

DRAFT URBAN ECOLOGY AND BIODIVERSITY STRATEGY

The city as an ecosystem



FOREWORD

Message from the City of Melbourne

Insert
images

Text to be written

Lord Mayor

Cr Arron Wood

Endorsement from Traditional Owners

Text to be written

Acknowledgements

The City of Melbourne respectfully acknowledges the Traditional Owners of the Land.

For the Woiwurrung (Wurundjeri), Boonwurrung, Taungurong, Dja Dja Wurrung groups who form the Kulin Nation, Melbourne has always been an important meeting place for events of social, educational, sporting and cultural significance.

The City of Melbourne is proud that Melbourne is a significant gathering place for all Aboriginal and Torres Strait Islander people.

Many people have contributed ideas presented within this strategy including within the broader City of Melbourne community, researchers at the Australian Research Centre for Urban Ecology (ARCUE), RMIT and the University of Melbourne.

A note on terminology

This report uses the term 'Aboriginal' rather than 'Indigenous' to refer to the First Nation Peoples of mainland Australia as this strategy relates specifically to the area of Melbourne, Victoria. The City of Melbourne recognises that the term 'Aboriginal' refers to a number of specific individuals and communities within Melbourne, Victoria¹. The term 'Indigenous' is used in instances where other individuals, literature or institutions and their initiatives have been quoted or referred to.

CONTENTS

VISION	6
1. EXECUTIVE SUMMARY	6
1.1 Why is an urban ecology and biodiversity strategy necessary?	7
1.2 Objectives.....	8
2. BACKGROUND AND CONTEXT	9
2.1 Why is ecology and biodiversity important for cities?	9
2.2 National and international context	10
2.3 Benefits of urban ecology and biodiversity	10
2.4 Challenges and opportunities	11
2.5 The new role of cities as havens for biodiversity	12
2.6 Nature in the city today	12
2.7 Community consultation.....	14
2.8 Looking towards the future.....	15
PRINCIPLE 1 – CONNECT PEOPLE TO NATURE	16
3.1 Strategy 1 – Explore the ways in which cultural and practical ‘Caring for Country’ principles will assist in integrating people with nature.....	16
3.2 Proposed Actions	16
3.3 What is Country?.....	16
3.4 What is Caring for Country?.....	17
3.5 How can Caring for Country be applied in Melbourne today?	18
3.6 Strategy 2 – Connect people to nature to improve social resilience, health and wellbeing	20
3.7 Proposed Actions	20
3.8 Biodiversity improves human health and wellbeing.....	19
3.9 Biodiversity builds social resilience.....	19
3.10 Connecting people to nature.....	19
3.11 Fostering stewardship.....	21
PRINCIPLE 2: PROTECT AND ENHANCE HEALTHY ECOSYSTEMS AND BIODIVERSITY ...	22
4.1 Strategy 3 – Protect and enhance existing habitat to support greater biodiversity in a changing climate	22
4.2 Proposed Actions	22
4.3 What does habitat in the city look like?.....	22
4.4 Managing for the future	23
4.5 Enhancing existing green spaces	23
4.6 Monitoring biodiversity over time	25

4.7 Strategy 4 – Support habitat creation within the private realm and other public land to maximize diversity and connectivity	26
4.8 Proposed Actions	26
4.9 Creating a connected habitat network	26
4.10 The expanding private realm	29
4.11 Unleashing the potential of private realm	30
PRINCIPLE 3: DEMONSTRATE LOCAL AND GLOBAL LEADERSHIP	31
5.1 Strategy 5 – Demonstrate local and global leadership in urban ecology and biodiversity..	31
5.2 Proposed Actions	31
5.3 Demonstrating leadership in urban ecology and biodiversity management.....	31
6. IMPLEMENTATION FRAMEWORK	32
6.1 Green Governance	32
6.2 Priority Implementation Actions Identified within the Strategy	32
6.3 Preliminary Targets Identified within the Strategy	33
6.4 Measurement, Monitoring and Review	33

VISION

The City of Melbourne will support a diverse, resilient and healthy ecosystem that contributes to the health and wellbeing of our community and the foundation of a liveable city.



1. EXECUTIVE SUMMARY

This is the City of Melbourne's first Urban Ecology and Biodiversity Strategy and is a companion document to the Urban Forest Strategy. It is the product of a collaborative process, developed with information, ideas and advice provided by a large number of stakeholders including local academics, interest groups including Traditional Owners and the broader community in Melbourne. In particular, the Australian Research Centre for Urban Ecology (ARCUE) has provided input and advice throughout the development of this document. This strategy responds to a core deliverable as identified in the City of Melbourne's Urban Forest Strategy.

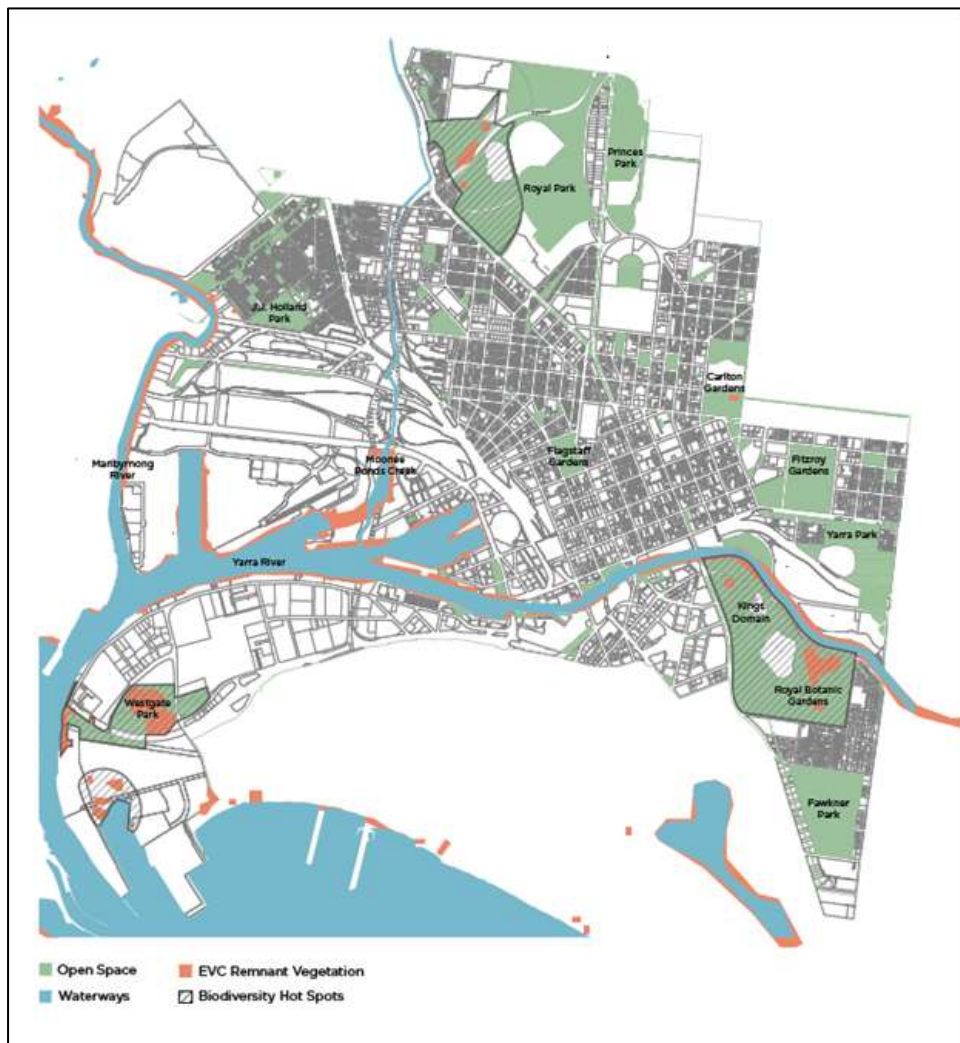
Healthy ecosystems and rich biodiversity are vital for the liveability and wellbeing of our city. Protecting and enhancing biodiversity will support the health and wellbeing of our community and contribute to effective climate change adaptation actions. The City of Melbourne has developed this strategy to provide direction about how it manages and enhances the municipal ecology, biodiversity and ecosystem services. This strategy recognises that nature is diverse, that there are numerous benefits to supporting biodiversity, and that action is required to support and enhance it. By considering our city as an ecosystem, there is the opportunity to actively foster connections between people, plants, animals and the landscape, to create the legacy of a resilient, balanced and healthy urban environment for future generations to enjoy, and to nurture delight in the natural environment.

As the capital city of Victoria, the City of Melbourne is uniquely positioned to demonstrate responsible stewardship and that it is possible for urban ecosystems to both exist in a highly urbanised area and thrive. Cities can play a key role in protecting and maintaining biodiversity. Far from being barren concrete jungles, cities are emerging as havens for many species of plants and animals. The City of Melbourne has a unique opportunity to create a healthy, resilient ecosystem for the future and play a leading role in biodiversity and ecology advocacy in an urban context. This strong leadership will enable us to unleash the potential of nature, and continue to maintain a liveable city in a climate challenged future. Further, Traditional Owners attach great cultural significance to the species and landscapes that feature in their Dreamtime and creation stories. Good management of biodiversity is therefore important in enabling Traditional Owners to continue to practise their culture.

1.1 Why is an urban ecology and biodiversity strategy necessary?

Melbourne is Victoria's capital city and the business, administrative, cultural and recreational hub of the state. The City of Melbourne municipality covers 37.6 km². It is made up of the city centre and a number of inner suburbs each with its own distinctive character and with different businesses, dwellings and communities living and working there.

The municipality of Melbourne is home to significant plant and animal biological diversity²³. While the City of Melbourne has a number of strategies that help provide space for people and biodiversity, this strategy explicitly outlines how the City of Melbourne will care for the full range of biodiversity in the municipality. It will guide us to enable our vision of a city that will support a diverse, resilient and healthy ecosystem.



The City of Melbourne municipal boundaries and overview of open spaces, waterways, remnant vegetation and biodiversity hotspots. Note: EVC refers to 'Ecological Vegetation Class'

The city currently faces two complex challenges - climate change and accelerated urban growth. It is estimated that approximately 891,000 people (residents, commuters and visitors combined) are present in our municipality on an average weekday. It is predicted that by 2055 the population of Greater Melbourne will reach eight million, making it Australia's biggest city⁴. This population growth will place increasing pressure on the built form, services

What is biodiversity?

Biodiversity is the variety of all life forms on earth; different plants, animals and microorganisms; their genes; and the terrestrial, marine and freshwater ecosystems of which they are a part (National Biodiversity Strategy Review Task Group, 2009). Biodiversity exists at three levels; genes, species and ecosystems. Indigenous biodiversity refers to the living things that originate in and are characteristic of a particular place – such as Melbourne.

and people of the city. At the same time, expected changes to the local environment due to climate change, including increase in storm and flood events and conversely long dry periods and extreme heat, will have significant implications for the species that can thrive within the municipality⁵.

Historically, urban biodiversity initiatives focus on remnant vegetation and indigenous plants and animals. However, the latest research in this area highlights that all biodiversity plays a role in contributing to healthy and resilient urban ecosystems. The inclusion of urban ecology in this strategy recognises there are important and inevitable interactions that occur between people and nature in Melbourne, and that there is a notable opportunity to deliver positive outcomes for both when considered together.

This strategy forms part of the City of Melbourne commitment to create a resilient, healthy and diverse natural environment that will contribute to the health and wellbeing of our community and the creation of a liveable city. It will build on Council strategies that relate to green space, sustainability and green infrastructure including the Urban Forest Strategy, Total Water Mark- City and a Catchment Strategy, Climate Change Adaptation Strategy, Zero Net Emissions Strategy, and projects such as Green Your Laneways, the Growing Green Guide, and the Rooftop Project.

1.2 Objectives

This strategy envisions a municipality that supports a diverse, resilient and healthy ecosystem that contributes to the health and wellbeing of our community and to the creation of a liveable city. The benefits of biodiversity in the built environment will be well understood. Society will place a high value on biodiversity and communities will be active in protecting and enhancing the nature around them. This will result in improved health and wellbeing in communities and healthier, more connected habitats with a greater resilience in the face of challenges such as population growth and climate change.



This strategy shares the three key priorities identified in the Urban Forest Strategy. To deliver successful outcomes that enhance the health and resilience of the social and ecological components of our city, it is essential to **engage with the community, manage our existing landscapes and adapt landscapes to new conditions.**

The strategy is underpinned by the following principles:

Principle 1. Connect people to nature.

Principle 2. Create a diverse, connected and resilient ecosystem

Principle 3. Demonstrate local and global leadership

What is an ecosystem?

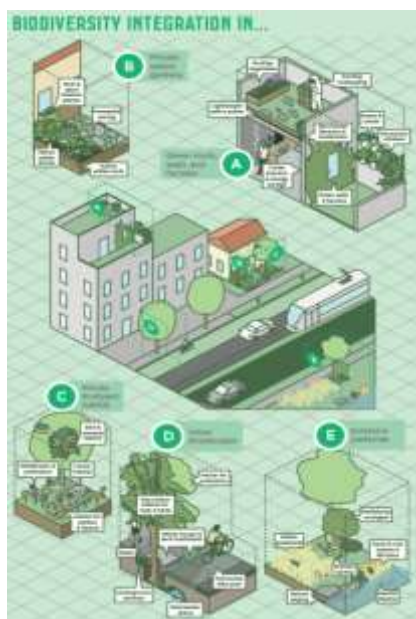
Ecosystems comprise natural components and include plants, animals, water, soil, air and their interactions. Cities are urban ecosystems which include both nature and humans, in a predominately human-built environment. Functioning ecosystems are the foundation of human wellbeing and most economic activity (TEEB, 2011).

2. BACKGROUND AND CONTEXT

2.1 Why is ecology and biodiversity important for cities?

The municipality is home to a world-renowned network of parks, gardens and streetscapes. These green layers contribute to its status as one of the world's most liveable cities. Whilst much is heard about Melbourne's liveability, its rich biological diversity is less often celebrated.

Biological diversity refers to a variety of nature, including all living organisms and the ecosystems they form. Biodiversity provides the foundation for goods and services that nature provides which are essential for the survival of humans and all living organisms. These 'ecosystem services' can be defined as the benefits that are obtained from the environment that contribute directly or indirectly to human wellbeing, such as clean air, clean water and climate regulation⁶. Urban biodiversity applies to the genes, species and communities of *all species* within the municipality. Locally indigenous plants and animals require specific attention if they are to be conserved, but there are also opportunities to enhance urban biodiversity outcomes by including the plants, animals and microorganisms that now call Melbourne home, regardless of whether their introduction was deliberate or accidental. This strategy focuses on this full complement of biodiversity that occurs within the municipality, in the present and future.



What are 'ecosystem services'? They are the benefits that are obtained from the environment that contribute directly or indirectly to human wellbeing, such as clean air, clean water and climate regulation

Cities are well known for their tall buildings, large numbers of people and extensive areas of paved surfaces. Far from being "concrete jungles", cities are living and breathing ecosystems with intertwining networks of blue (rivers, streams, wetlands and marine areas), green (parks, gardens, remnant vegetation, riparian zones, streetscapes, green roofs, green walls, water-sensitive urban design areas) and grey (roads, buildings and other "hard" infrastructure). These networks support a range of biodiversity from the indigenous plants and animals that lived in the area prior to urbanisation to the new animals and plants which have arrived through the deliberate and indirect actions of humans.

The blue and green networks within cities are increasingly recognised for both the resources they provide for biodiversity, as well as their importance in sustaining happy and healthy human lives. Extensive areas of green and blue cover help to moderate local air temperatures, provide pleasant spaces for fitness or relaxation, contribute to the character of an area, and provide habitat for many different plants, animals and microorganisms. This biodiversity also contributes to healthy urban ecosystems through pollination, regulation insects and other pests, development of healthy soils, and the sheer joy and delight of observing nature and animals in peoples' day-to-day lives.

2.2 National and international context

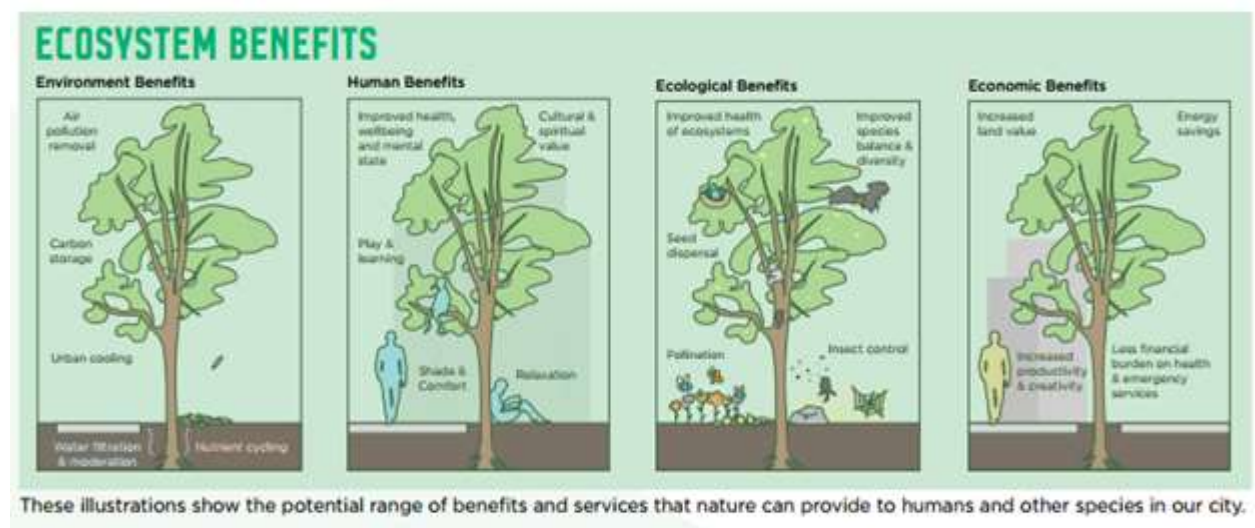
Biodiversity is recognised as a regional, national and global priority. As well as the intrinsic value of biodiversity for its own sake, there is an increasing body of evidence to suggest that it plays a critical role in the health and liveability of cities⁷. Indeed the Victorian State Government is currently consulting on its Biodiversity Strategy. It is becoming increasingly clear that cities can play a vital role in preserving biodiversity- not only in terms of education and advocacy but also in providing havens for some of the most vulnerable species. Cities have an important obligation to contribute to safe-guarding biodiversity on local and international scales. This strategy will support regional initiatives such as Plan Melbourne, The Regional Catchment Strategy for the Port Phillip and Western Port region and Protecting Victoria's Environment – Biodiversity 2036, and is consistent with the objectives of the Australian Biodiversity Conservation Strategy 2010-2030 and strategies identified in the United Nations Convention on Biological Diversity.

'Protecting Victoria's Environment – Biodiversity 2036' is the Victorian State Government's draft plan for managing the State's biodiversity. Two Goals underpin the stated vision of 'Victoria's biodiversity is healthy, valued and actively cared for'.

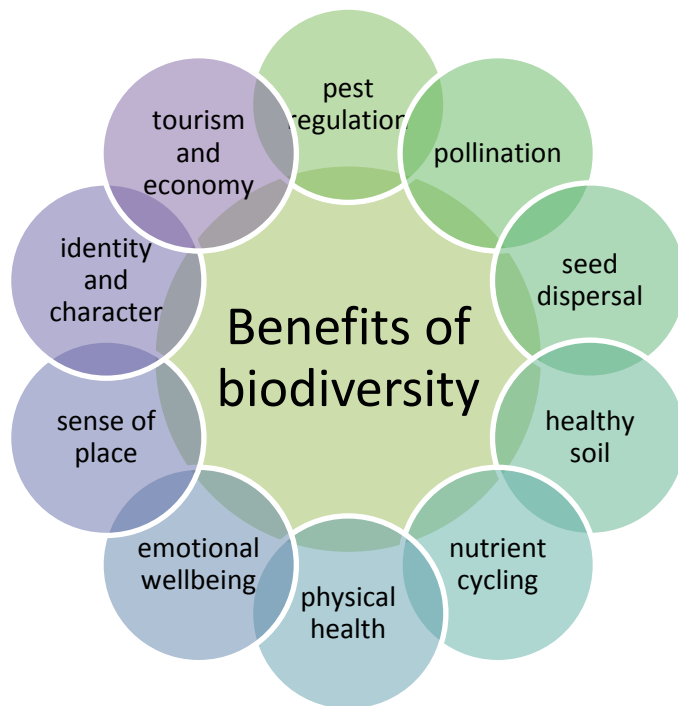
1. To encourage more Victorians to value nature.
2. To ensure that Victoria's natural environment is healthy.

2.3 Benefits of urban ecology and biodiversity

Australians are increasingly recognising the benefits provided by the natural environment. In cities, ecosystems play a crucial role in maintaining people's health and wellbeing through providing meaningful places where they can live, work and play, as well as healthy environments where their basic needs of clean air, water and food are provided for. Biodiversity is crucial to the functioning of these ecosystems and therefore underpins the delivery of many of these benefits.



The city's urban forest comprises 77,000 trees and many thousands of plants which remove significant amounts of pollution to clean the air that people breathe each day. This ecosystem service is critical for ameliorating the impact of vehicle and transport emissions in the city and supporting the health and wellbeing of those who inhabit and traverse the city.



The benefits of biodiversity – these are further outlined in Appendix 1

2.4 Challenges and opportunities

As the city has developed, a gradual erosion of nature and decline of many of the ecosystem services listed above has occurred. This strategy considers how to build and shape the city into the future in order to maintain or increase biodiversity to create a healthy and liveable urban form whilst contending with the challenges of rapid population growth, urban densification, an increase in invasive species and climate change.

Population growth

Greater Melbourne is home to nearly three-quarters of all Victorians and is Australia's fastest growing city. Creating healthy, habitable, urban living spaces for so many more people will be one of the defining challenges of current times. As the population grows there is a risk that people will find it difficult to access quality green space and become increasingly disconnected from nature, which in turn has detrimental effects on health, obesity and mental illness. However, cities are where most people live, work and play, so enhancing biodiversity in cities can benefit a great number of people⁸.

Urban densification

Urban growth and densification leads to increased pressure on biodiversity through habitat destruction, fragmentation and degradation. One of the biggest challenges that Melbourne faces is reducing the impact of urban development on natural ecosystems. A city's ecological footprint contributes significantly to biodiversity loss, both locally and at the global level. Cities hold the key to changing production and resource use – by decreasing waste production, increasing recycling, and moving citizens to more sustainable forms of consumption. The effects of these positive changes will be large and have far-reaching implications for biodiversity.

Invasive and pest species

Greater Melbourne is home to many introduced and native pest species. By competing with or preying on other plants and animals pest species can cause catastrophic declines in species populations and biodiversity. Weed invasion is the most commonly identified threat to native plants. After habitat loss,

predation by introduced species (mostly foxes and feral cats) is regarded as being the major threat to endangered terrestrial native animals.

Despite the problems that occur with introduced and pest species, a return to an urban ecosystem that resembles that which originally existed is unrealistic. A richer and more nuanced understanding of urban biodiversity is now emerging that recognises the native and cultivated plants and animals that persist in Melbourne's parks, gardens, rivers and other areas. Locally indigenous plants and animals require specific attention if they are to be conserved, but there are also opportunities to enhance urban biodiversity outcomes by including the plants, animals and microorganisms that now call Melbourne home, regardless of whether their introduction was deliberate or accidental. This strategy focuses on this full complement of biodiversity that occurs within the municipality, both now and into the future.

Climate change

The global climate is changing. Some of the risks and stressors that the municipality is subjected to under climate change include reduced rainfall and more frequent periods of drought, extreme heatwaves and bushfires, intense rainfall events, wind storms and sea level rise. In urban areas, many of these changes have been accelerated through the urban heat island effect and changes to moisture availability due to hard infrastructure as well as shifting local rainfall patterns. Temperature differences of up to 7°C have been recorded between the urban centre and Greater Melbourne's surrounding rural landscape, with the dome of the heat island centred on the municipality. By 2070, the average temperature is predicted to increase by 3.4°C due to global climate change based on business-as-usual scenarios⁹. It is also unknown how climate change will impact upon the traditional seasons. As the city continues to develop, increasing areas of impervious surface may further amplify the effect of these urban stressors. Managing these urban stressors will enable a broader range of species to persist within the municipality.

The city's urban forest and open spaces play an important role in mitigating these impacts as outlined in the City of Melbourne's Urban Forest Strategy and Open Space Strategy. It is expected that through the implementation of the Urban Forest Strategy, doubling the canopy cover will go some way to decrease municipal summertime temperatures. However, this target can be supported by measures to improve biodiversity and urban ecology, such as understorey planting.

2.5 The new role of cities as havens for biodiversity

Historically, cities developed in areas where there is ready access to a range of natural resources. These highly productive landscapes also tended to support a high diversity of locally indigenous plant and animal species¹⁰. A recent study has demonstrated that over 30% of Australia's threatened species are found in 99 of the country's largest urban areas - disproportionately high occurrence when compared to the physical extent of land these areas represent¹¹. For these reasons, conservation efforts that value the contribution of urban biodiversity and include the protection of biodiversity in urban environments are a critical consideration if the loss of local species is to be slowed.

Cities can play an unexpected role in protecting biodiversity – for example as European honeybees and other pollinator populations have been declining around the world, they have been sustained in urban environments. Bee health has recently been linked to interactions between parasites, pesticides and a reduction in the number of flowers available¹². It is considered that the lack of extensive broad-scale pesticide use in cities and the abundance of flowers throughout the year may contribute to supporting pollinators in urban habitats.

2.6 Nature in the city today

Prior to European colonization, the land where the city now sits was comprised of low lying floodplains filled with saltmarshes, swamps, wetlands and the meandering Yarra River, rising gently to areas of grassy woodlands dominated by the graceful figures of mature river red gum trees and wattles. A small creek wound down what is now Elizabeth St, and a small rocky waterfall separated the salt water of the bay from the freshwater of the Yarra River's upper catchments. The people of the Kulin Nation had lived within the landscape for thousands of years and witnessed many changes, including the retreat of ocean levels during the last ice age, and the re-establishment of Port Phillip Bay in the form apparent today.

Melbourne today is home to many different landscapes and characters that reflect its Indigenous, European colonial and immigrant history. The CBD, comprising the Hoddle Grid and concentrated development of skyscrapers and other tall buildings interspersed with laneways, acts as a hub of human activity, drawing in large numbers of people both day and night. Large landscaped parks such as Flagstaff Gardens, Treasury Gardens, Fitzroy Gardens, Queens Gardens, Fawkner Park and the Royal Botanic Gardens provide quiet places for recreation, relaxation or meeting friends. Established residential neighbourhoods around Parkville, North Melbourne, and Kensington with their mixture of house styles and personal gardens reflect the diversity of local residents. The waterways flowing through the city include the iconic Yarra River, Maribyrnong River and Moonee Ponds Creek. Iconic streetscapes in St. Kilda Rd and Royal Parade showcase the city's colonial European history while the wide open spaces of Royal Park, Westgate Park and sections of Moonee Ponds Creek reflect its pre-European indigenous landscapes, and provide access to the "wilder" parts of nature. Collectively, these landscapes chart the history of the city's development, and the ongoing relationship it has had with innovative urban design.

The diverse character of the city's landscape plays host in turn to varied biodiversity - whether watching the birds, frogs and turtles at the Royal Park wetlands, walking past the flower meadow at Birrarung Marr on the way to a sporting event, enjoying a quiet lunch with the oak trees and perennial flower beds at Carlton Gardens, or strolling down a grand avenue of elm trees on St Kilda Rd or Royal Parade; the plants, animals and insects of the city all contribute to shaping its identity and character. It is these unexpected interactions with nature in a dense urban environment - the rainbow lorikeets congregating in palm trees, the brush tail and ringtail possums in parks, the calls of the green tree frog or the spotted marsh frog – that help make the City of Melbourne a unique place in the world.

These green spaces support iconic species like the kookaburra, blue tongue lizard and fairy wren and provide habitat for regionally significant populations of White's skink and vulnerable species such as the powerful owl. Microbats roost in the tree hollows, seals and dolphins occasionally venture into the bay, pipe-fish reside under the Westgate Bridge and nationally rare species of moth occasionally flutter through. Recent initiatives, including Melbourne BioBlitz, (see page 21), have successfully

Melbournians share the municipality of Melbourne with around 150 species of birds, 7 species of reptiles, 12 species of mammals, 4 species of frogs and over 1300 species of insects and at least 15 species of fish¹⁰.

There are recent records for six nationally threatened species, protected by the Environment Protection and Biodiversity Conservation Act (EPBC); the Australasian bittern, swift parrot, grey headed flying fox, Australian painted snipe, swamp everlasting and Angelsea grevillea,

The city is also home to a number of species protected by the *Fauna and Flora Guarantee Act 1988 (Vic)*. This includes birds such as the great egret, intermediate egret, powerful owl and grey goshawk and around 11 plant species including salt lawrence and the woolly water lily,

engaged communities with nature in the city and helped to develop a baseline for biodiversity using the power of citizen science.

2.7 Community consultation

Over the past three years, this strategy's development has been conducted in a highly collaborative and transparent way in order to understand the community's perception and expectations about biodiversity within the city. As part of this collaborative development, a discussion paper was released to start the conversation with the community about Urban Ecology – 'Unleashing the Potential of nature Discussion paper on City Ecology, ecosystems and biodiversity'¹³. 'Participation in development of the strategy has also been driven strongly through the City of Melbourne's Participate Melbourne webpage (<http://participate.melbourne.vic.gov.au/nature>.)

The City of Melbourne has consulted with the public by:

- Online and face to face forums on city ecology, ecosystems and biodiversity guided by the discussion paper 'Unleashing the potential of nature', from February to April 2015. 200 members of the public attended the facilitated public forum, with 3,323 people visiting the online forum via the Participate Melbourne website
- Five external stakeholders meetings including the one with Elders of Wurundjeri Tribe Land Council
- 18 internal stakeholder meetings
- Facebook campaigns from February to April, 2015, reaching a total audience of 45,677 people.

'Unleashing the Potential of Nature in Melbourne Community Consultation Report' summarises in detail the feedback from the community¹⁴.



Left: Community discussion forum. Right: Keywords linked to the importance of biodiversity to society, as a result of the survey. The size of the words is proportional to the amount of times the words were found within answers.

The following tenets have also informed and underpin the development of this strategy –

Recognising and enhancing the integral relationship between people and nature is fundamental to the city's future. The actions of the people who live, work and play in the city have a direct impact on its health and resilience, and the urban ecosystem has a direct impact on the health and resilience of its people.

People value nature for many different reasons. While some people respond to the intrinsic values of knowing biodiversity is present in the landscape, other people may appreciate nature for the resources it provides, the opportunities it presents for recreation or other experiences, or the connection it may have with their heritage and culture. The strategy and its implementation needs to cater for the ranges of values people hold for natural areas.

Resilient biodiversity is essential to a healthy, liveable, prosperous city. By maximising biodiversity, more options are created for ecological systems to adapt to future stressors and therefore increase the likelihood that the city will remain resilient into the future.

Engaging the private realm and looking beyond municipal boundaries will be critical to successful implementation. A holistic view will be required to establish a habitat network and functioning corridors across the city and beyond the city's boundary.

Better outcomes for the city will be achieved by increasing the value people place on biodiversity and nurturing genuine partnerships. These partnerships encompass State government, local authorities, Victoria's Aboriginal people, business, industry, and the community who live, work and play in the city, and many other stakeholders

Collaboration with researchers will be critical to successful implementation. Collaborating to enable more meaningful and informed targets to be established and effective monitoring of the impact of initiatives is critical.

2.8 Looking towards the future

Three primary principles have been identified to achieve the vision of the city as a diverse, resilient, and healthy ecosystem. The principles and strategies identified in the strategy have been developed after consultation and include outcomes from workshops, community engagement, research partnerships and the 'Unleashing the Potential of Nature' discussion paper¹⁵.

Vision: City as an ecosystem					
Principle	Principle 1: Connect people to nature		Principle 2: Create a diverse, connected and resilient ecosystem		Principle 3: Demonstrate local and global leadership
Strategy	Strategy 1: Explore the ways in which cultural and practical 'Caring for Country' principles will assist in integrating people with nature.	Strategy 2: Connect people to nature to improve social resilience, health and wellbeing	Strategy 3: Protect and enhance existing habitat to support greater biodiversity in a changing climate	Strategy 4: Support habitat creation within the private realm and other public land to maximize diversity and connectivity	Strategy 5: Demonstrate local and global leadership in urban ecology and biodiversity

PRINCIPLE 1 – CONNECT PEOPLE TO NATURE

3.1 Strategy 1 – Explore the ways in which cultural and practical ‘Caring for Country’ principles will assist in integrating people with nature.

By supporting and embracing a Caring for Country approach, the City of Melbourne will be more effective in nurturing, sharing and communicating the important relationship between people and nature.

Proposed Target: Work with Traditional Owners and the local Aboriginal community to identify opportunities to celebrate, promote and educate about *Caring for Country* approaches such as the local seasons.

3.2 Proposed Actions

- Investigate an appropriate and effective partnership model to support and inform this strategy in conjunction with key researchers, Traditional Owners and the local Aboriginal community.
- Protect existing indigenous vegetation and increase the use of indigenous planting practices.
- Support partnerships and research that further Caring for Country knowledge.
- Identify initiatives that celebrate the cultural and environmental significance of the Yarra River and other waterways.
- Work with Traditional Owners and the local Aboriginal community to explore opportunities to create a new public space where ceremonies and traditional practices can be carried out.

The City of Melbourne has collaborated with representatives of the Kulin Nation, in the spirit of reconciliation and in recognition of our shared future on the content of this Chapter. The City of Melbourne pays deep respect to the Kulin Nation elders, past and present, who have nurtured this Country for many thousands of years and generously share their traditional knowledge.

The City of Melbourne has a long and proud natural and cultural history. This began with the Woiwurrung (Wurundjeri), Boonwurrung, Taungurong, Dja Djawurrung, and Wauthaurong people of the Kulin Nation, who inhabited a landscape that was rich in wetlands, and open scattered forest. For the people of the Kulin Nation, Bunjil (an eaglehawk) is the creator spirit of the land, the lore and its people. As First Nations people, the Kulin Nation had, and continue to have, an intimate understanding of, and a deep connection with the land.

3.3 What is Country?

Country is the term used by Aboriginal people to describe their home – the land, water, air, natural systems, living things and stories that make up a place. The word *Country* cannot be replaced by landscape or environment because *Country* also refers to people, past, present and future, as well as culture and heritage. In a contemporary context, country includes the built form within the city.

The area known as Melbourne today is the *Country* of the people of the Kulin Nation. Unlike western notions of land ownership, Country is not ‘owned’ but rather it is cared for by its people. In fact, people are seen to belong to *Country*, the same way one belongs to a family. Humans are seen as a part of nature, as opposed to the traditional Western view of nature being separate from humans and an economic resource to be utilised.

3.4 What is Caring for Country?

Country is considered to be a living being, sometimes referred to as a brother or mother. The relationship between people and *Country* is one of symbiosis, where it is understood that if people care for *Country*, *Country* will in turn care for them. This notion refers in part to the idea that human physical and spiritual health and wellbeing is directly linked to the health of the environment. Humans rely on healthy ecosystems for essential things like clean air and water, so protecting and enhancing the function of ecosystems is critical for community wellbeing.

Caring for Country is a belief system and land management practice that seeks to retain natural balance and abundance. In a practical sense, *Caring for Country* is about recognising that natural resources are finite and managing them sustainably, but in a cultural and spiritual sense it is about respecting and valuing natural systems as the source of all life. *Country* is healthy when natural systems are able to function effectively and everything is in balance.

Seasons in Melbourne

Caring for Country requires a deep understanding of natural systems and processes, which Aboriginal people have developed through more than 40,000 years of connection and experience. An example of this local knowledge is their understanding of seasons. Unlike the European notion of four seasons, the Wurundjeri people identified six seasons in Melbourne (there are many variations in the number of seasons recognised depending on unique local environment and cultural practices). Reading the seasonal rhythm helped maximise the availability of food and shelter. When food was plentiful there

were opportunities to carry out ritual responsibilities and ceremonial gatherings.

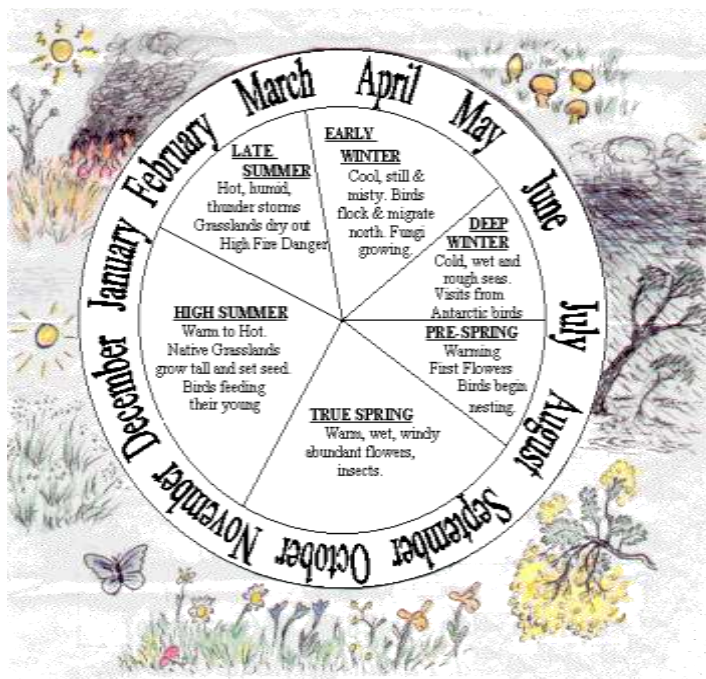


Image and Text Provided courtesy of Wurundjeri Tribe Land & Compensation Cultural Heritage Council Incorporated

Seasons were defined not only by temperature and the amount of rainfall, but also by more subtle distinctions related to patterns of rainfall and the types of events. For example, even though the months of April and May have similar levels of rainfall, it is common for April rain to occur in the first half of the month and May rain to occur in the second half of the month. In fact, there are actually

three seasons in the traditional 'autumn'. These are in turn a warm wet autumn, a cool dry autumn, and a cool wet autumn.

Season	Events
Iuk	Eels migrate up the river, eels traps are made - March
Waring	Wombats burrowing and hibernating – April to July
Guling	Orchids flower and the starchy tubers are ready to harvest - August
Poorneet	Tadpole season – a time of plenty. September and October
Buath Gurru	Grass flowering season, bats feed on abundant insects - November
Kangaroo Apple	Kangaroo apple fruit is ready to harvest - December
Biderap	Dry season – January - February
<i>Information provided by Wurundjeri as part of the Return To Royal Park Project</i>	

Each season is marked by the movement of the stars in the night sky and changes in the weather, coinciding with the life cycles of plants and animals. Overlaid on the traditional seasons are another two non-annual seasons - Flood season, which is likely to occur on average about every 28 years, and Fire season, which occurs on average about every seven years.

3.5 How can Caring for Country be applied in Melbourne today?

There is a common misconception that Aboriginal Australians live predominantly in remote places. As such, the application of Caring for Country principles has to date been restricted to remote or rural Australia. However, 33 per cent of Aboriginal Australians and Torres Straight Islanders live in cities and there is a great opportunity for Melbourne to demonstrate leadership in the urban context.

At a time when the city is experiencing the impacts of climate change and urban growth pressure, combining traditional knowledge with contemporary understandings can provide a holistic framework for meeting these challenges. The principles of Caring for Country can be respectfully applied in modern Melbourne to celebrate and acknowledge Aboriginal culture and also contribute to a more sustainable city. Some opportunities are detailed below, and a more comprehensive examination of the opportunities is detailed in the report *Caring for Country: An urban application*¹⁶.

Revaluing nature

The first step to integrating Caring for Country is to reassess the value placed on nature. This means recognising that humans rely on the abundance of nature to survive, but also to be happy and healthy. The outcome of revaluing nature should be that when individuals, organisations, governments or groups are making decisions, the impact of their actions on natural systems will be considered as important as any other factor.

Reinterpreting 'sustainability'

In many ways, the modern sustainability movement operates on the same principles and seeks to achieve the same objectives that are embodied in Caring for Country. Aboriginal people have been meeting the needs of the present while ensuring the means for future generations to meet their own needs¹⁷ for thousands of years. Exploring ways to reinterpret sustainability through the lens of Caring for Country may strengthen sustainability outcomes whilst also strengthening the community's connection with nature.

Incorporate indigenous knowledge into land management practices

Local knowledge passed down through generations of Aboriginal people can provide great insight into the way land is managed, even in today's urban context. For example, recognising Melbourne's true

seasons could help fine tune irrigation regimes, annual pruning or species selection. There are also traditional maintenance techniques, such as the use of fire or soil aeration, which could be integrated into current approaches to achieve better outcomes.

Restore the balance of urban ecosystems to create healthy country

Healthy *Country* can be created by investing in programs, projects and initiatives that help restore natural systems in the city. This includes greening, reducing air and waterway pollution, reducing emissions and increasing open space. Increasing biodiversity helps to enhance natural systems and is in turn a good indicator of ecosystem health. Multi-layered planting and allowing 'wild' spaces can significantly increase biodiversity, as well as creating a more interesting landscape.

Connect people to *Country*

The design of the city should explore the creation of opportunities for people to interact with nature in their everyday lives so that experiencing the city is to experience nature. Plants and animals remind people that despite the dominance of built infrastructure, this *Country* is a living and natural place with a long cultural history. Reflecting culture, naming and ceremony in the city will support this connection.

The provision of places and opportunities for Aboriginal people to carry out traditional practices and ceremonies will be vital, (such as beside waterways or in places of cultural significance). Protecting and enhancing native biodiversity will also provide more resources for Aboriginal cultural practices, stories and ceremony.

Build lasting relationships with the Aboriginal community

Ongoing partnership and collaboration with the Kulin Nation will be essential for integrating *Caring for Country*. It is a philosophy that can benefit with the whole community, provided it is shared and celebrated with respect and the full involvement of Aboriginal people.

Creation story – provided by Wurundjeri

Long age Bunjil, the Eagle Hawk, was a very powerful man. He was the headman of the Kulin. Bunjil had two wives and a son whose name was Binbeal, the Rainbow, whose wife was the second bow, sometimes seen showing fainter than the first. Bunjil had also six other 'Young Men', who went together in pairs, looking after the people for him, and carrying out his orders.

The six young men were: Djurt-djurt, the Nankeen Kestrel, and Thara, the Quail Hawk, Yukope, the Green Parakeet, and Dantum, the Blue Mountain Parrot; Tadjeri, the Brush-tail Possum, and Turnung, the Glider Possum, both of whom lived on the trees; and all these young men were powerful wizards.

After Bunjil had made the mountains and the rivers, and man and all the animals, he taught men how to make weapons, how to fight with them, and how to behave with one another. When he had finished he became tired of staying upon the earth. So he gathered about him his wives and sons, and told Bellin-bellin, the Musk Crow, who had charge of the winds: "Open your bags and let out some wind." So Bellin-bellin opened one of the bags in which he kept the whirlwinds and let out a blast that blew great trees into the air, roots and all. Bunjil said, "That is not enough, let out more wind". Bellin-bellin opened all his bags at once, and a terrific whirlwind came out, and blew Bunjil and all his people to the sky where they live in plenty, and look down on the world as stars.

Case Study: Royal Park

Working with the Wurundjeri Tribe and Land Council, the City of Melbourne created a new park that encourages people to read the ecological landscape through a cultural lens.

The park design celebrates the seven Wurundjeri seasons - luk, Waring, Guling, Poorneet, Buath Gurru, Kangaroo Apple and Biderap, each represented by unique landscape features in different areas, such as the tunnels of wombats in the cooler hibernation season or the swirling shapes of eel trap structures that double as play equipment.

The park includes information about many animals including the eagle, wombat and eel, and plants such as grasses, orchids and the murnong (yam daisy). As several ecosystems exist across the Melbourne region, these have been represented as forests, grasslands, shrubby-woodlands and riparian areas. Water is also featured with water play areas and river species planted in swales for future harvesting for weaving and basket making.

Astronomy and interpreting the stars is also an important part of seasons in Wurundjeri culture. The park paths show constellations of stars representing different animals.

3.6 Strategy 2 – Connect people to nature to improve social resilience, health and wellbeing

Human health, wellbeing and social resilience are linked to the condition of the environment in which people find themselves; healthy ecosystems and biodiversity provide the greatest opportunities to deliver positive outcomes to the people who live, work and play here.

Proposed Target:

Raise the profile of biodiversity in the city

3.7 Proposed Actions

- Establish a 2017 social baseline of how people value nature.
- Implement and support initiatives that educate and engage the community with nature in the city including creating unexpected encounters with biodiversity, and supporting urban agriculture such as community, home and rooftop food gardening.
- Identify continued opportunities to improve, create and connect small green spaces throughout Melbourne's most urbanised areas, and begin implementation.
- Increase the value of existing public open spaces by creating programs that activate stewardship and a sense of shared ownership for the people who live in, work in and visit Melbourne.
- Provide opportunities for community involvement in the implementation of the strategy through the use of citizen science.
- Create a digital platform to engage the community and share information about biodiversity in Melbourne.

3.8 Biodiversity improves human health and wellbeing

Healthy, biodiversity rich green spaces have been linked with the health and wellbeing of individuals and communities. There is a large body of evidence to show that time spent in natural spaces is linked to positive short and long-term health benefits, including faster illness recovery, strengthening immunity, reducing stress, and assisting depression. Numerous studies have demonstrated the importance of nature play for children and recent research is beginning to suggest that it is not simply access to green space but the quality, or biodiversity, of that space that influences the extent of the benefits shown. The evidence is clear-nature, particularly biodiversity, is good for you.

3.9 Biodiversity builds social resilience

Social resilience, which describes the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change, is also linked to healthy, biodiverse ecosystems¹⁸. People that are healthy and happy in a thriving, tight-knit community with a strong 'sense of place' are more likely to be able to cope and adapt in the face of challenges. Programs that facilitate positive interactions with nature - for example community gardens - foster the development of community identity, bring people from different backgrounds together, increase social inclusion and build stronger communities. Particular benefits can be gained through connecting vulnerable and disadvantaged members of society to nature. These programs can address disadvantage and also promote feelings of inclusion and belonging.

Citizen Forester Program

The Citizen Forester Program allows volunteers to engage with and contribute to the City of Melbourne's work managing the urban forest. Citizen Foresters receive training and can choose to participate in a series of activities.

Activities have included genetic sampling of elm trees to evaluate resilience to pests and disease and mapping of understory vegetation across Melbourne. Volunteering as a Citizen Forester is a valuable opportunity to establish a deeper connection and understanding of the city's biodiversity and the community's role in protecting it.



3.10 Connecting people to nature

This strategy sets out to reinforce and re-inject nature into the fabric of the city, making interaction with nature an unavoidable experience for people in the city. Whether it is exploring a network of small green spaces and laneways, or hearing the sounds of native birds, to experience Melbourne will be to experience nature.

The City of Melbourne has already initiated a number of programs and initiatives that help to connect people with nature. The Open Space Strategy is providing more, higher quality opportunities for people to connect with nature. The award-winning 'Return to Royal Park' playground is widely acclaimed as one of the best examples of a nature playground in Australia, connecting inner city children to nature. The City of Melbourne Park Ranger program, the Junior Ranger program and work

with schools, and the Urban Forest Citizen Forester program are all helping to foster a greater appreciation of nature in young people and the wider community.

Backyard and community edible gardens are increasing in popularity in urban environments and offer an opportunity to connect the community with nature and for children to develop deeper understanding of plant lifecycles, food knowledge and foster a delight of the environment. These gardens are also an opportunity to support urban ecology through increasing plant diversity, which in turn provide food sources for pollinator species. Beneficial insects attracted to gardens can provide food sources for larger wildlife species, such as mammals and birds.

Opportunities to strengthen the community's connection to nature may be further enhanced through many of the actions identified throughout this strategy, including education and advocacy of Caring for Country principles, an expansion of existing initiatives such community gardens, citizen science programs (e.g. Birdlife's Aussie Backyard Bird Count and Melbourne Water's Frog Census), wildlife gardening, nature play, expansion of existing volunteer resident groups, such as 'Friends' groups, underlining the importance of schools, particularly secondary schools, in promoting environmental education and promoting nature play opportunities for older children, art installations and workshops, and a digital platform to engage and inform the community about ways they can be involved with nature, interpretive signage to explain native plantings, guides to local nature hotspots, city nature trails.

BioBlitz – Connecting Citizens to Nature

Melbourne BioBlitz offers a unique opportunity for citizen scientists to engage with the City's wildlife. As part of the BioBlitz, participants could upload photos of nature in the City on the dedicated Instagram hashtag using #bioblitzmelb. A wide variety of species were photographed, with contributors often adding engaging anecdotes as captions. A few of the submissions include:



I'm loving all of these native bees! Who'd have thought that we had so many! We think this is a [#Lasioglossum](#) - if anyone can help ID let us know! [#bioblitzmelb](#) [#bee](#)



We certainly have some beautiful [#WildFlowers](#) in our [#Grassland](#) ! These are some Convolvulus angustissimus (Blushing Bindweed) we found at Cooper St Grassland this morning.

Hello! Here's a superb fairy wren, a male, one of the local residents of Westgate Pk [#bioblitzmelb](#) @cityofmelbourne image credit David Paul



Surprisingly, since I took part in [#bioblitzmelb](#) I have a newfound respect for flies. I can't wait to load this one up on [#bowerbird](#) and learn more about who it is and how it fits into our ecosystem.



Case study: Nature Play Week - Melbourne, Victoria

Nature Play Week (NPW) is a signature annual event that was developed to raise the profile of nature play and reconnect children with nature and the outdoors. NPW was developed collaboratively by individuals and organisations involved in the Kids in Nature Network, including the Royal Botanic Gardens of Victoria and Playgroups Victoria. The inaugural Nature Play Week ran from 1-6 April 2014. The week was filled with over 40 nature play activities, events and workshops facilitated by local organisations, parents and schools across Victoria and two in NSW. It is estimated that around 2000 children and parents participated. In 2016, over 170 events took place around Australia. The rapid expansion of the program demonstrates the increasing need people feel to connect to nature and the increasing value people are placing on nature.

3.11 Fostering stewardship

Connecting people to nature and 'country', will not only bring benefits in terms of improving health and wellbeing and building social resilience, but will foster a sense of stewardship over the natural environment, which will be fundamental to the successful implementation of this strategy. To improve biodiversity networks and urban ecology across the city, the support and participation of Melbournians is crucial. The City of Melbourne will be calling on individuals, communities, schools and businesses to play an active role in:

- protecting, enhancing and monitoring biodiversity
- understanding how their actions and decisions can help reduce the ecological footprint of the city with lasting positive effects on biodiversity.

An informed community that is connected to nature and deeply values biodiversity will help us together achieve our vision of the city that supports a diverse, resilient and healthy ecosystem.

Green Your Laneway Program

In 2015, the City of Melbourne accepted nominations from the community for city laneways to be transformed into green spaces. The City has committed to funding the greening of four laneways that were selected from a list of over 800 nominations. Collaboration with the community ensures that a diversity of priorities are considered and also fosters active community engagement with the greening of the city. Implementation of the pilot program is occurring in the 2016-17 financial year.



PRINCIPLE 2: PROTECT AND ENHANCE HEALTHY ECOSYSTEMS AND BIODIVERSITY

4.1 Strategy 3 – Protect and enhance existing habitat to support greater biodiversity in a changing climate

Healthy ecosystems and biodiversity lie at the heart of this strategy, and the conservation and management of species and habitats are a focal point. There are two parts to this challenge – land managed by the City of Melbourne, and land within the private realm.

Proposed Targets:

Prevent further loss of existing urban habitats.

Increase mid-storey habitat by 20 percent.

4.2 Proposed Actions

- Undertake an assessment of the municipality to evaluate existing habitat quality, identify opportunities for habitat enhancement and develop appropriate targets for enhancement.
- Assess the vulnerability of key species in the ecosystem and identify target species and habitats for rewilding programs.
- Research, implement, and advocate appropriate habitat opportunities such as dead trees, artificial tree hollows, and bee ‘hotels’.
- Develop a plan to increase soil health in parks, gardens and medians, including a review of chemical use in land management processes.
- Develop best practice guidelines for an ecologically informed management of green spaces in the face of climate change
- Develop and implement a monitoring program to evaluate biodiversity and habitat on an ongoing basis.
- Further integrate biodiversity and urban ecology values into the planning of parks, green spaces, precincts and waterways through masterplans, structure plans, precinct plans, The Open Space Strategy and Total Watermark- City as a Catchment.

4.3 What does habitat in the city look like?

The City of Melbourne encompasses a wide range of different habitats, including waterways, green infrastructure (street trees, green roofs, facades, parks, median strips), residential gardens, formal parks (e.g. Fawkner Park, Fitzroy Gardens), native ecosystems (remnant vegetation, Westgate Park), marine and estuarine habitats. This strategy needs to consider the biodiversity and function of all of these dimensions if it is to maximise the benefits that nature in the city can provide.

Protecting habitat, particularly remnant vegetation, in existing green spaces within the city will be fundamental to securing the future of its biodiversity. Management practices will need to be reviewed and best practice shared to help reduce the possible impacts of climate change on biodiversity and to prevent further loss of species. Enhancing existing green spaces to allow them to support a greater level of biodiversity will further build resilience in the face of climate change and provide a more diverse landscape for humans to enjoy.

4.4 Managing for the future

Existing habitats support a surprising array of biodiversity considering the extent of urban growth. To maintain or increase biodiversity in the face of climate change, the resilience of the ecosystem must be increased. Recognising the ever-changing and complex nature of urban ecosystems, an adaptive management approach is required to protect and enhance habitat. Impacts must be monitored and management practices adjusted in response to new information. Key considerations to enable us to build ecological resilience in the face of climate change will include:

- species choice for plantings – species need to be well suited to the expected future climate
- increasing the diversity of species used will build resilience in the system
- integrating caring for country principles to inform more sustainable land management
- utilising water sensitive urban design (WSUD) - many WSUD features can contribute to climate change adaptation and should also be considered for reducing run-off, harvesting water, recycling grey water and the storage of flood water
- improving soil health- vegetation health is dependent on soil biology, fertility and structure
- managing pest species.

Some management practices can negatively affect the environment and reduce the quality of the habitat available for species. The use of chemicals¹⁹ which are commonly present in herbicides or neonicotinoids^{20,21} in some insecticides, not only have adverse effects on the targeted organisms, but have also been shown to have unintended effects on non-target species²². Finding ways to reduce and mitigate these impacts is a key challenge in supporting a broad range of biodiversity in the cities.

4.5 Enhancing existing green spaces

In order to develop appropriate and biologically relevant targets for habitat enhancement, green spaces will need to be assessed to determine the quality of existing habitat, identify what species are associated with particular habitats and identify opportunities and priorities for habitat enhancement. The presence, or possible presence, of threatened and vulnerable species will also need to be considered.

Appropriate enhancements for a site will vary depending on the habitat type, historical and current biodiversity supported, characteristics of neighbouring green spaces and physical and environmental constraints for example water availability and soil profile. Decisions for appropriate enhancement can sometimes be guided by observing the ecological memories of species, such as the behaviours of cockatoos returning to locations that had previously been part of their foraging range. Some examples of priority habitat enhancements the City of Melbourne will employ are detailed below.

Understory planting

A key way to enhance existing green space will be to increase multi-layered planting, by adding a diversity of resilient, low maintenance native shrubs and grasses. Planting will need to be carried out with consideration of water availability and soil profile. Understory vegetation is a key contributor to a healthy ecosystem. A recent study of insects in the City of Melbourne found species richness was four times higher in mid-storey habitat than in lawn. Understory vegetation provides food and shelter to a wide range of organisms. This can significantly increase biodiversity in the city, as well as create a more interesting landscape for humans. Understory planting may also play an important role in control of over-abundant species. Noisy mynahs are one of Australia's most aggressive bird species. Their high prevalence in urban environments is one factor contributing to the dramatic decline in the number of small bird species. Noisy mynahs prefer open spaces and research suggests that an

increase in understory planting will result in a decrease in noisy miners and an increase in a more diverse range of small birds.

Using dead trees

Where possible, habitat can be improved through the use of dead trees. This approach will need to be managed to ensure health and safety for everyone. Standing and fallen decaying wood and old plants are important to wildlife—even small amounts are of great value to insects, fungi, mosses and lichen. Nutrients are broken down and returned to the soil, creating a more balanced ecosystem. Birds feed on insects that make their home in old wood and use dead branches as song or display posts. Natural and artificially created hollows in trees provide important roosting sites for microbats and native birds. Artificial hollows can be particularly useful as they can employ careful design to create space for target species whilst excluding pest or invasive species. These initiatives need to be accompanied by informative signage to raise awareness of the importance of these processes in the urban environment.

Personal Connections to Trees

The City of Melbourne's Urban Forest Visual allows members of the public to send an email to individual trees. Initially intended as a source of information and data about trees, the Urban Forest Visual and tree emails have captured the attention of people across the world. Emails expressing appreciation for trees and the wildlife they support are frequently received. The gratitude and love for the trees often shines through, especially for local residents with a personal connection to particular trees. One such email was received from a family in North Melbourne:

*To dear Elm Tree #1015114,
We often look at you, not only because you are a beautiful tree, but because you also have an incredible Bee colony living in one of your hollows. Lucien my 4 y/o son has named the park 'Bee Park' where you live, because of your life giving trunk. Thank you lovely Elm tree!
-Bridget, Piers and Lucien*



Photo Credit: Bridget Mac

Artificial habitat

The adaptability of urban species reveals a whole new arena of actions that can be performed to support biodiversity in urban areas. While nest-boxes and bee-hives are two of the best known forms of artificial habitat, there are many other examples of animals using novel structures in urban areas as habitat. These include bee-hotels or floating islands that are deliberately provided by the people of the city, as well as habitats that are “remodelled and repurposed” by the animals themselves.

Introduction of artificial habitats will need to be informed by research to achieve the best outcome.

The Little things that run the City – How do Melbourne’s green spaces support insect biodiversity and ecosystem health?

Insect species occurring in the City of Melbourne deliver at least four benefits to its city-dwellers: biological pest control, soil fertility, pollination of crop and ornamental plants, and persistence of plants that are naturally dispersed by ants.

In 2014, the City of Melbourne and RMIT co-funded an insect ecology and biodiversity project to assess how the different types of public green space contribute to the insect biological diversity of the City of Melbourne.

During the summer of 2014-15, over 200 sampling plots within 18 different urban green space sites including temporary landscapes throughout the City of Melbourne were surveyed, produced a series of interesting findings:

- 1351 insect species have been recorded in the City of Melbourne, represented by 834 genera, 215 families and 16 orders.
- Royal Park had the highest species richness with 202 different insect species. Followed by Fitzroy-Treasury Gardens (112 species), Princes Park (94 species) and Westgate Park (72 species).

The mid-storey habitat type had the highest species richness, with 166 insect species recorded in the targeted survey across all sites, followed by grassland (126 species) and tree habitat types (98 species). lawn had the lowest species richness, with only 42 insect species.

4.6 Monitoring biodiversity over time

In order to assess the effectiveness of changing management practice or habitat enhancement it will be necessary to establish an ongoing monitoring program to establish how biodiversity changes over time. Citizen science programs such as the Melbourne BioBlitz, could be adapted to perform this function and provide an opportunity to develop increased community stewardship over green spaces.

If you plant it, they will come.

In the 1970s there was a trend towards planting species that were indigenous to northern New South Wales and Queensland in the urban landscape of Melbourne (e.g., Spotted Gum *Corymbia maculata* and Lemon Scented Gum *Corymbia citriodora*). This has facilitated an increase in the populations of Rainbow Lorikeets and Grey-headed Flying Foxes that utilise the nectar resources provided by these trees. This is a strong demonstration that the composition, abundance and distribution of plant species will influence biodiversity. Expanding the range of plant species for wildlife needed to attract to City of Melbourne can be achieved by identifying important habitat resources, limiting factors and designing and building landscapes that satisfy these requirements (ARCUE 2012).

4.7 Strategy 4 – Support habitat creation within the private realm and other public land to maximize diversity and connectivity

Habitat creation on City of Melbourne land must be strengthened through green governance initiatives that support integrated actions by other major landholders and the private realm to create connected habitat networks. This connectivity also supports species resilience in the face of climate change by enabling migration.

Proposed Target: Increase ecological connectivity through biodiversity corridors within and beyond the municipality.

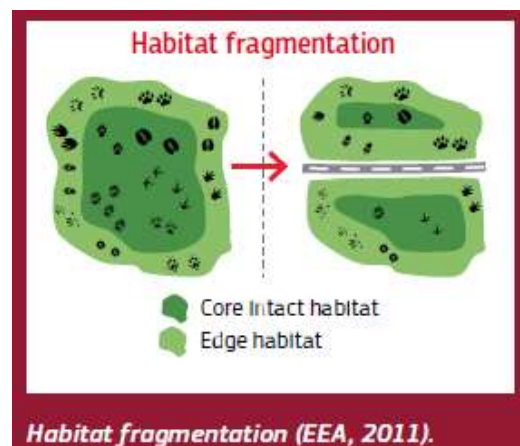
4.8 Proposed Actions

- Work with partners to undertake an assessment of existing and potential biodiversity corridors, including waterways and connections beyond the city's municipal boundaries.
- Enhance ecological connectivity through stepping stones and corridors along streets and bio-links between larger green spaces.
- Continue to investigate and research the barriers to urban ecology enhancement across different building types and stakeholders and understand the opportunities to influence behaviour. Implement programs and initiatives to encourage residents and businesses to support biodiversity and on their own properties, such as case studies and guidelines.
- Assess the feasibility of a planning scheme amendment to encourage appropriate development that minimises impact and enhances urban ecology and biodiversity.
- Work with the State Government to explore the opportunity to establish an incentive framework based on the global environmental accounting system to acknowledge and encourage the private sector to invest in biodiversity and reduce its ecological footprint.

4.9 Creating a connected habitat network

Supporting and encouraging a wide diversity of plants, animals and other organisms into cities relies on providing them with sufficient areas of high quality habitat, and ensuring that all of the interdependencies that exist within the system are supported. This includes opportunities to move across the landscape, as well as providing access to the habitat elements that individual species are dependent upon. Delivering a network of high quality, connected habitats is a key target for this Biodiversity and Urban Ecology Strategy.

Landscape connectivity is an important concept in ecology, and relates to how easily plants, animals, nutrients, water and energy can move across the landscape. The movement and dispersal of organisms across the landscape contributes to the health of the populations, as it allows species to move between patches of resources, and facilitates gene flow between populations. It also increases resilience, as organisms are able to move to areas with more favourable conditions in response to climate change or extreme weather conditions.



Habitat fragmentation and edge effects
(European Environmental Agency, 2011)

As organisms move and disperse in different ways, they will respond to different features in the landscape and may perceive different levels of connectivity within the same landscape. For example, birds and bats are highly mobile and can respond to an aerial perception of the landscape, the connectivity of the urban tree canopy may therefore be a strong indicator of their perception of the movement opportunities within the landscape. However, small ground-based animals, such as frogs, have more limited dispersal ability and their perception of landscape connectivity may be more strongly related to the number of barriers such as roads, buildings and fences. Creating and managing corridors will need to consider the different dispersal requirements of different groups of organisms.



Corridors within the City of Melbourne

The City of Melbourne is committed to providing functioning corridors and a network of smaller green spaces as outlined in the Open Space Strategy.

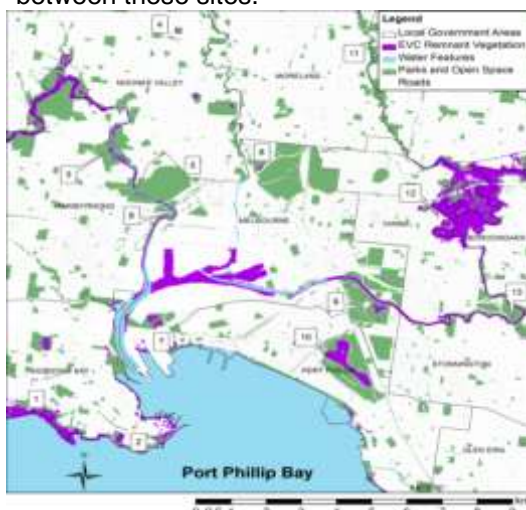


Location of proposed corridors and new small green spaces detailed in the City of Melbourne Open Space Strategy

Within the City of Melbourne there are three local hotspots of biodiversity, Royal Park in the north, Westgate Park in the south-west and the Domain Parklands and Royal Botanic Gardens in the south-east (see right). This strategy will build on the work of the Open Space Strategy with the aim to create and maintain opportunities for organisms to move between these sites and across the City of Melbourne. This will involve identifying major dispersal routes within the landscape for different types of organisms, and strategically placing the new urban habitats within these routes to augment their potential for supporting the movement of biodiversity across the landscape.

Looking beyond the municipal boundary

Landscape connectivity is about more than just connecting urban habitats within the City of Melbourne, it is also about providing connections to important urban habitats within the greater Melbourne metropolitan area. There are opportunities to explore how the City of Melbourne can work with other stakeholders including the State Government to develop a functioning network of linkages between these sites.



The network of open space and remnant vegetation in the LGAs adjoining the City of Melbourne including: 1) Altona Coastal Park and Jawbone Conservation Reserve, 2) Point Gellibrand Coastal Heritage Park, 3) Pipemakers Park, 4) Napier Park, 5) Flemington Racecourse, 6) Newells Paddock, 7) Westgate Park/ Webb Dock, 8) Royal Park, 9) Domain Parklands including Royal Botanic Gardens, 10) Albert Park, 11) Merri Creek corridor, 12) Yarra Bend and 13) Burnley Gardens.

The importance of waterways and riparian habitat

The City of Melbourne sits in a unique location in relation to the convergence of three important waterways in greater metropolitan Melbourne – the Yarra River, Moonee Ponds Creek and the Maribyrnong River. These waterways act as critical biodiversity corridors for water and land based species. Although the City of Melbourne does not have sole jurisdiction over waterways, by improving the habitat alongside waterways with native vegetation there will be flow on effects for the health of the waterways themselves.

The Port Phillip and Westernport Catchment Management Authority has developed a Regional Catchment Strategy setting out potential nature links through the region

(Figure 3). As this is a strategy across multiple council jurisdictions, the City of Melbourne has the ability to link into targets set by other councils and landholders to meet broader regional goals. Meeting these goals would require partnership, as well as establishing principles for enhancing biodiversity within the municipality guided by academic research and community values.



Port Phillip and Westernport CMA nature link opportunities agreed with LGAs and Parks Victoria

Even small spaces are important

Whilst large patches are often prioritised as more suitable habitat for biodiversity, some good research supports encouraging smaller patches, closely enough connected for species to pass from one to another²³. These parcels in close proximity to one another may provide good potential as habitat, for example, median strips and roadside verges can offer refuge for birds, insects and other species if suitable habitat structure is planted. Connectivity and patch size are both important for supporting biodiversity in urban landscapes. Gardens and green spaces in schools, city roads and laneways, businesses and residential homes can make a significant contribution to creating a habitat network. Particularly if advice on planting is provided so that it complements planting in local parks, green spaces and nearby corridors.



"Yeah, we moved from the country last year. We can be closer to Joey's school, and I like walking to work. The city's so much more vibrant these days!"

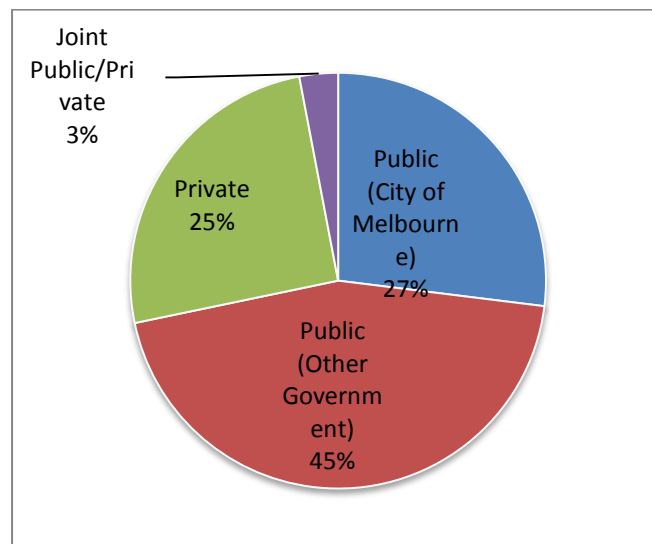
Knox City Council – Gardens for Wildlife

Knox City Council has developed a program that encourages local residents to modify their gardens to be more suitable for wildlife. Residents who register to be part of the Gardens for Wildlife program receive a home visit from an assessor, who provides tailored advice on the types of plants that will attract different wildlife species (Knox City Council). Improved habitat quality in even these small patches leads to increased patch size and connectivity, enhancing the available habitat for a range of native fauna species.

4.10 The expanding private realm

In the municipality only 27% of the land (i.e. parks, roads, property, water, etc.) is owned or managed by the council, with 45% by other government agencies and 25% by private sector.

Focusing on property only, 35.4% of property space (land area plus building floor area) is privately governed, with 42.2 % by other government authorities or cultural institutions.



Land ownership within the City of Melbourne (Data source: City of Melbourne Property Service, 2015)

The **Private Realm** of our city is the property area that is privately owned. It includes **all land and built features** of these properties as well as the people who own, manage or make use of these features for living, work or leisure.

With rapid urban densification, the private realm is continuing to expand and presents both challenges and opportunities for biodiversity and urban ecology. Whilst the establishment of new property space could pose a threat to existing biodiversity, these developments have the potential to establish new habitats and create healthier buildings for the community to live and work in.²⁴ Recent research by RMIT suggested that by thoughtful design with the community, the City of Melbourne can embrace the urban densification with positive contribution to the local biodiversity and ecology.

Within the municipality, while many businesses and residents have already engaged in initiatives to improve the city's ecology and biodiversity, there are extensive areas that are under private tenure or managed by other major landholders which have an untapped potential to contribute to the ecological health of the city.

In cities and towns around the world, privately owned spaces make substantial contributions to the local ecology and biodiversity. In Linz, Austria the 404 green roofs on public and private property provide 40 football fields worth of green space to enhance the city's ecology and liveability (Millar et al. 2014). In Chicago, 359 green roofs contribute a total of 51 hectares of urban habitat across the city (GHD 2013).

Medibank Building, 720 Bourke Street, Docklands



Medibank Building, Docklands

Constructed in 2014, the 18-story Medibank building in Dockland is important to the city's health and ecological wellbeing.

Approximately 10% of the building's surface area is greened, including 16 green terraces, dozens of green facades and two green walls with a total of 11,600 plants over 72 plant species. The property also includes 1500m² of publically accessible green space. These spaces make the building a healthy place to work whilst providing habitat for the city's biodiversity.

4.11 Unleashing the potential of private realm

Engaging the private realm and other major land holders in the protection and enhancement of Melbourne's urban ecology and biodiversity is key to achieving the community's vision of resilient and connected ecosystem. To make the most of these additional opportunities, meaningful partnerships need to be developed to ensure that efforts made to preserve and enhance biodiversity in the municipality are supported by complementary actions on non-council lands. These essential partnerships also provide the City of Melbourne with an opportunity to explore how they can help reconnect people with nature in more personalised settings, such as their home gardens, balconies and places where they work.

The consultation workshops undertaken during the development of this strategy highlighted a clear desire from the community for the private realm to play its part in upholding the liveability and productivity of the city. Over the past years, the City of Melbourne has investigated mechanisms, including regulation, incentives, and education, to provide more habitat and nature in the city in the past years. Various studies commissioned by the City of Melbourne suggest that financial & non-financial incentives are often effective to encourage greening²⁵.

Accounting for the environment

In 2012, the United Nations launched a new global environmental accounting system as a framework for linking the quantity and quality of environmental assets to socio-economic benefits. The System of Environmental-Economic Accounting (SEEA) is being adopted by DELWP and other lead agencies internationally. It is an internationally accepted standard, with a set of established accounting principles that can help recognise the interdependence of societies, economies and the environment²⁶. It aims, in short, to support governments and environment agencies make more informed, integrated and coherent decisions.

PRINCIPLE 3: DEMONSTRATE LOCAL AND GLOBAL LEADERSHIP

5.1 Strategy 5 – Demonstrate local and global leadership in urban ecology and biodiversity

The City of Melbourne will demonstrate local and global leadership through its approach and commitment to delivering positive outcomes related to biodiversity and urban ecology.

Proposed Target: Select an emblematic species to represent the city and promote awareness of biodiversity.

5.2 Proposed Actions

- Undertake ongoing advocacy and education to increase awareness of biodiversity.
- Undertake a community-wide survey to select an emblematic species to represent the City of Melbourne and further promote awareness of biodiversity in the city.
- Partner with researchers to position Melbourne internationally as a hub for urban ecology and biodiversity research.
- Support and partner with local volunteer groups to enhance biodiversity management.
- Develop local and international networks on biodiversity (C40, ICELI, Biophilic Cities Network)
- Deliver a flagship biodiversity and urban ecology project that is recognised locally and internationally as an innovative and outstanding example of rewilding in a dense urban fabric.

5.3 Demonstrating leadership in urban ecology and biodiversity management

The City of Melbourne is a hub of information and innovation and is uniquely positioned to demonstrate how responsible stewardship of urban biodiversity and urban ecosystems can be achieved within a highly urbanised environment; and that these actions also contribute to the health and wellbeing of Melburnians.

Through the City of Melbourne's involvement with global projects such as the C40 Cities program²⁶ and the 100 Resilient Cities Challenge²⁷, as well as local involvement with the Inner Melbourne Action Plan²⁸, Growing Green Guide²⁹, Greening the West³⁰, and the 2020 Vision³¹, a commitment has been demonstrated to local and international leadership. As biodiversity and urban ecology are integral to the goal of becoming an ecologically resilient city, the City of Melbourne is committed to addressing the challenge of identifying, developing and implementing best practice and innovative new examples of good governance and management of biodiversity across the public and private realm.

In addressing this challenge, there is a need to understand the conflicts, stakeholder interests and concerns that form potential barriers to implementation. These barriers will be explored with a view to better enabling innovative outcomes through the development of genuine collaborative partnerships. The City of Melbourne will work collaboratively with the State of Victoria and others to identify opportunities for contributing to larger scale changes.

The City of Melbourne will continue to demonstrate leadership by engaging with the community and inviting the public to participate in the decision-making and stewardship related to biodiversity and urban ecology in the city, and will further expand this participatory governance by working towards closer collaborations with the Victorian Aboriginal community, to ensure they have opportunities to Care for Country.

6. IMPLEMENTATION FRAMEWORK

This strategy proposes principles and strategies that will guide the long-term planning, development and management of the city's ecosystem. It also sets out a set of actions and targets to evaluate the success of implementation.

The development and implementation of urban ecology and biodiversity policy within this strategy looks to a ten-year time horizon. This period has been selected in recognition that urban ecology and biodiversity are rapidly evolving areas of research and practice, and many innovations and developments are likely to emerge over the next decade. Ten years is also a sufficient time to allow the delivery of longer-term strategic planning, whilst also implementing some shorter term and project-focused planning.

6.1 Green Governance

The Urban Forest Strategy articulated the importance of 'Green Governance' in shaping the plans and decision that influence the development of urban forestry. This Green Governance approach is equally important in relation to urban ecology and biodiversity. The success of this strategy therefore, requires collaboration and partnership with other stakeholders for cohesive policy and management of decisions that affect the city's urban ecology. As with the Urban Forest Strategy, integrated planning, knowledge sharing and communication are critical components for successful green governance. "They need to occur on a range of levels and work across administrative boundaries and disciplines within the municipality and beyond".³²

- **Internal council collaboration** – involves internal council stakeholder cooperation. Planners, architects, park services officers and others work directly with urban ecologists, urban foresters and green infrastructure practitioners to integrate policy and practices.
- **Community and professional collaboration** – means the role of non-public proponents becomes more influential by raising public and bi-partisan political awareness. The maintenance and enhancement of interaction and input from the community to ensure these values are considered during planning and decision making is critical.
- **Inter-agency collaboration** – involves the need for policy makers to link together with other local municipalities. This allows for a more cohesive and holistic assessment of urban ecology and biodiversity across larger bio-geographical areas beyond arbitrary political boundaries.
- **International cooperation** – There is a need to network globally to drive uptake of the principles of urban ecology, to share research, methodologies and technical knowledge, and to achieve better outcomes for the world's cities as the urban environment continues to expand.

6.2 Priority Implementation Actions Identified within the Strategy

This strategy will be implemented by influencing existing City of Melbourne programs and existing capital and renewal projects, and will be largely funded through existing budgets that are subject to the annual cycle and budget process and service delivery priorities. The business impact of each proposed action is outlined below in Paragraph 6.5.

Urban ecology and biodiversity is a new and rapidly expanding field of research. The idea that a city can support meaningful biodiversity is still a relatively new concept. There is a limited understanding

currently of the status of biodiversity in the city, particularly on land that is not managed by the City of Melbourne, and of biodiversity in neighbouring municipalities.

For this reason, priority implementation actions that have been identified within this strategy are mostly research based and will need to be **revisited in five years** to establish their relevance. The actions include:

- Work with Traditional Owners to identify opportunities to celebrate, promote and educate about Caring for Country approaches such as the local seasons.
- Identify opportunities to increase ecological connectivity through biodiversity corridors.
- Establish a 2017 baseline of biodiversity within the city.
- Develop and implement a monitoring program to evaluate biodiversity and habitat on an ongoing basis.
- Develop Community engagement programs.

‘...more than one policy option should be implemented at once, and policies should be supportive and reinforcing of each other’

Growing Green Guide

6.3 Preliminary Targets Identified within the Strategy

Preliminary targets resulting from the implementation actions are as follows:

- Work with Traditional Owners and the local Aboriginal community to identify opportunities to celebrate, promote and educate about Caring for Country approaches (such as the local seasons).
- Establish a public participation and engagement framework.
- Prevent further loss of existing urban habitats.
- By 2026 increase mid-storey habitat by 20 percent
- By 2026 increase fauna and flora species diversity to contribute to a more resilient ecosystem
- Increase ecological connectivity through biodiversity corridors within and beyond the municipality
- Select an emblematic species to represent the city and promote awareness of biodiversity.

6.4 Measurement, Monitoring and Review

A robust, ongoing monitoring program will be fundamental to understanding the success of implementation programs, informing targets and guiding future decisions. This will include monitoring:

- The community’s attitude towards nature and their perception of biodiversity
- the frequency and quality of people’s connection to nature
- community understanding of Caring for Country including the seasonal calendar
- habitat quality and quantity
- Species diversity.

A monitoring framework will be developed in collaboration with ARCUE and other research scientists. This is likely to involve social surveys of the community, and the development of a diversity monitoring program that involves citizen scientists and ecologists.

6.5 PROPOSED FUTURE ACTIONS

The following table outlines the actions set out in the strategy and their proposed timing, and potential for collaboration. These actions are subject to the Council annual cycle and budget approval process and service delivery priorities.

Principle	Strategy & Action	Suggested Timeframe (years 1 to 10)	Potential Collaborations	Business Impact (e.g. Incorporated into business as usual budgets & processes, part of capital works project, or subject to separate approval/business case)
1. Connect people to nature	Strategy 1 – Explore the ways in which cultural and practical ‘Caring for Country’ principles will assist in integrating people with nature.			
	Investigate an appropriate and effective partnership model to support and inform this strategy in conjunction with key researchers, Traditional Owners and the local Aboriginal community.	Year 1	Traditional Owner Groups, other Aboriginal elders, CAUL Hub, Monash Sustainability Institute and other education and research institutions, State Government	Incorporated into business as usual budgets & processes
	Protect existing indigenous vegetation and increase the use of indigenous planting practices.	Year 1 - 10	Community groups, State Government, Melbourne Water, non—council land owners and managers	Incorporated into business as usual budgets & processes and current capital works projects
	Support partnerships and research that further expand knowledge in this area.	Year 1 - 10	Education and Research Institutions, State Government	Year 1 existing budget allocation Year 2-10 subject to separate approval/business case
	Identify initiatives that celebrate the cultural and environmental significance of the Yarra River and other waterways.	Year 2	Traditional Owner Groups, the local Aboriginal community, Water organisations and authorities including Melbourne Water, Yarra River keepers, community groups	Subject to separate approval/business case
	Work with Traditional Owners and the local Aboriginal community to explore opportunities to create a new public space where ceremonies and traditional practices can be carried out	Year 3	Traditional Owner Groups and the local Aboriginal community.	Subject to separate approval/business case

	Strategy 2- Connect people to nature to improve social resilience, health and wellbeing			
	Establish a 2017 social baseline of how people value nature	Year 2	ARCUE, Universities, State government or other LGAs	Subject to separate approval/business case or collaboration/funding from the State Government
	Identify continued opportunities to improve, create and connect small green spaces throughout Melbourne's most urbanised areas, and begin implementation.	Year 1 - 10	Non-Council land owners and managers	Incorporated into business as usual budgets & processes and current capital works projects and where outside of existing scope, subject to separate approval/business case
	Increase the value of existing public open spaces by delivering a program that activates stewardship and a sense of shared ownership for the people who live in, work in and visit Melbourne.	Year 3	Volunteer, not-for-profit and community groups	Incorporated into business as usual budgets & processes and current capital works projects
	Provide opportunities for community involvement in the implementation of the strategy through the use of citizen science, such as the BioBlitz.	Years 1 – 10	BioBlitz Partners – Royal Botanic Gardens of Victoria, community groups, Museum Victoria, Universities and other state agencies	Year 1 existing budget allocation Year 2-10 subject to separate approval/business case
	Create a digital platform to engage the community and share information about biodiversity in Melbourne.	Year 2	Museum Victoria, Atlas of Living Australia, other conservation groups, community groups	Subject to separate approval/business case
2. Protect and enhance healthy ecosystems and biodiversity	Strategy 3 – Protect and enhance existing habitat to support greater biodiversity in a changing climate			
	Establish a 2017 baseline of biodiversity within the city	Year 1	Museum Victoria, Universities, Royal Botanic Gardens of Victoria, other conservation groups, community groups	Year 1 existing budget allocation
	Undertake an assessment of the municipality to evaluate existing habitat quality, identify opportunities for habitat enhancement and develop appropriate targets for habitat enhancement.	Year 1 -3	Universities, other conservation groups, community groups	Year 1 existing budget allocation Year 2-3 subject to separate approval/business case
	Assess the vulnerability of key species in the ecosystem and identify target species and habitats for rewilding programs.	Year 2 - 3	Universities, CAUL hub, other conservation groups, community groups	Incorporated into business as usual budgets & processes

	Research, implement, and advocate appropriate habitat opportunities such as dead trees, artificial tree hollows, and bee 'hotels'.	Year 1 - 10	Private land owners and managers Or maybe 'Non-Council land owners and managers' other conservation and community groups.	Incorporated into business as usual budgets & processes
	Develop a plan to increase soil health in parks, gardens and medians, including a review of chemical use in land management practices.	Year 2	Universities, other conservation groups, State Government, IMAP and other Victorian Councils	Incorporated into business as usual budgets & processes
	Develop best practice guidelines for an ecologically informed management of green spaces in the face of climate change.	Year 3 - 4	Universities, State Government, IMAP and other Victorian Councils	Subject to separate approval/business case
	Develop and implement a monitoring program to evaluate biodiversity and habitat on an ongoing basis.	Year 1 - 10	Universities, Museum Victoria, ARCUE, State Government, IMAP and other Victorian Councils	Incorporated into business as usual budgets & processes
Strategy 4 - Support habitat creation within the private realm and other public land to maximize diversity and connectivity				
	Work with partners to undertake an assessment of existing and potential biodiversity corridors, including waterways and connections beyond the city's municipal boundaries.	Year 1 - 2	IMAP, other councils, Universities, community groups, Museum Victoria, NGOs	Year 1 existing budget allocation Year 2-10 subject to separate approval/business case
	Enhance ecological connectivity within the municipality through stepping stones and corridors along streets and bio-links between larger green spaces.	Year 2 - 10	Non-Council land owners and managers' Community groups	Incorporated into business as usual budgets & processes and current capital works projects
	Continue to investigate and research the barriers to urban ecology enhancement across different building types and stakeholders and understand the opportunities to influence behaviour.	Year 3 - 4	Universities, Green building Council Australia, State Government, IMAP and other Victorian Councils	Subject to separate approval/business case
	Implement programs and initiatives to encourage residents and businesses to support biodiversity and on their own properties, such as case studies and guidelines.	Year 4 - 5	Non-Council land owners and managers' Community groups	Incorporated into business as usual budgets & processes Where relevant may require research funding
	Assess the feasibility of a planning scheme	Year 3	State Government, IMAP and other Victorian	Subject to separate

	amendment to encourage appropriate development that minimises impact and enhances urban ecology and biodiversity.		Councils	approval/business case
	Explore the opportunity to establish an incentive framework based on the global environmental accounting system to acknowledge and encourage private sector to invest in biodiversity and reduce ecological footprint.	Year 3	State Government, IMAP and other Victorian Councils NGOs and Charities	Incorporated into business as usual budgets & processes
3. Demonstrate local and global leadership	Strategy 5 - Demonstrate local and global leadership in urban ecology and biodiversity			
	Undertake ongoing advocacy and education to increase awareness about importance of biodiversity within the city.	Year 1 - 10	Universities, communities groups, other government agencies	Incorporated into business as usual budgets & processes
	Undertake a community-wide survey to select emblematic species to represent the City of Melbourne and further promote awareness of biodiversity in the city.	Year 1	Universities, communities groups, other government agencies	Year 1 budget allocation
	Partner with local researchers to position Melbourne internationally as a hub for urban ecology and biodiversity research.	Ongoing	Universities and research institutions	Incorporated into business as usual budgets & processes and research funding
	Support and partner with local volunteer groups to enhance biodiversity management in the municipality.	Year 1 - ongoing	Community groups	Incorporated into business as usual budgets & processes
	Develop local and international networks on biodiversity such as C40, ICLEI and Biophilic Cities Network.	Year 1 - ongoing	C40, ICLEI, Biophilic Cities Network and other cities	Incorporated into business as usual budgets & processes
	Deliver a flagship biodiversity and urban ecology project within the City of Melbourne that is recognised locally and internationally as an innovative and outstanding example of rewilding in a dense urban fabric.	Year 2 - ongoing	Community groups, State Government, contributors to Urban Forest Fund	Subject to separate approval/business case

GLOSSARY

Biodiversity: Biodiversity is the variety of all life forms on earth; different plants, animals and microorganisms; their genes; and the terrestrial, marine and freshwater ecosystems of which they are a part³³. Biodiversity exists at three levels; genes, species and ecosystems.

Ecology: Ecology is the study of plants and animals, and their interaction with the environment. Urban ecology is the study of the relationship between living organisms and their environment in an urbanised context. Living organisms and the ecosystems they form are commonly termed 'biodiversity', a truncation of the words 'biological' and 'diversity'.

Ecological resilience: Ecological resilience is the capacity of an ecosystem to respond to a disturbance by resisting damage and recovering quickly. Resilience is dependent on components functioning.

Ecosystems: Ecosystems comprise of natural components, such as plants, animals, water, soil, air and their interactions. Cities are urban ecosystems which include both nature and humans, in a predominately human-built environment. Functioning ecosystems are the foundation of human wellbeing and most economic activity⁴.

Ecosystem services: Ecosystem services are the benefits that are obtained from nature that contribute directly or indirectly to human wellbeing³⁴ (MEA, 2005). They include clean air, noise reduction, climate regulation, water filtration, recreation, nature education, natural heritage, among others. In cities, ecosystem services can come from green infrastructure such as parks, gardens and forests as well as street trees, pop-up parks, wetlands and lakes. These services can be valued in several ways such as economic, ecological, socio-cultural,

health or insurance contribution. Ecosystem services can be considered in four categories:

1. provisioning services such as food and fresh water
2. regulating services such as climate amelioration
3. supporting services such as pollination
4. cultural services such as aesthetic contributions and spiritual connections

Green infrastructure: There are various descriptions for green infrastructure. At City of Melbourne we use the term to describe the layers and infrastructures in the city that directly provide multiple ecosystem services or support the provision of those services. Examples of green infrastructure in Melbourne include; all vegetation, parks, gardens, reserves, greenways, living green roofs and walls, stormwater and rainwater harvesting interventions, permeable surfaces, waterways and wetlands.

Private realm: This is land that is privately managed. The City of Melbourne currently manages public land under Council control; however much of the land in the city is under private tenure.

Social Resilience: Social Resilience is the capacity of individuals, communities, businesses and systems within a city to survive, adapt and grow not just as a response to shocks (such as heat, fires and floods) – but also to the stresses that weaken the fabric of a city on a day-to-day or cyclical basis. Examples include high unemployment, an over-stretched or inefficient public transportation system, endemic violence and chronic energy or water shortages³⁵.

Tenure Actors: These are the people responsible for managing spaces within the City of Melbourne. They include other local government authorities, major landholders, owner's corporations, landlords and developers in the residential sector as well all actors in the commercial and industrial sectors.

Appendix 1

Detailed Benefits of biodiversity

Pollination	Flowers are the plant world's mating cues. They come in many different colours, forms and sizes, with the shared goal of attracting pollinators so the plant life cycle can continue. The pollinators vary from the well-recognised: bees, birds, bats and butterflies, to the less obvious: bugs, beetles, moths, flies and small mammals. When these pollinators visit the flowers, they help move pollen between different individuals and populations of plants- thereby maintaining genetic diversity, as well as being an essential step in producing many of the fruits, vegetables and other crop plants that we eat. Without a diversity of pollinators, we would risk a contraction in both the diversity and abundance of these food sources and other plants.
Pest Regulation	The role of ladybugs in reducing aphid populations, and spiders catching flies, are well known examples of the role that biodiversity can play in regulating pest species. Other examples include the role of small insectivorous birds, bats and frogs in controlling the number of adult mosquitoes and other insects, while fish and tadpoles can reduce the larval stages of mosquito populations. Blue-tongued lizards munch on both snails and dandelion flowers making them a gardener's best friend. Throughout the animal world, there are many examples of how biodiversity can contribute to reducing the number of pest species.
Safeguarding our future	The Millennium Seed Bank ³⁶ and the heirloom seed movement are examples of major initiatives that have arisen in recognition of the link between biodiversity and the future of humanity. Whether we are talking about flower or vegetable gardens, parks or streets, a diverse array of plants will support a diverse array of other species. By maximising this diversity, we retain more options for responding to changing conditions in the future.
Seed Dispersal	In natural ecosystems, many plants rely on birds, reptiles, mammals and other animals to move their seeds to new locations. This allows the seeds to be moved to suitable "safe sites" away from the parent plant, where the seeds have the best chance to germinate and grow. In some cases, the seeds need to pass through the animals' digestive system before they are able to germinate. In urban areas, seed dispersal continues to be important as it is a sign of a healthy, self-sustaining ecosystem.
Nutrient Cycling	Below the soil surface, there are an abundance of microbes, invertebrates and fungi that work to decompose organic material back into forms that can be used by plants. Above the soil surface, they are assisted by the ants, slaters, millipedes, and other decomposers which help to shred and chew the leaves and other dead organic material, into smaller fragments that are more easily accessed by the microbes and invertebrates below the soil surface. The biodiversity associated with decomposition is not only important because they help complete the natural recycling process, reducing the reliance on artificial and supplemental fertilizers, but they also ensure the planet's surface isn't overrun by the build-up of dead organic matter and animal waste.

Healthy Soils	Healthy soils are the foundation for a well-functioning urban ecosystem. The organisms living in the soil and on the soil surface are critical to the development of healthy soils. Their movement under the soil surface helps to create soil profiles that allow water to easily infiltrate, and their role in decomposition of leaves and other organic material helps with nutrient cycling and ensure the soils contain the organic matter and nutrients required to support healthy plants.
Soil Stabilization and Water Filtration	Plant root systems come in many different forms, ranging from fibrous mats, to large tap roots, tubers and other underground storage organs. This diversity of forms is one of the reasons why plants can be found in so many different environments. In urban areas, we can work with this natural diversity of root systems to contribute to a healthy urban ecosystem by selecting plants for specific purposes.
Resilient ecological systems	Resilience is the capacity of a system to cope with change. In human-made systems, resilience can be achieved through duplication (e.g. backing up files) and multiple pathways (e.g. capacity to divert electricity through other routes). In natural systems, biodiversity contributes to resilience. When multiple species can play a similar role (e.g. pollination or pest regulation), then the temporary or permanent loss of one species can have a smaller impact on the system, as other species can move in to fill that role.
Identity and character	Australia's unique wildlife are one of the attractions for overseas visitors, and make their time spent here memorable. Similarly, the avenues of elm trees along St Kilda Road, the Plane Trees in Lygon St, and the River Red Gums at the MCG all contribute to the identity and character of the City, as demonstrated during the precinct planning process undertaken for the Urban Forest Strategy. The eels and turtles in the Ornamental Lake at the Royal Botanic Gardens, the cicadas in the summer, and the seagulls circling the Art Centre spire are additional examples of how biodiversity contributes to the identity and character of Melbourne.
Sense of place	Sense of Place is related to the emotions experienced in response to the identity and character of a landscape. Whether it is the scent of a wattle tree in full bloom, the silhouette of a grey-headed flying fox at dusk, the croak of a tree frog or the experience of being in your favourite park, biodiversity can trigger memories that transport you back in time, or make you mindful of being on an adventurous journey or returning home
Physical health	Interesting green spaces and opportunities to interact with nature contribute to peoples' physical health by enticing them to spend time reconnecting with nature and being active outdoors, away from sedentary indoor entertainments. Exposure to a diversity of flowering plant species can also help reduce disposition to allergies ³⁷ .
Emotional Health and Wellbeing	For many people, specific animals or plants can convey a particular meaning that aligns with their feeling of emotional health and wellbeing. This relationship may be based on culture, such as the connection that the people of the Koolin Nations have with Bunjil, the Eaglehawk; or it may be an informal and personal connection, such as the joy of watching how the plants or animals in your garden shift with the changing seasons.
Nature Tourism	In 2013-14, tourism was worth an estimated \$20.6 billion to the Victorian economy, with nature-based tourism visitors representing 70 per cent of all international overnight visitors. Increasing the quantity and quality of biodiversity in the city – particularly initiating flagship projects - could result in an increased number of visitors spending time in Melbourne, boosting local economy

References

-
- ¹ Heiss, A. 2012, p. 4, *Am I Black Enough For You*, Random House Books.
- ² Aronson et al. 2014 A global analysis of the impacts of urbanisation on bird and plant diversity reveals key anthropogenic drivers
- ³ ARCUE, 2012. Urban Biodiversity and Ecology Report for City of Melbourne
- ⁴ Australian Bureau of Statistics, 2016. Capital Cities: Past, Present and Future. <http://www.abs.gov.au/ausstats/abs@.nsf/products/AC53A071B4B231A6CA257CAE000ECCE5?OpenDocument>
- ⁵ City of Melbourne 2009. Climate Change Adaptation Strategy. <http://www.melbourne.vic.gov.au/about-council/vision-goals/eco-city/Pages/climate-change-adaption-strategy.aspx>
- ⁶ TEEB - The Economics of Ecosystem Biodiversity, 2011. TEEB Manual for Cities: Ecosystem Services in urban management. www.teebweb.org
- ⁷ Victorian Institute of Strategic Economic Studies (VISES) 2015. Green Infrastructure Economic Framework. Victoria University, Melbourne
- ⁸ Miller, J.R. & Hobbs, R.J., 2002. Conservation where people live and work. *Conservation biology* 16(2): 330-337.
- ⁹ City of Melbourne 2009. Climate Change Adaptation Strategy. <http://www.melbourne.vic.gov.au/about-council/vision-goals/eco-city/Pages/climate-change-adaption-strategy.aspx>
- ¹⁰ Luck, G.W., Smallbone, L., McDonald, S. & Duffy, D., 2010. What drives the positive correlation between human population density and bird species richness in Australia?. *Global Ecology and Biogeography* 19(5): 673-683.
- ¹¹ Ives, C.D., Lentini, P.E., Threlfall, C.G., Ikin, K., Shanahan, D.F., Garrard, G.E., Bekessy, S.A., Fuller, R.A., Mumaw, L., Rayner, L. Rowe, R. & Kendal, D. 2016. Cities are hotspots for threatened species. *Global Ecology and Biogeography* 25(1): 117-126.
- ¹² Goulson, D., Nicholls, E., Botías, C. & Rotheray, E.L., 2015. Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. *Science*, 347(6229): 1255957.
- ¹³ Unleashing the Potential of nature Discussion paper on City Ecology, ecosystems and biodiversity. City of Melbourne 2015
- ¹⁴ Unleashing the Potential of Nature, City of Melbourne, 2015.
- ¹⁵ City of Melbourne 2015
- ¹⁶ City of Melbourne 2016. Caring for Country: An Urban Application. http://www.nespurban.edu.au/resources/CaringforCountryReport_Apr2016.pdf
- ¹⁷ United Nations, 1987. Chapter 2: Towards Sustainable Development. Our Common Future: Report of the World Commission on Environment and Development. <http://www.un-documents.net/ocf-02.htm>
- ¹⁸ Adger, W.N., 2000. Social and ecological resilience: are they related?. *Progress in Human Geography* 24(3): 347-364
- ¹⁹ Wylie, I. 2015. Glyphosate is a 'probably carcinogenic' herbicide. Why do cities still use it? *The Guardian*, Tuesday 21 April 2015. <http://www.theguardian.com/cities/2015/apr/21/glyphosate-probably-carcinogenic-pesticide-why-cities-use-it>

-
- ²⁰ Kindemba, V., 2009. The impact of neonicotinoid insecticides on bumblebees, honey bees and other non-target invertebrates. Buglife Invertebrate Conservation Trust, UK.
- ²¹ Pesticide Action Network UK. Bees – Neonicotinoids. <http://bees.pan-uk.org/neonicotinoids>
- ²² Alavanja, M.C., Ross, M.K. & Bonner, M.R., 2013. Increased cancer burden among pesticide applicators and others due to pesticide exposure. *CA: A Cancer Journal for Clinicians* 63(2): 120-142.
- ²³ Banks, S.C., Finlayson, G.R., Lawson, S.J., Lindenmayer, D.B., Paetkau, D., Ward, S.J. & Taylor, A.C. 2005. The effects of habitat fragmentation due to forestry plantation establishment on the demography and genetic variation of a marsupial carnivore, *Antechinus agilis*. *Biological Conservation* 122(4): 581-597
- ²⁴ Lay Ong, B, Hes, D, Fryd, O, Aye, L & Ngo, T., 2013. Report on Urban Greenery in the Private Realm for the City of Melbourne. City of Melbourne & The University of Melbourne.
- ²⁵ GHD, 2013. Green Infrastructure and the Private realm: International Review report.' Unpublished.
- ²⁶ C40 Cities, 2016. <http://www.c40.org/>
- ²⁷ 100 Resilience Cities, 2016. Melbourne's Resilience Challenge. <http://www.100resilientcities.org/cities/entry/melbournes-resilience-challenge#/->
- ²⁸ Inner Melbourne Action Plan. <http://imap.vic.gov.au/>
- ²⁹ Growing Green Guide, 2014. <http://www.growinggreenguide.org/technical-guide/>
- ³⁰ Greening the West, 2016. <http://greeningthewest.org.au/>
- ³¹ 2020 Vision. <http://2020vision.com.au/>
- ³² City of Melbourne 2014. Urban Forest Strategy: page 53. <http://www.melbourne.vic.gov.au/community/parks-open-spaces/urban-forest/pages/urban-forest-strategy.aspx>
- ³³ National Biodiversity Strategy Review Task Group 2009, Australia's Biodiversity Conservation Strategy 2010–2020, Consultation Draft, Australian Government, Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.
- ³⁴ Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. <http://www.millenniumassessment.org/documents/document.356.aspx.pdf>
- ³⁵ City of Melbourne, 2016. 100 Resilient Cities. <http://www.melbourne.vic.gov.au/about-melbourne/melbourne-profile/Pages/100-resilient-cities.aspx>
- ³⁶ Kew Royal Botanic Gardens. Millenium Seed Bank. <http://www.kew.org/science-conservation/collections/millennium-seed-bank>
- ³⁷ Hanski, I., von Hertzen, L., Fyhrquist, N., Koskinen, K., Torppa, K., Laatikainen, T., Karisola, P., Auvinen, P., Paulin, L., Mäkelä, M.J. & Vartiainen, E., 2012. Environmental biodiversity, human microbiota, and allergy are interrelated. *Proceedings of the National Academy of Sciences* 109(21): 8334-8339.