STORMWATER QUALITY STRATEGY

CITY OF GREATER GEELONG

FINAL REPORT 2015

CITY OF GREATER GEELONG

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CONTENTS

EXECUTIVE SUMMARY

The City of Greater Geelong is characterised by its coastal foreshores, natural waterways and wetlands including many that are recognised under international treaties such as Ramsar. These natural ecosystems are threatened by stormwater flows and pollutants from diffuse urban sources as well as future urban growth within their catchments. Urbanisation has other impacts including increased flood risk and urban heat island impacts that can adversely affect human health and well-being.

The City of Greater Geelong are a responsible authority with obligations under the State Environment Protection Policy (Waters of Victoria) (Thwaites, 2003) to ensure that planning of new developments meets requirements for stormwater management set out in the policy and to have a plan in place to improve the health of waterways, wetlands and bays. It is expected the City will not only works towards improving stormwater management but provide leadership to the community through its actions and the planning process.

Water sensitive urban design (WSUD) is an approach to designing our towns and cities so they are 'water sensitive', resilient, liveable and sustainable. A water sensitive city manages urban stormwater runoff to mitigate its impacts on natural waterways, wetlands and bays.

The City of Greater Geelong already owns many WSUD assets that treat stormwater to remove pollutants, control flows to protect waterways as well as reduce flood impacts, provide fit for purpose water for irrigation and contribute to biodiversity and reduced urban heat island effects. These assets are valued at over $20 million. It is recognised that current levels of maintenance need to increase so these assets will continue to function effectively and their potential benefits are realised. Investment in pro-active maintenance provides doubled returns through both improved performance and savings in renewal costs and the City plans to invest in maintaining an increasing proportion of its assets.

The City is experiencing significant growth and there is a need for WSUD within future urban development to protect waterways and wetlands including the Barwon River, Lake Connewarre, Hovell's Creek and Limeburners Bay. These developments will result in the construction of many new WSUD assets that Council will inherit and manage for the community. The City plans to improve its management processes to provide clear guidance for developers and careful due diligence on inherited assets to protect the community's interests. These will provide a streamlined approach to facilitate development in accordance with water sensitive urban design principles and ensure the community receives assets in good working order that continue to provide benefits for many years.

The City is embarking on a number of visionary projects to revitalise the central business district of Geelong and introduce trees and vegetation to provide a more vibrant, liveable and healthy space. These projects will incorporate WSUD approaches that direct stormwater through planted areas for stormwater treatment and passive irrigation resulting in improvements for both the environment and human health. The City will also explore stormwater treatment opportunities throughout priority catchments, such as stormwater treatment wetlands within parks and retarding basins near waterways, streetscape opportunities and stormwater harvesting and implement those where the greatest progress can be made towards protecting its high value waterways, wetlands and bays.

GLOSSARY

Alternative water source: Water that isn't sourced from the mains water supply system, this includes rainwater, stormwater and recycled water.

BPEM Standards: The Best Practice Environmental Management Guidelines: Stormwater (Victoria Stormwater Committee, 1999) set out objectives for stormwater management, including reductions in typical urban stormwater pollutant loads as follows:

- Total suspended solids (TSS): 80%
- Total phosphorus (TP): 45%
- Total nitrogen (TN): 45%
- Litter: 70%

City of Greater Geelong (CoGG): The City of Greater Geelong is located in south-western Victoria, about 75 kilometres south west of the Melbourne CBD. The City of Greater Geelong is one of the largest Councils in the State covering 1,247 km^2 and housing a population of 231,453 in 2015.

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

Gross pollutant trap: Structures that use physical processes to trap solid waste such as litter and coarse sediment. They are commonly used as a pre-treatment because they mostly remove non-biodegradable large pollutants.

Integrated water cycle management (IWCM) (also known as Whole of Water Cycle Management): A whole-of-water-cycle approach to the sustainable management of all water sources that optimises the opportunities and manages the risks and costs of providing water services by considering all aspects of the water cycle (e.g. wastewater, recycled water, stormwater, greywater and groundwater) at multiple scales (e.g. lot, precinct, regional). Also known as whole of water cycle management.

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

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

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

Potable water: Water that is fit for drinking purposes.

Raingarden: A system with vegetation and layered filter media that captures, retains and treats stormwater before slowly releasing it to receiving waterways. Also known as biofilters and bioretention systems.

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

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

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

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

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

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

WSUD assets: Man-made assets that are used to manage stormwater runoff. Examples include swales and raingardens.

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

1.0 INTRODUCTION

Geelong's natural environment is a key drawcard and significant characteristic of the region. Effective management of stormwater is a key element of protecting these natural environment as well as sustaining healthy and liveable cities by improving amenity and providing microclimate benefits. The value of a water sensitive urban design (WSUD) approach using technologies such as rain gardens, wetlands and swales to provide multiple benefits in our new and existing areas is now widely recognised.

WSUD assets are now a requirement for urban development to reduce the impacts of development on receiving waters. After construction these assets become the responsibility of Council. It is important they are designed, constructed, established and maintained to work effectively and deliver the expected stormwater quality and quantity requirements as well as urban amenity outcomes expected by our community.

'GREATER GEELONG: BUILDING OUR COMMUNITY THROUGH ENTERPRISE, OPPORTUNITY AND INNOVATION IN A QUALITY ENVIRONMENT'

Council vision, City Plan 2013-2017

1.1 Project Objectives

E2Designlab were commissioned by the City of Greater Geelong to develop a Stormwater Quality Strategy. The project had the following objectives:

- clarify and define the objectives of implementing WSUD within CoGG and the targets to be met
- understand waterway values and stormwater threats across the municipality;
- identify opportunities to mitigate these threats through stormwater management investments, with a focus on high risk catchments;
- understand current WSUD asset management framework and WSUD asset portfolio;
- understand of growth impacts on Council's WSUD asset portfolio; and
- identify opportunities and develop an implementation plan to better manage WSUD assets and include future WSUD capital and operating expenditure within the broader asset management and financial systems.

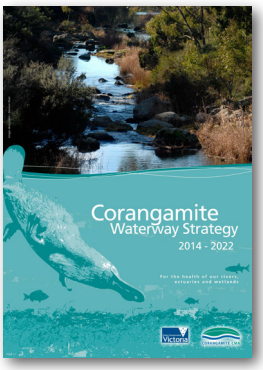
This project does not:

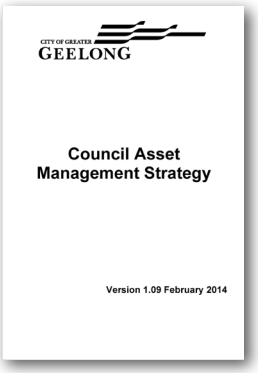
- Directly address waterway values and actions in rural areas as these are set out in the Corangamite Waterway Strategy 2014-2022 (Corangamite CMA, 2015).
- Cover broad aspects of whole of water cycle management. However, it is expected that this project may inform the development of an integrated water cycle management study in future.

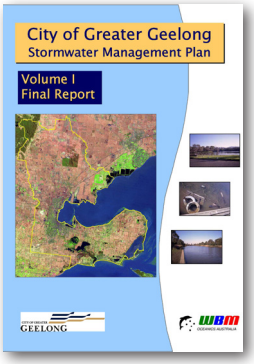
1.2 Previous Reports

This report was informed by the following existing related documents:

- Corangamite Waterway Strategy 2014-2022, Corangamite Catchment Management Authority.
- City of Greater Geelong Stormwater Management Plan, WBM 2002.
- City of Greater Geelong Council Asset Management Strategy, 2014.





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2.0 GEELONG - A WATER SENSITIVE CITY

2.1 What is a Water Sensitive City?

"Water sensitive cities are resilient, liveable, productive and sustainable. They interact with the urban hydrological cycle in ways that:

- provide the water security essential for economic prosperity through efficient use of the diversity of water resources available,
- enhance and protect the health of watercourses and wetlands,
- mitigate flood risk and damage,
- create public spaces that harvest, clean and recycle water; and
- strategies and systems contribute to biodiversity, carbon sequestration and reduction of urban heat island effects" (CRC WSC, 2014).

The typical transition stages in the movement towards a water sensitive city are presented in Figure 1.

Geelong is currently a Waterways City. Significant efforts have been made to establish Water Sensitive Urban Design (WSUD) within the planning system but considerably more work is required to improve the health of its waterways and waterbodies.

Efforts are being made to transition Geelong to a Water Sensitive City that challenges conventional urban water servicing by linking the management of urban water streams (potable supply, wastewater and stormwater) with the goals of minimising and treating pollution discharges, reducing potable water use, and efficiently matching different water sources such as stormwater and recycled water to 'fit for purpose' uses. This requires a focus on the synergies within and between the urban water cycle, built form and landscape and recognition of the important role that organisational and community values play in urban design decisions and water management practices.

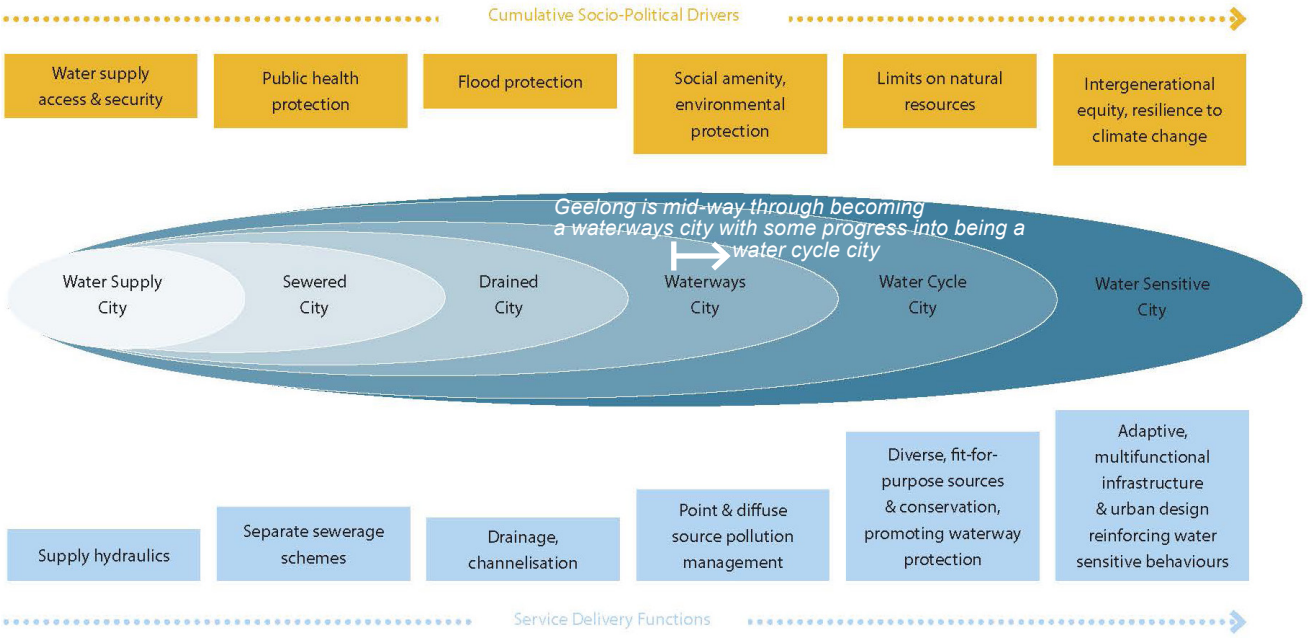


Figure 1 Typical transition stages in the movement towards a water sensitive city (Brown et al 2007)

From a stormwater management perspective (the emphasis of this study), achieving the aspiration of becoming a Water Sensitive City requires the City of Greater Geelong to demonstrate full commitment to sustainable water management by implementing and maintaining WSUD across all their assets including parks and gardens, buildings and roads. Council's influence must extend beyond adoption within the public domain, by developing regulations, providing education and supporting the community to improve the uptake of WSUD across the private domain, including commercial and residential sites. It requires institutional capacity and governance arrangements to support integrated water management at all scales of urban design and development.

Fundamental to the transition to a Water Sensitive City are the broader concepts of Integrated Water Cycle Management (IWCM) which include water saving measures, alternative water supplies (including stormwater harvesting, water recycling and reuse), wastewater management, riverine flooding, etc. These broader facets of water management may be developed as part of a broader IWCM Strategy or green infrastructure strategy.

2.2 The Impact of Urbanisation

Urbanisation significantly affects the natural water cycle, see Figure 2 . Urban development increases the proportion of hard surfaces (i.e. impervious areas) within a catchment while reducing the extent of vegetation. This greatly reduces the volume of water that is evaporated and transpired by plants into the atmosphere (called evapotranspiration) and infiltrates into groundwater. Conversely, stormwater runoff greatly increases, resulting in more frequent and severe flooding, altered stream hydrology and an increase in pollutant transportation and deposition.

2.3 What is Water Sensitive Urban Design?

Water sensitive urban design (WSUD) seeks to manage water wherever it is in the landscape and built form to improve environmental outcomes by providing treatment, flow management and a raft of other benefits (e.g. reduced potable water use, temperature control and increased amenity). Typical examples are shown in Figure 3.

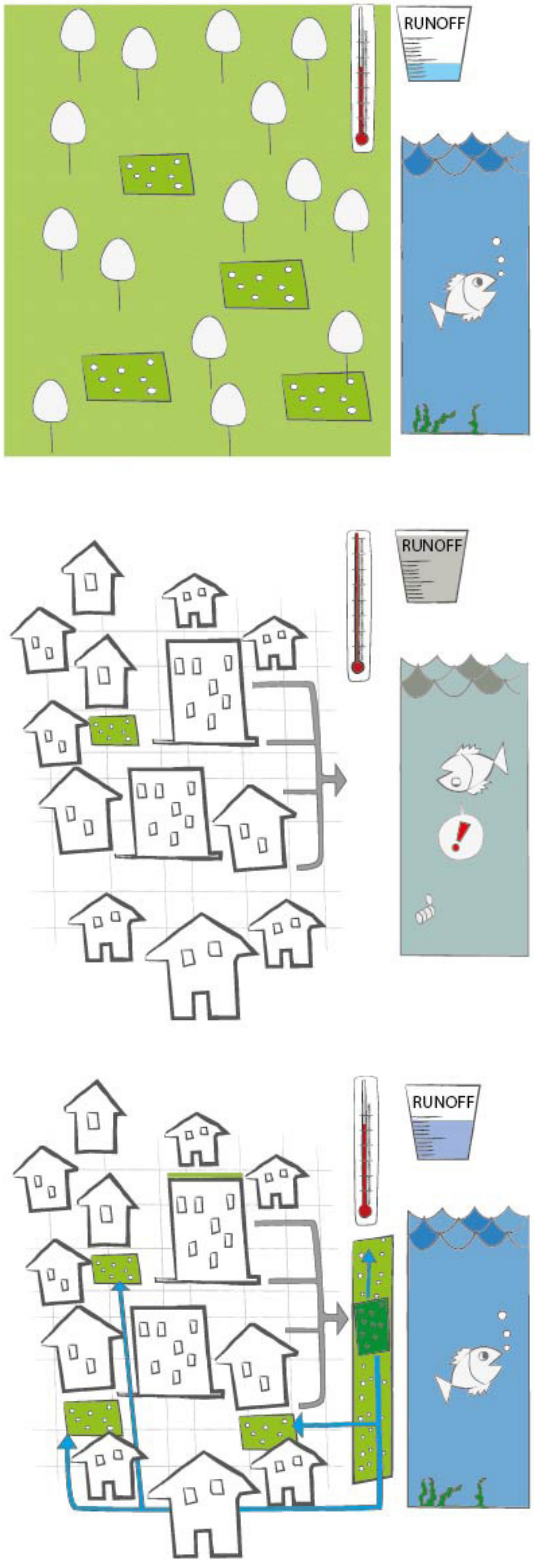


Figure 2 The impacts of urbanisation on landscape, atmosphere and hydrology and potential benefits of WSUD and stormwater harvesting

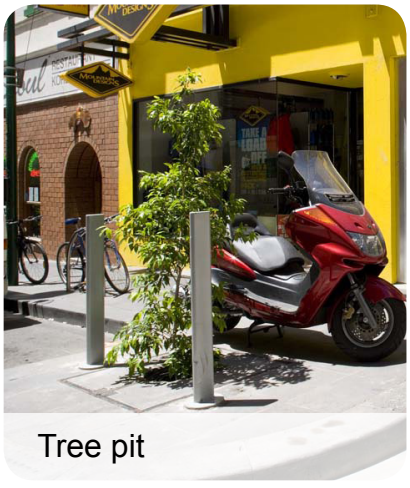
Raingarden

Rainwater tank

Swale

Sediment pond

Constructed wetland



Tree pit

Stormwater harvesting

Figure 3 Examples of WSUD for stormwater management

2.4 Key Characteristics of Geelong

The City of Greater Geelong covers 1,247 km^2 and is located approximately 75 km from Melbourne's CBD. It is Victoria's largest regional city with a population of over 225,000 people.

2.4.1 Land use

The City of Greater Geelong is home to a diverse range of land uses, ranging from typical urban land uses to those that are distinctly rural in character (Figure 4). Rural land uses, namely farming account for more than 60% of the total municipal area. Environmental land uses are also significant with large conservation zones covering important natural assets including the Brisbane Ranges National Park, You Yangs Regional Park and the land surrounding the Lake Connewarre complex and Swan Bay. The urban land use zones are the focus of this report and Council efforts for improved stormwater management.

Geelong is the main urban centre in the municipality, stretching from Corio in the north to Grovedale in the south. The regions major business districts are located in Central Geelong and south of Fyans Street. There is a significant amount of industrial land use concentrated along the central and northern sections of Corio Bay Esplanade and Point Henry. There are also several industrial zones located adjacent to the Barwon River. The remainder of the Geelong urban area consists of residential areas. These contain fragmented pockets of open space, with major areas along the Barwon River and Eastern Park serving as key recreation corridors. Other significant settlements within the municipality include Anakie, Balliang, Barwon Heads, Batesford, Ceres, Clifton Springs, Drysdale, Lara, Ocean Grove, Portarlington and St Leonards.

Substantial future growth in the urban residential sector is planned across the municipality. Major growth zones are located in Armstrong Creek, Lovely Banks and Lara. The character of land use in these areas will change substantially as development progresses.

2.4.2 Climate

The mean annual rainfall in the City of Greater Geelong region ranges from 462 mm to 656 mm with an average of 563 mm/yr. Rainfall is highest in the west and along the peninsula but decreases towards the north east. The average temperature varies from 26ºC in summer to 15ºC in winter (COGG City Plan 2013/17).

Climate change will impact both rainfall and temperature in the Greater Geelong municipality. AECOM and Monash University (2013) report that in the Corangamite Region:

- Rainfall is expected to decrease by up to 12% by 2070 under a high emissions scenario.
- Rainfall events are expected to increase in intensity.
- Annual average temperature is expected to increase by 0.5 to 1.1ºC by 2030 under a medium emissions scenario and up to 1.6 to 3.5 ºC under a high emissions scenario.
- There will be up to 12 more days over 35ºC per year by 2070 under a high emissions scenario.

WSUD can address some of the risks of worsening urban heat island impacts. It can support urban heat mitigation opportunities including increased vegetation for shading and increased evapotranspiration, use of parkland and open space to provide local cooling and green roofs or walls for reduced heat transfer.

2.4.3 Population and dwelling growth

The City of Greater Geelong has a population estimated at 229,471 in 2015. This is expected to grow to 297,956 by 2031. The Armstrong Creek Growth Area will experience the largest growth in dwellings (>8,800) with significant growth also forecast in Lara, Ocean Grove and Drysdale (>5,800).

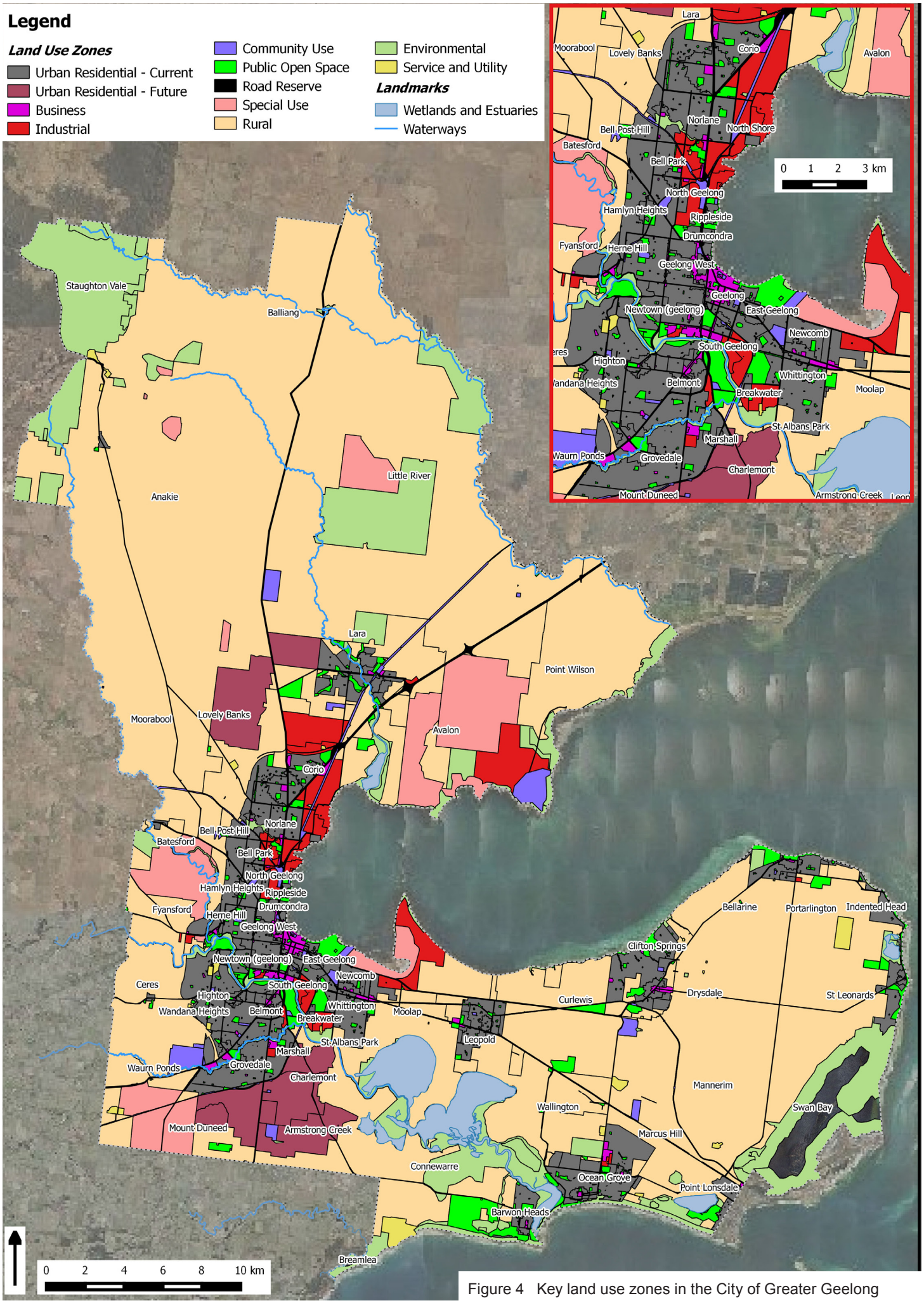


Figure 4 Key land use zones in the City of Greater Geelong

2.4.4 Receiving waterways and wetlands

The City of Greater Geelong region is characterised largely by its picturesque coastal foreshores and the abundance of natural waterways and wetlands (Figure 6). Council recognises the value of these important natural water systems in terms of the environmental values, social values and economic values they provide. They are therefore committed to the protection, enhancement and management of these important natural assets.

The two major waterways which flow through the municipality are the Barwon and Moorabool which meet and flow into Bass Strait. There are also several smaller waterways including Armstrong Creek and Waurn Ponds Creek that drain to the Barwon River, Sutherlands Creek that drains to the Moorabool River, Hovells Creek and Cowies Creek that drain to Corio Bay and Little River which drains to Port Phillip Bay.

Geelong is rich in natural wetlands with over 100 wetlands which support important waterbird populations, including migratory shorebirds. The wetlands also provide other important functions including habitat for a large diversity of plants and animals and also providing water quality management. A number of these important areas have been recognised as being of national importance and are listed under the Ramsar Convention.

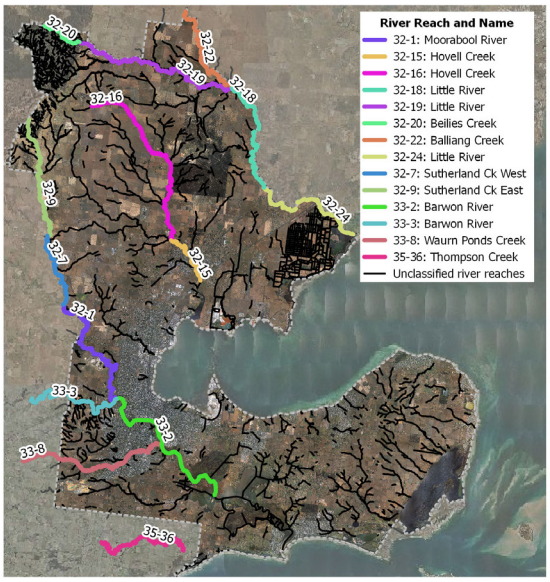
Geelong's wetlands are dominated by large saline wetlands associated with the Port Phillip and Bass Strait coasts, including the estuaries of Hovells Creek and Barwon River and the intertidal and marine areas of Swan Bay, northern Corio Bay and Limeburners Bay. Semi-permanent saltmarsh habitats are also present adjacent to the coast and the Cheetham salt works. The largest freshwater wetland is Reedy Lake which is a deep freshwater marsh habitat.

Urban development, and the associated impacts on stormwater runoff (increased volumes and pollutant loads) may have significant impacts on these important waterway and wetland systems if it is not managed appropriately.

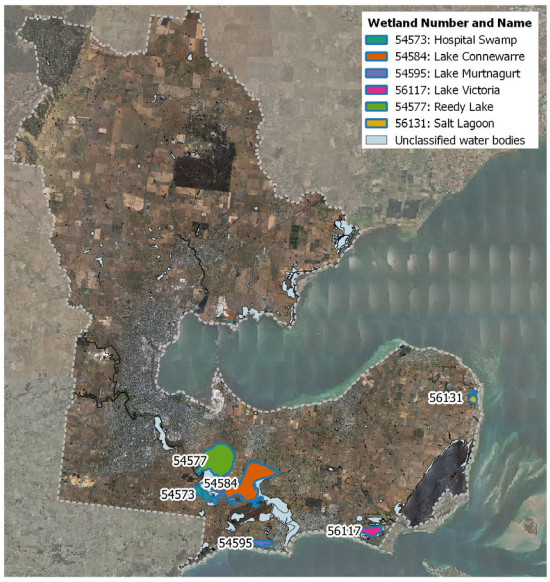
A large portion of the City of Geelong drains to the Barwon River and through the Ramsar listed receiving waters of Lake Connewarre. The remainder of the city drains to Corio Bay while several townships such as Portarlington and Clifton Springs drain to Port Phillip Bay. The townships of Lara and Little River drain into Limeburners Bay (Ramsar listed) before discharging into Corio Bay. Ocean Grove and Barwon Heads drain to the lower Barwon River and to Bass Straight.

In total over 200 catchments were identified in the region, for reporting purposes these catchments have been condensed to 13 catchments based on the major waterways and receiving waters they drain to.

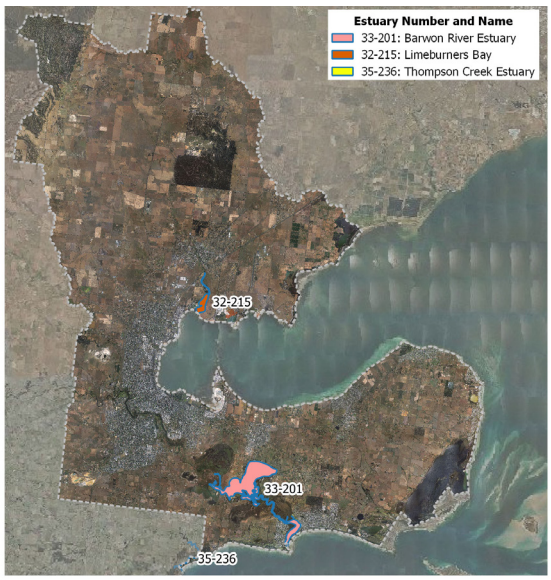
Figure 5 The Barwon River (left) and Moorabool River (right)



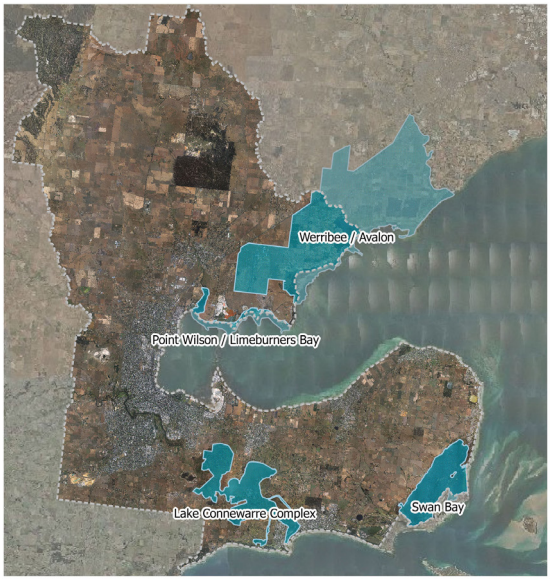
(a) River Reaches



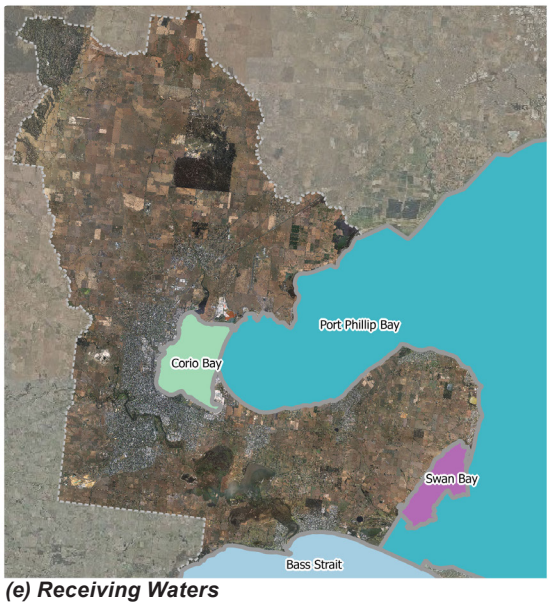
(b) Major Wetlands



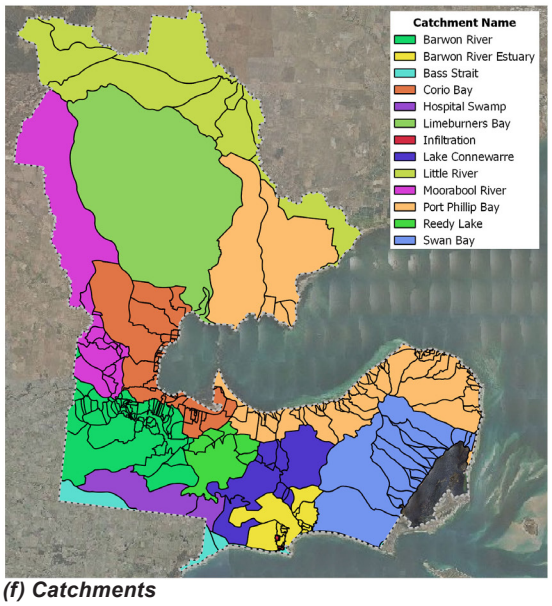
(c) Estuaries



(d) Ramsar Sites



(e) Receiving Waters



(f) Catchments

Figure 6 Summary of waterways, including reaches, wetlands and estuaries, Ramsar Sites, receiving waters and catchments in the City of Greater Geelong region.

3.0 GEELONG'S STORMWATER

3.1 Stormwater Management Requirements

3.1.1 Planning and Legislation

There are many federal, state and local regulations that influence the management of stormwater in Geelong (e.g. Figure 7).

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

Best practice stormwater targets require an:

- 80% reduction in suspended solids
- 45% reduction in phosphorus
- 45% reduction in nitrogen

The water industry is in a period of significant change and it is likely that new and broader stormwater quality treatment objectives will be introduced in the future.

Key agencies and organisations involved in the management of stormwater in the Geelong region include the *City of Greater Geelong, Corangamite Catchment Management Authority, Environment Protection Authority, Barwon Water and Barwon Region Integrated Water Cycle Management Network.*

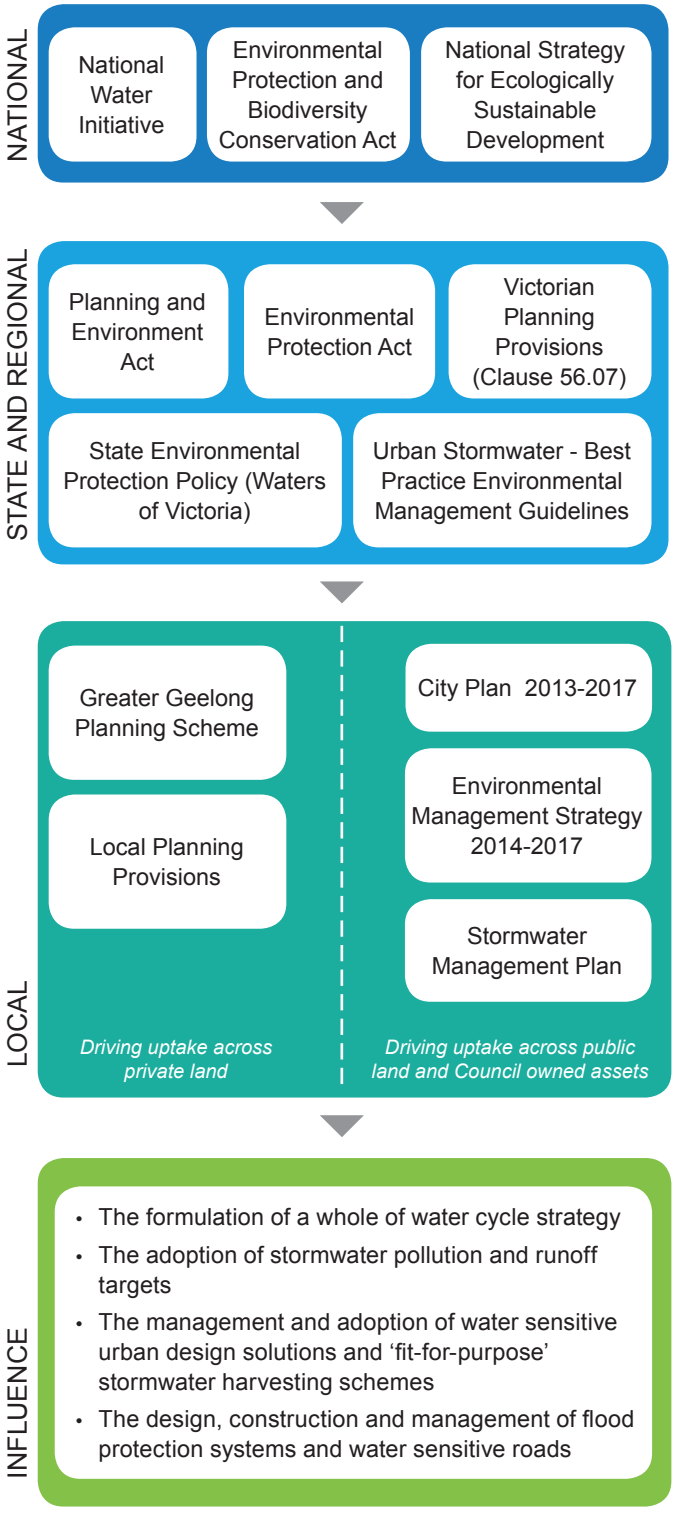


Figure 7 A summary of key documents that set out Councils stormwater management obligations

3.2 Stormwater Characteristics

The majority of water flowing through the Barwon and Moorabool Rivers is generated outside the City of Greater Geelong (Figure 8). Within the municipality 130 GL/year of stormwater runoff is generated. Although only 20% of Geelong's land use is urban these areas generate almost 40% of the regions stormwater runoff. In contrast, non-urban land use covers more than 80% of the municipality but only generates approximately 60% of the runoff.

The relatively large proportion of urban runoff across Geelong presents a significant stormwater management challenge. Urban runoff is quickly transported into to waterways during storms, creating a 'flashy' flow regime that damages waterway geomorphology and aquatic life. Consequently, urban stormwater runoff requires careful management to control both the volume and pattern of runoff.

Stormwater pollution across the municipality is substantial. Each year more than 12,000 tonnes of total suspended solids (TSS), 37,000 kg of total phosphorus (TP) and 305,000 kg of total nitrogen (TN) are discharged into local waterways.

Urban land uses also account for a high proportion of this pollution. Approximately 60% of all urban pollutant loads are generated in the residential sector. Roads are also a major source of pollutants, contributing over 20% of suspended solids and 15% of phosphorus loads. Industrial land use is the third largest source of suspended solids and phosphorus and the second largest source of nitrogen. In addition, high levels of heavy metals and hydrocarbons are discharged from urban areas, particularly industrial areas and roads.

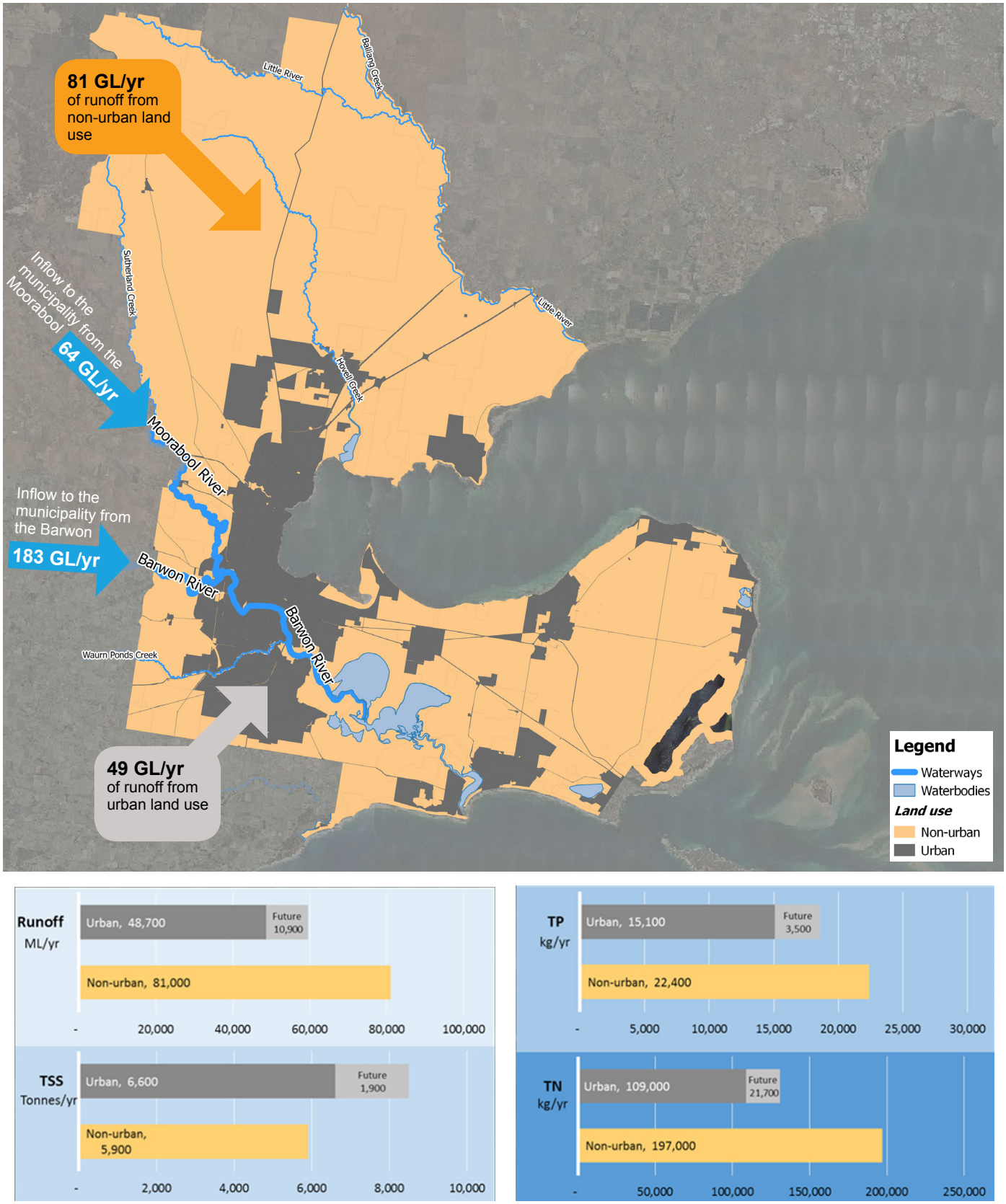


Figure 8 Water and pollutant balance for the City of Greater Geelong

3.3 Waterway Values, Risks and Stormwater Impacts

Geelong's catchments have been prioritised for stormwater management using a six step process. This approach considers the importance of all downstream waterways and the risk posed by the runoff leaving each catchment based on its level of development and land use characteristics. The resulting map of catchment prioritisation is provided in Attachment 3 (see Figures 19 and 20).

The prioritisation of catchments helps to identify those with the greatest values needing protection and those with the greatest risks of adverse impacts from urbanisation. This will allow efforts to improve stormwater quality and waterway health to be targetted towards those catchments where the greatest gains can be made.

More than 30% of Geelong's catchments were rated as having high values with an elevated risk to local waterways. The catchment with the highest priority score flows into a series of high value water ecosystems, including Hovells Creek, Limeburners Bay and Corio Bay. This catchment contains predominantly rural land uses, consequently management will largely be coordinated by the Corangamite CMA. However, Council should carefully manage runoff from Lara's existing urban and industrial areas and plan for the substantial urban expansion expected in the Lovely Banks and Lara growth areas.

Only two catchments have the second highest priority score of 7. The first is located in South Geelong and drains to the Barwon River upstream of the high value and Ramsar protected Lake Connewarre complex. This catchment is moderately impervious but its land use is dominated by industrial activities (>90%). The second catchment is located along the southern shores of the municipality, covering Point Lonsdale as well as parts of Ocean Grove and Marcus Hill. This catchment contains low levels of development and industrial land use, however, it drains into some of the highest value natural assets in the region, including Lake Victoria and Swan Bay.

Eight of the twelve catchments with a priority score of 6 are located close to Geelong's urban centre and drain into the Barwon River. These catchments contain well established urban developments with moderate levels of industrial land use. In these locations the capture and treatment of runoff prior to discharge into the Barwon using WSUD technologies located within the catchment (e.g. rain gardens) and at the end of the catchment (e.g. wetlands) should be pursued. Furthermore, changes to planning regulations could be used to ensure that infill development contribute to improving stormwater quality outcomes within the catchment.

Three neighbouring catchments located to the south of Waurn Ponds Creek and the Barwon River also have a priority score of 6. These catchments have a high risk due to the significant level of future development they contain, including the Armstrong Creek Urban Growth Area. It is essential that suitable erosion and sediment control measures are put in place during the construction phases to avoid high pollution loads entering valuable downstream waterway ecosystems, including the Ramsar protected Lake Connewarre Complex.

There is also one highly impervious and industrial catchment located in North Geelong with a priority score of 6, this catchment requires specific management responses that reflect its industrial (port) based activities.

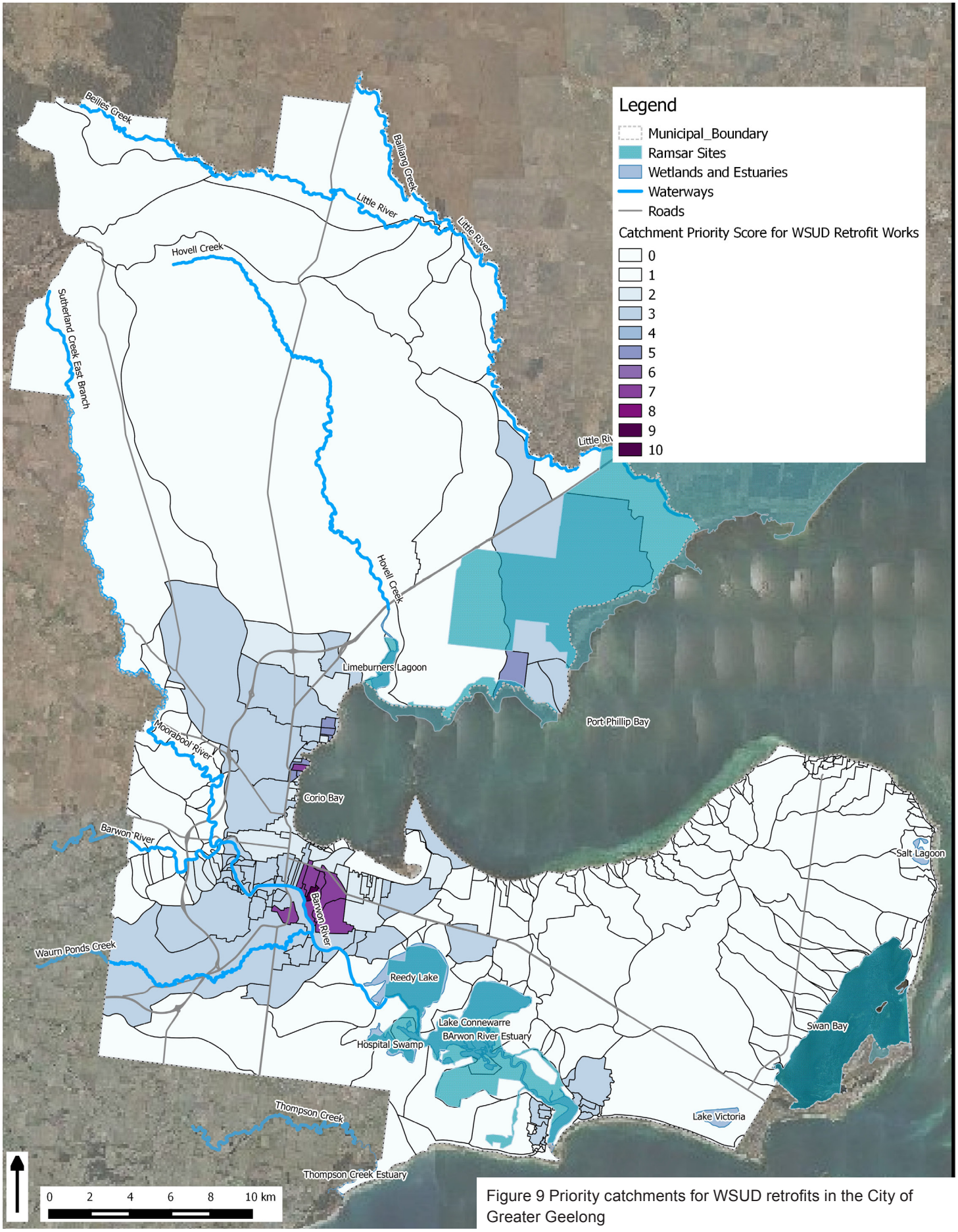


Figure 9 Priority catchments for WSUD retrofits in the City of Greater Geelong

3.4 Catchment Based Stormwater Management

3.4.1 Overview

The City of Greater Geelong has been developing for over 150 years. Along with great prosperity human settlement has also produced substantial environmental degradation. With a long term outlook and sustained commitment to improved stormwater management CoGG can rectify and avoid many of the mistakes of the past.

Given the scale of human impact on the landscape it is important that CoGG adopt a prioritised and cost effective approach to tackling the regions diverse stormwater challenges. Focus should be placed on areas where the greatest gains can be made. This requires a trade-off between the economic, environmental and social value of the aquatic environment being protected and the opportunities for improved stormwater treatment that are available in the target catchment.

3.4.2 Existing urban development

Catchments with high catchment priority scores and high levels of existing development have been flagged for WSUD retrofit projects (Figure 11). Given the lack of space in these areas Council will need to strategically construct WSUD assets in these catchments in the minimal open space that is available or as part of other upgrade works (e.g. road resurfacing, building construction).

It is recommended that CoGG target an additional 150 kg/yr of total nitrogen load reductions. This would enable Council to treat over 700 ha of impervious surfaces, equivalent to meeting best practice stormwater targets in the top 25 catchments identified for WSUD retrofit works (Figure 10). This level of action would represent a major step forward in CoGG's transition to a Water Sensitive City. Substantial challenges will still lie ahead for Council as the majority of existing impervious areas in the region will still remain untreated. However, major steps towards returning to a more natural water cycle will have been initiated.

3.4.3 Future urban development

CoGG is set to experience substantial growth in coming years, particularly in the area of Lara and Armstrong Creek (see Figure 2, Attachment 2). New developments provide the community with a great opportunity to avoid the mistakes of the past by implementing robust stormwater management processes from the outset. Priority catchments that have a high degree of future growth within them have been earmarked for greater oversight of erosion and sediment control procedures at construction sites. Improvements in the planning, design, construction and handover of WSUD assets are also needed in order to ensure that CoGG inherits effective assets from developers.

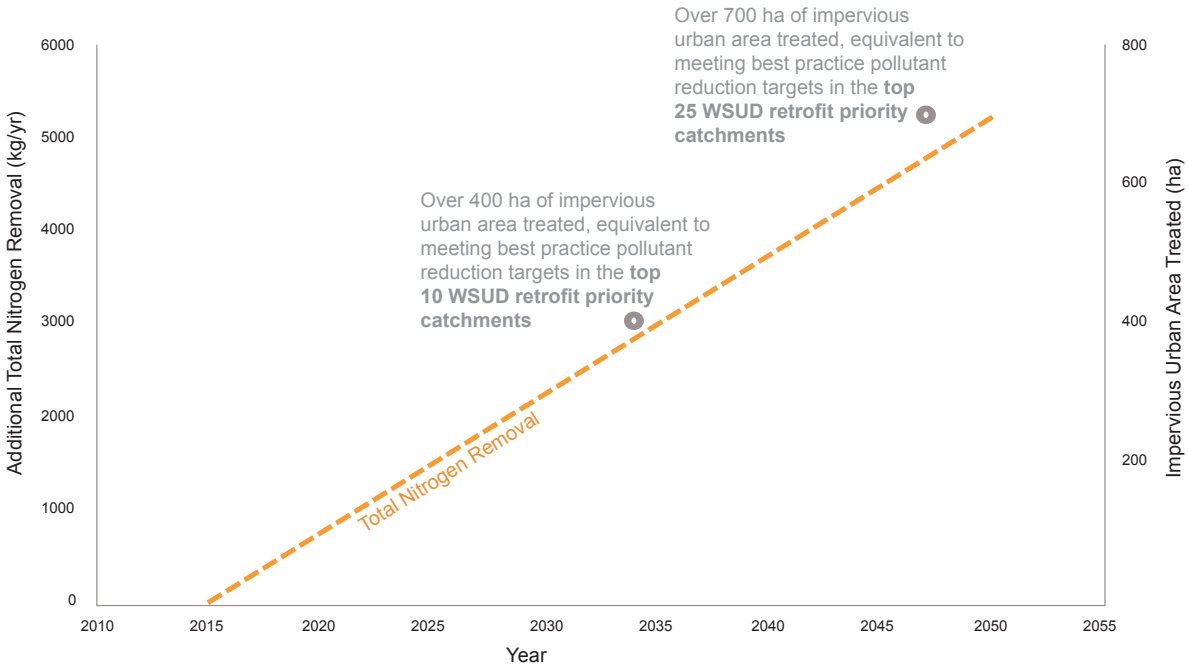


Figure 10 A potential trajectory for reducing stormwater pollutant loads to protect our waterways and bays

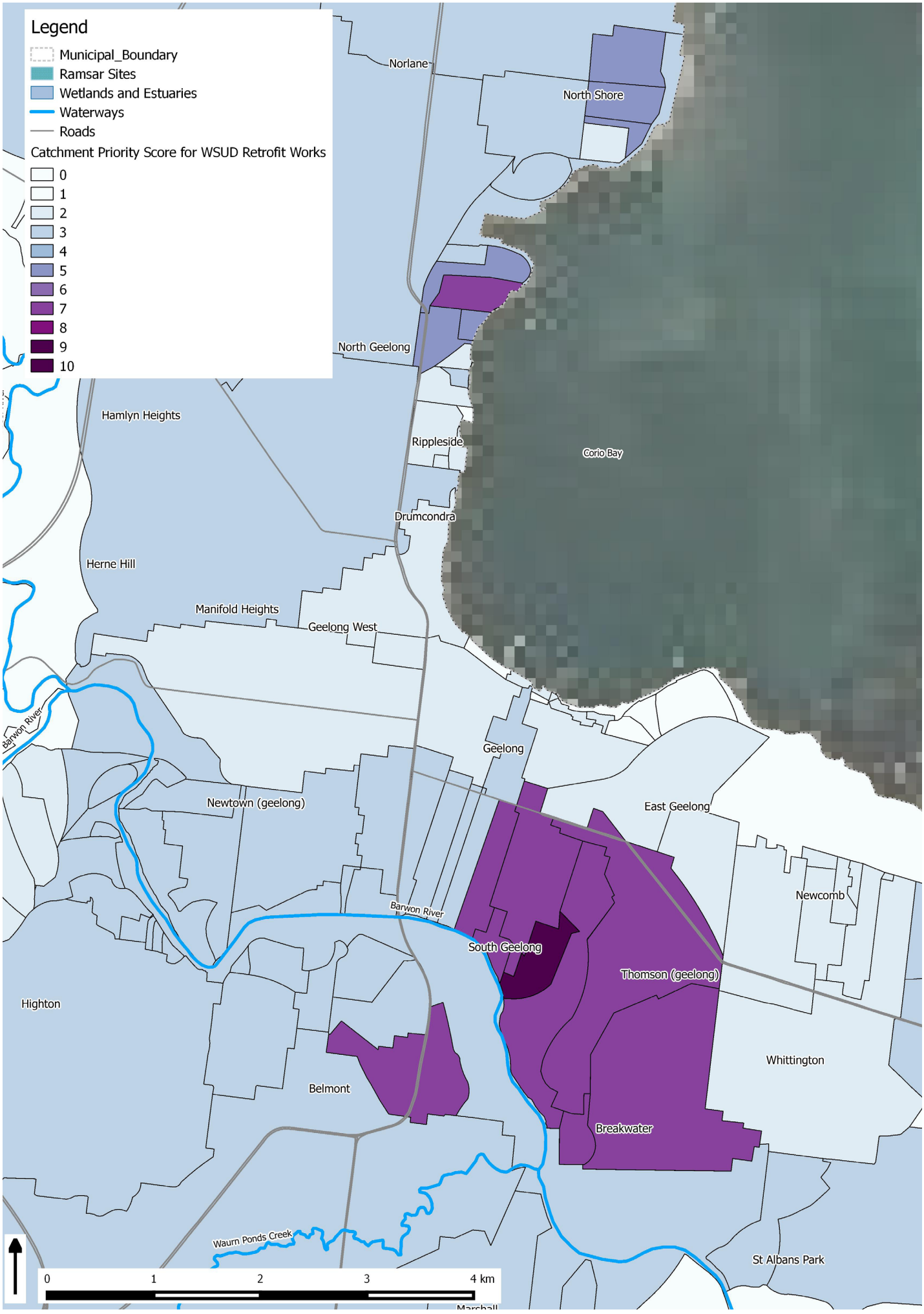


Figure 11 Priority catchments for WSUD retrofits in Geelong

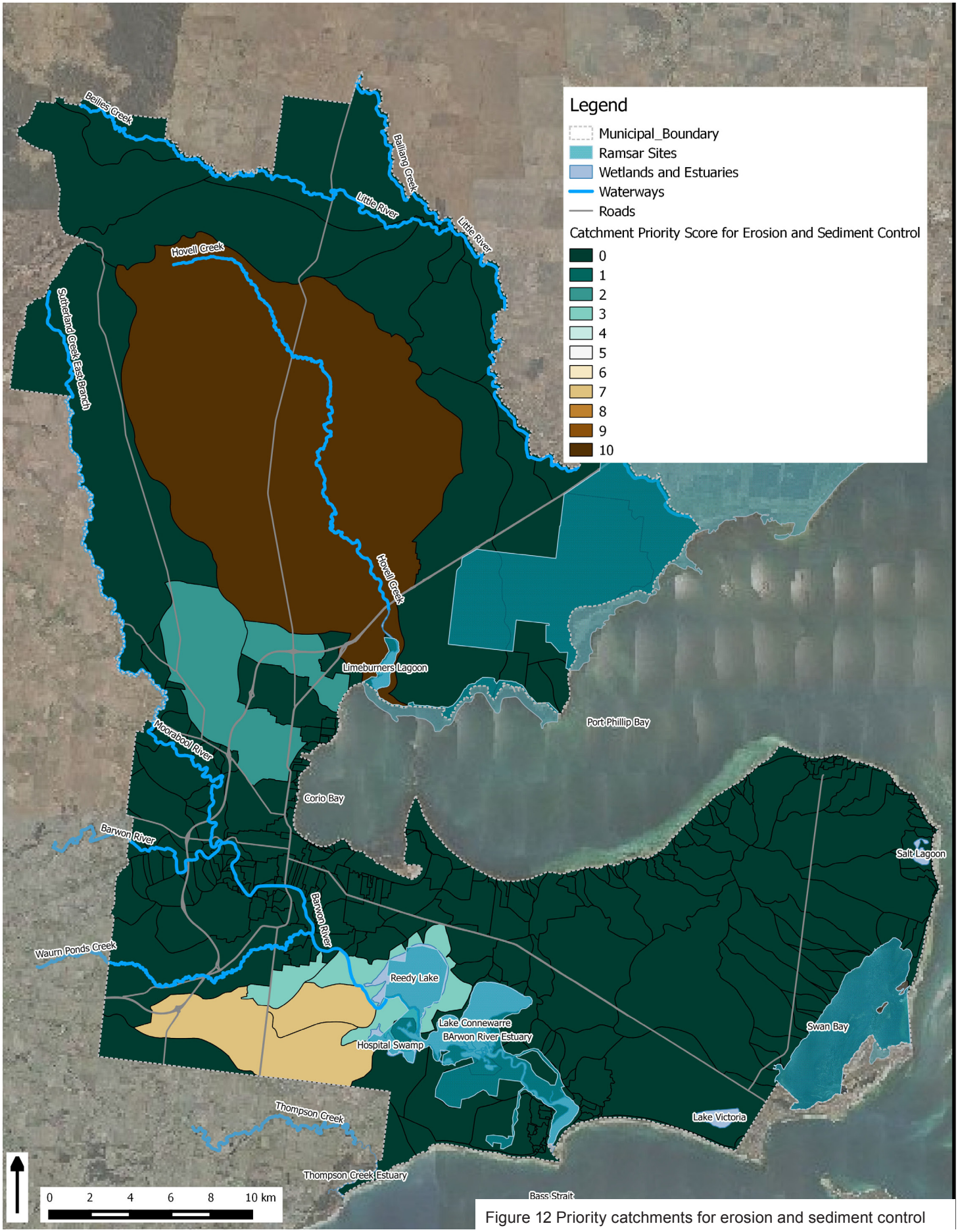


Figure 12 Priority catchments for erosion and sediment control

3.5 Current Stormwater Management

3.5.1 Geelong's WSUD assets

The City of Geelong has approximately 312 water sensitive urban design sites providing some form of stormwater treatment to protect its waterways and bays. These include 98 large assets (e.g. wetlands and ponds), 65 raingardens, 28 tree pits and 121 litter and gross pollutant traps.

Vegetated assets like wetlands, raingardens and swales improve urban amenity through urban greening, provide passive irrigation and increased evapotranspiration, mitigate minor flooding and can improve property values. Other assets may provide specific functions such as litter removal to improve waterway amenity or harvest stormwater for reuse.

The replacement value of Geelong's WSUD assets is estimated at $21 M and it is important these are managed effectively to provide value for the community and protect the city's valuable natural assets including waterways and beaches. A breakdown of current renewal value is provided in Attachment 6.

The City inherits large numbers of WSUD assets from developers as an outcome of urban development and planning requirements to meet objectives for SEPP and Clause 56.07 of the Victorian Planning Provisions (VPPs). Council has also invested in WSUD assets including several stormwater harvesting schemes and streetscape WSUD in recent years to make progress in retro-fitting existing areas to improve amenity and protect waterways and water bodies.

Figure 13 Selection of WSUD assets clockwise from top left (a) wetland (Grinter Reserve), (b) bioretention (Creekside Drive), (c) swale (Forest Lake), (d) sedimentation basin (Estuary Boulevard)

3.5.2 Stormwater quality achievements

The stormwater quality improvements that are currently being delivered by CoGGs suite of WSUD assets and operational stormwater harvesting projects is summarised in Table 1. Vicroads also own several WSUD assets within the region, these are predominantly swales associated with the Geelong Ring Road. The treatment performance provided by Vicroads assets add to the considerable water quality improvements already being achieved by Council.

Although Council has made good progress in establishing, recording and beginning to maintain WSUD assets the majority of stormwater pollutants generated in Geelong's urban areas remain untreated (Figure 14). Consequently a substantial and prolonged increase in investment would be required before the municipality could meet BPEM targets.

Table 1 Predicted pollutant load reductions achieved by CoGG and VicRoad assets

Parameter	Unit	Pollutant Load Reductions			
		Council WSUD assets	Council stormwater harvesting projects	VicRoads WSUD assets	Total
Total suspended solids	tonnes/yr	244	88	91	423
Total phosphorus	kg/yr	427	174	122	722
Nitrogen	kg/yr	2,540	970	280	3,790

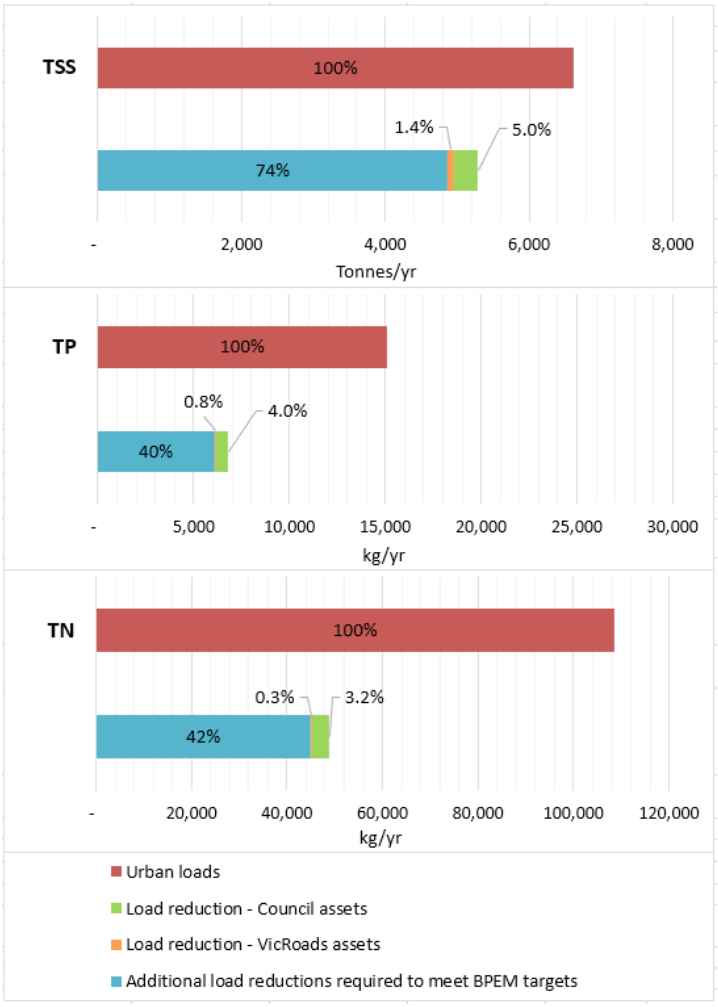


Figure 14 Estimate of urban stormwater pollutant load reductions

4.0 GEELONG'S STORMWATER MANAGEMENT OBJECTIVES

A vision and set of stormwater management strategies was developed for COGG based on the City's strategic goals, recognition of the importance and value of waterways, wetlands and coasts within the region and fulfilment of its regulatory requirements under the State Environment Protection Policy (Waters of Victoria) (Thwaites, 2003).

The vision for the stormwater quality strategy is to:

Protect Geelong's unique waterways and bays by constructing and managing WSUD to control urban stormwater pollutant flows and loads to best practice standards

This is supported by three main strategies to:

1. Maintain and renew WSUD assets.
2. Manage new development WSUD assets.
3. Increase stormwater treatment capacity in existing urban areas.

Within each of these strategies, there are a number of objectives:

1. Maintain and renew WSUD assets.
    a. Operate an ongoing program of works for maintenance and renewals.
    b. Provide adequate funding for maintenance and renewals.
    c. Improve WSUD understanding, capability, and procedures within Council.
    d. Effectively manage WSUD asset data.
2. Manage new development WSUD assets.
    a. Ensure developments comply with Clause 56.07 and SEPP requirements.
    b. Ensure pollutant loads from new infill development are treated or offset (WSUD Contribution Levy).
    c. Ensure Council inherits high quality WSUD assets from developers that are functional and maintainable.
    d. Improve WSUD understanding, capability, and procedures within Council.
3. Increase stormwater treatment capacity in existing urban areas.
    a. Prioritise and implement projects based on an assessment of catchment risk, waterway value, cost, pollutant load reductions and other benefits.
    b. Integrate WSUD into other Council strategies and projects to realise strategic goals of improving amenity and liveability, reducing urban heat island effects, providing climate change resilience and reducing impacts of flooding.
    c. Enable and support stormwater harvesting that is beneficial for the community.

The Stormwater Quality Strategy is closely linked with and supports a number of other Council strategies and plans to realise Council's strategic directions and priorities. Relevant links are summarised in Table 2.

Table 2 Council strategic direct and relationship to stormwater quality strategy

Strategic directions	Priorities	Stormwater quality strategy supports the following strategies
Community wellbeing	• Healthy lifestyles • Healthy environments	• Geelong Public Health and Wellbeing Plan • Greater Geelong Physical Activity Strategy
Growing our economy	• Greater Geelong is a leading city for tourism, arts, culture and events • A successful and vibrant city centre	• Municipal Strategic Statement • Armstrong Creek Urban Growth Plan • Future Proofing Geelong/Low Carbon Growth Plan • Central Geelong Action Plan
Sustainable built and natural environment	• Enhance and protect natural areas and ecosystem health • Support our community to live sustainably • Advocate for and promote sustainable design and development • Minimise our environmental footprint	• Climate Change Adaptation Strategy • Future Proofing Geelong/Low Carbon Growth Plan • Environment and Management Strategy • Biodiversity Management Strategy • Sustainable Water Use Plan • Geelong Wetlands Strategy • Drainage and Flood Management Strategies
How we do business	• Responsible and sustainable financial management	• Asset Management Strategy

5.0 WSUD OPPORTUNITIES

5.1 General Principles for the Assessment of WSUD Opportunities

The following general principles should be pursued in selecting appropriate stormwater treatment measures:

- Assets should be constructed using a treatment train approach with preliminary and primary treatment of litter and sediment preceding secondary treatment of nutrients.
- Multi-functional assets are preferred over single purpose assets. For example, a wetland within a retarding basin is preferable to two separate assets and a rain garden which provides liveability benefits is preferable to a cartridge filter system that only provides stormwater treatment.
- Assets should be low maintenance and where maintenance is required appropriate access should be available.
- Assets within Council's control are preferred over assets in private land.
- Assets in private land must have a management plan in place with clear responsibilities.
- Assets that are more robust are preferred. Wetlands are preferred over bioretention for greenfield developments as they are more likely to be designed, constructed and maintained correctly while bioretention systems within retarding basins can be prone to clogging.
- Assets within public parks and open spaces are preferred to streetscape assets as they are usually more cost effective to construct and maintain. This must be balanced with the opportunity cost of land.
- Open water bodies such as ponds or lakes (less than 80% vegetated) are considered receiving waters and should have upstream treatment for sediment and nutrient removal. Ponds and 'over-sized' sediment basins are not acceptable stormwater treatment measures.
- Natural assets are not relied upon for treatment (e.g. treatments are located upstream of waterways not within them, natural wetlands are protected by upstream treatment).
- Stormwater harvesting schemes should provide overall benefits to the community, taking into account water harvested, pollutant load reductions and other benefits.

Once potential WSUD opportunities have been identified a business case should be prepared to assess its merits relative to other opportunities. A standardised business case template that takes into consideration financial costs, measurable benefits and intangible benefits is provided in Attachment 5. Primary environmental benefits include improved stormwater quality and flow regimes. Other benefits include greener and cooler urban landscapes that enhance amenity and liveability. WSUD has also been linked with increased property values in several Australian studies.

5.2 WSUD across Multiple Scales

WSUD opportunities are commonly assessed at the precinct, streetscape and lot scale. Efforts at the precinct scale have been focused on public open spaces as these areas contain the greatest opportunity for Council. An overview of opportunities across these three spatial scales is provided below in Table 3.

Table 3 Hierarchy of WSUD opportunities across multiple scales

WSUD Treatment	Public Open Space	Streetscape	Lot
Stormwater harvesting	✓	✗	✗
Constructed wetlands	✓	✗	✗
Raingardens	✓	✓	✓
Swales	✓	✓	✓
Tree pits	✗	✓	✗
Rainwater tanks	✓	✗	✓

KEY

✓ Primary opportunity

✓ Secondary opportunity

✗ Not suitable

5.3 Geelong's Specific WSUD Opportunity Areas

Fifteen WSUD opportunity areas have been identified to help the City of Greater Geelong become a truly Water Sensitive City. By focusing efforts in these opportunity areas Council will be able to improving WSUD outcomes by enhancing the management of its current assets, adequately preparing for new development in the region and cost-effectively identify and implement WSUD projects in existing areas.

Table 4 Categorisation of Geelong's WSUD opportunity areas

WSUD Opportunity Area	Relevance to Strategies		
	Maintain and renew WSUD assets	Manage new development WSUD assets	Increase stormwater treatment capacity in existing urban areas
Non-structural approaches			
Asset management	High	Moderate	Moderate
Training for improved WSUD capacity within Council	High	Moderate	Moderate
Community education	Low	Low	Low
Streetscape litter management	Moderate	Low	Low
Construction site sediment and erosion control	n/a	High	Moderate
Industrial stormwater code of practice	n/a	Moderate	Moderate
Managing development			
Greenfield development WSUD	n/a	High	n/a
Infill development WSUD	n/a	High	n/a
WSUD contribution levy	n/a	High	Moderate
Retrofit opportunities			
Implementation within other Council works	n/a	n/a	High
Co-location with other assets	n/a	n/a	High
Stormwater harvesting	n/a	n/a	High
Public open space	n/a	n/a	High
Streetscape	n/a	n/a	Moderate
Private land	n/a	n/a	Low
Catchment analysis to identify opportunities	n/a	n/a	High

5.4 Project Examples

End-of-pipe WSUD retrofits within parks along the Barwon River provide a great opportunity to tackle some of Geelong's most urbanised and problematic catchments. This avoids the challenges of retrofitting distributed WSUD systems into highly constrained catchments and allows for significant volumes to be treated in one centralised location.

Existing retarding basins have a great potential for WSUD integration. They are already connected to substantial catchments and contain land that has limited or no competing uses. The inclusion of a wetland within a retarding basin creates a multifunctional asset that delivers flood control and stormwater treatment.

There are many low lying areas located adjacent to Geelong's waterways that already contain stands of vegetation. These areas could be modified to provide additional treatment by (a) directing additional runoff into them, (b) reshaping to increase their volume and (c) selectively planting for improved pollutant removal capacity.

Streetscapes are challenging areas for WSUD interventions although they provide benefits including shade, passive watering and improved urban micro-climate. In these areas costs can be high relative to performance due to site constraints and traffic management issues. However, WSUD can be cost effectively retrofitted into streetscapes by including them as part of other Council works (e.g. street upgrades, road resurfacing).

6.0 FINANCIAL ANALYSIS

The main benefit of fully functional and well maintained WSUD assets is improved stormwater quality and flow management. This translates into healthier aquatic environments that provide valuable ecosystems services. Healthy waterways are an important part of healthy communities as these natural assets promote activity and engagement within the community.

CoGG have already invested considerable efforts in the construction and establishment of a variety of stormwater treatment measures. However, to date funding and training for appropriate maintenance has been insufficient to realise the full benefit of these investments. In addition to impaired treatment, inadequate maintenance can result in undesirable amenity outcomes (e.g. accumulation of litter and loss of vegetation) and can significantly reduce the lifespan of assets. Reduced lifespans result in more frequent renewal costs, consequently, perceived 'savings' due to lower maintenance budgets actually result in the accrual of substantially higher renewal liabilities.

Financial modelling illustrates the impact of enhanced maintenance on treatment performance and renewal costs. The three funding scenarios that were modelled are described below with results and inputs presented in Figure 15, Table 5 and Table 6. This analysis indicates that with increased funding of WSUD maintenance CoGG can substantially reduce its renewal liability. This results in a net saving under Scenario 1 (see Figure 16 and Figure 17). With additional funding for maintenance and capital under Scenario 2 CoGG are able to further reduce their renewals liability and also actively pursue improved stormwater quality in high priority catchments.

Assets are maintained to varying standards or 'levels of service' for various values including stormwater treatment and amenity. The level of service depends on the relative importance of an asset and the functions it provides. For example a high profile wetland in a well used park or a raingarden in a shopping strip may be maintained to a higher amenity standard than another wetland that provides stormwater treatment but is rarely visited. Both would be maintained to ensure they continue to provide stormwater treatment although assets protecting high value waterways and RAMSAR listed water bodies would receive priority.

Base Case

A primary level of funding for WSUD maintenance works reflecting historical level of funding available. This is insufficient to maintain or renew assets resulting in under-performance, poor cost efficiency and failure to comply with statutory obligations. No funding for WSUD asset renewal or further capital works.

The base case reflects what was spent historically as well as the accruing cost of renewals for which funding is not expended but a financial liability is accruing.

Scenario 1

A secondary level of funding for WSUD maintenance, renewal and capital works. Additional funding for a WSUD Officer position, $150,000 per year for maintenance and application of the WSUD levy reflect Geelong's current budget in 2015/2016. Further increases in maintenance funding of $100,000 per year are assumed."

Sustained increases in maintenance efforts significantly and cost effectively increase stormwater treatment performance and realise asset potential. Large financial savings are realised as well as partial compliance with statutory obligations. Without capital works there is little progress in addressing pollution from existing areas.

Scenario 2

A tertiary level of funding building on Scenario 1 to ensure that all WSUD assets are maintained and renewals are funded through depreciation by 2050. This scenario includes sufficient capital resources for Council to actively address stormwater pollution from existing urban areas by increasing treatment capacity. This allows Council to pursue WSUD retrofit opportunities in the priority catchments identified above in Section 3.4 and within other works projects. Based on catchment prioritisation analysis, Scenario 2 funding allows Council to improve stormwater runoff from 25 priority catchments containing the most damaging land practices (e.g. industrial and highly impervious areas) flowing into the highest value regional waterways.

Scenario 2 represents a long term plan that is financially rational and allows CoGG to deliver on its statutory obligations whilst also delivering many environmental and social benefits. It is recommended that the CoGG pursue Scenario 2 although a staged increase of maintenance, renewal then capital works funding and internal resourcing may be adopted.

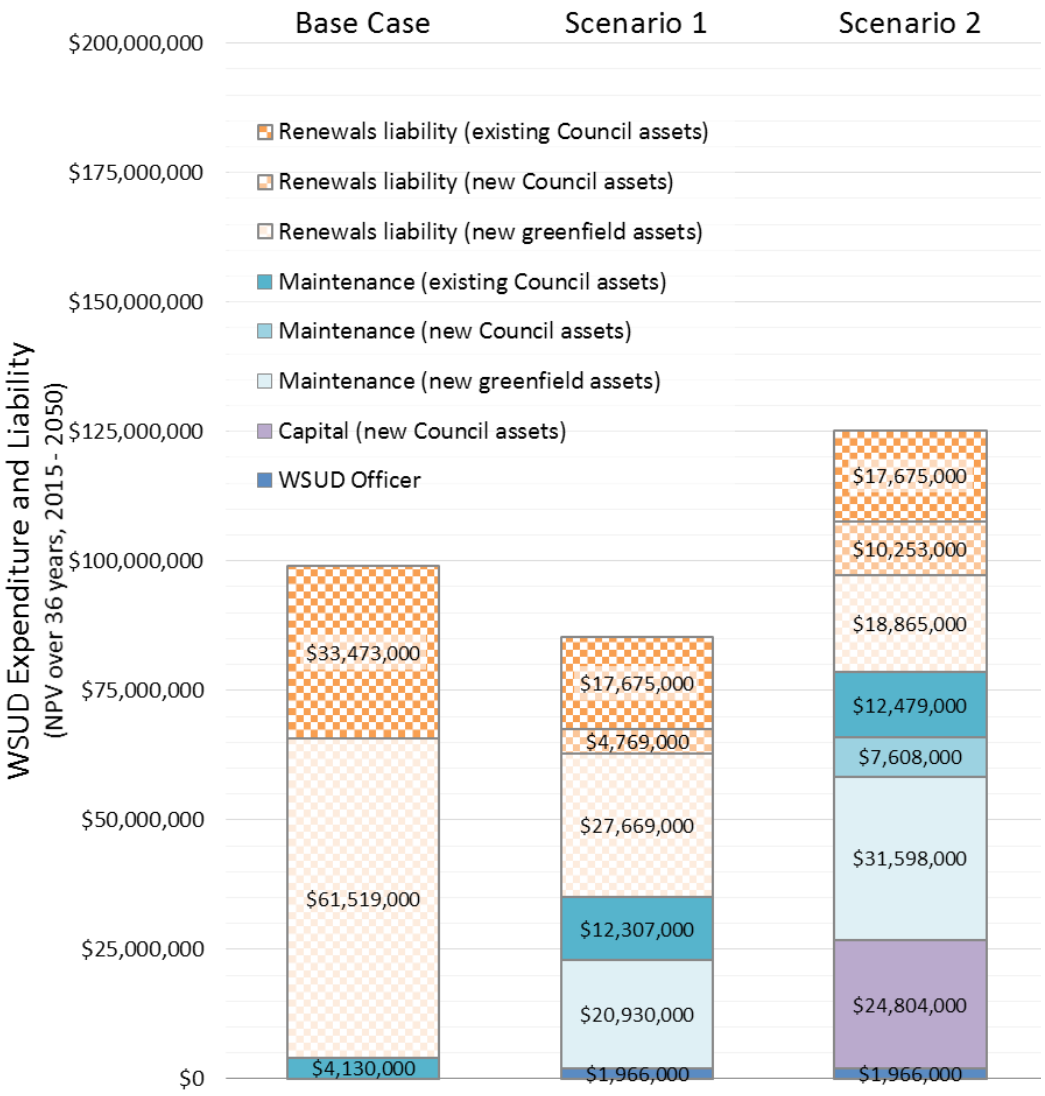


Figure 15 Financial modelling results, $ 2015 PV (4.0% discount rate)

Table 5 Impact of each financial model on Geelongs stormwater quality

Measure	Unit / timeframe	Base case	Scenario 1	Scenario 2
Compliance with Council SEPP legal obligations?		No	Partial	Yes
Amenity and liveability outcomes for WSUD assets		Poor	Good	Excellent
Priority catchments treated to best practice by 2050		0	0	25
Reduction in urban nitrogen loads	% in 2050	5%	10%	16%
	kg/yr in 2050	7,000	13,300	20,400
WSUD assets with full maintenance	% in 2050	<1%	73%	97%
Total expenditure and liability	$ NPV, 2015-2050	$99,123,000	$92,199,000	$132,130,000

Table 6 Summary of financial model inputs and results

			Model inputs $000 / yr	**Results** $000 NPV, 2015-2050
Base case	Expenditure (funded)	Maintenance*	$210	$4,130
		Capital: WSUD levy	$0	$0
		Capital: Council funded	$0	$0
		WSUD Officer	$0	$0
	Liability (not funded)	Renewal**: Existing assets	$1,702	$94,993
		Renewal**: New assets	$4,019	
Scenario 1	Expenditure (funded)	Maintenance	$200 • Plus $150 in 2015 • Plus a rolling increase of $100 per year from 2016 onwards	$33,237
		Capital: WSUD levy	$350	$6,883
		Capital: Council funded	$0	$0
		WSUD Officer	$100	$1,966
	Liability (not funded)	Renewal**: Existing assets	$899	$50,113
		Renewal**: New assets	$2,119	
Scenario 2	Expenditure (funded)	Maintenance	$200 • Plus $150 in 2015 • Plus a rolling increase of $170 per year from 2016	$51,685
		Capital: WSUD levy	$350	$6,883
		Capital: Council funded	$1,329	$24,804
		WSUD Officer	$100	$1,966
	Liability (not funded)	Renewal**: Existing assets	$899	$46,793
		Renewal**: New assets	$1,902.08	

* Consists of $200k/yr for maintenance of GPTs and litter traps and $10k/yr for maintenance of WSUD assets.
** Renewal liabilities recognise the future cost of renewing assets (which is currently not funded), these were averaged over the period of analysis.

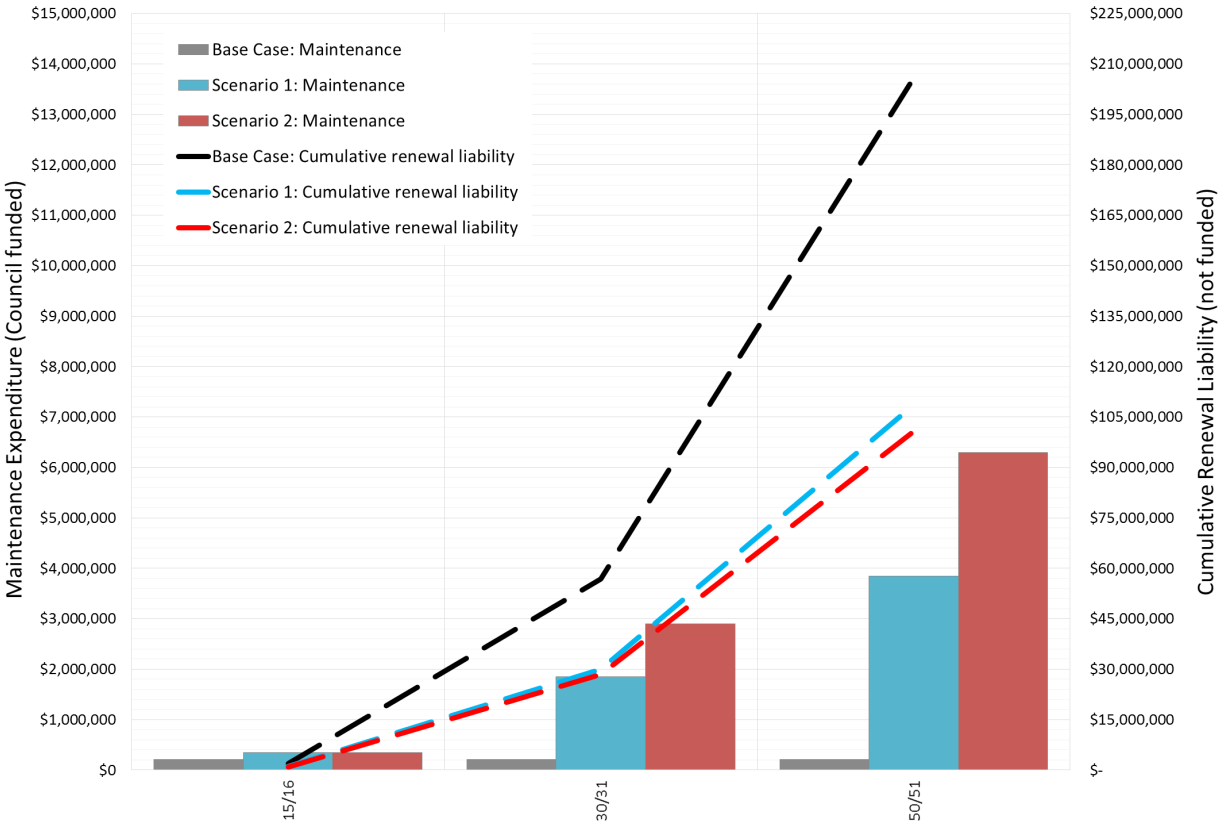


Figure 16 The relationship between increased maintenance expenditure and reduced renewals liability

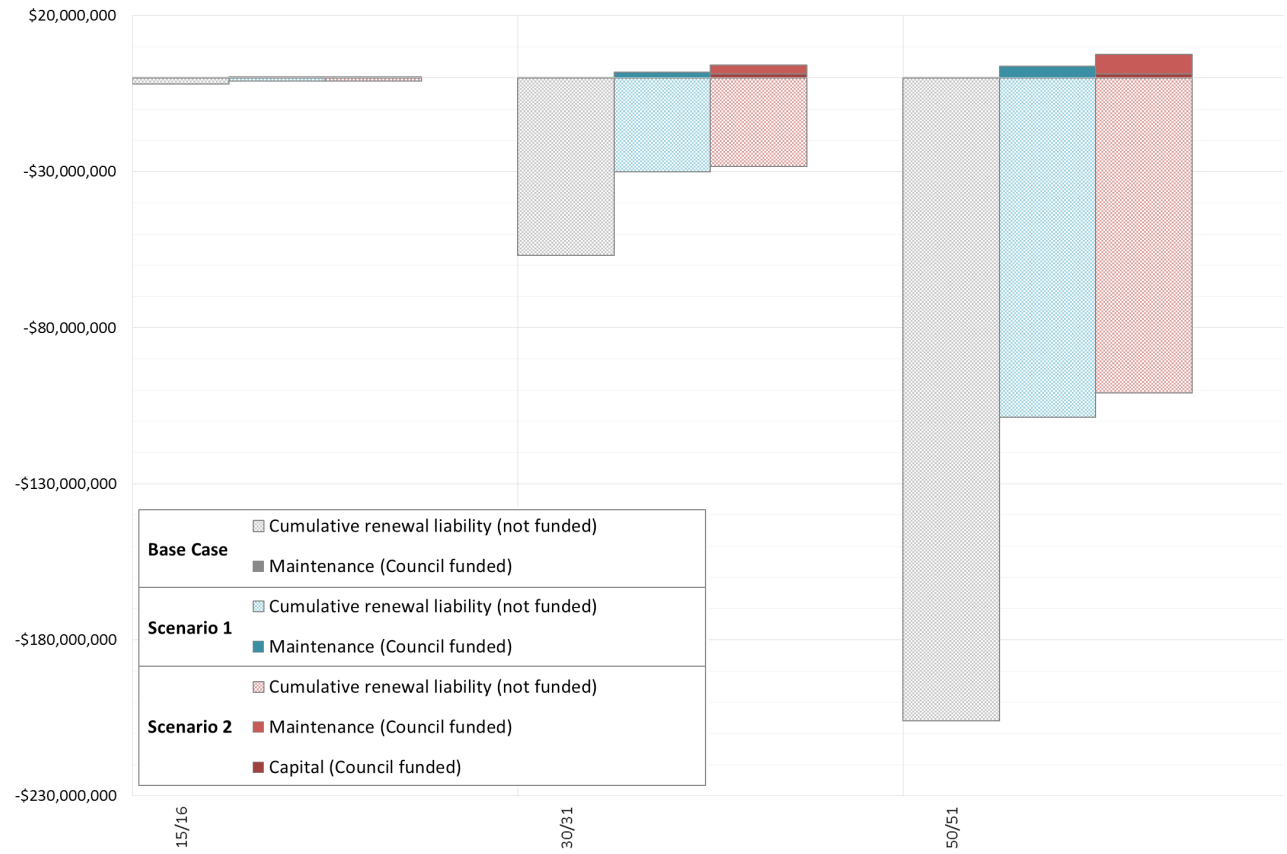


Figure 17 CoGG spend and renewal liability (does not include capital expenditure from the WSUD levy as this is not Council funded)

7.0 IMPLEMENTATION PLAN

An implementation plan was developed to realise the City of Greater Geelong's Stormwater Quality Strategy and its vision to:

Protect Geelong's unique waterways and bays by constructing and managing WSUD to control urban stormwater pollutant flows and loads to best practice standards

The first priority for the City is to effectively manage and renew its existing WSUD assets to ensure the potential benefits of these are realised.

The second priority is to prepare for future growth by strengthening its processing for assessing and taking on ownership of new WSUD assets.

The third and final priority is to pursue capital works in existing urban areas to increase stormwater treatment capacity and improve amenity and liveability within its public spaces.

A series of actions within these three strategies were developed into an implementation plan and these are summarised below. Progress towards completing the actions should be reported on a 3 monthly basis to the WSUD Steering Committee.

The implementation plan consists of a series of action within the three strategies on the following pages.

7.1 Maintain and Renew WSUD Assets

Objective	#	Action	Measure and target	Timeframe	Council Division(s)
Operate an ongoing program of works for maintenance and renewals.	1.1	Develop a method to assign condition ratings to WSUD		2015	
	1.2	Condition assessment of all or a representative sample of WSUD assets to identify and prioritise maintenance and renewal actions and to assign and record condition rating		2015	Engineering
	1.3	Establish maintenance and renewal program for WSUD assets.	% of WSUD assets maintained or renewed (Target 100%)	2016	Engineering
	1.4	Prepare inspection and maintenance checklists and manuals for WSUD including construction and establishment phase and inspection of existing WSUD assets and incorporate into Infrastructure Management manual.		2016	Engineering, Asset Management, Subdivisions
	1.5	Provide maintenance staff with training on WSUD functionality, purpose, modes of failure and maintenance solutions.	No. of maintenance staff trained	2017	Operations and Maintenance, Engineering
	1.6	Employ WSUD Officer		2015	Engineering
Provide adequate funding for maintenance and renewals.	1.7	Annual increase in maintenance budget of $100,000/year to occur, each year	% of required maintenance budget (Target 100%)	Within 10 years.	Engineering, Finance, Operations and Maintenance
	1.8	Develop revised estimate of renewal costs of assets based on outcomes of condition assessment Provide annual budget increase for WSUD renewals. Account for all unfunded liabilities within financial reporting and include asset renewal gap for WSUD in Council Annual Report.	Asset renewal gap (Target to reduce unfunded liabilities to zero)	Within 10 years	Engineering, Finance
Improve WSUD understanding, capability, and procedures within Council.	1.9	Establish agreed process for classifying assets with both an environmental service and stormwater treatment function		2016	Engineering, Environment

7.1 Maintain and Renew WSUD Assets (Cont.)

Objective	#	Action	Measure and target	Timeframe	Council Division(s)
Effectively manage WSUD asset data.	1.10	Restructure asset database to store WSUD assets within three tables: 1. Site tables 2. WSUD asset table 3. Inspection and maintenance table and include relevant fields identified within strategy		2015	Asset Management, Engineering
	1.11	Collate and update data within database for existing WSUD assets		2016	Asset Management, Engineering
	1.22	Develop a prioritisation framework to prioritise maintenance and renewal works	Site tables	2016	Engineering

7.2 Manage New Development WSUD Assets

Objective	#	Action	Measure and target	Timeframe	Council Division(s)
Ensure developments comply with Clause 56.07 and SEPP requirements.	2.1	Establish and maintain an up to date register of new development and corresponding WSUD.	% of new greenfield residential developments for which WSUD implemented % of non-residential developments complying with SEPP requirements	2017	Engineering, Statutory Planning
	2.2	Review requirements for non-residential development and consider potential to introduce stormwater requirements similar to Clause 56.07 or Moonee Valley C108 Amendment.		2020	Strategic Planning, Engineering
	2.3	Develop education campaign to minimise sediment and pollution discharges from building sites		2016	Subdivisions, Engineering
	2.4	Enforce Neighbourhood Amenity Local Law 2014 - Clause 55 for erosion and sediment control for building sites		2016	Subdivisions, Engineering
	2.5	Integrate community notification of illegal building site stormwater discharges into the CoGG mobile app 'Report a Problem' page		2017	Subdivisions, Engineering
Ensure pollutant loads from new infill development are treated or offset (WSUD Contribution Levy).	2.6	Develop a policy to guide application of WSUD Contribution Levy funds.	% of WSUD Contribution Levy effectively invested in WSUD capital works % of pollutant loads generated from infill developments paying levy offset by corresponding WSUD works	End 2016	Engineering, Asset Management
	2.7	Develop and implement ongoing capital works program for expenditure of WSUD Contribution Levy.		End 2016	
	2.8	Review levy rate based on average cost of program works		End 2016	
	2.9	Establish process to record where funds come from and are spent.		End 2016	
	2.10	Obtain advice to confirm legal status of WSUD levy and ensure it complies with relevant requirements		End 2016	

7.2 Manage New Development WSUD Assets (Cont.)

Objective	#	Action	Measure and target	Timeframe	Council Division(s)
Ensure Council inherits high quality WSUD assets from developers that are functional and maintainable.	2.11	Improve assessment process of proposed WSUD assets: • Increased training of staff • Apply strategy recommendations regarding priority of opportunities		2017	Engineering
	2.12	Establish processes for: • Handover of maintenance manual and drawings to the operations and maintenance team showing layout and key elements of WSUD systems. • Completion of standard WSUD asset template to collect information for asset management database		2016	Statutory Planning, Operations and Maintenance, Asset Management
	2.13	Establish process to provide developers with WSUD information as part of pre-application briefings		2015	Statutory Planning, Engineering
Improve WSUD understanding, capability, and procedures within Council.	2.14	Prepare standard drawings for key WSUD elements and standard specifications for WSUD including maintenance requirements and ensure these are accessible by multiple departments.		2018	Engineering, Design, Construction, Roads/Transport
	2.15	Provide training for subdivisions inspectors in assessment of WSUD		2016	Subdivisions, Engineering

7.3 Increase Stormwater Treatment Capacity in Existing Urban Areas

Objective	#	Action	Measure and target	Timeframe	Council Division(s)
Prioritise and implement projects based on an assessment of catchment risk, waterway value, cost, pollutant load reductions and other benefits.	3.1	Establish prioritised program for WSUD retrofits based on business cases prepared for potential projects.	• Priority catchments treated • Impervious area treated • Pollutant load reductions	By 2035: ≥2,400 kg/year of new TN reductions (equivalent to 10 priority catchments treated to best practice) By 2050: ≥5,400 kg/year of new TN reductions (equivalent to 25 priority catchments treated to best practice	Engineering, Capital Works, Design, Construction
	3.2	Introduce industrial stormwater code of conduct (refer to in overlays?)	Number of properties adopting code	Introduce code of practice by 2018	Strategic Planning, Engineering, Statutory Planning
Integrate WSUD into other Council strategies and projects to realise strategic goals of improving amenity and liveability, reducing urban heat island effects, providing climate change resilience and reducing impacts of flooding.	3.3	Investigate opportunities to integrate WSUD within the 'City in a Park' strategy and ensure new trees and planting within the project area are passively or actively watered with stormwater where possible.			Capital Works, Design, Engineering
	3.4	Investigate the potential for collaborative works to support both the Urban Forest Strategy and Stormwater Quality Strategy through tree plantings with passive irrigation from stormwater			Capital Works, Design, Engineering, Open Space
	3.5	Implement a community education program within 'City in a Park' to educate the community about stormwater impacts and the benefits of WSUD for protecting waterways and bays, improving amenity and liveability through passive watering and healthy vegetation.			
	3.6	Update the Stormwater Management Plan		2017	Engineering, Asset Management

7.3 Increase Stormwater Treatment Capacity in Existing Urban Areas (Cont.)

Objective	#	Action	Measure and target	Timeframe	Council Division(s)
Enable and support stormwater harvesting that is beneficial for the community.	3.7	Update the Water Management Policy		2016	Engineering