WHITEHORSE CITY COUNCIL

Urban Forest Strategy 2021-2031

BACKGROUND DOCUMENT

DOCUMENT TRACKING	
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Whitehorse Urban Forest

Background Document

The purpose of the Background Document

This background document provides the evidence base to draft the Whitehorse Urban Forest Strategy 2021-2031.

This document considers the broader issues of climate change, urban heat island effects and population growth that can have detrimental impacts on the urban forest. It considers Council's role in the design, planting and management of trees and vegetation across land tenures to meet community aspirations and align with Federal and State Government policies (Appendix A) along with the Living Melbourne Strategy 2019 (Figure 3).

What is an Urban Forest?

The urban forest is all the trees, shrubs and other vegetation across public and private land. It incorporates all vegetation in streets, parks, gardens, campuses, alongside rivers and creeks, private gardens, balconies and rooftops. It includes the soil, the water and the wildlife vegetation relies on. (The Nature Conservancy and Resilient Melbourne 2019b)

Benefits of Nature and the Urban Forest

More and more, scientific research highlights the connections between healthy urban forests and enhanced liveability. A well planned and managed urban forest results in important environmental, community and economic benefits. These benefits are a result of effective ecosystem services such as water and air purification, carbon sequestration, stormwater management, shading and cooling.

Urban forests are a significant element of the character of Whitehorse. Trees and vegetation provide a visual relief from the built form. They provide habitat for wildlife, a sense of seasonality and a connection with nature in a suburban setting.

Access to a treed environment brings improvements to the mental and physical well-being of the community. There is an abundance of scientific research that highlights the mental-health benefits derived from trees and vegetation. Many of us feel more relaxed, calmer and optimistic after a walk in a park or reserve. People have greater peace of mind and are reinvigorated (Hartig and Kahn 2016; The Heart Foundation 2019).

All of these benefits are intimately linked to human well-being, the liveability of a city and urban resilience. With good design, strategic management and allocated funding these benefits can help us achieve the Council Vision.

With good design, trees can be strategically included into the urban fabric to achieve a diverse range of benefits to the community. These elements are illustrated in Figure 1.

> *A well-managed and integrated urban forest will provide benefits that strengthen community resilience, adapt to climate change and thrive in the world of population growth and globalisation (The Nature Conservancy and Resilient Melbourne, 2019a, p. 9)*

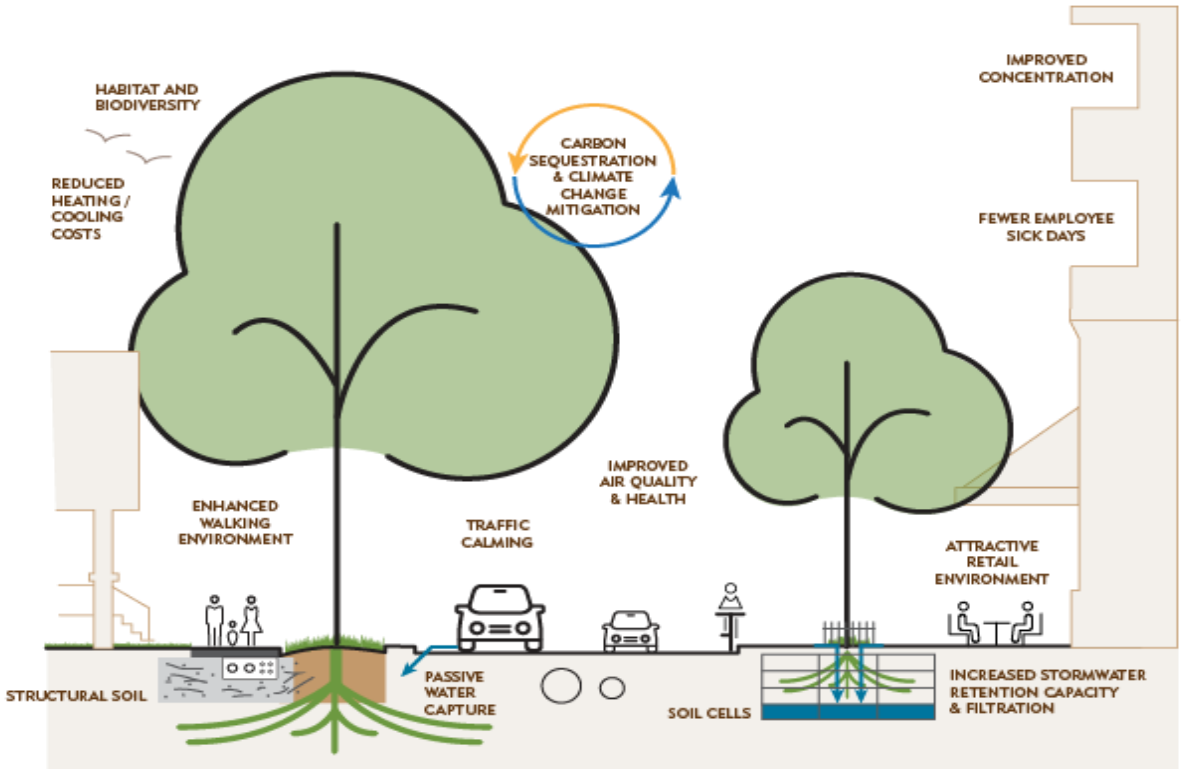


Figure 1: Successful integration of trees and vegetation into the urban landscape brings many benefits to society.

Benefits associated with a healthy urban forest can be separated into three interconnected categories:

- Environmental
- Health and wellbeing
- Economic

Environmental benefits

Air purification: Vegetation produces oxygen, reduces air pollution and air-borne particulates. Within the streetscape trees are best placed to intercept airborne particulates and reduce carbon dioxide.

Carbon stores: Urban trees sequester carbon, reducing the overall concentration of greenhouse gases in the atmosphere.

Enhanced biodiversity: A healthy and diverse urban forest enables the enhancement of biodiversity. Trees and vegetation provide habitat for a range of wildlife. Connectivity can be improved for species to disperse and access what they need to survive. People depend on nature for their own survival, nature in its own right deserves to be conserved and protected intrinsically (DELWP 2017b) . As stewards of nature, land managers and owners, Council and the community have a role to play in the conservation of nature in its own right.

Water filtration and flood mitigation: Tree canopies and root systems capture rainfall mitigating flood levels during extreme events. Vegetation has the ability to lower and slow stormwater flows into drainage infrastructure (DELWP 2019c). Vegetation decreases the flow of polluted water into waterways by intercepting and using nutrients that would otherwise be discharged to waterways.

Health and wellbeing benefits

Mental and Physical health: Evidence shows that connecting with nature is linked to positive long-term health outcomes. Increasing urbanisation leads to a decrease in people being able to access nature, resulting in poorer physical and mental health (DELWP 2017b). Access to trees and green spaces promotes physical activity, reduces stress, improving the overall quality of life in cities and towns (Townsend and Weerasuriya 2010).

Heat reduction: Trees within the streetscape can reduce the effects of heatwaves. The shading and cooling effects from trees reduces the urban heat island effect by shading pavement, streets, carparks and other hard surfaces (DELWP 2019c).

Walking and cycling: With good design, the use of trees and vegetation in the streetscape can create a more appealing and safe environment that encourages active travel such as cycling and walking (Trees & Design Action Group 2014, 55).

Social connectedness and cohesion: parks and reserves foster social cohesion, inclusion and interaction. They provide places to hold major events, festivals and celebrations throughout the year. Events and spaces can bring together diverse groups of people by providing a public realm that is available for everyone to enjoy. They give residents a stronger sense of place and local identity (The Nature Conservancy and Resilient Melbourne 2019b, 14).

Slow traffic and calm drivers: Roadside vegetation can help calm traffic, reduce drivers' stress and has been correlated with reduced driving speeds (Trees & Design Action Group 2014, 55). Trees and vegetation can be designed into the streetscape to help reduce a driver's urge to accelerate down a long stretch of road.

Child development: Access to active and self-directed play in nature and the outdoors is essential for healthy child development, physical health, mental health and wellbeing (Kids in Nature Network 2018, 5). Children who have the freedom to play in nature have more developed physical, cognitive, social and emotional skills. Playing outdoors amongst nature enables the development of resilience, self-confidence, initiative, creativity and more. (Herrington and Brussoni 2015).

Connection to Country: Aboriginal Victorians, the Traditional Owners of the land, attach great value to biodiversity, which is core to many cultural practices and obligations. Connection to Country is fundamentally important for Victorian Aboriginal communities (The Nature Conservancy and Resilient Melbourne 2019b, 11). Urban forests enable these connections to continue within a city context. Increasingly, we understand that a connection with nature will motivate people to care for nature.

Improved amenity and access to nature: Trees increase the visual amenity of streets and open spaces, providing a connection within suburbia to nature. They contribute to the character of the area as well as a sense of place and identity. Increasingly, we understand that all parts of society benefit from being closely connected to nature.

Economic benefits

Reduced UV damage on infrastructure: Trees can improve the lifespan of infrastructure such as asphalt pavements by protecting them from heat and direct UV exposure. This reduces the need for regular maintenance and extends the life expectancy of such assets (Moore 2009)

Shopping: Neighbourhoods and shopping strips with healthy tree-cover attract visitors, industry and commercial activity. Where shopping precincts are more treed, people tend to linger and shop longer (Planet Ark 2014).

Increased property value: Trees add value to real-estate. Homes that include landscaping with suitable trees sell more quickly and are worth 5 to 15 per cent more than homes without trees. Where the entire street is tree-lined, homes may be worth 25 per cent more. Where a canopy of trees exists, research indicates that apartments and offices rent more quickly and have a higher occupancy rate (Planet Ark 2014).

Improved productivity: Workers that have access to a green, leafy environment are often more productive and exhibit less absenteeism (Planet Ark 2014). Good evidence now exists showing an association between plants in a workplace and improved employee performance and productivity through they improved indoor air quality and amenity (Torpy 2013).

The larger, the healthier, the greater the benefit.

All vegetation large, small, native, exotic and indigenous play a role in achieving different kinds of benefits. However, within a built environment it is worthwhile noting that large canopy trees can deliver 60-70 times the benefits of small trees (City of Melbourne 2011, 14). For example, a strategically located large-stature tree has a bigger impact on conserving energy, mitigating the urban heat island effect and absorbing carbon dioxide than a corresponding quantity of smaller trees (City of Melbourne 2011, 14). Ultimately, the larger the tree, the greater the benefits and, ultimately, the more liveable neighbourhoods become (figure 2).

Likewise, the benefits provided by trees is more evident in healthy trees. They are more aesthetically pleasing, have greater longevity, have reduced management demands and provide greater benefits to the community. Factors that influence the health of a tree include the environmental conditions, soil conditions, water availability, pests and diseases, maintenance history and history of root disturbance.

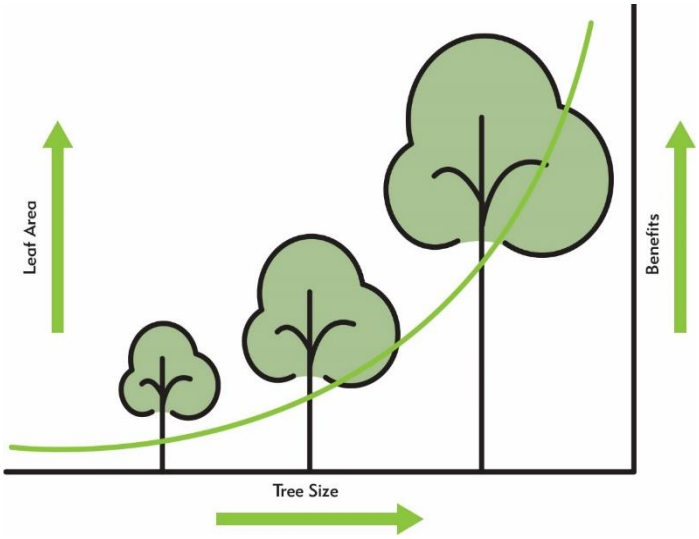


Figure 2: Benefits of trees increase with size and increased area.

Living Melbourne: A metropolitan wide urban forest strategy

Early in 2019, Whitehorse City Council endorsed Living Melbourne: A Metropolitan Wide Urban Forest Strategy. The strategy has gained support for a unified vision across local government, state government, water authorities, statutory agencies, academics and more.

Living Melbourne was conceived in recognition of the need to balance people and nature in cities. The aims span across mental health and well-being, city liveability and conservation with the aim to build urban resilience (The Nature Conservancy and Resilient Melbourne 2019b, 6). These aims are reflected in this version of the Whitehorse Urban Forest Strategy. Figure 3 provides an overview of the vision, aims and actions as set by Living Melbourne.

Resilient Melbourne in partnership with The Nature Conservancy (TNC) led the development of Living Melbourne, now endorsed by 41 organisations representing local government, Victorian government, water authorities, statutory agencies and industry bodies.

Managing the urban forest as suburbs become hotter and drier is a shared responsibility and requires a diverse response across the Melbourne Metropolitan area. Living Melbourne is a plan to reverse the current and future decline of vegetation and sustain Melbourne's liveability for people and nature, across the entire city and its suburbs. Evidence strongly supports that thriving urban nature means healthier urban people (The Nature Conservancy and Resilient Melbourne 2019b, 6).

The Strategy sets a common Vision with three goals and a set of 6 actions with the underpinning principle that "our urban forest protects human health, nurtures abundant nature and strengthens natural infrastructure" (The Nature Conservancy and Resilient Melbourne 2019b, 7)

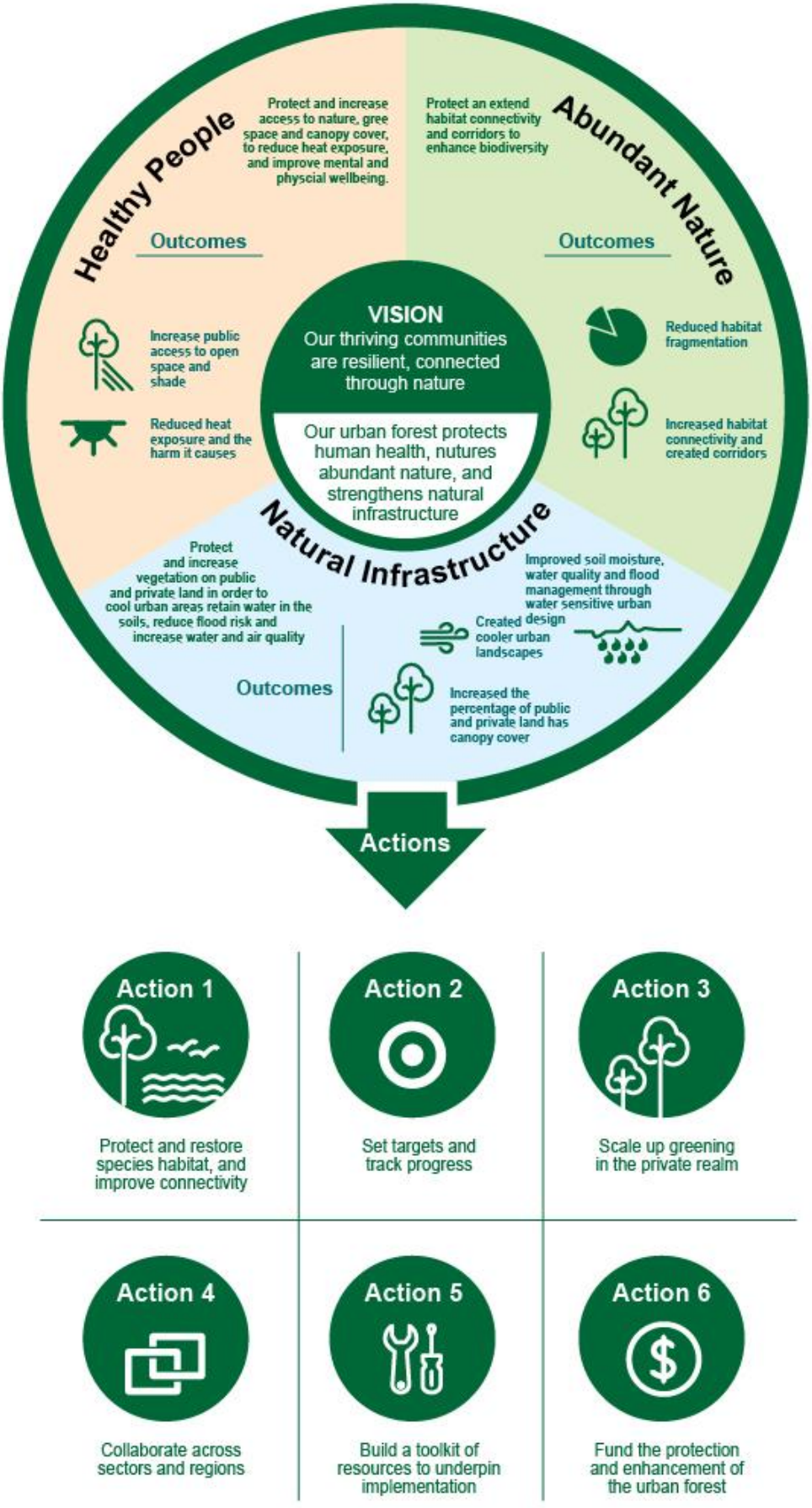


Figure 3: Living Melbourne: A metropolitan wide urban forest strategy; the Vision, aims and actions. (The Nature Conservancy and Resilient Melbourne, 2019a, p. 7)

The Context

The urban forest is constantly changing and has gone through a significant transformation over the last 200 years. Whitehorse once included expansive woodlands, grasslands and herb fields, as well as billabongs, wetlands, rivers and streams (Bull 2014; Practical Ecology 2014). Today the urban forest is made up of all the trees, shrubs and other vegetation across public and private land. It incorporates all vegetation in streets, parks, gardens, school campuses, alongside rivers and creeks, private gardens, balconies and rooftops. It includes the soil, the water and the wildlife that it supports.

The Wurundjeri Woi-Wurrung People are formally recognised as Traditional Owners. There are parts of Whitehorse, not yet formally recognised as belonging to any particular Traditional Owner group (figure 4). As land managers and the traditional custodians of the land, 'Country' has in-depth significance to Wurundjeri Woi-Wurrung People box 1 (Wurundjeri Woi-wurrung Narrap Rangers 2020).

Box 1: What 'Country' Means (Wurundjeri Woi-wurrung Narrap Rangers 2020).

- Country is the source of all life; Country is alive and continuing
- Country is all the resources of the land and water, the rivers, creeks and wetlands, the plants and animals, the processes and cycles that sustain life, and the health of these all
- Country is our connection to the past, to our ancestors, to our history and inheritance
- Country is the source of our well-being as people and as Traditional Owners, it is the survival, health and harmony of our people
- Country is our cultural heritage, our language, our stories and beliefs, our ceremonies, our spirituality. It is the basis of our relationships with other people, markers, and social boundaries
- Country is our special places, places of enjoyment, relaxation and peace
- Country is our responsibility

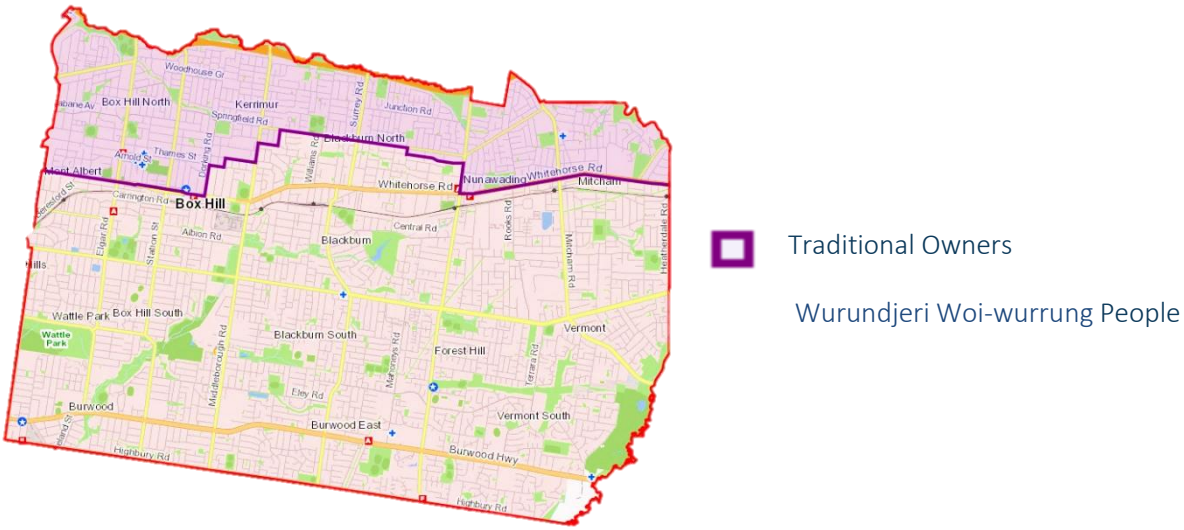


Figure 4: Map of Whitehorse showing the land that formally recognises the Wurundjeri Woi-Wurrung People as the Traditional Owners adopted from Aboriginal Victoria, 2019

In the 1850s, early settlers arrived in the area who established orchards and farms. Allotments were created and soon after, land sales began. The aerial images below represent land use changes across parts of Blackburn and Forest Hill between 1945 and 2019. The images in Figures 5-9 show the transition from farming to urbanisation to infill development. At the same time, conservation and revegetation achievements can be observed on the land surrounding Blackburn Lake.

Figure 5: Aerial imagery taken of Blackburn and Forest Hill in 1945

Figure 6: Aerial imagery of Blackburn and Forest Hill in 1964

Figure 7: Aerial imagery of Blackburn and Forest Hill 1987

Figure 8: Aerial imagery of Blackburn and Forest Hill in 1996

Figure 9: Aerial imagery of Blackburn and Forest Hill in February 2019

Changes in the Whitehorse landscape

Eucalyptus trees were a major part of the landscape. Silver stringybark (*Eucalyptus cephalocarpa*), narrow-leaved peppermint (*Eucalyptus radiata*), messmate (*Eucalyptus obliqua*) long-leaved box *(Eucalyptus goniocalyx*), red stringybark (*Eucalyptus macroryncha*, *and* yellow box (*Eucalyptus melliodora)*) formed much of the upper canopy forming a tall open woodland (Bull 2014). The smaller trees and shrubs included a range of Wattles (*acacia species*), Cherry Ballart (*Exocarpos cupressiformis*) and Sweet Bursaria (*Bursaria spinosa*). Native grasses interspersed with plants such as Chocolate Lilies (*Arthropodium strictum*), Flax Lilies (*Dianella species*) and Blue Pincushions (*Brunonia australis*). A variety of orchids and fungi came and went with the seasons (Practical Ecology 2014).

Whitehorse was first inhabited by the Indigenous people of the Kulin Nation. They are the direct descendants of the men and women who have lived on Country for many thousands of years. Their knowledge has been shared over thousands of generations which guides their practice on Country to this day (Wurundjeri Woi-Wurrung Cultural Heritage Aboriginal Corporation 2021). The Traditional Owners continue to have a special interest in caring for this land as it is central to their culture, their identity and wellbeing (Wurundjeri Woi-Wurrung Cultural Heritage Aboriginal Corporation 2021).

Orchards and farms were established by early settlers in the 1850s. Soon after, land sales began. Much of the landscape was cleared and turned into intensive farms, mostly for orchards and exotic flowers. Demand for new housing in the 1950s and 60s led to the subdivision of farms. Since then the land has become more and more urbanised

Today Whitehorse has over 330 open space reserves covering more than 690 hectares of land area which equates to 10.7% of the Municipality (Whitehorse City Council 2007). Of the total open space, approximately 590 hectares is Council owned and managed, comprising approximately 324 reserves. The remaining open space is owned and managed by other agencies such as Melbourne Water and Parks Victoria. There is a wide diversity of open space reserves throughout Whitehorse ranging from bushland reserves through to formal gardens.

Where are all the trees?

Using the statistical analysis and data provided by DELWP made accessible through their Cooling Greening Interactive Map http://mapshare.maps.vic.gov.au/coolinggreening/ (2019a), we can get an understanding of where existing trees are and what we can do to protect and expand the urban forest. The chart below shows the proportion of tree canopy cover and how it is distributed across different land owners and managers. The urban forest is central to the City's amenity and helps define the character and heritage of Whitehorse (Planisphere 2016). Other than patches of remnant vegetation within parks and reserves and the occasional self-seeded tree, the overwhelming majority of the tree population consists of those that have been purposefully planted since European settlement.

82% of Whitehorse has no tree cover.

Figure 10: Where are all the trees? The 18% canopy cover (All trees over 3m in height) is distributed across different land use in Whitehorse. Most of the canopy cover is across private residential land. (Analysis based on data from Vegetation Cover 2018, Spatial DELWP 2019a)

Residential land accounts for the highest proportion of total tree canopy, followed by parkland and then street trees. A small amount of canopy is found within industrial and commercial land; with an even smaller amount on land managed by other government agencies.

Data shows that there is a significant portion of trees that are on private land that are not managed or controlled by Council (Hurley et al. 2019). The data shows 11% of the existing tree cover is on private land. This data highlights the importance of protecting trees on private property and empowering the community to include trees and vegetation within their own gardens.

The land that is managed by Council exists mostly within parks and within streets. Open space is varied ranging from small pocket parks, large recreational facilities such as Elgar Park, bushland reserves such as Blackburn Lake Sanctuary and formal gardens such as the Box Hill Gardens.

Box 2: The importance of trees in home gardens

Trees on private land are influenced heavily by four things:

- people's preferences towards urban vegetation;
- urban densification;
- Victorian Planning System; and
- the success of implementing planning requirements.

We rely on residents to maintain healthy trees on private land. Whitehorse runs a series of events to inform residents and inspire everyone to keep growing green and biodiverse gardens.

https://www.whitehorse.vic.gov.au/waste-environment/trees-and-gardens/tree-education-program

Whitehorse Biodiversity

Within Whitehorse there is a wide range of wildlife and other living organisms that are found in ecosystems amongst the urban setting. Out of the 350 public parks, gardens and reserves, 50 of these are bushland reserves which are managed for their biodiversity values. The remnant vegetation and new planting within these reserves represents 9 different Ecological Vegetation Classes (Appendix B). These are considered to be "the biodiversity hot spots" of Whitehorse (Practical Ecology 2014).

In 2018, the first Whitehorse biodiversity inventory was carried out which surveyed 50 bushland reserves and 110 other open space sites. The inventory identified over 750 different flora species, 59 of these listed as significant (Practical Ecology 2014) (Appendix C). Among the significant species include a range of orchids, wildflowers, significant wattles and xanthorrhoea grass trees.

Box 3: Citizen Science

iNaturalist is an online network of people sharing biodiversity information to help each other learn about nature. Figure 10 shows the top 5 observed species per category within Whitehorse in 2019.

To date residents and visitors have identified over 1000 different species in Whitehorse alone.

You can use iNaturalist to see what animals and plants have been sighted in your neighbourhood. You too can record your own observations, and get help with identifications through this online platform. To find out more visit https://inaturalist.ala.org.au/projects/whitehorse.

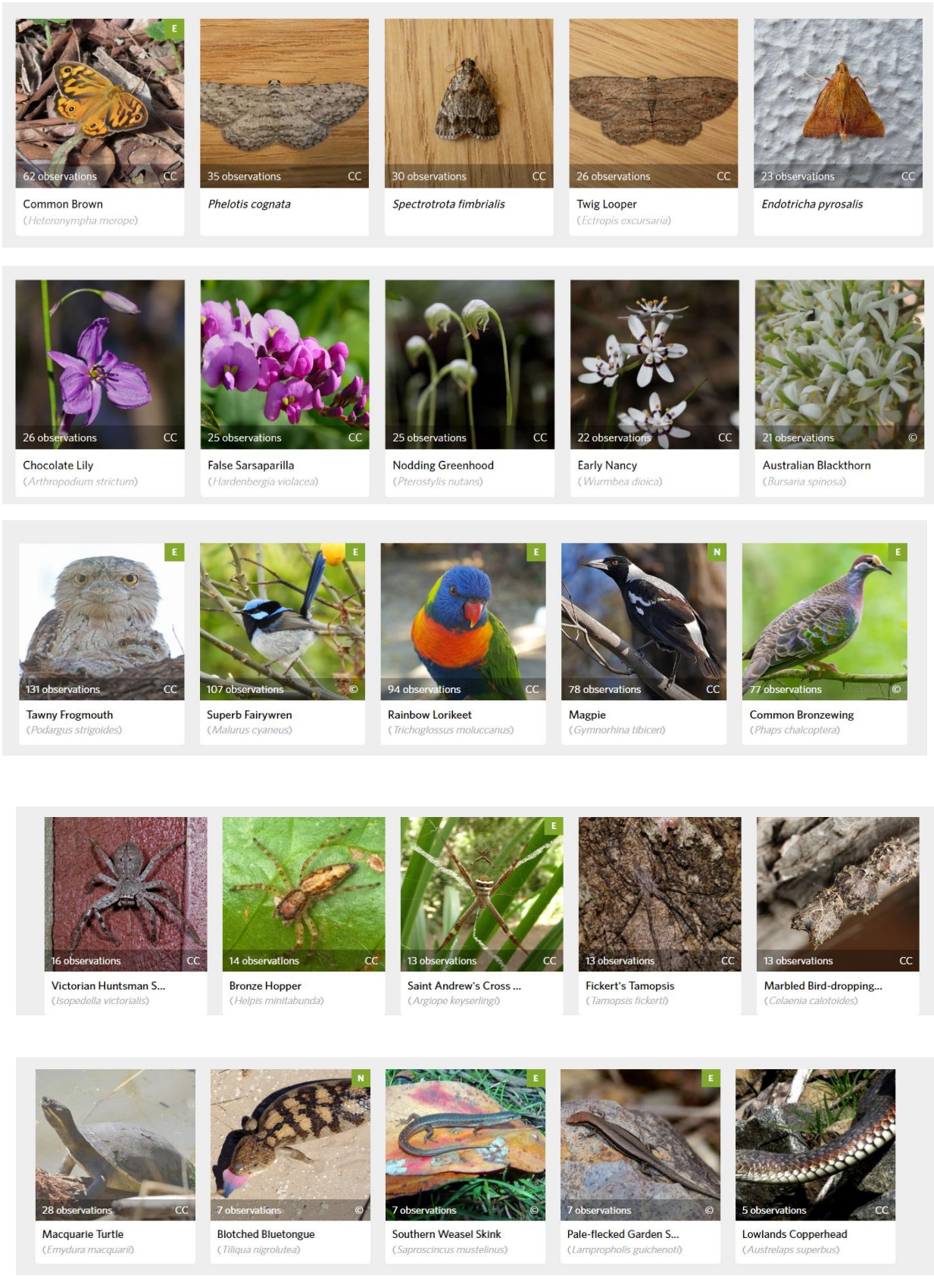
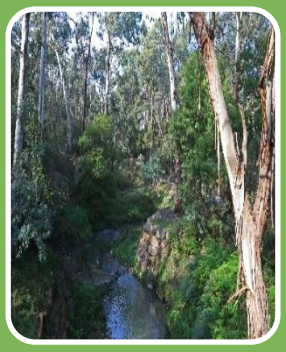


Figure 11: Top five species observed by our citizen scientists using iNaturalist per category of species

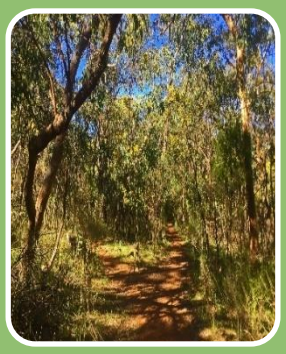
Box 4: A snapshot of bushland reserves in Whitehorse



Yarran Dheran Bushland Reserve

Yarran Dheran is a bushland reserve situated on the southern bank of the Mullum Mullum Creek in Mitcham. It is a mixture of original indigenous bushland and reconstructed bushland.

It forms part of an important corridor for wildlife along the Mullum Mullum Creek, flowing into the Yarra River in Templestowe. Swamp Wallabies and Eastern Grey Kangaroos are often seen, while Possums, Sugar Gliders , Eastern Long-necked Turtles and Echidnas are permanent inhabitants. The Reserve is home to over 84 species of birds including Tawny Frogmouths, Eastern Rosellas, Eastern Spinebills and Common Bronzewings



Antonio Park

Antonio Park showcases the kind of natural bushland that was once present across Whitehorse prior to European settlement – a forest of eucalypt, red stringybark and long leaf box trees, Acacia and tea tree, and small shrubs and wildflowers. Antonio Park is seven hectares in size and includes various walking trails, a playground, a BBQ area and bird watching opportunities. If you're lucky you may even come across a kangaroo or two.

Blackburn Lake Sanctuary

When visiting this Sanctuary you will be able to use the extensive walking tracks to explore the bushland. There are plenty of opportunites to watch water birds around the lake and throughout the wetlands. There is an Informative Visitor Centre, playground and large picnic area.

The lake and wetlands are particularily important for willdife that relies on water including frogs, turtles, fish and water birds. Over 80 different species of native birds have been sighted within the sanctuary. The Sanctuary provides significant habitat for landbased wildlife such as Sugar Gliders, Common Ringtail Possums, tawny frogmouts and others.

Heatherdale Creekland Reserve & BMX Track

The Heatherdale Creeklands offer an outstanding environment for recreation amidst an urban residential setting. The BMX track has been designed to integrate outdoor recreation with nature. The uninterrupted flow from one element to another enables the rider to fully experience the track which incorporates native vegetation. The track was established as part of a diverse linked network of outdoor areas aimed to connect people of different ages to natural environment.

Key Challenges

All cities are facing new and amplified challenges as a result of rapid urbanisation, a changing climate and globalisation. By 2030, Whitehorse is forecast to have a population that will reach 207 844 people (ABS 2020). This is an increase of 17% from a population of 182 171 in 2020 (ABS, 2020). With this kind of increase in population and growth comes tremendous opportunities for innovation and economic development. However, densification and climate change place significant stress on nature and compromise the benefits it provides to the people of Whitehorse.

As Whitehorse accommodates increasing infill development, it is likely that there will be an increase in the urban heat island effect particularly in high density precincts such as Box Hill. Trees selected and designed into the built environment for shading and cooling offer an affordable and effective way to mitigate the urban heat island effect (DELWP 2019c) . However, as we face climate change, temperature changes might be so drastic that certain trees won't survive (Kendal Dave et al. 2017) . Arborists and built environment specialists will need to research, identify, trial and select species that are able to adapt to climate change, tolerate harsh urban environments and ensure that water is made available to them during periods of lower rainfall.

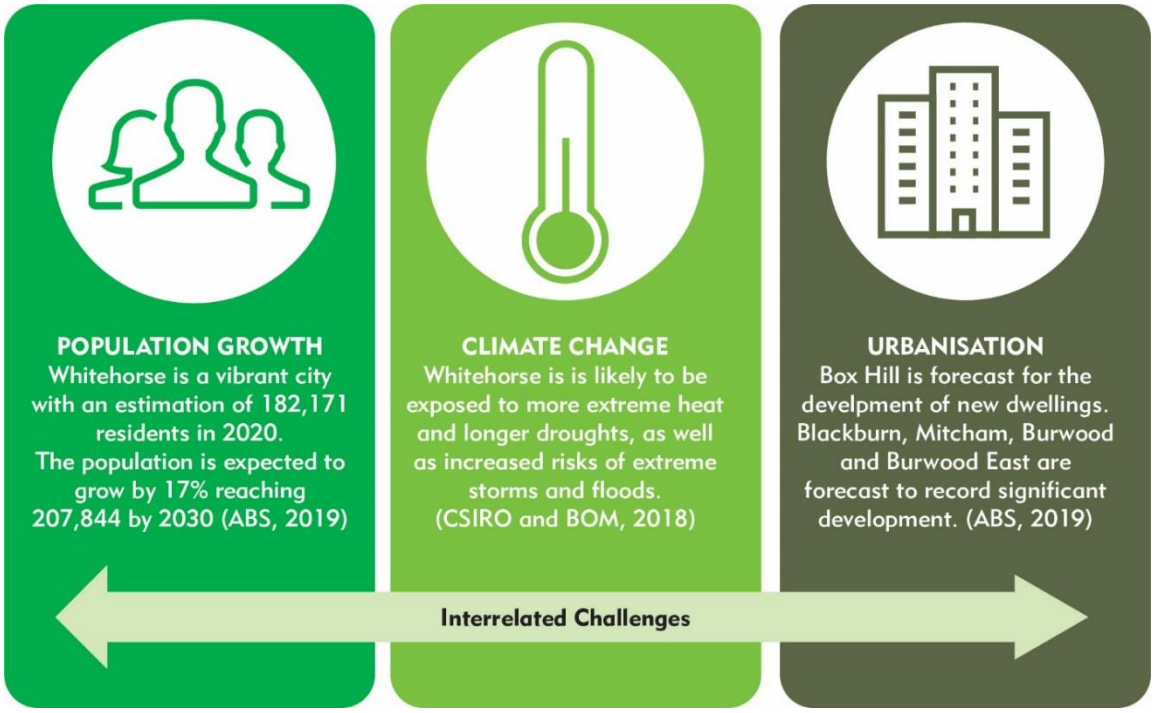


Figure 12: Increasing pressure from population growth, urbanisation and climate change

Generally, trees and vegetation in an urban environment face harsher conditions than in a more natural environment. Some of the key impacts include soil compaction, reduced water availability, altered microclimatic conditions, limited root space, mechanical damage, and contamination. Many of these challenges are further impacted from increasing urbanisation, population growth and climate change. As such the key challenges are:

- Densified development
- Climate change – rising temperature and extreme weather events
- Conflict with infrastructure and powerlines
- Population growth
- Resourcing
- Diverse community attitudes to trees and vegetation

Densified development

At first, much of Whitehorse's residential development consisted of detached houses covering roughly a third of the lot, with a large backyard. This design included space for large trees. However, since then infill development has seen a trend towards larger houses on smaller allotments. The applied Whitehorse Planning Scheme currently seeks to protect trees taller than 5 meters on residential land. However, despite some trees being protected, other vegetation is often cleared to make way for denser development.

Currently, it is estimated that in excess of 1,000 established trees are being removed from private land within the City of Whitehorse every year. This rapid loss of trees on private land places an increasing importance on both protecting established trees as well as establishing new trees.

With denser urban forms comes many challenges for vegetation. Taller buildings reduce sunlight availability, soil is often compacted, and moisture in the soil is limited making it more difficult for plants to thrive. Council requires tress to be replanted as part of a new development however, it is unclear of the survival rate of trees planted as part of the planning permit process. Without space and suitable soil, the urban forest will be difficult to expand and manage.

Box 5: The shocks and stresses of the 21st Century

The pressures associated with climate change, globalisation and urbanisation are varied. They can be defined as sudden or slow burning, natural or human-made, rare or regular, foreseen or not. However, they do not stand alone as a single shock or stress. They are a combination of these challenges, which can further threaten resilience. The 100 Resilient Cities project (100RC) supports cities around the world to become more resilient to the physical, social, and economic challenges that are a growing part of the 21st century (100 Resilient Cities 2019).

Climate change

Climate change presents many challenges that have a range of impacts on the urban forest. Predictions are expected for climatic conditions to get more extreme, creating harsher conditions for trees to survive and thrive (Kendal Dave et al. 2017, 1) as summarised here by DELWP (2019):

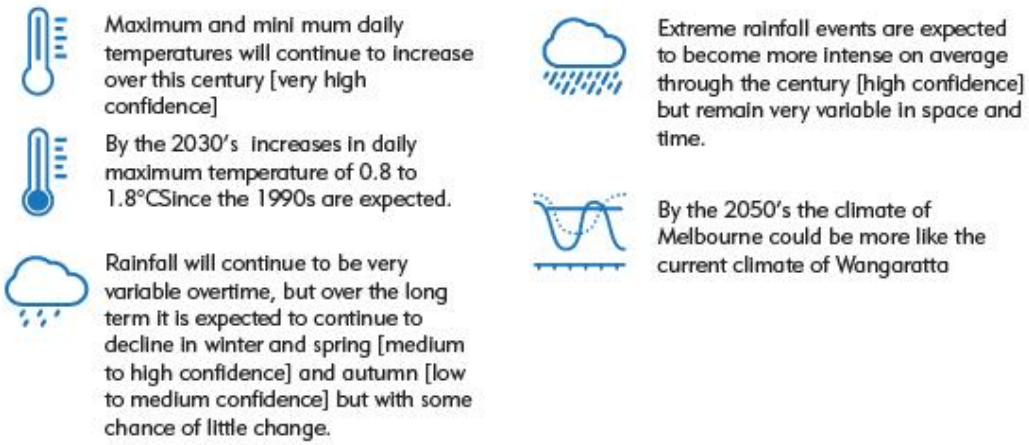


Figure 13: Summary of the impact of climate change (DELWP 2019)

These weather patterns are likely to impact on the urban forest in several ways:

- increased susceptibility to pests and diseases
- increased periods of drought
- reduced average rainfall but more frequent and intense storms
- increased fire risk
- species survival in a warmer climate
- synchronisation of pollinators and flowering times
- elevated tree losses during high intensity storm events

Drought and rainfall

Despite the predicted increase of rainfall events, Whitehorse will experience a reduction in average annual rainfall (CSIRO and BOM 2018). As a result, droughts will become more frequent and longer in duration, impacting the health and safety of the urban forest. Less rainfall over the Municipality, coupled with an increasing urban population and in-fill development will cause more stress on vegetation due to inconsistent access to water.

Heat waves and rising temperatures

Climate research continues to show that maximum and minimum temperatures are rising in Australia (CSIRO and BOM 2018). Plants have temperature tolerance limits that reflect adaptation to their native habitats. Studies have shown that predicted increases in temperature from urban heat and climate change could mean that many of the indigenous species won't survive (Kendal Dave et al. 2017; The Nature Conservancy and Resilient Melbourne 2019a).

The climate vulnerability of trees can be assessed by comparing the mean annual temperature of locations where species naturally occur, with several temperature projections under climate change (The Nature Conservancy and Resilient Melbourne 2019a). Many of the trees are expected to be at risk under climate change and future planting programs will need to account for the loss of those trees by succession planting and updating the tree palate to ensure that future plantings will be resilient to climate change.

In 2018, Whitehorse had an average summer Urban Heat Island (UHI) effect of over 7.0 degrees Celsius (DELWP 2019c, 20). This means that we experienced days that were 7.0 degrees hotter than non-urban areas on hot days. The UHI effect will compound the effects of climate change on the urban forest. Higher temperatures will impact on the health of trees and vegetation.

Whilst heat can damage and stress vegetation, trees have the ability to mitigate the urban heat island effect through cooling and shading. With good design trees can be integrated into the urban landscape to purposely cool the urban environment (DELWP 2019c).

Bushfire

The vast majority of the City of Whitehorse, is considered to have a bushfire risk rating that is low to moderate (Terramatrix 2019, 2). This is largely because the majority of reserves do not have sufficient space for a fire to fully develop. Even under elevated fire danger conditions, a fire will not be able to escalate to have extreme fire behaviour (Terramatrix 2019).

There are six larger reserves considered to be bushfire prone areas:

- Yarran Dheran
- Blackburn Lake Sanctuary
- Dandenong Creeklands
- Antonio Park
- Wattle Park (not managed by Council)
- Bellbird Dell

The Whitehorse Bushland Management Strategy applies to Council owned reserves. Managing this risk of fire in these reserves becomes a careful balance of reducing fuel loads and maintaining habitat. Council is developing Fire Management Statements for these reserves that will identify areas where not to plant as a means to manage the risk of fire.

The Bushfire Management Overlay (BMO) applies to land that may be significantly affected by a bushfire. The BMO triggers the need for a planning permit for certain developments and requires new developments to include appropriate bushfire protection measures (Figure 13). This includes appropriate landscaping and vegetation management

For residential properties within these areas the Country Fire Association has developed the Landscaping For Bushfire Garden Design (CFA 2011) Guidelines to provide advice on how to plan and maintain a garden within the BMO.

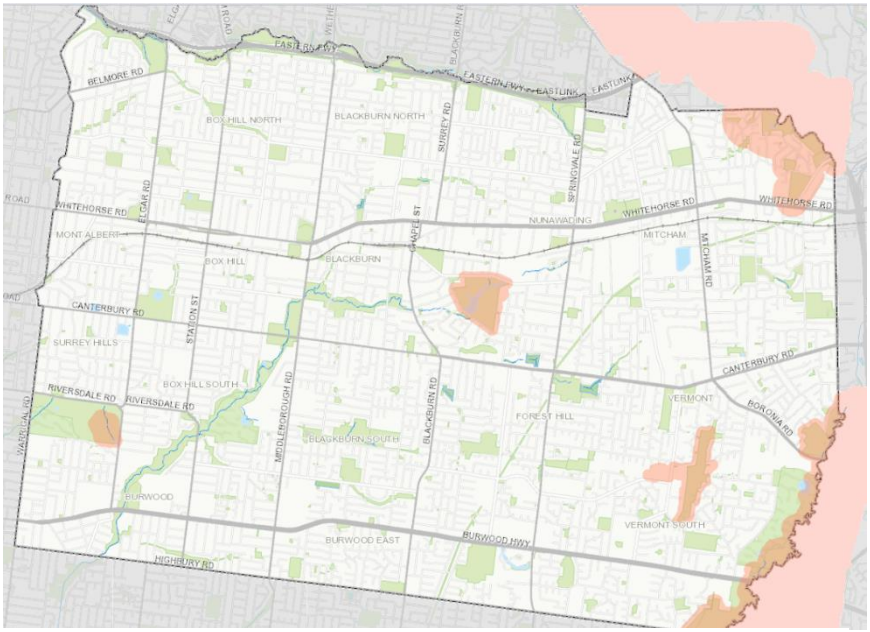


Figure 14: Map showing areas with an applied Bushfire Management Overlay

Conflict with infrastructure

The increased assets and services required in dense residential and commercial areas can limit the number and size of trees that can be planted:

- Higher demand for car parking and clearway times reduces or prevents in-road tree planting.
- New pavement cut-outs for trees should not reduce the width of footpath so they are not accessible for prams and wheelchairs.
- More services (stormwater, gas, sewerage and water) underneath the footpath limits planting locations.
- Shop awnings, tram wires, lighting and road signage restrict the space for tree canopies.
- Sight lines to bus and tram stops reduces tree planting.

Previous street tree planting regimes from 30-40 years ago did not necessarily consider species selection using 'the right tree for the right place for the right purpose' approach. As a result, we now need to manage the legacy of inappropriately planted trees where there is a conflict with both hard infrastructure and service provisions such as stormwater, sewerage and electricity. Species selection must consider the planting constraints of the urban context both above and below ground levels.

The Road Management ACT 2004 Code of Practice for the Management of Infrastructure in Road Reserves sets practical guidance on the management of roadside infrastructure including trees. The Allocation of Standard Utility Space in Road Reserves is guided by a number of objectives including:

- To provide space for the planting of street trees to ensure liveable streets (Victorian Government 2016, 40).
- The provision of space includes both above and below ground (Victorian Government 2016, 40).

Where possible, better integration with hard infrastructure could be achieved through the use of tree pits, soil media matrix to store water, installation of physical barriers to discourage root penetration, installation of flexible paving, passive irrigation and other innovations that enable the establishment of safe trees with larger canopy cover. Establishing more space for vegetation may mean relinquishing some road space or parking space.

Council receives a number of claims every year for alleged damage caused to buildings by trees. Such claims and damages put financial pressure on Council. These situations can cause resident angst and frustration reducing the positive perceptions of trees and other green infrastructure. As Council increases the number of trees within the streetscape perhaps such claims will increase. However, if the right tree is selected for the site with the aim to prevent conflicts and damage to infrastructure then perhaps his could be avoided. Good design, along with effective maintenance regimes will ensure successful integration of vegetation into the built environment.

Powerlines

The retention and expansion of the urban forest continues to be challenged by regulations governing powerline clearance, which mandate minimum clearance distances between vegetation and overhead powerlines (D'Ambrosio 2015). Where there are powerlines, either low growing trees or shrubs must be selected or pruning programs need to be established to ensure electrical line clearance. Both of these options compromise the expansion and health of the urban forest.

Undergrounding and installing aerial bundle cabling would help to remove some conflict. However there are substantial costs associated with the undergrounding of powerlines and aerial bundle cabling. In the current economic climate, significant funding for 'removing' powerlines in urban areas is unlikely to be available.

Underground services

Healthy trees require deep underground soil media layer to grow roots. Underground services can therefore be a major constraint. Service renewal or installation of underground services can disturb and destroy roots or even result in the removal of a tree. This process disproportionately effects large mature tree mortality

Impermeable surfaces – roads and footpaths

Within areas such as commercial shopping strips, car parks and dense residential areas there are generally higher impervious surfaces. This kind of surface prevents water from being absorbed into the soil, therefore restricting water availability to the roots of trees. These landscapes associated with these surfaces are dominated by the built form. Standard planting techniques in these highly urbanised and impermeable areas involve planting trees into the existing soil through a small cut-out in the pavement. These techniques do not provide the best outcomes for tree health, growth and longevity and only a small number of species can tolerate these conditions.

Road regulations

Another challenge is to increase the tree canopy within the road reserves (particularly on boulevards and major roads) without increasing risks to property and human life. Traffic authorities have restrictions on roadside tree planting with areas to be kept free of rigid objects such as trees above a specified trunk diameter (Vic Roads 2015).

Population growth

The population in Whitehorse, particularly in areas such as Box Hill is growing very quickly. This means that there is an increased demand on parks and reserves. Appropriate resourcing will need to reflect increased demand to maintain quality green spaces to support community well-being in the denser, more populated areas. With an increase of park use during the Covid-19 restrictions in 2020, Council needed to significantly increase maintenance programs across public open space areas.

Population growth will mean that there will be an increase in the pedestrian use of the road reserve. There is an increasing need to widen footpaths to provide safe and accessible areas for pedestrians. This puts increasing pressure on available space for tree and vegetation planting.

Emerging information and monitoring of the urban forest

Whitehorse is currently undertaking its first full street tree inventory. The data base will take 2 years to compile. Management of the urban forest will need to adapt as new data becomes available and a new analysis is made.

Currently there are a number of datasets available that measure the overall canopy cover of Whitehorse. It has been difficult analysing and comparing the various datasets as they have used different methodologies to collect the data. Through the Living Melbourne Strategy, it is anticipated that a common method of monitoring canopy cover will be established that Councils can access for consistency.

For the purpose of this strategy, data is provided by DWELP on canopy cover and urban heat has been http://mapshare.maps.vic.gov.au/coolinggreening/. The targets have been set based on this data.

Resourcing

Budget allocation for the management of street trees, park trees and bushland has not increased significantly in the last decade. Historically, within the sector the cost of establishing vegetation in the urban environment have been underestimated. Funding may not have taken into account the full lifecycle costings.

True success in maintaining and extending the urban forest depends on continuing financial support. A long-term funding commitment is required over the next two decades. Costings need to consider the planning and design, preparing the site (e.g. weed control, soil preparation etc.), establishment of vegetation (e.g. formative pruning, ongoing weed control, watering, mulching), ongoing maintenance as well as end of life tree removal and renewal.

Council has a finite budget that is under extreme pressure, increasing funding in any service area can only come by reducing the budget in another area.

Biodiversity loss

The loss of biodiversity is a significant threat to the health of the urban ecosystems, particularly in a changing climate and a more urbanised environment. Losses of even just a few populations can result in the destabilisation of natural ecological processes rendering a degraded environment for nature and humans. Rich biodiversity leads to a healthier, more resilient and functioning urban forest. As biodiversity declines, so does the potential to protect ecosystem properties and the services they provide to us.

There are concerns that many of the indigenous Eucalyptus species won't be able to adapt to a warmer drier climate (Kendal Dave et al. 2017). The implications of loss of biodiversity due to climate change are not fully understood. Further research is required to understand how to better guide the management of local biodiversity in a changing climate. As we lose species, it is difficult to understand the ramifications on other species including ourselves.

Pests, weeds and diseases

Pest animals and plants have pronounced environmental, social and economic impacts. They impact on people, businesses, agricultural productivity and biodiversity in the rural, peri urban and urban parts of this region. To mitigate and minimise the impact of pest species across the eastern Melbourne region, a coordinated, collaborative and consistent approach is needed to enable local pest management actions to have the greatest impact particularly for pest animal control (Eco Logical Australia 2020).

Animal pests

European Fox, Cat, European Rabbit, Feral Deer and the Common Myna have been identified as priority species for management as they have substantial impact on urban biodiversity (Eco Logical Australia 2020). Whitehorse City Council is a part of the Eastern Region Pest Animal Management Network. This Network aims to work collaboratively with surrounding Councils. Effective pest management involves a combination of preventing their dispersal into new areas and managing the negative impacts of those species that have become established (Eco Logical Australia 2020, 8).

Environmental Weeds

Environmental weeds are serious threat to the bushland reserves. The Whitehorse Biodiversity Inventory has identified species of introduced plants that have established in bushland reserves (Practical Ecology 2019). Weeds can out-compete mature indigenous plants and prevent the natural regeneration by preventing the germination of indigenous plants. Weed management is in place to systematically remove and control weed species. In general, weeds make the habitat less fit for native fauna and provide better conditions for introduced species. Effective weed management is complex and can be especially challenging in wetter years.

Plant Pests and Disease

Diseases and pests that target specific groups include Elm Leaf Beetle (affects some species in the genus Ulmus – the elms), Myrtle Rust (affects plants in the family Myrtaceae, which includes gums and wattles) and the

Sycamore Lace Bug (affects the genus Platanus – plane trees). While the threat of known pests and diseases can be monitored, it is difficult to predict what groups of plants may be vulnerable to additional pests and diseases in the future. Diversifying the species composition of the urban forest reduces the risk of a large proportion of trees being affected by any one pest or disease.

Council has a formative pruning program for all newly planted trees, problematic branches can be removed without creating large pruning wounds that can increase the incidence of pests and diseases. The Street tree palette should consist of species that are resistant to pests and diseases. Existing trees are likely to experience increased water and heat stress.

Urban forest biosecurity may be achieved through systems that aim to detect and prevent pest introductions or spread, or mitigate an outbreak if it occurs. It is reliant on national and international policies and plans for dealing with a pest incursion, supportive tree management agencies, vigilant trained staff working in the arboriculture industry and an informed general public.

Diverse community attitudes to trees and vegetation

Much of the community appreciate and respect the multitude of benefits that the urban forest provides. However, some do not share this view. Council officers are often required to manage community feedback and requests that arise from both real and perceived risks about vegetation. Trees and other vegetation are often requested to be removed for a range of reasons including root damage to foundations or utility infrastructure, limbs or trees at risk of falling, risk of fire, leaf litter, possums and hay fever. The Whitehorse Urban Forest Street Tree Removal policy emphasises that the benefits of trees in the landscape far outweigh subjective reasons to remove trees such as leaf fall, perceived danger, aesthetics, shading of pools and gardens or to improve outlook or view (The Nature Conservancy and Resilient Melbourne 2019a).

In a study carried out in 2016, “Healthy parks and vegetation” was identified as a top priority to achieve environmental sustainability and improved liveability by the Whitehorse community (Planisphere, 2016, p.18). However, trees are not always prioritised to be retained on private property, particularly when land is being developed.

Understanding community perceptions of the urban forest is a critical step to developing behaviour-change programs. A strategic and inclusive community engagement and capacity building approach is important for building appreciation and understanding of the urban forest to protect the urban forest across land tenures.

Key Opportunities

A healthy extensive urban forest improves liveability, builds urban resilience and enhances biodiversity. By negotiating the challenges of climate change, urbanisation and population growth, Council can find ways to:

- Increase canopy cover
- Enhance biodiversity
- Improve functionality of streetscapes
- Strengthen efforts on private property
- Reduce heat island effect
- Improve community engagement
- Improve understanding of the urban forest

Increase Canopy Cover

When viewed from above, we can estimate the total area of tree canopy across the Municipality. We can then establish a percentage of the municipality that is covered by trees. This is what we call Canopy Cover. It is one of the key criteria used to measure the success of urban forest management. Research shows that we can begin to reap greater social and environmental benefits from the urban forest when tree canopy cover exceeds 30% (The Nature Conservancy and Resilient Melbourne 2019a). Anything less, and there is generally not enough canopy cover to achieve the full benefits of the urban forest. Currently, it is estimated that Whitehorse has a Canopy Cover of 18% (DELWP 2019c).

Box 6: Measuring Canopy

Canopy cover, rather than number of trees, can be used to evaluate the urban forest. It is a simple measure of how much of the municipality, when viewed from above, is covered by tree canopy

According to a data set collected by DELWP in 2014 and again in 2018, Whitehorse recorded a point change in canopy cover of -2,28% over those 4 years (DELWP 2019a). This point change actually represents a 10% loss of the existing canopy cover since 2014. The first challenge is to halt the decline and achieve a net gain. With this in mind the ultimate aim is to achieve 30% canopy cover by 2050. To do this Whitehorse will need a collective effort across all land tenures. This means we need to protect and establish more trees on private property, include more trees within the streets, integrate more trees into the built environment and increase the greening efforts within parks and gardens. To do this we will need effective tree protection and renewal measures on private property and an increase in resources allocated to the planting, establishment and maintenance of new vegetation within streets, parks and reserves.

Comparing surrounding municipalities, 2018 data for canopy cover ranges from 14.2 – 27.8% between different Local Government Areas in Melbourne's East (DELWP 2019a). Figure 14 compares canopy cover within the eastern Melbourne metropolitan region. Across Melbourne, 32 Councils have endorsed the Living Melbourne (The Nature Conservancy and Resilient Melbourne 2019b) targets to achieve 30% canopy cover across the Metropolitan area. Each Council will have its own set of challenges to overcome to meet this target. The consensus is that more than ever before, we need nature in cities to improve liveability, improve health and well-being and conserve nature.

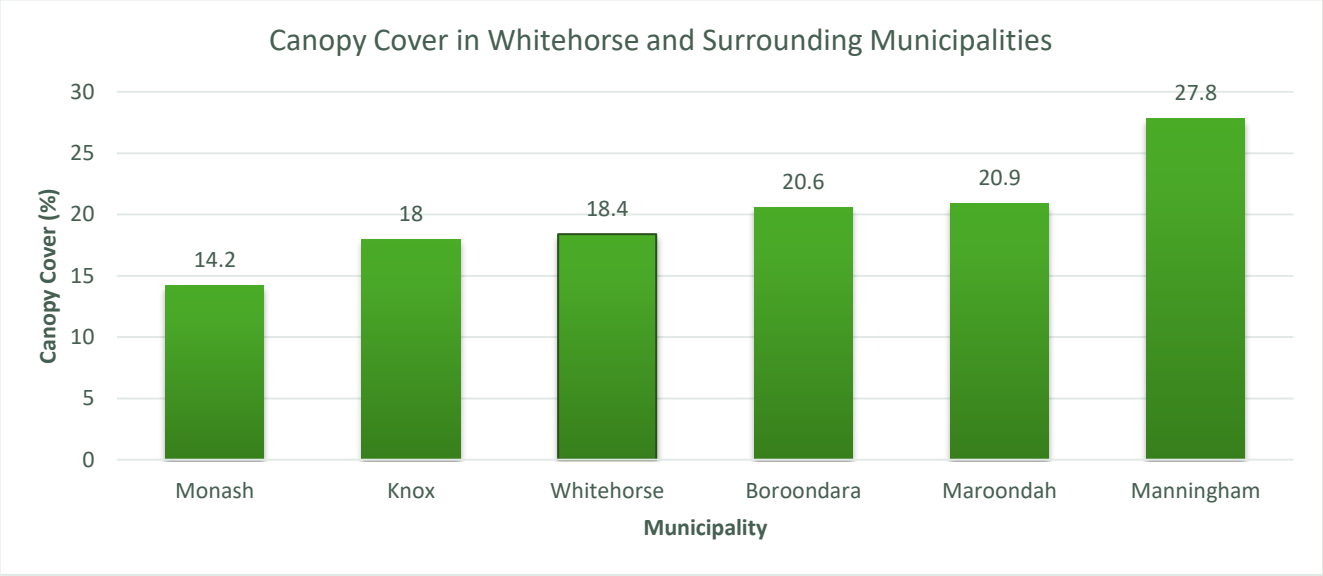


Figure 15: Canopy cover comparing surrounding Local Government Areas (DELWP 2019a)

The table below shows changes in canopy cover for each suburb within Whitehorse between 2014 and 2018. Areas with low canopy cover will be prioritised for new planting. The graph and map demonstrate the location of the higher to lower canopy suburbs.

Suburb	Canopy Cover 2018 (%)	Canopy Cover 2014 (%)	Point Change (%)
Burwood East	12.57	13.92	-1.35
Box Hill	15.21	17.34	-2.13
Box Hill North	15.35	17.15	-1.80
Nunawading	15.47	18.45	-2.98
Blackburn North	16.10	18.43	-2.33
Burwood	16.81	18.27	-1.46
Forest Hill	16.84	18.69	-1.85
Blackburn South	17.10	19.06	-1.96
Box Hill South	18.19	20.25	-2.06
Balwyn North	18.56	20.03	-1.47
Vermont South	18.84	19.46	-0.62
Vermont	20.95	23.88	-2.93
Mitcham	20.97	24.24	-3.27
Mont Albert North	21.04	23.53	-2.49
Surrey Hills	21.98	24.41	-2.43
Mont Albert	22.90	25.72	-2.82
Blackburn	24.84	28.46	-3.62

Figure 16: Table showing changes in canopy cover from 2014 – 2018 for trees over 3m adapted from DELWP 2019A

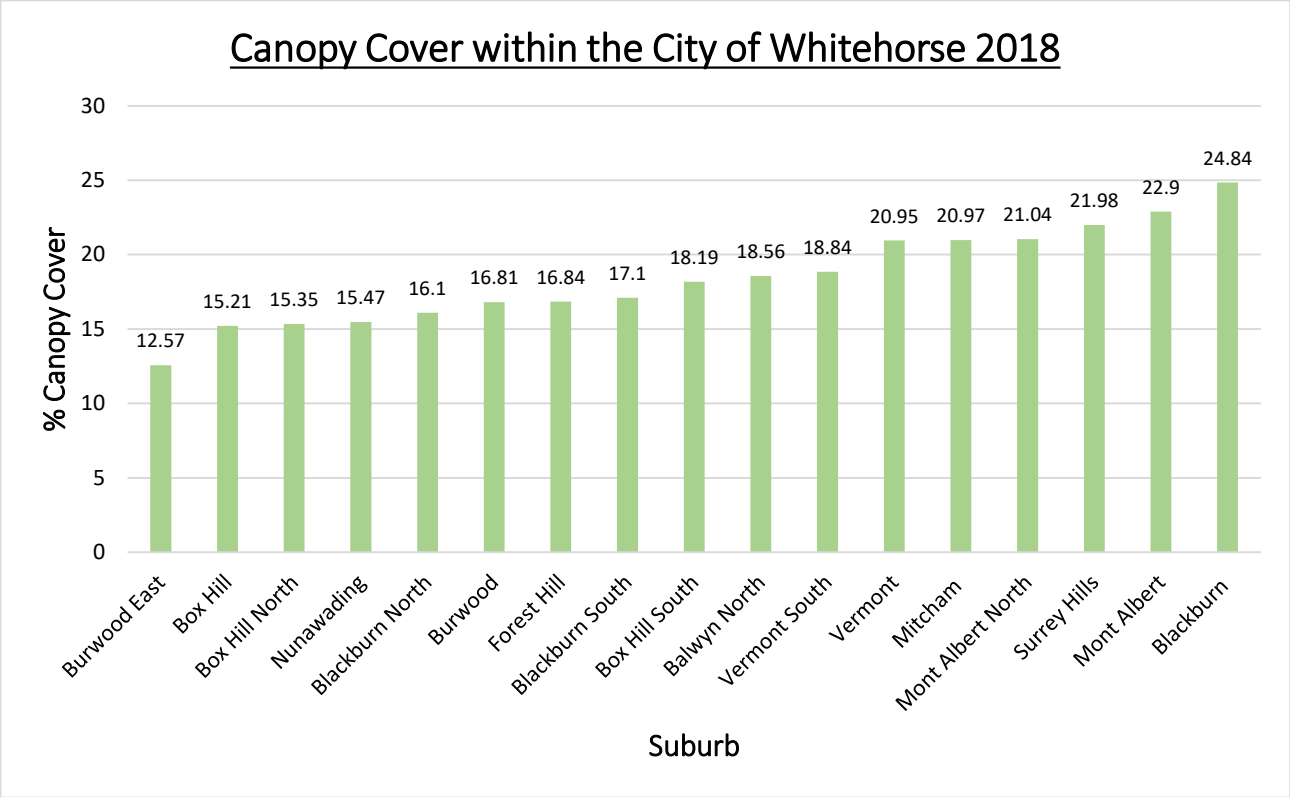


Figure 17: Bar graph showing Canopy cover per suburb for trees over 3 meters in 2018 (DELWP, 2019a)

Figure 18: Distribution of tree canopy cover in Whitehorse for trees over 3 meters- Modified Mesh Block (Hurley et al. 2019)

Enhance Biodiversity

Providing native habitat and improving biodiversity is key to a healthy functioning natural environment. Urban areas can be challenging places for wildlife and vegetation. Animals must battle with traffic, fragmented habitats as well as air, noise and light pollution. Trees and shrubs must endure compacted and drier soil, less growing space, hard surfaces and damage from human activity. All aspects of biodiversity are needing to adapt to the impacts of climate change for survival.

BOX 7: WHAT IS BIODIVESITY?

Generally the term biodiversity applies to the variety of plants and animals but it also applies to genetic diversity and ecosystem diversity. Biodiversity can be understood at different scales locally,

The main opportunities for enhancing biodiversity are:

1. Protect existing remnant vegetation and extend revegetation areas.
2. Strengthen green corridors to improve connectivity
3. Include biodiversity objectives on other Council owned land
4. Support land owners to enhance biodiversity on their land and protect trees on private property
5. Manage animal pests

1. Protect existing remnant vegetation and extend revegetation areas.

Whitehorse is already committed to preserving the remnant vegetation within Council owned bushland reserves to protect biodiversity. This includes:

- Managing environmental weeds that threaten sites of biodiversity significance.
- Partnering with volunteer groups to coordinate weeding, planting, citizen science, educational and clean-up type activities.
- Strengthening the resilience of indigenous vegetation and their plant communities.
- Fire management with consideration to environmental values.
- Community education and capacity building programs.
- Hollows management
- Monitoring and evaluation of bushland and management techniques

The bushland reserves make up less than 5% of the Municipality with remnant vegetation scattered across the landscape.

The bushland reserves have a primary focus on conservation. Within some of these reserves there is room to extend habitat through revegetation. New revegetation often requires advanced planning to successfully carry out weed control, obtain and plant appropriate species. Frequent maintenance for at least 3 years is required while the plants establish after which ongoing maintenance is required to ensure weeds are kept at bay, plants are replaced if required and fire risk is adequately managed. Each of these phases requires adequate funding to ensure the success of revegetation projects.

A Biodiversity Assets Management approach presents the opportunity to ensure adequate funding for managing existing remnant bushland for site renewal and then extension is planned for. The development of a Biodiversity Asset Management Plan (BAMP) would establish a detailed baseline of the extent and condition of all the biodiversity sites (assets) as identified in the Whitehorse biodiversity inventory (Practical Ecology, 2019). It provides a long-term framework for a staged approach to improving the condition and connectivity of areas currently managed for biodiversity as well as a strategy for managing new zones at existing biodiversity sites and some new sites as well. The BAMP outlines the long-term potential, given adequate resourcing, to extend conservation areas and improve connectivity.

2. Strengthen Green corridors to improve connectivity

Within the urban setting, many individual reserves are too small and spread out to support viable populations of many species (The Nature Conservancy and Resilient Melbourne 2019a, 15). Some species such as rainbow lorikeets and other birds, have adapted well to the urban environment and can easily get around flying from tree to tree (The Nature Conservancy and Resilient Melbourne 2019a, 15). Other species such as the sugar gliders depend on bushland reserves and also use adjacent home gardens for extra foraging opportunities.

The creeks and linear reserves of Whitehorse provide valuable habitat for wildlife. Importantly, they help to connect the bushland reserves enabling many species to travel within and beyond the municipality. This is called connectivity, a critical component of conservation. The greater the connectivity the more likely species are able to access what they need, not only to survive but to thrive within the urban environment.

The waterways are important ecological linkages, enabling species to disperse within and beyond and beyond the Municipality. The waterways continue for kilometres towards Melbourne on the Main Yarra Trail, and south to Stonnington on Gardiners Creek Trail and south east along the Dandenong Creek Trail. Creek lands provide extensive natural habitat and bushland spines that are either currently or have the potential to become links to a large number of the Whitehorse bushland reserves (Practical Ecology 2014, 14).

The Whitehorse Urban Biodiversity Strategy identifies important corridors for conservation (Practical Ecology 2014). There are three main urban creek corridors; the Mullum Mullum and Koonung Creeks along the northern perimeter and the Dandenong Creek along the south-east perimeter of the Municipality. There are several smaller waterways, which are highlighted as important for connectivity. Many of these have either been entirely or partially barrel-drained. The more significant of these are:

- Gardiners Creek
- Bushy Creek (an underground waterway; located in the north-west)
- The Forest Hill Drain (less than 1km to the south-east of Blackburn Lake)

The effectiveness of waterways as habitat corridors depends on both the condition of vegetation and the quality of the water. Challenges for waterway health include the impacts of urbanisation, with most waterways significantly altered in form and water quality. Modifications such as straightening, channelling and concrete-lining reduce the amount and quality of natural vegetation. Furthermore, waterway diversions upstream can cause seasonal low flows and low dissolved oxygen, which harms plants and animals in the waterway. When a weather event brings significant rainfall, then large amounts of polluted stormwater suddenly enter these waterways, reducing water quality and increasing water flow rates significantly. There is a need to adopt water sensitive design to reverse some of these implications.

By improving the vegetation within designated corridors we can link the bushland reserves and surrounding Municipalities to enable wildlife to access the habitat they need to thrive. An ecological connectivity study is currently being undertaken by Melbourne University. The study will help to gain a better understanding of how different animals move around and beyond the municipality to access their needs to survive and thrive. In collaboration with community and Council, a selection of focal species that represent a range of habitat and dispersal requirements will be selected to guide the analysis of the study. The map will identify:

- species guilds, their movement requirements and barriers.
- current limitations on connectivity based on the home range and dispersal capability of guilds.
- opportunities to improve ecological connectivity

3. Include biodiversity objectives on other Council owned land

The application of Environmental Sustainable Design (ESD) to enhance local biodiversity incorporated into Councils Capital works programs would strengthen connectivity outcomes when applied to projects located within green corridor zones. ESD to enhance biodiversity includes the implementation of best practice for:

- Stormwater Management
- Permeability
- Urban Ecology

Best practice includes setting biodiversity objectives such as:

- enhance the site's ecological value,
- improve habitat and vegetation quality; and/or
- improve connectivity.

This can be done by firstly making use of existing biodiversity assets and then incorporating water and biodiversity sensitive design responses to prompt ecological processes. Maintenance of existing vegetation and incorporating habitat strengthening features need to be built into the site design to ensure its success. Habitat elements include elements such as the use of indigenous and/or native plants, incorporating basking rocks, logs, artificial hollows, water, mulch and a range of flowering indigenous/native species. A variety of structural diversity in the vegetation selected is critical to promote a biodiverse landscape. This means incorporating a mix of groundcovers, shrubs and trees. Good design often facilitates a positive human-nature interaction, enabling people to connect with nature.

Gardens for Wildlife is a free program supporting local volunteers to set an area aside in their garden for locally threatened wildlife. By planting locally indigenous or selected Australian native plants, you can create a garden that attracts birds, insects, butterflies, lizards and much more.

At the time of writing, a Whitehorse ESD policy is being developed for Councils Capital Works Program which will guide the process for the uptake of ESD for Council's Capital Works Program.

Box 8: Gardens for Wildlife

Gardens for Wildlife is a community/council co-designed education and behaviour-change program which leads to active stewardship of nature on private land.

Whitehorse City Council would like to acknowledge Knox City Council and the Knox Environment Society for their assistance in introducing and operating The Gardens for Wildlife Program.

Driven by a team of local volunteers, Gardens for Wildlife is a network that supports residents to provide habitat and food sources for threatened wildlife (e.g. birds, insects, and frogs) through good design and the use indigenous plants.

4. Support private and other land owners to enhance biodiversity and grow healthy trees on private land.

On private land, each home garden plays an important role in contributing to the urban forest and its local biodiversity. Whether indigenous vegetation exists or not, each home garden, balcony or courtyard has the potential to provide habitat for butterflies and other insects, lizards, birds and more. A large percentage of canopy exists on private land including large old trees that have important hollows for nesting birds and mammals. The Whitehorse Gardens for Wildlife program (Box 8) is a fantastic opportunity for local residents to join a network of people with access to resources for creating beautiful gardens for both people and wildlife to enjoy.

On private land, Council has applied Planning Scheme controls to protect established trees, enhance the urban forest and prevent the development sites from being cleared of all vegetation. Council currently has in place interim tree protection controls across all residential zones to protect canopy trees. The main aim of these controls is to protect the Neighbourhood character of the municipality. However, by protecting trees on private land, local biodiversity will be enhanced.

5. Animal pest control

An Eastern Region Animal Pest Strategy 2020-2030 (Eco Logical Australia 2020) has been developed for the management of pest animals across 13 Eastern Melbourne Municipalities. The strategy aims to coordinate effective management of five priority pest species each which have an impact on local biodiversity.

- European Fox
- Cat
- European Rabbit
- Feral Deer
- Common Myna

Further analysis is required to better understand populations of pest animals and their impact on biodiversity within Whitehorse. With a better understanding of the impact of these species, an animal pest management plan for the most significant bushland reserves could be developed with a primary aim to improve the diversity of the local flora and fauna.

Whilst not necessarily classified as pests, domestic cats and dogs can have a negative impact on biodiversity. Whitehorse has a Cat Curfew in place that requires cat owners to keep their cats contained to their property overnight between the hours of 8pm to 6am. Cats are prohibited from many bushland reserves to ensure that local wildlife is protected from the threat of cats.

These same reserves have designated areas for dogs to be on lead in order to protect native wildlife.

Details of this local law can be found at this link https://www.whitehorse.vic.gov.au/living-working/pets/responsible-cat-ownership.

Through the Whitehorse Environmental Educational Program responsible pet ownership could be encouraged through behaviour change type programs to facilitate greater adherence to these local laws.

Improved functionality of streetscapes

Whitehorse is known for its leafy green streets. Trees planted along roadsides not only provide visual beauty but shading for pedestrians and cyclists. Particularly in suburbs with low-rise buildings, mature trees provide thermal comfort by reducing the urban heat island effect (Ng 2009, 232) in the height of summer.

Streetscapes are ideal for establishing a range of vegetation within the built environment. Typically, one street tree is allocated per residential property. Council is in the process of identifying existing vacant street tree sites in order to increase canopy cover within public space. Vacant sites are gaps along Council managed roads where ideally there could be a tree.

It is important to emphasise that streets are not just thoroughfares for motor vehicles; they serve as public spaces where people walk, shop, meet, and participate in activities. Street vegetation has a role to play for enhancing and softening the hard surfaces. We can design vegetation into the streetscape to enhance these functions such as providing shading and cooling for pedestrians and to improve the amenity (Trees & Design Action Group 2014, 56). The quality of the outdoor environment within streets can encourage walking and cycling, leading to greater physical health benefits.

There are certain circumstances where vegetation within the streetscape can be increased, where safe to do so, as a means of traffic calming. For example, within wide streetscapes where traffic tends to be unacceptably fast, in-road planting in tree-pits could be incorporated in conjunction with formal nature strip

tree planting to encourage slow traffic. Trees when located on both sides of the street create a sense of enclosure that discourages drivers from speeding (Trees & Design Action Group 2014, 56). These in-road planting sites can be designed to include tree pits that can accommodate large canopy trees and their root systems. Such systems could include passive irrigation from water harvested from the road. Furthermore, wider streets within identified green corridors can be prioritised for improvements of vegetation to increase connectivity for biodiversity. Street design needs to comply with the Australian Guide to Road Design (Austroad 2020).

The image below illustrates how, wider streetscapes, present an opportunity for Council to increase vegetation for urban cooling, traffic calming, flood mitigation, improved connectivity and increased amenity. Planting configuration should seek to maximise canopy cover in all cases. This design has negotiated the space constraints of overhead powerlines to include an extra row of smaller trees beneath the powerlines.

Figure 19: Visualisation of traffic calming streetscape with inroad planting to increase canopy cover and improve amenity (Moreland City Council, 2017)

Vic Roads has a Tree Planting Policy that acknowledges the value of trees in the streetscapes to reduce heat retention, encourage walking and cycling and in general the positive public health, environment and social benefits (Vic Roads 2015). The policy contains Road Safety Mitigation Methods for tree planting which considers both the impact forces on the vehicle occupants and the likelihood of a crash with a tree (Vic Roads 2015, 3)

Nature strips

The nature strip is a public space which has many uses. It provides open space and greening opportunities. The land has been allocated for the installation of underground services including drainage, water, sewer, telecommunications and gas. The nature strip may need to be excavated from time to time to access these services. Generally, it is common practice for residents in the adjacent property to maintain the lawn by regular mowing, weeding and picking up of litter.

Council is responsible for maintaining the street trees present within the nature strip. There is the potential to enhance the vegetation within the nature strip to include low growing shrubs. Nature strip planting of indigenous species would be of particular benefit within areas identified as green corridors to facilitate better

connectivity for wildlife. Through Council's environmental education and community engagement programs more residents could be encouraged to include a range of low growing plants on their nature strip plantings.

Residents can apply for a permit to add plants to the nature strip. There are a number of reasons why residents may wish to do this:

- to replace grass that is failing or performing poorly with other types of vegetation
- to beautify and bring visual interest to the nature strip
- to avoid the maintenance of regular mowing
- to support local biodiversity by planting indigenous or native plants
- to avoid or minimise the need for watering, herbicide or pesticide use

There are a number of terms and conditions that residents must adhere to in order to assure that the streetscape is safe and the needs of the general public are met including maintaining sightlines, accessibility and kerb side rubbish collection can occur.

More information about nature strip planting can be found here www.whitehorse.vic.gov.au/naturestrips.

Street trees

Whitehorse is currently collecting data to compile its first street tree inventory. We can examine the urban forest in a number of ways. In order to best manage existing vegetation and to guide the development of the urban forest of the future.

This involves the mapping and recording of data of each individual street tree including:

- species
- age
- useful life expectancy (ule)
- tree height and canopy; and a
- photographic record

This mapping provides key indicators to benchmark the forest, set future targets and measure change over time. For example, we can monitor tree diversity. A diverse urban forest increases the ability of the forest to withstand change. Trees should be of diverse ages, species, genera, and families in order to ensure the forest can adapt to future climate change scenarios. A forest characterised by low species diversity is more susceptible to the widespread effects of introduced pests and disease and potentially has a greater risk of large-scale loss from the environmental impacts associated with climate change. Box 9 goes into the detail of the importance of different aspects of diversity.

Box 9: The Importance of Street Tree Diversity

Species

Reliance on a few species is risky. A lack of species diversity leaves the urban forest more vulnerable to threats from pests, disease, and stress due to climate change.

Age

A uniform age profile makes it likely that many trees will decline and senesce at the same time leaving gaps within the streetscape as they are removed. A sustainable urban forest will have a spread of age classes to ensure continual canopy cover.

Height and Structure

Tree height plays an important role. In determining the scale of benefits delivered by each tree. Generally, the taller the tree the greater the tree is able to sequest carbon, purify the air, intercept rainfall, and provide shading and cooling.

Different shaped, sized and structured vegetation provide a greater range of habitat for more diverse and abundant wildlife.

When considering species for replanting street trees and planning new areas of canopy, Council will consider the following guidelines. These have been set to reduce vulnerability and adapt to climate change within the street tree population:

Species diversity

- No more than 5% of any one Species.
- No more than 10% of any one Genus.
- No more than 20% of any one Family

Age diversity

Diversity of tree age and growth rates will be encouraged through regular plantings each year to 2040. These regular plantings are to be much greater than the numbers of trees removed each year.

A sound tree management program would reduce the dominance of certain species over decades through the planting of other species across the Municipality. It is not encouraged to remove mature healthy trees to improve diversity outcomes.

These percentages do not apply to park, habitat or revegetation planting. They apply to street tree population of Whitehorse. The data collected in the inventory will help inform future planting programs for Whitehorse street trees.

Box 10: Avenue Plantings

Avenue plantings contribute significantly to the local character and heritage of Whitehorse. However, consistent lines of a single species, can limit species diversity. Reliance on a few species, and a lack of diversity in species distribution, leaves the urban forest vulnerable to threats from pests, disease, and stress due to climate change. These two conflicting pressures can be balanced with design guidelines and principles for species selection. For example, the City of Melbourne (2014) has identified ways to minimise the extent of homogenous avenue planting while maintaining a strong aesthetic and functional design outcome with the following approach:

- Establish a hierarchy of streets and paths most important to plant with continuous avenues and limit use elsewhere;
- Identify breaks in avenues at logical points along the length of streets, where species may change;
- Use asymmetrical treatments along some streets. For example, local streets where there are power lines on one side only so large trees may fit on one side and small ones on the other);
- Use mixed avenues of two or more species of similar form and character where appropriate;
- Use informal mixes of species where acceptable. For example, perimeters of parks and gardens, streets where most trees are senescent but important established specimens remain, streets where vegetation from private gardens occasionally overhangs into street space.
- Use a balance of proven and trial species to increase diversity but limit the use of trial species in streets to less than 10% of the precinct tree population.

Private property landscape enhancement

Private land and trees within the City of Whitehorse, make up the largest proportion of the urban forest. Over 85% of land in Whitehorse is privately owned and managed. An engaged and empowered community who value nature is essential to sustain and support a healthy, diverse and extensive urban forest in the private realm.

The Whitehorse Tree Education Program facilitates the planting and care of vegetation on private land through the provision of advice and guidance to planning applicants around tree selection, seminars and workshops for the community to enable enrichment of gardens and information on plant selection through written and online publications. The Gardens for Wildlife Program supports the community to modify their gardens in such a way as to create habitat for local fauna and to form connections between like-minded people to share knowledge and enthusiasm.

The City of Whitehorse coordinates an environmental education program that aims to connect people with nature and provide opportunities to actively care for nature within parks and reserves.

On private land, Council has applied planning scheme controls which aim to protect established trees, enhance the urban forest and prevent development sites from being totally cleared of all vegetation, commonly referred to as 'moon-scaping'. At the time of writing, Council has carried out a number of tree studies and invested in ways to better protect trees on private property. For more information on tree protection on private property visit: https://www.whitehorse.vic.gov.au/planning-building/do-i-need-permit/tree-removal-lopping-and-pruning

Residents and developers can contribute to the urban forest by:

- Planting and caring for canopy trees in front and backyards
- Planting more shrubs and groundcovers that support biodiversity
- Reducing impervious surfaces
- Harvesting rainwater
- Participating in community planting and weeding events
- Participating in citizen science
- Installing raingardens
- Establishing green roofs and walls
- Growing plants on balconies

Heat reduction – mitigation of the urban heat island effect.

Data and mapping produced by the Victorian Government indicates that, on average, Melbourne's urban areas are over 8˚C hotter than non-urban areas. Some parts of Whitehorse have recorded an average of 15 ˚C hotter (DELWP 2019c)(Appendix C). This effect caused by the built environment is called the urban heat island effect.

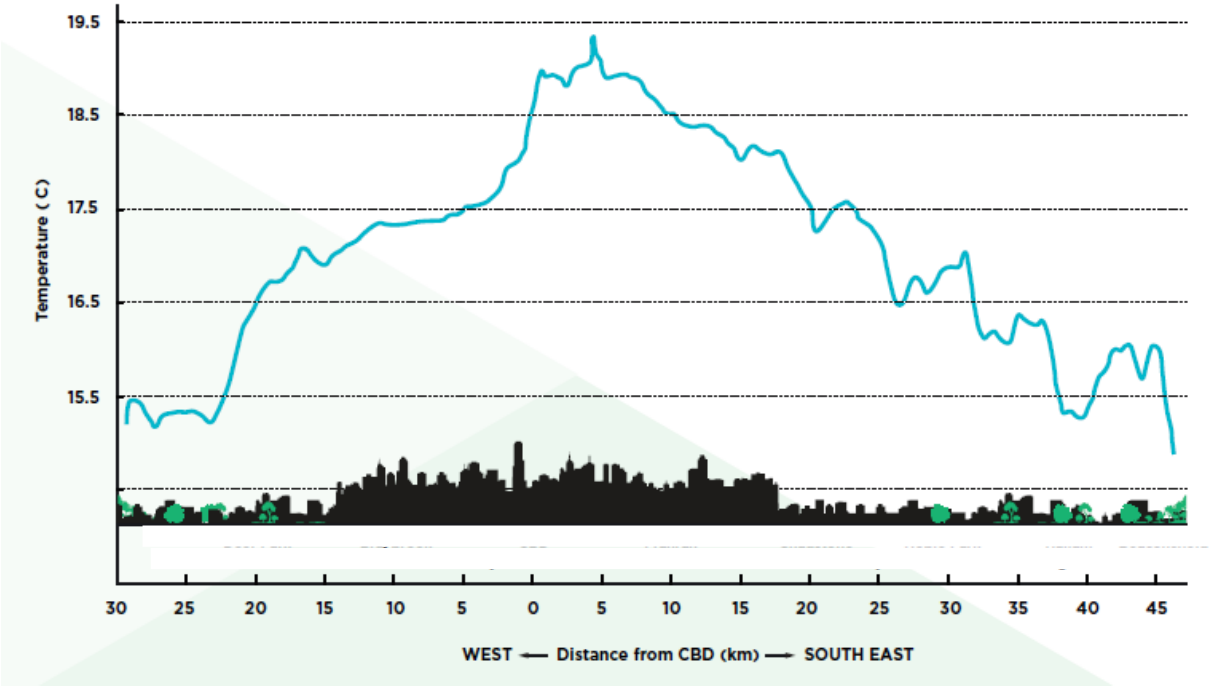


Figure 20: Illustration of the impacts of urban heat from densified development. Adapted from City of Melbourne Urban Forest Startegy (2014)

Typically, the identified "hot spots" in Whitehorse have a high coverage of hard surfaces with limited vegetation. These kinds of urban environments exacerbate the urban heat island effect and usually create excess stormwater runoff, and negatively impact human and ecological health due to a lack of trees and other vegetation.

As a result, on hotter days and nights health risks are increased for the most vulnerable people within these areas, particularly the young and elderly. The four examples below highlight the need to incorporate trees and vegetation into hard landscapes such as car parks and shopping centre rooftops. Street trees are an effective means of urban cooling as described in more detail below.

Figure 21: Hot spot 1 – North Blackburn Shopping Centre located at 66-104 Springfield Road, North Blackburn

Figure 22: Hot spot 2 – Vermont South Shopping Centre, 495 Burwood Hwy, Vermont South

Figure 23: Hot spot 3 – Box Hill Central 1 Main St, Box Hill

Figure 24: Hot spot 2 - 495 Burwood Hwy, Vermont South

Trees and vegetation are one of the most effective providers of shading and localised cooling (DELWP 2019c) . Many cities are incorporating trees into hardscapes for this very purpose. To do this well, good design is required to create healthy growing conditions in an otherwise harsh urban environment. The heat mapping provided by DELWP is used to prioritise the street tree planting program across the Municipality. Certain species are more effective at urban cooling. Council's tree pallet should be refined to consider species that are more suitable for different areas, depending on the anticipated conditions under a new climate regime. Appendix E shows parts of Whitehorse where residents are particularly vulnerable to heat. Infants and children younger than 4 and adults older than 65 are at higher risk of heat exhaustion. The frequency of extreme heat events for Melbourne is increasing (State of the Climate 2020 - CSIRO 2020).

The cooler areas within Whitehorse contain high canopy cover and often a water body or creek line (Sun et al. 2018). Preserving these cool spots is a priority.

In the built environment, other mechanisms to reduce the urban heat island effect include selecting materials that reflect heat away by using lighter coloured roofing, road or pavement materials along with surfaces that are impervious. Green walls and façades can be included on buildings to mitigate urban heat issues. When water is consistently available in soils, vegetation is more likely to be healthier which increases the effect of shading and cooling. The use of Water Sensitive Urban Design can mitigate urban heat island effect. (DELWP 2017a).

Community engagement, education and behaviour change

The health and extent of the urban forest relies on a community who values and cares for the trees and vegetation throughout Whitehorse. Council has an important role in advocacy and supporting the community to protect and enhance the urban forest. Council has an established Tree Education program and Environmental Education program that raises awareness and promotes the value of vegetation throughout the municipality on both private and public land.

Volunteer involvement is a critical aspect in biodiversity management. Council supports a committed network of volunteers who contribute invaluably to the conservation of Whitehorse biodiversity and the urban forest. The Gardens for Wildlife Program, The Environmental Education Program, "Friends of" groups and the community operated indigenous plant nurseries rely on strong community leadership and participation. The skills, commitment and capacity of volunteers is highly valued by council.

Box 11: Whitehorse Environmental Education Program

The Environmental Education program is a free program that enables the exploration of environmental issues through direct contact with nature.

It provides environmental and sustainability education to local schools, residents and community organisations with the purpose of:

- Building in-depth understanding of the value of bushland and urban biodiversity.
- Developing opportunities for various age groups to experience and learn through meaningful experiences with nature.
- Providing opportunities to actively care for nature.

Opportunities include:

- Build on existing educational and volunteer programs to extend the reach and be inclusive and culturally appropriate for diverse participation across Whitehorse.
- Strengthen community reporting and data gathering through citizen science to ensure voluntary work and research is captured and utilised in biodiversity management.

Collaborations across sectors and agencies

Momentum is gaining across sectors and government agencies to protect and expand the urban forest across Melbourne. Achieving collective action by bringing people and projects together offers greater benefits, opportunities and efficiency. Living Melbourne: our metropolitan wide urban forest strategy (The Nature Conservancy and Resilient Melbourne 2019b) has identified that the fragmentation of efforts is one of the most significant barriers to reaching urban forest goals. Ongoing partnerships between departments, non-government organisations and community will help to disseminate, and gain support for a well-managed urban forest.

Whitehorse City Council has endorsed the Living Melbourne Strategy along with 40 other agencies. Living Melbourne provides a framework to work in collaboration to implement actions that work towards enhancing the urban forest across the community, sectors, and government's agencies and departments.

Improved understanding of the urban forest

Council is currently collecting a full set of data to establish a street tree inventory. This data will help Council arboriculture staff manage and monitor individual trees in the public realm and the public tree population as a whole. Collecting tree specific data is critical in implementing and sustaining an urban forest approach. Understanding what trees exist, species mix, current tree conditions, identifying trees for removal, disease/pest outbreaks and areas for new planting all rely on a comprehensive set of data.

The tree inventory could be extended to include all council managed trees. It can be continuously updated as monitoring, pruning, removal and planting works on individual trees are undertaken. The species, height, age and health of each tree should be recorded in the inventory and this data can be used to develop a profile of the trees in the public realm and give thorough understanding of the state of the existing urban forest.

Whitehorse City Council has carried out a biodiversity inventory and habitat assessment. Further data could be harvested to get a better understanding of the extent of biodiversity assets and ecological connectivity. Such data will enable the mapping of existing and new areas for biodiversity connectivity at different scales, and prioritise areas for strengthening connectivity, including responses to climate change.

The collection of tree data is useful to correlate with other known information such as socio-economic, active transport mapping, urban heat mapping and flooding. DELWP has commenced data harvests and analysis across Melbourne for urban heat and heat vulnerability with data collected in 2014 and then again in 2018. As data sets are repeated, trends will be revealed providing Councils with more insights into the health of the urban forest across land tenures. DELWP has made available an interactive map share tool that consolidates 2014 and 2018 data in a single platform has also been developed: Cooling and Greening Melbourne Interactive Map .

Through Living Melbourne (The Nature Conservancy and Resilient Melbourne 2019b) Whitehorse can establish a clear and consistent method for long-term monitoring and evaluation of the quality and extent of the urban forest. An action is to develop a system for consistently collecting and analysing urban forest data, and coordinate the collection and publication of data in a publicly available, comparable database.

As more data becomes available, Council can improve understanding of the urban forest and adapt methodologies and actions accordingly. Within an environment that is constantly changing, an adaptive management approach, will enable Council to constantly learn and adapt for continual improvement in urban forest management.

A Strategy for the Future

Trees and vegetation within the urban setting create a tangible sense of place, enhanced amenity and deliver important environmental and social benefits to the community. Current data shows that canopy cover is in decline across the Municipality. Without a robust strategy in place, we risk a continual loss of canopy cover, compromising the health and extent of the canopy to deliver little return to the detriment of the community.

This background document will underpin the Whitehorse Urban Forest Strategy 2021-2031 to reverse the decline of vegetation with the key target of achieving 27% canopy cover by 2031.

Growing the urban forest takes time, effective management and substantial resourcing. Collective effort across sectors and land tenure will be vital to successfully protect and extend the urban forest. As understanding of the urban forest improves and we discover new ways to optimise the urban forest, it is hoped that in the long term Council will reach a 30% canopy cover.

Glossary

Adaptation: Human actions designed to minimise the negative effects of anticipated climate change and capitalise on positive opportunities associated with impacts, as well as the changes that will occur in natural systems as climatic conditions change.

Biodiversity: All components of the living world: the number and variety of plants, animals and other living things (including fungi and micro-organisms) across land, rivers, coast, and ocean. It includes the diversity of their genetic information, the habitats and ecosystems within which they live, and their connections with other life forms and the natural world.

Bioregions: Biogeographic areas that capture the patterns of ecological characteristics in the landscape or seascape, providing a natural framework for recognising and responding to biodiversity values.

Climate Change: A long-term change of the earth's temperature and weather patterns, generally attributed directly or indirectly to human activities such as fossil fuel combustion and vegetation clearing and burning.

Connectivity corridors: are elements of the landscape which, by linking otherwise isolated areas, permit movement of organisms or genetic flows across the landscape. This is a more general term than wildlife corridors, which are strips of habitat that permit movement of animals between otherwise isolated patches of habitat.

Conservation: In relation to biodiversity, conservation is the protection, maintenance, management, sustainable use, restoration and improvement of the natural environment; in relation to natural and cultural heritage, conservation is, generally, keeping in safety or preserving the existing state of a heritage resource from destruction or change.

Degradation: In the context of environmental values, degradation refers to a loss of quality or functionality. It is used in various ways, e.g. forms of land degradation include salinity, wind erosion, water erosion, soil acidity; degradation of vegetation may refer to loss of extent, condition or capacity to self-regenerate.

Evapotranspiration: Movement of water from the soil to the atmosphere by plants via their roots, vascular tissue and stomatal pores resulting in a reduction of temperature in the immediate surrounds.

Ecological Vegetation Class (EVC): a type of native vegetation classification that is described through a combination of its floristic, life form, and ecological characteristics, and through an inferred fidelity to particular environmental attributes. Each EVC includes a collection of floristic communities (i.e. a lower level in the classification that is based solely on groups of the same species) that occur across a biogeographic range, and although differing in species, have similar habitat and ecological processes operating.

Ecological sustainability: describes a state in which biological systems will remain diverse and productive over time, even though change will occur. The idea of ecological sustainability recognises that human use or development of biological systems must be consistent with protection of biological diversity and maintenance of essential ecological processes and life-support systems.

Ecosystem services: The benefits people obtain from healthy ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on earth.

Fragmentation: describe the result of removal (usually by clearing) of large parts of a natural area, resulting in the retention of only small parts (fragments or remnants) of habitat. Fragmentation is an issue for marine and other aquatic environments as well as terrestrial environments.

Green Economy: An economy in which economic growth and the health of natural resources sustain each other, and market, business and government better reflect the value of nature.

Greenhouse gas emissions: Atmospheric gas that absorbs and emits infrared or heat radiation, giving rise to the greenhouse effect. Typical greenhouse gases include carbon dioxide, methane, nitrous oxide and refrigerants.

Guild: Any group of species that utilises or accesses the same resources for survival.

Habitat: All the physical and biological things that collectively make up the place where a plant or animal lives.

Hot spot: Areas that are greater than ten degrees Celsius warmer than their estimated non-urban baseline temperature. This may include areas of concentrated heat retention, such as major roads, commercial and industrial centres, and new residential subdivisions.

Integrated water management: Collaborative planning that brings together organisations that influence all elements of the water cycle, including waterways and bays, wastewater management, alternative and potable water supply, stormwater management and water treatment.

Landscape: All the natural features of land or territory encompassed in a single view (e.g. fields, hills, forests and water), which distinguish one part of the Earth's surface from another.

Liveability: A measure of a city's residents' quality of life, used to benchmark cities around the world. It includes socioeconomic, environmental, transport and recreational measures.

Metropolitan Melbourne: The 31 municipalities that make up metropolitan Melbourne, plus part of Mitchell Shire within the urban growth boundary.

Natural infrastructure: strategically planned and managed network of natural lands, such as forests and wetlands, working landscapes, and other open spaces that conserves or enhances ecosystem values and functions and provides associated benefits to human populations.

Net Gain: is where, over a specified area and period of time, losses of native vegetation and habitat, as measured by a combined quality-quantity measure (habitat hectare), are reduced, minimised and more than offset by commensurate gains.

Open space: Includes land reserved for natural landscape, parklands, recreation and active sports, as well as waterways and bays.

Permeability: The readiness with which a surface, whether man-made (such as a paved road) or natural (such as soil or rock) allows water, air or plant roots to penetrate or pass through.

Public urban realm is any part of the built or natural environment that is available to the public. It forms a complex system of social, cultural, recreational and economic exchanges that may be planned, spontaneous or accidental.

Riparian: The interface between land and a river or stream; land alongside creeks, streams, gullies, rivers and wetlands.

Resilience: The capacity of individuals, communities, institutions, businesses, systems and infrastructure to survive, adapt and grow, no matter what chronic stresses or shocks they encounter.

Shrub: A woody plant growing smaller than a tree. Usually has several stems arising at or near the ground.

Species: A level of biological classification comprising one or more populations of individuals capable of interbreeding to produce fertile offspring.

Threatened Species: Species of plants, animals or other life forms that are considered either vulnerable, endangered, or critically endangered.

Tree: A woody plant that grows 3m or higher. Typically having a trunk and bearing lateral branches at some distance from the ground.-

Tree canopy: the uppermost trees or branches of trees in a forest, forming an almost continuous layer of foliage. The topmost layer of bioactivity in a forest setting.

Urban design is a collaborative and multi-disciplinary process of shaping physical space across a range of urban and suburban environments.

Urban forest: All of the trees and other vegetation along with the soil and water that support them. Urban forest incorporates vegetation in streets, parks, gardens, plazas, campuses, river and creek embankments, wetlands, railway corridors, community gardens, green walls, balconies and roofs.

Urban greening: Growing plants wherever possible in cities to contribute to urban vegetation coverage, and providing a connection to nature.

Urban heat island effect The phenomenon of dense urban areas having significantly warmer air and land surface temperatures than surrounding rural areas.

Water-sensitive city: Resilient, liveable, productive and sustainable cities that interact with the urban water cycle to provide water security, healthy watercourses and wetlands, mitigate flood risk, create healthy spaces and contribute to biodiversity, urban heat-island reduction and carbon sequestration.

These definitions have been extracted from Living Melbourne (2019), Australia's Biodiversity Conservation Strategy 2010-2030 and Victoria's Native Vegetation Management Framework

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Appendix A: Alignment with national, state, regional and local

A range of Victorian Government documents provide support and guidance relating to Whitehorse's urban forest. These include Plan Melbourne 2017–2050, the Victorian Climate Change Adaptation Plan 2017–2020, Protecting Victoria's Environment – Biodiversity 2037, and the Victorian Public Health and Wellbeing Plan, among others. The table below shows major policies and strategies across levels of government that relate to the management of the urban forest.

Political context: Major government policies and strategies relevant to Melbourne's urban forest. Adapted from Living Melbourne (2019)						
	Cities, Urban Design & Planning	Urban green Space	Climate change: mitigation; adaptation	Waterways, integrated water management	Ecology & Biodiversity	Culture
Federal	Smart Cities Plan 2015		Climate Change Act 2017 National Climate and Resilience and Adaptation Strategy 2015	National Urban Water Planning Principles 2008: and Review 2013-14	Australia's Biodiversity Conservation Strategy 2010-2030 Environment Protection and Biodiversity Conservation Act 1999	
State	Plan Melbourne 2017-2050 **20-minute Neighbourhood Principle** Victoria Planning Provisions 2019 Infrastructure Victoria Strategy 2016 Electricity Safety Regulations 2015	Linking People and Spaces 2002 (New Metropolitan Open Space Strategy in development)	Victoria's Climate Change Adaptation Plan 2017-2020 Climate Change Framework 2017 Victorian Public Health and Wellbeing Plan 2015-2019	Water for Victoria 2016 Yarra River Action Plan Healthy Waterways Strategy 2018-2028 Integrated Water Management Framework for Victoria 2017	Protecting Victoria's Environment – Biodiversity 2037 Victoria's Native Vegetation Management – A Framework for Action	Korin Korin BalitDjak: Aboriginal Health, Wellbeing and Safety Strategic Plan 2017-2027
Regional	Living Melbourne: our metropolitan urban forest Integrated Water Management Forums, Greenhouse alliances action plans (EAGA), Council Arboriculture Vic, LGPro Biodiversity Planners Network, Port Phillip and Westernport Regional Catchment Strategy, Eastern Region Animal Pest Management Strategy					
Local statutory	Whitehorse Council Plan 2017-2021 The Whitehorse Planning Scheme Whitehorse Electric Line Clearance Management Plan 2018-19	Whitehorse Open Space Strategy	Whitehorse Municipal Public Health and Wellbeing Plan 2017-2021			
Local	Neighbourhood Character Statements The Whitehorse Urban Realm Vision Whitehorse Landscape Guidelines The Whitehorse Tree Study	Whitehorse Bushland Reserves Fire Management Strategy 2010 Whitehorse Urban Forest Policy and Tree Management Plan	The Whitehorse Sustainability Strategy and Action Plan 2016-2022		Whitehorse Urban Biodiversity Strategy	Whitehorse Reconciliation Action Plan

Appendix B:

The Main Ecological Vegetation Classes of Whitehorse

Native vegetation in Victoria has been classified into distinctive groupings known as Ecological Vegetation Classes or EVCs. This classification system groups vegetation communities based on the plant species present, the vegetation structure, landforms and environmental characteristics. EVCs are classified according to the geographic area or bioregion in which they occur. Whitehorse is located within the Gippsland Plain Bioregion.

There are eight dominant EVCs within Whitehorse:

Valley Heathy Forest – EVC 127

Conservation Status: Endangered
Area in Whitehorse: 58 ha
This EVC is the most common in Whitehorse. It is located on lower slopes, hills, plateaus and valley floors. The underlying soils are generally duplex grey-yellow loams and clays which may become waterlogged in winter and dry out in summer.
Vegetation: A low, open forest with a sedgy/grassy understorey with a component of small ericoid shrubs and grass-trees.

Creekline Herb-rich Woodland- EVC 164

Conservation Status: Endangered
Area in Whitehorse: 19 ha
Occurs along narrow swampy gullies and shallow drainage lines that are on very shallow gradients. Soils are characterised by alluvial sands, silts and clays.
Vegetation: The region depicts woodland or open forest to 15m tall. There is a sparse shrub layer above a grassy/sedgy understory, often rich in herbs within the inter-tussock spaces.

Valley Grassy Forest – EVC 47

Conservation Status: Vulnerable
Area in Whitehorse: 12 ha
Observed in the west of the municipality. It occurs throughout the hillier landscape on the sheltered, lower slopes that typifies the Box Hill area. The underlying soils are generally fertile.
Vegetation: The region depicts an open forest to 20m tall that may carry a variety of eucalypts. In season, an array of herbs, lilies, grasses and sedges dominate the ground layer.

Swampy Riparian Complex – EVC 126

Conservation Status: Endangered
Area in Whitehorse: 5 ha
Swampy Riparian Complex occurs on poor drainage areas located in topographically protected high rainfall country.
Vegetation: The complex consists of emergent eucalypts over a shrub layer with a ground layer primarily ferny to sedgy in character, including mixtures of wet forest and poor-drainage species.

Grassy Woodland – EVC 175

Conservation Status: Endangered
Area in Whitehorse: 1 ha
Occurs on flat to undulating terrain, on fertile soils (often with a gravelly or sandy component) of variable origin, with good drainage.
Vegetation: The plant community is dominated by a variable open eucalypt woodland to 15m tall or occasionally Sheoak woodland to 10m tall over a diverse ground later of grasses and herb. The shrub component is usually sparse.

Plains Grassy Woodland – EVC 55

Conservation Status: Endangered
Area in Whitehorse: minimal
An open, grassy eucalypt woodland in low (<700mm/yr) rainfall areas occurring on fertile soils on flats and gently undulating plains at low elevations (<500m above sea level).
Vegetation: The region is characterised as an open, eucalypt woodland with trees to 15m tall. The understory consists of sparse shrubs over a diverse grassy, herb-rich ground layer.

Swampy Riparian Woodland – EVC 83

Conservation Status: Endangered
Area in Whitehorse: 22 ha
Corridors along small, low-gradient gullies, usually following a watercourse. These woodlands are frequently inundated by minor flooding which often deposits silts and gravels.
Vegetation: The region is dominated by Eucalypt woodland to 15m tall with ground layer dominated by tussock grasses, sedges and herbs. Shrubs are often scattered throughout.

Riparian Forest – EVC 18

Conservation Status: Vulnerable
Area in Whitehorse: minimal
A tall forest corridor along the banks and alluvial terraces of larger waterways that are subject to flooding.
Vegetation: The region is dominated by tall eucalypts but also has an open to sparse secondary tree layer of wattles and scattered shrubs, ferns, grasses and herbs.

The information for this table was extracted from the DWELP Gippsland Plain Bioregion Analysis and the Whitehorse Sustainability Strategy 2016-2022

Bioregion Conservation Status:

The bioregion conservation status of an EVC is an assessment of its conservation status that is based on its occurrence, its level of depletion and current level of degradation.

There are five bioregional conservation status categories – presumed extinct (X), endangered (E), vulnerable (V), depleted (D), rare (R) and of least concern (LC)

Additional EVCs observed in Whitehorse

A further two EVCs have been identified within one or two reserves during the Whitehorse Biodiversity Inventory fieldwork:

- Swamp Scrub – EVC 53
- Swampy Woodland – EVC 937

Appendix C: Significant Flora of Whitehorse

The Inventory of Whitehorse Biodiversity and Urban Habitat (Practical Ecology 2019) outlines the significant flora species recorded in each reserve and their State (VROTs or DEWLP Advisory List only) Regional and /or Local significance rating as follows.

Key to Status abbreviations:

Legislative status:
EPBC – Listed as threatened under the federal Environment Protection and Biodiversity Conservation Act.
L - Listed as threatened under the Victorian Flora and Fauna Guarantee Act

Victorian Rare or Threatened (VROT):
E - Endangered in Victoria under the Victorian Advisory List
K - Poorly Known in Victoria under the Victorian Advisory List
R - Rare in Victoria under the Victorian Advisory List
V - Vulnerable in Victoria under the Victorian Advisory List

Regional status:
CE - critically endangered flora in the Greater Melbourne (GM)
R1 - regionally endangered flora in GM.
R2 - regionally vulnerable flora in GM.
R3 - regionally rare flora in GM.
R4 - regionally depleted flora in GM.
L1 - locally restricted flora in North-east Melbourne (NEM).
L2 - locally depleted flora in NEM
L3 – other locally restricted flora in NEM
RS – relatively secure flora in NM

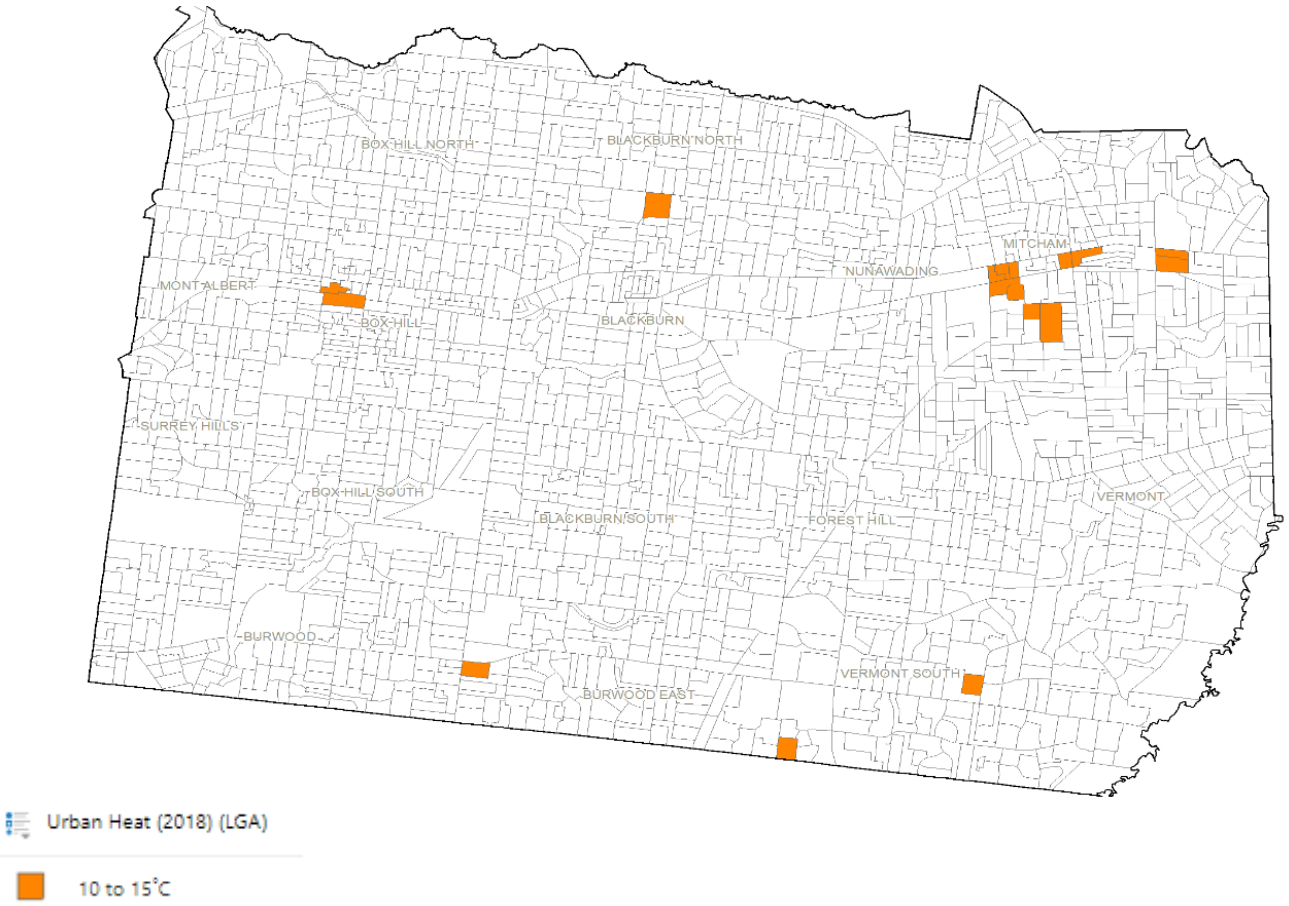
Scientific Name	Common Name	Conservation Status
Antonio Park		
Acacia aculeatissima	Thin-leaf Wattle	R4
Adiantum aethiopicum	Common Maidenhair	L
Caladenia carnea s.s.	Pink Fingers	L
Chamaescilla corymbosa var. corymbosa	Blue Stars	L
Daviesia latifolia	Hop Bitter-pea	R4
Daviesia latifolia x leptophylla	Hybrid Bitter-pea	R4
Dipodium roseum s.s.	Rosy Hyacinth-orchid	L
Diuris orientis	Wallflower Orchid	R4
Diuris pardina	Leopard Orchid	L
Glossodia major	Wax-lip Orchid	L
Hakea decurrens	Bushy Needlewood	L
Hibbertia australis	Upright Guinea-flower	R2
Laginifera gracilis	Small Bottle-daisy	L
Lindsaea linearis	Screw Fern	L
Lyperanthus suaveolens	Brown-beaks	R2
Pterostylis melagramma	Tall Greenhood	L
Pterostylis nutans	Nodding Greenhood	L
Stylidium armeria	Common Triggerplant	L
Xanthosia dissecta s.s.	Native Parsley	L
Bellbird Dell		
Adiantum aethiopicum	Common Maidenhair	L
Daviesia latifolia	Hop Bitter-pea	R4
Hibbertia australis	Upright Guinea-flower	R2
Opercularia ovata	Broad-leaf Stinkweed	L
Xanthosia dissecta s.s.	Native Parsley	L

Blackburn Lake Sanctuary		
Caladenia carnea s.s.	Pink Fingers	L
Caladenia catenata s.s.	White Fingers	CE
Calochilus paludosus	Red Beard-orchid	R4
Calochilus robertsonii	Purple Beard-orchid	L
Cryptostylis subulata	Large Tongue-orchid	R2
Dipodium roseum s.s.	Rosy Hyacinth-orchid	L
Diuris orientis	Wallflower Orchid	R4
Hibbertia australis	Upright Guinea-flower	R2
Laginifera gracilis	Small Bottle-daisy	L
Olearia phlogopappa	Dusty Daisy-bush	L
Pterostylis curta	Blunt Greenhood	L
Pterostylis melagramma	Tall Greenhood	L
Pterostylis nana	Dwarf Greenhood	R4
Pterostylis nutans	Nodding Greenhood	L
Sphaerolobium minus	Eastern Globe-pea	R2
Stylidium armeria	Common Triggerplant	L
Campbells Croft		
Adiantum aethiopicum	Common Maidenhair	L
Goodia lotifolia var. lotifolia	Golden Tip	L
Imperata cylindrica	Blady Grass	R4
Lycopus australis	Australian Gipsywort	L
Persicaria praetermissa	Spotted Knotweed	L
Esplanade Reserve		
Daviesia latifolia	Hop Bitter-pea	R4
Pterostylis nutans	Nodding Greenhood	L
Heatherdale Reserve		
Hibbertia australis	Upright Guinea-flower	R2
Pultenaea daphnoides	Large-leaf Bush-pea	L
Xanthorrhoea minor subsp. lutea	Small Grass-tree	L
Highbury Park		
Hibbertia riparia	Erect Guinea Flower	L
Microtis unifolia	Onion orchid	L
Rytidosperma indutum	Tall Wallaby Grass	R4
Joseph Street Reserve		
Xanthorrhoea minor subsp. lutea	Small Grass-tree	L
Senecio runcinifolius	Tall Groundsel	L
Lagenophora gracilis	Slender Bottle-daisy	L
Senecio bathurstianus	Dissected Fireweed	R2
Pterostylis concinna	Trim Greenhood	R4
Caesia calliantha	Blue Grass-lily	R2
Koonung Creek Reserve		
Dianella sp. aff. longifolia (Benambra)	Arching Flax-lily	vulnerable (VROTs)
Xerochrysum viscosum	Shiny Everlasting	R4
Pterostylis concinna	Trim Greenhood	R4
Lookout Trail		
Eucalyptus yarraensis	Yarra Gum	Rare (VROTs)
Morack Golf Course		
Eucalyptus yarraensis	Yarra Gum	Rare (VROTs)

R E Gray Reserve		
Acacia aculeatissima	Thin-leaf Wattle	R4
Caesia calliantha	Blue Grass-lily	R2
Cassytha pubescens s.s.	Downy Dodder-laurel	L
Diuris chryseopsis	Golden Moths	R4
Eucalyptus leucoxylon subsp. connata	Melbourne Yellow-gum	vulnerable (VROTs)
Hakea decurrens subsp. physocarpa	Bushy Needlewood	L
Lagenophora gracilis	Slender Bottle-daisy	L
Pterostylis nutans	Nodding Greenhood	L
Thelymitra pauciflora s.s.	Slender Sun-orchid	L
Xerochrysum viscosum	Shiny Everlasting	R4
Schwerkolt Cottage		
Senecio campylocarpus	Floodplain Fireweed	Rare (VROTs)
Somers Trail		
Adiantum aethiopicum	Common Maidenhair	L
Goodia lotifolia var. lotifolia	Common Golden-tip	L
Pteris tremula	Tender Brake	R4
Stephens Reserve		
Caesia parviflora var. parviflora	Pale Grass-lily	R4
Centella cordifolia	Centella	L
Glossodia major	Wax-lip Orchid	L
Pterostylis nutans	Nodding Greenhood	L
Rytidosperma lepidopodum	Scaly-foot Wallaby-grass	R4
Trove Park		
Banksia spinulosa var. cunninghamii	Hairpin Banksia	L
Hakea decurrens subsp. physocarpa	Bushy Needlewood	L
Wandinong Sanctuary		
Acacia stictophylla	Dandenong Wattle	Rare (VROTs)
Allocasuarina littoralis	Black Sheoak	L
Banksia spinulosa var. cunninghamii	Hairpin Banksia	L
Eucalyptus globoidea	White Stringybark	R4
Pterostylis curta	Blunt Greenhood	L
Pterostylis nana	Dwarf Greenhood	R4
Pterostylis nutans	Nodding Greenhood	L
Senecio bathurstianus	Dissected Fireweed	R2
Wurundjeri Walk		
Hypolepis rugosula	Ruddy Ground-fern	L
Pteris tremula	Tender Brake	R4
Yarran Dheran		
Allocasuarina littoralis	Black Sheoak	L
Cynoglossum suaveolens	Sweet Hound's-tongue	L
Hakea decurrens	Bushy Needlewood	L
Spirodela polyrhiza	Large Duckweed	Poorly known (VROTS)

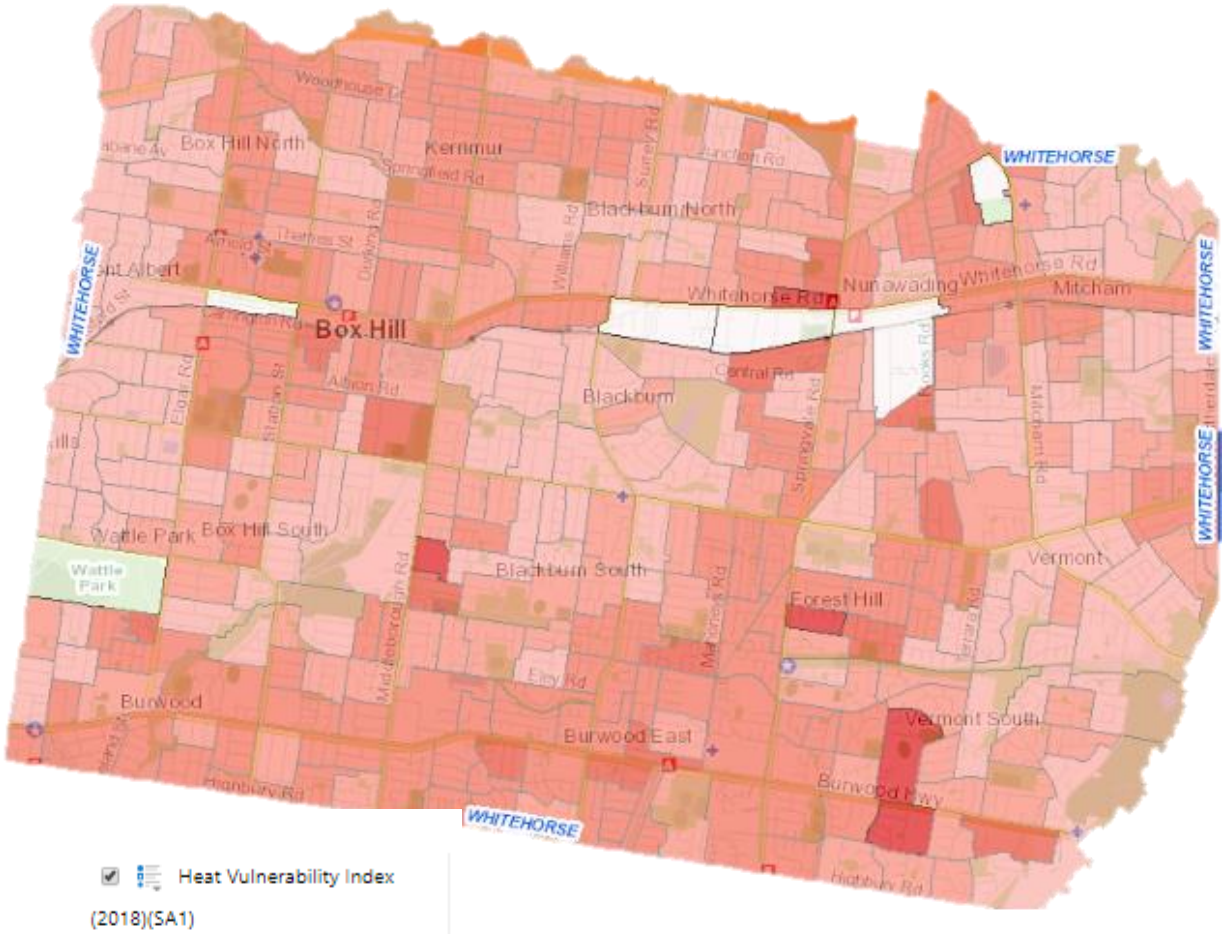
Appendix D: Hot spots in Whitehorse

Data and mapping produced by the Department of Environment, Land, Water and Planning indicates that on average, Melbourne's urban areas are over 8˚C hotter than non-urban areas (DELWP 2019a). This map identifies areas that are particularly hot, 10 degrees or higher known as hot spots. For more detail visit http://mapshare.maps.vic.gov.au/coolinggreening/



Appendix E: Heat Vulnerability Index

The **heat vulnerability index** (HVI) indicates how vulnerable specific populations are to extreme heat events. The HVI consists of three indicators: heat exposure, sensitivity to heat, and adaptive capability of the population within that area. Vulnerability ratings are determined by the sum of the aggregated indicators and are scaled from 1 to 5 (1 = low vulnerability, 5 = high vulnerability). The map below has been adapted from the Cooling and Greening Melbourne Interactive Map showing the distribution of HVI across Whitehorse as recorded in 2018 (DELWP 2019a).



Heat Vulnerability Index (2018)(SA1)

- 5
- 4
- 3
- 2
- 1
- No data