Report for City of Ryde

Urban Forest Strategy

September 2022

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Acknowledgement of Country

The City of Ryde acknowledges the Traditional Custodians of this land, the Wallumedegal clan, and their connections to land, sea and community. We pay respect to their elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples.

Front cover: Macquarie Park corridor, looking south east down Talavera Rd; Image provided by City of Ryde.

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Executive Summary

The City of Ryde's urban forest refers to all trees growing within the Ryde Local Government Area. Though often taken for granted and increasingly being diminished through insensitive urban development, it is a critical part of the urban environment, forming the foundation of the City's character, identity, and resilience to climate change. The value of the urban forest for community, environment, and economy, both now and into the future, is being increasingly recognised and prioritised, though more still needs to be done, including limiting tree loss through tree retention/protection advocacy via planning and community education programs.

This Urban Forest Strategy (UFS) is an update of the existing 2013 Tree Management Plan and 2013 Street Tree Masterplan and is intended to replace both documents. This new UFS aims to elevate Council's urban forest as a critical urban asset, providing clear justifications and the evidence-base for decisions relating to feasible canopy cover targets and planting priorities.

Of particular importance is the examination of the feasibility of Council's adopted 40% canopy cover target by 2030. Whilst the cover target aligns with State policy directives, the evidence presented herein indicates the 2030 timeframe target is unrealistic considering current and future tree growth and availability of space for replanting. Consideration must be given to how the current canopy cover can therefore be increased to ensure Council does not fail to deliver on commitments and ensure the City remains cool and liveable into the future.

Further, a 5-year street tree planting program has been identified, prioritising streets by heat, current canopy cover, plantable opportunities, and vulnerable communities.

The UFS also draws on extensive feedback from community surveys and internal Council workshops, ensuring that the recommended actions for implementation are relevant and responsive to current weaknesses and barriers.

The UFS does not include a detailed tree asset management protocol, or an evaluation of ecosystem services or interdependencies, though these aspects are included as important actions for implementation moving forwards to ensure our urban trees maximise their useful life expectancy and are able to be financially valued as any other urban asset.

The strategic framework for this UFS is based on five interconnected principles:

1. Learn;
2. Grow;
3. Protect;
4. Invest; and
5. Engage.

Each principle has a key objective and a set of actions. In total 35 actions have been recommended, based on internal and external input, technical analyses, global best practice, and an understanding of the issues and challenges for growing the urban forest. Together, this UFS and its actions provide the City of Ryde with a clear evidence-base on which to grow and protect the urban forest.

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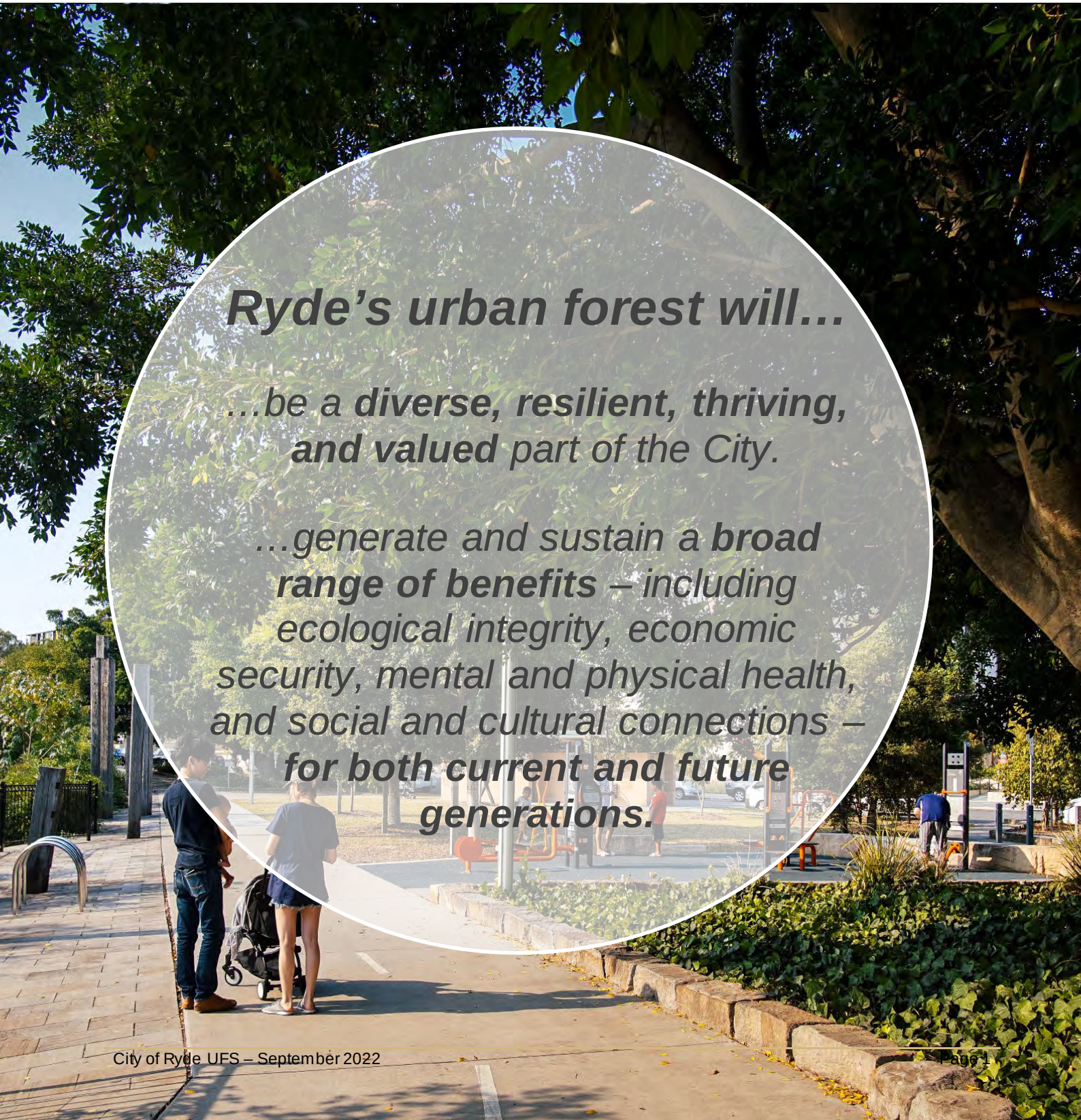
Vision Statement

The following vision for Ryde's urban forest echoes the key objectives of the previous Tree Management Plan and builds on this by recognising the urban forest as a keystone in the City's long-term resilience planning, health, longevity, prosperity, desirability, and inclusiveness. It establishes Ryde as a forward-thinking and leading urban land manager. In doing so, the vision also responds to the overarching vision and seven goals established within the City's Community Strategic Plan 2028 and planning priorities of the Greater Sydney Commission's North District Plan/City of Ryde LSPS (2020).



PART 1.

INTRODUCTION AND CONTEXT

1 Defining the Urban Forest

1.1 Defining the urban forest

Over recent decades, the urban forest has become a focus of sustainability-based and resilience-based planning, strategies and actions in cities world-wide due to the integral role it plays in the long term for community and biodiversity. Over the years, multiple definitions of *urban forest* have emerged depending on different priorities and management drivers, these definitions generally centre around either just trees, or trees and other vegetation. The definitions outlined below are those provided by two leading NSW government sources:

- NSW DPE's definition as included in the *Greener Neighbourhoods Guide* (Hopwood, et al., 2021):
  - "An urban forest comprises all trees and vegetation – and the soils and water that support them – in an urban area. These components are strategically planned, designed, and managed to support resilience and wellbeing"
- NSW Government Architect's definition as included in the Greener Places: An Urban Green Infrastructure Design Framework for NSW (Government Architect New South Wales, 2020):
  - The layer of trees and tree populations that exist in urban settings.

For the purposes of this Urban Forest Strategy (UFS), the definition adopted aligns with the NSW Government Architect's definition, as the strategy will focus on the City's tree population. This definition also aligns with other Council documents such as the City of Ryde Development Control Plan 2014. Whilst the focus here is on trees, the City of Ryde recognises and acknowledges the importance and benefits provided by all vegetation. The definition for this UFS therefore is as follows:

The City of Ryde's urban forest comprises all trees within the city's boundary, irrespective of the tenure or context within which the tree grows.

1.2 What is the City's urban forest?

The City of Ryde's urban forest is a critical part of our urban environment, forming the foundation of our City's character, identity, and resilience to climate change. The urban forest is immensely diverse and dynamic, ranging from natural bushland and mangrove-lined waterways to public open spaces, street verges, backyard plantings, and green roofs to balcony pots (Plate 1). This diverse urban forest provides a multitude of benefits to the City's communities, wildlife, environment, local economy, and infrastructure (Figure 1).

Plate 1. Examples of vegetation comprising the urban forest: (a) natural bushland; (b) street trees; (c) private garden trees; and (d) parkland/open space trees.

2 Why the Urban Forest is Important

The urban forest provides a multitude of environmental, social, cultural, and economic benefits. Whilst most of these benefits are provided by trees, benefits provided by other vegetation (e.g. shrubs, grasses, and aquatic plants) should not be discounted, particularly with regard to the benefits provided to biodiversity, urban cooling, and aesthetics.

To help maximise the benefits of the City's greening actions and to align with State canopy cover directives, the primary focus of this Strategy is on the City's urban trees.

Urban trees are one of the very few public assets that appreciate in value over time, with larger and well-growing trees providing greater benefits than small trees and those in poor health or condition. This is largely attributed to the numerous benefits trees provide and the long-term impacts when lost and associated delays in re-establishment of that value until the new tree then reaches maturity. This, in many cases can take decades whilst in the interim the loss impacts not only the natural environment contribution but to that of community in the area.

Health data is also connecting the strong link of human health to the value of trees and cooling benefits in the urban environment including links to increased mortality rates and biodiversity decline as a direct result of loss or heat. This is being experienced globally as urban temperatures continue to rise causing intensified and more frequently occurring heat waves exacerbated by urban growth and densification and removal of canopy providing critical shade, cooling and water retention in our cities. Heat contributes to the deaths of over 1,000 people aged over 65 across Australia each year (Osmond & Sharifi, 2017) and is now widely being experienced in Greater Western Sydney.

The range of benefits provided by urban trees are broadly categorised as social, environmental, and economic (Figure 1). These benefits are well studied, globally acknowledged, and increasingly quantified by their service and financial value. For example:

- London – the world's first National Park City with a canopy cover of just over 21%, report that critical services provided by their urban trees each year, such as flood and air pollution reduction and carbon sequestration, are valued at £132.7 million; and the replacement cost of their urban forest is more than £6 billion (Rogers, et al., 2015);
- New York – with an urban canopy cover of 24%, report that their 5.2 million trees provide annual benefits valued at US$122 million, returning $5.60 worth of value for every $1 spent on managing them (Peper, et al., 2007; Nowak, et al., 2018); and
- Melbourne – report that their urban trees, which provide a 22% canopy cover across the city, provide annual services valued at AUD$650 million (City of Melbourne, 2012).

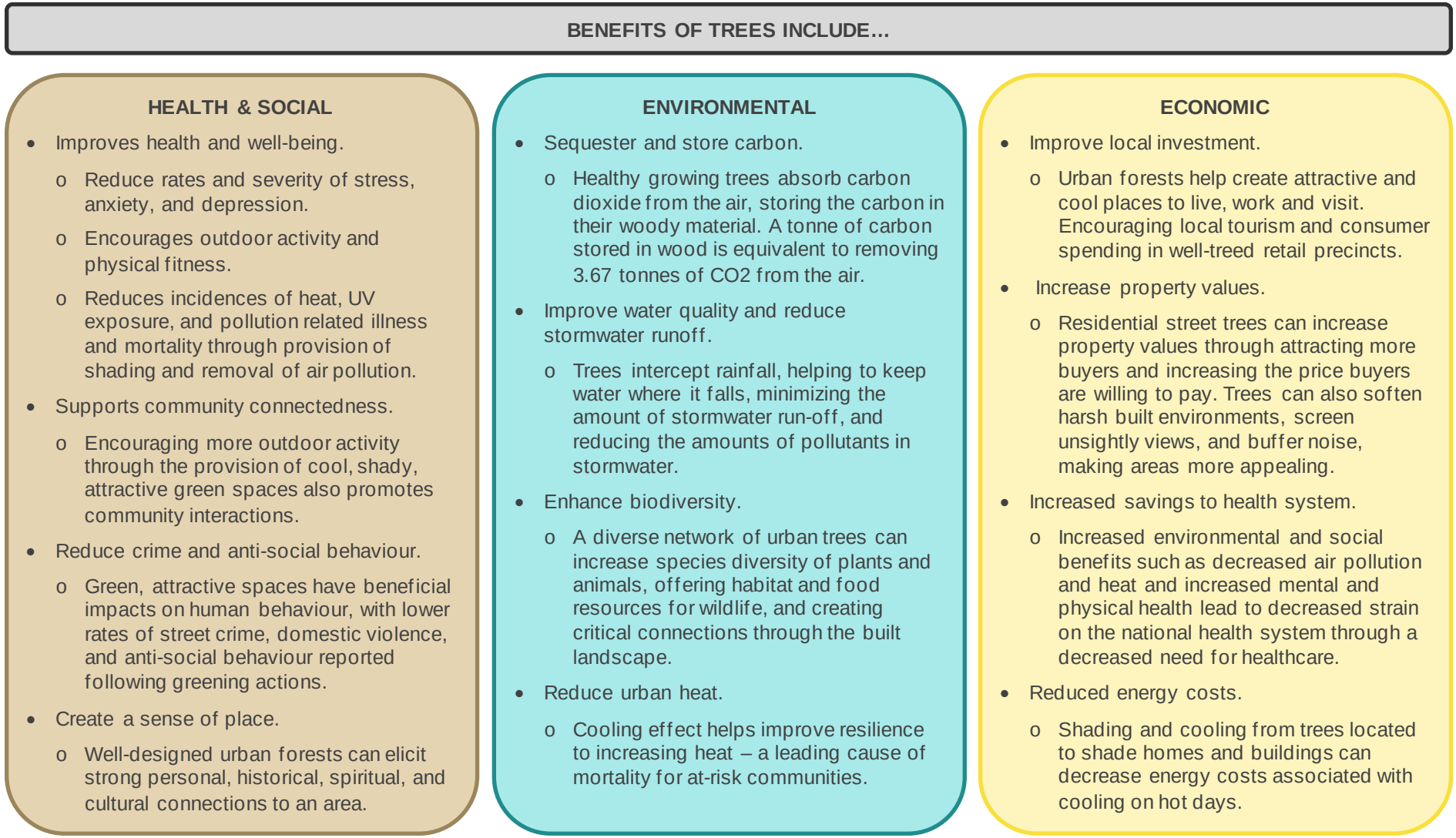


Figure 1. Examples of social, environmental, and economic benefits provided by urban trees.

3 What the City's Residents Say

A review of a Council's recent (Nov. 2021) community survey about trees was reviewed to gauge public perceptions and trends relevant to growing and managing the urban forest. Survey responses were received from 755 individual residents representing:

- nine of the City's 16 suburbs;
- roughly equal numbers of males and females;
- a greater proportion of older (>50 years old) than younger age groups (68% versus 32%, respectively);
- predominantly (88%) English only speakers; and
- predominantly (77%) people living in detached houses.

The key survey findings, together with a review of Council's "Community Consultation Report 2021: Management of Trees" are as follows:

IMPORTANCE OF STREET TREES

The majority of respondents place a high importance on street tree plantings on their street[1].

- **More than 75% of all people** regardless of main language or age place a **higher importance** on having trees planted on their street.
  - This trend held true at the suburb level for: Ryde, North Ryde, Eastwood, Gladesville, East Ryde, Meadowbank, Melrose Park, Denistone West, and Chatswood West.
- **A greater percentage** of residents of **higher density housing (84%)** place **high importance** on having trees in their street.

SATISFACTION WITH STREET TREES

Whilst there is a high proportion of respondents that place a high importance on having street trees on their street, a similarly high proportion are not satisfied with the current tree planting on their street.

- Approximately **70-80% of residents** across all language and age groups **express lower satisfaction** with tree planting on their street (due to, for example, species selection, location, maintenance).

PERCEIVED BENEFITS OF STREET TREES

The perceived benefits provided by trees are often biased towards visual and environmental benefits that are most readily observed or felt, with less recognition, or value, placed on the economic and social benefits provided by trees. This trend holds true in these surveys.

- Trees are viewed as **most beneficial for improving air quality**, the **visual quality of streets** and **providing shade** and **pedestrian comfort**. The potential benefits of trees on real estate values and privacy are ranked lowest.
  - These trends held true across demographics, housing types and suburbs.
  - However, it is interesting to note that significantly more younger people (<50 years) than older people placed a higher importance on the benefits of trees on property values and privacy.
  - Further, privacy provided by trees was significantly more important to residents currently living in high density housing than those in detached houses.

[1] NB. The 2028 Community Strategic Plan also echoed the community's support of the urban forest through ranking tree retention/protection and nature connection as a top 3 priority for Council.

PERCEIVED ISSUES WITH STREET TREES

It is common for people to focus disproportionately on the few issues posed by trees than their multitude of benefits. Such issues tend to show substantial demographic trends and differences.

- Of the 11 issues presented, the **main issues of importance** to respondents were: **tree species**, **poor tree health**, **trees under powerlines**, **damage to pavements/trip hazard**, and **safety – traffic visibility.**
    - **Non-English speakers** were significantly **more concerned about** numerous issues with **street trees** than English speakers[2].
- Whilst **leaf/fruit drop** was perceived as a **much lesser issue**, significantly more elderly respondents (>65 years) viewed tree species as a significant issue. This may be due to the propensity of leaf/fruit drop by certain species perceived to increase trip/slip risk, or potentially issues associated with allergies.
- **In general,** residents said that too few street trees were an issue whilst too many street trees was the lowest ranked issue. This suggests that **more street trees would be** perceived as **a net-positive**.

[2] Likely attributed to 'fear of the unknown' resulting from different cultural-based environmental connectivity/experiences together with an unfamiliarity with natural Australian environments

4 Developing the Urban Forest Strategy

The approach to develop this UFS involved desktop reviews, workshops with council staff, and baseline spatial analyses (

Figure 2; Annexes A-E).

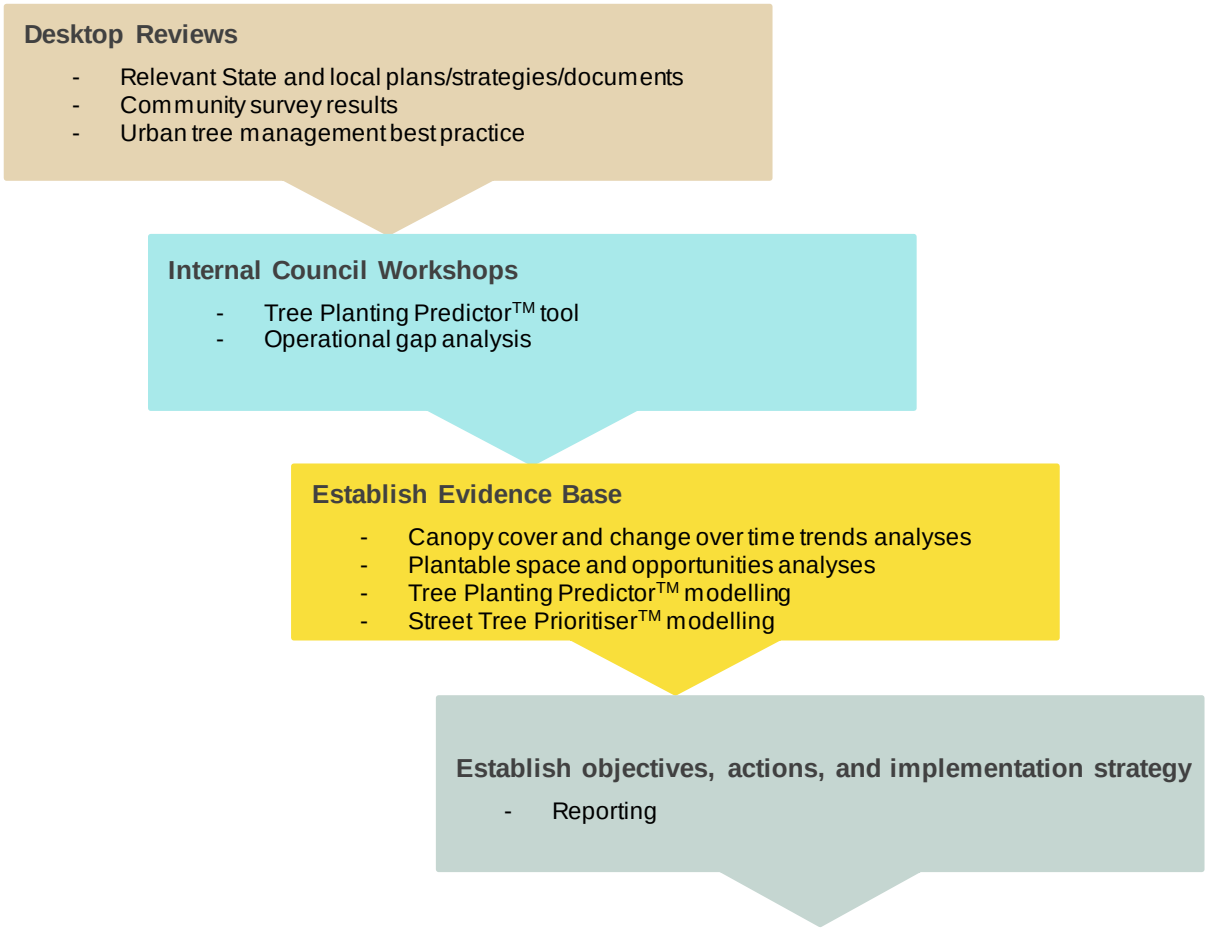


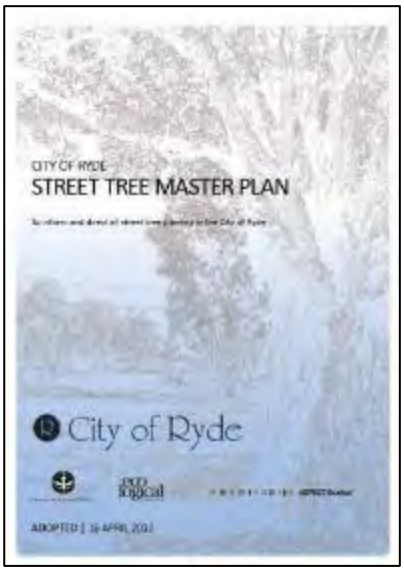
Figure 2. Approach taken to develop this Urban Forest Strategy.

5 Strategic Context

In 2013, the City of Ryde adopted the *Urban Forest Plan* and *Street Tree Masterplan* (STMP) - strategic documents that established Council's commitment and action framework to the improved holistic management of the urban forest.

In 2016, the *Urban Forest Plan* was renamed the *Tree Management Plan* (TMP) due to divisions at that time relating to the term "urban forest". Over the last 5 years, especially, there has been substantial advances in the urban tree management and planning space, and the term 'urban forest' is now widely used and accepted as a collective term for all urban trees, and in some cases, all urban plants (see Section 1.1).

This UFS is an evolution of, and will supersede, both the TMP and STMP, establishing the framework, evidence-base, objectives, and actions for the City's urban forest over the next five years.



Driving and supporting documents related to the Urban Forest Strategy

The NSW strategic planning framework connects key planning priorities identified at regional or district scale with the finer-grained planning at the local level (Figure 3). This UFS will relate either directly or indirectly to the following existing local and State documents. Further details on the relevance of these documents to the UFS is provided in Annex A.

The UFS is also influenced by guiding and supporting State Government documents and programs such as the Greater Sydney Green Grid, the Greening Our City Premier's Priority and the Greener Neighbourhoods program.

- State level documents of relevance:
  - Premier Priorities: Greening our City[3]
  - Environmental Planning and Assessment Act 1979;
  - Biodiversity Conservation Act 2016;
  - Greater Sydney Region Plan; and
  - North District Plan.
- City of Ryde documents of relevance:

[3] Increase the tree canopy and green cover across Greater Sydney by planting 1 million trees by 2022, as part of the government's longer-term commitment to plant 5 million trees by 2030 and increase average canopy cover across Greater Sydney to 40%.

- Planning Ryde: Local Strategic Planning Statement 2020;
- Community Strategic Plan 2028;
- Ryde Local Environmental Plan 2014;
- Ryde Development Control Plan 2014;
- Integrated Open Space Plan 2012;
- Ryde Biodiversity Plan 2016;
- Plans of Management (various);
- Ryde Resilience Plan 2030 (adopted September 2020);
- Tree Management Plan 2013; and
- Street Tree Masterplan 2013.

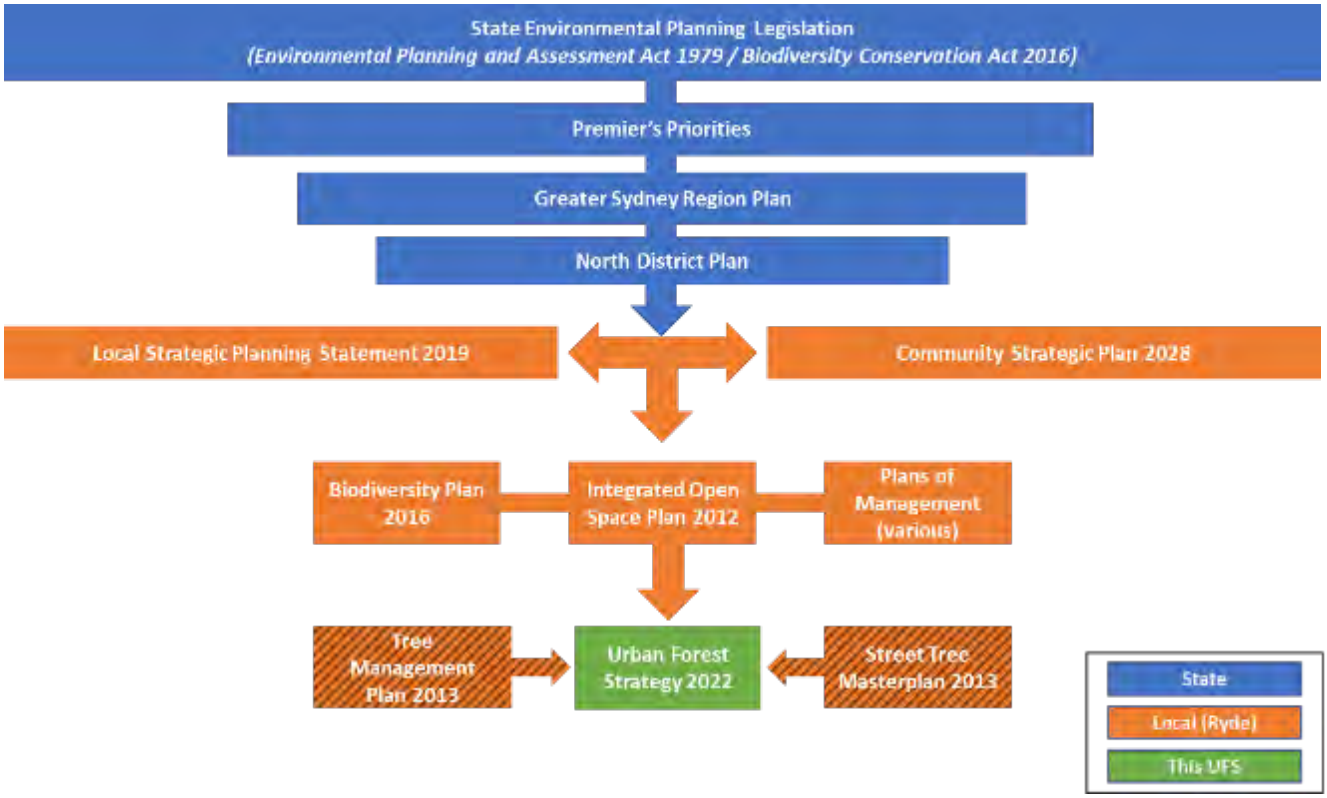


Figure 3. Strategic context for the Urban Forest Strategy, showing its relationship to key State and local documents of relevance. Note, the Urban Forest Strategy will supersede the Tree Management Plan 2013 and the Street Tree Masterplan 2013.

PART 2.

CANOPY TARGETS, TRENDS AND PRIORITIES

6 Canopy Cover Targets

With the benefits provided by urban forests now being widely acknowledged and increasingly understood, there is a growing global focus on increasing urban forest cover to increase the derived benefits to communities, environment, and economies. This may be achieved through two main mechanisms: (1) retaining and protecting existing trees to allow for maximum tree growth[4]; and (2) planting new trees to replace more mature trees that may be lost and also to add to the existing tree population.

Whilst retention/protection and new plantings are the key mechanisms for growing the urban forest, effective planning and management requires establishing baselines on which targets can be set and progress measured. With most of the benefits provided by trees provided by the tree's leaves and above-ground woody material (e.g. stems and branches), canopy cover[5] is widely used as a proxy for quantifying urban forest cover. Local Councils are therefore commonly establishing ambitious canopy cover targets, though often without a clear understanding of what their current canopy cover is and the practical implications required to achieve the target, such as the: number of trees that need to be planted, financial commitment, and space required within the target timeline.

The City of Ryde has committed to increasing canopy cover to 40% by the year 2030. This target aligns with State government directives for Metropolitan Sydney and target timeframe for adoption by councils.

The remainder of this report identifies:

- Recent trends in the City's canopy cover and gaps between the existing canopy and targets;
- Issues and challenges to meeting the targets;
- Tree planting requirements to achieve the 40% target by 2040 using Edge's Tree Planting PredictorTM (TPP) tool;
- Prioritised street tree plantings using Edge's Street Tree Prioritiser (STP) tool;
- Best practice planting and tree management guidelines; and
- An Actions and Implementation Plan

[4] Larger and more vigorously growing trees provide the greatest benefits.

[5] A tree 'crown' is the leaves, branches and stems of an individual tree, whereas tree 'canopy' refers to the multiple tree crowns growing in a given area.

7 Canopy Status and Trends

7.1 Land Zones

Cover was assessed across the City and within 11 Council land zones. The spatial boundaries of these zones are based on 2020 Council zoning spatial layers (Table 1; Figure 4), though with modification of zone boundaries as required to align with the State Government's road reserves layer (which comprises Council's road area as well as adjacent road verge areas that fall within other Council zone boundaries). Note that modification to align with the State Government's road reserves layer was only applied to those roads and verges that Council has high influence over management and tree plantings. Specifically, the following roads were excluded from Council's road reserve area:

- Victoria Road;
- Epping Road;
- The M2 motorway;
- Blaxland Road;
- First Avenue / Rutledge Street;
- Lane Cove Road;
- Balaclava Road;
- Wicks Road / Goulding Road;
- Pittwater Road; and
- Herring Road and Talavera Road.

The modified land zone areas and canopy cover areas for each zone is shown in Table 1. All analyses are based on the modified areas.

7.2 Current Canopy

Canopy cover was assessed using artificial intelligence (AI) and photogrammetry datasets available through NearMap (further details available in Annex C). This dataset defines a tree as vegetation greater than 2m in height.

The low density residential (R2) zone comprises the greatest proportion of the City area - which at 40.78% is substantially higher than public parkland and local roads combined (at 21.64%). Medium density residential (R1, R3) comprised the least area (0.70%) (Table 1). Each land zone was also allocated to an area of 'council influence', which indicates the relative level of control (low, medium, high) that the City of Ryde has over tree plantings in each of the zones (Table 1).

Current (i.e. 2020) **canopy cover** using this methodology across the City, was calculated at **28.9%** (11,665.69 km^2; Table 1; Figure 5). Nearly one-third of this canopy cover occurs on land zoned Low Density Residential, which covers nearly 41% of the Council area and over which Council has medium control for influence or increase in tree plantings (Table 1).

Nearly half of the City's canopy cover occurs on the four land zones under high Council influence, which together cover nearly 32% of the Council area (Table 1; Figure 5).

Table 1. Land Zones assessed, listed in order of land area within each of the Council Influence areas (see also Figure 4).

Council Influence Area	Land Zone & (Planning Code)	Area m^2 (% City Area)	Canopy Cover m^2 (% Land Zone)
City-wide		***40,365,263***	***11,665,692 (28.90%)***
High	Council controlled road reserves (Roads)	6,645,960.89 (16.46%)	1,238,862 (18.64%)
	NPWS (E1/C1)	2,638,363 (6.54%)	2,238,650 (84.85%)
	Parkland (RE1)	2,091,952 (5.18%)	777,311 (37.6%)

	Natural areas (E2/C2)	1,458,288 (3.61%)	1,312,723 (90.02%)
Medium	Low density residential (R2)	16,461,311 (40.78%)	3,358,557 (20.40%)
	Private recreation (RE2)	758,417 (1.88%)	183,716 (24.22%)
Low	Various special infrastructure (SP1, SP2)	4,347,491 (10.77%)	1,242,196 (28.57%)
	Town/neighbourhood centres (B1, B3, B4, B5, B6, B7, DM)	4,037,064 (10.00%)	839,628 (20.8%)
	High density residential (R4)	1,293,118 (3.20%)	375,688 (29.05%)
	Industrial (IN2, IN4)	351,193 (0.87%)	34,309 (9.77%)
	Medium density residential (R1, R3)	282,105 (0.70%)	64,052 (22.70%)

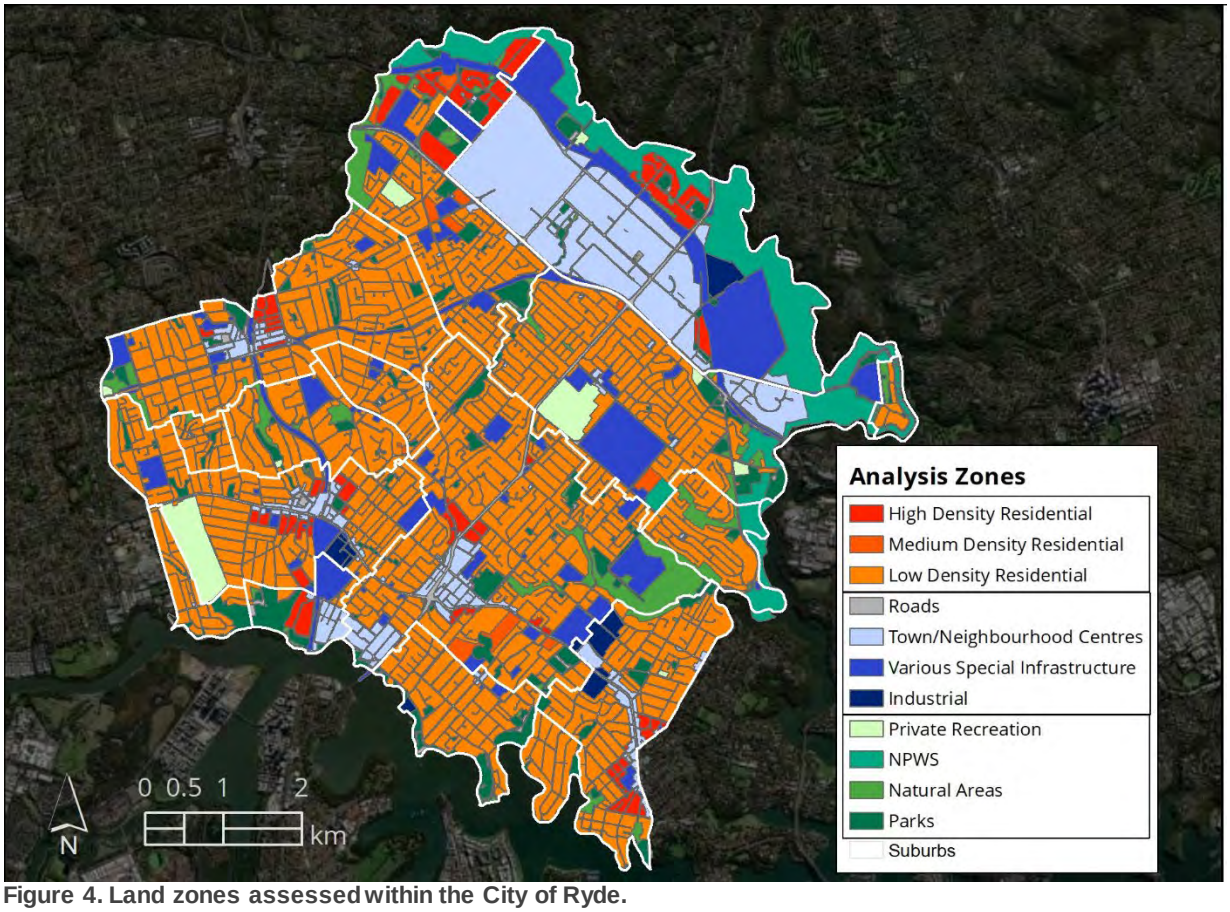


Figure 4. Land zones assessed within the City of Ryde.

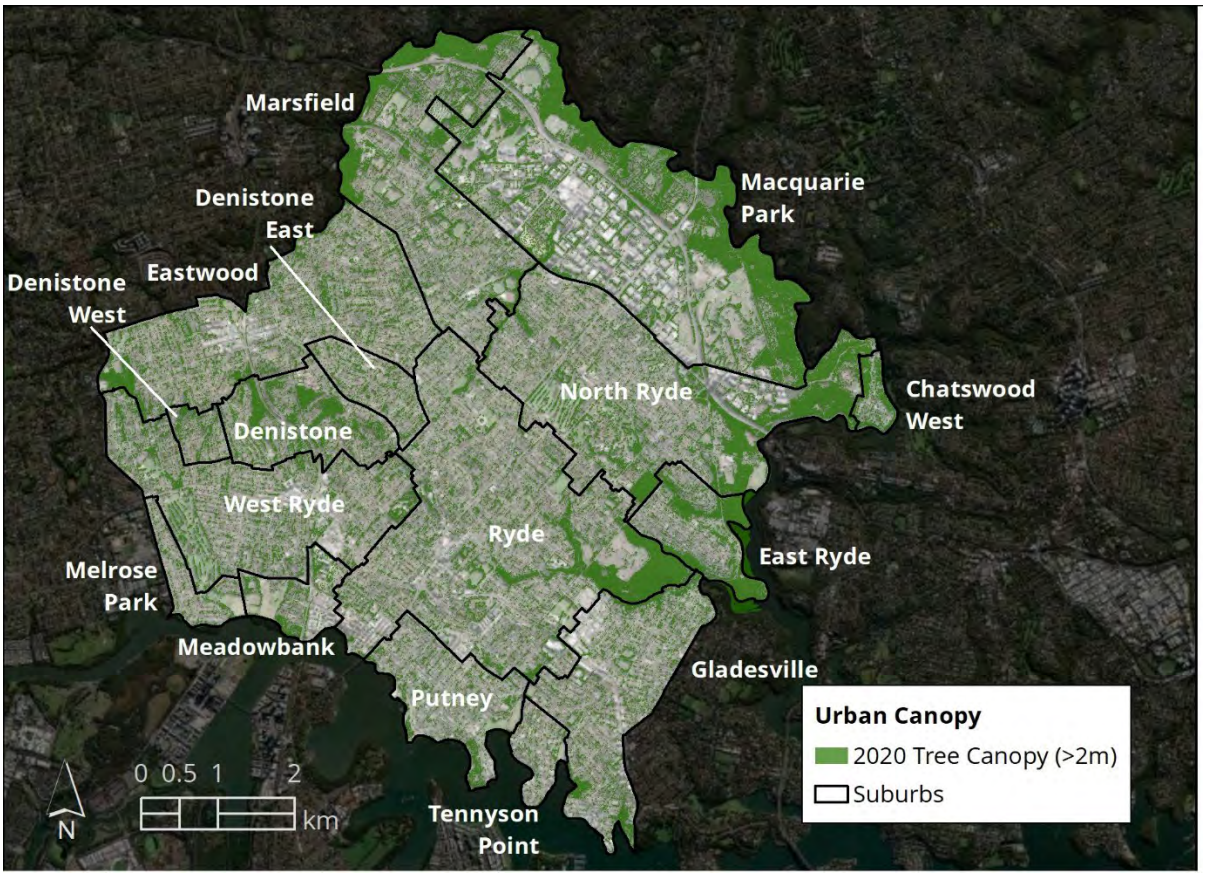


Figure 5. Mapped canopy cover (28.9%) for 2020 within the City of Ryde.

7.3 Change over time

Canopy cover within each zone was also assessed over time to identify trends in canopy cover change. Change was assessed between 2010-2017, 2017-2020, and 2010-2020.

The 2017 interim time period was selected for analysis to investigate potential impacts on canopy cover resulting from the following changes made at this time to the DCP controls, specifically:

- Pruning of up to 10% of the crown of a tree within each calendar year without approval permitted;
- Distance where tree works can be conducted without approval increased from 3m to 4m from the stem of a tree of a legally constructed dwelling, outbuilding greater than 20m^2, carport or pool; and
- Further tree species added as exempt from requiring approval for tree works/removal.

Whilst more recent changes to State government planning and building codes will also influence Council's ability to protect and retain trees on private land, such changes are considered too recent to allow for meaningful impacts on canopy cover to be detected.

Across the City, canopy cover was lost between 2010-2017 and 2017-2020, resulting in an overall **loss of 1.83%** canopy over the decade **between 2010 and 2020**, from **30.73% to 28.9%** (Figure 6). This equates to a net loss of 0.737km^2, or the equivalent area of 102 rugby fields.

Whilst there was an overall gain in canopy cover within the high control areas (1.20%), these were outpaced by overall losses within low and medium control areas (-12.88% and -5.15%, respectively) (Figure 7). The sections below summarise the key trends over time for each of the control areas, with further details for each land zone provided in Annex C – Table 12.

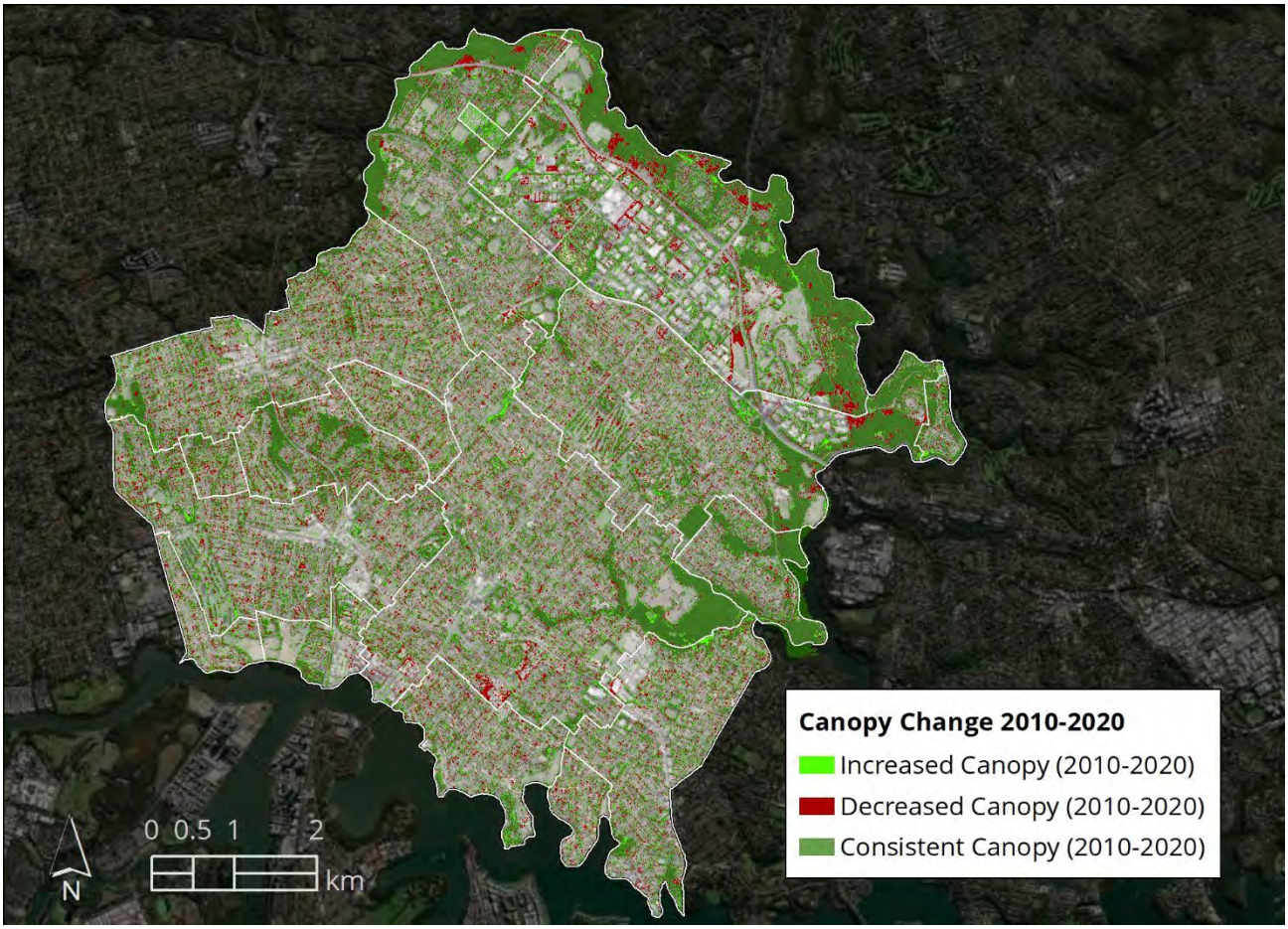


Figure 6. Canopy change within the City of Ryde and suburbs (white lines) showing increases and decreases of canopy between 2010 and 2020.

High influence areas

Canopy cover in both parklands and road reserves increased across each time period assessed (by 4.41% and 0.75%, respectively). Natural areas overall also experienced an increase in canopy cover (0.52%), though this increase was negatively impacted by a loss of 0.24% in the most recent years (Figure 7). More surprisingly was the loss of canopy within the NPWS land zone across each time period, resulting in an overall loss of 4.54% between 2010-2020 (Figure 7). This may have been as a result of hazard reduction burns in the Lane Cove National Park.

Medium control areas

Canopy cover in both the low density residential and private recreation land zones decreased across each time period assessed (by -3.81% and -1.31%, respectively) (Figure 7). Whilst the majority of this loss on low density residential land occurred in the initial 7 years, within private recreation land, more than twice as much canopy loss occurred in the most recent 3 years, than in the initial 7 years (-0.88% and -0.43%) (Figure 7).

Low control areas

Canopy cover decreased across each time period assessed in the medium density residential, various special infrastructure, high density residential, and town/neighbourhood centres land zones (-7.86%. -1.25%, -1.65% and -0.65%, respectively) (Figure 7).

Comparatively, the industrial land zones experienced losses and gains across the time periods assessed, though overall, more loss than gains occurred within the zone between 2010-2020.

Of interest, the medium density residential land zone experienced the greatest loss in canopy cover of all land zones since 2010 (-7.86%), despite gains in canopy cover over the last 3 years of 0.62% (Figure 7).

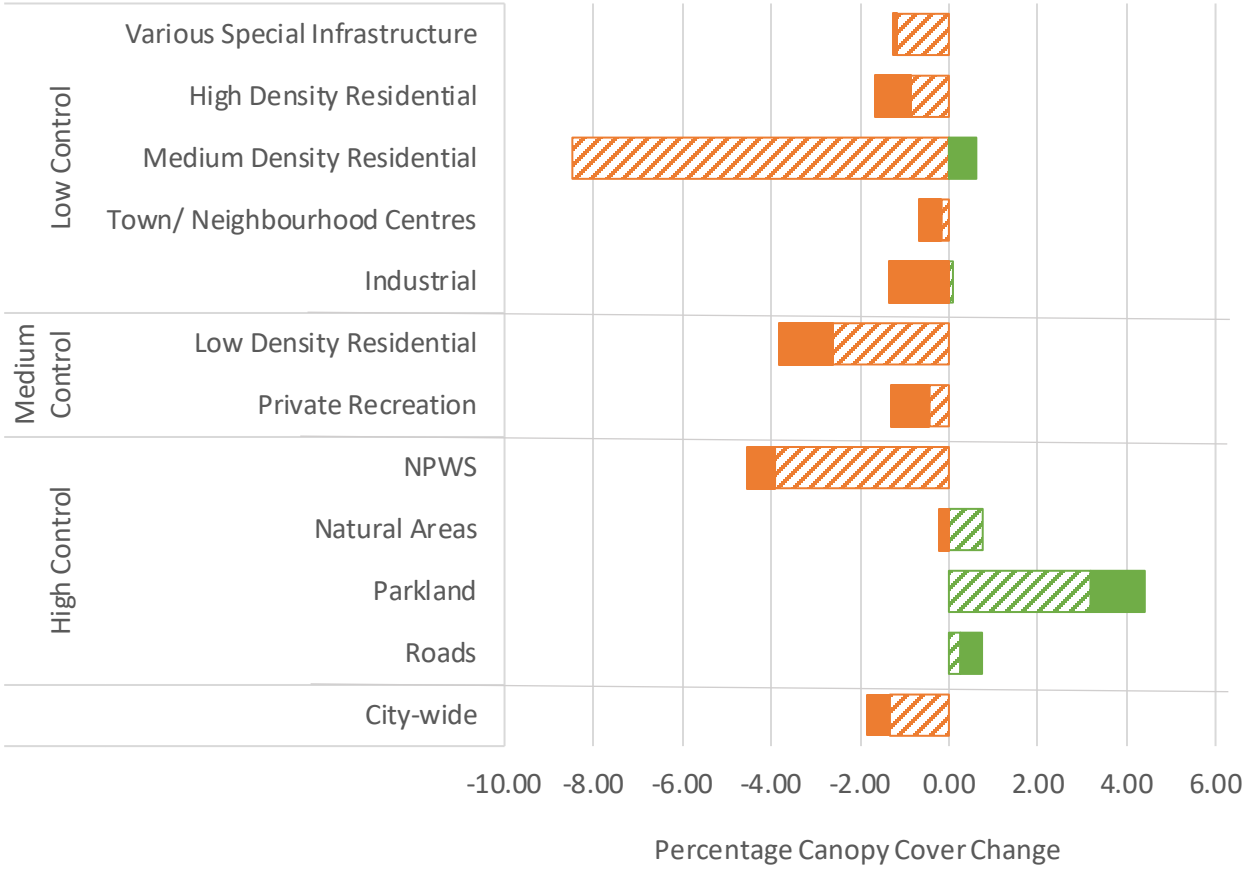


Figure 7. Trends in canopy cover change within each Land Zone: 2010 - 2017 (lined); 2017-2020 (solid). Orange shading represents a loss of canopy cover and green shading a gain.

8 Planting Scenarios for Achieving 40% Canopy Cover

The feasibility and requirements to achieve the 40% target[6] by 2030 were investigated using Edge Environment's Tree Planting Predictor™ (TPP) tool[7]. Given the uncertainty around the requirements or feasibility of achieving the cover target by 2030, as part of the investigation, the implications of achieving the cover target over longer time frames (2040 and 2050) were also investigated and compared. Further details on the TPP are provided in Annex D.

8.1 What is achievable under a business as usual (BAU) scenario?

The City of Ryde currently plants, on average, 750 trees per year representing 42 species, of which 7% are categorised as class A trees, 42% category B, 16% category C, 24% category D, and 11% category E[8] (Annex D).

Under this **BAU scenario** (factoring in planting to 2050), the canopy area **by 2030** will be 11,580,202 m^2 (28.7% of the City) (Figure 8). This is marginally less than the starting canopy of 11,665,569 m^2, with **the reduction being due to the rate of growth of trees not being enough within the next 7 years to keep up with the current rate of loss (currently 0.18% per annum)**. In practical terms, neutralising this loss requires at least 700 Category D trees to be planted per annum and more for smaller crowned species.

By 2040, the canopy area starts to increase as larger trees move through their active growth phase, achieving a canopy of 11,675,804 m^2, and by 2050, the canopy area is projected to be 11,958,639 m^2 (29.1%) (Figure 8).

This highlights a need to increase the current planting rate and potentially adjust the species selection to achieve the 40% canopy target. Alternatively, if no changes are made to current planting rates and species mixes, a more achievable canopy target should be considered.

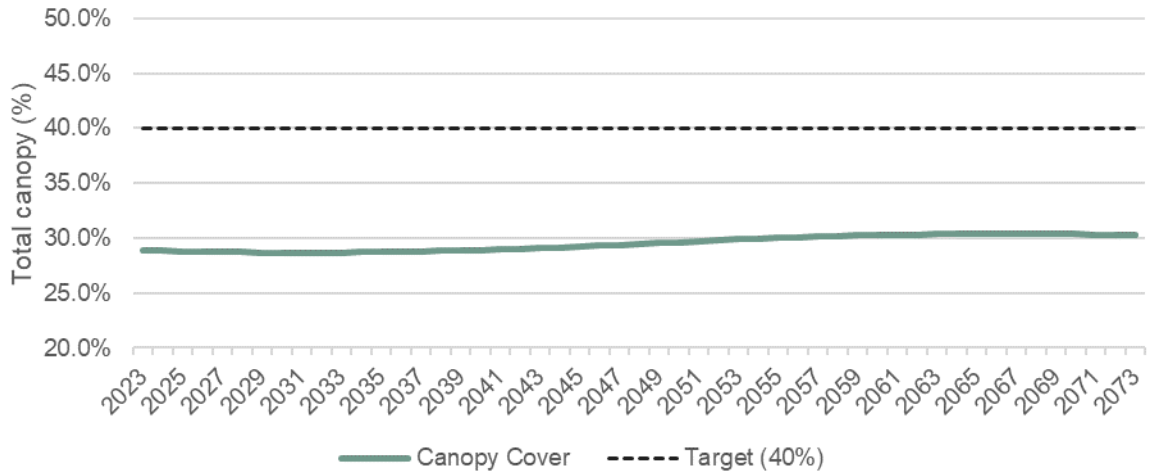


Figure 8. Increase in total canopy cover (blue line) over time under a BAU planting scenario of 750 trees per year. Current plantable space is indicated by the red dotted line, and the canopy cover target shown by the black dotted line.

[6] Total canopy cover area of 16,145,912 m^2.

[7] Noting that modelling assumed tree planting year 1 is 2022, though the baseline canopy cover applied was from 2020. Therefore, any plantings completed between 2020 and 2022 will not have been captured in the baseline canopy cover input data.

[8] tree categories are applied in the TPP tool and relate to tree growth rate, crown spread at maturity, and height at maturity. They range from small (Category A) to large (Category E trees). See Annex D for further details.

8.2 Alternate scenarios: how many trees need to be planted, and at what cost, to achieve the 40% canopy target?

The number of trees that need to be planted to achieve a 40% canopy cover in the future was assessed using the Tree Planting Predictor. To explore how this could be achieved a number of planting scenarios were developed (Table 2) with the outputs shown in Tables 3 and 4, noting that a maximum annual planting rate of 3,000 trees per year has been applied to Council land across all scenarios. The cumulative canopy cover graphs from each scenario are shown in Figure 9.

Table 2. Planting scenarios compared within the TPP modelling. For each scenario, the number of trees planted in year 1 (2023) is shown, together with the percentage increase of decrease of planting numbers each year, and the planting mix applied each year of Category A-E sized trees.

Scenario	# Trees Planted in 2023	% Increase in Tree Planting Numbers Per Year*	Planting Mix				
			Category A	Category B	Category C	Category D	Category E
A	750	2024-2035: +30%	7%	42%	16%	24%	11%
B	750	2024: +200% 2025: +100% 2026: +50% 2027-2029: +10% 2030: 5% 2031: 0% 2032-2033: -5%	7%	42%	16%	24%	11%
C	750	2024-2029: +30% 2030-2050: 0%	7%	42%	16%	24%	11%
D	15,000	2024: +65% 2025: 0% 2026: -50% 2027: -70%	7%	22%	26%	34%	11%
E	22,000	2024: +80% 2025: -30% 2026: -80%	7%	42%	16%	24%	11%

** % increase values for each year are relative to the preceding year's planting number. A positive percentage values indicates an increase in tree numbers planted, whereas a negative percentage value indicates a decrease in the number of trees planted.*

Scenario A shows that if Council increases its rate of planting from 750 trees per year by 30% per year until 2033 (with the same planting mix as BAU), then the 40% target can be achieved by 2059. If a more accelerated increase occurs with a 200% increase in 2024 (**Scenario B**), then the 40% target could be achieved six years earlier, by 2053. **Scenario C** illustrates how, if Council increased the rate of planting each year to a more modest 3,000 trees per annum by 2029 (and then levelled planting out at this rate), the target would not be reached until 2069.

The challenge in meeting a 2040 target is that the slower initial planting rates lead to slower growth in the canopy. Whilst likely to not be practical because of the resource requirement, **Scenario D** has an initial planting rate of 15,000 trees in 2023 and an altered planting mix that includes a greater proportion of larger Category C and D trees. This results in meeting the 40% target by 2042. Comparatively, **Scenario E** keeps the planting mix the same as the BAU mix but significantly increases the rate of planting in the first few years, resulting in the target being achieved in a similar timeframe to Scenario D but required about 17.5% more trees to be planted.

Due to Council's tree planting funding capacity limits, there will likely be a growing reliance on the number of trees that will need to be planted and paid for by private land holders.

Table 3 shows the number of trees that would need to be planted each year to reach future targets. Other than Scenario C which is capped at 3,000 trees per year, all other scenarios require some level of planting and payment by private landholders. For example, under Scenario A, 43% of required plantings are by Council and 57% will have to be on private land).

A further issue for consideration is the amount of plantable space required to achieve the canopy increase. At a landscape level, there is 4,690,819m^2 of plantable space in the public and private realm, which is about 5% more than is required to achieve the 40% target. However, not all of this land will be plantable in practice, for example, overhead and underground utilities may render some areas unplantable. The number of plantable opportunities therefore requires further analysis, including whether areas not currently considered as plantable (e.g. car parks, roadways) can be used for future plantings. This constraint is discussed in more detail in Section 8.4, below.

Scenario	Year that the target is reached	Total trees planted	Trees planted on Council land	Trees planted on private land
A	2059	71,875	30,567 (43%)	41,308 (57%)
B	2053	75,169	30,000 (40%)	45,169 (60%)
C	2069	75,567	75,567 (100%)	
D	2042	80,762	15,000 (19%)	65,762 (81%)
E	2041	94,864	12,000 (13%)	82,864 (87%)

Overall, the analysis indicates that while a 40% target is achievable, whether and how this occurs will be influenced by the planting rate and especially whether higher rates of planting can occur in earlier years, the species mix and proportion of larger trees planted, the ability for private landholders to contribute to tree planting efforts, and the availability of plantable space. Furthermore, the analyses suggest that the achievement of targets could be accelerated if plantings on private lands are brought forward.

Table 3. The year that each of the five planting scenarios reaches the 40% target and the number of trees that need to be planted to achieve the target. It was assumed that for any given year where the number of trees planted exceeded 3,000 that additional trees would be planted on private land. The ordering of the scenarios moves from a close to BAU approach (Scenarios A-C) to more ambitious plantings (Scenarios D-E).

Scenario	Year that the target is reached	Total trees planted	Trees planted on Council land	Trees required on private land
A	2059	71,875	30,567 (43%)	41,308 (57%)
B	2053	75,169	30,000 (40%)	45,169 (60%)
C	2069	75,567	75,567 (100%)	
D	2042	80,762	15,000 (19%)	65,762 (81%)
E	2041	94,864	12,000 (13%)	82,864 (87%)

Table 4. Summary of the number of trees planted per year for each of the five planting scenarios. The % change indicates the change in planting numbers from one year to the next. This data was used as an input direct into the Tree Planting Predictor. Note that for Scenarios C the annual planting rate is assumed to continue at 3,000 trees per year each year from 2035 to 2050. It was assumed that for any given year where the number of trees planted exceeded 3,000 that additional trees would be planted on private land.

	Trees													
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	>2050
Scenario A														
Trees planted/yr total	750	975	1,268	1,648	2,142	2,785	3,620	4,706	6,118	7,953	10,339	13,441	16,129	
% change		30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	20%	
Scenario B														
Trees planted/yr total	750	2,250	4,500	6,750	7,425	8,168	8,984	9,433	9,433	8,962	8,514			
% change		200%	100%	50%	10%	10%	10%	5%	0%	-5%	-5%			
Scenario C														
Trees planted/yr total	750	975	1,268	1,648	2,142	2,785	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
% change		30%	30%	30%	30%	30%	30%	0%	0%	0%	0%	0%	0%	0%
Scenario D														
Trees planted/yr total	15,000	24,816	24,816	12,408	3,722									
% change		65%	0%	-50%	-70%									
Scenario E														
Trees planted/yr total	22,000	39,600	27,720	5,544										
% change		80%	-30%	-80%										

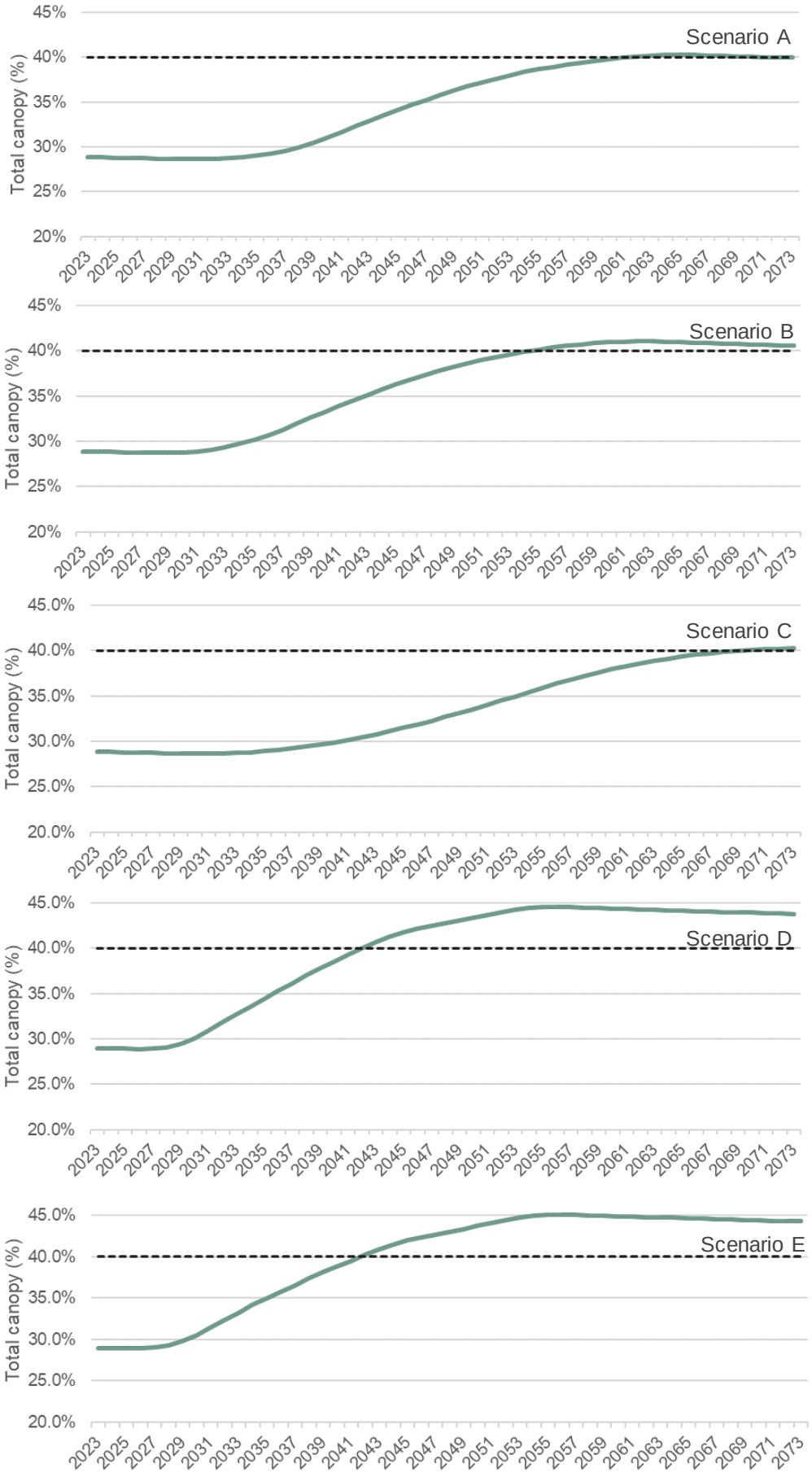


Figure 9. Cumulative canopy cover for planting Scenarios A – E expressed as a % of the total land area.

8.3 What are the cost implications?

The cost estimates for planting trees is based on an average cost of $200 per tree, which includes purchase cost, planting labour, and management over a 12 month establishment period. For each subsequent planting year, a 2.5% CPI[9] increase in the cost per tree has been applied.

The total cost commitment required to achieve the 40% canopy cover target by 2050 to 2060 (Scenarios A and B) is about $18 million (Table 5), whereas reaching the target by 2040 would cost $17-$20 million. However, this investment would be over a shorter period of time because of the need to plant larger numbers early meaning that the cost by 2030 is nearly fifteen times higher than the current BAU spend for 750 trees per year, and nearly six times higher than if 3,000 trees were planted each year.

Table 5. Projected total and average annual costs of tree plantings across the TPP scenarios modelled.

Scenario	Total Cost to 2030	Total Cost to 2035	Total Cost
BAU (40% target not achieved)	$1,310,417	$2,271,066	$5,978,970
A - 40% target achieved **by 2059**	$4,032,734	$18,022,585	$18,022,585
B - 40% target achieved **by 2053**	$10,824,412	$17,541,224	$17,541,224
C - 40% target achieved **by 2069**	$3,483,141	$7,325,737	$22,157,352
D - 40% target achieved **by 2042**	$16,795,920	$16,795,920	$16,795,920
E - 40% target achieved **by 2041**	$19,536,721	$19,536,721	$19,536,721

8.4 Is there enough space?

Another key consideration in assessing the feasibility of canopy cover targets is the sufficiency of space to plant the required number of trees (i.e. plantable space), and further, how much of that space occurs on Council-owned and managed land versus State or privately-owned land. For the purposes of these analyses, **plantable space** is defined as any pervious surface lacking woody vegetation cover, such as grassed and bare ground areas. In addition, council-defined 'discount factors' were then applied to plantable space for the following land zones to help reflect the need to maintain recreational open spaces within the urban matrix:

- High influence areas
  - RE1 (parks): 63%;
  - E2 (natural areas): 5%; and
- Medium influence areas
  - RE2 (Private recreation): 100%

Whilst steps have been taken to reflect actual plantable space with consideration to maintaining recreational open space, ground-truthing should be undertaken to refine these assumptions. These proportions will vary not only among tenure types, but also relative to context and current and future land uses. Refinement of the modelling to include ground-truthed plantable space across land use types should be a focus of future analyses.

Nearly 14% (5,616,446m^2) of the City was identified as plantable space (Table 6). Given a total 4,480,344m^2 of additional canopy cover is needed to achieve a 40% canopy cover (assuming no loss of canopy from the 2020 cover amount, see Section 8.2), these analyses suggest that the current plantable space is adequate to achieve the canopy cover target, though 80% of the plantable space would need to be used. It is noted though that the plantable space has not been ground-truthed as part of this project and analysis, so there may be less than 14% plantable space, given planting

[9] https://www.abs.gov.au/statistics/research/70-years-inflation-australia

restrictions such as overhead and underground services, and available soil volume not included in these analyses. Considering these additional planting restrictions it may be that there is not currently enough space available to plant the number of trees needed to achieve the canopy cover target. In this case, alternative options will need to be considered, such as replacing infrastructure with plantable space (e.g. traffic islands, road protuberances, areas within car parking lots).

It is therefore apparent that reaching the canopy cover target may be challenging, but compounding this challenge is that just over 25% of the City's plantable space falls within high influence areas, primarily within the road corridors; with the majority of plantable space occurring in medium influence areas within the low density residential zone (Table 6, Figure 10). These findings suggest that:

- to achieve the 40% canopy cover target, regardless of the year achieved, there will need to be a collaborative effort between Council, developers, and private landowners and managers;
- options for increasing plantable space (e.g. road protuberances) will likely be required in order to plant the number of trees needed to meet the canopy cover target; and
- within high influence areas, parks will play an important role for supporting increased tree plantings. This is especially important given that larger crowned trees will be able to the planted in parkland zones, compared to road reserves, for example, that generally can only support smaller-crowned trees.

Table 6. Relative plantable space within each of the Council influence areas.

Council Influence Area	Total Area (m^2)	2020 Plantable Space (m^2)	% of Influence Area Plantable	% of Total Plantable Space
High	12,834,564	1,199,716	9.35	25.36
Medium	17,219,728	2,115,935	12.29	44.73
Low	10,310,971	1,415,222	13.73	29.91
Total	***40,365,263***	***4,730,873***	***12.00***	***100.00***

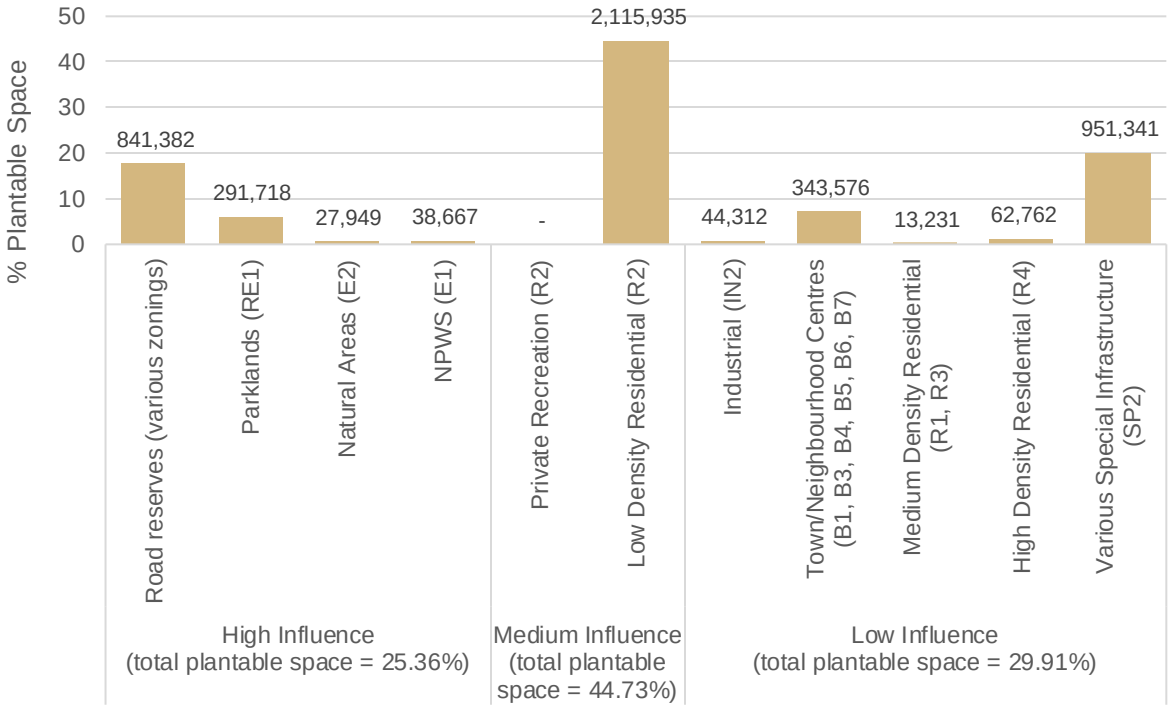


Figure 10. Contribution of each Council land zone and Council control area to total plantable space. Also shown for each land zone is the total area of plantable space within the zone.

9 Prioritising Street Tree Plantings

The City's urban streetscapes comprise a significant portion of the City's urban canopy. Furthermore, streetscapes and verges are a primary target for tree planting as the trees provide shading over bitumen – one of the hottest surfaces in urban environments and a significant contributor to urban heat – and can reduce temperatures as much as 20ºC. Trees also provide cooling for pedestrians which increases walkability and can greatly reduce car reliance and associated carbon emission increases.

To understand the capacity of streetscapes to accommodate more trees, Edge Environment's Street Tree Prioritiser™ (STP) was applied to the City of Ryde to identify the plantable opportunities available within street corridors, and to provide a realistic estimate of the number of additional trees that could be planted in those areas to help in meeting urban canopy targets. For these analyses, the **street corridor** (hereafter referred to as 'road reserve') is defined by the New South Wales Road Corridor Dataset which includes all road areas from footpath to footpath (i.e., all road surfaces and areas including road-adjacent footpaths, approximately 4 metres surrounding most road surfaces).

Plantable opportunities are derived from identified plantable space (see Section 8.4) and broadly defined as an area of plantable space that is larger than 1m^2 and at least 5m away from the next nearest plantable opportunity. Further details regarding the method applied to derive plantable opportunities is provided in Annex E.

9.1 Plantable opportunities within road reserves

The STP identified 15,959 plantable opportunities (Annex E - Figure 21) within Ryde's road reserves (along 425.85 kilometres of road) equating to an average of 3.7 plantable opportunities per 100 metres of road (out of a theoretical maximum of 40 opportunities per 100m accounting for verges on both sides of the road).

Assuming that all plantable opportunities were planted with a small standard tree that achieves a 5m crown diameter at maturity, the 15,959 plantable opportunities could contribute approximately 7% to the city-wide required canopy cover increase needed to meet the 40% target. The potential impact of planting larger trees in the road corridor is explored in Section 9.1.1.

To understand these plantable opportunities in more actionable terms, plantable opportunities were aggregated to street levels. Aggregating results to this level identified 53 street segments with more than 50 plantable opportunities. Further, the top 10 streets account for 901 of the 15,959 plantable opportunities, with Quarry Road and Twin Road in Ryde being the most plantable having 134 and 102 plantable opportunities, respectively (Table 7).

Table 7. Top 10 streets with the most plantable opportunities (full dataset provide in Excel spreadsheet and to be confirmed through site ground truthing.

Top 10 Streets	Suburb	Plantable Opportunities
QUARRY RD	Ryde	134
TWIN RD	North Ryde	102
LANCASTER AVE	Melrose Park	92
COXS RD	North Ryde	90
AGINCOURT RD	Marsfield	84
VICTORIA RD	West Ryde	84
PHILLIP RD	Putney	81
TALAVERA RD	Macquarie Park	79
EPPING RD	Macquarie Park	78
PRINCES ST	Ryde	78

To account for road length, the plantable opportunities per 100 metres of road length was also assessed, resulting in 71 streets having more than 10 plantable opportunities per 100 metres of road, including Lardelli Drive and Buffalo Road in Ryde having 70 and 53 plantable opportunities per 100 metres (Table 8, Figure 11). This way of quantifying plantable opportunities prioritise some shorter streets that have a high density of plantable opportunities.

Table 8. Top 10 streets with the most plantable opportunities per 100 metres of road (full dataset provided in Excel spreadsheet).

Top 10 Streets	Suburb	Total Plantable Opportunities	Plantable Opportunities per 100m
LARDELLI DR	Ryde	32	70
BUFFALO RD	Ryde	73	53
UNNAMED	Meadowbank	71	40
BLAXLAND RD	Denistone	32	34
RYEDALE RD	Eastwood	19	27
SMALLS RD	Ryde	25	26
STURDEE ST	North Ryde	16	25
BAY ST	Melrose Park	27	24
TWIN RD	Ryde	9	23
WINSTON ST	Marsfield	17	22

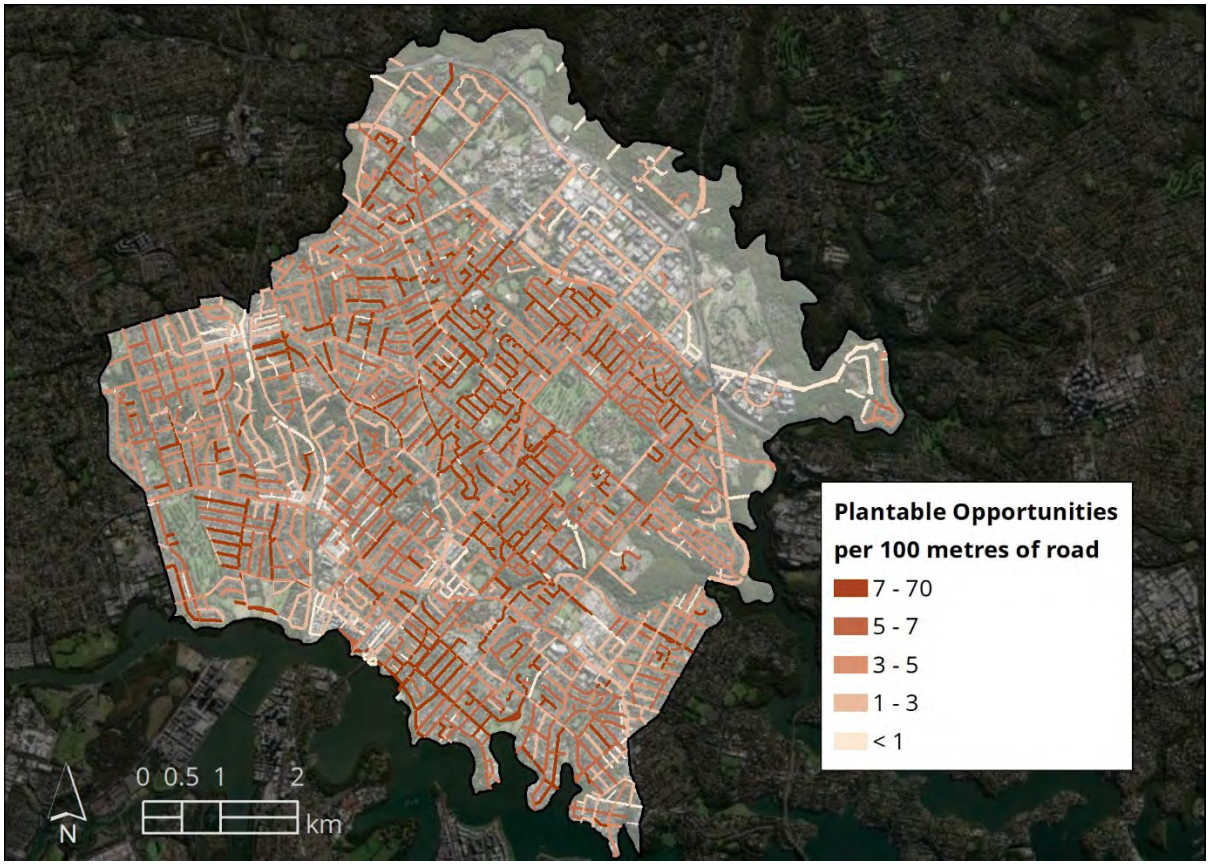


Figure 11. Plantable opportunities per 100 metres of road. Data symbolised by Quintile, with each colour representing 20% of the total roads.

Comparative analysis of tree size influence on STP outputs

Examining the effect of planting trees of various crown sizes at maturity on the outcomes from the STP was examined for Brabyn Street, as a case study. The comparison reveals a non-linear pattern of exponential increase in canopy coverage with larger trees (Table 9), with this shown visually for a section of Brabyn Street in Figure 12.

The default STP modelling uses 5m spacing and trees with a 5m diameter crown[10], resulting in 19 plantable opportunities with a projected total canopy area of 390m^2 at maturity. Here we compared the impact on the contribution to total canopy cover area if we planted trees with average crown spreads aligning with the small (Category A), medium (Category C) and large (Category E) trees used in the Tree Planting Predictor modelling.

Compared to the default STP modelling, planting using only small, Category A trees (2m diameter crown at maturity) would allow for approximately 157% more plantable opportunities (49) but with approximately 60% less contribution to canopy cover (154m^2). Comparatively, increasing the size of trees planted reduces the number of plantable opportunities but increases the overall contribution to canopy cover. For example, increasing tree sizes to Category C trees (6.5m diameter crown), compared to Category A trees, reduces the number of plantable opportunities along Brabyn Street by just over 60% (19) but increases the overall canopy contribution at maturity by more than 300% (630.5m^2). Similarly, Even more pronounced is the impact of planting Category E trees which reduces the number of plantable opportunities to 9 (82% less than Category A and 53% less than Category C), but substantially increases the contribution to canopy cover along the street to 3,578m^2 (2,225% more than Category A and 467.5% more than Category C).

The larger trees provide substantially more canopy cover over the road surface, creating a larger urban cooling impact through shading streets. However, a reduced number of plantings increases the vulnerability to the urban canopy as any single tree failing to reach maturity would have a more significant impact on canopy cover targets than losing a smaller tree.

Table 9. The influence of tree size on plantable opportunities and overall contribution to canopy cover.

Tree Size Category and Assumed Mature Crown Spread (m)	Number of Plantable Opportunities	Total Contribution to Canopy Cover at Maturity (m2)
Category A (2m)	49	153.94
Default STP Tree Size (5m)	20	392.70
Category C (6.5m)	19	630.48
Category E (22.5m)	9	3,578.47

[10] Equivalent to an extra-large Category B tree or smaller Category C tree.

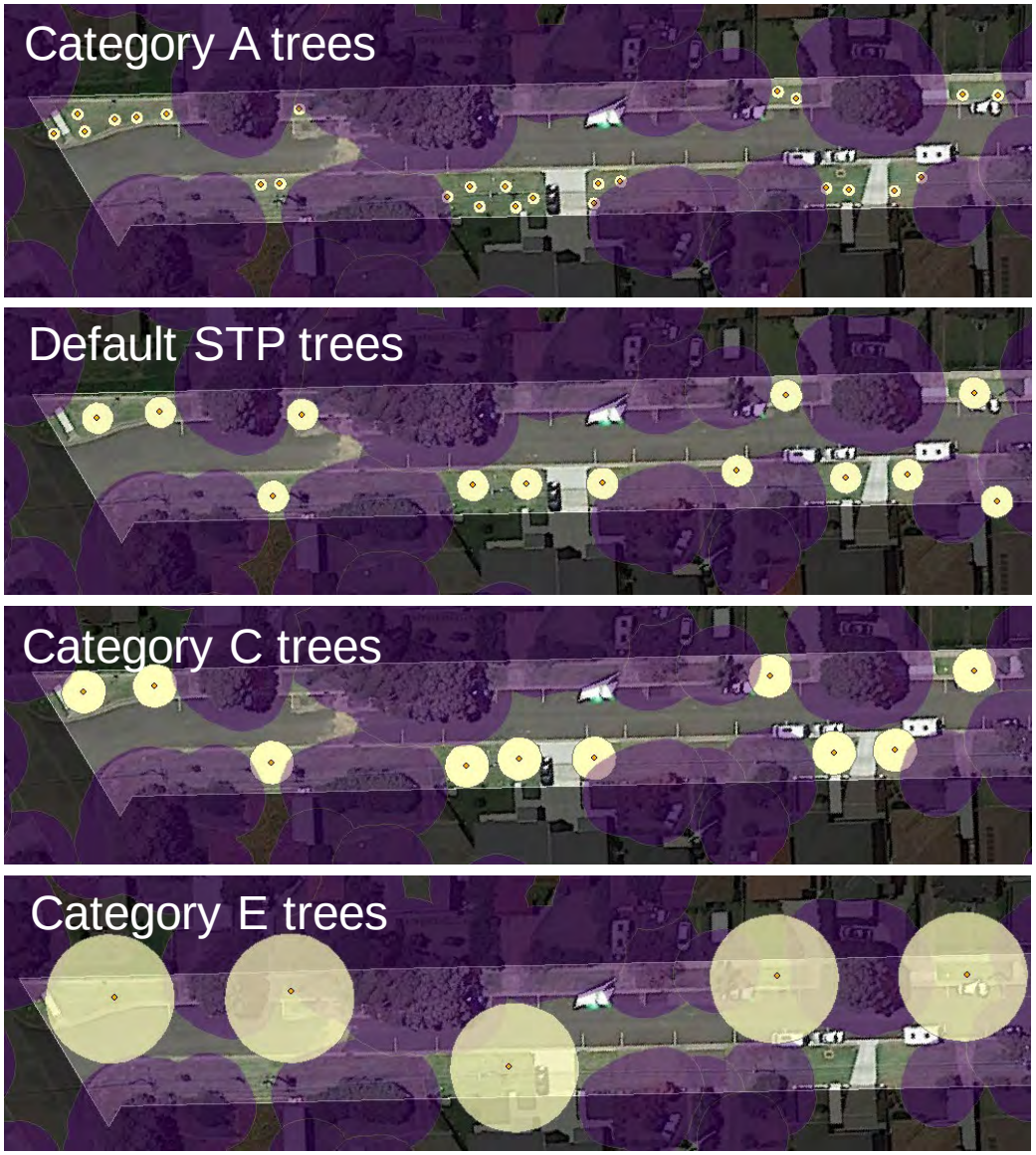


Figure 12. Impact of planting different sized street trees on total canopy cover, showing a small portion of Brabyn Street to visualise impact.

9.2 Differing impacts of planting locations

Not all plantable opportunities are equal in that planting trees in some locations may have a bigger impact than in other areas. As such, plantable opportunities have been ranked according to three metrics: lack of canopy, urban heat vulnerability, and social vulnerability[11]. Further details about the method for data extraction is provided in Annex E.

Adding trees to areas with the lowest current canopy aims to fill in "blank spots" within the urban canopy. Adding trees in areas of high heat vulnerability provides cooling in areas where it is (and will be) needed most contributing to an overall increase in city evapotranspiration benefit. Adding trees in areas of lower socioeconomic status aims to reduce inequalities of green amenities and provide benefits where people may not be able to plant trees themselves or withstand impacts of heat due to lack of trees. This will have additional benefits such as reducing the household cost of cooling in extended hot weather or heatwave periods (via the reduction of appliance use) and a reduced long-term economic burden on this vulnerable community.

[11] This is consistent with the NSW government approach (NSW Department of Planning, Industry and Environment, 2021)

Each of these three metrics individually provide a robust rationale for prioritising planting. However, combining all three metrics into a single indicator provides a quantitative approach to prioritise tree plantings based on multiple factors. As such, the Integrated Priority Assessment (IPA) normalises each of the three input metrics for each road segment and computes a single comparative prioritisation metric. The IPA analysis ranks each road segment based on the three factors and tabulates the number of plantable opportunities within each road (Figure 13, Table 10).

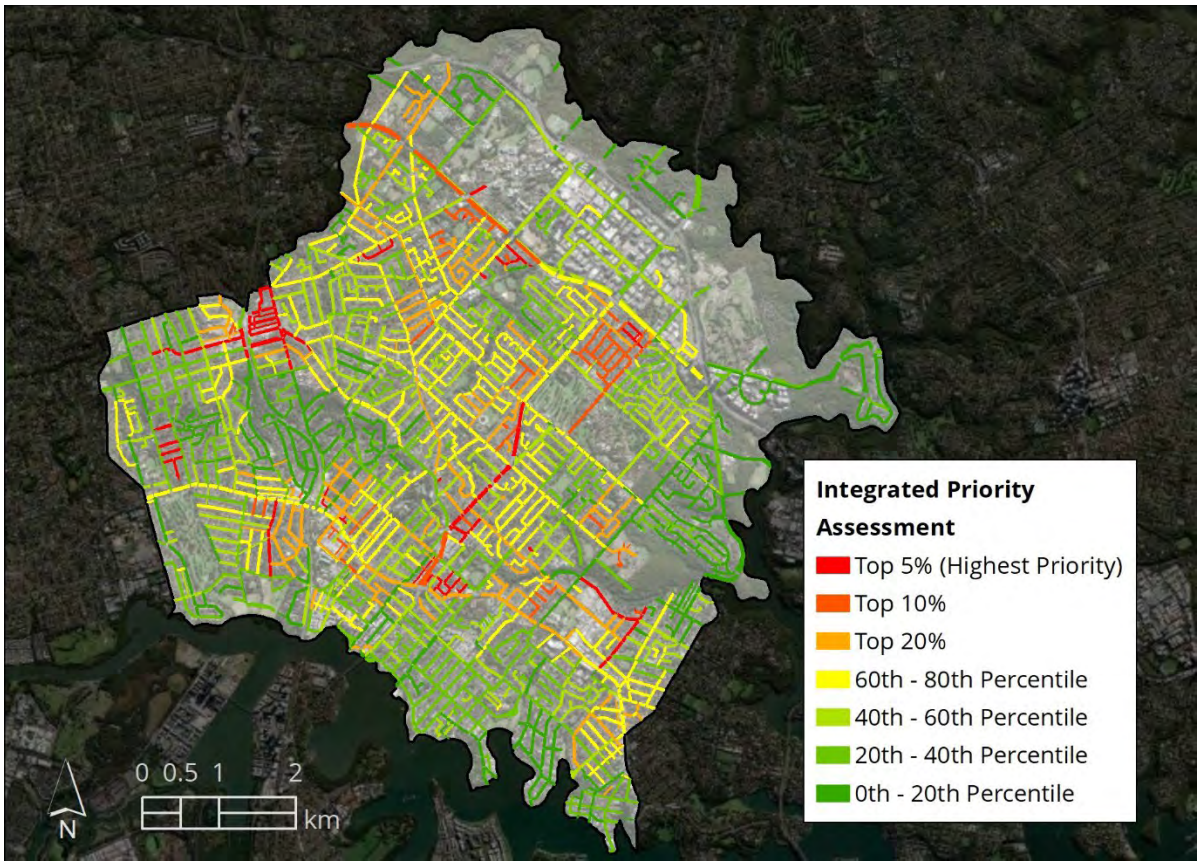


Figure 13. Integrated Priority Assessment highlighting top areas for street tree planting across the City.

When coupled with the BAU planting rate of 750 trees per year, this allows for a detailed planting schedule identifying which roads should be targeted for planting in each of the next five years (Figure 14). Highest priority areas for planting include Balaclava Rd in Macquarie Park and Ball Ave and Railway Parade in Eastwood and other high priority planting areas with 20 or more plantable opportunities include: Blaxland Rd, Irene Cr, Rowe Street, and First Ave in Eastwood, Higginbotham Rd in Gladsville, and Tramway St in West Ryde, among others (Table 10).

Other roads, including Lane Cove Rd and Victoria Rd in Ryde and Epping Rd in Marsfield, were identified as high priority areas but fall outside Council's remit, with control lying with the State government. Still, pursuing plantings along these roads in concert with appropriate decision makers would generate substantial benefits.

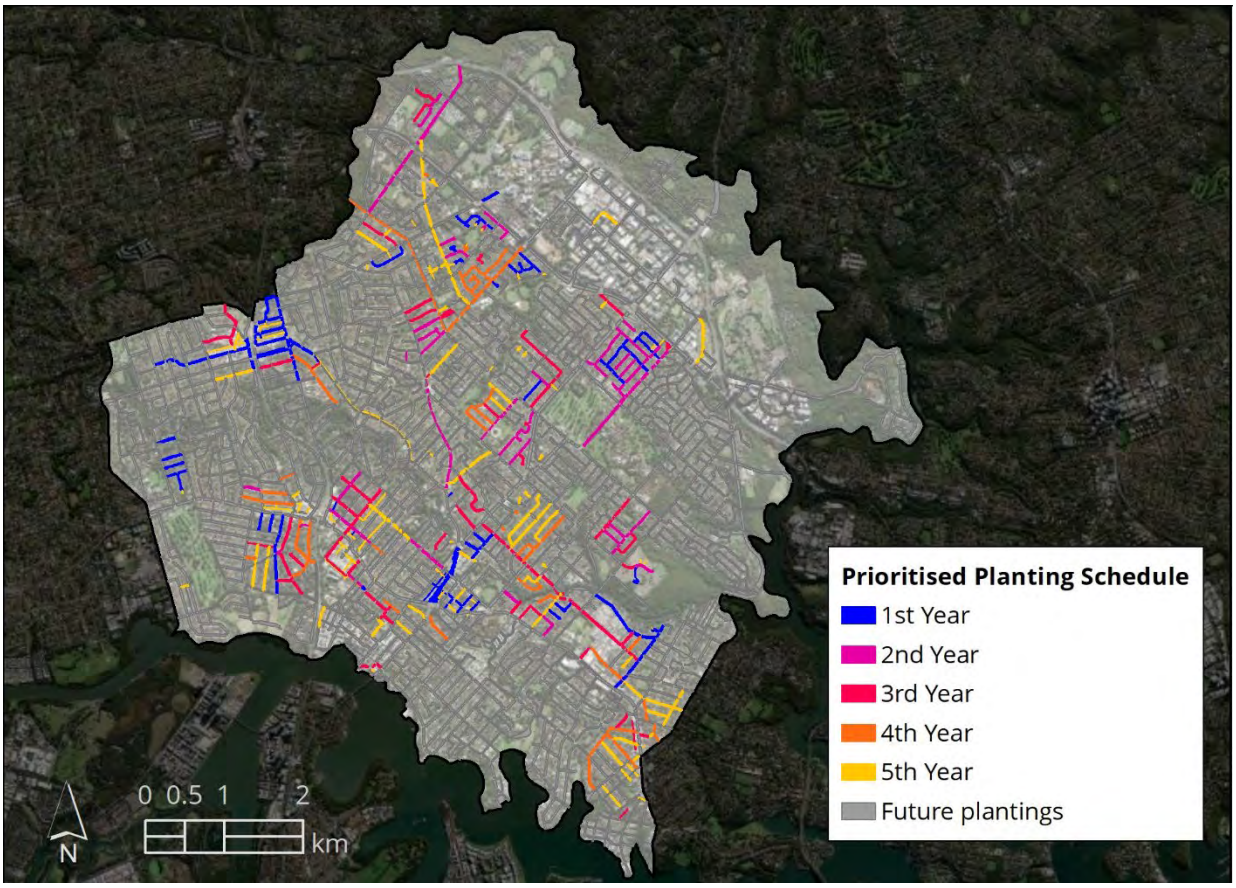


Figure 14. Prioritised planting schedule using the Integrated Priority Assessment to highlight the top 750 trees to be planted in each of the next 5 years.

Table 10. Top 10 streets for planting based on the Integrated Priority Assessment (full dataset provided in Excel spreadsheet).

Top 10 Streets	Suburb	Plantable Opportunities	Canopy Percent (%)	Heat Vulnerability Index	SEIFA Score	Integrated Priority score
1. BALACLAVA RD	Macquarie Park	9	26.36	5	882	0.90
2. BALL AVE	Eastwood	7	27.45	5	922	0.85
3. RAILWAY PDE	Eastwood	2	5.39	5	982	0.85
4. STATION LANE	Eastwood	1	8.31	5	982	0.84
5. ETHEL ST	Eastwood	9	12.56	5	982	0.82
6. IRENE CR	Eastwood	33	10.39	3	890	0.81
7. ROWE ST	Eastwood	24	12.87	5	990	0.81
8. LITTLE CHURCH ST	Ryde	1	17.05	5	982	0.81
9. WEST PDE	Eastwood	2	15.78	5	990	0.80
10. CURZON ST	Ryde	5	21.09	5	983	0.79

9.3 Planting location priorities

Many factors influence planting decisions. The IPA score and subsequent planting schedule (Figure 14) addresses some of the considerations influencing planting decisions, by highlighting locations that will maximising some of the co-benefits provided by trees (e.g. increasing canopy, reducing urban heat, and improving human health and wellbeing in disadvantaged areas). However, a suite of other factors, not assessed here, should also be considered including, for example: infrastructure conflicts, land ownership, resident preferences, and wildlife corridor linkages.

While the IPA score provides a broad benefits indicator ranked by general planting benefits, the inclusion of specific variables in the datasheet allows Council to develop planting schedules to suit local preferences and additional considerations to achieve optimal results. For example, road segments could readily be ranked by any of the composite IPA factors independently should Council wish to build a planting schedule aimed at improving any one of those factors individually[12]. Furthermore, other provided metrics can also be used to develop a planting schedule, such as the density of plantable opportunities (given as plantable opportunities per 100m of road length) which may provide logistical efficiency in planting large numbers of trees as quickly as possible.

It should be noted that where planting location priorities spatially correlate with wildlife corridors identified in the Ryde Biodiversity Plan, locally indigenous tree species should be used in plantings.

[12] All data provided in City of Ryde Canopy and Plantable Opportunity Datasheet.

PART 3.

ISSUES AND CHALLENGES TO MEETING CANOPY COVER TARGETS

10 Issues and Challenges

Whilst the City of Ryde's urban forest is highly valued, it is also highly vulnerable. There are a number of threats to the existing urban forest and challenges faced with protecting and growing it.

10.1 Urban densification

A leading driver of canopy cover loss in most cities is urban densification on private land, particularly urban in-fill which subdivides undeveloped or low density developed lands into more densely developed lots. Traditional development styles mean this process often results in significant conversion of green space to hard/built surfaces, leaving little if any room for tree retention or planting.

Like most cities, the majority of land (75%) within the City of Ryde is privately owned and managed, with Council having low to moderate influence over tree retention and plantings in these areas (Table 1). However, this land also often supports a substantial proportion of the City's canopy cover. This land cover trend holds true in the City of Ryde, with lands on which Council has low and moderate influence for tree plantings currently supporting 46% of the City's canopy cover (Table 1) and experiencing nearly 85% of the loss in canopy cover between 2010-2020 (Appendix C).

Council's estimated resident population is projected to increase from 116,302 in 2016 to 160,000 by 2031, an increase of nearly 40% (City of Ryde, 2020; ABS, 2020). This equates to an increase in average population density of an additional 1,080 people per square kilometre. Supporting such population growth is estimated to require an additional 17,000 new dwellings, as well as additional infrastructure to maintain or improve liveability within the City (City of Ryde, 2020).

Without a change in how urban development occurs so that tree protection and plantings are prioritised, such urban densification places nearly half of the City's current canopy cover at significant risk from loss due to land conversion.

10.2 Climate change impacts

The Council region will experience climate change impacts that result in the local climate becoming hotter, drier, with more high fire danger days, and intense and frequent flash storms and flooding events (AdaptNSW, 2022).

For urban trees, such changes will affect tree health and longevity through a number of mechanisms:

- decreased average rainfall will have implications for water security, leading to increased droughts, and increased water stress and mortality of trees. Such impacts will be particularly challenging in locations such as the City of Ryde where regular, long-term irrigation of trees is not currently part of the management schedule and will significantly impact planting targets should this be required due to cost;
- extreme weather, such as heat waves, storms, flood, and fire, will affect tree health and condition.
    - heat waves can cause crown desiccation and increase imperviousness of existing soils as they dry under increased and extended hot weather periods leading to water table retention being reduced and increasing overland flow volumes;
    - heat waves can exacerbate fire risk, frequency, intensity and spread as hotter and drier conditions provide the ideal fire climate for faster dispersal and more intense fires causing irreversible damage where regeneration opportunities would otherwise have existed;
    - fires will burn trunks, and potentially also branches and crowns, and increase pollution of air and water;
    - storms can shred leaves, break branches and uproot whole trees;
    - intense rainfall events and floods can destabilise root systems and increase soil salinity; and

- extreme weather can impact flower and fruit production (and seed dispersal for natural regeneration), which in turn can impact on fauna species reliant on such food resources for survival.

The changing climate may also facilitate the introduction of new pests and diseases into the region. These could have deleterious impacts on various tree species, potentially including species that are not currently susceptible to existing pests and diseases. Further, the increased stress and declining health and condition of trees outlined above will increase the vulnerability of trees to pests and diseases and their ability to resist and recover from such attacks will be compromised.

10.3 Understanding the urban forest

Being able to effectively **plan** the urban forest first requires establishing a baseline understanding of the current status of City tree assets. Only by understanding the current forest can realistic targets and actions to achieve these be established.

Being able to effectively **manage** the urban forest requires a clear knowledge of current tree assets and a rigorous and repeatable record and monitoring system. There are numerous approaches available to measure, record, and monitor the urban forest. Whilst the selected approach/es should aim to capture a rigorous evidence-base using leading and emerging tools and systems, the choice of approach will also depend on existing information, desired outputs and use, and budget.

Council's existing Significant Tree Register 2007 (STR) is a strong starting point to understanding the whole urban forest, with the STR focussed on locating, recording, protecting, and monitoring tree assets of particular importance on public and private land. The STR defines 'significant trees' as: "…*a single tree or a larger grouping of trees…*[that]…*may possess values relating to their visual, historic, botanical, cultural, commemorative or other significance as defined in the approved category list shown…*". The STR list was last updated in 2021 to include approved nominations not captured in the 2007 list, though it is noted that no nominations have been approved after the year 2010. This may be due to a number of reasons, though warrants a Council-wide audit to ensure all significant trees are captured in the STR.

To best manage the whole urban forest, the STR should form part of a Council-wide street tree register of all public trees. Key base-line information about the trees in this public tree register should include the following metrics as a recommended minimum to make informed and defensible decisions:

- Canopy cover (calculated city-wide and by defined management boundaries)
  - Total area;
  - Change over time;
  - Count of trees comprising the urban canopy;
- Tree data:
  - Spatial location;
  - Species;
  - Age, size, condition;
  - Useful life expectancy (ULE);
- Opportunities
  - Plantable space;
  - Plantable opportunities.

This Strategy draws on analyses of canopy cover and plantable opportunities, with tree data analyses forming part of the recommended actions moving forwards. Understanding this information can be used to:

- establish realistic canopy cover targets;
- identify key drivers of canopy loss and target actions to minimise impacts;
- quantify the number of trees needed to achieve canopy cover targets;

- identify tree planting priorities;
- monitor and manage tree risks;
- improve resilience to climate change impacts through increased species diversity; and
- plan for replacement plantings to counteract loss of species through natural senescence.

10.4 Age diversity

An aging tree population in its own right is not necessarily an issue. Larger, more mature trees tend to provide greater benefits, such as carbon storage, pollution removal, and biodiversity resources. In fact, a number of councils recognise the value of even dead trees in the landscape for carbon storage and biodiversity, and actively seek to protect such "standing stags" (Plate 2).

However, aging trees become an issue when they are not managed appropriately to mitigate risk, and planning does not allow for plantings that will offset future losses due to senescence Intergenerational plantings can help to address canopy loss through senescence.

The City of Ryde currently does not know what the age diversity of their urban forest is, or the useful life expectancy (ULE) of their public trees, both of which significantly impedes the ability to address this challenge.

Plate 2. Protected urban stag tree in the City of Onkaparinga, SA. (Photo credit: J. Garden, 2019)

10.5 Species selection and diversity

Species selections for planting programs generally are based on set criteria, including suitability for the location (see Section 10.6), aesthetics, function (e.g. habitat trees, screening), and availability (e.g. from nurseries).

It is increasingly important that species selection is biased towards climate resilience. This will include species that are able to withstand current and future climate extremes (e.g. drought), and also enhance the diversity of tree species comprising the urban forest.

- Future climate extremes:
  - Identifying species that are able to tolerate future climate conditions has previously been difficult, relying on identifying regions that are current climate analogues for the future climate conditions and drawing on learnings from those regions about which species grow well. New tools and searchable databases are now being developed to facilitate this process, such as the recently released *Which Plant Where* online plant selector tool[13], trialled in Ryde under the 5yr research project.
- Species diversity:
  - Without a relatively high level of genetic diversity, the urban forest is at risk of catastrophic decline from pests and diseases. Maximising genetic diversity helps to maximise resilience. Santamour's diversity, also known as the 10-20-30 rule of thumb, is proposed as a minimum diversity for urban forests. The rule states that, as a minimum, urban forests should comprise no more than 10% of any on species, 20% of any one Genus, or 30% of any one Family (Santamour, 1999).

[13] https://www.whichplantwhere.com.au/

10.6 Forward planning

Understanding how many trees and of which species are needed for long-term planting programs will be essential in effectively growing the urban forest and ensuring its long-term resilience to climate change. This is especially the case if additional species diversity is required, or planting palettes are to be revised and altered, to ensure species with the greatest resilience to climate change are planted. This level of detailed forward planning is essential in order to allow for growing lead times required by nurseries/suppliers to produce the required stock for the required years. Such forward planning though is especially challenging for councils who lack the funding and resources to enable such future forecasting of planting needs.

10.7 Right tree, right place, right way

Planting trees represents a significant investment for Council, and public spaces (i.e. streets and parks) are highly contested. Together these challenges make it essential to plant the 'right tree' in the 'right place' and in the 'right way'. Best practice approaches and national standards should underpin the selection of species, preparation of planting sites, and management of tree assets (see Part 4).

A new tool recently made publicly available to facilitate such decisions is the 'Which Plant Where' tool[11]. This tool was developed through a 5 year research program led by Western Sydney and Macquarie Universities that lab tested plant species responses under different climatic conditions. The resulting online plant selector tool enables climate-ready decision-making around species selections that will be resilient to climate change in the short to long-term. The City of Ryde (with representatives from the Environment/Natural Areas team and the Tree Officers who coordinate the 'Street Tree Planting Program') participated in pilot trials of the tool to examine its functionality in guiding future planting considerations to minimise loss whilst promoting cooling and biodiversity. Whilst based on sound scientific research and laboratory trials, the ultimate success of species-selections using this tool will only be determined over the next decade or more of practical implementation.

10.8 Community perceptions

The support of residents is critical for achieving planting and canopy cover targets, especially as most land and plantable space within the City of Ryde falls within privately owned and managed land tenures. The City's, residents, as identified in the Community Survey discussed in Section 3, generally support increased tree plantings, including on streets.

Though there is support for tree plantings, trees can still be extremely polarising for people for a range of reasons, including: cultural backgrounds, spiritual beliefs, aesthetic preferences, health conflicts (e.g. asthma), fear (e.g. of limb fall, fire), and general perceived nuisance (e.g. clearing leaves from gutters). Understanding these perceived issues within the community is essential for targeting actions that can help overcome negative perceptions.

The City's community has communicated that species selection, tree health, plantings under powerlines, and safety-related damage to infrastructure are their greatest concerns regarding trees (see Part 1, Section 3). This suggests that opportunities for supporting a sense of stewardship over trees (e.g. through participating in species selections, tree plantings, or data collection), together with community engagement around tree management and the provision of incentives and support services for tree management (e.g. provision of gutter guards and increased green waste services) may be priority actions for growing and protecting the City's trees.

Plate 3. Example of a Tree Tag, a community engagement and education tool, regarding benefits provided by trees. (Photo credit: J. Garden, 2020)

Often the required solution involves a combination of practical planning and management actions, together with engagement and education around tree benefits. For example, Tree Tags (Plate 3) and Tree Tag Trails[14] are a proven successful way of passively engaging and educating the community about some of the benefits provided by trees. In doing so, Tree Tags aim to create a positive perception change of urban trees.

Other engagement programs are direct, rather than passive. For example, the Cool Streets[15] program aims to empower communities around street tree plantings. The program combines modelling and community input to design street plantings providing an increased sense of community support and stewardship around street tree plantings. Similarly, the Adopt a Tree[16] program encourages and empowers residents to help case for street tree plantings.

10.9 Conflicting land uses

A main limiting factor to tree plantings in urban areas are the multitude of conflicting land uses which either limits the space available to plant a tree or limits the size of tree that can be planted. For example, there is a need to balance space for tree plantings with recreation space, infrastructure space and buildings. As such, there will always be a finite amount of plantable space that needs to be balanced against these other needs. This significantly impacts Council's ability to achieve canopy cover targets on public land alone.

Further, the benefits provided by trees planted within or adjacent to multi-use areas (e.g. roads, sporting fields) can also be negatively impacted by the requirements of the conflicting land-use. For example, pruning activities required to support road sight lines, facilitate large vehicles, or minimise risk to overhead powerlines.

There is a need to investigate and implement solutions to allow trees to grow naturally and co-exist with other land uses. This may include a combination of strategic and infrastructure solutions such as:

- refining/updating appropriate species planting lists for specific locations so that the planting palette ensures species growth is suitable for a given location without needing to negatively impact tree growth forms through pruning; or,
- altering infrastructure such as putting wide or high-capacity parking streets on a "street diet" to free up space to plant additional and/or larger trees in the street verges or road islands without negatively impacting on road use.

Similarly, encouraging and working with asset providers to underground electricity cables or retrofit overhead cables with Aerial Bundled Cables could allow for larger trees to be planted and negate the need for ongoing pruning of tree crowns.

10.10 Tree protection and removals

Improving the current DCP controls around trees on private land was identified as a key area for improvement during the Operational Capacity workshop (Annex B). For example, there is potential to set mandated canopy targets and tighter controls around tree removal (i.e. removal of the 4m exemption rule). Attention should also be given to alignment with Council's LSPS and with future DCP amendments and community resilience objectives.

10.11 Biodiversity

With all the land-use, climate change, and community challenges to contend with, the consideration of biodiversity in tree planting programs can often be overlooked or not considered as a driving/priority factor in decision-making. This is particularly problematic given some of the areas most severely

[14] Example of a Tree Tags trail available at: https://collaborate.canadabay.nsw.gov.au/canadabaytreetrail

[15] https://www.coolstreets.com.au/

[16] e.g.https://www.onkaparingacity.com/Services-and-projects/Environment-and-sustainability/Trees/Adopt-a-Tree; https://www.marion.sa.gov.au/services-we-offer/environment/street-trees/trees-are-cool

impacted within, and by, urban landscapes are bushland habitats and natural spaces that have previously provided important, habitat, food, and movement resources for native wildlife.

Such habitat areas are subjected to ongoing habitat loss, degradation and fragmentation, resulting in spaces that are: more lineal and disconnected in nature, have numerous competing land-uses that pose various threats to different species (e.g. stormwater runoff, assets or infrastructure dissection, lighting and a reduced rate of fire ability for natural regeneration), and facilitate the infiltration and domination of introduced and native pest species.

Tree planting programs in urban areas can help to reverse such impacts on native species, though will require dedicated consideration and prioritisation of native biodiversity requirements and sensitivities. Without such considerations, the impacts of urbanisation will continue to negatively, and at times deleteriously, impact native biodiversity and ecosystem functioning.

With appropriate consideration though, the co-benefits to biodiversity from tree plantings can be leveraged towards rebuilding connections of biodiversity corridors, replenishing habitat and food resources, restoring natural ecosystem processes, and inhibiting pest species incursions. In particular, identifying species of conservation concern within the region and their requirements and sensitivities should be used to inform the selection of tree species as well as the spatial location of plantings.

PART 4.

BEST PRACTICE PLANTING AND MANAGEMENT GUIDELINES

11 Guidelines for Tree Plantings

Successful tree planting and establishment requires four key success factors (Figure 15):

6. planning and species selection;
7. quality stock;
8. correct planting; and
9. establishment maintenance.

Each of these factors are equally important, meaning if one is ignored or neglected the whole process can be compromised. The process should further be underpinned by good communication and monitoring throughout all stages to ensure all stakeholders understand the process and that each stage is monitored for quality and correct practices.

The following sections outline the main considerations for each of the key success factors.

Figure 15. The key success factors for tree planting and establishment. (Credit: G. Griffiths 2021)

11.1 Factor 1. Planning and species selection

Tree planting programs should be underpinned by a sound, evidence-based plan. This plan will help to ensure the 'right tree' is planted in the 'right place'.

- **Species selection –** should be the primary foundation of any planting program. Species selection should consider, as a minimum: climate resilience (current and future), suitability for planting location, tree size at maturity, maintenance requirements, nearby vegetation communities, risk mitigation, aesthetics, and community support.
- **Prioritise planting locations:** tree planning should commence with identifying at a strategic level where tree planting will make the most impact. An emerging leading approach to this prioritisation is the Street Tree Prioritisation™ tool (see Section 9).
- **Identify suitable planting sites:** At a more detailed, site-specific level, consideration should be given to proximity of planting sites to services (above and below ground), distance from buildings and other built infrastructure, sight lines, and offsets from intersections.
- **Soil type, volume and quality:** should be assessed prior to planting to help inform the selection of suitable species and also to allow for any necessary adjustments or improvements.
- **Available space:** the available below- and above-ground space should be used to inform species selection and each site should be capitalised on by selecting the largest size tree suitable for that location.
- **Water sensitive urban design (WSUD):** should be incorporated as a priority, wherever possible, in planting pit designs. This is particularly important to help improve *in situ* water security in the face of climate change impacts. WSUD may range from simple solutions such as sloping pavements towards the tree pits (i.e. passive irrigation), to more complex solutions such as water harvesting and biofiltration systems that divert water from surrounding kerbs or pipes into an engineered soil structure for utilisation by trees.
- **Other factors:** include drainage and microclimate considerations which can influence the success of different tree species.

11.2 Factor 2. Quality stock

The tree itself is generally the smallest cost of the project when compared to labour costs to plant and maintain the tree, however the quality of the tree itself can make or break a planting project.

- **Stock standards –** ensure trees have been grown in accordance with AS 2303:2018 Tree Stock For Landscape Use (Committee EV-018, 2018). Self-assessment of stock prior to purchase to ensure compliance to these standards should also be a priority.
- **Contract growing –** establishing a growing contract with a nursery can ensure desired stock is available at the time needed. This is especially important as planting palettes change to focus on more climate resilient species for an area. Though noting that a 3-5 year lead time may be required for the supply of certain species. As such, having a clear long-term planting program, including understanding of how many trees of each species is needed, will be required.
- **Tree size –** the size of tree planted should be considered with regard to cost (or purchase and maintenance), establishment success and rate, and its ability to meet project needs. In many circumstances, larger stock sizes tend to be favoured despite the greater purchase cost, as they have lower initial maintenance requirements (e.g. early formative pruning already undertaken), and there is a pre-conceived notion that larger planted trees will achieve larger mature sizes faster. However, the opposite has been found to be true. Research suggests that smaller planted trees, tend to establish faster and reach a larger mature size than larger planted trees (Watson, 2005; Gilman, et al., 2010). In fact, studies indicate that smaller planted trees will usually outgrow a larger planted tree within a decade.

11.3 Factor 3. Correct Planting

Correct planting requires adherence to the following key elements:

- **Size of hole –** the hole should be excavated to three times the diameter of the container to provide enough 'good' soil around the root ball and allow for unimpeded root development during the early life of the tree. This early root development is important to set the tree up for the future by ensuring an even structural root crown is established.
- **Drainage and soil improvement –** the planting hole must be free draining and not retain excessive water. Root systems will suffocate and die if the planting hole retains water due to the exclusion of oxygen and creation of toxic anaerobic conditions. Any soil additives or organic matter should be well incorporated ensuring not too much organic matter is placed at depth within the hole.
- **Height of root ball –** The root ball should be placed onto a consolidated base at the bottom of the planting hole, this ensures the weight of the tree itself will not cause subsidence and lead to collar rot. Ideally, the top of the root ball should be level with the surrounding ground. Studies indicate tree health and establishment may be compromised for 'deep planted' trees (i.e. planted 7.5-15cm or more below ground level), though this impact may be highly species-specific (Wells, et al., 2006; Day, et al., 2009).
- **Root pruning –** the root ball should be inspected prior to planting for any pot bound roots. If found, these roots should be cleanly pruned with sharp knife or secateurs to promote even root extension growth. Roots that are circling in the pot will never straighten themselves out in the ground and will generally just keep circling.
- **Staking –** 'protective' staking is encouraged to provide a buffer around the tree to prevent any damage, especially in highly urbanised areas and high traffic areas. It is important to note that stakes are not intended to provide support; if the tree is not self-supporting is should not be planted. New-to-market products such as the Tree Coach[17] system, which are emerging as future leading best practice, should also be considered for trial or replacement of traditional staking methods. In addition to protecting planted trees, such systems have been shown to improve the growth quality of trees, leading to reduced mortality rates during tree establishment periods.
- **Watering –** the tree must be watered in the pot prior to planting to ensure the root ball is soaked and then watered again immediately once planted in ground. The formation of a 'bund' or 'bermed dish' close to the edge of the root ball with assist with establishment watering. Care must be taken though to also ensure good drainage within the hole to prevent long-term water-logging as the tree grows. Adding moisture support in the form of water crystals can assist in supporting the establishment period where consistent watering ability is limited.
- **Mulching –** mulch should be applied immediately after planting and topped-up over time as needed. Mulch helps to retain moisture in the soil and provides organic matter to replenish the soil as it breaks down. The best mulch is 'leaf mulch' produced from a chipper as it has a variation of particle sizes that allow for aeration and different rates of decomposition. The mulch area should extend 1.5-2.5m from the tree stem and be applied to a depth of 5-10cm (after settling). Ideally the mulch should 'rest' for a period of 3 months to release tannins stored in bark based mulch and to ensure the mulch is weed seed free.

[17] https://naturalgrowthpartners.com.au/about-tree-coach/

11.4 Factor 4. Establishment Maintenance

It is essential to carefully manage and tend to newly-planted trees during their establishment period. The duration of the established period can vary and is influenced by climate and the size of tree at the time of the planting.

Adequate resourcing – ideally the establishment period is somewhere between 12 and 24 months, though up to three years is sometimes observed in more arid climates. This will require careful consideration of required resources to ensure appropriate management during the establishment period possible.

Watering – undoubtedly the most important element of establishing a newly planted tree. Planting a tree and relying solely on rainfall is rarely an option, particularly with large tree stock, and under drying climate conditions. The amount of water required in any one watering event will depend on the size of the root ball and the soil type. The general rule-of-thumb is that the amount of water should be equivalent to 20% of root ball volume. That means, for example, a 45L tree would require a minimum of 9L of water at each application, though this may vary depending on soil type. Frequency of watering is dependent on the time of year, with generally less required in cooler months and more in hotter months. Further, trees also require more water directly after planting and less as the tree establishes.

Other maintenance – other tree establishment maintenance that should be undertaken during the establishment period include: weeding and rubbish removal from tree surrounds; fertilising; pest and disease control; adjustment, removal or replacement of protective staking; and formative and selective pruning (as required).

12 Guidelines for Tree Asset Management

Best practice tree management involves a strategic approach, recognising trees as assets within operational planning and maintenance programs and managing trees with a 'whole of life' asset management approach (Figure 16).

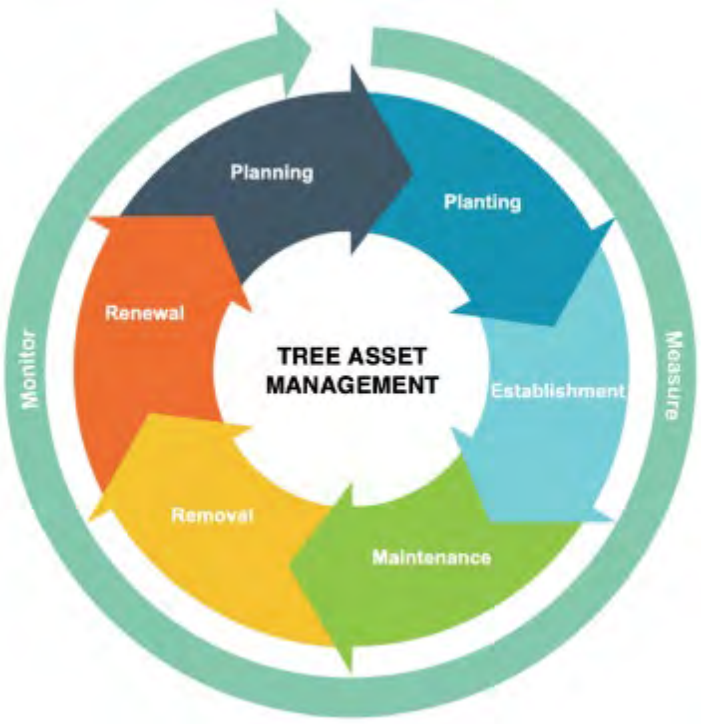


Figure 16. The strategic 'whole of life' tree asset management cycle. (Credit: G. Griffiths 2021)

This ensures that risks from trees are managed and that costs associated with maintaining trees over their life time are accounted for. Managing and monitoring tree assets should involve two main steps: developing and maintaining a tree inventory, and operational planning.

12.1 Tree Inventory

You need to know what you have to know how to manage it. As such, establishing a complete public tree inventory is required. A tree inventory provides a powerful and transparent system for whole-of-life tree asset management. The ability to map, track, manage, monitor public tree assets allows Council to more readily and pro-actively: identify and mitigate risk; plan and budget for future maintenance and renewal programs; and inform future strategic directions and planning.

Collecting inventory data

What approach to take

There are a number of ways to approach data collection of tree inventory data, with the approach selected being primarily dependent on resource availability.

- **Bulk data collection –** refers to data collected as part of one process or project over a consecutive period of time. This data is generally the most accurate as it is usually collected with a consistent set of specifications, by a select group of assessors working to the same objective, and in a single consecutive time period. The cost of bulk acquisitions can be a limiting factor, scales of economy tend to be realised at tree numbers above 10,000. This is because project start-up costs are a significant portion

of the cost to acquiring bulk acquisitions and the more trees in the project the better the per tree rate. Collaborating with neighbouring Councils on broad-scale tree inventory projects may provide a more cost-effective solution.

- **Ad-hoc data collection –** refers to data collected at sporadic intervals over a long period of time. This approach, whilst cost effective, can pose issues with accuracy and consistency unless parameters are well defined up-front and inspections are undertaken by similarly qualified personnel using a standardised methodology.
- **Representative data collection –** refers to a partial inventory to represent the whole of forest. High target areas or key precincts, such as town centres or main roads, can be a worthwhile focus of such representative data collection, particularly from a risk management point of view. With this approach you can focus your tree maintenance resources or high target areas or areas with higher risk trees. Alternatively, a stratified random sample of sites can be targeted for data collection with the outputs extrapolated across the city area, though this approach can mask important anomalies or risks.

What data to record

Clearly defining the method and required data for each tree is imperative prior to commencing data collection. Further, ensuring data is collected by adequately qualified personnel (arborist with minimum Australian Qualifications Framework Level 5 (AQF5) qualification) will be important. Best practice minimum data requirements for each tree, including data needed for an i-Tree Eco valuation[18], are:

- location (GPS coordinates, street name, and building number if relevant);
- botanic name of the species (common name is less important);
- trunk diameter (DBH) at a standard height above ground level (e.g. 1.4m);
- significant tree status (if applicable);
- tree height and canopy width;
- condition (good, fair, poor, dead/dying);
- presence of pests/diseases;
- useful life expectancy (ULE);
- risk profile (using an industry recognised methodology);
- maintenance requirements; and
- location and type of potential planting sites for new trees.

Additional data that may also be collected if resources allow.

Organising, managing, and updating data

Data organisation

Inventory database systems can vary from basic Excel-spreadsheets to fully customised tree asset management platforms. It all comes down to useability, function, and cost. Several companies in the market offer bespoke asset management systems specifically designed for local council tree operational management (e.g. Forestree[19]). Such systems are worth considering as much of the work defining data fields and enabling GIS capability is included.

However, existing council asset management systems used for other assets such as roads and footpaths, may also be used. In this case though, it is important that these systems offer flexibility with custom fields to allow for tree-specific data to be recorded. Above all else, the platform used to record the tree inventory should be: easy to access and intuitive to use; allow for rapid and accurate data entry; be compatible with existing Council databases and GIS; and, allow for strategic management planning and monitoring.

Data management

[18] i-Tree Eco is a globally leading approach for quantifying and valuing ecosystem services provided by trees; https://www.itreetools.org/tools/i-tree-eco

[19] https://forestree.app/

Once data is collected and collated in a system, knowing how to analyse this data is key to harnessing its potential for informing decision-making. Interrogating and monitoring the urban forest data is key to successful planning for operational maintenance and planting programs, including, for example: building a business case, accessing grants, KPI reporting, and achieving targets.

Updating data

It is important to note though that tree inventory data is only as accurate as the most recent record date. For any tree inventory database to be successful, it is essential that adequate resources and processes are in place to ensure it is well maintained and regularly updated.

Inventory data maintenance should be embedded in every process associated with tree maintenance and planting. Every time a tree is inspected, pruned, planted, or removed it should be updated in the inventory. The inventory should not be a static entity, rather it must be continually evolving and maintained to stay relevant. The operational tree management teams within Council should become 'owners' of the system and ensure it is maintained as a 'live' database.

12.2 Operational planning

With the information from a tree inventory, works can be categorised and prioritised according to risk, forming the basis of a proactive tree maintenance program. The inventory can be organised spatially into 'precincts' to allow for cyclic maintenance approaches to be implemented. These precincts may be organised based on suburbs, town centres, or high target areas (i.e. locations with high pedestrian/vehicle traffic and trees with a higher risk profile).

Also important in establishing a proactive maintenance program is the initiation of a forward inspection program to assess trees on a regular basis. This is the most effective way to maintain the inventory database and address tree risk.

The program involves a cyclic scheduled inspection of trees, based on precincts or register of higher risk trees, to assess any potential hazards and update key inventory data fields.

Inspections should be undertaken using an industry-recognised risk assessment framework such as QTRA, TRAQ, or VALID. Inspections are then followed up with scheduled maintenance as required. The aim is to assess potential risks before an issue arises and undertake maintenance works as needed.

Whilst funding and resourcing of this level of inspection and data management can be prohibitive, it should be weighed against the cost savings associated with maintaining the data rather than collecting it all over again, and risk mitigation.

13 Alignment with best practice

Based on the operational capacity workshop held with Council, the following summarises Council's current alignment with best practice planting and management guidelines (Sections 11 and 12). Opportunities for improvement and key recommendations are outlined where current operational capacity diverges from best practice.

13.1 What Council is doing well

The City of Ryde is currently taking pro-active steps to better understand and manage its urban forest. Such steps should not be undervalued or overlooked in the shadow of the opportunities for improvement. The workshop discussions identified the following as positive steps and actions being undertaken by Council that should be maintained and evolved as relevant.

- Capable and experienced in-house tree maintenance team;
- Highly developed existing documentation (e.g. technical manual, this UFS which updates the STMP and TMP documents);
- Tree inventory under development;
- Successful grant funding for tree planting programs;
- Highly engaged and informed staff;
- Robust internal processes in place; and
- Clear information provided to residents (e.g. website and brochures).

13.2 Opportunities for improvement

Focus Area 1: Tree asset management

The City of Ryde's publicly maintained trees are not currently recorded within a tree inventory and trees are not managed as operational assets. Whilst there is a project underway (at the time of writing this UFS) to capture a sample of public trees (~ 1000), there are currently no plans or committed budget to expand this inventory across the whole City. This poses issues from a data collection and operational programming point of view as it is impossible to know how to manage what you have unless you understand it.

Lack of information on public trees has implications for risk management but also best practice urban forest planning. An inventory can provide accurate data on tree health and condition, species diversity, age distribution, and risk profile. Ongoing updating and access to such information allows for informed and transparent decision-making and effective public tree management.

Recommendation *– Identify funding to undertake a full inventory of Council managed trees and integrate this database with Council's Asset Management System (AMS).*

Focus Area 2: Tree maintenance

The City of Ryde currently undertakes only reactive tree maintenance, rather than proactive or cyclic tree maintenance programs. Further, only high-risk reactive maintenance works are undertaken primarily as a result of customer requests. Works are carried out primarily by Council in-house crews with a lack of resources and budget identified as being a barrier to increasing the levels of tree maintenance.

The current tree maintenance service level has implications on tree risk management. Without a proactive tree maintenance program, tree risk is not being identified until it is already an issue. Whilst it is acknowledged that all trees pose varying inherent levels of risk and the aim of management is not to eliminate all risk from trees, a tree risk-benefit management approach should be adopted. Such an approach recognises that that the risk from trees must also be balanced by the benefits they provide to achieve a tolerable level of risk.

Recommendation – *Identify funding to increase tree maintenance budgets to allow for delivery of a proactive tree maintenance program. This program could initially focus on QTRA assessed dangerous trees and high target areas such as town centres or main streets (see Section 11).*

Focus Area 3: Tree planting program

Public land increasingly needs to accommodate more trees as private space development is intensified. It is therefore essential that Council has a well-resourced tree planting program to support an increase in canopy.

Current tree planting programs are delivered primarily by in-house crews and occasionally external contractors. Approximately 600-700 trees are planted annually, depending on the amount of grant funding available in particular years.

Establishment maintenance for new trees is generally limited to a 3-month period and tree stock is usually a 300mm container size. Procuring tree stock was identified as an issue, with the lack of species availability, species diversity, and container size substitutions also being common barriers.

It was also discussed that Council's public tree planting programs are not of a scale adequate to facilitate the increase in canopy required to meet the LSPS canopy target of 40% by 2030 (see Section 8).

Whilst the analysis undertaken as part of the development of this UFS has provided an evidence-base for achieving targets and planting priorities over the next 5 years, additional budget and staff resources will be required for implementation of the planting program.

Recommendations –

- *Identify funding to increase tree planting budgets to allow for delivery of an expanded tree planting and establishment program.*
- *Establish a growing contract for tree supply to ensure the quality and reliability of tree stock for planting programs.*

Focus Area 4: Internal Culture and Integration

Internal culture and attitudes towards trees play a key part in the delivery of best practice urban forest management. The perceived value of trees within Council was reportedly low and acknowledged as a major barrier to manage and growing the City's urban forest. Delivering on canopy targets will be significantly impeded without a united Council approach and vision, with broad-scale recognition by staff and elected members of trees as essential assets and support for urban forest management and growth objectives.

Further, the protection and planting of trees must be integrated into the delivery of Council's capital programs. For example, all new capital or infrastructure renewal works should incorporate and appropriately budget for adequate new tree planting and greening where practical; and innovative civil infrastructure design solutions, such as structural soil and soil vaults for built-up areas where soil volume is limited, should be embraced. Designs should also look to maximise canopy to assist with achieving the LSPS target.

Recommendation – utilise this Urban Forest Strategy as a vehicle for change within the organisation and to educate key internal staff on the importance of trees. Integrate delivery of green, blue and grey infrastructure capital programs.

Focus Area 5: DCP controls

Council only has high control over around 25% of land within the City, hence the impact of changes in canopy on land outside the control of Council is significant.

Improving the current DCP controls around trees on non-Council owned and managed land was identified as a key area for improvement. For example, there is potential to set mandated canopy targets and tighter controls around tree removal (i.e. reconsidering the 4m exemption rule). Further,

advocacy and lobbying of State planning controls should help enable Council to reach canopy cover targets and improve the City's long-term liveability.

Attention should also be given to alignment with Council's LSPS and with future precinct-based DCPs, such as the upcoming Macquarie Park DCP. Further, enforcing financial penalties for tree removals based on an understanding of tree ecosystem service values can then be used to plant additional trees on site and/or contribute to Council's city-wide planting programs.

Recommendation – *Undertake a holistic review of Council LEP and DCP controls to improve the protection of trees and provision of new trees on private land.*

Focus Area 6: Social issues around trees and community engagement

Pressure from the community and negative attitudes towards trees were identified as major obstacles to improving urban forest outcomes. These negative attitudes can range from a fear of trees from a risk perspective or cultural barriers to acceptance of trees from an aesthetics perspective.

Improved education and engagement around trees were seen as the way to improve this issue. It was however recognised that this is difficult to do well and needs a well-considered approach to achieve any real improvement.

There are several current Council-led urban forest engagement initiatives underway however it was identified that more could be done in this area, including a regular community tree giveaway program. This would provide for increased tree planting on private land and the opportunity to meaningfully engage with the community on the benefits of trees.

Recommendation – *Continue to engage with the community via tree giveaway and planting programs and expand programs that educate residents on the benefits of trees (see Section 12).*

PART 5.

ACTIONS AND IMPLEMENTATION PLAN

14 Principles, Objectives and Actions

The UFS will be implemented through a framework of five guiding principles, each with their own objectives and actions. These are outlined below, with the Implementation Plan detailed below in Section 14.

Principle 1. Learn

Council understands the structure, composition, and condition of, and benefits provided by, the urban forest. Council understands where to prioritise plantings to maximise co-benefits.

Principle 2. Grow

The City's urban forest is planned and managed to support healthy growth and achieve realistic targets. Council applies up-to-date data and leading best-practice approaches.

Principle 3. Protect

Council advocates for protection of the City's urban trees from development and urban intensification activities.

Principle 4. Invest

The City's urban forest is valued as an urban asset and funded to ensure effective planning and management is not impeded.

Principle 5. Engage

Council staff and community value urban trees and work together to grow the urban forest on private and public land. The City supports an integrated delivery of green, blue and grey infrastructure capital programs.

Principle 1. Learn

We understand the structure, composition, and condition of, and benefits provided by, our urban forest.

We understand where to prioritise plantings to maximise co-benefits.

Action 1.1 Undertake a public tree inventory

Using best practice approaches outlined in Part 4, Section 12, undertake a bulk data collection complete inventory of the City's public tree assets, incorporating the STR into this inventory.

Action 1.2 Quantify species diversity and resilience of the urban forest

Based on the public tree inventory, examine how well the City's urban forest diversity aligns with the 10-20-30 rule[20].

Action 1.3 Integrate public tree assets into Council's AMS

Following completion of Action 1.1, ensure that tree asset data is integrated into Council's existing asset management system.

Action 1.4 Build the business-case for trees

Based on information collected from Action 1.1 complete an i-Tree Eco assessment of the City's public trees to quantify and value ecosystem service benefits provided by the trees. Combine this output with planting costs identified in Section 8.3 to calculate the business-case for the City's public trees.

Action 1.5 Review species planting list

Undertake a review of Council's suitable tree planting list every three years to determine ongoing suitability of species to climate change impacts, and increase diversity as required from Actions 1.1 and 1.2. Use the *Which Plant Where*[21] tool to help identify climate-ready species.

Action 1.6 Identify priority street tree planting locations that correlate with wildlife corridors

The Ryde Biodiversity Plan identifies a series of regional and local wildlife corridors, with an aim to better connect these corridors, especially in the streetscape, outside of parks and reserves. The priority street tree planting locations should be spatially overlaid with wildlife corridors to identify spatial correlations. In these areas, street plantings should include locally indigenous species where possible.

Action 1.7 Improve understanding of private trees

Investigate opportunities for building knowledge of private trees in order to better understand the City's urban forest as a whole. This may include, for example, an inventory of public trees, monitoring tree gains and losses through development and private actions and engaging private land holders around the benefits of tree retention.

[20] See Section 6.5

[21] https://www.which-plant-where.com.au/

Principle 1. Learn

We understand the structure, composition, and condition of, and benefits provided by, our urban forest.

We understand where to prioritise plantings to maximise co-benefits.

Action 1.8 Monitor canopy cover change

Undertake a reassessment of the City's canopy cover every two years (based on data from same months) to determine change, impact of actions herein, and action adaptations as required. Reassessments should ensure the previous two years' tree planting programs are captured in canopy assessments and future target setting.

Action 1.9 Verify public domain plantable opportunities

Ground-truth and spatially map tree planting opportunities within Council's GIS software to help refine where tree planting opportunities and other capital programs overlap to deliver an integrated outcome.

Action 1.10 Review prioritised tree planting locations

Every two years undertake a reassessment of prioritisation of tree planting locations, noting priorities may change as urban heat distribution, canopy cover, and social vulnerability are dynamic in nature. The review will ensure tree plantings continue to maximise co-benefits as land cover changes over time.

Action 1.11 Revise timeframe to achieve canopy cover

Whilst the current 40% canopy cover target aligns with State directives, findings from modelling (see Section 8.2) indicate that the 2030 delivery timeframe for the target (as included in the City's LSPS) is unrealistic. The current target does not fulfill the "A" (i.e. achievable") criteria of S.M.A.R.T. goals that underpin management decisions. A revised, more realistic, timeframe for the canopy cover target should be established.

Action 1.12 Investigate parkland planting priorities

Model priority planting locations within public parklands to complement the street tree planting prioritisation modelling[22]. This should include ground-truthing of Open Space planting capacity.

Action 1.13 Refine TPP and STP modelling

The modelling undertaken herein provides initial guiding baselines, targets, and recommendations. Based on the learnings herein, this modelling should be further refined to include, for example:

- a review of the level of council influence for plantings within the low density residential land zones[23];
- improved representation of actual plantable space proportions within different land zones
- inclusion of 'town/neighbourhood centres' land use as medium level of council influence, given Council's input into preparing Masterplans and implementing upgrades in these areas.

[22] See Section 9

[23] The low density residential land use zone () was included herein as a 'medium' level of influence for Council tree plantings, though increasing complying development and the reduced role of Council in development approval is such that this is likely to change to a 'low' level of influence in the future.

Principle 2. Grow

Our urban forest is planned and managed to support healthy growth and achieve realistic targets.

We apply up-to-date data and leading best-practice approaches.

Action 2.1 Implement a 4-year prioritised Street Tree Planting program

Using the outputs from Section 9 (and the associated Excel spreadsheet) implement the street tree planting program.

Action 2.2 Investigate opportunities to increase plantable opportunities

Based on the findings from Action 1.8, where required, undertake an investigation of opportunities to increase plantable space, particularly over impervious surfaces. This may include, for example, utilising some on-street parking for tree plantings, "street diets", installation of road protuberances, and reclaiming space in public carparks and hardstands in town centres.

Action 2.3 Encourage tree planting on private land

Based on findings from Action 5.1, establish and implement incentives and support programs to encourage and support tree plantings on private land. This may include, for example: continuing free tree give-aways, providing outward celebration and recognition for 'community foresters', and offering additional green waste support. Such incentives should be coupled with promotion of Council's 'River to River Corridor – Habitat Friendly Garden Guide' to educate community on the values of planting within private land.

Action 2.4 Updating Council's DCP

Together with Action 3.4, undertake a review of Council DCP controls, as per Council's DCP review program, to:

- enhance retention of mature trees;
- incorporate a value based target ensuring a minimum 2:1 planting replacement is enabled;
- ensure adequate space is provided in new council-approved developments to allow for tree plantings, with incentives provided that will encourage more and larger tree plantings; and
- ensure adequate consideration is given to shading, corridor connectivity, heritage, fauna habitat, and aesthetic values.

Action 2.5 Establish a growing contract

As recommended under Focus Area 3 in Section 13.2, above, and based on the outputs from Actions 1.1, 1.2, 1.5, and 1.8 together with the outputs provided in Section 8.2, establish:

- a long-term growing contract for tree supply to ensure the quality, reliability, and availability of tree stock for planting programs, and
- partnerships with local community nurseries to use local seed collection and species continuity where appropriate.

Principle 2. Grow

Our urban forest is planned and managed to support healthy growth and achieve realistic targets.

We apply up-to-date data and leading best-practice approaches.

Action 2.7 Generate a whole of public land planting prioritisation program

Combine the parkland (Action 2.6) and street tree planting priorities to develop a whole of public land planting prioritisation program.

Action 2.8 Incorporate tree plantings into capital works programs

Capitalise on capital works by:

- undertaking tree plantings as an integral component of these projects, particularly within road reserves and
- factoring in these planting programs at business case and planning phases.

Action 2.9 Create a Monitoring and Evaluation Plan

Develop a Monitoring and Evaluation Plan (MEP) to support this UFS. The MEP should clearly identify, for each action, the: target, baseline, implementation action, indicator, data collection method, data source, frequency, and reporting. The MEP should be undertaken every 3 years to create an adaptive management framework in which actions are altered if they are found to be failing at achieving their target.

Monitoring should also specifically respond to any State Government Housing code changes. For example, recent changes to the housing code SEPP and small/medium density as well as private certification new laws which impact canopy cover and loss.

Principle 3. Protect

Our urban trees are protected from development and urban intensification activities.

Action 3.1 Review significant tree register

Undertake a review of the Significant Tree Register, including protocols and assessment reporting, audit of these trees, and compliance with responsibilities.

Action 3.2 Incentives for tree retention on private land

Based on the findings from Action 5.1, establish and implement progressive incentives and support programs to encourage and support tree retention on private land. This may include for example, tax benefits and other financial rewards and rebates for residents protecting their private trees[24].

Action 3.3 Incentivise tree protection in new developments

Investigate and implement incentives scheme/s that will encourage and reward developers and other proponents who actively seek to prioritise retention of trees within new development planning and design. This is a common action within local Council urban forest strategies (e.g. Sydney, Wollondilly), though other NSW council examples of such incentives scheme implementation are not apparent[25].

Action 3.4 DCP controls to protect trees on private land

As recommended under Focus Area 5 in Section 13.2, above, and together with Action 2.4, ensure that DCP controls improve the protection of trees on private land and within new developments as part of Council's existing program for review of DCP controls, improvements and opportunities to improve protections.

Action 3.5 Establish tree protection compliance approach

Using a spatially-based AI algorithm, establish annual compliance monitoring of private trees to identify illegal removals[26] and develop a plan for managing private trees, as resources allow.

Action 3.6 Increase DA tree planting compliance

Where resources allow, implement regular monitoring of consents within DAs to plant trees.

Action 3.7 Council capital projects

For Council capital projects, tree removal should be a last resort. When required and where feasible, establish a 2:1 replanting rate or

[24] Examples: (Ordóñez, et al., 2020); https://www.npsp.sa.gov.au/our_services/trees-and-leaves/tree-incentive-program; (Stone Environmental Inc., 2014); (Ordóñez-Barona, et al., 2021)

[25] A national example of such incentive implementation though comes from the City of Stirling (WA) who have approved the fast-tracking (i.e. prioritised) of assessments of DAs that retain significant trees on private land.

[26] For example, City of Stirling Local Planning Scheme No. 3, Amendment No. 9 and Local Planning Policy 6.11 https://www.stirling.wa.gov.au/your-city/documents-and-publications/planning-and-building/develop-my-property/6-11-trees-and-development-guidelines

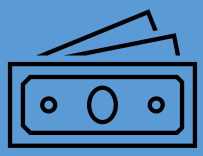
Principle 3. Protect

Our urban trees are protected from development and urban intensification activities.

assess the tree value (see Action 1.4) to establish the required replanting to replace lost services from tree removals.

Action 3.8 Advocate to the State government about SEPP impacts

Advocate to the State government regarding the State Environmental Planning Policy's impact on expanded footprints of private lot developments and private certification impacts on the removal of trees and Council's ability to achieve cooling and canopy cover targets.



Principle 4. Invest

Our urban forest is valued as an urban asset and funded to ensure effective planning and management is not impeded.

Action 4.1 Seek additional Council funding to support expanded tree planting programs.

As recommended under Focus Area 3 in Section 13.2, above, and based on the outputs from Action 1.4, advocate for adequate funding to undertake significantly expanded planting and establishment programs as required to achieve a realistic canopy cover target[27] and meet the sustainability targets outlined in the LSPS.

Action 4.2 Identify funding to undertake full tree inventory

As recommended under Focus Area 1 in Section 13.2, above, internal and external funding streams (e.g. State Government's Greener Neighbourhoods Grant) should be approached for funding to complete the public tree inventory (as a bulk data collection project) (Action 1.1). Collaborative opportunities with neighbouring councils to share inventory project costs should also be investigated.

Action 4.3 Advocate for funding to increase tree maintenance budgets

As recommended under Focus Area 2 in Section 13.2, above, an increased tree maintenance budget will allow for delivery of a proactive (rather than reactive) tree maintenance program, as will be required with increased tree plantings to achieve the canopy cover target. This program could initially focus on high target areas such as town centres or main streets (see Section 11).

Action 4.4 Advocate for increased funding to support additional community education and engagement programs

There is a need to be more transparent around Council's planting and management programs, not only to raise community awareness, but also community support and stewardship for urban trees.

Action 4.5 Invest in AMS maintenance

An up-to-date, leading ASM will be important in facilitating the long-term planning and management of the City's urban forest. Funding will be needed to allow for ongoing maintenance of the AMS to ensure integrity is maintained.

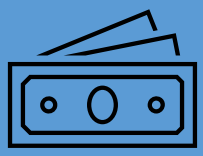
Action 4.6 Invest in canopy cover monitoring

Implementing Action 1.7 (tracking canopy cover) will require committed, ongoing investment to ensure this is undertaken in a timely manner.

Action 4.7 Invest in new technologies

To be a leader in urban forest planning and management will require implementation of new and leading technologies and products to

[27] See section 8



Principle 4. Invest

Our urban forest is valued as an urban asset and funded to ensure effective planning and management is not impeded.

increase efficiencies (e.g. use of AI-derived technology for planning and products such as Tree Coach for management; see Part 4).

Principle 5. Engage

Our community values urban trees and green cover and works together to grow the urban forest on private and public land.

Action 5.1 Understand community barriers and incentives

The level of community support can make or break tree planting programs. Ensuring support for tree plantings on public and private land requires an understanding of community perceptions, barriers, and drivers relating to tree planting and protection. A community-based social marketing (CBSM)[28] assessment of incentives and support schemes that resonate with the community around tree planting and retention should be undertaken.

Action 5.2 Internal Council education and awareness

As recommended under Focus Area 4 in Section 13.2, above, utilise this Urban Forest Strategy as a vehicle for change within the organisation and to educate and engage internal staff on the importance of trees. Moving to a more integrated delivery of green, blue, and grey infrastructure capital programs.

Action 5.3 External community education and awareness

As recommended under Focus Area 4 in Section 13.2, above, and based on the findings from Action 5.1, together with the existing community surveys around tree perceptions, establish a program of education and engagement events/actions. This may include, for example, continuing with tree give-aways and planting days, installing Tree Tags and Tree Trails (potentially involving community volunteers), Cool Streets engagement, demonstration plantings, and Adopt a Tree programs[29].

[28] https://www.sustainability.upenn.edu/sites/default/files/Guide%20to%20Community-Based%20Social%20Marketing.pdf; (de Guzman, et al., 2018); https://sdrufc.com/2017/09/14/community-based-social-marketing-overcoming-barriers-in-tree-care-calreleaf-webinar/

[29] For example: Section 6.7; https://www.unley.sa.gov.au/Environmental-Sustainability/Greening-Unley

15 Implementation Plan

The following is an indicative implementation plan for the actions outlined in Section 13. This should be refined, as needed, as part of Action 5.4.

Principle	Action	Time Frame	Preliminary Action/s Required?	Responsible Department	Funding Source
1. Learn 	1.1 Undertake a public tree inventory	1-2 years	Action 4.2	Parks	Existing
	1.2 Quantify species diversity and resilience of the urban forest	2 years	Action 1.1	Parks	Existing
	1.3 Integrate public tree assets into Council's AMS	2 years	Action 1.1	Parks	Existing
	1.4 Build the business-case for trees	2 years	Action 1.1	Parks	Existing
	1.5 Review species planting list	1 year	Action 1.1 Action 1.2	Parks	Existing
	1.6 Identify priority street tree planting locations that correlate with wildlife corridors	1 year		Parks	Existing
	1.7 Improve understanding of private trees	2-3 years		Environment	Additional
	1.8 Monitor canopy cover change	2-3 years		Environment	Existing
	1.9 Verify plantable opportunities	Ongoing		Parks	Existing
	1.10 Review prioritised tree planting locations	Ongoing		Parks	Existing
	1.11 Review timeframe to achieve canopy cover target	1 year		Urban Strategy	Existing
	1.12 Investigate parkland planting capacity and priorities	2 years		Parks	Existing
	1.13 Refine TPP and STP modelling	2-3 years	Action 1.1 Action 1.9 Action 1.12 Action 2.2	Parks	Additional
2. Grow 	2.1 Implement a 4-year prioritised Street Tree Planting program	1-5 years	Action 1.8 Action 2.5 Action 4.1	Parks	Additional
	2.2 Investigate opportunities to increase plantable opportunities	1-2 years	Action 1.8	Parks	Existing
	2.3 Encourage tree planting on private land	Ongoing	Action 5.1	Environment	Existing
	2.4 Amend Council's DCP	Ongoing	Action 3.4	Urban Strategy	Existing

Principle	Action	Time Frame	Preliminary Action/s Required?	Responsible Department	Funding Source
	2.5 Establish a growing contract	1-2 years	Action 1.1 Action 1.2 Action 1.5 Action 1.8	Parks	Existing
	2.6 Generate a whole of public land planting prioritisation program	2 years	Action 2.6	Parks	Additional
	2.7 Incorporate tree plantings in capital works programs	ongoing	Action 2.7	Parks, Environment and Projects	Existing
	2.8 Create a Monitoring and Evaluation Plan	1-2 years		Environment	Additional
3. Protect 	3.1 Review significant tree register	1 year		Parks	Existing
	3.2 Encourage tree retention on private land	Ongoing	Action 1.6	Environment	Additional
	3.3 Incentivise tree protection in new developments	Ongoing	Action 1.6	Urban Strategy	Additional
	3.4 DCP controls to protect trees on private land	Ongoing	Action 2.4	Urban Strategy	Additional
	3.5 Establish tree protection compliance approach	1-2 years		Parks	Additional
	3.6 Increase DA tree planting compliance	TBC - requires additional resources/ skills		Development Assessment & Health and Building	Additional
	3.7 Canopy retention in capital projects	Ongoing		Projects	Existing
	3.8 Advocate to the State government about SEPP impacts	1-2 years		Urban Strategy	Additional
4. Invest 	4.1 Seek additional Council funding to support expanded tree planting programs	1 year	Action 1.4	Parks	Additional
	4.2 Identify funding to undertake full tree inventory	1 year		Parks	Existing
	4.3 Advocate for funding to increase tree maintenance budgets	1-2 years	Action 1.4	Parks	Additional
	4.4 Advocate for increased funding to support additional community education and engagement programs	Ongoing		Parks and Environment	Additional
	4.5 Invest in ASM maintenance	1-2 years		Parks	Additional

Principle	Action	Time Frame	Preliminary Action/s Required?	Responsible Department	Funding Source
	4.6 Invest in canopy cover monitoring	1-2 years	Action 1.4	Environment	Additional
	4.7 Invest in new technologies	1-2 years		Parks	Additional
5. Engage 	5.1 Understand community barriers and incentives	1-2 years		Environment	Additional
	5.2 Internal Council education and awareness	1 year	Action 1.1 Action 1.2 Action 1.8 Action 1.9	Parks and Environment	Existing
	5.3 External community education and awareness	1-2 years	Action 1.1 Action 1.2 Action 1.8 Action 1.9	Environment	Additional

PART 6.

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16 References

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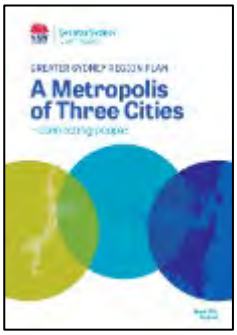
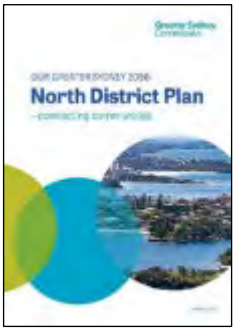
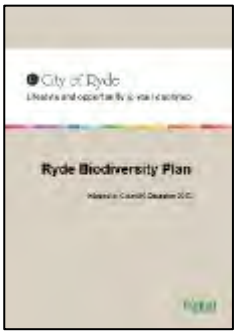
Annex A. State and Local Documents of Relevance to the Urban Forest Strategy

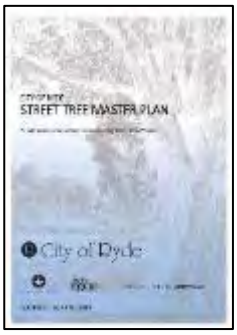
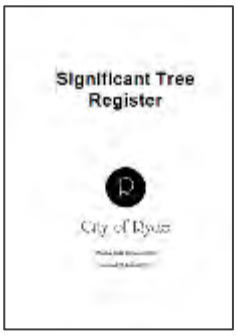
Document	Relevance to the Urban Forest Strategy
State Level	
Environmental Planning and Assessment Act 1979	Establishes the legislative requirements for all land use plans and developments in NSW.
Biodiversity Conservation Act 2016	The main legislation that protects ecological communities and threated species populations in NSW.
Greater Sydney Region Plan 	The 40-year vision, framework and objectives for liveability, productivity, and sustainability across all of Greater Sydney. Implementation of the Plan is delivered through 5 District Plans, including the North District Plan which includes the City of Ryde and eight other LGAs[30] . • Sustainability Direction 8 - A City in its Landscape o Objective 25: The coast and waterways are protected and healthier o Objective 27: Biodiversity is protected, urban bushland and remnant vegetation is enhanced o Objective 28: Scenic and cultural landscapes are protected o Objective 30: Urban tree canopy cover is increased, specifically that "*A target has been set to increase tree canopy cover to 40 per cent, up from the current 23 per cent.*" o Objective 31: Public open space is accessible, protected and enhanced o Objective 32: The Green Grid links parks, open spaces, bushland and walking and cycling paths
North District Plan 	Provides the North District's implementation framework and priorities for delivering the Greater Sydney Region Plan. • Planning Priority N19 - Increasing urban tree canopy cover and delivering Green Grid connections; specifically "*The NSW Government has set a target to increase tree canopy cover across Greater Sydney to 40 per cent*" • Planning Priority N22 - Adapting to the impacts of urban and natural hazards and climate change, such as: - supporting initiatives that respond to the impacts of climate change; and - mitigating the urban heat island effect and reducing vulnerability to extreme heat.

[30] North District Plan comprises the following LGAs: City of Ryde, Hornsby, Hunters Hill, Ku-ring-gai, Lane Cove, Mosman, North Sydney, Northern Beaches, and Willoughby

Document	Relevance to the Urban Forest Strategy
Council Level	
Local Strategic Planning Statement 2019  	Establishes Council's 20-year vision and guides development and implementation of more detailed Council plans, planning controls, and policies. Part 3 Liveability • Section 3.1 Housing supply, affordability, diversity and amenity o Planning Priority Action H5.1: Provide street tree planting in accordance with street tree master plans through Council's capital works program and the development process. Ongoing • Section 3.2 Centres o 3.2.4 Targets: Public domain within all centres will be increased and, there will be more street trees and shade. o Section 3.2.7.3 Gladesville Town Centre – Opportunities for improvement B4: Create a tree-lined boulevard along Victoria Road Part 4 Productivity • Section 4.2 Macquarie Park o Planning Priority Action M1.1: - 'Urban structure and placemaking': Retain and enhance the valued green character of Macquarie Park including significant native tree planting. - 'Sustainability': Identify and retain significant trees o Planning Priority Action M4.1: - Ensure new developments retain and enhance valued qualities such as tree-lined streets, natural creek lines and links to the Lane Cove National Park as the precinct develops o Planning Priority Action M5.1: - Create a well-used public domain that: …encourages people to linger in the public spaces by providing shade (more trees, awnings and shade structures), seating, community events, markets activation Part 5 Sustainability • Section 5.1 Open space and active recreation: o Section 5.1.4 Targets: Local flora and fauna will be effectively conserved. • Section 5.2 Environment o Section 5.24 Targets: By 2030, at least 40 per cent of the City of Ryde will have tree canopy cover, which is an overall increase on 2019 levels o Section 5.2.5 Planning Priority E2: Increase urban tree canopy cover and deliver 'green grid' connections. - Action E2.1: Continue to implement the current City of Ryde Street Tree Masterplan and Tree Management Policy and Plan - Action E2.2: Collaborate with North District and other councils to implement a regional 'Green Grid' Masterplan aimed at

Document	Relevance to the Urban Forest Strategy
	managing and increasing the extent of urban forest canopy cover (across public and private lands) - Action E2.3: Increase cooling shade cover to 40 per cent of the LGA to mitigate urban heat island effects - Action E2.4: Complete an assets valuation for trees for inclusion in revised Development Control Plan
Community Strategic Plan 2028 	A 10-year plan that establishes the strategic framework and priority actions for how the City will progress as a desirable place to be for lifestyle and opportunity. The plan prioritises protecting and enhancing vegetation and green spaces within the City, including increasing the amount included in new developments. • Outcome 3 - Our natural and sustainable city o Priority 2: Protecting natural areas
Local Environmental Plan 2014	Implements the LSPS by providing the local environmental planning provisions for land in Ryde. The Plan is itself implemented through the Development Control Plan. • Part 2 – Land Use Table: Zones SP1, RE1, RE2, C1, and C2
Development Control Plan 2014 	Implements the LEP through detailed guidelines, objectives and controls for future development in the City. • Part 9 – Other Provisions o 9.5: Tree Preservation
Integrated Open Space Plan 2012 	Establishes the framework and objectives for conserving and enhancing the City's public open space network and ensuring the needs of the community are met. Throughout this Plan are themes and objectives relating to the UFS, including: • maintaining, enhancing, and connecting open spaces and natural environment areas; • improving walkability through street tree plantings to increase shade; and • providing social and cultural connections to the landscape through native tree plantings and selections • reducing heat and improving microclimate conditions through provision of more shade trees; and • enhancing biodiversity and conservation through plantings and open space management.

Document	Relevance to the Urban Forest Strategy
Ryde Resilience Plan 2030 (Vol. 1 & 2)   	Establishes the framework, objectives and actions for building local resilience in the city. Volume 2 • Part 4: Climate change, extreme weather events and natural hazards • Part 5: Biodiversity and natural systems • Part 6: Transport and connecting our community
Biodiversity Plan 2016  	Provides the framework for conserving, managing, and enhancing natural areas and biodiversity within the City. The Plan's five interconnected themes all relate to the UFS: • Theme 1 - native vegetation: protecting and managing Ryde's native vegetation • Theme 2 - urban waterways: restoring waterways and surrounding environments • Theme 3 - corridors and connectivity: linking the landscape • Theme 4 – public spaces: managing our reserves to promote biodiversity and community interaction • Theme 5 – urban habitat: protecting and managing biodiversity in the urban landscape
Tree Management Plan 2013  	The UFS will supersede this plan, combining and evolving concepts, priorities, and actions included in this Plan and the Street Tree Masterplan 2013. Note that the 2016 change to this document was limited to the title change.

Document	Relevance to the Urban Forest Strategy
Street Tree Masterplan 2013 	The UFS will supersede this plan, combining and evolving concepts, priorities, and actions included in this Plan and the Tree Management Plan 2013.
Significant Tree Register 2007 (updated 2021)  	Integration of the STR should be undertaken as part of the deliverable actions from the UFS.

Annex B. Operational Capacity Workshop Outcomes

Fundamental to the delivery of improved urban forest and canopy outcomes is the organisational capacity to deliver these outcomes. To understand the current challenges and barriers that exist in achieving improved urban forest outcomes within the City of Ryde an internal workshop was undertaken with selected relevant Council staff (Table 11) on February 9, 2022. The objective of the workshop was to determine the organisation's capacity and current level of progress in urban forest management.

The workshop was conducted online using an interactive MURAL platform (Figure 17) and was designed to gauge what Council is doing well and opportunities for improvement regarding:

(1) public trees and operations; and

(2) private tree management and planning.

This Annex summarises the key findings from the workshop, including six 'focus areas' based on issues or topics determined by the group as being the most important opportunities for improvement and development.

Table 11. City of Ryde officers who participated in the Organisational Capacity workshop.

Council Officer	Position
Rob Parsonson	Open Space Planner
Michael Longworth	Senior Coordinator Parks Planning
Terrence English	Landscape Architect
Elizabeth Read	Team Leader Landscape Architects
Paul Bu	Urban Designer/Strategic Planner
Naomi L'Oste-Brown	Senior Coordinator Strategic Planning
Kylie McMahon	Manager Environment
Sandra Payne	Natural Areas Coordinator
Joanne Verdon	Tree Management Officer
Stephen Ellul	Manager Operations
Jonathan Harris	Senior Coordinator Passive Parks & Streetscapes
Craig Newbury	Passive Parks and Streetscapes Coordinator

Figure 17. MURAL mind mapping outputs from the Council workshop. See also figures 19a-19f for closer view of each topic cluster.

Figure 18a. MURAL mind mapping outputs from the Council workshop for the Private Trees topic.

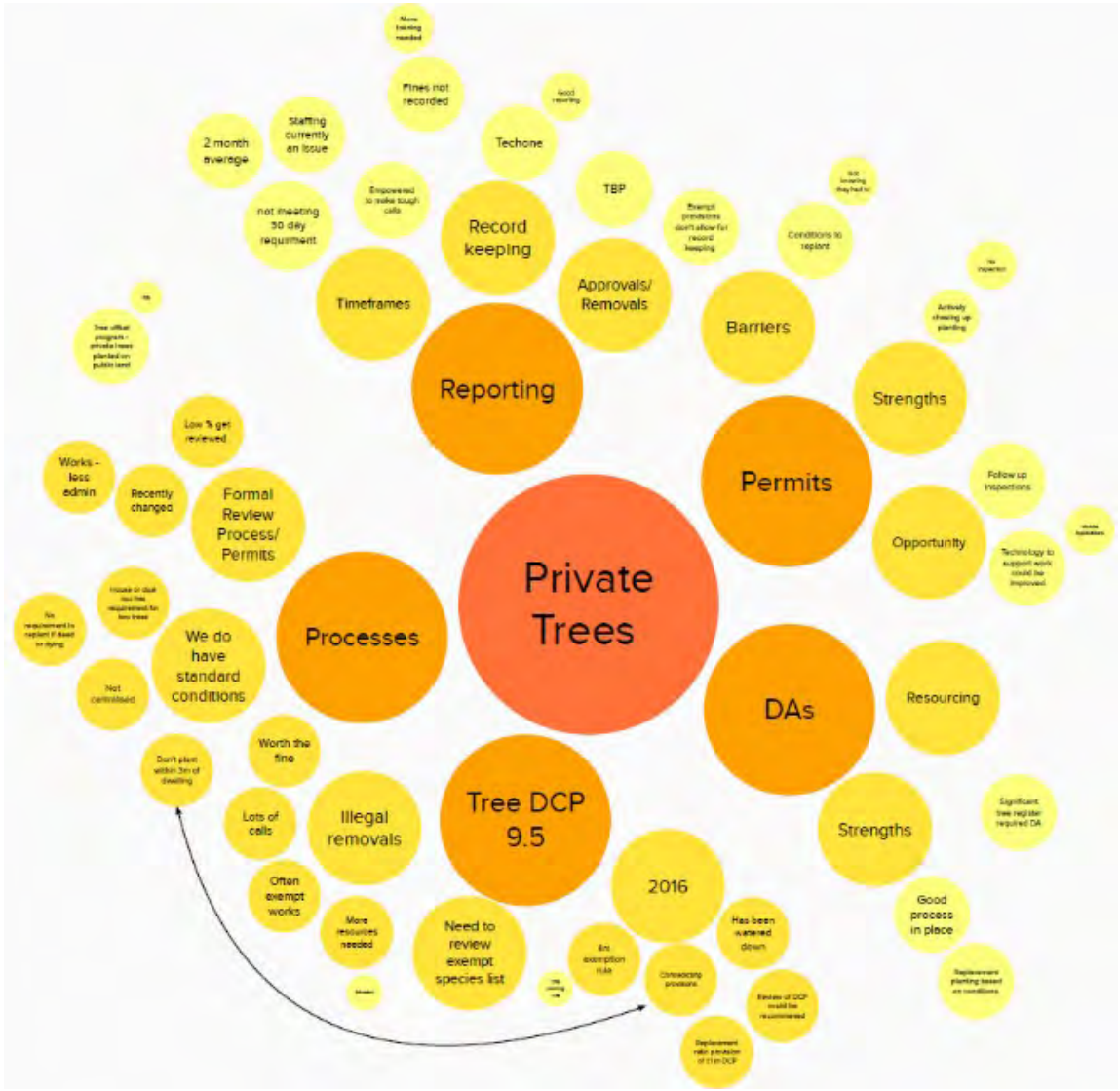


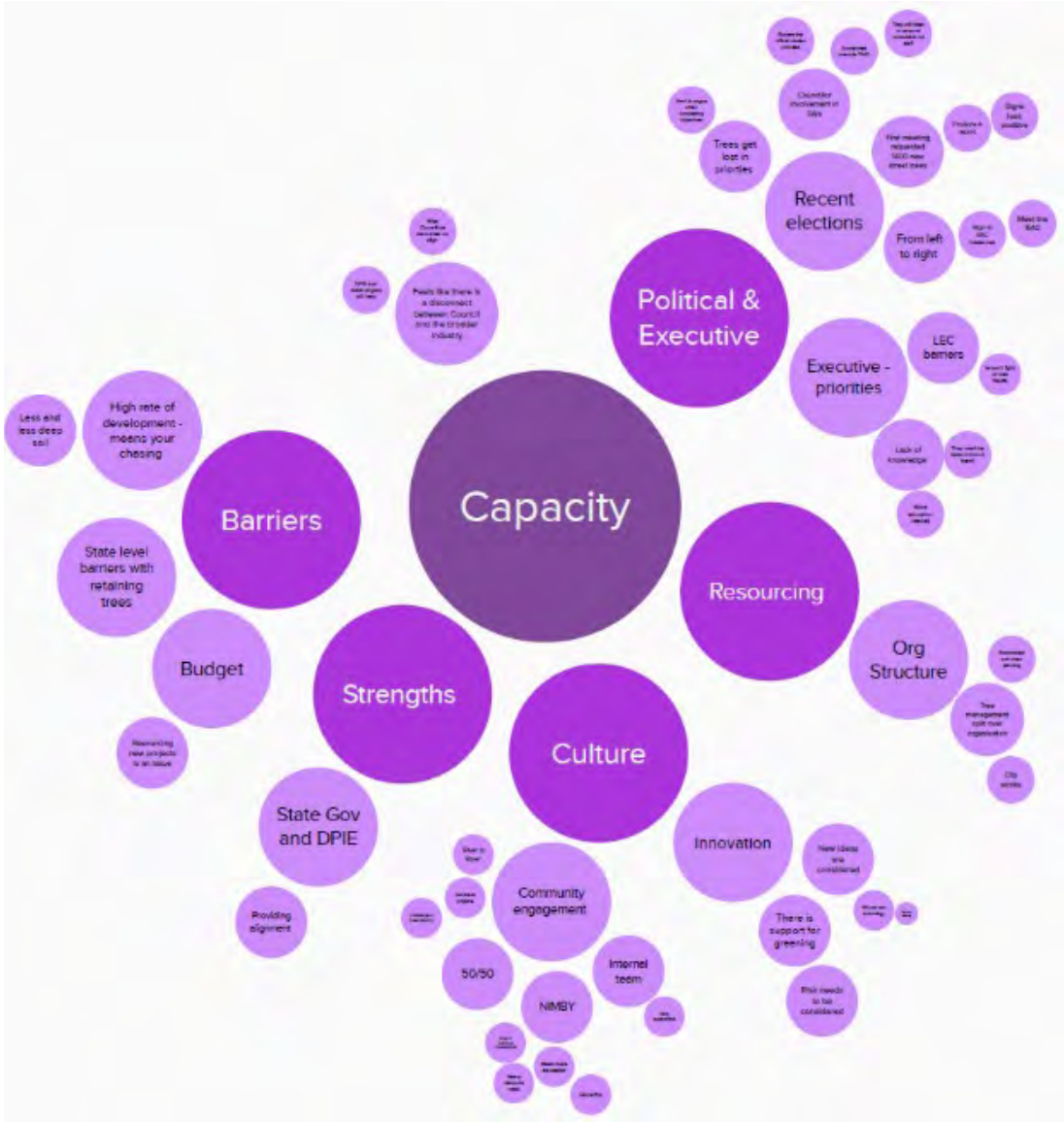
Figure 19b. MURAL mind mapping outputs from the Council workshop for the Planning Framework topic.

Figure 17c. MURAL mind mapping outputs from the Council workshop for the Maintenance topic.

Figure 17d. MURAL mind mapping outputs from the Council workshop for the Planting topic.

Figure 17e. MURAL mind mapping outputs from the Council workshop for the Planting topic.

Figure 17f. MURAL mind mapping outputs from the Council workshop for the Capacity topic.



Annex C. Canopy Cover

The urban canopy cover assessment was undertaken using 2010, 2017 and 2020 NearMap AI Vegetation data. Using NearMap data provides access to a deep record of high-quality spatial data. Furthermore, NearMap's AI datapacks apply a robust spatial analysis methodology to generate consistent data outputs. This ensures any potential errors in the data processing are systematic and will therefore be the same in subsequent analyses enhancing the accuracy of change over time statistics.

Table 12 shows, for each Council control area and zone, the percentage canopy cover in each time period and the percent change over time between 2010-2017 and 2010-2020.

Table 12. Percent canopy cover and change within each Zone over time.

Council Control Area	Zone	Area (m2)	% City Area	Canopy 2010 (%)	Canopy 2017 (%)	Canopy 2020 (%)	Canopy Change 2010-2017 (%)	Canopy Change 2010-2020 (%)
High	Road reserve (various zonings)	6,645,960.89	16.46%	17.89	18.15	18.64	0.26	0.75
	Parklands (RE1)	2,091,952.35	5.18%	32.75	35.94	37.16	3.19	4.41
	Natural Areas (E2)	1,458,287.75	3.61%	89.50	90.26	90.02	0.76	0.52
	NPWS (E1)	2,638,362.70	6.54%	89.39	85.48	84.85	-3.91	-4.54
Medium	Private Recreation (RE2)	758,417.52	1.88%	25.53	25.10	24.22	-0.43	-1.31
	Low Density Residential (R2)	16,461,310.72	40.78%	24.22	21.59	20.40	-2.62	-3.81
Low	Industrial (IN2)	351,192.81	0.87%	11.02	11.12	9.77	0.09	-1.26
	Town/Neighbourhood Centres (B1, B3, B4, B5, B6, B7)	4,037,064.46	10.00%	21.45	21.29	20.80	-0.16	-0.65
	Medium Density Residential (R1, R3)	282,105.02	0.70%	30.56	22.09	22.70	-8.47	-7.86
	High Density Residential (R4)	1,293,118.05	3.20%	30.70	29.84	29.05	-0.87	-1.65
	Various Special Infrastructure (SP2)	4,347,490.57	10.77%	29.82	28.65	28.57	-1.17	-1.25

Annex D. Tree Planting Predictor

The Tree Planting Predictor™ (TPP) was developed by Edge Environment to directly support urban land managers and decision-makers, make evidenced-based decisions about setting future canopy cover targets. The tool is Excel-based and designed to be delivered in a paired workshop process, which helps tailor its application for given locations and build confidence from technical staff through to decision-makers about the underlying technical rigour.

The tool considers a range of input metrics relating to current canopy, rates of loss, and establishments success, as well as the number of different species planted (Table 13). At the core of the tool's modelling, are over 500,000 equations that relate to the growth rate and crown spread at maturity of five categories of trees (Table 14). Noting that the growth rate and crown spread at maturity are able to be customised to each specific project location, as is the species mix and numbers planted on average each year (Table 16).

Table 13. TPP input metrics provided by the City of Ryde.

Required information	Data provided/obtained
1. Location of the site	City of Ryde
2. Area of the study region (m^2)	40,365,263 m^2 (40.36 km^2)
3. Area of specified zones (m^2)	High control – 13.17 km^2 Medium control – 17.14 km^2 Low control – 10.05 km^2
4. Current canopy area (m^2)	11,665,692 m^2 (28.9%)
5. Plantable space (m^2)	4,730,873 m^2 (12%)
6. Target canopy area (m^2)	16,145,911.97 m^2 (40%)
7. Date for future canopy target (Year: 20xx)	2030 (plus 2040 and 2050 comparisons)
8. Net annual change of current canopy (%)	0.0183% (loss)
9. Establishment success rate (%)	95%
10. Establishment cost for plantings (AUD)	$200/tree
11. Irrigation (yes/no? Duration?)	No
10. Species to be planted	750 trees/yr, 42 species (see Table 15)

Table 14. Tree categories used in the TPP and examples of each. The average crown spread at maturity is derived from the minimum and maximum canopy spread for each category.

Category	Years to Maturity	Average Crown Spread at Maturity (m)	Example Tree Species	
A	5	2	Crepe myrtle, Callery pear, NSW Christmas Bush	
B	10	4	Weeping bottlebrush, Box elder, Willow myrtle	
C	15	6.5	Yellow gum, Jacaranda, Zelkova, Chinese elm	
D	20	11.5	Norfolk Island pine, London plane, Turpentine	
E	30	22.5	Moreton Bay fig	

Table 15. Species and quantity planted on average per year within the City of Ryde.

Species	Common name	BAU Planting Number	TPP Category Size
Angophora bakeri	Apple Myrtle, Smooth-barked apple	11	D
Angophora floribunda	Rough-barked apple	7	D
Angophora hispida	Dwarf apple	37	A
Angophora costata	Smooth bark apple	41	D
Banskia serrata	Old man banksia	14	D

Species	Common name	BAU Planting Number	TPP Category Size
Brachychiton acerifolius	Illawarra flame tree	7	D
Buckinghamia celisissima	Ivory curl flower	52	B
Caesalpinia ferrea	Leopard tree	21	B
Ceratopetalum gummiferum	New South Wales Christmas bush	44	B
Corymbia eximia	Yellow bloodwood	14	D
Corymbia ficifolia	Red flowering gum	43	B
Corymbia gummifera	Red bloodwood	7	C
Cupaniopsis anacardioides	Tuckeroo	36	C
Elaeocarpus reticulatus	Blueberry ash	5	B
Eucalyptus crebra	Narrow-Leaved red ironbark	14	D
Eucalyptus fibrosa	Broad-Leaved red ironbark	18	D
Eucalyptus haemastoma	Broad-leaved scribbly gum	6	B
Eucalyptus leucoxylon	Pink-flowered blue gum	4	D
Eucalyptus melliodora	Yellow box	6	E
Eucalyptus paniculata	Grey ironbark	4	D
Eucalyptus pilularis	Blackbutt	23	E
Eucalyptus piperita	Sydney peppermint gum	3	B
Eucalyptus punctata	Grey gum	18	C
Eucalyptus racemosa	Narrow-leaved scribbly gum	3	D
Eucalyptus robusta	Swamp mahogany	4	D
Eucalyptus saligna	Sydney blue gum	52	E
Eucalyptus tereticornis	Forest red gum	12	D
Ficus macrophylla	Moreton Bay fig	3	E
Flindersia australis	Crow's ash, Australian teak	19	D
Glochidion ferdinandi	Cheese tree	19	B
Hymenosporum flavum	Native frangipani	32	B
Leptospermum petersonii	Lemon-scented tea-tree	16	A
Liriodendron tulipifera	Tulip tree	1	D
Melaleuca decora	White cloud tree	21	B
Melaleuca styphelioides	Prickly paperbark	5	B
Nyssa sylvatica	Tupelo	1	B
Quercus palustris	Pin oak	7	C
Syncarpia glomulifera	Turpentine	38	C
Tristaniopsis laurina	Water gum	62	B
Trochocarpa laurina	Tree heath, waddy wood	1	C
Ulmus parvifolia	Chinese elm	4	D
Waterhousea floribunda	Weeping lilly pilly	15	C

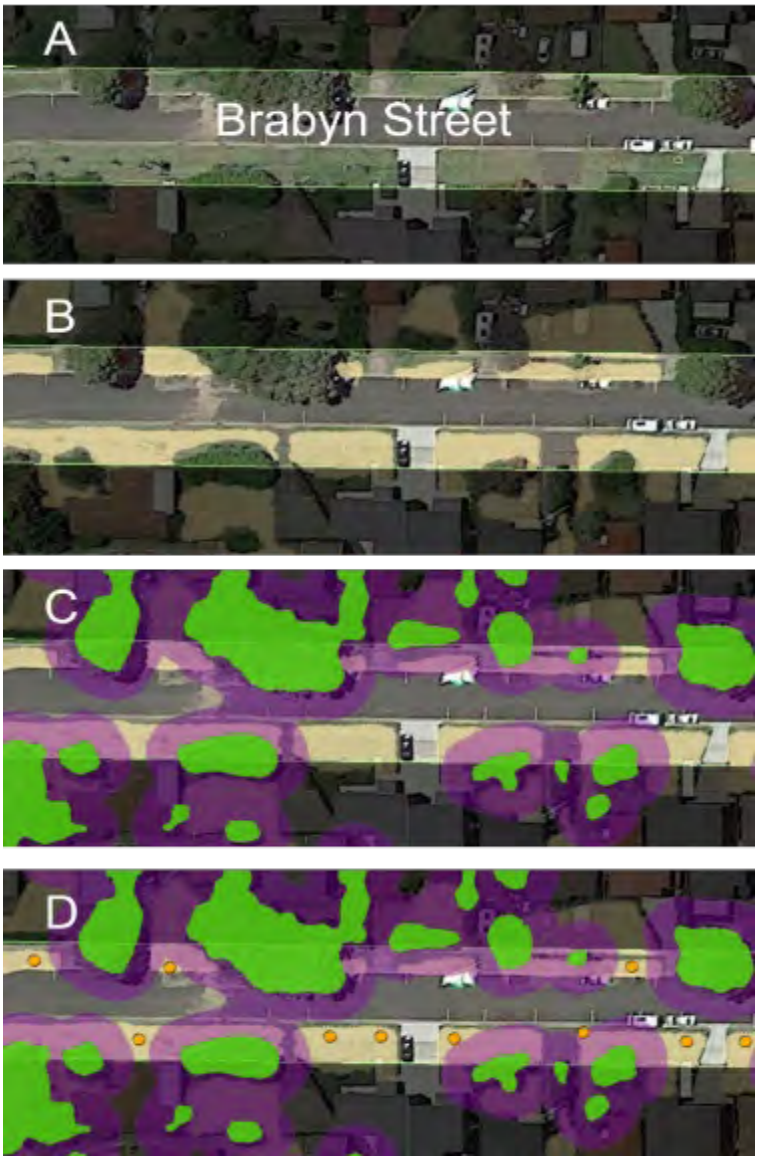
Annex E. Street Tree Planting Prioritisation

Plantable opportunities

The Street Tree Predictor (STP) process begins by assessing plantable space as the combination of "lawn grass" or "natural" surfaces from the NearMap AI Surfaces Datapack. This data was derived from imagery collected on January 21, 2020.

Brabyn Street in Denistone East provides an illustrative example of the STP process (Figure 20A). Road corridors are defined by the New South Wales Road Corridor Dataset which generally includes all road surfaces and the surrounding 4 metres of verge area (approximately). Within the road corridor, plantable space is identified from NearMap data (Figure 20B). Current canopy is also extracted from NearMap data and all areas within 5 metres of current canopy are excluded from the plantable space layer (Figure 20C). Finally, for all remaining plantable space, a bin packing algorithm is applied to find all suitable locations that are larger than $1m^2$ and at least 5m away from the next nearest plantable opportunity (Figure 20D).

These plantable opportunities are then aggregated for each road segment. All analyses were undertaken using ArcGIS and QGIS software. Given the definition used here for plantable space, the prioritisation process will not capture streets with entirely sealed verges, such as may occur in town centres.



Box A: Brabyn St. in Denistone East with highlighted road corridor.

Box B: Plantable space show in beige.

Box C: Current tree canopy extent shown in green with 5m canopy buffer shown in purple.

Box D: Plantable opportunities shown in orange representing each location that has > $1m^2$ of plantable space, which is >5m from current tree canopy and >5m from next nearest plantable opportunity.

Figure 20. Example of the process to derive plantable opportunities.

The STP identified 15,959 plantable opportunities (Figure 21) within the road reserve along the City's 425.85 kilometres of road, equating to an average of 3.7 plantable opportunities per 100 metres of road (out of a theoretical maximum of 40 opportunities per 100m accounting for verges on both sides of the road).

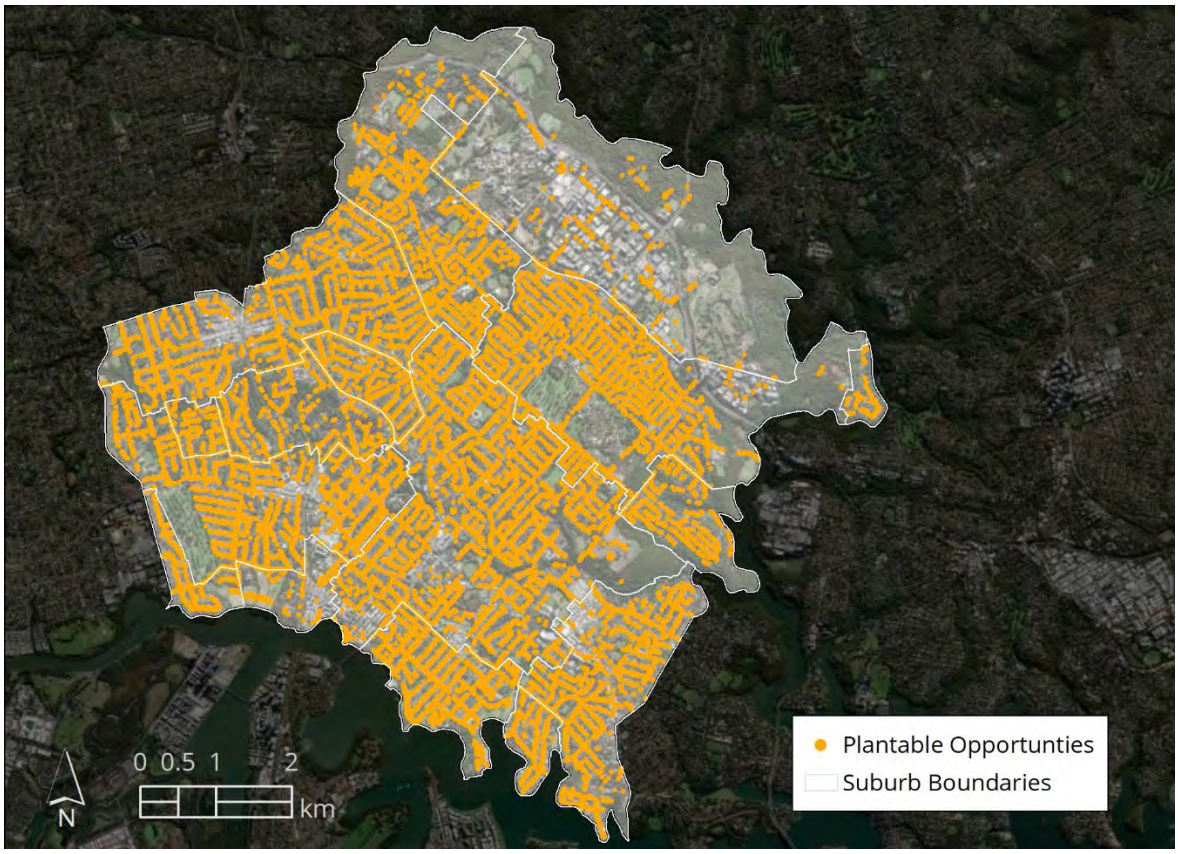


Figure 21. 15,959 Plantable opportunities for street trees to be planted within the City's street corridors. Suburb boundaries shown in white as white lines.

To understand these plantable opportunities in more actionable terms, plantable opportunities were aggregated to street levels. Each street segment was defined as street area including the adjacent verge areas (as identified in the NSW Road Corridor dataset), excluding intersections, and within a single suburb (any road segment spanning two suburbs was split at the suburb line).

Aggregating results to this level identified 53 street segments with more than 50 plantable opportunities, with Quarry Road and Twin Road in Ryde being the most plantable having 134 and 102 plantable opportunities, respectively.

To account for road length, the plantable opportunities per 100 metres of road length were also assessed, resulting in 71 streets having more than 10 plantable opportunities per 100 metres of road, including Lardelli Drive and Buffalo Road in Ryde having 70 and 53 plantable opportunities per 100 metres (Figure 11, Table 8).

Full details of each street are provided in the associated Excel spreadsheet outputs for this modelling (see Table 16).

Table 16. Excerpt of Street Tree Prioritiser results table.

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
BALACLAVA RD	Macquarie Park	976.00	26.36	5	882	9	5	0.90
BALL AVE	Eastwood	1753.06	27.45	5	922	7	2	0.85
RAILWAY PDE	Eastwood	172.25	5.39	5	982	2	1	0.85
STATION LANE	Eastwood	30.44	8.31	5	982	1	2	0.84
BLAXLAND RD	Eastwood	1218.69	9.37	5	982	32	5	0.83
ETHEL ST	Eastwood	672.50	12.56	5	982	9	3	0.82
IRENE CR	Eastwood	712.50	10.39	3	890	33	6	0.81
ROWE ST	Eastwood	2958.88	12.87	5	990	24	2	0.81
LITTLE CHURCH ST	Ryde	217.31	17.05	5	982	1	1	0.81
WEST PDE	Eastwood	877.13	15.78	5	990	2	0	0.80
RYEDALE RD	Eastwood	1218.38	18.62	5	990	19	27	0.79
CURZON ST	Ryde	653.69	21.09	5	983	5	3	0.79
MAY ST	Eastwood	931.94	22.49	5	982	3	1	0.79
GOWRIE ST	Ryde	43.44	2.57	5	1036	1	1	0.79
FIRST AVE	Eastwood	2408.06	20.82	5	990	27	8	0.78
SINDEL ST	West Ryde	351.94	12.43	3	913	9	5	0.78
HIGGINBOTHAM RD	Gladesville	796.19	8.33	2	874	33	4	0.77
BOOTH ST	Marsfield	554.06	12.65	3	921	21	7	0.77
TRAMWAY ST	West Ryde	508.50	13.14	3	913	17	8	0.77
HATTON ST	Ryde	105.38	7.20	5	1036	4	3	0.77
DORA ST	Marsfield	601.06	13.70	3	921	22	6	0.76
CHEERS ST	West Ryde	512.00	15.79	3	913	11	5	0.76
CLIFTON ST	West Ryde	542.25	18.72	3	913	9	4	0.76
LEONARD PL	Marsfield	21.50	1.62	3	957	7	10	0.76

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
WILLIAM ST	Ryde	276.06	10.64	5	1036	1	0	0.76
HERBERT LANE	West Ryde	2.50	0.69	4	1014	1	2	0.75
SMITH ST	Ryde	432.19	8.09	4	1008	24	9	0.74
RYEDALE LANE	West Ryde	0.50	0.07	4	1027	4	4	0.74
MONS AVE	West Ryde	1813.44	11.95	4	1004	58	8	0.73
LANE COVE RD	Ryde	3307.06	8.91	4	1008	46	4	0.73
BEIHLER LANE	Ryde	239.13	39.72	4	928	3	5	0.73
MONASH RD	Gladesville	3112.88	23.47	2	874	20	3	0.72
BARR ST	North Ryde	799.31	19.77	4	991	17	6	0.72
HIGGINBOTHAM RD	Ryde	1440.25	25.42	2	874	9	2	0.72
CAM ST	North Ryde	675.06	22.76	4	991	14	5	0.71
BOREE ST	Marsfield	106.56	5.04	4	1040	11	9	0.71
WAYELLA ST	West Ryde	1072.56	31.39	3	913	8	4	0.71
BELMORE LANE	Ryde	188.63	10.35	4	1025	2	1	0.71
RIVERVIEW ST	West Ryde	793.63	21.94	4	1004	4	2	0.70
BRIGHT ST	Ryde	172.06	4.53	3	1003	24	10	0.69
NORTHCOTT ST	North Ryde	165.75	4.06	3	1006	24	9	0.69
DOLAN ST	Ryde	73.69	2.99	3	1003	18	12	0.69
DEVLIN ST	Ryde	907.63	4.11	3	1006	7	1	0.69
DOVER ST	Marsfield	213.00	10.34	4	1040	6	5	0.69
LEAWILL PL	Gladesville	432.81	32.26	2	874	4	4	0.69
NOLA ST	Marsfield	466.19	33.86	3	921	3	4	0.69
ZANCO RD	Marsfield	580.06	11.56	3	988	21	7	0.68
UNNAMED ROAD 782	Ryde	37.88	2.03	2	965	14	11	0.68
KATOA PL	Marsfield	137.69	12.84	3	988	7	9	0.68
ISABEL ST	Ryde	719.69	24.38	4	1008	6	4	0.68

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
ENDEAVOUR ST	West Ryde	975.75	25.51	4	1004	3	2	0.68
AMELIA ST	North Ryde	423.00	7.14	4	1064	36	11	0.67
EPPING RD	Marsfield	10439.31	15.51	3	991	23	1	0.67
LARKARD ST	North Ryde	665.06	35.75	4	991	4	3	0.67
MACPHERSON ST	Ryde	46.38	5.53	4	1069	2	2	0.67
CHURCH LANE	Ryde	192.06	21.75	4	1025	1	1	0.67
FOLKARD ST	North Ryde	667.31	10.70	4	1064	32	8	0.66
MARILYN ST	North Ryde	480.63	8.90	4	1064	28	9	0.66
BEATRICE ST	North Ryde	461.63	8.18	3	1013	23	8	0.66
WARING ST	Marsfield	1044.00	18.41	3	988	13	3	0.66
VINCENTIA ST	Marsfield	533.00	18.18	4	1040	11	7	0.66
KOORONG ST	Marsfield	453.88	17.77	3	988	8	5	0.66
BIARA CL	Marsfield	204.94	19.11	3	988	3	4	0.66
COONEY ST	North Ryde	749.19	11.68	3	1013	32	5	0.65
ARTHUR ST	Ryde	159.19	3.16	3	1040	32	10	0.65
AVON RD	North Ryde	1245.25	13.73	3	1013	31	6	0.65
DONOVAN ST	Eastwood	266.63	5.46	2	975	28	9	0.65
PAMELA ST	North Ryde	457.94	11.87	3	1013	21	8	0.65
BEAZLEY ST	Ryde	736.81	17.39	3	1003	20	7	0.65
MILNE ST	Ryde	353.31	11.26	2	965	14	7	0.65
MAVIS ST	North Ryde	434.81	14.41	3	1006	13	7	0.65
ALLENGROVE CR	North Ryde	323.44	11.66	4	1064	9	5	0.65
MACPHERSON ST	West Ryde	149.94	10.18	4	1069	7	4	0.65
OLIVIERI PL	Ryde	24.06	2.19	3	1040	6	10	0.65
WICKS RD	North Ryde	3143.69	13.92	3	1013	76	7	0.64

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
LAVARACK ST	Ryde	511.44	5.49	3	1040	63	11	0.64
LORNA AVE	North Ryde	952.56	15.01	4	1064	24	6	0.64
HALL ST	West Ryde	302.75	8.41	3	1034	17	9	0.64
KATHLEEN ST	North Ryde	499.19	14.09	3	1013	16	7	0.64
PARKES ST	Ryde	1174.31	17.03	3	1006	13	4	0.64
VALEWOOD CR	Marsfield	988.63	26.37	4	1040	11	5	0.64
FRANK ST	Ryde	0.00	0.00	3	1055	2	3	0.64
JOHN MILLER ST	Ryde	1172.13	16.75	2	965	28	6	0.63
WOORANG ST	Eastwood	875.06	13.62	2	975	28	9	0.63
NORTH RD	Ryde	688.88	6.48	2	991	22	20	0.63
TURNER AVE	Ryde	159.19	4.31	3	1051	20	11	0.63
FORSTER ST	West Ryde	2523.81	34.41	4	1027	19	5	0.63
UNNAMED ROAD 781	Ryde	664.25	16.81	2	965	14	6	0.63
CALLAGHAN ST	Ryde	551.75	16.96	2	965	6	3	0.63
DUNMORE RD	West Ryde	278.31	19.82	3	1009	4	11	0.63
MAXIM LANE	West Ryde	92.13	13.11	3	1025	2	1	0.63
VIMIERA RD	Macquarie Park	560.31	26.50	3	991	1	0	0.63
VIMIERA RD	Marsfield	9153.75	28.54	3	991	60	8	0.62
HERBERT ST	West Ryde	908.56	10.23	3	1043	30	6	0.62
SMALLS RD	Ryde	492.63	10.09	3	1040	25	26	0.62
SQUIRE ST	Ryde	842.69	15.90	3	1029	25	9	0.62
FERRABETTA AVE	Eastwood	678.31	14.63	2	975	22	8	0.62
BADAJOZ RD	Ryde	1864.25	20.94	2	965	21	4	0.62
ALISON ST	Eastwood	779.00	16.88	2	975	17	6	0.62
SHIPWAY ST	Marsfield	2155.56	29.87	3	991	15	4	0.62

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
ARRAS PDE	Ryde	231.13	7.77	3	1051	15	10	0.62
ACACIA LANE	Eastwood	61.19	9.43	2	991	4	4	0.62
GERARD LANE	Gladesville	97.19	6.15	3	1056	1	0	0.62
VICTORIA RD	Ryde	3482.25	7.19	3	1055	73	4	0.61
WATTLE ST	West Ryde	815.38	13.81	3	1043	17	6	0.61
BAREENA PL	Marsfield	1479.38	33.30	3	991	12	5	0.61
SHERBROOKE RD	West Ryde	805.44	26.39	3	1009	10	7	0.61
DUNBAR ST	Ryde	875.56	27.08	3	1006	7	3	0.61
BRUNTON PL	Marsfield	1499.44	32.09	3	991	6	3	0.61
DALTON AVE	Eastwood	30.25	3.06	3	1067	5	5	0.61
EDEN ST	Ryde	101.19	13.14	3	1040	4	11	0.61
PARSONAGE ST	Ryde	113.38	6.11	3	1063	4	11	0.61
GLEN ST	Eastwood	1250.81	21.53	3	1019	1	0	0.61
UNNAMED ROAD 2355	Ryde	457.75	24.00	2	965	1	1	0.61
ASHBURN LANE	Gladesville	125.81	15.62	3	1040	1	1	0.61
EASTVIEW AVE	North Ryde	5555.63	30.62	3	1006	47	4	0.60
HERMITAGE RD	West Ryde	2546.06	15.61	3	1043	45	6	0.60
SECOND AVE	Eastwood	644.31	9.96	2	1008	30	9	0.60
IRVINE CR	Ryde	653.69	13.41	3	1051	25	8	0.60
PAUL ST	North Ryde	706.63	12.92	3	1051	24	11	0.60
KINGSFORD AVE	Eastwood	1339.94	20.93	2	975	23	7	0.60
BIRD ST	Ryde	1364.00	25.96	2	965	16	5	0.60
SUTHERLAND AVE	Ryde	513.69	21.62	3	1029	10	8	0.60
BUFFALO RD	Gladesville	1031.19	11.61	3	1055	9	1	0.60
HUGHES ST	West Ryde	713.56	17.38	3	1038	8	4	0.60

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
MELLOR ST	West Ryde	766.06	24.83	4	1069	7	5	0.60
LAKESIDE RD	Eastwood	2226.38	26.40	3	1019	7	2	0.60
FRANK ST	Gladesville	265.50	12.72	3	1055	4	3	0.60
RHODES ST	West Ryde	689.00	25.26	4	1069	3	1	0.60
WELL ST	Ryde	80.88	8.11	3	1063	2	1	0.60
SPOONER PL	North Ryde	1226.31	56.78	4	991	2	3	0.60
BUFFALO RD	Ryde	3517.88	13.17	3	1055	73	53	0.59
WOLGER RD	Ryde	1471.44	14.22	3	1052	50	10	0.59
UNNAMED ROAD 2911	Marsfield	153.75	2.73	2	1035	46	5	0.59
STATION ST	West Ryde	3145.25	19.79	3	1038	39	5	0.59
RAYMOND ST	Eastwood	727.69	12.01	2	1007	27	7	0.59
NEVILLE ST	Ryde	242.13	7.88	2	1021	18	9	0.59
ORCHARD ST	West Ryde	1291.50	18.51	3	1043	17	5	0.59
LEXCEN PL	Marsfield	209.31	8.69	3	1070	11	9	0.59
EVAN ST	Gladesville	549.81	14.22	3	1056	11	6	0.59
NELSON ST	Gladesville	502.94	15.42	3	1055	11	7	0.59
BETOLA PL	Ryde	467.38	19.65	3	1040	8	6	0.59
YERONG ST	Ryde	744.50	25.57	3	1029	8	4	0.59
THISTLE ST	Ryde	585.44	23.59	3	1029	6	5	0.59
PRICE ST	Ryde	1300.00	23.61	3	1027	5	2	0.59
ANNIE LANE	West Ryde	168.75	10.87	3	1067	5	2	0.59
STANSELL ST	Gladesville	237.31	13.04	3	1055	2	2	0.59
WATTS RD	Eastwood	1.06	0.35	2	1038	2	2	0.59
WESTERN CR	Gladesville	3180.31	16.53	3	1056	64	6	0.58
FAWCETT ST	Ryde	1140.31	11.67	2	1021	52	8	0.58
ABUKLEA RD	Eastwood	3673.44	26.31	2	975	34	2	0.58
WILDING ST	Marsfield	647.56	10.83	3	1070	32	7	0.58

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
MAXIM ST	West Ryde	2986.00	24.78	3	1038	32	5	0.58
GAZA RD	West Ryde	2285.06	22.58	3	1038	30	5	0.58
WANDOO AVE	Ryde	896.75	15.49	3	1058	29	9	0.58
CLAYTON ST	Ryde	513.81	9.82	2	1024	25	8	0.58
SANTAROSA AVE	Ryde	415.25	10.32	2	1021	23	9	0.58
BLUNDELL ST	Marsfield	619.56	11.96	3	1070	20	7	0.58
BAIRD AVE	Ryde	376.50	10.51	2	1024	20	8	0.58
DARCY ST	Marsfield	483.63	10.51	3	1070	19	8	0.58
DENISTONE RD	Eastwood	645.19	11.69	3	1067	19	8	0.58
WINSTON ST	Marsfield	293.56	11.20	3	1070	17	22	0.58
COOPER ST	Marsfield	364.75	11.74	3	1070	17	5	0.58
LYNDHURST ST	Gladesville	608.63	16.15	3	1055	12	6	0.58
SEMPLE ST	Ryde	4.25	0.47	2	1046	8	14	0.58
COOINDA CL	Marsfield	2.38	0.26	2	1051	8	7	0.58
ADAM ST	Ryde	0.19	0.03	2	1046	5	15	0.58
PARK AVE	West Ryde	185.56	23.60	3	1038	5	2	0.58
HARVARD ST	Gladesville	530.06	17.68	3	1055	5	3	0.58
MACPHERSON ST	Meadowbank	499.44	32.98	4	1069	4	3	0.58
GRIFFITHS LANE	West Ryde	63.00	6.09	2	1034	3	2	0.58
CHERRY CT	Marsfield	726.88	44.17	4	1040	2	2	0.58
HERRING RD	Marsfield	2538.69	13.49	3	1070	63	12	0.57
GARDENER AVE	Ryde	957.19	8.49	2	1031	55	10	0.57
TYRELL ST	Gladesville	710.38	10.80	3	1084	28	9	0.57
DICKSON AVE	West Ryde	2976.63	28.26	3	1034	26	5	0.57
JONES ST	Ryde	660.56	10.08	2	1031	26	6	0.57

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
DENISTONE RD	Denistone	1106.44	14.77	3	1067	22	5	0.57
LINCOLN ST	Eastwood	1441.06	19.22	2	1007	22	6	0.57
GERARD ST	Gladesville	1149.94	18.60	3	1056	21	7	0.57
CAMERON CR	Ryde	323.31	9.52	2	1031	18	8	0.57
FERNVALE AVE	West Ryde	1520.38	27.94	3	1034	16	6	0.57
RATCLIFFE ST	Ryde	413.13	12.42	2	1024	15	7	0.57
OXFORD ST	Gladesville	454.88	13.36	3	1073	14	8	0.57
COLLEGE ST	Gladesville	1635.06	19.83	3	1055	10	2	0.57
PEARL ST	West Ryde	304.25	15.11	3	1067	8	8	0.57
LILY ST	North Ryde	0.19	0.02	2	1057	8	19	0.57
DESMOND ST	Eastwood	250.50	19.52	2	1007	7	9	0.57
PATRICIA ST	Ryde	0.00	0.00	2	1058	3	3	0.57
CONCORD PL	Gladesville	198.81	21.32	3	1055	2	4	0.57
AGINCOURT RD	Marsfield	4574.31	16.65	3	1070	84	6	0.56
GREENE AVE	Ryde	1485.19	13.42	2	1031	41	7	0.56
GRAND AVE	West Ryde	1598.94	19.82	3	1067	30	7	0.56
BLAXLAND RD	Denistone East	2938.19	18.68	3	1067	23	2	0.56
HEPBURN AVE	Gladesville	1202.00	22.05	3	1056	16	6	0.56
CLANALPINE ST	Eastwood	1645.81	21.87	3	1063	16	4	0.56
PROVIDENCE RD	Ryde	1120.56	23.54	3	1051	13	4	0.56
CROTOYE PL	Marsfield	189.94	11.36	2	1035	8	9	0.56
KEATS AVE	Ryde	23.63	2.62	2	1061	7	14	0.56
TULIP ST	North Ryde	30.31	3.56	2	1057	6	14	0.56
EILEEN ST	Ryde	80.25	7.11	2	1046	5	8	0.56
DALTON AVE	Denistone	177.25	17.87	3	1067	4	3	0.56
WATTLE LANE	West Ryde	659.75	27.54	3	1043	4	1	0.56
OWEN ST	Gladesville	617.44	23.91	3	1055	4	3	0.56

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
PARER ST	Melrose Park	12.88	1.24	2	1064	3	4	0.56
BOWDEN ST	West Ryde	96.00	11.43	2	1034	2	1	0.56
AEOLUS AVE	Ryde	300.44	2.86	2	1062	64	11	0.55
WOODBINE CR	Ryde	1876.50	15.36	2	1031	56	9	0.55
ELTHAM ST	Gladesville	2370.69	20.08	3	1073	30	5	0.55
FEDERAL RD	West Ryde	1890.06	22.16	3	1067	27	6	0.55
DOBSON CR	Ryde	500.38	11.21	2	1046	27	9	0.55
ZOLA AVE	Ryde	392.88	8.73	2	1046	26	9	0.55
PARKES ST	West Ryde	1059.44	13.03	2	1034	25	6	0.55
WATTS RD	Ryde	867.69	12.04	2	1038	24	5	0.55
GERRISH ST	Gladesville	1317.25	20.81	3	1073	21	6	0.55
WILLANDRA ST	Ryde	696.00	21.99	3	1065	16	8	0.55
WARREN ST	Ryde	273.50	8.79	2	1046	13	6	0.55
KEILEY ST	Marsfield	572.00	13.19	2	1036	13	4	0.55
KARINGAL CT	Marsfield	166.81	7.87	2	1051	10	8	0.55
GALE ST	Ryde	1614.00	35.36	3	1029	9	4	0.55
SUTTOR AVE	Ryde	686.63	22.98	3	1065	9	5	0.55
DIANE ST	Marsfield	262.63	15.12	2	1036	9	12	0.55
MCGREGOR ST	North Ryde	343.38	27.26	3	1051	7	8	0.55
PERCY ST	Gladesville	844.63	20.72	3	1073	7	3	0.55
MARTIN ST	Ryde	118.31	9.45	2	1046	6	8	0.55
GEORGE ST	Gladesville	467.19	12.88	2	1040	5	2	0.55
POPE ST	Ryde	110.69	3.92	2	1058	3	2	0.55
HEATH LANE	Ryde	22.56	4.42	2	1062	3	4	0.55
HALIFAX ST	Macquarie Park	132.31	1.50	2	1067	2	0	0.55
RHODES ST	Meadowbank	1292.94	40.45	4	1069	1	1	0.55
ORR ST	Gladesville	243.19	13.26	2	1040	1	1	0.55

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
PATRICIA ST	Marsfield	992.06	9.69	2	1058	63	9	0.54
KUPPA RD	Ryde	342.75	3.94	2	1070	53	12	0.54
BRIDGE RD	Ryde	2199.00	16.48	2	1038	49	8	0.54
BOWDEN ST	Ryde	2657.81	16.24	2	1034	48	4	0.54
FORSYTH ST	West Ryde	1600.13	17.31	2	1034	45	7	0.54
VIMIERA RD	Eastwood	5118.75	27.18	2	1007	42	4	0.54
HEATH ST	Ryde	509.63	7.21	2	1062	39	10	0.54
CHRISTINE AVE	Ryde	772.38	11.63	2	1046	38	9	0.54
WATT AVE	Ryde	590.38	9.15	2	1058	36	9	0.54
TALLWOOD AVE	Eastwood	1314.13	16.13	2	1038	33	8	0.54
FLINDERS RD	North Ryde	635.94	10.01	2	1057	32	8	0.54
ABUKLEA RD	Marsfield	5729.81	40.34	2	975	30	2	0.54
CRESCENT AVE	Ryde	468.69	9.48	2	1058	26	11	0.54
BIRDWOOD ST	Denistone East	1158.19	16.54	2	1037	25	7	0.54
BANKSIA ST	Eastwood	1596.38	32.32	2	991	18	6	0.54
BYGRAVE ST	Ryde	324.06	13.16	2	1048	13	8	0.54
WILGA PL	Marsfield	575.19	17.90	2	1036	13	8	0.54
COSIMO PL	Ryde	111.81	7.04	2	1062	11	12	0.54
DANBURY CL	Marsfield	469.31	17.89	2	1035	11	5	0.54
MONDIAL PL	West Ryde	50.25	3.83	2	1070	8	16	0.54
YAMBA CL	Marsfield	352.63	18.11	2	1036	8	9	0.54
PRATTEN AVE	Ryde	143.13	7.53	2	1058	7	4	0.54
CAMBRIDGE ST	Gladesville	1741.19	30.90	3	1055	5	2	0.54
LINSLEY ST	Gladesville	763.69	14.87	2	1040	4	1	0.54
MAZE AVE	Ryde	714.38	30.85	3	1051	4	3	0.54
BELLEVUE AVE	Eastwood	0.00	0.00	2	1080	4	3	0.54
KARALEE CL	Marsfield	162.44	11.77	2	1051	4	6	0.54

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
JARVIS CCT	Macquarie Park	281.19	4.08	2	1067	3	0	0.54
UNNAMED ROAD 2648	Ryde	31.69	19.85	2	1024	1	1	0.54
TWIN RD	North Ryde	2537.94	10.54	2	1057	102	7	0.53
VICTORIA RD	West Ryde	3220.38	6.44	2	1072	84	4	0.53
BALACLAVA RD	Eastwood	3303.88	13.46	2	1056	60	5	0.53
FORD ST	North Ryde	1043.69	10.44	2	1057	55	9	0.53
EPPING RD	North Ryde	3879.00	7.70	2	1067	49	4	0.53
GRIFFITHS AVE	West Ryde	2162.56	20.46	2	1034	46	9	0.53
TORRINGTON DR	Marsfield	857.75	12.48	2	1052	36	9	0.53
MACLEAY ST	Ryde	255.56	3.91	2	1080	36	11	0.53
SOBRAON RD	Marsfield	3010.56	26.47	3	1070	32	6	0.53
DAN ST	Marsfield	517.13	9.83	2	1058	31	8	0.53
LINTON AVE	West Ryde	1969.06	20.98	2	1034	31	7	0.53
BRUCE ST	Ryde	550.56	10.40	2	1057	29	8	0.53
COOK ST	North Ryde	509.88	10.60	2	1057	26	8	0.53
RONALD AVE	Ryde	157.25	3.23	2	1077	26	8	0.53
CRIMEA RD	Marsfield	17575.13	57.69	3	991	19	3	0.53
BYRON AVE	Ryde	326.56	11.59	2	1061	19	11	0.53
ERINA ST	Eastwood	138.44	6.97	2	1069	14	11	0.53
SALERWONG PL	Ryde	256.63	10.93	2	1061	11	5	0.53
THE AVENUE	Gladesville	0.00	0.00	2	1090	11	13	0.53
BAVIN AVE	Ryde	223.00	10.22	2	1058	9	6	0.53
BRENDON ST	North Ryde	224.88	11.49	2	1057	9	7	0.53
SUMMIT CL	Marsfield	517.50	20.29	2	1036	9	5	0.53
STEPHEN AVE	Ryde	164.19	9.10	2	1064	8	8	0.53

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
ILMA ST	Marsfield	340.56	14.45	2	1051	8	7	0.53
EDEN PARK DR	Macquarie Park	419.06	9.35	2	1067	8	5	0.53
CLIVE RD	Eastwood	1755.44	45.27	3	1019	7	4	0.53
FAY PL	Marsfield	473.94	20.49	2	1035	7	5	0.53
RUTH ST	Marsfield	186.69	19.02	2	1036	6	13	0.53
MARGARET ST	Ryde	151.06	4.97	2	1074	6	2	0.53
ORIENT ST	Gladesville	1628.19	33.35	3	1055	4	2	0.53
FIG PL	Eastwood	82.81	10.59	2	1056	3	7	0.53
YOUNG PDE	Eastwood	704.25	29.52	2	1008	1	0	0.53
LANE COVE RD	North Ryde	4050.56	10.44	2	1068	55	4	0.52
OLIVE ST	Ryde	640.75	7.43	2	1077	54	10	0.52
LOVELL RD	Eastwood	430.56	4.38	2	1083	49	4	0.52
O'KEEFE CR	Eastwood	818.44	9.16	2	1069	44	10	0.52
MELVILLE ST	West Ryde	695.81	9.44	2	1070	34	6	0.52
WESTMINSTER RD	Gladesville	5472.44	27.49	3	1073	32	3	0.52
VICTORIA RD	Gladesville	294.81	1.16	2	1090	27	3	0.52
WINBOURNE ST E	West Ryde	711.31	12.07	2	1063	21	6	0.52
HILLVIEW RD	Eastwood	1368.31	14.34	2	1060	21	4	0.52
ACACIA ST	Eastwood	392.50	10.24	2	1072	19	7	0.52
ALLAN AVE	Ryde	360.69	9.40	2	1071	17	9	0.52
STUART ST	Ryde	187.81	7.29	2	1080	16	10	0.52
HALCYON ST	Gladesville	123.31	5.35	2	1079	12	8	0.52
BRIAN ST	Ryde	127.13	5.94	2	1081	12	10	0.52
EDITH ST	Marsfield	357.69	15.03	2	1058	12	8	0.52
WEAVER ST	Ryde	239.19	7.90	2	1074	11	5	0.52
MOUNT ST	West Ryde	133.06	8.75	2	1070	8	10	0.52

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
TOWRI PL	Marsfield	0.00	0.00	1	1043	7	20	0.52
BIGLAND AVE	Denistone	103.69	7.17	2	1080	7	5	0.52
READFORD PL	Ryde	126.56	9.45	2	1070	6	10	0.52
VALDA PL	Marsfield	487.88	23.52	2	1036	6	7	0.52
JULIE ST	Marsfield	305.19	15.70	2	1058	6	5	0.52
META ST	Ryde	190.19	17.56	2	1048	5	8	0.52
NILE CL	Marsfield	279.50	14.71	2	1054	3	4	0.52
BAMBI ST	Ryde	376.44	24.57	2	1031	3	4	0.52
NERANG ST	North Ryde	101.75	19.31	2	1048	2	3	0.52
NANCARROW AVE	Ryde	0.00	0.00	2	1094	1	1	0.52
QUARRY RD	Ryde	7349.63	17.19	2	1062	134	6	0.51
NORTH RD	Eastwood	2399.50	12.67	2	1072	48	4	0.51
BENNETT ST	West Ryde	1696.56	12.91	2	1072	47	6	0.51
DAVID AVE	North Ryde	900.50	10.34	2	1080	45	8	0.51
KELLS RD	Ryde	398.94	6.67	2	1083	44	11	0.51
TRELAWNEY ST	Eastwood	2296.88	15.58	2	1064	44	6	0.51
CLERMONT AVE	Ryde	1074.50	15.05	2	1062	37	9	0.51
JOPLING ST	North Ryde	598.94	8.82	2	1082	35	8	0.51
FARNELL ST	West Ryde	1833.06	15.87	2	1063	33	4	0.51
BLAXLAND RD	Denistone	940.69	8.17	2	1079	32	34	0.51
HOLT ST	North Ryde	537.13	9.04	2	1080	31	8	0.51
STEWART ST	Eastwood	974.75	13.66	2	1064	30	9	0.51
CHARLES ST	Ryde	2172.13	17.69	2	1058	28	5	0.51
WELBY ST	Eastwood	607.50	11.39	2	1077	23	9	0.51
MURRAY ST	West Ryde	359.06	9.67	2	1078	20	11	0.51
BURMAH RD	Denistone	434.75	10.22	2	1080	20	9	0.51
CAVE AVE	North Ryde	566.50	16.73	2	1057	19	8	0.51

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
RUNDLE PL	Gladesville	197.88	8.28	2	1079	18	14	0.51
ADA ST	North Ryde	755.31	16.82	2	1057	18	6	0.51
EDGAR ST	Eastwood	1613.88	18.47	2	1056	18	4	0.51
DEMPSEY ST	North Ryde	578.63	17.50	2	1061	15	7	0.51
PINE ST	North Ryde	216.31	10.23	2	1080	11	8	0.51
MELVILLE ST	Ryde	393.00	11.36	2	1070	10	5	0.51
RAVEN ST	Gladesville	1705.44	27.45	3	1084	10	3	0.51
ORANA ST	North Ryde	299.44	14.42	2	1068	10	8	0.51
COLLINS ST	North Ryde	81.69	6.93	2	1082	9	11	0.51
JAYNE ST	West Ryde	239.06	14.50	2	1068	9	10	0.51
GUNYAH PL	Marsfield	152.38	9.90	2	1075	7	8	0.51
JOHN ST	West Ryde	171.38	13.40	2	1068	7	10	0.51
ENGEL AVE	Marsfield	386.13	18.87	2	1052	6	3	0.51
WALKER ST	Putney	15.50	2.02	2	1098	5	10	0.51
WALSH ST	Eastwood	214.25	12.61	2	1072	5	5	0.51
HOLLY AVE	Ryde	656.94	32.12	2	1022	4	4	0.51
VICTORIA RD	Melrose Park	97.75	5.68	2	1085	3	5	0.51
SUNHILL PL	North Ryde	110.75	9.84	2	1080	3	5	0.51
UNNAMED ROAD 2441	Ryde	34.69	11.60	2	1070	2	1	0.51
REDSHAW ST	Ryde	30.63	4.09	2	1090	1	3	0.51
MORRISON RD	Ryde	511.00	4.75	2	1098	41	14	0.50
SAMUEL ST	Ryde	1595.00	16.98	2	1070	36	6	0.50
HANCOTT ST	Ryde	1401.56	16.97	2	1070	34	8	0.50
LOVELL RD	Denistone East	1171.75	11.47	2	1083	32	3	0.50
DARWIN ST	West Ryde	711.88	9.58	2	1090	32	9	0.50
HOLLIS AVE	Denistone East	706.94	10.98	2	1079	29	9	0.50
SWAN ST	Gladesville	713.94	11.06	2	1079	27	6	0.50

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
YANGALLA ST	Marsfield	690.56	13.82	2	1075	24	8	0.50
KOKODA ST	North Ryde	471.69	12.20	2	1082	24	9	0.50
FISHER AVE	Ryde	506.38	10.58	2	1080	23	7	0.50
PICKFORD AVE	Eastwood	426.06	12.03	2	1083	23	13	0.50
BRIDGE RD	North Ryde	1845.38	20.31	2	1058	22	3	0.50
CORUNNA RD	Eastwood	1041.50	14.79	2	1069	21	4	0.50
TOBRUK ST	North Ryde	444.56	11.17	2	1082	21	8	0.50
ANDERSON AVE	Ryde	732.81	14.68	2	1071	19	7	0.50
LAMBERT ST	West Ryde	693.19	15.85	2	1068	17	6	0.50
NAPIER CR	North Ryde	399.13	11.47	2	1080	16	8	0.50
MILHAM AVE	Eastwood	570.38	16.16	2	1067	13	7	0.50
EULALIA ST	West Ryde	548.75	17.22	2	1068	13	9	0.50
BASS ST	Putney	140.69	6.49	2	1098	13	9	0.50
LANSDOWNE ST	Eastwood	1298.75	20.38	2	1056	12	4	0.50
ALAN BOND PL	Marsfield	644.81	21.25	2	1057	11	5	0.50
LIONEL AVE	North Ryde	239.00	12.11	2	1082	10	8	0.50
BOWDEN ST	Meadowbank	501.13	6.76	2	1094	9	1	0.50
BYFIELD ST	Macquarie Park	1319.38	17.32	2	1067	7	2	0.50
KAGA PL	Marsfield	603.44	27.85	2	1036	6	6	0.50
REX ST	West Ryde	719.44	38.37	3	1067	5	5	0.50
BEACON AVE	Putney	24.19	2.51	2	1103	4	3	0.50
STAR ST	Eastwood	118.25	16.79	2	1069	3	8	0.50
TREHARNE CL	Marsfield	852.38	34.52	3	1070	2	1	0.50
MENZIES LANE	Marsfield	9.88	5.15	1	1043	2	5	0.50
UNNAMED ROAD 1644	Ryde	7.50	3.39	2	1104	1	1	0.50
UNNAMED ROAD 3347	Gladesville	10.00	1.83	2	1109	1	1	0.50

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
COXS RD	North Ryde	5216.38	15.47	2	1082	90	8	0.49
TALAVERA RD	Macquarie Park	10087.50	18.54	2	1067	79	3	0.49
BELLEVUE AVE	Denistone	2123.00	14.30	2	1080	57	6	0.49
SHEPHERD ST	Ryde	2447.94	18.81	2	1070	47	7	0.49
WATERLOO RD	Macquarie Park	10582.94	20.95	2	1067	42	2	0.49
DOROTHY ST	Ryde	1106.69	16.44	2	1077	41	8	0.49
OSGATHORPE RD	Gladesville	889.81	9.79	2	1090	39	7	0.49
BETTY HENDRY PDE	North Ryde	611.44	7.93	2	1096	35	8	0.49
FORREST RD	Ryde	1011.94	12.77	2	1083	33	8	0.49
ROSS ST	Gladesville	3444.50	30.04	2	1040	30	7	0.49
BADAJOZ RD	North Ryde	2926.94	22.89	2	1057	28	3	0.49
KULGOA AVE	Ryde	1355.19	18.59	2	1070	28	7	0.49
CUTLER PDE	North Ryde	590.88	9.03	2	1096	27	8	0.49
TUNKS ST	Ryde	1036.06	18.30	2	1070	26	9	0.49
GREGORY ST	Putney	317.19	7.72	2	1098	26	10	0.49
HAIG AVE	Denistone East	2310.81	30.38	2	1037	24	6	0.49
ELIZABETH ST	Ryde	619.50	14.65	2	1080	19	7	0.49
MYRA AVE	Ryde	2522.19	28.19	2	1046	19	4	0.49
FONTI ST	Eastwood	713.00	18.68	2	1069	18	7	0.49
BALACLAVA RD	Marsfield	3802.94	26.62	2	1052	17	2	0.49
SEWELL ST	Ryde	723.69	17.49	2	1070	15	7	0.49
HERMOYNE ST	West Ryde	712.63	19.87	2	1068	15	7	0.49
UNION ST	West Ryde	996.88	22.71	2	1063	15	7	0.49
GLENAYR AVE	West Ryde	450.38	14.79	2	1078	14	7	0.49
BIDGEE RD	Ryde	370.69	15.32	2	1083	14	9	0.49

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
WILLOW CR	Ryde	938.75	22.18	2	1062	13	5	0.49
RUGBY RD	Marsfield	558.50	17.78	2	1075	13	7	0.49
PLUNKETT ST	Marsfield	665.81	19.77	2	1067	12	6	0.49
LEVY ST	Putney	155.06	7.44	2	1101	12	10	0.49
EMU ST	West Ryde	431.69	18.05	2	1068	11	7	0.49
NASH PL	North Ryde	276.19	13.41	2	1082	10	8	0.49
EAGLE ST	Ryde	1860.81	41.98	3	1058	9	3	0.49
KENNETH ST	Ryde	293.56	23.15	2	1058	9	11	0.49
VERA ST	Eastwood	439.25	17.67	2	1072	8	6	0.49
BANK ST	Meadowbank	5798.56	46.86	3	1052	8	1	0.49
EULO PDE	Ryde	477.69	21.44	2	1062	6	5	0.49
BRIDGE RD	Eastwood	546.81	29.52	2	1038	4	1	0.49
LAWRENCE ST	West Ryde	276.88	18.19	2	1068	4	4	0.49
NANBAREE RD	Ryde	155.06	12.68	2	1083	4	5	0.49
BOYCE ST	North Ryde	62.13	7.27	2	1104	4	5	0.49
BRIDGE RD	Marsfield	524.25	30.31	2	1038	3	2	0.49
DOIG AVE	Denistone East	78.19	7.31	2	1102	3	5	0.49
STONE ST	Ryde	61.50	9.55	2	1094	2	2	0.49
PHILLIP LANE	Putney	0.75	0.14	2	1116	1	1	0.49
BLAIR ST	Gladesville	521.06	29.30	2	1040	1	1	0.49
CORAL ST	Marsfield	191.75	25.68	2	1051	1	3	0.49
TUCKER ST	Ryde	1266.38	23.08	2	1058	1	0	0.49
GARDENERS LANE	West Ryde	196.75	17.91	2	1072	1	1	0.49
EPPING RD	Macquarie Park	13378.06	23.94	2	1067	78	3	0.48
FALCONER ST	West Ryde	3867.88	20.53	2	1070	65	7	0.48
PARKLANDS RD	North Ryde	2233.31	17.87	2	1080	57	7	0.48

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
MOSS ST	West Ryde	2271.63	16.61	2	1083	48	6	0.48
BESWICK AVE	North Ryde	1557.00	17.54	2	1080	36	6	0.48
MAWARRA CR	Marsfield	824.56	12.52	1	1043	33	8	0.48
AITCHANDAR RD	Ryde	1444.31	16.99	2	1083	32	6	0.48
BEVERLEY CR	Marsfield	225.25	4.78	1	1065	32	9	0.48
CLARKE ST	West Ryde	1865.75	22.28	2	1070	30	8	0.48
TENNYSON RD	Gladesville	1320.75	14.12	2	1090	26	5	0.48
ORANGE ST	Eastwood	859.63	16.92	2	1083	25	10	0.48
GWENDALE CR	Eastwood	1088.31	17.65	2	1077	24	7	0.48
WARATAH ST	Eastwood	1187.63	20.04	2	1072	24	9	0.48
BRERETON ST	Gladesville	746.31	13.18	2	1090	23	6	0.48
HUNTS AVE	Eastwood	1378.56	21.24	2	1069	23	7	0.48
DEAKIN ST	West Ryde	636.75	13.88	2	1090	23	10	0.48
BLENHEIM RD	North Ryde	2248.06	17.77	2	1082	23	4	0.48
CHAUVEL ST	North Ryde	499.63	10.54	2	1103	23	7	0.48
KINGS RD	Denistone East	1575.38	18.38	2	1079	22	5	0.48
SHAFTSBURY RD	West Ryde	901.19	18.97	2	1080	18	5	0.48
CAMPBELL ST	Eastwood	2084.44	29.17	2	1054	18	5	0.48
STURDEE ST	North Ryde	322.50	10.55	2	1096	16	25	0.48
LAURA ST	Gladesville	246.00	10.56	1	1046	15	10	0.48
WADE ST	Putney	174.44	6.02	2	1112	15	10	0.48
OATES AVE	Gladesville	854.13	18.03	2	1079	14	5	0.48
NORTH RD	Denistone East	358.50	10.34	2	1102	14	2	0.48
LILAC PL	Eastwood	380.69	18.22	2	1083	12	12	0.48
SCHUMACK ST	North Ryde	481.31	17.07	2	1082	11	6	0.48
HOPETOUN AVE	Denistone East	340.63	18.45	2	1079	11	6	0.48

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
THIRD AVE	Eastwood	2935.44	43.96	2	1008	10	3	0.48
LYLE ST	Ryde	431.00	16.83	2	1081	10	8	0.48
CLARENCE ST	North Ryde	480.31	16.93	2	1081	9	5	0.48
ROKEVA ST	Eastwood	651.94	22.65	2	1067	9	5	0.48
DAFFODIL ST	Eastwood	934.19	27.67	2	1056	8	4	0.48
COWELL ST	Ryde	84.06	4.08	2	1119	8	5	0.48
STONE ST	Meadowbank	183.13	13.73	2	1094	6	6	0.48
NICOLL AVE	Ryde	483.13	21.42	2	1070	5	4	0.48
BEAUMONT AVE	Denistone	196.63	18.09	2	1080	4	7	0.48
BOND ST	North Ryde	306.44	24.21	2	1061	3	4	0.48
PELLISIER PL	Putney	13.75	4.09	2	1116	3	11	0.48
FIR TREE AVE	West Ryde	260.19	22.82	2	1068	3	5	0.48
TONI CR	Ryde	155.69	30.08	2	1046	2	8	0.48
HEARD ST	Denistone East	75.63	9.67	2	1102	2	5	0.48
MORSHEAD ST	North Ryde	1595.44	15.61	2	1096	52	6	0.47
THRELFALL ST	Eastwood	1808.13	15.78	2	1090	51	9	0.47
THOMPSON ST	Gladesville	2547.25	20.98	2	1079	40	8	0.47
GOULDING RD	Ryde	2909.00	21.03	2	1080	35	9	0.47
ALEXANDRIA AVE	Eastwood	2037.00	21.27	2	1077	34	7	0.47
EDMONDSON ST	North Ryde	961.31	14.38	2	1096	34	8	0.47
MALVINA ST	Ryde	1831.69	20.64	2	1083	34	8	0.47
SHAFTSBURY RD	Eastwood	3585.88	19.88	2	1080	32	3	0.47
ANDREW ST	Melrose Park	1738.50	17.81	2	1090	32	5	0.47
HUXLEY ST	West Ryde	1020.56	16.06	2	1090	29	9	0.47
GROVE ST	Eastwood	1247.81	19.07	2	1083	29	9	0.47

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
HARRISON AVE	Eastwood	1461.56	20.43	2	1081	27	8	0.47
ELLEN ST	Ryde	1308.19	21.63	2	1081	27	4	0.47
STANBURY ST	Gladesville	629.81	11.10	2	1107	26	8	0.47
GRAHAM AVE	Eastwood	1861.31	26.94	2	1067	23	7	0.47
GORDON ST	Eastwood	2742.63	29.19	2	1056	20	4	0.47
CHURCH ST	Ryde	1858.44	9.94	2	1112	20	2	0.47
KEPPEL RD	Ryde	1383.63	22.34	2	1080	20	7	0.47
SHAFTSBURY RD	Denistone West	971.56	21.55	2	1080	19	1	0.47
BERRYMAN ST	North Ryde	455.31	15.66	2	1096	18	9	0.47
OAKES AVE	Eastwood	1825.63	25.43	2	1067	17	5	0.47
ADDINGTON AVE	Ryde	1291.00	24.73	2	1070	16	6	0.47
HIBBLE ST	West Ryde	619.94	16.91	2	1090	15	8	0.47
DONNELLY ST	Putney	360.31	12.73	2	1098	14	6	0.47
PINDARI ST	North Ryde	1066.88	24.79	2	1068	14	5	0.47
HERRING RD	Macquarie Park	7139.19	24.63	2	1067	13	1	0.47
ROCCA ST	Ryde	1095.19	21.63	2	1077	13	5	0.47
SEARLE ST	Ryde	938.13	24.28	2	1074	13	7	0.47
CARMEN ST	Marsfield	113.25	6.90	1	1065	12	14	0.47
	Eastwood	408.69	18.92	2	1083	9	3	0.47
RIVERSIDE AVE	Putney	204.13	7.97	2	1112	9	7	0.47
IMPERIAL AVE	Gladesville	358.06	13.19	1	1046	9	4	0.47
PARRY ST	Ryde	472.31	13.75	2	1098	9	2	0.47
COLLINGRIDGE DR	Ryde	183.69	6.13	2	1119	9	11	0.47
GIFFNOCK AVE	Macquarie Park	2730.75	25.07	2	1067	7	1	0.47
IAN ST	North Ryde	388.06	20.47	2	1081	6	3	0.47

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
IDA ST	Putney	329.88	14.22	2	1098	6	3	0.47
ANGAS ST	Meadowbank	967.13	16.24	2	1094	6	2	0.47
MUNRO ST	Eastwood	1054.44	25.82	2	1069	6	3	0.47
GIBB ST	North Ryde	442.31	24.69	2	1068	5	5	0.47
NIOKA ST	Gladesville	167.50	11.19	2	1107	5	6	0.47
DAPHNE ST	West Ryde	533.06	26.06	2	1068	5	4	0.47
BIGLAND AVE	West Ryde	265.31	22.18	2	1080	5	3	0.47
OSLO ST	Marsfield	468.13	31.52	2	1051	4	5	0.47
UNNAMED ROAD 1657	Gladesville	111.75	17.16	2	1090	4	9	0.47
MACQUARIE PL	Denistone East	688.13	37.32	2	1037	4	4	0.47
COLVIN CR	Denistone East	153.00	11.48	2	1102	3	3	0.47
IRIS ST	North Ryde	237.38	28.82	2	1057	2	5	0.47
ASTER ST	Eastwood	321.50	30.16	2	1056	2	3	0.47
SUSAN PL	Eastwood	189.25	25.88	2	1069	2	5	0.47
POTTS ST	Gladesville	1.63	0.95	1	1083	2	3	0.47
ANDREW LANE	Melrose Park	480.56	28.29	2	1064	1	0	0.47
NUMA RD	North Ryde	1168.31	13.83	2	1104	39	6	0.46
LARDELLI DR	Ryde	533.81	7.71	2	1119	32	70	0.46
RUSSELL ST	Denistone East	2723.94	23.07	2	1079	25	4	0.46
CHADWICK ST	Putney	359.81	9.46	2	1116	23	8	0.46
SHAFTSBURY RD	Denistone	1246.81	22.99	2	1080	12	2	0.46
GANNET ST	Gladesville	669.88	23.10	2	1079	10	5	0.46
BENNELONG WAY	Ryde	211.13	8.05	2	1119	9	5	0.46
CROSS ST	Ryde	100.00	5.01	1	1075	9	9	0.46
HEARNSHAW ST	North Ryde	276.88	16.58	2	1096	8	7	0.46

Street Name	Suburb	Canopy (sqm)	Canopy (%)	Heat Vulnerability Index	SEIFA	Plantable Opportunities	Plantable Opportunities (/100m)	IPA score
BATTEN AVE	Melrose Park	417.75	20.89	2	1085	8	8	0.46
JOHNSON AVE	Melrose Park	339.69	20.84	2	1085	7	9	0.46
PELICAN ST	Gladesville	353.00	23.27	2	1079	6	7	0.46
BELL AVE	West Ryde	463.50	29.23	2	1063	5	5	0.46
MACPHERSON LANE	Meadowbank	266.69	17.38	2	1094	2	1	0.46

Prioritising planting locations

Plantable opportunities have been ranked according to three metrics: lack of canopy, urban heat vulnerability, and social vulnerability. Tree canopy was calculated using the 2020 NearMap canopy (>2 metres height) data and was calculated for each individual street across each suburb (Figure 22). Urban heat vulnerability was extracted from the 2015-2016 summer New South Wales Heat Vulnerability Index at the ABS Statistical Area 1 (SA1) level (Figure 227). Socioeconomic status was measured using the 2016 Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socio-economic Disadvantage (IRSD) calculated at the SA1 level (Figure 24).

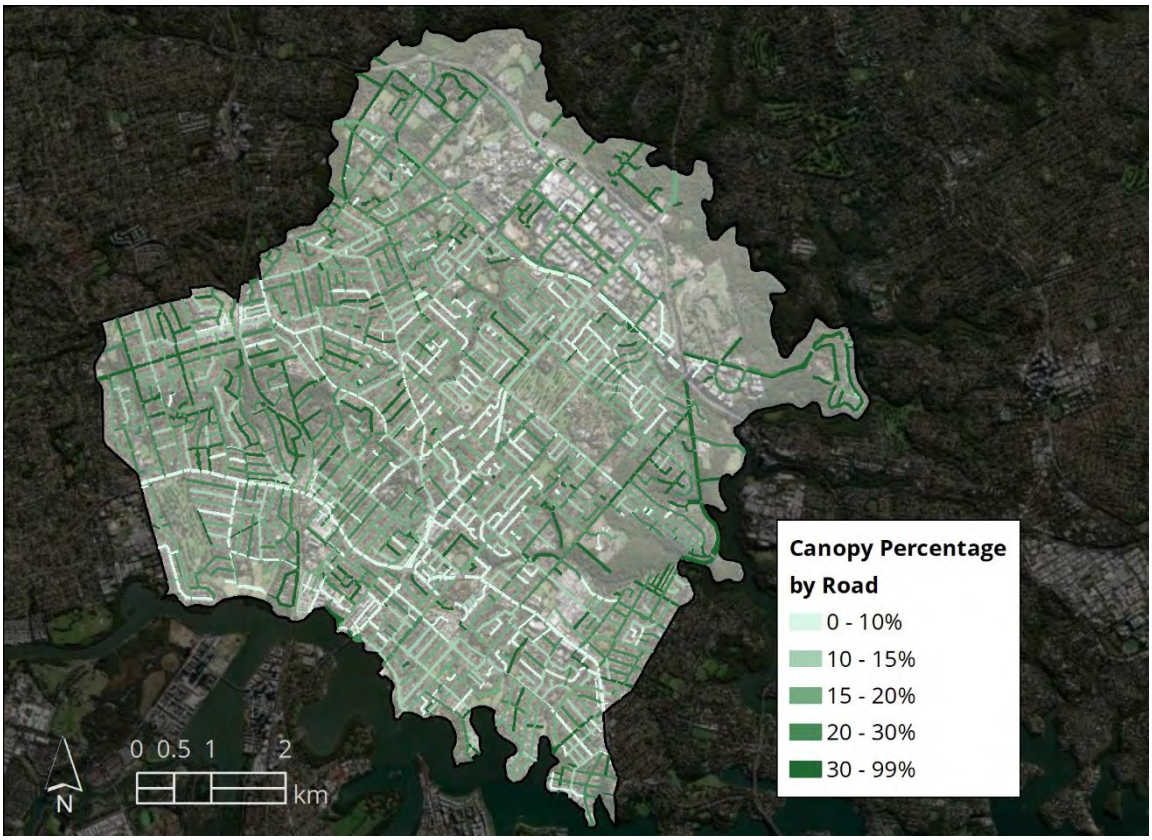


Figure 22. Canopy coverage of each road segment, including verges.

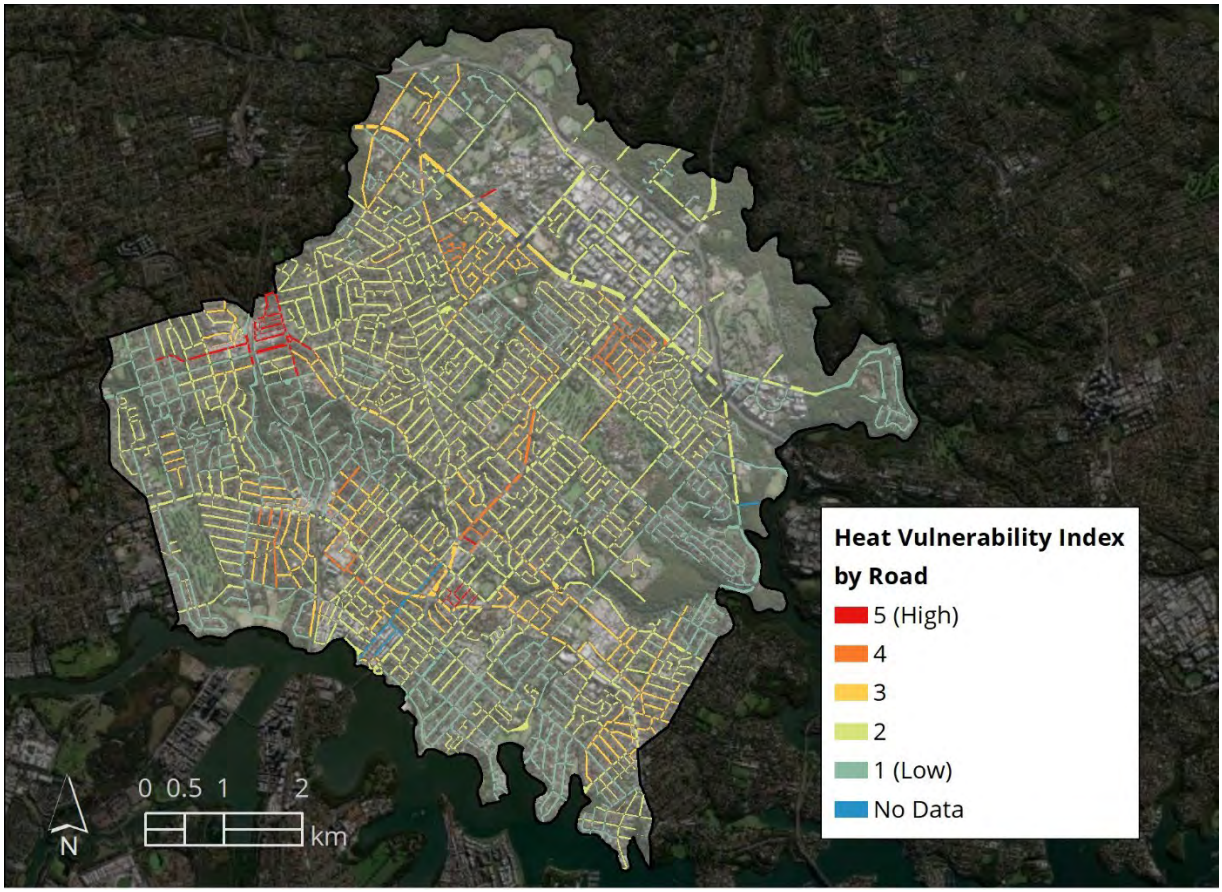


Figure 23. Heat vulnerability along each road segment, as calculated using the NSW 2015-2016 summer Heat Vulnerability Index.

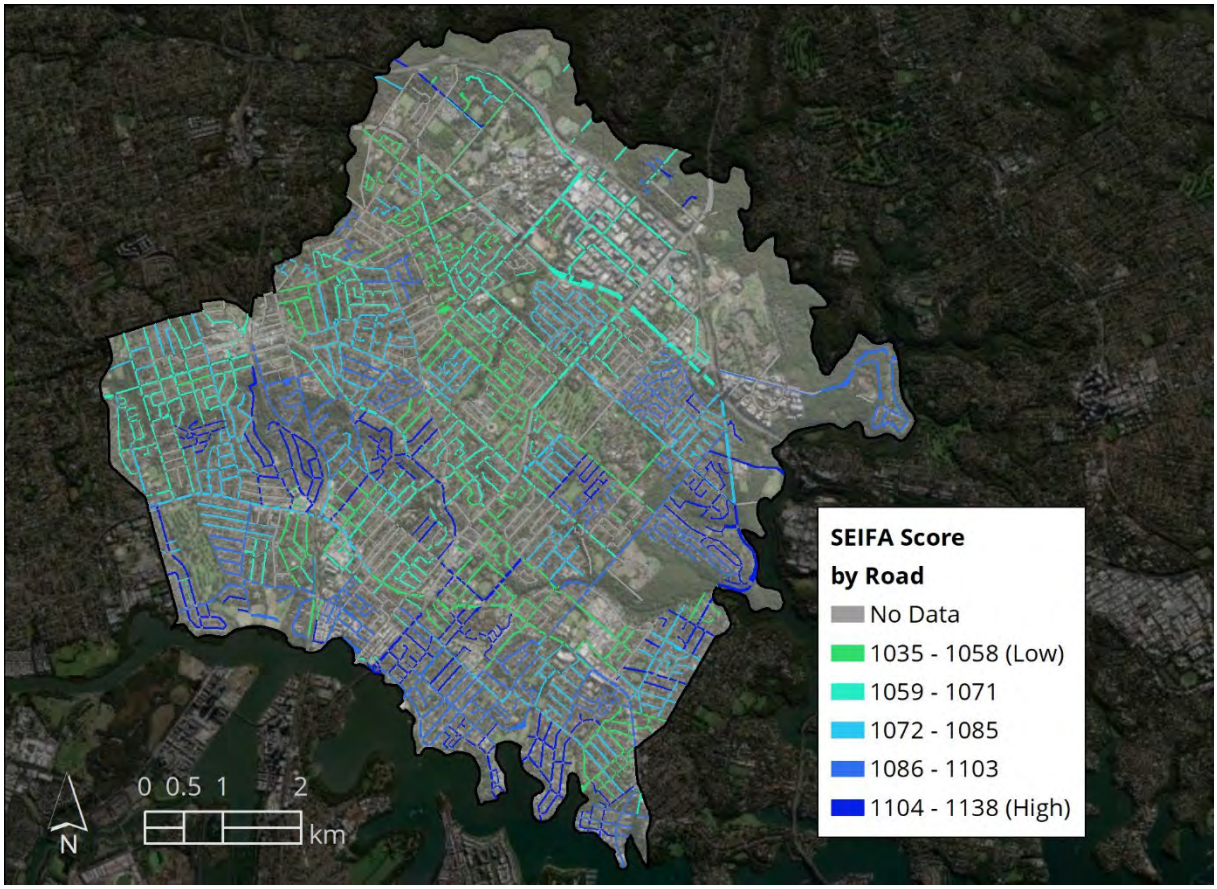


Figure 24. Socio-economic status by road as calculated from the SEIFA 2016 Index of Relative Socio-economic Disadvantage (IRSD) with lower scores equating to disadvantaged areas (i.e. areas with greater social vulnerability).

The Integrated Priority Assessment (IPA) integrates all three of the above data layers to identify optimal planting locations.

Each metric is normalized from 0-1 with values of 1 identified as high priority for planting and 0 identified as low priority.

For the lack of canopy metric, the canopy percentage cover for each street was calculated and normalised with 0% canopy cover assigned a normalised value of 1 (high priority for planting), and 100% canopy cover assigned a value of 0.

Heat Island Vulnerability data was provided for each SA1 area using a 1-5 score with 5 equating to high vulnerability. The IPA analysis, these scores were normalised with a Heat Island Vulnerability score of 5 equating to 1 (high priority for planting).

SEIFA ISDR scores ranged from 874 (disadvantaged) to 1138 (advantaged). For the IPA assessment, SEIFA scores of 874 received a 1 (high priority for planting) and scores of 1138 received a 0, with all other scores normalised between 1 and 0.

The three normalised metrics were averaged together for all road segments resulting in the overall IPA score.

Each street segment was then ranked according to IPA scores. Combined with the TPP suggested planting schedule of 750 trees per year, the highest priority 750 plantable opportunities were selected for year 1 planting, with the next 750 plantable opportunities slated for year 2 planting, and so on for five years (Figure 14, page 28).