

**Better Placed**



**A framework to improve  
urban biodiversity in NSW**

## Design objectives for NSW

Seven objectives define the key considerations in the design of the built environment.



**Better fit**  
contextual, local  
and of its place



**Better performance**  
sustainable, adaptable  
and durable



**Better for community**  
inclusive, connected  
and diverse



**Better for people**  
safe, comfortable  
and liveable



**Better working**  
functional, efficient  
and fit for purpose



**Better value**  
creating and  
adding value



**Better look and feel**  
engaging, inviting  
and attractive

# GA

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# Acknowledgement of Country

We acknowledge the Traditional Custodians, the First Peoples of Australia. We acknowledge their many Countries, knowledges and cultures. We acknowledge their evolving, living cultures and dynamic relationships with Country. We pay our respects to their Elders – past and present. We recognise that Country has been cared for by First Nations peoples for millennia. We also pay our respects to the cultural knowledge-holders who have guided us in the development of this project.



**Kaurna Kardla Parranthi  
Cultural Burn**  
Image: Catherine Leo.



# Executive summary

**In a time of ecological and biodiversity crisis, our urban green spaces must be created and cared for in ways that allow them to support global efforts to restore ecosystems.**

**Biodiversity in Place is a call to action to support nature recovery and enhance biodiversity. We must meet the growing demand for housing. But we must also continue ‘greening’ our cities, bringing the benefits of this and an enhanced biodiversity to our communities.**

## **Our cities should be buzzing with both people and pollinators**

Historically, urban environments have posed a threat to biodiversity and natural ecosystems. But they can – and must – also be part of the solution. Our cities play an important role in supporting a diverse range of flora and fauna, while providing critical habitat for endangered species.

For 39 threatened species, urban areas in Australia are the last remaining places where they exist.

As we plan for more housing, there is an urgent need to address the issue of biodiversity loss. We must improve the design and construction of new developments as well as retrofitting existing developments.

Through Biodiversity in Place, Government Architect NSW advocates for nature-positive approaches to the urban environment by introducing ecology-rich planting to verges, backyards, balconies, public spaces, rooftops and critical infrastructure such as roads, railways and creek corridors.

Biodiversity in Place explains how communities, policymakers and industry can assist in reshaping nature-positive urban environments to reconnect people with larger natural systems. This will create cooler places, provide wildlife habitat and food, support biodiversity, improve mental health and beautify our living spaces.

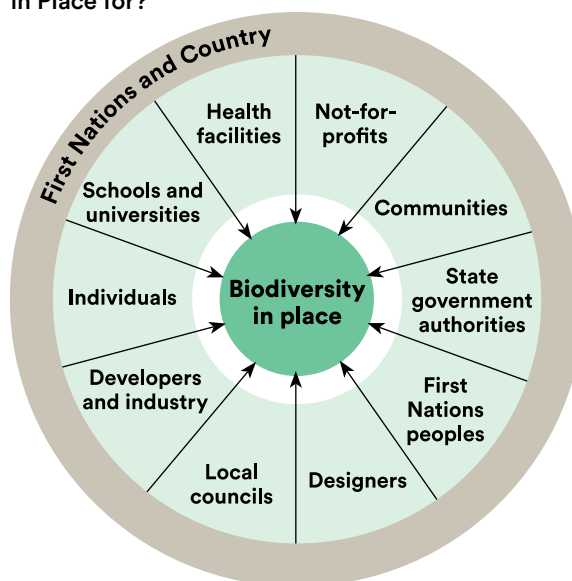
Supporting biodiversity represents a significant opportunity to connect with Country and foster collaboration and knowledge-sharing between Aboriginal and non-Aboriginal communities to ensure sustainable and resilient outcomes.

Biodiversity in Place identifies typologies and tools that provide a helping hand, enabling different agencies to step up and address the issue of biodiversity loss. It will support agencies already on the journey and help bring along those not yet involved. **Everyone has a part to play.**

## **Who is Biodiversity in Place for?**

Biodiversity in Place is for everyone – communities, industry, local councils and government agencies. It can be used by a wide range of stakeholders to instil an ecological agenda into all future development that takes place in our urban spaces across NSW.

Who is Biodiversity in Place for?



**‘Wherever there’s a space, nature will take it. Every single part and piece in the core of the biggest city in the world has an opportunity to recover some functionality and wildlife. Every little intentional patch forms a matrix that together creates connectivity.’**

— Juan Rovalo, Jacobs  
(via Urban Land Institute)

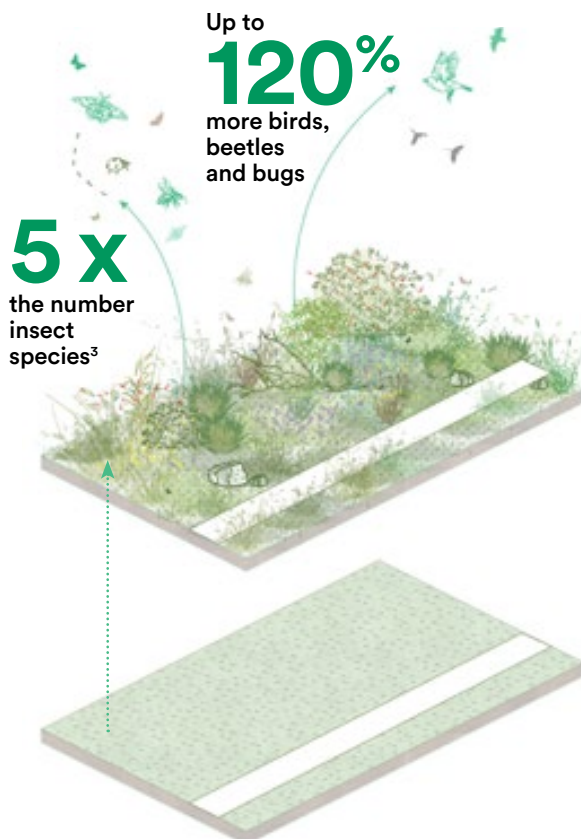


Sydney Metro  
Planting Trials  
Image: Hassell

## Not all green is equal. Let's help our green spaces work harder for biodiversity.

Some 50% to 70% of our public green space is covered in lawn. Although providing important public amenity, lawns are considered biodiversity deserts.<sup>1</sup>

We can enhance biodiversity through a wide range of interventions such as increasing understorey planting and altering maintenance practices; an increase in the volume of native understorey from 10-30% can have a 30-120% increase in species such as native birds, bats, and insects<sup>2</sup>.



### Every space counts

Just as we need to make our urban spaces work harder, we must consider every pocket of the city to help to embed biodiversity into the urban fabric. These statistics from across Australian cities demonstrate the potential for our urban spaces to address biodiversity loss.

**36%**

of public green space is made up of **street verges**<sup>4</sup>, most of which is covered in lawn. Imagine if we converted just a portion of this to biodiverse planting.

**21,100 km**

is the length of council managed **streets**<sup>5</sup> in greater Sydney that could be used for verge planting.

**127 ha**

of new urban habitat could be created in a single suburb if just 30% of people revegetated their **backyards**.<sup>6</sup>

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Section 1

**ABOUT  
BIODIVERSITY  
IN  
PLACE**





# 1.1 What is Biodiversity in Place?

Missing in action in many of our cities and suburban streets is an abundance of birds, bees and butterflies. Superb blue wrens, willy wagtails and blue-banded bees are lying low when they should be making merry. As our suburbs become more built up, wildlife keeps exiting. Biodiversity in Place is a place-based, multiscale approach to bring our built environment to life by creating and supporting urban biodiversity.

## Urban biodiversity, urban nature?

Urban biodiversity is the variety and abundance of life in a city whereas urban nature refers to all life in a city, including expansive green and blue spaces, as well as backyards, street trees, birds, and bugs. Different elements of urban nature can be home to different types and amounts of biodiversity. For example, a city park with bushland trails, a creek and a wetland may be rich in urban biodiversity because it is home to many types and large numbers of trees, birds, frogs, fish and beneficial microbes. In contrast, another nearby city park that features sports fields and picnic areas is also an example of urban nature but supports little biodiversity. Another way to consider this is that urban nature defines the extent of the space, while urban biodiversity refers to specific characteristics of that space, such as species richness or abundance.

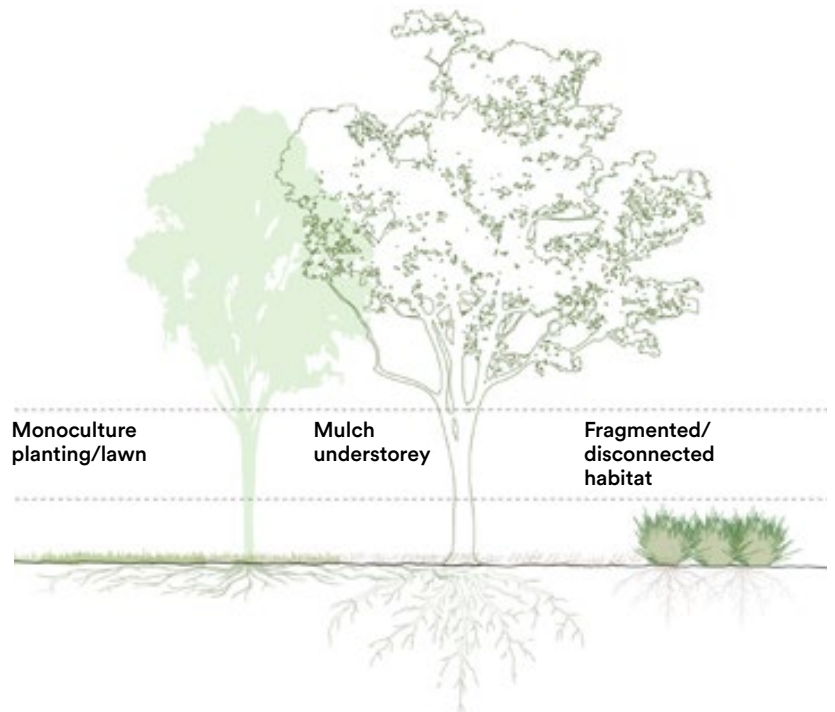
## A multiscale approach

Integrating biodiversity into our cities requires a multiscale approach. Biodiversity in Place considers all typologies within the urban environments such as critical infrastructure, roads, creeks and river ways, plazas, parks, backyards and verges as potential connections to nature. No space is too small.

Biodiversity in Place seeks to contribute to local habitat conservation and creation by providing new habitats as well as establishing connections between existing habitats and populations. It is imperative that we support local habitat corridors, ranging from large ecosystems such as national parks to networks and stepping stones of urban parks, gardens and biodiverse streetscapes.

## Beyond business as usual

With green spaces in urban areas, we have the potential to carefully consider biodiversity, climate, place and ongoing management. If we don't do this, there is a risk that 'set and forget' mono-cultural landscapes will become the norm. As urban diversity is in significant decline, we must ensure our greening efforts deliver the greatest possible benefits to flora and fauna.



**'It is the native shrubs, perennial herbs and grasses that are critically important to insects and small birds. This understorey is their refuge.'**

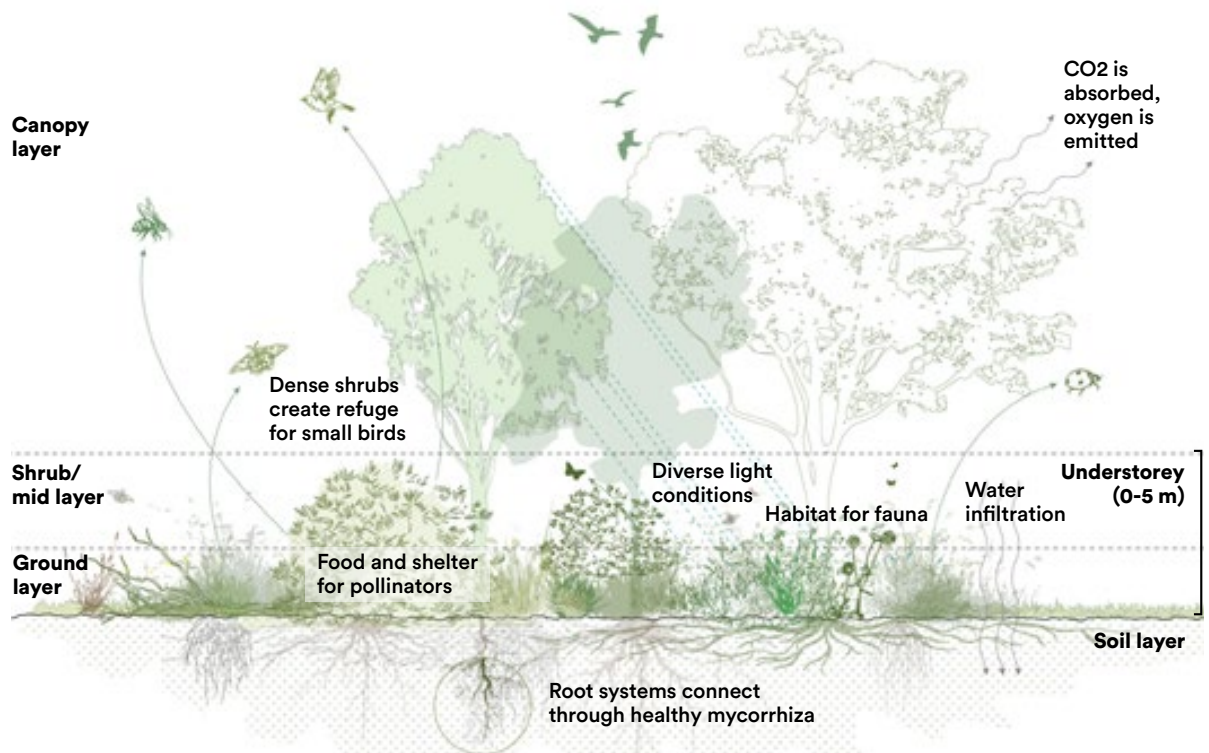
— Vick Bachelard, Waverley Council

Previous page:  
Hills Showground  
Planting Trials  
Image: Hassell.

## Biodiversity in place

Integral to this approach is a diverse understorey. While many of our public green spaces contain trees and lawn, there is a striking gap when it comes to the spaces in between.

Diversity in shrubs, perennial herbs, grasses and ground covers are critically important to insects and birds. This understorey is their refuge and includes habitat features such as logs, rocks and fresh water, which together build stepping stones that connect to broader systems.



## Moving away from business as usual

These are examples of projects underway that are already working towards building biodiversity in our urban environments, primarily working with existing spaces.

### Replacing failed monocultural plantings

Sydney Metro planting trials.  
Images: Hassell



### Revitalising leftover spaces in Centennial Park

Centennial Park Cultural Garden.  
Images: Brett Boardman for Arcadia



### Retrofitting a street and introducing planting for biodiversity

Clowes Street, Melbourne.  
Images: City of Melbourne



# 1.2 What makes Biodiversity in Place?

Biodiverse landscapes are dynamic and in constant flux. Our urban landscapes should not be considered complete on the day they are installed or mown, clipped, mulched, weeded and watered to maintain this stasis. Instead, our urban landscapes should be encouraged to grow and become resilient to change. They provide a home to our declining urban fauna.

## Rewild?

The term ‘rewild’ is becoming a familiar term and trend across the globe. In places like the United Kingdom, it refers to the practice of returning land to its natural uncultivated state, in particular to the re-introduction of lost fauna such as wolves and beavers. Biodiversity in Place deliberately does not use the term ‘rewilding’. After consultation with our Indigenous communities, we acknowledge that Country in Australia was never wild. It has been managed for tens of thousands of years.

First Nations peoples across this continent have long understood the balance with the natural world and have developed complex traditional practices and knowledge systems to support this way of life. Working with and supporting the nuanced knowledges and connections between First Nations and Country is essential for the success of future landscape health.

Biodiversity in Place requires integrating sensitive management practices through appropriate ecological knowledge, disturbance/fire regimes and weed control. By also introducing more diverse nature into cities and streets, through encouraging private home gardens, parks and plazas with natural style planting to replace lawn and concrete, we can enable healthier, better connected ecological systems. This approach encourages a series of smaller and iterative moves to create a network across the urban environment and connect to wider ecological systems.

## Six key principles that go towards creating Biodiversity in Place:

### 1. Nature as partner

Be guided by nature through an understanding of natural processes, and allow these processes to play out over time. This requires a step change in how our communities and stakeholders value and perceive the role of nature in our public spaces.



### 2. For humans and non-humans

Create resilient spaces for both humans and animals to thrive through creating niches and habitat opportunities as well as opportunities for humans to encounter and be immersed in nature.



Image: Jiwah

**‘No plantation can ever replace the wild,  
but if we do plant, we should seek  
to recreate its wonder and variety.’**

— Peter Ridgeway, *A Wide & Open Land*, 2021

### 3. Guided by the landscape

Urban biodiversity must be inspired by the beauty and complexity of nature, without necessarily attempting to recreate it. Biodiversity in Place respects soils, aspect, rainfall and uses and is inspired by indigenous species where appropriate to support wildlife.



### 4. Highly diverse planting

Diverse understorey planting of shrubs, grasses and flowering plants provides fruit, pollen and nectar resources, while also creating beautiful public spaces. Diverse vegetation with an emphasis on indigenous species and local provenance ensures a greater continuity of supply resources for local fauna.



Image:  
Jon Hazelwood

### 5. Sensitive and skilled management

Urban landscapes must be managed with consideration for wildlife and biodiversity, for example, by reducing the use of pesticides and herbicides and mowing.



Image:  
Wildflower

### 6. Connected across scales

From small to large, no space is too small to be valuable, to build corridors and create stepping stones. One green roof here, a rain garden there or a beautiful pocket of naturalistic planting will have some local small-scale effects. But it is the connecting of these elements on a city scale that will make them transformational.



# Places within the urban environment where biodiversity can occur.

Image: City of Melbourne.

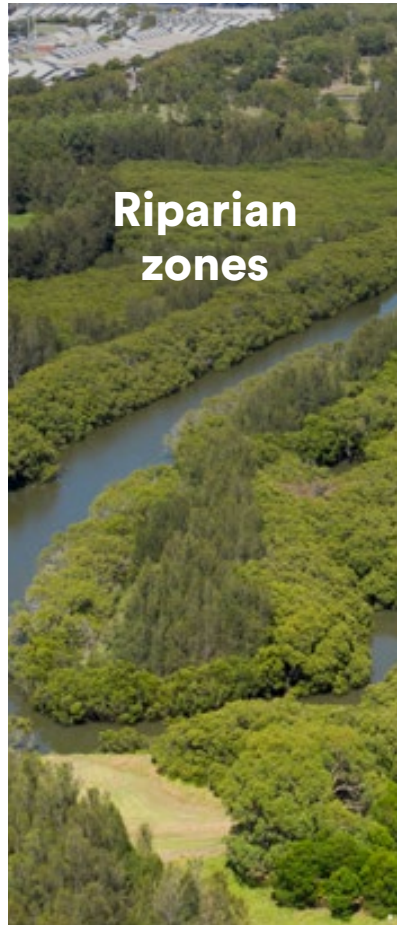


Image: Sarah Panell.

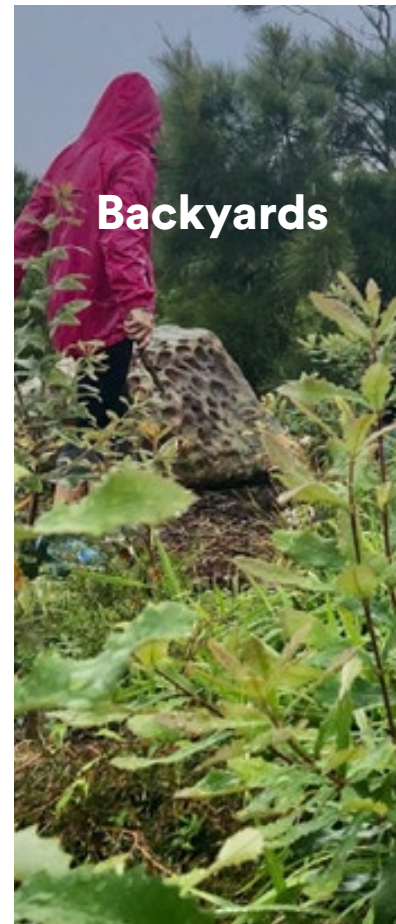
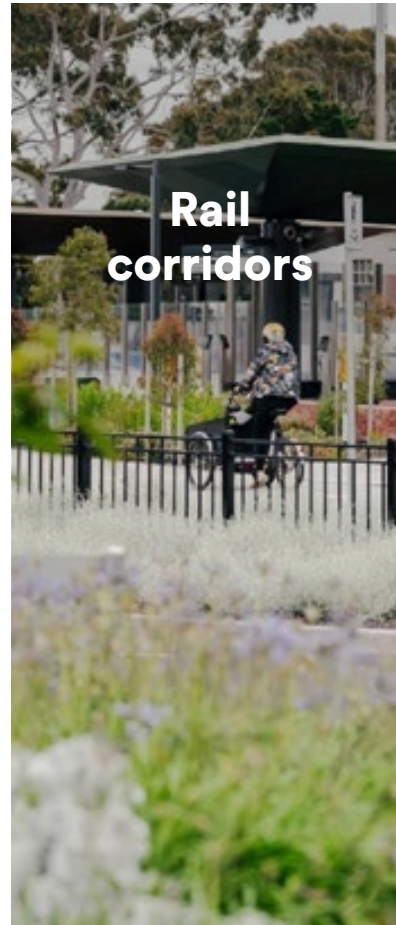


Image: Jon Hazelwood.

Image: Jon Hazelwood.

Image: Barbara Schaffer.



Image: Jon Hazelwood.



Image: Nigel Dunnett.



Image: Jessica Maurer, Dirt Witches.

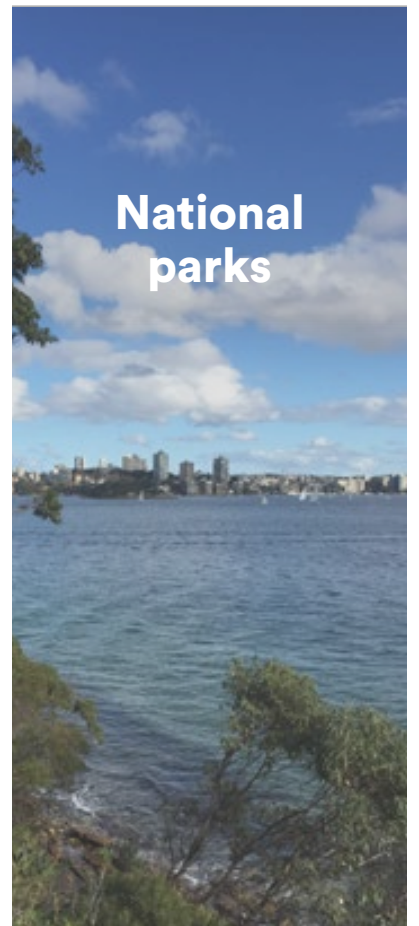
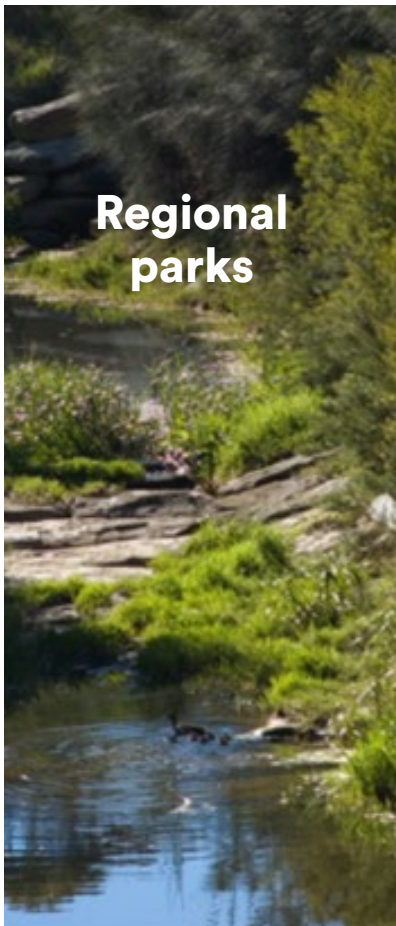
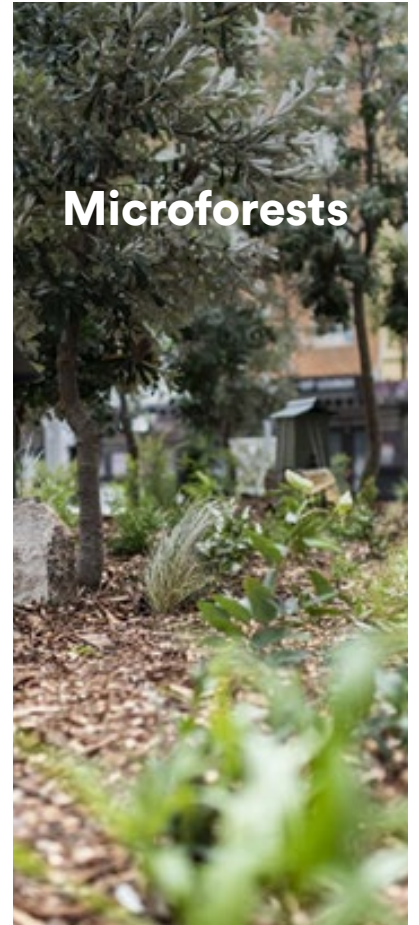


Image: Barbara Schaffer.

Image: Chloe Walsh.

Section 2

**WHY  
WE NEED  
BIODIVERSITY  
IN  
PLACE**



Image: Jon Hazelwood

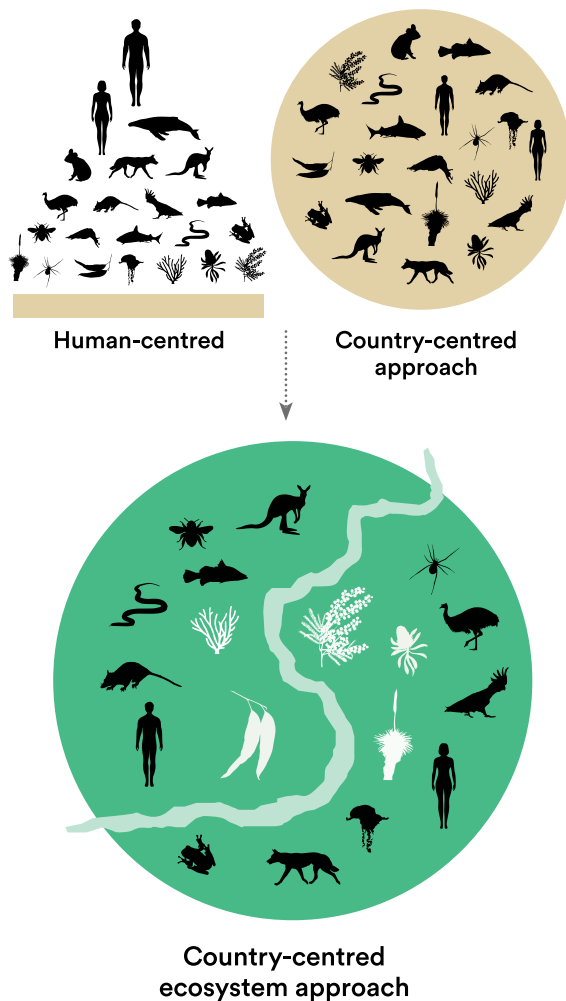


## 2.1 The importance of Biodiversity in Place

The UN Decade of Ecosystem Restoration 2021–2030 aims to prevent, halt and reverse degradation of ecosystems on every continent and in every ocean. It is a rallying call for the protection and revival of ecosystems all around the world for the benefit of the natural environment that supports current and future generations. Now is our time to act.

### Human-centred approach or Country-centred approach

Diagram adapted from German architect Steffen Lehmann's 'Eco v Ego' diagram, 2010.



### Where are the blue-banded bees?

Biodiversity loss is one of the greatest threats worldwide. Despite the pressures of urbanisation on local habitat, urban areas can be home to significant numbers of species, offering local habitat protection and nature experiences for people. Evidence is now clear that for vegetation to support more life and be more resilient, we need to encourage more biodiversity in urban places.

### Future nature

Greater urbanisation does not mean we cannot pursue the role of urban biodiversity in our public and private spaces. The European ideal of what a 'civic' space is can no longer be at the expense of nature and the benefits it brings. This will require shifts in how our communities, our stakeholders and our policymakers view the value of nature in the city.

### Taking the green grid to the next level in NSW

Biodiversity in Place supports the enhancement of the green and blue grid, by taking a nature-first approach. This interconnected network of open space provides the framework for an intensive urban biodiversity response. By protecting the health of our natural ecosystems and augmenting the biodiversity component of our parks, green corridors, streets, plazas and built elements, we can create threads of nature from the city to the suburbs. Biodiverse peri-urban landscapes can enable our cities to become more resilient, improve health and happiness and create special places for both people and wildlife.

The Greening our City Program has delivered policy guidance and investment to expand urban tree canopy cover in Greater Sydney. Local councils play an important role in the planning and management of our urban forests, and the Greener Neighbourhoods Program recognises this and supports councils to improve greening practices and outcomes. Biodiversity in Place will complement this existing work to take urban greening to the next level by incorporating more elements of nature and biodiversity.

**'Our world must not only become net zero, but also nature positive, for the benefit of both people and the planet, with a focus on promoting sustainable and inclusive development. Nature, and the biodiversity that underpins it, ultimately sustains our economies, livelihoods and wellbeing.'**

— G7 2030 Nature Compact

## The research is clear

### Biodiversity and habitat in cities

**20 x**

When microforests are densely planted with multilayered diverse plant species they can support up to 20 x more species.<sup>7</sup>

'There is a positive relationship between the species richness or number of species of birds present and the vertical structural complexity of vegetation.'<sup>8</sup>



One study in Melbourne replaces 2 species of plants with 12 in an urban park and after just 3 years found they supported 5 x the number of insect species and 15 x the number of species interactions.<sup>9</sup>



**9 x**  
the number  
of insect  
diversity

A diverse green roof was capable of supporting 4 x the avian and 9 x the insect diversity compared with a conventional roof.<sup>10</sup>

'Ecosystems that contain many different structural elements are likely to have a variety of resources (e.g. pollen, nectar, leaf litter, hollows and shelter sites) and support a greater diversity of species.'<sup>11</sup>

'Urban areas provide opportunity for people to connect with environmental processes and phenomena, including those who lack the means or motivation to travel to non-urban areas, where exposure-based wildlife education has been located traditionally.'<sup>12</sup>

### Public perception, wellbeing and community connection

Children who play in natural environments and come into contact with **plants** and **soil** develop **fewer allergies**.<sup>13</sup>



'Planting with flower cover of 27% or more is perceived as the **most attractive**. Subtle green planting affords the greatest restorative effects and planting that is naturally structured is the most restorative.'<sup>15</sup>



People value green space with high measured biodiversity significantly more than that with a low measure.<sup>17</sup>

The significance of the relationship between human health and the natural environment is increasingly clear. Over the past decade there had been a rapid rise in scientific literature on the physical and psychological benefits of nature as a preventative healthcare and self-care solution.

'The biodiversity of natural areas has been found to be associated with human wellbeing, with participants across 15 parks reporting that they **feel better in the environment** with the greater species richness of plants and, to a lesser extent, birds and butterflies.'<sup>14</sup>

**90%**  
felt more  
connected  
to others

A study outlined the benefits that landcare volunteers experience: 90% felt more connected to people, 93% felt more connected to the environment and a majority noted greater mental wellbeing.<sup>16</sup>

Perceived **species richness** has been positively associated with greater connection to nature and improved site satisfaction.<sup>18</sup>

### Value and ecosystem services

'Food production relies on biodiversity for a variety of food plants, pollination, pest control, nutrient provision, genetic diversity and disease prevention and control.'<sup>19</sup>



'Natural parks, defined as parks with more than 50% native or habitat protected vegetation, have a greater contribution to property value increase than other park types.'<sup>20</sup>



## 2.2 Communities for Biodiversity in Place

**Community interest and personal investment in Biodiversity in Place is essential for the long-term success of this approach. Many grassroots initiatives are already spearheading urban biodiversity efforts. These help to foster healthier, more connected and resilient communities.**

Top-down regulation and policy are essential for large-scale change, however, it is important to acknowledge the efforts that are happening on the ground. Grassroots approaches play a key role in restoration efforts and can greatly improve environmental awareness and ecological literacy among the general public.



### **Fostering stewardship and ecological knowledge**

When people care for and connect with their local environments, it helps to foster important ecological, place-based knowledge. Understanding the uniqueness of our local environments encourages communities to support and advocate for their protection and regeneration. Projects at this scale help to embed local identities that celebrate indigenous and endemic plants, animals, birds and insects. In this sense, the idea of community begins to expand from just people to include the plants, animals, soils and waters of a place.

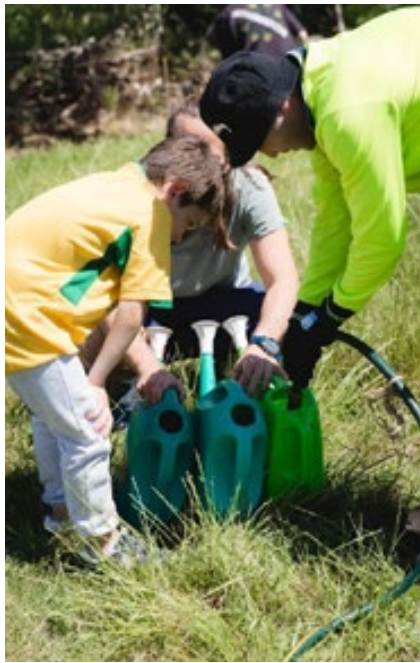
Tree Rites, a project in Sydney, revegetates parcels of land in a ritual that coincides with cultural rites of passage. Each project honours or celebrates a culturally significant event, like a birthday or someone's passing. These tiny forests and planted pockets become embedded with meaning and memories for those who participate, while supporting environmental healing and stewardship.

**‘We are who we are because of our encounters with the more-than-human world. Any future in which we survive and thrive will require us to become even more together – in our lives, in our thinking, in our being and in our society.’**

— James Bridle, 2022

**Downer microforest working bee, Canberra, The Climate Factory.**  
Image: Edwina Robinson.





**Signal Reserve planting day organised by Tree Rites in collaboration with Woollahra Municipal Council.**

Images: Barbara Schaffer.



**City of Parramatta Bushcare Program.**

Images: Parramatta Bushcare  
City of Parramatta Council.



**Diego Bonetto leads workshops on foraging for edible 'weeds', celebrating the spontaneous plants of our urban spaces.**

Images: Nisa Mackie, Hellene Algic.



Section 3

**HOW WE  
CREATE  
BIODIVERSITY  
IN PLACE**





# 3.1 Pathways to Biodiversity in Place

There are many ways to create Biodiversity in Place. An ecologically rich place can mean different things depending on the scale, location and identified goals for biodiversity of that space and those who use it.

Ideally local government agencies will undertake a local government area overview, map ecological values and identify opportunities to improve urban habitat and connectivity.

The following pages outline some steps that can help you to create more biodiverse spaces within our cities.

**‘Visionary urban design can significantly improve the status and trends of biodiversity in cities and their surrounding regions.’**

— CSIRO

## Creating spaces for life

Monocultural plantings, hard surfaces and trimmed lawns offer little room for wildlife to co-exist with humans in our urban spaces. To create Biodiversity in Place we must introduce diverse, layered, flowering vegetation to provide the resources needed for a range of native birds and insects. These species also need shelter in the form of habitat features, such as loose rocks, logs and leaf litter.

## A spectrum of interventions

Altering/reducing existing maintenance practices

‘Retrofitting’ existing low-diversity green spaces with biodiverse plantings

Establishing and managing entirely new biodiverse ecosystems



Previous page: MIFGS Garden, Melbourne by Superbloom, MoU and Hassell  
Image: Sarah Pannell.

Grey to Green, Sheffield, UK. Sheffield City Council.  
Image: Nigel Dunnett.

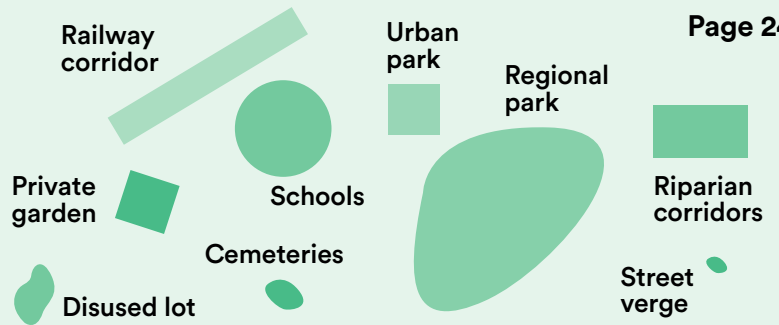


## Plan for success

# 1

### Identify typology

Understanding the site conditions, scale, context and intended use of your space is essential for knowing how to meaningfully intervene within a space.



Page 24

### Seek partnerships

Setting up early partnerships will enable knowledge-sharing and support. For example, a developer may partner with researchers to support new research and develop evidence-based outcomes or community-led groups may seek funding and support from local or state government.

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### Define goals

Healthy biodiverse spaces don't all look the same. So identifying goals clearly will help to give your project direction and clarity. Many of the goals might overlap and the most successful places will achieve more than one.

Water filtration  
Urban cooling  
Ecosystem services  
Carbon sequestration  
Air quality

Habitat (for who?)  
Improve local ecological knowledge  
Country focused  
Beauty and aesthetic

Community connection  
Management  
Human health and wellbeing  
Ecosystem connectivity  
Climate resilience

# 2

### Choose your tools

Depending on the site conditions, and the resources and skills you have available, determine how you will intervene to create and support biodiversity.

Microforests  
Habitat features  
Urban grassy meadow  
Seasonal planting  
Planting for pollinators

Architecture for multiple species  
Woody meadow  
High-density planting  
Wildlife boxes  
Sensitive and skilled management

Nature connection designs and activations  
Invasive species removal  
Freshwater sources

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# 3

### Monitor and manage

Biodiverse places are not finished on the day they are installed. They require ongoing management and care. Different biodiversity measures will require different levels of investment as well as maintenance costs and expertise. There are exciting opportunities here for research to monitor the successes and learnings of plant and habitat management. With this in mind, it is important for designers and decision-makers to build relationships with management, staff and local communities that will enable innovative and resilient outcomes.

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## 3.2 Creating a network of Biodiversity in Place

Building on the unique qualities of each place, Biodiversity in Place weaves our distinctive NSW landscapes – each with its own indigenous plants, songbirds and stories – back into our urban environments, facilitating the connection to nature that people are craving.

**‘While our national parks and wilderness areas are essential for protecting biodiversity, our cities and towns also provide critical habitat for threatened species.’**

— Australian Conservation Foundation

### Corridors and networks

Biodiversity in Place seeks to contribute to local conservation by providing new habitat or establishing connections between existing habitats and populations.

Habitat connectivity is essential. Species must be able to move around safely and easily to access food and new habitat and to mate to ensure genetic diversity. Safe movement corridors also help animals avoid contact with vehicles and move in response to natural disasters and climate events. This will become increasingly important as the climate continues to change.

It is imperative that we support local habitat networks, ranging from large ecosystems such as national parks to networks of urban parks, gardens and green streetscapes. Protecting urban biodiversity is about more than just threatened species. It extends to all the plants, animals and microorganisms that live in our urban areas. Biodiversity already exists in our streets, gardens and brownfield sites and in other unexpected places. It needs to be protected, fostered and enhanced.

Biodiversity in Place supports the enhancement of the green and blue grid by taking a nature-first approach. This interconnected network of open spaces provides the framework for an intensive urban biodiversity response.

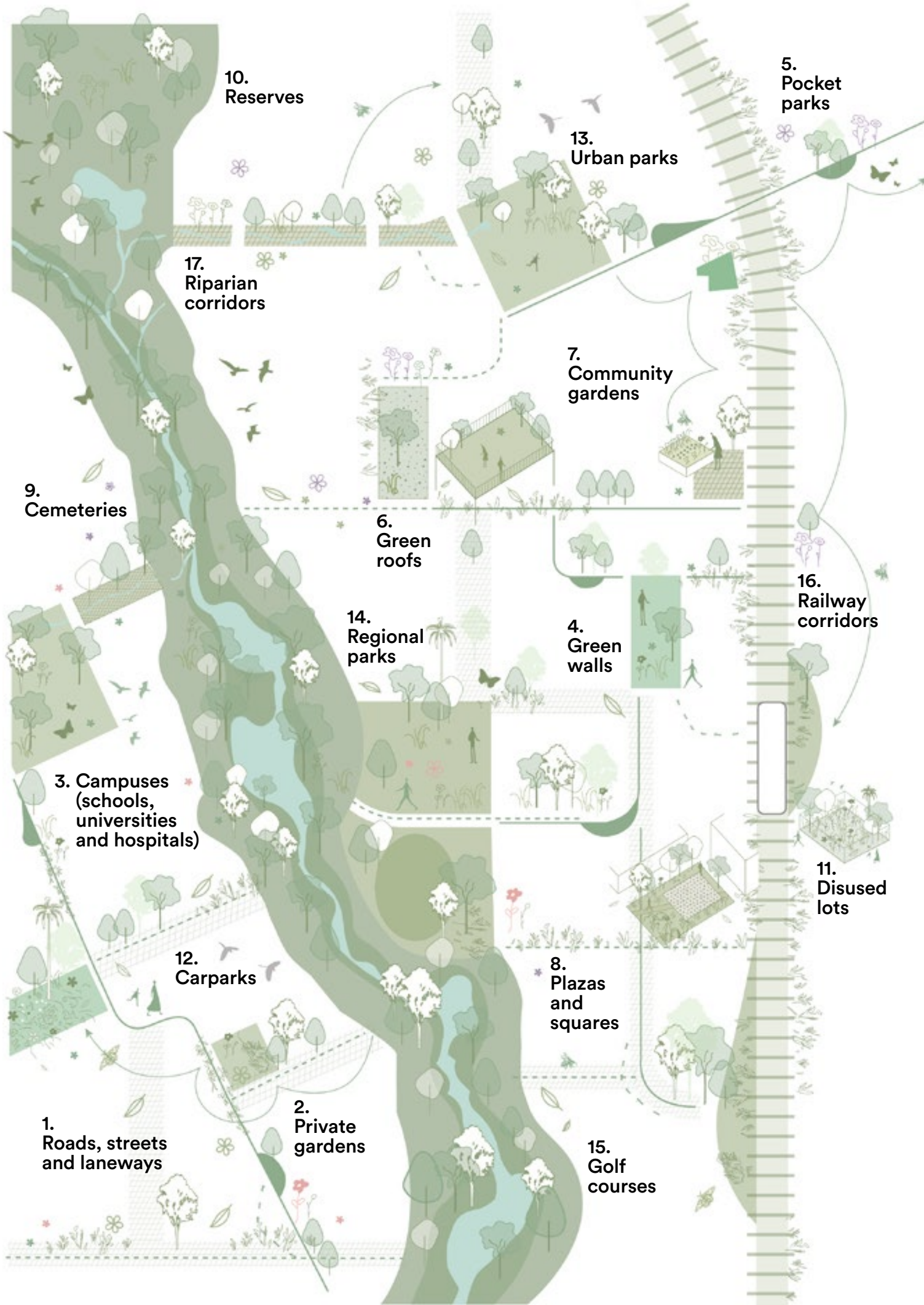
Biodiversity in Place is a strategy for our urban environments. It is not focused on very large-scale ecological restoration and revegetation that may take place at the broad landscape scale on agricultural land and in state and national parks.

#### Framework focus

- |   |                       |                        |                    |
|---|-----------------------|------------------------|--------------------|
| 1. Roads, streets and laneways                    | 6. Green roofs        | 12. Carparks           |                    |
| 2. Private gardens                                | 7. Community gardens  | 13. Urban parks        |                    |
| 3. Campuses (schools, universities and hospitals) | 8. Plazas and squares | 14. Regional parks     |                    |
| 4. Green walls                                    | 9. Cemeteries         | 15. Golf courses       | National parks     |
| 5. Pocket parks                                   | 10. Reserves          | 16. Railway corridors  | State parks        |
|   | 11. Disused lots      | 17. Riparian corridors | Agricultural lands |

Urban

Rural



10. Reserves

5. Pocket parks

13. Urban parks

17. Riparian corridors

7. Community gardens

9. Cemeteries

6. Green roofs

16. Railway corridors

14. Regional parks

4. Green walls

3. Campuses (schools, universities and hospitals)

11. Disused lots

12. Carparks

8. Plazas and squares

1. Roads, streets and laneways

2. Private gardens

15. Golf courses

# 1

## Identify a typology

To create a mosaic of connected, biodiverse spaces, the Biodiversity in Place framework considers the various typologies that are present across urban areas, outlining the opportunities that are possible to enhance their biodiversity value.

### The right approach for the right place

The spaces that make up our urban places vary considerably. Therefore, the approach to increase their biodiversity value will be varied. Streets and backyards might more heavily focus on floral plantings for pollinators, while riparian corridors can take on larger-scale ecological regeneration efforts.

### Governance and care

When identifying the typology, consider who and how these places will be managed over time. Who are the Traditional Custodians and how can they be involved or consulted? Who will be the stewards of these spaces long term, and how can they be invited to participate in altering these spaces to ensure the health of both human and non-human species? Consideration must be given to who will be responsible for ongoing maintenance and funding.

## 1. Roads, streets and laneways



**Scale:**  
Ecological corridors, stepping stones

**Stewards:**  
Local council, private residents, developers

Road and street edges offer a unique and underutilised opportunity for habitat restoration in residential neighbourhoods. A study in Perth found 88% of just over 900 people reported a preference for natural, woody foliage along streetscapes over bare grass.<sup>21</sup> This finding also suggests that the common argument, that such plantings create safety concerns for pedestrians, may be outdated.<sup>22</sup>

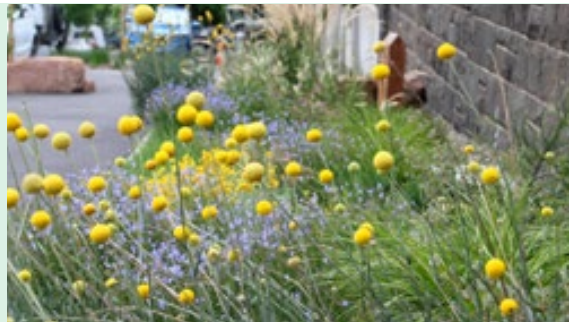
### Opportunities:

Integrate water-sensitive urban design to treat and hold water

Plant diverse understorey to support street tree health

Wildlife boxes

Insect hotels



### Project: Clowes Street, Streetscape Biodiversity Project

University of Melbourne trialled the installation of low understorey species along a Melbourne street in order to bring more biodiversity to inner-city streetscapes.

Image: City of Melbourne.

## 2. Private gardens



**Scale:**  
Stepping stones, corridors

**Stewards:**  
Private residents

Domestic gardens can make up at least half of the green space in cities. Wildlife gardening is an approach to engage people with nature in their own backyards by planting indigenous species, removing weeds, retaining mature trees and remnant vegetation, planting in layers from groundcover to canopy and adding habitat elements like shelters, nesting sites and water features.

### Opportunities:

Planting for pollinators

Fruiting trees

Edible gardens

Wildlife boxes

Insect hotels

Architecture for multiple species



### Project: Nursery plant giveaways

Blacktown City Council (along with many other councils around Sydney) participate in plant giveaway programs. Over 20,000 plants are grown at the Council nursery to green Blacktown City. The plants are given away to local residents, schools and community groups to encourage backyard biodiversity.

Image: Blacktown City Council.

## 3. Campuses (schools, universities and hospitals)



**Scale:**  
Ecological corridors, stepping stones

**Stewards:**  
Students, teachers, local families, local council

Campus grounds are underused spaces for biodiversity. There are substantial opportunities to enhance the habitat provided on a wide range of campuses by planting diverse vegetation and providing resources like frog bogs and artificial nesting structures.

### Opportunities:

Integrate water-sensitive urban design to treat and hold water

Plant diverse understorey

Edible gardens

Circular compost economy (see [page 39](#))

Wildlife boxes

Insect hotels

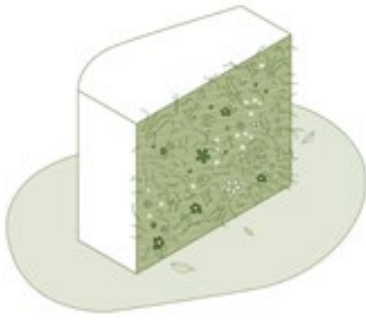


### Project: Cooling the Schools Sydney

Greening Australia works with students and teachers to plant native trees and plants in school yards to create healthier, more biodiverse learning environments. In the process students learn the importance of environmental stewardship. The program is led by ecologists and co-delivered with Aboriginal cultural education provider Deadly Ed.

Image: Greening Australia

## 4. Green walls



**Scale:**  
Stepping stones

**Stewards:**  
Private landowners,  
developers

Green walls have the potential to create additional habitat for native species while addressing the shortage of space in urban areas. Consideration of irrigation requirements and aspect should help to inform the placement and scale of greenwalls. Low-tech greenwalls that use climbing plants can also provide many benefits such as air pollution capture and filtration, urban cooling and habitat for insects.

### Opportunities:

Integrate flowering species for pollinators

Integrate insect hotels or wildlife boxes

Opportunities for low-tech climbing plants over high-maintenance and costly potted systems

Architecture for multiple species



### Project: Global Change Institute

This green wall constructed by the Greenwall Company is made from 95% recycled materials. The use of inorganic recycled materials means it does not require ongoing topping up of soil and needs less irrigation than many traditional garden beds.

Image: The Green Wall Company, Hassell.

## 5. Pocket parks



**Scale:**  
Stepping stones,  
corridors

**Stewards:**  
Local council,  
community groups,  
developers

Pocket parks provide important stepping stones between larger urban and regional parks. When these spaces are connected to biodiverse streets and residential gardens, their potential for habitat and biodiversity value also increases.

### Opportunities:

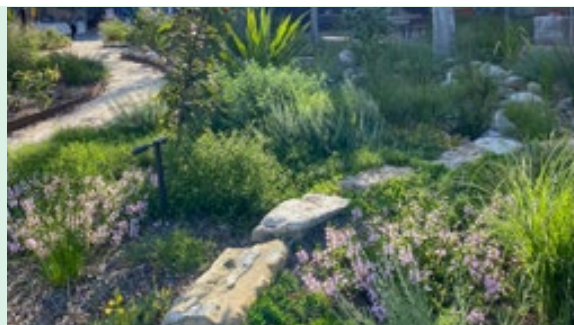
Seasonal flowering

Reduce areas of turf

Wildlife boxes

Insect hotels

Integrate water-sensitive urban design to treat and hold water



### Project: South Eveleigh Cultural Garden

This pocket park was designed and constructed by Indigenous landscape company Jiwah in collaboration with local Indigenous community members. It integrates locally significant species that can be used for toolmaking, food and medicine. It is a highly diverse pocket park and its planting style challenges expectations about what urban pocket parks can be.

Image: Jiwah.



## 6. Green roofs



**Scale:**  
Core ecological habitat

**Stewards:**  
Local council, developers, community groups

Green roofs have the potential to create additional habitat for a range of species while addressing the shortage of space in urban areas. When implemented at heights of around 5 stories or below, these small patches of habitat can also significantly contribute towards the overall ecological connectivity of the landscape for smaller organisms.<sup>23</sup>

### Opportunities:

Pollinator focus

Wildlife boxes

Rock and log features

Opportunity for vegetation and solar panels where rooftops are inaccessible



### Project: Burnely Living Roofs

Burnely Living Roofs for the University of Melbourne provides a purpose-built space for the horticulture team to undertake research. Three roofs make up the campus: the Research Roof, Biodiversity Roof and Demonstration Roof.

Image: Hassell.

## 7. Community gardens



**Scale:**  
Stepping stones

**Stewards:**  
Local council, community groups, developers

Community gardens often have high rates of biodiversity when principles like permaculture and companion plantings of flowering species are combined with food production planting. Community gardens also provide important opportunities for locals to connect with one another, connect with plants and strengthen food resilience.

### Opportunities:

Pollinator focus

Seasonal flowering

Fruiting trees and plants

Permaculture

Circular compost economy



### Project: Friendship Community Garden

This community garden in Wollongong is based on a permaculture model and is a space for Afghans, Iranians and the wider cultural community to develop and learn ecological management practices as well as develop community capacity and leadership skills within a social setting.

Image: Food Fairness Illawarra.

## 8. Plazas and squares



**Scale:**  
Stepping stones,  
corridors

**Stewards:**  
Local council,  
developers

Urban plazas and squares are often associated with expansive areas of hardstand due to their inherited aesthetic connections to European town squares. There is much opportunity in Australian cities to introduce greater planting and diversity in these spaces that will help to mitigate the impacts of climate change and contribute to a new 'civic' identity in our urban environments.

### Opportunities:

Integrate diverse understorey and shrub layers into planting designs

Floral and feature planting

Integrate water-sensitive urban design to treat and hold water

Wildlife boxes

Architecture for multiple species



### Project: Sydney Metro planting trials

An urban railway plaza has been the testing ground for highly diverse and dense planting mixes that aim to bring more biodiversity and delight to a space that previously hosted monocultures.

Image: Jon Hazelwood.

## 9. Cemeteries



**Scale:**  
Core habitat,  
stepping stones

**Stewards:**  
Local council,  
community groups

Cemeteries can provide important refuges for wildlife and plant species as they are often less frequented by people than parks. In Australia particularly, old cemeteries can support remnant ecological communities due to their lack of soil disturbance. Examples include grasslands, lichens and mosses, which are unable to exist elsewhere in urban environments.

### Opportunities:

Create habitat niches for flora and fauna refuges

Seasonal flowering

Reduce areas of turf, differential mowing  
(see page 37)

Programs that connect people with  
environmental stewardship

Monitoring and regeneration of remnant  
ecological communities



### Project: Native grassland regeneration in Camperdown Cemetery

Remnant grasslands are cared for by local residents alongside the Inner West Council urban ecology team in this inner-Sydney cemetery in Camperdown.

Image: Chloe Walsh.

## 10. Reserves



**Scale:**  
Core habitat,  
ecological corridors

**Stewards:**  
Local council,  
community groups

Reserves are open spaces that are often associated with having a greater proportion of native or bushland-like character than other parks. Taking advantage of this, reserves can offer an intense diversity of plantings and provide a great opportunity for residents to learn and connect with their indigenous plant and animal species.

### Opportunities:

Wildlife boxes

Reduce areas of turf and replace with understorey and shrub layers

Microforests

Cultural stewardship and volunteer/education programs



### Project: Wallumatta Nature Reserve

This reserve in North Ryde is a demonstration site for best-practice management of Turpentine-ironbark forest. Despite being only 6 ha and surrounded by residential development, the reserve aids in research and education for local schools and universities in the area.

Image: National Parks NSW.

## 11. Disused lots



**Scale:**  
Ecological corridors,  
stepping stones

**Stewards:**  
Private landowners,  
developers

Disused lots are interesting urban spaces as they often host a diverse array of both native and non-native species. Researchers have found vacant lots can harbour rich communities of plants, insects and birds. This is because they are not accessible or infrequently used by humans. They may even present greater species richness than formal green spaces or rural sites.<sup>24</sup>

### Opportunities:

Retention of spontaneous plants and trees

Temporary or permanent refuge for species of interest

Space to monitor and study novel ecologies and their value

Microforests

Interventions such as signage that communicate ecological impact and target public perceptions



### Project: The Hill

An area of contaminated crown land in Glebe dubbed The Hill by local residents is set to be transformed into an urban wildlife refuge. The Glebe Society have been given a \$40,000 innovation grant from City of Sydney to monitor wildlife in the lot through hidden cameras and surveys.

Image: Andrew Wood, the Glebe Society.

## 12. Carparks



**Scale:**  
Stepping stones

**Stewards:**  
Private landowners,  
local council,  
community groups

Carparks make up a large areas of our urban spaces. In Sydney, the CBD alone provides just under 29,000 spaces,<sup>25</sup> all of which are impermeable hardstand. There is great opportunity to design and retrofit carparks to better support biodiversity, including by increasing tree canopy, providing greater diversity and density in adjacent garden beds and using permeable hardstand. Many carparks are multi-deck and their design or retrofitting could include considering how site edges and roof conditions might support biodiversity.

### Opportunities:

Greater understorey and tree canopy cover

Permeable surfaces

Extensive planting on rooftops

Wildlife boxes



### Project: Botanic Gardens, Missouri

This carpark was redesigned to demonstrate best practice for sustainable design of an 'eco-lot'. It increased tree canopy significantly, introduced bioretention swales, native planting and 5 types of porous paving to allow better water filtration and retention.

Image: Pashek + MTR.

## 13. Urban parks



**Scale:**  
Core ecological  
habitat

**Stewards:**  
Local council,  
community groups

Urban parks represent critical habitat for native species as they offer contiguous areas of vegetation surrounded by impervious surfaces. Current parkland design tends to prioritise amenities such sporting fields, playgrounds and dog exercise yards, with small, manicured patches of vegetation. Research suggests much can be done to improve biodiversity in parks, including by increasing native vegetation cover and altering maintenance practices.<sup>26</sup>

### Opportunities:

Develop understorey and shrub planting that frames recreation spaces

Reduce turf, differential mowing, establish meadows or grasslands

Cultural stewardship and volunteer/educational programs

Habitat features (logs, stones and rocks)



### Project: Prince Alfred Park

This urban park designed by Sue Barnsley Design integrates a native meadow along its edges where native species are allowed to flourish. This condition has helped challenge public perceptions of 'messy' or more 'naturalistic' plantings in urban spaces.

Image: Brett Boardman, Landscape Australia.

## 14. Regional parks



**Scale:**  
Core ecological habitat, regional

**Stewards:**  
Local council, community groups, state government

Similarly to urban parks, regional parks can offer core and critical habitat. These parks have scale on their side. While demand for human activity and enjoyment is still significant, these spaces can offer areas that are more targeted at wildlife habitat. One study found that an increase in native vegetation of 20% could result in up to 140% higher occupancy of native species.<sup>27</sup> The biodiversity value of urban parks is also positively associated with greater physical health and social relations among local residents.<sup>28</sup>

### Opportunities:

Large-scale endemic regeneration initiatives

Differential mowing/grassland establishment

Large-scale water retention and treatment

Wildlife boxes

Insect hotels

Rock and log features



### Project: Sydney Park

Sydney Park is an exemplar project for designing for biodiversity in urban parks. It hosts wetlands and many pockets of native bushland and planting across the site as well as community gardens that provide habitat and refuge for many species.

Sydney Park Water Reuse. Image: Turf Design Studio & Environmental Partnership

## 15. Golf courses



**Scale:**  
Core ecological habitat, regional

**Stewards:**  
Private land owners, individuals, community groups

Golf courses make up almost 1 in 10 parcels of Crown land across Sydney, taking up a large proportion of open green space.<sup>29</sup> Research shows they support biodiversity, with one study (of urban areas in Melbourne) finding they support more birds, beetles, bugs and bats than any other urban green space typology. This is because they often feature pockets that have diverse, layered vegetation in out-of-bounds areas that are largely not accessed by people. They often also feature mature trees (under less pressure of development) and areas of unmaintained vegetation, which are rare to find in urban parks.<sup>30</sup>

### Opportunities:

Restoration and wildlife refuge zones

Wetland and water resources

Wildlife boxes and monitoring programs

Conversion to habitat and open space where appropriate



### Project: Northcote Golf Hub

Half of this 24 ha parcel of land in Melbourne is occupied by the golf course and the rest is dedicated to habitat restoration and recreation. The site features stands of mature trees with nesting boxes, a wetland, trial areas of endemic planting and a community garden. This course also supports a small population of swamp wallabies that live along Merri Creek.

Image: Northcote Golf Course.

## 16. Railway corridors



**Scale:**  
Core ecological habitat

**Stewards:**  
Transport NSW, Metro

Transport corridors in urban landscapes cover a broad variety of informal and overlooked linear green spaces, often crossing multiple neighbourhood and government boundaries. They can not only provide significant space for native vegetation, but also provide other resources for nature, such as relatively undisturbed perching, nesting and hiding sites.<sup>31</sup>

### Opportunities:

Develop understorey species along rail edges

Establish pockets of microforests for habitat stepping stones

Retain and integrate spontaneous plants into ongoing management

Dedicate pockets along railway corridors for biodiversity and encourage connections between existing and new biodiversity focused projects



**Project:** Level crossings removals, Victoria

The level crossings project in Victoria has seen the creation of diverse linear parks along the new raised railways lines. This project in Wangarratta demonstrates the potential for introducing large buffers of diverse planting along railway lines.

Image: Hassell.

## 17. Riparian corridors



**Scale:**  
Core ecological habitat, corridors

**Stewards:**  
Local councils, community groups

Creeks and streams are important places for urban biodiversity, as they provide continuous linear strips of habitat, often composed of remnant or restored riparian vegetation.<sup>32</sup> They are therefore likely to function as wildlife corridors, increasing habitat connectivity and facilitating the movement of birds, mammals and amphibians through the urban landscape. The act of protecting and restoring creek lines will also ensure the continuation of ecosystem services, like flood control and water filtration.<sup>33</sup>

### Opportunities:

Large-scale endemic regeneration

Management for biodiversity (retention of dead trees, leaf litter, etc. for habitat and soil health)

Cultural stewardship and volunteer/education programs



**Project:** Cooks River

While having a reputation for being one of the most polluted rivers in Sydney, the Cooks River has a large number of projects, community groups and organisations dedicated to caring for and improving the health of the river. This has seen the regeneration of mangroves and habitat areas along the length of the river.



**Pimelea Western  
Sydney Parklands.**  
McGregor Coxall.  
Image: Simon Wood.

# Seek partnerships

Once the spatial typology is understood, building connections and partnerships between communities, industry, researchers and government bodies can enable robust, evidence-based and meaningful Biodiversity in Place projects.

Biodiversity in Place is about using our own skills, roles and resources to effect positive change and establish a network of collaborations. Below are just some examples of how various groups can become involved.

**First Nations peoples and communities** should help lead and consult on ecological restoration efforts. It is up to all the stakeholders to consider, and engage when appropriate, First Nations peoples so they can be involved in and, at their discretion, share their voices and knowledges on how ecosystem regeneration should take place.

**Individuals** can connect with their local community groups and councils to gain support and knowledge to plant out their backyards and street verges.

**Communities** can organise 'bioblitz' or citizen science projects alongside researchers to help monitor certain species. They might start their own grassroots planting projects or art/science programs for environmental education and work with local councils to advocate for the protection or expansion of certain habitat areas.

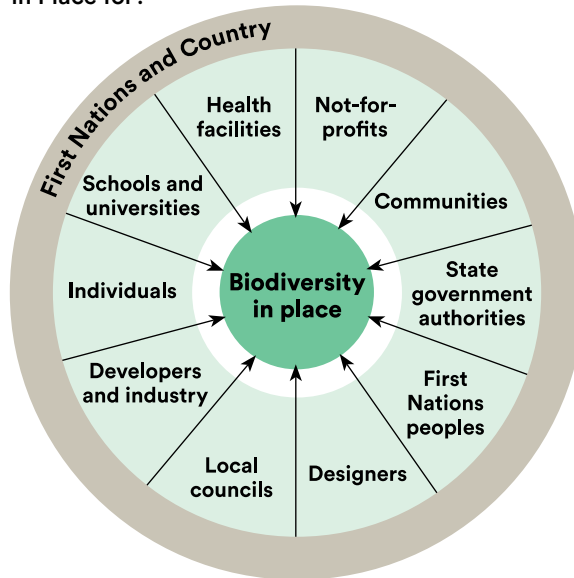
**Not-for-profit** organisations can collaborate and be supported by industry professionals and governments.

**Local councils** can work with designers and industry to develop alternative management and installation techniques for public park plantings. They might develop a targeted biodiversity strategy, establish pollinator corridors or identify key species to support in their area.

**Designers** can engage experts to contribute to their design projects. They might work with a university research team to test and monitor different kinds of planting or habitat interventions or work with local communities on education and environmental advocacy.

**Researchers** can work with industry professionals and educators to share their knowledge and help implement both recent and established research findings.

Who is Biodiversity in Place for?



**Public institutions** can collaborate and engage with multiple stakeholders such as First Nations peoples, designers and researchers to effect positive biodiversity improvements on their campuses.

**Government authorities**, such as Transport for NSW, might collaborate with scientists and landscape architects to trial new planting approaches.

## Existing partnerships

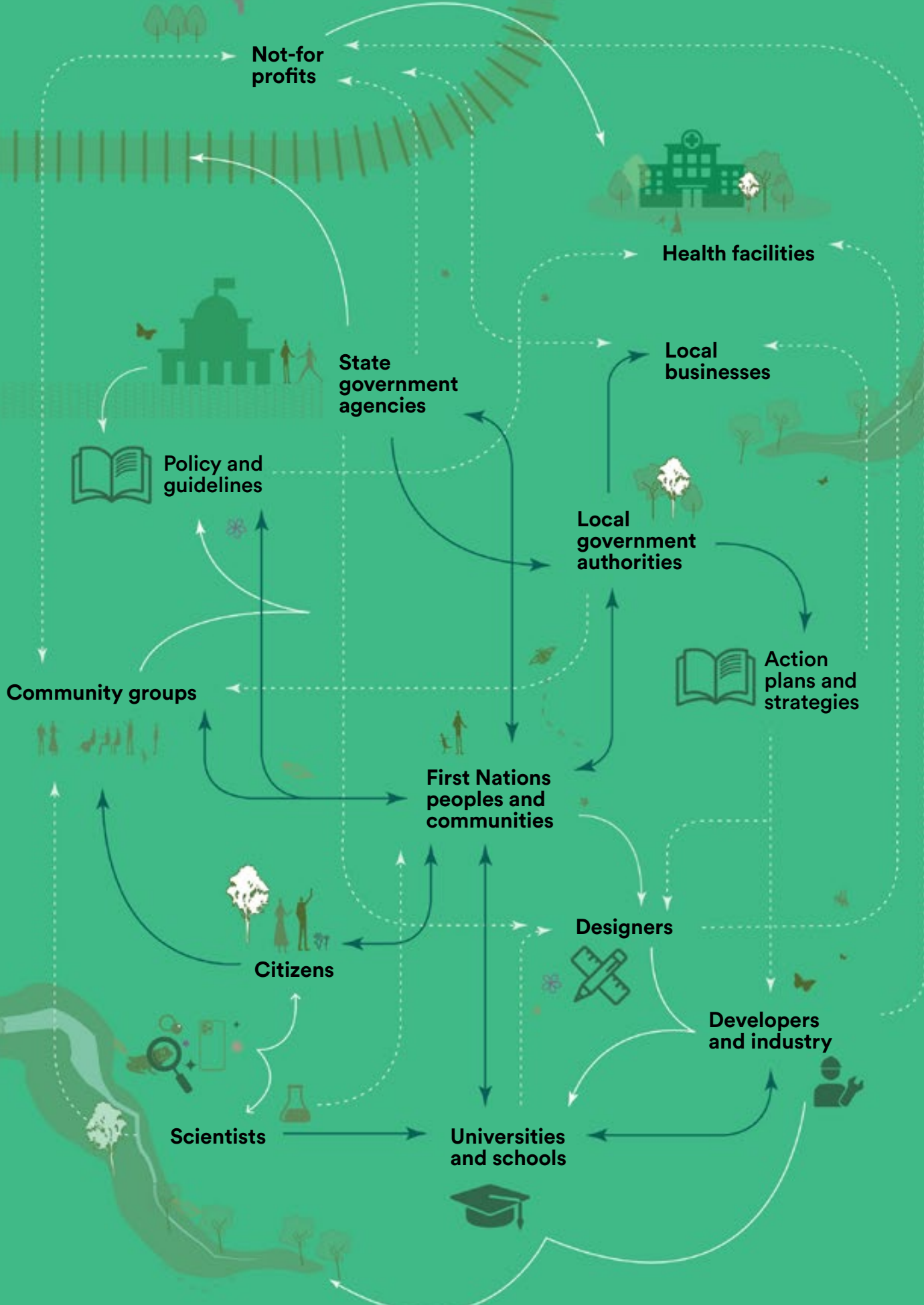
The NSW Government's Greening our City Program has partnered with non-government organisations such as Landcare NSW and Greening Australia to deliver innovative urban greening programs in schools, hospitals and other community facilities and public spaces across Greater Sydney.

## Restore and renew

The Research Centre for Ecosystem Resilience at the Botanic Gardens of Sydney has developed a program called Restore and Renew where genetic information across the whole of a plant species' geographic range is determined using genomics tools and then made freely accessible to the community. This has now been completed for a number of threatened species and can be used to develop genetically diverse seed production orchards to in turn produce larger quantities of genetically diverse seed. The power of this approach is that, depending on the species, a seed production orchard can be created in a small garden bed, a rooftop, a carpark or in a larger urban planting in a park or new development. This not only contributes to enhancing species diversity but also provides opportunities to create seed supplies for community nurseries or local government to use more broadly and contribute to the long-term survival of threatened species in the urban environment.



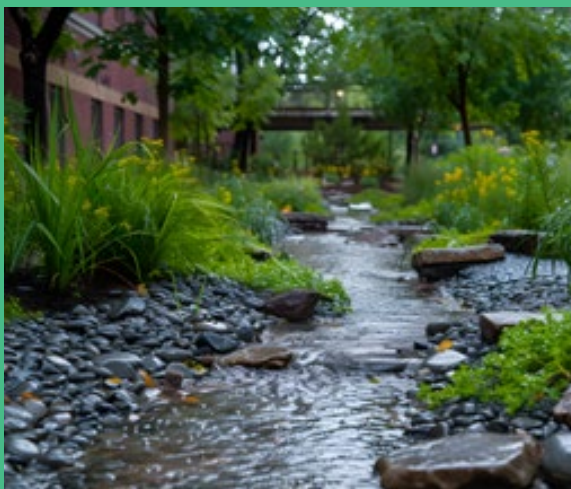
A network of collaborations and relationships can be strengthened through Biodiversity in Place initiatives.



# 2

## Tools for Biodiversity in Place

Look for opportunities to integrate these and other tools that can help to build a more biodiverse urban landscape.



### Rain gardens and water-sensitive urban design

Rain gardens and other water-sensitive urban design approaches like swales and retention basins help to slow down and treat stormwater in urban environments. This helps to prevent erosion and holds the water in the landscape for longer. The result is cool spaces, microclimates and healthier urban soils, plants and wildlife.



### Plants for pollinators

Plants with high flowering rates are important for providing resources for pollinators. Where possible, integrate plants that support insects at every life stage. Research also shows that many bees prefer blue and purple toned flowers while flies (also important for pollination) enjoy those with yellow tones.<sup>34</sup> Keep in mind that some large flowers can attract aggressive/dominant birds.<sup>35</sup>

Image: Jon Hazelwood.



### Establish a shrub layer

Multi-layered planting provides a range of benefits in urban areas, creating habitat for a wide variety of species, increasing the abundance of bird and insect life, increasing carbon capture, reducing stormwater run-off and reducing the opportunity for weeds to take hold through increased groundcover.

Image: The Climate Factory.



## Architecture for multiple species

The kinds of buildings we create in urban environments can have a significant impact on the health of urban wildlife, particularly birds. Glass facades designed without consideration for birds can result in high numbers of deaths from collisions. Consideration of wildlife can be integrated into building design in many ways, through design details or overall material selection.

Image: José Hevia.



## High-density planting

Diverse understory species planted closely together helps prevent erosion, retain water and stop spontaneous plants from popping up. Overseeding of existing planted beds can also help to diversify and build healthier, more-densely planted beds.

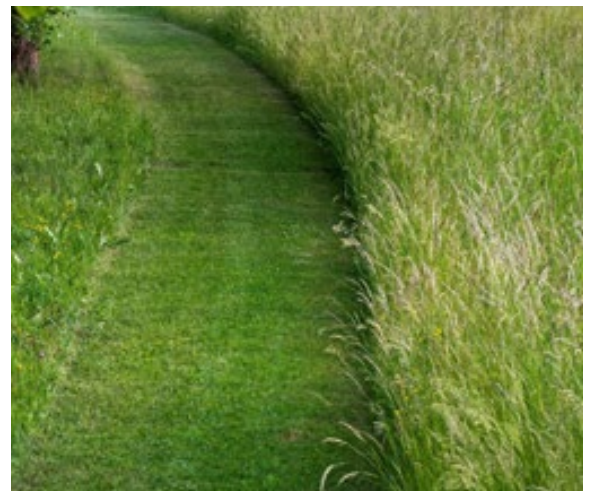
Image: Chloe Walsh.



## Microforests

Microforests in urban areas provide a promising way in which to build habitat, capture carbon and form stepping stones connecting to larger core habitat. Microforests can make even the smallest spaces within the city into diverse, planted havens thriving with life.

Image: Jessica Maurer, Dirt Witches.



## Establish urban meadows and grasslands

Meadows and grasslands can be a low-cost way to encourage and support insect populations that are essential for biodiversity. These can be established through differential mowing of existing turf, a method where areas are left to grow long or are mown on different time cycles with consideration of particular grass species. These areas can be dictated by their level of use and should be clear and distinct in their patterning so people can recognize that it is intentional. For higher diversity and flowering mixes, turf can be removed and replaced with diverse grasslands or overseeded.



## Shallow, on-slab planting

On-slab planting provides an important opportunity to increase the available area of understorey vegetation in dense urban areas when deep soil beds are not possible. Water requirements and soil depth are important considerations when designing on-slab planting.

Image: Living Roofs.



## Allow some spontaneous plants to grow

Many of the plant species that grow prolifically in our urban environments are destroyed because they are considered weeds, like the dandelion. However, these plants provide food for pollinators, clean the air, can absorb toxins, and improve water retention. These plants should be retained in highly disturbed sites that do not contain core ecological communities with consideration of species that are invasive.

Image: Chloe Walsh.



## Insect hotels and wildlife boxes

Small scale 'hotels' for insects to nest and rest in can help support their populations. They can also play an important role in raising people's awareness of their presence in urban spaces. Dead trees, hollows, logs and artificial nests provide important habitat for birds, possums and microbats in urban environments.



## Water

Having fresh water available in urban environments is essential for wildlife. Ponds, water features or even small bowls in gardens can help to provide relief on hot days. Consider the placement of water elements in the landscape. They should be adjacent to shade and planting to allow wildlife to take refuge, as well as near sloped or rock edge conditions to allow safe access for smaller species like lizards, amphibians and insects.



## Circular compost economy

Households create a wealth of food waste that can be turned into a biodiversity resource. Composting can be used to form local circular economies that aid in the health of loving plantings like community gardens.



## Retain leaf litter for soil health

Healthy soil means healthy plants. Management techniques that focus on soil health, like retaining leaf litter and cuttings, helps to return important nutrients back into the earth. It also improves water retention and habitat for insects and reptiles. Integrating these into management plans is a real opportunity to increase soil health in urban environments.



## Beehives

Both European and native beehives provide homes for bees in urban environments. Diverse planting near the hive is essential for the health of many native bees, who stay within close proximity to their hives (50–200 m).



## Rock, sand and log features

All species require their own niche conditions in which to thrive. Birds, reptiles and insects take refuge or nest in the cracks and crevices of these spaces. Integrating rocks, logs, sand and gravel into the design of our urban spaces can help to make space for a wide range of species.

Image: Jessica Maurer, Dirt Witches.

Image: Peter Irga and Kate Egan, UTS.

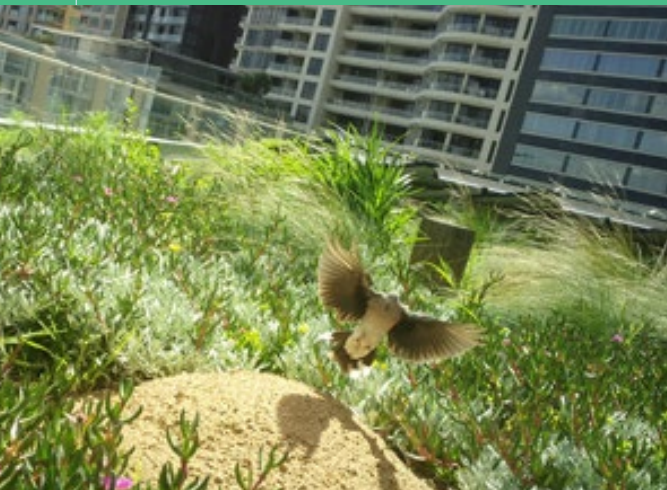
# 3

## Monitoring and management

Biodiverse places are not finished on the day they are installed. They require ongoing management and care. With this in mind, it is important for designers and decision-makers to build relationships with management, staff and local communities that will nurture ongoing healthy biodiversity.

At Daramu House Living Roof, Barrangaroo, camera traps monitor the site for insect and bird life, providing evidence to inform design for biodiversity on future projects.

Image: Peter Irga and Kate Egan, UTS.



### Managing for biodiversity

Many commonly used maintenance practices are largely based on European conceptions and expectations of tidiness and outdated landscape aesthetics. Many commonly used horticultural maintenance practices have a negative impact on biodiversity and insect and bird life. The use of pesticides and herbicides may remove essential species as well as the targeted weeds and pests.

Biodiversity in Place requires a move away from maintenance towards management of a dynamic ecological system. In the long term, these management techniques can require fewer inputs and costs per area than traditional maintenance.

Management practices that support biodiversity:

- Retain deadheads on flowers.
- Reduce mowing.
- Reduce herbicide and pesticide application where possible.
- Review disturbance and fire regimes where appropriate.
- Distinguish between self-seeding plants that are desirable and those that are not.
- Retain weeds that are beneficial.
- Retain leaf litter.
- Apply fertiliser sensitively.
- Encourage citizen science and community participation through documentation of species observations and plant growth (e.g. iNaturalist and Chronolog).

Different approaches to urban biodiversity have different maintenance regimes. On-ground approaches such as understory planting on verges and in private gardens will be less stringent than maintenance requirements on a green roof or wall.

### Learning from both success and failure

There are exciting opportunities for research to monitor the successes and learnings related to plant and habitat management. Formal partnerships with universities and citizen science can provide evidence to support plant success, determine biodiversity and habitat value and establish guidelines for future management practices.

Chronolog is a smartphone-enabled monitoring tool that helps people to participate in citizen science. Fixed phone-holders and step-by-step instructions allow individuals to take a photo in place and then email images to a database to allow researchers to gain an understanding of how a landscape changes over time.

**‘The more you cultivate good relationships with all those involved with a landscape, the better future that landscape will have ... If we move closer to knowing how to make landscapes with the magic that comes from wonderful plants, then we can stop the further proliferation of the Mow, Blow, and Go landscapes that everyone knows and no one loves.’**

— Landscapes Over Time, Michael Van Valkenburgh 2013



**Wildflower is a not-for-profit social enterprise led by First Nations people with an approach to management informed by traditional and new horticultural knowledge.**  
Images: Wildflower

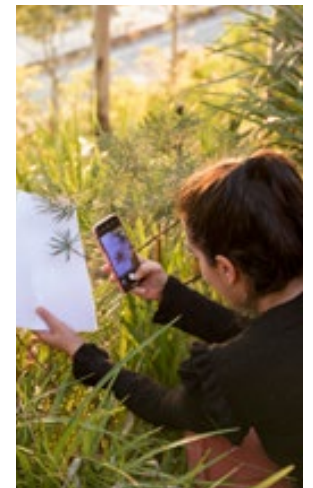


**Grey to Green in Sheffield, UK, is managed by local contractors and specialists in innovative landscape management, Green Estate Ltd.**  
Images: Nigel Dunnet



**The Woody Meadows Project by the University of Melbourne uses innovative management techniques such as coppicing to increase flowering and maintain dense cover.**

Images: Melbourne Uni, Woody Meadows project.



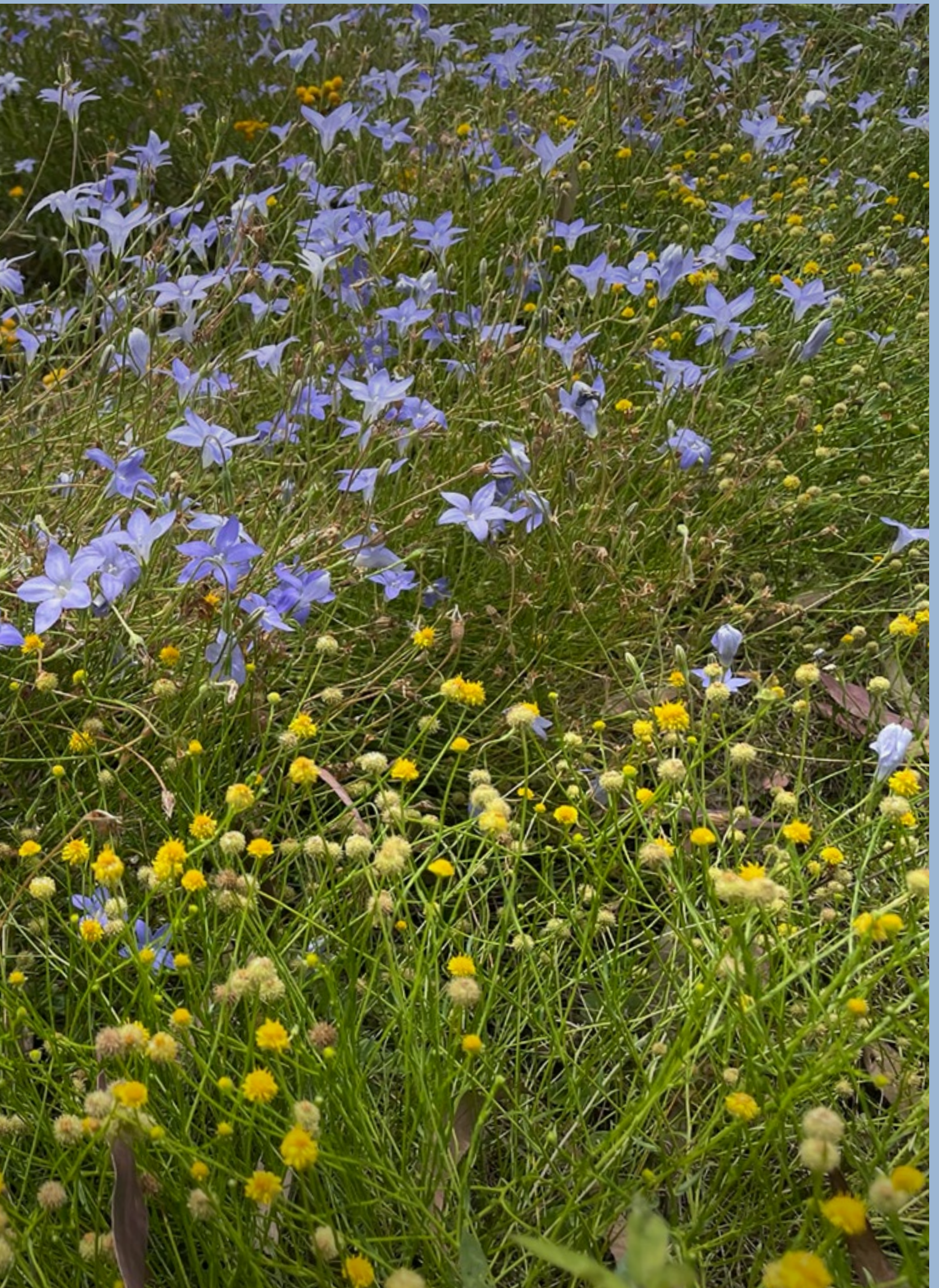
**Citizen science projects can help researchers monitor environments and species as well as build ecological knowledge in the general public.**

Images: Chronolog, Chloe Walsh, Chloe Ferres, Hassell.

Section 4

**WHERE  
THIS HAS  
BEEN  
DONE**





# SHOWGROUND METRO PLANTING TRIALS



The Sydney Metro planting trials demonstrate how diverse, seasonal and captivating planting can be achieved in urban plazas. This has resulted in the planting of 1,000 m<sup>2</sup> of novel, naturalistic plant communities. The diverse, flowering and layered planting includes more than 100 Australian and exotic plant species.

**Spectacle:**  
Bulbine lillies on display  
at the Showground  
Metro planting trials.  
Image: Hassell / Jon Hazelwood.

## Quick facts

**Typology:**  
Urban plaza

**Project type:**  
Planting trials

**Project scale:**  
Medium

**Design team:**  
Sydney Metro  
Hassell

**Location:**  
Sydney, Australia

**Site area:**  
6,000 m<sup>2</sup>

**Research team:**  
John Rayner and  
Claire Farrell  
(University of  
Melbourne)

**Client:**  
Sydney Metro

**Year completed:**  
2022



**Previous page:**  
Camden Reserve  
by Paul Gibson Roy  
Image: Hassell.



## Design outcome

The Showground Metro trials have resulted in 1,000 m<sup>2</sup> of highly diverse, flowering and layered planting of more than 100 Australian and exotic species. Plants were installed at densities of up to 13 plants per m<sup>2</sup> in mixes that ranged from flowering grassland to coppiced woody shrub communities based on learning from the Woody Meadow project at the University of Melbourne.

Design of the planting trials focused on planting outcomes that were 'naturalistic' in layout and aimed to achieve a 3-layered structure to maximise habitat value and reduce maintenance. Compared to standard industry practice and adjacent streetside plantings, the trials have achieved significantly increased vegetation cover and floral display over the first 12 months of monitoring.

## Design process

Previous planting on the site had failed due to issues with drainage and soils. Given the need to restore the planting, an opportunity was created for a trial study investigating diverse, layered, flowering planting on an existing public site. It was agreed that the planting trials would incorporate Australian and exotic species suitable for the Sydney region.

A collaboration between Sydney Metro, Hassell and the University of Melbourne led to the development of new trial mixes prioritising minimal maintenance and maximum flowering time to improve public perception and provide pollinator resources.

## Challenges

Factors such as site preparation, plant supply and ongoing management required some adaptation within the project. For instance, procuring large numbers of sometimes uncommon plants proved challenging, and delays in production due to wet weather required plant substitutions to be made, deviating from the initial proposed mixes.

**Compared to standard industry practice and adjacent streetside plantings, the trials have achieved greatly increased vegetation cover and floral display over the first 12 months of monitoring.**

## Installation, management and monitoring

### 1 Site prep and remediation:

Repairs to any damaged or failing drainage and irrigation systems

Removal of all existing vegetation, except the trees (*Triadica sebifera*)

Excavation and removal of existing soil to 250 mm depth

Replacement of topsoil with a mineral based, free-draining, relatively low-nutrient growing media suited to on-structure applications

Installation of new irrigation system of in-line drippers below new substrate

### 2 Planting installation:

Planting took place in August 2022.

Set-out was done by the Metro and Hassell teams following a randomised method.

### 3 Management:

Weekly hand-watering was used to supplement irrigation in the first 2 months of establishment.

Weed control and some tip pruning of plants was undertaken over the first 12 months (average 1.3 days per month) with greater inputs over summer and autumn months between December and April.

Roadside beds required installation of fencing to prevent trampling.

### 4 Monitoring:

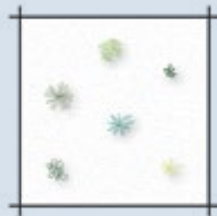
The planting will be monitored for 24 months through onsite observation, photographic comparisons and point cloud scanning which builds a digital 3D model of the plants that allows them to be compared overtime.

## Planting approach

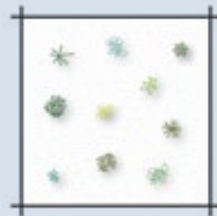
Material on the following spreads is taken from the Sydney Metro planting guidelines that have been developed to inform future Sydney Metro projects.

### Densities

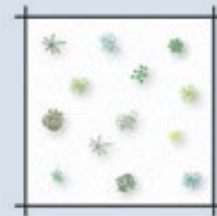
Plants were installed at a range of trial densities from 6 to 13 plants per m<sup>2</sup>. Beds with higher planted densities achieved canopy closure much earlier than the lowest density plantings.



6 plants per m<sup>2</sup>



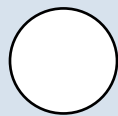
10 plants per m<sup>2</sup>



13 plants per m<sup>2</sup>

### Pot sizes

Plants were installed from 50 to 200 mm pot sizes. One year after installation, smaller tubestock plants were well developed, with some 75 mm plants reaching more than 1.2 m.



200 mm



150 mm



140 mm



75 mm



50 mm

### Set-out

Set-out followed a method of separating each species into their respective layers and using a 'randomised' arrangement. This was done manually on site by the Metro and Hassell teams.



Randomly set-out  
base layer species



Randomly set-out  
middle layer species



Randomly set-out  
upper layer species

### Layers

Adapted from the methods of the Woody Meadow Project, the planting mimics the structure of natural shrub ecosystems with 3 layers: base, middle and upper. In some instances, the mixes followed the structure of a grassland with fewer or no upper species.



Base  
(0–200 mm)  
Aim for 3  
species per m<sup>2</sup>

Middle  
(200–400 mm)  
Aim for 3  
species per m<sup>2</sup>

Upper  
(400–800 mm)  
Aim for 3  
species per m<sup>2</sup>

## Planting mixes

### Mix 01

Density: 13/m<sup>2</sup>

Primarily grassy + herbaceous



October, 2022

### Mix 06

Density: 6/m<sup>2</sup>

60% groundcover + structural shrubs



September, 2023

### Mix 02

Density: 13/m<sup>2</sup>

Grassy + herbaceous with structural shrubs

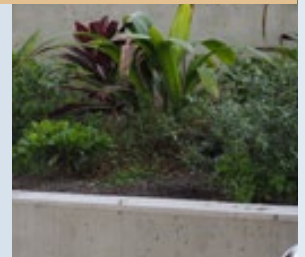


October, 2023

### Mix 07

Density: 10/m<sup>2</sup>

Shade planting



April, 2023

### Mix 03

Density: 10/m<sup>2</sup>

Balanced woody + herbaceous + grassy structure



October, 2023

### Mix 08

Density: 10/m<sup>2</sup>

Narrow raised planter mix



April, 2023

### Mix 04

Density: 6/m<sup>2</sup>

60% woody shrubs + 40% woody and herbaceous groundcover

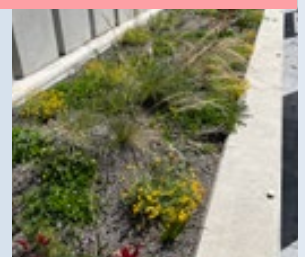


September, 2023

### Mix 09

Density: 10/m<sup>2</sup>

70% groundcover + 20% grasses + 10% structural shrubs



December, 2022

### Mix 05

Density: 6/m<sup>2</sup>

60% shrubs + 35% groundcover + 5% rushes and grasses

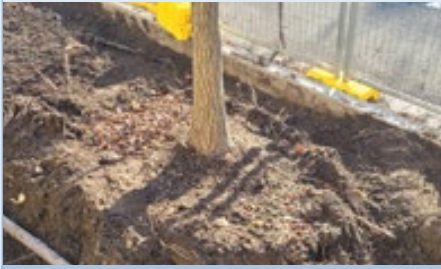


October, 2023

All images taken and sourced by Hassell.

# Monitoring plant growth and progression

All images taken and sourced by Hassell.



Site preparation, early July 2022



Installation day, July 2022



1 month, September 2022



3 months, October 2022



13 months, September 2023



14 months, October 2023

## Comparisons



1 month, bed 1, August 2022



6 months, bed 1, January 2023



12 months, bed 1, August 2023



1 month, bed 12, August 2022



6 months, bed 12, January 2023



12 months, bed 12, August 2023

## Recommendations

# 10

**Minimum  
10 plants per m<sup>2</sup>**

### Ongoing care

#### 1 Plant removals and pruning of herbaceous plants

Selectively remove or prune aggressive and overly dominant plants (grasses, perennials). This includes selective plant removal and clearing of dead biomass from beds to reduce densities.

#### 2 Weeding and mulching

Weed the planting, being careful to retain some recruited seedlings (after correct identification). At planting, the addition of a 5 cm layer of mineral mulch is likely to reduce weeds.

#### 3 Coppicing

All shrubs should be pruned to a height of 12 cm above the ground in early spring and all plant material moved from the site.

#### 4 Replantings

Some beds or areas will require supplementary, infill or replacement planting following observations over the growing season.

#### 5 Fertiliser

Top-up fertiliser may be required in some areas; add as necessary.

### Care is needed in designing plant mixes that balance plant types and growth rates.

Avoiding or reducing the number of overly vigorous plants in mixes, such as some of the grasses, sedges and perennial herbs, needs to be balanced against longer-lived and often slower-growing plants in mixes, such as the woody plants. This is of particular importance in smaller beds with limited soil volumes. Consider soil properties, in particular fertility and drainage, as well as sufficient plant coverage to achieve weed suppression.



### Installation of both planting and seeding should aim to occur in September or May to allow plants the best chance to establish in optimal growing conditions.

**Substituting non-natives can aid in filling in the gaps during the year when natives are not flowering. This will ensure nectar and pollen resources are available for insects and birds all year round.**

### Plant procurement

1. A pre-grow contract would be the ideal method of ensuring plant species are available.
2. Build relationships with local suppliers.
3. Use online resources where available to find rare species.

### Future planting trials

Establish and plan a clear process for monitoring and documenting changes in plant growth. Conducting invertebrate and fauna surveys prior to planting can also assist in measuring biodiversity outcomes.



**Considering the microclimate and site conditions during the design is essential for planting success.**

# SHEFFIELD GREY TO GREEN



Sheffield's 'Grey to Green' is an award-winning, transformative project that has created a beautiful and sustainable urban streetscape. The integration of innovations in both water-sensitive urban design and planting design have led to an increase in biodiversity of over 500%.

**Spectacle:** Stunning displays of flowering perennials and grasses attract visitors to Sheffield City Centre.  
Image: Nigel Dunnett.

## Quick facts

**Typology:**  
Street



**Project type:**  
Water-sensitive urban design corridor

**Location:**  
Sheffield, UK

**Client:**  
Sheffield City Council

**Project scale:**  
Large

**Site area:**  
0.7 km (Stage 1)

**Year completed:**  
2016

**Design team:**  
Planting Design  
Zac Tudor and Nigel Dunnett

**Scheme Design:**  
Sheffield City Council with Robert Bray Associates

**Maintenance:**  
Green Estate

**Design Awards:**  
Green Apple Awards  
National Green  
Champion Award

Yorkshire in Bloom  
Gold Standard  
Best Environmental  
Project

Sheffield Design  
Awards  
Best Open Space  
Overall Outstanding  
Project



As the United Kingdom's longest green street, Grey to Green is a prime example of the power of collaboration between local government, university and industry.

### Design outcome

When the introduction of a new ring-road reduced traffic pressure in Sheffield's city centre, an opportunity was created for a biodiversity transformation. Two lanes of the existing roadway were replaced with a sustainable urban drainage system, planted with highly diverse native and exotic flowering species. Diverse flowering planting resulted in a 561% increase in biodiversity value for Stage 2, assessed using the BREEAM calculator. BREEAM (Building Research Establishment Environmental Assessment Method) is a calculator that uses scientific-based methods to assess, rate, and certify the sustainability of built projects.

The project is multifunctional, increasing urban biodiversity, improving air quality, providing urban cooling, treating contaminated water, improving surface water management, removing microplastics and promoting health and wellbeing. This redevelopment has also stimulated local investment, leading to new office and residential developments in surrounding areas. Grey to Green demonstrates the potential value of high-quality planting in the public realm.

**Multifunctional:** The project is both a beautiful public realm transformation and a complex stormwater management system.

Image: Nigel Dunnett.



### Design process

The project was initiated after major flooding in 2007 caused disruption and economic damage. The city recognised a need to address issues with water run-off. The resounding success of the project is a result of strong collaboration between local government, universities and industry. The position of in-house designers at Sheffield City Council with principal landscape architect Zac Tudor created a sense of ownership and enabled innovative approaches to design.

A collaboration between the University of Sheffield and Sheffield City Council led students with Nigel Dunnett to explore the feasibility and potential of a biodiverse sustainable urban drainage system corridor. The ongoing involvement of the university enables future evidence-based design through monitoring and research programs.

Key to the continued success of the planting scheme is the maintenance by local contractors and specialists in innovative landscape management, Green Estate Ltd.

**Biodiverse:** Careful planning of diverse native and exotic flowering planting ensures visual interest and pollinator activity year round.

Image: Nigel Dunnett.



# MELBOURNE POLLINATOR CORRIDOR



The Melbourne Pollinator Corridor will be an 8 km long community-driven wildlife corridor linking Westgate Park to the Royal Botanic Gardens in Melbourne. It is an initiative championed by Emma Cutting's Heart Gardening Project, a community-led not-for-profit organisation that connects humans and nature through street gardening.

**Engagement:** Emma offers regular tours and walkthroughs of the project to engage with visitors and the local community.

Image: Jon Hazelwood, Hassell.

## Quick facts

**Typology:**  
Street

**Project type:**  
Community-led biodiversity corridor

**Project scale:**  
Large

**Design team:**  
Planting design and organiser  
Heart Gardening Project/Emma Cutting

**Location:**  
Melbourne, Australia

**Site area:**  
8 km proposed corridor

**Year completed:**  
2020 to the present

**Client:**  
Non-profit community initiative



**These gardens not only serve as visually striking landmarks but also act as catalysts for social cohesion, fostering a sense of pride and ownership within the community.**

### **Design outcome**

The pollinator corridor is a prime example of how a linear green corridor can benefit the amenity and biodiversity of urban areas. The project has brought together residents, schools and local organisations to collaboratively create diverse street gardens throughout Melbourne.

The project has helped to create more than 70 street gardens, planted over 8,000 plants and given away over 600 pollinator-loving plants to other street gardeners.

Beyond their aesthetic appeal, the gardens enhance urban biodiversity and promote environmental sustainability by incorporating native and exotic plant species that attract key pollinators. Careful selection of plant varieties ensures these gardens thrive in Melbourne's unique climate.

**Agnostic planting:** The project makes use of both native species and cultural gardenesque plantings that may be more familiar to local residents.

Image: Hassell.



### **Design process**

The project began as a single street garden, and has expanded over time into a proposal for an 8 km long pollinator corridor. Emma Cutting's Heart Gardening Project has published *The Melbourne Pollinator Corridor Handbook*, a comprehensive guide providing valuable insights and information on creating pollinator-friendly habitats in street gardens.

The project has also used crowd-sourced funding, allowing for the production of Corridor Starter Kits that provide individuals and community groups with the necessary tools and materials to establish pollinator habitats in their own street gardens.

The Melbourne Pollinator Corridor is a community-driven initiative that not only creates essential habitats for pollinators but also empowers individuals and organisations to actively participate in the conservation of biodiversity and the promotion of sustainable landscapes throughout Melbourne. The project encourages social interaction, environmental stewardship and a deeper connection with nature in the heart of Melbourne.

**A feast for bees:** A huge diversity of plant species used in the corridor provide year-round resources for local pollinators.

Image: Hassell.



# DARAMU HOUSE LIVING ROOF



The Living Roof at Daramu House has a number of habitat features including diverse native and exotic planting, insect hotels, and a variety of surfaces and loose materials. Compared to a standard urban rooftop, this has created an increase in bird life of 400% and insect life of 900%.

**Living roof:** an array of options is available for insect habitat.

Image: Peter Irga and Kate Egan.

## Quick facts

**Typology:**  
Green roof



**Project type:**  
Industry-led green roof and research project

**Location:**  
Sydney, Australia

**Client:**  
Lendlease

**Project scale:**  
Medium

**Site area:**  
1,800 m<sup>2</sup>

**Year completed:**  
2019

**Design team:**  
Architect  
Tzannes

**Green roof specialist:**  
Junglery

**Design awards:**  
National Architecture Awards

Commendation  
Sustainable Architecture

Green Good Design Award  
Sustainable Design

The project is an exemplar for how the integration of peer-reviewed academic research into construction and development can lead to innovation and collaboration across industries.

### Design outcome

The rooftop is a win for urban biodiversity, with researchers finding that in comparison to an adjacent control rooftop, the Daramu House Living Roof hosted 900% more insect life, including the Lychee metallic shield bug and Australian blue-banded bee, and 400% more bird life, including spotted doves and Australian ravens.

Beyond its visual and thermal advantages, the living roof provides numerous environmental benefits. Low-water-use native and exotic species minimise irrigation demand, and the planting helps to mitigate stormwater runoff by absorbing and filtering rainwater. Improved air quality contributes to biodiversity conservation by providing habitat for various insects, birds and other small organisms. The Living Roof at Daramu House truly exemplifies the integration of nature into urban spaces.

### Design process

During the development of Daramu House and International House, the City of Sydney awarded a research grant to a partnership including Lendlease, Junglefy and the University of Technology Sydney to investigate the effectiveness of urban green roofs in tackling environmental challenges.

The team embraced an interdisciplinary approach, drawing upon expertise from various fields to create a living roof that not only enhances the visual appeal of Daramu House but also investigates the benefits to stormwater, renewable energy generation, thermal performance and local biodiversity.

**Life in the sky:** Camera traps capture bird life on the rooftop of Daramu House to assess biodiversity.

Image: Peter Irga and Kate Egan.



**Urban greening:** The living roof sits within urban development at Barangaroo, Sydney.

Image: Lendlease.



# SOUTH EVELEIGH NATIVE ROOFTOP FARM



This 500 m<sup>2</sup> native rooftop farm uses principles of Indigenous knowledge, collaborative design and permaculture to create and maintain the Australia's first Indigenous rooftop farm for urban food production.

**Urban oasis:** The rooftop farm includes areas for gathering and teaching.  
Image: Yerrabingin.

## Quick facts

**Typology:**  
Green roof



**Project type:**  
Rooftop garden

**Location:**  
Sydney, Australia

**Client:**  
Mirvac

**Project scale:**  
Medium

**Site area:**  
500 m<sup>2</sup>

**Year completed:**  
2019

**Design team:**  
Design and  
implementation  
Yerrabingin  
Jiwah

**Green roof specialist:**  
Junglefy

**Design awards:**  
2019 Sustainability  
Awards  
Best Public and  
Urban Project

The project is multifaceted, creating opportunities for community interaction and mentoring, as well as peer-reviewed research in living infrastructure and green roof systems.

### Design outcome

The South Eveleigh Native Rooftop Farm is a pilot project experimenting with native plants and Indigenous land management principles in an urban environment. It is home to more than 2,000 edible, medicinal and culturally significant plants in 500 m<sup>2</sup> of rooftop garden.

Maintenance practices are organic and use permaculture techniques such as nitrogen-fixing plants. The rooftop is a venue for workshops and events, allowing it to be self-funded. The project is multifaceted, creating opportunities for community interaction and mentoring, as well as peer-reviewed research in living infrastructure and green roof systems. The planting is ecologically informed and includes threatened species such as the murnong or yam daisy *Microseris lanceolata*.

Bringing community members into the garden for tours and workshops also provides a forum for the discussion of connection to Country, Indigenous perspectives on plant cultivation, and landscape practices informed by cultural knowledge.

**Activation:** The rooftop farm is funded by a program of events and workshops managed by Yerrabingin. Image: Matt McKay, Yerrabingin.



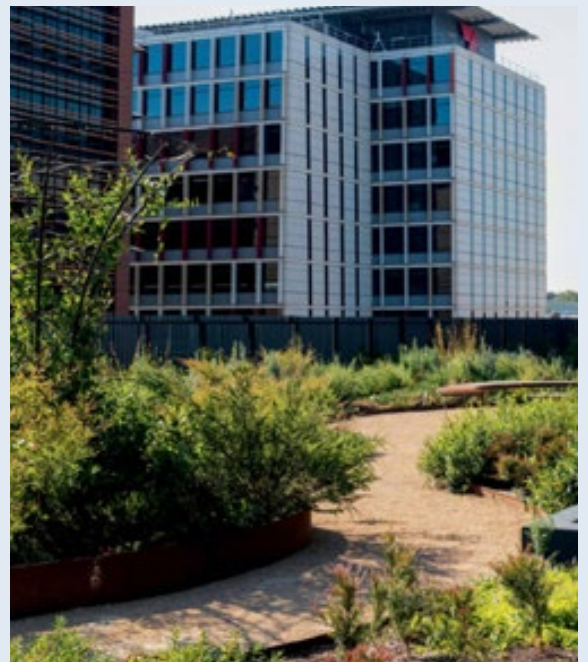
### Design process

Indigenous designers Christian Hampson and Clarence Slockee were engaged by Mirvac to develop the space as part of the South Eveleigh development. The concept of the rooftop farm informed by Indigenous landscape knowledge was developed through workshops with community, stakeholders and collaborators.

Indigenous involvement continued after the design process, including during construction and installation. Indigenous people play an ongoing role in maintenance and venue management. About 80% of the maintenance workforce is Indigenous, and the project provides opportunities for mentoring and employment as well as connection to other Indigenous-owned local businesses and events.

The significant success of the rooftop farm has led to the renaming of the associated development to Yerrabingin House.

**Layering:** Due to challenges in planting trees and large shrubs on the rooftop, a series of sculptural pollinator trellises were constructed to create vertical layers. Image: Matt McKay, Yerrabingin.



# VANCOUVER POLLINATOR MEADOWS



Pollinator meadow trials by the Vancouver Board of Parks and Recreation transform passive turf areas in public open space into diverse flowering habitat for insects and birds. Open discussion and collaboration between community members, the board and maintenance staff are key to the initiatives' ongoing success.

**A new approach to public space:**

Meadows were created in existing parks and reserves.

Image: Vancouver Board of Parks and Recreation / Jack Tupper.

## Quick facts

**Typology:**  
Urban park

**Project type:**  
Urban meadows

**Site area:**  
370,000 m<sup>2</sup>

**Awards:**  
**World Green  
City Awards**  
Certificate of Merit

**Location:**  
Vancouver, Canada

**Year completed:**  
2016

**Client:**  
Vancouver Board of  
Parks and Recreation

**Design team:**  
**Design and  
implementation**  
Vancouver Board of  
Parks and Recreation

**Project scale:**  
Large





Compared to adjacent traditional lawns, meadow sites achieve between 10 to 80 times the bloom count and 2 to 9 times more pollinator visitation, hold 20–30% more soil moisture and have surface soils that are on average 1.2 °C cooler.

### Design outcome

The Vancouver Board of Parks and Recreation have converted 6% of managed passive turf areas into various forms of pollinator habitat. The pollinator meadow trials test 4 different construction and maintenance regimes: no mow, low mow, enhanced low mow (with wildflower over-seeding) and constructed wildflower meadows. Each method has varying inputs for both initial set-up and ongoing maintenance.

Research partners and board staff have been engaged to assess the impact of the trials.

Compared with traditional cut lawns, the trials found a:

- 1,000–8,000% increase in bloom count
- 200–900% increase in pollinator visitation
- 20–30% increase in soil moisture
- 1.2 °C decrease in surface temperatures.

The abundance of pollinators such as bees and other insects, bats and birds also showed an increase at trial sites.

**Pollinator refuge:** Meadows were host to a range of bee species not encountered in adjacent turf areas.

Image: Vancouver Board of Parks and Recreation / Jack Tupper.



### Design process

The project was initiated following financial pressure on maintenance budgets as a result of the COVID-19 pandemic. A graduate research project collaborating with the board's maintenance team provided the initial evidence to support the meadow approach. Design was a collaborative process between interdisciplinary staff of the board, research partners from local universities and not-for-profits.

Following implementation, email and social media were used to collect feedback from community members. Future stages will be informed by this feedback, integrating 'cues to care' that communicate the goals and intention of the project as well as giving a clear appearance of an intentional and designed space.

Key to the success of the project has been direct engagement with maintenance staff to share experiences. Maintenance staff have been given additional training and also provided critical feedback on barriers and challenges to implementation on the ground.

**Wild places:** Lawns in passive areas are sown with wildflowers and mown infrequently.

Image: Vancouver Board of Parks and Recreation / Jack Tupper.



# REWILD BONDI



**Rewild Bondi seeks to transform the nature strips of Brighton Boulevard from grass to vibrant native gardens, provide habitat to nurture biodiversity and create a place for locals to come together to admire the beauty of it all.**

**Pollinator paradise:**  
A beautiful mix of locally sourced native plants thrive at Brighton Boulevard 18 months down the track.  
Image: Barbara Schaffer.

## Quick facts

**Typology:**  
Street

**Project type:**  
Street garden

**Project scale:**  
Small

**Design team:**  
Design and implementation  
Barbara Schaffer  
Brighton Boulevard Informal Community Group

**Location:**  
Sydney, Australia

**Site area:**  
85 m<sup>2</sup>

**Client:**  
Waverley Council (demonstration project funded by an environment grant)

**Year completed:**  
2022



**‘Rewild Bondi is seeking to bring our verges to life. Integral to this initiative is understorey. While many of our streets contain trees and lawn, there is a striking gap when it comes to the space in between’**

— Vicky Bachelard, Sustainable Engagement, Waverley Council

### **Design outcome**

This community-inspired project is transforming barren grass verges into beautiful habitat gardens, one verge at a time, and sparking joyful conversations between neighbours who previously might not have had the opportunity to connect.

Five habitat gardens have been constructed in Brighton Boulevard ranging in size from approximately 20 m<sup>2</sup> to 90 m<sup>2</sup> each. They will help to enhance the connection between people and nature in Waverley and contribute to a unique local character.

### **Design process**

At the start of the COVID-19 pandemic, the grass verge in front of 58 Brighton Boulevard was transformed into a beautiful flowering biodiverse native garden. Many local passers-by expressed an interest in the creation of verge gardens. In October 2021, a letterbox drop was organised inviting local residents to come together with the purpose of transforming the grass verges on Brighton Boulevard into thriving gardens for edible food, native habitat and a sense of community. A group has subsequently formed with the intention of working together to transform Brighton Boulevard one verge at a time, starting with verges in front of local residents who support the project.

This project puts Waverley Council’s recently updated Verge Garden Policy into practice. It is an outstanding example of the potential of local government policies and grants to empower communities to take ownership and create biodiversity in their own neighbourhoods.

**Educating and informing:** Starting with the youngest members of our community is a way to change perception from lawn-centric landscapes to beautiful verdant native gardens.

Image: Annabel Osborne Photography.



**Together:** Community members participated in clearing, planting and maintenance.

Image: Michelle Creamer.



# SKYPARK GARDENS



SkyPark Gardens is a coastal native pollinator and bush tucker garden located near Good Start learning centre on level 6 of Westfield Shopping Centre in Bondi Junction, Sydney. This pollinator garden on the rooftop carpark was created as part of Waverley Council's new SkyParks sustainability initiative aimed at cooling our cities.

**Knowledge to digest:** Children from the neighbouring early learning centre use the diverse species within the bush tucker garden as an outdoor learning environment.

Image: Scentre Group.

## Quick facts

**Typology:**  
Green roof



**Project type:**  
Pollinator and bush tucker garden

**Location:**  
Sydney, Australia

**Client:**  
Waverley Council funded by the NSW Government's Greening our City Grant Program

**Project scale:**  
Small

**Site area:**  
150 m<sup>2</sup>

**Year completed:**  
2022

**Design team:**  
Design and implementation  
Scentre Group  
Westfield, Gujaga Foundation, Good Start Early Learning, Biofilta, Fytogreen, UNSW Sydney, Studio Georgouras

**Design awards:**  
2022 Australian Institute of Landscape Architects  
NSW Award of Excellence for Small Projects

## ‘SkyParks are contributing to learnings about how greening can contribute to biodiversity and cooling, as well as improve air and water quality.’

### Design outcome

SkyParks, funded under the NSW Government’s Greening Our City initiative, involves establishing rooftop gardens in unloved spaces. As well as increasing urban greening, the SkyParks are contributing to learning about how greening can contribute to biodiversity, cooling and improving air and water quality.

The project installed extensive lightweight modular green-roof units that included bush tucker and coastal native pollinator gardens. This project highlights the value of green infrastructure in delivering ecological and heat reduction benefits. More importantly, it advances research and thinking on carbon sequestration and biodiversity potential. The knowledge and learning are applicable at a larger scale.

**Biodiverse pit stops:** Although not as high in biodiversity as parks and reserves, these gardens in the sky can provide ‘urban ecology lily pads’ for migratory animals such as birds and bees.

Image: Studio Georgouras.



### Design process

The project was delivered in collaboration with Scentre Group (owner and operator of Westfield Bondi Junction Shopping Centre), Good Start Learning, Biofilta and UNSW Sydney. It was assisted by the NSW Government’s Greening our City Grant Program and supported by Local Government NSW. It provided opportunities to research and measure cooling and species suitability and also to understand the potential business, community wellbeing and education benefits of installing vegetation in hot urban spaces.

Waverley Council consulted with the local Aboriginal land council on the bush tucker garden to harness opportunities for incorporating local cultural information and learning into the project. The Gujaga Foundation contributed local Aboriginal language and cultural knowledge from Indigenous researchers, Elders and knowledge-holders. This included recommendations on local plants, use of First Nations language and cultural importance. It also included guidance on local promotion that reflects seasonal, authentic and culturally appropriate information relevant to Country (land, waterways and skyways). The bush tucker garden has also been incorporated into educational materials and lesson plans for children at Good Start Early Learning centres. Westfield Bondi Junction has also contributed to wayfinding aspects of the program to share knowledge about the gardens with customers.

**A visual delight:** Using a diverse native plant palette arranged in a swathe-like layout creates both structural distinction and visual flow, proven to promote well-being.

Image: Studio Georgouras.



# TRANSFORMING GREEN SPACES INTO WELLNESS PLACES



The NatureFix Nature Wellness Garden at the Manly Adolescent and Young Adult Hospice redefines open-space planning through the creation of a health experience that has become an integral part of visitation for patients, staff and visitors.

The guided audios are matched to the natural features within the garden and bushland surrounds. First Nations stories on the healing benefits of Country complement the cultural importance of sites, Indigenous and bushfoods plantings and a yarning circle. Image: NatureFix.

## Quick facts

**Typology:**  
Campus



**Project type:**  
Nature-based health intervention

**Location:**  
Sydney, Australia

**Client:**  
Northern Sydney Local Health District (Manly Adolescent and Young Adult Hospice)

**Project scale:**  
Small

**Site area:**  
220 m<sup>2</sup>

**Year completed:**  
2023

**Design team:**  
Design and Implementation NatureFix and the Northern Sydney Local Health District

## ‘The garden and nature connection activations transform a minute in nature into a meaningful moment, amplifying the health-giving potential of this green space.’

— Waminda Parker, Nature Fix Director

### Design outcome

The Manly Adolescent and Young Adult Hospice is Australia’s first dedicated service for young people with life-limiting illness. The service provides holistic, specialised care for patients and their families, including bereavement support and counselling.

The NatureFix Nature Wellness Garden is designed to unlock the restorative powers of nature as a place of respite, comfort, reflection and repair. Short self-guided nature connection activities are matched with the optimal natural features known to improve wellbeing. This design transforms a person’s minute in nature into a quality moment with nature – and thereby unlocks the health benefits as a low-cost and high-reward wellbeing and place activation outcome. The garden and NatureFix activations are being used for individual emotional regulation, to enable and support counselling outdoors and as an invitation for special time with family and friends. The overall result is a green space that is beautiful by design but also contains innovative place activation strategies that untap the full health potential of this restorative garden area.

Garden visitors simply scan the QR code on the NatureFix sign to access the playlist of nature connection activities. Each activity lasts between 2 and 10 minutes and can be enjoyed anytime for a quick reset and restore.

Images: NatureFix.

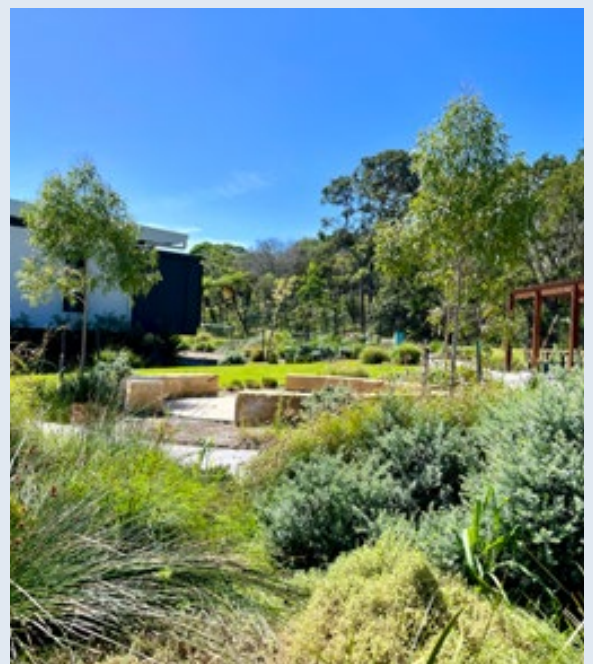


### Design process

It’s not just the contact with nature but also the nature of the contact that counts. The team at NatureFix conducted a site assessment in the early stages of garden development to identify and install suitable guided activities that increase place appreciation and levels of connectedness to nature. Global interdisciplinary research shows that psychological measures of how connected we are to nature, is an important indicator of wellbeing. It is also significantly correlated with increases in pro-social and pro-environmental behaviours.

Geolocated audio activities take visitors on an immersive journey with the surrounding nature, such as promoting feelings of awe, finding beauty in nature, noticing the diversity of the native foliage and pollinator activity (e.g. bees, butterflies and dragonflies) and being introduced to the health benefits of listening to bird sound and First Nations storytelling.

These types of experiences can be installed across parks, hospitals, universities, schools, restoration sites and private and corporate spaces.



# REVEGETATING DEGRADED BUSHLAND AT EDMONDSON PARK



On-site bush regeneration at Edmondson Park brought the local community and kids, ecologists, the 1st Ingleburn Scouts and Landcom staff together to plant a variety of native species including *Cymbopogon refractus* (barbed-wire grass), *Dianella longifolia* (blueberry lily) and *Themeda triandra* (kangaroo grass) to support increased biodiversity across the site and enhance local awareness and protection of nature.

**Stewards:** Local scouts share their enthusiasm for the environment.  
Image: Landcom.

## Quick facts

**Typology:**  
Regional park

**Project type:**  
Bush regeneration and on-site offset credits

**Client:**  
Landcom

**Design and implementation team:**  
Eco Logical Australia  
Place Design Group  
NSW National Parks and Wildlife Service  
1st Ingleburn Scouts

**Location:**  
Sydney, Australia

**Project scale:**  
Medium

**Year completed:**  
2023





## Design outcome

Revitalising land that was previously used to train the Australian army, the Edmondson Park project has created a brand-new suburb in south-west Sydney across 425 ha. The project is transforming under-utilised government-owned land, boosting Sydney's housing supply with up to 8,000 new homes.

Landcom worked with the NSW National Parks and Wildlife Service to re-vegetate the landscape and enhance the natural features of the area including the 150 ha regional park and open spaces along the creek corridors. By dedicating 150 ha of revegetated bushland in the middle of the community to NSW National Parks and Wildlife Service, residents benefit from continued access and stewardship of nature, while enhancing and preserving biodiversity in perpetuity.

The Edmondson Park project separately generated biodiversity offset credits through replanting and regeneration activities within the development footprint on the site to account for the biodiversity impacts of the new ring road to service the community. By generating biodiversity offset credits on-site and in the locality, instead of paying into the Biodiversity Offset Fund, the project will generate place-based benefits for both the community and nature.

**Connecting:** Industry and community come together to regenerate places.

Image: Landcom.



## Design process

The community planted a variety of native species including *Cymbopogon refractus* (barbed-wire grass), *Dianella longifolia* (blueberry lily) and *Themeda triandra* (kangaroo grass) to support increased biodiversity across the site.

Consultants from Eco Logical Australia and a representative from NSW National Parks and Wildlife Service were also on hand to explain the importance of native vegetation, correct planting techniques and promote the importance of protection and awareness for nature. Diligent planting saw all the tube stock firmly in place in less than a day.

The planting area is located on the site of a former waste treatment plant, which Landcom has been remediating since 2019. Landcom's delivery partners, Eco Logical Australia, will continue revegetating the remaining land, sowing the equivalent of 90,390 seeds across 22 native species.

**Collaboration:** Landcom, NSW National Parks and Wildlife and Community share knowledge and enthusiasm.

Image: Landcom.



# COOLING THE SCHOOLS



The Cooling the Schools Sydney program connects kids to nature and empowers them to take action in their communities to create greener, cooler places where people and nature thrive.

**Experiential learning:** Children ‘learn by doing’ and actively participate in planting trees and understorey plants. They also learn about the broader issues of urban heat and biodiversity loss.  
Image: Greening Australia.

## Quick facts

**Typology:**  
Campus



**Project type:**  
Microforest and planting for pollinators

**Location:**  
Metropolitan Sydney

**Client:**  
Department of Planning, Housing and Infrastructure  
Funded by the NSW Government’s Greening our City Grant Program

**Project scale:**  
130 schools, 23,382 trees and 8,320 understorey plants

**Year completed:**  
2020–23

**Design team:**  
Department of Planning, Housing and Infrastructure, Schools Infrastructure NSW, the NSW Department of Education, Greening Australia and Deadly Ed

**Design awards:**  
NSW Sustainability Awards Finalist

## The program was designed to help tackle the twin challenges of climate change and biodiversity loss.

### Design outcome

Cooling the Schools Sydney is delivered by Greening Australia in partnership with the NSW Department of Planning, Housing and Infrastructure, as part of its urban greening program to achieve 40% canopy cover in Greater Sydney by 2036. Cooling the Schools Sydney works with students and teachers to add thousands of native trees and plants to schoolyards, creating cooler, greener and more inviting biodiverse spaces for learning and play. As they plant, students learn firsthand about the environmental and cultural benefits of planting native trees and plants for First Nations cultures, urban cooling and biodiversity.

**Making a difference:** The program enables young people to lead restoration projects at their schools and to take pride in creating green spaces that will be enjoyed for generations to come.

Image: Tom Yau



### Design process

Cooling the Schools Sydney works with schools across the Greater Sydney region to provide free planting sessions that empower students to create wildlife habitat, reduce urban heat and increase tree canopy cover in their schools. The program is offered to all schools: public, private, primary and secondary. It is tailored to the local site conditions.

Led by restoration ecologists and co-delivered with Aboriginal cultural education provider Deadly Ed, students get their hands dirty while learning about the environmental and cultural value of native plant species. Thanks to a partnership with the National Parks and Wildlife Service, the program also provides opportunities to teach students with learning resources aligned with the national curriculum.

The program also sets out to involve local communities in areas with the lowest canopy cover, which are most vulnerable to the urban heat island effect. Community planting events are held in Greater Sydney to establish urban 'micro-forests' as living legacy landmarks for the local community. Over time these micro-forests will grow and become important sources of shade, cooling and recreation in local green spaces.

**Starting young:** The true value of the program lies in the promotion of nature to the next generation. Local communities have the opportunity to take ownership to protect, enhance and advocate for nature in cities moving forward.

Image: Toby Peet



## 4.12 Further examples and resources



The **Indigenous Cultural Landscape Garden** at South Eveleigh connects biodiversity with culturally significant plant species.

Image: Jiwah.



**Barlow Street Microforest** was established by the Dirt Witches, a group of female academics and climate activists. Image: Jessica Maurer, Dirt Witches.



At **Elara Riparian Parklands**, more than 17 ha of riparian revegetation has been created within a residential community. Image: Graham Jepson.

### National



Community group the **Climate Factory** has established 3 microforests across Canberra.

Image: Jarra Joseph McGrath.



**Royal Park Direct Seeding Project** is a collaboration between City of Melbourne and the University of Melbourne to sow almost 1 million seeds of native meadow species.

Image: Chloe Walsh.



The University of Melbourne has designed **Woody Meadows** across Australian cities as a novel low-cost and resilient alternative to typical low-maintenance green spaces that have low diversity, visual appeal and function.

Image: University of Melbourne, Woody Meadows Project.



The City of Melbourne collaborated with the University of Melbourne to develop and test an understory plant palette designed to increase streetscape biodiversity in the urban environment, with trials installed at **Clowes St**.

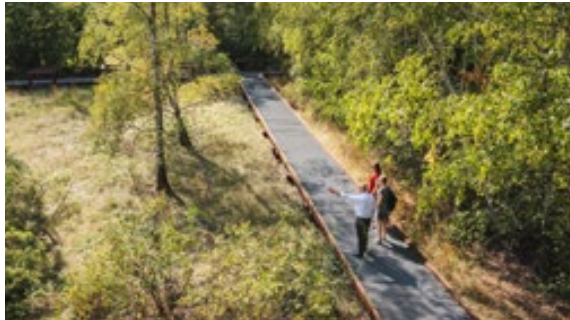
Image: City of Melbourne.



At **Wooten Road Reserve, Victoria**, a beautiful grassland restoration project has been implemented within a public park.

Image: Glas Landscape Architects, Drew Echberg.

## International



**Schoneberg Natur Park, Germany** protects and celebrates a novel forest ecosystem.

Image: Natur Park Suedgelaende.



**Waterbug Bioblitz South Australia** is a citizen science initiative that promotes education about the importance of waterbugs in our waterways.

Image: Hills and Fleurieu Landscape Board.



**No Mow May by Plantlife, UK**, is an annual campaign calling all garden owners and green space managers not to mow during May – liberating lawns and providing a space for nature.

Image: The Cap Times, Ruthie Hauge.

## Online resources

Efforts to increase biodiversity in urban NSW also rely on access to important data and resources. Below are just some of the free resources available that can be used online.

- **Greener Neighbourhoods guide** helps councils to create greener and shadier urban areas by developing or updating strategic urban forest plans. The guide is for all local councils across NSW who want to establish, build upon or re-envisage strategic planning for their urban forests. It gives guidance on how to understand, plan for, monitor and manage urban forests and promotes best practice and consistency in urban forest planning.
- **Trees Near Me NSW** is a state government initiative that maps trees and plants that are growing currently, as well as ecological communities that previously grew across NSW.
- **The Atlas of Living Australia** is an open access portal providing data on Australia's biodiversity.
- **iNaturalist.com** is an online platform for the general public to contribute to citizen science and datasets of local biodiversity.
- **BioNet** and **SEED** are NSW Government GIS data sets that provide important mapping on ecologically significant communities.
- **SIX Maps** is an online mapping platform that provides cadastral and topographic

information, satellite data and aerial photography for NSW.

- **Which Plant Where** is a plant selection tool underpinned by the latest scientific evidence, providing growers, nurseries, landscape architects and urban greening professionals with integrated tools and resources to develop resilient and sustainable urban green spaces for the future.

## Local provenance and nurseries

Local provenance describes native plant populations that naturally occur in an area. It refers to the local genetic variation, meaning the plants are likely to be able to survive within the specific local conditions of a landscape.

Below are just some of the nurseries in urban NSW that source local provenance, indigenous and endemic plant species.

- **IndigiGrow**
- **Apunga Native Nursery**
- **Sydney Wildflower Nursery**
- **Trees in Newcastle**
- **Community Environment Network Wildplant Community Nursery**
- **The Habitat Network**
- **Indigo Native Nursery**
- **Randwick Community Nursery**

# GLOSSARY

<b>B</b>		<b>S</b>	
<b>Biodiversity</b>	The variety of species of plants, animals and microorganisms, their genes, and the ecosystems they comprise, often considered in relation to a particular area	<b>Species richness</b>	The number of different species present in a given community or ecosystem
<b>D</b>		<b>Species diversity</b>	A measure that includes both the number of species and the relative abundance of each species in a community or ecosystem
<b>Differential mowing, no-mow, low-mow</b>	Management practices for grass-dominated plant communities that reduce mowing practices or remove them entirely, allowing for the growth of wildflowers and increase in species and structural diversity	<b>Spontaneous vegetation</b>	Plants that grow and reproduce without intentional planting – in many cases these plants may be perceived as weeds, although they may be contributors to species richness and biodiversity
<b>E</b>		<b>Structural complexity</b>	Variation in the vertical and horizontal structure of vegetation – more variation generally provides more ‘niches’ and opportunities for organisms at different life stages, increasing biodiversity of invertebrates and others
<b>Ecosystem services</b>	The goods and services that biodiversity provides, including soil formation, the provision of food and fibre, air quality and climate regulation, the regulation of water supply and quality, and the cultural and aesthetic value of certain plants and species	<b>V</b>	
<b>Endemic</b>	Species that are native and can be only found in that location	<b>Vegetation management</b>	The care of vegetation with an appreciation for the dynamics and change inherent in natural systems, in contrast to maintenance practices to promote a stable, unchanging landscape
<b>G</b>		<b>W</b>	
<b>Genetic diversity</b>	A measure of diversity that includes variation within a species, which may be relevant in landscape practice for increased resilience to disease or climatic variation	<b>Water-sensitive urban design</b>	An engineering and design approach to make best use of the urban water cycle (stormwater and groundwater) through holding and filtration techniques that also help to reduce erosion and flooding
<b>I</b>			
<b>Indigenous</b>	Species that are native to a local area and are also native to other areas		
<b>M</b>			
<b>Microforest</b>	A strategy for creating small plots containing dense, multilayered planting with high biodiversity		
<b>Monoculture</b>	Vegetation that is dominated by a single species or few species groups – common in traditional horticultural practice		
<b>N</b>			
<b>Native</b>	Species that originate on the continent Australia		
<b>Niche</b>	The match of a species to a set of environmental conditions that may include vegetation structure, resource availability and competition		
<b>R</b>			
<b>Rewilding</b>	A comprehensive often large-scale, conservation effort focused on restoring sustainable biodiversity and ecosystem health by protecting core habitat areas, providing connectivity between such areas, and protecting or reintroducing apex predators and highly interactive species		

# REFERENCES



## Endnotes

1. Ignatieva M, Haase D, Dushkova D and Haase A (2020) 'Lawns in cities: from a globalised urban green space phenomenon to sustainable nature-based solutions', *Land* 9, 73.
2. Threlfall CG, Mata L, Mackie JA, Hahs AK, Stork NE, Williams NSG and Livesley SJ (2017) 'Increasing biodiversity in urban green spaces through simple vegetation interventions', *Journal of Applied Ecology* 54: 6, 1874–1883.
3. Mata L, Hahs AK, Palma E, Backstrom A, Johnston N, King T, Olson AR, Renowden C, Smith TR, Vogel B, & Ward S (2023). Large positive ecological changes of small urban greening actions. *Ecological Solutions and Evidence*, 4(3), e12259. <https://doi.org/10.1002/2688-8319.12259>
4. Marshall AJ, Grose MJ and Williams NSG (2019) 'From little things: More than a third of public green space is road verge', *Urban Forestry & Urban Greening* 44, 126423.
5. NSW Government (2024) *NSW Roads Network*, Transport for NSW website, [www.transport.nsw.gov.au/operations/nsw-roads-network](http://www.transport.nsw.gov.au/operations/nsw-roads-network), NSW Government.
6. Arup (2023) *Biodiversity in your Backyard: the future of nature in your hands*, report prepared for Conservation Volunteers Australia by Arup.
7. Manuel C (2020) *The Miyawaki method – Data & concepts*, Urban Forests Company.
8. Southon G, Jorgensen A, Dunnett N, Hoyle H and Evans K (2018) 'Perceived species-richness in urban green spaces: Cues, accuracy and well-being impacts', *Landscape and Urban Planning* 172, 1–10.
9. Mata L, Hahs AK, Palma E, Backstrom A, Johnston N, King T, Olson AR, Renowden C, Smith TR, Vogel B and Ward S (2023) 'Large positive ecological changes of small urban greening actions', *Ecological Solutions and Evidence* 4(3), e12259.
10. Irga P et al. (2021) *Green Roof & Solar Array – Comparative Research Project, Final Report July 2021*, University of Technology Sydney.
11. Gunnarsson B, Knez I, Hedblom M and Ode Sang Å (2016) 'Effects of biodiversity and environment-related attitude on perception of urban green space', *Urban Ecosystems* 20(1).
12. Dearborn DC and Kark S (2010) 'Motivations for Conserving Urban Biodiversity', *Conservation Biology* 24(2), 432–440.
13. Roslund MI et al. and ADELE research group (2020) 'Biodiversity intervention enhances immune regulation and health-associated commensal microbiota among daycare children', *Science Advances* 6(42), eaba2578.
14. Taylor L and Hochuli D (2015) 'Creating better cities: how biodiversity and ecosystem functioning enhance urban residents' wellbeing', *Urban Ecosystems* 18(3), 747–762.
15. Hoyle H, Hitchmough J and Jorgensen A (2017) 'All about the 'wow factor'? The relationships between aesthetics, restorative effect and perceived biodiversity in designed urban planting', *Landscape and Urban Planning* 164, 109–123.
16. Fitzsimmons C (2022) 'A VIP back-stage pass to nature': How young people are taking over Landcare', *The Sydney Morning Herald*, 13 August 2022.
17. Gunnarsson B, Knez I, Hedblom M and Ode Sang Å (2016) 'Effects of biodiversity and environment-related attitude on perception of urban green space' *Urban Ecosystems* 20(1).
18. Southon G, Jorgensen A, Dunnett N, Hoyle H and Evans K (2018) 'Perceived species-richness in urban green spaces: Cues, accuracy and well-being impacts', *Landscape and Urban Planning* 172, 1–10.
19. Richman E (2011) *Economic Benefits of Biodiversity*, Pennsylvania Land Trust Association.
20. Lutzenhiser M and Netusil N (2001) 'The effect of open spaces on a home's sale price', *Contemporary Economic Policy* 19(3):291–298.
21. Babington A, Hughes M, Farrell C, Chambers J and Standish R (2023) 'Preference for multi-layered, flowering, woody streetscape planting in a mediterranean-type climate', *Urban Forestry & Urban Greening* 89, 128094.
22. Bekessy S, Kirk H, Humphrey J and Visintin C (2024) *A typology of urban green spaces and their potential benefits for biodiversity*, RMIT University.
23. Braaker S, Ghazoul J, Obrist MK and Moretti M (2014) 'Habitat connectivity shapes urban arthropod communities: the key role of green roofs', *Ecology* 95(4), 1010–1021.
24. Maurer U, Peschel T and Schmitz S (2000) 'The flora of selected urban land-use types in Berlin and Potsdam with regard to nature conservation in cities', *Landscape and Urban Planning* 46(4), 209–215.
25. Pojani D, Mateo-Babiano D, Corcoran J and Sipe NG (2017) 'Freeing up the huge areas set aside for parking can transform our cities' *The Conversation*, 30 October 2017.
26. Threlfall CG, Mata L, Mackie JA, Hahs AK, Stork NE, Williams NSG and Livesley SJ (2017) 'Increasing biodiversity in urban green spaces through simple vegetation interventions', *Journal of Applied Ecology* 54: 6, 1874–1883.
27. *ibid.*
28. Reyes-Riveros R, Altamirano A, De La Barrera F, et al (2021). Linking public urban green spaces and human well-being: a systematic review. *Urban For Urban Green* 61:127105.
29. Fitzsimmons C (2019, April). 'Why aren't they parks?: Golf's huge footprint on Sydney's open space'. *Sydney Morning Herald*.
30. Williams N, Hahs A, Threlfall C and Livesley S (2020) 'Urban golf courses are biodiversity oases. Opening them up puts that at risk', *The Conversation*, 5 November 2020.
31. Morelli F, Beim M, Jerzak L, Jones D and Tryjanowski P (2014) 'Can roads, railways and related structures have positive effects on birds? – A review', *Transportation Research Part D: Transport and Environment* 30, 21–31.
32. Palmer GC and Bennett AF (2006) 'Riparian zones provide for distinct bird assemblages in forest mosaics of south-east Australia', *Biological Conservation* 130(3):447–457.
33. Jones KB, Slonecker ET, Nash MS, et al (2010) Riparian habitat changes across the continental United States (1972–2003) and potential implications for sustaining ecosystem services. *Lands Ecol* 25:1261–1275.
34. Schiller J, Rayner JP and Williams NSG (2023) *Guidelines for Biodiversity Green Roofs, Report for the City of Melbourne*.
35. Dyer A, Garcia J and Shrestha M (2021) 'Flies like yellow, bees like blue: how flower colours cater to the taste of pollinating insects', *The Conversation*, 2 September 2021.

# CREDITS

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