The *Urban Forest Strategy* is a supporting document to the draft *Environmental Action 2016 – 2021 Strategy and Action Plan* that was endorsed by the City of Sydney for public exhibition in June 2015. The City's most up to date set of environmental targets and actions are contained in *Environmental Action 2016 – 2021 Strategy and Action Plan.*

2030

CITY OF SYDNEY

Urban Forest Strategy

2013

city of villages

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Acknowledgements:
The City of Sydney would like to acknowledge the following people for their contribution to the production of this Urban Forest Strategy, 2013.

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The Vision

The City of Sydney's urban forest contributes greatly to the City's character and is integral to making Sydney a green, global and connected city.

A thriving urban forest can provide cleaner air, filtered stormwater and lower city temperatures. Trees shrubs and other plants create important habitat for birds, insects and reptiles and make beautiful city streets. Streets filled with trees and landscaping can also have psychological benefits in reducing stress and providing spaces for relaxation and contact with nature.

We are working to create an urban forest with greater tree canopy and more diversity to provide these proven benefits of plants and trees in a city.

This Urban Forest Strategy works to provide healthy and diverse landscaping in our streets and parks and create beautiful streets and public spaces that contribute to the health and wellbeing of everyone.

Lord Mayor
Cr Clover Moore

"To exist as a nation, to prosper as a state, and to live as people, we must have trees. "

Theodore Roosevelt


"The best friend on Earth
of a man is the tree"
Frank Lloyd Wright

Executive Summary

Urban forestry is broadly defined as the management of trees, shrubs and other vegetation in urban areas. It focuses on the "forest" or larger population of trees rather than individual trees along streets, in parks and open spaces and within commercial, industrial and residential properties. Trees in cities are a major component of the green infrastructure, the natural resources upon which the City relies.

Trees and the urban forest provide many benefits in urban areas, both direct and indirect. This includes environmental improvements, aesthetic enhancements, psychological and social benefits and economic savings. Trees also have costs associated with planting and maintaining them and many challenges involved in growing healthy trees in complex, and often unnatural, urban environments. Although our urban forest can most definitely be considered an asset, when not properly cared for and managed, it can also become a liability.

"A society grows great when old men plant trees whose shade they know they shall never sit in."

Greek Proverb

In 2012 the City of Sydney (the City) adopted the Greening Sydney Plan. One of the key elements of that Plan is to develop and protect the City's urban forest. This Urban Forest Strategy outlines the way the City will work to improve the environment, using trees, while managing the associated risks and costs. This will require an integrated effort by all departments and levels within the Council. Trees must be incorporated into the urban planning process and given the appropriate resources to grow and survive. The following key initiatives are detailed in this document;

The City will **prioritise the maintenance and protection** of its existing tree population in order to maximise the benefits already received from this asset.

The City will **increase the average total canopy** cover from the current 15.5% to 23.25% by 2030, and then to 27.13% by 2050, through targeted programs for trees located in streets, parks and private property.

The City will improve the **age spread** of our street and park trees. We will also increase **species diversity**, by ensuring the population does not comprise more than 40% for any particular family, 30% for any particular genus, and 10% for any one species.

The City will **engage and educate the community** on the benefits of trees and their management requirements and assist community participation in the greening of Sydney.

"The best time to plant a tree was 50 years ago. The second best time is right now."

Chinese Proverb

1. Introduction

1.1 What is an urban forest?

The City's urban forest consists of all trees and vegetation located throughout the local government area; irrespective of the tree species origin (native, exotic), location (street, park, garden, school) or ownership (public, private, institutional).

The urban forest, measured as a canopy cover percentage of the total land area, is recognised as a primary component of the urban ecosystem (LGA NSW 2003). It is one component of a complex built environment that includes roads, car parks, footpaths, underground services, buildings and other structures (North Sydney 2011).

Urban forestry can be described as the science and art of managing trees, forests and natural ecosystems in and around urban communities to maximise the physiological, sociological, economic and aesthetic benefits that trees provide society (Schwab 2008).

The term 'forestry' understandably evokes a certain image or connotation in most peoples' minds. To be clear, urban forestry is not the planting of trees in the city for timber, it is not connected to the management of the national parks and state forests located in the greater metropolitan area, nor is it converting our parks and sport fields into forests.

Figure 1- The urban forest - part of the city's green infrastructure (Photo R. Smart)

Introduction

Where we have been .... Traditional Urban Tree Management	Where we need to be.... Modern Urban Forestry Model
Trees as ornaments	Trees viewed as critical infrastructure
Focus on individual trees	Focus on overall canopy cover and forest
Trees treated with low priority	Trees have equal priority to other urban infrastructure such as roads and services
Trees have no monetary or economic value	Economic value of forest recognised and valued
Focus on smaller and ornamental species	Focus on larger longer lived canopy trees
Individual tree maintenance	Overall forest management
Aesthetic based design only	Ecological based design
Legal boundaries determine tree management	Urban forest seen as a continuous resource regardless of ownership boundaries

Table 1- Traditional vs modern urban forest approach (North Sydney Council 2011)

The table above, developed by North Sydney Council, succinctly describes traditional (and in many cases the current) management approach to trees in the left column and details the preferred urban forest management approach in the right column.

Figure 2- Baptist Street Redfern - The great streets of the future are dependent on how we plan our street planting today. (Photo G. Griffiths)

1.2 Why do we need an Urban Forest Strategy?

Urban forests play a vital role in the health, social framework and economic sustainability of a city. An abundance of research shows that trees improve our air, soil and water quality; they improve mental health and well-being, reduce anger and aggression, provide a sense of place and enhance property values. Canopy coverage over paved surfaces is a cost-effective means of mitigating urban heat islands, reducing emissions of hydrocarbons involved in ozone depletion, controlling storm-water run-off, and increasing pavement longevity.

These environmental, social and economic benefits underpin the City's desire to develop this Urban Forest Strategy.

The overall objectives of developing an Urban Forest Strategy are to:

- Improve the quality and quantity of the City's urban forest;
- Provide and integrate strategic / systematic planning processes to maximise the benefits of the urban forest; and
- To educate and promote the benefits of the urban forest to the community.

The development of an Urban Forest Strategy will assist the City in managing the conceptual shift from dealing with our trees on an individual basis, to managing the vegetation as a collective and integrated canopy. Under this unified management approach, the City's tree population will be managed as a number of stands, with canopy coverage measured and future targets set to be achieved by 2030 (the target year) for each City village.

The focus of this Strategy is largely urban trees and the canopy cover they provide. Canopy targets and improved tree protection measures will be incorporated into the City's development planning framework. Other projects for the development, protection and enhancement of the urban forest will be identified and implemented to achieve the 2030 targets.

Other vegetation elements are covered in other Council policies and procedures, including the Greening Sydney Plan, Draft Urban Ecology Strategy and Draft Landscape Code. Whilst an urban forest includes understory planting, this Strategy's focus remains largely on urban trees; as understory plantings are covered extensively in the City's Draft Urban Ecology Strategy.

Figure 3 - The Sydney CBD is characterised by tall buildings, awnings, busy streets and pedestrian footpaths (Photo R. Smart)

Figure 4 - Despite the harsh conditions, trees in the CBD humanise the space and contribute greatly to the amenity of the city. (Photo. R. Smart)

Rental rates are up to 7% higher for commercial office properties having a quality landscape. Furthermore, consumers report being willing to spend up to 12% more in central business districts having large trees (Wolf 2009).

1.3 Urban forest benefits

Urban forests play a vital role in the health, social framework and economic sustainability of a city. Trees are on the job working for us 24 hours a day, every day, improving our environment and quality of life.

Previously, these benefits were largely considered at a micro level; directly related to the individual or immediate property owner. Urban forest benefits however, are considered at the macro level. That is, the urban forest is the sum of all its parts. At this scale, the benefits are significant and justify the City's fundamental objective to maximise the benefits to the community and ensure they are distributed equitably.

There is an abundance of international research, increasing in diversity and depth, on the tangible benefits derived from the urban forest. This spans many topics including health, social interactions, ecology, water, climate, pollution and economy. An overview of these benefits is outlined below.

Trees improve community health, wellbeing and help build stronger communities. Some of the social and psychological benefits of tree planting include:-

- Improved sociological benefits with studies showing correlation of well planted areas with reduced social services, reduced domestic violence, and strengthened community ties. (Wolf, 1998)
- Creation of feelings of relaxation and well-being. Hospital patients, for example, are shown to recover quicker and with fewer complications when in rooms with views of trees. Workers and students are also shown to be more productive when their environments have views to trees.
- Providing a link to nature and a source of delight.
- Calming traffic, slowing speeds and providing a buffer between pedestrians and cars. They are also useful in delineating and signifying curves and direction in a street.

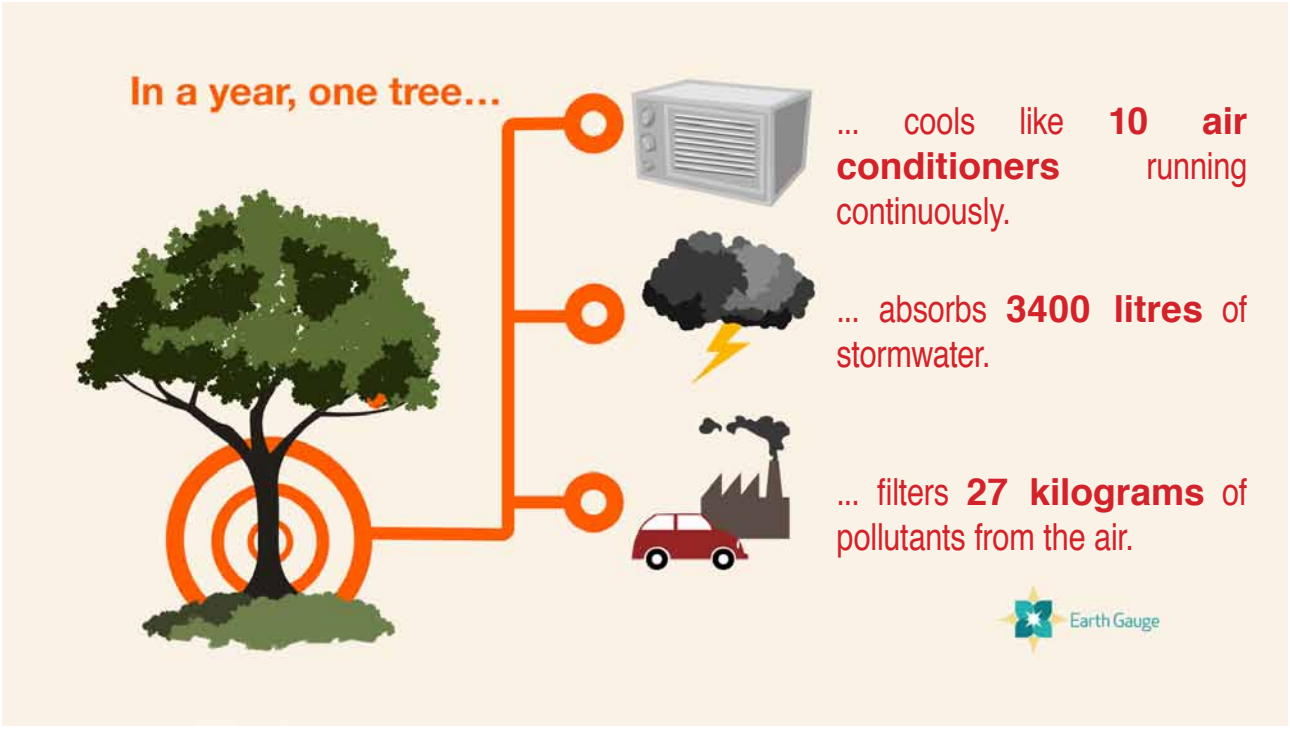

Figure 5- Trees are a vital component of our urban environment - they are core components of our valuable green infrastructure providing many environmental, economic, social, psychological and aesthetic benefits. (Source ; National Environmental Education Foundation (NEEF) and the American Meteorological Society (AMS) website. http://www.earthgauge.net/2012/national-arbor-day (accessed 16/7/2012))

Introduction

Trees improve the City's ecology and provide a higher quality urban fabric:-

- Providing habitat and a food source for urban fauna.
- Improving comfort and amenity as tree canopies can shade pedestrians, diminish traffic noise, screen unwanted views and reduce glare.
- Defining precincts and links with history. Tree lined streets can provide orientation, and contribute to the City's character.
- Providing a human scale that contrasts with the towers and large buildings that dominate some city streets.
- Providing seasonal interest and natural beauty through foliage and their interesting leaf patterns, flowers, bark, fruit and canopy.

Trees improve the quality of Sydney Harbour and our water ways:-

- Tree canopies, trunks, roots, and associated soil, filter polluting particulate matter from stormwater and creeks. Reducing the flow of stormwater reduces the amount of pollution that is washed into drainage areas. Trees also use nutrients like nitrogen, phosphorus, and potassium which can otherwise pollute streams.
- Intercepting and reducing rainfall and runoff and reducing erosion of soils.

Trees reduce air pollution and improve thermal comfort, and microclimate of an area:-

- Removal of many gaseous pollutants by absorbing them with normal air components through the stomates in the leaf surface. (eg. Sulphur Dioxide, Ozone, Nitrogen Oxide)
- They also capture and remove particulate matter and dust from the air.
- Shading of pavement, cars and buildings, thereby reducing our energy consumption and hydrocarbon emissions.
- Shading of asphalt pavements can also extend its life.

Trees store and sequester carbon:-

- A single mature tree can absorb carbon dioxide at a rate of 21 kg/year and release enough oxygen back into the atmosphere to support 2 people's needs. (McAliney, M, 1993.)

Trees contribute to the local economy:-

- Improving economic performance by increasing the attractiveness of businesses and tourism areas. People typically linger, shop and dine longer in tree-lined streets.
- Shops, apartments and housing in well planted areas usually attract higher rents and sale prices.
- Reducing energy consumption, through shading and reductions in the "urban heat island" effects.

Figure 6 - Bayswater Road, Elizabeth Bay - Well treed streets can have many positive economic benefits - attracting people to shop and dwell longer. (Photo G. Griffiths)

Introduction

Does tree size matter?

Research has shown that the greatest benefits are provided by large trees. Large trees typically:-

- Create more shade per tree due to a larger and wider canopy spread.
- Create better shade to buildings as they are taller and can cast shadow over roofs and walls of buildings.
- Intercept larger amounts of particulate pollutants and rainfall due to significantly larger leaf areas.
- Absorb more gaseous pollutants.
- Can provide larger canopy cover with potentially less intrusion at the ground from stems, trunks and lower branches.
- Are often less susceptible to careless or malicious vandalism by passers-by once established.
- Can be pruned to provide higher canopy clearance over roadways, parking lots and pedestrian footpaths.
- Typically contribute more to calming and slowing traffic on local streets than small trees.

Large trees can cost more to maintain and remove towards the end of their life. However, when one considers the cost to install a tree and look after it in the first few years to establishment, the associated costs are essentially the same regardless of whether the tree is a large or small growing tree.

Though large trees require larger soil volumes and more physical space above and below ground than small trees, the ultimate benefits to the community are exponentially increased over their life time.

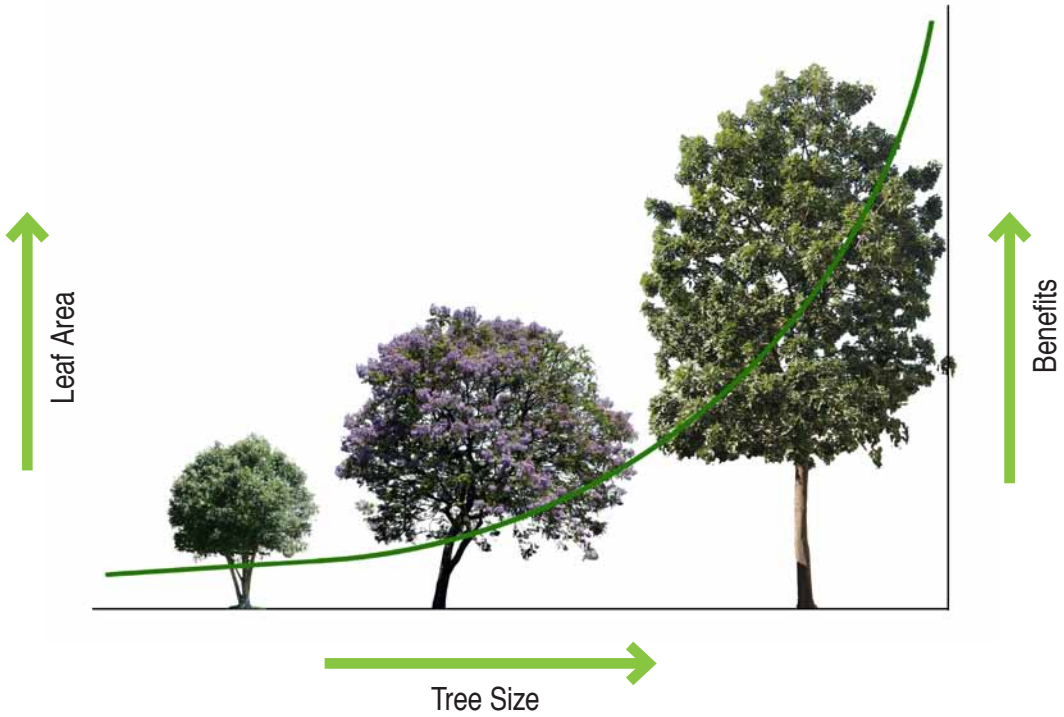

Figure 7 - Tree size does matter - the benefits of trees increase exponentially with size and increase in leaf area. (Adapted from Urban Tree Alliance http://www.urbantreealliance.org/why-trees/ accessed 12/7/2012)

Introduction

Does tree species matter?

Tree species always matters. The desire for increased diversity and the selection of trees that are locally indigenous to the City should not override the critical requirement to select the right tree for the right place. When appropriate to the planting site and its context, a locally indigenous species should be selected wherever possible and prudent. This will contribute to the creation and enhancement of habitat for native micro and macro fauna and will mean that the tree is well suited to the overall prevailing climatic conditions.

Consideration should be given, however, to the often highly altered prevailing conditions such as the microclimate created by the surroundings, the level of pruning or maintenance required and the fact that the new soil and hydrological conditions may not suit a locally indigenous or even an Australian native species.

In an urban environment it is necessary to accommodate exotic deciduous trees to facilitate effective solar access in winter months and to deal with higher atmospheric pollution loads. Exotic or non-locally indigenous native evergreen species (ie rainforest species) may also be better suited to the highly altered and overshadowed environments of inner city streets. Exotic trees are key components of our significant public gardens and street plantings; it is essential to maintain and reinstate these trees to preserve Sydney's landscape character and safeguard our heritage.

When considering the urban forest as a whole, it is important to consider the benefits that a successful, low maintenance tree contributes to the overall forest objectives, regardless of its origin and whether it is deciduous or evergreen.

Figure 8 - Weeping Lilly Pilly - Waterhousea floribunda in fruit (Photo R. Smart)

1.4 What is a sustainable urban forest?

Sustainable urban forest management usually encompasses considerations such as maintaining biodiversity, productivity, regenerative capacity and the potential to fulfil relevant ecological, economic and social functions.

A key principle of sustainable urban forest management is minimizing resource inputs. Tree planning, installation, maintenance and removal consume resources - human (i.e. intellectual and labour), financial and physical (i.e. water and fuel). Planning and maintaining trees through best practice techniques should protect the City's investment in its urban forest.

For an urban forest to be sustainable there must be a wide age-distribution of trees. Apart from ensuring that there is a new generation of trees to take the place of trees that must be removed for health or structural reasons, the most expensive stages of a tree's life are in the very early stages and in old age or senescence. Hence a mix of ages is more economically sustainable.

Figure 9 - Trees are important for the benefits of the human population and support some native fauna within urban areas (Photo D. Hunt)

Another principle of sustainability is an appropriately diverse mix of species – both native and exotic. This reduces the risk of loss should one species be susceptible to a new pest or disease. Diversity of tree species also provides benefits for biodiversity, aesthetic reasons, improves resilience and the provision of summer shade and winter sun. (Sydney University 2008).

Figure 10 - Appropriate and pro-active tree maintenance is the key to a sustainable and safe urban forest (Photo R. Smart)

2. Strategic Direction

2.1 Fundamental objectives of this strategy

The development of an Urban Forest Strategy will assist the City to manage the vegetation as a collective canopy and set realistic and achievable targets to maximise the social, economic and ecological benefits from its urban tree canopy. The Strategy has been considered in relation to other existing, draft and proposed Council policies.

The fundamental objective of this strategy is to maximise the benefits provided from our urban forest and ensure these benefits are distributed equitably across the entire Local Government Area (LGA).

Four strategic objectives have been identified to achieve this fundamental objective and to ensure that all aspects of the urban forest, its planning, planting, protection, management and renewal, meet and respond to the City's and the community's current and future needs.

The objectives for this strategy are outlined here. These objectives are largely complementary and should be considered as a set rather than isolated statements. Specific recommendations for how the City will achieve these are outlined in Section 4.

1 - Protect and maintain the existing urban forest

The City will prioritise the maintenance and protection of existing trees in order to maximise the benefits already received from this asset.

2 - Increase canopy cover

The City will increase the canopy cover from 15.5% to 23.25% by 2030, and then to 27.13% by 2050, through targeted programs for trees located in streets, parks and private property.

3 - Improve urban forest diversity

The City will improve the age spread of our street and park trees. We will also increase species diversity, while ensuring the population does not comprise of more than 40% for any one family, 30% for any one genus and 10% for any particular species.

4 - Increase community knowledge and engagement

The City will educate the community on the benefits of trees and their management requirements and assist in community participation in the greening of Sydney.

Strategic Direction

2.2 Sustainable Sydney 2030

Sustainable Sydney 2030 is the City's guiding strategic plan for the sustainable development of the City to 2030 and beyond. It sets a vision for a Green, Global and Connected City.

Sustainable development is about linking the physical environment with the economy, society and cultures with bold ideas and good governance that will result in better outcomes for current and future communities. Sustainable Sydney 2030 expresses the community's vision and the City's commitment to a Green, Global and Connected City.

- **Greening**, in the form of parks, gardens, trees, rooftops and walls, plays an important role in the livability and environmental sustainability of the City and its neighbourhoods, streets and buildings.

- **Global** in economic development, global in links and knowledge exchange, global and open-minded in outlook and attitude.

- **Connected** physically by walking, cycling and high quality public transport, connected 'virtually' by world-class telecommunications, connected through a sense of community and social well being; connected to other spheres of government and to those with an interest in the City.

The Sustainable Sydney 2030 strategy demonstrates that the City is an organisation that constantly focuses on sustainable practices that continue to service the community, while protecting the interest of the natural environment and remaining fiscally responsible.

The City will not only be an environmental leader, through its actions to support the development of green industries and reduce greenhouse emissions, it will be physically transforming the City.

2.3 Greening Sydney Plan

The commitment to Green living outlined in the Sustainable Sydney 2030 not only focuses on making environmentally sustainable lifestyle choices, but also the physical greening of our urban environment.

The Greening Sydney Plan focuses on outlining the broad strategies and programs that are to be employed by the City to green its urban landscapes. It recognises and reinforces the importance of trees and other vegetation and their potential to support diverse ecosystems in an urban environment.

The Greening Sydney Plan spells out 6 key policy initiatives of:-

- Expanding the urban forest.
- Creating greener streets.
- Providing more parks and open space.
- Ensuring greener outcomes for new developments on private land.
- Establishing green linkages and wildlife corridors.
- Empowering the community to assist in the greening of the City.

One of the fundamental objectives from the Greening Sydney Plan is the need for an Urban Forest Strategy which will outline the strategies for:-

- Improving the quality and quantity of the urban forest
- Providing integrated planning processes to maximise the benefits and protection of the urban forest
- Educating and promoting the benefits of the urban forest to the community.

Importantly, The Greening Sydney Plan identifies the canopy cover targets to be reached by 2030 and 2050. The Greening Sydney Plan outlines the vision for the City to increase its current canopy cover by 50% by the year 2030 and by 75% by the year 2050.

This Urban Forest Strategy lies at the heart of delivering the City's Sustainable 2030 vision and the Greening Sydney Plan.

2.4 Relationship to other plans and policies

The key strategic polices and plans, and their impact to this Urban Forest Strategy, are outlined below.

Tree Management Policy
The City's Tree Management Policy is the 'umbrella policy' with key strategies outlined for:

- Tree protection.
- Tree planting and selection.
- Tree removal and replacement,
- Tree assessment management.
- Community consultation and involvement.

This Urban Forest Strategy supports the Tree Management Policy. It incorporates the strategies outlined above, whilst providing priority actions for the urban forest at the macro and micro scale.

City Plan
The City Plan is a single set of planning controls that will guide the future development throughout the City of Sydney Local Government Area. The City Plan consists of a single Local Environmental Plan (LEP) and Development Control Plan (DCP) and supporting information.

The LEP is the principal legal document for controlling development and guiding planning decisions made by Council. The LEP provides development controls for new buildings and other development. The controls include environmental protection measures, tree protection and conservation protection requirements.

The DCP supports the LEP with more detailed planning and design guidelines. The City's DCP includes protection of existing trees on private property and promotes future canopy coverage targets. The DCP currently requires a provision of 15% canopy coverage for all land classes / development types.

Urban Ecology Strategic Action Plan (Draft)
The City has prepared a draft Urban Ecology Strategic Action Plan that will provide baseline information about biodiversity of the LGA and identify the actions that will be implemented to conserve and enhance it.

Landscape Code
The City is developing a Landscape Code that will inform the City Plan on landscape development standards. The Landscape Code will assist the City to achieve an increase in canopy cover in private land.

Other guiding documents
A list of other related documents of particular relevance includes:

- Environmental Management Plan
- Street Tree Master Plan
- Register of Significant Trees
- Tree Management Plans
- Streets Design Code
- Park Plans of Management
- Open Space and Recreation Needs Study
- Community Gardens Policy
- Liveable Green Network
- Integration of Water Sensitive Urban Design in Footpaths

Many of these documents have compatible objectives and will complement this Strategy. Likewise the implementation of many of the strategic objectives and priority actions contained in this Strategy will enhance the realisation of the other policies, particularly by:

- Increasing planting opportunities within the City.
- Increasing the canopy coverage of the City.
- Reinforcing the primary green corridors within the City.
- Increasing biodiversity.

Figure 11 on the following page outlines the strategic framework for this Strategy.

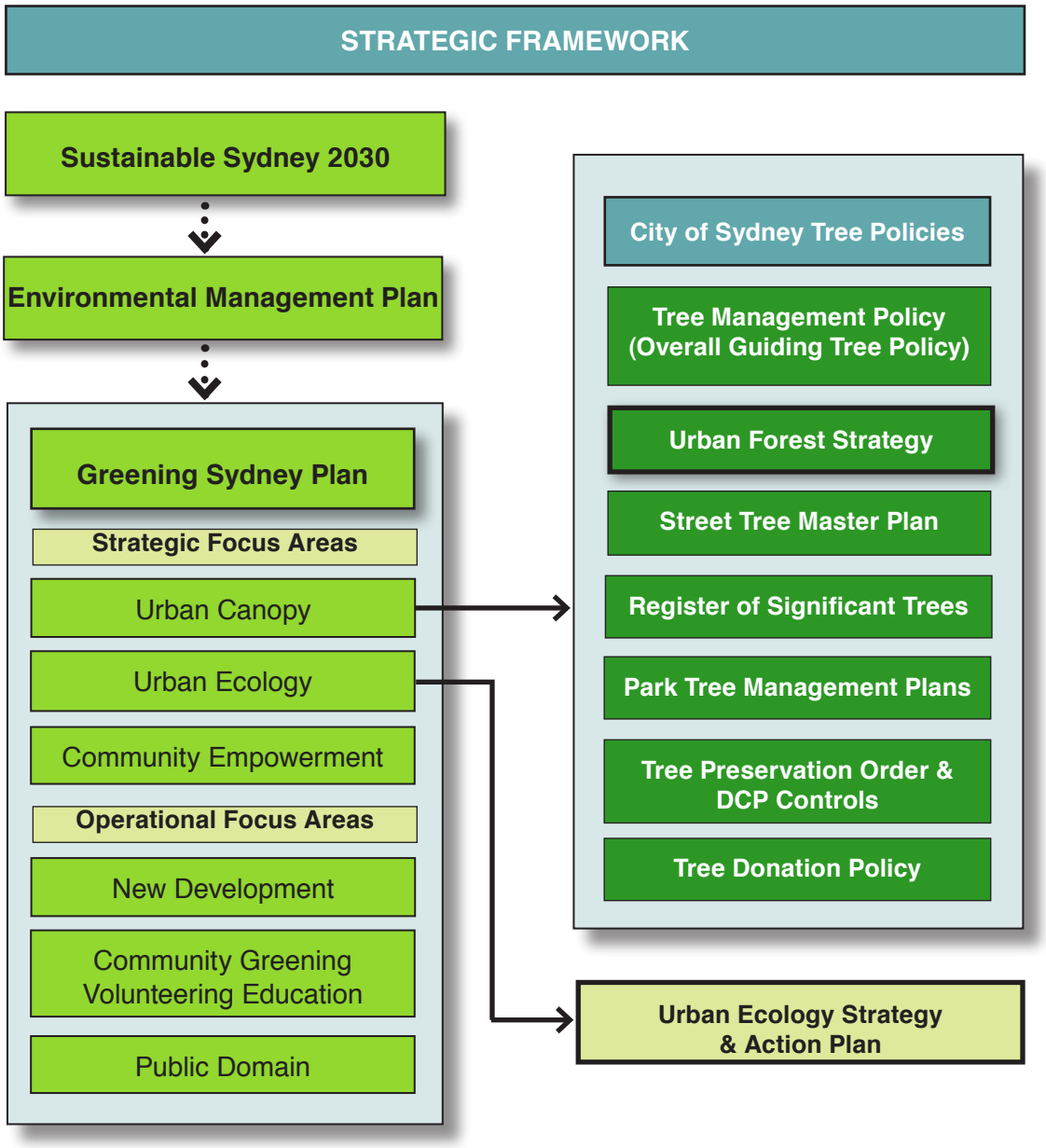

Figure 11 - The Greening Sydney Plan - the relationship of the key planning documents and where the Urban Forest Strategy sits within the wider suite of City documents.

3. The Past and Present

3.1 The City of Sydney

The City of Sydney's local government area (LGA) is approximately 26 square kilometres in size. The City is home to the highest commercial and residential densities in Australia, with an estimated residential population of 182,226 as at 30 June 2010.

Given its location as the economic and cultural heart of the Sydney metropolitan area, the land is intensively used for a variety of purposes including residential, commercial, industrial and institutional uses as well as tourist and cultural attractions, and parks and open space. Approximately 62% of the LGA is covered with hard surfaces such as roads and buildings.

Sydney is the largest central business district (CBD) office market in Australia, and within the top 20 worldwide. Approximately half of all floor space in the City of Sydney is used for commercial purposes devoted to financial, retail, tourism, entertainment and other business services. The remainder is used for residential and other non-commercial uses.

Within the boundaries of the City's LGA are some public areas under the executive control of various State Government agencies. These agencies include the Sydney Harbour Foreshore Authority, Barangaroo Delivery Authority, Centennial and Moore Park Trust and the Royal Botanic Gardens and Domain Trust.

Figure 12 - City of Sydney from above (Photo R.Smart)

The Past and Present

Map 1. The City of Sydney - Local Government Area and Context Plan

3.2 The history of the City's urban forest

In 1788, this City was covered in a vast, uninterrupted mosaic of vegetation which included estuarine and freshwater wetlands, open woodlands on steep sandstone scarps, heaths and Banksia scrubs on old sand dunes and forests on the richer shale-derived soils of the higher ridges and plateaus.

The Aboriginal population was dependent on the continuity and management of limited resources. European settlers, initially through timber-getting and clearing for farming and later through suburban expansion, had a dramatic impact on this balance, irreversibly altering Aboriginal society, existing natural ecosystems and biodiversity.

Since European settlement in Sydney Cove on the southern shores of Port Jackson, the natural vegetation cover has been reduced to a few scattered individual trees and shrubs, descendants of this once vast and complex natural system. These descendants are largely confined to the Royal Botanic Gardens, Mrs Macquarie's Point, the steep slopes of Garden Island and parts of Glebe. They include a few Forest Red Gum, Blackbutt, Swamp Oak, Cheese Tree, Pittosporum, Blueberry Ash and a few shrub species. Of all these natural remnants the Port Jackson Fig, a ubiquitous lithophyte, remains a true survivor – highly adaptable and a constant component of the City's urban landscape.

Figure 13 - Natural vegetation and Eucalypt forests such as this would have once blanketed much of Sydney prior to European settlement (Photo R.Smart)

Figure 14 – Hickson Road circa 1947. Note the Sussex hotel and Napoleon Street to the left (Source: CoS Photo Archives - http://photosau.com.au/Cos/scripts/home.asp accessed 5/12/11)

The Past and Present

As the natural vegetation was cleared, a new cultural landscape began to take shape. In 1879, Charles Moore, Director of the Botanic Gardens reported on the disappearance of the last naturally occurring Eucalypts in the Domain. Avenues and parklands of planted native and exotic trees progressively replaced these natural landscapes with all their understorey and wild flowers.

By 1902, Joseph Maiden, Director of the Botanic Gardens, wrote about the 100 remaining native plants "growing without cultivation in the Outer Domain" (Benson & Howell, p. 45, 1990). The new cultivated landscape of Sydney's public parkland, dominated by Moreton Bay Figs and Port Jackson Figs, was established during this mid-to late nineteenth century period; a landscape which was to transform the visual and aesthetic character of Sydney.

This is now an ageing landscape within an increasingly urbanised environment. These multilayered heritage values are being threatened by a range of processes and interventions. There has been a drastic decline in the original vegetation with clearing of forests, filling of swampland, reclamation of shorelines, increased hard pavements, roofs, piping stormwater runoff and modification of soil profiles with imported fill material.

As a result, the City is the most urbanised local government area in Australia. Increased pressure on the plantings has occurred during Sydney's evolving development and little remnant vegetation remains.

Space for trees and landscapes, within private property, streets, parks and open spaces, is continually being reduced under pressures of urban intensification. There are less than 380 hectares of open space (14% land area) with a rate of provision of less than 21 square metres of open space per resident. The quality of our canopy cover, open space and public domain is very important in meeting the needs of a healthy community.

Figure 15 - The Sydney landscape and urban forest owes much to our 19th century parks and the signature plantings of the long term directors of the Sydney Royal Botanic Gardens at that time , Charles Moore and Joseph Maiden (Photo R.Smart)

3.3 Where we are now?

Sydney's urban forest has developed over time and now consists of a mixture of native, exotic, deciduous and evergreen species. The trees naturally have different sizes, ages and levels of significance in the landscape.

Individually, we know a great deal about the trees located in the City's streets, parks and open spaces. These trees are assessed annually and all necessary maintenance is then performed in an effort to maintain good health and condition. All of the City's trees are on a database that is regularly updated, and records the tree location, species, size, health and condition, and all maintenance works performed on the tree.

The City's 29,500 street trees include more than 230 different species, while our 12,000 park trees comprise approximately 200 different species.

The information we have on the private tree population, is on the other hand, limited as the City is not responsible for their maintenance. However, we estimate there are at least 50,000 private trees, and the range of species is likely to be more diverse than those in our public spaces.

Despite the differences in tree location, species, age, size and ownership, all of these trees collectively contribute to provide our community with many as outlined in Section 1.3.

Figure 16 - The grand avenue planting of Hills Weeping Figs in Hyde Park in central Sydney - one of Sydney's signature landscape features and now part of planned removal and replacement program being managed by the City (Photo R.Smart)

3.4 Canopy cover

Canopy cover is a key element of this Strategy. Canopy cover is simply a measure of the physical coverage of the combined tree canopy cover over the land (CoM 2011). Square metre measurements are taken periodically to determine how the canopy cover has changed over time, including its location and what progress has been made to achieve this Strategy's directions.

In 2002, American Forests (a branch of the United States Department of Agriculture - USDA) identified canopy cover targets by land use. They recommended the ideal canopy to maximise the benefits canopy provides (depending on climate and land use patterns). The recommended canopy cover is:

15% in central business district and industrial areas.
25% in urban residential and light commercial areas.
50% in suburban residential areas.

Canopy cover targets are now being developed by many Councils and municipalities throughout the world. This is due to the recognition of the multiple social, ecological and economic benefits of urban forests and the obvious links to other policy initiatives including climate change, air quality and public health. It is also increasingly recognised that formal adoption of tree canopy targets - including institutionalising these in tree by-laws, regulations and comprehensive planning efforts - is critical to realizing urban forestry objectives (Nowack 2008).

Importantly, direct comparisons can not be made between different cities existing canopy cover and their targets. Each city has different factors affecting their urban forest, with key differences being history, planning and establishment, surrounding land use (central business district, residential, rural), climate (rainfall, temperature), soil types and maintenance budgets.

Measuring the existing canopy coverage is an essential first step in understanding the extent of the City's urban forest, as this data will then be used to guide our strategic directions – including setting canopy cover targets.

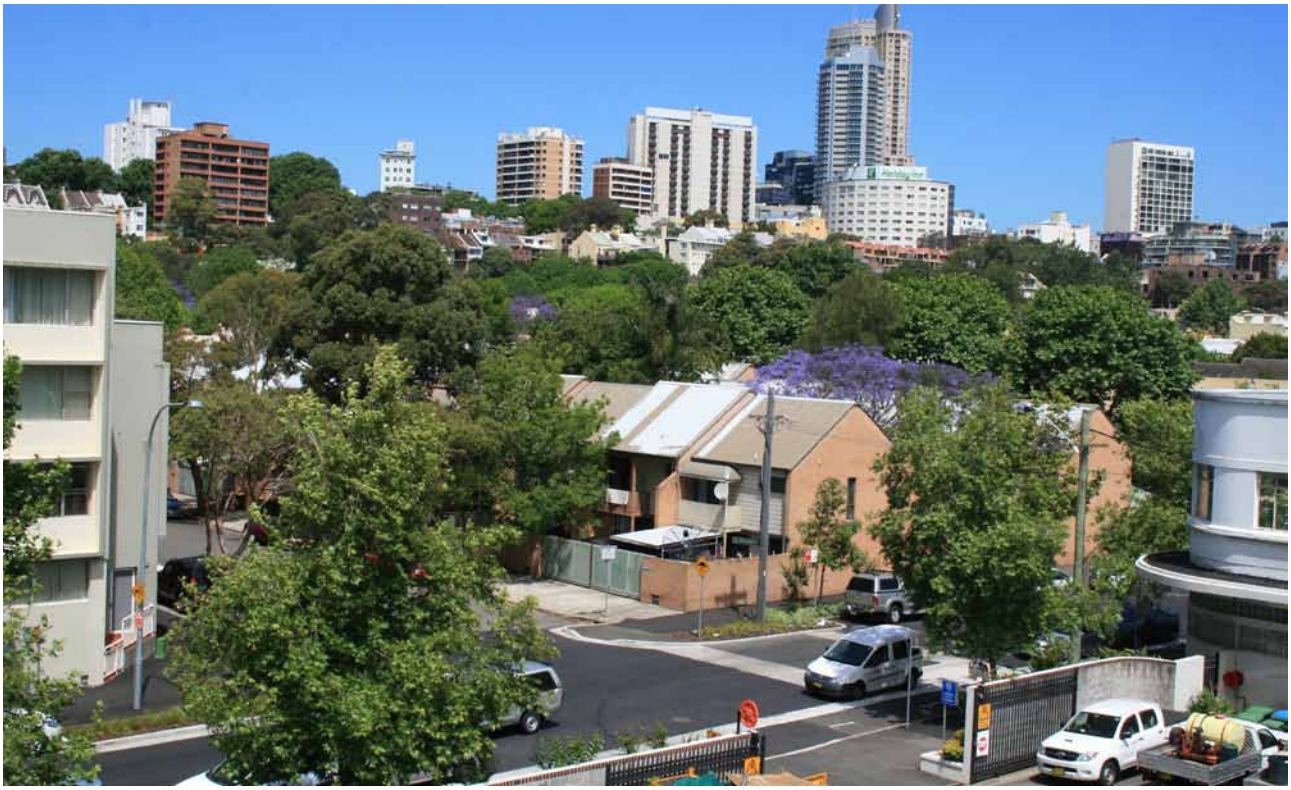

Figure 17 - Street trees, park trees and private property trees are a vital component of our urban environment - they are core components of our valuable green infrastructure providing many environmental, economic, social, psychological and aesthetic benefits. (Photo R. Smart)

The Past and Present

Figure 18 - 100% canopy coverage - natural undisturbed bushland as it would have been over much of the Sydney LGA.

Figure 19 - Avalon in Sydney's northen coastal area illustrates it is possible to achieve 60-75% canopy coverage in urban areas.

Figure 20 - Meadowbank in Sydney's west has similarities in age and lot sizes to portions of the LGA and illustrates the required 45-65% canopy coverage in these development types.

Figure 21 - Haymarket in central Sydney has one of the lowest canopy covers in the LGA with less than 10% cover.

Figure 22 - Redevelopment areas such as Green Square promise to deliver significant improvements in canopy cover.

Figure 23 - Centennial and Moore Park in the LGA, with large streets and block sizes, offer good contributions to existing canopy cover targets.

3.5 The City's current canopy cover

To establish the City's canopy cover, we conducted a GIS-based tree canopy study in 2008, using aerial photography and LiDAR (light detection and ranging) data. The height of the vegetation throughout the LGA was measured in four height categories (>20m, 10-20m, 5-10m and 3-5m) and a percentage breakdown of canopy coverage within the streets, parks and private properties of each suburb was identified.

In 2008, the City's total average canopy cover was estimated to be 15.5%. Of this;

- 6.6% canopy cover is on private land (61.7% of the City's total land use)
- 4.9% canopy cover is on roads (22.7% of the City's total land use)
- 4.1% canopy cover is in parks (15.6% of the City's total land use)

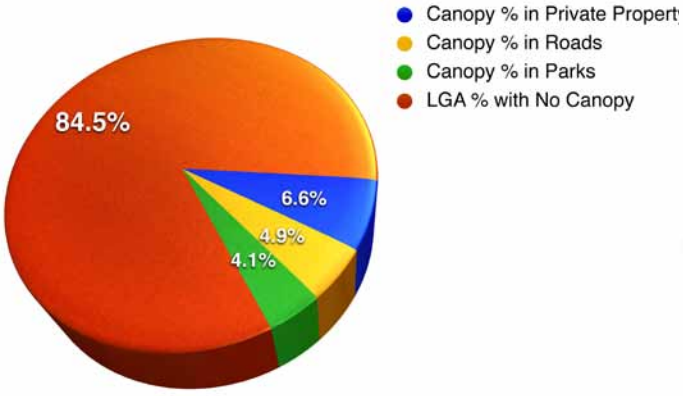

Figure 24

Total Canopy Cover
This graph shows the % of land area with canopy in the City. 84.5% has no canopy cover all.

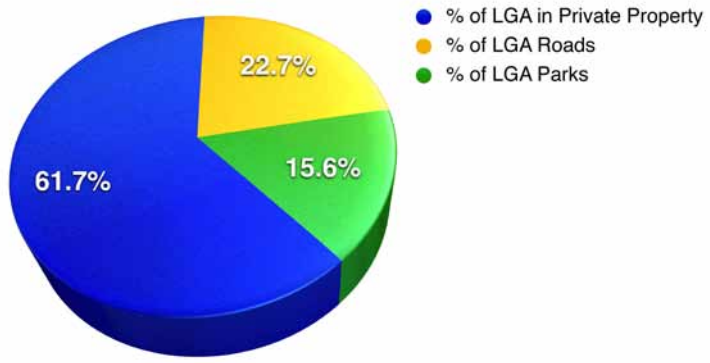

Figure 25

Land use in the city
This graph shows the breakdown of land use simply based on private property, roads and parks.

At 61.7%, private property forms the bulk of the land usage. Our roads and parks are a much smaller proportion.

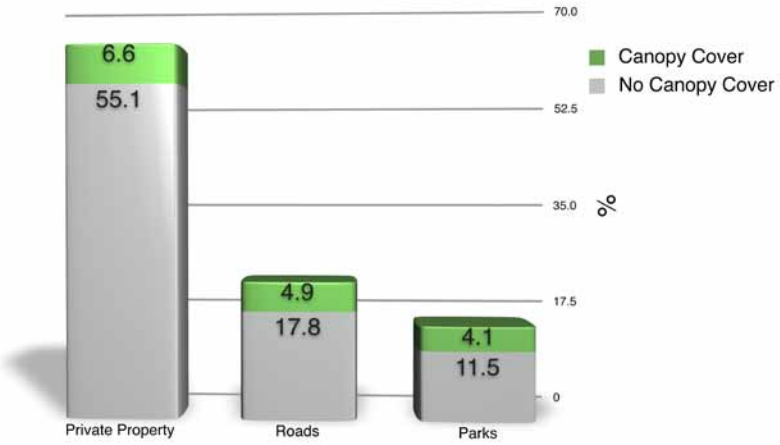

Figure 26

Canopy cover by land use
The graph shows how each land use type performs with canopy cover. The percentages shown in the graph represent the % compared to the total LGA land area, but as a ratio of the canopy cover retative to each land use area:-

- Just 10.6% of private property is covered by canopy.
- 21.5% of our roads are covered by canopy.
- 26.0 % of our parks are covered by canopy.

There is much scope for improvement.

3.6 Breakdown of canopy cover by suburb

The canopy cover data was analysed further to determine its location across the City's suburbs. This allows the us to see at a glance suburbs that are performing well, and those that need active intervention to ensure the canopy is maintained and increased so that the community can access the benefits provided. Appendix A outlines the breakdown of the City's suburbs into these three land use categories, coupled with each areas current canopy cover and the target.

Figure 30, outlines those suburbs with a high canopy cover, averaging over 20% of the total land use area. These suburbs include Centennial Park, Forest Lodge, Erskineville, Surry Hills, Darlinghurst and Rushcutters Bay.

Suburbs with low canopy, of just 7-9% canopy cover include including Millers Point, Pyrmont, Haymarket, Eveleigh and St Peters.

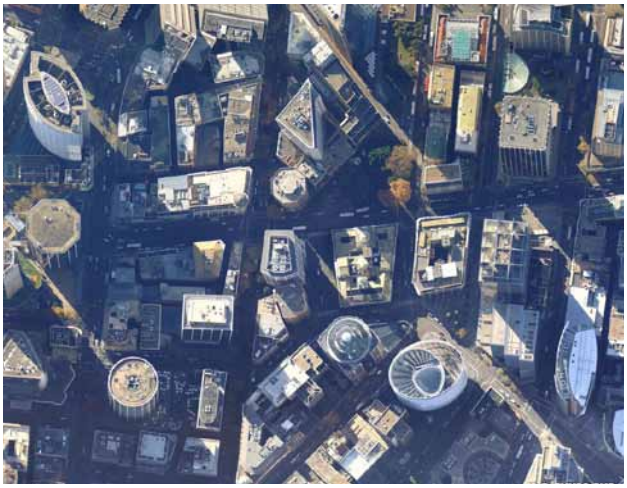

Figure 27 - The City - CBD area

Figure 28 - Redfern urban residential area

Figure 29 - Alexandria industrial area

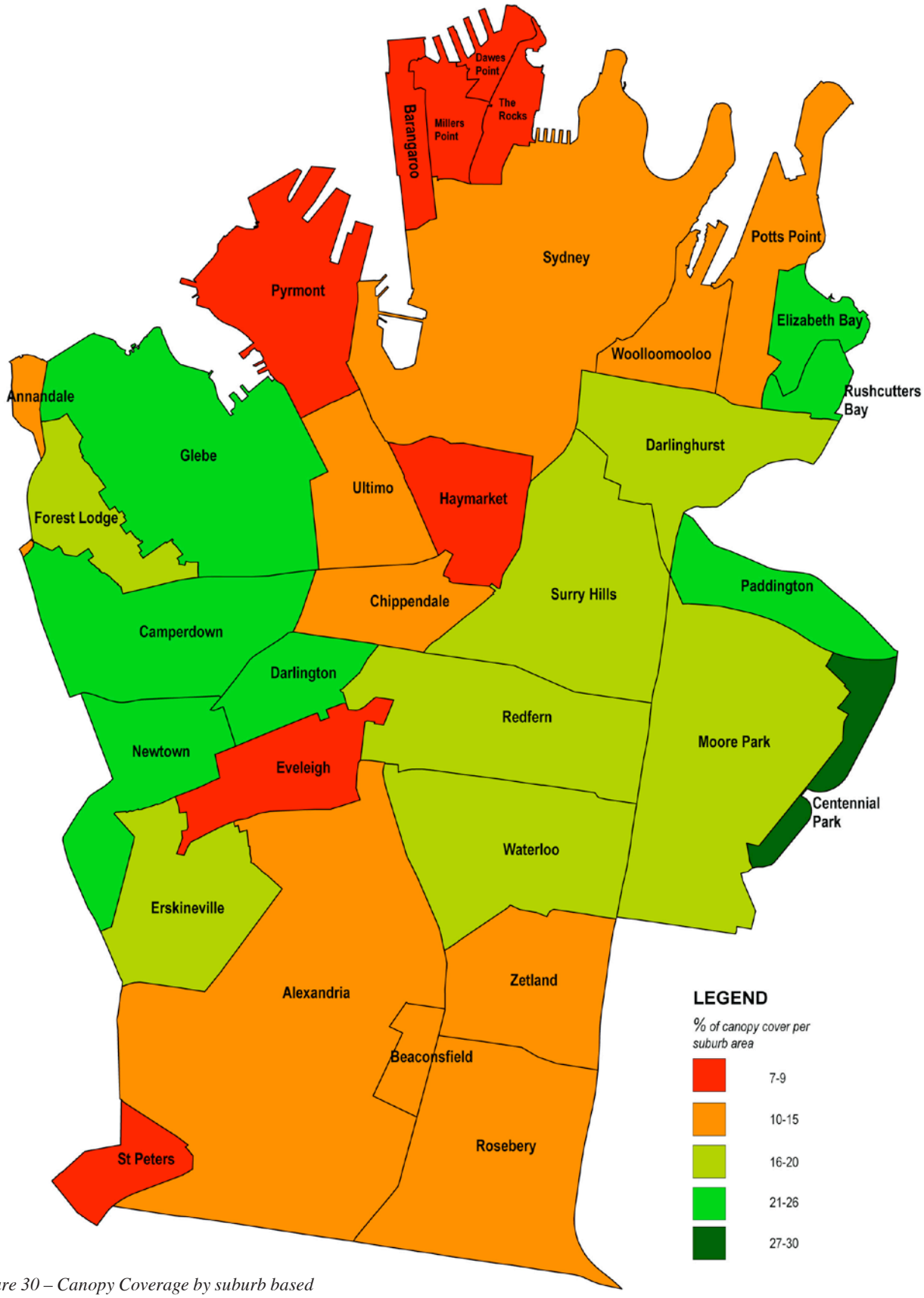

Figure 30 – Canopy Coverage by suburb based on 2008 Lidar measurements

3.7 Tree height ranges

The vegetation height was measured as part of the data collection in an attempt to understand the size of our trees. Why is that important? As outlined earlier, larger trees provide increased benefits at an exponential rate.

Figure 31 shows that the majority of vegetation is between 5-20 metres in height. This is expected with many street trees located under power lines, coupled with the City's recent tree planting efforts, as the trees are still maturing.

Just 3.3% of our vegetation is over 20 metres tall. Analysis of our street tree data has shown that the percentage of larger tree species planted will increase over time (refer Figure 32).

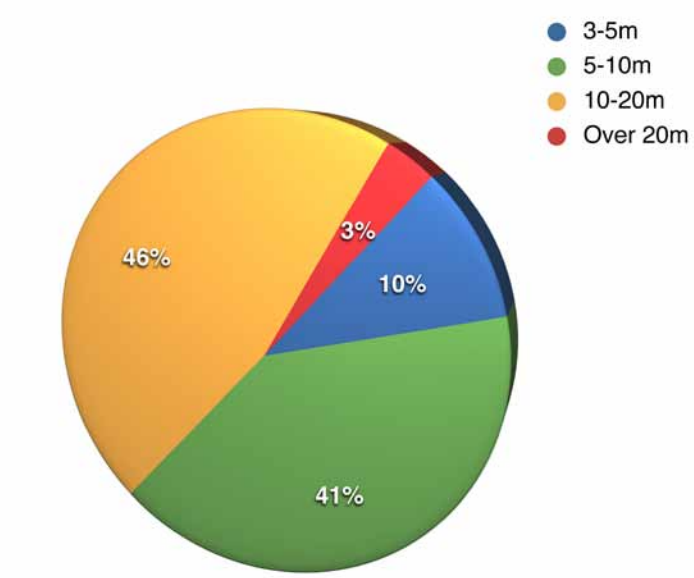

Figure 31 – vegetation height range from 2008 LIDAR measurements

3.8 Tree age class

The vegetation has also been sorted by age class. A key objective in creating a sustainable urban forest is to ensure a spread of age classes. Too many trees becoming senescent at the same time means lots of tree removal, gaps in streetscapes and parks, community concern over tree removal and significant expense to Council.

By maintaining a mixture of age classes, tree removal and replacement will be ongoing. This spreads the financial costs as well as lessens the overall visual impacts from tree removals. Importantly a mixture of age classes ensures that the overall benefits provided by the urban forest are maintained over time, across the LGA.

An assessment of the age of the City's street and park trees indicates that the majority of trees are semi-mature or mature (refer Figure 33).

Whilst the combined age spread is good, closer assessment reveals that the canopy cover of the City's parks trees is derived from predominantly mature trees (refer Figure 34).

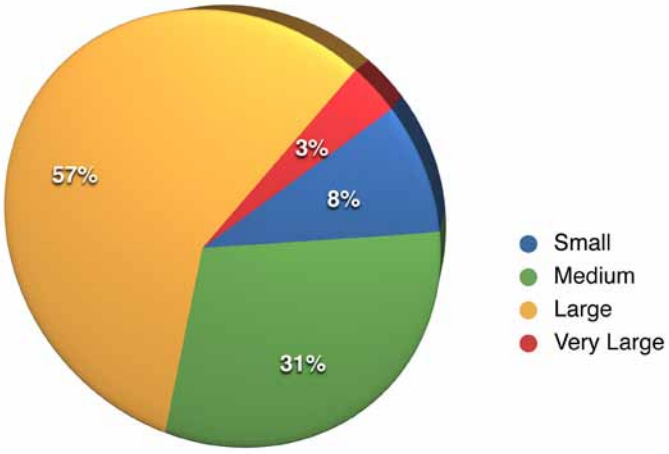

Figure 32 – Street trees – projected future height ranges.

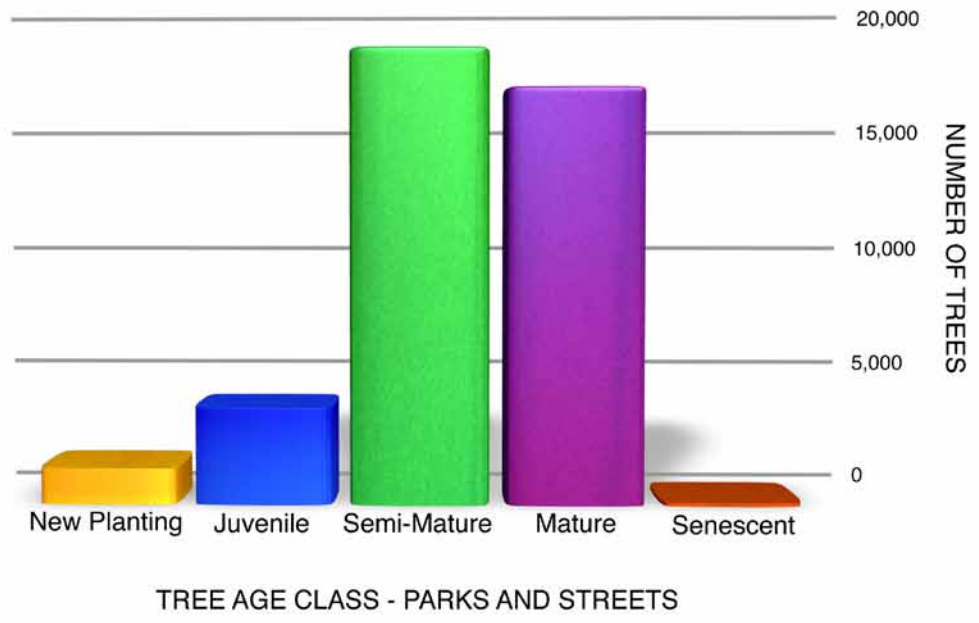

Figure 33 – Age spread of all street and park trees

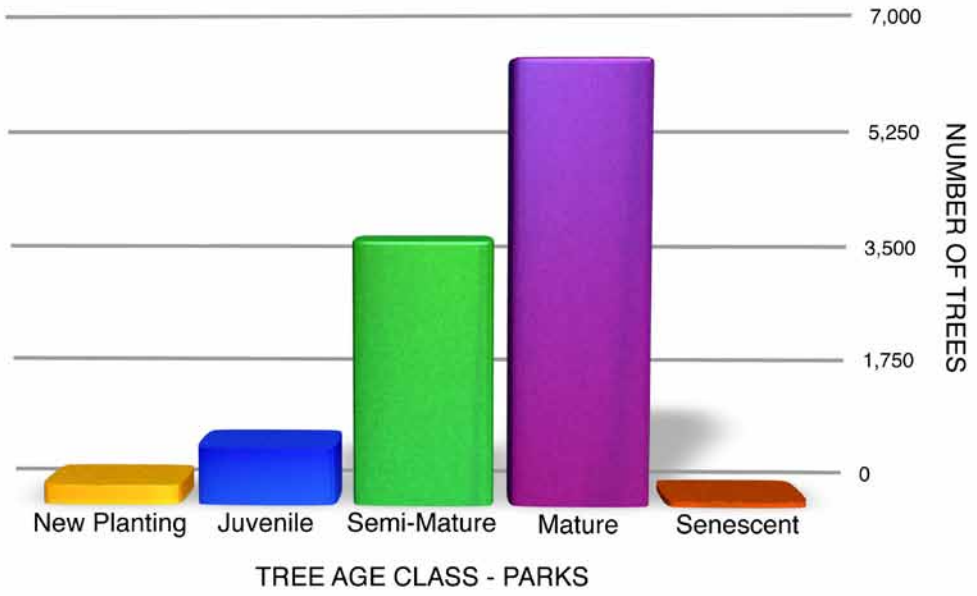

Figure 34 – Age spread of park trees only

3.9 Species diversity

Species diversity is an important component in managing a sustainable urban forest. The wider the range of tree species and families the lower risk to the canopy cover in the event of pest and disease outbreaks, and impacts such as climate change causing prolonged and significant drought etc. Increased diversity also helps to support more diversity of fauna, by providing a variety of food and habitat.

Species diversity is often measured by the percentage of the tree population in particular families, genera and species. Accepted standards are in the range of:-

30% - 40% for any particular family;
20% - 30% for any particular genus and
5% - 10% for any one species.

An assessment of the City's street and park trees species has been undertaken, as outlined in Tables 2 and 3 below. In terms of families, it shows that Myrtaceae at 40% of the total tree population is the most common and is used extensively throughout the LGA. This is understandable; this family is native to Australia and includes more than 80 different species planted in the City's streets and parks alone. This includes trees such as the Eucalypt, Paperbark, Brush Box, Angophora, Corymbia, Turpentine and Lilly Pilly to name but a few.

In relation to species, the Plane tree is the most common with 9.5%, followed closely by Paperbarks 8.8% and Brush Box 8.8%. As the City is reaching the top of the range considered acceptable, careful ongoing species selection will be required.

It is important to remember that this is a guiding principle and desire for increased diversity should not override the more appropriate requirement to select the right tree for the right place.

Family	Representative Genera (Common Names)	Total Number of Trees (Parks and Streets)	% of Tree Population (Parks and Streets)
Myrtaceae	Eucalypts, Paperbarks, Brush Box, Angophora, Lilly Pilly, Water Gum	16492	40%
Platanaceae	Plane Trees	4340	11%
Moraceae	Figs	2293	6%
Fabaceae	Acacia / Wattles, Robinia	1543	4%
Oleaceae	Olives and Ash	1344	3%
Arecaceae	Palms	1300	3%
Bignoniaceae	Jacaranda	1257	3%
Sapindaceae	Tuckeroo, Tulipwood, Golden Rain Tree	1214	3%
Casuarinaceae	Casuarina and She-Oaks	1099	3%
Ulmaceae	Elms, Zelkova and Celtis	1081	3%
Elaeocarpaceae	Blue Berry Ash, Quondong	1063	3%
Salicaceae	Poplars, Cottonwood, Willows	1017	2%

Table 2 - Diversity of trees at the Family Level - ideally no greater than 40% should be represented in any one family

Common Name	Species	Total Number of Trees (Parks and Streets)	% of Tree Population (Parks and Streets)
London Plane Tree	*Platanus x acerifolia*	3909	9.5%
Broad Leaf Paperbark	*Melaleuca quinquenervia*	3594	8.8%
Brush Box	*Lophostemon confertus*	3473	8.5%
Water Gum	*Tristaniopsis laurina*	1867	4.5%
She Oak	*Casuarina glauca* & *C. cunninghamia*	1488	3.6%
Spotted Gum	*Corymbia maculata*	1439	3.5%
Golden Robina	*Robinia pseudoacacia 'Frisia'*	1234	3.0%
Hills Weeping Fig	*Ficus microcarpa var. "Hillii'*	1104	2.7%
Jacaranda	*Jacaranda mimosifolia*	1092	2.7%
Blue Berry Ash	*Elaeocarpus reticulatus*	1063	2.6%

Table 3 - Diversity of trees at the Species Level - ideally no greater than 10% should be represented in any one species

Figure 35 – London Plane Trees (Photo R.Smart)

Figure 36 – Broadleaf Paperbark (Photo R.Smart)

Figure 37 – Brush Box (Photo R.Smart)

4. The Future

4.1 The Future

The four strategic objectives listed below provide a comprehensive and cohesive approach for the City to achieve the fundamental objective; to maximise the benefits provided from our urban forest and ensure these benefits are distributed equitably across the LGA.

These strategic objectives cannot be considered in isolation; they build on each other.

1. Protecting the existing urban forest,
2. Increasing and expanding the canopy coverage,
3. Ensuring tree health and diversity is improved, and
4. Encouraging community engagement.

The priority actions derived from these strategic objectives are outlined in the implementation details in Section 6.2.

4.2 Protect and maintain the existing urban forest

The most effective action for increasing average tree size and tree canopy is to protect and manage existing trees in the City.

The City's urban forest is living in a harsh urban environment, which can be unforgiving on trees. Ongoing maintenance and tree protection are vital due to the impacts of pollution, poor soil conditions, limited water and changing infrastructure.

With approximately 9% canopy cover provided by the City's 42,000 street and park trees, it is imperative that best practice maintenance techniques are used to improve their health and condition.

The City is committed to the long-term health of its urban forest and will prioritise the maintenance and conservation of existing trees in order to maximise the benefits already received from this asset. The following actions, of tree retention, tree protection and improved asset management have been recommended to achieve this.

Tree retention

Establishing the City's urban forest has already required considerable expense and represents a considerable financial asset. Planting undertaken by Council, private developers and home owners over time has created this extensive and diverse forest.

Trees take many years to grow. As we already have an established forest, it simply makes sense that the City should implement strategies and actions to retain trees that are healthy and in good condition. This applies to all trees, except those classified as noxious or environmental weed species, where staged replacement may be required, as all trees contribute to the micro and macro benefits outlined before in Section 1.3.

Importantly, larger trees have been found to be more valuable (providing between 4 to 8 times the benefits) than small trees. (Portland 2004). Therefore, the City recognises it needs to promote the maintenance and protection of these assets.

The City's Register of Significant Trees identifies and recognises the importance of significant trees in the changing urban landscape. Over 1,900 trees have been identified that are of special aesthetic, historical, social or environmental significance. These trees are located in the City's public spaces, parkland, reserves, streetscapes and privately owned properties.

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Many of these trees have a story to tell and may have strong associations with past events and people. They are also integral parts of the City's historic, social, aesthetic and botanical heritage. The Register helps to guide the management of these trees and to ensure their continued protection for the benefit of the community and for future generations.

The City will encourage retention of existing trees by:-

- Regulating and assessing applications to prune or remove trees through the Tree Management controls detailed in the City Plan and Development Control Plan.
- Updating regulations and providing incentives to ensure current and future development projects are designed to retain existing trees and to expand the tree canopy cover.
- Using education and regulatory compliance tools, where required, to ensure that all developments, including construction hoardings, are built in a manner that protect the trees to be retained.
- Recognising and promoting the trees listed within the City's Register of Significant Trees, which contribute to the environmental, cultural, social character of the City. The retention of significant trees is a priority warranting the reassessment or relocation of any proposed or existing competing activity.

Figure 38 - Tree protection fencing and signage (Photo G. Griffiths)

Tree protection

The protection of trees will be given high priority in all aspects of the City's activities.

The Tree Management controls within the City Plan and Development Control Plan (DCP) will be the main tool to regulate and assess applications to prune or remove trees on private property. The use of assessment criteria by tree management staff will ensure a consistent approach to tree assessment.

Trees will also be given adequate protection from construction and other activities, such as major events, that are likely to have an adverse effect on their health and appearance. The Australian Standard for the Protection of Trees on Development Sites (AS4970) will be the main tool to specify and enforce the tree protection methods.

The City will encourage the protection of existing trees by:-

- Providing comprehensive tree protection guidelines developed in accordance with the Australian Standard for the Protection of Trees on Development Sites (AS4970).
- Ensuring that development application submissions include all necessary information to allow full assessment of potential impacts on trees.
- Imposing tree protection bonds on developers and event organisers to ensure protection of Council street and park trees.
- Enforcing tree protection requirements through the available regulatory tools.
- Refusing the pruning or removal of trees for inappropriate reasons / activities including; to create / restore a view, create solar access to solar panels, to reduce maintenance as a result of leaf, fruit, bird, bat droppings, provision of off street parking, or unsubstantiated fears of tree failure.
- Prosecuting anyone found responsible for the unauthorised pruning, removal or poisoning of trees.
- Pursuing the relocation of overhead powerlines and underground utility infrastructure away from trees or promoting other measures to reduce need for excessive canopy or root pruning.

The Future

Asset management to improve tree health

The City will ensure its high quality maintenance regimes are continued and that we provide adequate resources for managing the urban forest. We will keep abreast of new technology in the field of arboriculture, as well as pest and disease control and incorporate these into our management and maintenance techniques where appropriate.

Our trees exist in an urban environment surrounded by built infrastructure, including roads, houses, drains, walls and fences. In some situations conflict occurs between these assets. In most situations the issue can be resolved without the need for tree removal, with priority given to 'tree friendly' repairs such as pier and beam footings, in conjunction with selective root pruning. Tree removal will be a "last resort option".

While trees play an important role in the urban landscape, it is also recognised that trees of the wrong type, or growing in the wrong place, can create problems and unreasonable risks in an urban environment. Property owners and public authorities have certain obligations with respect to the protection of trees, and responsibilities for any damage or injury associated with the presence, failure or growth of trees.

Tree management is all about managing the various risks and benefits of trees in the urban environment to ensure the best community outcome. The City will continue utilising information systems on trees to facilitate decision making and allow prioritisation of management resources.

The City will set the standard for tree maintenance practises by:-

- Undertaking proactive maintenance regimes for Council's street and park trees assets.
- Creating best management practices for the pruning, watering, tree bases, pest and disease control and general maintenance of trees.
- Hiring appropriately qualified arboricultural staff and external service providers to undertake all maintenance activities.
- Developing Tree Management Plans for key parks and streetscapes to provide long term strategies that guide the short term activities required to ensure the health and amenity of our tree assets.

Manage tree related risks by:-

- Undertaking regular audits of the maintenance performance to ensure all works performed are in accordance with the relevant Australian Standards.
- Recording all maintenance activities into the City's centralised electronic tree database, to manage the asset most effectively whilst also managing any risks.

4.3 Increase canopy cover

The urban forest provides extensive and wide-ranging social, economic and environmental benefits. As canopy cover increases, so do the benefits afforded by the increased leaf area.

It is therefore imperative that the City increases the canopy cover across the LGA. The City's existing canopy cover is just 15.5%. Our vision is for an increase of 50% canopy cover by 2030, and 75% by 2050. This equates to canopy cover of 23.25% and 27.13% respectively.

Importantly, this vision is aligned with the USDA's guidelines for canopy cover. The City's overall canopy target should be at least 22.3% based on the City's land uses. This includes the 15% canopy targets for the central business district (i.e. Sydney CBD) and industrial areas (e.g. Alexandria), 25% canopy cover in urban residential (e.g. Glebe, Newtown) areas and 50% canopy cover in suburban residential (i.e. Rosebery, Moore Park).

Based on the City's land uses, an assessment of the City's existing canopy cover and comparison to international guidelines, reveals there is a significant gap that needs to be addressed to meet the international benchmark and the City's vision. The table below (adapted from North Sydney Council) highlights the City's current performance and where improvements are required.

The following actions have been recommended to achieve canopy targets, prioritising actions for low canopied areas, and ensuring only quality trees are planted.

Strive to achieve the canopy cover targets

Increasing the canopy cover by 50% by 2030 is no easy task. It involves managing the gradual removal of the existing canopy through natural attrition or due to impacts such as development, ensuring replacement trees are planted where appropriate and identifying opportunities for new trees.

Whilst this may sound straightforward, the City understands the complexity in the direct and indirect decision making processes that will impact the performance of the existing and future canopy cover.

Land Use	Existing % Canopy Coverage	Recommended % Canopy Coverage	Gap between Existing and Target % Canopy Coverage	Proportion of Total LGA area covered by that Landuse	Required Canopy Cover as a % of the Total LGA area per Landuse
Central Business District (CBD) & Industrial Areas	14.3%	15.0%	0.7%	33%	5.0%
Urban Residential and Light Commercial Area	15.8%	25.0%	9.2%	64%	16.0%
Suburban Residential Areas	15.2%	50.0%	34.8%	3%	1.3%
Target % Canopy Cover for Sydney LGA based on international standards					22.3%

Table 4 - Existing and recommended canopy coverage targets and how we proposed to meet them

The Future

Setting these targets, endorsing them, and actively striving to achieve them, makes it clear to all parties that the City is serious about improving the quality of the environment, social cohesion and economic prosperity of Sydney. It provides a valuable tool to encourage collaboration across disciplines, in making well informed and justified decisions, whilst measuring the City's performance over time.

Importantly, the targets also form the major transition from measuring performance based on individual trees to focusing on the collective coverage and benefits gained. Our knowledge and ability to manage this transition, whilst ensuring canopy cover increases, is critical.

The City will strive to achieve the canopy cover targets by:-

- Working collaboratively with a wide range of stakeholders, in various professions, to ensure decisions that will impact canopy cover are well informed.
- Keep informed and updated of emerging research and technology that can physically deliver increased canopy, or assist in marketing / advocating its benefits.
- Adapting the City's related policies, plans, programs and procedures to actively support canopy cover increase;
- Measuring the canopy cover at specific intervals (every 5 years) to check City's performance.
- Using the City Plan (DCP) controls, ensuring that a minimum of a developed site has 15% canopy coverage on the site within a period of 10 years from development, to ensure adequate space is provided for the existing and future urban forest within private property.
- Continuing to seek new opportunities for planting in streets and parks, and planting large canopy trees in appropriate locations.
- Investigating the development of a matching grant program that encourages and facilitates community canopy tree planting on private property.
- Maintaining existing trees as outlined in strategic direction Section 4.2.

Target low canopy areas

Low canopied areas are an obvious place to concentrate the City's efforts in maintaining and increasing cover. Low canopy cover is measured across a range of factors, such as suburb, land use and activities.

Individual initiatives are required to treat these different target areas. A 'one size' fits all approach will not be effective across the various land uses, land owners and decision makers. The initiatives developed will not be mutually exclusive; they will collectively increase canopy cover across the LGA. Further, a balance of a 'carrot' and 'stick' approach will be used in order to achieve results.

The City will focus its efforts to increase canopy by land ownership; in private, institutional and public (streets and roads) land. As outlined earlier, private property contributes just 7% canopy cover whilst being 62% of the land use. The City will implement a balanced approach to increase planting on private property, through enforcing tree planting as part of developments using the City Plan, whilst also investigating incentive planting programs to help home owners green their yards.

New planting opportunities in the City's streets and parks will be actively pursued, planting the largest tree possible for the site. Examples include the City's 'in-road' tree planting program, identified in the Street Tree Master Plan, where new trees are planted in specially created medians or planting sites within kerb blisters and the like.

At the suburb level, the City will focus on areas with a canopy cover percentages lower than 12%, or those with a gap greater than 30% from their identified target (see Appendix 1 for high priority areas). Developing programs for specific land use activities, such as car parks with very low canopy cover will also be a focus.

Figure 39 - Canopy Cover - Much opportunity exists in areas like Primrose Ave, Rosebery to increase canopy cover (Photo R. Smart)

The Future

Importantly, not all suburbs will be able to achieve their optimum canopy cover. In low canopy cover suburbs, existing trees will be carefully managed and any new planting opportunities will be quickly actioned.

The City will focus on low canopy cover areas by:-

- Targeting planting projects and tree retention efforts in suburbs with less than 12% canopy cover.
- Increasing the compliance focus to ensure private property owners undertake the planting of trees following any tree removal or development works.
- Using the City Plan (DCP) controls to ensure new car parks achieve a minimum of one tree per four car spaces, with each tree providing a minimum 50 square metres of canopy cover.
- Investigating opportunities for a matching grants program that focuses on improving the health and condition of existing trees in low canopied areas, and improving the long term canopy cover provided in existing car parks (through new planting, soil improvements etc).

Successful New Tree Planting

A critical element of increasing canopy coverage is ensuring good quality trees are supplied, planted correctly and receive regular maintenance in their formative years. There is no point planting if the new or replacement tree will not thrive in the site and reach maturity.

Often tree failure can be attributable to the standard of stock that is planted. The City will ensure only quality trees are planted in our streets through adherence to quality standards and specifications.

Planting a tree correctly is also vital in ensuring it establishes and provides the desired benefits. The City will ensure our staff and service providers are highly skilled in tree planting techniques. We will also assess landscape plans for private development sites to increase the establishment of canopy cover on private property.

The maintenance performed on newly planted and young trees is critical in ensuring you gain the maximum from your investment. Resolving minor issues such as branch location or minor defects when the tree is small is of limited expense. Resolving the issues once the tree has matured, or worse, failed, is much more costly. This cost is borne by the tree owner, and also the community, where the environmental, social or economic benefits desired are never realised.

The City will achieve healthy tree planting by:-

- Planting in accordance with the City's Street Tree Master Plan, relevant Tree Management Plans and approved landscape plans for private development sites.
- Ensuring only quality trees are supplied for planting. These trees must conform with the NATSPEC "Guide for assessing the quality of and purchasing of landscape trees".
- Paying close attention to tree installation plans and techniques to ensure successful establishment of tree stock.
- Undertaking specialised young tree maintenance on all planted street and park trees, including formative pruning, for a minimum period of two years.
- Ensuring adequate maintenance plans are in place for new trees planted in private development sites.

Figure 40 - Canopy Cover - Much opportunity exists to provide much better planting outcomes in car parks (Photo R. Smart)

4.4 Improve urban forest diversity

Urban forest diversity comes in two main forms; the plants age and their species. Diversity is important as the urban forest is a living and natural asset; it has a lifespan, it provides sustenance, homes and other benefits to other living organisms and it is also susceptible to pests and diseases.

The City is committed to, and has developed numerous plans and policies to help us achieve a diverse urban forest.

To assist in managing the forest's age spread, we have developed specialised Tree Management Plans for our 19th century parks. We also review our street trees to manage a gradual transition in the canopy cover provided from the aged and senescent trees, to the newly planted trees.

The City's Street Tree Master Plan and Draft Urban Ecology Strategy, along with the individual park Tree Management Plans, have been developed to assist us in managing species selection. These documents share similar objectives, whilst acknowledging and managing the often competing commitments of tree selection, such as arboricultural needs, biodiversity, heritage, landscape design, cultural and food provision aspects.

Age class diversity - tree removal and replacement

Trees like all living things grow, age and eventually die. An assessment on the age of the City's tree population indicates that the park tree population is ageing, consisting of 57% mature trees and 33% semi mature. The City's street tree population consists of 35% mature trees and 50% semi mature, following an extensive tree planting program.

Whilst this is the overall tree population, particular suburbs and parks do have a high number of ageing trees. This impacts the tree maintenance and renewal cycles, as the programmed removal and replacement of these trees will be vital in managing the asset, risk and ensuring that the numerous benefits provided from trees are sustained for future generations. Selective removal and replacement programs, over many years, with similar sized trees at maturity allow canopy cover to be managed at a sustained level.

In managing this renewal, the City will be required to assess trees proposed for removal in both the public and private domain. Also there are some trees in the City that have performed poorly due to previous inappropriate species selection, poor installation techniques or use of inferior nursery stock. In these instances an assessment should be made to determine the merits of a removal and replacement program with more appropriate tree species.

The City will explore all possible options to retain trees, with tree removal considered a "last resort option".

The City will achieve age class diversity by:-

- Developing and implementing Tree Management Plans for the City's 19th century parks and other aging streetscapes to sensitively manage the renewal of the aging asset.
- Reviewing the age classes of trees in specific areas and implementing special planting / renewal projects to reduce the impact of future removals.
- Applying standard tree assessment procedures to ensure consistency in the approach to determining tree removal, root pruning and pruning applications.
- Identifying and assessing the potential removal of trees that do not grow to maturity, offer little aesthetic value or fail to maintain acceptable health.
- Pre-ordering tree stock, where feasible, to ensure the installation of super advanced replacement trees that conform to the NATSPEC "Guide for assessing the quality of and purchasing of landscape trees".
- Informing and consulting with the community about tree removal proposal to give understanding of the issues and rational for tree removal and replacement programs.

Species Diversity

The City's urban forest consists of more than 370 different tree species in its parks and its streets alone. Species diversity in private properties is considered to be even higher, as the constraints on planting (overhead and underground utilities, soil conditions, reduced water availability etc) are largely reduced.

Whilst the number of the different species is high, it is important to consider the concentration of family and species numbers. As outlined in Section 3.9, 40% of the City's street and park trees are from the Myrtaceae family.

Urban forest diversity is important as it may assist in improving the diversity and abundance of native plants and animals. The City's Draft Urban Ecology Strategic Plan outlines actions that

The Future

will be implemented in unison with the Urban Forest Strategy with the aim of enhancing the City's biodiversity.

These include:-

- Expanding planting of a floristically and structurally diverse mix of indigenous vegetation, including trees, particularly in under utilised or publicly inaccessible sections of parks and particularly where near potential and identified habitat linkages.
- Expanding and encouraging restoration of possible remnant trees in Glebe, the Domain, Sydney Royal Botanic Gardens, and Garden Island.
- Installing microbat roosting boxes and hives for stingless indigenous bees which could be undertaken in concert with normal urban forestry maintenance activities.
- Maintaining hollows where possible, where the risks to public safety are avoided.
- Including locally indigenous understorey planting with all new in-road planting opportunities.
- Undertaking trials of suitable locally indigenous tree species that have recognised habitat value for priority fauna species.
- Expanding community engagement and awareness of biodiversity issues and objectives and encouraging residents to plant understorey vegetation as well as trees in their own properties and local schools.

A wider range of tree species also helps us to mitigate the potential impact from any new pest or disease incursion, ensuring any canopy cover loss from such an event is minimised to manageable levels.

The City will achieve species diversity by:-

- Implementing the relevant policies for tree species selection and planting including the Street Tree Master Plan for all street tree planting, the relevant Tree Management Plan for planting trees in our 19th century parks and the Draft Urban Ecology Strategy for guiding planting in other locations, particularly those with specific biodiversity and habitat requirements.
- Selecting trees species for planting depending on their suitability for the site, aesthetic, functional and biological attributes, performance and potential to contribute to the environment, using the philosophy of the “right tree for the right location”.
- Assessing Development Applications to ensure that proposed tree selection is compatible with desired canopy cover levels, biodiversity needs and landscape character for particular precincts or villages.
- Selecting tree species to meet the accepted diversity standards of no more than 40% for families, 30% genera and 10% for any one species.
- Considering known pest and disease impacts when selecting tree species and managing tree replacements.

Figure 41 - Canopy Cover - New planting in areas associated with redevelopment provides opportunities for large trees and greater age and species diversity, such as Queen Street, Rosebery (Photo R. Smart)

4.5 Increase community knowledge and engagement

The City manages street and park trees for and on behalf of the community. We assess applications for the pruning or removal of trees on private property using a consistent approach, in order to maintain and protect the trees, so that all the community receive their benefits.

We understand that trees in particular are a sensitive and emotive issue. There are many members of the community who love trees, those that do not, and some that may actually fear them.

This Strategy has been developed to assist the community in understanding how and why the City makes its decisions on urban forest management. That said, the City values its community's opinion and will undertake meaningful two way consultation and communications in relation to tree removal, renewal and management.

Further, we seek to provide and encourage individuals and groups to take an active role in the ongoing care of their neighbourhood trees.

The City will promote the value of a healthy urban forest to the community by:-

- Developing a specialised marketing strategy to disseminate information on the numerous environmental, social and economic benefits that trees provide.
- Identifying and cultivating partnerships with other stakeholders, that are mutually beneficial, that share similar ideals such as health or environmental departments or organisations.
- Encouraging and supporting further research into Australian urban forestry.

The City will raise awareness among key stakeholders by:-

- Informing and consulting the community regarding projects impacting on trees such as streetscape planning, tree removal and tree planting.
- Reviewing and updating the City's website to provide timely and accurate tree management information.
- Preparing information sheets covering topics such as: Correct planting techniques; How to help care for trees, Solving tree problems – trees located on boundaries and neighbour conflicts.

Figure 42 - Trees - a delight and a source of life long inspirations and memories. (Photo R. Smart)

The City will encourage community stewardship by:-

- Implementing the Tree Donation Policy that encourages and supports the community to green the City.
- Promoting involvement in community planting days.
- Developing an appropriate grant scheme that helps to facilitate projects that meet this strategy's aims.

5. Challenges and Issues

5.1 Challenges in managing the urban forest

This section provides an overview of the various challenges and issues that have been considered in developing our strategic directions to manage the urban forest.

Many of the challenges and issues outlined below directly impact the forest, such as the competition for space and pest and disease issues. If these issues aren't adequately addressed, the other challenges the urban forest and the community faces, such as the impact of climate change and the urban heat island effect, will continue to worsen.

The cause and effect of many of these issues are linked. Why is this important? Understanding the related issues highlights the importance of our urban forest, exposes its threats, whilst identifying its ability to mitigate many of the challenges faced. These issues include:-

- Competition for physical space
- Climate change
- Urban heat island effects
- Pests and diseases
- Aging tree populations
- Available research information
- Achieving and measuring targets
- Community expectations and resistance to change

Figure 43 - Establishing trees in urban areas is difficult - but it is a challenge we must rise to and succeed. (Photo R. Smart)

5.2 Competition for space

Canopy trees need room to grow and the competition for the physical space to grow mature trees (above and below ground) is rapidly increasing.

The City is home to the highest commercial and residential densities in Australia. In less than a decade the residential population has increased by 49,000 (38%). The City of Sydney absorbed approximately 20% of the entire Sydney metropolitan residential growth in the period 2001-2006. The increase in the City's population was the largest increase of a Local Government area in the Metropolitan area and double the population increase of the second and third fastest growing local government areas (Blacktown and Baulkham Hills) combined.

In servicing this population density increase, the urban forest has been gradually reduced as the existing trees make way for development or other land usage. In many instances, the opportunity to replace the trees and open spaces has been lost forever.

Private property allotment sizes vary throughout the City, however most residential allotments are relatively small and the commercial and industrial sites have maximised their built form to extend to property boundaries. Trees are competing with off street parking, rear studio apartments and plunge pools and in some instances, the desire for 'maintenance free' yards.

Studies in Melbourne have found that the greatest decrease in urban canopy cover from 1993 to 2000 has occurred in private property (Mullalay 2000). Whilst this study was undertaken in Melbourne, the same issues and pressures have been faced by the City's trees. That is, canopy cover from private property is being significantly reduced for the creation of infill development and other competing land use.

While the City's parks already have extensive tree plantings, a balance must be maintained between tree cover and areas of canopy free open space for passive and organised recreational activities.

The competition for space also extends into the public domain, with infrastructure another major threat to the City's urban forest. Underground and overhead utilities, driveway crossings and awnings can limit the available space for street tree planting and large volumes of canopy are periodically removed to provide clearances for overhead power lines.

In an ideal world, the overhead powerlines plaguing Sydney streets would be placed underground. However, the financial costs of such a program to the asset owner, AusGrid, are apparently prohibitive.

While key streets will have electrical structures placed underground to address the restrictions and impacts from overhead services, the City will continue to fund and manage its current Aerial Bundled Cabling (ABC) program. The somewhat simple conversion of multi span wires into one cable drastically reduces the extent of pruning required for nominal line clearance. Standard multiple wires require approximately 5.5 metres cut from the centre of the tree; the ABC requires just one metre.

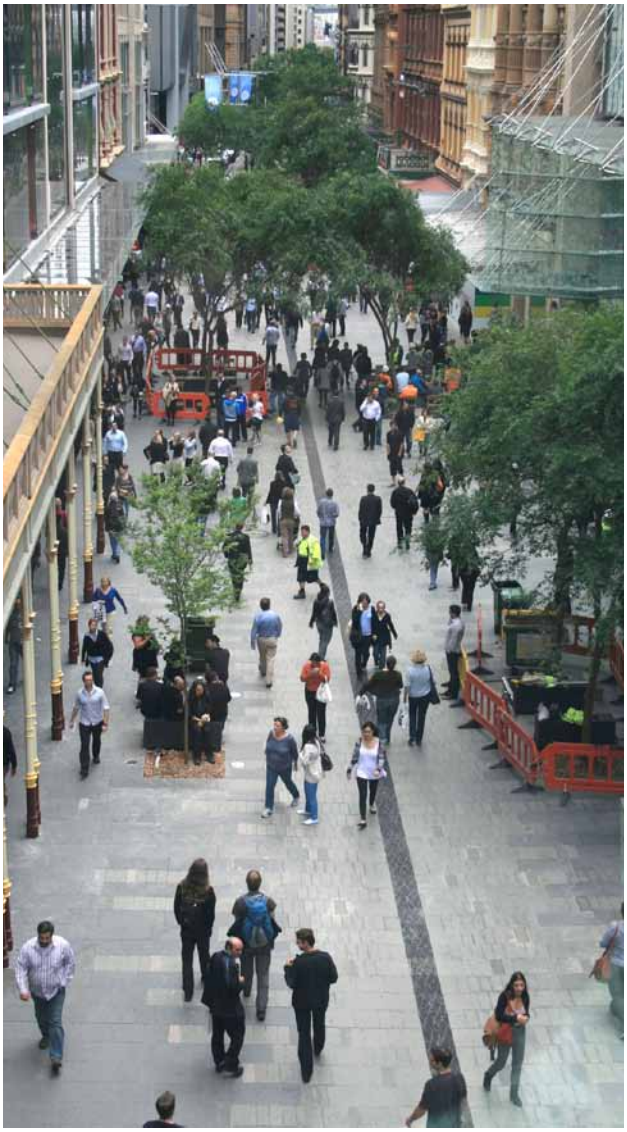

Figure 44 - Pitt Street Mall - Sydney CBD (Photo R. Smart)

5.3 Climate change

Climate change is the change in the average pattern of weather over a long period of time. There is clear evidence that our climate is changing, due largely to human activities.

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, produced in 2007, states global warming is 'unequivocal' and 'most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in greenhouse gas concentrations'. In other words, there is overwhelming evidence for human-made global warming.

Climate change is not just about global warming. The science indicates that the climate will be altered in many other ways. For example, there will be changes in rainfall patterns and ocean currents, changes to the intensity and frequency of extreme events such as storms, droughts and floods, rising global sea levels and ocean acidification (AGCCD 2011).

The impacts of climate changes are often talked about at the global level. However there are real and tangible impacts at a federal, state and local government level.

The Climate Commission, an independent body that provides information on climate change to the Australian people and Government, has produced numerous reports on climate change. Key issues from their report titled The Critical Decade: New South Wales climate impacts and opportunities (2011) found that NSW is becoming hotter and drier. Record-breaking hot days have more than doubled across Australia since 1960 and heatwaves in the greater Sydney region, especially in the western suburbs, have increased in duration and intensity. The period from 2000-2009 was the state's hottest decade on record.

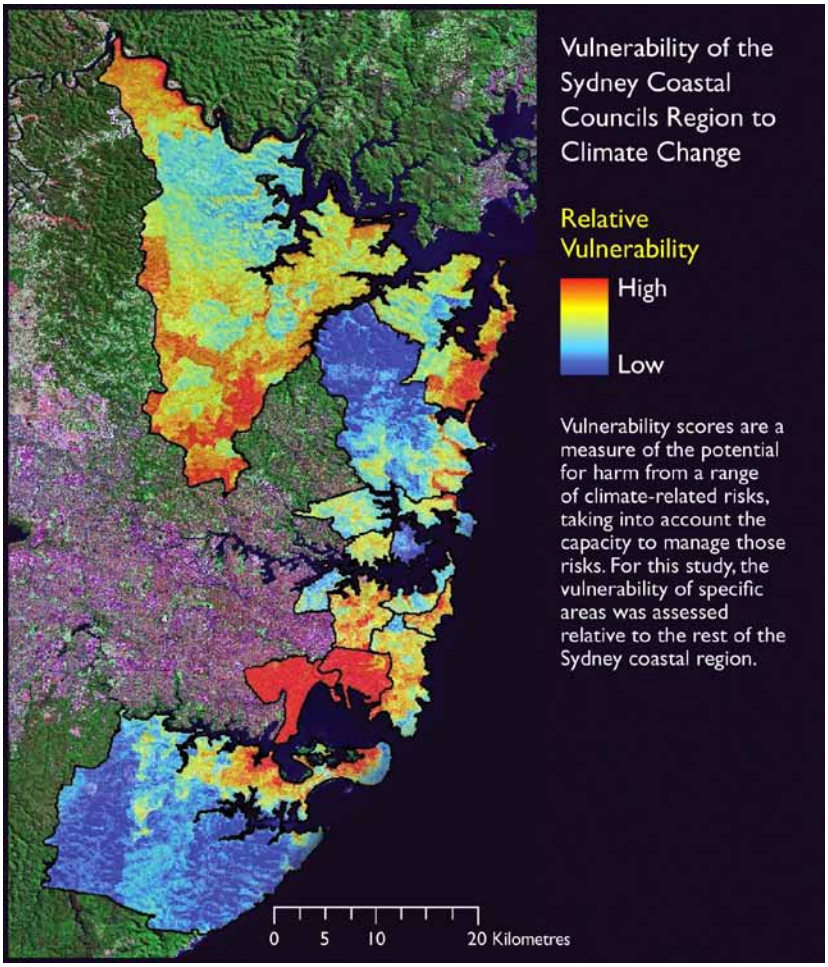

Figure 45 - Sydney Climate Change Vulnerability (Source : CSIRO - http://www.scienceimage.csiro.au/mediarelease/images/Vulnerability_Map.jpg accessed 12/7/12)

Challenges and Issues

Currently in eastern Sydney, there are about 3 days above 35°C a year. By 2030 this is projected to increase to 4–5 days per year, and to 9 days per year by 2070 (Table 5; CSIRO and BOM, 2012).

At the local level, in 2008 the CSIRO and the Sydney Coastal Councils Group undertook an assessment of the vulnerability of Sydney Councils to climate change. Five areas of potential climate impact were selected for vulnerability assessment :-

- Extreme heat and human health effects.
- Sea-level rise and coastal hazards
- Extreme rainfall and urban stormwater management
- Bushfires
- Natural ecosystems and assets

As shown in Figure 45, the City of Sydney is considered in the medium range of vulnerability, with some areas in the high vulnerability category. (http://www.csiro.au/Organisation-Structure/Divisions/Ecosystem-Sciences/MappingSydneysVulnerability.aspx)

	2008	2030	2070	2100
SYDNEY	3.3	4.4	9	14

Table 5 - Numbers of days expected to exceed 35° in the coming decades (Source: Climate Commission - The Critical Decade New South Wales climate impacts and opportunities 2012. - originally from CSIRO, and cited in Garnaut, 2008)

Climate Change

Over many decades thousands of scientists have painted an unambiguous picture: the global climate is changing and humanity is almost surely the dominant cause. The risks have never been clearer and the case for action has never been more urgent.

Our Earth's surface is warming rapidly and we can already see social, economic and environmental impacts in Australia. Failing to take sufficient action today entails potentially huge risks to our economy, society and way of life into the future. This is the critical decade for action.

Climate Commission, 2011

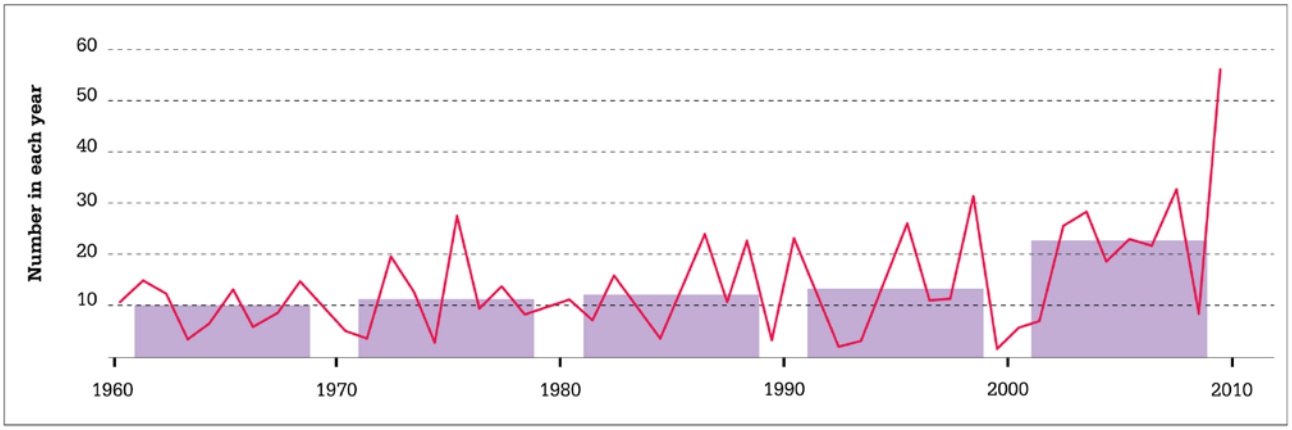

Figure 46 - Average number of record-breaking hot temperatures each year across Australia. Yearly average shown by red line and 10-year average shown by purple bars. (Source: Climate Commission - The Critical Decade New South Wales climate impacts and opportunities 2012. - originally from Bureau of Meterology)

Challenges and Issues

What does this mean for Sydney and its urban forest? Below is a summarised snap shot of the key risks and impacts from climate change on the City's urban forest.

Higher average temperatures

- Decline in health for the existing trees species suited to Sydney's current (cooler) climate.
- Increased impact from pests, as their life cycle and reproduction rates increase, coupled with improved ability to survive over-winter, will increase the detrimental impact on tree health.
- Increase in the range of pests or other pathogens that can extend their geographical range to include Sydney, effectively increasing urban forest vulnerability.
- Increase in the range of tree species from northern NSW, QLD that may now be more suitable for planting in the increase climate.

Heatwaves

- Premature death of some trees / species, not tolerant to heat or associated water stress. This will be particularly evident in young trees, that have not built up the stored energy or resources required to survive such events.
- Trees' leaves are scorched, leading to decline in tree health.

Long-term drought and decreased rainfall

- Increase premature tree deaths, and detrimental impacts to tree health.
- Impact on the number of new trees planted in the event of water restrictions.

Flood and increased rainfall intensity

- Heavy rains can lead to tree stability issues, and health impacts where inundation occurs over longer periods.
- Disease impacts may also worsen, with inundation improving the environment for pathogens that cause root rot or decay in trees.

Extreme weather events

- High winds and heavy rains can lead to increased branch and whole tree failures. Importantly, this can impact trees that are in otherwise perfect health and condition.
- Increased risk, claims and litigation, from any damage caused by tree failure.
- Increased community concern about large canopy trees, due to perceived risk impacts. Desire by many to remove trees, which only worsens urban heat island and climate change impacts.

5.4 Urban heat island effect

Urban heat islands occur in an area such as a city or industrial site leading to consistently higher temperatures than surrounding areas because of a greater retention of heat. This is caused by the suns heat being absorbed, and not reflected, by buildings, dark roofs, car parks, paved services and roads.

Lack of shade and high density of buildings trapping the sun's heat increase the effect. (Figure 47) (Climate Commission 2011). Human activities, such as motorised transport and using air conditioning also increase the waste heat generated. On hot summer days, cities can be several degrees hotter than their rural surrounds. (Greening Australia 2010).

The urban heat island effect has the potential to adversely impact a city's public health, air quality and energy use (Greening Australia). The urban heat island effect intensifies heat waves in cities, making residents and workers uncomfortable and putting them at increased risk of heat exhaustion and heat stroke. Hotter temperatures increase the demand for air conditioning, increasing energy use when demand is already high. This in turn contributes to power shortages and increasing carbon dioxide emissions. (http://www.hotcities.org/ and www.bom.gov.au/info/leaflets/urban_design.pdf)

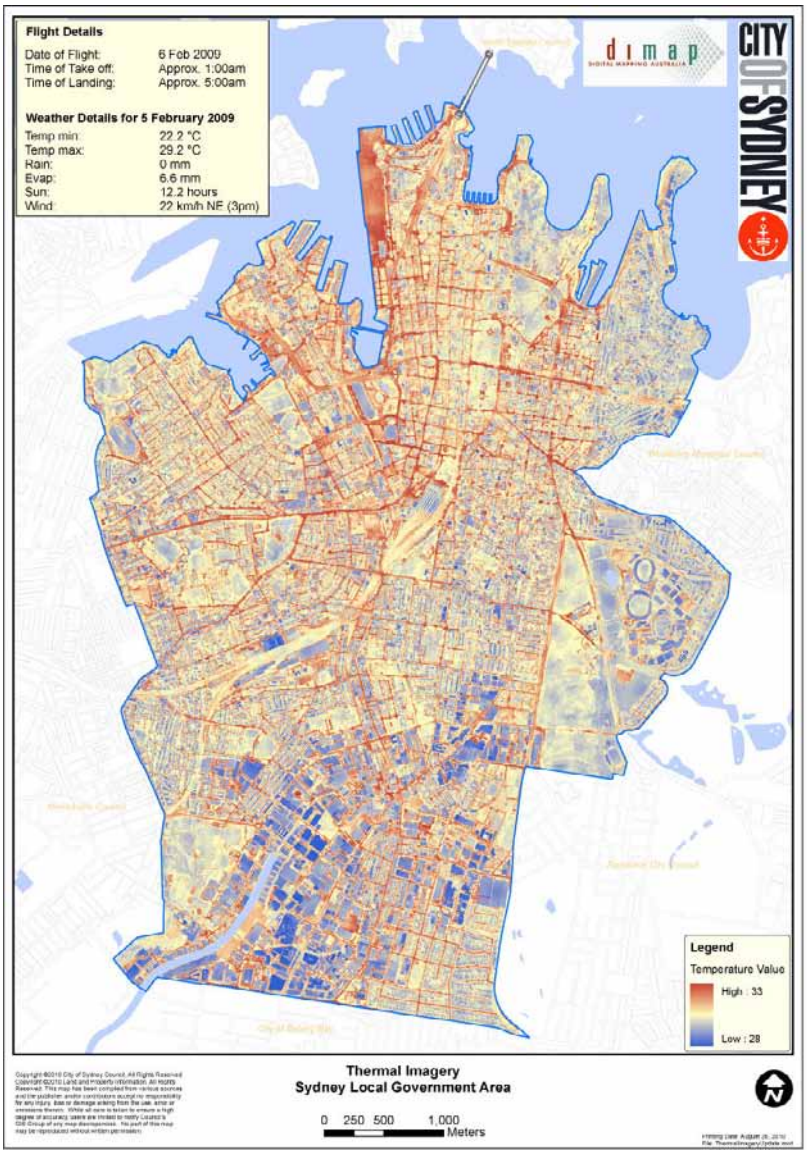

Figure 48 - The urban heat island effect - thermal imaging of the City of Sydney.

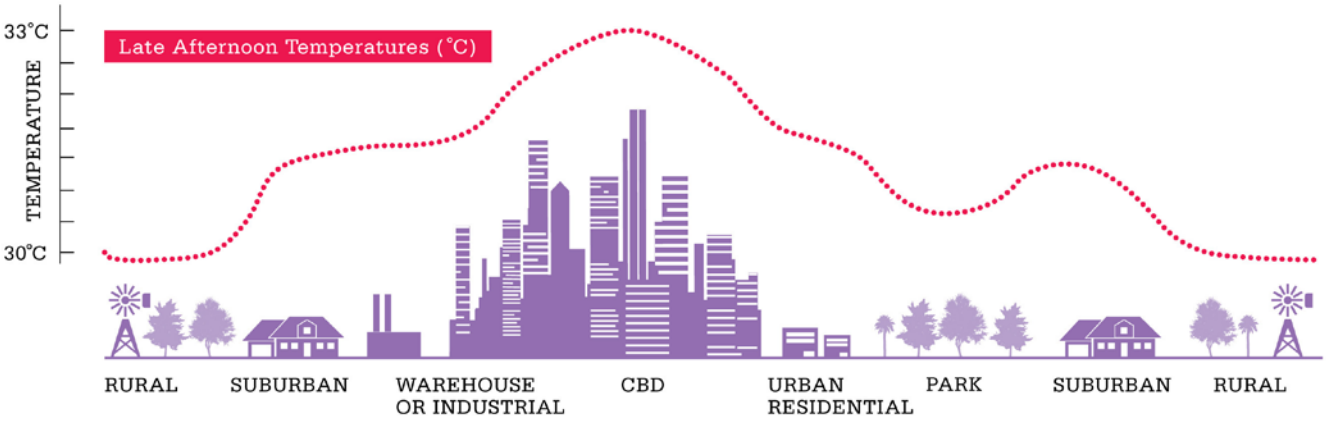

Figure 47 - The urban heat island effect. The average annual air temperature in cities (more than one million people) may be 1 to 3°C hotter than surrounding areas. (Source: Climate Commission - The Critical Decade New South Wales climate impacts and opportunities 2012. - originally from US EPA, 2008 and NASA, 1999)

Challenges and Issues

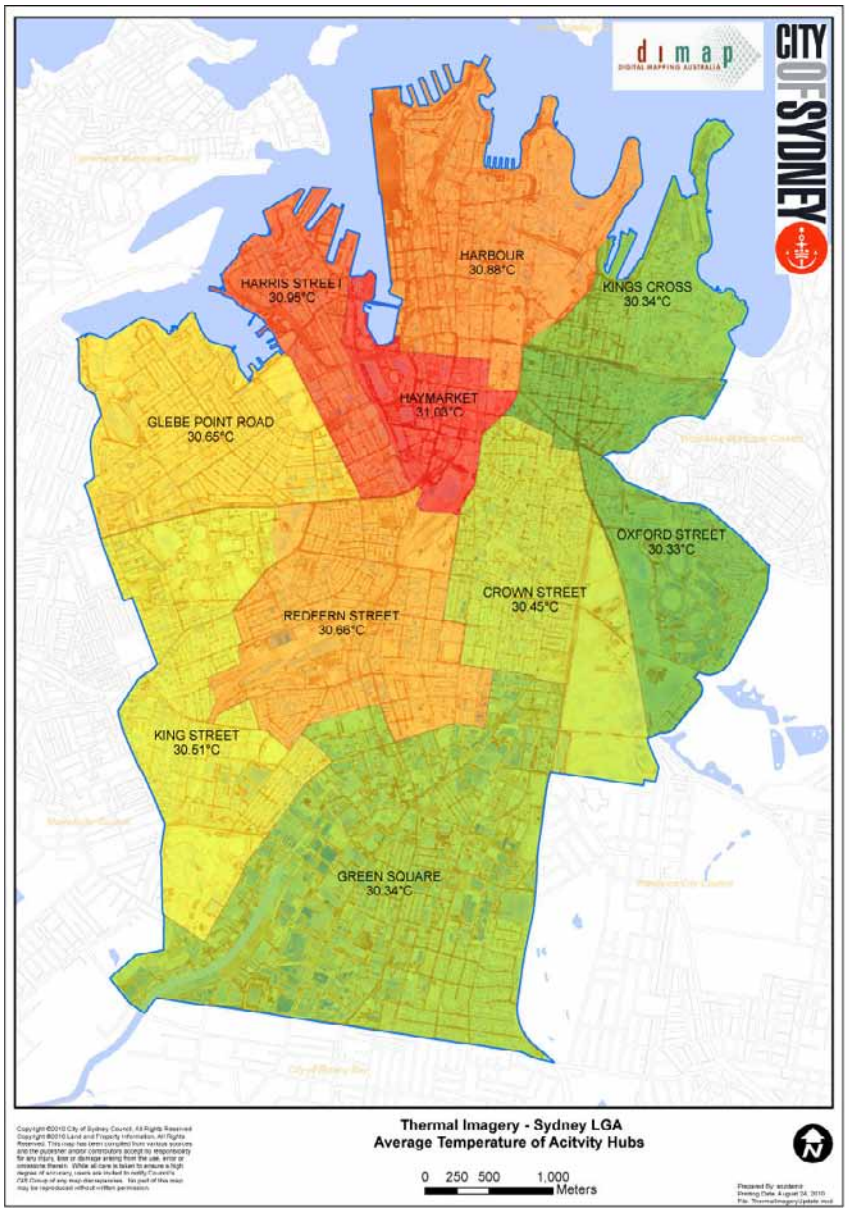

Figure 49 - The urban heat island effect - average temperatures by suburb.

Other documented impacts as a result of the urban heat island effect include impacts to biodiversity, increased water demand, decreased productivity and even increased rates of domestic violence. (Greening Australia)

Thermal aerial photographs (Figures 48 and 49) have been taken across the City's LGA to show the way that different road surfaces, buildings, parks and open spaces retain heat during the day that is released at night. This highlights the different areas temperatures, largely due to building use and the extent of canopy cover.

An example of this is the Haymarket and Pyrmont Point areas. These are the hottest parts of the City, which is not surprising given the low canopy cover of just 9.2% and 9.5% respectively, coupled with the recent and increasing high rise development. Conversely, the areas with high canopy cover, around Centennial Park and Rushcutters Bay, have the lowest temperature impacts. Note that in some areas, such as Green Square, the cooler 'blue' areas in Figure 48 indicate buildings with extensive air conditioning in use.

Urban forests have proven to be one of the most effective methods for mitigating heat retained in urban centres. Shade from trees regulates temperature extremes, reducing the total energy used for heating and cooling. They also cool the air by releasing water vapour through transpiration. It has been calculated that a 5% increase in canopy cover can reduce summer air temperatures by 1-2 degrees Celsius.

There are key challenges in mitigating the urban heat island effect through canopy cover:-

- The current canopy cover is just 15.5%, so more than 84% of the surfaces in the LGA absorb heat.
- It takes about 20 years for trees to mature and provide the canopy required, and
- The ongoing temperature changes and impacts of climate change will place greater stresses and demands on the existing trees, and those we need to plant.

5.5 Pests and diseases

Overseas experience shows that widespread infestations of harmful pests and diseases can have devastating consequences on parts of our urban tree populations.

The impact of pest and disease on the City's urban forest is only likely to increase. This is due to a range of factors, such as climate change, with increased temperatures, storm events, greater or lower rainfall events, coupled with the increase in international travel with the risk of a pest 'hitching a ride' to Sydney.

Current pest and diseases impacting the City's trees include;

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

Tree species selection is an important part of managing the risk from pest and diseases. The more diversification, the less risk of canopy cover loss from a major pest or disease event.

Incursion of pests and outbreaks of disease can take tree managers by surprise. Trees once thought to be 'bullet proof 'can be severely debilitated by previously unknown pest and diseases (see information boxes Sycamore Lace Bug and Myrtle Rust). Some recently arrived pest and diseases will be impossible to eradicate and treatment has proved to be expensive, difficult or limited in its efficacy.

A trees ability to cope with a pest or disease depends in part on the environment in which it is growing. The City's street trees, especially in the CBD, are growing in very tough environments. Coping with compacted soils, shade, wind, pollution, limited water, constricted root system and regular pruning makes it difficult for trees to deal with pests and diseases.

This represents a key challenge, to improve biodiversity, reduce the risk of canopy cover loss from pest or disease, whilst still ensuring the species selected are able to thrive and provide the canopy cover the City needs.

Sycamore Lace Bug

Sycamore Lace Bug (*Corythucha ciliata*) is an insect introduced from North America that mostly affects Plane Trees. An infestation of the Sycamore Lace Bug was confirmed in the City of Sydney LGA in 2006. The tiny adults and nymphs feed on the underside of the leaves, causing bronzing, chlorosis and premature leaf drop. Severe infestations can cause complete defoliation. Several consecutive years of infestation may kill affected trees. The Lace Bugs potential association with the Canker Stain disease of Plane trees (Ceratocystis platani) is a significant concern.

The Lace Bug is now widespread in the Sydney basin and evidence suggests it is spreading along major transport routes. Establishment of young trees in affected areas is proving to be particularly difficult.

The City has implemented a program of injecting Plane trees with systemic insecticide in an attempt to control insect numbers and therefore lessen the impact on tree health.

Figure 50 - Sycamore Lace Bug - Adult Stage (Source : www.flickr.com/photos/xx_chaton_xx/5139448467/sizes/l/in/photostream/ -accessed 5/3/11)

Challenges and Issues

Figure 51 - 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)

Myrtle Rust

Myrtle Rust (*Uredo rangelii*) is a particularly serious fungal disease native to South America. It was first detected in Australia on the Central Coast of NSW in April 2010. This fungus can affect plants belonging to the family Myrtaceae which includes many of the very common native species such as Eucalypts, Paperbarks, Myrtles, Lilly Pillys, Bottlebrush and Water Gums. These trees represent a very large proportion of the City's street trees and native vegetation communities.

It is very easily spread and the NSW Department of Agriculture, Fisheries and Forestry have now advised that they do not believe it can be effectively contained or eradicated. It has recently been listed as a Key Threatening Process under the NSW Threatened Species Act 1995.

When severely infected, young plants and new growth may become stunted and in worst case the plant may die. Little is currently known about the disease and its impacts to plants under Australian conditions.

Treatment using various fungicides may be possible, but this will usually prove unviable on large trees in public areas. Control will really only apply to small plants and controlled nursery environments and the like. The ultimate affect of this disease is currently unknown.

Figure 52- Tree injections with insecticide is costly and time consuming but trials currently underway by the City may prove useful in limited areas to help control the impact of the Sycamore Lace Bug. (Photo R. Smart)

5.6 Aging tree population

Trees are reaching the end of their lifespan in many of the City's older parks and streetscapes. Timely replacement is critical to maintaining canopy cover in these areas. An example of this includes the Central Avenue in Hyde Park, as outlined in Figure 53 below.

1920's commonly known as "Lovers Walk"

2008 replacement tree supply program begins

The Central Avenue of Fig trees in Hyde Park has evolved over time.

Staged block replacement strategies have now been developed to ensure this historic landscape is continued for future generations.

1930's the avenue removed and replaced during City Circle railway construction

1990's avenue at its peak

Figure 53 - Hyde Park, Sydney - History and tree replacement strategy. (Source CoS)

5.7 Community expectations and resistance to change

The City has a wide and varied population of residents, living in apartments, terrace houses, small and large lot suburban housing. Each have a different perspective and interaction with trees and the urban forest. The community as a whole also includes business owners and employees who may visit and engage with the City and its trees every day. As such, the City encompasses many people with an extremely diverse range of interests and attitudes towards trees. These are often influenced by an equally diverse range of factors such as age, income, education, cultural background and exposure to natural environments. At the extreme there is often the irrational fear of trees, even though statistically there is far greater chance of being killed by lightening than dying due to a tree failure.

An individual's behaviour and attitude towards trees on their own land is often intensely personal. Given that 61.7% of City's land use is in private ownership it is essential that the City's urban forest strategy and the education program targets all audiences, especially those that may not have an appreciation for the importance or value of trees. In short, it needs to focus on addressing barriers to behavioural change rather than just building awareness. On a practical level this may entail having information available in different languages and at venues such as religious institutions and community centres that might not be obvious targets.

We have all had the thought that enter our minds at some time that we "love trees but it's ……

- cracking my pavement and walls,
- clogging my pipes,
- obstructing my views,
- dropping leaves and fruit in my gutters,
- shedding branches,
- shading my porch or,
- blocking my sunlight.

These are all valid concerns and often they will need to be addressed. People need to be educated and informed about the most appropriate ways to deal with these issues and that unnecessary tree removal and the repercussions of individual actions can threaten the long term viability and sustainability of the urban forest. Often many of these issues can be adequately addressed without tree removal. Appropriate maintenance and pruning can often alleviate concerns, and appropriate repair or redesign of infrastructure can also be undertaken with little impact to the tree and the tree can continue its valuable contribution for many decades to come.

It is also important that people recognise and are informed about the need for change. Trees are living organisms and as such will grow, mature and eventually die. As trees age they will require maintenance and then eventually require removal and replacement. In a natural ecosystem this happens gradually and with little fan fair or impact to people. In an urban environment an aging or hazardous tree can usually not be left until it completely falls apart.

Tree removal can be traumatic and emotional. Often trees have been there for many decades prior and people have grown up with them and become attached to their presence, their size and their aesthetic appeal. The trees may also represent associations and links to past events and historical places. For these and many other reasons, some parts of the community often have expectations of trees being retained for very long periods. They may even entertain retaining a tree no matter what the costs. There will come a time, however, when the benefit of keeping an individual tree is far outweighed by the hazard to life or property and the monetary cost of maintaining it. As with all forests it will need to be replaced with the next generation, as painful as this may be. When managing and establishing an urban forest the needs of the many may often have to outweigh the needs of the few.

5.8 Available research information

American cities have the distinct advantage of the USDA's iTree program, which enables the measurement of various environmental benefits provided by each cities tree population. This includes the capture of water, airborne pollutants and the amount of CO^2 sequestered, and the monetary savings as a result.

This information is a powerful tool in communicating the benefits of the urban forest to the community, politicians and other decisions makers. The Chicago study case study below for the powerful contribution the urban forest makes to the City's environmental and financial sustainability.

The development of the i-Tree program for Australia is underway. A coalition of Councils, including Melbourne City Council, Brisbane City Council and the City of Sydney, along with the Nursery and Garden Industry Association (NGIA) has contributed funding to assist in the adaptation of the algorithms for its application in Australia, as well as providing environmental and pollution data for each state.

Once adapted for use in Australia, the City will use the i-Tree program to measure the performance of our urban canopy. This will help us to achieve, monitor and communicate the objectives of this Strategy and our 2030 targets.

Chicago's Urban Forest Effects (UFORE) Model Study

Building upon the work of the United States Department of Agriculture Forest Service's Chicago's Urban Forest Climate Project, a study of the benefits of the urban forest was completed in 2007. From this survey they learned that:

Number of trees
3,585,000

Canopy cover
17.2%

Structural value
(cost of replacing with a similar tree)
$2.3 billion

Pollution Removal
754 tons/year ($6.4 million/ year)

Carbon Storage
716,000 tons ($14.8 million)

Carbon Sequestration
25,200 tons/year ($ 521,000/year)

Source : Chicago Urban Forest Agenda

Figure 54 - Aerial view of Elizabeth Bay

5.9 Achieving and measuring the canopy targets

An increase in canopy cover from 15.5% to 23% may not appear much. However, the challenge will necessitate balancing the removal of aging trees and the impacts of new development, whilst maintaining a steady replacement planting of larger growing trees.

Canopy is largely driven by the land made available to it, coupled with the arboricultural knowledge for its maintenance and management, and community and political will to ensure sufficient resources are given to do so.

Direct and indirect decisions that impact the existing and future canopy cover performance are made by a range of people, often without realising it. This includes many disciplines that work within local government, such as the elected representatives, town planners, engineers, architects, project managers and arborists to name a few. Outside of the organisation, many members of the community also impact the decision making process, such as the property owner who does / does not plant a tree within their property.

Assessments have shown simply removing and replacing trees will not suffice. We need to actively locate new planting opportunities, and plant large canopy trees as much as possible, to achieve the canopy cover targets within specific areas, land types and across the LGA.

Challenges and Issues

In some instances, the opportunities to increase canopy cover are straightforward. Rosebery is a great example of a suburb that can easily increase its canopy cover. It has just 10.6% cover now, and as a suburban residential area, the optimal canopy cover is 50%. Rosebery properties have large rear yards, front yards and wide nature strips. There is plenty of room for planting large canopy trees and the City has already planted over 7,800 new street trees over the past 6 years across the LGA. The main issue will be convincing the residents that planting canopy trees in their yards will provide real benefits.

In some suburbs, such as Alexandria, the opportunity to increase canopy cover is much harder. The 'industrial box' style development that extends along and out to all property boundaries, reduces the ability to plant trees. The opportunities to plant may therefore need to be located on green roofs and car parks. Appendix C includes case studies on Rosebery, Alexandria and Glebe, to highlight the different management issues.

Some land uses, such as car parks, also provide a challenge. Car parks are notoriously denuded, and around the world are often considered the most failed landscape category. Retrofitting trees into existing car parks is a difficult task. The pavement, soils and water to support tree establishment needs to be improved, and may also necessitate parking reconfiguration. However the substantial benefits of increased shade can not be forgotten. New car parking designs, with substantially greater canopy cover, should be undertaken as a priority.

Finally, it is recognised that not all suburbs will be able to achieve their optimum canopy cover. Eveleigh is a good example of this, as the area is predominately State Rail land and is not conducive to tree planting. Within suburbs like this, existing trees will be carefully managed and any new planting opportunities that present themselves will have high priority and attention.

Figure 55 - Eveleigh Rail Yards - Some parts of the City will never be able to greatly contribute to canopy coverage due to the infrastructure and landuse requirements within a large and international city such as Sydney.

6. Implementation, Monitoring and Review

6.1 Priority actions

An implementation plan has been developed to outline priority actions and realistic delivery timeframes. The actions are directly linked to the strategic objectives identified earlier within the Strategy:-

Actions to protect and maintain the existing urban forest

The City will prioritise the maintenance and protection of existing trees in order to maximise the benefits already received from this asset.

Actions to increase the urban canopy cover

The City will increase the canopy cover from 15.5% to 23.25% by 2030, and then to 27.13% by 2050, through targeted programs for trees located in streets, parks and private property.

Actions to improve urban forest diversity

The City will improve the age spread of our street and park trees. We will also increase species diversity, while ensuring it does not comprise of more than 40% for a family, 30% for a genus, and 10% for a species.

Actions to increase community knowledge and engagement

The City will educate the community on the benefits of trees and their management requirements, and assist community participation in the greening of Sydney.

The Action Plans outlined in the following pages and will 'stand alone' in terms of ongoing review and implementation.

Figure 56 - Tree planting within properly designed and installed in-road planting will be key to achieving increased canopy within the built up areas of the City. (Photo P. Hardyman)

6.2 Implementation Action Plans

Table 6 - Actions to protect and maintain the existing urban forest

The City will prioritise the maintenance and protection of existing trees to maximise the benefits already received from this asset.

Strategic Focus	Action	Implementation Timeframe (years)			
		1-2	3-5	5+	On-going
Tree Retention	Regulate and assess applications to prune or remove trees through the Tree Management controls detailed in the City Plan and Development Control Plan	✔			✔
	Update regulations and provide incentives to ensure current and future development projects are designed to retain existing trees and to expand the urban canopy cover		✔		
	Use education and regulatory compliance tools to ensure all developments are built in a manner that protect trees to be retained		✔		✔
	Recognise and promote the trees listed within the City's Register of Significant Trees.				✔
Tree Protection	Provide comprehensive tree protection guidelines developed in accordance with the Australian Standard for the Protection of Trees on Development Sites (AS4970)				✔
	Ensure development application submissions include all information to allow for full assessment of impacts on existing trees				✔
	Impose tree protection bonds on developers and event organisers to ensure protection of Council street and park trees	✔			
	Enforce tree protection requirements through the available regulatory tools				✔
	Refuse the pruning or removal of trees for inappropriate reasons / activities				✔
	Prosecute anyone found responsible for the unauthorised pruning, removal or poisoning of trees				✔
	Ensure all trees granted removal consent under the City Plan Tree Management controls have replacement conditions wherever there is available space				✔
	Ensure replacement conditions are monitored and enforced				✔
	Relocate overhead powerlines and underground utility infrastructure away from trees or promote other measures to reduce need for excessive canopy or root pruning				✔
Tree Maintenance Standards	Undertake proactive maintenance regimes for Council's street and park tree assets				✔
	Utilise best management practices for the pruning, watering, tree bases, pest and disease control and general maintenance of trees				✔
	Hire appropriately qualified aboricultural staff and external service providers to undertake all tree maintenance activities				✔
	Develop Tree Management Plans for key parks and streetscapes				✔
	Undertake regular audits of the maintenance performance to ensure all works are performed in accordance with the relevant Australian Standards				✔
	Record all maintenance activities into the City's centralised electronic tree database.				✔

Implementation, Monitoring and Review

Table 7 - Actions to increase the urban canopy cover

The City will increase the canopy cover from 15.5% to 23.25% by 2030, and then to 27.13% by 2050, through targeted programs for trees located in streets, parks and private property.

Strategic Focus	Action	Implementation Timeframe (years)			
		1-2	3-5	5+	On-going
Achieve Canopy Targets	Work collaboratively with a wide range of stakeholders, in various professions, to ensure decisions that will impact the canopy are well informed	✔			✔
	Keep informed with emerging research and technology that can physically deliver increased canopy, or assist in marketing or advocating its benefits				✔
	Adapt the City's related policies, plans, programs and procedures to actively support canopy cover increase	✔			
	Measure the canopy cover at specific intervals (every 5 years) to check the City's performance			✔	
	Use the City Plan (LEP and DCP) controls, that a minimum of the site has 15% canopy coverage on the site within a period of 10 years from development			✔	
	Continue to seek new opportunities for planting in streets and parks and plant large canopy trees in appropriate locations				✔
	Investigate the development of a matching grants program that encourages and facilitates community greening programs	✔			
Target Low Canopy Areas	Target planting projects and tree retention efforts in suburbs with less than 12% canopy cover	✔			✔
	Increase the compliance focus to ensure private property owners undertake and maintain the planting of trees following tree removal / development works	✔			✔
	Use the City Plan (DCP) controls to ensure all new car parks achieve the minimum canopy requirements				✔
	Investigate opportunities for a matching grants program that improves the health and condition of existing trees	✔			
Healthy Tree Planting	Plant in accordance with the City's Street Tree Master Plan, relevant Tree Management Plans and approved landscape plans for private development sites				✔
	Ensure only quality trees are supplied for planting; ie they must conform to the NATSPEC Guide				✔
	Pay close attention to tree installation plans and techniques to ensure successful establishment of trees				✔
	Undertake specialised young tree maintenance on all planted street and park trees, including formative pruning, for a minimum period of two years				✔
	Ensure maintenance plans are in place for new trees planted in private development sites	✔			✔

Table 8 - Actions to improve urban forest diversity

The City will improve the age spread of our street and park trees. We will also increase species diversity, while ensuring it does not comprise of more than 40% for a family, 30% for a genus, and 10% for a species.

Strategic Focus	Action	Implementation Timeframe (years)			
		1-2	3-5	5+	On-going
Achieve Age Diversity	Implement Tree Management Plans for the City's 19th century parks and other aging streetscapes to sensitively manage renewal of aging trees				✔
	Review age class in specific suburbs and areas to identify potential issues and implement special planting and renewal projects as needed		✔		
	Apply standard tree assessment procedures to ensure consistency in approaches to tree removals				✔
	Identify and assess the potential for removal and replacement of trees that are not growing to maturity, offer little aesthetic value or fail to maintain acceptable health				✔
	Pre-order and grow tree stock to ensure the installation of super advanced replacement trees to minimise the impact of renewal and replacement projects	✔			
	Inform and consult with community about planned tree removals to give an understanding of the issues and replacement programs				✔
Achieve Species Diversity	Implement the relevant policies for tree selection and planting including the Street Tree Master Plan for street tree planting, Tree Management Plans for our 19th century parks and the Draft Urban Ecology Strategy for areas with specific habitat or biodiversity requirements				✔
	Select trees species ensuring their suitability for specific site, aesthetic, functional and biological attributes				✔
	Assess Development Applications to ensure proposed tree selection is compatible with desired canopy cover targets, biodiversity needs and landscape character for particular precincts or villages				✔
	Consider the accepted standards of maximum of 40% for any one family, 30% for any one genera and 10% for any one species within the LGA				✔
	Consider the vulnerability of the species to potential pest and disease impacts and likely climate change trends				✔
	Maintain up-to-date knowledge on latest plant cultivars and potential new species that may be well suited to Sydney's urban conditions and implement trial planting of new species that may prove beneficial to achieving these and other urban forest initiatives				✔
	Encourage the staged removal of environmental weed species, such as Celtis sinensis (Chinese Hackberry), to be removed and replaced with suitable alternatives where appropriate				✔

Table 9 - Actions to increase community knowledge and engagement

The City will educate the community on the benefits of trees and their management requirements, and assist community participation in the greening of Sydney.

Strategic Focus	Action	Implementation Timeframe (years)			
		1-2	3-5	5+	On-going
Promote Value of Urban Forestry	Host conferences and collaborate with Universities on research and involvement in urban forest studies				✔
	Develop key health and wellbeing indicators to benchmark the role of urban forests in contributing to human health and measure every 5 years			✔	
	Investigate and support grants for community and stakeholder collaborative projects (and research and planting)		✔		
Achieve Key Stakeholder Awareness	Organise awareness strategies such as - "Great Tree Hunts" to look for significant trees or commemorative trees - Public information centres - Annual workshops and tours - Planting days - 'Urban Forest' exhibitions - of ideas and artistic reflections - Presentation and demonstration gardens and forest planting		✔		
	Create outreach and education strategies such as - Flyers / Brochure - Educational field trips for schools - Helping schools to develop their own Tree Management Plans		✔		
	Provide mulch delivery service to community groups to reuse pruned material, promote urban forestry and educate community on benefits				✔
	Update the Register of Significant Trees with the creation of a user friendly database and mobile device application to facilitate its broader use		✔		
	Continue website development to include awareness information and resources (eg. about tree programs / DA info)				✔
Encourage Community Stewardship	Continue with the City's Tree Donation Policy and investigate a community "Adopt a Tree" program		✔		✔
	Investigate opportunity for citizen training programs (pruning and maintenance) eg. in NYC an exam qualifies residents to legally look after street trees (with some excluded areas). Volunteer groups receive work assignments and suggest further projects. 'Citizen Pruners' meet with Council to review tasks and receive training.		✔		
	Investigate community interest in forming resident urban forestry groups - potential groups may include LEAF - local enhancement and appreciation of forests - and SUFF - Sydney Urban Forest Friends		✔		
	Investigate subsidising tree supply & planting programs for residents	✔			
	Engage with corporate citizens to investigate opportunities of tree planting for other services. An example may include Ausgrid to provide a tree to residents in exchange for going onto automated billing		✔		

Implementation, Monitoring and Review

6.3 Monitoring

Monitoring will be undertaken in relation to the targets outlined in Section 4.1 and Section 6.2 to evaluate the City's performance in implementing the Strategy. Performance criteria and monitoring details are outlined below in Table 10.

Figure 57 - Hyde Park in the 1920's (CoS Archives)

6.4 Review

The Urban Forest Strategy will be subject to the principles of adaptive management. The success and progress of the actions outlined in 6.2 will be reviewed annually and modified and adapted where:

- Monitoring results indicate this is necessary.
- To incorporate new advances or knowledge in the field of urban forestry.
- To take advantage of new opportunities that may arise in the City.

The Strategy will also be subject to a full review after a five year period.

Strategic Focus	Target	Monitoring	Frequency
Protect Existing Forest	No net loss of trees in LGA managed parks and streets	Record numbers of tree removals vs numbers planted	Annually
	Trees maintained in a safe condition utilising recognised best practice	Record all maintenance activities and tree failures	Ongoing - summary report annually
	Trees identified for retention are successfully retained following development	Follow up random inspections of key sites and trees	Annual Findings Report
Increase Canopy Cover	% Canopy cover increased in all LGA areas	LiDAR mapping	Every 5 years prior to UFS review
	Proposed planting in new developments and car parks achieves canopy targets	Follow up random inspections of key sites and trees	Annual Findings Report
Improve Forest Diversity	Improved age and species diversity achieved	Park and street tree populations analysed and diversity assessment undertaken	Every 5 years prior to UFS review
Community Engagement	Community support and knowledge of urban forest increased	Survey of local residents and businesses Survey of Council Staff	Every 5 years prior to UFS review

Table 10 - Proposed monitoring program for the Urban Forest Strategy

Appendicies

Appendicies

A. Suburban Land Use and Total Canopy Coverage (%) 2008

Suburb	Land Use	Canopy Target (%)	2008 Actual Canopy (%)	Gap
Alexandria & St Peters	Industrial Area	25	9.8	-15.2
Barangaroo	Central Business District	15	4.7	-10.3
Beaconsfield	Urban Residential / Light Commercial	25	9.0	-16.0
Camperdown	Urban Residential / Light Commercial (includes Sydney University)	25	20.2	-4.8
Chippendale	Urban Residential / Light Commercial	15	9.6	-5.4
Darlinghurst	Urban Residential / Light Commercial	25	14.9	-10.1
Darlington	Urban Residential / Light Commercial	25	18.5	-6.5
Elizabeth Bay & Rushcutters Bay	Urban Residential / Light Commercial	25	25.3	0.3
Erskineville	Urban Residential / Light Commercial	25	15.6	-9.4
Eveleigh	Central Business District (includes extensive rail infrastructure)	15	5.9	-9.1
Glebe, Forest Lodge, Annandale	Urban Residential / Light Commercial	25	28.2	3.2
Haymarket	Central Business District	15	9.2	-5.8
Newtown	Urban Residential / Light Commercial	20	18.0	-2.0
Paddington, Centennial, Moore Park	Suburban Residential (includes Moore Park Parkland)	15	19.5	4.5
Potts Point	Central Business District	15	14.9	-0.1
Pyrmont	Urban Residential / Light Commercial	25	9.5	-15.5
Redfern	Urban Residential / Light Commercial	25	17.9	-7.1
Rosebery	Suburban Residential	50	10.6	-39.4
Surry Hills	Urban Residential / Light Commercial	25	17.6	-7.4
Sydney	Central Business District	15	16.6	1.6
The Rocks, Millers & Dawes Point	Central Business District	15	12.7	-2.3
Ultimo	Urban Residential / Light Commercial	20	10.8	-9.2
Waterloo	Urban Residential / Light Commercial	20	16.0	-4.0
Woolloomooloo	Urban Residential / Light Commercial	20	14.4	-5.6
Zetland	Urban Residential / Light Commercial	20	10.8	-9.2

B. Case Study - Managing Weedy Species

All trees contribute to the canopy cover of the City, providing economic, environmental and social benefits, irrespective of their species or origin. Some tree species are considered to be a 'weedy' species, as they quickly colonise bushland or other land areas, restricting the growth or availability to plant more desirable tree species.

The Celtis, commonly known as the Hackberry (or even the Glebe Weed) is one such species. Importantly, there are 3 different species of Celtis; Celtis sinensis, Celtis occidentalis and Celtis australis. Celtis sinensis is considered the 'weedy tree'.

Managing the removal and replacement of the Celtis requires careful thought and planning. The City takes tree removal very seriously. Given all the benefits provided by trees, tree removal is a last resort option. In many instances where Celtis are planted as street trees they cause few problems. Their self seeding nature, with seedlings growing in inappropriate locations, is more of a nuisance. To complicate matters, in many areas these trees form the dominant canopy cover.

In managing Celtis in our streets and parks, the City removes the young self seeding trees as they appear. For the larger trees, we aim to increase the canopy cover around these trees by planting more desirable species in streets and parks, so that there will be less impact when they are eventually removed.

In private property, the City takes a similar approach. The City's Tree Preservation Order protects Celtis that are over 10 metres tall. This helps us manage this transition in canopy cover over time. Importantly, if permission is given to remove a large Celtis, the City generally requires its replacement with a more suitable species.

Celtis removal is considered in the context of maintaining canopy cover. Canopy cover is measured at both the micro scale, eg the street / park impacted, and the macro scale, such as the suburb. As the City has information about all trees being removed (street, park and private) we take this knowledge into consideration when deciding which, if any, Celtis should be removed and when.

Figure 58 – Celtis sinensis in Reconciliation Park, Redfern contributes to the urban forest but will need to be managed and evetually replaced (Photo I. Groundwater)

Figure 59 – Celtis australis in Pyrmont - is typically not considered a weed and is a hardy and useful street tree (Photo R. Smart)

C. Case Study - Three suburbs within the City

A case study of three different suburbs has been undertaken to highlight the differences in canopy cover, species, age class and the impacts of land use. The suburbs of Glebe, Alexandria and Rosebery were selected as they represent three different land use patterns; urban residential, industrial and suburban residential. Their location within the City is outlined in Map 2 below.

Map 2. The City of Sydney - Local Government Area and Case Study Location Plan

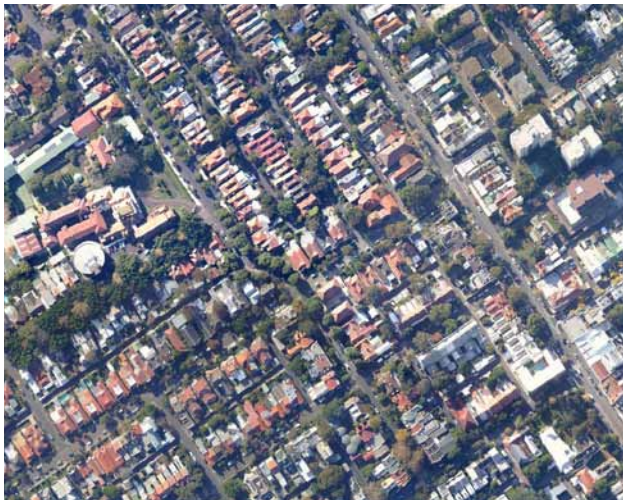

Figure 60- The older and larger residential allotments and well planted streets contribute to a 29% canopy cover for the suburb

Figure 61- There are many grand and historic homes throughout Glebe (Photo R. Smart)

Figure 62- Typically there are older and large canopy trees now with gaps in between where new planting has taken place (Photo R. Smart)

Glebe

- Typically Glebe has large canopy trees with gaps in between.
- Planting of new street trees has been undertaken, but they will take some time to reach their mature size. Therefore, gradual transition of canopy cover is occurring.
- Has one of the highest canopy covers within the LGA.
- Canopy is largely balanced across the parks, private property and streets.
- There is a good spread of age classes.
- Emerging issues around private tree losses related to Celtis tree removals, especially in Housing NSW properties, for off street parking and studio development.

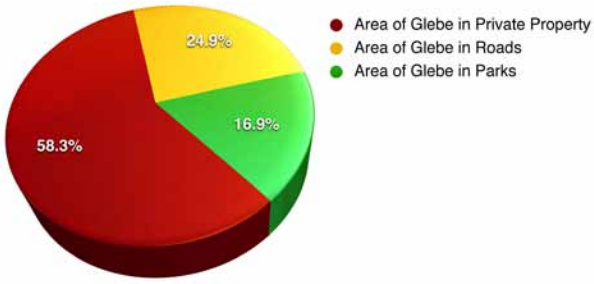

Figure 63 - Land use % in Glebe

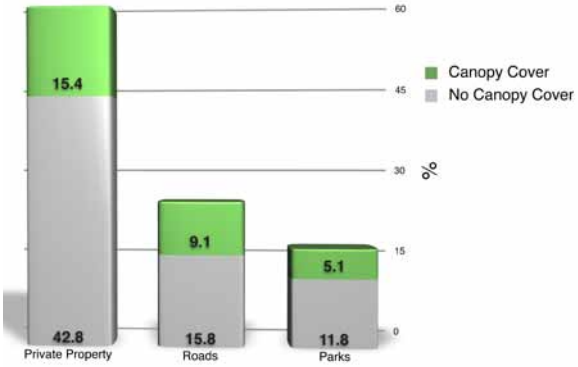

Figure 64 - % canopy per land use in Glebe

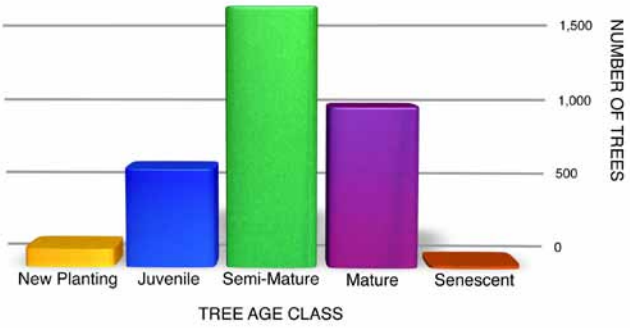

Figure 65 - Tree age class comparison in Glebe

Figure 66- Aerial view of a typical area within Alexandria

Figure 67- The mature Paperbarks such as those in Birmingham Street are critical as they form a great percentage of the suburb's existing canopy coverage (Photo R. Smart)

Figure 68- If designed thoughtfully there are still opportunities to plant larger canopy trees in between sites and within car parking areas.

Alexandria

- One of the lowest canopy coverages in the LGA at 10%.
- Pressures in Alexandria stem from the large box style developments with multiple driveways and large hardstand and car parking areas which remove existing trees, and limit their replacement.
- Street trees, particularly mature Paperbarks in Alexandria are critical as they form almost half of the suburbs tree canopy coverage.
- Planting can often still occur around the edges and in the middle of the sites.
- Predominance of mature aged trees requires management of replacements in coming years.

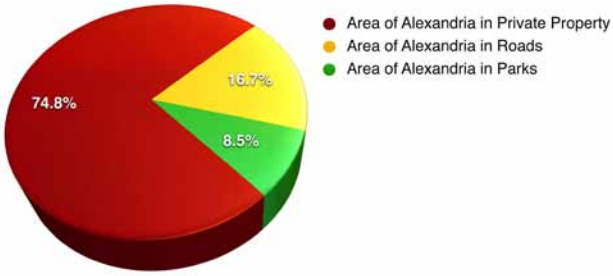

Figure 69- Land use % in Alexandria

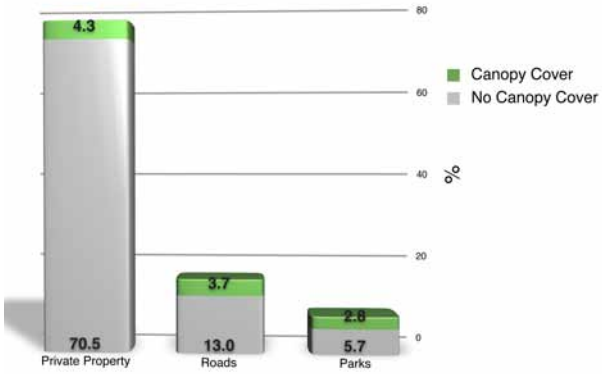

Figure 70- % canopy per land use in Alexandria

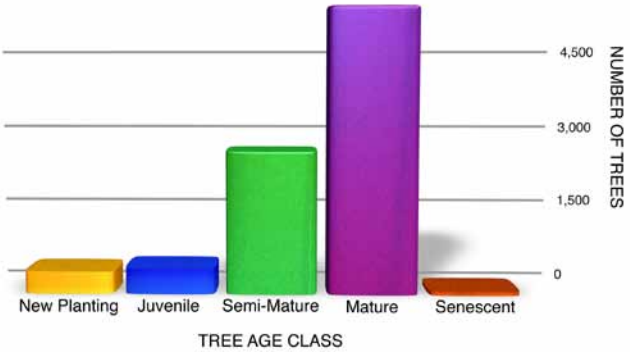

Figure 71- Tree age class comparison in Alexandria

Figure 72 - Aerial view of a typical area within Rosebery

Figure 73 - Relatively little canopy cover is provided in private lots despite there being room available (Photo R. Smart)

Figure 74 - There are numerous opportunities, as illustrated in this photomontage, for new in-road planting given the wide streets and sandy soils. This could add greatly to the suburbs cover in the medium term. (Image by Arterra)

Rosebery

- Very low canopy cover at 10.5% considering the suburban residential development and larger allotments.
- Little canopy cover is provided in private property with parks contributing well above their area %.
- Room and soil conditions available for large canopy trees.
- Issues with residents planting small fruit trees in the grass verge limiting the urban canopy and wider benefits provided.
- Tree age class primarily semi-mature largely as a result of the City's street tree planting focus in recent years.

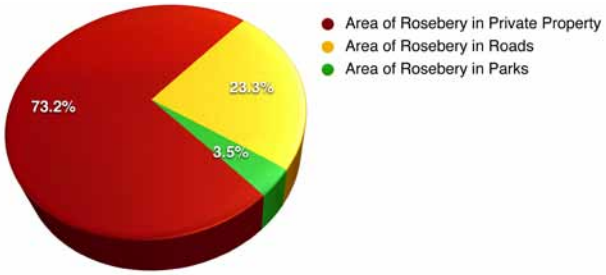

Figure 75 - Land use % in Rosebery

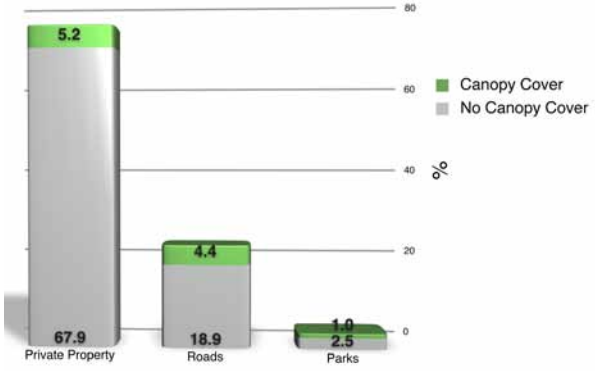

Figure 76 - % canopy per land use in Rosebery

Figure 77- Tree age class comparison in Rosebery

D. Glossary

Canopy Cover:
The proportion of land area occupied by the tree's crown or canopy when visualised from directly above. It is the two dimensional horizontal extent of the combined canopies on a given land area, often expressed as a percentage or the total area covered.

Carbon sequestration:
Amount of carbon removed from the atmosphere and stored by trees annually

Carbon Storage:
The amount of carbon held within a trees tissue, mainly the roots, stem and branches.

Locally Indigenous / Endemic:
A native plant usually with a restricted occurrence limited to a particular country or geographic area and often confined to a specific habitat.

Tree:
A woody perennial plant long-lived, greater than 5m high with one trunk or relatively few stems.

Urban Forestry:
Management of the entire population of trees and woody shrubs in an urban environment recognising them as critical elements of urban infrastructure providing physiological, sociological, economic and aesthetic benefits.

Urban Heat Island Effect:
Increased surface temperatures during summer months in urbanised areas resulting from paved surfaces such as asphalt and dark building surfaces which absorb and release more heat from the sun during the day and the night- time than the natural landscape, thereby increasing the ambient temperature and prolonging periods of higher air temperature.

Weed Species:
Any plant species exotic or native which is known to spread by the production of viable progeny in large numbers often out competing and disrupting existing species in gardens, parks or bushland. The species may be introduced from outside its area of natural distribution to an area where there are few or no natural predators, or it may have the ability to spread due to changes in land use creating a favourable habitat.

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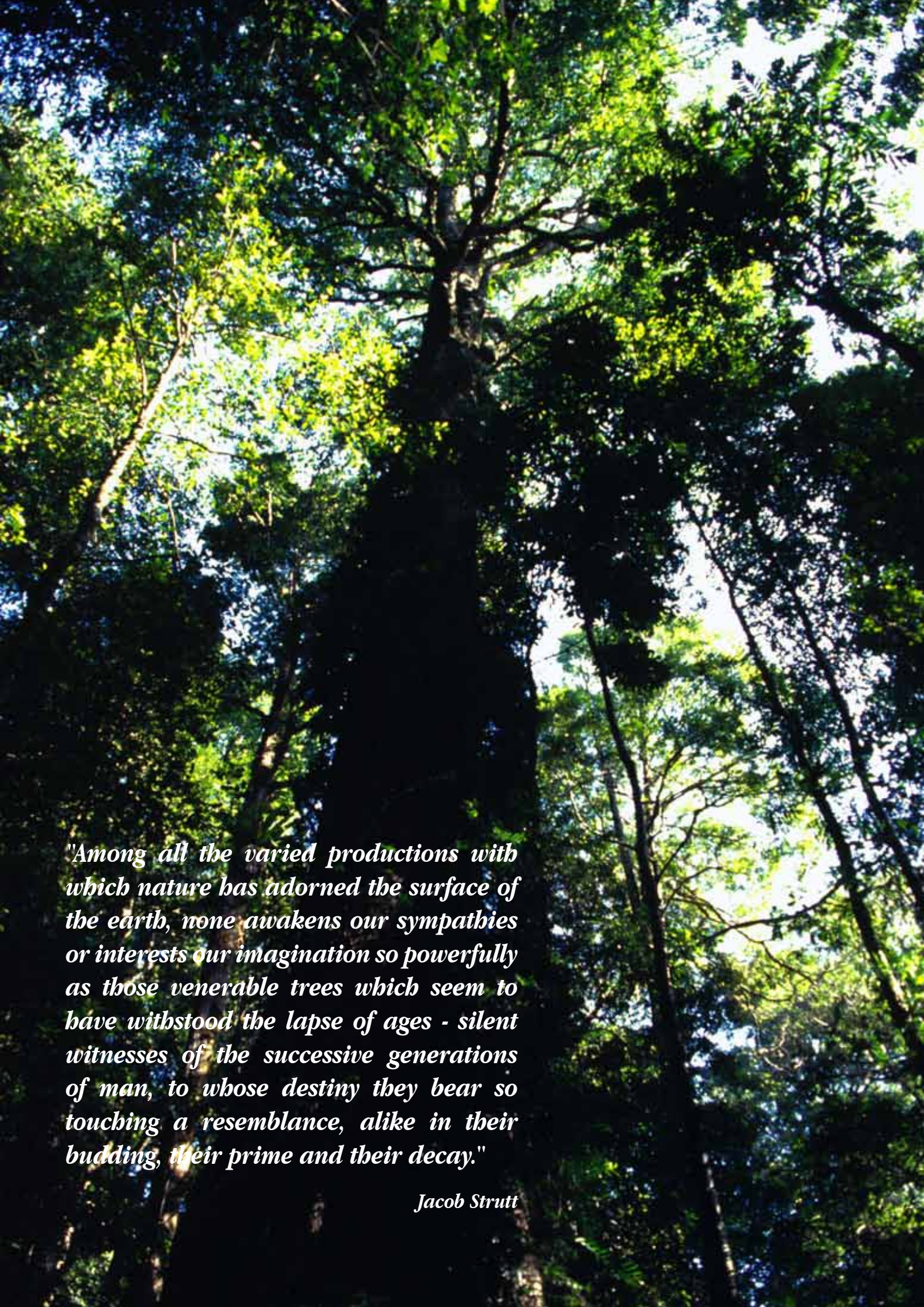

"Among all the varied productions with which nature has adorned the surface of the earth, none awakens our sympathies or interests our imagination so powerfully as those venerable trees which seem to have withstood the lapse of ages - silent witnesses of the successive generations of man, to whose destiny they bear so touching a resemblance, alike in their budding, their prime and their decay."

Jacob Strutt