Urban Tree Canopy Strategy

City of Canada Bay

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Urban Tree Canopy Strategy

City of Canada Bay

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Purpose, approach and planning context

Urban trees play a critical role in creating healthy cities; they provide shelter, improve air quality, absorb carbon and rainfall, cool local environments, and support wildlife. Collectively, urban trees make up the urban forest. A healthy and well-managed urban forest provides multiple environmental, social, and economic benefits.

The City of Canada Bay contains large expanses of public open space including over 150 parks and reserves and significant areas of streetscapes. This includes a mix of remnant bushland with stands of Sydney Turpentine and Ironbark Forests, active sporting fields and passive recreation areas. These natural assets are highly valued by the community.

The purpose of this Urban Tree Canopy Strategy is to inform the development of the revised City of Canada Bay Local Environment Plan and to present Council's vision, priorities and actions to managing the urban forest. The Strategy has been developed through a combination of technical analyses, review of statutory planning documents and community and key stakeholder engagement.

The planning context has been considered and incorporated into this Strategy and has informed the development of the priorities and implementation mechanisms. Key statutory planning documents and considerations include:

- The Greater Sydney Region Plan;
- Eastern City District Plan;
- Canada Bay Local Environmental Plans and Development Control Plans; and.
- State environmental planning policies.

Collectively these statutory planning documents provide a strong and clear direction to support investment in the urban forest, requiring an increase in urban tree canopy cover and providing mechanisms to protect existing tree canopy cover.

Aligning with community values

Council's vision for the City of Canada Bay and the supporting themes as identified in the Community Strategic Plan, can all be contributed to by the urban forest. For example:

- Theme 1: Inclusive, involved, prosperous - The urban forest contributes to creating a strong sense of place and through cooling benefits and visual aesthetics helps create local town centres that are vibrant and prosperous.

- Theme 2: Environmentally responsible - The urban forest plays a pivotal role in supporting environmental values, such as cleaning and managing stormwater, and more broadly, in biodiversity conservation.

- Theme 3: Easy to get around - Cooler and more aesthetically pleasing treed streets encourage more people to use and access public transport options and cycle or walk to work or for leisure.

- Theme 4: Engaged and future focussed - The urban forest provides a key natural asset located in areas of open space and encourages greater local amenity and places for community interaction.

- Theme 5: Visionary, smart and accountable - The urban forest helps create a more resilient and sustainable city through a range of benefits including cooling, generating oxygen, improving air and water quality, and contributing to mitigating climate change risk.

Based on the community and key stakeholder engagement undertaken as part of this project, trees were valued as:

- providing shade and cooling;
- providing a liveable space that is enjoyable and comfortable to be in;
- providing amenity, with trees being vital for the visual aspect of a place; and
- sustaining biodiversity by protecting and enhancing ecosystems and life.

Furthermore, a large majority of residents were in favour of more street trees in their local centre and on residential streets.

While trees are valued, there is also importance placed on ensuring that a range of potential challenges are managed. These include:

- protecting harbour views;
- managing nuisance issues associated with flowering, fruiting and growth habit; and
- addressing risk management concerns regarding the impact of roots and footpaths and loss of branches

The City of Canada Bay's urban forest

Features of the urban forest were analysed using three approaches, which aimed to establish land cover including tree canopy cover, the value of ecosystem services (i.e. the economic benefit provided by trees), and priority planting areas.

The City of Canada Bay's urban forest covers over 18% of the Council area, including public and private land, with the remaining land area being predominantly buildings and roads (55%). This is followed by land that could be planted with trees called "plantable space" (e.g. bare ground and grass) and a small area of unplantable space, such as open water and sporting fields.

Just over 80% of the Council area is privately owned and managed meaning that most land cover types are on private land. For example, nearly 8% of canopy cover is on public land whereas 10% of canopy cover is on private land. In contrast, 41% of impervious surfaces (e.g. buildings and roads) are on private land compared to 15% on public land.

Canada Bay's canopy cover is just below the 19% average cover across neighbouring Councils, and similar to the 18% average canopy cover across Council areas comprising the Eastern Harbour City region. However, it is lower than the average for all Sydney metropolitan Council areas of 27.5%.

Within the City of Canada Bay, the highest canopy cover was recorded in the section of Sydney Olympic Park within Council and Liberty Grove. In contrast the lowest canopy cover is in Breakfast Point and Wareemba.

As part of the development of this Strategy, extensive work was undertaken to better understand the economic value of parts of the urban forest. For the 818 street trees assessed, which represent about 5% of the City's street tree population, the structural (replacement) value was estimated at $5,848,998, while the carbon stored was 993 tonnes which is valued at $22,641. If this is extrapolated across the City's estimated street tree population, the street trees are estimated to have a structural (replacement) value of more than $181.5 million and store over 31,000 tonnes of carbon. There is also significant value in the City's parks. For example, an assessment of the value of trees in Queen Elizabeth Park suggests a structural (replacement) value of more than $3.6 million.

Future planting priorities were identified based on an integration of land cover analyses and thermal heat mapping assessments for each suburb. Specifically, priority planting areas were identified as areas where potential plantable space coincides with local hot spots where surface temperatures are greater than the Council wide average. The intersection with the Sydney Green Grid was also considered.

Based on an understanding of the location of urban heat islands and current canopy cover, priority suburbs Breakfast Point, Concord, Concord West, and North Strathfield. More specific recommendations relating to the Green Grid and at the street scale are described further in this Strategy.

Issues and challenges

As population continues to increase, so too do the demands for space from often competing land uses. In many cases, the trend has been for trees to be priorities lower than other land uses such as development. This pattern of land use change from "green" to "grey" has created a legacy of increasingly hot and less desirable places to live and work, commonly known as the urban heat island effect. Creating resilient and liveable cities and towns will require green and grey infrastructure to be better integrated and complementary in nature.

To achieve this, particularly with regard to trees, requires an understanding of the key issues and challenges present in an area.

For the City of Canada Bay, the 8 key issues and challenges faced in elevating trees as a priority component of urban areas are:

- population increase and urban intensification;
- climate change;
- urban heat islands
- community perceptions and conflicts;
- water availability;
- maintaining diversity and resilience in the urban forest;
- biodiversity; and
- open space management.

Management of these issues, or consideration of the impact they have on the condition of the urban forest, needs to be considered in prioritising actions for implementation.

Vision, targets, priorities and actions

The City of Canada Bay will:

Grow and protect a resilient and diverse urban forest that characterises our City as a cool, tranquil, and connected place to live, work and visit.

Our urban forest will be a highly valued urban asset that will managed collaboratively and strengthen the liveability of our City through supporting the health and well-being of our community, our native biodiversity, and our environment.

This vision will be underpinned by the principle of “right tree, right place”.

The City of Canada Bay will increase its tree canopy cover across the City to at least 25% by 2040, an increase of over 6%.The increase in canopy cover will occur primarily in streets and parks on public land and by working with private land holders.

This increase aligns with the recommendations of the Government Architect New South Wales for urban residential council areas with medium to high-density development and will contribute to the Greater Sydney Commission’s 40% canopy cover target across metropolitan Sydney by 2036.

This Strategy presents priorities and actions for a 10-year period. Short term actions will be prioritised for delivery within 1-3 years, mid-term actions for delivery within 3-5 years and long-term actions within 6-10 years. The Strategy will be subject to a mid-term review after 5 years and full review after 10 years.

The priority action themes to deliver this increase in canopy are:

- **Protect and value** - Ensure that tree management policies and programs help to protect the urban forest by increasing the retention of existing trees on public and private land.

- **Renew and grow** - Objective: Ensure that tree planting programs strategically plan for increasing the total canopy cover across council.

- **Support and sustain** - Manage the health and condition of urban trees to minimise risk and support and sustain a healthy, growing urban forest.

- **Engage and create** - Work with the community and key stakeholder groups to enhance the urban forest for amenity, liveability, and biodiversity benefits and provide opportunities for collaboration.

- **Manage and resource** - Reduce conflicts between people, infrastructure and trees and ensure adequate funding is available to support urban forest growth and management.

Priority actions are identified in the Strategy for each theme.

This Strategy represents a shift in focus from a traditional to a modern approach to urban forest management, the key features of which are summarised below.

Traditional urban forest management	**Modern urban forestry approach**
Trees as ornaments	Trees viewed as critical infrastructure
Focus on individual tees	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
Focus on smaller and ornamental trees	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 versus modern urban forest management approach. Based on North Sydney Council (2011).[1]

[1] North Sydney Council (2011). North Sydney Council Urban Forest Strategy. https://www.northsydney.nsw.gov.au/files/assets/public/docs/4_waste_environment/urbanforeststrategy_2011.pdf.

Implementation framework

The implementation framework addresses governance, monitoring and evaluation, and resourcing. Within the City of Canada Bay, the governance arrangements supporting this Strategy should seek to include:

- intra-council integration, particularly between the planning, sustainability, and parks and garden teams to recognise and elevate trees as critical urban assets;
- inter-council collaboration, particularly with other councils within the Eastern District, to promote consistent, cross-jurisdictional approaches to urban forest planning and management;
- community and business educational programs; and
- provision of support and incentives to encourage additional tree protection and planting.

Developing a monitoring and evaluation plan (MEP) will be essential in determining the success, or otherwise of actions in achieving targets. Based on current global best practice, key elements of the MEP framework should include:

- Target: Targets have been developed to be SMART (Specific, Measurable, Agreed-upon, Realistic, Time-based). Targets for this Strategy are shown in Section 7.2;
- Baseline: The baseline measurement provides a benchmark for assessing progress towards achieving the Target. In the future these may be derived from State Government spatial dataset sources and baseline outputs provided in Sections 5 and 6;
- Action: activities proposed to achieve the desired Target. Actions for this Strategy are shown in Section 7.3. Some actions may apply to multiple targets.
- Indicator: Indicators, or KPIs. may be qualitative or quantitative variables but must be able to be measured or described and when observed periodically, must be able to demonstrate trends in urban forest characteristics over time.
- Data collection method: This may include refined/detailed application of methods applied herein or may draw on State Government spatial datasets.

The City of Canada Bay recognises that meeting the vision and targets outlined in this Strategy will require sufficient resourcing, including a long-term funding commitment. Resourcing opportunities are explored in this Strategy, including State government grants, developer contributions and the role of the community in providing volunteer resources.

1 Introduction

1.1 Background

The City of Canada Bay is located on the Parramatta River in the Inner West of Sydney. The local government area (LGA) is located north of Parramatta Road and is approximately six kilometres west of the Sydney Central Business District. The LGA is approximately 20 square kilometres in area with a population of more than 92,000 residents.

The LGA has approximately 38 kilometres of foreshore along the Parramatta River and its structure is strongly influenced by both the underlying topography and the relationship with the river.

The City of Canada Bay contains large expanses of public open space including over 150 parks and reserves. This includes a mix of remnant bushland with stands of Sydney Turpentine and Ironbark Forests, active sporting fields and passive recreation areas. These natural assets are highly valued by the community.

It is now well established that urban trees play a critical role in creating healthy cities; they provide shelter, improve air quality, absorb carbon and rainfall, cool local environments, and support wildlife. Trees create attractive urban places, providing seasonal variation and creating memorable landmarks. A healthy and well-managed urban tree canopy provides multiple environmental, social, and economic benefits.

While the urban forest is valued, it is also facing a range of challenges. For example, the Council is growing at a significant rate, nearly double the national average. The construction of higher density developments place pressure on green open space and the existing urban forest across both the public and private realm.

In addition to the priority already placed on Council's urban forest, there is renewed focus on urban tree canopy in response to the Greater Sydney Commission's Eastern District Plan which calls for an increase in urban tree canopy cover. This is further supported by the NSW Government Architect, which has proposed tree canopy targets for councils across Greater Sydney.

1.2 Purpose and objectives

The purpose of this Urban Tree Canopy Strategy is to inform the development of the revised Local Environment Plan and to present Council's vision, priorities and actions to managing the urban forest over the coming 20 years.

Specifically, the objectives of the Strategy are to:

- present the vision and objectives for growing and protecting the urban forest;
- identify targets and timeframes for growing the urban tree canopy;

- describe the planning context relevant to managing the urban forest;
- develop a rigorous baseline that can be established to measure progress in canopy growth in the LGA;
- identify specific actions and implementation mechanisms for growing and protecting the urban forest and related resource implications, including priority planting areas as well as approaches to engaging with the community; and
- describe the ongoing monitoring and review arrangements to assess the effectiveness of proposed actions at meeting the objectives of the Strategy.

1.3 How the Strategy was developed

The Strategy has been developed through a combination of technical analyses, review of statutory planning documents and community and key stakeholder engagement. Specifically, this involved:

- Technical analysis
    - Assessment of the urban tree canopy cover and plantable space;
    - Valuation of ecosystem services provided by trees;
    - Urban heat island analysis;

- Planning review
    - Review of the planning context as outlined in key documents such as the Sydney Region Plan and Eastern District Plan;

- Engagement
    - Interviews and workshops with key stakeholders such as Bushcare groups, neighbouring councils, state agency staff, sporting groups;
    - Community engagement feedback; and
    - Feedback from Elected members and selected staff from within Council.

2 Planning context

To inform this Strategy, a review of the planning context was undertaken to understand how it informs the requirements for urban tree canopy in Canada Bay. The planning context has been considered and incorporated into this Strategy and has informed the development of the priorities and implementation mechanisms. The following sections provide a summary of key planning documents.

The Greater Sydney Region Plan: A Metropolis of Three Cities

The Greater Sydney Commission is leading metropolitan planning to make Greater Sydney more productive, sustainable and liveable. The Greater Sydney Region Plan is the guiding planning document for metropolitan Sydney, establishing a vision for a metropolis of three cities comprising the Eastern Harbour City, the Central River City and Western Parkland City. The Greater Sydney Region Plan is structured around 10 key directions, grouped into four themes, of which "liveability" and "sustainability" are most relevant to this Strategy.

The role and importance of urban tree canopy in contributing to sustainability is expressly identified under Objective 30 which seeks to increase urban tree canopy across Greater Sydney, with a specific tree canopy cover target of 40% by 2036.

More broadly, trees are recognised as key assets that contribute to promoting great places for people to live and work. Environmental values and assets are recognised as key contributors to liveable communities across Greater Sydney. Other key sustainability objectives related to urban tree canopy within the Plan seek to:

- protect scenic and cultural landscapes;
- protect and enhance environmental and social values;
- enhance and protect public open space;
- enhance the Green Grid linkages to parks, open spaces, bushland and walking/cycling paths;
- promote a low-carbon city and mitigate the impacts of climate change; and
- manage heatwaves and extreme heat.

Eastern City District Plan

The Eastern City District Plan ('The District Plan') sets out key planning priorities which seek to protect and enhance urban tree coverage. Key objectives include:

- protect and improve the health and enjoyment of Sydney Harbour and the District's waterways (E14);
- protect and enhance bushland and biodiversity (E15);
- protect and enhance scenic and cultural landscapes (E16);
- deliver high quality open space (E18); and
- increase urban tree canopy cover and deliver Green Grid Connections (E17).

The District Plan promotes a holistic approach to sustainability by also recognising the important role natural landscape features play in both contributing to environmental values, reducing impacts of natural hazards and cooling urban environments. It also notes that trees play an important role in reducing carbon emissions and reducing the impact of natural hazards and climate change.

The District Plan refers to the NSW Government's Green Infrastructure Plan 'Greener Places', acknowledging the role of trees in providing important ecological contributions to urban environments. It defines the urban tree canopy as a combination of street trees, urban bushland and tree coverage on private land.

Planning Priority E17

Planning Priority E17 seeks to increase urban tree canopy cover and deliver Green Grid Connections'. It has the following supporting objectives:

- Urban tree canopy cover is increased (Objective 30);
- The Green Grid links parks, open spaces, bushland and walking and cycling paths (Objective 32);

As Canada Bay urbanises and continues to grow, a focus on connecting and enhancing the Greater Sydney Green Grid has been identified as a long-term vision and priority. The Green Grid is a key initiative that underpins both the Regional and District Plans and promotes a network of high-quality green spaces that connects people across Greater Sydney (Figure 1). The provision of green infrastructure is expected to be transformative and lead to many environmental, social and sustainability outcomes with the direct linkage between liveability, quality of life and supporting green infrastructure is strongly stated in the Plan.

The Green Grid projects identified for the City of Canada Bay LGA are:

- **Powells Creek and Mason Park, Strathfield -** Providing walking and cycling links, urban greening, stormwater treatment and a mix of open space uses that link Concord West, North Strathfield, Homebush and Strathfield to Parramatta Road, Bicentennial Park and the Parramatta River foreshore;

- **Rhodes and Concord Open Space and Hospital Precincts -** Connecting the Parramatta River foreshore open spaces from Rhodes and Concord including Brays Bay Reserve, the Kokoda Track Memorial Walkway, Rocky Point, the Thomas Walker Hospital grounds, Concord Hospital grounds and river foreshores, the Dame Edith Walker Hospital grounds, Concord Golf Course and Concord RSL lands. This will make better use of under-utilised open space around the hospitals and community facilities and create a connected walking and cycling trail along the river foreshores;

- **Hen and Chicken Bay Foreshore -** Hen and Chicken Bay will be connected to the Bay Walk, providing more opportunities for walking and cycling. This project also provides opportunities for enhanced connections to Burwood via Burwood Road, St Luke's Park and Queen Elizabeth Park.

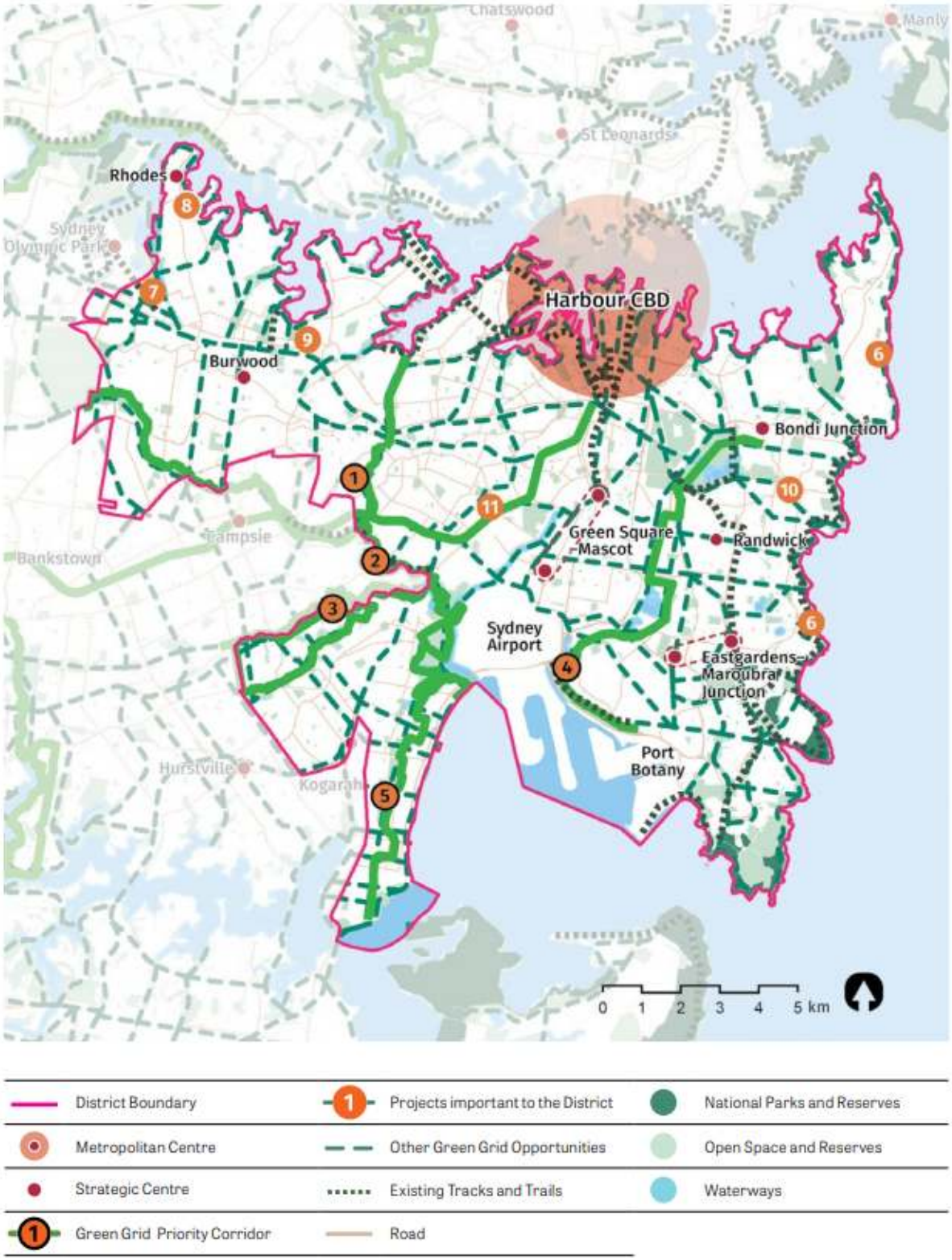

Figure 1. The Eastern City Green Grid.

There is a strong emphasis and recognition of the role of trees in urban environments within the Regional and District Plans, with specific policy directions related to increasing urban tree canopy, protecting and enhancing the provision of trees and reducing the impacts of climate change by using trees to mitigate against the heat. Both the Regional and District Plans state that trees contribute to liveability and sustainability objectives and outcomes and are important contributors to neighbourhood character and natural ecosystems and minimise the impact of the urban heat island effect.

Canada Bay Local Environmental Plans and Development Control Plans

The Canada Bay Local Environmental Plan 2013 (CLEP) is the key legislative document that regulates land use planning and development across the municipality. The CLEP contains broad objectives to protect and enhance environmental values such as character, amenity and ecological systems.

The Canada Bay Development Control Plan (DCP) provides specific design guidance relating to landscaping, vegetation and tree removal/pruning. These controls relate primarily to the private domain. Some site specific DCPs include concept plans that require the provision of trees and landscaping within the public realm.

State Environmental Planning Policies

At a State level, State Environmental Planning Policies (SEPP) set out statutory controls which must be considered in conjunction with other environmental planning instruments such as SEPP No. 19 Bushland in Urban Areas and SEPP Vegetation in Non Rural Areas. These SEPPs adopt a precautionary role in regulating land use and development within environmental and natural systems. While they do not expressly promote urban tree canopy, they do provide broad policy direction to preserve trees for their environmental functions and values.

3 Aligning with community values

3.1 Community Strategic Plan

Council has a strong vision for the City of Canada Bay, with its Community Strategic Plan outlining five themes to guide how the outcomes will be achieved. The urban forest can contribute to a number of these themes. For example:

Theme 1: Inclusive, involved, prosperous
Vision: Our diverse community enjoys a range of inclusive and accessible social, recreational and cultural opportunities and is actively involved in the life of our City. People have a sense of belonging, share strong relationships in friendly neighbourhoods and our local town centres are vibrant and prosperous.

The urban forest contributes to creating a strong sense of place and through cooling benefits and visual aesthetics helps create local town centres that are vibrant and prosperous. In particular, the urban forest is central to creating a healthy, liveable, thriving, and desirable place to live and work.

Theme 2: Environmentally responsible
Vision: Our community shares a collective responsibility to protect our environment and actively participates in innovative programs to mitigate climate change. These programs, along with our well cared for and cherished, active and passive open spaces and waterways, are sustaining our future.

The urban forest plays a pivotal role in supporting environmental values. It provides heat mitigation benefits that will become increasingly important under climate change and it can assist with climate change mitigation through storing carbon and reducing carbon emissions through shading of homes resulting in a lower demand for heating and cooling services. The urban forest also plays a key role in cleaning and managing stormwater, and more broadly, in biodiversity conservation. The City's urban forest contains systems of conservation significance and provides much of the key habitat and resources required by a range of native wildlife.

Theme 3: Easy to get around
Vision: It is easy to get around our City and wider Sydney region via a network of well-functioning and connected public transport, pathways and roads.

Increased use of public transport is a key initiative in Sydney for the future, especially in inner city suburbs such as those in the City of Canada Bay. Cooler and more aesthetically pleasing treed streets encourage more people to use and access public transport options and cycle or walk to work or for leisure. The Parramatta Ways project in a neighbouring

Council area represents an exemplar project that integrates movement (specifically walking and cycling and connections to public transport) and urban tree canopy and could serve as a model for project applications in the City of Canada Bay.

Theme 4: Engaged and future focussed
Vision: With our population continuing to grow, our community is engaged in planning for our future. The planning results in services that support our enviable lifestyle, quality open spaces, a range of housing types, commercial centres and infrastructure and developments that enhance and complement existing suburbs.

The urban forest provides a key natural asset located in areas of open space and is known to encourage greater local amenity and places for community interaction. Future planning and development must adopt novel and leading practices that aim to increase canopy cover amid development, including retaining existing trees as a priority.

Theme 5: Visionary, smart and accountable
Vision: Our City has strong leadership and is served by an effective and transparent local government. Smart processes and systems support both Council and the community to be more resilient, sustainable and efficient, connect easily, share knowledge, work together and be creative in finding solutions.

The urban forest helps create a more resilient and sustainable city through a range of benefits including cooling, generating oxygen, improving air and water quality, and contributing to mitigating climate change risk. The City should aim to be a leader in adopting best practice approaches to urban forest planning and management, including appropriate species selection, and elevating the urban forest as a priority community asset.

3.2 Supporting the values of key stakeholders and the broader community

Key stakeholders and the broader community provided input through a range of engagement activities, including workshops, interviews and a survey. This included discussions with Bushcare groups, sporting clubs, Sydney South Area Health District and Sydney Olympic Park Authority.
Based on this engagement, it is understood that high value is placed on the urban forest because of its role in:

- providing a liveable space that is enjoyable and comfortable to be in;
- providing shade and cooling;
- amenity, with trees being vital for the visual aspect of a place; and
- sustaining biodiversity by protecting and enhancing ecosystems and life.

While trees are valued, there is also importance placed on ensuring that a range of potential challenges are managed. These include:

- protecting harbour views;
- managing nuisance issues associated with flowering, fruiting and growth habit; and
- addressing risk management concerns regarding the impact of roots and footpaths and loss of branches

There is recognition that many of these challenges can be addressed through the selection of the “right tree” for a given location based on characteristics such as species, future height and flowering, fruiting and growth habit. Working with the key stakeholders and the community will be an important part of implementing the actions and implementation mechanisms in this Strategy.

Further to the community stakeholder engagement undertaken by Seed Consulting Services, broader community engagement was undertaken by Place Design Group. Based on this engagement process, a key message is that trees, particularly public trees on streets and in parks, are highly valued by the community. Specific findings relating to trees and the urban forest were:

- 75% of respondents would like more street trees in their local centre and neighbourhood;
- 44% of respondents believe more shady trees would assist with access to local centres;
- 62% and 61% of respondents believed more shady trees would encourage them to walk more in their local area, and visit other foreshore sites, respectively;
- 78% - 84% of respondents would like more trees in neighbourhood parks, on major roads, and local centres and shopping strips; and
- 64% of respondents would also support more trees on their own residential street, though only 30% would like more trees on their own property.

The City of Canada Bay has also previously worked with Macquarie University to undertake surveys with the community to understand how the community values and views the urban forest. Respondents of these surveys ranged from 19-25 years of age to over 66 years old, with most falling in the 26-35 and 36-45 age range (21% each), indicative of parents of young families and young working professional. The key findings from this study reinforce the community findings and messages from this project. Key findings from the study were:

- 73% of respondents identified improved air quality as a key benefit provided by trees and more than half recognised trees as providing benefits for biodiversity, aesthetics, and usability of parks and public places;

- 77%-94% of respondents rated street and park trees in their own neighbourhoods as fair to very good, with respect to shade provided, species diversity, aesthetics, abundance, and safety; and

- most respondents thought Council should plant or encourage tree plantings in neighbourhoods currently lacking trees (75% of respondents), followed by new developments (68%), in parks and reserves (64%), and along public streets (61%).

4 Why the urban forest matters?

The City of Canada Bay's urban forest includes all the trees growing within the city boundary, whether on public or private land. Our urban forest provides a wide range of benefits each day which significantly improve our urban environment and quality of life. Some benefits are readily observed and understood, such as providing shade, wildlife habitat, and an aesthetically pleasing contrast to the built urban infrastructure.

The benefits that trees provide extend well beyond these popular understandings, spanning a large range of environmental, social, and economic benefits, many of which are interrelated. The multiple benefits provided by trees make them an increasingly important component of our City, and a critical urban asset for ensuring the long-term sustainability, resilience, and liveability of Canada Bay.

The following sections describe some of the key beneficial services provided by our trees. For further details, refer to the suggested further reading list at the end of this Strategy.

4.1 Environmental benefits

Decrease urban heat – trees provide one of the best ways to cool cities, through a combination of direct shading together with evapotranspiration (i.e. cooling as wind moves across tree leaves), this also provides increased resilience to climate change related temperature increases;

Reduce climate change impacts – trees help mitigate climate change capturing atmospheric carbon dioxide (a primary greenhouse gas) and also by reducing greenhouse gas emissions through shading buildings which reduces energy demands and subsequent demands on greenhouse gas emitting electricity supplies;

Improves air quality – trees absorb gaseous pollutants (carbon dioxide, nitrogen oxide, sulphur dioxide) and capture airborne particulate matter on their leaves resulting in cleaner air where trees occur.

Provide wildlife habitat and resources – trees provide shelter, hollows, nesting sites, refuge opportunities, flowers/nectar, fruit, and insects for a range of native wildlife species. The provision of such habitat and resources in urban areas are increasingly important as wildlife habitats continue to be cleared. Trees and associated other vegetation can also provide critical movement corridors for wildlife through the built urban landscape, if they are designed and managed appropriately for specific species.

Reduce and improve stormwater runoff – trees intercept rainfall with their leaves and branches which helps to refill aquifers and reduces runoff that would otherwise flow into the drainage system. This rainfall interception also helps to filter and slow runoff into our rivers and bays, which improves overall water quality.

4.2 Social benefits

Longer and healthier lives – trees help to decrease heat-related deaths, alleviate respiratory system and cardiovascular related deaths, decreased sun (UV) exposure, improve immune system functioning, and encourage increased physical exercise which helps improve sleep quality.

Improved mental health and well-being – being around urban trees can act as a natural antidepressant, with people able to spend time in treed green spaces generally feeling happier, having reduced stress and anxiety, improved mental well-being, and enhanced productivity. Access to treed streets and open spaces also encourages people to spend time in public open spaces, which increases community connectedness.

Creates a sense of place – the visual amenity of trees and associated landscaping can enhance the public realm and provide important historical and spiritual connections. Further, communities encouraged to help plant and care for public trees builds neighbourhood pride, fosters social connections, and promotes beneficial relationships.

Improved youth development and health – children able to play in trees and forest-like environments have improved motor-skills, focus, social confidence, and problem-solving skills. Nature play in treed green spaces has also been shown to reduce the incidence and severity of ADHD.

Shorter hospital stays – hospital patients able to view trees and green spaces from their hospital bed have been found to have increased recovery rates and pain thresholds.

Connect people to nature – “biophilia” has been shown to be important for many aspects of human health and well-being, as well as being essential for building people’s affinity for nature and natural elements. A lack of nature connections leads to a cycle of disaffection toward nature, making it increasingly difficult to gain community support for greening actions on public and private land.

Reduced crime and violence – increased trees and greenery in residential streets and suburbs have been linked to decreased rates of neighbourhood crime, vandalism, littering, and domestic violence.

4.3 Economic benefits

Reduced heating and cooling costs – for buildings shaded and buffered from wind.

Decreased infrastructure costs – trees reduce the need expensive stormwater management infrastructure, and shading from trees can extend lifetimes of road and footpath surfaces thereby reducing maintenance costs.

Increased property values – studies have shown that people are willing to pay more for houses on leafy, tree-lined streets.

Improved commercial activity – treed shopping precincts encourage people to stay longer and increase the willingness for people to pay more for goods.

5 The City of Canada Bay's urban forest

5.1 Analysis approaches

Land cover trends were analysed using the i-Tree Canopy[2] software tool which allows a user to classify land cover amounts within a user-defined area overlaid on Google Earth imagery. Land cover classes and their definitions, as used for this assessment, are shown in Table 1. Each suburb was assessed using 384 randomly sampled points, equating to 6,912 points assessed for the entire LGA. This provides for a minimum 95% confidence level and 5% confidence interval for the outputs of this assessment.

Ecosystem services and economic benefits provided by trees comprising the urban forest were investigated by applying an i-Tree Eco[1] assessment to a selection of trees in the City. For this assessment, trees were selected for a detailed assessment in two streets and a public park, and a rapid assessment on a subset of street trees from 15 suburbs (Section 5.3).

Future planting priorities were identified based on an integration of land cover analyses and thermal heat mapping assessments for each suburb. Specifically, priority planting areas are identified as areas where potential plantable space coincides with local hot spots. The intersection with the Sydney Green Grid was also considered.

[2] https:/www./itreetools.org/

Table 2. Land cover class categories used for the i-Tree Canopy analysis.

Cover class categories	Code	Description
Impervious - building	IB	A permanent built structure (e.g. house, carport, shed). Residential, commercial, industrial, public or any other.
Impervious - other	IO	Impervious surfaces not included in building and road cover classes. Includes footpaths, driveways, car parks (including gravel car parks), sports courts, swimming pools, fences, water features, and perceived temporary structures (e.g. shade sails).
Impervious - road	IR	A sealed road, highway, service lane, and airport runways. Does not include unsealed roads.
Tree canopy	TC	Obvious tree canopy. Includes mangroves, native forest, plantation, park trees. Does not include dead trees.
Plantable - bare ground	PBG	Non-vegetated pervious surface with tree planting potential. Includes areas of erosion. Excludes bare ground between agricultural plantings.
Plantable - grass	PG	Grassed areas with tree planting potential. Includes public parks, private lawns and areas beside active portion of sporting fields, as well as non-tree plants (e.g. shrubs and short hedges), pasture, grasslands. Excludes fringing aquatic vegetation.
Unplantable - bare ground	UBG	Non-vegetated, non plantable pervious surfaces. Includes railway lines, light rail, mudflats, earthworks, cliffs, extractive industries (quarries), sand traps in golf courses, unsealed tracks/roads/driveways and horse running tracks. Excludes bare ground between agricultural plantings. Includes exposed mudflats and other areas where planting trees is unlikely due to environmental constraints (e.g. saltwater intrusion).
Unplantable - grass	UG	Grassed areas that are not plantable. Includes sporting fields, school ovals, golf fairways, putting greens, power line easements, grassed areas near or forming airport runways, and grass cover associated with extractive industries and ground works.
Unplantable - shrubs	US	Small plants such as shrubs, perennials, hedges, and vine thickets. Includes shrubby dune/mudflats vegetation. Does not include grass, trees, or aquatic vegetation.
Unplantable - beach	UB	Non-vegetated sandy beach areas associated with waterbodies. Includes river beaches, coastal beaches, and man-made beaches.
Unplantable - aquatic vegetation	UV	Vegetation (not trees) growing around wetlands and waterways. Includes fringing or aquatic vegetation (not trees) associated with waterbodies, sedge lands, saltmarsh, and mudflats.
Unplantable - water	UW	Aquatic & marine waterbodies. Includes rivers, creeks, estuaries, canals, lakes, dams, marina, quarry water pits. Excludes man-made pools and fountains/water features.

5.2 City-wide trends

5.2.1 Land cover

The City of Canada Bay's urban forest covers over 18% of the Council area, including public and private land, with the remaining land area being predominantly impervious surfaces (e.g. buildings and roads), followed by potential plantable space, and a small proportion of unplantable space, such as water and sporting fields (Figure 2).

Based on this assessment, to align with the NSW Government Architect's Office Tree Canopy Manual (draft) and the Council's *Your Future 2030* vision, the Council will need to achieve an increase in current canopy to at least 25% by the year 2036. That equates to an increase of approximately 1.35 km^2 of canopy cover, or around 190 rugby union fields' worth. A primary consideration in future planning is where and how this target increase in canopy cover can be achieved.

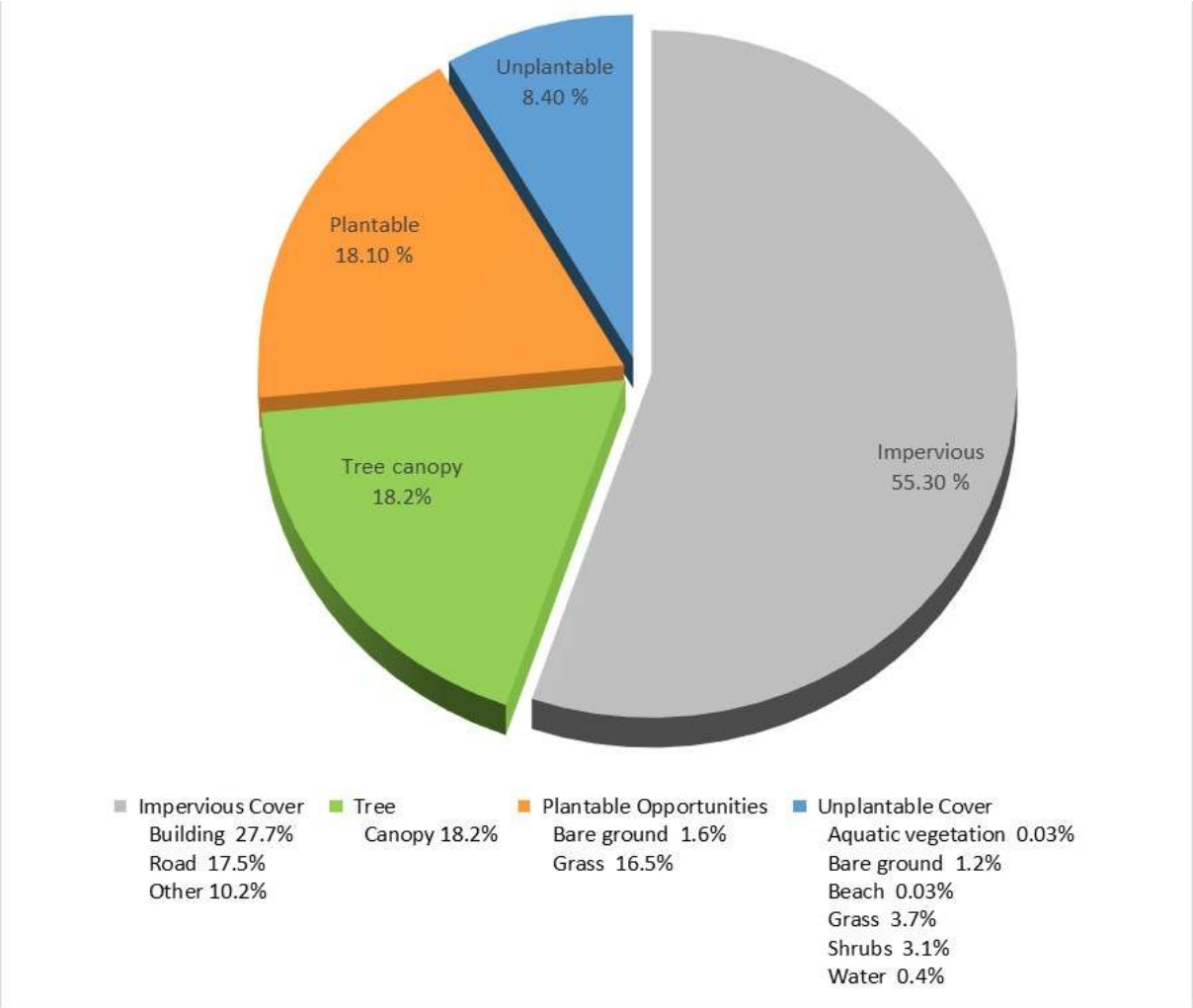

Figure 2. Estimated land cover, including tree canopy cover within the City of Canada Bay.

5.2.2 Land tenure

The ability to protect and grow the urban forest will depend not only on the health and age of existing trees, but also on:

- the proportion of trees currently located on private and public land; with trees on private land often at higher risk of being lost due to urban in-fill development and human/infrastructure conflict; and
- the proportion of potential plantable areas (i.e. potentially plantable with trees) located on private and public land.

Just over 80% of the Council area is privately owned and managed (Figure 3). It is therefore unsurprising that most of Council's impervious, canopy, plantable and unplantable cover types fall within private land (Figure 4).

Figure 3. Land tenure within the City of Canada Bay. Public land (green) covers 17% (0.6 km2) of the land area, and private land (blue) covers 83% (2.95 km2) of the land area.

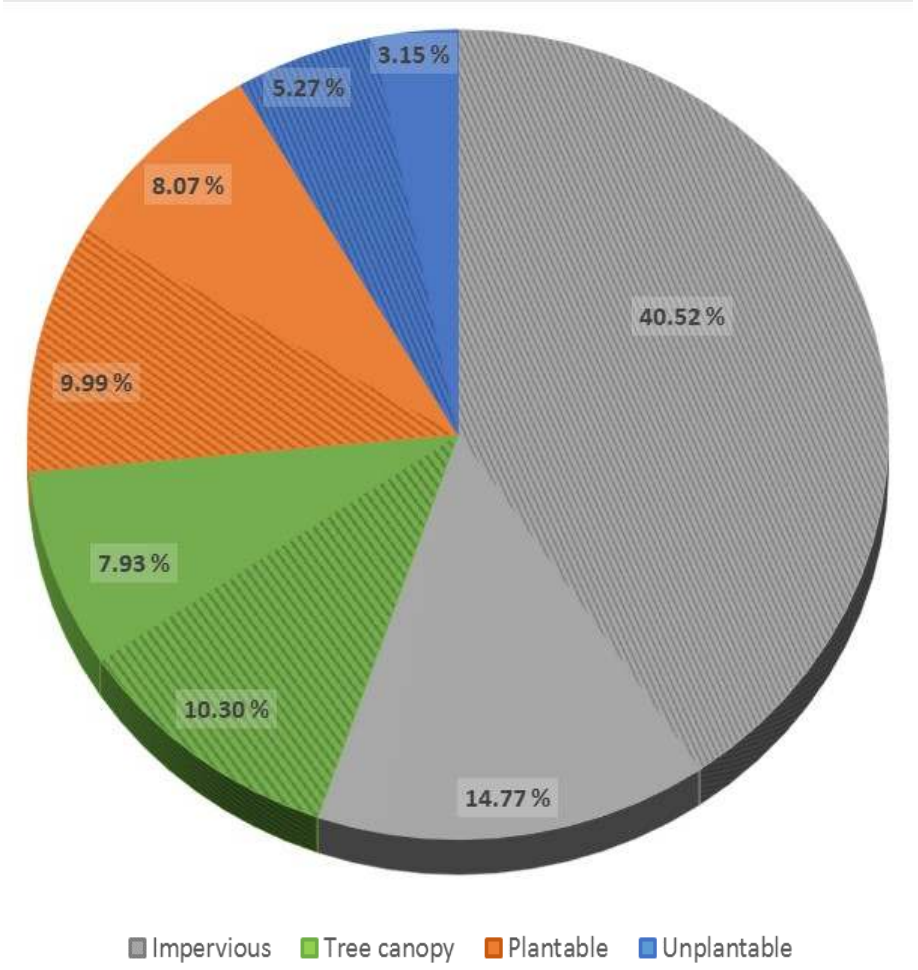

Figure 4. Proportions of each broad land cover type across the Council area falling within public (solid colour) versus private (lined) land.

The compositions of the broad land cover types though can vary between public and private land. Understanding these distinctions may facilitate future planning and provide insights in to drivers of change over time. For example, impervious cover on public land, is dominated by roads, whereas, buildings dominate on private land. Similarly, the unplantable space is primarily comprised of shrubs and bare ground on private land, but grass areas on public land. The relatively high contribution of bare ground to private plantable space generally reflects current active earthworks and development sites. Comparatively, whilst more of the plantable cover occurs on private land, grassy areas are the dominant entity on both public and private land.

The 8.1% of potentially plantable space on public land is equivalent to approximately 1.6 km^2. This amount is adequate to achieve the target canopy cover increase target on public land alone. However, the estimated plantable space is likely an overestimate of realistic plantable space, given on-ground constraints such as infrastructure and utilities that

may prevent planting in certain areas which otherwise appear suitable based on aerial imagery interpretation. Further, loss of existing canopy on private and public land will increase the total amount of canopy gain that is needed to achieve the longer-term targets. Achieving canopy cover targets will likely require a collaborative effort with private landholders, together with innovative solutions, such as roof top plantings and hard surface retrofitting to incorporate trees and permeable surfaces.

5.2.3 Are we greener than our neighbours?

Compared to all Sydney metropolitan local Council areas, Canada Bay's 18.2% canopy cover is lower than average (27.47%), though it should be noted that the metro-wide average includes the heavily treed northern council areas, which will skew the average across metro-councils (Figure 5). By comparison, Canada Bay's canopy cover is lower than the 19.08% average cover across neighbouring Councils, and similar to the 18.1% average canopy cover across Council areas comprising the Eastern Harbour City region.

Figure 5. Estimated percent canopy cover for local Councils in the metro-Sydney area. Councils indicated with the red bracket are immediate neighbours of Canada Bay[3]. Adapted from Jacobs et al. (2014).

[3] Adapted from Jacobs B., Mikhailovich N., Delaney C. (2014) Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment, prepared for Horticulture Australia Limited by the Institute for Sustainable Futures, University of Technology Sydney

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5.3 Suburb trends

With the exception of Sydney Olympic Park, all suburbs (

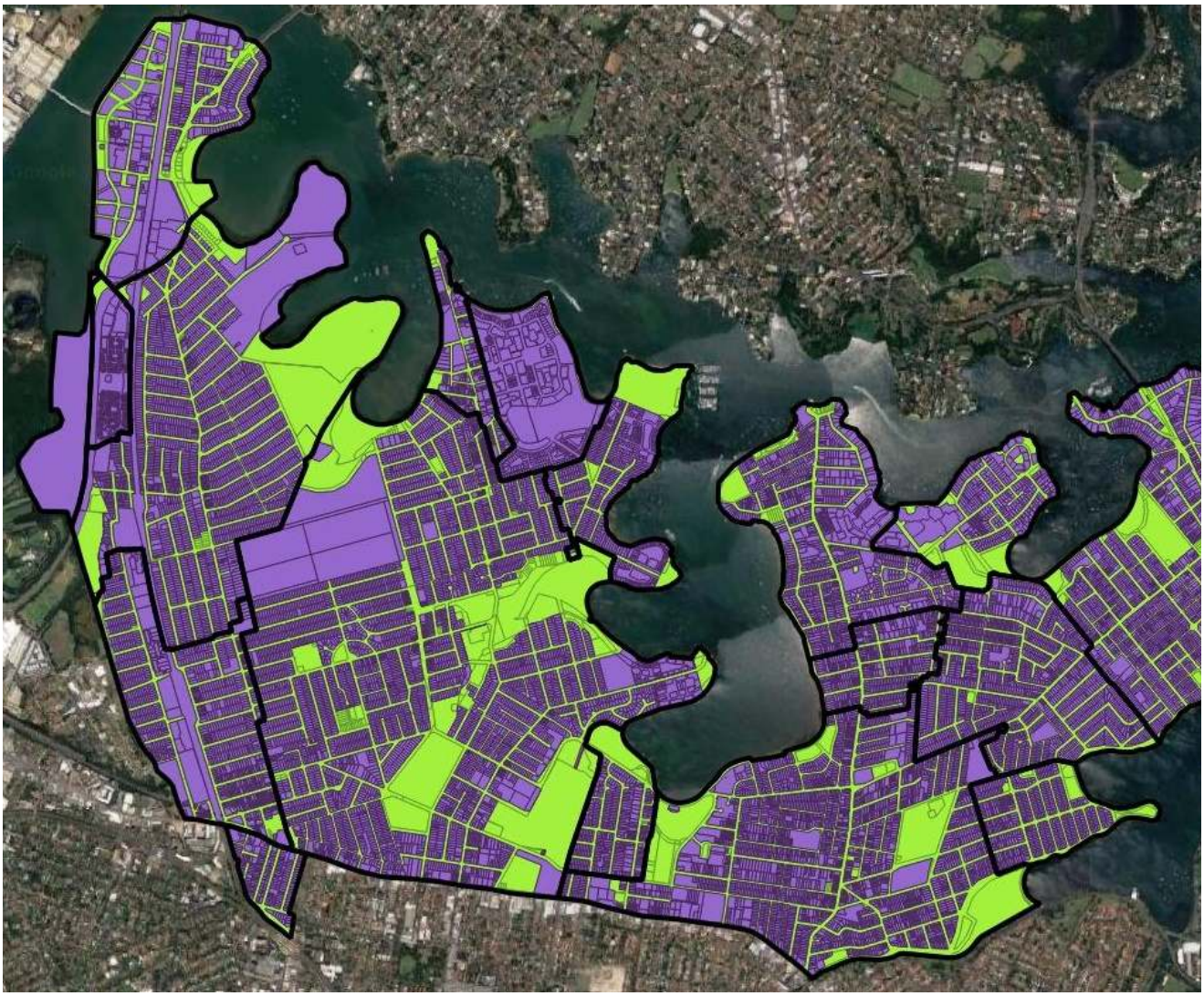


Figure 6) are comprised of between 50% - 60% impervious cover, between 20% - 30% canopy cover, and between 10% - 20% plantable space (Table 2; Figure 7a-d). Sydney Olympic Park is an anomaly as only a small, heavily treed portion of the suburb falls within the Council boundary. Understanding suburb-level nuances in canopy cover and plantable space (Sections 5.3.1 - 5.3.18), as well as change over time in land cover will facilitate prioritisation of actions aimed at growing the urban forest, including planting actions as well as community engagement and incentive actions.

A more detailed breakdown of land cover for each suburb is provided at Attachment A.

Table 3. Percent and area (km2) cover of impervious, tree canopy, plantable space and unplantable space in each suburb.

		IMPERVIOUS		TREE CANOPY		PLANTABLE SPACE		UNPLANTABLE SPACE	
SUBURB	**Area km²**	**% Sub.**	**Area km²**	**% Sub.**	**Area km²**	**% Sub.**	**Area km²**	**% Sub.**	**Area km²**
Abbotsford	1.02	60.94	0.75	16.67	0.20	14.06	0.17	8.33	0.10
Breakfast Point	0.52	49.48	0.31	9.90	0.06	27.60	0.17	13.02	0.08
Cabarita	0.52	53.91	0.34	22.14	0.14	16.67	0.10	7.29	0.05
Canada Bay	0.32	56.25	0.11	16.41	0.03	17.71	0.03	9.64	0.02
Chiswick	0.50	53.65	0.32	12.50	0.07	20.57	0.12	13.28	0.08
Concord	5.05	47.66	2.89	18.23	1.11	21.88	1.33	12.24	0.74
Concord West	2.67	50.52	1.62	21.35	0.68	23.70	0.76	4.43	0.14
Drummoyne	2.26	60.42	1.64	17.71	0.48	15.63	0.42	6.25	0.17
Five Dock	2.45	62.76	1.85	15.63	0.46	13.28	0.39	8.33	0.25
Liberty Grove	0.21	56.77	0.14	33.07	0.08	8.07	0.02	2.08	0.01
Mortlake	0.24	73.44	0.22	11.72	0.03	6.77	0.02	8.07	0.02
North Strathfield	0.97	62.24	0.72	15.10	0.18	14.84	0.17	7.81	0.09
Rhodes	1.00	61.72	0.74	18.23	0.22	12.76	0.15	7.29	0.09
Rodd Point	0.38	61.46	0.28	14.58	0.07	17.71	0.08	6.25	0.03
Russell Lea	1.02	63.02	0.77	14.84	0.18	15.89	0.19	6.25	0.08
Strathfield	0.16	59.38	0.11	22.14	0.04	13.28	0.03	5.21	0.01
Sydney Olympic Park	0.29	4.43	0.02	69.79	0.24	16.67	0.06	9.11	0.03
Wareemba	0.32	73.44	0.29	9.64	0.04	13.28	0.05	3.65	0.01

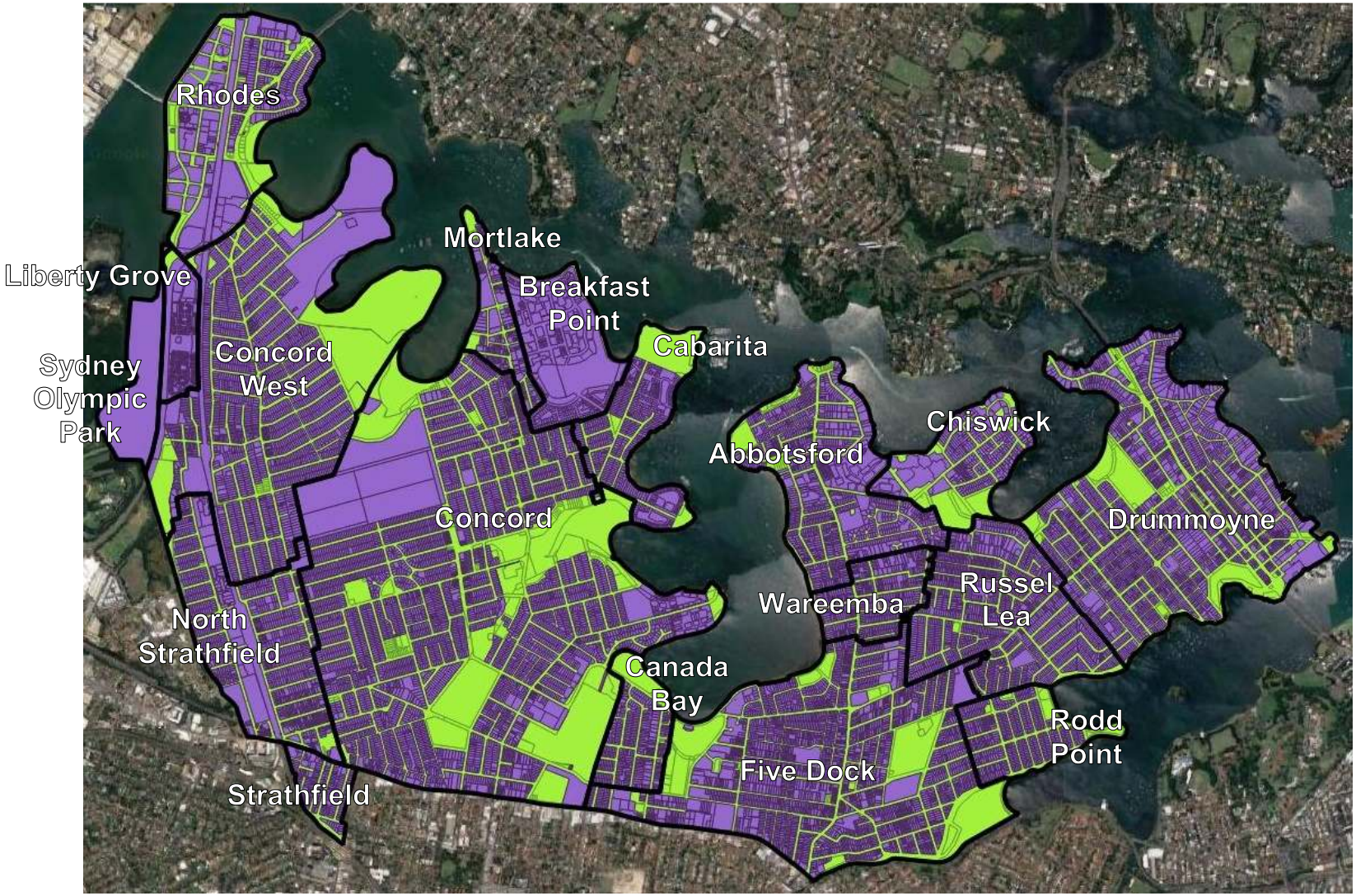


Figure 6. City of Canada Bay showing suburb boundaries (black lines) and private (purple) and public (green) land tenures.

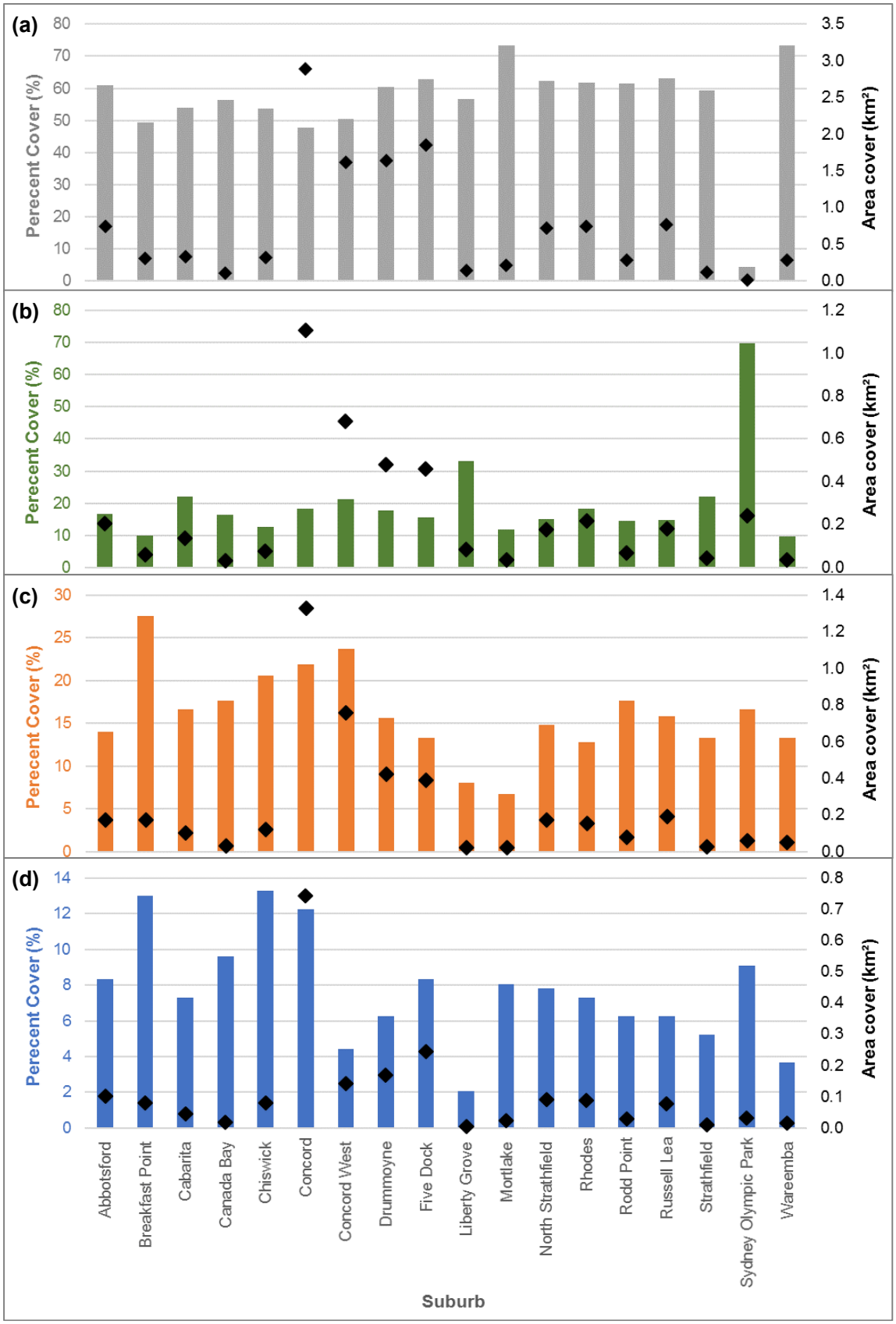
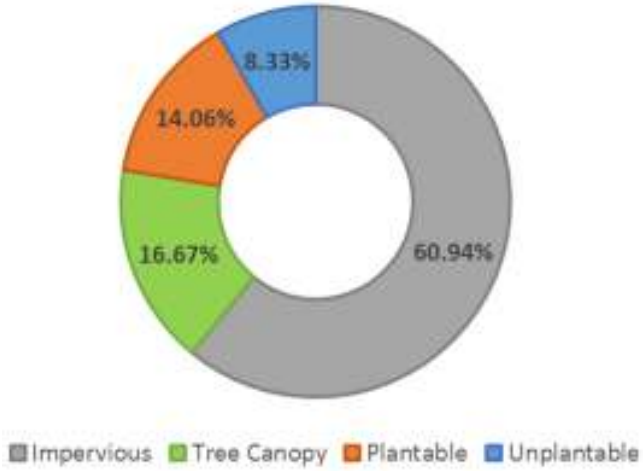


Figure 7. Percent and area (km2) cover of: (a) impervious; (b) tree canopy; (c) plantable space; and (d) unplantable space.

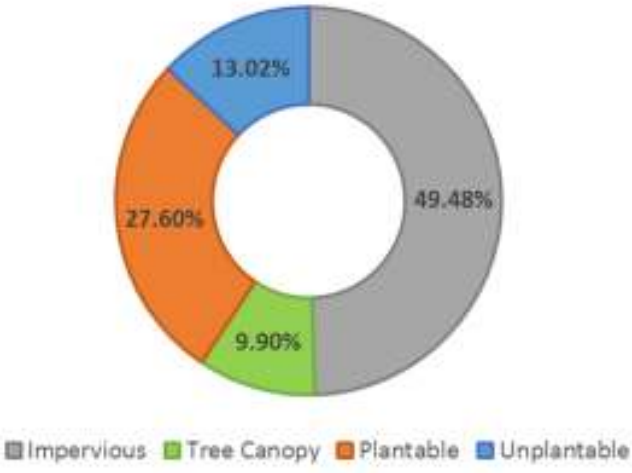
5.3.1 Abbotsford

Abbotsford comprises 5.1% of the Council area, and is dominated by impervious surfaces, followed by tree canopy, plantable space, and unplantable space. Public land in the suburb is comprised primarily of road reserves (9.38%). Compared to all suburbs, Abbotsford has a higher than average proportion of impervious cover (average = 56.19%), with most of this impervious cover falling on private land (47.66%). Less than 20% of the suburb is covered by tree canopy, and at 16.67% cover, is lower than the average tree cover across suburbs (average = 19.98%). Most of this canopy also falls on private land (11.98%), making the suburb highly vulnerable to canopy loss should urban in-fill occur. Approximately 20.5 rugby union fields' worth of potential plantable space occurs in this suburb, though only ~7.5 fields' worth occur on public land.



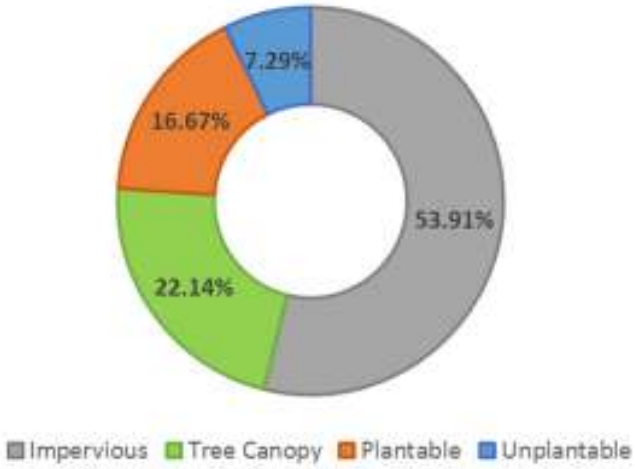
5.3.2 Breakfast Point

Breakfast Point comprises 2.6% of the Council area, and is dominated by impervious surfaces, followed by plantable space, unplantable space and tree canopy. Public land in the suburb is comprised primarily of potential plantable grassy space (2.34%). The small proportion of public land in Breakfast Point presents a challenge for Council increasing canopy cover in this area. The amount of canopy cover is lower than average (average = 19.98%), with the proportion of canopy cover being half as much as the average. Comparatively, Abbotsford contains the highest proportion of plantable cover, though the small size of the suburb means the actual land area of potential plantable space is relatively low (0.14 km^2). In terms of land area, potential plantable space is equivalent to nearly 20.5 rugby union fields, though only ~2.5 fields' worth occur on public land.



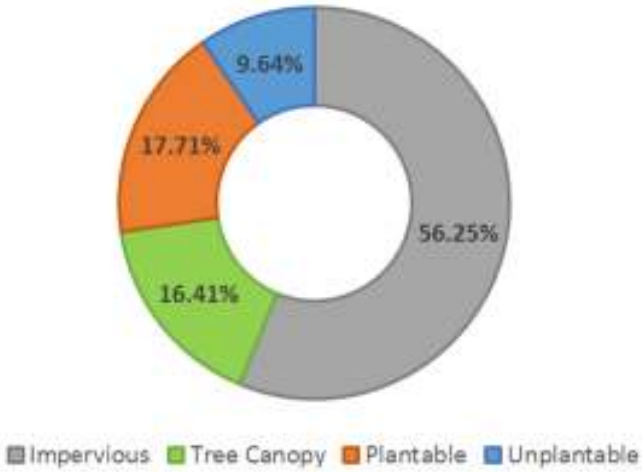
5.3.3 Cabarita

Cabarita comprises 2.6% of the Council area and is dominated by impervious surfaces, followed by tree canopy, plantable space, and unplantable space. Public land in the suburb is comprised primarily of tree canopy (16.15%). Cabarita has a slightly lower than average proportion of impervious cover (average = 56.19%), with most of this falling on private land (40.89%). Comparatively, the suburb's 22.14% canopy cover is slightly higher than average (average = 19.98%). Most of this canopy falls on public land, and at 16.15% is the highest proportion of public land canopy cover across all suburbs. Plantable space cover is nearly equal to the average amount across suburbs (average = 16.13%), though the equivalent land area of 0.09 km^2 (~12.3 rugby union fields) is amongst the lowest in any suburb. Plantable space cover was split relatively evenly between public and private land (9.38% and 7.29%, respectively), though slightly more occurs on public land (~ 7 rugby union fields' worth).



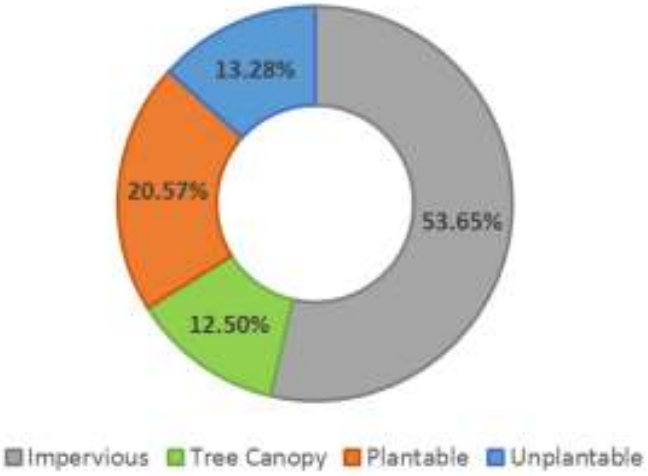
5.3.4 Canada Bay

Canada Bay comprises 1.6% of the Council area and is dominated by impervious surfaces, followed by plantable space, tree canopy, and unplantable space. Public land in the suburb is comprised primarily of road reserves (14.06%). Compared to all suburbs, Canada Bay has a slightly higher than average proportion of impervious cover (average = 56.19%), with most of this impervious cover falling on private land (39.06%). Less than 20% of the suburb is covered by tree canopy, and at 16.41% cover, is lower than the average tree cover across suburbs (average = 19.98%). The canopy cover occurs relatively equally on private and public land (7.81% and 8.59%, respectively), making the suburb vulnerable to canopy loss should urban in-fill occur. Approximately 8 rugby union fields' worth of potential plantable space occurs in this suburb, with most occurring on public land (~4.5 fields' worth).



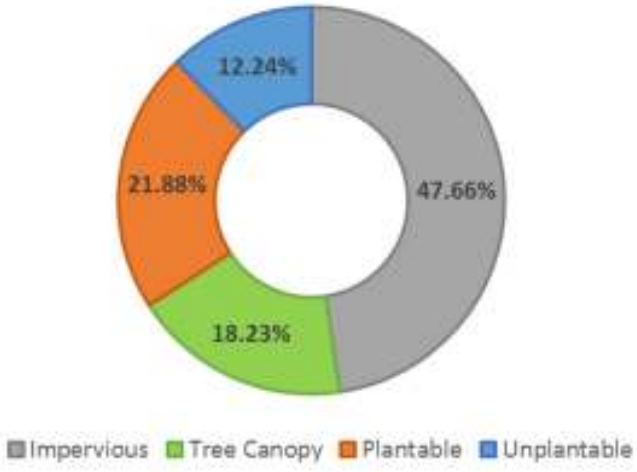
5.3.5 Chiswick

Chiswick comprises approximately 2.5% of the Council area and is dominated by impervious surfaces, plantable space, unplantable space, and tree canopy. Public land in the suburb is comprised primarily of potential grassy plantable areas (13.28%). Chiswick has a lower than average proportion of impervious cover (average = 56.19%), with most of this impervious cover falling on private land (39.84%). Less than 20% of the suburb is covered by tree canopy, and at 12.50% cover, is lower than the average tree cover across suburbs (average = 19.98%). Most of this canopy falls on public land (7.29%). Approximately 14.5 rugby union fields' worth of potential plantable space occurs in this suburb, with most occurring on public land (~10 fields' worth).



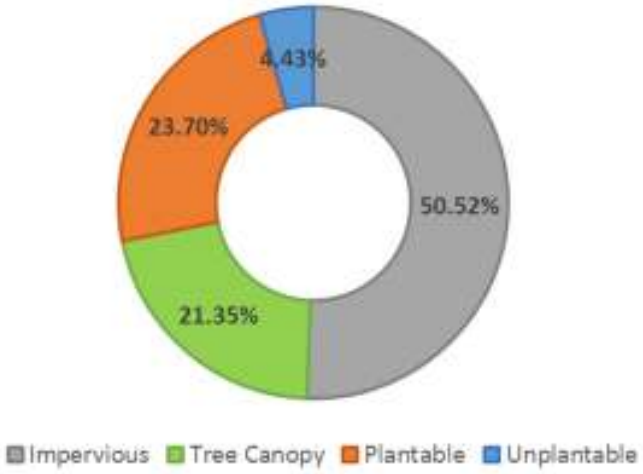
5.3.6 Concord

Concord is the largest suburb, comprising 25% of the Council area and dominated by impervious cover, followed by plantable space, tree canopy, and unplantable space. Percentages of land cover types are consistent with other suburbs, but its large land size means that areas of land cover are substantially greater than other suburbs. Public land in the suburb is comprised primarily of tree canopy (10.68%), followed by plantable grassy areas (10.16%). Relative to the other suburbs, Concord comprises below average proportions of impervious and tree canopy cover (averages = 56.19% and 19.98%), but higher than average plantable and unplantable spaces (averages = 16.13% and 7.70%). Most impervious and unplantable space falls on private land, whilst most tree canopy and plantable space falls on private land. Approximately 158 rugby union fields' worth of plantable space occurs, with most on private land (~86.5 fields' worth).



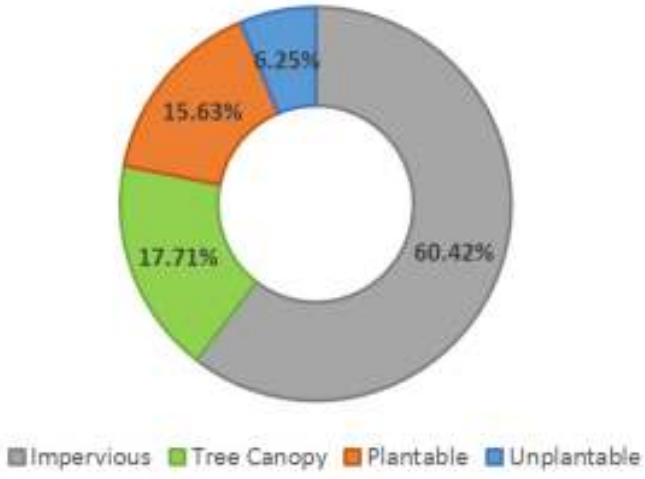
5.3.7 Concord West

Concord West comprises 13.4% of the Council area and is dominated by impervious cover, followed by plantable space, tree canopy, and unplantable space. Public land in the suburb is comprised primarily of road reserves and plantable grassy areas. Compared to all suburbs, Concord West has a higher than average proportion of tree canopy (average = 19.98%) and plantable space (average = 16.13%), and a lower proportion of impervious (average = 56.19%) and unplantable space (average = 7.7%). Just over 20% of the suburb is covered by tree canopy, with most of this canopy falling on private land (12.76%), making the suburb highly vulnerable to canopy loss should urban in-fill occur. Approximately 90 rugby union fields' worth of potential plantable space occurs in this suburb, though less than half occurs on public land (~ 42 fields' worth).



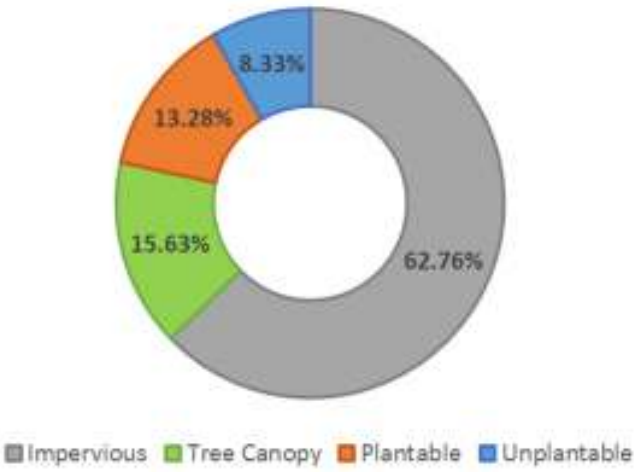
5.3.8 Drummoyne

Drummoyne comprises 11.4% of the Council area and is dominated by impervious cover, followed by tree canopy, plantable space, and unplantable space. Public land in the suburb is comprised primarily of road reserves. Compared to all suburbs, Drummoyne has a higher than average proportion of impervious cover (average = 56.19%), but a lower than average proportion of tree canopy (average = 19.98%), plantable space (average = 16.13%), and unplantable space (average = 7.7%). Less than 20% of the suburb is covered by tree canopy, with more of this canopy falling on private than public land (9.64% versus 8.07%), making the suburb vulnerable to canopy loss should urban in-fill occur. Approximately 50.5 rugby union fields' worth of potential plantable space occurs in this suburb, though less than half occurs on public land (~ 21 fields' worth).



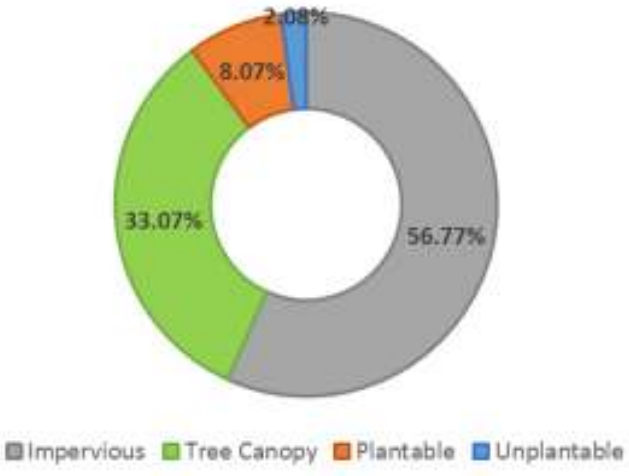
5.3.9 Five Dock

Five Dock comprises 12.3% of the Council area and is dominated by impervious cover, followed by tree canopy, plantable space, and unplantable space. Public land in the suburb is comprised primarily of road reserves. Compared to all suburbs, Five Dock has a higher than average proportion of impervious cover (average = 56.19%) and unplantable space (average = 7.70%), but a lower than average proportion of tree canopy (average = 19.98%), and plantable space (average = 16.13%). Less than 20% of the suburb is covered by tree canopy, with more of this canopy falling on private than public land (9.11% versus 6.51%), making the suburb vulnerable to canopy loss should urban in-fill occur. Approximately 46.5 rugby union fields' worth of potential plantable space occurs in this suburb, though less than half occurs on public land (~ 19 fields' worth).



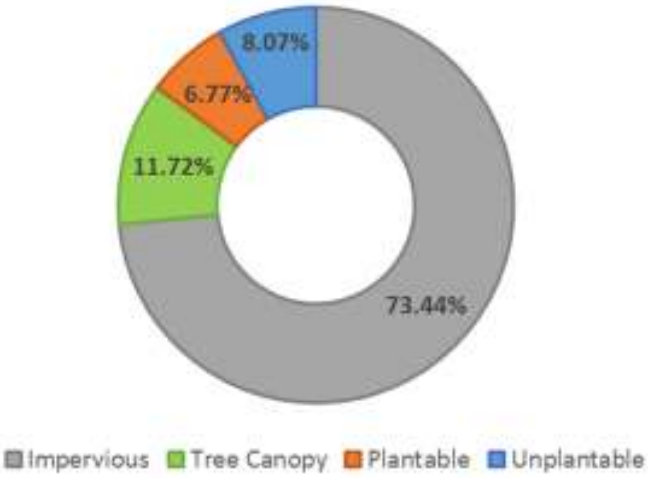
5.3.10 Liberty Grove

Liberty Grove comprises 1.0% of the Council area and is dominated by impervious cover, followed by tree canopy, plantable space, and unplantable space. Public land in the suburb is comprised primarily of tree canopy. Compared to all suburbs, Five Dock has a higher than average proportion of impervious cover (average = 56.19%) and tree canopy (average = 19.98%), and a lower proportion of plantable space (average = 16.13%) and unplantable space (average = 7.70%). More than a third of the suburb is covered by tree canopy, with almost all of this canopy falling on private rather than public land (30.47% versus 2.60%), making the suburb highly vulnerable to canopy loss from urban in-fill. Approximately 2 rugby union fields' worth of potential plantable space occurs in this suburb, though less than half occurs on public land (~ 0.2 fields' worth).



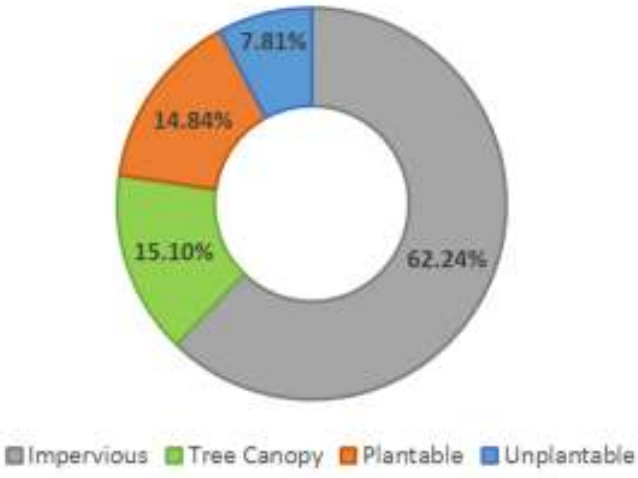
5.3.11 Mortlake

Mortlake comprises 1.2% of the Council area and is dominated by impervious cover, followed by tree canopy, unplantable space, and plantable space. Public land in the suburb is comprised primarily of road reserves. Compared to all suburbs, Mortlake has a higher than average proportion of impervious cover (average = 56.19%) and unplantable space (average = 7.70%), and a lower proportion of tree canopy (average = 19.98%) and plantable space (average = 16.13%). Just over one-tenth of the suburb is covered by tree canopy, with more of this canopy falling on public than private land (6.25% versus 5.47%). Approximately 2 rugby union fields' worth of potential plantable space occurs in this suburb, with more than half on public land (~ 1.5 fields' worth).



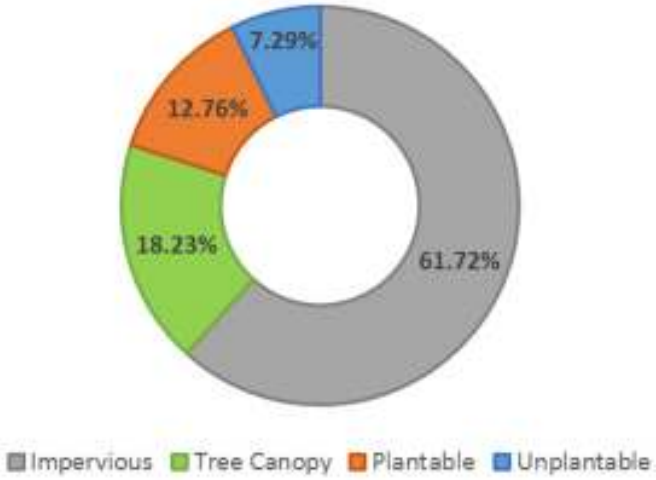
5.3.12 North Strathfield

North Strathfield comprises 4.9% of the Council area and is dominated by impervious cover, followed by tree canopy, plantable space, and unplantable space. Public in the suburb is comprised primarily of road reserves. Compared to all suburbs, North Strathfield has a higher than average proportion of impervious cover (average = 56.19%) and unplantable space (average = 7.70%), and a lower proportion of tree canopy (average = 19.98%) and plantable space (average = 16.13%). Less than 20% of the suburb is covered by tree canopy, with more of this canopy falling on private than public land (9.90% versus 5.21%). Approximately 20.5 rugby union fields' worth of potential plantable space occurs in this suburb, though less than half occurs on public land (~ 6 fields' worth).



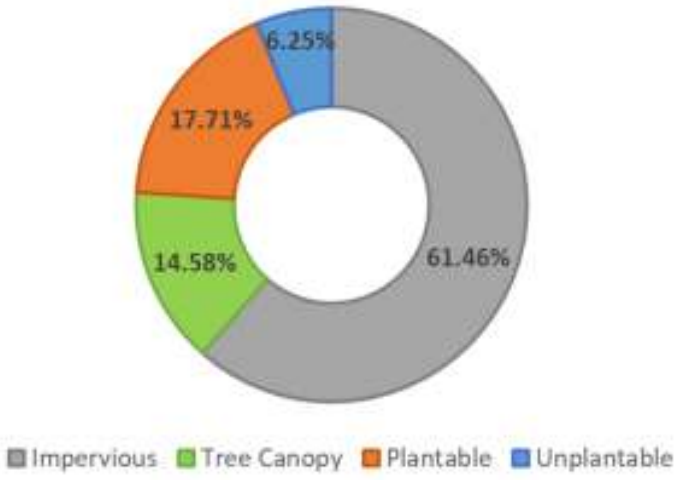
5.3.13 Rhodes

Rhodes comprises 5.0% of the Council area and is dominated by impervious cover, followed by tree canopy, plantable space, and unplantable space. Public land in the suburb is comprised primarily of road reserves. Compared to all suburbs, Rhodes has a higher than average proportion of impervious cover (average = 56.19%), and a lower than average proportion of tree canopy (average = 19.98%), plantable space (average = 16.13%), and unplantable space (average = 7.70%). Less than 20% of the suburb is covered by tree canopy, with slightly more of this canopy falling on private than public land (9.38% versus 8.85%). Approximately 18 rugby union fields' worth of potential plantable space occurs in this suburb, with approximately half on public land (~ 9 fields' worth).



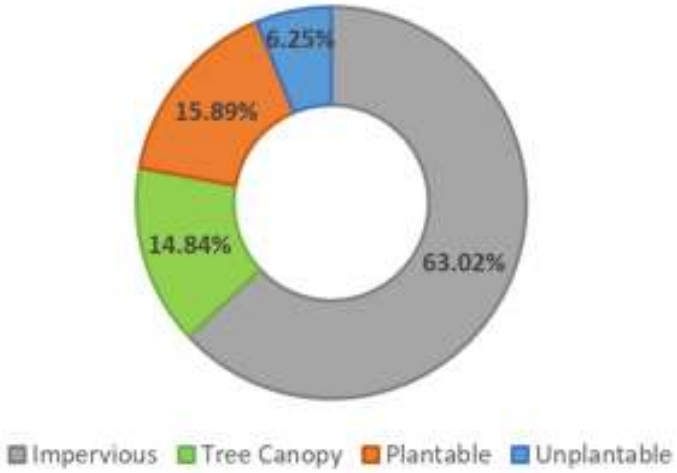
5.3.14 Rodd Point

Rodd Point comprises 1.9% of the Council area and is dominated by impervious cover, followed by plantable space, tree canopy, and unplantable space. Public land in the suburb is comprised primarily of road reserves. Compared to all suburbs, Rodd Point has a higher than average proportion of impervious cover (average = 56.19%) and plantable space (average = 16.13%), and a lower than average proportion of tree canopy (average = 19.98%) and unplantable space (average = 7.70%). Less than 20% of the suburb is covered by tree canopy, with almost twice as much canopy falling on public than private land (9.90% versus 4.69%). Approximately 9.5 rugby union fields' worth of potential plantable space occurs in this suburb, with half on public land (~ 4.8 fields' worth).



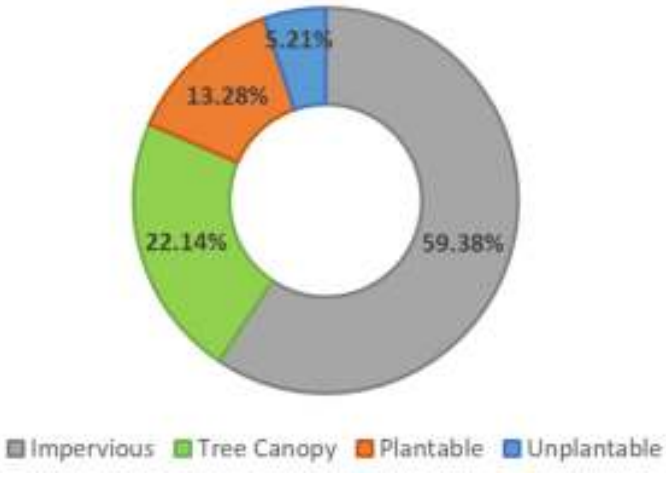
5.3.15 Russell Lea

Russell Lea comprises 5.1% of the Council area and is dominated by impervious cover, followed by plantable space, tree canopy, and unplantable space. Public land in the suburb is comprised primarily of road reserves. Compared to all suburbs, Russell Lea has a higher than average proportion of impervious cover (average = 56.19%), and a lower than average proportion of tree canopy (average = 19.98%), plantable space (average = 16.13%), and unplantable space (average = 7.70%). Less than 20% of the suburb is covered by tree canopy, with almost half as much canopy falling on public than private land (10.16% versus 4.69%). Approximately 23 rugby union fields' worth of potential plantable space occurs in this suburb, with less than a quarter on public land (~ 5.3 fields' worth).



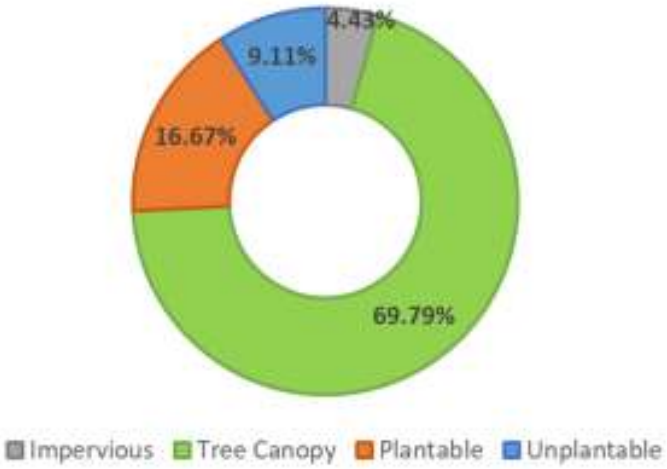
5.3.16 Strathfield

Strathfield is the Council's smallest suburb, comprising 0.8% of the Council area. Like the other suburbs, Strathfield is dominated by impervious cover, followed by tree canopy, plantable space, and unplantable space. Public land in the suburb is comprised primarily of road reserves. Compared to all suburbs, Strathfield has a higher than average proportion of impervious cover (average = 56.19%) and tree canopy (average = 19.98%), and a lower proportion of plantable space (average = 16.13%), and unplantable space (average = 7.70%). Slightly more than 20% of the suburb is covered by tree canopy, with nearly twice as much of this falling on private than public land (14.06% versus 8.07%). Approximately 3 rugby union fields' worth of potential plantable space occurs in this suburb, though very little falls on public land (~ 0.4 fields' worth) making increasing tree canopy in this suburb particularly challenging.



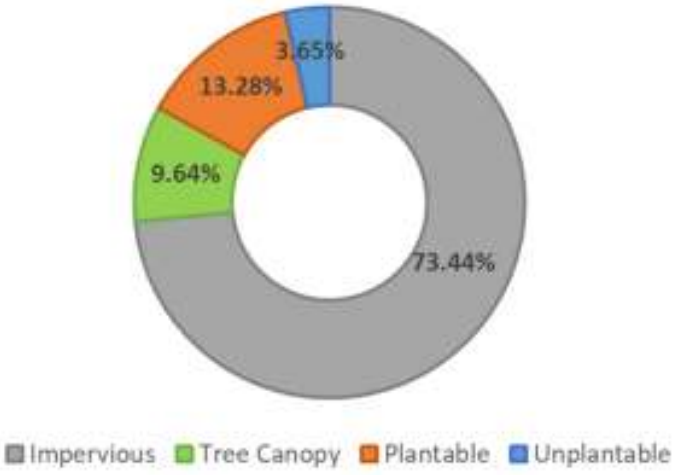
5.3.17 Sydney Olympic Park

Sydney Olympic Park comprises 1.5% of the Council area. Only a portion of this suburb falls within the Council boundary, with this portion being predominantly treed, private land. The portion of the suburb within the Council area is dominated by tree canopy, followed by plantable space, unplantable space, and impervious cover. Public land in the suburb is comprised entirely of tree canopy. Compared to all suburbs, Strathfield has a lower than average proportion of impervious cover (average = 56.19%), and a higher than average proportion of tree canopy (average = 19.98%), plantable space (average = 16.13%), and unplantable space (average = 7.70%). Tree canopy covers nearly 70% of the suburb with only 0.26% falling on public land. Approximately 7 rugby union fields' worth of potential plantable space occurs in this suburb, though none of this falls on the small percent of public land in the Council area.



5.3.18 Wareemba

Wareemba comprises 1.6% of the Council area and is dominated by impervious cover, followed by plantable space, tree canopy, and unplantable space. Public land in the suburb is comprised primarily of road reserves. Compared to all suburbs, Wareemba has a higher than average proportion of impervious cover (average = 56.19%), and a lower than average proportion of tree canopy (average = 19.98%), plantable space (average = 16.13%), and unplantable space (average = 7.70%). Less than 10% of the suburb is covered by tree canopy, with more falling on private than public land (6.51% versus 3.13%). Approximately 6 rugby union fields' worth of potential plantable space occurs in this suburb, though only a third occurs on public land (~ 2 fields' worth).



5.4 Valuing the urban forest

As trees grow and mature, they provide increasing amounts of ecosystem services and associated economic benefits, with such services and benefits only diminishing as trees senesce, decline in health, or are otherwise compromised (e.g. pruning). Maintaining a healthy growing and mature tree population will therefore help to maximise the benefits provided by tress to the environment, community, and economy.

Specific resourcing constraints of this project meant that a full inventory of the City's public trees was not feasible. However, it was considered desirable to have an indication of the benefits and values provided by trees and so a subset of trees were selected for an i-Tree Eco[4] assessment. Two main data collection approaches were explored:

1. **detailed complete inventory approach**, which involves recording at least 12 data variables per tree. This approach provides the most accurate outputs per tree. The trees measured in this were:

- 20 trees lining Roseby Street, Birkenhead (Figure 7) – selected as a busy pedestrian and vehicle hub;
- 20 trees lining Ingham Avenue, Five Dock (Figure 7)– selected as a representative treed residential street;
- 330 trees in Queen Elizabeth Park, Concord (Figure 8) – representing an estimated three-quarters of the Park's trees and selected as a representative of park trees.

2. **basic inventory approach,** which involves only two variables per tree being recorded: species and trunk girth. For the purposes of this project, a rapid assessment technique was used to visually estimate these variables. Using this approach, the i-Tree Eco model assumes a perfect growth form relative to species and trunk girth and estimates the full complement of data variables accordingly. This approach will therefore provide an indication of ecosystem service benefits, though outputs will likely be either over- or under-estimated, depending on the specific outputs type and its dependence on estimate data. The 778 trees measured in this way comprised:

    - 214 trees on 15 streets in Abbotsford;
    - 19 trees on one street in Breakfast Point;
    - 15 trees on two streets in Cabarita.
    - 26 trees on two street in Canada Bay;
    - 17 trees on one street in Chiswick;
    - 111 trees on 3 streets in Concord;
    - 51 trees on 2 streets in Concord West;
    - 46 trees on two streets in Drummoyne;
    - 41 trees on one street in Five Dock;
    - 13 trees on two streets in Mortlake;
    - 27 trees on two streets in North Strathfield;
    - 95 trees on two streets in Rhodes;
    - 37 trees on 2 streets in Rodd Point;
    - 39 trees on two streets in Russel Lea; and
    - 27 trees on two streets in Wareemba.

[4] https://www.itreetools.org/eco/

Figure 8. Trees measured (points) using detailed technique in Roseby Street (left) and Ingham Avenue (right).

Figure 9. Trees measured (points) using detailed technique in Queen Elizabeth Park (yellow boundary).

5.4.1 Street trees

The 818 street trees measured represent approximately 4.7% of the City's estimated 17,494 street tree population. Key outputs for these trees are as follows:

- Structural (replacement) value: $5,848,998.23;
- Carbon stored: 993.04 tonnes, valued at $22,641.37;
- Carbon sequestered annually: 3.21 tonnes/year, valued at $559.03;
- Pollution removed annually: 475.60 tonnes/year, valued at $14,650.05;
- Stormwater runoff avoided annually: 602.30 m^3/year, valued at $1,365.96;
- Oxygen provided annually: 65.27 tonnes/year, equivalent to the amount breathed by 212 people per year
- Shade provided (m^2): 81,371.10m^2, equivalent to the amount provided by 25,913 standard beach umbrellas

A coarse comparison of average outputs per tree between the detailed and rapid assessment techniques suggest that the rapid assessment techniques tend to underestimate outputs by about 44%. If this is taken in to account and then the outputs extrapolated across the City's estimated street tree population, the street trees are coarsely estimated to: have a structural/replacement value of between $121.6M and $181.5M; store up to 31,175 tonnes of carbon and sequester up to an additional 86 tonnes per year; remove up to nearly 15 tonnes of pollution and intercept up to 18,865 m^3 of rainfall each year; provide oxygen equivalent to the amount used by up to 6,629 people each year; and, provide shade equivalent to up to 810 thousand beach umbrellas. Such findings however are indicative only of the relative value the City's street trees provide and will vary significantly with a detailed assessment of the City's street trees.

5.4.2 Queen Elizabeth Park trees

The 330 trees measured in Queen Elizabeth Park are estimated to capture approximately 75% of the Park's total trees, giving an estimated total of 440 park trees. Key outputs for the park trees measured are as follows:

- Structural (replacement) value: $2,732,444.55;
- Carbon stored: 309.13 tonnes, valued at $7,048.21;
- Carbon sequestered annually: 13.65 tonnes/year, valued at $311.24;
- Pollution removed annually: 188.22 tonnes/year, valued at $5,750.50;
- Stormwater runoff avoided annually: 241 m^3/year, valued at $544.31;
- Oxygen provided annually: 36.41 tonnes/year, equivalent to the amount breathed by 118 people per year
- Shade provided (m^2): 112,845.90m^2, equivalent to the amount provided by 35,937 standard beach umbrellas

Extrapolating these outputs over the estimated 440 Park trees, the trees in Queen Elizabeth park number of trees in the Park are estimated to: have a structural/replacement value of more than $ 3.6M; store 412.18 tonnes of carbon and sequester an additional 18.20 tonnes

per year; remove more than 250 kilograms of pollution and intercept 321.33 m^3 of rainfall each year; provide oxygen equivalent to the amount used by 158 people each year; and, provide shade equivalent to more than 13.3 thousand beach umbrellas. Such findings however are an estimate only of the services and values provided by the Park's trees. A number of the tree unmeasured included several large fig trees, which tends to provide much greater services than most trees given their sheer size. It should be noted though that due to threshold limitations in the i-Tree Eco modelling program, tree trunk girths are capped at 2.54m, meaning that outputs for trees with a larger trunk girth are underestimated; this is often the case for mature fig trees.

Which tree/s provide the most?

Of the trees measured in Queen Elizabeth Park, the greatest services/values provided by an individual tree were for two mature trees as follows:

Blackbutt (*Eucalyptus pilularis*)

Provided the greatest amount of:

- Structural value: $39,135.13;
- Shade cover: 598.3 m^2
- Carbon stored: 5303.7 kg
- Avoided annual runoff: 4.3 m^3
- Total pollution removed annually: 3.39kg

Turpentine (*Syncarpia glomulifera*) (tag #54)

Provided the greatest amount of:

- Annual carbon sequestration: 123.5 kg
- Oxygen production annually: 329.3 kg

5.5 Future planting priorities

Achieving the proposed increased canopy cover target will require extensive tree plantings on public and private spaces. If planned appropriately, such plantings can achieve multiple outcomes and maximise the benefits from trees. To identify broad priority planting locations, the following factors were integrated: canopy cover, potential plantable space (Sections 5.2 and 5.3), thermal heat mapping (Section 6.4), and location of proposed green grid opportunities, parks and streets. The stepped process and outputs are summarised below:

1. **Priority suburbs** (Figure 9), defined as being the hottest suburbs and also with the most potential plantable space are Breakfast Point, Concord, Concord West, and North Strathfield.

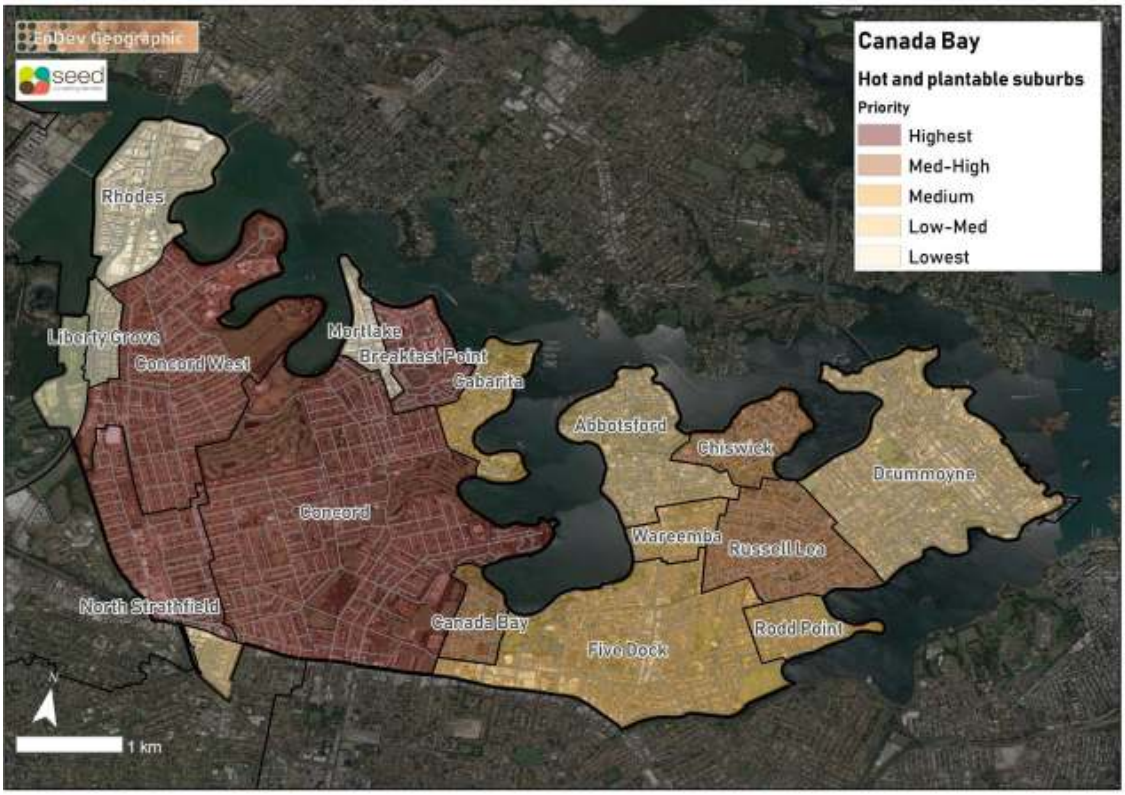


Figure 10. Priority tree planting suburbs

2. **Streets** with the fewest trees identified as priorities (Figure 10). Priority streets are further elevated if they also fall within the hottest suburbs.

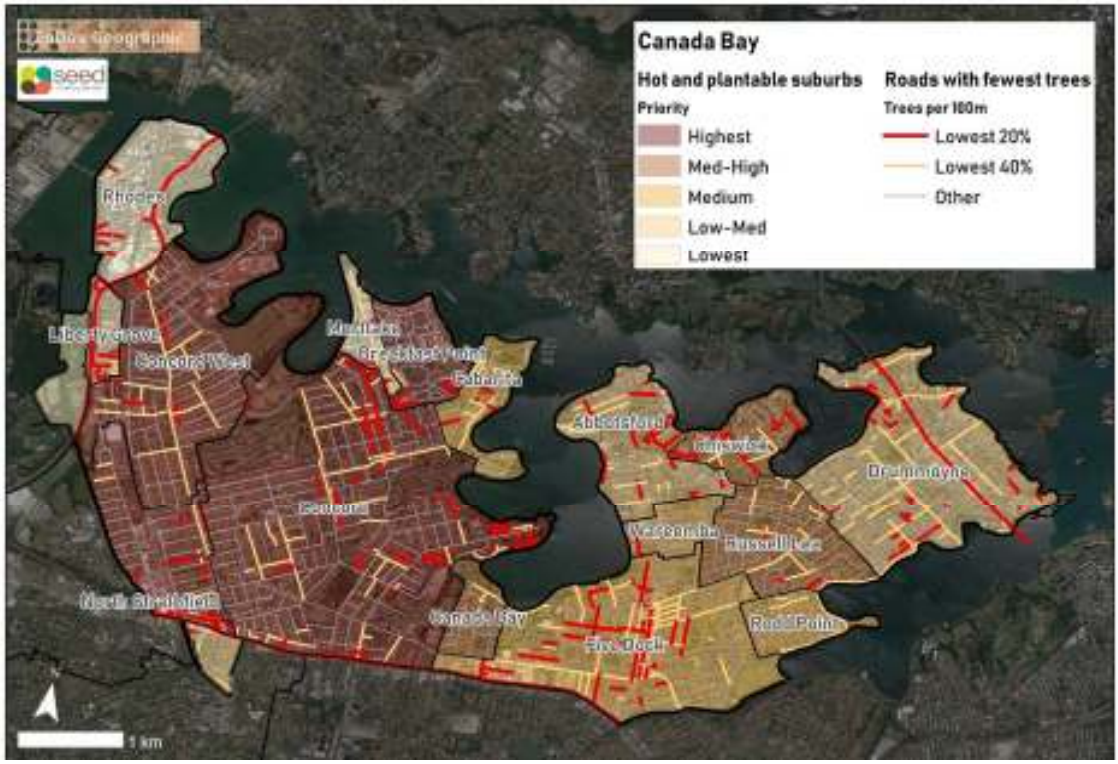


Figure 11. Priority tree planting streets within priority suburbs.

3. **Green grid and open space opportunities** were overlaid to identify where these areas coincided with priority suburbs, and also priority streets (Figure 11), and these being elevated if the streets also fall within the hottest suburbs.

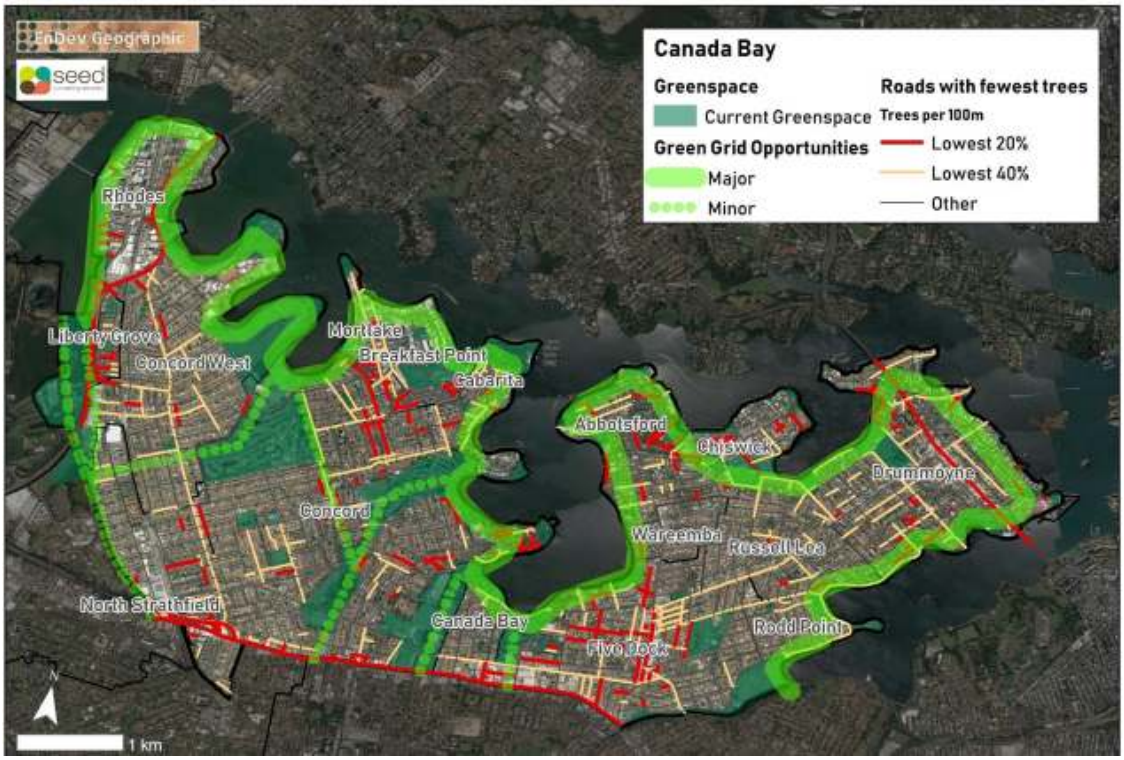


Figure 12. Priority tree planting green spaces, integrated with priority streets and suburbs.

Based on these integrations, priority planting areas can be refined. For example, highest priority streets for implementing tree plantings, that is, those that have the lowest amount of tree cover, occur in the hottest and most plantable suburbs, and also coincide with green grid opportunities include: Marceau Drive and the northern end of Nashs Lane in Concord.

Whilst this helps to refine priority planting areas, the implementation of on-ground plantings will realistically be further informed by a number of factors not considered in this high-level analysis, such as under- and over-ground utilities/services, proximity to infrastructure, aesthetics, land-use, and community support. Given these limitations, achieving the canopy targets across the whole City will require effort on both public and private land. Section 6 provides further discussion around such issues and challenges.

6 Issues and challenges

As population continues to increase, so too do the demands for space from often competing land uses. In many cases, the trend has been for trees to be priorities lower than other land uses such as development. This pattern of land use change from “green” to “grey” has created a legacy of increasingly hot and less desirable places to live and work. Creating resilient and liveable cities and towns will require green and grey infrastructure to be better integrated and complementary in nature. To achieve this, particularly with regard to trees, requires an understanding of the key issues and challenges present in an area.

For the City of Canada Bay, the 8 key issues and challenges faced in elevating trees as a priority component of urban areas are:

- population increase and urban intensification;
- climate change;
- urban heat islands
- community perceptions and conflicts;
- water availability;
- maintaining diversity and resilience in the urban forest;
- biodiversity; and
- open space management.

These issues and challenges are inter-related and will often vary in their relative importance across the Council area and among communities, as discussed below.

6.1 Population increase and urban intensification

One of the biggest challenges facing the task of increasing the City of Canada Bay’s urban forest is development. With a growing population comes an increasing demand for housing and infrastructure. According to the Local Housing Strategy the population growth in the LGA is expected to increase to 120,000 people by 2036 (up from 88,000 in 2016). The population increase is expected to be accommodated by 5,600 net new dwellings between 2018 and 2026.

Major development over the next 20 years will include urban renewal precincts in Rhodes East and the Parramatta Road corridor as well as redevelopment of local centers of North Strathfield and Five Dock. The future development of transport infrastructure, particularly the station locations of Sydney Metro West will also have a large influence on future housing demand. Development of these areas threatens to reduce existing urban forest, decrease available plantable space while create further pressure on open spaces required to service a growing population. Any future development will need to be balanced with the need for protection of both open space and the character of residential areas which includes the urban forest and biodiversity.

The greatest demand for dwellings is for flats, units and apartment dwellings with 88% of new demand for dwellings in the LGA by 2026 is likely to be for apartments. The Local Housing Strategy findings report that lower density subdivisions can contribute to the provision of housing capacity. Particularly those over 450 m^2 and less than 600 m^2 are identified as the best lots for multi-unit developments. This type of development of private land threatens to remove existing urban forest and mature trees located in backyards and decrease available plantable space.

Maintaining existing and increasing urban forest becomes increasingly important in an area that is growing in density and population. Open space and access to green space is vital to a population's health and well-being in high density areas where these spaces can function as a backyard for residents living in apartments.

With the increasing population comes a diversity of age, ethnicity, incomes, languages and culture. For example, there is expected to be a major growth in the number of people aged 55 and over and around a 75% increase in the number of residents aged 75 and over. This change in demographic brings challenges to the way that Council meets the variety of needs of its community. Green open space will not only have an increase in demand for access and use, but the way in which the open space is used. Spaces that include urban forest and shady canopy supports the activities of older people such as gentle exercise and walking or culturally diverse community members with different needs for example social gatherings, dancing, badminton or walking in the evening.

6.2 Climate change

Climate change is a change in the pattern of the weather, and related changes in oceans, land surfaces and ice sheets, occurring over time scales of decades or longer[5]. It is caused by an increase in the amount of greenhouse gases in the atmosphere, such as carbon dioxide. As these gases accumulate, increasing amounts of energy from the sun are trapped in the atmosphere and the oceans. This impacts weather through changes in temperature and rainfall along with changes in the oceans such as rising sea levels.

Future projections of climate change are developed using a range of international global climate models. This information has been used as the basis of developing climate projections for New South Wales, including Metropolitan Sydney. Of most relevance to the City of Canada Bay are the following projections for the near future and far future[6]:

[5] https://www.science.org.au/learning/general-audience/science-booklets-0/science-climate-change/1-what-climate-change

[6] NSW OEH (2019). Metropolitan Sydney Climate change snapshot. https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/Metro-Sydney-Climate-Change-Downloads. Access on 21 February 2019.

Temperature

- Maximum temperatures are projected to increase in the near future by 0.3–1.0°C and in the far future by 1.6–2.5°C;
- Minimum temperatures are projected to increase in the near future by 0.4–0.8°C and in the far future by 1.4–2.5°C;
- The number of hot days will increase and the number of cold nights will decrease. For example, in the near future the number of days over 35'C is expected to increase by 1 to 5, whereas in the far future there will be a further 5 – 10 days over 35°C.

Rainfall

- Rainfall is projected to decrease in spring and winter but increase increase in summer and autumn

Sea level rise

- Projections suggest at least a 10 cm rise by 2030 and up to 50 cm by 20907.

The projections for increasing temperatures in Sydney mean that the cooling benefits provided by trees will become increasingly important. Furthermore, planting additional trees in the LGA will help store more carbon – also called carbon sequestration – which helps mitigate the impact of climate change.

Climate change may also place greater stress on the urban forest. Declining rainfall in winter and spring could make establishment and maintenance of trees more challenging, whereas warmer summers with higher rainfall could further encourage pests and diseases that influence tree health. Periods of extreme heat will also place additional physiological stress on trees.

To address the challenges posed by climate change to the urban forest implementation of this strategy needs to consider species selection that is appropriate to a different future climate and its associated pest and disease pressures, and how to provide sufficient water for the establishment and maintenance of trees.

6.3 People and trees

The City of Canada Bay community values its public trees for their shading and cooling, their visual amenity, their biodiversity benefits, and for the improved outdoor lifestyle that they provide. However, while people generally appreciate trees, there is a just "Not In My Backyard" approach. Requests for single tree removals near property, or removal of trees on

[7] https://www.climatechangeinaustralia.gov.au/en/climate-projections/coastal-marine/marine-explorer/#

property, is contributing to canopy cover declines across the City. Within the City of Canada Bay, particular challenges and issues relate to:

- **Growth form or location:** form is either personally unappealing and/or growth blocks personal view of harbor;
- **Tree traits:** seasonal traits such as leaf drop by deciduous trees, and fruit fall present a maintenance nuisance for people;
- **Personal preferences:** for a specific tree type, such as native or non-native; and
- **Misperception of risk level:** fear of tree/branch fall often being much higher than warranted based on the tree in question and likelihood of actual incident.

The assessment of canopy and land cover within public and private realms across the City of Canada Bay clearly show that the large majority of the City's tree assets fall on privately owned and managed land. Furthermore, the amount of potential plantable space on public land is unlikely to be adequate for achieving increased canopy targets. This means that achieving canopy cover targets will require protection and plantings on both public and private land. Addressing and alleviating community conflicts and negative perceptions around trees will therefore be essential.

A multi-action approach will likely be necessary, including: consideration of "right tree, right place" together with local community values; increased education and awareness about tree benefits; and, altered built infrastructure design practices that actively seek to retain and protect existing trees.

For example, around existing infrastructure with water views, the selection of tree species and planting placement should aim to create framed, rather than blocked, views. Conversely for new developments around existing trees, development designs should aim to prioritise the retention and protection of existing trees whilst minimizing potential conflicts. Council incentives provided to private property owners to protect and grow trees on private land may also be considered. Such design, planting and incentives actions should be complemented by passive and active education and awareness campaigns around the range of tree benefits provided by trees, focusing on those benefits currently not widely understood by communities.

6.4 Urban heat island

Urban heat islands describe areas of land that accumulate and retain more heat than the surrounding landscape. Heat can accumulate where surface materials like bitumen and dark coloured roofs heat up to a greater extent than cooler surfaces like trees, irrigated grass and light coloured roofs. Heat islands can then form where there is greater accumulation of these hot spots in a given area. The impact of heat islands will be intensified by climate change.

The presence of urban heat islands is a key management issue for local government given that extreme heat leads to greater health problems for the community than any other natural hazard. This is especially so for vulnerable members of the community. Extreme heat also

impacts on economic productivity as well as native plants and animals. The urban forest in the City of Canada Bay is one of the most important assets the Council has in mitigating urban heat islands now and in the future.

In developing this Strategy, Council undertook an urban heat island analysis. This used thermal imagery collected by satellites in 2018 and 2013 to develop land surface temperature and heat island maps, with the heat island maps showing where land surface temperatures accumulated above the LGA wide average (Figure 13 and Figure 14). The analysis shows that the City of Canada Bay has distinct areas that are either hotter or cooler than the LGA wide average.

Some of the key findings of the analysis based on the 2018 data were that:

- North Strathfield registered as the hottest suburb in the 2018 assessment, measuring 1.5 ºC above the average suburb temperature, followed by Concord West, Five Dock, Concord, and Breakfast Point;

- The coolest suburbs included Rhodes, Cabarita, and Mortlake, which all measured 0.2 to 0.4 ºC below average, likely driven by close proximity to the cooling influence of the waterfront;

- The largest heat islands occurred over North Strathfield and Concord West with 47% and 43% of their areas falling within a heat island. These suburbs also had the two largest extreme heat islands with areas greater than 4 ºC above the LGA wide average; and

- The change in heat islands from 2013 to 2018 show that areas such as North Strathfield, Concord West and Concord warmed over the period.

In North Strathfield, the extreme heat island was driven by the commercial area at the southern end of George Street around high-density commercial and industrial buildings, which have both lower green cover and dark coloured roofs. The extreme heat island in Concord West correlates with the open space on the southern peninsula which was dry at the time of data collection. The higher surface temperature of dry grass has been observed elsewhere in Australia and highlights the importance of green, irrigated open space for heat mitigation.

The analysis also helps identify the drivers of cooler areas. For example, golf courses in the LGA with their irrigated grass typically showed as cooler areas, while the new development occurring in Rhodes shows as a cooler area presumably due to the combination of lighter coloured roofs and newly established green cover. The heat mapping also shows the general effect of being in close proximity to the water edge along the harbour.

The data collected for the study can be also used to determine where best to locate trees and green cover to mitigate urban islands. This is further discussed in Section 5.4.

Table 4. 2018 hottest suburbs.

	Hottest suburbs	Temperature above baseline (ºC)		Hottest suburbs	Temperature above baseline (ºC)
1st	North Strathfield	1.56	10th	Rodd Point	0.55
2nd	Concord West	1.44	11th	Chiswick	**0.32**
3rd	Five Dock	1.39	12th	Abbotsford	0.25
4th	Concord	1.36	13th	Liberty Grove	**0.05**
5th	Breakfast Point	1.35	14th	Drummoyne	-0.01
6th	Russell Lea	1.10	15th	Rhodes	**-0.20**
7th	Canada Bay	1.07	16th	Cabarita	-0.38
8th	Wareemba	0.81	17th	Mortlake	**-0.41**
9th	Strathfield	0.75	18th	Sydney Olympic Park (partial)	-2.29

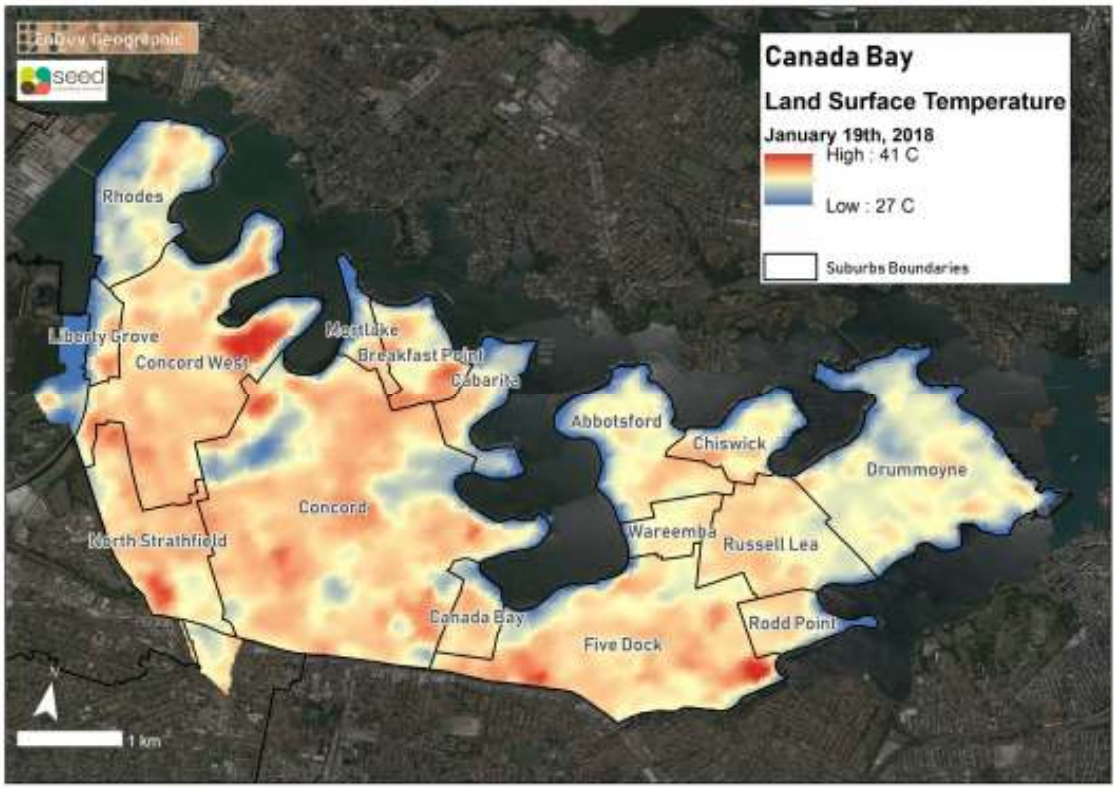


Figure 13. 2018 Land surface temperature map.

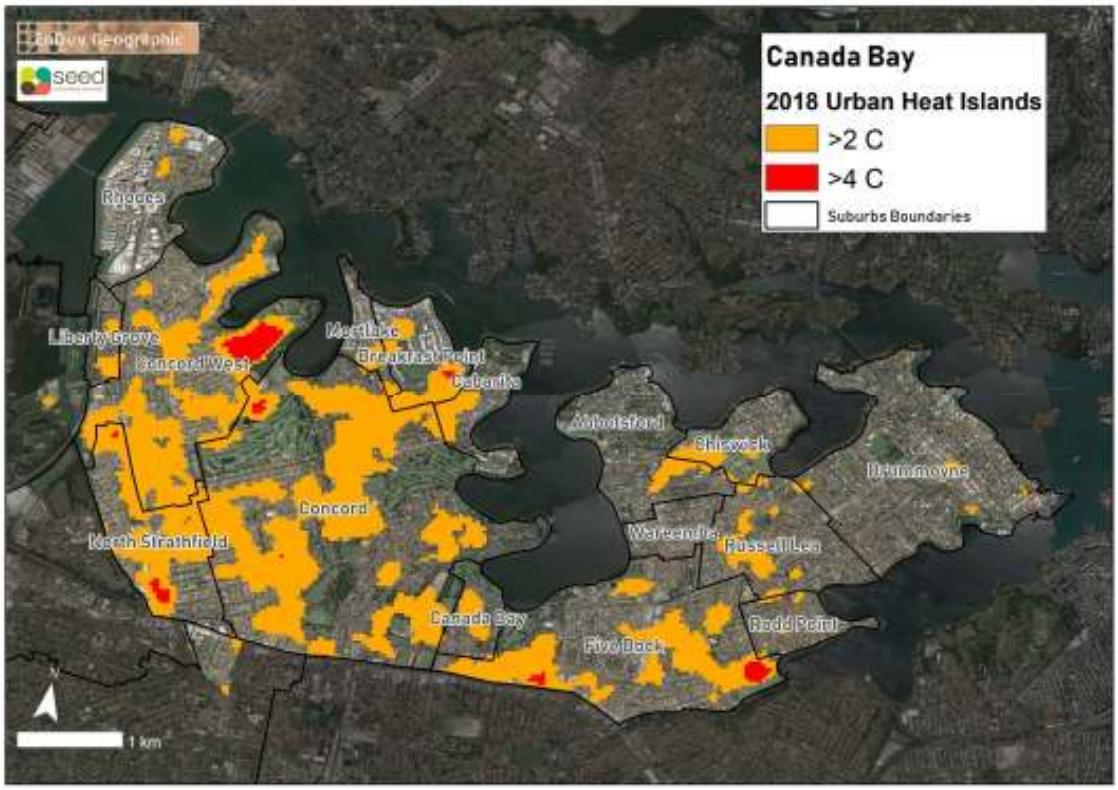


Figure 14. 2018 Heat islands map.

6.5 Water availability

Water is essential for creating green, vibrant cities. It is needed for establishing and maintaining healthy trees that can reach maturity in the urban forest. Healthy, mature trees help provide greater benefits to the community.

While trees can survive on rainfall, ensuring successful establishment will often require additional watering. Also, the location of some trees in the urban landscape, especially those surrounded by hard surfaces like roads and footpaths that do not allow for rainfall infiltration, means that other forms of watering is required. Changing rainfall patterns due to climate change may also lead to greater stress on trees in the future.

The City of Canada Bay has a long commitment to improving water management and re-use. Examples of Council's work include:

- Water for our Community[8] – This award winning stormwater harvesting, treatment and reuse project is one of the largest of its kind in Sydney and has reduced Council's reliance on drinking water by about 75%. It provides water for open space facilities, enhancing the quality and amenity of grounds, in particular during periods of drought and water restrictions;

- Concord Oval Rainwater Reuse – This project reduces Council's demand on drinking water supplies, but also reduces the amount of stormwater and pollutants entering waterways. The project demonstrates how to harness a sustainable alternative water source for one of Councils main water usage sites;

- Drummoyne Oval precinct upgrade – This project incorporated elements of integrated water cycle management, including rainwater and stormwater reuse and raingardens. Stormwater run-off from roads and rooftops surrounding Drummoyne Oval is captured, filtered and treated. It is then used to irrigate Drummoyne Oval and the adjacent playing fields. Surface run off water from the carpark and surrounding areas is diverted into vegetated swales and a rain garden to filter out pollutants before it reaches the Parramatta River.

Continued investment in water management projects such as these can contribute to providing the water requirements needed to establish and maintain more trees to help grow the urban forest.

[8] http://www.canadabay.nsw.gov.au/council/sustainable-council/water

6.6 Maintaining diversity and resilience in the urban forest

The long-term resilience of the City's urban forest, particularly under climate change, will require a diverse mix of species and age classes. Increasing and maintaining a diversity of tree species will be essential for resilience of the urban forest particularly if pest and diseases increase under climate change. An urban forest comprised of only a small number of tree species is at significant risk of rapidly losing a large proportion of their urban forest should conditions for those species become unsuitable.

How much species diversity, though, is enough the reduce the risk of catastrophic tree loss due to pests? The general best practice guideline for the minimum species diversity in urban forests follows the Santamour Rule, also known as the 10% Rule or 10-20-30 Rule[9]. This rule suggests an urban tree population should include no more than 10% of any one species, 20% of any one genus, or 30% of any family. Whilst not a perfect solution, adhering to this rule as a minimum species diversity target is preferable that the usual status quo in most urban areas.

In addition to species diversity, maintaining age diversity in the urban forest is also important. Without a focus on age diversity, we also risk large scale catastrophic losses of urban trees if they all senesce and mature at the same time. Further, the City's young and semi-mature trees are the future of its urban forest and so if young trees are permitted to be regularly removed to accommodate other land uses (usually development), then this will also seriously compromise the future urban forest.

At their maturity, trees provide their most benefits to people and place, with larger trees generally providing greater benefits. As well as providing substantial ecosystem service benefits, such large and remnant trees also provide an important historical link and a culturally significant sense of place for our City. Within in the City of Canada Bay, some of our mature and remnant trees also comprise important threatened ecosystems.

Ideally, to achieve increased canopy cover targets and maintain resilient urban forests, replacement plantings of dead/lost trees should be complemented by additional tree plantings. For replacement plantings, these are best planned as inter-generational plantings, meaning that the "replacement" tree is planted as the tree to be replaced reaches maturity, not as it begins to senesce and die, therefore helping to maintain canopy cover and a mature, healthy functioning urban forest.

Whilst detailed information about the City's trees species and age diversity is currently lacking, it is acknowledged that this information is important for effectively managing our urban forest and a process for effectively and efficiently collecting, collating, and managing this information has commenced.

[9] Santamour FS (1990) Trees for urban planting: diversity, uniformity, and common sense. In: *Proceedings of the 7th Conference of the Metropolitan Tree Improvement Alliance*. 57-65.

6.7 Biodiversity

Within the heavily modified and built urban landscape, our urban forest and associated vegetation are vital for enhancing and protecting native biodiversity in the City and surrounds. The network of street trees, parks, private gardens, and reserves can provide important movement corridors for species. Improving connectivity across public and privately-owned lands can provide important areas of habitat and contribute to linkages between bushland patches. Individual trees can also provide foraging resources (e.g. fruits and flowers), nesting and roosting resources (hollow-bearing trees are particularly important), and potential safe havens for species escaping dangers (e.g. cats and dogs). Simply increasing the total amount of vegetation and potential habitat can also have benefits to native biodiversity[10].

Different species though can have very different requirements and sensitivities. For example, the striated pardalote (*Pardalotus striatus*) a small bush bird prefers tall eucalypts where it forages on insects in the high canopies, and nests in small hollows close to the ground. Comparatively, another small bush bird, the superb fairy-wren (*Malurus cyaneus*), lives almost exclusively in understorey shrubs where it builds a small nest and forages for insects on low foliage or the ground. Birds such as rainbow lorikeets (*Trichoglossus moluccanus*) will forage on flowers, fruits and seeds of a wide range of trees and shrubs, but require hollow-bearing eucalypts for nesting, whereas the ubiquitous magpie (*Gymnorhina tibicen*) will readily forage on a wide range of resources (including human food) and nest in nearly any tree over 15m. Mammals, reptiles, and amphibians similarly have varying habitat and resource requirements. Understanding such species-specific requirements will be important for planning and managing our urban forests for native biodiversity[11].

Like many urban areas, the City of Canada Bay has a history of significant habitat loss, fragmentation, and species declines and loss. Two factors particularly threaten biodiversity in the City: a rapidly expanding population, and ongoing edge effects or encroachment on already small and fragmented areas. However, the City still supports a diversity of native species, including a number of local, State, nationally, and internationally significant species and ecosystems. These species and ecosystems are actively managed by Council together with Bushcare groups in the region[12]. The City of Canada Bay also has significant support from the community and strong participation in events such as National Tree Day and Schools Tree Day providing an opportunity for education on the value of trees.

Whilst planting more trees will provide some benefits to some species, significantly improving native biodiversity and preventing further decline and loss of species will require protection of existing trees and habitat, retaining vegetation across development and infrastructure zones, together with specific consideration of species requirements relating to

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[10] Garden JG, McAlpine CA, Possingham HP (2010) Multi-scald habitat considerations for conserving urban biodiversity: native reptiles and small mammals in Brisbane, Australia. *Landscape Ecology* 25: 1013-1028

[11] Garden JG, McAlpine CA, Possingham HP, Jones DN (2007) Habitat structure is more important than vegetation composition for local-level management of native terrestrial reptile and small mammal species living in urban remnants: A case study from Brisbane, Australia. *Austral Ecology* 32: 669-685.

[12] http://www.canadabay.nsw.gov.au/community/get-involved/bushcare

tree species, complementary plantings, and placement. Strategic planning and the use of key planning mechanisms (Local Environment Plan and the Development Control Plan) will play an important role in implementing vegetation controls to protect existing native habitat and enhance connectivity and biodiversity.

The Biodiversity Strategy, which is also being developed by the City of Canada Bay, is strongly aligned to this strategy with a vision to 'value, protect, conserve and enhance natural areas and biodiversity in an urban and river foreshore environment'. It's themes for focus compliment the objectives of this strategy, providing measures that promote the enhancement of native vegetation, corridors and connectivity, public spaces, urban habitat and green infrastructure.

6.8 Open space management

Open space is public land that is used for recreation, leisure and outdoor entertainment purposes. It provides both passive and active activities that allows people to connect and participate in for fun, play, relaxation and health. In recent years there has been a significant trend in recreation participation moving towards informal, unstructured recreation activities rather than traditional organised sport. The City of Canada Bay is a key provider of open space and will face significant pressure from the continued growth of the LGA on future social infrastructure needs.

The City of Canada Bay currently has 181 parcels of open space totalling 348ha with 31.8m2 of open space per person in total. This includes numerous parks, reserves and playing fields which contribute to the health and well-being of its residents and visitors. These areas have been allocated for passive and active public recreation, as well as areas of significant conservation value. Queen Elizabeth Park, for example, is one of the City's largest and significant open spaces in the City area; it comprises active playing fields and a clubhouse, children's play-ground and picnic tables, public amenities, passive recreation areas, a war memorial, and one of the most significant patches of the threatened Turpentine-Ironbark woodland ecosystem.

Trees form a vital component of highly used open spaces, primarily valued for their shade and cooling, as well as their visual amenity and contribution to the open space being considered a "nice", "relaxing" and "cool" place to visit and spend time. Open space areas connected by tree-lined footpaths and bikeways are more likely to be utilised, promote healthy outdoor activities that benefit human physical health, and encourage more people outdoors to common spaces which benefits human mental health and builds community connectedness.

The City's open spaces also present some of the best opportunities to plant additional public trees. Consideration in tree plantings should include the recreational use of the space, the biodiversity benefits, and also the benefits for people and the environment. Such planning should be undertaken in the context of the Sydney Green Grid to prioritise greening in and between open spaces that enhance the objectives of the Green Grid.

The Open Space Strategy, which is also being developed by the City of Canada Bay, identifies opportunities for Council to provide diverse passive and informal recreation for an increasingly diverse population, addressing the needs of children and parents, young people, and people with disability. It recognises the need to improve accessibility to open space through green streets and active transport links, to work in partnership with private and government agencies to share and deliver new open space and to balance recreation and open space needs with environmental needs. All of which strongly aligns with the objectives of this Strategy.

7 Vision and priorities

The Urban Tree Canopy Strategy sets the context and key directions for on-going planning and management of the City of Canada Bay's urban forest. The key directions are presented under five priorities which identify the short, medium- and long-term actions needed to achieve Council's vision and targets to 2040.

7.1 Vision

The City of Canada Bay will:

Grow and protect a resilient and diverse urban forest that characterises our City as a cool, tranquil, and connected place to live, work and visit.

Our urban forest will be a highly valued urban asset that will managed collaboratively and strengthen the liveability of our City through supporting the health and well-being of our community, our native biodiversity, and our environment.

This vision will be underpinned by the principle of "right tree, right place" which aims to grow and protect the urban forest by:

- ensuring that trees are selected that align with community values for shade, playable spaces and cultural relevance;
- matching tree size and form to local growing conditions, such as in streets and parks;
- accounting for future potential tree related risks to people and infrastructure; and
- allowing for projected changes in the local climate.

7.2 Target and outcomes

The City of Canada Bay will increase its tree canopy cover across the City to at least 25% by 2040, an increase of over 6%.

The increase in canopy cover will occur primarily in streets and parks on public land and by working with private land holders.

This increase aligns with the recommendations of the Government Architect New South Wales for urban residential council areas with medium to high-density development and will contribute to the Greater Sydney Commission's 40% canopy cover target across metropolitan Sydney by 2036.

The expected outcomes of achieving this canopy cover increase include:

- improved amenity and cooling of the built environment;
- enhanced native biodiversity and ecosystem health;
- greater community connectedness and well-being; and
- enhanced liveability and resilience.

Overall, this Strategy represents a shift in focus from a traditional to a modern approach to urban forest management, the key features of which are summarised in Table 5.

Traditional urban forest management	Modern urban forestry approach
Trees as ornaments	Trees viewed as critical infrastructure
Focus on individual tees	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
Focus on smaller and ornamental trees	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 5. Traditional versus modern urban forest management approach. Based on North Sydney Council (2011).[13]

7.3 Priorities and actions

This Strategy presents priorities and actions for a 10-year period. Short term actions will be prioritised for delivery within 1-3 years, mid-term actions for delivery within 3-5 years and long-term actions within 6-10 years. The Strategy will be subject to a mid-term review after 5 years and full review after 10 years.

7.3.1 Protect and value

***Objective**: Ensure that tree management policies and programs help to protect the urban forest by increasing the retention of existing trees on public and private land.*

Over 70% of the City of Canada Bay is privately owned and managed land, and more than 65% of the City's canopy cover falls within this private tenure. With an increasing trend of urban in-fill likely over the next 15 years, canopy cover on private land is particularly vulnerable to being lost to make room for new developments. The community valuing urban trees as assets will be essential if existing trees are to be prioritised and protected.

Protecting and valuing the urban forest will require Council to implement the following actions to encourage retention of trees on public and especially private land:

[13] North Sydney Council (2011). North Sydney Council Urban Forest Strategy. https://www.northsydney.nsw.gov.au/files/assets/public/docs/4_waste_environment/urbanforeststrategy_2011.pdf.

Short term (1-3 years)

- Review the development application tree assessment process, seeking to clarify internal processes with respect to the trigger for when an application is referred for further comment, responsibility for assessment and how to provide consistent level of referral comments consistent with the AS 4970-2009[14].

- Introduction of a new Council policy which clarifies when an arborist report is required. The trigger for requiring an arborist report should be related to the size and value of the tree not the type of development and note relevant provisions in AS 4970-2009 with respect to when a Tree Protection Zone (TPZ) must be assessed by an arborist against specified criteria.

- Update conditions for tree protection, pruning and planting to reflect current Australian standards and terminology.

- Review the definition of trees in the DCP that can be pruned or removed under Section C5.1 C1 to enable greater protection of existing trees. This may include reducing the maximum trunk diameter to 300 mm and the inclusion of a canopy cover provision.

- Benchmark Council's current canopy cover and ensure that our approach aligns with current best practice across Greater Sydney.

- Investigate a process for introducing tree bonds for new developments where trees are significant and/or at risk throughout construction. A tree bond would require a proponent to deposit an agreed amount of money with Council during development based on an agreed landscaping and tree planting specification. If the identified tree or trees are present and healthy after the development is completed, the funds would be returned.

- Further develop communications materials and activities, including:

    - raise awareness about measures for protecting trees as already provided for under the DCP. This would involve a review and development of new communications materials outlining the benefits of trees, expectations for tree protection and how these can be accommodated in new developments;

    - use engagement processes to better inform residents about how tree management risks are being addressed. Council actively manages tree risks through tree removal and improved selection of new trees for plantings in streets and parks. To ensure that residents and key stakeholders understands how Council actively manages these issues, further outreach and engagement opportunities will be identified;

[14] AS 4970-2009 is the Australian Standard for the “Protection of trees on development sites”.

- develop a communications package which encourages and supports tree plantings on private land through the provision of active support, information, guidelines, and incentives;

- engage with the community around perceptions of tree risk and actual tree risk. While trees can pose a risk to the safety of people and infrastructure, sometimes this risk can be managed through actions other than tree removal e.g. branch and root pruning, and regular sweeping of leaves, fruits and nuts. Understanding specific concerns and identifying management strategies can improve management of actual and perceived risks;

- explore innovative options for engaging residents and key stakeholders about the benefits of trees in streets and parks. This can include communication tools such as novelty tree tags that identify the benefits of trees or further supporting the involvement of community volunteers in tree planting and data collection.

- Undertake regular compliance activities to enforce conditions of consent.

- Create a local 'significant tree' register to identify those trees which have value due to factors such as heritage, species, size and location.

- Investigate a method to capture tree removals within the area to establish a loss rate of trees.

7.3.2 Renew and grow

Objective: *Ensure that tree planting programs strategically plan for increasing the total canopy cover across council.*

Growing the urban forest to achieve increased canopy cover targets will require not only protecting existing trees, but also additional trees are planted in available locations and ensuring ageing trees are replaced before they are lost.

In order to meet canopy cover targets for the City of Canada Bay, an increase of 6.8% in tree canopy is required by 2040. Based on estimates of plantable space, this can be achieved by:

- *Increasing canopy cover over streets*. Impervious surfaces on public streets currently cover an estimated 9% of land in the Council area. An increase in canopy cover of 28% over these impervious surfaces will deliver an additional 2.5% total canopy cover.

- *Increasing canopy cover in parks.* Plantable space in public parks currently cover an estimated 6% of land in the council area. An increase in canopy cover of 42% over these plantable areas will deliver an additional 2.5% total canopy cover.

- *Increasing canopy cover on private land.* Plantable space on private land currently covers an estimated 10% of land in the council area. An increase in canopy cover of 18% over these plantable areas will deliver an additional 1.8% total canopy cover.

Renewing and growing the urban forest will require Council to implement the following actions to encourage tree plantings on public and private land:

Short term (1-3 years)

- Develop a Park Tree Master Plan that provides a strategic approach to increasing canopy cover in parks. This should consider the following:
    - how inter-generational and in-fill plantings can be used to increase the age diversity profile of trees;
    - prioritise plantings in areas that will achieve positive habitat and connective outcomes for native diversity and coincide with the proposed NSW Government's Green Grid Corridors;
    - identify where additional plantings may be required to achieve canopy cover targets in parks; and
    - integrate biodiversity and urban ecology values into the planning of parks, green spaces, precincts and waterways through master plans where possible.
- Develop a Street Tree Master Plan that provides a strategic approach to increasing canopy cover over streets. This should identify the following:
    - priority planting locations in the context of the urban heat island, current areas with low canopy cover, biodiversity benefits and Green Grid Corridors;
    - approved trees for street planting, including culturally relevant species;
    - opportunities for increasing tree planting during road renewals, including in road planting and the potential streets in which this could be implemented;
    - planting strategies to increase the age diversity profile of trees;
    - identify where additional plantings may be required to achieve canopy cover targets in streets by suburb;
    - integrate biodiversity and urban ecology values into the planning of parks, green spaces, precincts and waterways through master plans where possible; and
    - consider and research opportunities for in road planting and the potential streets this could be implemented in. This approach to tree planting will require

engagement with residents to identify suitable streets and clear articulation of the broader benefits of in street planting, such as reduced vehicle speeds and greater shading of the road surface.

- Ensure that Master Plans and Precinct Plans include provisions for achieving 25% canopy cover. These Plans should recognise that trees are central to designing vibrant centres and describe how canopy cover will be increased in the priority areas of streets, parks and plantable private land.

- Develop a tree offset policy that requires an increased replanting ratio for trees removed on private land. This should explore a 4:1 ratio (i.e. 4 trees replanted for every tree removed).

- Update the DCP to reflect the outcomes of this Strategy. This should include a review and update of the list of recommended trees in the DCP, including the list of species that can be recommended for planting on private property. This should consider tree species that promote biodiversity and are culturally relevant to the communities that live in the City of Canada Bay, and species that are resilient to projected changes in climate.

- Create standard conditions of consent for the following:

    - develop more clearly defined and applicable conditions to improve landscaping adoption rates under Part E3.8 of the DCP. Specifically, this should focus on how to achieve the minimum number of canopy trees required to meet the provisions of Section E3.8 C4;

    - tree protection zones; and

    - minimising conflicts between people, infrastructure and trees. This should address issues such root barriers to reduce damage to footpaths and foundations, permeable paving that can provide water to trees and reduce roots running near the surface, and floating walkways that provide for pedestrian traffic over areas of large surface roots.

- Investigate opportunities for a replacement planting program which may allow for offset replanting on public land.

<u>Medium term (3-5 years)</u>

- Ensure that street trees are included in Section 7.12 contributions plans, informed by the requirements of the Street Tree Master Plan.

- Include trees as a public benefit to be delivered through the Planning Agreement Policy.

7.3.3 Support and sustain

Objective: *Manage the health and condition of urban trees to minimise risk and support and sustain a healthy, growing urban forest.*

While there is an inherent risk associated with certain tree species growing amongst people and property, no built infrastructure can adequately replace the range of benefits provided by trees. Healthy trees and systems are much less likely to pose risks than unhealthy trees, so trees should be proactively managed to minimise risk whilst promoting and sustaining urban tree health, structural condition, and amenity.

Supporting and sustaining the urban forest will require Council to implement the following actions to maintain the health and condition of trees:

<u>Short term (1-3 years)</u>

- Work with electricity companies to ensure trimming of trees under powerlines does not adversely affect tree condition and structure. Maintaining trees near powerlines is important for ensuring reliability of electricity supply, which can be interrupted when branches fall on powerlines. Improved tree pruning techniques can help to protect powerlines and also improve the overall condition of trees, ensuring that they survive longer and achieve greater canopy cover which provides more benefits to the community such as from shading.

- Promote the use of innovative techniques for water sensitive urban design and incorporate and expand water sensitive urban design measures wherever possible such as by:

    - greater inclusion of passive watering features such as leaky wells and rain gardens. This will provide greater ability retain water in the landscape which can support a healthier urban forest and more rapid growth of tree canopy cover.

    - selecting species that are robust and resilient to the potential effects of climate changes and urbanisation. This should be reflected in the development of the Park Master Plan, Street Tree Master Plan, Precinct Plans and in the recommended list of species in the DCP.

    - Incorporating water sensitive urban design (WSUD) into all new Council developments, upgrades and retrofits for streetscapes.

- Where tree planting options are limited, explore ways to enhance the structural diversity in green cover through green walls, green roofs and green laneways. This can be done by encouraging design, funding and implementation of these options where possible.

- Consistently monitor, treat and evaluate threats and attack from pest and pathogen as part of the tree maintenance program. This should be done as part of routine arboricultural management practices from within Council. The results can be recorded as part of the information retained on the tree inventory database.

Medium term (3-5 years)

- Develop and maintain a tree inventory database that identifies the age, useful life expectancy, condition and maintenance requirements of all trees on public land, including claims information. Using the tree inventory as a starting point:
-
    - develop and implement regular tree monitoring and maintenance assessments to underpin tree risk assessments for public trees. This will enable pre-emptive management of problem trees but also reduce risks from occurring in the first place.

    - explore options for including trees as assets in Council asset management plans. This should link with the development of a tree inventory database and consider how trees would be added and the consequence of this change for their ongoing management and maintenance.

- Undertake a Strategy review after 3 years which considers the following:

    - measure the canopy of the urban forest to assess progress toward meeting canopy targets. This should seek to characterise where canopy has increased and where declines may also be occurring on a suburb by suburb basis and for key precincts. Monitoring should be repeated on a 3 yearly basis and link with any state-wide monitoring that is occurring;

    - review the effectiveness of changes made to DCP controls designed to protect and increase urban tree canopy;

    - undertake canopy mapping to measure effectiveness of planting in streets and parks on public land and plantable private space;

    - evaluate the effectiveness of the Street Tree Master Plan, Park Tree Master Plan and Precinct and Master Plans in general in contributing to progress toward reaching canopy cover targets;

    - conduct a review of people, infrastructure and tree conflicts to identify common themes and successful management strategies. These learnings should be incorporated into programs that are implemented under this Strategy designed to grow and protect the urban forest; and

    - assess the extent to which resourcing under the Strategy has been able to support establishment of trees in the public realm. This should include characterisation of

activities that relate to planting, tree maintenance (e.g. watering, pruning), and direct engagement activities.

7.3.4 Engage and create

Objective: *Work with the community and key stakeholder groups to enhance the urban forest for amenity, liveability, and biodiversity benefits and provide opportunities for collaboration.*

Urban trees play a substantial role in how appealing and healthy urban areas are for people and native biodiversity. Creating engaging, attractive, and relaxing places for people to live, work and visit will contribute to the long-term liveability and resilience of the City.

The importance of trees to residents has been clearly identified by the community and key stakeholders through the engagement activities undertaken in developing this Strategy. However, while there is strong support for trees on public land, there is more concern about tree related risks for trees planted on private property. Involving the community and key stakeholder groups in tree planting and protection measures will be essential if the targets identified in this Strategy are to be met in the future.

Engaging the community and key stakeholder groups in activities that support growth and protection of the urban forest will require Council to implement the following actions:

<u>Short term (1-3 years)</u>

- Undertake a review of current engagement (e.g. letter box drop) approaches to working with residents regarding new street tree plantings. This will involve input from across Council to ensure the approach aligns with best practice from a communications and engagement perspective.

- Develop and implement a pilot project to explore new models of direct engagement with residents. This will aim to provide residents with greater opportunities to be involved with tree selection in their street and build on learnings from past engagement approaches. The approach will re-enforce the direction of the Street Tree Master Plan, especially in relation to priority streets and species selection.

- When other strategies developed by City of Canada Council are being reviewed, explore options to align their priorities and actions with this Strategy to ensure integration and consistency across Council. This is especially important given the impact of other strategy areas on the urban forest such as in relation to population growth, housing, development and transport.

<u>Long term (6-10 years)</u>

- Review the effectiveness of revised approaches to engaging with the community and key stakeholders over priority plantings in streets and parks. This should include success rates of plantings in streets and the relationship with street tree species selection.

- Undertake community and key stakeholder engagement surveys to identify any changes that may have occurred in attitudes towards trees, and the extent to which these can be attributed to programs implemented in years 1 to 5 of this Strategy.

7.3.5 Manage and resource

Objective: *Reduce conflicts between people, infrastructure and trees and ensure adequate funding is available to support urban forest growth and management.*

A number of mature, established trees exist in the City of Canada Bay. These include some remnant trees that are the last remaining from pre-development environments. Other established trees are a legacy of historical planting decisions, which likely do not align with how tree planting and species selection decisions are made today. Urban development occurring around these trees can result in conflicts with people and infrastructure resulting from a “right tree, wrong place”, “wrong tree, right place”, or “wrong tree, wrong place” scenario.

Council’s public infrastructure maintenance programs will need to be supported to ensure ongoing timely maintenance of conflicts. In addition, if the urban forest is to be increased amidst a growing urban population, applying a “right tree, right place” approach when selecting tree species and planting locations will be essential in minimising future conflicts. Appropriate resourcing must be supplied to ensure the urban forest is able to be grown and adequately managed and the community engaged and supported in helping to achieve these goals.

Managing conflicts between people, infrastructure and trees and ensuring adequate resourcing is available will require Council to implement the following actions:

<u>Short term (1-3 years)</u>

- Develop Tree Management Guidelines to reflect the outcomes of this Strategy, which consider the following public and private matters:

    - guidance on the types of trees that should be removed, such as camphor laurels. While noted as declared weeds in NSW, these trees also provide significant benefits to the community such as shading and street character. Where trees are identified for removal, a clear replacement program is required to ensure that the benefits provided by these mature trees are delivered by alternate species;

- guidelines for developers and residents to address requirements under Section E3.8 C4 of the DCP. Specifically, this should focus on how to achieve the minimum number of canopy trees required to meet the provisions;

- clarify when an arborist report is required;

- encourage the protection of private urban trees through provision of management guidelines and protection incentives that alleviate conflicts between development and maintaining canopy cover;

- encourage the protection of private urban trees through provision of management guidelines and protection incentives that alleviate conflicts between development and maintaining canopy cover;

- introduce new policies relating to revised definitions of trees and the introduction of tree bonds for new developments in appropriate circumstances;

- develop clear and consistent guidelines for the planting and maintenance of trees in varying environments such as, hard surfaces (tree pit design), podium tree planting and planting into deep soil to ensure resilience and support healthy tree growth; and

- innovative solutions for minimising infrastructure and community conflicts which do not require tree removal. This information should be provided to the community, key stakeholders and developers to assist in tree management decisions.

- Conduct an annual review of tree related claims to better inform street tree planting practices. This annual review can help inform the selection of the right tree for the right place.

- Review implementation responsibilities for tasks under this Strategy and prioritise actions to ensure they are adequately resourced

- Undertake training for staff in tree benefits, principles and best practice management processes and practices. This should align with how staff can support delivery of objectives and actions identified for the five priority themes in this Strategy.

<u>Medium term (3-5 years)</u>

- Develop a standard condition to incorporate best practice solutions for minimising conflicts between people, infrastructure and trees into the footpath application form. This should address issues such root barriers to reduce damage to footpaths and foundations, permeable paving that can provide water to trees and reduce roots running near the surface, and floating walkways that provide for pedestrian traffic over areas of large surface roots

- Undertake a review of internal processes and procedures to identify works areas that are either supporting or detracting from the delivery of this Strategy. This will include an evaluation of resources and should support the development of new guidelines or process documents where appropriate

- Explore how to use tree plantings in the public realm to generate carbon offsets. Such offsets can be used to support implementation of broader carbon mitigation strategies by Council.

8 Implementation framework

8.1 Governance

Governance describes the systematic approach to decision-making. For natural resources, this needs to be built on a foundation of government, business, and community collaboration and integration across multiple organisational levels and disciplines. With regard to governance of the urban forest, key will principles should include:

- entrenching trees in all levels of decision-making and action;
- envisioning the city and its communities as a component of the urban forest;
- engaging people (in community and organisations) around the benefits of urban trees to the environment, community health and well-being, and local economics; and
- encouraging the transition to a design that mimics the benefits of nature.

Within the City of Canada Bay, the governance arrangements supporting this Strategy should seek to include:

- intra-council integration, particularly between the planning, sustainability, and parks and garden teams to recognise and elevate trees as critical urban assets. This will result in actions being implemented across all priority areas of this Strategy and may require additional capacity building and training;

- inter-council collaboration, particularly with other councils within the Eastern District, to promote consistent, cross-jurisdictional approaches to urban forest planning and management. Given that most Councils in Greater Sydney will be aiming to increase their urban tree canopy cover, this inter-council collaboration can help develop a community of practice to assist with sharing of best practice approaches to protecting and growing the urban forest;

- community and business educational programs around the myriad of tree benefits. This should commence with existing networks of volunteer groups, such as Bushcare and extend to working with businesses in major retail precincts; and

- provision of support and incentives to encourage additional tree protection and planting on public and private land, and adoption of biophilic design principles

8.2 Monitoring and evaluation

Developing a monitoring and evaluation plan (MEP) will be essential in determining the success, or otherwise of actions in achieving targets. The timeframes for evaluation are for a mid-term review within 5 years and a full review of progress against priorities and actions within 10 years.

The first stage, prior to developing and implementing a MEP, will be to establish clear and detailed knowledge baselines about the current status of the City's urban forest. Outputs provided in this Strategy, together with recently released State data, partially fulfil this knowledge baseline. Key areas for further development relate to a finer scale understanding of the City's urban forest asset, including:

- developing a detailed public tree inventory database which will include details of:
    - tree location and health/condition;
    - tree size, canopy spread, depth, and condition;
    - species diversity and abundance;
    - management requirements;
- refining calculations of tree and urban forest benefits and values; and
- refining priority public planting programs based on species diversity, thermal mapping, plantable opportunities, and infrastructure.

In developing the MEP, the framework should be guided by global best practice for environmental monitoring and evaluation, specifically, it should be:

- **Fit-for-purpose:** tailored to the design, purpose and objectives of the projects and programs;
- **Credible:** based on scientifically and administratively defensible methods and approaches;
- **Transparent:** clearly demonstrates how public money has been spent, the resulting outputs, and where possible, outcomes; and
- **Cost effective:** costs within allowable limits, and where possible draw on and link with existing processes and information.

The Greater Sydney Regional Plan and Eastern District Plan provide a support frame for developing a MEP for this Strategy, including the development of consistent Key Performance Indicators (KPIs). In developing KPIs specific for this Strategy, the following should also be considered:

- **Temporal scale:** the monitoring framework should be established to exceed the lifetime of the Strategy, given growth times and response lags of urban trees that tend to respond over long periods, rather than instantaneously after implementation of an action.

    For example, a tree planted in year one will not substantially influence the urban forest canopy until reaching a certain level of establishment and maturity (e.g. 3-10 years depending on the species and its growth rate).

- **Spatial scale:** the appropriate scale for monitoring will vary depending on the action/s and target/s being monitored.

For example, improvements made at a single street scale may enhance the local environment yet not have a significant bearing on the overall City trends.

- **Data sources:** urban heat and green cover spatial datasets recently released by the OEH allow for a consistent benchmark to be generated for local Councils. The application of this data may be particularly useful for direct City-wide and suburb level comparisons with other Council areas and development of KPIS, though application to the finer spatial scale of action prioritisation and implementation is likely to be limited.
- **Socio-economics and stakeholder participation:** particularly in urban areas, the success or failure of many Urban Forest Strategies will be influenced by social and economic factors. Where possible, communities and stakeholders likely to affected by specific actions, either positively or negatively, should be considered, engaged and monitored.

Based on current global best practice, key elements of the MEP framework should be:

1. **Target:** the desired outcome for a biodiversity element. Targets have been developed to be SMART (Specific, Measurable, Agreed-upon, Realistic, Time-based).
    a. Targets for this Strategy are shown in Section 7.2.
2. **Baseline:** the "current" condition for a Target, that is, it's condition prior to or in the early stages of implementation of actions. The baseline measurement provides a benchmark for assessing progress towards achieving the Target.
    a. May be derived from OEH spatial dataset sources and baseline outputs provided in Sections 5 and 6.
3. **Action:** activities proposed to achieve the desired Target.
    a. Actions for this Strategy are shown in Section 7.3. Some actions may apply to multiple Targets.
4. **Indicator:** what needs to be measured to assess whether an action is achieving the desired Target.
    a. Indicators, or KPIs. may be qualitative or quantitative variables but must be able to be measured or described and when observed periodically, must be able to demonstrate trends in urban forest characteristics over time.
5. **Data collection method:** specific detail about how data will be collected for each indicator.
    a. This may include refined/detailed application of methods applied herein or may draw on OEH spatial datasets.
6. **Data source:** identifies where data will be measured (i.e. data collected).
7. **Frequency:** how often indicators will be measured.
8. **Responsible:** who will be responsible for measuring indicators and collating data.

9. **Reporting:** identifies where records of indicators measurements will be reported.

8.3 Resourcing

Growing the urban forest and maintaining the benefits it delivers will require ongoing support from the public sector, developers, businesses and the wider community.

The City of Canada Bay recognises that meeting the vision and targets outlined in this Strategy will require sufficient resourcing, including a long-term funding commitment. In the first instance this is required to achieve the 2030 canopy cover target. By outlining clear targets and supporting priorities and actions, the resourcing implications for implementing this Strategy can be assessed including the costs and benefits associated with increased tree planting in streets and parks.

Delivery of this Strategy will create some areas of new work not currently being undertaken by Council. It will also involve expanding the responsibilities of some internal program areas within Council to lead new actions, and for existing teams to start to work together more collaboratively. It is recognised that this may require additional staff resources and/or potentially a re-distribution of effort across program areas.

The development of this Strategy comes at a time when there is strong interest in the urban forest across Greater Sydney. Supported by the strategic direction and priority planting areas outlined in this Strategy, Council will pursue grant and funding opportunities to help cover costs such as those related to street tree planting. This can be supported via funding initiatives such as the state Government's 5 million trees initiative, which has successfully provided funding for tree planting that will commence in 2019/20. Other opportunities that will emerge for public funding will include part of major infrastructure projects that have provision for greening (e.g. roads and highways) and through natural landscape and conservation grants for plantings in parks and reserves.

Working with the development sector provides a major opportunity for investing in the urban forest. Significant areas of infill and development of precincts continues to occur in Council which provide opportunities for greater incorporation of trees in new developments. The community engagement work undertaken as part of this Strategy re-enforces that residents highly value trees in urban areas, which can provide developers with a marketing edge for their properties. Support for increased tree plantings can also be provided for by developer contributions, a number of which have been identified in this Strategy, such as provision of funds for planting new trees when tree removal occurs in developing a property.

The community plays a major role in helping to resource the growth and maintenance of the urban forest. The City of Canada Bay is fortunate to have a number of active Bushcare groups working in parks and reserves. An actively engaged community will also be important in planting trees on private land and helping to maintain trees in the streets, which will become a major focus for planting programs in the future.

Resourcing of this Strategy will also be enforced by continuing to understand the value of the urban forest. This Strategy provides the first ever estimate of the value of the street trees in the City of Canada Bay and for Queen Elizabeth Park. Continuing to build on this work, which can be done using volunteer community resources, can help to better justify project costs and build the business case for continued investment in the urban forest.

Glossary

Canopy	Multiple tree crowns
CLEP	Canada Bay Local Environment Plan
Crown	The living foliage of a single tree
DCP	Development Control Plan
KPI	Key Performance Indicator
MEP	Monitoring and Evaluation Plan
OEH	NSW Office of Environment and Heritage
SEPP	State Environment Planning Policies
Tree	Defined for the purposes of this project as a woody vegetation with a tree form of at least 3m in height at maturity
Urban forest	All trees on public and private land within the City
WSUD	Water sensitive urban design

Attachment A

For each suburb, the following information is provided: total area (km^2) of suburb, percent and equivalent area of each land cover type. Land cover types are: IB = Impervious – building; IO = Impervious – other; IR = Impervious – road; TC = Tree canopy; PBG = Plantable - bare ground; PG = Plantable - ground; UBG = Unplantable - bare ground; UG = Unplantable - ground; US = Unplantable – shrub; UB = Unplantable – beach; UV = Unplantable - aquatic vegetation; UW = Unplantable – water.

		IB		IO		IR		TC		PBG		PG		UBG		UG		US		UB		UV		UW	
Suburb	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**	**% Sub**	**Area km2**
Abbotsford	1.02	33.07	0.34	16.93	0.17	10.94	0.11	16.67	0.17	1.56	0.02	12.50	0.13	0.78	0.01	0.78	0.01	6.51	0.07	0.26	0.00	0.00	0.00	0.00	0.00
Breakfast Point	0.52	28.39	0.15	12.50	0.06	8.59	0.04	9.90	0.05	1.30	0.01	26.30	0.14	3.39	0.02	2.86	0.01	6.77	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Cabarita	0.52	24.74	0.13	19.01	0.10	10.16	0.05	22.14	0.12	1.30	0.01	15.36	0.08	1.82	0.01	0.00	0.00	5.21	0.03	0.26	0.00	0.00	0.00	0.00	0.00
Canada Bay	0.32	27.08	0.09	14.84	0.05	14.32	0.05	16.41	0.05	0.26	0.00	17.45	0.06	0.78	0.00	6.25	0.02	2.60	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Chiswick	0.50	23.70	0.12	18.49	0.09	11.46	0.06	12.50	0.06	0.78	0.00	19.79	0.10	1.04	0.01	7.29	0.04	4.95	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Concord	5.05	25.78	1.30	15.10	0.76	6.77	0.34	18.23	0.92	2.60	0.13	19.27	0.97	0.78	0.04	9.11	0.46	1.82	0.09	0.00	0.00	0.00	0.00	0.52	0.03
Concord West	2.67	24.48	0.65	15.89	0.42	10.16	0.27	21.35	0.57	2.60	0.07	21.09	0.56	1.82	0.05	0.78	0.02	1.56	0.04	0.00	0.00	0.00	0.00	0.26	0.01
Drummoyne	2.26	27.08	0.61	19.79	0.45	13.54	0.31	17.71	0.40	0.52	0.01	15.10	0.34	0.26	0.01	1.04	0.02	4.95	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Five Dock	2.45	27.60	0.68	22.40	0.55	12.76	0.31	15.63	0.38	1.04	0.03	12.24	0.30	0.78	0.02	5.21	0.13	1.82	0.04	0.00	0.00	0.00	0.00	0.52	0.01
Liberty Grove	0.21	23.96	0.05	15.89	0.03	16.93	0.04	33.07	0.07	0.78	0.00	7.29	0.02	0.00	0.00	0.26	0.00	1.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mortlake	0.24	40.10	0.10	19.53	0.05	13.80	0.03	11.72	0.03	1.56	0.00	5.21	0.01	5.47	0.01	0.00	0.00	2.08	0.01	0.00	0.00	0.00	0.00	0.52	0.00
North Strathfield	0.97	34.90	0.34	19.79	0.19	7.55	0.07	15.10	0.15	1.04	0.01	13.80	0.13	3.65	0.04	0.52	0.01	2.86	0.03	0.00	0.00	0.00	0.00	0.78	0.01
Rhodes	1.00	32.81	0.33	17.71	0.18	11.20	0.11	18.23	0.18	0.78	0.01	11.98	0.12	2.86	0.03	0.26	0.00	3.65	0.04	0.00	0.00	0.00	0.00	0.52	0.01
Rodd Point	0.38	29.43	0.11	17.45	0.07	14.58	0.06	14.58	0.06	0.52	0.00	17.19	0.06	1.56	0.01	0.52	0.00	3.65	0.01	0.26	0.00	0.00	0.00	0.26	0.00
Russell Lea	1.02	34.38	0.35	18.23	0.19	10.42	0.11	14.84	0.15	0.78	0.01	15.10	0.15	0.52	0.01	0.26	0.00	5.47	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Strathfield	0.16	27.86	0.04	16.93	0.03	14.58	0.02	22.14	0.04	1.04	0.00	12.24	0.02	0.26	0.00	0.26	0.00	4.69	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Sydney Olympic Park	0.29	0.52	0.00	3.13	0.01	0.78	0.00	69.79	0.20	1.56	0.00	15.10	0.04	0.26	0.00	0.52	0.00	0.00	0.00	0.00	0.00	1.82	0.01	6.51	0.02
Wareemba	0.32	36.98	0.12	24.48	0.08	11.98	0.04	9.64	0.03	0.26	0.00	13.02	0.04	0.52	0.00	0.52	0.00	2.60	0.01	0.00	0.00	0.00	0.00	0.00	0.00