CHAPTER 09
SUSTAINABILITY AND RESILIENCE

Plan Melbourne Outcome 6: Melbourne is a sustainable and resilient city

Plan Melbourne aims to create a resilient and sustainable city. It recognises the need to mitigate greenhouse gas emissions, reduce exposure to natural hazards, undertake whole of water cycle planning and design, and protect waterways. It also encourages resource efficiency and promotes the benefits of urban cooling and greening.

Photo credit: Department of Jobs, Precincts and Regions

The Inner Metro Region is the most urbanised built environment in metropolitan Melbourne. It faces significant challenges resulting from climate change including the urban heat island effect, heatwaves, drought, increased storm intensity, stormwater inundation, storm surges and coastal inundation, in combination with expected population growth.

Maximising opportunities to integrate urban cooling and greening to tackle climate change while accommodating significant growth will be vital to ensure the Inner Metro Region remains a safe, healthy place to live, work and visit to 2050. Large urban renewal sites, waterways, open spaces and the movement network provide opportunities to tackle these challenges in innovative, connected ways. The Inner Metro Region will require deliberate, coordinated action by government agencies and authorities to maintain a high standard of living for its current and future residents.

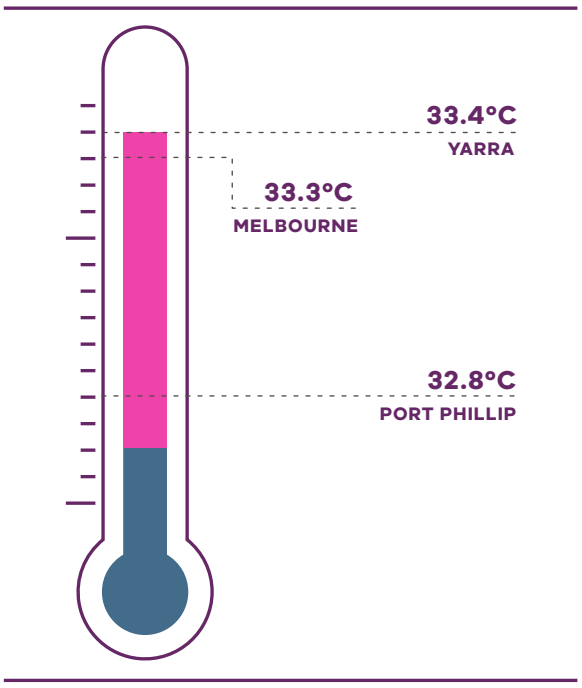
State of play

Urban heat environments

By 2050, the average annual temperature in the Inner Metro Region is forecast to increase between 0.6° and 2.1° Celsius under a medium emissions climate change scenario (Clarke, et al., 2019) As our climate warms, the number of people exposed to the risk of mortality from heatwaves will increase. It is estimated that around 287,000 residents were exposed to high urban heat conditions within the Inner Metro Region in 2018, and if current development practices and population trends continue this exposure rate is projected to substantially increase by 2051 (Urich & Hardy, 2020).

In 2018, the average land surface temperature (LST) in the Inner Metro Region was 33.2° Celsius, which was 0.7° Celsius less than the metropolitan Melbourne average. LST was highest in the City of Yarra at 33.4° Celsius, followed by the City of Melbourne at 33.3° Celsius and the City of Port Phillip at 32.8° Celsius (**Figure 22**) (DELWP, 2018a). Children, seniors, people with underlying illnesses and those with fewer resources to adapt are at greater risk on hot days and in prolonged periods of hot weather. Plan Melbourne notes that temperature decreases of between 1° Celsius and 2° Celsius can have a significant impact on reducing heat-related morbidity and mortality (DELWP, 2017a).

FIGURE 22. Average land surface temperature by LGA, 2018



Source: Department of Environment, Land, Water and Planning (2018) *Land Surface Temperature Data,* State of Victoria, Melbourne, Australia.

Areas of high urban heat vulnerability (areas of high recorded heat in addition to a greater population density or high numbers of people likely to experience heat sensitivity) have been mapped for the Inner Metro Region. These are scattered across the region, but there are concentrated areas located in the north, central and south-west parts of the region affected more significantly (**Figure 23**).

Urban environments that stay cooler on hot days are more physically comfortable and continue to support physical movement and recreation. Cooler urban environments are characterised by more tree cover, less hard surfaces, more water infiltration into the ground and fewer heat absorbing building materials (**Figure 24**). As the number and duration of hotter days increases, these environments will be important to reduce the likelihood of heat-related illness and support healthy communities.

FIGURE 23. Heat vulnerability index map for the Inner Metro Region, 2018

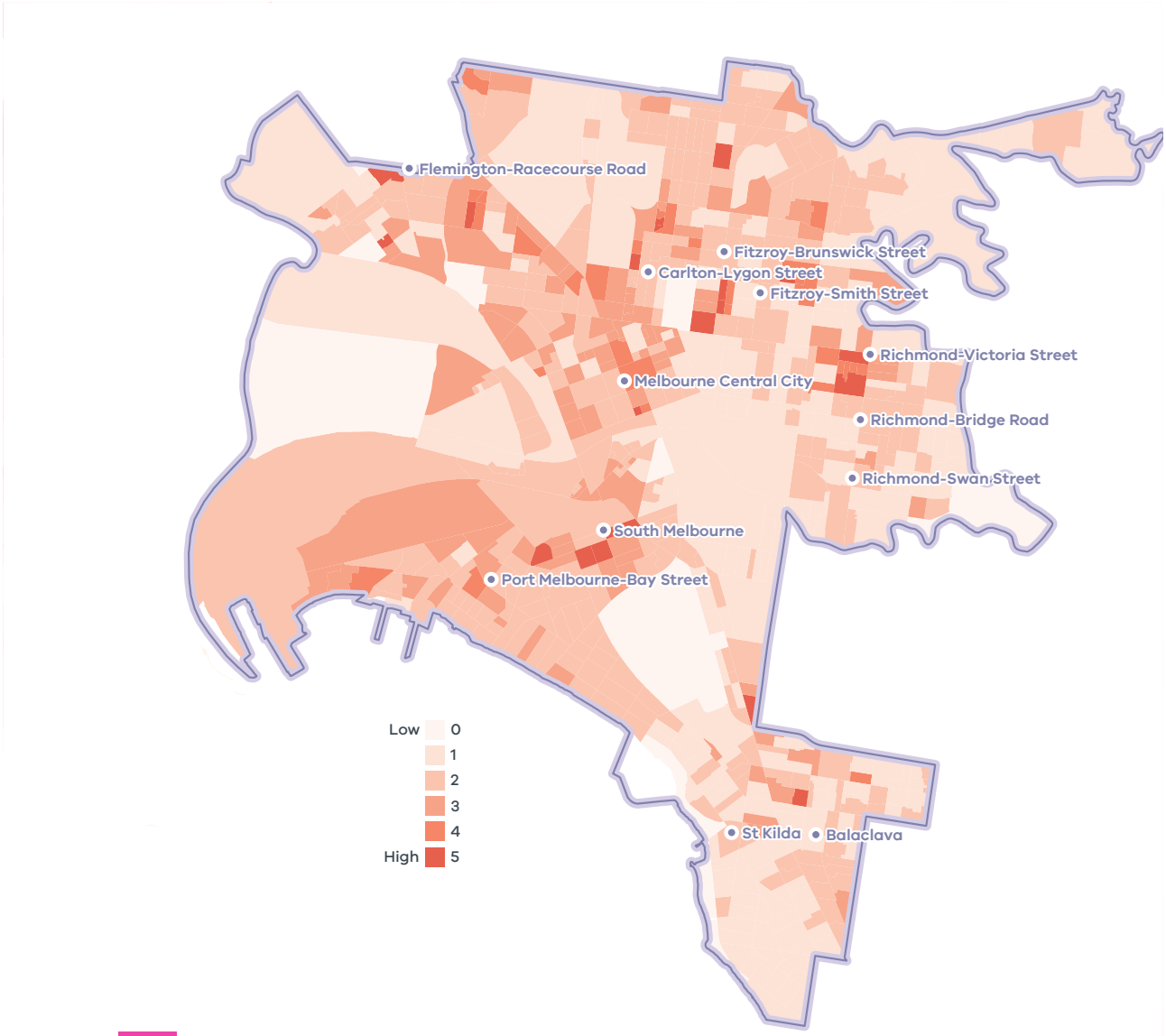
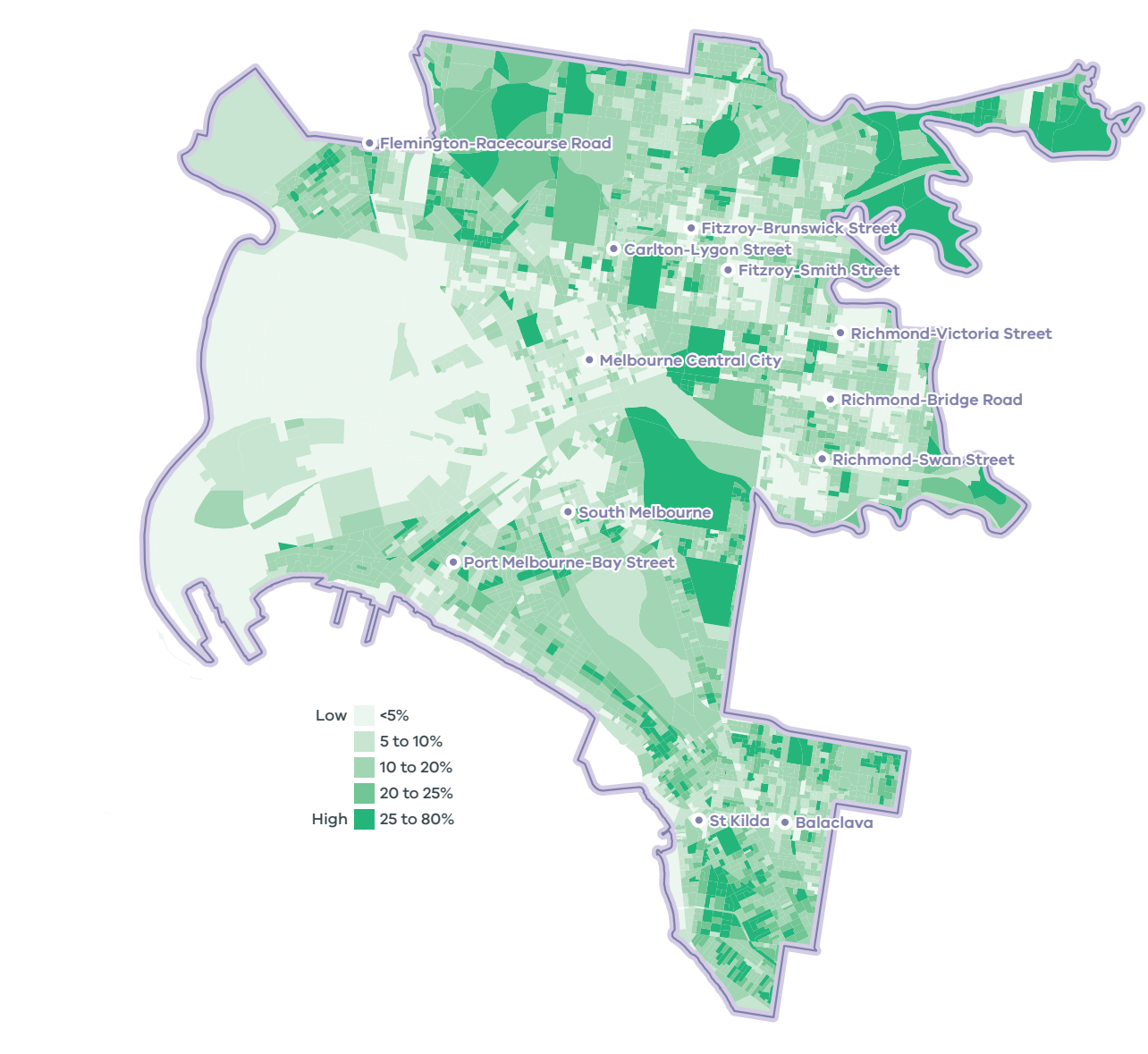


FIGURE 24. Inner Metro Region tree canopy cover, 2018



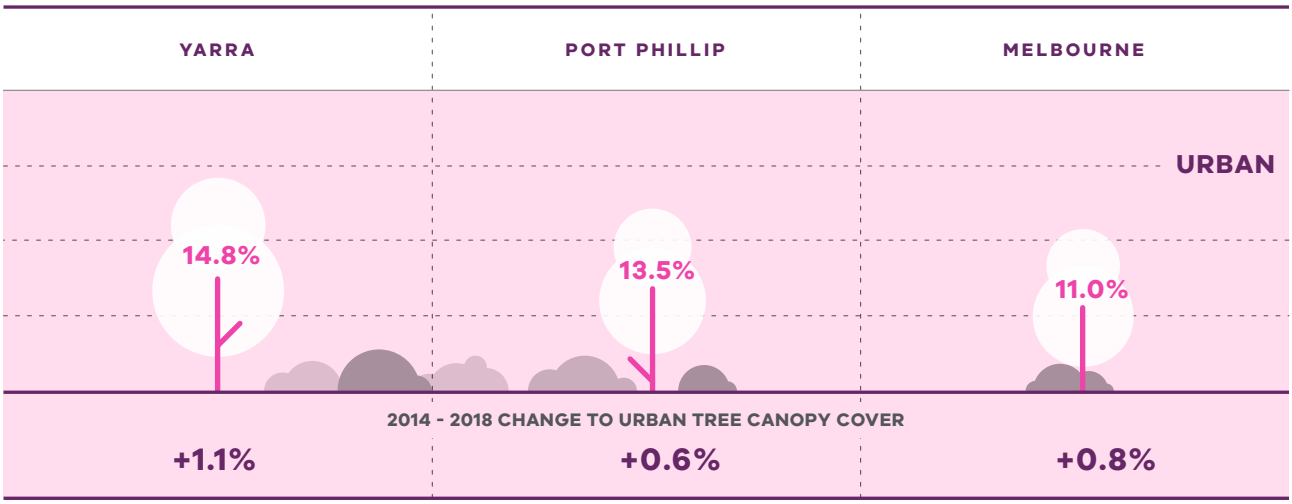
Urban tree canopy

In urban areas, trees and vegetation contribute to neighbourhood character, provide amenity and recreation for residents and provide habitat for wildlife. In 2018, the Inner Metro Region's total vegetation cover was 26.8 per cent, its combined shrub and tree cover was 17.4 per cent and its tree canopy cover was 12.6 per cent (Hurley, et al., 2019a) The fine-grain distribution of urban tree canopy cover relative to the total land areas of Yarra, Port Phillip and Melbourne LGAs is shown in **Figure 25**.

A comparison of tree canopy cover within the Inner Metro Region in 2014 and 2018 identifies an increase from 11.8 per cent to 12.6 per cent (from 915 to 981 hectares). This reflects efforts to increase tree canopy, largely on public land such as parkland and on infrastructure land (primarily streets) which increased by 1.4 per cent and 1.2 per cent respectively. Residential land also saw an increase in tree canopy of 0.7 per cent (**Figure 26**). Yarra LGA experienced gains in canopy cover in its residential, infrastructure and parkland areas; Melbourne LGA in residential and parkland; and the Port Phillip LGA in parkland only (Hurley, et al., 2019b).

Within the region, parkland was the largest contributor of trees, followed by infrastructure land (primarily streets) and residential (**Figure 26**) (Hurley, et al., 2019b).

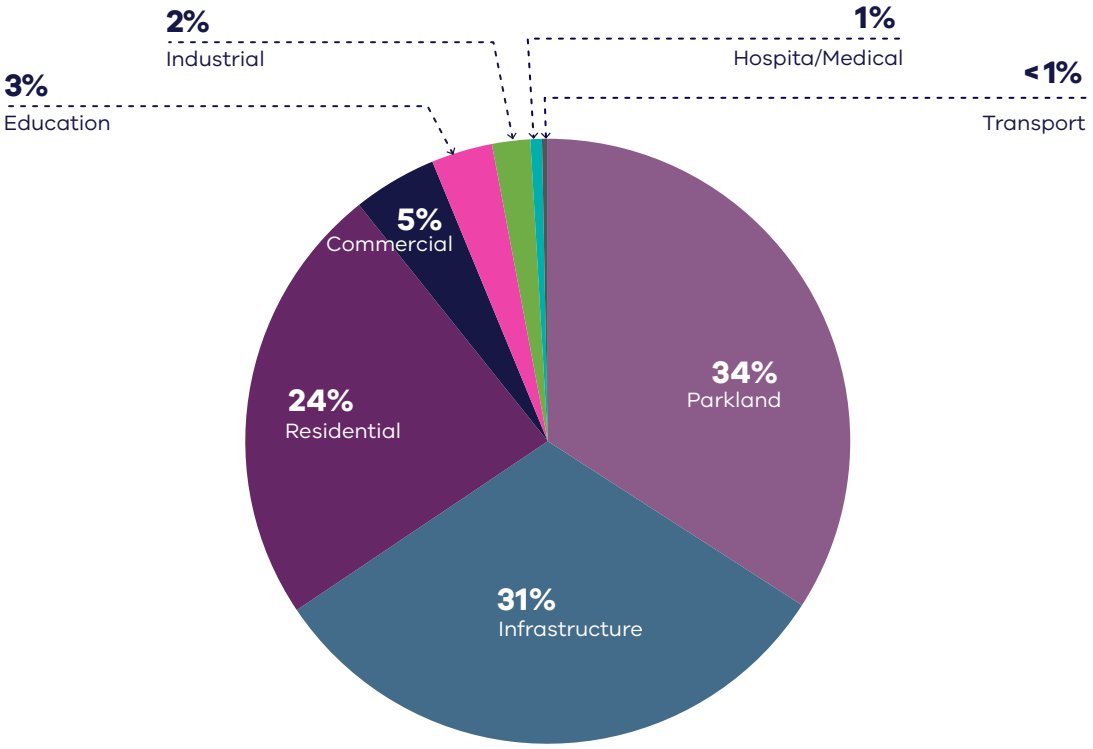
FIGURE 25. Tree canopy cover 2018, and tree canopy cover change 2014 to 2018, by LGA



Source: Hurley, J., Saunders, A., Amati, M., Boruff, B., Both, A., Sun, C., Caccetta, P., and Duncan, J. (2019) *Melbourne Vegetation Cover 2018, Inner Region,* Department of Environment, Land, Water and Planning, Melbourne, Australia.

Hurley, J., Saunders, A., Both, A., Sun, C., Boruff, B., Duncan, J., Amati, M., Caccetta, P. and Chia, J. (2019) *Urban Vegetation Cover Change in Melbourne 2014 - 2018,* Centre for Urban Research, RMIT University, Melbourne, Australia.

FIGURE 26. Urban tree canopy cover by land use, 2018



Source: Hurley, J., et al. (2019) Melbourne Vegetation Cover 2018, Inner Region, Department of Environment, Land, Water and Planning, Melbourne, Australia.

Flooding risk and waterway health

Despite anticipated reductions in overall average annual rainfall caused by climate change, it is also predicted that heavy rainfall events will occur more frequently within the Inner Metro Region including within its NEICs, urban renewal areas and large development sites. Continued urban consolidation and resultant increases in impermeable surfaces will exacerbate this situation, presenting a greater risk of stormwater inundation to both private and public property. Ageing drainage infrastructure within this historical region also intensifies the impacts of flooding. These challenges will require innovative solutions to maximise the capture, storage and re-use of stormwater.

The Inner Metro Region is located at the confluence of the Maribyrnong, Yarra and Dandenong catchments and includes many significant waterways and tidal estuaries: the Yarra River, the Maribyrnong River, Moonee Ponds Creek and Elster Creek. Heavy rainfall events in outlying areas and regions drain into these waterways and concentrate within the Inner Metro Region, making low-lying areas particularly vulnerable to stormwater inundation before runoff drains into the Yarra River and Port Phillip Bay. Litter and chemical contaminants flushed from the stormwater system and higher volume water flows during flood events will present further impacts to water quality and the health of the region's waterways and natural environments.

The Yarra River is a vital natural resource for eastern Melbourne and forms a significant landmark for the Inner Metro Region. The health of the Yarra River is under similar pressure from the impacts of climate change and encroaching development. The draft *Yarra Strategic Plan* sets out priorities for a coordinated response to the protection and management of the river by water authorities, local and state government and the community, to continue the rehabilitation of the river from past mismanagement and to future-proof it for the anticipated impacts of a changing climate.

Sea level rise and coastal inundation risk

Port Phillip Bay and its coastline have significant value to the Victorian community for a range of cultural, recreational, environmental and economic reasons but is under pressure from urbanisation and climate change. Rainfall intensification will exacerbate current impacts including increased stormwater and pollutant runoff. Marine and coastal environments will experience increases in water temperature and rising sea levels. Storm surges will also become more frequent, exposing the coastline to erosion and inundation (DELWP, 2017b).

As projected average temperatures continue trending upwards through this century, so too will global mean sea levels as oceans partially absorb atmospheric heat and glaciers and polar ice caps continue to melt. State planning policy recognises the need to plan for anticipated sea level rise in Port Phillip Bay. Given the uncertainty of our climate change future, planning policy will need to be responsive to future recalibration of sea levels.

The expected impact of tidal inundation – including storm surge, wave action and saline groundwater intrusion – will have an increasingly significant influence over future development in the Inner Metro Region, particularly in low-lying urban renewal precincts at Fishermans Bend, Arden, Macaulay and in established areas at Southbank, St Kilda, Balaclava and Elwood. Efforts made to protect property by ensuring ground floor levels (freeboard) of new buildings are constructed above projected flood levels will inadvertently present challenges in creating future mixed-use precincts that present active frontages at the street level. To optimise positive urban-scale outcomes within areas affected by tidal inundation, compromises and special consideration will need to be made between flood management agencies, local and state government and developers alike.

Sustainability in the built environment

In 2013, residential buildings were responsible for nearly 12 per cent of Australia's national greenhouse gas emissions, and commercial buildings contributed just over 11 per cent. The majority of these emissions were generated through the consumption of grid-supplied electricity to power appliances, lighting, and predominantly heating, ventilation and cooling (HVAC) systems (Australian Sustainable Built Environment Council, 2016).

As average temperatures rise due to climate change, greater numbers of people are expected to seek comfort indoors during periods of hot weather. This, combined with population growth and overall poor-performing building stock, means our city lacks energy efficiency and resilience on hot days. Maximising opportunities to incrementally improve the performance of buildings will reduce our reliance on appliances to cool buildings and contribute to a lower likelihood of blackouts during periods of hot weather.

Local councils within the Inner Metro Region are active in adopting policies and strategies to reduce carbon emissions and improve the sustainability of the built environment. Many are innovators and leaders in ESD and are implementing new practices to improve the energy efficiency of civic buildings and reduce emissions from operations.

Several LGAs are members of the Council Alliance for a Sustainable Built Environment (CASBE), an association committed to designing and applying a range of practical methodologies to increase sustainability outcomes for new buildings. The Built Environment Sustainability Scorecard (BESS) is an online tool developed by CASBE that assesses the sustainability of proposed developments. It aims to reduce waste and improve energy efficiency from the outset of the construction phase, through to occupation. As well as onsite energy generation, BESS promotes the use of energy-efficient appliances, thermally-efficient glazing, wall cladding and insulation, water-efficient fittings and fixtures, thermal comfort and overall environmentally sustainable performance. Other rating systems increasingly used by the building design industry to measure and assess the performance of ESD principles include Green Star (Green Building Council of Australia, 2021), NatHERS (Nationwide House Energy Rating Scheme, 2021) and MUSIC (MUSIC Auditor, 2021).

Regional strengths

- The region features a relatively high tree canopy cover, which can continue to be expanded while accommodating growth and change.

Regional challenges

- Flood events, storm surge, coastal inundation and sea level rise all pose significant risk to population, ecosystems, infrastructure and property.
- There are significant areas of high urban heat and heat vulnerable communities.

Photo credit: Department of Jobs, Precincts and Regions

Directions and strategies

The directions identified to achieve the 2050 vision for the Inner Metro Region in terms of maximising sustainability and resilience are:

Direction 23	Integrate cooling and greening initiatives with land use and infrastructure change to assist in managing urban heat
Direction 24	Increase the tree canopy cover across the Inner Metro Region to achieve 28 per cent cover by 2050
Direction 25	Implement integrated water management initiatives to improve water quality, reduce the impacts of stormwater inundation, utilise stormwater and protect the region's key water assets
Direction 26	Design urban renewal precincts and major redevelopment sites to support zero emissions and climate resilient urban areas
Direction 27	Manage the impact and risk of coastal inundation and sea level rise

Each direction is implemented through regionally-specific strategies identified in this land use framework plan.

Map 8 shows areas of the Inner Metro Region that are vulnerable to heat stress, high surface temperatures and the impacts of climate change.

Map 9 shows how sustainability and resilience will be enhanced across the Inner Metro Region by 2050 as a result of these directions and strategies, together with Plan Melbourne and other strategies and initiatives as outlined in **Appendix 01**.

Photo credit: Tim Bell Studio

MAP 8. Inner Metro Region sustainability and resilience state of play

Precincts and Activity Centres

- National employment & innovation cluster (NEIC)^
- Central city
- Major activity centre
- Central Business District

Transport

- State-significant road corridor
- Road network
- Train station
- Rail network

Environment

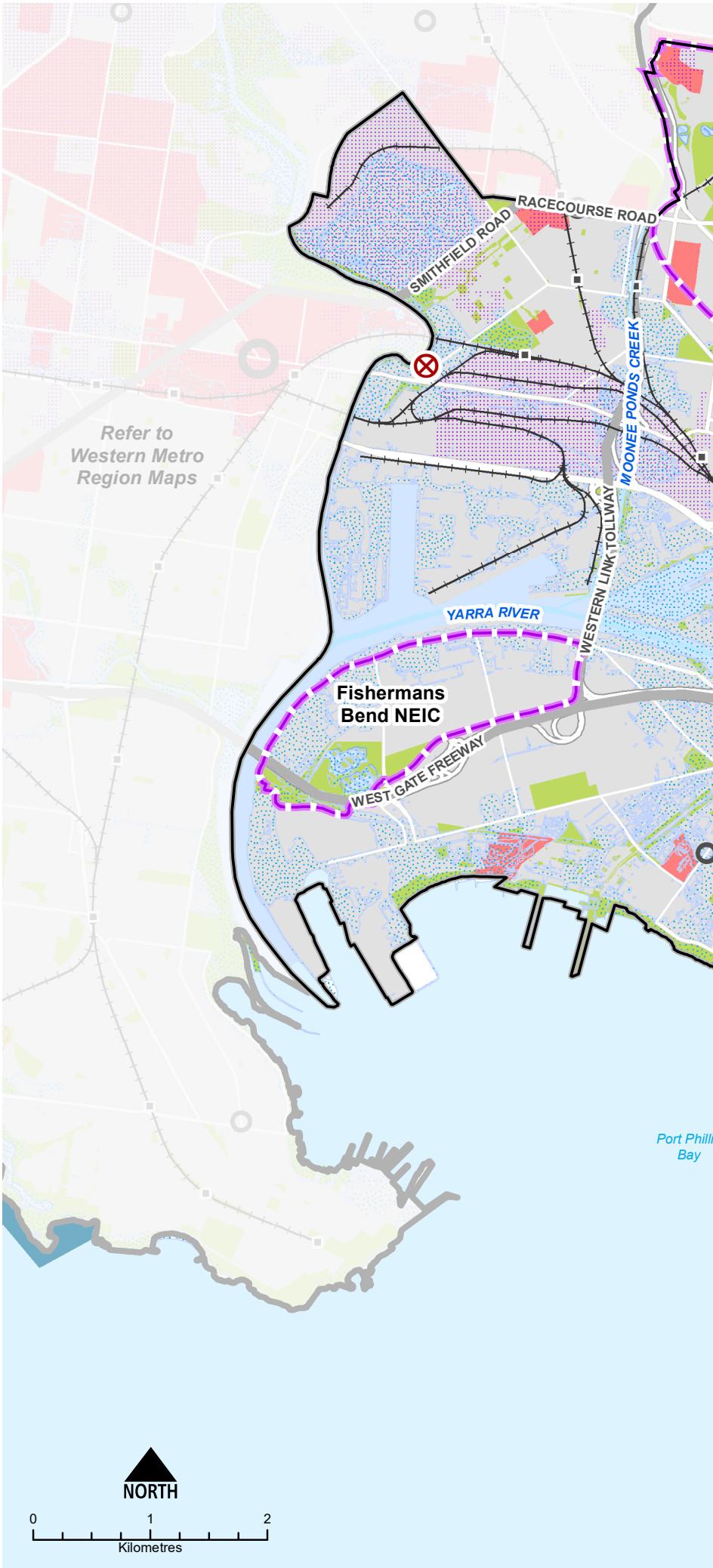
- Public open space
- Yarra River land
- Wetlands
- Waterway
- Areas subject to flooding (existing planning controls)
- Waste facility
- Waterbody
- High heat vulnerability areas (HVI >3)
- High land surface temperatures

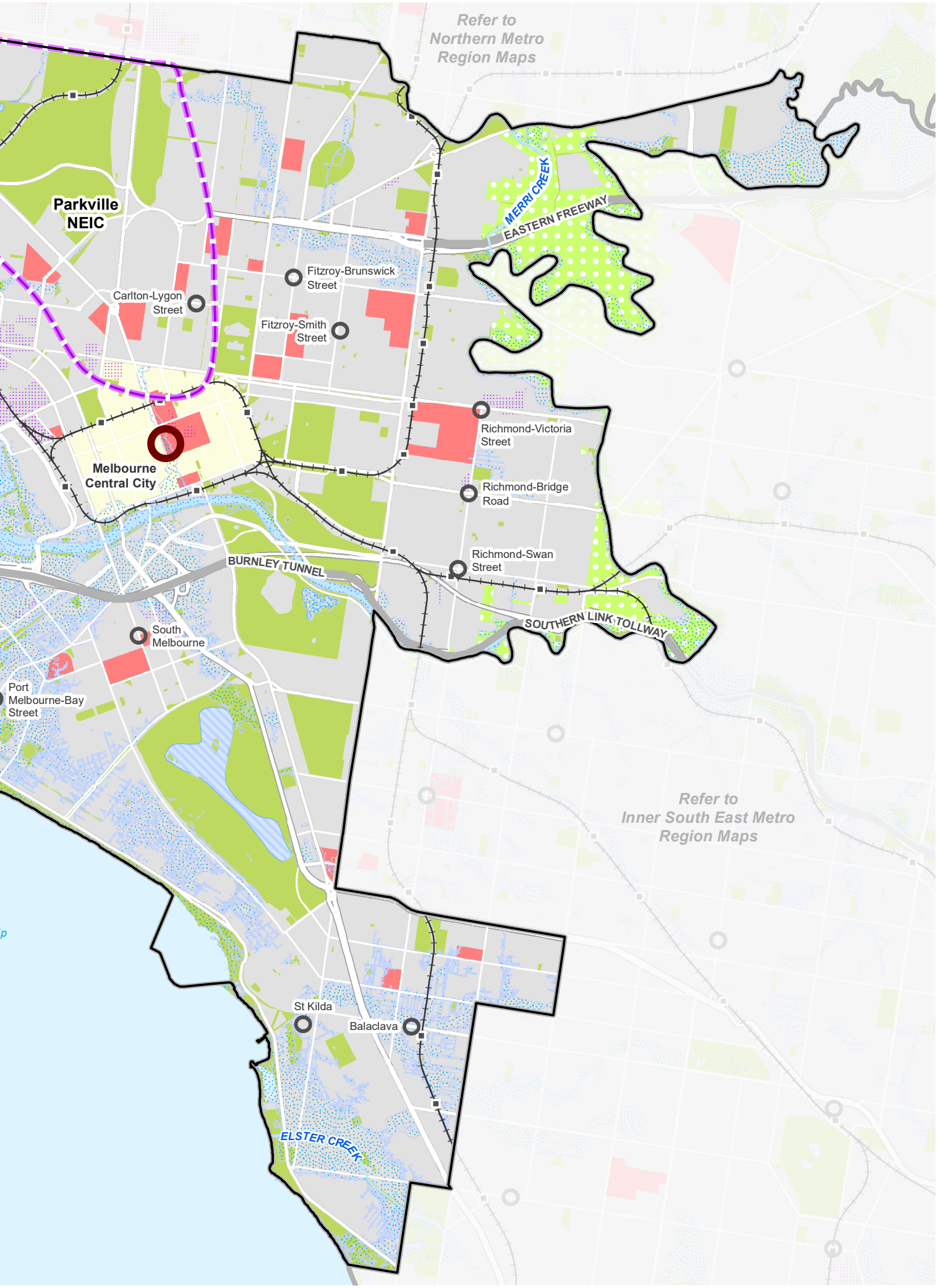
Land use/Administration

- Regional boundary
- Urban area

^NEIC boundary is indicative only and subject to detailed planning.

Location Map




Refer to
Northern Metro
Region Maps
Parkville
NEIC
MERRI CREEK
EASTERN FREEWAY
Fitzroy-Brunswick
Street
Carlton-Lygon
Street
Fitzroy-Smith
Street
Richmond-Victoria
Street
Melbourne
Central City
Richmond-Bridge
Road
Richmond-Swan
Street
BURNLEY TUNNEL
SOUTHERN LINK TOLLWAY
South
Melbourne
Port
Melbourne-Bay
Street
Refer to
Inner South East Metro
Region Maps
St Kilda
Balaclava
ELSTER CREEK

MAP 9. Inner Metro Region sustainability and resilience 2050

Precincts and Activity Centres

- National employment & innovation cluster (NEIC)^
- Central city
- Major activity centre

Transport

- State-significant road corridor
- Road network
- Train station
- Rail network

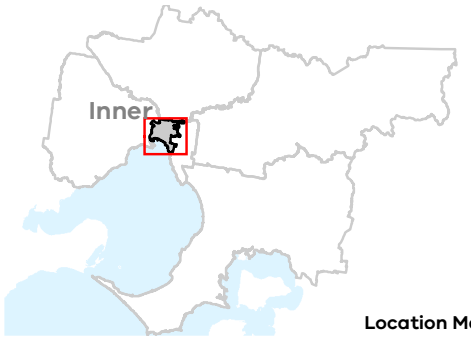
Environment

- Waterway
- Areas subject to flooding (Melbourne Water)
- Future coastal inundation risk
- Priority waterways for enhanced vegetation
- Waste facility
- Waterbody
- Priority - urban heat response
- Priority - expand urban tree canopy cover

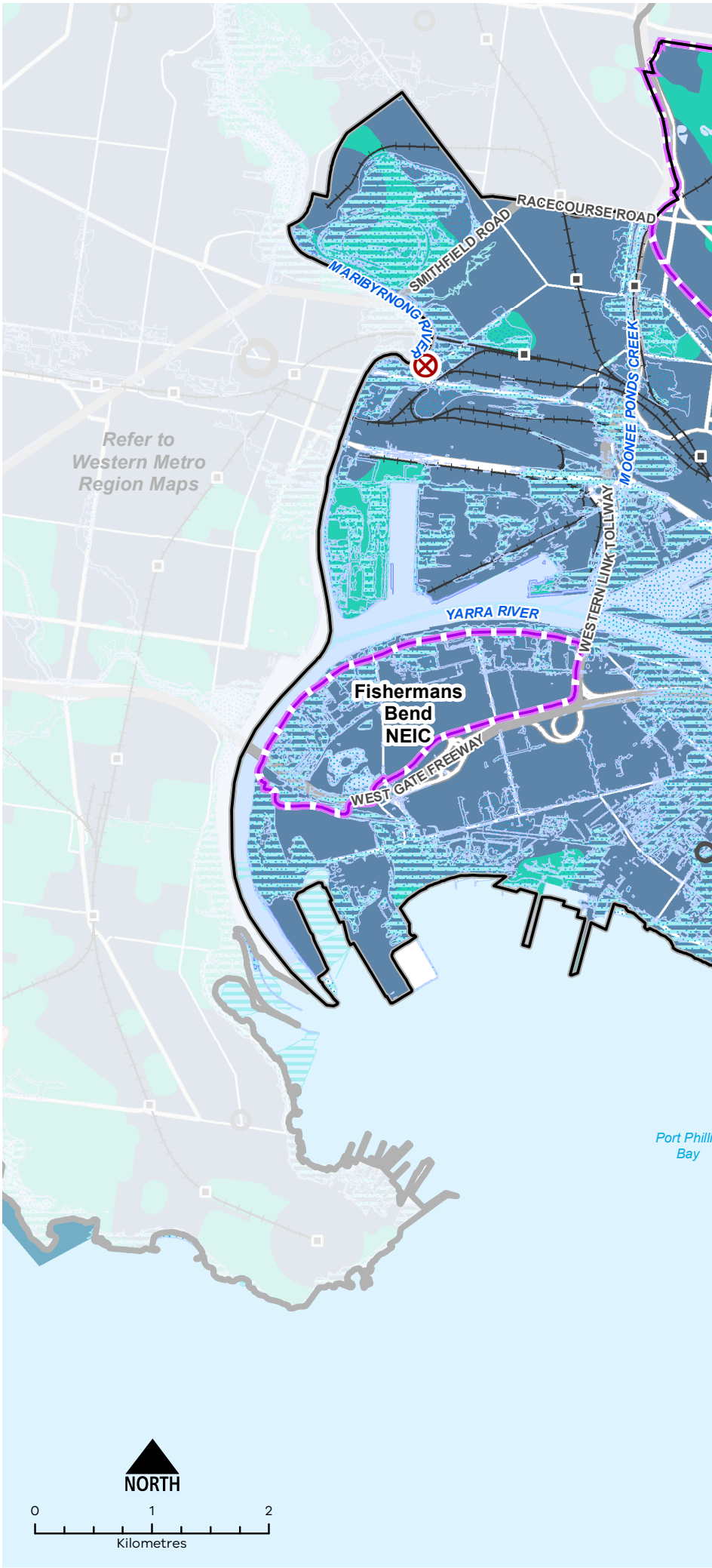
Land use/Administration

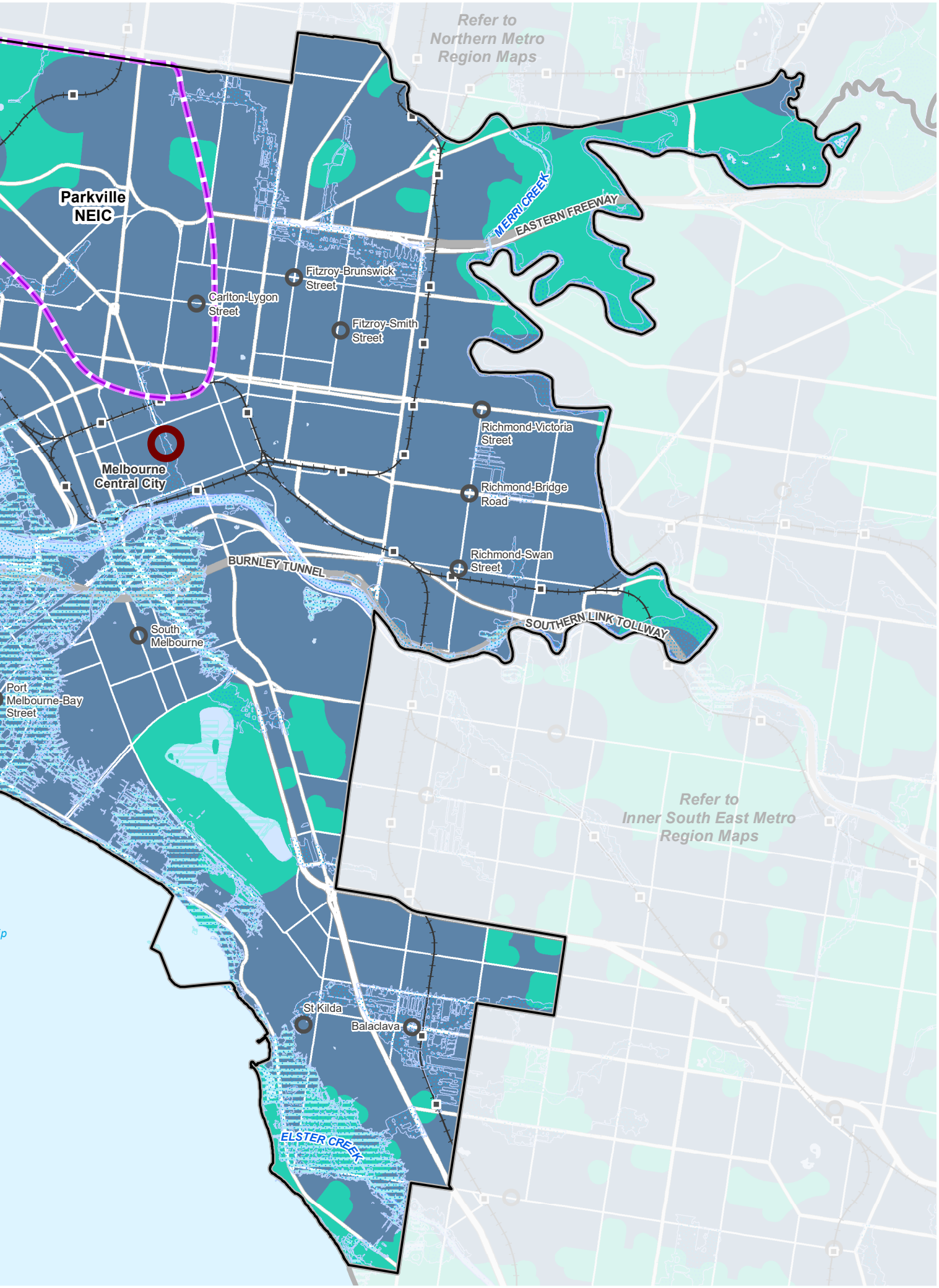
- Regional boundary
- Urban area

^NEIC boundary is indicative only and subject to detailed planning.



Location Map




Refer to
Northern Metro
Region Maps
Parkville
NEIC
MERRI CREEK
EASTERN FREEWAY
Fitzroy-Brunswick
Street
Carlton-Lygon
Street
Fitzroy-Smith
Street
Richmond-Victoria
Street
Melbourne
Central City
Richmond-Bridge
Road
Richmond-Swan
Street
BURNLEY TUNNEL
SOUTHERN LINK TOLLWAY
South
Melbourne
Port
Melbourne-Bay
Street
Refer to
Inner South East Metro
Region Maps
St Kilda
Balaclava
ELSTER CREEK

DIRECTION 23.
Integrate cooling and greening initiatives with land use and infrastructure change to assist in managing urban heat

Expansion of the tree canopy is the most effective measure to reduce the impact of urban heat.

However, due to the compact urban form of many parts of the Inner Metro Region and lack of space for new canopy trees, other forms of cooling and greening infrastructure will need to be used. This includes vertical and rooftop greening, green façades and planting more compact forms of vegetation within laneways, streets or narrow building setbacks. Cooling and greening needs to be considered for buildings, open spaces and pedestrian connections between key destinations.

Even in small spaces, urban greening and the use of water sensitive urban design (WSUD) will yield significant co-benefits of reducing urban temperatures, local climate regulation and stormwater management.

With most of the region's growth expected to occur within already densely developed areas of the Central City and around activity centres, a site-responsive approach will be required in new development to protect existing trees and accommodate other forms of cooling and greening.

An innovative approach to finding available space for greening is needed to accommodate planting and watering systems and to avoid conflicts with pedestrian movement, transport infrastructure, powerlines and underground services.

STRATEGY 94. **Design and develop outdoor spaces that are cool on hot days through materials, vegetation and water sensitive urban design particularly in and around activity centres, within the Central City, on major redevelopment sites and within urban renewal precincts.**

STRATEGY 95. **Encourage the greening of roofs, façades, walls or building setbacks with irrigated, climate resilient planting within apartment developments and large commercial or industrial sites.**

DIRECTION 24.
Increase the tree canopy cover across the Inner Metro Region to achieve 28 per cent cover by 2050

Trees provide an essential service for the region's environment and biodiversity. They are integral to managing urban heat and are important contributors to amenity and liveability. In the absence of water, trees and in particular clusters of trees, make the greatest contribution to reducing surface temperatures, along with contributing to stormwater filtration, amenity and biodiversity (Coutts & Tapper, 2017; Sun, et al., 2019).

Canopy trees are particularly effective at lowering maximum summer daytime air temperatures at ground level through transpiration and shading (The Nature Conservancy and Resilient Melbourne, 2019). Increased tree canopy cover and the clustering of trees provides the greatest response to the challenge of urban heat.

By 2051, it is estimated that continuing current development practices within the Inner Metro Region will reduce urban tree canopy by 7 per cent (or 0.3 square kilometres) and expose 612,000 people to high urban heat environments (CRCWSC, 2019).

Expanding the region's tree canopy cover can be achieved by preserving existing vegetation and planting new trees. Many parts of the Inner Metro Region achieve an appropriate proportion of tree canopy coverage, however, ongoing development and climate change will place pressure on the urban forest.

While residential land presently provides most of the tree canopy cover, tree canopy should also be expanded on other land uses such as rail corridors, streets, school grounds and parkland.

All three Inner Metro Region LGAs have endorsed the *Living Melbourne: Our Metropolitan Urban Forest* strategy, specifying a regional target of 28 per cent total tree canopy and 33 per cent combined tree canopy and shrubs by 2050 (The Nature Conservancy and Resilient Melbourne, 2019). To support this commitment, the tree canopy target is accompanied in **Table 14** by an aspirational distribution of tree canopy cover across four different land use types, adapted by DELWP from several different related datasets (Hurley, et al., 2019a) (Urich & Hardy, 2020) (PSMA Australia Limited, 2021).

TABLE 14. Inner Metro Region tree canopy cover target and aspirational distribution

2018 TREE CANOPY COVER: 12.6% 2050 TREE CANOPY COVER TARGET: 28% (+15.4% OR +1,190 HECTARES ADDITIONAL TREE CANOPY COVER)	
Residential, commercial, industrial and primary production	**40%**
Streets, roads and rail	**25%**
Parks, open space and waterways	**30%**
Education and hospital/medical	**5%**

STRATEGY 96. Support alternative siting of buildings and more compact building forms to retain mature canopy vegetation.

STRATEGY 97. Increase tree canopy along urban waterways and on streetscapes, public land, large developments within activity centres, open spaces and road reserves, and large commercial and industrial sites.

STRATEGY 98. Require revegetation within the redevelopment of key sites, activity centres and urban renewal precincts to allow for the irrigation and spatial requirements of a healthy urban forest and dense tree canopy cover.

Photo credit: DELWP

Photo credit: Tim Bell Studio

DIRECTION 25.
Implement integrated water management initiatives to improve water quality, reduce the impacts of stormwater inundation, utilise stormwater and protect the region's key water assets

Integrated stormwater management and stormwater re-use will help reduce runoff into waterways and wetlands and improve the climate resilience and liveability of the Inner Metro Region.

As the region's population, economic activity and development continues to grow, so does the volume of stormwater runoff and risk of flooding. This can negatively affect water quality and waterway health for aquatic life and riparian habitat. Responding to this change and supporting the health of the region's waterways, wetlands and the bay will be an ongoing challenge. Within the Inner Metro Region many low-lying areas which are particularly flood prone are subject to major redevelopment proposals, such as Fishermans Bend, Arden and Macaulay. An innovative approach to stormwater management is required.

Numerous organisations have regulatory and delivery responsibilities associated with the management of the Inner Metro Region catchment, including local councils, water corporations, catchment management authorities, Traditional Owner groups and State Government. A collaborative approach between affected stakeholders will be required to ensure integrated water management actions are balanced and respond to the needs of each individual organisation as well as the needs of the broader catchment.

Where areas of the Inner Metro Region are subject to flooding provisions, such as the Special Building Overlay (SBO) and Land Subject to Inundation Overlay (LSIO), there is an opportunity to increase stormwater and floodwater harvesting capabilities. Improved stormwater storage and stormwater harvesting and management across the region could reduce the risk and cost of major rainfall events and minimise impacts to the environment, infrastructure and property (DELWP, 2019). To accomplish this, however, flood provisions must be frequently reviewed and amended to accurately reflect the projected extent of flood events resulting from climate change.

Local capture of stormwater, water recycling, restoration and revegetation of urban waterways and greywater systems will improve the region's hydrological and ecological systems. Development can reduce the impacts of flooding, support healthy vegetation and prepare for drying conditions by increasing permeable areas, enlarging green spaces, avoiding paved areas and passively irrigating vegetation.

Harvesting stormwater and increasing water infiltration is important in dense suburbs to reduce runoff and service vegetation. Harvested stormwater can help maintain water-reliant facilities and amenities such as sporting fields and gardens, contribute to more resilient vegetation and reduce demand on drinking water. Open spaces, pedestrian and cycling networks should all use WSUD to improve urban amenity and retain water in the urban environment (DELWP, 2019).

STRATEGY 99. Implement a regional approach to floodplain management and waterway drainage.

STRATEGY 100. Retain and harvest stormwater at a range of scales to achieve co-benefits that respond to urban heat, reduce runoff volume and velocity, service community infrastructure and trees, and reduce reliance on potable water for urban greening.

STRATEGY 101. Design development to provide passive irrigation to onsite vegetation and on adjacent public land not affected by industrial contamination and/or seawater infiltration.

DIRECTION 26.
Design urban renewal precincts and major redevelopment sites to support zero emissions and climate resilient urban areas

Within the Inner Metro Region, urban renewal precincts and large redevelopment sites have significant potential to embrace and demonstrate leading sustainable development practices. Designing large sites anew presents an opportunity to adopt a site layout that maximises passive heating and cooling, showcases enhanced thermal efficiency across multiple buildings, and demonstrates a selection of low-carbon materials that are durable and assist with lowering surface temperatures.

Allowance can be made for new canopy trees of an appropriate species to be established over time to provide shade and amenity. Increased drought-tolerant landscaping, shade structures, roof gardens and green walls/façades can all be incorporated into the site planning. Other measures to optimise sustainability outcomes that may be achievable within a new development scenario include onsite stormwater and rainwater harvesting to support landscaping or for domestic use, water recycling, the use of smart technology to improve energy efficiency and car sharing schemes.

STRATEGY 102. Maximise the thermal efficiency and ability to support renewable and smart energy technology of the built environment through site layout and precinct design in major redevelopment sites and urban renewal precincts.

STRATEGY 103. Design buildings and the public realm with future stormwater needs and opportunities as a priority consideration to inform other precinct and building design outcomes and enhance pedestrian environments.

DIRECTION 27.
Manage the impact and risk of coastal inundation and sea level rise

Coastal areas are susceptible to rising sea levels as well as storm surges. To this end, much work continues to be undertaken at the state level to determine the impacts of sea level rise by 2100 in areas along Port Phillip Bay in the Inner Metro Region.

Future planning must respond to the impacts of storm surge and coastal inundation. In addition to residential communities, several significant public and commercial assets, as well as densely populated communities, are located on or within close proximity to the coastline, including the Port of Melbourne, Station Pier, the St Kilda Pier and Marina, and beaches and foreshore infrastructure stretching from Port Melbourne to Elwood. Regional planning can help integrate and manage land use and infrastructure change to reduce the risk to communities, infrastructure and natural assets from coastal inundation and storm surge.

DELWP is undertaking a Local Coastal Hazard Assessment for Port Phillip Bay. The Local Coastal Hazard Assessment will provide additional information about the expected impacts of coastal hazards such as saline groundwater intrusion, erosion and inundation that are exacerbated by the effects of climate change. This information will better inform planning decisions in coastal areas around the bay.

STRATEGY 104. Encourage settlement planning for coastal environments and communities to respond to sea level rise and natural hazard risk.

STRATEGY 105. Limit major land use change in locations with future coastal inundation.

ACTIONS – Sustainability and resilience

ACTION 10. Identify non-residential land where additional canopy trees can be planted to offset vegetation removal.

ACTION 11. Investigate options to develop a pilot fund to underground powerlines to support expanded tree canopy cover.

ACTION 12. Undertake detailed coastal settlement planning to identify short-, medium- and long-term options to reduce risk to population, infrastructure, ecosystems and property from sea level rise, storm surges, coastal erosion, tidal inundation and saline groundwater intrusion.