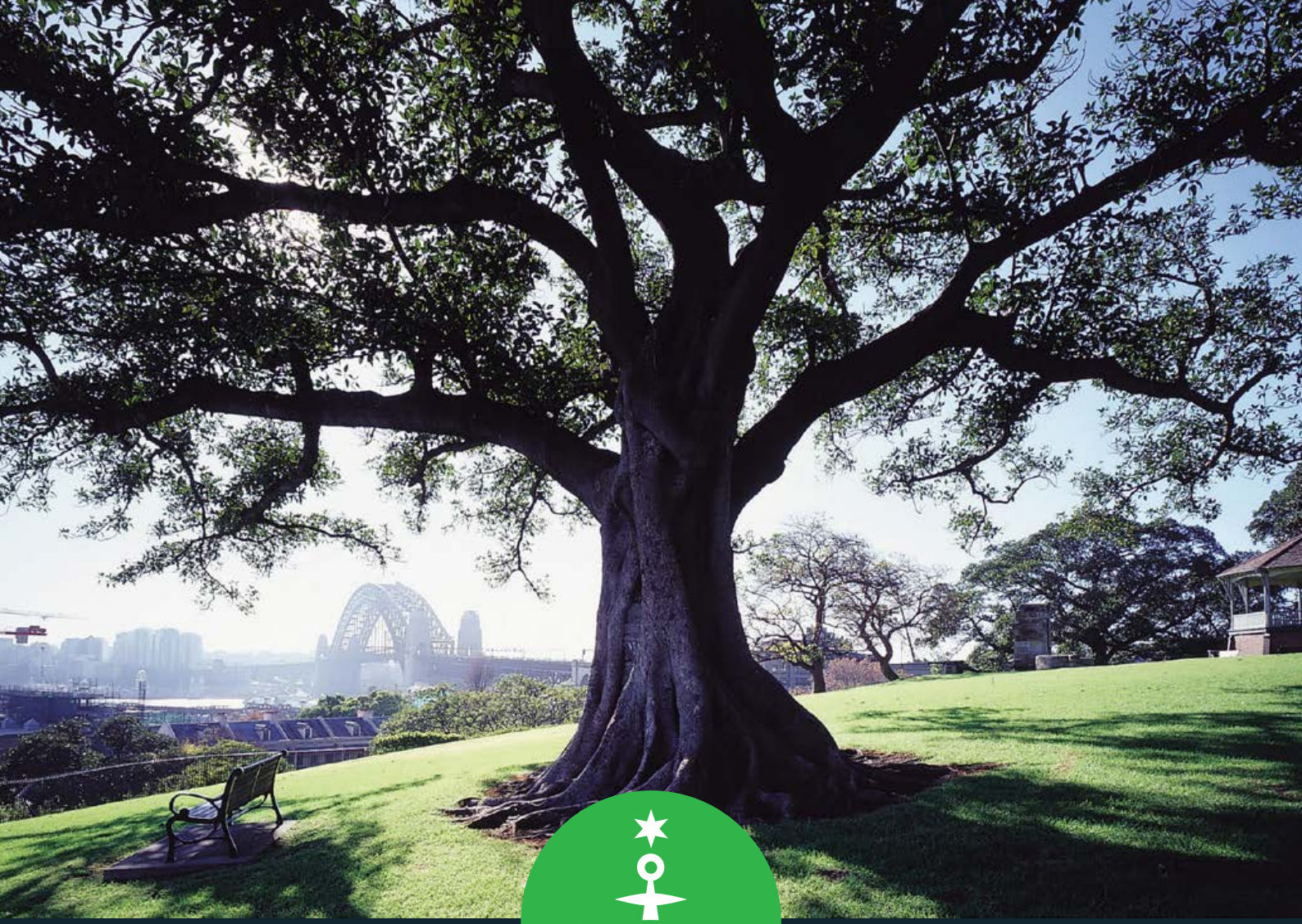
Attachment A

Greening Sydney Strategy (Draft)



Strategy
July 2021

Greening Sydney Strategy

Green Global Connected

CITY OF SYDNEY

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Acknowledgement of Country

Announcement of a major artwork to honour the First Peoples of Sydney and recognise the traditional custodians of Gadigal country. Photo: Joseph Mayers

The City acknowledges the Gadigal of the Eora Nation as the Traditional Custodians of this place we now call Sydney, and we acknowledge their continued connection to Country. We pay respect to Aboriginal and Torres Strait Islander Elders past, present and emerging.

Community and place

These are the principles that support our plans to green Sydney. They were developed by listening to our communities – Aboriginal and Torres Strait Islander peoples, local residents, school children, city workers and visitors. And they reflect their values.

These principles are guided by the world view of Aboriginal peoples. They reframe our systemic relationship with the land. Since invasion, the relationship between people and land has been disrupted with little respect for the land, animals, waterways, and First Peoples. We've seen the extinction of plants and animals and damage to waterways and land. Aboriginal lives have been lost in trying to protect country. By challenging our approach in this way, we hope to cause no further harm and begin to heal. The City of Sydney has an important role as caretaker of many of these places. We will consciously consider these principles in the decisions we make for the land we are responsible for. This includes how we maintain, change, and manage land.

Aboriginal world view of Country – First Nations workshop participant 'Country is our identity; spiritually, culturally, physically, and socially. We refer to Country as part of the family. We speak to Country; we sing to Country; and we dance for Country. Increasingly we worry for Country and seek greater protection measures to carry out our cultural obligations to the land and waterways. These are our fundamental rights and cultural responsibilities in protecting country as First Nations People.'

We are on Gadigal Country

These principles are founded in the understanding of Country in the worldview of the Aboriginal and Torres Strait Islander peoples. This understanding of Country includes the landscape – land, water and sky, the plants and animals, and the relationship between these. Aboriginal and Torres Strait Islander peoples are responsible for care of Country and the continuation of these relationships. Country has existed in this place for thousands of generations and precedes colonial boundaries.We acknowledge the responsibility that First Nations Peoples have in the carriage of their living cultures including access to land for practising culture to bring social, spiritual, and economic benefit to First Nations People.

We commit to truth-telling and decolonisation

Gadigal Country was never ceded. We recognise the significance of Gadigal land as the site of invasion. We work towards telling the history of these places with honesty and acknowledge the negative impacts caused to Country and to the people. We endeavour to cause no further harm to Aboriginal peoples and the relationship they hold to the land.

We value how important green places are to people's wellbeing

Parks and open spaces are a place of refuge and respite in an intensely urban environment. These places have cultural and community significance to many people. They are places of shared identity and pride, of community connection and celebration, and of protest and social transformation. They must be welcoming to all people and will provide equity of access to all to enjoy. We strengthen the connections between and within these places.

We are guided by Country and strive to heal and care for it

We learn about how this Country has been cared for thousands of generations. We respect the natural landforms, waterways, and endemic species. We work to heal places that have suffered degradation. We support these places to play their role in the health of the whole environment. We protect these places for future generations and we accept our role as caretakers of these places. These places must benefit the community now and in the future. As we face a changing climate and growing population, we make decisions that prepare these places and ensure their continued health into the future.

Guiding documents

– UN Declaration on the Rights of Indigenous Peoples

– Principles of Co-operation with Metropolitan Local Aboriginal Land Council

– City of Sydney Aboriginal and Torres Strait Islander Protocols.

Message from the Lord Mayor

We have been working towards a greener city since 2004 – creating new and enhancing existing parks, planting thousands of trees, increasing nature and wildlife and supporting community efforts.

We have created 24 hectares of new parkland, upgraded 200 parks and playgrounds, planted over 15,000 trees and completed over 100,000 square metres of landscaping with 800,000 new plants.

Despite the major urban renewal in our area, we have increased tree cover by 23%. That makes us one of the few councils in Australia to consistently increase canopy over the past decade.

Greening Sydney 2030 will guide this vital work, with ambitious targets and innovative solutions – practical ways to green roofs and walls and our 383-kilometre network of laneways, as well as new planning tools and data analysis to ensure we're protecting trees and greening equitably across the City.

We are aiming to increase our tree canopy to 27 per cent cover by the year 2050. We've earmarked $377 million to invest in parks, green roofs and walls, streetscape gardening and improved urban forests across the whole Local Government Area, including the planting of at least 700 trees a year.

We are already experiencing the impacts of climate change. By 2050, urban heating is predicted to increase temperatures between 1 point 5 and 3 degrees, so it's vital we plan, invest and adapt. We see trees and green spaces as essential infrastructure, as effective and extensive canopy cover can help reduce temperatures on the ground by up to 10 degrees.

A greener Sydney will improve our health and wellbeing, reduce the impact of heat, and bring nature into the city. Our greening work will be underpinned by climate science and collaboration with First Nations communities, who successfully cared for this land for millennia.

Achieving a greener city will require commitment and action from us all. Together, guided by innovation, partnership and our ambitious targets, we can create a cooler, calmer and more resilient city.

Executive Summary

This Greening Sydney Strategy outlines how we will be a cool, calm and resilient city. We will increase greening and share its benefits with the entire community.

Cool, calm and resilient

Our vision is for a greener Sydney that will help improve our health and wellbeing, reduce urban heat impacts, and bring nature into the city.

Our commitment to green living focuses on providing all of the community with equitable access to quality green spaces.

The City of Sydney, like other cities around the world, are embracing tree canopy and urban greening as a solution to address the climate and health challenges that our cities are facing.

In 2012, we released the first Greening Sydney Plan, which set our fundamental groundwork. We began measuring the city's canopy cover and identified important targets to increase our overall canopy cover to 22 per cent by 2030 and to 27 per cent by 2050.

We have made substantial gains in our urban greening and developing policies and programs to meet those commitments. These include:

– developing an urban forest strategy, an urban ecology strategic action plan, a green roof and walls policy, a streetscape gardening policy, and a landscape code.

– increasing canopy cover from the 2008 baseline of 15.5 per cent to 18.1 per cent in 2019.

– increasing our parks and open space network managed by the City from 190ha in 2012 to 211.9 ha in 2020.

– creating the Sydney City Farm and supporting the establishment of over 20 community gardens

– restoring and expanding native bushland areas from a baseline of 4.6 hectares in 2012 to 12.9 hectares in 2020.

– planting thousands of lower level gardens and shrubs within our parks and streets.

While we have achieved the goals above, providing healthy green infrastructure in urban environments is challenging. Streets are highly used and contested spaces. Parks and open spaces need to fulfil many roles, such as providing for active and passive recreation. Similarly, urban development patterns, characterised by increasing density and infill developments, reduce the space available for trees and other greening on private land.

However, there is growing research and community recognition that trees and greening is essential infrastructure.

Sydney is always changing. We must look forward to determine and actively plan the type of city we need.

There are many opportunities to harness future changes to provide these benefits. A decrease in vehicle ownership and use is one major area that supports redistribution of space to create more inclusive, active and healthy spaces.

Our focus for action

To achieve our vision, for a cool, calm and resilient city, this strategy outlines six directions, and 20 supporting actions.

1. Direction 1 – Turn grey to green
2. Direction 2 – Greening for all
3. Direction 3 – Cool and calm spaces
4. Direction 4 – Greener buildings
5. Direction 5 – Nature in the city
6. Direction 6 – Greening together

The City of Sydney will prioritise greening initiatives to address any inequities, to provide the greatest benefit, and to assist our most vulnerable communities. An implementation program is outlined in Attachment 1.

This strategy outlines the benefits, opportunities and obstacles to greening in our city and how we plan to implement and provide a cool, calm, beautiful and resilient place to live, work and visit.

Redfern Park, Redfern June 2014

Direction 1 – Turn grey to green

To meet all the future challenges we face, we need to set and achieve ambitious greening and canopy cover targets across the city, for our street, park and property portfolios.

The research indicates we ideally need to provide 30–40 per cent canopy cover for heat, and 30 per cent canopy cover for community health.

Our target is to increase overall green cover to **40 per cent** across the local area, including a minimum of **27 per cent** tree canopy by 2050.

Action 1 – Achieve the targets

We will develop policies, programs and projects to help each portfolio to achieve the targets. It is vital that everyone works together to meet these targets.

Green cover is all of the trees, plants, ground covers and turf throughout the city. Canopy cover relates solely to trees over three metres tall.

Action 2 – Green our laneways

Space in the city is highly contested. It is no longer considered appropriate that laneways, as underused public spaces, are not better designed to become a valued green network for the entire community.

We will transform laneways into greener shared spaces as we transition to a more sustainable city, with fewer private cars. This will include the development of new design solutions for laneways, that challenges the requirement for private vehicle use of laneways.

Action 3 – Harness innovation, technology and inspiration

The increasing momentum in the green infrastructure market continues to encourage cities to implement green policies. We will use, encourage and support the latest research, technology and innovation opportunities to transition our greening.

Direction 2 – Greening for all

In a just and fair city, it is vital that we distribute quality greening fairly across the city so that everyone shares the benefits provided by greening.

Action 4 – Distribute greening equitably

Research outlines 30 per cent canopy cover, within an area of around 1.6 kilometres, provides key heat and health benefits. To ensure greening is shared, we will make informed and data driven decisions about greening in our future projects and developments, making this information accessible where possible.

Action 5 – Provide fair access to quality green space

We need to ensure our green spaces accommodate a wide range of uses to meet our diverse community's needs. We will develop a parks design code and provide standardised maintenance services for robust and sustainable designs, and consistently well maintained open spaces across the city.

Action 6 – Adapt for climate

It is important that we provide mature, thriving and healthy landscapes for future generations. We will review the latest climate science, and available research to assist us to design green spaces and plant new species that will thrive under the changed climate conditions.

Action 7 – Grow food locally

Access to fruit and vegetables is a critical ingredient for our mental and physical health. We will continue to support the community to grow more food locally through our Sydney City Farm programs and community garden network, and increasingly look at opportunities for increased food production on private land.

Direction 3 – Cool and calm spaces

Two key issues facing most of the city's residents relate to high urban heat and impacts on physical and mental health.

Action 8 – Cool the hot spots

Cool streets improve the walkability and liveability of our city. To cool Sydney through greening we will provide programs that support tree planting, shading and using water in the landscape. We will prioritise programs areas and community groups that are particularly exposed to urban heat and other health related issues.

Action 9 – Calm green spaces

Substantial and meaningful greening provides refuge in a busy city, creating calm and healthy spaces that improve our mental health and wellbeing. We will identify and map the calm spaces, share information to assist with usage and wayfinding, consider calm spaces in future design and prioritise programs that provide the greening health benefits to those who most need it.

Action 10 – Celebrate water

Water sustains life and all living things depend on it. Sydney has a special connection with water. The harbour has shaped Sydney and its people for many thousands of years, from the First Nations through to new immigrants today. There are many water bodies across the city that provide us with a place that helps to restore and invigorate us in equal measure.

We will care for and celebrate water by recognising and communicating the importance of water in our lives. We will help ensure water is used efficiently as a natural resource and its role as a habitat for wildlife is understood and protected.

Direction 4 – Greener buildings

Property represents the largest proportion of land use at 61 per cent of the local government area.

To achieve the 40 per cent green cover target, including the 27 per cent canopy cover target, properties have to provide at least 28 per cent greening, including at least 20 per cent of that as tree canopy cover.

The community has also expressed their need for greener buildings. In the Sustainable Sydney 2050 community survey, 85 per cent of respondents want buildings covered with plants and that incorporate nature into their design.

Action 11 – Develop a green factor score

A green factor score is a tool that evaluates and quantifies the amount and quality of urban greening that a project provides.

We will develop a score, or equivalent planning controls, that will assist us to meet the green and canopy cover targets. We will embed the score into updated planning controls, including development control plans, to ensure greening is planned for and provided on private land.

Action 12 – Increase green roofs and walls

To increase the quantity and quality of green roofs and walls, we will review and update our green roofs and walls policy and landscape code. We will also gradually amend the planning controls to increase green roofs in new developments, and allow for retrofitting of existing buildings, where appropriate to do so.

Action 13 – Planning ahead

Greening is essential infrastructure and we need to give it sufficient space to thrive. Space in our city is contested and every square metre is valuable. We need to make informed decisions about how each square metre is used, understanding that we can't have it all and there will be trade-offs.

To plan for a greener future, we will develop minimum requirements within the planning controls to achieve the new greening property targets. We will also consider future land use and trends, such as studios and car ownership, that impact on the retention of or ability to increase greening.

Compliance will also be a focus to ensure long-term greening outcomes.

Central Park, Sydney 2020. Robert Smart

Direction 5 – Nature in the city

When designing and implementing our greening strategies we will be looking for ways to maximise habitat potential and nature in the city.

Action 14 – Recognise and support Indigenous ecological knowledge

The Gadigal of the Eora Nation managed their land resiliently for thousands of years. There is much we can learn to better care for this Country.

To achieve this, we wish to work with the local Aboriginal community to explore and identify opportunities to celebrate, promote and educate about Aboriginal ecological knowledge and principles.

Action 15 – Strengthen urban nature protection measures

As Sydney continues to grow, it is essential we have the necessary mechanisms in place to protect, and increase, nature in the city. To achieve this, we will identify and implement strong urban nature protection measures and include these into our planning controls. We will also develop targets to increase biodiversity, habitats, and ecosystem health, and implement best practice ecological connectivity approaches to allow for the safe movement of priority native fauna.

Action 16 – Perform an urban ecology health check

We will collect information about our existing urban biodiversity status to determine our progress, and to consolidate existing data to determine potential habitat measures, reassess priority works and to define performance targets.

Action 17 – Reconnect with nature

It is important for the community to reconnect with nature and seek to enhance the nature in the city. To achieve this, we will support more citizen science programs and participatory events, and develop a coordinated communication program on urban nature focused programs and achievements.

Direction 6 – Greening together

The community is one of the greatest resources for greening Sydney. Our communities continue to show a strong interest and are passionate about participating in greening the urban landscape.

Action 18 – Support community participation

We encourage the community to have a sense of ownership and acceptance of the community greening initiatives. We will continue to provide, and increase, opportunities for active participation in greening activities, including ongoing education and awareness of the importance of greening the urban environment, and hands-on activities and volunteering.

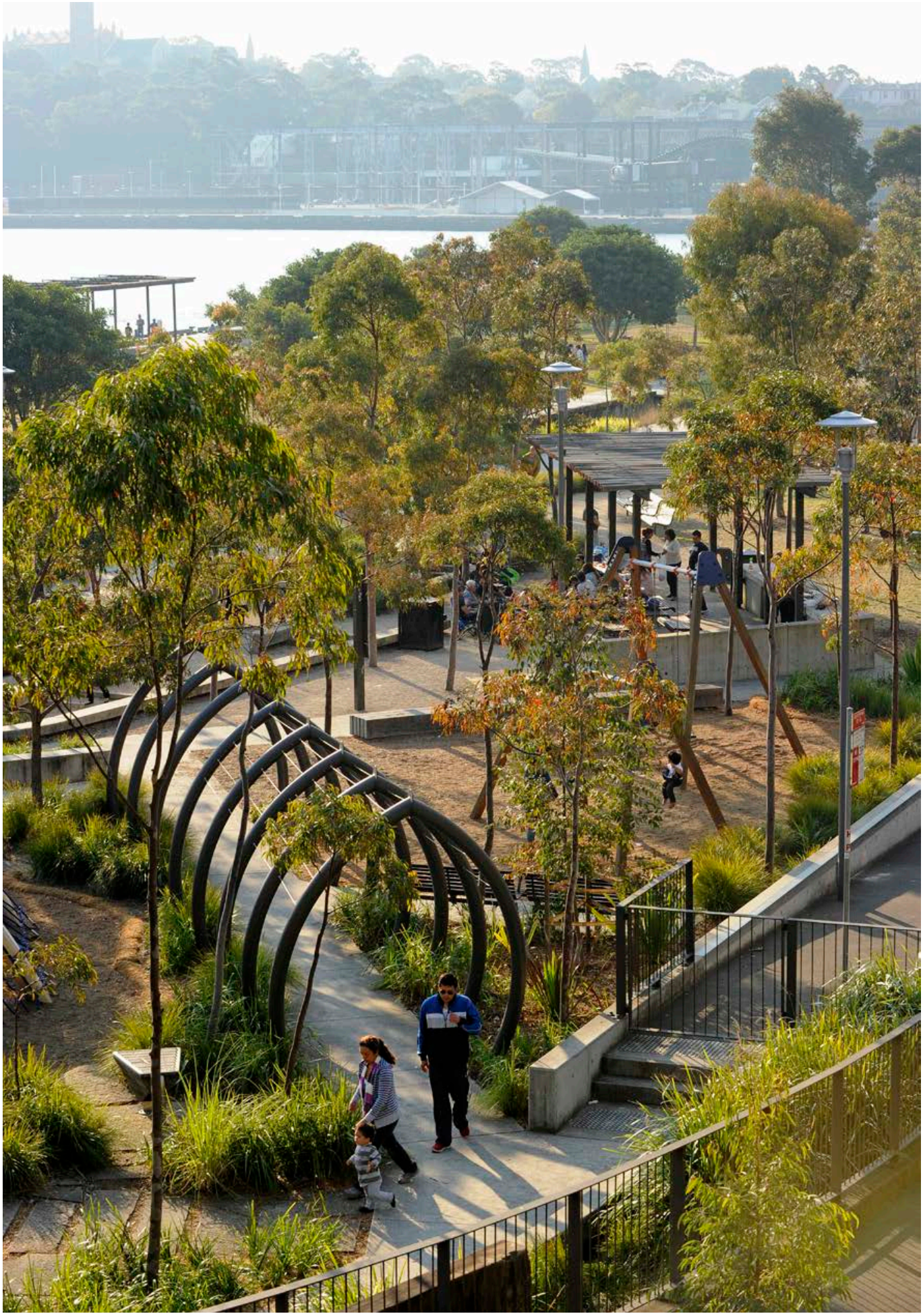
Action 19 – Develop a greening Sydney fund

The City uses extensive resources to plant and maintain public trees. When a tree is removed, the benefits from the tree are lost for many years until any replacement tree matures. In some instances, the benefits are permanently lost when a tree cannot be replaced. We will continue to place tree removal as a last resort. However, when removal of a public tree is required to facilitate a development / project, we will investigate ways to ensure the City is appropriately compensated for the loss and identify how any compensation received can be used to create the greening Sydney fund.

The City would manage any fund to provide a grants program aimed at improving greening outcomes on private land in line with this strategy. This may include programs such as matching grants programs for residents and landowners to undertake new tree planting, nature plantings or install green roofs.

Action 20 – Increase our community engagement

We will review our community engagement approaches, including our online presence, to maximise engagement with a wider audience. We will also develop a green volunteer network to allow for community knowledge sharing, networking and learning across the city at both an online and face-to-face levels.



Pirrama Park, Pyrmont 2014. Adam Hollingworth

Why we need to green our city

Benefits of greening

Green infrastructure is a city's natural life support system, essential for all functions. It provides multiple social, environmental and economic benefits. Our society relies on these benefits every day; making green infrastructure essential infrastructure.

We have identified community health, climate change and urban heat, and biodiversity and nature as the key risks to our city. Green infrastructure plays a vital role in mitigating these risks.

For millennia humans have had a relationship with forests. The sounds of the forest, the scent of the trees, the sunlight playing through the leaves, the fresh clean air. These things give us a sense of comfort, ease stress and worry, help us relax and think more clearly. Being in contact with nature can restore our mood, give us back our energy and vitality, refresh and rejuvenate us.

The concept that humans have a biological need to connect to nature is called biophilia. American biologist E O Wilson summarised in 1984 that we are 'hardwired' to affiliate with the natural world and just as our health improves when we are in it, so our health suffers when we are divorced from it.

Whether it is for managing heat or mental health issues, happiness, physical activity or reduced incidences of disease and illness, an increase in our canopy cover, green space, and nature provides multiple benefits to the community.

Bourke Street Surry Hills, 2020.
City of Sydney

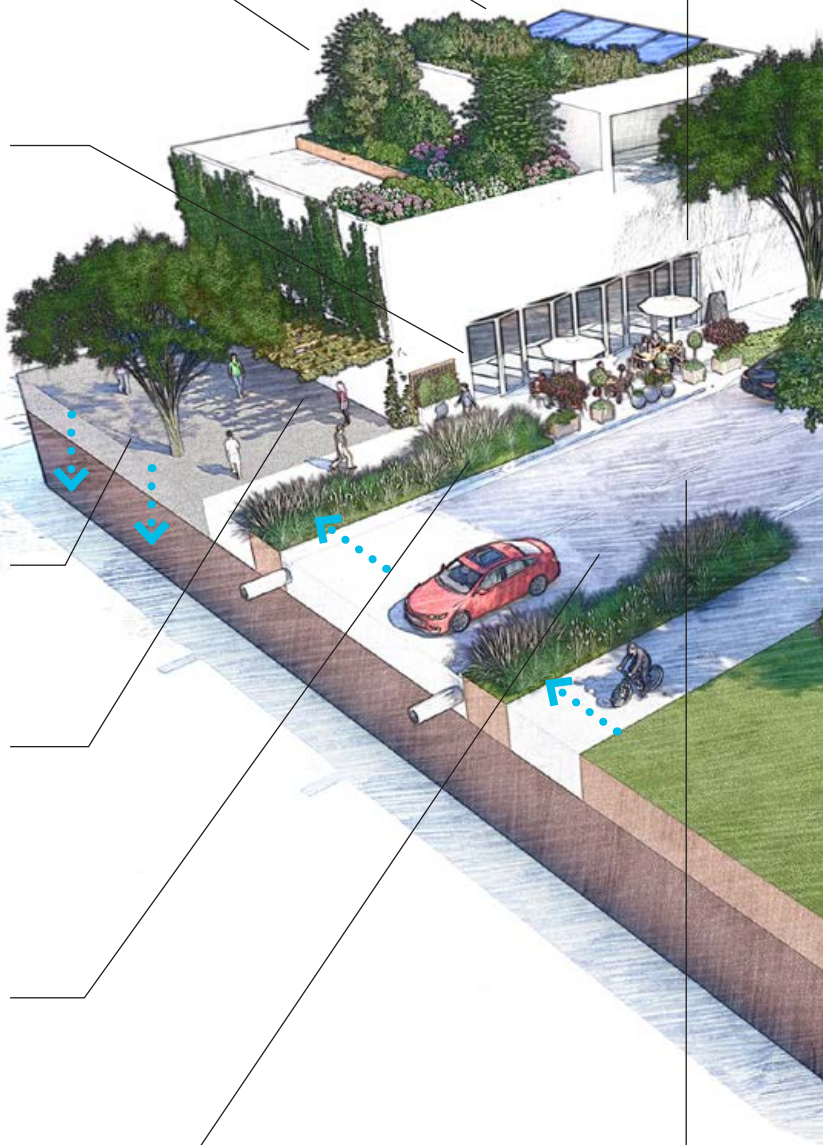
THE BENEFITS OF URBAN GREENING

Cooler roofs as a result of green roofs increase photovoltaic collector efficiency.

Shade provided by trees helps reduce air conditioning costs.

Green roofs extend the opportunity for habitat, increase building insulation, store and slow rainfall runoff and drastically reduce urban heat build up during the day and night.

People tend to shop, dine and linger longer in attractive green environments improving commercial returns.



Permeable pavements and raingardens slow and collect rain water that can then support urban greening and remove pollutants.

Vine covered shade structures and green fascades provide shade to buildings, reduce urban heat, increase visual appeal and privacy. They can also be used where spaces don't allow tree planting.

Views of trees and lower level greenery increases the value of residential and commercial property.

Shading of road and other pavements increases their longevity and drastically reduces ambient heat buildup and radiation at night.

Canopy coverage of at least 30% reduces mental health issues and leads to better perceptions of overall health. It also reduces employee sick leave, improves employee and student concentration.

Trees and other greenery increase habitat, shelter and food for animals.

Leaves and foliage provide shade, filter and absorb pollutants and capture and slow rainfall. They also release scents and aromas that can create a positive emotional response.

Leaves and timber from pruned and removed trees can be recycled as mulch to improve soil, nutrients and water holding of soils.

Tree and vegetation roots retain soil, preventing erosion and absorb water.

Quality green spaces and tree canopy cover create a greater sense of community and increase opportunities for physical activity, socialisation and connections to nature. They generally improve mood and restore our minds from stress and fatigue.

Irrigated lawns and gardens reduce urban heat and increase infiltration of rainwater.

Trees provide shade that reduces overall urban heat, improves the walkability of streets and reduces incidences of skin cancer. Use of deciduous trees can also allow winter sun and thereby reduce heating costs in winter and facilitate use of parks in cooler months.

Trees and greenery and other permeable pavements help decrease stormwater runoff and recharge groundwater supplies and provide passive irrigation to make more resilient and longer lived trees.

Climate emergency

The United Nations describes climate change as the defining issue of our time. In June 2019, the City of Sydney declared that climate change poses a serious risk to the people of Sydney and should be treated as a national emergency.

The City's Climate Emergency Response is very clear on the impacts to the city and its community, and how the City will respond to this emergency.

Average global temperatures are approaching a 1.2°C increase above pre-industrial levels, with significant consequences and impacts.

Any rise above 2°C would have devastating impacts on Australia, including:

– more extreme weather events

– reduced rainfall

– longer, hotter and more frequent heatwaves

– water scarcity

– more extreme bushfires

– increased risks to food production

– reduced biodiversity

– inundation of coastal areas.

We are already seeing the effects of global heating.

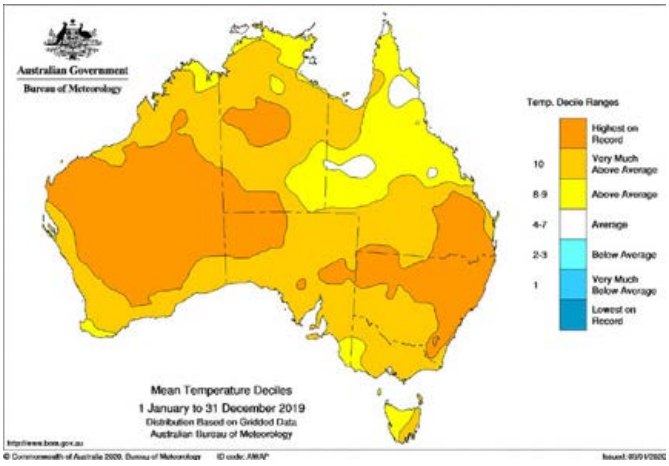
Australia's climate has warmed on average by 1.44 ± 0.24 °C since national records began in 1910. In 2019, Australia experienced its warmest year on record. It was also our driest year on record[1], and one of the worst bushfire seasons experienced.

We are experiencing the impacts of climate change in our urban areas.

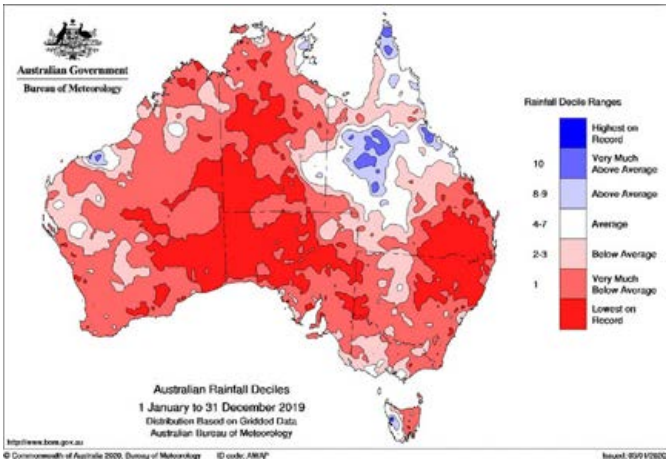
Heat records have continued to be broken, with Sydney reaching its highest ever recorded temperature, and Penrith reaching a staggering 48.9°C during the heatwave of 4 January 2020.

Sydney had many months with below-average rainfall, but also some wet months but still its annual total rainfall was in the driest 15 per cent of years.

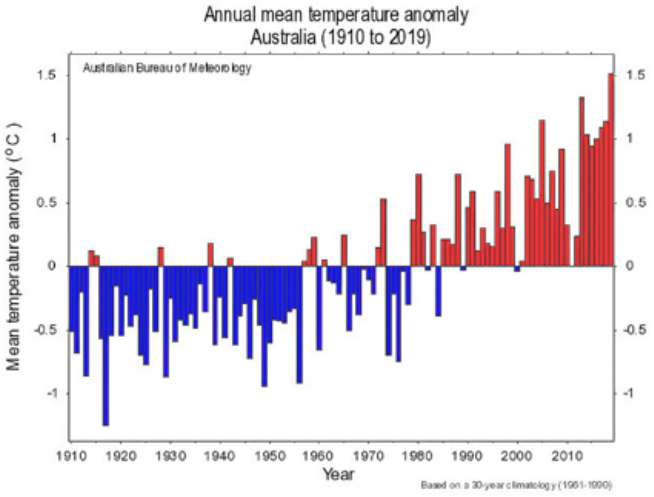
In NSW the Air Quality Index (AQI) reached the hazardous category (with an AQI greater than 200) on a total of 115 days[2].



Australian Mean Temperature Decile Map – 2019
[Source : Australian Bureau of Meteorology – 30/1/2020]

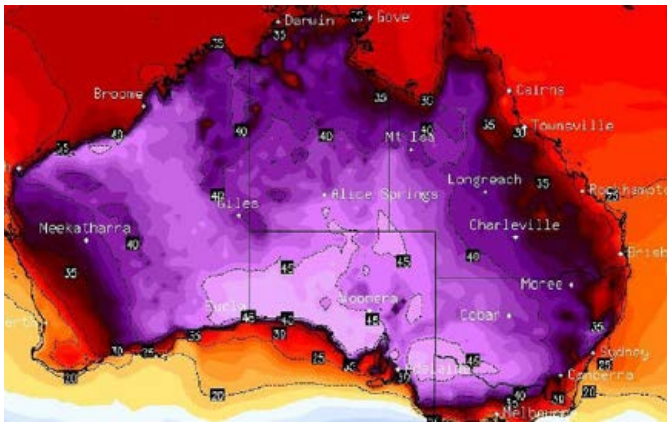


Australian Rainfall Decile Map – 2019
[Source : Australian Bureau of Meteorology – 30/1/2020]



Australian Mean Temperature Anomaly – 1910–2019
[Source: Australian Bureau of Meteorology – 30/1/2020]

1 Bureau of Meteorology: Annual climate statement 2019. bom.gov.au/climate/current/annual/aus/
2 NSW Planning, Industry and Environment. environment.nsw.gov.au/topics/air/air-quality-statementp



Images from top: Sydney storm front 2014, Cassie Trotter/Getty Images. Sydney smoky with poor air quality 2019, James D. Morgan/Getty Images. Centennial Park ponds dry, 2019 Cole Bennetts. Australian temperature map 2019, news.com.

In coming decades our city will see further:

– increases in sea and air temperatures, with many more hot days and marine heatwaves, and fewer cool extremes.

– sea level rises and ocean acidification.

– decreases in rainfall across southern Australia with more time in drought, but an increase in intense and heavy rainfall events throughout Australia.

– rainfall extremes that are becoming more intense. These short-duration rain extremes are often associated with flash flooding.

– temperature increases with the number of days over 35°C each year expected to rise from 4 days in 2015 to over 15 days by 2070.

Every year that passes without action will increase the scale and severity of the response Australia will need to undertake to mitigate the impacts of global heating.

Our city must adapt to the changing climate and increase its resilience to the likely impacts. There are opportunities to accelerate our action in the areas of canopy cover, greening and biodiversity, as these actions help us mitigate, and adapt, to the impacts of climate change.

Urban heat mitigation

Heatwaves are Australia's deadliest natural hazard. They now arrive earlier, are hotter, and last longer. Urban temperature extremes can present us with life-or-death situations.

In Sydney, the heatwave of February 2011 resulted in 595 people needing treatment in hospital emergency departments, and it killed 96 people.

In 2009, the Black Saturday bushfires killed 173 people, but the heatwave at his time killed 374 people in Melbourne alone.

Urban areas create 'heat islands', as the built materials, such as buildings, roads, and footpaths, absorb heat during the day, and release it at night.

Urban heat mitigation through greening can significantly reduce human heat related morbidity and mortality.

Canopy trees facilitates the cooling of our homes and streets and parklands via evapotranspiration, shading and providing cooler surfaces to reduce mean radiant temperature. It can result in substantially decreased demand for energy due to reduced air conditioning use as well as lower water consumption. (Low Carbon Living, 2017)

Reducing paved surfaces also helps to reduce heat that is absorbed and radiated into the air. Extreme heat is moderated most effectively where there is more canopy cover and less hard paved surfaces.

Numerous research studies outline the benefits that trees and canopy cover provide, measured at the individual tree, street level and on a precinct scale.

Individual trees can make a valuable difference to air temperatures, by as much as 10°C.

Groups of trees that combine to provide greater than 40 per cent canopy cover at the scale of a city block have been found to reduce local ambient air temperature by more than 1.3°C (Ziter, C. et al 2019).

At the local scale, recent research from Western Sydney University found that temperatures at ground level could vary significantly. In some areas the difference was more than 10°C. The research compared two streets located 1km apart that had the same microclimate and other site factors.

The key difference was the extent of canopy cover; one street had 30 per cent cover and the other 10 per cent. The street with the higher canopy cover was 10°C cooler.

At the precinct scale, 2017 Australian research found that "a lack of tree canopy correlates to higher intensity of the urban heat island effect in temperate climates. Urban trees provide local shade and evaporative cooling. Increased urban greenery reaching the ideal ratio of 30 per cent combined with water sensitive urban design can provide up to 2°C cooler urban climates compared to business as usual scenario and assist achieving cooler and healthier urban environments in the context of climate change."

When addressing the impacts of urban heat, research confirms we need canopy at both the local and precinct scale – ideally with **a minimum of 30 per cent canopy cover.**

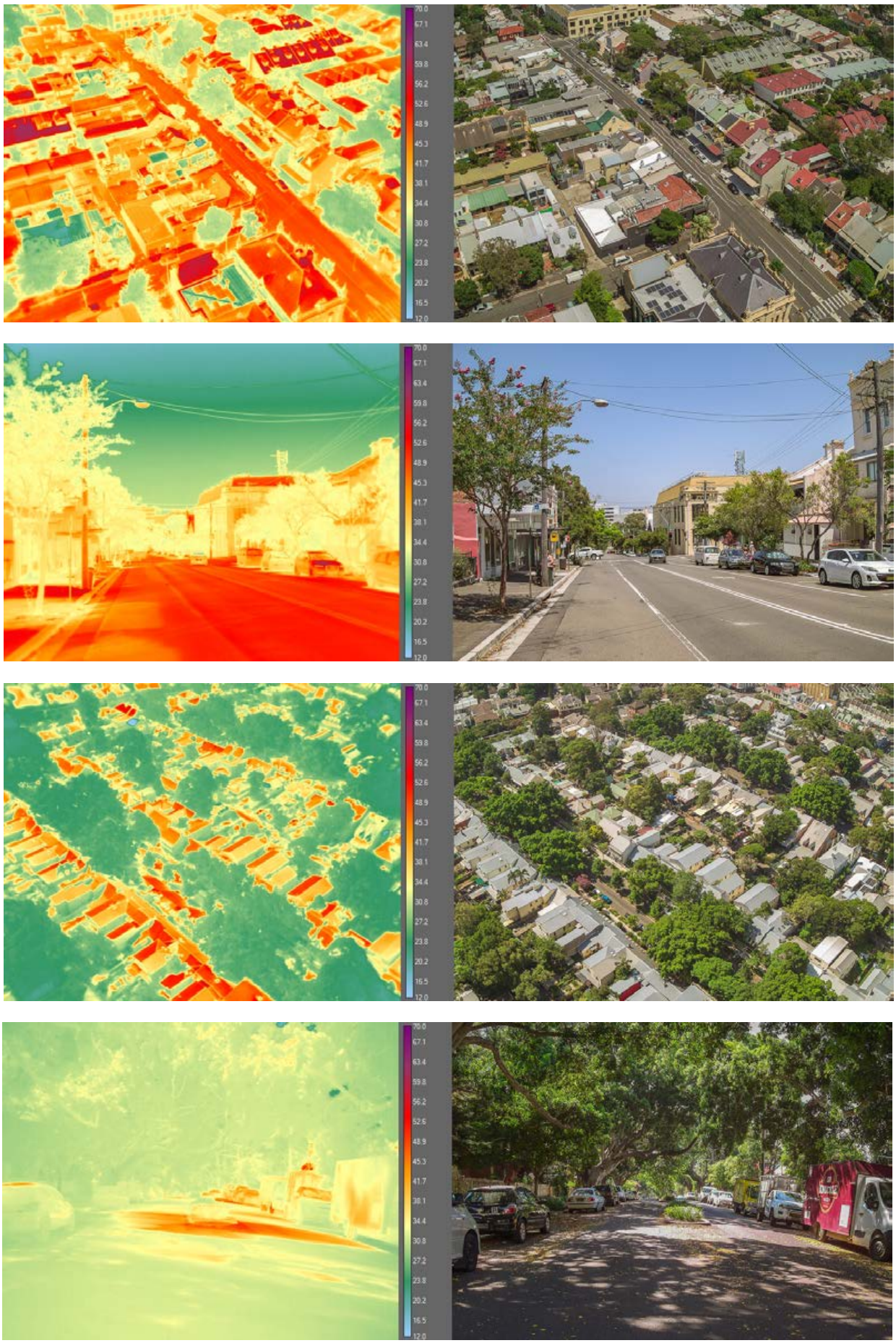
Why is heat an issue for me?

Heat creates physical stressors on humans. You start by getting overly hot, sweaty and uncomfortable. As the temperature rises it starts to affect your concentration and decision-making. You might do things that are more dangerous.

At the threshold of 41 degrees Celsius, critical internal organs – the heart, liver, kidneys and so on – start to function more poorly. Once past that critical threshold, they can actually start to fail and death is more likely to occur.

Going about your daily activities, both at home and work, would become increasingly difficult and this would have a ripple effect across the economy. In addition, hospital admission rates already rise dramatically during heatwave events because heat exacerbates underlying health condition. Sick, young and older patients are particularly vulnerable. But as we move forward, that demographic could expand to include groups currently otherwise considered healthy – individuals from 15 to 55. So, heat and heatwaves increase the burden on the health system.

Prof Dominey-Howes, University of Sydney



Images from top: Aerial view and street views of St Johns Road Glebe, followed by Westmoreland Street Glebe, 25 January 2019 showing the temperature difference as a result of tree canopy.

Community health and wellbeing

There is growing realisation, backed by a rapidly increasing body of research, that green infrastructure also sustains and enhances our health and wellbeing. Compelling data proves connecting with nature for as little as a couple of hours provides a multitude of benefits.

There is no greater good that can be done for health promotion than the protection of greenery on which all humans depend. (Coutts, C. and Hahn M. 2015)

During the Covid-19 pandemic people flocked to nature to help them stay strong – physically and mentally. Access to quality green space is vital, and not just in times of emergencies.

Mental health and wellbeing

The Word Health Organisation has called stress a health epidemic of the twenty first century. One in four people worldwide will suffer a significant mental health episode in their lives. Mental ill health and suicide are costing Australia up to $180 billion a year (the Productivity Commission found in October 2019). Anxiety and depression are estimated to cost the European Union €170 billion a year and in the USA over $210 billion.

Finding a way to manage this is critical to our health and wellbeing. Trees, nature and other greenery can help immensely.

Simply being in, nearby, or with a view of green spaces may help build mental health capacity, contribute to our ability to restore depleted cognitive capacities, enhance recovery from stress and increase our optimism. Exposure to nature, including sensory elements such as bird song, also has beneficial outcomes for our mental health.

A 2019 Australian study 'Association of Urban Green Space with Mental Health and General Health Among Adults in Australia' by Prof Astell-Burt and Dr Feng found that urban communities with a healthy amount of tree cover – not just grass and green space – were psychologically healthier than those that didn't.

In neighbourhoods with a tree canopy of 30 per cent or more, adults had lower odds of developing;

– psychological distress by 31 per cent

– diabetes by 31 per cent

– cardiovascular disease by 21 per cent

– cardio hypertension by 21 per cent

– rating their general health as fair or poor over six years by 33 per cent.

Urban green spaces with open grass rather than a tree canopy did not provide the same benefits.

This research, which focused on Sydney, Newcastle and Wollongong, helps provide a solid target to work towards to provide the community with tangible health outcomes.

Physical health

Greening also helps to address urban air quality. In most cities, the most damaging air pollutant is particulate matter. Fine particulate matter (less than 2.5 micrograms in diameter) can be deeply inhaled into the lungs and is estimated to cause 3.2 million deaths per year primarily from strokes and heart disease. It also contributes to chronic and acute respiratory diseases, including asthma. One study forecast that by 2050, fine particulate matter could kill 6.2 million people per year world-wide. (The Nature Conservancy, 2016).

It is estimated that air pollution from vehicle emissions causes 60 per cent more than the number of deaths from motor vehicle crashes in NSW (The Electric Vehicle Council and Asthma Australia report 2019). In addition to cars, cities are increasingly exposed to air pollution from distant bushfires as experienced by most Australian cities in the 2019/20 bushfire season.

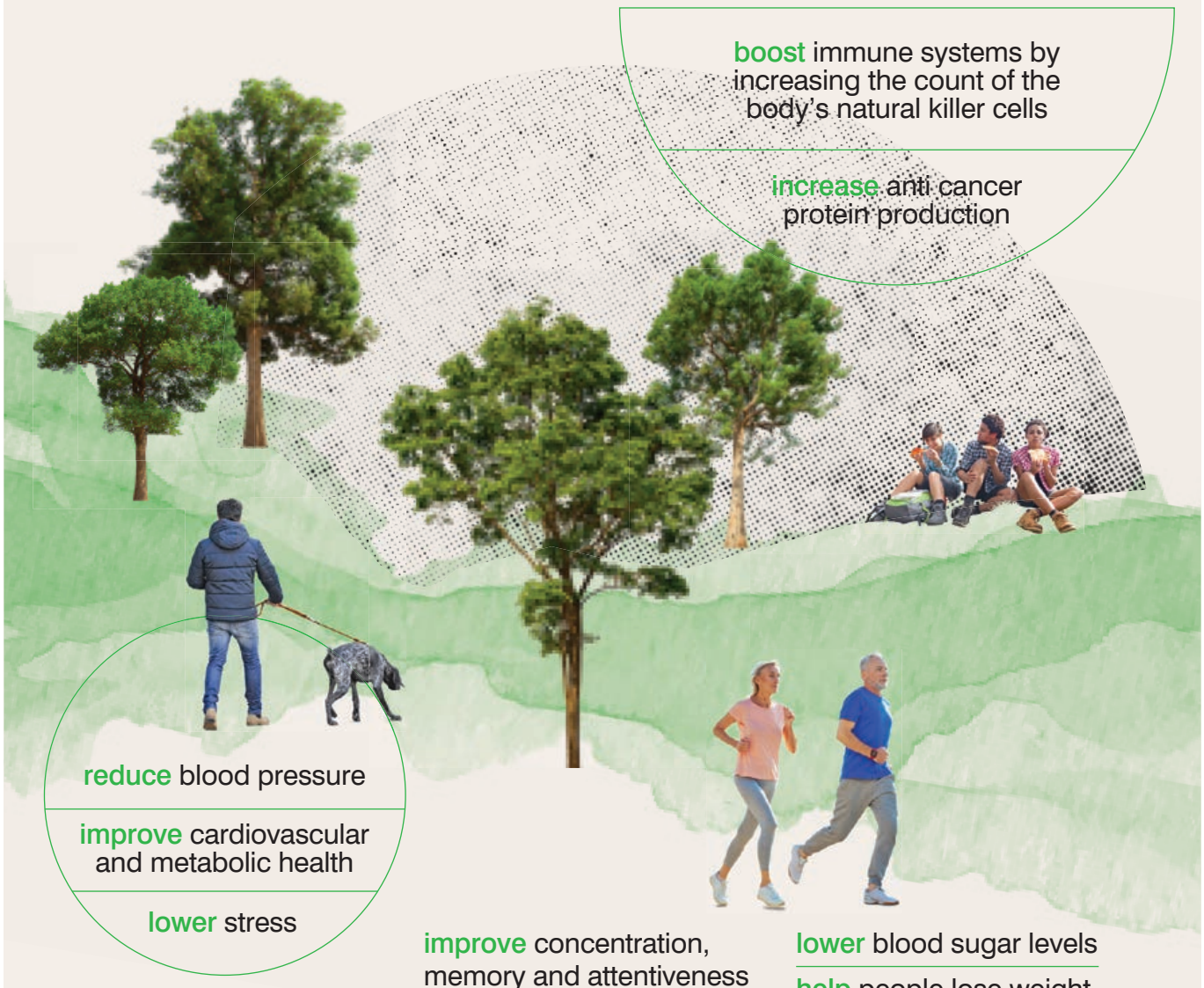
Local trees will therefore play an important role in making our local air healthier, too. Dozens of studies now show that the tree leaves filter out particulate matter from the atmosphere, along with absorbing many other air pollutants.

Quality shade provision can also reduce exposure to damaging UV by up to 75 per cent. This can be provided by built structures or trees, but trees also produce numerous other benefits.

Greening also has massive benefits for our city's connectivity and walkability. Walking and cycling are important benchmarks for a liveable city. High levels of walking mean a city is safe, vibrant and easily accessible by everyone.

Health Benefits

Compelling data now proves that connecting with nature for as little as a couple of hours can:



boost immune systems by increasing the count of the body's natural killer cells

increase anti cancer protein production

reduce blood pressure

improve cardiovascular and metabolic health

lower stress

improve concentration, memory and attentiveness

lift feelings of depression

improve pain thresholds

improve feelings of energy

lower blood sugar levels

help people lose weight

Biodiversity and habitat

Sydney's natural landscape has changed dramatically and is nearly unrecognisable from its state before colonisation more than two centuries ago.

Ecosystem health and biodiversity is important for a sustainable world. Protecting and improving urban biodiversity, while also reclaiming and managing functional ecosystem health and function in the city, can play a role in improving the health of its residents and the liveability of the city.

Biodiversity and habitat can be enhanced by providing environmental conditions and supporting functional ecosystems that will support a diversity of plant species and then in turn these plant communities may provide habitat for wildlife. (Rowe, B., 2019).

Australia's urban areas contain disproportionately more threatened species than non-urban areas. Recent research shows that 30 per cent of Australia's threatened species (370 species) come from within our cities and towns. This reinforces the significance of planning and managing our landscapes to conserve and enhance biodiversity.

> We can learn from Indigenous culture and "ways of viewing, interacting with and respecting nature". (Martin, C. 2019)

There is an opportunity to reimagine spaces to create steppingstones and biodiversity corridors for our urban wildlife. Even small patches of biodiverse nature can re-invite and support an incredibly diverse population of plant and animal species. From pocket parks, to backyards, to balcony gardens and to formal partnerships with larger landowners.

Creating and fostering a healthy and diverse nature is fundamental for our environment but also our own health and wellbeing. Creating this nature, an effort to rewild across public and private property will not only increase greenery in these spaces but will help boost efforts to reclaim ecosystem function and health, increase canopy cover and wildlife habitat.

Bioblitz Sydney Park 2018

The City understands and acknowledges how interrelated all the components of our natural and urban environment can be.

By increasing the greening in our city, implementing water sensitive designs and naturalising our storm water collection and storage we are also creating numerous opportunities for worthwhile and co-dependant habitat creation.

> Ecological systems do not discern between public and private and no one government agency, private corporation or professional discipline can deal with this complexity. (Martin, C. 2019)

There are numerous threats to our biodiversity and our efforts in restoring nature in the city that is common to most urban areas, particularly inner-city locations, including:

– limited habitat availability
– lack of habitat connectivity
– destruction and fragmentation of remaining habitat
– low genetic diversity
– weed invasion
– use of chemical herbicides and pesticides
– soil degradation
– introduced fauna, diseases and pathogens
– poor water quality and inappropriate hydrological regimes
– light, noise, traffic, and other disturbance, and
– climate change.

A zero carbon city

The NSW Government and the Greater Sydney Commission both aspire NSW and metropolitan Sydney to achieving net-zero emissions by 2050 and to help NSW become more resilient to a changing climate.

The City of Sydney target is for net zero emissions across the local government area by 2040.

Achieving a carbon neutral city largely relies on our government and community's adoption of renewable energy sources, changes in building design and construction, changes to transport infrastructure and fossil fuel use.

While it is essential we reduce emissions and build better buildings and deal with waste, it is also advantageous to capture and sequester the carbon already in the atmosphere. Studies have shown urban trees contribute to this process, and young and rapidly growing trees can capture carbon at higher rates than more mature and slower-growing counterparts. (Coutts, C. and Hahn M. 2015)

Greening initiatives, therefore, have a large role to play to helping our city achieve this aspirational outcome.

– Reduce energy consumption by shading buildings and streets.
– Reduce car and transport reliance by establishing and making active transport more desirable through 'Cool' and desirable streets and expanding our Liveable Green Networks.
– Green roofs can insulate buildings and lower ambient temperatures.
– Green roofs and other greening can drastically increase rooftop solar panel efficiency by lowering ambient temperatures.
– Plants take up and use carbon dioxide and trees can sequester carbon within their timber and roots.

Cool city streets, Arterra 2020.

Our City

THE CITY TODAY

Workers (2019)
637,651

Residential population
259,273

Dwellings (2019)
131,293

Densest local government area in NSW **9212 persons/km²**

6th largest
LGA in Sydney Metropolitan area

Economic activity
$130 billion

18.1%
Canopy cover (2019)

WE'VE CHANGED A LOT

30,000
homes built over last 10 years

One of the fastest growing LGAs in Australia

67,000
more people over last 10 years

Cost of new Green Square community facilities **$450 million**

30%
jobs growth over last 10 years

2.6% increase
Canopy cover (2006-2019)

Office space down
20%
per worker (2007-2017)

MORE CHANGE TO COME

115,000
additional people by 2036

New dwelling by 2036
56,000

1.7 million
people in the LGA each day

Most housing will be in high density apartments **80% by 2036**

5+ new
Metro stations

200,000 more jobs by 2036

Net zero emissions
City target by 2050

Greening in the City

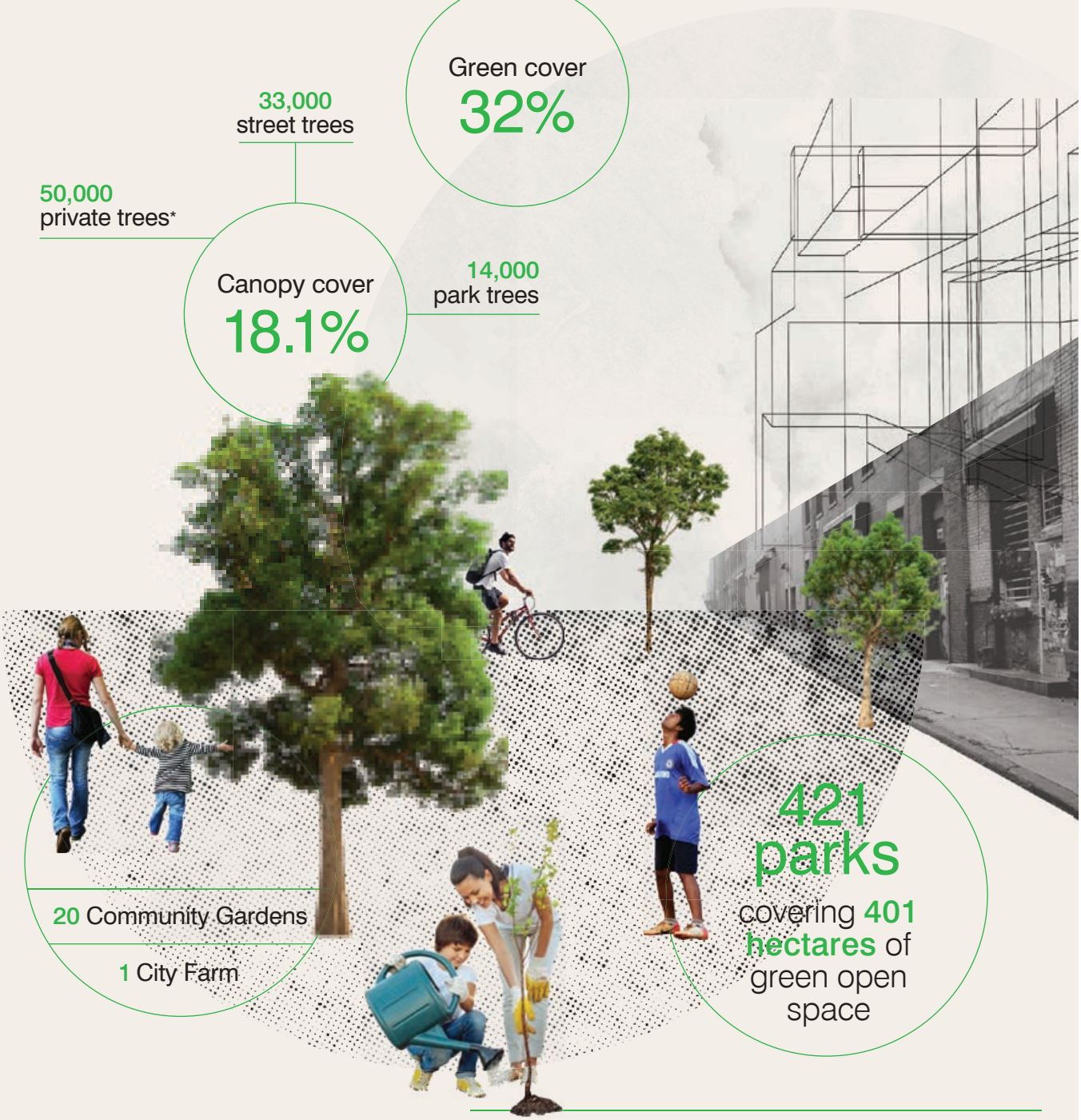
Green cover
32%

33,000
street trees

50,000
private trees*

Canopy cover
18.1%

14,000
park trees



20 Community Gardens

1 City Farm

421
parks
covering **401 hectares** of green open space

212 hectares of parkland is managed by the City of Sydney, consisting of **345 parks**, including:

- **22** iconic parks
- **38** neighbourhood parks
- **285** pocket parks
- **32** civic parks
- **14** sports fields

There are also **2114** traffic bed gardens and **2853** streetscape gardens.

*(estimated)

Sustainable Sydney 2050

The City is reviewing Sustainable Sydney 2030, a set of goals we set our city to help make it as green, global and connected as possible by 2030.

We are creating a plan for our local area to 2050, with everyone who has an interest in our city.

You spoke and we listened. For Sustainable Sydney 2050, you want:

– A city for **people**

– A city that **moves**

– A city that is **environmentally responsive**

– A **lively, cultural and creative** city

– A city with a **future focussed economy**

From the community engagement undertaken for our Sydney 2050 plans we heard:

– People need a city that is **green with trees, plants**, **gardens and urban farming** has quality public spaces and different types of housing that is affordable.

– People need to be using public transport, **walking and bikes** to move around. They want a reduction of cars. They want streets and public spaces that are easily accessible to people.

– People overwhelmingly want a **response to climate change**. They want a city with sustainable use of resources. People want to see a reduction in emissions and changes to how we use our city to reduce our impact on the environment.

People surveyed for the City's community recovery plan have also identified lack of parks, trees, green and recreation spaces within their top ten concerns for the future.

"Sydney is a big city and so it needs to compensate for reduced air quality with more trees and parks, which are necessary for living a healthier and better life."

Spanish community session

77% of respondents want a green city with parks, trees and nature.

85% of respondents want buildings covered with plants and that incorporate nature into their design.

Our community have also acknowledged that the most vulnerable in our community can often bear an unequal share of the consequences of climate risks or the effects of our changed climate.

We are developing Sydney 2050 to meet these needs. 2050 sounds a long way off, and in many respects, it is. But when it comes to the work of transforming cities to perform in the face of mounting local and global challenges, the next 30 years will be critical.

Sydney 2050 will outline the need for a green and cool city. We will:

– increase our **overall vegetation cover**, including all trees, shrubs and groundcovers

– increase our **tree canopy cover**

– put **blue and green infrastructure** at the heart of our city-making

– **connect** our green and blue infrastructure into a wider and valuable city-wide network

– live with and adapt to our **changing climate**

– provide greenery at **every doorstep**

– provide greenery in a **fair and equitable** way and prioritise the way we implement and expand our greening to assist those that are most vulnerable.

"I want underground cars and green up top."

Primary school students survey

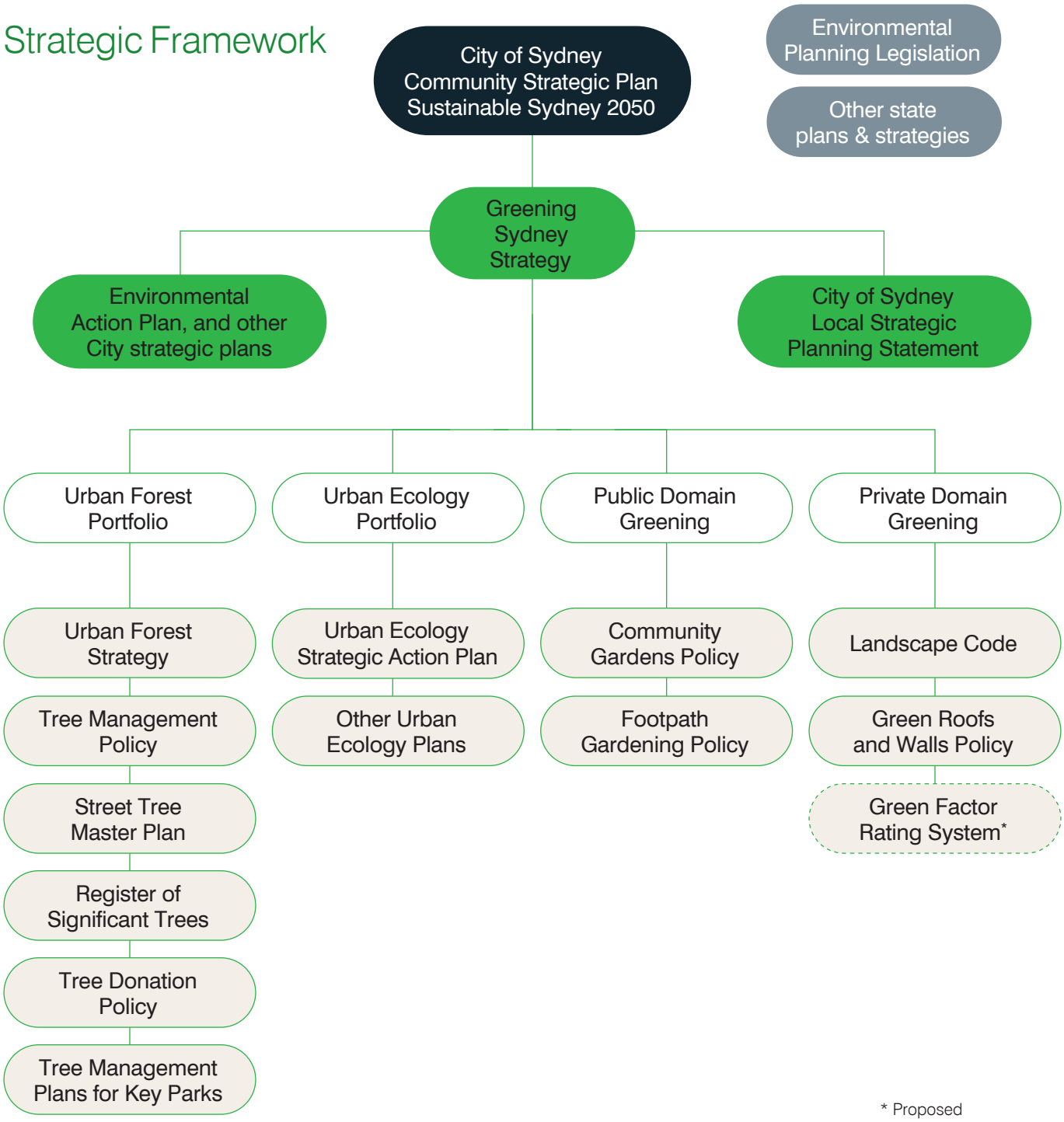
Policy context

We have a comprehensive suite of greening strategies, policies and plans across various portfolios to meet our greening aims and objectives.

This Greening Sydney Strategy will be a key document outlining Sydney's commitment to becoming a green, cool and resilient city by 2050.

The commitment to green living must be implemented at both the city-wide scale and the micro scale of individual businesses and homes. It must involve the public domain, parks, streets and the privately managed domains of buildings, open spaces and gardens.

Strategic Framework



* Proposed

Our green achievements

The City has long valued the important environmental, social and economic benefits that greening and canopy cover provide our community.

We have been actively adapting to climate change. We have ensured our streets, parks and private open spaces have more greening, which is critical as our city's density increases.

In 2012, we developed our first Greening Sydney Plan, and we have many programs and measures to increase canopy cover, biodiversity and nature in our city, and to expand and improve our open spaces and streetscapes. Our key achievements since 2012 are the;

Development and implementation of our:

– urban forest strategy

– urban ecology strategic action plan

– green roof and walls policy

– landscape code

– streetscape gardening policy

Development and support of these programs:

– community gardens – established 20 gardens, two community footpath gardens and one community composting group.

– Sydney City Farm – established in Sydney Park. Volunteer sessions and education programs.

– bushcare groups – established five groups who play a vital role in restoring bushland areas.

– biodiversity engagement programs – participation in numerous programs such as BioBlitz, Birdlife Australia programs, Wildlife Watch etc.

And the following outcomes:

– increased canopy cover across the entire city, from the 2008 baseline of 15.5%, to 18.1% in 2019.

– planted 14,692 new street trees since 2005.

– increased our parks and open space network, with 17 new parks contributing an additional 21.9 hectares.

– upgraded 52 parks.

– increased bush restoration sites by 300% from the baseline of 4.3ha, and planted thousands of native plants and increased habitat across the city.

– installed 78,219 square metres of landscaping throughout the city's streets.

– installed 574,133 new shrubs and grasses installed in City parks and streets.

– continued the popular annual floral displays and hanging baskets in areas with limitations for permanent landscaping.

– installed 249 raingardens.

– facilitated volunteer and educational sessions at the City Farm with seasonal produce harvested donated to local charities.

– installed provision for future collection and distribution of recycled water within the George Street upgrade.

– installed green roof projects at Surry Hills Library, Prince Alfred Park Pool, and Beare Park amenities block. Currently the city has at least 155,319 square metres of green roofs and walls. 2019 saw an additional 4212 square metres provided on eight new properties.

We are one of only a handful of councils across all of Australia that has managed to increase its canopy over recent years. Most have a decline in measured canopy due to increased development pressure and tree removals.

The easiest opportunities for greening and tree planting have now largely been exhausted. To increase greening from now on needs a more focused, multi-disciplinary and entire council approach.

Challenges and opportunities

We must understand and address the key risks, challenges and opportunities to green infrastructure to provide this strategy and make our greening resilient.

The challenges and opportunities for our greening include:

– water and the green-blue connection

– competition with other infrastructure and services and resulting lack of space for greening

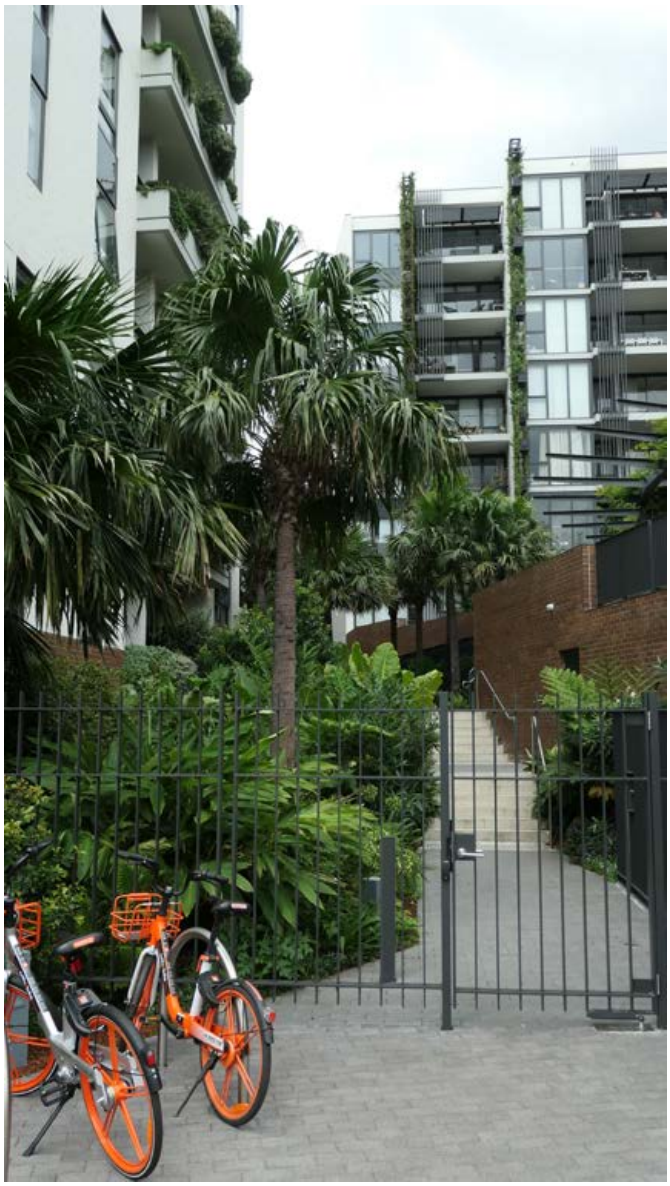
– climate change and its impact on existing and proposed plant species

– pest and diseases

– maintenance and funding

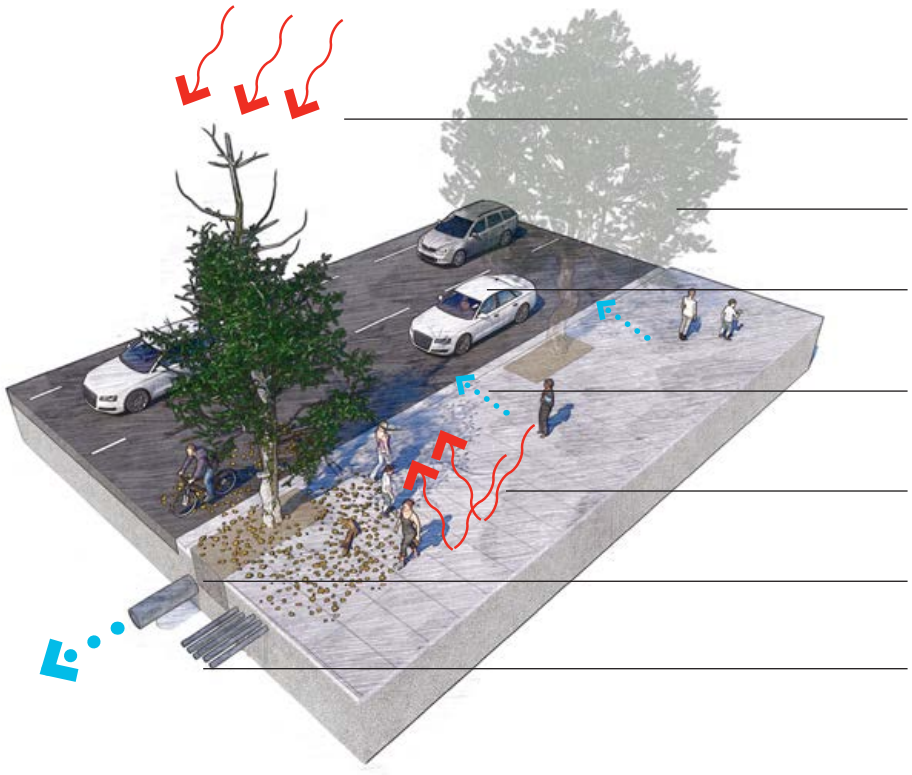
– removing inter-governmental and other authority roadblocks and impediments to greening

Our plan to address these threats, to build a resilient and sustainable city, and meet our targets, is highlighted in the diagrams below.



Greener buildings, Harold Park 2020. Robert Smart.

KEY THREATS TO GREENING OUR CITY



Insufficient resources to maintain and increase urban green

Loss of habitat and connectivity

Impacts from climate change

Trees and vegetation subject to excessive and extreme heat leading to death or poor health

Loss of existing trees and vegetation due to infill and other development

Continued reliance on cars as it is too hot to walk or cycle

Water not collected for the benefit of greening and leading to flooding and erosion and downstream problems

Heat absorbed and radiated from exposed and dark pavements and buildings affecting vegetation and human health

Insufficient space and soil quantity and quality to sustain resilient trees and other vegetation

Competition for space where services, power lines and other elements are given priority over trees and other greening

IMPROVING OUR CITY'S RESILIENCE

Ensure community engagement and education

Undertake continuous monitoring, perform trials and consider new and worthy innovations

Strong habitat protection, with improved connectivity for a diverse range of wildlife

Strong tree management controls and enforcement. Largest trees possible used in all planting situations

Diversity of species, ages and sizes throughout the City with dependable, proven and hardy species capable of dealing with changing climate

More greenery at ground level and reductions in hard paved surfaces

Cool and shaded streets to improve human health and liveability, less reliance on cars

Increased use of light coloured pavement to reduce heat absorption

Greater use of permeable pavements to allow water infiltration

Soil volumes and conditions are well designed to sustain trees and vegetation for the long term

Water is recycled and used well for greening

Water – The blue green connection

Water and plants are natural partners. Many natural systems rely on the connection between plants and water. Plants require water for photosynthesis and growth, and without adequate water plants will die. Plants also contribute to the natural cycle of water through the landscape, as their roots absorb moisture from the soil and transpire it into the atmosphere. In doing so, they effect local humidity and temperature.

Challenges

City landscapes often disrupt the natural connections between water and plants. Conventional roads, roofs and other hard surfaces prevent rainwater soaking into the soil, and typical storm water pipes drain rainwater directly into the harbour before any plants can use it. However, it does not need to be this way. More sustainable designs and approaches are available to mimic and reconnect these natural systems in urban landscapes.

Water is a valuable resource in cities. Changes to our climate are likely to cause increasingly variable and unpredictable supplies of water as we experience droughts and floods. Securing a reliable supply of adequate water for parks and other greening is a challenge we must overcome.

The alignment of both our greening and water strategies and initiatives will be key in addressing this challenge and realising the benefits of a reconnected blue-green urban landscape.

Opportunities

Mutual benefits are gained from a more sustainable and integrated approach to water management. Recent stormwater studies conducted in Melbourne reveal that the integration of trees within rain gardens has the potential to markedly increase the evapotranspiration of water from the rain gardens and therefore further reduce the volume of stormwater runoff (Thom, Jasmine K. 2020).

Potential opportunities to enhance and reconnect our blue and green infrastructure exist at all scales, from large public infrastructure projects to small private developments, and include:

– Diverting storm water from engineered piped solutions to deep soil, landscaped green areas and trees whenever possible;

– The use of permeable pavements and timber decks (where hard surfaces are necessary) to allow water to recharge ground water storage;

– The local collection and storage of storm water for reuse in efficient landscape irrigation;

– The local treatment of waste / grey water and distribution for use in private and public greening;

– Promoting the greening of previously hard surfaces, including available space within roadways and rooftops;

– The selection of plant species that suit the available water whilst maximising the benefits they provide.

– Working with Sydney Water to improve access to climate resilient water supplies, like recycled water, to support greening.

Images from top: Green Square Water Treatment Plant 2018, Sydney Park water reuse wetlands 2015.

Competition for space

A significant impediment to urban greening is the lack of space and the conflict with services.

Cities are congested and contested places. They are always under pressure with competition for space above and below ground and subject to constant change and development.

By 2051, over 2 million people are expected within the city.

This Greening Sydney Strategy considers many competing functions and interests. Our buildings, houses, roads, services and open spaces need to co-exist and function together. We are also a very diverse community with many different views and aspirations as to how green Sydney should be.

Challenges

Our challenge is to give greening the priority it deserves while still accommodating all the other necessary city functions and services.

The key greening challenges are the;

– **Increasing population** placing additional pressure on the provision of transport infrastructure, parks and recreation facilities and providing enough space on our footpaths for a steadily increasing pedestrian load.

– **Reliance on vehicles as the** major means of accessing and servicing the city, dominating street use, and increasing backyards for off street parking. This limits greening and other use options.

– Desire to **maximise private land use** for financial or recreation pursuits, such as extensions, rear studios, off street parking, plunge pools, and 'low maintenance' lifestyles.

– **Overhead and underground services and other infrastructure** continue to affect existing vegetation, and limit options for future greening increases.

– Managing the **increased usage of parks** whilst balancing the wide range of park user needs (from organised sport, passive play and contemplative spaces).

– Ensuring **safety, visibility and accessibility across the city** through sensitive and sympathetic green infrastructure design.

– Increasing **connectivity** is important for a healthy and resilient urban landscape, yet a continuous vegetated corridor requires numerous landowner's commitment and investment.

– Increasing **nature in the city** and protecting wildlife with minimal human impact.

Opportunities

– Increase the priority that we give to our green infrastructure and particularly to tree planting.

– Encourage and demand that development provides appropriate and efficient ways to include greening and water sensitive urban design solutions into all developments while still providing the other functional needs.

– Investigate all available opportunities to achieve multiple and space efficient uses within our streets and other public areas, while facilitating greening through innovative design solutions.

– Consider and promote a future where there may be fewer cars, particularly within the city centre, and thereby accommodate additional spaces for tree planting and lower level greening.

– Integrate green infrastructure into all pedestrian, cycling and public transport solutions.

– Increase our collaboration with service authorities to minimise, relocate or remove impediments to effective and longer term greening.

Changing climate, and pests and disease

As Australia's climate changes over the next 50 to 100 years, the species of trees and plants used in our city today may not be suited to the range of conditions presented by the new climate.

Research has found that Sydney's climate would be more like Grafton by 2050.

Climate shift by 2050

Sydney currently has an average annual temperature of 22.7C, average summer of 26.7C, average winter of 18.1C.

Grafton's average annual temperature of 25.5C, average summer of 29.4C, average winter of 20.9C

Our average number of days above 35C goes from 4.9 currently to 10.9 days.

CSIRO Climate Analogue Explorer. https://www.climatechangeinaustralia.gov.au/en/climate-projections/climate-analogues/analogues-explorer/

Some species are more vulnerable than others. It will also depend greatly on microclimatic influences and the amount of soil and water that is available to the plants.

For example, in Canberra, experts believe that around 27 per cent of tree species are becoming unsuitable for Canberra's new summer normal.

A nationwide study that examined 2.5 million Australian herbaria specimens found that 47 per cent of the country's native vegetation is potentially at risk from rising temperatures by 2070. Gallagher et al. 2019.

As we implement our greening strategies we will continually monitor and update our underlying policies and plans to cater for updated information on different species. When we review our urban forestry policy, street tree master plan and urban ecology strategic action plan we will consider species selections that can survive potential heat waves and prolonged dry spells in the coming decades. Particular relevance will be placed on species with:

– proven heat resilience

– tolerance to droughts and prolonged dry periods

– contribution to urban cooling via its transpiration and shade provision

– tolerance to pollution

– the ability to trap air pollutants and minimised contribution to photochemical smog via its own emissions of volatile organic compounds.

As the species change, so too will the look, and in some cases feel, of our cultural landscapes. We will increase our stakeholder engagement relating to this change, as we transition from the landscapes we know and love, to new landscapes that will grow on us over time.

Which Plant Where

The City will use the latest research when selecting the species that will cope, and thrive, under the emerging conditions.

Which Plant Where is a five-year industry collaborate research project that will provide information on how species respond, adapt and survive heatwaves and drought events. Additionally, the project will provide information in regard to how different cooling benefits provided by the plant species influence insect biodiversity.

Some plants can cope with adverse weather conditions better than others. It is important to understand just how much heat and drought stress each of our existing and proposed species can tolerate.

This will be critical for a sustainable, robust and thriving green Sydney for future generations.

Land tenure and change

We have a wide and varied population of residents - living in apartments, terrace houses, small and large lot suburban housing. Each resident will have a different perspective and interaction with public and private trees and the wider urban forest. The community also includes business owners and employees who may visit and engage with the area and its vegetation every day. As such, our city encompasses many people with an extremely diverse range of interests and attitudes towards trees and vegetation.

2016 Australian Bureau Statistics census data found that 72% of all households within the City of Sydney moved from their previous location to another location within only 5 years (between 2011 and 2016).

Further extrapolating this information, nearly all residents will only occupy their houses for a maximum of 10–15 years before moving on.

In contrast the trees selected for our streets, parks and even private properties may occupy their sites for between 50 to 150 years, or even longer.

This illustrates that our trees must be increasingly viewed as longer term assets that will outlive numerous owners of the same property. We should merely consider ourselves as temporary custodians of the landscapes that we occupy.

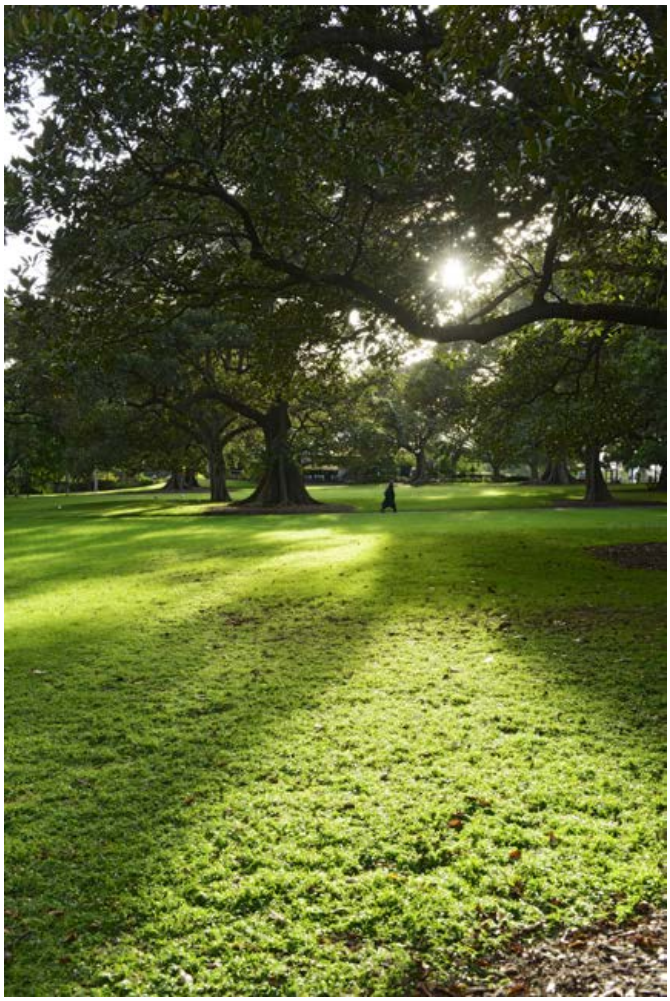
Likewise, landscapes and tree planting are often a product of short term 'fashion' and current societal objectives that can easily change over time. What we do now may not reflect what we did in the past, and likewise in the future we may do things differently.

Consider, for instance, 20 years ago solar panels on private dwellings were a rarity. Today it's common place and even expected that most new houses will include solar panels. Likewise, in another 20–30 years, green roofs and private yards dominated by large trees may be the norm rather than a rarity.

Therefore, if we currently have a large tree, let us consider its overall life span and its contribution to the wider urban forest and community, ahead of shorter term or personal outcomes.

Trees can last for well over 100 years, yet most people occupy their houses for less than 10 years. We must consider ourselves as custodians rather than masters, and nurture and improve our greenery for the benefit of following generations.

We need to consider ourselves merely as custodians of the surroundings under our control. Rather than looking for reasons to remove trees and other nature from within our city, we should instead try to maintain it past our own short tenure and secure a better future for our children and their children beyond them.



The Domain, 2013, Adam Hollingworth

Management and funding

Green infrastructure can provide incredible returns on investment as well as many other far less tangible benefits. We need to commit to the ongoing management and funding of our greening, just as we do with any other asset.

We recognise that there will be different levels of investment required. Numerous small-scale initiatives and simple changes can be just as important as larger capital projects. Greening Sydney needs to be multi-faceted, both micro and macro scales and both public and private.

Challenges

Maintaining and increasing greening requires expenditure by Council and the private sector to provide the greening targets that are both essential for, and desired by, the community.

Perceptions and attitudes may also need adjustment. Greening is an essential service and can no longer be viewed as a 'nice to have' or solely as an amenity product.

The funding and maintenance of greening can be susceptible to various external shocks and crisis. These can be natural factors, such as extreme weather events, or unexpected global incidents resulting in financial market volatility, affecting the efforts to fund greening initiatives.

This Greening Sydney Strategy is an important component of responding to such shocks. A resilient and healthy society is better placed to deal with such stresses. A resilient, green and healthy city is at the core of our greening policies.

Opportunities

The opportunities available include to;

– Strengthen our acknowledgment that greening is an essential asset that supplies numerous public benefits.

– Communicate to stakeholders how they benefit from the City's initiatives and that it is equitable that in some instances they share the costs.

– Where reasonable and effective to do so, partner with and assist property owners where it can have a demonstrated benefit to the City's greening and community outcomes.

– Work proactively with other stakeholders to find opportunities and streamlined ways to provide greening initiatives, and to access funding from other private and public sources to support the City's greening outcomes.

> Investments made in trees has a definite return on investment, with one study finding that every dollar invested in planting, cities can see an average US$2.25 return on that investment each and every year. (Dr David Nowak)

Collaboration with government and other agency stakeholders

There is a ground-swell of support for urban greening and we aim to be at the forefront of this movement. Substantial opportunities now exist with this growing recognition and we must capitalise and act.

Importantly, we cannot green Sydney alone.

There are many stakeholders who benefit from our greening. There are also many stakeholders that have an impact on our current green assets, and our ability to increase greening across the city.

We are actively listening to and engaging with our community and higher level agencies, governments and other key stakeholders such as the NSW Government, Greater Sydney Commission, NSW Government Architect, adjoining local government authorities and Resilient Sydney.

We will work with all stakeholders to ensure they are aware of the greening benefits they receive, and to also ensure they are aware of their impact to greening.

It is vital that every stakeholder understands their impact so that they can make informed decisions and be accountable for their policies and action impact on a greener Sydney.

Our greening strategy

Direction 1
Turn grey to green

Our green targets

To meet all the future challenges we face, we need to set and achieve ambitious greening and canopy cover targets.

The research indicates we ideally need to provide 30–40 percent canopy cover for heat, and 30 per cent canopy cover for community health.

We also need to consider the city's context and capacity to meet these research guides.

To develop our targets, significant detailed analysis was undertaken of the extent of existing greening and the capacity to provide increased greening across the city. This included all of our streets, parks and our largest land use – property.

Our target is to increase our overall green cover to **40 per cent** across the local area, including a minimum of **27 per cent** tree canopy by 2050.

Two targets – green and canopy cover

The two principal and inter-related targets have been developed to ensure that all our greening efforts are measured, valued, protected and enhanced. The first being the overall greening cover and the second being the canopy over. Both are equally important.

Green cover target – based on all trees, plants, ground covers and turf located throughout the local government area.

Canopy cover target – based solely on trees over 3 metres in height. As trees provide exponentially more benefit than other plants, we need to ensure they are prioritised ahead of other greenery.

How we developed the targets

Detailed analysis and careful consideration have been given to the various types of streets, parks and property. The attributes of each area were measured and assessed, using precise data from the City's corporate systems. Attachment 2 has a more detail on the methodology.

We have undertaken extensive analysis and modelling to:

– determine the current extent of greening and canopy across streets, parks and property

– determine the current and future capacity available for further greening and canopy (based on public and private space configurations)

– confirm and commit to our greening targets for 2050.

Action 1 – Achieve the green and canopy cover targets

The green and canopy cover targets recognise the important benefits the physical greenery in our streets, parks and property provides.

As trees provide exponentially more benefits than other types of greening, the City has a specific target for canopy cover.

The community's need for an increase in greening, especially on buildings and as part of development, is measured through this target.

The minimum overall green target for the city is 40 per cent, including an overall canopy target of 27 per cent.

This is based on the provision of greening and canopy cover being shared between all our streets, our parks and all property.

To achieve the target, we will ensure that across their portfolio:

– streets provide 39 per cent green cover with a minimum 34 per cent canopy cover

– parks provide 86 per cent green cover with a minimum of 46 per cent canopy cover

– property areas provide 28 per cent green cover with a minimum of 20 per cent canopy cover.

Importantly, each portfolio needs to provide their share, as there is limited capacity for others to make up any difference. It is vital that all everyone works together to provide the targets.

The City will develop policies, programs and projects to help all parties to achieve the targets in each portfolio, including in;

– **Streets** by increasing the number and type of street gardens and inroad plantings, and planting more street trees, including a comprehensive review to ensure the largest tree species appropriate for the space is planted.

– **Parks** by planting more trees in parks, to meet the individual parks capacity for canopy trees, and through minimising hard surfaces in the parks, where appropriate to do so.

– **Property** through developing planning tools and programs like the green space factor and greening Sydney fund. This will assist the increasing of canopy, greening, trees in deep soil and the number of green roofs, walls and façades, and ensuring every development application provides its minimal greening target.

We will also work with other authorities and agencies, such as Ausgrid and Transport for NSW, to ensure they understand their impact, make informed decisions and are accountable for their actions on greening Sydney.

The City will review the targets as new research becomes available, technology (especially for the aerial canopy / greening measurement) improves and as the city develops and changes over time.

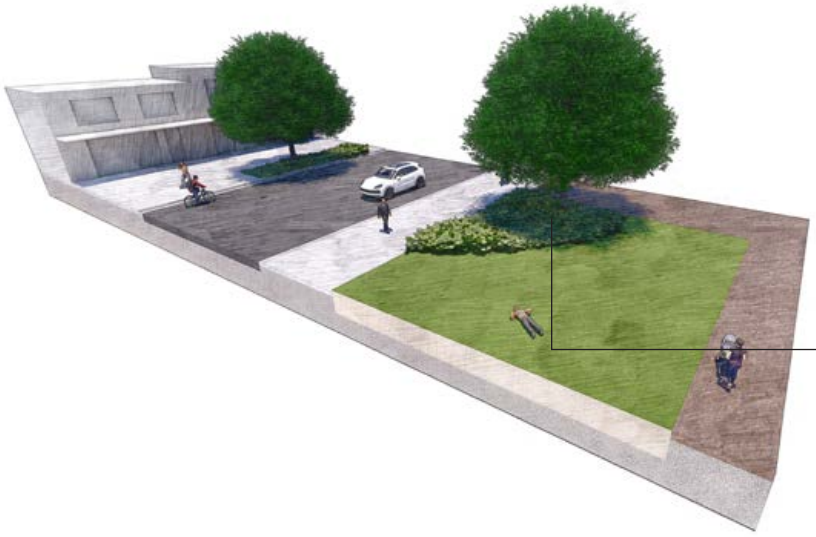
Figure 1: Green cover targets

Property Type	Existing Green Cover 2019	Proposed Green Cover 2050
Streets	33%	39%
Parks	80%	86%
Property	20%	28%
TOTAL	**32%**	**40%**

Figure 2: Canopy cover targets

Property Type	Existing Canopy Cover 2019	Proposed Canopy Cover 2050
Streets	25%	34%
Parks	31%	46%
Property	12%	20%
TOTAL	**18%**	**27%**

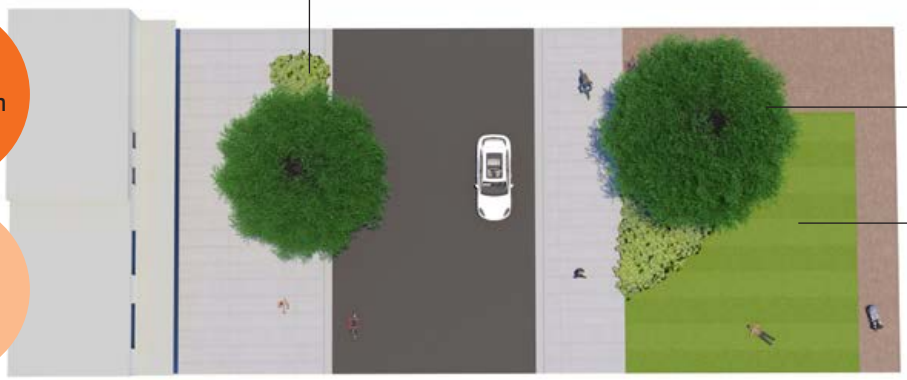
WHERE WE ARE NOW
2020



Greening and canopy is measured by looking down from above. Shrubs and lawns under canopy is not counted only the canopy above is measured.

33% Overall Green Cover

18% Canopy Cover



Shrubs and other low planting counts towards overall greening when not under canopy.

Tree canopy is counted towards overall greening even when over paving and roads.

Grass is counted towards overall greening when not under trees.

40% Overall Green Cover

27% Canopy Cover

New trees will expand our canopy and overall greening cover.

Growth in the canopy of existing trees will help expand our canopy cover.

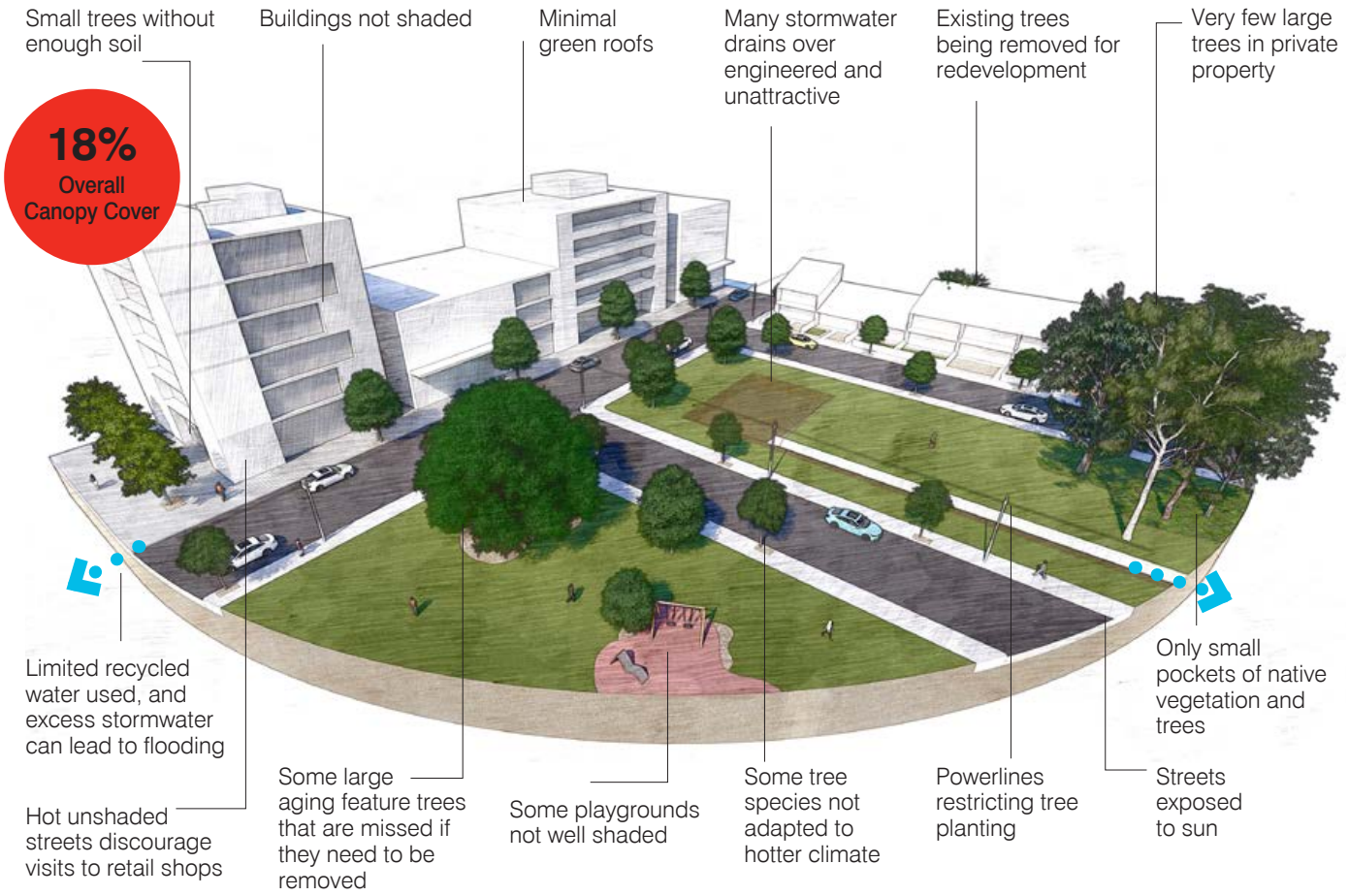
Grass will count towards overall greening when not under trees.

WHERE WE NEED TO BE
2050

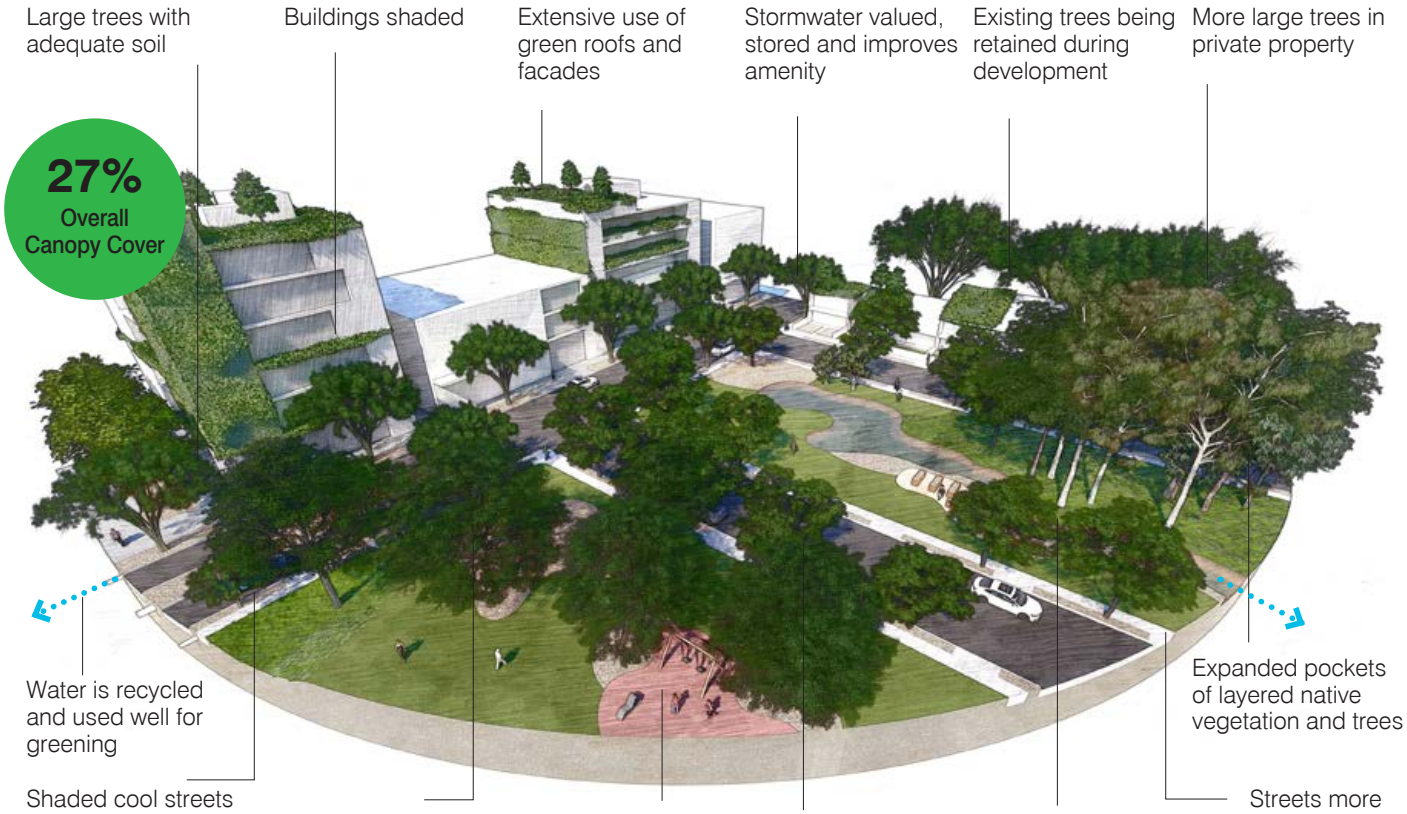
Green roof and additional shrub and ground covers, when not under tree canopy will expand our overall greening.

Greening and canopy is measured by looking down from above. Shrubs and lawns under canopy is not counted only the canopy above is measured.

WHERE ARE WE NOW – 2020

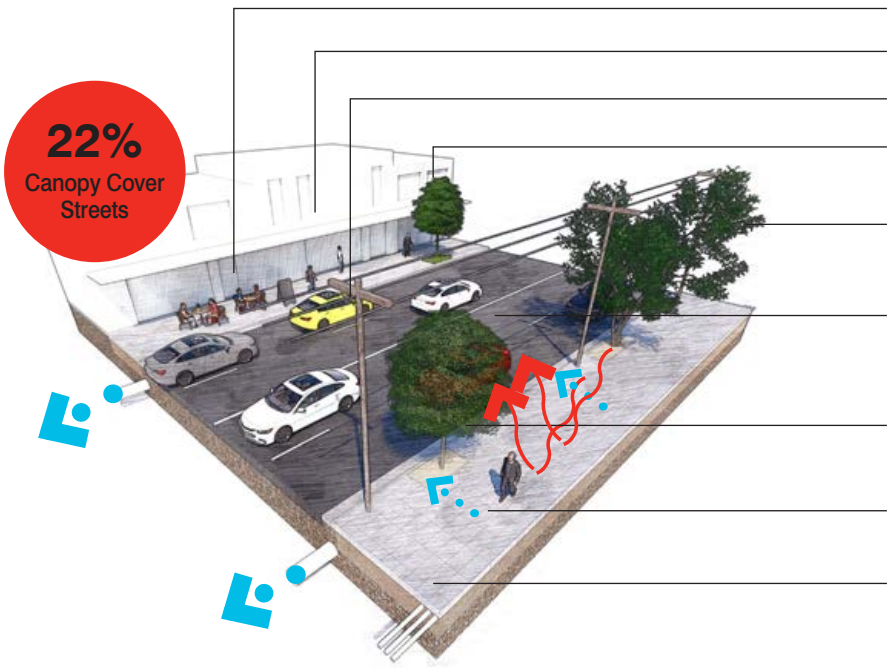


WHERE WE NEED TO BE – 2050



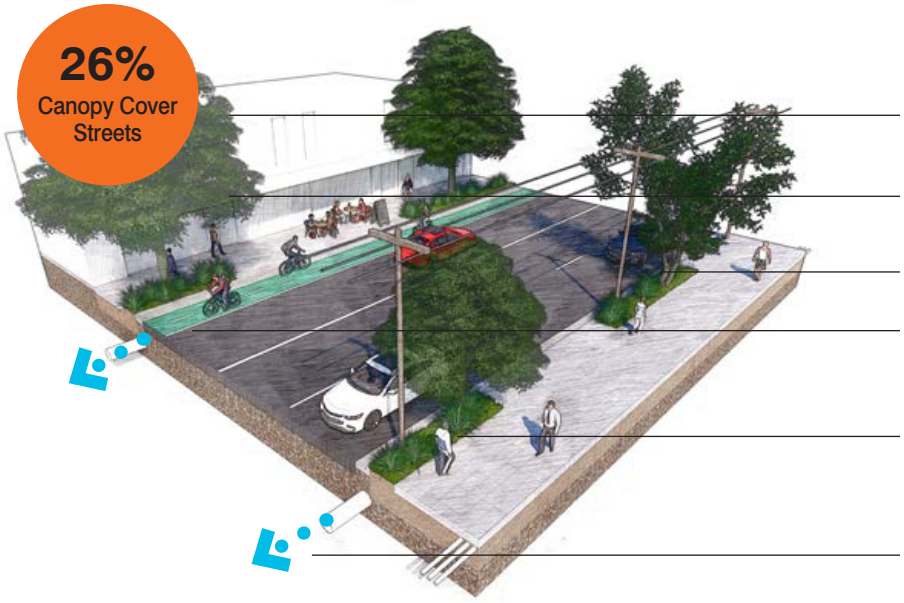
PUBLIC DOMAIN – STREETS

WHERE WE WERE – 2008



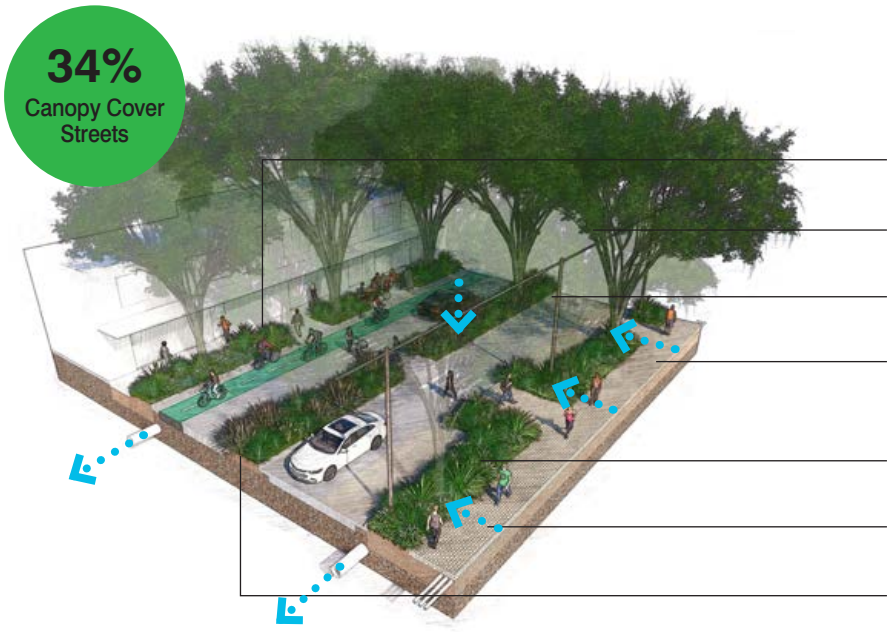
- Outdoor dining uncomfortable
- Building facades exposed to heat and sun
- Parked cars unshaded
- Small trees in small tree pits close to road
- Trees excessively pruned for powerline clearance
- Wide streets not optimised for walking and cycling
- Small and ineffective trees under powerlines
- Water not collected for greening and leading to flooding and downstream problems
- Heat absorbed and radiated from exposed and dark pavements

WHERE WE ARE NOW – 2020



- Some buildings shaded, outdoor dining experience improved in some locations
- Larger and new trees planted with roadside gardens incorporated
- Trees still impacted by power lines
- Dedicated and shaded cycleways rolled out across City
- Small trees still installed under power lines. Slightly expanded tree pits but still close to road
- Improvement in water collected for greening and reduced downstream problems

WHERE WE NEED TO BE – 2050



- More greenery at ground levels and reductions in hard paved surfaces
- Cool and shaded streets to improve human health and liveability, less reliance on cars
- Impacts from utilities minimised
- Greater use of permeable pavements. Increased use of light coloured pavements to reduce heat absorption
- Soil volumes and conditions are well designed to sustain trees and vegetation for the long term
- Water is recycled and used well for greening
- Median tree planting to increase shading of roads

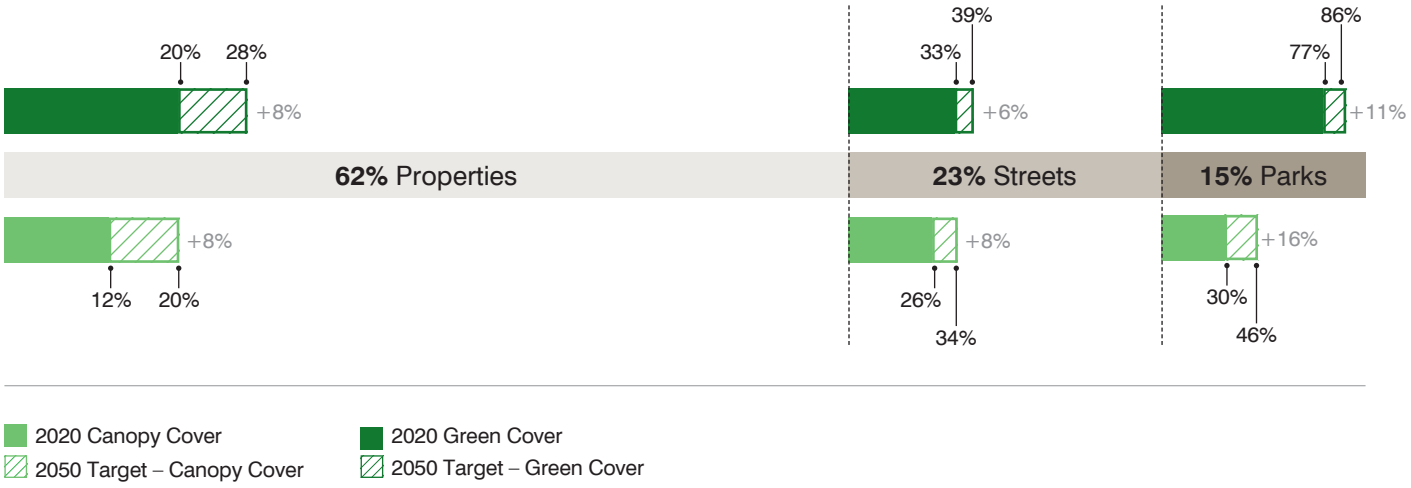


Figure 3 – Land use relative to existing cover and future targets for greening and canopy cover.

Action 2 – Green our laneways

Across the city, there is 383,000m^2 (38.3 hectares) of narrow streets classified as laneways. That is a considerable amount of space, and community owned land, that could be harnessed for greening.

Laneways are often under used and unappreciated. Often they are only infrequently used by very local traffic to access off-street parking, or by waste management teams for waste collection.

Where other space is so contested, it is considered appropriate that these underused spaces are looked at in more detail and better designed to become a valued green network, for the entire community.

Opportunities to increase laneway greening, however, is limited by their size, which is generally only sufficient widths for passenger and service vehicles.

Transforming laneways into greener shared spaces can be achieved as we transition to a more sustainable city, with fewer private cars and more innovative design solutions for other constraints such as waste collection.

To realise this vision, we will:

– review the various design and usage issues to identify laneway greening projects or programs that are most easily provided.

– review the impacts and the need for new development and site usage that requires private vehicle use of laneways.

– collaborate with waste management experts to identify opportunities for innovative waste storage and collection systems, to reduce service vehicle usage of laneways.

Laneways in Green Square and Alexandria, 2020 City of Sydney.

Action 3 – Harness innovation, technology and inspiration

The increasing momentum in the green infrastructure market continues to drive cities to implement green policies, which in turn help stimulate innovation and job growth in the green building sectors.

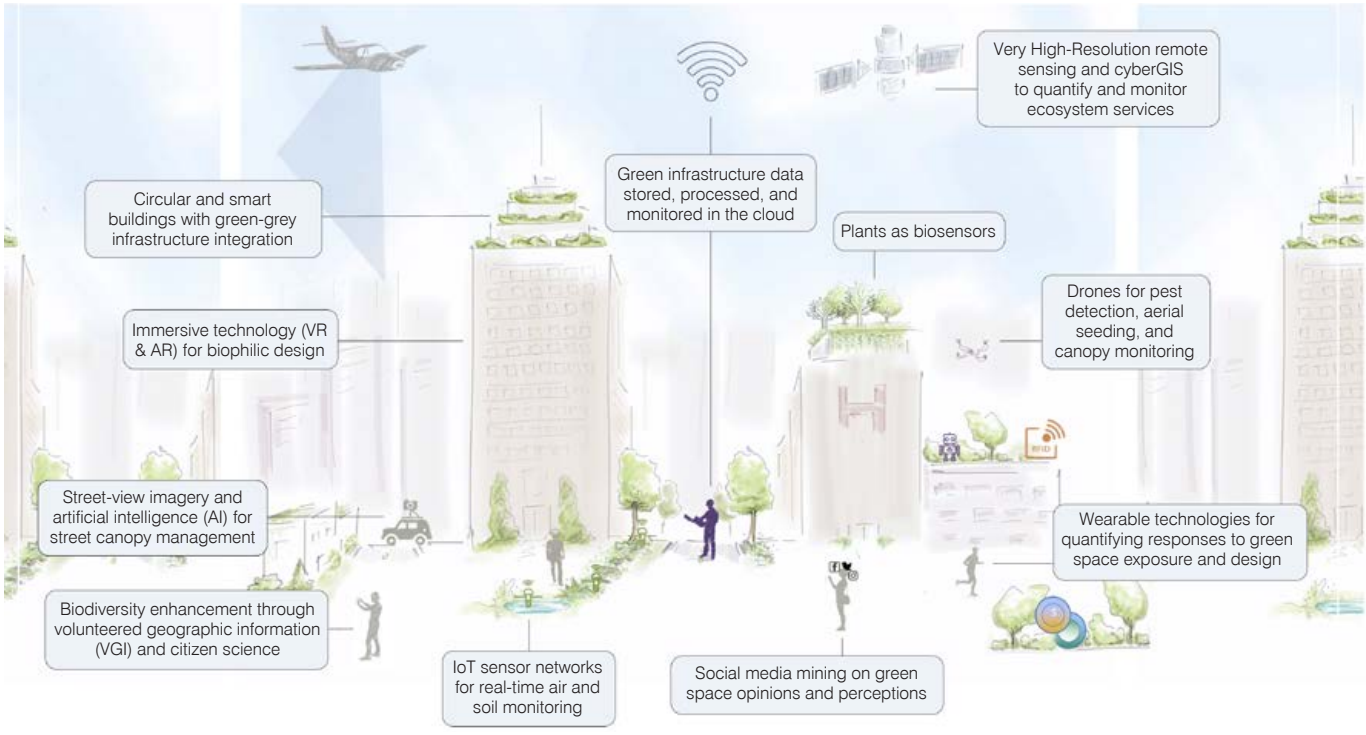
Research on the benefits of greening has exponentially increased. This research guides improved policy development, which helps drive innovation, and innovation can drive economic development and environmental outcomes.

The City understands the various roles it plays within this process. We use the latest research to inform the policy and strategic levers for city governance. Further, we encourage and support continuous improvement and innovation, including through leading by example for our own projects, operations and services.

One of the City's key advantages is our extensive asset and operational data. We are also planning for digital transformation, as 5G and new technology becomes available. This will be a key focus area over the next decade.

To transition our greening, we will

- share insights from our data analysis and visualisations with relevant stakeholders.
- encourage, and where appropriate support, new business models and products that will assist us achieve a greener Sydney.
- investigate innovative solutions for addressing key challenges, such as:
  - Reducing heat through movable planters, misters and vines where canopy trees cannot be installed.
  - Increasing green moments through pop-up parks and green spaces where permanent greening is not achievable.
- continue to review the opportunities for improved management of our green and blue assets through technology improvements.
- work with Sydney Water to improve access to climate resilient water supplies, like recycled water, to support greening.



The Internet of Nature: Examples and applications for urban forestry and green infrastructure management. From The Internet of Nature.

Jubilee Park foreshore, Glebe 2014. Adam Hollingworth

Direction 2
Greening for all

A just and fair city

The City needs to provide sufficient and quality greening across our streets, park and other council land under our control.

It is also imperative that the community has equitable access to the greening benefits.

Trees and plants help cool the city, create more liveable places, support our well-being and support urban biodiversity. Improved mechanisms to equitably green the city will be needed.

In a just and fair city, we need to ensure:

– All of the community contributes and has access to the benefits of trees, canopy cover, greenery and open spaces.

– All land use types (streets, parks and properties) to contribute to achieve the precinct and city wide cover.

Greening must not be concentrated in specific areas. We must remember that residents in Rosebery will require as much canopy cover as residents in Potts Point.

With the expected increase in the number of hot days, one group of residents should not experience temperatures 10°C hotter than other groups due to tree and green cover not being prioritised for our most vulnerable and impacted areas.

It is not all just about quantity of greening. Access to quality green space is also important. Well designed and maintained green spaces and assets provide our community a tool for maintaining their health and wellbeing. Quality green spaces enhance our sense of place and belonging, and demonstrates our recognition and care for the natural world.

Action 4 – Distribute greening equitably

It is vital that we distribute greening fairly across the local government area so that everyone shares the benefits provided by greening.

Research outlines 30 per cent canopy cover, within an area of around 1.6 kilometres, provides key heat and health benefits.

Analysis of each individual site (street, park and property) has been undertaken to confirm the extent of greening and canopy cover distribution across the city.

As shown on both images below, an increase is required across most of the city, especially in the southern suburbs of Alexandria, St Peters, and Rosebery, and the northern suburb of Pyrmont.

To ensure greening is shared and each community member has access, we will;

– Make informed and data driven decisions regarding greening in our future projects and developments, including through the comparison of the individual site extent of greening provided against its greening / canopy cover capacity.

– Regularly review and update the data to ensure we respond to the latest site conditions or research available.

– Make the information accessible, where appropriate, to assist stakeholders to engage and provide equitable greening.

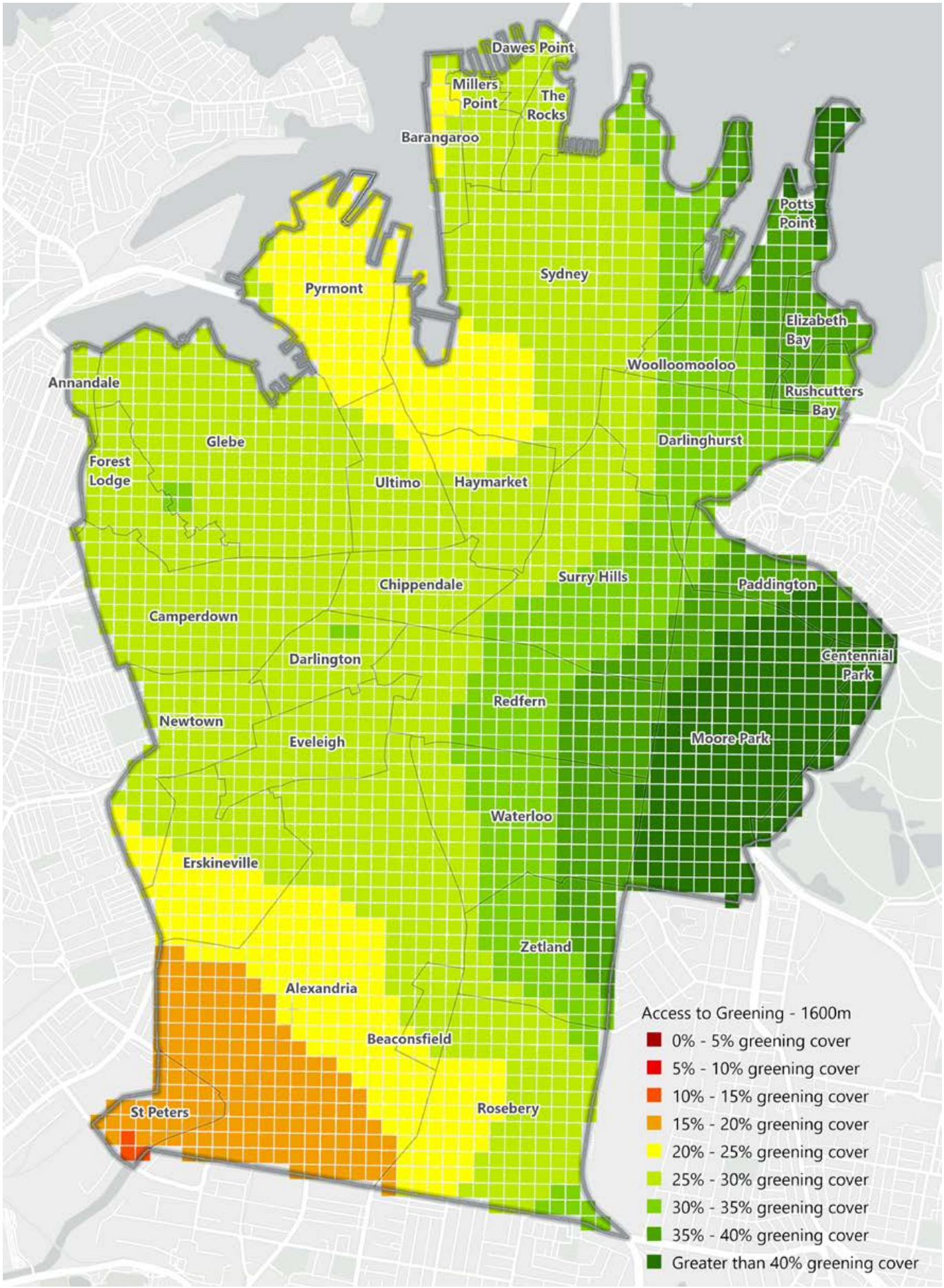


Figure 4 – The community's current access to **greening** across the local government area. Each coloured point measures the amount of greening, in streets, parks and private land, within a 1.6 kilometre radius of that point (including surrounding council areas).

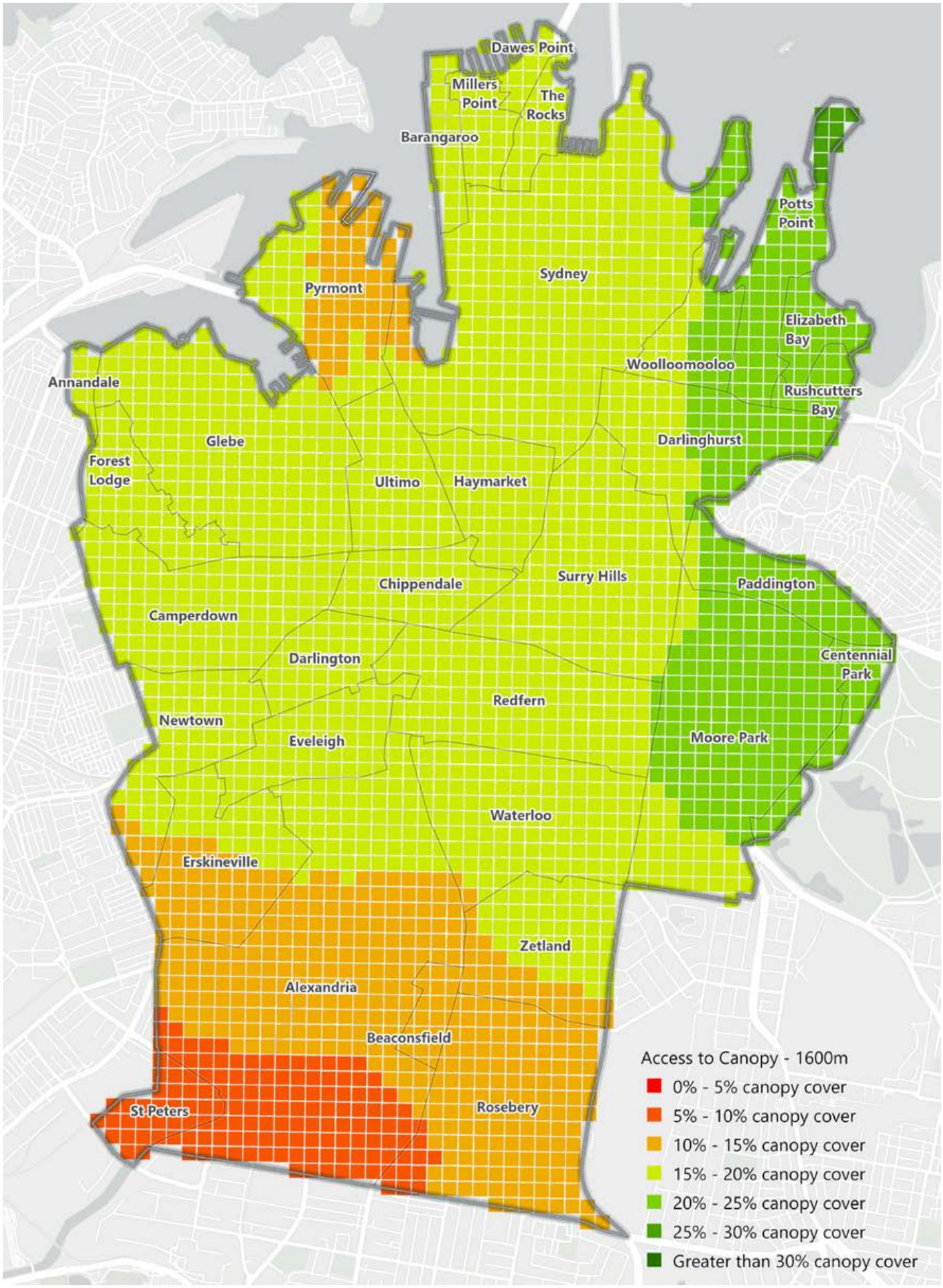


Figure 5 – The community's current access to **canopy cover** across the local government area. Each coloured point measures the amount of canopy, in streets, parks and private land, within a 1.6 kilometre radius of that point (including surrounding council areas).

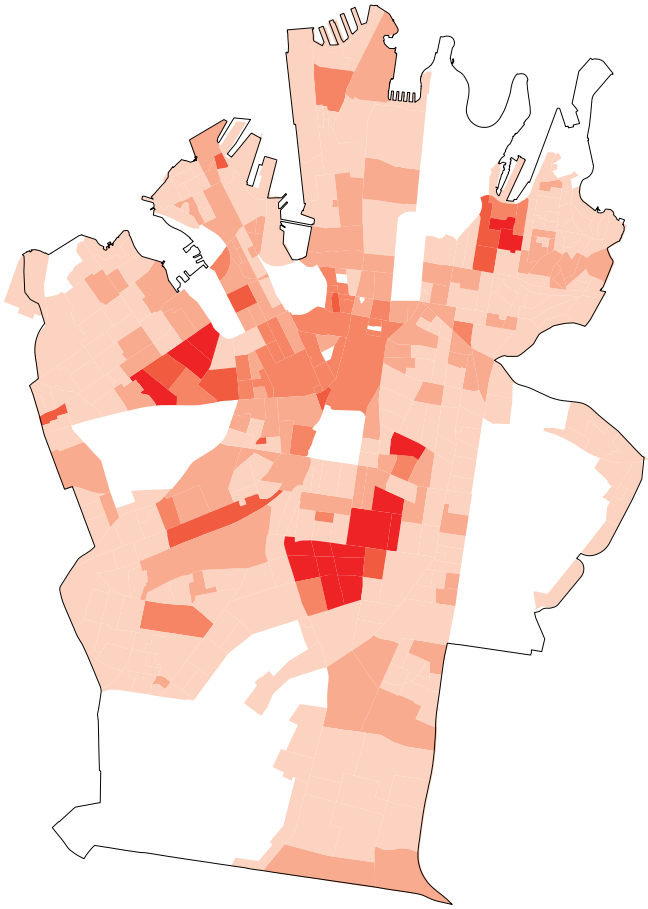


Figure 6 – The community's vulnerability to heatwaves.
Source: Australian Bureau of Statistics (ABS)

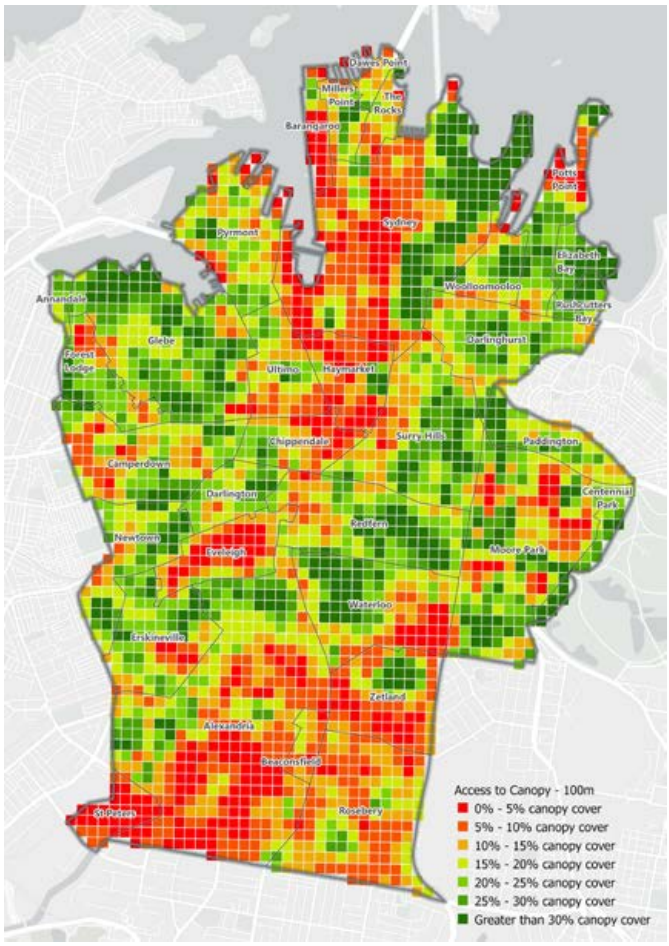


Figure 7 – the community's current access to **canopy cover** across the local government area. Each coloured point measures the amount of canopy, in streets, parks and private land, within 100 metre radius of that point (including surrounding council areas).

Action 5 – Provide fair access to quality green spaces

The City's green spaces need to accommodate a wide range of uses to meet our diverse community's needs.

Our green space network, consisting of over 420 parks, caters for active sports, passive play and contemplative places, for people and their companion animals, and for wildlife.

With competition for space so high, and our population increasing, the City needs to balance the competing uses and desires.

In some instances, this will require a considerable change in materials. For example, to meet the demand for sport fields, synthetic sportsfield will be used in some parks to provide equitable access for the number of people, the various sporting groups, and the different sport types (e.g. AFL, Hockey, soccer etc.).

To achieve equitable access to greening, we will;

– Develop a Parks Design Code to ensure consistent robust designs and application of materials are used across the parks network.
– Continue to look for opportunities to adapt the green space network, where appropriate, to cater for community needs.
– Continue to implement the standardised maintenance service levels throughout the city – to ensure park types are maintained to the same levels across the entire local government area.
– Make informed and data driven decisions regarding our parks and open spaces, and make the information accessible, where appropriate, to communicate issues to stakeholders.

Action 6 – Adapt for climate

Greening for all includes providing for future generations. We have been fortunate. We inherited many beautifully established parks, with significant trees that are more than a hundred and fifty years old.

It is important that we provide such mature, thriving and healthy landscapes to future generations.

To do so requires us to understand the impacts of climate change on our existing plant species and green spaces. We now have to design green spaces and plant new species that will thrive under the changed climate conditions.

Importantly, we will need to communicate these changes well, as we prepare for our much loved landscapes to change overtime.

To provide greening for future generations and climate adaptation, we will:

– Review the existing tree and plant species used across our public spaces, and plant appropriate species to suit changing environmental conditions.
– Keep up to date with the latest climate science, and available research on species adaptability / tolerance for Sydney's future climate conditions.
– Continually monitor and update our underlying policies and plans to cater for updated information on different species.
– Ensure new landscapes are designed to be adaptable, resilient spaces that accommodate people and environmental requirements.
– Manage the change in our cultural landscapes over time, with comprehensive community engagement, ensuring future generations inherit healthy, mature parks and trees.

Action 7 – Grow food locally

Access to fruit and vegetables is a critical ingredient for our mental and physical health. Food insecurity is also increasing. There are many reasons to increase the food we grow locally.

For many people, growing food restores a connection to nature, and the ability to nurture themselves, their friends and family through food. There is much joy in watching fruit and vegetables grow, the anticipation and patience waiting for the right time to harvest a crop, and then sharing recipes and produce with friends, family and even the wider community.

Unfortunately, an increasing number of people struggle to afford fresh food. Access to locally grown food from friends, neighbours or through community gardens, increases the opportunities for those who need it most.

We will continue to support the community to grow more food locally through;

– Our Sydney City Farm programs and community garden network.

– Encouraging proposals that support increased food production on private land. This includes the potential for dedicated large green roofs for food production.

– Encouraging innovative solutions for urban food production, including integrated community, food and gardening spaces.

Images above: Yerrabingin Rooftop Farm, A world-first Indigenous rooftop farm in the heart of Sydney. The farm grows over 2,000 edible, medicinal or cultural plants, using the principles of Indigenous knowledge and permaculture. Credit Destination NSW and Mirvac

Direction 3
Cool and calm spaces

Two key issues facing most of the city's residents relate to high urban heat and impacts on physical and mental health.

Heatwaves are Australia's deadliest natural hazard. They now arrive earlier, are hotter, and last longer.

As outlined earlier, research indicates that we ideally need a minimum of 30 per cent canopy cover. This canopy cover can reduce temperatures at ground level by more than 10°C.

During the COVID 19 pandemic, people flocked to nature to help them stay strong – physically and mentally. Access to quality green space is vital, and not just in times of emergencies. We all need to make sure green space is not taken for granted.

"In times of crisis, the natural world is a source of both joy and solace. The natural world produces comfort that can come from nothing else".

David Attenborough

Trees and plants are nature's air conditioners

The natural process of photosynthesis requires that trees and plants use energy and transpire. This transpiration is what cools the air around the green spaces and reduces ambient temperatures.

Greening also facilitates the cooling of our homes, streets and parklands by shading and providing cooler surfaces to reduce mean radiant temperature.

Trees improve our health

Professor Astell-Burt and Professor Feng found that the residents of neighbourhoods with a higher amount of tree canopy had better mental and general health, but didn't find the same correlation when the type of green space was open, grassed areas.

They advise the shapes, colours, smells and sounds of rustling leaves also provide a natural distraction from our thoughts (particularly stressful ones) and attractive spaces for social and physical recreation.[1] [2]

Does sleep grow on trees?

Professor Astell-Burt and Professor Feng also investigated whether people with more green space had lower odds of developing insufficient sleep over about six years.

They found 13% lower odds of developing insufficient sleep among people in areas where 30% or more of land cover within 1.6km had tree canopy, compared to people in areas with less than 10%. These results were consistent after taking into account factors that can influence both our sleep and access to neighbourhoods with more tree cover. These factors included age, sex, education, work status, marital status and household income.[3]

1 Astell-Burt, T. and Feng, X., 2019 Association of urban green space with mental health and general health among adults in Australia
2 Astell-Burt, T. and Feng, X., 2020. Urban green space, tree canopy and prevention of cardiometabolic diseases: a multilevel longitudinal study of 46 786 Australians. International journal of epidemiology, 49(3), pp.926-933.
3 Astell-Burt, T. and Feng, X., 2020. Does sleep grow on trees?

Action 8 – Cool the hot spots

Cool streets improve the walkability and liveability of our city. To cool Sydney through greening we will:

– Increase the shade provided by trees, and select species to help channel cooling breezes to where they are most needed.

– Reduce absorbed and radiated heat from buildings, roads and paving, including reducing the amount of paving.

– Celebrate water in our landscape, by providing a range of opportunities for people and our vegetation to access water. This includes increasing passive irrigation, the storage and re-use of water to support vegetation and facilitate the cooling effects of evapotranspiration.

– Increase the provision of shaded and appropriately spaced seating and rest stops

– Include other suitable vine covered or artificial shade structures and misters where trees are not possible.

The City's priorities will be based on vulnerability analysis. We will analyse and map socio economic indicators to identify vulnerable groups, and combine that with our greening data to establish areas that are particularly exposed to urban heat and other health related issues. These areas will benefit most from our greening efforts.

What is a cool street or park?

Cool streets and parks have these elements in common:

– Greater than 30 per cent canopy cover

– Provides sun protection

– Contain the largest trees possible (ideally large to medium trees)

– Reduced amounts of paving, particularly dark paving

– Provide comfortable, shady and safe rest stops

– Lower level greening is combined with trees

– Good access to water and passive irrigation to support vegetation health and growth

Action 9 – Calm green spaces

Provision of substantial and meaningful greening can provide refuge from a busy city, creating calm and healthy spaces that improve our mental health and wellbeing. To calm Sydney through greening we will:

– Identify the calm spaces located throughout the city.

– Map these spaces and identify any areas that require intervention to provide a calm space network. Further, we will share this mapping with the community to assist in calm space usage and wayfinding.

– Identify the community most in need of greening, and prioritise our programs to provide the greening health benefits.

– Consider how future green space design can further accommodate calm spaces, whilst managing the range of other open space use requirements.

– Investigate opportunities to use temporary and 'pop-up' parks and green spaces that provide new calming or respite in areas where permanent greening is not available.

What is a calm space?

Calm spaces have these elements;

– Well maintained and balanced mix of tree canopy, biodiverse gardens and open turf areas.

– Access to water bodies, including the harbour, lakes or water features.

– Low traffic noise and visual screening from busy streets.

– Seating and rest stops as opportunities for tranquil 'time-outs'.

Action 10 – Celebrate water

The City is fortunate that our northern boundary adjoins Sydney harbour. The harbour has shaped Sydney and its people for many thousands of years, from the First Nations through to new immigrants today. It's is a place that helps to restore and invigorate us in equal measure. Importantly, it is also precious habitat for wildlife.

There are also many natural and created wetlands, lakes, canals and other water features across the city that provide us with the opportunity to enjoy and connect with water.

We understand that water has particular importance for our Indigenous community. The depth and strength of this connection is vast, and vital.

We also acknowledge that water plays both special and everyday parts in all of our lives.

Water sustains life and all living things depend on it. Therefore, we must care for and celebrate water.

To do this, we will;

– Identify opportunities to celebrate water in our landscapes.

– Recognise and communicate the importance of water in our lives, particularly for keeping us cool.

– Ensure the efficient and effective use of water as a natural resource.

– Ensure that water as a habitat for wildlife is understood and protected.

– Look for alternative water sources to assist us to adapt to changing climate and sustainably keep our green spaces green.

Images from top: Archibald Fountain Hyde Park, Sydney Park wetlands, Pirrama Park, Pyrmont

Direction 4
Greener buildings

Greener buildings are designed to promote, encourage and foster significant greening as part of all new developments.

Our appreciation of having access to and outlook or views to greening has recently been heightened as the community stayed at home and spatially isolated during the COVID19 pandemic response. We recognised during that time that the research was right, people need greening for physical and mental health and wellbeing. Further, we need to plan that everyone can see and have access to greenery from their property.

Property represents the largest proportion of land use at 61 per cent of the local government area.

To achieve the 40 per cent green cover target, including the 27 per cent canopy cover target, property has to provide at least 28 per cent greening, including at least 20 per cent of that as tree canopy cover.

To meet these targets, in addition to trees, other forms of greening is going to be an important and integral design consideration for all new buildings. As will considering ways to enable nature to be integrated into the design. Most of these new buildings will occur on property.

Policy changes will be required, and these policies will build on the earlier Directions, by providing quality greening equitably across the city.

85 per cent
of respondents want buildings covered with plants and that incorporate nature into their design.

Sustainable Sydney 2050 community survey.

Action 11 – Develop a green factor score

A Green Factor Score is a planning tool that evaluates and quantifies the **amount** and **quality** of **urban greening** a project provides.

It is designed to promote, encourage and foster significant greening as part of all new developments. Its focus is to assist all parties to green property and achieve wider community outcomes.

A Green Factor Score is embedded into the relevant planning controls to help designers, developers and homeowners to informed decisions about good design to achieve appropriate levels of greening in any new development.

Most importantly, a green factor score takes into account that not all greening is equal.

Medium to large canopy trees provide the largest benefit to the city and lawn grass providing the least. For example, a green factor tool applied in Seattle equates one large tree to 39 shrubs, or 6 smaller trees, or 3 medium trees or a roof top garden 33 square metres in size.

The tool therefore allows architects, planners and other experts to determine how they plan to green their property and meet the City's requirements and planning controls.

Equivalent green factor tools have been in place in many international cities for years, including Berlin, London, Seattle and Helsinki. There is also Columbia's 'Flexible Green Area Ratio Policy', 'Portland Eco-roof Requirement' and the 'Denver's Green Roof Initiative'. The City of Melbourne is also developing a web-based tool.

To develop a new green tool, City will;

– Review the various green factor scores currently being implemented.

– Develop an appropriate Green Factor Score, or equivalent planning controls that facilitates the assessment of greening features (quantity and quality), for the City that will assist us to meet the green and canopy cover targets.

– Embed the Green Factor Score into updated planning controls, including the Development Control Plan to ensure greening is planned for and provided on private land.

How does it work?

The Green Factor Score assigns an overall greening score, based on the extent of greening on the site, compared to the overall property area.

The required score can be based on the development type (e.g. commercial or residential), its geographic location (e.g. CBD, suburban) or other site considerations (e.g. heritage, storm water management).

A bias has been placed on the ability to retain and protect existing trees on private land in deep soil. The score favours the re-establishment of medium and larger trees. Where retention and tree planting cannot be achieved, only then are other greening options considered in the scoring. As a guide to designers, hierarchy of greening alternatives and benefits is provided on a sliding scale. These include installing green roofs, walls and permeable pavements amongst many other types of greening. The ranking is commensurate with the greening benefits provide, and the relative ongoing maintenance costs, together with its effective lifespan.

For example, trees in natural ground have significantly greater benefits than shrubs. Shrubs have greater greening and habitat benefits over turf and grasses. Green roofs are also valuable, but due to their shorter lifespans and higher maintenance costs they score less than trees. Typically, green walls or facades have far fewer benefits than these other forms of greening and are ranked accordingly.

Like the BASIX tool, the Green Factor Score is a minimum score-based system to assist developers and Council to determine the appropriate type of greening (trees, ground covers, turf etc.) and the required quantity to ensure green infrastructure benefits are provided.

Action 12 – Increase green roofs and walls

Imagine a building designed and constructed to function elegantly and efficiently. Imagine a building that responds to the climatic region and native plants in which it belongs. Imagine a building that generates its own renewable energy, captures and treats its own water and the building is beautiful. All of this is possible now, and green roofs, green walls and green facades are an essential part of that puzzle.

Green roofs and walls are becoming increasingly common in new developments, as developers seek to make the most of rooftop spaces and provide attractive offerings for residents and workers.

Rooftop, communal open spaces and podium gardens have great potential to improve our urban environments and can be incorporated into higher density residential, mixed use and commercial buildings. They can be retrofitted to some existing buildings. They can also be achieved without taking up additional space because they are part of the building footprint.

We understand that not all our buildings can incorporate green roofs or walls. However, we increasingly expect, and in time will insist, that all new buildings contribute to urban greening and biodiversity. Further, we will look for opportunities and innovations for retrofitting urban greening on existing buildings.

To increase the quantity and quality of green roofs and walls, we will;

- **Review and update our Green Roofs and Walls Policy**, **Sydney Landscape Code** and technical details to demonstrate how such greening can be done in a sustainable way with suitable consideration to energy, maintenance inputs, water use and life span.
- Gradually amend the City's planning controls to increase the adoption and use of green roofs **in new developments**, particularly where green cover is currently limited, such as in the CBD, commercial and industrial areas.
- Gradually amend the planning controls for the **retrofitting of existing buildings**, where possible and appropriate, with suitable low-weight extensive green roofs when applications for alterations or additions are received.
- Assess any **potential or perceived barriers** for installation or ongoing maintenance. Adapt our policy, controls and conditions to address such issues, in an effort to ensure the benefits of green roofs are realised and their longevity ensured.
- Continue to **provide knowledge and skills** to the community about creating domestic scale green walls and roofs through Sydney City Farm education programs.

Benefits of green roofs

Green roofs can:

- Store and treat rainwater, slow water discharge and use captured stormwater for irrigated reuse. In similar cities, green roofs can retain between 86–92% of annual stormwater runoff, depending on rainfall patterns and intensity. Rainfall retention is enhanced by deeper substrates with greater water-holding capacity.
- Use captured and stored greywater from the building for irrigation.
- Provide cooling and improved insulation to reduce energy costs.
- Greatly reduce urban heat island effects by removing surfaces that absorb and then radiate heat at night.
- Improve efficiency of solar panels by reducing the ambient temperatures around the panels when they are installed with surrounding greenery.
- Provide significant gains in aesthetics and recreation, even if only for the neighbours who overlook them.
- Provide valuable locations for social and business activities.
- Facilitate installation of community gardens, orchards, bee hives and urban food production.
- Improve biodiversity and habitat for wildlife, and contribute to connectivity across the urban landscape.
- Improve financial returns and increases in property values.

Action 13 – Planning ahead

Sydney is always changing. We must look forward to determine and actively plan the type of city we need.

With greening recognised as essential infrastructure for addressing urban heat and improving our health and wellbeing, we need to ensure we give greening sufficient space to grow and thrive.

Space is contested. Every square metre above and below ground is valuable. In developing our plans for the future, we need to make informed decisions about how every square metre should be used. Understanding that, we can't have it all, there will be trade-offs.

For example, if we prioritise standalone studios over backyards, we may increase small housing and short term visitor accommodation, but our suburbs will be hotter and our health and wellbeing will diminish.

For off-street above ground parking, do we start planning now for the expected extensive reduction in car ownership, so that we maintain that space for greening?

How do we increase our population and density, whilst maintaining the greening and overall character of the area?

The City has an important role to play, through our planning controls and processes, in ensuring we make these informed decisions, and ensure the community contributes to the greening on their land.

To plan for a greener future, we will:

– Amend the planning controls to include the key initiatives developed from this Strategy.

– Develop minimum requirements within the planning controls to achieve the new greening and canopy cover targets on property.

– Consider future land use and trends, such as building studios, basements and car ownership, that impact on the retention or ability to increase greening. Adopt a position that ensures greening and the environment is a key priority through the informed decision making.

– Consider the use of incentives, where appropriate, to provide sustainable greening outcomes where they would otherwise be considered unachievable.

– Ensure compliance of greening outcomes is achieved, including the retention and protection of greening throughout the development process and long term greening maintenance outcomes.

Central Park, R. Smart 2020 and Bosco Verticale, Italy https://commons.wikimedia.org/wiki/File:Bosco_verticale.jpg

Direction 5
Nature in the city

Urban ecology has a wide scope of applications from the building scale to the whole city including streetscapes, private space and public open space.

When designing and implementing our greening strategies we will be looking for ways to maximise habitat potential and nature in the city. The key elements that we will focus on include:

– providing a wide diversity of plants, with preference for species, particularly locally native where appropriate, that will contribute to habitat and food sources for native wildlife

– considering all sizes and types of native wildlife, small mammals, bats, reptiles and even insects. Ecosystems require a complex 'food web' and without smaller animals such as insects, other animals can't survive and prosper either

– continuing the restoration of urban bushland and seek opportunities to rewild where nature and ecosystems have the opportunity to recover from degradation

– strengthen biodiversity corridors to facilitate the safe movement of species between places of refuge and food sources

– support healthy natural aquatic systems such as creeks and wetlands

– seeking opportunities to translate research into relevant on ground actions to improve how we manage and restore urban nature and healthy ecosystems

– developing opportunities for the community to reconnect with nature and seek to enhance the natural values of the city

– continuing to improve knowledge, skills and resources to enhance urban nature in the city.

The City of Sydney expresses deep respect for the traditional custodians and seeks to draw on the sophisticated, resilient and continuous culture of this place. The City acknowledges we all stand on sacred land.

City of Sydney Reconciliation Action Plan 2015

Action 14 – Recognise and support Aboriginal ecological knowledge

The Gadigal of the Eora Nation managed their land resiliently for thousands of years. Aboriginal people know that if we care for Country, it will care for us. There is much we can learn to better care for this Country.

To achieve this, we wish to work with the local Aboriginal community to explore and identify opportunities to celebrate, promote and educate about Aboriginal ecological knowledge and principles.

The City will engage with the local Aboriginal community to identify the cultural and practical principles that should be considered when designing new spaces or that may contribute to help integrate people with nature.

Working together, we will listen first and explore opportunities to expand greening within the Eora Journey, and emerging approaches such as the Government Architect of NSW 'Designing with Country'.

Images from top: Bio Blitz 2018, Moorhen in Sydney Park wetlands, Seawall pots installation 2016.

Action 15 – Strengthen urban nature protection measures

As Sydney continues to grow, it is essential we have the necessary mechanisms in place to protect, and increase, nature in the city. To achieve this, we will;

– Identify and implement strong urban nature protection measures.

– Develop stronger biodiversity planning controls and assessment checklists for planners and proponents.

– Set targets by 2023 to provide net increase in biodiversity, habitats, and ecosystem health and provide by 2033.

– Strengthen urban nature protection through the inclusion of urban habitat targets in the City's planning controls.

– Identify and refine the biodiversity corridors and embed in planning controls.

– Identify and implement best practice ecological connectivity approaches to enhance biodiversity and allow for the safe movement of priority native fauna.

– Increase the contribution of the private realm in supporting biodiversity conservation and ecosystem health.

Glebe bush care group in Forest Lodge, 2018.

Action 16 – Perform an urban ecology health check

Works will be undertaken to collect information about our existing urban biodiversity status to determine the progress the City has made since the baseline data was collected. This will be combined with other data sources to not only contribute to the surveys but also to consolidate existing data to determine potential habitat measures, reassess priority works and to define performance targets.

Action 17 – Reconnect with nature

It is important for the community to reconnect with nature and seek to enhance the urban natural values of the city. To achieve this, we will;

– Support more citizen science programs and participatory events. These events play a major role for the success of urban nature focused programs

– Increase community engagement through urban nature volunteering and grant opportunities.

– Develop a coordinated communication program on urban nature focused programs and achievements.

Direction 6
Greening together

The community is one of the greatest resources for greening Sydney. Our community continue to show a strong interest and are passionate to participate in greening the urban landscape.

One of the most important things the community can do is to green their own property.

They can also assist greening efforts on City land, and ideally assist others in the community with gardening on their property.

There are social capital benefits to this work. For example, the Sydney City Farm involves the community in meaningful volunteer opportunities while learning about urban agriculture and sustainable food production.

The ongoing participation in nature focused programs, such as National Tree Day, show community desire to not only green the city but to work together to achieve this goal.

Communications that raise awareness about the importance of greening and nature is essential in developing a cue to care.

Further, communication and support with volunteer groups, which work independently from the City, are important to nurture to provide community empowerment. They provide people with the responsibility and autonomy to undertake greening projects in partnership with the City without directing resources away from the core City business.

The City will also look at opportunities to assist the community to green their property. The establishment of a fund and grants program is being considered to assist the community to provide resilient greening initiatives on property.

National Tree Day 2014, Sydney Park

Action 18 – Support community participation

We encourage the community to have a sense of ownership and acceptance of the community greening initiatives.

Further, we understand it is crucial to provide opportunities for active participation in greening activities throughout the city, including ongoing education and awareness of the importance of greening the urban environment, citizen science programs and participatory events, and hands-on activities and volunteering.

To achieve this, we will continue to support:

– our community gardens and their members. We will also assist new groups to develop gardens.

– Sydney City Farm volunteering and the provision of high quality educational programs for the farm members and wider community.

– bushcare and landcare groups in restoring bushland areas in line with the Bushland Restoration Management Plan.

– footpath gardening projects undertaken by community members in line with the City's Footpath Gardening Policy.

– donation of trees, to commemorate a special event or loved one, as outlined in the Tree Donation Policy.

– wide-ranging annual greening events, such as Free Tree Giveaway, National Tree Day, community planting days, Bioblitz, fauna counts and many other events that support the aims of this strategy.

We will also undertake a comprehensive review of our current policies and programs, including the Community Gardens Policy, Urban Ecology Strategic Action Plan, and Sydney City Farm.

Opportunities for programs that assist the community to help others green and garden their property will also be investigated.

The reviews will help us explore innovative potential models and frameworks that will assist us to meet the increase community involvement.

Images from top: Sydney City Farm 2017, Beaconsfield Community Garden Group 2017, Reconciliation Park Community Garden 2018, City Farm Indigenous talk 2015.

Action 19 – Develop a greening Sydney fund

Cities are congested and contested places, above and below ground. They are always under pressure and subject to constant change and development. There are many competing social, and economic demands to be considered. This places our urban trees at risk.

The City uses extensive resources to plant and maintain public trees. Tree removal is always considered as a last resort. When a tree is removed, the environmental, social and economic benefits are lost for many years until any replacement tree matures. In some instances, those benefits are permanently lost when a tree cannot be replaced.

With appreciation that trees are essential urban assets, and the community correctly places a high value on their retention and management, it is considered appropriate that the City seeks appropriate compensation for their removal.

The City will continue to place tree removal as a last resort. However, when removal of a Council-owned tree is required to facilitate a development / project the City will investigate ways to ensure it is appropriately compensated for the loss and identify how any compensation received can be used to create the greening Sydney fund.

Any fund would be managed by the City to provide a grants program aimed at improving greening outcomes on private land in line with this strategy. This may include programs such as matching grants programs for residents and landowners to undertake new tree planting, new habitat / nature plantings, or install green roofs, green walls and façades.

In investigating options for the fund, we will:

– review how the program can be developed within the existing statutory framework and develop any necessary policies to support the program

– have a balanced approach in establishing the tree removal compensation values – a value will be based on various tree attributes, but not of too high a value that is a major financial hardship

– ensure any grants program developed achieves the key greening objectives of this strategy

Action 20 – Increase our community engagement

Community engagement is key to developing green initiatives that the community wish to see and want to participate in.

Better solutions often appear when a diverse set of people participate and embrace the problems and potential solutions. Collecting diverse opinions, knowledge and perspectives from within the community will help to provide a more balanced, and inclusive solution.

To achieve this, we will:

– review our community engagement approaches to maximise engagement with a wider audience.

– increase our online presence, including providing more resources, data and information on our greening initiatives, programs and assets.

– develop Green Volunteer Network to allow for community knowledge sharing, networking and learning across the city at both an online and face-to-face levels.

Images from top: James Street community Garden, 2011, Sydney City Farm Workshop 2017.

Our green future

We have developed this strategy to re-ignite and affirm our commitment to provide a greener, cooler, calmer and resilient Sydney to all of our community.

Trees and other urban greenery are a vital and integral part of our urban lives. It is as important as roads and broadband internet, and significantly more beautiful than either. More and more studies are revealing that there can be no greater good for human health than to protect and enhance the green infrastructure within and around our cities.

Trees remove thousands of tonnes of pollution from our air, store carbon and help mitigate extreme weather. Their roots and leaves absorb water and help slow down and deal with excess rainfall. They provide respite and relief from noise and dirt, boost our immune systems and relieve stress, depression and anxiety.

As trees are lost to development, buildings and roads, to disease and storms there is an ever-pressing need for us to value everything that the broader urban forest and greenery can do for us.

In 2015 the World Economic Forum made increasing green cover one of its top 10 urban initiatives. Across the entire world there are movements to encourage cities to plant more trees and increase their green spaces. Analysis reveals that much of our green cover is located in private land, on golf course and on railway and other utility corridors. This shows that individual contributions and intergovernmental approaches to urban greening is vital. Every tree counts, even it is only a small tree in your back garden.

Singapore, already the greenest city in the world, is aiming to make itself even greener. Its goal is to have 85 per cent of all its residents to live within only 400 metres of a green space. Sydney must strive for such outcomes as well.

As cities become more crowded, they also have to become more innovative about how to create more green space. Inspiring projects such as New York's High Line railway and the Promenade Plantee in Paris, illustrate how cities across the world are turning disused railways and motorways into parks and green space. The Skygarden in Seoul has been built on an abandoned motorway flyover. The former concrete overpass has been planted with 24,000 shrubs and trees and is open 24 hours a day.

It is vital that we share knowledge on lessons learned. We must regularly review and update polices, plans and planning controls, using data to make informed decisions, in order to continue producing innovative technologies to meet the climate change challenge and support green building initiatives.

The City has developed this strategy to drive everything we do. We need to encompass both small and large actions. We need to address our streets, our parks and buildings and new development on both public and private lands.

We need to look after our future. We are the only ones that can. The time for action is now. Please help and support us in our efforts to green our city.

Attachment 1 – Review, implementation and action plan

We will implement this Greening Sydney Strategy over the next ten years.

As greening is located across streets, parks and property, several departments will be involved in leading the specific actions, as outlined below.

A review of this strategy will be done by 2031. The review will include an assessment of the new research, technology and how the city has developed and changed during that time. This will include a comprehensive review of the greening and canopy targets, and all other actions required to provide a cool, calm and resilient city.

Images from the top: 100 Joynton Ave, Zetland, 2015 credit Adam Hollingworth, Turruwul Park, Sydney Park 2015.

Strategic Direction	Action	Lead Responsibility	Implementation (years)			
			1–2	3–5	5+	On-going
Direction 1 – Turn grey to green	Action 1 – Achieve the targets	City Services				✓
	Action 2 – Greener laneways	City Planning, Development and Transport		✓	✓	✓
	Action 3 – Harness innovation, technology and inspiration	All departments			✓	✓
Direction 2 – Greening for all	Action 4 – Equitable greening distribution	City Services				✓
	Action 5 – Fair access to quality green spaces	City Services		✓		✓
	Action 6 – Adapting for climate	City Services		✓	✓	✓
	Action 7 – Growing food locally	City Services				✓
Direction 3 – Cool and calm spaces	Action 8 – Cool the hot spots	City Services			✓	✓
	Action 9 – Calm green spaces	City Services		✓	✓	✓
	Action 10 – Celebrate water	All departments			✓	✓
Direction 4 – Greener buildings	Action 11 – Green Factor Score	City Planning, Development and Transport	✓			✓
	Action 12 – Increase green roofs & walls	City Planning, Development and Transport		✓		✓
	Action 13 – Planning ahead	City Planning, Development and Transport		✓		✓
Direction 5 – Nature in the City	Action 14 – Recognise and support Indigenous ecological knowledge	City Services		✓	✓	✓
	Action 15 – Strengthen urban nature protection measures	City Services		✓		
	Action 16 – Urban ecology health check	City Services	✓			
	Action 17 – Reconnecting with nature	City Services				✓
Direction 6 – Greening Together	Action 18 – Support community participation	City Services				✓
	Action 19 – Greening Sydney Fund	City Services		✓	✓	✓
	Action 20 – Increase our community engagement	City Services	✓			✓

Attachment 2 – Target methods

Introduction

Urban local government areas differ in their capacity to accommodate tree canopy and greening. The relative proportions of streets, parks, and other built or open spaces is a major influence on this capacity. The City of Sydney has endeavoured to develop targets for greening and canopy that are ambitious, yet also achievable and relative to the current and future opportunities provided by the specific composition of land uses within our local government area. Consideration was also given to research that suggests minimum amounts of canopy or green cover is required for community health or cooling outcomes.

In the process of setting targets for greening and canopy, all land within the City of Sydney local government boundary (the city) was considered and assessed, including all public and private land regardless of ownership or accessibility.

The capacity and opportunity for greening and canopy was quantified and assessed at the scale of individual land parcels using techniques specific to their land use type. Analysis at such a fine scale allows for the data to be aggregated in many different ways, but for the purpose of setting greening and canopy targets it was summarised under three broad land-use themes; being Streets, Parks, and Properties. Overall targets for greening and canopy for the entire city were produced as a sum of these parts.

Our stratified approach to the development of targets provides a rich dataset that may be used to guide site-specific actions towards their achievement. This approach also promotes accountability within each of the three land-use themes, encouraging land managers to strive to meet the targets specific to the land or site that are managing.

To allow the targets to be directly compared and assessed against current or future aerial measurement of vegetation areas, the analysis of land parcels included only those that are visible from the air. Road tunnels and street segments beneath bridges or viaducts were not assessed. Similarly, parcels of property that exist above or below the surface (e.g. private basements beneath roads etc.) were also excluded from the analysis.

Figure 1: Example of street, park, and property land parcels, each with a unique site code identifier, overlayed on aerial image and aerial acquisition of vegetation height strata.

Street method

The city's road network is a sum of 4915 individual road segments, covering a total of 608.8 hectares (or 23%) of the city's land area.

Most street segments follow a conventional layout, with road pavement areas allowing movement of heavy traffic and roadside verge or nature strip areas between the road pavement and other land parcels being the space for typical street tree planting.

Attributes and measurements of these street segments were used as inputs to formulas to calculate the capacity of each street segment to host tree canopy.

The aim was to quantify the potential canopy area that may be achieved within the boundary of each street segment under real world conditions, and model the potential for additional canopy based on specific scenarios.

Data used

The following road segment attributes and measurements were compiled or calculated from existing City datasets:

– Segment code, name, location, suburb

– Street Segment Type (Street Section or Street Intersection)

– Street Classification (State, Regional, Local, Laneway, Motorway)

– Street segment area (m^2)

– Street segment length (m)

– Street segment width (m, derived from area and length)

– Road pavement width (m)

– Street verge width (m, derived from road segment width and road pavement width)

– Percentage of existing trees impacted by overhead power lines

The optimal mature size of tree suitable for planting in each street segment was determined based on the available street verge width in accordance with the City's Street Tree Master Plan guidelines.

Street Verge Width	Mature Tree Size	Mature Tree Canopy Diameter
Less than 1.3m	Unable to Plant	-
1.3m – 1.8m	Small	5m
1.8m – 3m	Medium	8m
Greater than 3m	Large	12m

The number of trees able to be planted within each street segment was calculated using the following formula:

$$Tree\ Quantity = 2(P - V)\left[\left(\frac{L - 10}{S}\right) + 1\right]$$

Where:

P = Planting Optimisation Rate (expressed as a decimal)

V = Panting Site Vacancy Rate (expressed as a decimal)

L = Street Segment Length (m)

S = Tree Spacing (m)

The formula assumes typical street segments have two single rows of trees and a 10m tree setback on approach to intersections. Tree spacing is proportional to the size of tree suitable for the street segment, and was equal to mature tree canopy diameter.

The planting optimisation rate is an indication of the reduced proportion of trees able to exist due to conflicts within the streetscape (e.g. driveways, poles, shop awnings etc.). The general rate applied in the city was 0.8 (or 80%), however a lower rate (0.7) was applied in the central business district due to a greater prevalence of awnings and below ground utility conflicts.

The vacancy rate is the proportion of planting sites that may be expected to be vacant at any point in time. The rate used by the City, based on historical data, is 0.015 (or 1.5%).

Street intersection segments were treated in a similar way but assumed one row of trees only and a reduced optimisation rate of 0.5. All street segments defined as motorways were assigned a tree quantity of zero to reflect the inability to plant trees within roads of this type in the city.

Age diversity in trees

Not all trees in the City's streets are mature. Therefore, a diversity of tree ages was factored into the analysis before the quantity of trees was used to calculate the canopy area.

A percentage age class distribution was used to represent the expected distribution of age classes for the entire population of street trees. For the city this was determined to be 60% mature (including over-mature), 30% semi-mature, and 10% juvenile, based on the current age distribution of the City's tree assets and expected future removal and planting rates. The canopy diameter for semi-mature and juvenile trees were defined as 75% and 25% of the mature canopy diameter respectively.

These relative proportions and size parameters were applied to the quantity of trees in each street segment to calculate a realistic and sustainable total canopy area produced by trees located within each street segment.

Infrastructure impacts

Data on the proportion of existing street trees within each street segment impacted by overhead power lines was used as a factor in the analysis to reflect the reduced potential of trees beneath such infrastructure.

Within relevant street segments, the proportion of impacted large, medium, and small sized trees were assumed to achieve 60%, 50%, and 80% of their respective potential canopy area. This analysis enabled the modelling of reduced impact scenarios, such as exposed low voltage power lines being converted to insulated bundled cables or the complete removal of overhead wires.

Canopy calculations

The total canopy capacity for each street segment was calculated as the sum of each tree canopy area, factoring in the above considerations, using simple formula for the area of a circle. Since canopy cover is measured and aggregated according to boundaries between land use types it was necessary to calculate the areas of canopy overhanging other land parcels adjacent to the road segment and subtracted these from the total canopy capacity area. This was done by applying a trigonometric formula for the area of a circle segment, where the known parameters are the circle segment height and circle radius. The circle segment height was derived from the width of the road verge and the typical tree setback from the road kerb for each tree size.

In-road planting scenarios

The planting of trees within the road pavement area is an opportunity to increase tree canopy within the street network above that provided by typical planting within the verge. Three different in-road tree planting scenarios were modelled and added to the base canopy capacity calculation for relevant sites, as listed below.

1. Tree planting within parking lanes. Within local road segments wider than 12m, every third tree located within the verge is replaced with a large sized tree planted within the parking lane.
2. Tree planting within laneways. Within local road segments or laneways wider than 6m, having narrow verges unable to accommodate conventional tree planting, a single row of trees is planted within the parking lane at the side of the road. If the road pavement width was wider than 10m the tree size was large. If less than 10m it was medium.
3. Tree planting within medians. In local roads wider than 15m, an additional row of large sized trees is planted in a median island.

If more than one modelled scenario applied to any single street segment, the scenario that produced the highest canopy amount was used.

Overall street targets

The canopy capacity areas overhanging each street segment were summed to provide an overall capacity for the entire street network. This total canopy area was divided by the total area of the street network to give a percentage canopy target for the city's streets. Since the overall target is an aggregate of individual site analyses, the overall target is a summary and cannot be applied to any specific site. Each individual street segment has a site-specific canopy target equal to its calculated capacity.

Targets for green cover were recommended for each street type classification and aggregated to an overall target for the street network. They were based on the existing green cover and a consideration of the potential increase in green cover realistically able to be achieved within each street type in addition to the increase in tree canopy cover.

Park method

Parks are parcels of land dedicated for public open space and recreation.

A total of 421 parks covering a total of 401.7 hectares were assessed in this analysis, representing 15% of the city land area. They are owned and managed by a number of government agencies, including the City, the Royal Botanic Gardens and Domain Trust, Centennial Parklands, and Property NSW.

Parks must provide for a range of competing uses and may serve a variety of functions, including active and passive recreation, heritage conservation, wildlife habitat, and other environmental services. The expected uses and functions of a park influence the amount of greening or tree canopy cover that is appropriate for the space, and therefore parks with similar uses and functions are assumed to have similar potential for canopy and green cover.

An analysis of the parks was undertaken, with the aim being to determine the most appropriate amount of tree canopy and green cover for each park type.

Park classifications

All parks were grouped into one of the following park types; iconic, neighbourhood, pocket, civic, sports field, or golf course. These park types were existing functional categories used by the City for park asset management.

Within each category, parks were ranked by their existing canopy cover percentages (2019 aerial canopy measurement). The median and per centiles above and below the median (15%, 25%, 75%, and 85%) were plotted over the ranked distribution of parks.

This analysis was then used to identify and select five examples within each of the park types, each having different levels of canopy cover. Consideration was given to the age of the parks and maturity of trees when selecting each of the examples.

Qualitative survey

A survey was developed asking respondents to score each of the examples on a scale on 1 (least appropriate) to 5 (most appropriate) in terms of the amount of canopy cover being appropriate for the type of park. Aerial images were used to present the examples within the survey.

Professional staff of the City familiar with park management issues were invited to participate, including professionals in park and tree management, landscape architecture and city design. Staff less involved with parks management also participated, including strategic planning and engineering. 46 responses to the survey were received.

The survey results were used to consider and identify the most appropriate target for canopy cover for each park type.

Overall park targets

Target percentages were also identified for green cover for each park type based on the function and design expectations for their spaces. The relevant target percentages were applied to each park, with target canopy and greening areas calculated and summed to determine an overall target amount of canopy and greening area and percentage canopy and greening cover for the entire park land-use area of the city

Property method

For the purposes of this analysis, property was considered to be any land parcel not classified as a street or a park. It included 26,527 individual parcels of land covering 1,651 hectares (or 62%) of the city land area.

A wide variety of uses, ownership arrangements, and controls apply to this large group of land parcels. They range from small single lot private residences through to large commercial CBD properties and large tracts of government owned land used for transport infrastructure or education.

Estimating private open space

Analysis was undertaken to estimate the amount of open space potentially available for tree planting within these land parcels. Data gathered from the City's floor space and employment survey was used to calculate an approximate building footprint area per land parcel, with the remaining unbuilt portion of each land parcel then used to assess the potential for tree canopy.

The area of private open space required to accommodate trees was determined to be 20–25m^2 for a small sized tree, 25–60m^2 for a medium sized tree, and >60m^2 for a large sized tree. Areas of private open space less than 20m^2 were considered as inadequate spaces for any tree. If a land parcel had greater than 200m^2 of open space, multiple large trees were assigned to the parcel with each requiring at least 200m^2 of space.

A consideration of age diversity was factored into the analysis (using the same method as for the street tree analysis) to estimate the potential canopy area for each private land parcel.

The potential canopy areas for each land parcel, along with the measured amount of existing tree canopy and greening per parcel, were aggregated by the City of Sydney Local Environment Plan land zonings to assess and consider potential targets for tree canopy cover and green cover for each zoning and the private land use overall.

Assumptions and limitations

The above analysis for private land is based on a number of assumptions that make it less reliable than the capacity analysis used for the street land area. The analysis inaccurately assumes that any open space not occupied by a building is available for tree planting, and that tree canopy is unable to overhand buildings. It is also based on existing land development only, with no consideration for how properties may change or be developed in future.

Overall property targets

For the reasons outlined above, the analysis was used as a guide to indicate existing potential only, and to compare and contrast the existing potential between different zonings and specific areas such as heritage conservation areas, urban renewal areas, and the city centre.

The future development and potential for canopy and greening, along with the City's ambition for greener development of private open spaces were important considerations when setting overall targets for properties.

Achieving these targets

Analysis at the scale of individual land parcels has resulted in a detailed comparison of existing and targets for greening and canopy cover.

The analysis highlights sites that are over or under achieving, and provides insight to drive site-specific projects and programs aimed towards the achievement of targets. It will also help to highlight specific land where the removal of greening or canopy will compromise the ability to achieve targets.

Combining the site-specific analysis with the City's asset management data will provide further opportunity to better manage the City's park and tree assets within roads and parks.

Future analysis will be undertaken to determine the best method to express the target for property, and the controls required to promote its future achievement.

Within a ten year period, a comprehensive review of these greening and canopy targets will be undertaken as new research, technology and other tools become available. This will include improved technology for the acquisition of aerial greening and canopy cover data.

Further, as the city develops and changes over time, we will closely review any land use changes over time – such as new park, streets and changes to planning controls for properties.

These targets are based on current land use. As these change over time, so too will the potential extent of greening and canopy cover. We will need to ensure that greening and canopy is a key consideration in those changes, to provide a cool, calm and resilient Sydney.

References

Astell-Burt, T. and Feng, X., 2019 Association of urban green space with mental health and general health among adults in Australia.

Astell-Burt, T. and Feng, X., 2020. Does sleep grow on trees? A longitudinal study to investigate potential prevention of insufficient sleep with different types of urban green space. SSM-population health, 10, p.100497.

Astell-Burt, T. and Feng, X., 2020. Urban green space, tree canopy and prevention of cardiometabolic diseases: a multilevel longitudinal study of 46 786 Australians. International journal of epidemiology, 49(3), pp.926-933.

Bosco Image - Marco Sala [CC BY-SA (https://creativecommons.org/licenses/by-sa/4.0)] [accessed 14/2/20] The Bosco Verticale in Milan in spring, West side. Building by Boeri Studio, Milan.

Coutts, C., & Hahn, M., 2015, Green Infrastructure, Ecosystems Services, and Human Health, International Journal of Environmental Research and Public Health.

Gallagher, R.V., Allen, S. & Wright, I.J. Safety margins and adaptive capacity of vegetation to climate change. Sci Rep 9, 8241 (2019).

Government Architects, 2017, [Draft] Greener Places, NSW Government, Unpublished Report.

Government Architects, 2018, [Draft] Urban Tree Canopy Guide, NSW Government, Unpublished Report.

Greater Sydney Commission, 2018, Our Greater Sydney 2056 Western Sydney District Plan - Connecting Communities, Unpublished Report.

Low Carbon Living, 2017, Guide to Urban Cooling Strategies, by Osmond, P and Sharifi, E, Low Carbon Living CRC, Australia.

Markevych I., Schoierer,J., Hartig, T, Chudnovsky, A., Hystad,P., Angel M. Dzhambov,A., de Vries,S., Margarita Triguero-Mas, Brauer,M., Nieuwenhuijsen M.J., Lupp,G.. Richardson E.A., Astell-Burt, T., Dimitrova, D. et al., 2017. Exploring pathways linking greenspace to health: Theoretical and methodological guidance Environmental Research, 158, 301-317 Elsevier.

Rowe, B., 2019, Enhancing Biodiversity on Green Roofs Through Plant Selection, Living Architecture Monitor, Green Roofs for Healthy Cities, Toronto, US

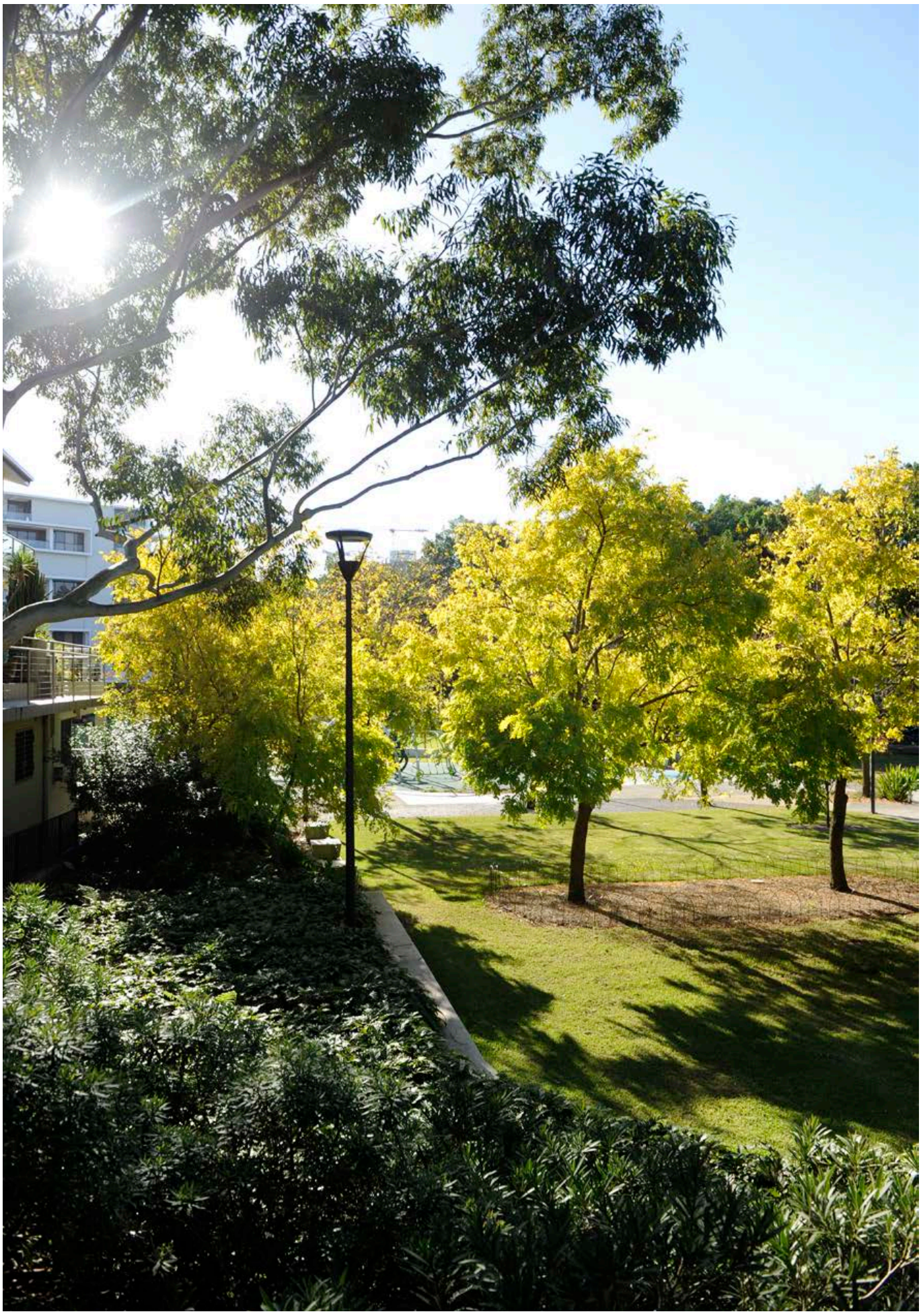
Thom, Jasmine K. et al, 2020, Transpiration by established trees could increase the efficiency of stormwater control measures. Water Research Journal 173, Elsevier, Melbourne

Truong, S., Gray, T., Tracey, D., and Ward, K. 2018. The Impact of Royal Botanic Gardens' Community Greening program on perceived health, wellbeing and social benefits in social housing communities in NSW: Research report. Sydney NSW: Centre for Educational Research, Western Sydney University

Western Sydney Regional Organisation of Councils. 2018, Turn Down the Heat – Strategy and Action Plan, Sydney

Western Sydney University, 2016, Cooling the Commons: Pilot Research Report, Unpublished Report.

Ziter, C.D, Pedersen, E.J, Kucharik, C.J and Turner, M,G. 2019, Scale-dependent interactions between tree canopy cover and impervious surfaces reduce daytime urban heat during Summer. Proceedings of the National Academy of Sciences USA, 116(15) 7575-7580



Green Square urban renewel project, Zetland 2015. Adam Hollingworth