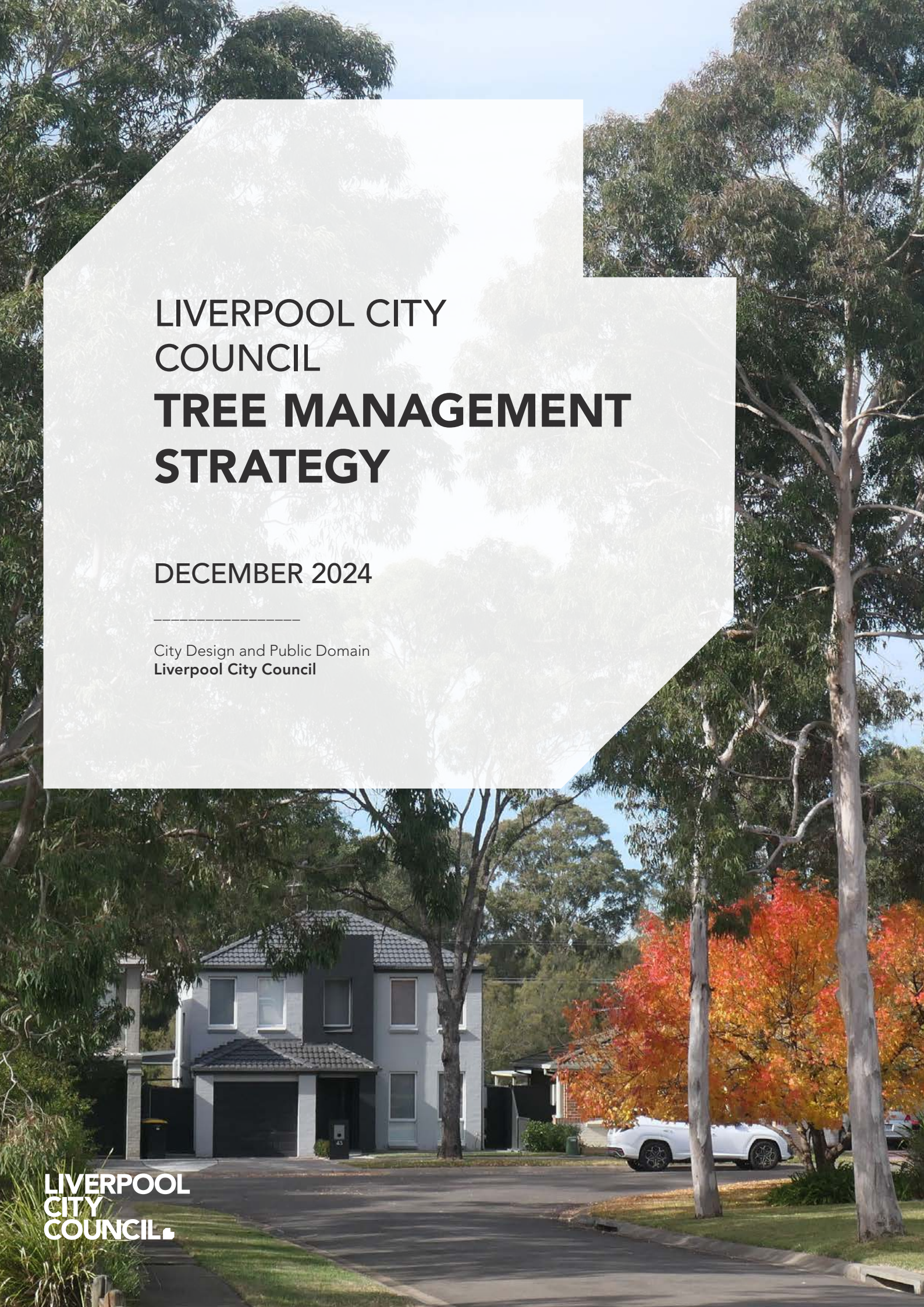




LIVERPOOL CITY COUNCIL **TREE MANAGEMENT STRATEGY**

DECEMBER 2024

City Design and Public Domain
Liverpool City Council

Document Control

Version	Amended By	Changes Made	Date	TRIM Number
1	Council Resolution	None. New Document	10 December 2024	043023.2025

Authorised by

Council

Document Owner

City Design and Public Domain Team
Urban Tree Management Team

Effective From

10 December 2024

Review Date

10 December 2034

For further Information



Visit Us

Liverpool CBD Customer Service Hub
Yellamundie, Lower Ground Floor
52 Scott Street, Liverpool, NSW 2170
Open Monday - Friday, 8.30am - 4.30pm

Carnes Hill Customer Service Hub
600 Kurrajong Road, Carnes Hill, NSW 2171
Opening Hours: Monday - Friday, 9.30am - 4.30pm

Moorebank Customer Service Hub
Cnr Nuwarra Road & Maddecks Avenue,
Moorebank, NSW 2170
Opening Hours: Monday - Friday, 9.30am - 4.30pm



Phone

1300 36 2170
Calling from interstate: (02) 8711 7000
National Relay Service (NRS): 133 677
(for hearing and speech impaired customers)



Email

lcc@liverpool.nsw.gov.au



Post

Locked Bag 7064, Liverpool BC, NSW 1871



Website

www.liverpool.nsw.gov.au



Subscribe

www.liverpool.nsw.gov.au/subscribe

Front Cover Image: View looking east across Lyons Reserve, Horningsea Park, Liverpool NSW. (Source: Arterra)

EXECUTIVE SUMMARY

Liverpool City Council recognises that trees are an important part of our natural and cultural landscape. We are committed to promoting and protecting these important assets. This Tree Management Strategy is a vital part of our tree management commitment. It is a step towards maintaining and managing our trees in a professional, consistent and appropriate way.

Liverpool has a population of over 230,000 people, covers some 305 square kilometres and stretches some 33 kilometres from Georges River and Chipping Norton in the east to the Nepean River and Silverdale in the west. Over 40% of our residents are born overseas. We have over 500 open space reserves and land uses that range from native bushland through to high and low density residential, agriculture, and world class recreation, entertainment and tourism facilities.

We are part of South West Sydney's growth corridor, home to Western Sydney International Airport (Nancy Bird Walton) and the extensive Holsworthy Army Barracks. Liverpool City Centre is the main hub within this large and diverse area.

Trees are an important part of Liverpool. The trees tell the natural and cultural history of our area, reflecting the changes in land use and changes in cultural practices that have helped shape the landscape of the Cumberland Plains and the wider tree population. It is not simply the age, species or size of the trees that makes them important, it is their links to nature, the past, and their relationship with the story of the people and the changing landscapes of Western Sydney.

Council is mindful that the significant green infrastructure of our area, which include some extensive areas of remnant native trees, are some of the most defining and precious elements of the landscape. We must continue to expand, protect, manage and replace our trees in order to pass on a legacy for the enjoyment and benefit of present and future generations.



Image: St Andrews Park, Casula, Liverpool NSW. (Source : Arterra)

“Rich in nature, rich in opportunity, creating community; our place to share and grow.”

MESSAGE FROM THE MAYOR



As the Mayor of Liverpool City Council, I am proud to introduce our Tree Management Strategy (TMS), a document that cements Council's long-term vision and priorities for the management of the trees in our LGA and underscores the vital role they play within our lives.

The TMS has been developed as part of a broader Tree Management Framework which includes the Tree Policy, Tree Management Strategy and Tree Management Technical Guidelines, to overhaul Council's existing process.

The framework demonstrates Council's commitment to promoting and protecting these crucial assets, as fundamental parts of our natural, historical, and cultural identity, which provide an extensive array of social, environmental, and economic benefits to the community.

Healthy and established trees are central to the character of our most treasured suburbs, streetscapes, plazas, and parks, providing the beauty and amenity that shape our urban areas and diverse landscapes. As we continue to experience rapid growth and development in the coming years, tree canopy cover will be essential in addressing many environmental and urban heat issues brought about by higher-density development and urban expansion.

The Tree Management Strategy is the cornerstone of our commitment to the management of our trees and urban canopy cover. Designed to assist in managing both public and private trees, the strategy emphasises the planning, planting, protection, management, and renewal of urban trees to achieve our strategic targets and vision of a sustainable, cool, and green city.

While trees perform essential ecological functions, we must also remember their intrinsic value. Trees bring joy through their aesthetic beauty, create a sense of place, and foster a strong connection with the natural world. They reflect the changes in land use and cultural practices that have shaped the landscape of the Cumberland Plains and the broader Western Sydney region. The significance of our trees extends beyond their age, species, or size - they embody our connection to nature, the past, and the evolving story of our community.

The Tree Management Strategy is a vital initiative that enhances our urban environment. By proactively managing our urban forest, as it grows, we aim to create a resilient, healthy, and vibrant community, ensuring the enduring benefits of our trees remain for all to enjoy.



NED MANNOUN
Mayor of Liverpool

December 2024

MESSAGE FROM THE ACTING CEO



As Liverpool embarks on a period of immense growth, our LGA is poised to welcome many new homes and residents. The state government has set ambitious housing targets, heralding the development of new suburbs and precincts throughout our LGA.

Trees and other green infrastructure are some of the most defining and precious elements of our landscape, crucial for creating healthy, cool, and sustainable neighbourhoods. It is imperative that trees play a fundamental role within these rapidly changing areas of our LGA. Council is committed to expanding, protecting, managing, and renewing our trees to ensure a legacy of green infrastructure for future generations.

Council's framework for trees is initiated with the Community Strategic Plan's Strategic Objective - Liveable, Sustainable, Resilient - which aims to deliver a sustainable, cool and green city.

The Tree Policy, Tree Management Strategy (this document), and Tree Management Technical Guidelines collectively form Council's comprehensive tree management framework, designed to support the best practice management of trees, providing strategic targets, resources and guidance to Council staff, private developers, other government agencies, business owners, and the wider community. The Tree Management Strategy is a crucial tool to inform and unite the people of Liverpool to work towards a sustainable, cool, and green city.

With an estimated average canopy cover of 23%, our LGA appears to be well-placed. However, the situation is less favourable than the numbers initially suggest. Excluding the densely vegetated Holsworthy Defence site, the LGA's average tree canopy cover drops to around 15%, which contributes to much higher temperatures than most other urban areas in Sydney. The urban heat island effect, exacerbated by rising temperatures, poor canopy cover and rapidly urbanising landscapes, significantly impacts the community, the environment, and our health.

Council's target of 30% canopy cover by 2050 endeavours to mitigate these impacts by establishing achievable planting targets that can facilitate our goal of a sustainable, cool, and green city.

Regardless of characteristics or ownership, all trees contribute to our urban forest. In this regard, with Council managing less than 9% of the LGA's total land, achieving our vision requires ongoing community collaboration and a major shift in how we perceive and value our trees.

As we grow, so too must our commitment to preserving and enhancing our urban forest, ensuring that the benefits of trees are shared and enjoyed by all residents, now and in the future.

JASON BRETON
Acting CEO, Liverpool City Council

December 2024



Acknowledgment of Country

We would like to acknowledge the Cabrogal Clan of the Darug Nation who are the traditional custodians of the land that now reside within Liverpool City Council's boundaries. We acknowledge that this land was also accessed by peoples of the Dhurawal and Darug Nations.

Background Image: Indigenous artwork in the former Liverpool City Library forecourt, Liverpool NSW. (Source: Liverpool City Council)

TABLE OF CONTENTS

1.0	INTRODUCTION	9	5.0	IMPLEMENTATION	97
1.1	Purpose of the Strategy	10	5.1	Funding and Resources	98
1.2	Benefits of Trees	11	5.2	Responsibility	99
1.3	Strategic Framework	16	5.3	Priorities and Timing	100
1.4	Assessment Methodology	20	5.4	Estimates of Costs and Funding	102
1.5	Community Engagement	21	5.5	Monitoring and Review	103
2.0	EXISTING CONDITIONS	23	6.0	APPENDICES	105
2.1	Our Urban Character	24	6.1	Opinion of Cost	106
2.2	Existing Trees and Canopy Cover	32	6.2	Stakeholder and Community Consultation	112
2.3	Our History	34	6.3	Benchmarking and Documents Reviewed	114
2.4	Current and Future Development	37	6.4	Summary of Natural Soils and Vegetation	116
3.0	ANALYSIS AND APPRAISAL	39	6.5	References and Links	118
3.1	A Changing Climate	40			
3.2	Indigenous Recognition	44			
3.3	Canopy Cover	46			
3.4	Significant Trees	52			
3.5	Soils and Natural Vegetation	54			
3.6	Green Grid and Corridors	58			
3.7	Urban Growth	60			
3.8	Utilities and Services	61			
3.9	Traffic and Vehicles	62			
3.10	Cultural Attitudes	63			
3.11	Other Key Threats	64			
3.12	Key Opportunities	66			
4.0	THE STRATEGY	69			
4.1	The Vision	70			
4.2	Canopy Cover Targets	71			
4.3	Our Strategic Directions	77			
	Direction 1 - Manage Trees as Assets	78			
	Direction 2 - Increase Canopy Cover	80			
	Direction 3 - Best Practice Management	82			
	Direction 4 - Manage Tree Risks	84			
	Direction 5 - Link the Green and Blue	86			
	Direction 6 - Promote Private Trees	88			
	Direction 7 - Build Capacity	90			
	Direction 8 - Community Engagement	91			
	Direction 9 - Manage Development Impacts	92			

This introductory section of the Strategy establishes the context of the study and the importance of trees within the Liverpool City Council area. It outlines their benefits and the context of this document with regard to other Council and government policies.





1.0

INTRODUCTION



1.0

INTRODUCTION

1.1 Purpose of the Strategy

The Tree Management Strategy has been designed to assist the Liverpool City Council to manage both public and private trees in the Liverpool Local Government Area (LGA). Collectively, trees are the most important component of our urban forest. The Strategy addresses the planning, planting, protection, management and renewal of trees to achieve our vision for a greener, cooler, healthier and inclusive place to live, work and visit.

Tree canopy cover is an essential component of public domain infrastructure that addresses climate change and the impacts of urban heat. It also contributes to the creation of greener and cooler neighbourhoods, enhances the character of the built environment and improves the overall quality of life for residents, workers and visitors.

As part of Council's commitment to increasing tree canopy, and improving tree management this document has been prepared to communicate a clear vision, strategic directions and the respective actions to guide the future of tree management. It identifies the range of considerations required to carry out this commitment and provides an overview of the actions required.

A 'tree' for the purposes of all our documents is typically defined as:

A woody perennial plant greater than 5m tall and with a trunk diameter of at least 140mm when measured at a height of 1.4m above the ground or a canopy spread greater than 4m.

Refer to Tree Management Technical Guidelines - Section 2 - Tree Preservation for further guidance and detail.

Nearly all trees can contribute to our 'urban forest', irrespective of the tree species, origin (native, exotic), location (street, park, garden, school) or ownership (public, private, institutional). This Strategy seeks to support appropriate trees, in all contexts, and to provide Council staff, private developers and other stakeholders such as other government agencies, business owners, and the wider community, with the resources and guidance to assist in this endeavour.

Urban ecosystems, including shrubs, grasses, green roofs and other vegetation, all contribute to 'greening' of the urban landscape and creating diversity, food and habitat for our wildlife. The importance of this other vegetation is well acknowledged, however, it is not specifically addressed within this Strategy. The primary focus of the Tree Management Strategy is our urban trees, rather than native bushland and more natural areas. Particular emphasis is also placed on trees and lands under Council management, where immediate actions can be taken for the broadest community benefits.

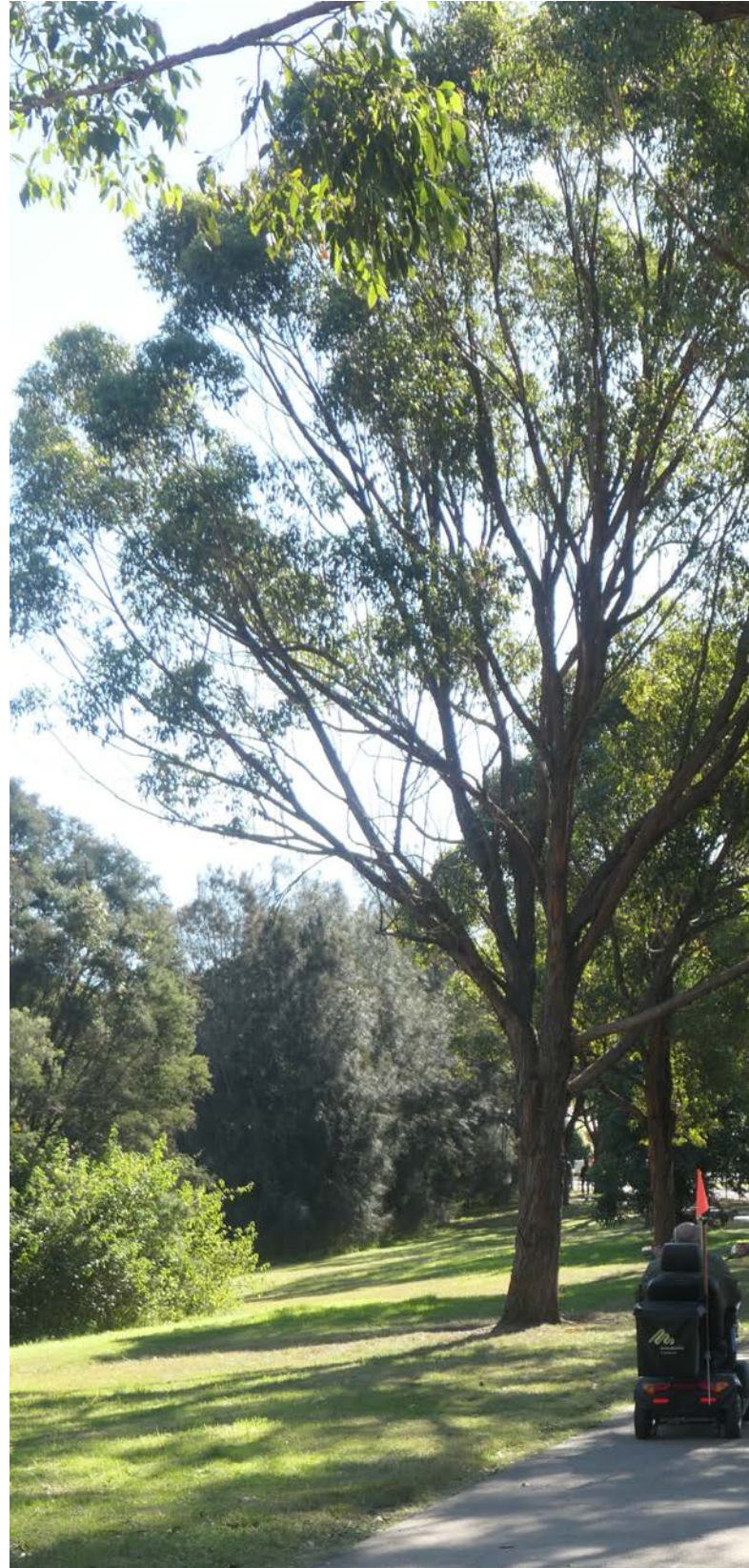


Figure 1: View along a tree shaded walkway in Dunumbral Park alongside Spencer Drive, Cecil Hills. (Source : Arterra)

1.2

Introduction

Benefits of Trees



1.2 Benefits of Trees

There is a considerable body of recent research confirming the extraordinary benefits of urban trees as part of our overall green infrastructure. Trees provide a broad range of social, economic and environmental benefits.

In our urban areas in particular, well grown and established trees contribute significantly to the character and create a “sense of place”. Our most highly valued streetscapes, plazas and parks commonly have excellent overarching tree canopies or relatively closely spaced trees. Trees have the ability to transform and beautify our streets and define the villages and precincts we all value. They can be just as important, if not more important, as the surrounding built forms in many locations. They provide enclosure and comfort, green outlooks, habitat and a ‘softening’ of the surrounding buildings.

As a targeted growth centre, the Liverpool LGA is set to increase significantly in population and density over the coming decades. Higher density living comes with many challenges and impacts on our health and well-being. A thriving urban forest of street trees, park trees and private trees, can help counter many of these challenges through:

- reducing the urban heat island effects and moderating hot and cold winds and other weather extremes;
- providing cooling and valuable shade to pedestrians and buildings;
- increasing longevity of pavements and road surfaces due to increased shading;
- interception and storage of rainwater and stormwater in their leaves and roots and the soils that support them;
- improving air quality by temporarily filtering particulate matter and absorbing polluting gases;
- production of atmospheric oxygen and the uptake (and storage) of carbon dioxide;
- provision of habitat and resources for native fauna, birds and insects; and
- making important contributions to general human health, calming and wellbeing.

The most critical and overarching benefit that trees can provide in the Western Sydney context is to “facilitate resilience to heat by providing shadow and evaporative cooling” (Soltani & Sharifi, 2017).

1.2

Introduction

Benefits of Trees

Some of the environmental benefits of trees include:

- Carbon sequestration and storage. One large evergreen tree can sequester 2351kg of CO₂ in its life with an average of 98kg annually. It also releases enough oxygen back into the atmosphere to support two people's needs.
- Biofiltration of gaseous pollutants by absorbing them through stomates in the leaf surface and permanently converting them inside the leaf. Importantly, this includes sulphur dioxide, carbon monoxide, nitrogen dioxide and ozone.
- Short term removal of particulate matter from the air, which can then be safely washed away later by rain.
- Use of nutrients like nitrogen, phosphorus, and potassium which can otherwise pollute our creeks and waterways.
- Intercepting and reducing rainfall intensity reaching the ground and slowing down stormwater runoff and thereby helping to reduced erosion of soils and creeks.
- Providing vital habitat and a food source for urban fauna and vital linkages to wider bushland and creeks .

Some of the human health, well-being and social benefits of trees include:

- Creation of feelings of relaxation, optimism and well-being. Hospital patients, for example, are shown to recover more quickly and with fewer complications when in rooms with a view of trees. Workers and students are shown to be more productive when their environments have views to trees.
- Improving outdoor comfort and amenity as street tree canopies can shade pedestrians, diminish traffic noise and reduce glare. Trees can screen unwanted views including softening the presence of towers and other large buildings that would otherwise dominate some streets.
- Use of deciduous trees within our commercial centres and other residential streets, to permit sun light and warmth to reach the streets and adjoining outdoor dining areas, houses and apartments during winter.
- Calming traffic, slowing vehicle speeds, and providing a buffer between pedestrians and cars.
- Improved sociological benefits with studies showing correlation with well planted areas and reduced reliance on social services, lower domestic violence, and strengthened community ties.
- Defining precincts and links with history. Tree lined streets can provide way finding and orientation cues and contribute to urban character. Large trees, or those with distinctive forms, can serve as landmarks in the landscape, helping to demarcate gateways, or to define streets and important precincts.
- Providing seasonal interest and natural beauty through their foliage and interesting leaf patterns, flowers, bark, fruit and canopy generally. Providing a constant link to 'nature' and a source of delight.

Some of the economic benefits of trees include:

- Improving economic performance by increasing the attractiveness of retail, dining and tourism areas. People typically will want to visit, linger, shop and dine longer in attractive and tree-lined streets.
- Reducing energy consumption, through shading of pavement, cars and buildings in summer. Appropriately positioned and sized winter deciduous trees can also assist with increased sunlight and warmth in winter, reducing the need for artificial heating in the few cooler months.
- Reducing the "urban heat island" effect reducing the need for artificial cooling in the warmer months.
- Attracting higher rents and sale prices. Shops, apartments and housing that are located in well planted areas are usually more desirable and can attract greater returns.

Beyond the 'work' that trees perform, in cleaning and cooling the environment and supporting life, we should not forget that we have always planted and cared for them because they are a source of joy to humanity; for their aesthetic beauty, the sense of place they create and for the strong connection they provide with the natural world.

***"...urban forests may not provide critical habitats for threatened or endangered animals in the same way that more remote or larger nature reserves might. Similarly, these urban forests may sequester only a small fraction of the carbon sequestered by managed plantations and natural forest systems. However, an increasing number of us live an "urban life", so it is this urban forest that provides the best, or most frequent, opportunity for society to interact with nature, to be environmentally aware in the truest sense, to directly observe the impacts of climate change, and to feel empowered that your urban landscape contributes in some small way to a better world."*(Livesley, Escobedo, & Morgenroth, 2016)**

1.2

Introduction

Benefits of Trees

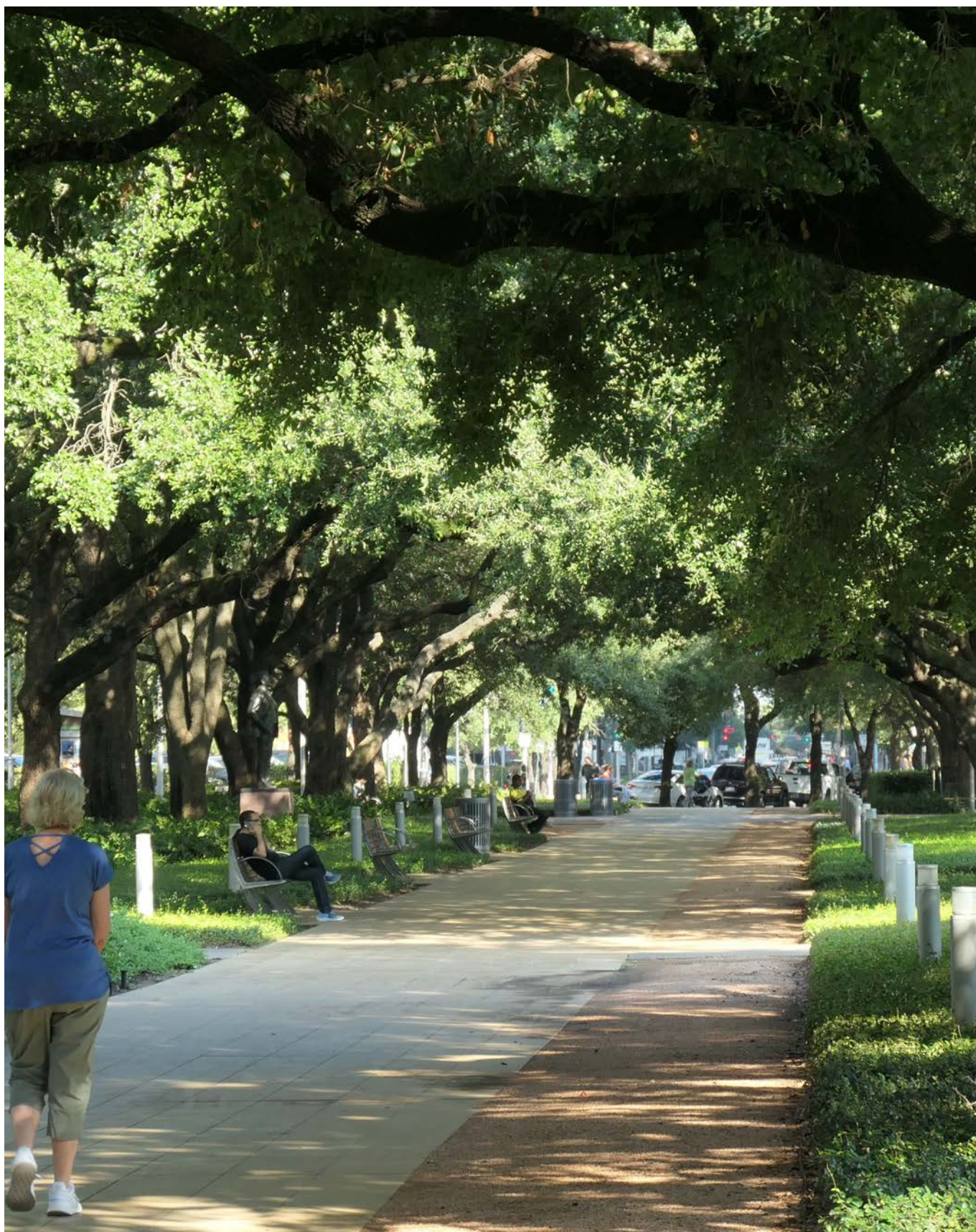


Figure 2: Discovery Green, Houston, Texas. (Source : Arterra)

1.2

Introduction

Benefits of Trees

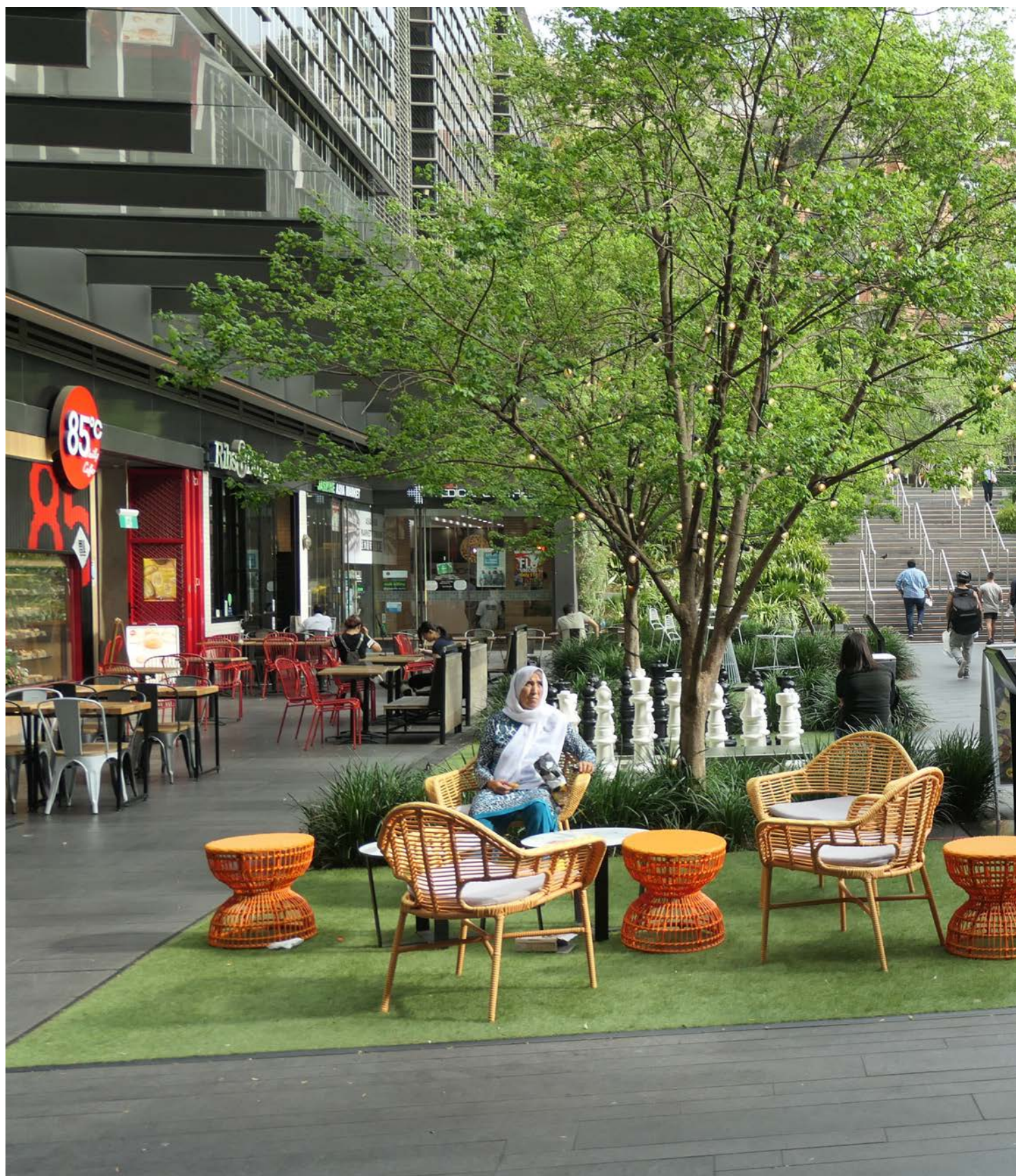


Figure 3: Central Park, Chippendale, Sydney. (Source : Arterra)

1.2

Introduction

Benefits of Trees

The concept that humans have a biological need to connect to nature is called biophilia. American biologist E. O Wilson surmised 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. In 1950, 749 million people lived in urban areas, by 2014 there were 3.9 billion. By 2050 it is forecast that 75% of the world's population will be living in urban areas, which means there will be over 9 billion people living in the world's cities. Australia has one of the highest urbanised populations in the world, with around 90% already living in cities and large towns and increasing. Cities are full of excitement, innovation and energy, but they are also stressful. The more we live in them, the more stressed we become, and the sicker we get. This results in more:

- heart attacks
- strokes
- cancer
- mental illness
- more addictive behaviours
- loneliness
- depression
- anxiety

The World Health Organisation calls 'stress' the health epidemic of the twenty first century. Finding a way to manage this is critical to our health and wellbeing and trees and other greenery can help immensely. Incorporating biophilic elements into the built environment can have profound, measurable benefits for human performance, including improved:

- productivity
- emotional wellbeing
- stress reduction
- learning
- healing

Biophilic based design can foster an appreciation of nature, which can lead to a greater protection of natural areas, species conservation and pollution prevention (Piacentini, R., 2018). Data now proves that connecting with nature for as little as a couple of hours can:

- reduce blood pressure
- lower stress
- improve cardio vascular and metabolic health
- lower blood sugar levels
- improve concentration, memory and attentiveness
- lift feelings of depression
- improve pain thresholds
- improve feelings of energy
- boost immune systems by increasing the count of the body's natural killer cells
- increase anti cancer protein production
- help people loose weight (Li, 2018).

1.3

Introduction

Strategic Framework

1.3 Strategic Framework

The Tree Management Strategy aligns with Liverpool City Council's Integrated Planning and Reporting (IP&R) framework, which is centred around the community's aspirations for the future. These are a set of integrated plans that express the community's vision and goals for the Liverpool LGA, the strategic actions to achieve them, and a reporting structure to communicate progress to Council and the community.

The framework begins with the Community Strategic Plan (CSP) which is supported by a Resourcing Strategy comprising a 10-year term Financial Plan and required workforce strategy and asset management plans. The Tree Policy, Tree Management Strategy (this document) and Tree Management Technical Guidelines, collectively form Council's tree management framework. Figure 4 illustrates how this framework relates to Council's broader IP&R framework, and an overview of our tree management framework is outlined below.

Our tree management framework is aligned with the important NSW Government policies, strategies and plans relating to Western Sydney, as part of the vision for Greater Sydney. This includes the:

- Western City District Plan — Our Greater Sydney 2056 (updated 2018)
- Western Sydney City Deal — Smart Cities Plan
- A Metropolis of Three Cities — Greater Sydney Regional Plan

A complete listing of additional references and resources used in the preparation of this Strategy are included in Appendix 6.3

The Tree Management Strategy is part of a suite of documents which comprises the:

1. Tree Policy
2. Tree Management Strategy
3. Tree Management Technical Guidelines

Tree Policy

The Tree Policy sets out Council's overarching vision and commitment to the management of trees in the Liverpool LGA, and is consistent with the community's aspirations. Its purpose is to maximise and promote the preservation and proper management of existing trees within Liverpool, the planting of new trees and the protection and expansion of our overall tree canopy cover.

Tree Management Strategy (this document)

The Tree Management Strategy, assesses our tree assets, analyses internal and external factors affecting the management of trees, and develops strategic directions. These then feed into respective actions to guide us in the realisation of our core goals, being:

- To establish best practice standards and processes for mitigating the effects of climate change and urban heat, through increased and improved tree canopy.
- To highlight the importance of canopy cover in creating a healthy and more liveable and resilient urban environment.
- To increase the diversity of trees within our urban areas while still selecting trees that are suitable for the local conditions and future climate.
- To improve the health and longevity of our trees.
- To improve the soil and ground conditions to enable trees to grow successfully.
- To identify opportunities to maintain and increase canopy cover.
- To improve our urban ecology.
- As a tool to obtain funding for tree planting initiatives.

Tree Management Technical Guidelines

The Tree Management Technical Guidelines is vital part of the framework. It is a more technical document providing the practical and detailed guidance and procedures for carrying out all tree-related management decisions including requirements for tree related design, selection, and installation and then the procedures for the assessment, management and maintenance of our trees.

The guidelines specifically provides:

- directions and standards for managing trees and tree-related requests;
- actions and standards required for the removal, pruning and planting trees on Council land; and
- standardised approach to ensure uniformity and consistency in the maintenance and management of trees on Council land.

1.3

Introduction

Strategic Framework

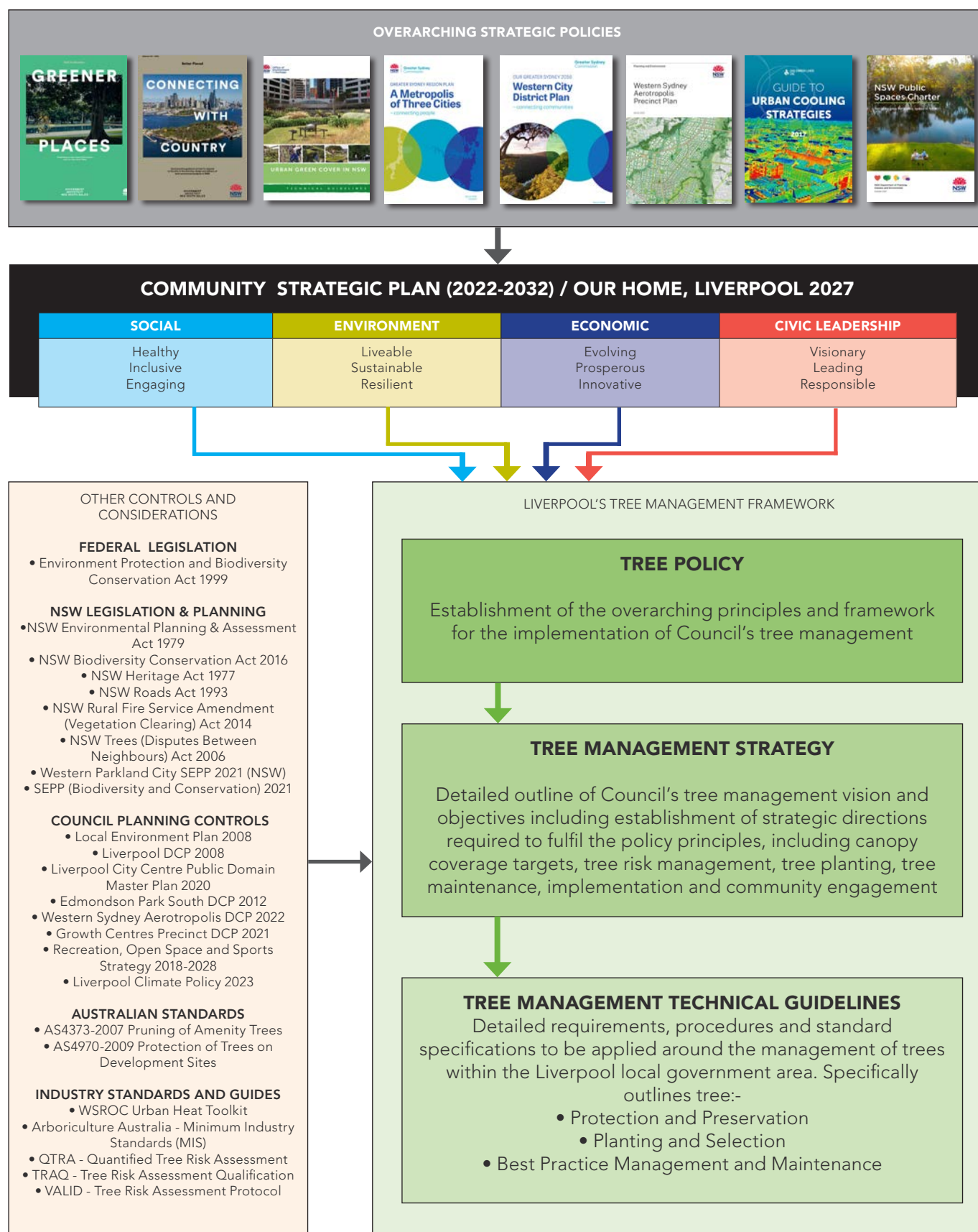


Figure 4: Diagram illustrating the Tree Management Framework, in relation to Council's Strategic and Policy context.

1.3

Introduction Strategic Framework



Figure 5: Voyager Park, Voyager Point. (Source : Arterra)

1.3

Introduction

Strategic Framework



How the Tree Management Strategy is addressing the Community's Priorities

SOCIAL

- Improving the quality of public places and creating comfortable and safe environments conducive to social interaction and connection
- Respecting historically important trees and landscapes
- Connecting with Country
- Improving our health and wellbeing

ENVIRONMENT

- Addressing the impacts of climate change
- Mitigating the effects of urban heat
- Improving the health of the urban forest
- Increasing biodiversity
- Maximising efficient use of our water resources
- Creating habitat linkages, revegetating water way corridors and healing Country
- Increasing sustainability and resilience within a changing climate

ECONOMIC

- Decreasing liability through tree risk assessments and risk mitigation
- Reducing summertime energy bills through improved shading
- Reducing road and pavement maintenance costs, through improved shading
- Increasing property values, through creating more desirable places to live

LEADING THROUGH COLLABORATION

- Council increasing canopy cover through collaboration with the community
- Council collaborating with private owners and other government agencies that manage trees in our LGA

1.4

Introduction

Assessment Methodology

1.4 Assessment Methodology

The Tree Management Strategy was developed through a process of data collection and analysis of our existing urban tree population and their growing environments. It included analysis of the challenges Council is facing in maintaining a thriving urban forest; benchmarking of current best practices in tree management; and the identification of key opportunities to improve adverse conditions experienced by trees throughout our area.

Desktop data collection and review was undertaken from the following sources:

- General tree canopy cover data published by the NSW Government for 2016 and 2019.
- Councils Geoscape 'Trees' – digital dataset which digitised canopy cover information from both satellite and aerial imagery for use in our geographic information system (GIS).
- Council's local government area street, park, flooding and land use zone mapping obtained from our GIS.
- More detailed reviews of existing canopy cover and analysis undertaken on a random selection of parks and reserves throughout the LGA.
- Soil mapping information published by the NSW Department of Planning, Industry and Environment, sourced from eSPADEV2.2 web application (<https://www.environment.nsw.gov.au/eSpade2Webapp/>).

- Climate data from the Bureau of Meteorology.
- Current and historic aerial photography.

Data on the nature and quality of existing trees throughout the LGA (both Council-managed and others) and a rudimentary audit of Council's tree management practices, were collected as follows:

- Windscreen survey (systematic observation undertaken from a moving vehicle) of our streetscapes and parklands, for each suburb.
- Walking survey (systematic observation undertaken on foot) of some selected areas within each suburb. The character and quality of the areas and trees were recorded photographically. Excellent examples of tree management practice were recorded in detail as were particularly poor examples and notable and recurring tree-related issues.
- Meetings and focus groups held between Council staff and external arboricultural consultants for gap analysis in relation to tree management (for example a review of the current tree management practices, formulation of the ideal future practices and identification of key opportunities for improvements).

Benchmarking of best practice in tree management was undertaken by reviewing a range of Tree and Urban Forest strategies, management and statutory documents, from various Councils in NSW and elsewhere. The review focused on examples from the Sydney Metropolitan area. A full list of the documents is provided in Appendix 6.3.



Figure 6: Existing mature native trees retained during recent redevelopment and more recent tree planting undertaken at Newgate Park, Elizabeth Hills. (Source : Arterra)

1.5

Introduction

Community Engagement

1.5 Community Engagement

The Strategy has proceeded from the vision and priorities of our community as outlined recently in the Community Strategic Plan, Our Home, Liverpool 2027. The priorities outlined in the above were formulated through the active engagement of government, business, the not-for-profit sector and our local residents.

The community voiced the need for high-quality, sustainable urban environments to create a great place to live, work and play, including:

- Creation of more green spaces
- Creation of well-planned, attractive and people-friendly urban environments.
- Encouraging sustainability.
- Protecting and enhancing bushland and rivers and visual amenity.
- Planting and preserving trees on private property.
- Air quality improvements.
- Well managed use of our resources.
- Striving for best practice in Council processes.

Preparation of a comprehensive tree management framework is one of a series of processes undertaken in relation to delivering a greener and more comfortable urban environment for our community. To ensure maximum input from the community, the suite of documents comprising the framework will be placed on public exhibition for a period of 62 days from July - September 2024, and submissions from the public were encouraged.

In order to convey the key ideas of the framework to parts of the community from culturally and linguistically diverse backgrounds, the executive summary was translated into the 10 most common community languages of the LGA and provided as part of the exhibition materials. Additionally, the Gandangara, Deerubin and Thrawal Local Aboriginal Land Councils were specifically invited to review and comment.

Summary details will be included in the final document's appendices. Additionally, informal feedback will be gathered through conversations with the Mayor, Councillors and Council staff and via other platforms such as social media. The entirety of the feedback was carefully considered and used in the finalisation of our Tree Management Framework documents.

There is interest from some sectors of the community for greater involvement in tree planting and maintenance. Council can accommodate this by supporting 'greening' activities on private property, within identified bushland regeneration areas and in supervised community planting days. In relation to street trees, where larger trees are



Figure 7: View along at street at Voyager Point . (Source : Arterra)

involved, detailed specifications, as well as technical complexities related to above and below ground services, Council needs to ensure any tree planting and maintenance is undertaken only by qualified personnel.

Some other ways in which local residents are encouraged to be involved in our tree management are to:

- Look out for opportunities where additional street or park trees may be planted in their locality and report them to Council.
- Assist Council with watering around the base of newly planted street trees, and help maintain the immediate surrounds of our trees in a tidy condition.
- Report any problems or damage that are noticed and associated with Council-managed trees.
- Report any concerns regarding trees that may need pruning or are potentially causing clearance issues or damage to public or private infrastructure.
- Participate in supervised community planting days, where particular areas may be targeted for new tree installations and the community can participate in planting, and early establishment of the young trees and increasing our area's canopy cover.

This section of the Strategy identifies the relevant current context surrounding Liverpool City Council's urban trees and it's urban forest.





2.0

EXISTING CONDITIONS



2.0

EXISTING CONDITIONS

2.1 Our Urban Character

Liverpool LGA is a large local government area in Western Sydney, situated between the Georges River in the east and the Nepean River in the west. The landform generally comprises the low-lying lands of the Cumberland Plain with gently undulating plains and low hills.

A series of creeks and smaller drainage lines, cross our area in an approximately north-south orientation, the main ones being South Creek, Kemps Creek, Badgerys Creek, Cabramatta Creek and Brickmakers Creek. There is a somewhat elevated area running north-south from Cecil Hills towards Leppington and the southern portions of the regional Western Sydney Parkland is situated to west of this low but prominent ridge.

Liverpool incorporates 43 suburbs and features a wide range of urban, suburban and rural landscapes. The highest concentration of development lies in the eastern part of Liverpool LGA and is surrounding the Liverpool City Centre which has emerged as Sydney's third CBD. In 2018, 25 hectares in the heart of the city were rezoned to Mixed Use to boost the economy and foster a greener, more walkable city centre.

The eastern part of the Liverpool LGA includes extensive residential development including low, medium and high density. Residential land uses amount to around 20% of the Liverpool LGA. To the western portions, the landscape generally retains a more rural and semi-rural character. It includes rural lands, primary production lands and small lot primary production.

The largest portion of the Liverpool LGA is zoned as Special Activities and includes areas set aside for special purposes. These include the substantial land holding of the Holsworthy defence training site in the southeast; the Western Sydney International (Nancy Bird Walton) Airport, and the planned Aerotropolis and lands allocated for associated enterprise activities, in the northwest. The Special Activities zoning represents 31% of the LGA.

Council manages less than **9%** of the total LGA area, primarily being the Council controlled public parklands, drainage reserves and local roadways. It is the entity primarily responsible for the planting and maintenance of trees on these lands.



Figure 8: Liverpool urban forest has diverse range of trees and conditions, ranging from our CBD, parklands, low density residential development through to some extensive industrial and warehousing areas. (Source: Liverpool City Council)

2.1

Existing Conditions

Our Urban Character



Figure 9: Liverpool is comprised of a diverse range of landuses and conditions with much of the western areas dominated by rural activity and large lot residential development. (Source: Liverpool City Council)

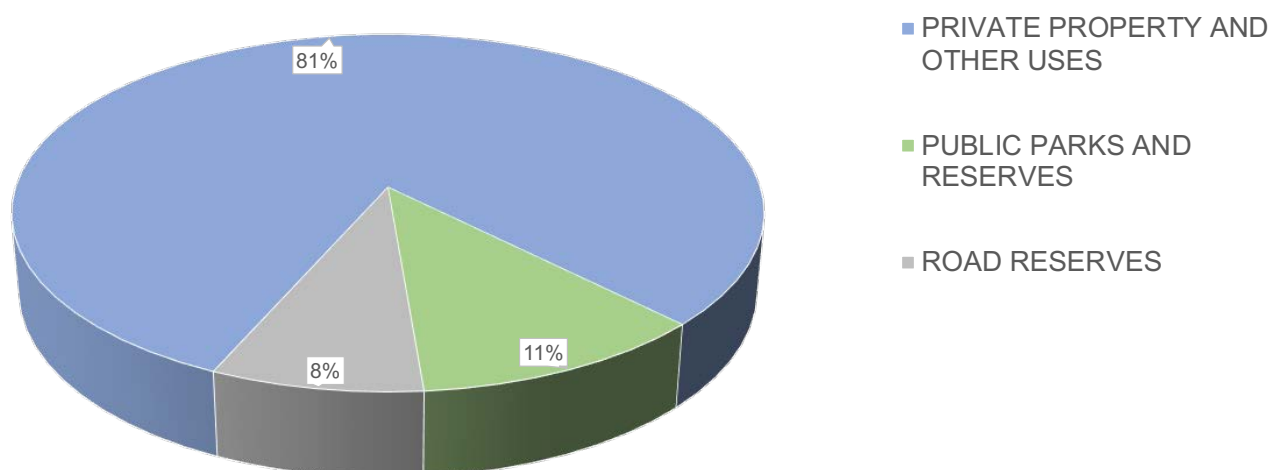


Figure 10: Pie chart showing the general land area breakup in the Liverpool Council area. The vast majority of land is in private or other government control. Our parks and reserves represent around 11% of our area and roads make up around 8%. Most roads and parks are managed by Council and represent a relatively small percentage of the overall area. (Note some roads and parks/reserves are managed by other government departments). (Source : Arterra)

2.1

Existing Conditions

Our Urban Character

The character of the Liverpool LGA is heavily influenced by landform, major features like the rivers and creeks and the intrinsic landuse types that make up our area. Figure 11 illustrates the diverse breakup of different land uses that currently exist and Figure 12 illustrates the relative proportions of the major landuse type categories.

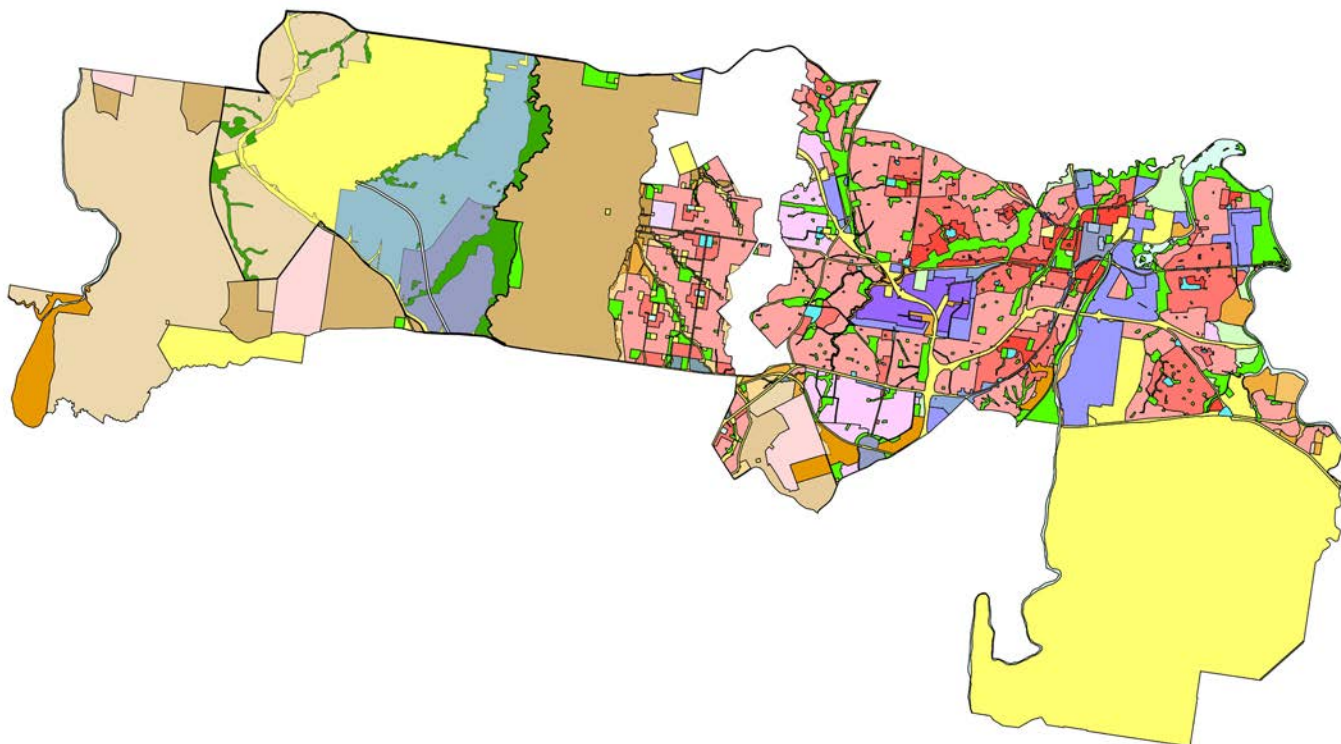


Figure 11: Diagram illustrating the general landuse area breakup in the Liverpool City Council LGA. The main landuse that dominates the make up our area is special uses which include the substantial areas for the proposed international airport, the Holsworthy defence land, motorways and schools. The other main areas include residential uses (at 21%) and farmland and rural pursuits (at 20%). (Source: Liverpool City Council)

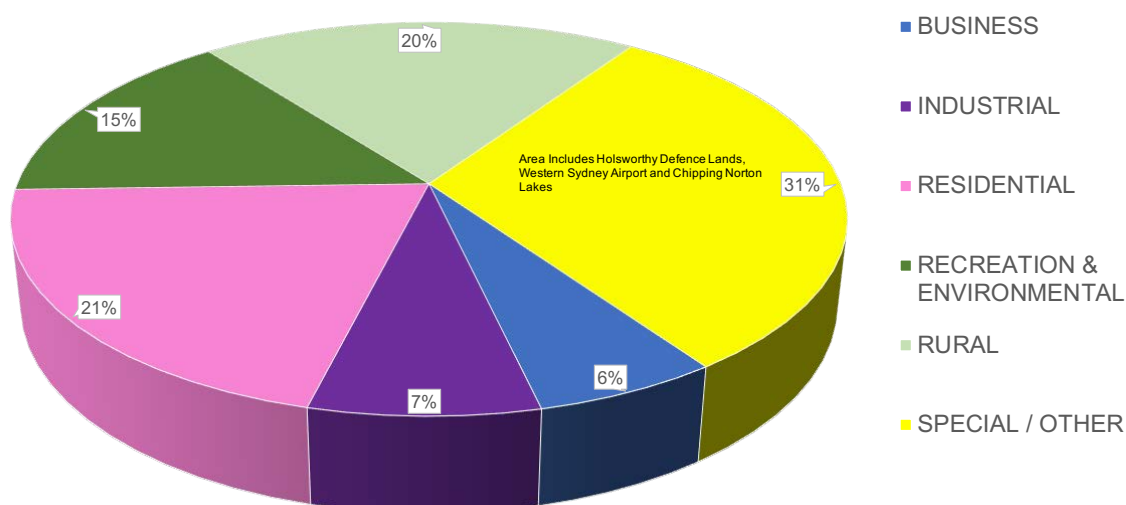


Figure 12: Pie chart showing the broad landuse area breakup in the Liverpool Council area. The main landuse that dominates the make up our area is special uses which include the substantial areas for the proposed Western Sydney International Airport, the Holsworthy defence land, motorways and schools. The other main areas include residential uses at 21% and farmland and rural pursuits representing 20%, but mainly in the western portions. (Source: Arterra)

2.1

Existing Conditions

Our Urban Character

Table 1 Broad categories of land use based on zone type		
Zoning/ Land Use Type	Area (ha)	% of LGA
Special Activities	9414	31%
Residential	6309	21%
Rural	6126	20%
Recreation/Environmental	4593	15%
Industrial	2314	7%
Business	1867	6%
TOTAL	30,623	100%



Figure 13: Liverpool has a very diverse range of landuses including large areas dedicated to special uses like Holsworthy defence land and the future international airport. (Source: Liverpool City Council)



Figure 14: Liverpool has a very diverse range of landuses that create differing opportunities and constraints for canopy cover and managing trees. (Source: Liverpool City Council)

2.1

Existing Conditions Our Urban Character

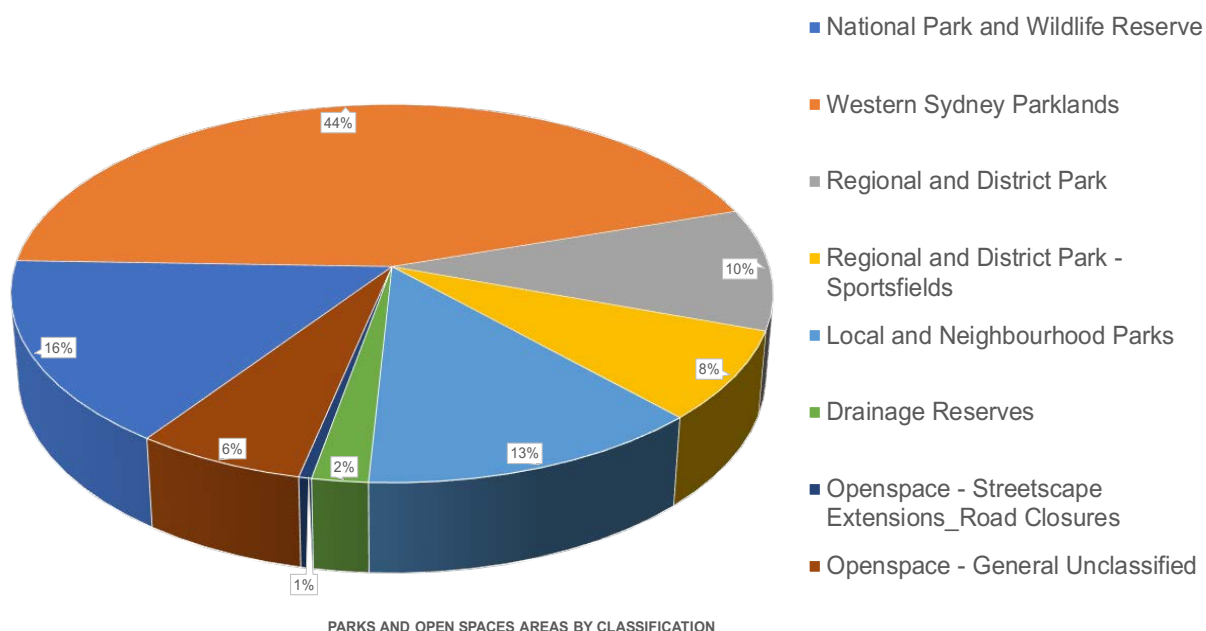


Figure 15: Recreational and Environmental land use makes up around 15% of the LGA. The pie chart shows the relative proportions of these lands, in terms of their current broad classifications. Although included here for context, 60% of all public open space in the LGA is managed by others, including NPWS area of Bents Basin and Western Sydney Parklands. Council manages around 40% of Liverpool LGA's overall public open space and park area. (Source : Arterra)

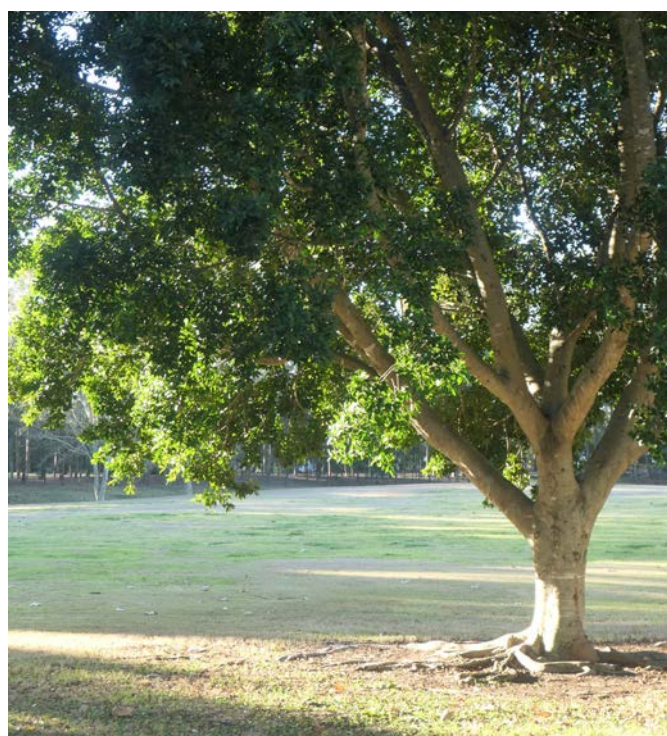


Figure 16: View Council's extensive park areas running along the Georges River at Chipping Norton. (Source : Arterra)

Table 2 Broad categories of parks and open space		
Park Type	Area (ha)	% of Parks
National Parks and Wildlife Reserve	543	16%
Western Sydney Parklands	1529	44%
Regional and District Parks	358	10%
Regional and District Parks - Sportfields	263	8%
Local and Neighbourhood Parks	441	13%
Drainage Reserves	72	2%
Openspace - Streetscapes/ Road Closures	16	<1%
Openspace - Unclassified	217	6%
TOTAL	3,440	11% of LGA

2.1

Existing Conditions

Our Urban Character



Figure 17: The extensive bushland and parks associated with the regional Western Sydney Park makes up more than 40% of the parklands of Liverpool LGA. These areas are a valuable resource, used intensively by our community, and are managed by Western Sydney Parklands Trust, rather than Council. (Source : Arterra)

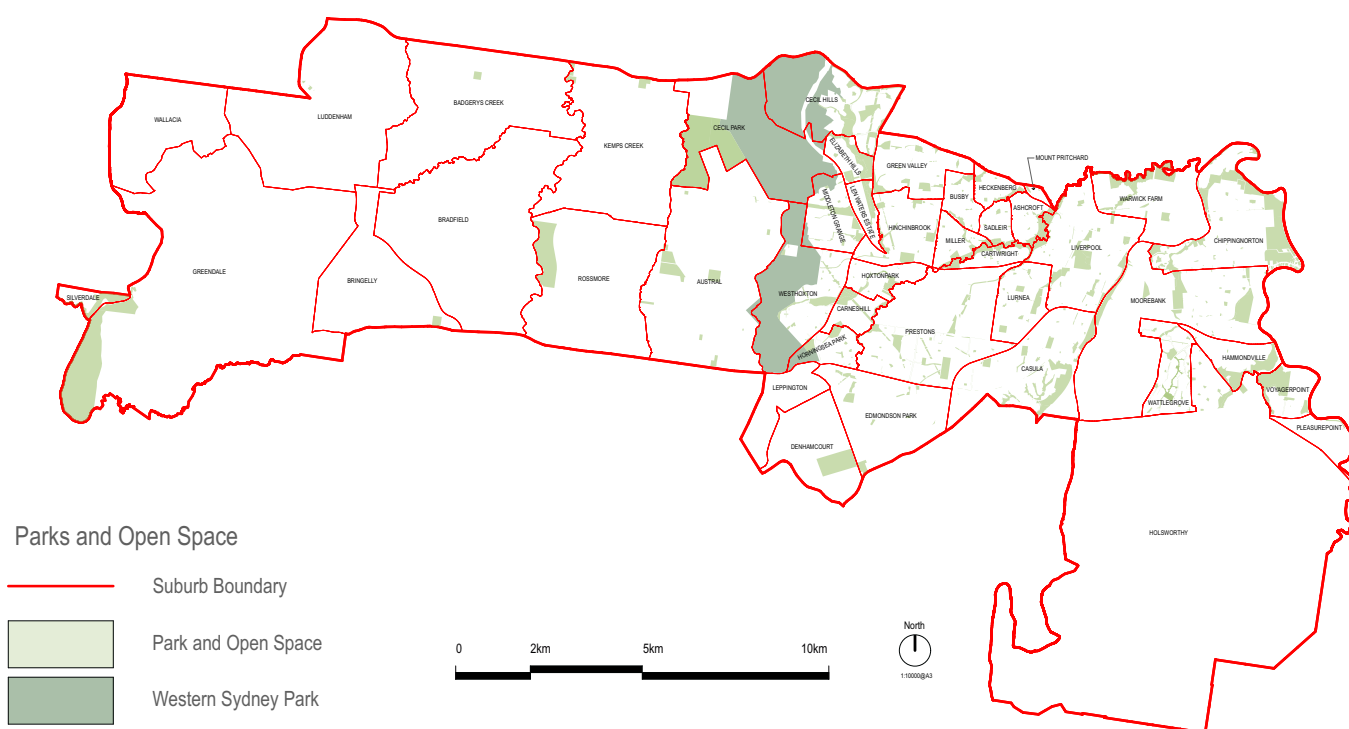


Figure 18: Parks and open space constitute 15% of the LGA. The most significant 'band' of parkland being associated with the regional Western Sydney Parklands, running north south and centrally located within our area. (Source : Arterra)

2.1

Existing Conditions Our Urban Character

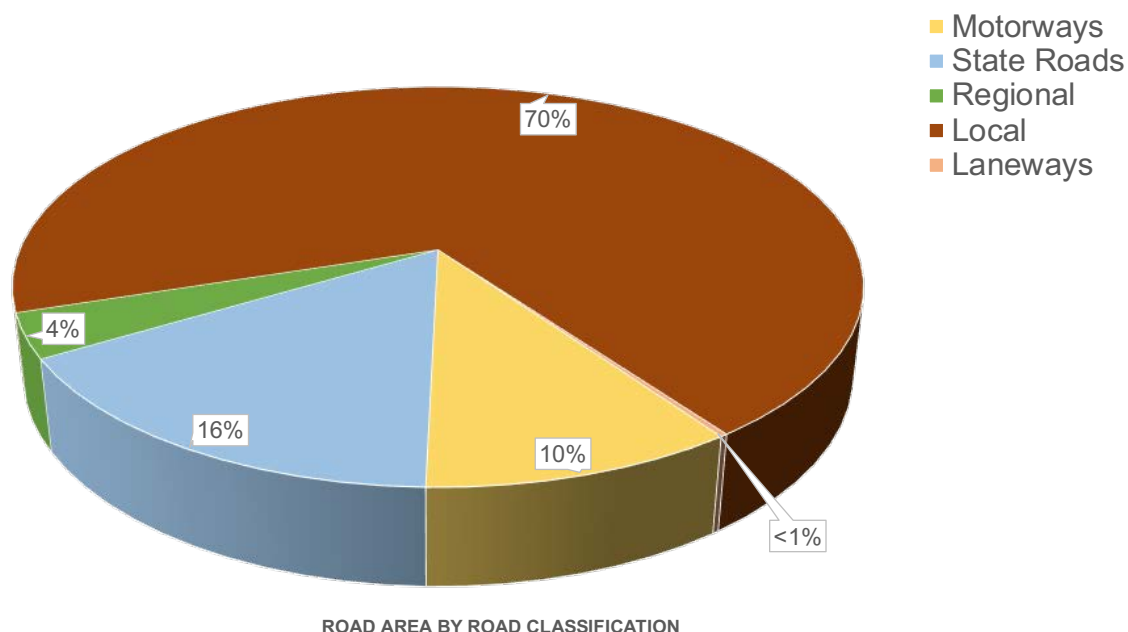


Figure 19: Pie chart showing the road reserves which make up around 8% of the total Liverpool LGA, although some of that overall percentage is also controlled and managed by the State Government such as the motorways and state roads. (Source : Arterra)



Figure 20: Over 70% of our road reserves are local access streets that are primarily managed and controlled by Council. This is where Council can make a positive contribution to increasing our canopy cover and improving the liveability and sustainability outcomes. (Source : Arterra)

Table 3 Broad categories of roads		
Road Type	Area (ha)	% of Parks
Motorways	247	10%
State Roads	393	16%
Regional Roads	88	4%
Local Roads	1,713	70%
Laneways	6	<1%
TOTAL	2,446	8% of LGA

2.1

Existing Conditions

Our Urban Character



Figure 21: Many of our more major and high profile roadways are controlled and managed by the state government rather than Council. Council can still have an influence on tree planting and management on these streets but often they are heavily affected by priorities and constraints that inhibit good tree planting such as truck and bus clearances, overhead power lines, extensive driveways, utilities and services, bus stops, signage and traffic site lines and other safety clearances. (Source: Arterra)



Figure 22: Many of our major motorways are controlled and managed by the state government rather than Council. Due to the nature of these corridors, many of the more recently constructed motorways actively contribute to our canopy cover and habitat connectivity through extensive roadside tree planting. (Source: Arterra)

2.2

Existing Conditions

Existing Trees and Canopy Cover



Figure 23: Canopy cover and trees are vital to creating a resilient urban area.
(Source : Arterra)

2.2 Existing Trees and Canopy Cover

Our trees are spread across our natural landscapes, rural areas and our urban and residential settings. Those trees that lie within our more natural, rural or bushland settings are important contributors to our canopy coverage but are not specifically intended to be addressed within this Strategy, except to ensure that management actions do not conflict with the care and protection of these important natural areas and the trees within them. Our focus is particularly on trees within more urban settings which comprise both public and privately managed trees. They include trees that are directly managed by Council such as our street or park trees, and also trees managed by other agencies such as trees in schools or hospital sites, residential development, business or industrial properties.

Measuring our existing canopy coverage is an essential first step in understanding the extent and concentration of the LGA's trees. Most importantly it allows us to benchmark success as well as recognise areas where we may be falling short and need to address as a priority. Our current canopy cover data, drawn from the relatively recent Geoscape tree canopy cover data set, provides the basis on which we have:

- determined our strategic directions moving forward;
- established suitable and realistic aspirational canopy cover targets; and
- chosen to focus our limited resources.

Zoning/ Land Use Type	Area (ha)	Landuse as % of LGA	Existing Canopy Cover as % of the Landuse
Special Activities	9,414	31%	42%
Residential	6,309	21%	9%
Rural	6,126	20%	19%
Recreation/ Environmental	4,593	15%	28%
Industrial	2,314	7%	6%
Business	1,867	6%	5%
TOTAL	30,623	100%	23%

Council-managed parks and roads are two key areas where responsibility for trees and canopy cover lies wholly with Council. Roads make up 8% of the LGA and over 70% of these are local roads and laneways. Council parks and reserves are only around 4% of the total area of the LGA. They include our district parks and sports fields, neighbourhood parks and other recreation areas, drainage reserves and other general open spaces. The figures for tree canopy cover across our roads and parks, varies greatly depending on type of use. For example, and as expected, sports fields have a small fraction of tree cover compared to our more passive recreation areas or bushland reserves.

2.2

Existing Conditions

Existing Trees and Canopy Cover

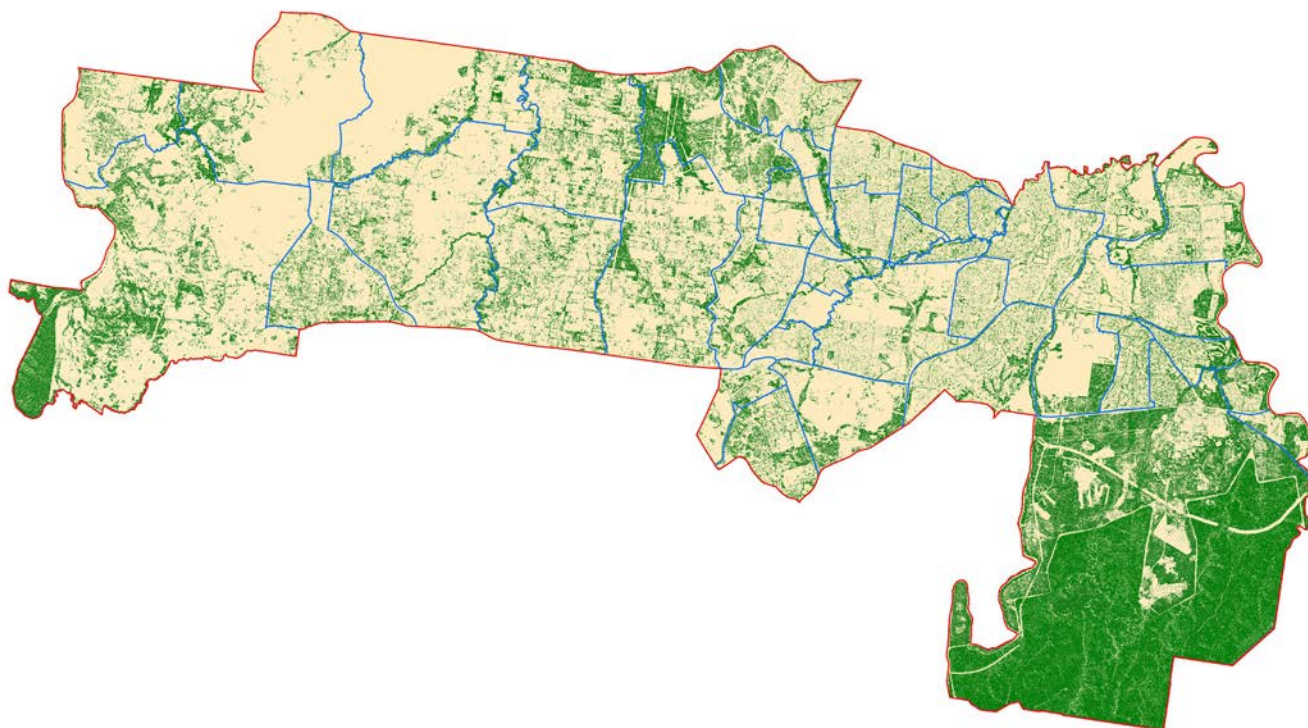


Figure 24: Canopy cover across the Liverpool LGA, showing tree cover in green and highlighting those areas with a more obvious lack of trees. (Source: Liverpool City Council)

Calculated and interpolated existing canopy cover figures, are shown in the tables below. They are a fair but approximate indication of our existing canopy cover within roads and parks and their relative percentage cover.

Park Type	Area (ha)	% of Total Parks	Existing Canopy Cover as % of the Parks
National Parks and Wildlife Reserve	543	16%	45%
Western Sydney Parklands	1,529	44%	24%
Regional and District Parks	358	10%	32%
Regional and District Parks - Sportfields	263	8%	8%
Local and Neighbourhood Parks	441	13%	18%
Drainage Reserves	72	2%	57%
Openspace - Streetscapes/ Road Closures	16	<1%	50%
Openspace - Unclassified	217	6%	66%
TOTAL	3,439	11% of LGA	29%

It is worth noting that these are simply pre-existing data figures based on historic data capture. Further and more detailed canopy cover analysis occurs within Section 3.3 where we analyse these statistics further for the purpose of generating our future canopy cover aspirations and targets.

Road Type	Area (ha)	% of Total Roads	Existing Canopy Cover as % of the Roads
Motorways	247	10%	17%
State Roads	393	16%	8%
Regional Roads	88	4%	10%
Local Roads	1,713	70%	9%
Laneways	6	<1%	9%
TOTAL	2,447	8% of LGA	10%

2.3

Existing Conditions

Our History

2.3 Our History

The original inhabitants of the Liverpool area were the Cabrogal (Cah-bro-gal) people. They occupied the Liverpool and Cabramatta areas and spoke the 'Darug' language. The Cabrogal name derives from the estuarine teredo or shipworm (the co-bro) which served as a dietary staple for the Aboriginal people of the area. Cabramatta Creek at Liverpool is literally 'creek of the cabro' (Kelly, 2007).

On 7 November 1810 Governor Lachlan Macquarie founded Liverpool and named it in honour of the Earl of Liverpool, establishing it as a major convict administrative centre. Macquarie planned Bigge Square (later known as Bigge Park) as the town common. It was an allotment of 6 acres intended to be a Public Market Place and location of an annual fair. It was centrally located and surrounded by important public buildings such as the hospital and the gaol. Emancipated convict and architect Francis Greenway, designed St Luke's Anglican Church and the old convict Hospital, both of which remain as two of Liverpool's most significant buildings.

As European settlement expanded and competition for resources grew, tensions also increased between white settlers and Aboriginal people. Major clashes occurred that led to the rapid dislocation of local Aboriginal groups.

Remnants of the Cabrogal clan remained in the area in the 1840's, with many individuals being employed by local landholders. Employment and intermarriage ensured the survival of the Darug in the Liverpool region. The end of transportation in 1840s, led to the winding down of the convict system and economic decline for Liverpool largely due to the loss of the labour source (Casey and Lowe Associates, 1999). By 1857 Liverpool was no longer the main town in the district as Campbelltown was beginning to increase in importance.

The coming of the railway, opened in September 1856 and the electric telegraph in 1858, provided speedy, safe transport and communication. The railway brought trade and industry to the town and began the transformation of Liverpool into a major regional city.

By the 1870s settlement in the township had not spread far beyond the nucleus of dwellings established in the 1820s. Larger estates were subdivided, and the population doubled during the 1880s. As farming developed, grains largely disappeared, and dairying took over. A number of orchards and vineyards were also located in Moorebank, Holsworthy and Casula, during this period. A series of smaller service centres emerged, to cater for the local farming communities, including the hamlet of Bringelly, the villages of Luddenham and Rossmore and 'town' of Cabramatta (Kass, 2004).



Figure 25: Long before colonial occupation, indigenous Australians managed and utilise the lands of Liverpool. There may still be occasional trees that have significance to aboriginal culture. This may be because they relate to a significant cultural site or they may be remnant 'scar trees' where bark was potentially removed for shields and other practices. (Source: National Library of Australia - Joseph Lycett circa 1828 - Aboriginals hunting kangaroo with fire)

2.3

Existing Conditions

Our History



Figure 26: View of Georges River near Liverpool NSW in 1819, the property of G Johnston Esquire. (Source: SLNSW_FL3322835).



Figure 27: The 1824 Lycett image of Liverpool shows a well-ordered township with rolling pasture lands, often surrounded by extensive native trees and bushland. (Source: SLNSW_FL12628688)

2.3

Existing Conditions
Our History

Figure 28: Military camp at Liverpool, circa 1940s. (Source: SLNSW_FL1444606)



Figure 29: Aerial view of Green Valley in 1962, showing the early stages of extensive public housing development. (Source: SLNSW_FL8808337)

2.4

Existing Conditions

Current and Future Development

The first World War brought extensive military training activities to Liverpool and German prisoners of war were held at Holsworthy. The Holsworthy-Moorebank area was again used during World War II to train and house thousands of troops. The Army has maintained its long association with the Liverpool community through the extensive Holsworthy barracks and field training establishments.

Liverpool was declared a city in 1960. Significant growth occurred in the 1960s when the Green Valley Housing estate (comprising the suburbs of Ashcroft, Busby, Cartwright, Heckenberg, Miller and Sadleir) was established. It was the largest single housing scheme attempted to that date, with 7,464 cottages, flats and units constructed within a five-year period (1961-1965). (Pollon, 1996)

The rapid growth of the Liverpool LGA over more recent years has been fuelled by the development of housing in urban release areas providing affordable home-owning opportunities for families and couples from the south western suburbs of Sydney. The population in 2023 is estimated to be 245,902 and forecast to increase to 371,303 by 2041, representing a greater than 50% increase.

2.4 Current and Future Development

This role and function of Liverpool LGA as a region for urban expansion is expected to continue as part of the Western District Plan for Greater Sydney, especially given the impact of the future development of the Western Sydney (Nancy Bird Walton) Airport, and its surrounding infrastructure and supporting industries.

Further growth is also anticipated through new urban release areas and redevelopment and densification in more established areas. Growth fronts are currently identified at Edmondson Park, Austral and Leppington. Older suburbs, such as Cartwright, Busby and Sadleir, are also likely to undergo regeneration over the next 15 to 20 years with opportunities for lot consolidation and re-development of more medium density town housing, units and apartments.

Existing development methods associated with current patterns of outer lying urban release lands, are often not conducive to the protection of existing trees nor the establishment or expansion of tree canopy. Small sized allotments, in combination with the tendency to build very large residences, results in extremely limited opportunities for tree planting within the private property.

The constraints for tree planting and canopy coverage under the existing patterns of new residential development need to be better addressed if the growth areas are to be cool, green and healthy places to live.



Figure 30: Current patterns of urban release lands, are often not conducive to the protection of existing trees or the establishment or expansion of tree canopy. Small sized allotments, in combination with the tendency to build very large residences, results in extremely limited opportunities for tree planting on private property. (Source: Liverpool City Council)

This section of the Strategy analyses the key factors that can influence tree management and the future planting of trees throughout our community.





3.0

ANALYSIS AND APPRAISAL



3.0

ANALYSIS AND APPRAISAL

3.1 A Changing Climate

Changing Weather patterns

Climate change refers to the long-term shifts in temperature and weather patterns (United Nations, n.d.). The average temperature of the Earth's surface is now about 1.1 °C warmer than any time in the last 100,000 years and there is overwhelming evidence for human-induced global warming. Higher average temperatures are only one of the results of climate change. Weather data from 2019, our hottest year on record, illustrates the extent of the impact of our changing climate.

Weather effects are likely to include more intense and longer-term droughts, water scarcity, flooding, catastrophic storms and increased high winds. Other consequences related to climate are potentially severe bushfires and declining biodiversity.

The key risks to our tree resources from climate change are summarised below:

- Decline in health for some existing tree species better suited to Liverpool's historic climate.
- Premature death of some trees that are not tolerant of heatwaves or associated water stress. This is particularly a concern for younger trees that have not yet fully established or older trees that may already be declining.
- Impacts on the ability to plant and numbers of new trees planted at times of potential water restrictions.
- Increased impacts from pests as higher temperatures may increase their reproduction rates and improve their ability to survive and thrive over winters.
- Increased disease impacts with temporary inundation improving the environment for pathogens that may cause root rot and wood decay.
- Instability from high winds and heavy rains, and the potential increased risk for branch and whole-of-tree failures.

Emissions Reductions and Net Zero Carbon Targets

Council has adopted a Climate Change Policy (2023) and developed a Climate Action Plan. This has 3 principle commitments.

1. Achieve net-zero carbon emissions from Council operations by 2050.
2. Provide effective and strong leadership to the Liverpool community in responding to climate change and building a sustainable city.
3. Assist our community to reach the NSW target of net-zero emissions by 2050.

As part of the above policy Council are committed to "incorporating best practice urban heat resilience and green infrastructure, including increased canopy cover, street vegetation and urban heat refuges".

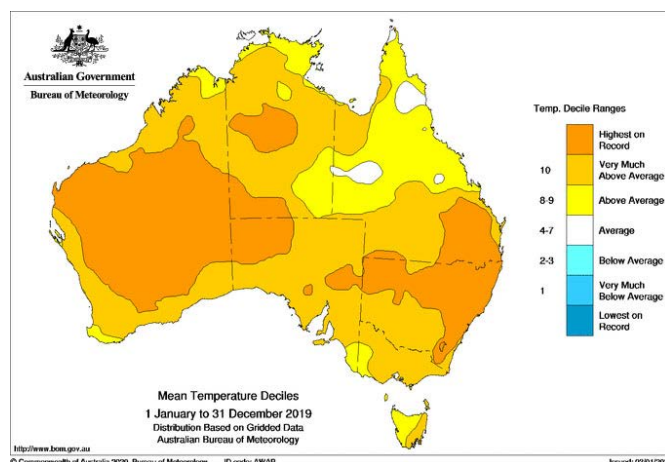


Figure 31: Australian Mean Temperature Decile Map — 2019 (Source: Australian Bureau of Meteorology 30/1/2020)

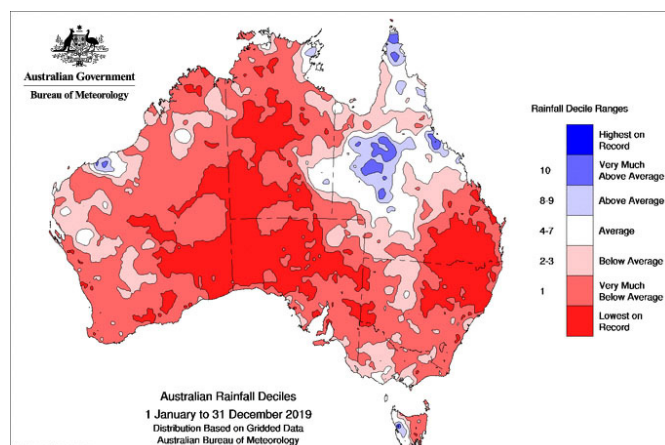


Figure 32: Australian Rainfall Decile Map — 2019 (Source: Australian Bureau of Meteorology 30/1/2020)

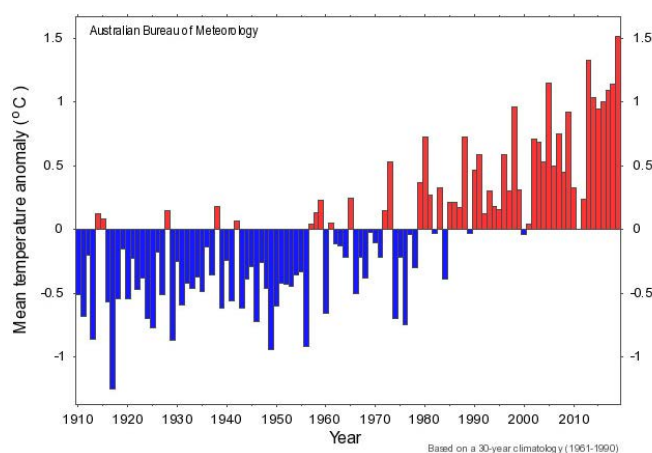


Figure 33: Australian Mean Temperature Anomaly — 1910-2019. (Source: Australian Bureau of Meteorology 30/1/2020)

3.1

Analysis and Appraisal

A Changing Climate

Green infrastructure must be strategically applied to enhance biological and ecological functions at a range of scales. When designed and applied properly, it should help regulate flows of water, energy and materials that maintain urban ecological functions with a definite view to progressing towards carbon neutrality.

Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide (CO₂) and other greenhouse gas emissions occur in the coming decades. Limiting human-induced global warming to a specific level requires limiting cumulative CO₂ emissions, reaching at least 'net zero' CO₂ emissions targets, along with strong reductions in other greenhouse gas emissions (IPCC, 2021).

Many global policies and targets are now striving to achieve carbon neutrality worldwide. For example, the Paris Agreement sets out a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C. It has strongly outlined a target of net zero carbon emissions by 2050.

Although changes in energy and emissions are key, the uptake of carbon is also a vital component. For example, one large tree can sequester 2351kg of CO₂ in its life (taking up on average 98kg annually). If all new projects are designed to meet such specific targets at their core, then over their foreseeable life they could potentially sequester more CO₂ than they cause to be emitted via their construction and significantly further our cause towards a carbon neutral future. Successful tree planting, expanded tree planting and maintenance and protection of our existing trees is absolutely central to this goal.

The Urban Heat Island Effect

The increased incidence of climate extremes, due to climate change, affects all parts of the LGA. However, heavily developed places such as city centres or densely built-up industrial sites are far more affected, due to what is known as the 'urban heat island effect'.

This phenomenon is caused by the prevalence in cities of heat absorbing materials such as dark coloured pavements and roofs, concrete, urban canyons trapping hot air and a general lack of shade and green space. This results in urban areas being significantly warmer than surrounding rural areas. Temperatures in cities can be up to 4°C higher than surrounding suburbs, during the day, and in the evenings they can be up to 12°C higher. This can have dire consequences for the most vulnerable in our communities such as the elderly, lower socio-economic groups and the young. An Australian research project, carried out in Adelaide, found differences in temperatures between urban and rural areas of up to 5.9°C (Soltani & Sharifi, 2017, pp. 529-538). During heatwaves, "temperatures in western Sydney, which have less green cover, are sometimes 10°C higher than in eastern Sydney", (NSW Government).

URBAN HEAT IMPACTS ALL ASPECTS OF OUR CITIES



Figure 34: Urban heat results in a range of impacts to people's health, the natural and built environments and eventually impacts the economy as well. (Source: WSROC - Turn down the heat, 2018)

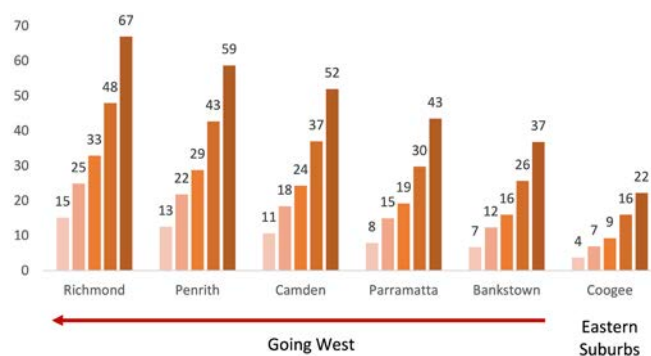


Figure 35: Contrasting the number of days over 35 °C, between eastern and western suburbs of Sydney. Projections suggest that by 2050, the Liverpool LGA may experience as many as 20-25 days per year with temperatures over 35 °C and by 2090 this may be over 50 days. (Source: The Australian Institute of CSIRO).

3.1

Analysis and Appraisal

A Changing Climate



Figure 36: Thermal mapping of two areas over Glebe in January 2019 illustrating the reductions in temperature and substantial cooling benefits of trees and urban canopy cover. The upper image over St Johns Rd, the lower image indicating nearby and well treed Westmoreland St. (Source: City of Sydney Greening Strategy 2023)

Urban Heat Mitigation

Well established and larger canopy trees can facilitate cooling of our homes, streets and parklands through transpiration and shading. Transpiration cooling is the process by which trees release water through their leaves back into the atmosphere, thereby cooling the surrounding air. In street and civic plaza settings, species offering a greater density of foliage, broader crowns and higher rates of transpiration for evaporative cooling, are most useful in mitigating urban heat island effects. These are characteristics often found in trees of exotic or more sub-tropical origins. Broadly speaking, many of our native and endemic trees have sparser foliage by comparison. They offer reduced shade quality and have a tendency to naturally 'shut down' their transpiration processes during more extreme heat to conserve water.

Medium to large trees also provide the greatest ecological and community benefits, in comparison to small trees. They have greater canopy spreads and shading benefits, absorption of more gaseous pollutants, greater stormwater interception, lower levels of tree vandalism, and achieve higher canopy clearances. For example, one very large tree

(such as a *Ficus macrophylla* – Morton Bay Fig) with a canopy diameter of 25 metres, can nominally achieve a canopy coverage of 490 square metres. One would need to plant at least 17 smaller trees to achieve the same coverage. A small tree (such as *Tristaniaopsis laurina* – Water Gum) with a canopy diameter of 6 metres, achieves only a nominal 28 square metre canopy coverage. Smaller trees are also limited in their contribution to wind mitigation, shading and stormwater interception.

Medium and larger growing trees are also commonly longer lived than smaller trees, however, they do require larger soil volumes and more physical space above and below ground than small trees. This needs to be factored into any new planting. Using the paradigm of 'right tree for the right place', a medium to large tree should only be specified and planted in an area where there is sufficient space, and the growing conditions are suitable for the foreseeable life span of the tree. Smaller trees will also have a place in the urban forest in areas where physical space, overhead infrastructure, parking and traffic restrictions or exposure are overriding factors.

3.1

Analysis and Appraisal

A Changing Climate

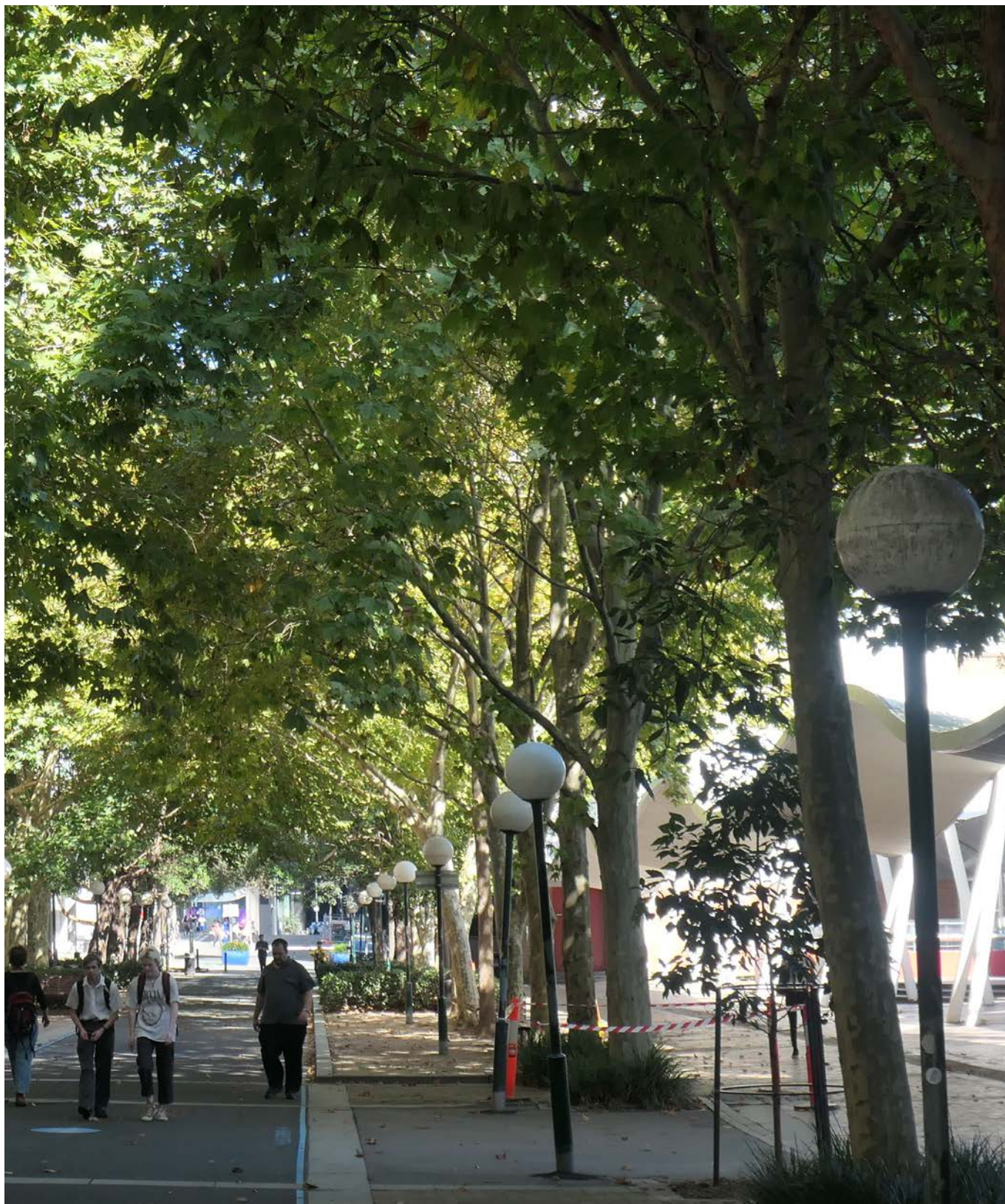


Figure 37: Not all trees are equal when it comes to mitigating urban heat. Some species provide far greater shade and evaporative cooling benefits than others. (Source : Arterra)

3.2

Analysis and Appraisal

Indigenous Recognition

3.2 Indigenous Recognition

Liverpool City Council recognises the First People and traditional custodians of the land and waters of the place we now call Liverpool. We recognise and acknowledge their great resilience and generosity of spirit towards other peoples with whom they now share their lands and waters. Our cities and urban places are now much altered, but traditional wisdom and knowledge in land management can still assist in framing the solutions to this area and dealing with the increasing challenges posed by a changing climate (CoS-GSS, 2021).

To be resilient and successful our urban forest and its planning needs to focus on creating a place where everyone, and all living things, can thrive. Quality green spaces, adequate urban tree canopy and water sensitive urban designs have a key role to play in caring for Country.

Never has it been more pertinent to consider our responsibility to look after our Country. As espoused by Elder April Bright *"If you don't look after Country, Country won't look after you"*. Indigenous peoples talk about Country in the same way as they would talk about a person. They speak to Country, they visit Country, worry and grieve for Country and long for Country. To them Country is a living entity with a yesterday, today and tomorrow.

"If you don't look after Country, Country won't look after you". (Elder April Bright)



Figure 38: The natural environment of Cabrogal and the wider Cumberland Plain was a rich assemblage of plants, animals, water, soils and sky. When we care for our lands, and care about something no matter how small, it often contributes to the health of the whole. We need to acknowledge that we are all just a small part of something much bigger. (Source : Arterra)

3.2

Analysis and Appraisal Indigenous Recognition

Being charged with the design and implementation of our urban spaces, we must respect, understand and work in partnership with Indigenous people, nurturing healthy and stimulating places, and creating landscapes and strategies that align to the spirit and values of 'Country' that are observed by Indigenous people and cultures (Jones, et al, 2018).

The Cabrogal Clan of the Darug Nation are the original inhabitants of the Liverpool LGA and the Dharug, Gandangara and Tharawal people have long term traditional ties with the land and waters of this Country. Traditional wisdom and knowledge in land management can assist in framing healing solutions for Country that has been altered through urban development and which will be increasingly challenged by the changing climate.

The Tree Management Framework incorporates Connecting with Country principles in the following ways.

- An overall desire for the regeneration of Country.
- Fostering the custodianship of Aboriginal people and the healing connection to culture and land.
- Tree planting approach that evokes the underlying geology, hydrology and fauna, through integration of endemic plant species as a priority together with suitable exotic trees when necessary.
- Improvement of our integration of water into the landscape, including passive irrigation strategies, bioswales and rain gardens, and recharge of or streams and aquifers, rather than losing it to stormwater systems.
- Holistic understanding of trees within the landscape including their important spiritual and cultural dimensions.
- Development of an appropriate definition for significant trees and species that recognises the important difference between value judgements made by Aboriginal people as compared to conservation practitioners.

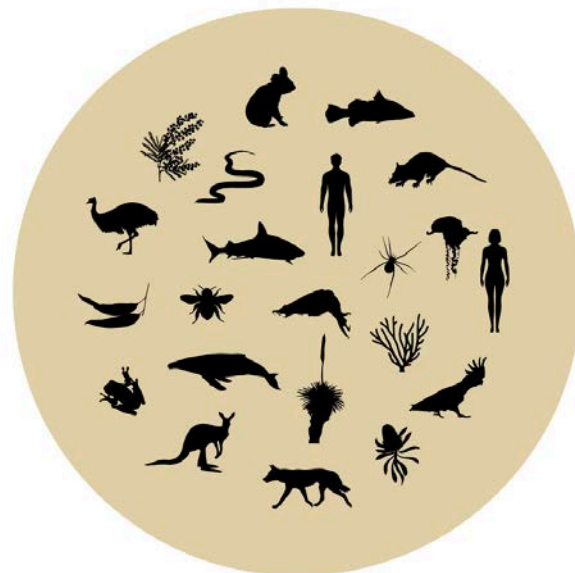


Figure 39: Connection to Country is strongly associated with good environmental custodianship. Importantly it needs to acknowledge that we are simply part of the larger natural world and not above or divorced from it. Connection with traditional knowledge in land management will enrich our approaches and methods to Caring for Country including our tree management practices. (Source : NSW Government Architect - Draft Connecting with Country)



Figure 40: Trees an have special meaning and cultural significance for First Nations people such as Aboriginal scar trees. (Source: SLNSW)

3.3

Analysis and Appraisal

Canopy Cover

3.3 Canopy Cover

Benchmarking

Leading and current Australian research indicates that 30-40% canopy cover is required to optimise heat mitigation and obtain the greatest community health benefits. Individual trees can make a valuable difference to air temperatures at the scale of individual properties, but recent studies have shown that larger groupings of trees, that combine to provide >40% canopy cover, at the scale of a city block can reduce local ambient air temperature by more than 1.3°C (Ziter, C. et al 2019).

Local governments, in Australia and overseas, are increasingly recognising the importance of urban greening and tree canopy coverage. They are commonly setting targets within their policy documents to achieve particular coverage targets within their urban setting. The Greener Places design framework (Government Architect NSW) recommends aiming for 40% canopy cover across greater Sydney by 2036. Importantly this includes the following canopy targets for different land uses:

- > 15% canopy cover in CBD areas.
- > 25% in urban residential (medium to high density) and light commercial areas.
- > 40% in suburban areas.

Objective 30 of the Greater Sydney Commission also sets a broad target of 40% tree canopy cover across Greater Sydney. The table below includes some examples of actual targets within Australia and internationally. A number of comparable LGAs within the Sydney basin are aiming for 40% cover, in line with the Greater Sydney Commission target and NSW Government Architect recommendations.

Place	Current/ Previous	Proposed
City of Ryde	29%	40% by 2030
City of Blacktown	17%	40% by 2040 (ambitious target was backed by significant amount of grant money from the state government for greening.)
City of Campbelltown	24% (2018)	29% by 2045
City of Fairfield	15% (2020)	30%
City of Parramatta	33%	40% by 2050
City of Sydney	20%	23% by 2030 and 27% by 2050. (the City of Sydney is a highly urbanised environment, 27% cover has been modelled as the maximum attainable within the current planning and fabric of the City)
City of Melbourne	22% (2012)	40% by 2040
City of Canberra	21% (2019)	30% by 2045
Seattle City, US	28% (2021)	30% by 2037
Toronto City, Canada	28% (2018)	40% by 2050

3.3

Analysis and Appraisal

Canopy Cover



Figure 41: 30% canopy is considered the minimum cover for community health benefits. Refer to Section 1.2. (Source: Arterra)

3.3

Analysis and Appraisal

Canopy Cover

Liverpool LGA Existing Canopy

Tree canopy in the Liverpool LGA is currently measured at approximately **23%** (using Council's most recent tree canopy data). When compared to the 33 LGAs within Greater Sydney, Liverpool LGA is in 17th place, which is approximately the middle. On the surface it may appear that we are going well. However, this modest position is largely due to some very large expanses of natural and rural areas (such as the Holsworthy Defence site at 62% cover) that contribute a substantial amount of canopy to the overall LGA measurement.

Analysis of canopy cover, by suburb, reveals a far more uneven spread of cover across the LGA. Holsworthy, Cecil Park and Silverdale are areas of good canopy cover, as they are largely undeveloped areas, with many natural or rural landscapes, representing Australian Defence lands, Western Sydney Parklands and the Bents Basin Conservation Areas. There is a striking contrast however with our older and more densely developed suburbs like Green Valley and Carnes Hill. These measure with a very low canopy cover, of only around **7%**.

When one considers the LGA's 43 suburbs, 37 have less canopy cover than the LGA average. More worryingly, two thirds of the suburbs have 15% or less canopy coverage, including the suburb of Liverpool with its highly urbanised Central Business District. The suburbs with the lowest percentage of existing canopy cover are:

- Luddenham
- Badgerys Creek
- Carnes Hill
- Green Valley
- Lurnea
- Bradfield
- Prestons
- Horningsea Park
- Hinchinbrook
- Liverpool centre
- Sadleir
- Leppington
- Edmonson Park
- Middleton Grange

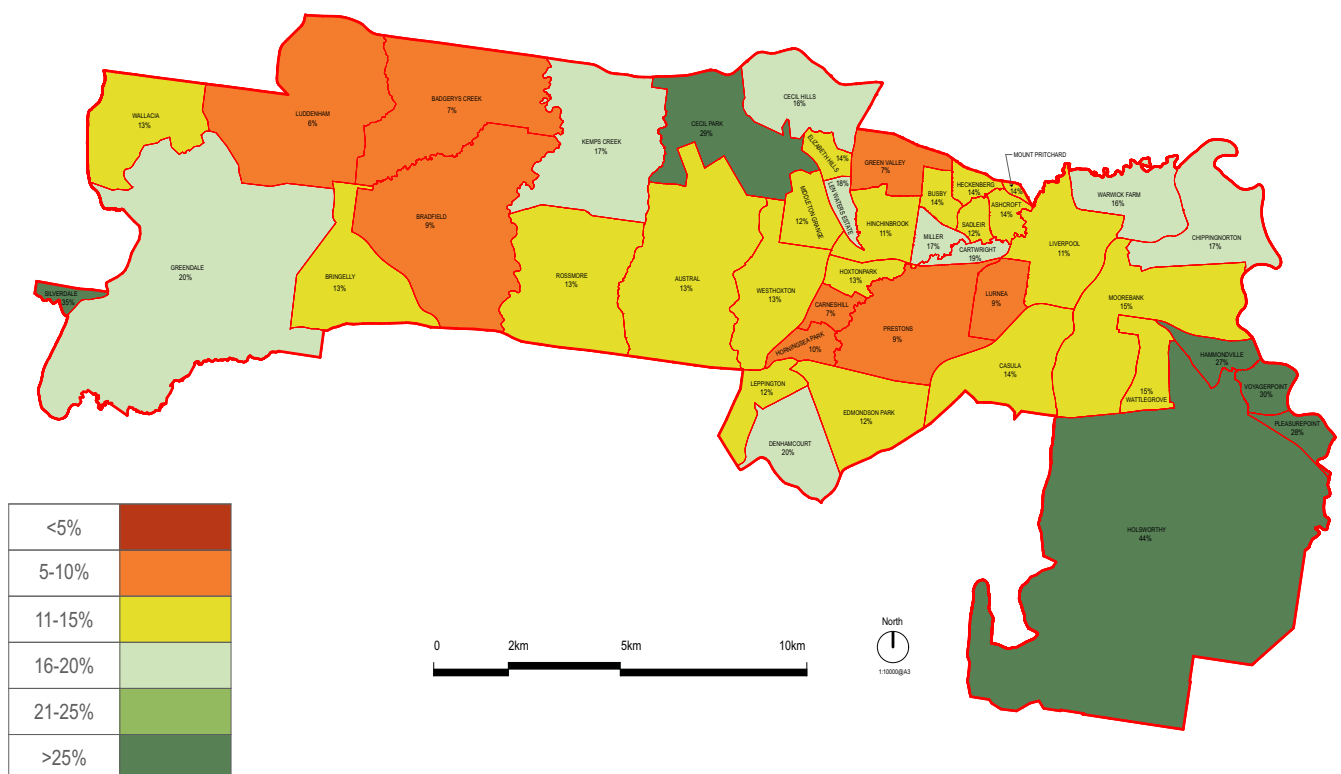


Figure 42: Canopy cover across the Liverpool LGA, showing relative percentage of tree cover. The best tree cover of the LGA is found in the reserves and parkland of Holsworthy, Cecil Park and Silverdale; and in the residential suburbs of Pleasure Point, Voyager Point and Hammondville. (Source: Arterra / Liverpool City Council)

3.3

Analysis and Appraisal

Canopy Cover

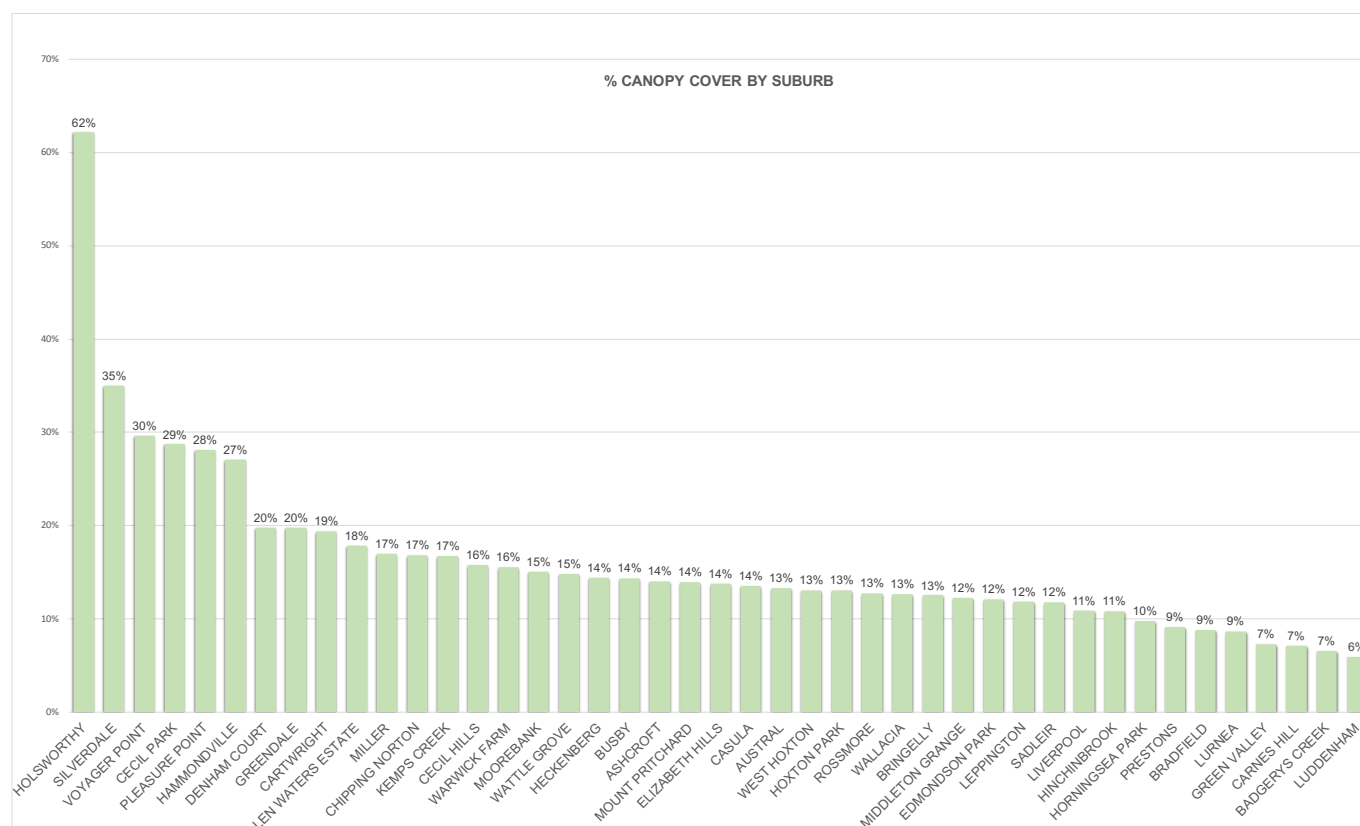


Figure 43: Canopy cover across the Liverpool LGA, showing relative percentage of tree cover. The best tree cover of the LGA is found in the reserves and parkland of Holsworthy, Cecil Park and Silverdale; and in the residential suburbs of Pleasure Point, Voyager Point and Hammondville. (Source: Arterra / Liverpool City Council)

Another helpful metric in understanding where tree resources and increases of canopy cover should be focused for a more equitable benefit is the Heat Vulnerability Index (HVI). The NSW Department of Planning's Heat Vulnerability Index (Department of Planning and Environment, 2022), draws from city wide 2019 canopy data.

The study uses indicators for exposure, sensitivity and adaptive capacity to calculate an average HVI for each suburb. Suburbs with an index of 0 and 1 are less vulnerable to urban heat than those suburbs with an index of 5 that are highly vulnerable. Unsurprisingly, Holsworthy is shown to have an HVI of 0, while the Liverpool suburb, is shown to have an HVI of 4. A number of Liverpool LGA suburbs are identified as being vulnerable and highly vulnerable to urban heat. The suburbs in our area with highest HVI values are listed in the following table.

Table 8 - Summary of Heat Vulnerability Index (NSW DPE)	
HVI 5 Highly vulnerable	Green Valley
	Lurnea
	Sadleir
	Hoxton Park
HVI 4 Vulnerable	Hinchinbrook
	Liverpool centre
	Mount Pritchard
	Ashcroft
	Busby
	Heckenberg
	Miller
	Cartwright

The high level of development in the LGA in the last 4 years, since the above data was collected and synthesised in 2019, as well as indicators of overall decreasing canopy cover, suggests that it is likely more suburbs would show increased vulnerability to urban heat and would need to be considered part of the above list.

3.3

Analysis and Appraisal

Canopy Cover

Developing Appropriate Canopy Targets and the Threats to Achieving Them

The World Health Organisation calls stress the health epidemic of the twenty first century. 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 and trees and other greenery can help immensely.

A 2019 Australian study titled 'Association of Urban Green Space with Mental Health and General Health Among Adults in Australia' by Dr 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%** or more, adults had 31% lower odds of developing psychological distress, and 33% lower odds of rating their general health as "fair" or "poor" over six years. Urban green spaces with open grass rather than a tree canopy did not deliver the same benefits.

This research, which focused on Sydney, Newcastle and Wollongong, provides a solid minimum target to work towards to provide the community with tangible psychological health outcomes. Importantly, there are many other health benefits associated with urban greening, such as reductions in cardio-vascular disease and skin cancer rates.

Our Tree Canopy Coverage Targets at this point in time will be based on measurement of tree canopy coverage that is over 3m in height. As trees provide significantly more benefit than other plants and ground covers, we need to ensure they are prioritised ahead of other greenery.

In the review and development of our targets we have analysed how much canopy cover we have, where it is located, and what realistic possibilities there are to increase it. We have undertaken extensive analysis and modelling to:

- determine the current extent of canopy across the wider LGA as well as more detailed analysis of our roads, parks and private property;
- determine the current capacity that may be available for further tree planting and increases in canopy based on the types of land uses and their relative carrying capacity for trees and the types of different parks and roadways and their differing abilities to increase tree planting; and
- help Council and the community confirm and commit to our recommended targets for 2035 and 2050.

In developing any urban tree canopy targets we must always consider the more site specific details and land uses. It is very easy to outline highly aspirational targets but if they can never be reached are they really performing the task intended? It is also critical to not unrealistically compare targets with quite different areas. Some Councils have vastly

Living in a neighbourhood with

30% or more Tree Canopy*



* Compared to people living in neighbourhoods with tree canopy of 0-9 % within 1.6km



31.3% lower
odds of developing
type 2 diabetes



21.8 % lower
odds of developing
cardiovascular disease



17.2 % lower
odds of developing
hypertension



Publication

download free

Thomas Astell-Burt, Xiaoqi Feng,
Urban green space, tree canopy and prevention
of cardiometabolic diseases: a multilevel
longitudinal study of 46 786 Australians,
International Journal of Epidemiology, 2019,
dyy2239, <https://doi.org/10.1093/ije/dyy2239>

Figure 44: Achieving greater canopy cover is important to all urban areas and human health and well being. (Source: Thomas Astell-Burt)

3.3

Analysis and Appraisal

Canopy Cover

KEY THREATS TO GREENING LIVERPOOL

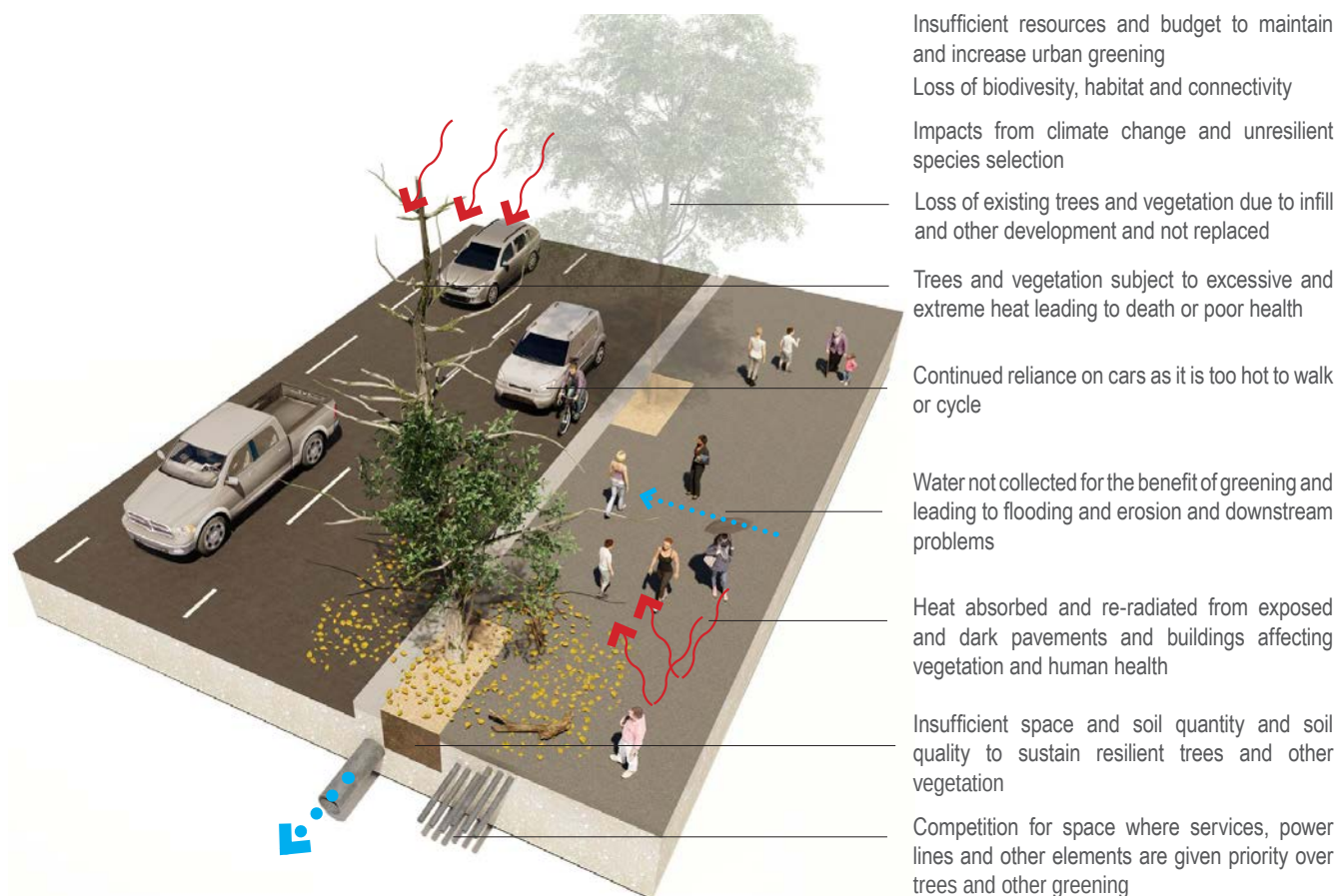


Figure 45: Diagram illustrating the key threats to achieving key tree management and greening outcomes. (Source: Arterra)

different land uses, development pressures, resources and budgets and differing natural soil and climatic conditions. It is not helpful to compare what canopy Liverpool may be able to achieve with our more coastal counterparts or areas that have greater proportions of low density housing and a higher socio-economic demographic.

In analysing our potential canopy coverage detailed analysis and careful consideration was given to our particular various types of roads, parks and property landuses. The basic attributes of each type were measured and assessed.

We must also recognise that canopy trees cannot be planted in all locations, so we must continue to recognise the important benefits of other urban greening initiatives such as green roofs, green facades, irrigated lawns and ground level planting.

Finally, we must acknowledge that Council manages less than 9% of the lands of the LGA, primarily in the form of our parks and roads. Close to 90% of the LGA is therefore managed and controlled by others, including large parcels of land managed by other government agencies, such as Defence, Health, National Parks and Airport Authority. The figure also includes approximately 50% of the LGA which is in private ownership, including substantial private residential, business and agricultural land. To affect meaningful change we will require widespread cooperation from our residents, the wider community and many other agencies of Government.

3.4

Analysis and Appraisal

Significant Trees

3.4 Significant Trees

The Liverpool Local Environmental Plan 2008 (LEP 2008) Environmental Heritage schedule currently lists 3 heritage items that are trees and one heritage item which references trees in the name of the item. These listed trees are shown in the table below.

Item	Name	Address
21	Palm Trees (Phoenix canariensis)	Cnr Governor Macquarie Drive and Epsom Road, Chipping Norton
22	Avenue of Trees	Riverside Park, fronting Riverside Road, Chipping Norton
94	Row of 3 Palm Trees	Macquarie Street median strip, opposite 306 Macquarie Street, Liverpool
99	Soldier's Memorial School of Arts, including ... palm trees	306-310 Macquarie Street, Liverpool

Additionally, there are heritage items without specific identification of trees, for which the setting including the trees would be a contributory component of the character. These include Bigge Park, Collingwood Heritage Precinct group, Liverpool Pioneers' Memorial Park, St Luke's Anglican Church, Cecil Hills Farm and Berryman Reserve.

There has been no survey and assessment of the urban areas to identify trees of outstanding value. It is likely that there are many other trees within the LGA that should be recognised for their heritage significance, Aboriginal Cultural Heritage values or other horticultural values. These trees need to be identified and given a higher level of protection that comes with appropriate registration or heritage listing.



Figure 46: Glenfield Farm, with its Colonial period homestead. The setting contains historic plantings as well as later contributory trees. (Source: Arterra)



Figure 47: St Luke's Church, Liverpool. The site trees contribute to the setting of the church building as well as the amenity of the locality. Recognition of our significant trees of the LGA, will help to ensure they are recognised and protected and will be an important outcome of improved recognition of trees in Liverpool. (Source: Arterra)

3.4

Analysis and Appraisal Significant Trees



Figure 48: One of our majestic endemic trees - the Grey Box (*Eucalyptus moluccana*) at Rossmore. (Source: Arterra)

3.5

Analysis and Appraisal

Soils and Natural Vegetation

3.5 Soils and Natural Vegetation

Our Soils

The landscape of the Liverpool LGA generally forms part of the gently undulating Cumberland lowlands and is crossed by drainage lines that generally run in a north-south orientation. There are a number of clay-based soil communities associated with this landscape, derived from the underlying and dominant Wianamatta Shales geology.

The most widespread is the Blacktown Soil Landscape Association. Other abundantly occurring soil associations are the Luddenham Soil Landscape Association occurring on ridges and crests and the South Creek Soil Landscape Association found along the active floodplains and drainage networks. In general, the soils of the council area are vulnerable to compaction. They have a tendency to be hard setting, compacted and repellent when dry, which leads to high run-off and eventually waterlogging, after heavy rains.

To the south and west of the LGA, in areas of rolling rises and hills, there are soils derived from Hawkesbury Sandstone geology. These soils are generally found beyond the urban areas of Liverpool, for example Gulguer Nature Reserve and Holsworthy Defence lands. They include the soil associations of the Hawkesbury Soil Landscape Association and Gymea Soil Landscape Association.

Large expanses of our natural soils have undergone chemical and structural modification associated with agricultural land uses and urban development. The soils have been disturbed by earthworks, cultivation, as well as altered by nutrient and moisture enrichment. The most disturbed terrain is found around the highly developed landscaped of the Liverpool City centre, the modified lands around the artificial lakes of Chipping Norton and parts of the suburbs of Cartwright, Moorebank and Wattlegrove.

The condition of the soils has major implications for the health and vigour of trees and the success or failure of new tree plantings. Our soils typically need to be well protected from compaction caused by construction activities or inappropriate vehicular parking. Where our soils are highly modified, there is an even higher requirement for introduction of better-quality soil, and in sufficient volumes for tree growth.

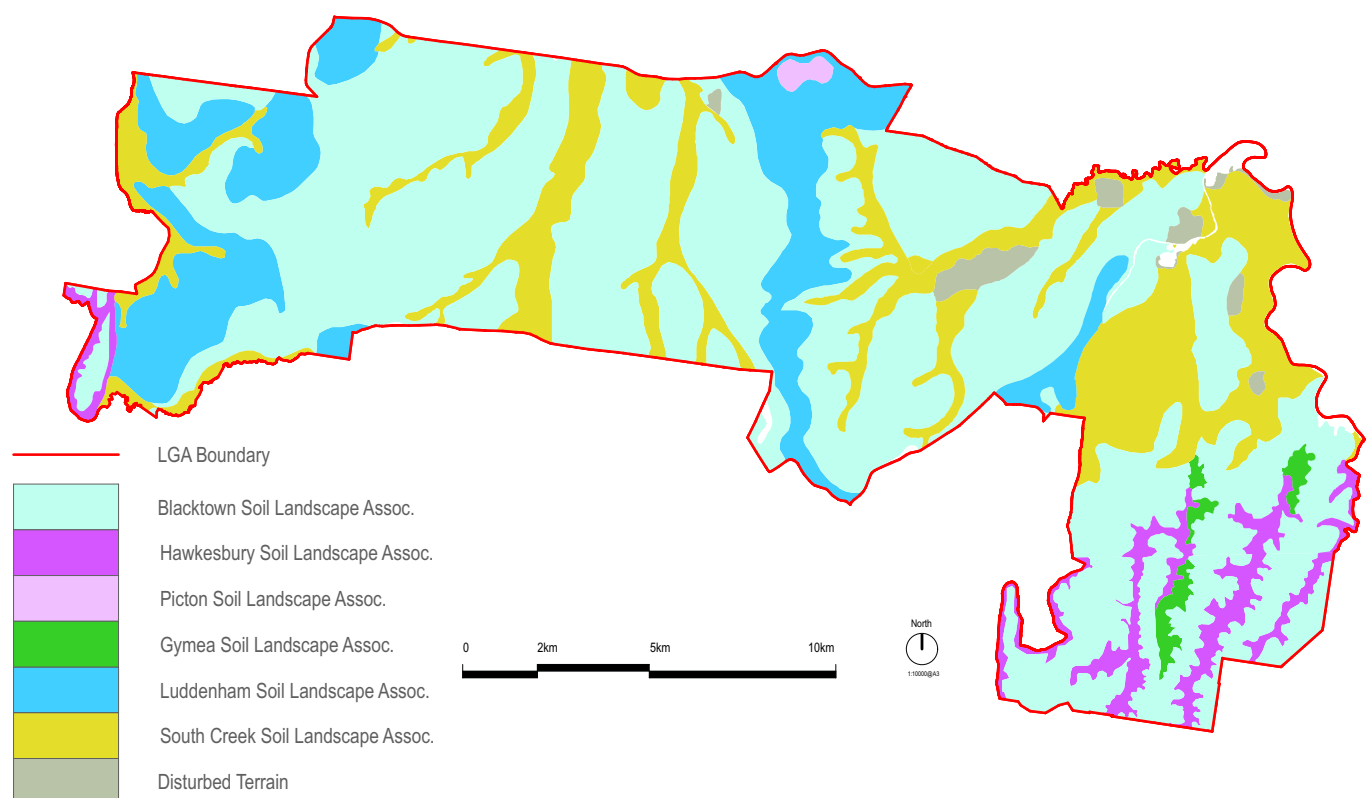


Figure 49: Soil Landscape associations of the Liverpool LGA (Source: Arterra from Soil Landscape Association Series 1:100,000 mapping Penrith - Chapman 1989)

3.5

Analysis and Appraisal

Soils and Natural Vegetation



Figure 50: Typical soil profile from the clay and shale based soils of the Cumberland Plain. (Source: Arterra)



Figure 51: In many urban areas the soil bears little resemblance to natural soil conditions. (Source: Arterra)



Figure 52: Our dominant soil conditions often result in shallow clay topsoils that are easily waterlogged, particularly in winter months. (Source: Arterra)



Figure 53: Our dominant soil conditions often are very easily compacted which can be a great challenge to achieve successful tree growth and can often impact our mature existing trees due to lack of soil aeration and water ingress. (Source: Arterra)

3.5

Analysis and Appraisal

Soils and Natural Vegetation

Natural Vegetation

The most widespread natural vegetation community of the Liverpool LGA, as it existed prior to European settlement, was the Cumberland Plain Woodland. Liverpool is situated approximately in the middle of the broad shallow basin identified as the Cumberland Plain, which extends well beyond Liverpool LGA, to both the north and south.

The Cumberland Plain is not necessarily vegetated with a single, consistent and homogeneous woodland. It can be broadly categorised as containing Shale Hills Woodland and Shale Plains Woodland sub-communities.

Only 12% of the original extent of the Cumberland Plain Woodland remains and it was listed as a Critically Endangered Ecological Community under the NSW Biodiversity Conservation Act 2016 and is also listed as a nationally endangered ecological community under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (NSW Department of Planning, Industry and Environment).

In the western portions of the LGA there are also stands of the Camden White Gum (*Eucalyptus benthamii*), which is a critically endangered tree species that naturally occurs along the Nepean River.

Fifteen more distinct, Plant Community Types (PCT) are identified as occurring throughout the LGA. Remnant and endemic tree species representing these communities are found throughout the LGA.

These endemic species should be prioritised and utilised as much as possible within our parklands, where the growing conditions and space are likely to be favourable for them to thrive. Only a few of these species, however, are particularly appropriate for use as urban street trees. This is due to their ultimate size, habit and forms, the harshness of the urban environment, higher levels of air pollution and often severely limited soil volumes or altered conditions in which to grow.

An extensive list of Recommended Tree species has been developed for use in various contexts, including recommendations for street trees. These are listed in Section 3.3 of Liverpool's Tree Management Technical Guidelines.

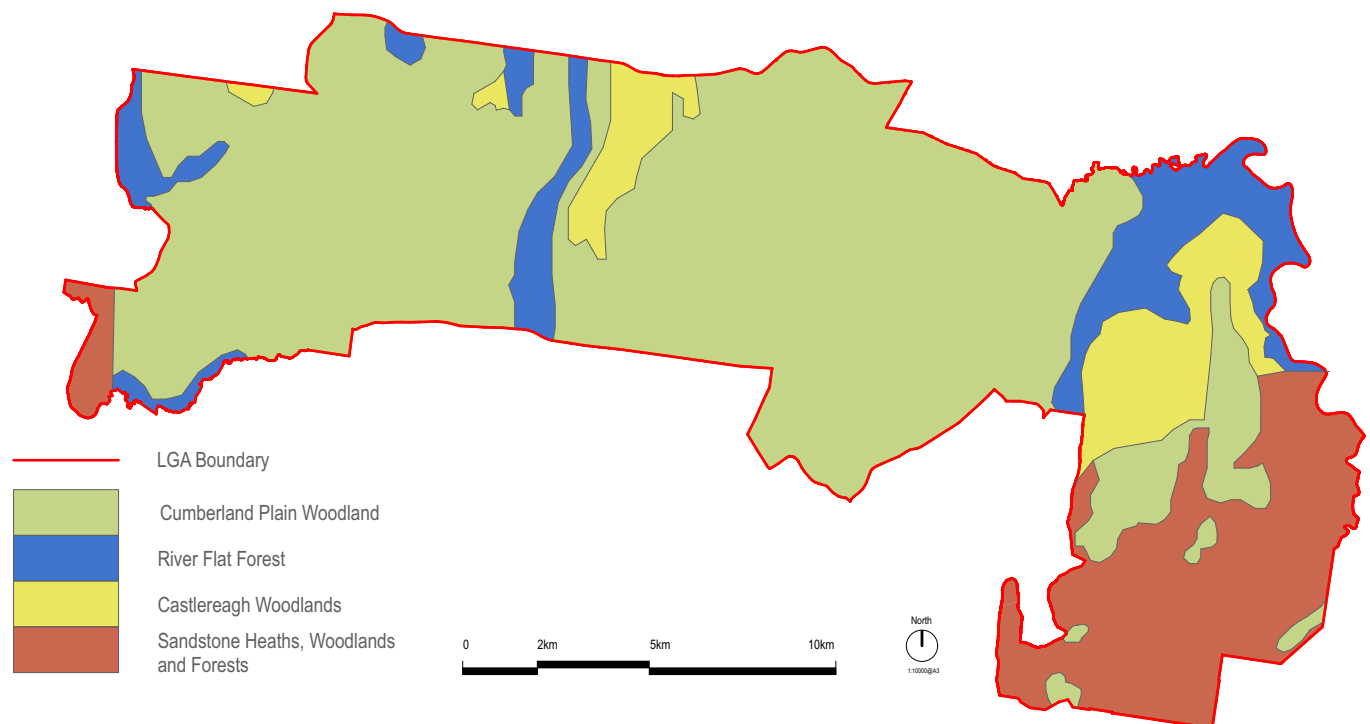


Figure 54: Simplified mapping of naturally occurring vegetation of the Liverpool LGA, as it likely existed prior to 1788. (Source: Arterra adapted from 'Taken for Granted' Benson and Howell)

3.5

Analysis and Appraisal

Soils and Natural Vegetation



Figure 55: An example of the once extensive and ecologically diverse Cumberland Plain Woodlands and related vegetation communities that dominated much of the Liverpool LGA . (Source: Arterra)



Figure 56: A Forest Red Gum planted around Gough Whitlam Park. (Source: Arterra)

Primary Endemic Tree Species

Angophora floribunda (Broad-leaved Apple)
Casuarina cunninghamiana (River She-Oak)
Corymbia maculata (Spotted Gum)
Eucalyptus tereticornis (Forest Red Gum)
Eucalyptus amplifolia (Cabbage Gum)
Eucalyptus botryoides (Bangalay)
Eucalyptus crebra (Narrow-leaved Ironbark)
Eucalyptus fibrosa (Red Ironbark)
Eucalyptus moluccana (Grey Box)
Melaleuca decora (White Feather Honeymyrtle)

Secondary Endemic Tree Species

Angophora bakeri (Narrow-leaved Apple)
Eucalyptus elata (River peppermint)
Eucalyptus eugenioides (Thin-leaved Stringybark)
Eucalyptus longifolia (Woollybutt)
Eucalyptus parramattensis (Parramatta Red Gum)
Eucalyptus racemosa (Hard-leaved Scribbly Gum)

3.6

Analysis and Appraisal

Green Grid and Corridors

3.6 Green Grid and Corridors

The Green Grid proposal for Greater Sydney is an interconnected network of high quality green spaces. An interwoven landscape of green space improves the 'liveability' of places, keeps urban spaces cooler, as well as enhancing biodiversity and ecological resilience. The Liverpool LGA is rich in an existing network of rivers and creeks, linking the landscape. Together with road corridors they provide major opportunities to increase the connectivity of green spaces. Stronger links can be created through better planting of major road corridors, riparian zones and our parks and reserves.

Road Corridors

By their nature, road corridors are continuous, linking ribbons of land, criss-crossing the LGA. Well planted road corridors, especially where there are generously sized verges, can serve as a vegetated link between parks, drainage reserves and private landscapes.

The Northern Road and portions of Elizabeth Drive are noted as particular opportunities for establishment of green boulevards.



Figure 58: Road corridors are essential for connection and transport, within and through the LGA. Nearby verge and street tree planting is an obvious 'linking' opportunity for the LGA's green grid. (Source: Arterra)

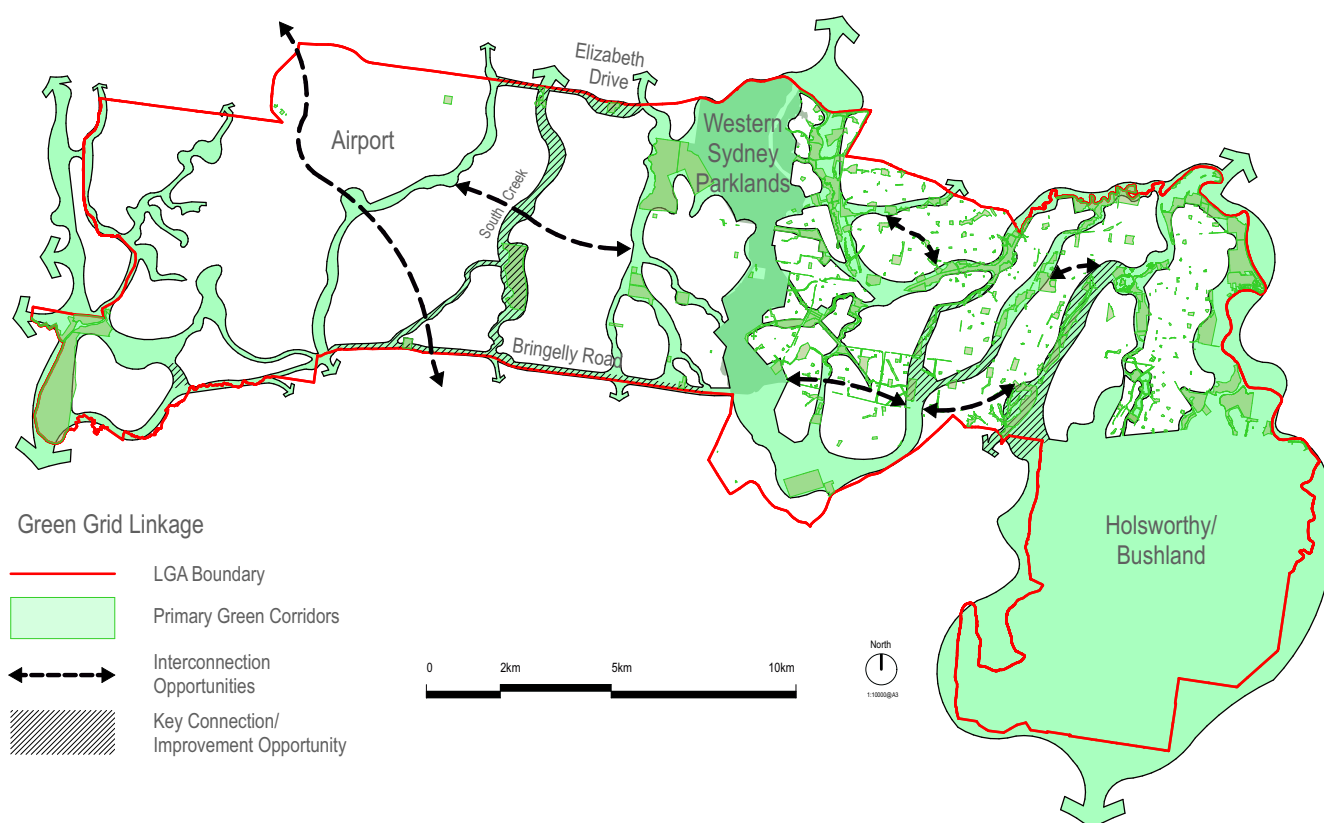


Figure 57: Diagrammatic representation of some the major opportunities to reinforce and link existing green spaces, creeks and major road corridors for the social and environmental benefits of a more interconnected series of forested 'greenways'. (Source: Arterra)

3.6

Analysis and Appraisal

Green Grid and Corridors

Riparian Corridors

Similar to roadways, watercourses provide a valuable opportunity for continuity of tree cover and ecological connectivity of open space.

The Liverpool LGA has a predominantly north-south system of rivers and creeks. This includes significant tributaries of the Hawkesbury-Nepean River, such as South Creek, Kemps Creek, and Badgerys Creek in the western areas.

The eastern part of Liverpool drains to the George's River and includes the tributaries of Hinchinbrook Creek, Cabramatta Creek, Maxwells Creek and Brickmaker's Creek.

Some of these waterways are currently degraded, however, revegetation, and tree planting in particular, can begin the natural processes that create better water quality and support connectivity for wildlife.

Restoration of the South Creek riparian corridor has been identified as a priority project in the Western Sydney City Deal. Council has a key role and responsibility to work with government stakeholders and private property owners to bring this project to fruition.

Upper Canals

Another priority project opportunity in the Sydney Green Grid plan is the urban greening of the Upper Canal open space. This state heritage listed structure is approximately 58kms of tunnels, aqueducts and open channels that extends from Cecil Hills to West Hoxton, and represents a significant amount of land in public ownership. The Upper Canal is managed by the Sydney Water Catchment Authority. Council has a role to collaborate with the Authority for this major greening project within the LGA.

Park Lands

Council parks and reserves constitute approximately 4% of the total LGA. They provide sports and recreation space as well as environmental services and have the potential to be the highest quality green spaces in the LGA. Although parks represent a small percentage of the LGA their capacity for new tree plantings is very high.

Canopy cover in parks can be increased to 50-70%, while still allowing a range of solar access, including places of deep shade, dappled shade, as well as open, sunny areas. Denser planting in some parts of our parks and drainage reserves creates the opportunity for far better quality ecological linkages and biodiversity.



Figure 59: Restoration of creek and river banks, especially through tree planting, enhances the ecological connectivity of green spaces and their biodiversity potential. It also present immense opportunities for high quality passive recreation. (Source: Arterra)

3.7

Analysis and Appraisal

Urban Growth

3.7 Urban Growth

The planned population increase for the Liverpool LGA and the resultant loss of semi-rural landscapes that accompanies this, will only exacerbate the current western Sydney 'heat island' conditions. Existing neighbourhoods that lack trees and shady recreation places, will need green infrastructure to be improved. It will become increasingly important to design new landscapes with sufficient tree planting, to ensure they are resilient spaces to comfortably accommodate people and environmental requirements.

Intensification of the LGA is not only associated with the creation of new suburbs through urban release and subdivision, it also relates to the increasing density of development. "Since 2008, most areas of Liverpool required a back yard of minimum 60m². Newer areas such as Middleton Grange have this reduced to 50m²" (Liverpool City Council, 2008).

Over time, more and more new dwellings only meet the minimum private open space size, with limited deep soil to allow for growth of trees. This trend towards a reduction in private property trees places increasing emphasis on the importance of public trees and the responsibility for Council to plant and maintain trees within the public domain.



Figure 60: Solar panels are an important sustainability initiative, however it is hugely counter productive to remove trees to merely facilitate solar panel efficiency. They need to co-exist. (Source: Arterra)

The City of Sydney's DCP General Provisions require that major, new tree plantings should maintain solar access to existing panels, where possible, having regard to a range of factors, however, there is no provision allowing existing, mature trees to be pruned or removed to accommodate solar panels.

The City of Melbourne Tree Retention and Removal Policy is unequivocal in stating that tree pruning or removal will not be considered for solar access to private property, gardens or solar panels.



Figure 61: Urban growth and development has a major impact on existing trees and existing young street trees. They do offer very real opportunity to achieve progressive and ultimate urban canopy cover if designed and installed well, with trees as vital infrastructure and not an after thought. (Source: Arterra)

3.8

Analysis and Appraisal

Utility and Services

3.8 Utilities and Services

Trees are essential infrastructure however they are often in conflict with other services in streets and roadways; and needing room to grow. While in the past provision of services has been prioritised, the increasing understanding of the value of trees and their unique ability to mitigate the effects of climate change and the heat island effect, means they now need to be given equal priority in decision making for public space.

There are a few places where the presence of services would prevent trees being considered for planting (for example under high voltage lines and immediately adjacent to storm water inlets). In general, trees can be considered for inclusion in most street situations, and it is a wasted opportunity not to plant trees due to the presence of services.

Overhead Utilities

Careful consideration needs to be given to locations situated beneath powerlines, especially under high voltage lines, that require greater clearances. A poorly chosen tree can result in ongoing maintenance issues. Opportunities for tree planting below overhead power lines include the:

- selection of a suitable small growing tree that will not grow into the lines; or
- negotiating for installation of Aerial Bundled Conductors (ABC).

It is generally accepted that bigger trees provide greater overall benefits than smaller trees. By stipulating ABC (good option) or undergrounding (best option) of services in its relevant planning controls, Council can minimise future conflicts with services and gain the benefits of larger trees and the greater canopy cover that they provide. Where ABC wires are proposed, larger tree species may be selected for planting (refer to the tree species section of the TMTG). It will be encouraged that all new developments (where practical and feasible), undertake the under-grounding or upgrading of existing overhead electrical infrastructure to ABC, to facilitate the implementation of larger (an increased canopy providing) tree plantings.

The City of Sydney, and many other Councils, have been successful in using the ABC method to reduce the amount of clearances required and allowing a more natural tree form to be planted and retained for their streets. This has the further benefit of reduced costs for ongoing pruning maintenance. In-road planting is a further opportunity for tree planting to better avoid overhead wires, and should be considered where road widths and budgets allow.

For new subdivisions, and where larger scale redevelopment or urban renewal projects are undertaken, all traditionally overhead services should ideally be placed underground, especially in those situations where only small trees may need to be removed to allow this to occur. The long term benefits of larger trees that do not need clearance pruning, are likely to far outweigh the short term loss of canopy.



Figure 62: Trees and overhead power lines can co-exist if managed well and over head cables are converted to ABC before planting reaches mature heights. A particularly successful outcome is demonstrated along Gardners Road in Rosebery. (Source: Arterra)

Underground Utilities

Trees are often competing with in-ground services for room. Roots will spread opportunistically, finding all available space to grow, including sometimes into private property and below roadways. Where possible, trees should be planted in a well prepared and designated zone that does not overly interfere with services or access for maintenance purposes.

Solar panels

Solar panels and trees are both useful initiatives for an environmentally friendly, sustainable future. Sometimes the two are in conflict, where trees are shading panels, limiting their exposure to sunlight. Solar panels are most effective when they receive direct sunlight. Shade, clouds and rain may reduce output of the system, however, both direct and indirect sunlight will result in production of electricity.

Our Tree Policy takes into account the lifespan of a large tree and its contribution to the wide community and prioritises the broader community benefits ahead of shorter term or personal outcomes. It is counter-productive to remove trees for the sole purpose of allowing sunlight to solar panels. Liverpool City Council follows best practice in prioritising existing trees, over solar panel exposure. However, consideration may be given to existing solar panels, when determining the location of new tree planting.

3.9

Analysis and Appraisal

Traffic and Vehicles

3.9 Traffic and Vehicles

Roads and Traffic Authority's 2008 Landscape Guideline, provides a minimum landscape design standard for the greening of road corridors. It is focussed on safety, ease of maintenance and cost effectiveness and is often more relevant to motorways and highways.

The guideline document is due for review; however the key messages include:

- Tree planting should not obscure important sight lines.
- Landscape installations should preferably require low maintenance.
- Design of a road corridor should ensure adequate space is allowed for landscape and trees.
- Clear zones are determined on the basis of maximum speed limits.
- Appropriate planting sizes and spacing should be observed for urban road reserves, streets and avenues.

Updated and detailed specifications for tree selection in road corridors is provided in the Tree Management Technical Guidelines.

Council recognises the importance of designing for safety and appropriate road use and has incorporated current standards and guidelines for any street tree planting within our Tree Management Technical Guidelines.



Figure 64: By shading pavements, trees not only reduce the heat island affect but also reduce maintenance costs for roads and footpaths by preserving them from the damaging effects of sun. (Source: Arterra)



Figure 63: The right choice of tree, with a high canopy, can maintain good view lines for safety and also greatly contribute to the canopy cover and amenity of a neighbourhood. (Source: Arterra)

3.10

Analysis and Appraisal

Cultural Attitudes

3.10 Cultural Attitudes

Liverpool has a wide and diverse population, living in apartments, small and large allotment suburban housing, and public housing. The community includes residents, business owners and those who live elsewhere but travel to Liverpool for work. The community ranges in age, income and education and is one of the most culturally diverse LGAs in NSW with almost one in three people born overseas and almost half the population speaking a language other than English at home. Liverpool also has a significant Aboriginal community. All have differing interests and attitudes toward trees, from those who engage positively in greening activities to attitudes of extreme or irrational fear of trees. An individual's attitude towards trees on their own land is often intensely personal.

More than 80% of the LGA is not managed by Council. This includes land managed by other government agencies and approximately 50% of the LGA which is private ownership, including residential, business and agricultural land.

Greater canopy cover will require the community to embrace trees as part of the private open space, which may require a radical shift of broader community attitudes. The level of change required may be a generational outcome, so educational efforts and awareness programs need to begin as early as possible and to target all audiences to address barriers to behavioural change.



Figure 66: Even a small canopy tree is better than no canopy tree. We must alter our thinking if we are to ever address our climate emergency and make Liverpool a healthy and sustainable place to live. (Source: Arterra)



Figure 65: We need to overcome the cultural and socio-economic barriers to trees around our houses. Just one tree can make a huge difference at the scale of the individual property, the precinct and the neighbourhood. (Source: Arterra)

3.11

Analysis and Appraisal

Other Key Threats

3.11 Other Key Threats

Current and Future Pests and Diseases

Pests and diseases can pose a great risk to the health and longevity of our tree assets. Pest and disease threats are increasing and changing within our urban environments due to climate change, greater global trade, movement of people and gradual reductions of Australia's biosecurity measures.

Pest and disease control on a large scale can be challenging, costly, and in many circumstances, not even practical or feasible. Some diseases also have no effective treatments. Some diseases have proven to have devastating effects on tree populations. Overseas examples, such as Dutch Elm Disease and Emerald Ash Borer, illustrate how quickly entire tree populations can be all but wiped out. Analysis, understanding and ongoing monitoring of major pest and disease outbreaks is a critical part of our tree management.

There are already known hotspots of Phytophthora dieback (*Phytophthora cinnamomi*) at Kemps Creek. Previous instances of tree die-back caused by concentration and repeated occurrences of Eucalypt psyllids have also led to extensive tree losses and impacts to tree health, particularly within our native Grey Boxes (*Eucalyptus moluccana*) populations.

There are several known pests and diseases that have, and can affect the trees in Liverpool. As with much of Sydney, these include:

- Australian Honey Fungus (*Armillaria luteobubalina*)
- Plane Anthracnose (*Apiognomonia veneta*)
- Cuban Laurel Thrips (*Gynaikothrips ficorum*)
- Eucalypt / Grey Box Psyllid (*Cardiaspina* sp.)
- Fig Psyllid (*Mycopsylla fici*)
- Figleaf Beetle (*Poneridia australis*)
- Fusarium Wilt (*Fusarium oxysporum*)
- Painted Apple Moth (*Teia anartoides*)
- Pink Wax Scale (*Ceroplastes rubens*)
- White Rots (*Phellinus* sp.)
- Phytophthora dieback (*Phytophthora cinnamomi*)
- Sycamore Lace Bug (*Corythucha ciliata*)
- Winter Bronzing Bug (*Thaumastocoris* sp.)
- Myrtle Rust (*Uredo rangelii*)

The key ways we will deal with pests and diseases include:

- Monitoring for pests and diseases on a continuous basis as part of regular tree inspections
- Maintaining a diverse range of species. The more diversification, the less risk of major tree and canopy cover loss from a major pest or disease event.
- Maintaining appropriate and healthy trees. A tree's ability to cope with a pest or disease depends in large part on the environment in which it is growing. Harsh conditions and poor maintenance often makes it more difficult for trees to naturally defend and recover from outbreaks.
- Reviewing any unexplained tree deaths to understand the reason behind any larger scale tree decline.
- Implementing appropriate hygiene protocols

Refer to Section 4.4 in the Tree Management Technical Guidelines for further guidance and information.



Figure 67: Illustration of the purple discolouration and distortion of the leaves and the prominent yellow fruiting spores of the Myrtle Rust. (Source : www.flickr.com/photos/48395196@N05/5402288905/sizes/o/in/photostream/ - accessed 5/3/11)

3.11

Analysis and Appraisal

Other Key Threats



Figure 68: Sycamore Lace Bug damage to London Plane Tree illustrating the premature death of some leaves, the attempt by the tree at secondary foliage growth late in the season and the subsequent chlorosis occurring also to those new leaves as a result of the pest. (Source : Arterra)



Figure 69: Sycamore Lace Bug - Adult Stage (Source : www.flickr.com/photos/xx_chaton_xx/5139448467/sizes/l/in/photostream/ -accessed 5/3/11)

Soil Salinity

Soil salinity (also referred to as dryland salinity) is the cause of serious land and water degradation in many parts of Australia. A complex range of biophysical factors contribute to dryland salinity. Salinity is the accumulation of salt in land and water to a level that impacts on both the natural and built environments. The impacts of salinity can affect native plants and animals, aquatic and terrestrial ecosystems, agricultural crops and pastures, water supplies and infrastructure such as roads and buildings.

Salinity is a process inherent in the Australian landscape; however, human activities have accelerated the process of salt mobilisation and accumulation.

In urban areas the increased recharge and rising groundwater are caused by activities such as clearing of vegetation for development, over-irrigation of gardens and public parks, inappropriate stormwater discharge, disruption of natural drainage lines and leakage from water pipes and swimming pools.

Soil salinity issues can occur when the water balance in the landscape is changed and salt is mobilised by groundwater as it rises to the land surface. The removal of native vegetation and its replacement with agriculture or urban development has resulted in significant change to the water balance in many areas. To manage dryland salinity, groundwater levels must be lowered and the equilibrium between water inputs and outputs re-established.

In the absence of information about their long term impacts, many of our past land management practices caused excessive loss of topsoil through erosion, compaction of topsoil and subsurface soils, soil structure decline, depletion of organic matter and increased acidity. These changes have resulted in degraded soils with a much reduced water holding capacity. (NSW DPI, 2009)

Key factors Council will try to address to deal with our existing and potential soil salinity issues are to:

- Increase our urban tree and canopy cover to improve natural rainwater infiltration and natural water uptake by vegetation.
- Improved soil health and resilience.
- Reduce impervious surfaces and allow more natural rainwater infiltration and passive irrigation outcomes.
- Utilising and trialling salt tolerant native species where salinity is already affecting health and establishment of trees.

3.12

Analysis and Appraisal

Key Opportunities

3.12 Key Opportunities

Analysis of the physical and cultural context of the Liverpool LGA, taking into account its vulnerability to heat and its location as a growth area of Sydney, highlights the importance of using trees for greater liveability. This gives rise to a range of opportunities where Council has both agency and responsibility to effect change, including:

- Mitigate the heat island effect and provide cooler places by extending urban tree canopy and retaining water in the landscape.
- Focus on the care and assessment of Council-managed trees.
- Increase canopy through planting of Council-managed streets, parks, and other sites.
- Incorporate trees as an essential component of all Council's major projects including road upgrade projects and the Fifteenth Avenue smart transit (FAST) corridor.
- Focus on the parts of the LGA with least canopy, highest heat island indicators, and most vulnerable populations.
- Raise awareness in the community about the benefits of trees and work with private owners and other government agencies to increase canopy cover.
- Work in co-operation with the NSW Government to restore and protect South Creek.
- Regulate preservation of trees and expansion of canopy through statutory instruments and enforce compliance.



Figure 71: A key opportunity for Council is to increase tree canopy through additional planting of Council-managed parks. (Source: Liverpool City Council)



Figure 70: Well cared for trees in our urban areas contribute to our physical and mental well-being and our increasing need for cool, green and resilient public spaces. (Source: Arterra)

3.12

Analysis and Appraisal

Key Opportunities

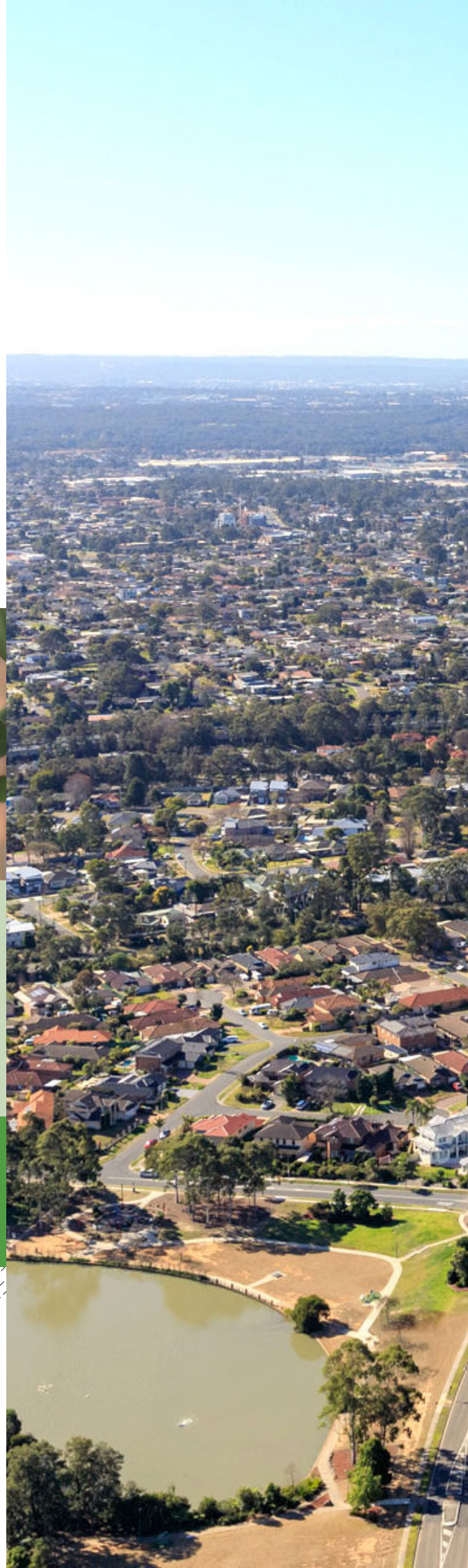


Figure 72: Hume Highway at Casula. Wide verge between a major and local road, has provided a unique opportunity for large trees and dense tree planting. Large native trees are able to be situated away from potential conflicts with overhead wires while still allowing excellent visibility for vehicular traffic and passive surveillance. (Source: Arterra)

The City of Ryde is a comparable LGA to Liverpool. They conducted a community survey on trees (Nov 2021) found more than 75% of all residents surveyed, place a high importance on street planting in their street and identified having too few trees. There was a noticeable age bias in attitudes towards trees. Younger people (<50 years) placed higher importance on the benefits of trees to property values and privacy, while older residents (>65) years were concerned with leaf and fruit drop.

While 88% of responders were English-only speakers, non-English speakers were significantly more concerned about numerous issues with street trees than English speakers.

This section of the Strategy establishes the goals that Liverpool is setting and the strategic directions to achieving these, through a specific set of actions.





4.0

THE STRATEGY



4.0

THE STRATEGY



Figure 73: Mature trees are the most significant component of green and liveable cities. Trees provide similar benefits for people, whether they are in natural places or urbanised areas. (Source: Arterra)

4.1 The Vision

Liverpool has developed a vision for its tree management and canopy cover enhancements to guide all our practices and achieve our long term targets.

Our vision:

Create a greener, healthier and more beautiful, comfortable, inclusive place to live, work and visit.

Council will take a leading role in creating a greener Liverpool by actively caring, protecting and enhancing our urban trees and canopies, ensuring that they are fairly distributed and healthy for a sustainable and resilient environment, for the future wellbeing of our community and a changing climate.

Council will actively support, and provide opportunity to the community to help contribute to the realisation of a greener Liverpool.

Natural growth, that truly sustains people and communities, takes generations to mature.

Because of this we must intentionally invest in the foundations now, while respecting and building on the ones laid out by those before us.

Only then can we nurture and create a better world for the many generations that follow. (Tree Coach ®)

4.2

The Strategy

Canopy Cover Targets

4.2 Canopy Cover Targets

For the Liverpool LGA, an increase of 7% from the current overall 23% cover to the desirable average of 30% cover is achievable. This can be reasonably undertaken over the next 20-30 years, if we break it into two stages and aim to achieve:

- **28% canopy cover by 2035;** and
- **30% canopy cover by 2050**

These targets include Holsworthy and Greendale, which are predominantly non-urban areas, have a large proportion of bushland and skew the percentages higher. Refer to the following section on Urban Canopy Targets for more detailed discussion around proposed canopy enhancements.

These targets may not appear as ambitious as the targets of other western Sydney LGAs, however they realistically take into account the expected canopy losses that are anticipated as a result of projected urban growth and development of urban release areas and also the realistic prospects of introducing a significant amount of tree planting, when Council manages less than 9% of the land area.

It is not intended that these target figures would represent a homogeneous canopy percentage across the LGA. Some areas, such as public parks and Holsworthy can achieve much higher percentages of cover, while highly urban places like the Liverpool Central Business District, industrial areas and regional roads, can only achieve a more moderate cover as they are limited in their planting opportunities and often have harsher growing conditions.

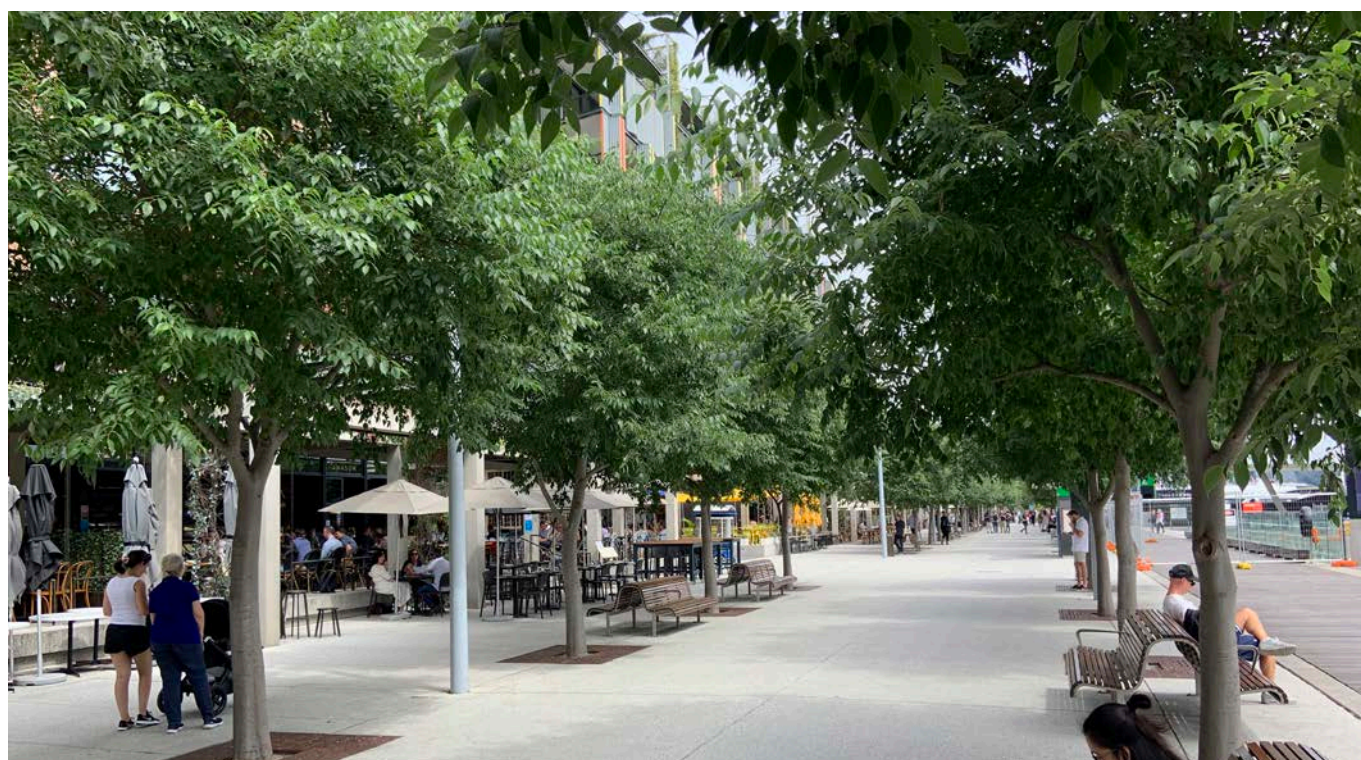


Figure 74: Barangaroo, Sydney, illustrating that great tree planting can coexist with pavements and other urban activities. There is a notable drop in temperatures on summer days in this area when compared to nearby similar areas with fewer trees. (Source: Arterra)

4.2

The Strategy

Canopy Cover Targets

More Detailed Urban Areas Canopy Targets

Current canopy cover of our more urban area is lower than the overall LGA average and is only achieving approximately 14% cover. We need to do better and focus on our urban and more vulnerable areas as the first priority.

Our goals for canopy cover have been developed through research of current best practice in Australia and overseas and are based on detailed analysis of our landuses and capacity for tree planting. This underpins the rationale for the greening objectives. A 30% cover is generally considered the minimum coverage to aim for to achieve the measurable benefits and aligns with the intentions and aspirations of many other local and international cities.

We will work towards an increased canopy cover in the broader urban and suburban areas with the following more specific average targets. If we can aspire to these then we believe we can reach the stated overall objective of 30% average canopy cover for the whole LGA by 2050.

Table 10 Average Canopy Targets for General Land Use Types

Land Use Type	Existing Canopy 2023 (%)	Target Canopy 2035 (%)	Target Canopy 2050 (%)
Business	5%	8%	10%
Industrial	6%	20%	23%
Residential	9%	22%	28%
Recreation & Environmental	28%	38%	46%
Rural	19%	29%	31%
Special Uses	42%	48%	48%
TOTAL AVERAGE FOR LGA	23%	28%	30%

*Achieving a 30% canopy cover, requires more than **300,000** new trees to be planted across the LGA in the next 26 years.*

Table 11 Average Canopy Targets for Major Land Use Zonings

Land Use Type	Zoning Code	Existing Canopy 2023 (%)	Target Canopy 2035 (%)	Target Canopy 2050 (%)
Agribusiness	AGB	3%	5%	10%
Business	B1	8%	10%	10%
Business - Local Centre	B2	9%	10%	10%
Business	B4	5%	10%	10%
Business Development	B5	17%	17%	20%
Local Centre	E1	7%	10%	10%
Commercial Centre	E2	4%	10%	10%
Productivity Support	E3	5%	10%	10%
Mixed Use - Aerotropolis	MU	6%	10%	10%
Mixed Use	MU1	7%	15%	15%
Industrial - General	E4	6%	10%	15%
Industrial - Heavy	E5	3%	5%	10%
Enterprise- Aerotropolis	ENT	7%	25%	25%
Industrial - Light	IN2	7%	10%	15%
Res-General Residential	R1	3%	10%	15%
Res-Low Density Residential	R2	8%	15%	20%
Res-Medium Density Resid.	R3	11%	15%	20%
Res-High Density Resid.	R4	13%	20%	25%
Res-Large Lot Residential	R5	14%	25%	30%
Public Recreation	RE1	30%	45%	50%
Unzoned WSP	WSP	24%	30%	40%
Private Recreation	RE2	20%	25%	30%
Env. Protection	C1	37%	50%	60%
Env. Protection (NP & Res)	C1	43%	50%	70%
Environmental Conservation	C2	42%	50%	70%
Environmental Management	C3	39%	50%	60%
Environmental Protection	C4	12%	30%	30%
Env. and Recreation	ENZ	24%	30%	30%
Rural - Primary Production	RU1	23%	25%	25%
Rural - Rural Landscape	RU2	21%	25%	25%
Rural - Prim. Prod. - Sm Lot	RU4	15%	15%	15%
Rural - Transition	RU6	14%	15%	15%
Schools (suburban)	varies	15%(est)	25%	40%
Schools (urban)	varies	10%(est)	20%	25%
Special Activities - 1	SP1	2%	5%	5%
Special Activities - 2	SP2	3%	5%	5%
Special Activities (Defence)	SP2	67%	67%	67%
Special Activities (Airport)	SP2	4%	5%	5%
Water	W1	0%	0%	0%
TOTAL AVERAGE FOR LGA		23%	28%	30%

4.2

The Strategy

Canopy Cover Targets

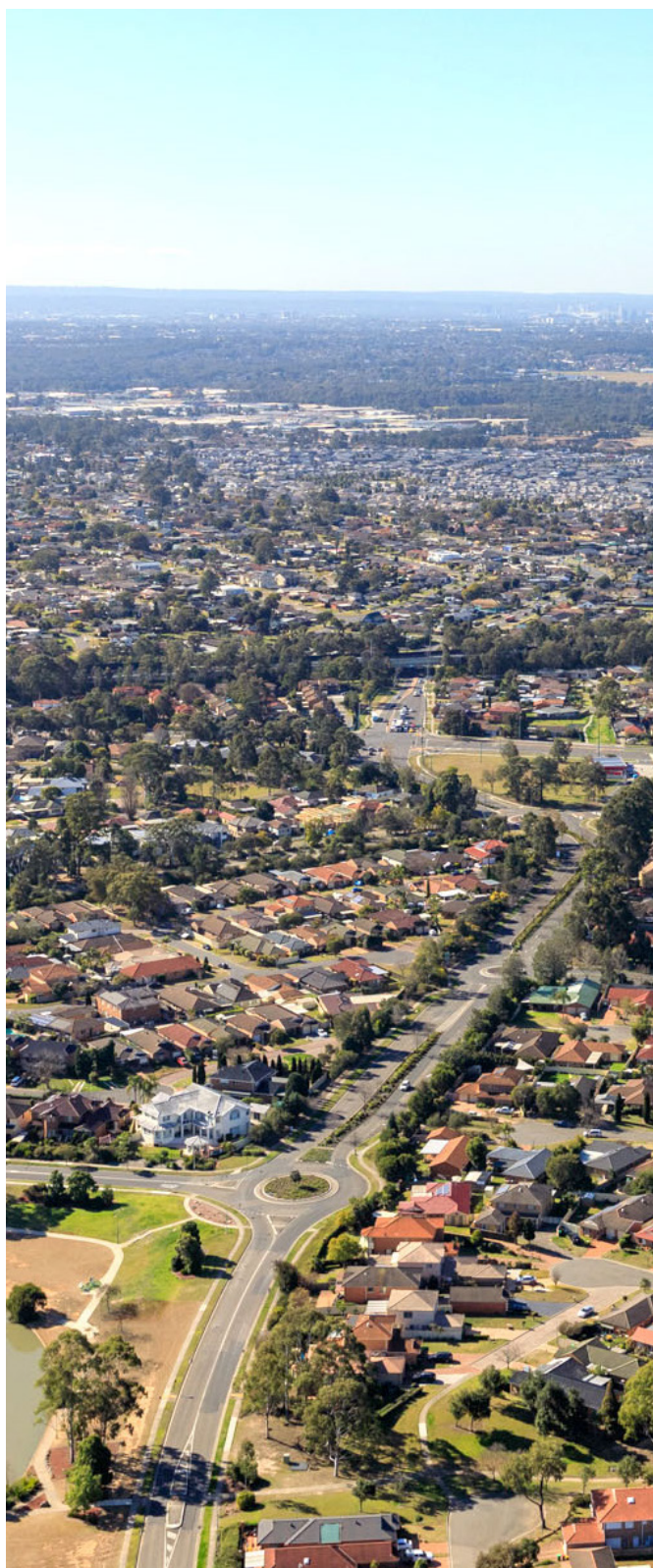


Figure 75: To create canopy cover, create additional canopy cover and improve our community's health and well being we need to plant more than 200,000 new trees over the coming two decades.

Council's commitment is to lead the way and substantially increase canopy cover with new tree plantings in the public domain, that is, in our streets and the public parklands of the LGA. Council-managed land, however, amounts to only **9%** of the LGA. We will work towards the following targets for our streets and parks.

Table 12 Canopy Targets for Road Categories			
Street Type	Existing Canopy 2023 (%)	Target Canopy 2035 (%)	Target Canopy 2050 (%)
Motorways **	17%	20%	20%
State Roads **	8%	10%	10%
Regional Roads	10%	15%	20%
Local Roads	9%	30%	35%
Laneways	9%	15%	20%
TOTAL AVERAGE FOR ROADS	10%	25%	30%

** Some areas within these categories are not managed by Council.

Table 13 Canopy Targets for Open Space Categories			
Park Type	Existing Canopy 2023 (%)	Target Canopy 2035 (%)	Target Canopy 2050 (%)
Regional and District Parks **	32%	40%	50%
Regional & District Sportsfields	8%	10%	10%
Local & Neighbourhood	18%	60%	70%
Pocket Parks/ Road closures	50%	50%	60%
Drainage Reserves	57%	80%	80%
Unclassified Open Space	66%	70%	75%
TOTAL AVERAGE FOR PARKS	29%	40%	50%

** Some areas within these categories are not managed by Council.

4.2

The Strategy

Canopy Cover Targets

Canopy Targets and Numbers of Trees

To achieve a canopy cover of 30% it is estimated to require adding approximately 2,200 hectares of tree canopy to our existing 7,100 hectares of tree canopy across the LGA. This also requires us to retain and protect as many of our current trees as possible. This can be achieved if we start immediately and continue in a consistent and staged manner over the next 20-30 years.

Taking into account losses that are expected as trees age and die, or removed as sites are developed, the targets will require more than **15,000 trees to be planted annually** across the LGA as a whole, over the next 11 years till 2035.

This requires:

- **2,700** trees / year in our parklands, drainage reserves;
- **4,300** trees / year in streets; and
- **8,000** trees / year in private property or lands managed by other agencies.

For the 15 years beyond 2035, assuming we are meeting those targets (2035 - 2050) will we require **10,000 trees to be planted annually**.

This requires:

- **1,000** trees / year in parklands, drainage reserves;
- **1,000** trees/year in streets; and
- **8,000** trees/year in private property or lands managed by other agencies.

The numbers estimated are based on an average sized medium tree, with an ultimate mature canopy of around 70-80 square metres. Initially, tree planting efforts will have minimal impact on canopy measurements as we wait for them to mature. For this reason, the bulk of the planting is proposed to occur in the earlier time period to allow trees the time needed to grow their crown and begin to achieve meaningful contributions to our canopy cover.

While Council will do what it can, achieving our broader canopy targets will require some proportional increases in tree planting to occur on private lands. Reaching the target, or exceeding it, necessitates a significant shift in the community's attitude towards trees. This is likely to be a gradual, and perhaps a generational change.

In the shorter term, it is expected that some other government agencies that manage trees in the Liverpool LGA will also help contribute to our canopy targets, especially those agencies that oversee areas of parkland and larger open space, including:

- Western Sydney Parklands;
- Water NSW;
- National Parks and Wildlife Service;
- The Aerotropolis and
- Australian Defence Force (Holsworthy Defence Lands)

Development and the Relationship to Bushfire Asset Protection Zones (APZs)

Significant limitations on site specific canopy targets can occur because of currently documented Rural Fire Service bushfire and APZ creation requirements. This poses significant challenges for new urban release areas, and some other developments, to achieve the canopy targets set out by both state and local governments. In this regard, it is strongly encouraged that for any new developments, where an adjoining site is already zoned to facilitate a future increase in density and is likely to be redeveloped (within a foreseeable time frame), the applicable RFS bushfire and APZ requirements should be amended, or relaxed, to properly account for the likely significant reductions in the associated bushfire risks and often the ultimate elimination of the need for any APZs. In particular, the requirement for adherence to a maximum of only 15% canopy cover and non-overlapping canopy requirements need to be urgently reconsidered by all levels of Government.

It is acknowledged that this is a common issue without any obvious solution. The TMS, like other strategic documents can't predict what may or may not happen with future individual developments, and in particular can't predict how long a land owner may, or may not, take to develop a forested site.

Additionally, influencing the Rural Fire Service's bushfire planning process is currently beyond the scope of the TMS and Council. This is a state government issue, which is highly problematic on many fronts, as it frequently precludes canopy cover being achieved on many sites and particularly on special use sites where the APZ requirements are often applied across the entire site.

Applying retrospective canopy coverage would only be possible when a site use changes, or a new DA is lodged. In some instances it could be several decades before the effects of the APZ can be overcome. Imposing a retrospective canopy coverage without some sort of trigger is likely to be unworkable and unenforceable. Delayed conditions of consent applied through the typical planning and approval process may be applicable but may also be impractical. A more common sense and holistic approach to the application of bushfire restrictions on achieving desired canopy percentages should be advocated for by Council, directly with relevant state government agencies and officials.

4.2

The Strategy

Canopy Cover Targets

To achieve our targets we need to plant

2,700
trees a year in our parks

4,300
trees a year in our streets

and encourage and support our residents, businesses and other agencies to plant

in excess of
8,000
trees a year
within their own properties

Every year.... for the next 11 years.

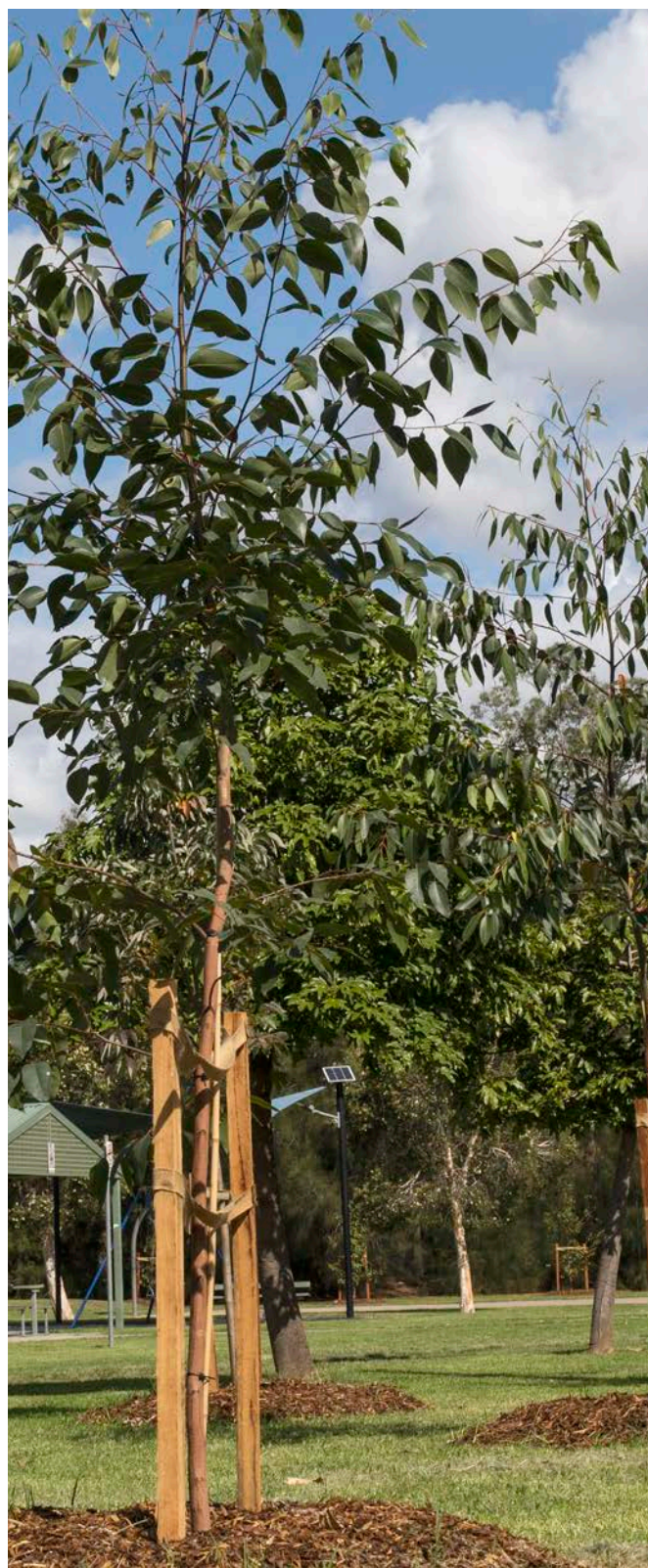


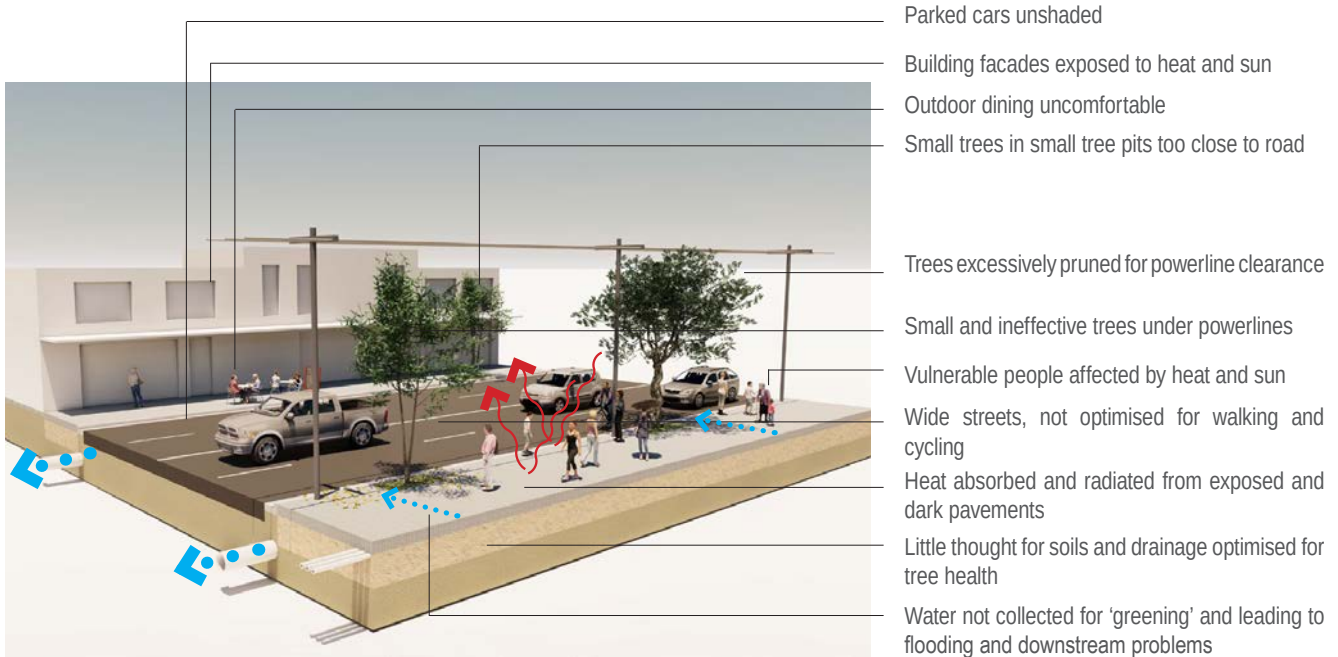
Figure 76: Trees need time to grow and we already need to be replacing trees as they die or are removed. We must embark on an ambitious tree planting program, and start immediately. Council will lead the way, but our residents must contribute to improving our tree cover as well. (Source: Arterra)

4.2

The Strategy

Canopy Cover Targets

WHERE WE ARE 2023



WHERE WE NEED TO BE 2050

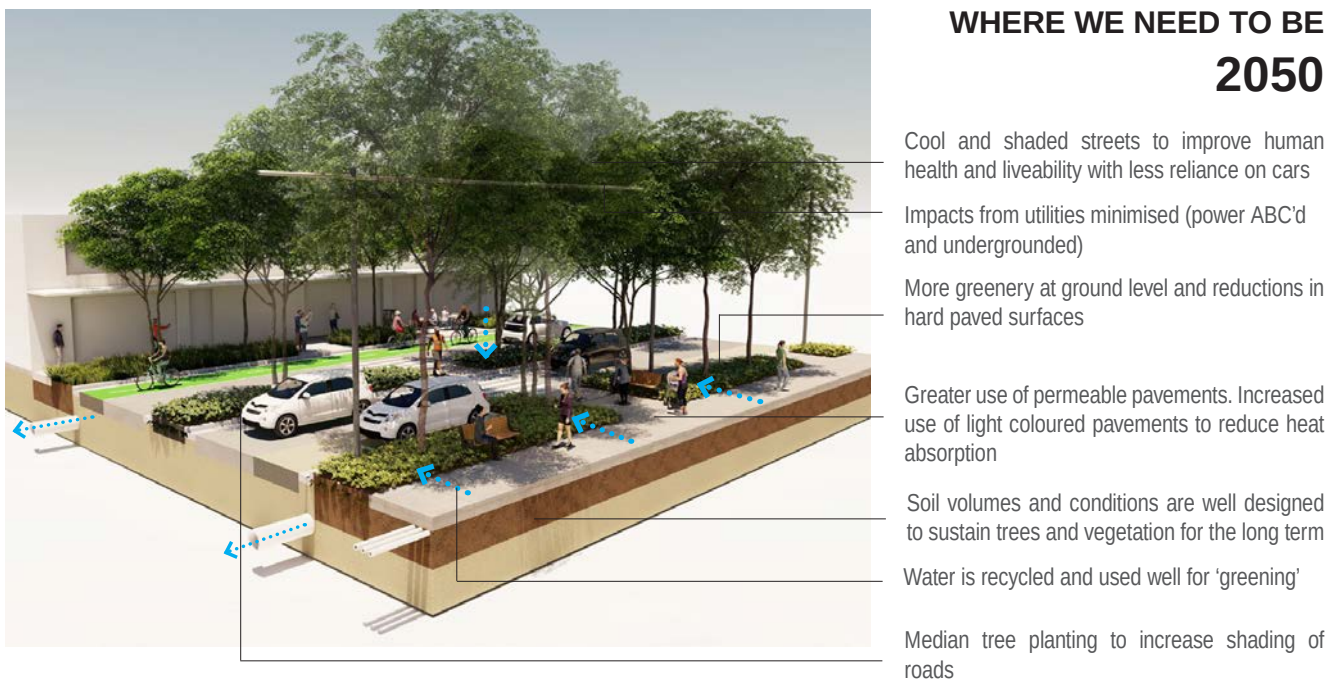


Figure 77: Visual representations of the approaches and intended long term outcomes of our Tree Management Strategy. (Source: Arterra)

4.3

The Strategy

Our Strategic Directions

4.3 Our Strategic Directions

The preceding sections set out the primary objective of this Tree Management Strategy and the specific goals that we will aim for and measure against. In responding to the vision and goals, a set of 10 specific directions have been devised to address each aspect of our goals and what is required to achieve them. Our strategic tree management directions are summarised below and further expanded upon in the following pages.

1. **Value** - *Identify and manage trees as assets*
2. **Canopy Cover** - *Increase canopy cover and build resilience*
3. **Manage** - *Manage the urban forest in accordance with best practice*
4. **Mitigate Risk** - *Manage tree-related risks*
5. **Living** - *Recognise the vital connection between 'green' and 'blue' infrastructure*
6. **Promote** - *Protect and promote trees on privately owned land*
7. **Capacity** - *Build Council capacity for tree management, planting and protection*
8. **Education** - *Build community awareness and encourage participation in urban greening*
9. **Protect** - *Manage the impact of development on existing trees*
10. **Support** - *Review planning policy and development controls to promote trees and tree retention*



Figure 78: Trees should be seen as a vital part of urban infrastructure. (Source : Arterra)

4.3

The Strategy

Direction 1 - Manage Trees as Assets

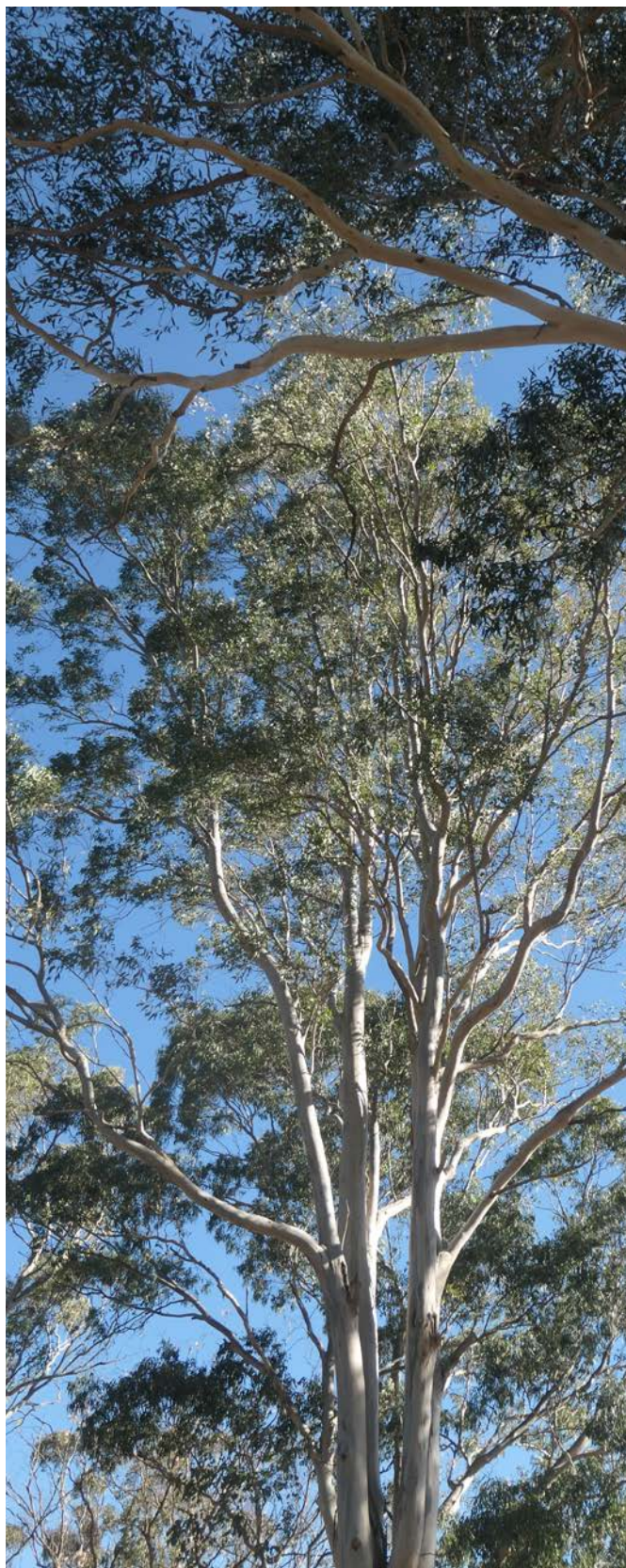


Figure 79: Healthy, mature trees, provide a range of environmental services and need to be managed as the community assets they are. (Source: Arterra)

Direction 1 - Manage Trees as Assets

Council managed trees are not currently consistently recorded, or managed as operational assets. What goes unmeasured is often undervalued. Good data is a pre-requisite for proper and defensible risk management and for providing an accurate basis for tree management decisions. In order to manage our trees and plan for appropriate planting and renewal programs, it is essential to identify our trees through survey and to establish a record of where the trees are, what they are and what is their condition. It is also essential to know how valuable they are individually, as larger groups, and as an LGA-wide canopy asset.

In addition to individual tree records, we will require updated data on the extent of canopy cover to use as a baseline against which our ongoing canopy goals can be measured and compared.

Ideally, management of street trees and park trees should be guided by more granular and specific master planning and management documents. The size of the LGA makes it difficult to undertake a comprehensive street tree master plan for all parts of the LGA. Initially, direction for street planting will be taken from this Strategy. In coming years, when resources permit, Council may embark on more definitive street tree master planning within some of the urban areas.

In decision making for new or replacement plantings, consideration will be given to achieving specific urban design outcomes such as dense summer shade, winter solar access, wind mitigation and providing appropriate scaled trees for the planting positions available. Species selection, planting design and installation methodology will adhere to our Tree Management Technical Guidelines.

While all trees in the LGA are protected under the Liverpool City Council's tree preservation requirements, outlined in the Tree Policy and the Tree Management Technical Guidelines, very few trees currently have the added protection associated with registration or statutory listing as a heritage item. Council will work towards identification and protection of our more significant trees, through an electronic 'Register of Significant Trees'. This will include private trees as well as trees in the public domain and other public ownerships. However, before we undertake this exercise we first need to address the basics of managing our trees as assets.

4.3

The Strategy

Direction 1 - Manage Trees as Assets

Actions:

1.1 Identify trees in our streets and parks as essential assets within our urban infrastructure and incorporate tree management into our broader asset management thinking and activities.

1.2 Progressively survey and adequately record all public trees, that are managed by the City of Liverpool, including our street trees, park trees and trees on any Crown land managed by the Council.

1.3 Progressively compile a tree inventory using an electronic Tree Asset Register. The register will be established as an accessible and scalable electronic database that can hold a complete history for each tree, with data including images and maintenance records.

1.4 The Tree Asset register will also maintain records of all assets that have undergone any formal risk assessment, together with any actions identified to minimise tree-related risk, details of any compensation claims (eg. for repairs to private structures) and the scheduling of future inspections.

1.5 Council will investigate whether to update our existing internal asset management systems, to add tree data, OR to purchase a more 'tailored' and proprietary tree management system, of which several are available.

1.6 Engage specialist consultants to survey key areas of the LGA for trees of heritage significance or other outstanding values; and to then begin to prepare listings for a Significant Tree Register.

1.7 Engage with Aboriginal communities of the Liverpool LGA and knowledge holders to identify trees of Aboriginal cultural significance that are appropriate for listing. (Noting, there may be trees with cultural value that cannot be shared or identified on a public register.)

1.8 Co-ordinate the Tree Asset Register with information on known significant trees, so that significant trees managed by Council are clearly identified and managed accordingly.

1.9 Continue to undertake tree canopy measurements and establish ideally annual (or at least a minimum of 3-yearly) measurements, reviews and reporting. Tree height threshold for measurement should ideally align with Council's definition for a 'tree', being greater than 5 metres tall. Refer to Section 1.1 and Section 2.3 in the Tree Management Technical Guidelines for further information related to tree preservation.

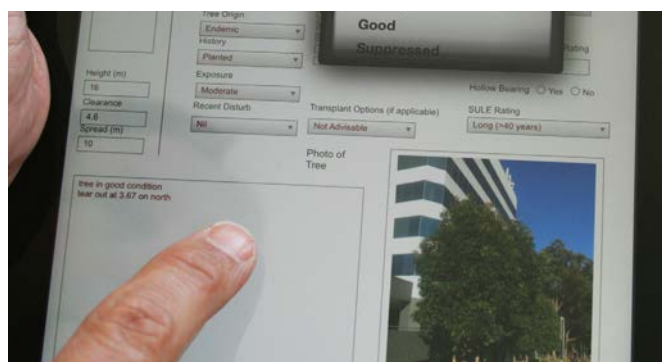


Figure 81: Identification and recording of our trees in an easily used and accessed electronic database system is key to the proper management and understanding of our tree resources. (Source : Arterra)

Species Insight

Your Species at a glance



Figure 80: Image shows graphs and charts in 'Forestree', an example of an Australian developed Urban Forest Management software. Being able to measure, record and analyse is a key requirement to successfully manage any asset. Council is committed to improving the way we capture, report and monitor our urban forest resources. (Image Source: Forestree website)

4.3

The Strategy

Direction 2 - Increase Canopy Cover



Figure 83: Well treed city parks play a significant role in mitigating the urban heat island effect. Groupings, copses and avenues of trees with dense canopies have the most profound impact on mitigating urban heat. (Source: Arterra)

Direction 2 - Increase Canopy Cover

This strategy is at the heart of our vision as well as the key to its success. Canopy cover data from many Sydney Councils suggest that more trees are being removed or dying than are being replenished by Councils or private property owners. As private land is developed, greater pressure is placed on our public lands to accommodate many more trees and to provide the major contribution to our urban forest canopy. Council will lead by example in expanding our public tree assets and will focus our resources in areas that have the least existing canopy cover and highest heat vulnerability.

A strong tree planting program will facilitate an increase in our canopy cover. Current average measurements for existing canopy cover in our roads and parks, suggests there is ample opportunity for expansion of canopy. We will progressively undertake street and park audits to identify immediate gaps and opportunities in our street tree plantings and identify new tree planting opportunities within our parks and reserves. We will employ this data to instigate an extensive tree planting program, using appropriate species and we will execute this in a manner that is equitable both geographically, demographically and generationally.



Figure 82: St Andrews Park, Casula, is an example of a successful park, incorporating existing mature trees that provide areas of shade and respite from the sun in Summer and a beautiful destination to relax and enjoy. (Source: Arterra)

4.3

The Strategy

Direction 2 - Increase Canopy Cover

Actions:

2.1 Protect our existing trees and canopy by avoiding unnecessary pruning or removals.

2.2 Establish an annual tree planting program. We will plan for the planting of over 7,000 trees each year, for the next 11-year period. Street plantings will be of advanced, robust-sized trees of at least 45L and preferably 100L or above. Park trees will be planted in a greater variety of sizes and include smaller containers and tube stock, where appropriate, as well as more mature feature plantings of >200L trees for premier parks. Planting using cost effective tube stock will also be targeted along drainage lines. We will nurture our newly planted trees in accordance with best practice for establishment, as set out in the Tree Management Technical Guidelines.

2.3 Begin a progressive audit of all Council parks, with an aim for identification of major tree planting opportunities, referencing any Park Management Plans, for those parks that have them. We will focus on opportunities in our most vulnerable areas and follow up with planting.

2.4 Council will promote and manage our neighbourhood parks and urban plazas to create 'oases' of shade within the public domain.

2.5 Carry out 'gap' audit of existing street tree planting locations, in accordance with the Western Sydney Street Design Guidelines, that recommend achieving continuous canopy cover on both sides of every street. Fill any identified locations with an appropriate tree, including replacement of any dead or senescing trees. Actively seek new locations for establishing street tree planting, such as additional planting in wide areas of pavement and in-road planting in wider roadways.

2.6 An urgent replacement program will be established for dead or under-performing street and park trees, as well as committing to a scheduled and timely replacement of any future street or park trees that are removed. Removing a tree and not replacing it is no longer a reasonable outcome.

2.7 Specific tree planting policies will be introduced into any new Park Management Plans or new parks delivered in new developments, for the maintenance and replacement of trees, in accordance with this strategy document and consistent with the Tree Management Technical Guidelines.

2.8 Street tree master plans will be undertaken for key urban spaces, incorporating summer shade for pedestrian footpaths and cycleways, wherever possible. Trees will be introduced into all extensively paved public spaces such as plazas and car parks.

2.9 As much as possible, street tree installations will be detailed in accordance with the principles of Water Sensitive Urban Design. This will maximise stormwater harvesting in public places, to support soil moisture and tree health.

*For the next 11 years,
Council proposes to plant...
7,000 trees annually*

2,700 park trees
4,300 street trees



PARK AREA	48 783m ² (4.8 hectares)	CANOPY AREA	671m ²	CANOPY COVER	1.34%
Paramor Reserve Green Valley					



PARK AREA	1990m ² (0.199 hectares)	CANOPY AREA	196m ²	CANOPY COVER	9.8%
Meehan Park Hammondville					

Figure 84: A random audit of Council managed parks identified many are falling well short of providing positive contributions to our regions canopy cover. There is enormous scope to increase tree planting within many of our parks. A systematic and ongoing audit process will be developed to identify planting opportunities that can be immediately addressed. The above sample of Paramor Reserve (top) has less than 1.34% cover, while Meehan Park (bottom) provides less than 9.8% cover. This illustrates major opportunities to easily work towards our target of 60-70% cover for our local and neighbourhood parks. (Source: Arterra)

4.3

The Strategy

Direction 3 - Best Practice Management



Figure 86: The image above highlights the potentially lost opportunity to plant and shade the building and outdoor spaces and car parking. More needs to be done to achieve and maintain canopy cover and environmental benefits, particularly around our schools and playgrounds. (Source: Arterra)

Direction 3 - Best Practice Management

Significant public investment in trees requires monitoring to ensure healthy urban forests that provide a long-term flow of benefits. Healthy trees are resilient and provide the greatest benefits. Beyond canopy cover analysis, it is important that we understand and manage tree population dynamics and identify any undesirable population trends. In general, greater diversity increases our urban forest resilience and the ability to withstand change.

Once the LGA's public tree assets have been identified and incorporated in an asset register, it will be possible for us to better interrogate the data for urban forest health indicators, using metrics such as:

- Individual tree health.
- Diversity in species, genus and family composition.
- Diversity in age and tree life expectancy ratings.
- Balance of endemic/ native/ exotic trees.
- Availability of habitat and food sources for endemic fauna.

Our tree management and tree planting will work towards a better connection with Country through:

- Responding to the underlying geology and hydrology of the land.
- Integrating endemic tree species where the conditions are favourable for them to thrive.
- Replacing weed species with endemic plants, particularly in natural areas, parklands and along watercourses.
- Contributing to biodiversity and healing of our lands through increased revegetation and biodiversity.



Figure 85: Shaded cycleways combine the environmental benefits of trees with an environmentally friendly mode of transport. (Source: Arterra)

4.3

The Strategy

Direction 3 - Best Practice Management

Actions:

3.1 Adhere to the practice and principle of 'right tree in the right place' with emphasis on using the largest tree possible for each identified location.

3.2 Utilise a mixture of tree species to provide diversity of sizes and habitat, ideally achieving a mix of at least 3 different botanic families for all our major streets and park plantings.

3.3 Increase overall urban forest diversity through considered tree species selection in all street and park master plans and reduce over reliance on only a few species.

3.4 Achieve a diversity of mature tree sizes with an aim of achieving a minimum of:

- 10% civic scale trees (>20m height or canopy spread);
- 10-30% large trees (12-20m height or canopy spread);
- 50-60% medium trees (8-12m height or canopy spread); and
- no more than 10% small trees <8m height or canopy spread).

3.5 Improve soil conditions for all newly planted trees, using adequate soil volumes and appropriate tree installation methodology, as per the Tree Management Technical Guidelines.

3.6 Select species and planting environments for our changing climatic conditions and use the principle of 'the right tree in the right place', as outlined in the Recommended Tree Selection Schedule, in Section 3.3 of the Tree Management Technical Guidelines.

3.7 Discourage and control weed species and undesirable plants to remove potential weed sources and ongoing urban maintenance burdens. This may exclude any trees that are identified as heritage trees or having other exceptional values. Refer to Section 2.3 of the Tree Management Technical Guidelines.

3.8 Collect and re-use rainwater as much as possible to the benefit of green infrastructure. Identify stormwater harvesting opportunities and install new street trees with stormwater harvesting details, and passive irrigation wherever possible.

3.9 Establish a proactive, cyclical tree maintenance program for public urban trees.



Figure 87: Use of large, native trees in parklands where favourable conditions allow them to reach their potential size and maximise environmental benefits. (Source: Arterra)

3.10 Establish a clear protocol for managing site contamination so it does not unnecessarily lead to existing tree impacts, prevent tree planting or cause unacceptable risks to workers or the public. Refer to Section 4.10 of the Tree Management Technical Guidelines.

3.11 Increase public involvement in the monitoring and stewardship of trees on private lands.

3.12 Engage with the traditional ecological knowledge of local Aboriginal communities for revegetation and healing of Country with a focus on drainage reserves and riparian corridors.

4.3

The Strategy

Direction 4 - Manage Tree Risks



Figure 88: Our public spaces need to be maintained and managed to appropriately minimise potential risks from tree failures, but this always has to be weighed against the substantial benefits that trees provide to the community. (Source: Liverpool City Council)

Direction 4 - Manage Tree Risks

Tree risk management is not about precisely predicting or preventing tree failure. It is about taking a systematic approach to broadly identify tree-related risks and then determine the probability of tree failure and the likely consequence, using a consistent assessment method. Our tree risk management is based on the following principles:

- Trees (both public and private) are essential infrastructure assets providing innumerable benefits to our community.
- The overall risk from trees and branches falling is typically extremely low.
- We cannot eliminate tree risks entirely – any tree can fail, even a healthy tree. They are living structures and they can sometimes shed branches or fall over, particularly in extreme weather.

The Liverpool local government area covers a vast and diverse area of 306km² with numerous public trees that are managed with very limited resources. It is important that our approach to tree risk management is therefore targeted. Council will focus **active risk assessment** in those places with a confluence of high use and larger trees, where there may be higher consequences in the event of a failure.

Risk assessment will be carried out by appropriately trained professionals and undertaken using an industry-accepted best practice tree risk assessment protocol. A range of risk mitigation measures will always be considered to try and retain a tree, in preference to complete removal. Detailed guidance is provided in the Tree Management Technical Guidelines.



Figure 89: Public spaces of high use and occupancy require greater vigilance to maintain trees in good health and minimise tree-related risks. (Source: Arterra)

4.3

The Strategy

Direction 4 - Manage Tree Risks

Actions:

4.1 Maintain public safety and reduce the risk of personal injury or property damage through the use of best practice tree assessment and risk mitigation.

4.2 Promote tree risk management (for both public and private trees) that explores all appropriate opportunities for tree retention, over removal. A decision-making protocol for tree removals will be established, based on the Tree Policy and methods outlined in the Tree Management Technical Guidelines.

4.3 Active assessment of Council-managed trees will be undertaken in zones of highest occupancy and at a regular interval. These will be expanded to other areas over time, to include all trees within our asset management system.

4.4 Records will be maintained of the trees that have undergone risk assessment and any actions identified to minimise risk.

4.5 A process will be established to address risk management requirements, in a timely manner, for any Council-managed trees that have been assessed as having elevated risks, and to generate appropriate work orders for risk mitigation actions where appropriate.



Figure 90: Public spaces of high use and occupancy require greater vigilance to maintain trees in good health and minimise tree-related risks. (Source: Arterra)



Figure 91: A good tree risk management strategy will help reduce tree-related risks through risk assessment, tree maintenance and other risk mitigation procedures. (Source: Arterra)

4.3

The Strategy

Direction 5 - Link the Green and Blue



Figure 92: Sydney Park incorporates a water harvesting function, collecting storm water from the surrounding streets, allowing it to move through the parkland and slowly be purified of pollutants through a process of biofiltration. (Source: Arterra)



Figure 93: Extensive rain gardens and passive irrigation for street and tree planting in Knoxville, Tennessee. (Source: Arterra)



Figure 94: Permeable and street side rain gardens can be used extensively in public spaces to allow water to be retained in the landscape, replenish the water table and provide a passive, economical and sustainable source of moisture for tree growth. (Source: Arterra)

Direction 5 - Link the Green and Blue

All living things need water. Many natural ecosystems rely on the intrinsic connection between plants and water. In urban contexts, substantial mutual benefits are gained from an integrated approach to water management, where trees frequently benefit from additional water being channelled to them. This in turn, decreases the amount of stormwater runoff by intercepting water in the canopy and increasing soil water infiltration. This is part of an integrated approach to designing public places, allowing green infrastructure to better deliver multiple ecosystem, environmental and other services simultaneously.

Additionally, the process of biofiltration, removes pollutants as well as nutrients like soluble nitrogen and phosphorus, thereby reducing the disturbance to the health of aquatic ecosystems. Recent stormwater studies conducted in Melbourne demonstrated the above, in experiments where the integration of trees within 'rain gardens' markedly increased the evapotranspiration of water from the 'rain gardens' resulting in a reduction in the volume of stormwater runoff (Denman, May, & Moore, 2011).

The twin challenges of modern-day stormwater management and climate resilience require our urban developments to depart from traditional approaches and implement a new view on water infrastructure. The more that we embrace integrated stormwater management, the more we will have a cleaner, greener future where we are able to better manage risks, keep water costs low, and provide the widest possible range of environmental, economic and social benefits. It will also reduce our reliance and use of valuable potable water (Valderrama, 2018).

While shading is the key process by which trees cool the environment, evapotranspiration of water is another way trees help cool the environment. Trees draw water through their roots and use a small amount in the process of photosynthesis. Most of the water evaporates through the leaf surface in a process called transpiration. The conversion from water to water vapour, results in a cooling effect. This also means that trees become susceptible to damage and leaf scorch if they run out of water in hot weather. Our trees need to be well-watered if they are to be healthy, resilient, long lived and provide maximum environmental benefits.

Use of stormwater and other forms of passive and active irrigation to support canopy trees will contribute to tree growth in the long term. However, during establishment phases watering is key and prevents wasted resources. During extended periods of drought, some modest active irrigation may be required to ensure tree health and longevity. This is not possible on a larger scale, which is where appropriate soil volumes and passive irrigation are so important.

4.3

The Strategy

Direction 5 - Link the Green and Blue

Actions:

5.1 Ensure all premier urban parks are sustainably irrigated, to help support trees transpiration processes and their cooling effect.

5.2 Introduce Water Sensitive Urban Design (WSUD) philosophy as a practical objective for all public spaces. Divert stormwater to trees and green landscaped areas, wherever possible, using the LGA's extensive network of roadways to harvest water, and through engineered and integrated systems of kerb inlets, rain gardens, constructed soil profiles and structural soils.

5.3 Actively discourage and reduce the extent of impervious surfaces used throughout the LGA. Where hard surfaces are necessary, preference the use of permeable pavements wherever possible, to mimic natural hydrological movement and contribute to recharging of ground water storage and passive irrigation.

5.4 Encourage private use and local collection and storage of stormwater and rainwater for reuse in landscape irrigation within all new developments.

5.5 Encourage the use of 'smart' irrigation systems linked to soil moisture and weather conditions to avoid waste.

5.6 Select tree species with an aim to balance drought and heat tolerance, together with the need for transpiration and good shade provision during summer and heatwaves.

5.7 Establish ongoing but sustainable irrigation for any significant trees and important trees in key public places. Respond flexibly when necessary to temporarily irrigate such trees during drought conditions, and in a timely fashion.

5.8 Make water issues, reuse and passive irrigation more visible to the public and educate the community about sustainable water use and ecological benefits.



Figure 95: Water needs to be seen as a resource that is precious. It should be used wisely, and where possible, directed to our green infrastructure first before being directed to our creeks and water ways through pipes and culverts. (Source: Arterra)

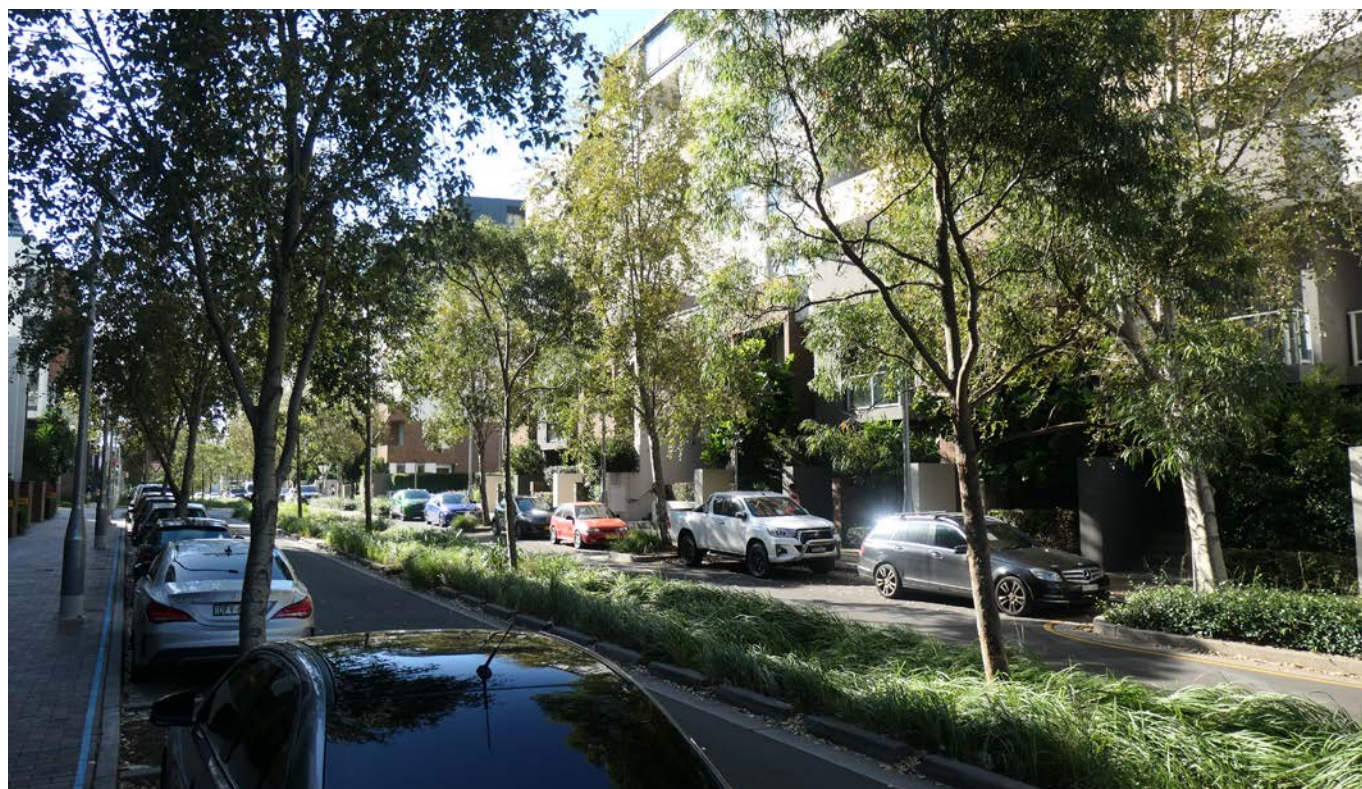


Figure 96: Harold Park, Sydney where median swales and rain gardens serve to treat stormwater and passively irrigate extensive tree planting. (Source: Arterra)

4.3

The Strategy

Direction 6 - Promote Private Trees



Figure 97: Use of trees in private gardens adds a depth to the landscape as well as greater canopy cover. (Source: Arterra)

Direction 6 - Promote Private Trees

There are many stakeholders that have an impact on the urban canopy of the LGA and our ability to increase the canopy coverage. The vast majority of land within the LGA is privately owned, including residential, retail and industrial sites. Trees are a common resource, regardless of what land they grow on or who the current custodians might be. Trees on privately-owned land have potential to make vital contributions to the canopy of our urban forest. In fact, achieving our canopy targets is heavily reliant on the participation of private property owners, in tree preservation, new tree-planting and overall greening efforts.

Newly planted trees take many years to reach maturity and provide the benefits we seek from an extensive tree canopy. Loss of mature trees, results in an instantaneous loss of ecosystem services they provide. This cannot be immediately mitigated with replacement by young trees or much smaller trees. If we are to increase our tree assets and canopy cover, we must first reduce the loss of our existing tree assets, including those on private property.

Council is not responsible for managing trees on private property, however, it is the authorising body for works involving trees on private land. Council will prescribe guidelines for tree protection and preservation, as well as guidelines for appropriate risk management, tree maintenance and removals.

Canopy targets will be promoted to all stakeholders within the Liverpool LGA, including private landholders and government agency managers. It is vital that every stakeholder understands their potential impact so they can make more informed decisions and be accountable for the policies and actions that relate to the urban forest and canopy cover.

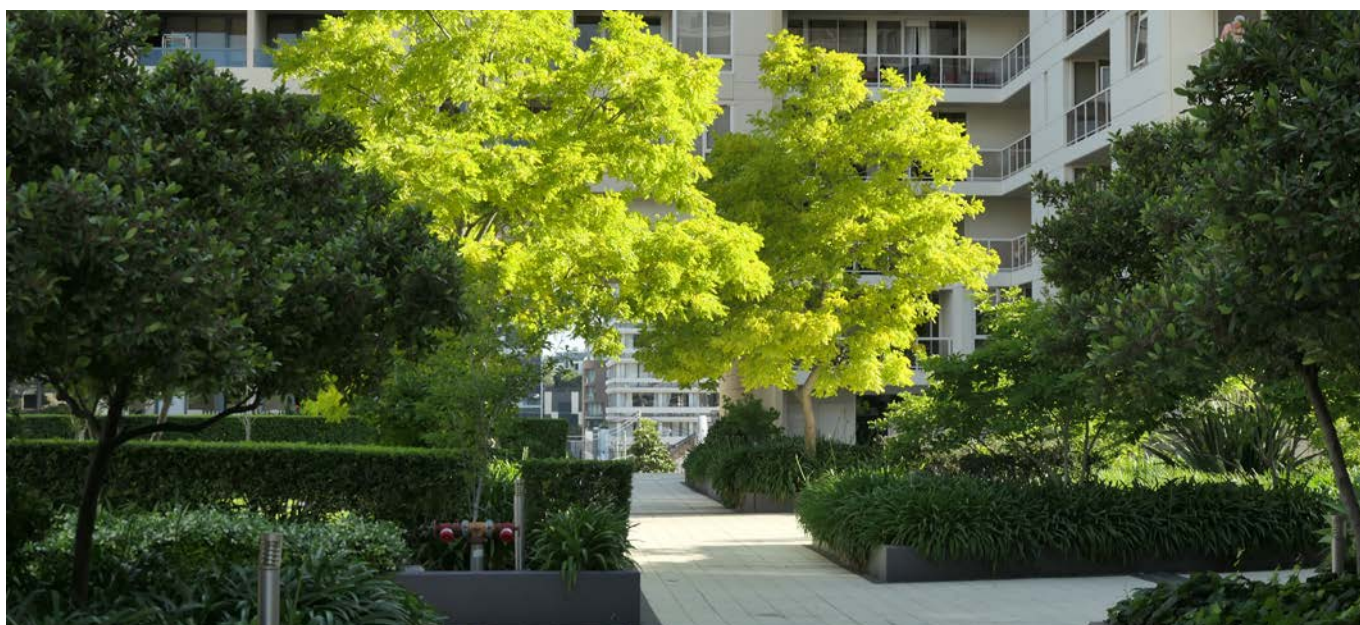


Figure 98: Common areas and gardens on private property can make a valuable contribution to canopy cover as well as property value if suitably planted. (Source: Arterra)

4.3

The Strategy

Direction 6 - Promote Private Trees

Actions:

6.1 Council will consistently apply development controls related to trees to mitigate and slow the loss of existing, mature and healthy trees. This will include initiatives such as:

- Limiting unauthorised clearing and tree removals
- Ensuring tree removal is only undertaken for valid reasons and not for convenience or trivial reasons

6.2 Tree-related information on Council's website will be updated to promote the planting and retention of trees on private land, to inform and guide the community, private developers and contractors on all tree matters and be consistent with the Tree Management Strategy and Tree Management Technical Guidelines.

6.3 Council will provide clear guidelines for risk assessment requirements relating to private trees, including:

- assessment and reporting requirements;
- use of appropriately qualified arborists; and
- risk tolerance.

6.4 Aim to achieve appropriate offset ratios for any existing trees removed. Ensuring that trees removed are replaced, and ideally, more trees are planted than trees removed, particularly if large or significant trees are removed. Refer to Section 4.8 in the Tree Management Technical Guidelines.

6.5 Liaise with private owners of larger industrial or commercial sites backing onto riparian corridors, to provide support with our vegetation activities. For example the majority of South Creek and Kemps Creek corridors are in private or rural residential holdings.

6.6 Proactively engage and partner with other agencies who manage trees within Liverpool LGA, to share resources, build awareness and provide ongoing leadership with regard to urban canopy and tree management, including with:

- Western Sydney Parklands
- Western Sydney International Airport (Nancy Bird Walton) and Aerotropolis
- South Western Sydney Local Health District
- Water NSW
- National Parks and Wildlife Service

6.7 Investigate adoption of incentives for developers to retain existing mature trees or achieve best practice canopy cover targets in new developments.

6.8 Investigate development of a community nursery supplying local residents and developers with a source of endemic trees and supporting the vision for a greener Liverpool through private tree planting.

**Achieving 30% canopy cover,
requires 8,000
new, private trees to be planted
annually until 2050.**



Figure 99: Use of the right tree in the right place minimises the potential for trees to come into conflict with other components of the built environment or to require excessive maintenance. Use of trees in private gardens adds a depth life and amenity to the landscape as well as greater canopy cover. (Source: Arterra)

4.3

The Strategy

Direction 7 - Build Capacity



Figure 100: Council will add capacity for quick response risk mitigation, as well as ongoing cyclical maintenance. (Source: Arterra)

Direction 7 - Build Capacity

Delivery of a more extensive and improved urban forest requires executive and political support within Council, alignment of all our internal departments as well as increased capacity and technical skill within the Council park and tree management team. Our key functions for urban tree management relate to:

- Public tree asset management – including proper planning, planting, ongoing maintenance and risk management.
- Private trees – maximising tree preservation through appropriate development controls, regulations and general community education and engagement.

Actions:

7.1 Establish an appropriate annual and recurring budget for capital expenditure and maintenance, as part of a long-term financial plan for achieving the aims of this Strategy.

7.2 Establish a fund through annual budget allowances, together with state and federal government grants, and development contributions for the improved management of trees and canopy cover in the LGA.

7.3 Establish a dedicated and well resourced Council Tree Team and build in-house tree expertise through increased staffing and training. Consider creating a Council officer position specifically for identification of tree planting opportunities and a Council officer position to foster inclusion of Aboriginal ecological knowledge and Connection to Country.

7.4 Expand Council's ongoing tree maintenance capacity using both in-house and out-sourced specialist contractors and consultants.

7.5 Ensure adequate resources are provided (including skilled personnel and time allocations) to carry out systematic and proactive tree risk assessments.

7.6 Ensure adequate resources are provided (including skilled personnel and time allocation) to carry out identified risk mitigation tree work. If there are insufficient staff to carry out urgent tree work, this service will be outsourced.

7.7 Use external contractors for additional capacity for tree-planting and cyclic maintenance.

7.8 Use external consultants for additional capacity for tree surveys and risk assessment.

4.3

The Strategy

Direction 8 - Community Engagement

Direction 8 - Community Engagement

Council recognises the importance of community values in contributing to the successful stewardship of trees as a community asset. We will undertake education and awareness building activities to disseminate evidence-based information on the extraordinary capacity of trees and other green infrastructure to mitigate the impacts of climate change and urban heat. We will provide information on our website, using high quality graphics, to showcase successful tree planting and retention projects, provide helpful information on suitable tree species and how well treed neighbourhoods demonstrate the positive effect of trees on property prices, physical, social and mental well-being.

Educational materials will be made available in the predominant languages of the LGA and will also be made available at community centres and other community institutions.

Council will champion the use of trees within our built environments with a strong emphasis on the use of good quality trees, appropriate soil and drainage provisions and, appropriate species selections in all new Council facilities. We will actively promote trees and positive outcomes online, through social media and at community events.

Actions:

8.1 Develop a community engagement strategy for urban greening that promotes the benefits of trees on Council's website, social media and through community events. Identify key streets to pilot a community street tree planting program.

8.2 Prepare a comprehensive suite of public facing tree information 'pages' for Council's website. These should include information on tree removals as well as positive 'greening' messages. This is to include specific and clearly articulated additions to Council's website for residents to request new tree planting/s and/or a new planting locations with protocols established that facilitate appropriate internal referral and processes for logging, assessing and responding to the requests.

8.3 Prepare printed educational materials that can be disseminated in community centres and other community institutions and events.

8.4 Provide the community and landscape designers, architects and engineers with tools to evaluate the quality of urban greening and differentiate between the benefits of say a large shade tree, compared to an area of lawn.

8.5 Encourage community participation in urban greening, bush care, and street tree planting activities.

8.6 Notify community about tree planting events.

8.7 Establish a community nursery for growing and distributing locally suitable and endemic tree and plant species, similar to that run by Sutherland Shire.

8.8 Undertake annual greening events such as National Tree Day, community planting days, free tree giveaways.



Figure 101: Community planting days and community led projects for an environmental, cultural and sustainable corridor with ongoing, active support from local residents and volunteers, including bush care groups, community-based art programs, schools and government agencies. (Source: Arterra)



Figure 102: Cool Streets Blacktown– pilot project on community-led decision-making and implementation project for street trees. Collaborative design and community consultation methods aimed at building on resident's knowledge about climate extremes and giving them agency in the process. (Source: NSW Government Architects website)

4.3

The Strategy

Direction 9 - Manage Development Impacts

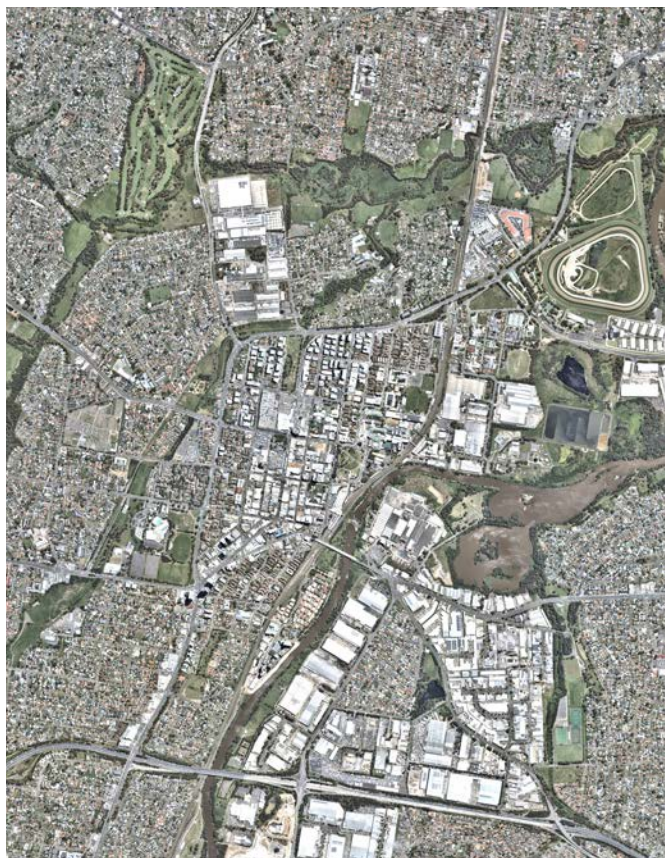


Figure 103: Aerial photograph over the central business district of Liverpool and industrial area to the south, showing the impact of development on the landscape and tree cover. (Source: NearMap)

Direction 9 - Manage Development Impacts

Existing Development Control Plans (DCPs) are sometimes not adequately protecting existing trees nor stipulating requirements for individual developments to contribute to our tree canopy targets. Local development controls are required to ensure that future neighbourhoods in the growth corridor are green environments that can sustain a healthy lifestyle. Council will review and update our suite of DCPs to better guide and control development and positive tree outcomes. This will require that consideration for retention and inclusion of trees is a core element of the design proposals.

Actions:

9.1 For all development projects, development controls will include:

- Minimum space requirements, both above and below ground to accommodate adequate space for tree root growth, trunks and canopy.
- Minimum requirements for soil quality, volumes and structure, including requirements for topsoil retention and consideration of levels and services.
- Avoidance of monoculture landscapes, through inclusion of a more diverse range of species, with not more than:
 - 40% of trees from any one plant family;
 - 30% from any one genus; and
 - 10% from any one species.
- Use of 'right tree in the right place' principles, emphasising the use and benefit of the largest tree possible for each location.



Figure 104: New developments in the LGA must aspire to the spacious, and well-treed characters of our older established suburbs. (Source: Arterra)

4.3

The Strategy

Direction 9 - Manage Development Impacts

9.2 Clear guidance will be provided for subdivision planning and redevelopment/urban renewal projects to support tree retention and potential to achieve canopy targets, allowing for the long-term coexistence of infrastructure, housing, vehicles and trees. This will include specific requirements for:

- Minimum road width allocation.
- Minimum verge width allocations
- Minimum space and soil volumes to support large trees capable of providing good canopy coverage.
- Planning to avoid conflicts between services and a tree's growing space.
- Water Sensitive Urban Design including integrated water management for passive irrigation of street and park trees.
- Frequency / density of tree planting.
- Species selections

9.3 Multi-dwelling, mixed use and commercial development applications will be required to demonstrate how tree cover targets, long term and sustainable growth will be met.

9.4 Council will introduce and enforce appropriate tree bonds for the protection of public trees and some significant private trees to be retained. (Calculation of bonds to be based on industry average cost to supply and install equivalent tree plus 104 weeks of maintenance). Refer to Section 2.7 of the Tree Management Technical Guidelines for further guidance.

9.5 Council will require compensation for trees that are removed from public land due to development, including those trees that are approved for removal and trees accidentally damaged during construction. Calculation of the compensation amount will take into account any costs incurred by Council for removing the tree and suitable reinstatement costs to replace the tree and its values in the landscape. The tree valuation component will be determined in accordance with Action 9.6, below.

9.6 A tree valuation methodology will be adopted by Council that is consistent with or endorsed by the current

version of Arboriculture Australia's "Tree Valuation – Industry Guidance on Tree Valuation Methodologies, Practices and Standards". Refer to Section 2.7 of the Tree Management Technical Guidelines for further guidance.

9.7 Council will introduce development consent conditions and bonds relating to protection of all newly planted street trees on all development sites and then enforce compliance and/or replanting if trees are damaged or destroyed during development, at no cost to Council.

9.8 Council to review and lobby state Government for protocols to better deal with APZ requirements in new urban release areas. Significant limitations on site specific canopy targets exist due to bushfire and asset protection requirements. For new developments, where an adjoining site is already zoned to facilitate a future development and likely to be developed (within a foreseeable time frame), the applicable RFS bushfire and APZ requirements should be amended, to account for the likely significant reductions in bushfire risk and often the ultimate elimination of the APZs, which would allow far greater canopy cover to be enforced and achieved and conditioned during the initial DA process.



Figure 105: New developments must seek to retain and protect existing trees. Where public trees are removed or damaged they shall be replaced using suitable funding and enforcement mechanisms (Source: Arterra)

The City of Melbourne has developed a compensation process for public trees lost to development that recognises trees have greater value than the cost of their removal and replacement. The calculation considers the amenity and ecological value in the landscape, in addition to removal and reinstatement costs.

Value (V) = Basic Value (\$) x Species (S) x Aesthetics (A) x Locality (L) x Condition (C)

4.3

The Strategy

Direction 10 - Policy Alignment



Figure 107: Newer developments leave little space for trees, plants or even grass. Where small lot sizes make private tree planting difficult or impossible, this needs to be balanced by creating far more generous roadway allowances with sufficient area for vehicles as well as ample growing space for trees. (Source: Arterra)

Direction 10 - Policy Alignment

All policies and associated documents related to our trees and tree management within the Liverpool LGA, need to be consistent and aligned in relation to tree management and tree canopy targets. The strategic directions of this Strategy can only be effective if they are appropriately conveyed to developers and the community, elaborated within the Local Environmental Plan, Development Control Plans, and then applied consistently throughout the LGA.

It is intended that updated and revised planning controls in relation to trees, may lessen the impact of any State policies that are at odds with greening initiatives.



Figure 106: Comparison with older established suburbs shows that there was less 'house' and more open space that allowed more tree planting opportunities and more overall green space. Our newer developments leave little space for trees, plants or even grass. What little road verge space is left for grass, is often taken over as additional 'off-street' parking. Where small lot sizes make private tree planting difficult or impossible, this needs to be balanced by a more generous roadway allowances ensuring sufficient areas for vehicles as well as ample growing space for large and spreading trees. (Source: Arterra)

4.3

The Strategy

Direction 10 - Policy Alignment

Actions:

10.1 Amend Council planning controls to address the key initiatives of this Strategy, including those items identified as part of Strategic direction 9.

10.2 The LEP review which is currently underway will ensure that the critical issue of retention and expansion of tree canopy cover is addressed in the context of urban heat mitigation, for:

- Residential land
- Commercial land
- Industrial land
- Environmental land

10.3 Protection of biodiversity and vegetated connectivity will be addressed in the urban context as well as for areas of natural vegetation.

10.4 DCP reviews will update provisions for tree preservation and any related landscape design provisions.

10.5 Insistence on the provision of professional and adequate arboricultural impact assessments for all trees on development sites. This will support Council planners with making decisions on requisite tree retention in relation to canopy targets and drafting of appropriate tree-related conditions of consent.

10.6 Tree provisions will be drafted with urban heat mitigation as an objective, with guidance from the Urban Heat Planning Toolkit, Western Sydney Regional Organisation of Councils (2021) and other like documents.

10.7 Minimum requirements will be established in relevant planning controls for canopy cover targets to be applied in the future for the various land use zones throughout the LGA, on both public and private property.

10.8 All new car parks will be required to be appropriately planted with suitable, broad spreading shade trees, demonstrating a reasonable prospect of achieving a minimum of 30% canopy cover to the area of the site applied as an open-air, at-grade car park.

10.9 Planning controls shall be applied rigorously and consistently to ensure compliance with tree retention requirements, planting and canopy cover targets.

10.10 Partner with other Western Sydney LGAs to advocate to the NSW Government to mandate urban tree canopy cover targets in all future release areas and amendment of the Exempt and Complying Code to require higher standards for landscaped areas and tree planting for smaller lot residential development.



Figure 108: Incorporation of trees in car parks, provides very welcome shade for cars as well as reducing heat loads and re-radiated heat from pavements. Lack of tree planting and shade to car park and inappropriate space and physical provision for trees should no longer be accepted. (Source: Arterra)

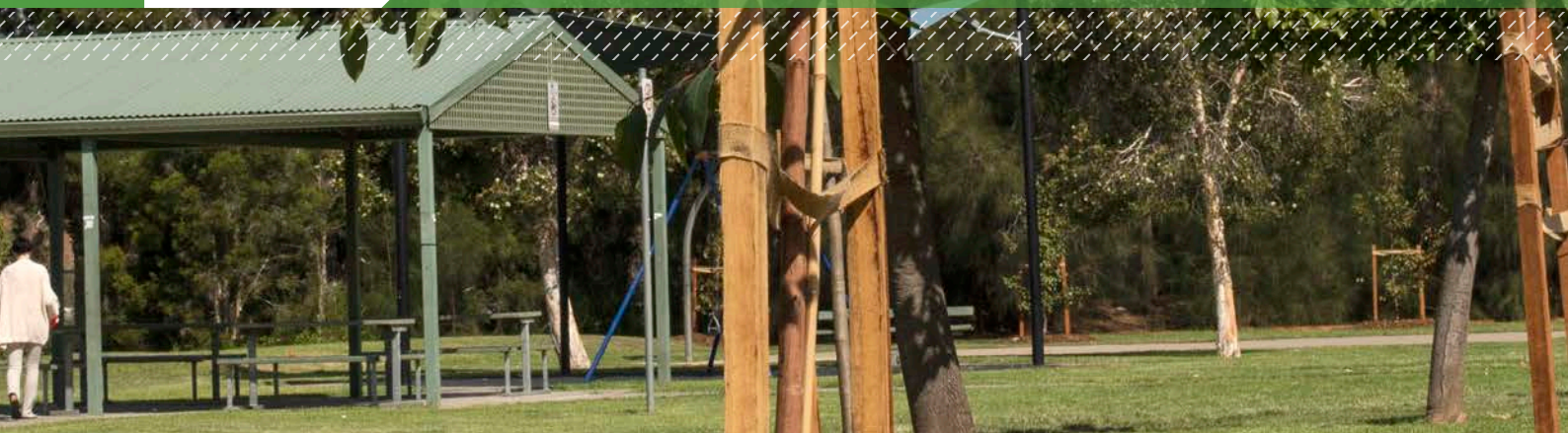
This section of the Strategy establishes the broad implementation requirements to achieve our tree management and urban greening targets.





5.0

IMPLEMENTATION



5.0

IMPLEMENTATION

5.1 Funding and Resources

Implementation of the Tree Management Strategy will require significant additional resources to achieve. Appropriate funding, both recurrent and one-off capital injections will need to be provided as part of a resourcing strategy within Council's long-term financial plan.

To achieve the directions identified in this Strategy, Council will need to consider:

- Allocating or employing suitable Council staff to oversee and co-ordinate all park and street tree planting programs, including organising advanced plant procurement, supply methods and contracts, as well as scheduling and resourcing of planting programs and suitable after planting care.
 - Maintaining suitably resourced and appropriately trained staff (or contractors) for the ongoing management and pruning of mature street and park trees.
 - Maintaining suitably resourced and appropriately trained staff (or contractors) for the ongoing assessment and mitigation of tree risk.
- A broad opinion of probable costs is outlined in section 5.4, as a guide. The project-related actions within the Strategy are proposed to be funded from various sources, including the following:
- Planning Proposals (PP), Development Assessment (DA) applications and Voluntary Planning Agreements (VPAs) – the Strategy will be used to negotiate suitable streetscape and other public domain improvements provided by others, where they are impacted by private development.
 - Grant Funding – Many projects will require external or grant funding from alternate sources. This Strategy will be used to help support applications for state and federal funding, with project-based opportunities in relation to urban greening, community development, education, health and heritage.
 - The Western Sydney City Deal – especially in relation to commitments like the restoration and protection of South Creek, as well as more general 'liveability' projects associated with urban green canopy and open space.
 - Council funding – the Strategy will inform Council funded projects within the city centre and inner suburbs, including capital works projects and recurring maintenance.
 - Council will also explore opportunities for further corporate sponsorships or philanthropic project contributions.



Figure 109: 'Baking' hot asphalt surfaces of carparks in summer can be cooled by shading with tree canopy. (Source: Arterra)

5.2

Implementation
Responsibility

5.2 Responsibility

Historically Council has not had a dedicated 'Urban Forest' manager, unit or department within Council. Given the growing importance of urban greening, biodiversity and climate change, Council will investigate the potential to establish a dedicated department and manager for these pursuits, under one banner. This would benefit outcomes with clearer definition of budgets, responsibilities and resources for this multi-faceted and cross-department resource.

In the absence of a single department, the directions outlined in this Strategy will be delivered in a cross-disciplinary manner, with responsibility distributed throughout virtually all Council's various teams and departments. These broader responsibilities include:

- Review of statutory documents in light of the Tree Management Framework.
- Incorporation of trees as a fundamental component of all existing and future street and public space design.
- Incorporation of water harvesting details within public projects.
- Championing the use of trees in the built environment with a strong emphasis on integrating good quality, appropriate trees in all new Council facilities.
- Management of contracts for tree supply, maintenance and planting.
- Developing and running community education programs.
- Preparation of information and educational materials for the website, social media and other outlets.
- Engagement with private owners of lands situated along riparian and other open space corridors.
- Collaboration with other agencies such as Western Sydney Parklands, Department of Defence and National Parks and Wildlife Service.
- Regulatory role in relation to development assessments and enforcing compliance with approvals.
- Engage of external specialist consultants and utility arborists to expand our capacity to deliver tree management in accordance with the Strategy.



Achieving a 30% canopy cover, requires Council to plant more than 100,000 new trees between 2024 -2050.

5.3

Implementation

Priorities and Timing

5.3 Priorities and Timing

While this strategy sets out tree canopy targets for the next 25 years, Council intends all the key actions to be instigated within a 2-5 year time frame. This is to allow for the large-scale, physical changes to the environment that can only come with the urban forest expanding and maturing, in the fullness of time. It is important we act now and act decisively. Physical conditions and targets will only become more difficult as time goes on.

The Tree Management Strategy does not identify any low priority items. The strategic directions are all part of an integrated approach of actions that need to be progressed concurrently and in a co-ordinated cross-department fashion, for a noticeable impact on canopy cover and heat mitigation and consequent lifestyle and health improvement for the community of the Liverpool LGA.

The climate emergency and western Sydney's high vulnerability to the effects of climate change, require immediate and ongoing action on all items. For this reason, actions are categorised as:

- Urgent Tasks
- Ongoing Tasks – internal
- Ongoing Tasks – outsourced

Urgent Tasks

- Adopt the Tree Management Strategy and Tree Management Technical Guidelines to establish Council's documented positions on tree protection requirements, tree management, canopy cover and tree planting targets, including a climate appropriate species lists, exempt species list and appropriate planting details and relevant specifications.
- Seek increased capital and recurring budgets for tree planting and management, including for streets, drainage and riparian corridors and other vulnerable areas.
- Adopt a formal, recognised and defensible Tree Risk Management approach.
- Initiate and maintain a comprehensive and user-friendly Tree Asset Management System.
- Update and align the LEP and relevant DCP for consistency with the Tree Management documents, particularly to achieve appropriate canopy cover targets for different land uses and to better cater for street tree planting in new subdivisions and avoid duplication and ambiguity.

Ongoing – internal

- Commence inventory of all public trees (parks and streets).
- Commence risk assessment of all priority parks and high use areas (CBD, transport interchange nodes, children's playgrounds)

- Commence improving canopy cover in key urban areas. Start in the most heat vulnerable areas (eg. Green Valley) and then progressively work outwards:
 - Audit of parks and identify immediate planting opportunities.
 - Audit non-bushland drainage reserves and dry basins and identify planting opportunities.
 - Start planting existing streets that have few or no street trees. Make sure trees are as large as possible for each selected location. Ensure they are planted with appropriate installation methodology, in accordance with the Tree Management Technical Guidelines.
 - Replace all existing dead and dying public trees in a timely fashion.
 - Initiate car park retrofits for tree planting with adequate soil volumes and WSUD detailing.
- Undertake tree planting in public areas, including establishment maintenance and formative pruning using dedicated in-house staff with appropriate resources and training.
- Initiate a strong and consistent approach to protection of trees on development sites including:
 - Thorough consideration of potential tree losses vs canopy targets in DA assessments, especially in the context of the 'green' and 'blue' nexus.
 - Consistent program of compliance checks for development applications and construction sites.
 - Initiation of bonds for protection and replacement of street trees in new subdivisions.
- Progressively update website and social media materials.

Items critical to the success of the Tree Management Strategy

1. Instigation of a computerised tree asset management system.

2. Planting opportunity audit of all Council managed parks.

3. Begin street tree planting and replacements in suburbs and areas of least canopy cover.

4. Professional and recorded risk assessments for trees in high use areas.

5.3

Implementation Priorities and Timing



Figure 110: Trees should be seen as a vital part of all urban infrastructure. They are long term assets that take years to mature and provide their full benefits. (Source: Arterra)

- Liaise with other government stakeholders that are responsible for trees and tree planting within the LGA.
- Regularly monitor canopy and measure key performance indicators for progress.

Ongoing – external

- Establish formal Contracts for tree work:
 - reactive and cyclic tree maintenance and pruning; and
 - urgent risk mitigation work and other tree removals
- Establish briefs and contracts for ongoing assessments and studies using external consultants and contractors:
 - tree risk assessments;
 - assistance with tree inventory surveys;
 - street tree master plans and/or planting strategies for key urban areas;
 - ongoing Park audits and tree planting plans;
 - establishment of a Significant Tree Register; and
 - canopy cover measurement.

“The great French Marshal Lyautey once asked his gardener to plant a tree. The gardener objected that the tree was slow growing and would not reach maturity for 100 years. The Marshal replied, ‘In that case, there is no time to lose; plant it this afternoon!’ ”.

John F. Kennedy

5.4 Implementation

Estimates of Costs and Funding

5.4 Estimates of Costs and Funding

The opinion of probable cost (more detailed and itemised in Appendix 6.1) is to be used as a guide to understand the overall magnitude of costs associated with the proposed actions outlined in the Strategy. It will be used to help inform Council's long-term financial plan and allocating suitable resources, staffing and funds for implementation of the

Councils' Tree Management Framework. Further discussions will occur within Council to develop ongoing detailed capital and recurring budgets for each item.

Table 14 - Summary of Key Costs and Funding Requirements

Strategic Direction Allocations	Approximate Capital or One off Expenditure	Approximate Annual Expenditure
1. Value Trees - Identify and manage trees as assets	\$670,000	\$300,000
2. Canopy Cover - Increase canopy cover and build resilience	\$560,000	\$2,651,000
3. Manage Trees - Manage the urban forest in accordance with best practice	\$600,000	\$340,000
4. Mitigate Tree Risk - Manage tree-related risks	-	\$70,000
5. Living Elements - Recognise the vital connections between 'green' and 'blue' infrastructure	-	\$4,100,000
6. Promote Trees - Protect and promote trees on privately owned land	\$40,000	\$112,000
7. Capacity - Build Council capacity for tree management, planting and protection	-	\$1,646,000
8. Education - Build community awareness and encourage participation in urban greening	\$350,000	\$200,000
9. Protect Trees - Manage the impact of development on existing trees	-	-
10. Support - Review planning policy and development controls to promote trees and tree retentions	-	-
TOTAL	\$2,220,000	\$9,419,000

Table 15 - Summary of Key Costs and Funding Requirements Based on Priority

Total Funding Allocations per Capital or Recurring	High Priority - Needed for core Goals	Moderate Priority - Will actively support outcomes	Lower Priority- Could wait a short time until funding or grants become available
1. Capital Expenses (\$2,220,000)	\$440,000	\$1,160,000	\$620,000
2. Annual Expenses (\$9,419,000)	\$4,911,000	\$1,338,000	\$3,170,000

5.5 Implementation Monitoring and Review

5.5 Monitoring and Review

It is recommended that a review and update of the Tree Strategy and associated Tree Management Technical Guidelines be undertaken on a 10 yearly basis.

In accordance with the Integrated Planning and Reporting Guidelines, basic progress on the delivery of action items in the Strategy will be reported monthly and annually.

Ongoing measurement, monitoring and reporting of more detailed progress on the strategic directions for tree management should be undertaken every 3 years.

This should report on the following performance indicators:

- Canopy cover — measure for net increase; identify gains and losses and where they have occurred.
- Number of trees planted — measure for net increase, and as a comparison to number of trees approved for removal or otherwise removed by Council .
- Number of trees removed — measure for net number of trees approved for removal, as compared to number of trees planted.
- Temperature readings in key urban areas — measure for average temperatures and potential reductions or increases over time.
- Distance from a defined 'gridded' point system to the nearest green infrastructure or park, within urban areas.
- Community attitudes — survey of residents for a better understanding of intrinsic attitude to trees, willingness to participate in greening activities, and success of community education and awareness programs.

Council will commit to canopy measurements being undertaken and analysed within the Council's GIS system on a minimum of 3-yearly basis, to assess how the initiatives of the Tree Management Strategy are progressing and whether there is a need to advance the delivery programs.

This section of the Strategy contains additional, related information.





6.0

APPENDICES

6.1

APPENDICES

OPINION OF COST

Opinion of Probable Cost			
Action Item	Comment/implications	Responsible department	Cost
Strategic Direction 1 — identify and manage trees as assets			
1.1 Identify trees in our streets and parks as essential assets of our urban infrastructure and incorporate tree management into broader asset management thinking and activities.	Policy position		
1.2 Survey all public trees, managed by the City of Liverpool, including street trees, park trees and trees on Crown land managed by the Council.	Engage external consultants		\$250,000 annually
1.3 Prepare a tree inventory as an electronic Tree Asset Register. The register will be established as an updateable electronic database that can hold complete history for each tree, with data including images and maintenance records.	Policy position		–
1.4 The Tree Asset register will also maintain records of all assets that have undergone formal risk assessment, together with any actions identified to minimise tree-related risk, details of any compensation claims (eg for repairs to private structures) and scheduling of future inspections.	Policy position		\$50,000 annually
1.5 Council will investigate whether to update the internal asset management system to add tree data OR purchase a proprietary tree management system such as 'Forestree', 'Arbostar'.	Update Council's asset management system – one off cost + ongoing support. Purchase tree management system – one off cost + ongoing support		\$250,000
1.6 Engage a specialist consultant to survey key areas of the LGA for trees of heritage significance or other outstanding value; and to prepare a Significant Tree Register.	Engage external consultants		\$250,000
1.7 Co-ordinate the Tree Asset Register with information on known significant trees, so that significant trees managed by Council are clearly identified and managed accordingly.	Data entry/data export		\$20,000
1.8 Undertake a tree canopy survey and establish annual (or maximum 3-yearly) reviews.	Engage external service		\$150,000
Strategic Direction 2 — Increase canopy cover			
2.1 Protect existing canopy, avoiding unnecessary pruning or removals.	Policy position and engage enforcement officer		\$52,000 annually
2.2 Establish an annual tree planting program. We will plan for the planting of over 7000 trees each year, for the next 11-year period. Street plantings will be of advanced, robust-sized trees of at least 45L and preferably 100L or above. Park trees will be planted in a greater variety of sizes and include small trees and tube stock, where appropriate, as well as substantial feature plantings of >200L trees for premier parks. Mass planting using tube stock will also be undertaken along drainage lines.	Annual, recurring budget for: 4,300 Street trees – 200L x 100 – 100L x 2,000 – 45L x 2,200 2,700 Park trees – 200L x 50 – 100L x 150 – 45L x 300 – 5L x 200 – tube stock x 2000		\$2,409,000 annually being: 4,300 Street trees \$500,000 \$1,300,000 \$374,000 2,700 Park trees \$100,000 \$75,000 \$45,000 \$ 5000 \$10,000
2.3 Undertake an initial audit for planting opportunities in Council park lands, then follow up with ongoing audit of park lands for further tree planting.	Initial audit could be outsourced if Council can't resource in house.		\$100,000 annually
2.4 Council will manage public parks and plazas to create 'oases' of shade in the public domain.			included above

6.1

Appendices

Opinion of Cost

Opinion of Probable Cost			
Action Item	Comment/implications	Responsible department	Cost
2.5 Carry out 'gap' audit of existing street tree planting locations, in accordance with the Western Sydney Street Design Guidelines, that recommend achieving continuous canopy cover of both sides of every street. Fill any identified locations with an appropriate tree, including replacing of dead or senescing trees. Actively seek new locations for establishing tree planting, such as additional planting in wide areas of pavement, in-road planting in wide roadways.	Dedicated role within Council		\$90,000 annually
2.6 An urgent replacement program will be established for dead or under-performing street and park trees, as well as a practice of scheduling replacement of any street or park trees that are removed.	Policy position & associated scheduling requirements.		included above
2.7 Specific tree planting policies will be introduced into Park Management Plans, for the maintenance and replacement of trees, in accordance with this Strategy document and consistent with the Tree Management Specifications.	Implemented as park management plans are prepared.		–
2.8 Street tree masterplans will be undertaken for key urban spaces, incorporating summer shade for pedestrian footpaths and cycleways, wherever possible. Trees will be introduced into all extensively paved public spaces such as plazas and carparks.	Updated Liverpool CBD and 10 x densely populated urban/suburban areas @ \$50K/report/ master plan		\$60,000 \$500,000
2.9 As much as possible, street tree installation will be detailed in accordance with the principles of Water Sensitive Urban Design. This will maximise stormwater harvesting in public places, to support soil moisture.			–
Strategic Direction 3 — Manage the urban forest in accordance with best practice			
3.1 Practice the principle of 'right tree in the right place' with emphasis on using the largest tree possible for each location.	Policy position Implications for budget allowance		–
3.2 Utilise a mixture of trees species to provide diversity of sizes and habitat, achieving a mix from at least 3 different botanic families for all major streets and park plantings.	Policy position		–
3.3 Increase urban forest diversity through considered tree species selection in all street and park masterplans.	Ongoing monitoring of tree asset register, no addition cost		–
3.4 Achieve a diversity of mature tree sizes with a minimum of: – 10% civic scale trees – 30-35% large trees – 50-55% medium trees – No more than 10% small trees.			–
3.5 Improve soil conditions for newly planted trees, using adequate soil volumes and appropriate tree installation methodology, as per the Tree Management Guidelines.	Implications for trees planted in streets and plazas. Allow up to \$15K for addressing over an above planting requirements for difficult sites		\$240,000 annually
3.6 Select species and planting environments for changing climatic conditions and use the principle of 'the right tree in the right place', as outlined in the Recommended Tree Selection Schedule, in Tree Management Technical Guidelines.	Instigate broad use of Recommended Tree Selection schedule.		–
3.7 Remove weed species and undesirable plants to remove potential weed sources and urban maintenance burdens.	Following Action 1.2, review asset register and plan for replacement of weed species.		\$100,000 annual allowance

6.1

Appendices

Opinion of Cost

Opinion of Probable Cost			
Action Item	Comment/implications	Responsible department	Cost
3.8 Collect and re-use rainwater as much as possible. Identify storm water harvesting opportunities and install new street trees with storm water harvesting details, where appropriate.	Project based cost implications. Plan for 3 new installations per year?		Determined per project but allow \$600,00 for pilot projects, demonstration sites
Strategic Direction 4 — Manage tree risk			
4.1 Maintain public safety and reduce the risk of property damage through the use of best practice tree assessment and risk mitigation.	Policy position		—
4.2 Promote tree risk management (for both public and private trees) that explores all appropriate opportunities for retention, over removal. A decision-making protocol for tree removals will be established, based on the Tree Policy.	Policy position		—
4.3 Active assessment of Council-managed trees will be undertaken in zones of highest occupancy at a regular interval, and expanded out to other areas over time, to include all trees on our asset management system.	Undertake formal certification of staff. Additionally outsource urgent work in well-treed high use areas - see also Action 7.5		\$20,000 annually
4.4 Records will be maintained of the trees that have undergone risk assessment and any actions identified to minimise risk.	Ongoing record keeping		—
4.5 A process will be established to address risk mitigation requirements, in a timely manner, for any Council-managed trees that have been assessed as having elevated risks, and to generate appropriate work orders for risk mitigation actions.	Ongoing process for work order generation and implementation		\$50,000 annual allowance
Strategic Direction 5 — Recognise the link between 'green' and 'blue'			
5.1 Ensure all planted parks are irrigated, to support trees transpiration processes and their cooling effect.	Design and installation of 'smart' irrigation systems to work in tandem with passive irrigation. Review park irrigation throughout LGA and allow for installation of irrigation, stormwater harvesting to 6 parks/year		\$3,000,000 annually
5.2 Introduce Water Sensitive Urban Design (WSUD) philosophy as a practical objective for all public spaces. Divert storm water to trees and green landscaped areas, wherever possible, using the LGA's extensive network of roadways to harvest water, through engineered, integrated systems of kerb inlet pits, rain gardens, constructed soil profiles and structural soils.	Policy position Over an above cost implications per project compared to status quo. Plan for 2 new/renewal projects per year? Included as part of project costs		\$600,000 annually
5.3 Reduce the extent of impervious surfaces throughout the LGA. Where hard surfaces are necessary, preference the use of permeable pavements wherever possible, to mimic natural hydrological movement and contribute to recharging of ground water storage, particularly in the vicinity of tree plantings	Cost implication per project. Plan for 2 new/renewal projects per year? Determined per project, not part of tree budget.		\$500,000 annually
5.4 Encourage private use of local collection and storage of storm water for re use in landscape irrigation.	Policy position. See Strategic Direction 8. Implement through development assessment/ approval process, as appropriate.		—

6.1

Appendices

Opinion of Cost

Opinion of Probable Cost			
Action Item	Comment/implications	Responsible department	Cost
5.5 Encourage use of 'smart' irrigation systems linked to soil moisture and weather conditions to avoid waste.	Policy position. See Strategic Direction 8		–
5.6 Select tree species to balance drought and heat tolerance, with the need for transpiration and shading.	Implemented in association with Strategic Direction 3. Refer to Recommended Tree selection schedule		–
5.7 Establish ongoing irrigation of significant trees and trees in key public places. Respond flexibly to temporarily irrigate trees during drought conditions.	Following Action 1.2, establish irrigation for significant trees (including Heritage items 21, 22, 94 & 99). Add trees identified as part of Action 1.6.	Tree maintenance team	Determined per tree
5.8 Make water issues more visible to the public and educate the community about water use and conservation benefits.	Refer Actions 6.2 & 8.2.		–
Strategic Direction 6 — Manage trees on privately owned land (or land managed by other agencies)			
6.1 Council will consistently apply development controls related to trees to stem the loss of existing, mature and healthy trees.	Ongoing assessment of development applications and tree permits applications.		–
6.2 Tree-related information on Council's website will be updated to inform and guide the community, private developers and contractors on all tree matters and be consistent with the Tree Management Strategy and Guidelines.	Web pages prepared internally. Content to be based on Tree Management Framework and normal Council reporting cycles.		\$15,000
6.3 Council will provide clear guidelines for risk assessment requirements relating to private trees, including: – Assessment and reporting requirements – Use of appropriately qualified arborists – Risk tolerance	Refer Actions 6.2 & 8.2.		\$25,000
6.4 Council's policy will aim to achieve an offset ratio of 3 to 1 for any existing trees removed. That is, 3 trees to be planted for each tree removed.	To be implement as part of development assessment/ approval process and tree permit application process.		–
6.5 Liaise with private owners of industrial sites backing the riparian corridors, to provide support with vegetation activities. The majority of South Creek and Kemps Creek are in private, rural residential holdings. Council will focus on private commercial landowners regarding vegetation activities.	May be undertaken internally or contracted to a community engagement consultant. Option to provide grant or similar cost matching contributions or donations of plants etc.		\$100,000 annual allowance to be spent primarily on achieving measurable outcomes of additional planting on private lands
6.6 Proactively engage and partner with other agencies who manage trees within Liverpool LGA to share resources, build awareness and provide leadership for tree management.	Quarterly contact with other agencies such as Western Sydney Park, Aerotropolis, Western Sydney International Airport, Sydney Water, NPWS, TfNSW Allow 60 person hours annually, recurring		\$12,000 annually

6.1

Appendices

Opinion of Cost

Opinion of Probable Cost			
Action Item	Comment/implications	Responsible department	Cost
Strategic Direction 7 — Build Council Capacity for Tree Management			
7.1 Establish an appropriate annual budget for capital expenditure, as part of a long-term financial plan for achieving the aims of this Strategy.	Part of financial planning process.		—
7.2 Establish a fund through annual budget allowance, state and federal government grants and development contributions for the management of trees in the LGA.	Preparation of grant applications for various projects. Can undertake this via a 6-month temporary part-time officer role (allow say \$40K salary) *Blacktown council was successful in being awarded 1.7M from the 2022 'Greening our City' grant		\$40,000 annually
7.3 Establish a council Tree Team and build in-house tree expertise through increased staffing. Consider creating a Council officer position specifically for identification of tree planting opportunities and a council officer position to foster inclusion of Aboriginal ecological knowledge and Connection to Country	Additional 2 tree officers, AQF 5 for: - Management of database, ID planting opportunities and implementation of planting programs. - Input into DA assessments and compliance. Aboriginal ecological officer with tree expertise, to assist implementation of TMS and overlay with knowledge of Country, bush fire management practices, etc.		\$300,000 annually
7.4 Expand Council ongoing tree planting and maintenance capacity	Second planting/ maintenance crew: 2 utility arborists (plus irrigation experience) + vehicle + equipment.		\$306,000 annually
7.5 Ensure adequate resources (including skilled personnel and time allocation) to carry out systematic, active tree risk assessments.	Engage qualified arborists. Allow assessment of 200 trees per year @ average of \$1,000/tree for consultant fees; Tree Risk Assessment training for tree team, see Action 4.3.		\$200,000 annually
7.6 Ensure adequate resources (including skilled personnel and time allocation) to carry out identified physical programmed and reactive tree work. If there are insufficient personnel to carry out urgent tree work, this service could be outsourced.	Engage qualified utility arborists for periodic, emergency and urgent tree work.		Standing Contract with rates - say \$800,000 annually
7.7 Use external contractors for additional capacity for tree-planting and cyclic maintenance.	As required, project-based		included above
7.8 Use external consultants for additional capacity for tree surveys, and risk assessment.			included above

6.1

Appendices

Opinion of Cost

Opinion of Probable Cost			
Action Item	Comment/implications	Responsible department	Cost
Strategic Direction 8 — Build community awareness and encourage participation in urban greening			
8.1 Develop a community engagement strategy for urban greening that promotes benefits of trees on Council website and through community and school events.	Policy position		\$100,000
8.2 Prepare a comprehensive suite of public facing tree information 'pages' for Council's website. These should include information on tree removals as well as positive 'greening' messages.	Web pages prepared internally or outsourced. Content to be based on Tree Management Framework.		Internal graphic design staff
8.3 Prepare printed educational materials that can be disseminated in community centres and other community institutions and events.	Graphics to be prepared internally or outsourced. Content to be based on Tree Management Framework.		Internal graphic design staff and community liaison officers
8.4 Provide the community and design professionals with tools to evaluate the quality of urban greening and differentiate between the benefits of say a large shade tree compared to an area of lawn.	Developed in association with materials for Action 8.2		included above
8.5 Encourage participation in urban greening, bush care, and street tree planting activities.			\$20,000 annual allowance
8.6 Notify community about tree planting events.	Notices to be provided on Council website and newsletters.		\$10,000 annual allowance
8.7 Establish a community nursery for growing and distributing locally suitable tree species.	Could be undertaken as a special funded project		\$250,000 setup then \$150,000 annually
8.8 Undertake annual greening events such as National Tree Day, community planting days, free tree giveaways.			\$20,000
Strategic Direction 9 — Manage impact of development on trees			
Actions 9.1 to 9.6 - Part of normal Council functions and existing budgets			
—			
Strategic Direction 10 — Review planning policy and development controls			
Actions 10.1-10.9 - Part of normal Council functions and existing budgets			
—			

6.2

APPENDICES

STAKEHOLDER AND COMMUNITY CONSULTATION

Introduction

A community and stakeholder engagement and consultation plan was prepared with key intents to:

- Provide all stakeholders with information on tree issues in the Liverpool LGA and to assist them in understanding the opportunities and solutions.
- Offer those who will be affected by the outcomes, a chance to voice their opinions;
- Enable the project team to identify the key stakeholders and understand the relationship they have with the project;
- Bring the relevant people together to pool knowledge, experience and expertise to co-create solutions; and
- Listen to and acknowledge concerns and aspirations and provide feedback on how public input influenced the outcomes.

Internal Stakeholders

The plan identified internal stakeholders as follows:

- Mayor and Councillors
- Executive Leadership Team
- Liverpool Planning & Infrastructure Governance Committee
- Community & Lifestyles
- Chief Executive Officer
- Corporate Support
- City Futures
- Customer & Business Performance
- Operations
- Planning & Compliance

External Stakeholders

- NSW Department of Planning and Environment
- NSW Department of Health (South Western Sydney Local Health District)
- Transport for NSW
- Heritage NSW
- Local Residents and Property Owners
- Local Businesses

Methodology for Engagement

Internal briefings and consultation have followed Council's standard and documented processes. NSW Government Departments and Agencies have been and will be consulted through invitations to comment on the draft documents.

Community engagement will undertaken by both passive and active methods. Information sharing on the draft Tree Management Strategy and Tree Management Technical Guidelines will be through the following:

- Council's website
- Advertisement in local newspapers
- Newsletter to letterboxes
- e-newsletter to subscribers
- Community meetings

Consultation has been by way of exhibition of the suite of documents comprising the Tree Framework: Tree Policy, Tree Management Strategy and Tree Management Technical Guidelines, from 15 July 2024 to 15 September 2024 (a period of 62 days), accompanied by invitations for feedback from individuals and communities, including business groups.

In order to convey the key ideas of the draft Tree Policy and supporting documents to parts of the community from culturally and linguistically diverse backgrounds, the executive summary was translated into the 10 most common community languages of the LGA and provided as part of the exhibition materials. Additionally, the Gandangara, Deerubin and Tharawal Local Aboriginal Land Councils were specifically invited to comment.

Once the Tree Policy, Tree Management Strategy and Tree Management Technical Guidelines are finalised and adopted, it is anticipated that in accordance with the actions outlined in this report a Community Engagement Strategy, specifically for urban greening will be developed to promote benefits of trees and identify ways the community can get further involved.

6.2

Appendices

Stakeholder and Community Consultation

Outcomes

The entirety of the feedback has been considered in the finalisation of the Tree Management Framework. Internal stakeholder feedback has already been considered and was included within the draft documents exhibited. The results of the public exhibition period are summarised below.

Formal submissions from the Community and other internal and external stakeholders were collated and reviewed. Each emerging theme was considered by Council and the project team.

Summary and Comments on Submissions

A total of 10 formal submissions were received following the exhibition of the draft documents. Some of these contained comments that related to multiple topics and were spread across the range of documents.

- 6 comments were received from Council staff / Internal Council departments
- 3 comments were received from local residents and/or members of the Liverpool Environmental Advisory Committee
- 1 comment was received from the Liverpool Design Excellence Panel

Generally the comments primarily related to the Tree Policy or the Tree Management Strategy and focussed on:

- Tree removal and pruning criteria and their applications.
- Canopy cover targets, their application and interpretation.
- Planting details and particularly the potential application of root barriers and planting edging types.
- Overhead power implications and the application of Aerial Bundled Conductors and tree size.
- Bushfire regulations and the impact on tree retention and canopy cover.
- Tree planting objectives and species selection criteria.
- Ultimate enforcement of the objectives and impacts of development upon trees and tree planting.

For the most part the comments were received, appreciated and noted but did not require specific amendment of the documents. They were either outside the perceived scope of the document(s) or considered to be adequately addresses already within the documents. It is noted that existing and future local development controls will be required to ensure that future neighbourhoods in the growth corridor are green environments that can sustain a healthy lifestyle. Council will continue to review and update our suite of DCP's to better guide and control development and positive tree outcomes. This will require that consideration for retention and inclusion of trees is a core element of design proposals.

The canopy targets expressed for particular zonings are intended to test and convey that each different land use type may have a different capacity to contribute to the ultimate LGA wide goal. Different types of roads, for example, have different abilities to achieve canopy cover. Likewise, different lot sizes and types of business or developments will have different abilities to contribute to canopy cover. The percentages conveyed in Section 4.2 of the TMS are an educated hypothesis to primarily test whether those percentages would facilitate the ability to initially set and then ultimately reach a LGA wide target, based on the simplistic categories of land use type.

It is also noted that the zonings may include roads which are in turn subject to their own canopy targets and is not necessarily a lot by lot style assessment. These initial aspirational targets were based on the measured 'existing canopy' cover. For example, agribusiness currently measures less than 3% cover, therefore specifying 10% is considered aspirational. The TMS will be used to inform any future changes to prescriptive planning documents (eg: DCPs), to assist Council in achieving the aspirational LGA wide canopy targets through the application of percentage targets for broad land use categories. At a later stage, Council will determine whether these figures contradict or are less than any current DCP targets for a particular land use zone. It is noted, where there are canopy targets in existing DCPs which specify a different canopy percentage than the TMS, (at Council's discretion) precedence should be given to the higher of the two.

Amendments Made

The following amendments were made to the document following exhibition and subsequently put forward for adoption.

- Tree Policy amended to include additional information on reasons Council will not prune or remove trees on public land.
- TMTG standard planting details were amended to include notations and placement of optional root barrier installations, where relevant, and additional commentary regarding root barriers was added to TMTG Section 4.11 and Appendix 5.4 item 12.
- Commentary was added to Section 3.8 around overhead wires, ABC and tree selection. TMTG tree selection definitions were amended to better clarify use of larger trees when under ABC.
- Commentary was included in the TMS Canopy Targets and Direction 9 - Manage Development regarding difficulty of application of State Government regulated bushfire APZs
- Two additional categories and canopy cover targets were added to Table 11 to account for Schools as an important land use that can occur within multiple different landuse zones.
- Additional commentary added to Action 8.2 within the TMS to facilitate resident requests for tree planting.

6.3

APPENDICES

BENCHMARKING AND DOCUMENTS REVIEWED

Benchmarking of best practice in tree management was undertaken by review of a range of tree and urban forest strategy and management documents, from various Councils particularly in NSW, ACT and Victoria. The review focused on examples from the Sydney Metropolitan area demonstrating best practice strategies and built examples, for the increase and improvement of tree canopy cover in urban areas.

Benchmark Documents

- City of Sydney, Greening Sydney Strategy, 2023
- City of Sydney, Street Tree Master Plan, 2022
- City of Sydney, Street Tree Technical Guidelines
- City of Sydney, Development Control Plan – Section 3.5.3 Tree Management, 2012
- City of Melbourne Urban Forest Strategy 2012-2032
- North Sydney Council Urban Forest Strategy, 2018
- North Sydney Council Development Control Plan — Section 16 Tree and Vegetation Management, 2013
- ACT Government Urban Forest Strategy 2021-2045
- Canberra's Living Infrastructure Plan: Cooling the City
- City of Ryde (Draft) Urban Forest Strategy, 2022
- City of Ryde Tree Management Technical Manual, 2016
- Newcastle Urban Forest – Background Paper 2007
- Ku-ring-gai Council Urban Forest Strategy, 2022
- Ku-ring-gai Council Development Control Plan — Part 13 Tree and Vegetation Preservation, 2022
- Wingecarribee Shire Council Street Tree Implementation Plan 2016
- Climate Ready Street tree trials – A best practice guide
- Western Sydney Planning Partnership, Street Design Guidelines, 2020
- WSROC - Urban Heat Planning Toolkit (2021)
- Low Carbon Living CRC – Guide to Urban Cooling Strategies (July 2017)
- Clean Air and Urban Landscapes Hub - Cities for People and Nature (2020)

Policy Context – Liverpool City Council

- LCC Community Strategic Plan 2022-2032
- LCC Connected Liverpool 2040
- LCC Our Home, Liverpool 2027 (Community Strategic Plan Update Developed in 2017)
- LCC Local Environmental Plan 2008
- LCC Development Control Plan 2008
- LCC City Centre Public Domain Master Plan 2020
- LCC Recreation, Open Space and Sports Strategy 2018-2028
- LCC Climate Change Policy (Draft)
- LCC Climate Action Plan 2021
- LCC Liverpool Bike Plan 2018

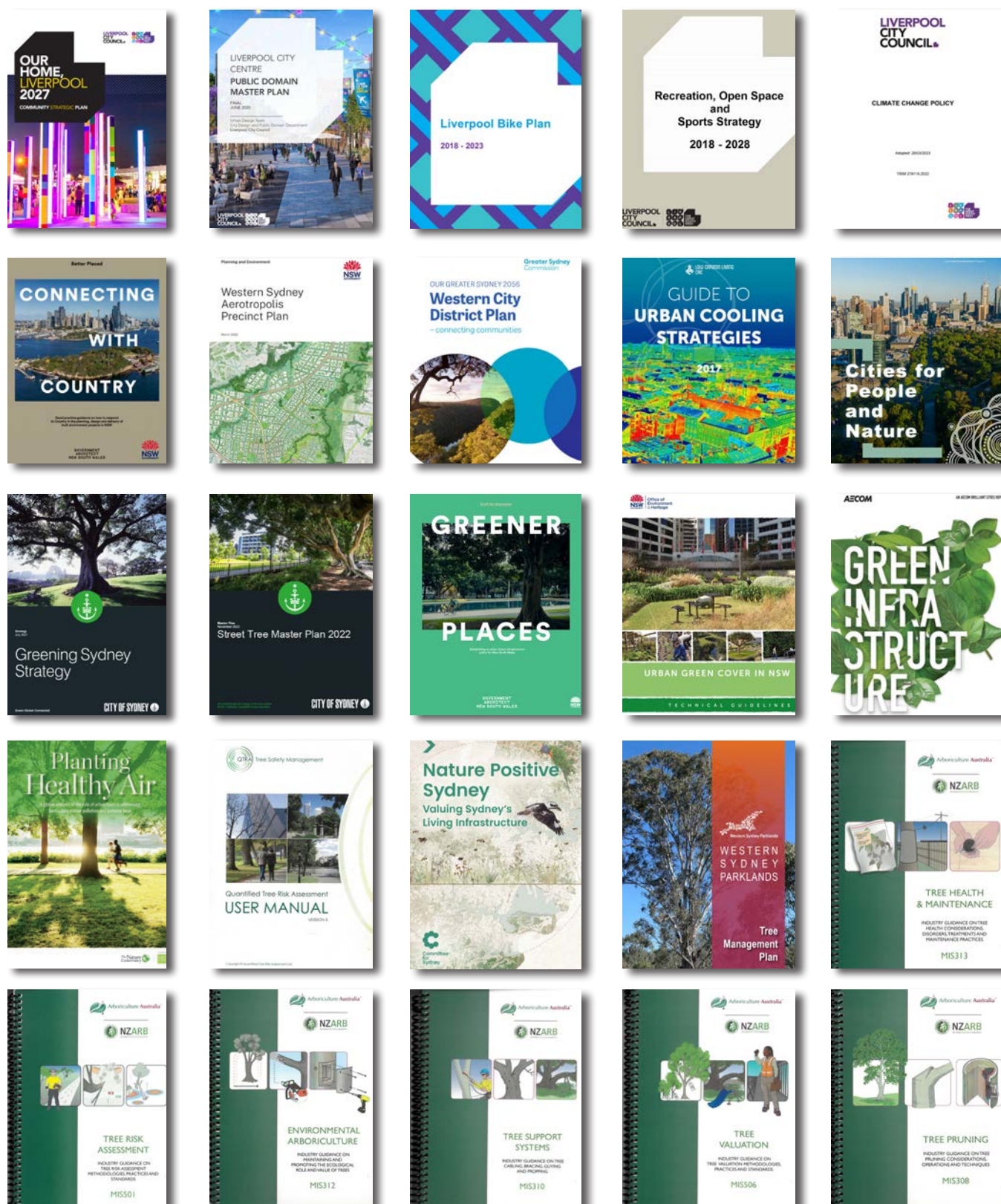
Policy Context – State and Regional

- Western City District Plan — Our Greater Sydney 2056 (updated 2018)
- Western Sydney City Deal — Smart Cities Plan
- A Metropolis of Three Cities — Greater Sydney Regional Plan
- NSW Government Architects Office, Greener Places (2020)
- NSW Government Architects Office, Connecting With Country (2023)
- NSW Government Architects Office, Biodiversity in Place (2024)
- NSW Government Architects Office -The Green Grid-creating Sydney's open space network
- NSW Department of Planning, Industry and Environment, NSW Public Spaces Charter (October 2022)
- Committee for Sydney Nature Positive Sydney - Valuing Sydney's Living Infrastructure (February 2023)

6.3

Appendices

Benchmarking and Documents Reviewed



6.4

APPENDICES

SUMMARY OF NATURAL SOILS AND VEGETATION

Table 16 - Summary Table of Major Soil Landscape Associations and Natural Vegetation of the City of Liverpool

Soil Landscape	Code	Location/ Suburbs	Vegetation
Blacktown	bt	Predominant soil landscape throughout the Liverpool LGA Found in Cabramatta; Prestons	• <i>Eucalyptus tereticornis</i> (Forest Red Gum) • <i>E. maculata</i> (Spotted Gum) • <i>E. globoidea</i> (White Stringybark) • <i>E. fibrosa</i> (Broadleaved Ironbark) • <i>E. longifolia</i> (Woollybutt)
Luddenham	lu	Associated with higher ground of the LGA Found in Denham Court; Cecil Park	• <i>E. maculata</i> (Spotted Gum) • <i>E. moluccana</i> (Grey Box) • <i>Allocasuarina torulosa</i> (Forest Oak) • <i>Acacia implexa</i> (Hickory Wattle) Lesser occurrences of: • <i>E. fibrosa</i> (Broadleaved Ironbark) • <i>E. crebra</i> (Narrow-leaved Ironbark) • <i>Eucalyptus tereticornis</i> (Forest Red Gum)
South Creek	sc	Around waterways: South Creek, Kemps Creek and tributaries Found at Prestons; Hoxton Park	• <i>Angophora subvelutina</i> (Broad-leafed Apple) • <i>Eucalyptus amplifolia</i> (Cabbage Gum) • <i>Casuarina glauca</i> (Swamp Oak) On elevated banks, tall shrubland includes: • <i>Melaleuca spp</i> (Paperbark) • <i>Leptospermum spp</i> (Tea Tree)
Berkshire Park	bp	Around waterways: Georges River and tributaries Found at Chipping Norton; Holsworthy	• <i>Eucalyptus fibrosa</i> (Broad-leaved Ironbark) • <i>Angophora bakeri</i> (Narrow-leaved Apple) • <i>E. sclerophylla</i> (Scribbly Gum) • <i>Melaleuca decora</i> (White Feather Honey Myrtle) • <i>M. nodosa</i> (Prickly leaved Paperbark)
Richmond	ri	Around waterways Found at Crana; Wallacia	• <i>Toona australis</i> (Australian Red Cedar) • <i>Ceratopetalum apetalum</i> (Coachwood) • <i>Melaleuca spp.</i> (Paperbarks) Regrowth is dominated by: • <i>Acacia spp</i> (Wattles) • <i>Eucalyptus piperita</i> (Sydney Peppermint)

Other Minor Soil Landscape	Code	Location/ Suburbs
Faulconbridge	fb	Associated with Hawkesbury sandstone of the Blue Mountains plateau. Little Mountain
Picton	pn	Small patches within Western Sydney Parklands
Hawkesbury	ha	Holsworthy site
GyMEA	gy	Holsworthy site
Disturbed	xx	Associated with highly urbanised areas; CBD

6.4

Appendices

Summary of Natural Soils and Vegetation



Figure 111: Cumberland Plain Woodland in western Sydney, near Liverpool. (Source : Arterra)

6.5

APPENDICES REFERENCES AND LINKS

Websites and document links

Australian Government - Environmental Protection Biodiversity Conservation Act 1999

<https://www.legislation.gov.au/C2004A00485/latest/versions>

NSW Government - Heritage Act 1977

<https://www.legislation.nsw.gov.au/#/view/act/1977/136>

Local Government Act 1993

<https://legislation.nsw.gov.au/view/html/inforce/current/act-1993-030>

Environmental Planning and Assessment Act 1979

<https://legislation.nsw.gov.au/view/html/inforce/current/act-1979-203>

Trees (Disputes Between Neighbours) Act 2006

<https://legislation.nsw.gov.au/view/html/inforce/current/act-2006-126>

NSW Department of Planning and Infrastructure - State Environmental Planning Policy (Infrastructure) 2007

<https://www.legislation.nsw.gov.au/#/view/EPI/2007/641/part3/div12>

Western Sydney Regional Organisation of Councils (WSROC) Urban Heat Planning Toolkit

<https://wsroc.com.au/projects/project-turn-down-the-heat/turn-down-the-heat-resources-2>

City of Sydney – Greening Sydney Strategy 2023

<https://www.cityofsydney.nsw.gov.au/strategies-action-plans/greening-sydney-strategy>

Liverpool Community Strategic Plan 2022-2023

https://www.liverpool.nsw.gov.au/_data/assets/pdf_file/0005/216968/Community-Strategic-Plan-2022-2032.pdf

NSW Biodiversity Conservation Act 2016

<https://legislation.nsw.gov.au/view/html/inforce/current/act-2016-063>

NSW Weedwise

<https://weeds.dpi.nsw.gov.au>

6.5

Appendices

References and Links

References

- Amati, M., Boruff, B., Caccetta, P., Devereux, D., Kaspar, J., Phelan, K., Saunders, A., 2017, Where should all the trees go? Investigating the impact of tree canopy cover of socio-economic status and wellbeing in LGA's .
- Astell-Burt, T., Hartig, T., Eckerman, S., Nieuwenhuijsen, M., McMunn, A., Frumkin, H. & Feng, X., 2021, More green, less lonely? a longitudinal cohort study.
- Astell-Burt, T., Navakatikyan, M. A., Feng, X., 2020, Urban green space, tree canopy and 11-year risk of dementia in a cohort of 109,688 Australians.
- Astell-Burt, T. & Feng, X., 2019, Association of Urban Green Space With Mental Health and General Health Among Adults in Australia, JAMA Network Open, accessed on the 12/08/2019 <https://doi.org/10.1001/jamanetworkopen.2019.8209>.
- Astell-Burt, T., & Feng, X., 2019, Urban Green Space, Tree Canopy and Prevention of Cardiometabolic Diseases: A Multilevel Longitudinal Study of 46 786 Australians, International Journal of Epidemiology, Oxford University Press.
- Australian Bureau of Meteorology – Climatic Statistics Sydney http://www.bom.gov.au/climate/averages/tables/cw_066047.shtml (Accessed 16/11/2023)
- Benson, D., and Howell, J., 1995, Taken for granted – the bushland of Sydney and its suburbs, Kangaroo Press in association with the Royal Botanic Gardens Sydney, Kenthurst, NSW.
- Carpani, S., 2016, "Health Benefits of Urban Trees", Arborist News Vol25 No.3 pp22-25.
- Carter, J. & Kazmierczak, A., 2010, Adaptation to Climate Change Using Green and Blue Infrastructure: A Database of Case Studies, University of Melbourne.
- Casey and Lowe Associates, 1999, Department of Education and Training site, Corner Bigge and Moore Streets, Liverpool - Archaeological Assessment.
- Catteral, C.P. et al, 1991, Habitat use by Birds across a forest-suburb interface in Brisbane - implications for corridors. Nature Conservation, No. 2, pp247-258.
- Chapman, G.A and Murphy, C.L, 1989, Soil landscapes of the Sydney 1:100 000 Sheet Report, Soil Conservation Service of NSW, Sydney, NSW.
- Clean Air and Urban Landscapes Hub – Cities for People and Nature (2020).
- City of Melbourne/Victorian Department of Environment, Land, Water and Planning – How to grow an urban forest, 2015.
- Coutts, C., & Hahn, M., 2015, Green Infrastructure, Ecosystems Services, and Human Health, International Journal of Environmental Research and Public Health.
- City of Sydney – Street Tree Master Plan 2023.
- City of Sydney – Greening Sydney Strategy 2021.
- Committee for Sydney, Nature Positive Sydney – Valuing Sydney's Living Infrastructure (2023).
- Davies, P., Corkery, L., Nipperess, D., 2017, Urban Ecology: theory, policy and practice in New South Wales, Australia, National Green Infrastructure Network.
- Denman, E. C., May, P., & Moore, G., 2011, the use of trees in urvban stormwater management. Retrieved July 2023, from treenet: <https://treenet.org/resource/the-use-of-trees-in-urban-stormwater-management/>
- Department of Planning and Environment, 2022, A Guide to the South West Growth Area.
- Department of Planning and Environment, Western Sydney Aerotropolis Development Control Plan 2022.
- Department of Planning and Environment, 2022, Western Sydney Aerotropolis Precinct Plan.
- Department of Plannning and Environment, 2022, Average tree canopy cover, heat vulnerability index and urban heat island of suburbs in Greater Sydney. Retrieved July 2023, from https://www.dpie.nsw.gov.au/__data/assets/pdf_file/0019/536320/Average-tree-canopy-cover-heat-vulnerability-heat-islands.pdf
- Department of Planning, Industry and Environment. (n.d.), Recovering Bushland on the Cumberland Plan - best practice guidelines. Retrieved July 2023, from NSW Department of Planning, Industry and Environment: <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10191>
- Department of Primary Industries, 2022, Weeds and the Biosecurity Act – A handbook for local councils and councillors in NSW.
- Department of Primary Industries, Primefact 936, 2009, Dryland Salinity - causes and impacts.
- Ferrini, F., Konijnendijk van den Bosch, C.C., Fini, A., (Editors), 2017, Routledge Handbook of Urban Forestry, Routledge, London, UK.
- Gilman, E.F., 2012, An illustrated guide to pruning (Third Ed.), Delmar Cengage Learning, New York, USA.
- Green Building Council of Australia, 2010, Green Star Communities National Framework.
- Harris, R.W., Clark, J.R. and Matheny, N.P., 1999, Arboriculture: Integrated management of landscape trees, shrubs and vines, 3rd Ed. Prentice Hall, New Jersey, US.
- Jones D. S., Low Choy, D., Tucker, R., Heyes, S., Revell, G., Bird, S., 2018, Indigenous Knowledge in the Built Environment: A guide to Tertiary Educators. Australian Government – Department of Education and Training, Canberra ACT.
- Kass, t., 2004, A Thematic History of the City of Liverpool.
- Kelly, M., 2007, Liverpool Hospital, Liverpool NSW - Historical Archaeological Assessment, Research Design & Excavation Methodology.
- Lindsey, P., & Bassuk, N., 1991, Specifying Soil Volumes to Meet the Water Needs of Mature Urban Trees and Trees in Containers, Journal of Arboriculture, Volume 17, No. 6 pp 141 – 149.

6.5

Appendices

References and Links

- Livesley, S. J., Escobedo, F. J., & Morgenroth, J., 2016, The Biodiversity of Urban and Peri-Urban Forests and the Diverse Ecosystem Services They Provide as Socio-Ecological Systems. Retrieved from MDPI: <https://www.mdpi.com/1999-4907/7/12/291>
- Low Carbon Living CRC – Guide to Urban Cooling Strategies (July 2017)
- MassonDelmotte, V.P., Zhai, A., Pirani, S. L., Connors, C., Péan, S., Berger, N., Caud, Y., Chen, L., et al. 2021. IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Manea, A., Stass, L., Plant, L., Ossola, A., Beaumont, L., Power, S., Johnson, T., Gallagher, R., Griffiths, G. & Leishman, M., 2021, Climate ready street tree trials: A best practice guide.
- Manning, A.D., Gibbons, P., and Lindenmayer, D.B., 2009, Scattered trees: a complementary strategy for facilitating adaptive responses to climate change in modified landscapes? *Journal of Applied Ecology* 46(4), PP915-919. doi:10.1111/j.1365-2664.2009.01657.x.
- Matheny, N. P. & Clark J.R., 1998, Trees and development - a technical guide to preservation of trees during land development, International Society of Arboriculture, Illinois, US.
- Moore, G. M., Urban Tree Valuation – A Current Perspective and Progress Report, 2006.
- National Green Infrastructure Network-Urban Ecology : Theory Policy and Practice in NSW (May 2017).
- NSW Government, (n.d.), Urban Heat, Retrieved July 2023 from NSW Planning.
- NSW Government Architects Office, The Green Grid – Creating Sydney's open space network.
- NSW Government Architects Office, Greener Places (2020)
- NSW Government Architects Office, Biodiversity in Place (2024)
- NSW Government Architects Office, Connecting With Country (2023)
- North Sydney Council, 2019. North Sydney Urban Forest Strategy
- OPC Architects, 2015, Bigge Park Liverpool – Heritage Impact Statement.
- Pollon, F., 1996, the Book of Sydney Suburbs, Cornstalk.
- Roberts, J., Jackson, N., & Smith, M., 2006. Tree roots in the built environment, No.8 Research for Amenity Trees, Department for Communities and Local Government, London.
- Ryder, C.M. & Moore G.M., 2013, "The arboricultural and economic benefits of formative pruning street trees", *Journal of Arboriculture*, Volume 39, No. 1 pp 17 – 24.
- Soltani, A., & Sharifi, E., 2017, Daily variation of urban heat island effect and its correlation to urban greenery: a case study of Adelaide. *Frontiers of Architectural Research*.
- Schwab, J. C. (Ed). 2009, Planning the urban Forest: Ecology, economy and Community Development, American Planning Association Planning Advisory Services Report No.555.
- Smith, K. & Smith, I., 2020, Grow Your Own Bush Foods : A complete guide to planting, eating and harvesting. New Holland Publishers, Sydney.
- Soumya, M., Dunshea, A., Chong, S., Jalaludin, B., 2020, Tree Canopy Cover Is Best Associated with Perceptions of Greenspace: A Short Communication.
- Stagall, K., Lindenmayer, D.B., Knight, E., Fischer, J. and Manning, A.D., 2012, Large trees are keystone structures in urban parks. *Conservation Letters* 5(2), PP115-122. doi:10.1111/j.1755-263X.2011.00216.x.
- Standards Australia, 2007, AS 4373-2007 Pruning of amenity trees. Standards Australia, Sydney.
- Standards Australia, 2009, AS 4970-2009 Protection of Trees on Development Sites. Standards Australia, Sydney.
- Standards Australia, 2007, AS 4687-2007 Temporary fencing and hoardings. Standards Australia, Sydney.
- Standards Australia, 2021, Green Spaces: A Cool Future, <<https://www.standards.org.au/news/green-spaces-colon-a-cool-future> >, accessed on 10/08/21.
- State Library of NSW, 2011, Carved Trees – Aboriginal Cultures of Western NSW, State Library of NSW, Sydney.
- Sydney Urban Parks Education & Research Group, 2019, The Value of Public Open Space for Community Service Provision, Super Group Information.
- National Green Infrastructure Network-Urban Ecology : Theory Policy and Practice in NSW (May 2017).
- The Guardian, 2021, Australia Needs to Cut Emissions by at Least 50% by 2030 to meet Paris Goals, Experts Say, The Guardian, accessed on 25/08/21 < <https://www.theguardian.com/australia-news/2021/jan/28/australia-needs-to-cut-emissions-by-at-least-50-by-2030-to-meet-paris-goals-experts-say> >.
- The Nature Conservancy Washington – Outside our Doors (2016).
- The Nature Conservancy Washington – Planting Healthy Air (2016)
- Transport NSW – Cycling Future 2013, Walking Future 2013.
- Thom, J. K. et al, 2020, Transpiration by established trees could increase the efficiency of stormwater control measures, *Water Research Journal* 173, Elsevier, Melbourne.
- Trees and Design Action Group – No trees, no future : trees in the urban realm (Nov 2008).

6.5

Appendices References and Links

- United Nations, (n.d.) What is Climate Change. Retrieved July 2023, from United Nations Climate Action: <https://www.un.org/en/climatechange/what-is-climate-change>
- Valderrama, A., 2018, Making Stormwater Markets: How Cities Can Spur Voluntary Green Stormwater Management on Private Land, Living Architecture Monitor, Green Roofs for Healthy Cities, Toronto, Canada
- Wolf, K. L., PhD, 2011, Human Dimensions of Urban Forestry and Urban Greening <http://www.naturewithin.info/> (accessed 15/5/2011).
- Wolf, K. L., 2005, Business district streetscapes, trees and consumer responses. *Journal of Forestry* 103(8), 396-400.
- Wolf, K. L., 2009, Trees Mean Business: City Trees and the Retail Streetscape by University of Washington.
- Wolf, K. L., 1998, Urban Nature Benefits: Psycho-Social Dimensions of People and Plants. Centre for Urban Horticulture, University of Washington, College of Forest Resources - Fact Sheet No. 1, November 1998 .
- 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.