater runoff by 2050 (baseline year 2000)

As outlined earlier in this Plan, the impermeable nature of the Elizabeth Street Catchment means it generates a lot of stormwater runoff. Increasing the amount of open space and tree canopy cover and capturing stormwater will all reduce runoff, helping to minimise flooding.

This is an Office of Living Victoria target for metropolitan Melbourne.

Water Quality

Water Quality

- 5. 20% reduction in Total Nitrogen contributed to the waterways from the municipality of Melbourne's catchment (baseline year 2000).

- 30% reduction in Total Nitrogen contributed to the waterways from the municipality of Melbourne's catchment (baseline year 2000).

Nitrogen is used as an indicator of pollutants in stormwater because it is the hardest pollutant to remove. Achieving the Total Nitrogen reduction target will also remove sediments, nutrients like phosphorus, heavy metals and litter.

Achieving the previous four targets will likely allow us to meet this target, as long as stormwater quality requirements are considered in the design and implementation of all projects.

Unsealed soil

- 8. 40% of the Elizabeth Street Catchment's soil surface is unsealed by 2030 (baseline year 2014)

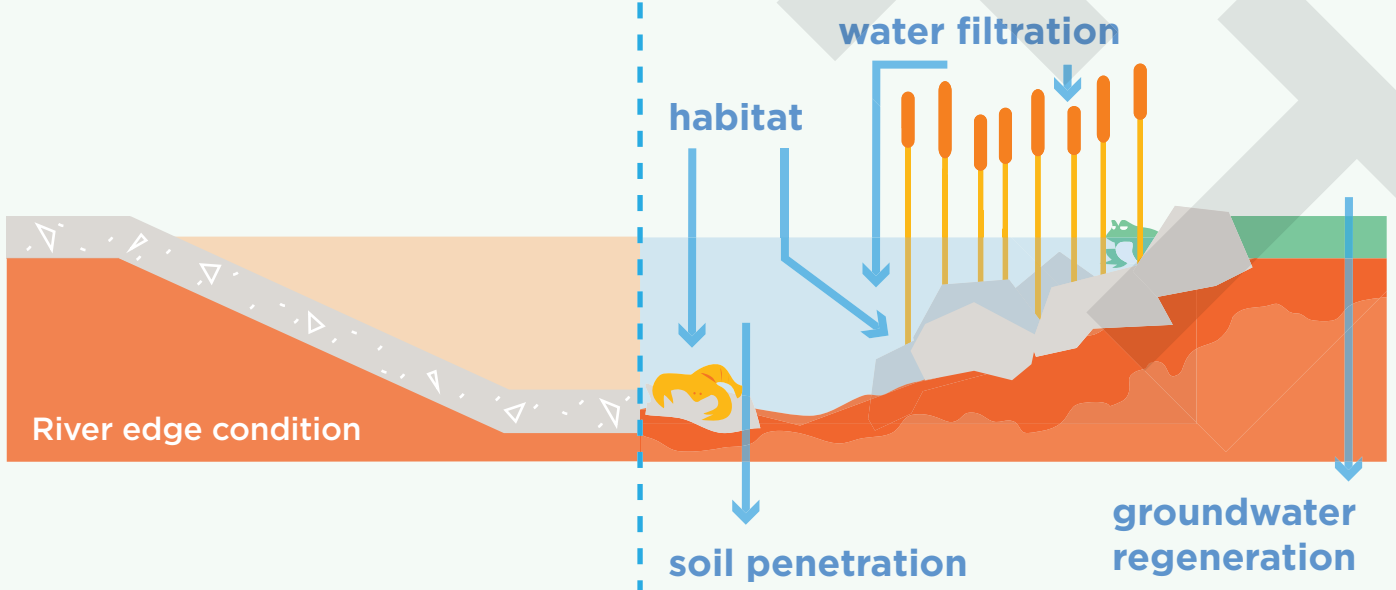
Sealed soil refers to paving, roads and buildings covering the soil, preventing air and water from getting in. Unsealed, or permeable soil includes soil that has no asphalt, concrete or paving on it, whether it be bare earth, or soil covered by grass or other vegetation. Permeable paving is an approximate of unsealed soil, as it allows water and air to permeate through paved surfaces, including road surfaces. Green roofs are one of the methods used to offset the effect of creating a sealed surface. Although water cannot reach the ground under a building, a new layer of soil is being provided on the rooftop that can hold some water. This is an ambitious target when applied across both public and private land.

Sealed soil

- very little water filtration
- speeds water up

Unsealed soil

- slows water down
- improves water & soil health



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Diagram: Analysis of existing of drainage capacity for different flood types, and an indication of where greater water storage is necessary



Figure 2

What's Needed

In order to meet our targets, we needed to determine the current drainage capacity and flood extents, establish current levels of water use and measure the amount of sealed soil.

Drainage Capacity

To achieve the 1:20 Average Recurrence Interval (ARI) flow capacity of all council drains within the catchment we needed to know the current capacity of the drains. This was assessed using geographic information system (GIS) data on pipes, pits and the LiDAR (Light Detection and Ranging) data from the catchment. We then modelled the catchment to determine what ARI event the drainage network could currently cope with. Where the capacity was under the 1:20 ARI level, we modelled the level of retention storages needed to take some of the flow and bring the capacity of the drain up to the 1:20 ARI level. Retention storages can be single or multiple tanks, ponds or other structures that start to fill when the drain is full of water. At this point the water is able to spill into the retention structure. The results of this analysis are shown in figure 2.

Figure 2 displays where we need to place storages throughout the Catchment. As shown, storages are most needed in the upper catchment areas. The lengths of drains that are most under-sized are displayed in red. We now need to analyse the GIS data against our site survey of the pipes and pits, to determine if the recommended pipe upgrades listed below are feasible. Then we will need to determine how to implement the retention storages in the required locations.

The storages can take various forms including traditional retention basins but also, depending on how they are designed and managed, can include rainwater tanks, stormwater harvesting systems, infiltration and permeable paving systems, raingardens and tree pits.

Current Drainage Capacity

Catchment		Existing Capacity
Elizabeth Street	Therry Street between Elizabeth Street and Victoria Street	< 5 yr ARI
	Bouverie Street from Victoria Street to approximately 150m north of Victoria Street	< 5 yr ARI
Swanston Street	Lonsdale Street between Swanston Street and Exhibition Street	Generally < 5 yr ARI
	Exhibition between Little Lonsdale Street and Lonsdale Street	Generally < 5 yr ARI

Water use

To set our alternative water use targets by 2018 and 2030, we needed to know how much water is currently consumed in the Catchment. City West Water has provided us with the following water usage data, including all private and public water use. The City of Melbourne (council) portion of this water is mainly used to irrigate open space, street trees and medians.

Year	Total annual volume (ML) public and private water used
2011/12	7,230.6
2012/13	7,425.7
2013/14	7,600*

Water use

The table below outlines our municipal and council alternative water use targets and the volumes of water needed annually to achieve these targets:

2018 Targets	2030 Targets
8% of all municipal water use sourced from alternative water sources	20% of all municipal water use sourced from alternative water sources
608 million litres (based on 2013/14 use)	1520 million litres (based on 2013/14 use)
3.3 million litres to meet Councils irrigation demand	8.2 million litres to meet Councils irrigation demands

The following table shows the City of Melbourne (council) irrigation water needs in the Elizabeth Street Catchment

2018 Targets	2030 Targets	Demand (ML)	
Open Spaces	Irrigated Area (m2)	Total Demand with zero rainfall	Total Demand with efficient use of rainfall
University Square	8469	6.2	2.9
Lincoln	9897	7.3	3.4
Argyle	8550	6.19	2.84
Haymarket	3000	2.14	0.97
Bedford/Courtney	2625	1.87	0.85
CUB	3000	2.14	0.97
Flagstaff Gardens	57823	42.4	19.7
	93363	68.24	31.63
Street Trees and medians			
Elizabeth St (Haymarket to A'Beckett)	Irrigated area: 100%	2.67	1.2
Royal Pde (to Morrah St)	Irrigated area: 100%	2.8	1.3
Flemington Rd (to Park St)	Irrigated area: 100%	2.8	1.3
Peel St (Haymarket to William)	Irrigated area: 100%	2.4	1.1
Swanston (Elgin to A'Beckett)	Irrigated area: 100%	3.6	1.6
Pelham (Elizabeth to Swanston)	Irrigated area: 100%	1.03	0.46
Queensbury (Capel to Swanston)	Irrigated area: 100%	1.4	0.63
Victoria (Capel to Swanston)	Irrigated area: 100%	1.44	0.65
Grattan (Flemington to Swanston)	Irrigated area: 100%	1.54	0.7
Bouverie	Irrigated area: 100%	0.62	0.28
subtotal		20.3	9.22
TOTAL		88.54	40.85

Sealed soil

The table below outlines the current level of sealed and unsealed surfaces/soil that exist in the Catchment. The areas are divided into council managed and private areas to more clearly define the works required.

Our target is that by 2030, more than 40 per cent of the Elizabeth Street Catchment’s soil surface is unsealed.

As can be seen, council managed land is almost at the 40 per cent level, however,

privately managed land is well below 40 per cent. In order to meet our target by 2030, we have proposed targets of 55 per cent and 30 per cent respectively for council managed and private areas.

This equates to 224,825 square metres of council managed land being unsealed by 2030, and 185,731 square metres of private areas.

Sealed surface areas

City of Melbourne managed areas		Total area (m ²)	Private Areas		Total area (m ²)
Sealed surfaces			Sealed surfaces		
Roads	841,571		Hard Surfaces	308,498	
Nature Strips	63,140		Roofs	1,397,556	
Unsealed surfaces			Unsealed surfaces		
Trees	330,454		Trees	330,454	
Vegetation	135,382		Vegetation	135,382	
Total	1,370,547		Total	2,171,890	
% of unsealed soil	39%		% of unsealed soil	21%	
% of sealed soil	61%		% of sealed soil	79%	

Total current percentage of sealed and unsealed soil

% of unsealed soil	28%	% of sealed soil	72%
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To meet target by 2030

	% of unsealed soil	Total area (m ²)
Whole catchment	40%	1,416,975
City of Melbourne managed areas	55%	753,801
Private	30%	651,567

Key opportunities

To reach the targets and objectives of this plan it is necessary to implement a range of new projects. We have the opportunity to implement the projects outlined in the City of Melbourne's structure plans and other strategies related to the Catchment.

There are also numerous development projects in the pipeline, including the redevelopment of Queen Victorian Market. These works present opportunities to create more open space, increase soil moisture and the proportion of unsealed soil, improve the health of existing vegetation and reduce flooding.

The Catchment presents exciting possibilities for maximising open space and increasing the urban forest through planting trees and other vegetation. It has quite wide roads that will allow us to create new parks and medians or widen existing medians.

We have the ability to use new permeable asphalt and bluestone paving techniques when updating our roads and footpaths.

Through implementing the recommendations contained in the Urban Forest precinct plans for Carlton and the Central City, we can increase

the permeability of the Catchment. We can increase the infiltration of stormwater by designing new or replacement tree planting in line with integrated water cycle management principles.

We are also looking to work with key landholders in the Catchment to reduce runoff when they are carrying out building or renovation works.

Our role involves investigating the effectiveness of our current planning tools in delivering the Draft Plan's targets and looking at whether improvements need to be made to strengthen these guidelines.

Our 2012 City North Structure Plan states that there will be more than 10,000 new people living in the Catchment by 2040, which means a rapid increase in development of new buildings and urban form. This development presents key opportunities to firmly implement the techniques outlined in this Draft Plan. These include mitigating flooding by introducing retention storages, increasing drainage capacity and using green roofs and streetscape renewal to unseal soil.

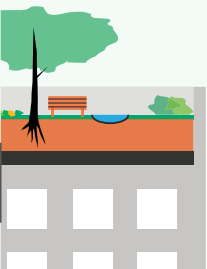
GREEN ROOFS

Green roofs and other green infrastructures were key in providing Berlin's urban landscape with multiple benefits, such as water purification, runoff delay, increased urban biodiversity and proved to effectively address a large number of issues for Berlin.

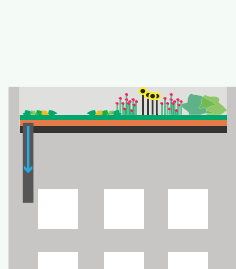
City of Melbourne also recognises the importance of green roofs, as opposed to traditional standard roofing options (as depicted below). This recognition is reflected in our Growing Green Guide which is a substantial guide on green infrastructures.

DIFFERENT ROOF TYPES

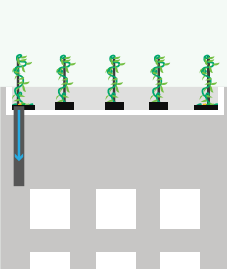
Intensive green roof



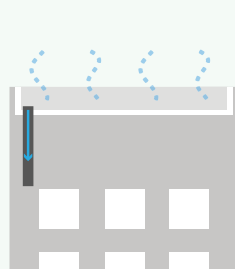
Extensive green roof



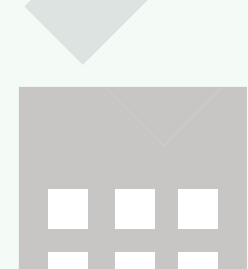
Roof garden



Cool roof



Standard roof



Projects in the pipeline

The following projects are already in the pipeline for Elizabeth Street Catchment. As the City of Melbourne is leading the development and implementation they can be adapted to more effectively meet our objectives. All the projects below are currently in the concept design and community engagement stage.

Queen Victoria Market redevelopment

In late 2013 the City of Melbourne announced the largest investment in its history to renew the Queen Victoria Market. The redevelopment will include enhancing facilities for traders and market visitors, providing more open spaces, places for events, eating and meeting, better parking facilities, and easier access for pedestrians, cyclists and commuters.

University Square project

Based on preliminary site assessments and community input, some ideas we are already considering in the design include:

- Expanding University Square to create more green space thus unsealing soil
- Enhance passive water infiltration and connect to a stormwater harvesting project to irrigate the park and reduce flooding
- Planting more trees

Lincoln Square expansion project

- By partially converting asphalt in Lincoln Square North and South, there is potential to expand the green space, plant more trees and unseal soil.

Carlton Square flood mitigation and stormwater harvesting scheme

- Located near Lincoln Square on the Bouverie Street side, the current concept includes a two million-litre storage tank that will help flood mitigation by increasing the drainage capacity downstream of this point from a two year ARI to a 20 year ARI capacity. It will also provide an alternative water supply for University, Lincoln and Argyle Squares meeting up to 80 per cent of the annual irrigation demand.

Argyle Square expansion project

- There is the potential to expand the green space and unseal soil by partially converting asphalt in Argyle Square and planting more trees.

Elizabeth Street Urban Design Master Plan

- This Master Plan will provide direction for tram, street and footpath redevelopment over the next 10 years.

What else is possible?

The following projects are already in the pipeline for Elizabeth Street Catchment. As the City of Melbourne is leading the development and implementation they can be adapted to more effectively meet our objectives. All the projects below are currently in the concept design and community engagement stage.

As part of the three-month consultation, we will be asking stakeholders in the community for their input. Several opportunities exist for future projects in the Catchment. Some of them are represented below.

Elizabeth Street – Victoria to Haymarket – avenue trees and median expansion

There is an opportunity to increase the size of the medians, increase unsealed soil and infiltration capacity of the median and footpath trees

Haymarket – roundabout expansion

The opportunity exists to expand the Haymarket roundabout to increase accessibility and usability in this largely underutilized open space

CUB site redevelopment

We have the opportunity to negotiate with the site developers to provide high quality open space above the regulated minimum

Bedford Street reserve

We could expand Bedford Street reserve into the surrounding quiet local streets

Green roof demonstration project

We could create a green roof demonstration project with one of the landowners within the Catchment.

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