FINAL REPORT

Woollahra: Greening our LGA – Revision F

For: Woollahra Municipal Council

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Executive Summary

Purpose, context and approach

Amendments to planning controls and development application guidance are recommended to protect and enhance the leafy character of Woollahra. These amendments emerge from best practice and the context of Woollahra's future vision expressed in the Community Strategic Plan 2030 and the Local Strategic Planning Statement 2020. In particular, these amendments draw upon the tree canopy goals and guidance offered by the state government in support of sustainable development, liveable neighbourhoods and reducing the impact of the urban heat island effect across Greater Sydney. Utilising a very collaborative approach across Council, proposed tree canopy controls were developed and tested.

Desired approach to urban tree canopy management

A review of current planning controls for landscaping on development sites and feedback from internal stakeholders supported a shift in the regulatory controls to focus on tree canopy management in Woollahra. A summary of the elements of the recommended shift are presented in Table 1.

Current landscaping controls	**Recommended tree canopy controls**
Unclear line of sight between Woollahra landscape controls and canopy cover outcomes	Strong support for regional Sydney 40% canopy cover aspirations
Risk of development diluting the leafy Woollahra character	Focus on conserving and enhancing Woollahra's leafy character
Disconnect between deep soil areas and canopy cover outcomes	Deep soil areas linked to site area and land-use based canopy cover targets
Shortfall in community expectations for suitable quantity and quality of trees on development sites	Better balance between tree canopy quantity and quality outcomes- including urban cooling and urban forest resilience
Comparative or anecdotal controls content	Evidence and best practice basis for improving tree canopy outcomes
Focus on smaller and ornamental trees	Focus on larger longer-lived, functional canopy trees
Treatment of landscape and tree canopy outcomes in isolation from other built form controls	Integration of tree canopy controls with FSR amendments
Favour Aesthetic based landscape design	Promote multifunctional landscape design

Table 1 Elements of the proposed shift from current to proposed tree canopy controls

Policy recommendations

The recommended amendments propose to embed a minimum 40% tree canopy control for detached dwellings and dual occupancy residential development and a minimum 30% tree canopy control for multi-dwellings and residential flat buildings, into the regulatory framework. These proposed canopy cover outcomes are supported by specific requirements for minimum deep soil landscaped areas as percentage of site area, preferred canopy trees and minimum dimensions of spaces to better suit the long term growth and stability of canopy trees. A summary of the proposed Local Environment Plan and Development Control Plan amendments are provided in Table 2.

The proposed canopy cover controls have been tested across a range of approved development sites and locations of various sizes, development types, constraint levels and Floor Space Ratios (FSRs). It was clear that the proposed Floor Space Ratio of 0.5:1 would help support the achievement of proposed tree canopy cover in low density residential developments. However, constraints to achieving required tree canopy areas on some site types, higher FSRs and Heritage Conservation Areas (HCAs) are acknowledged. It is proposed to retain existing controls on the retention of mature trees and garden settings in HCAs. Amendments are also proposed to the information required in development applications to support assessment of the tree canopy controls. Further guidance is proposed to optimise outcomes on constrained sites, support the retention of existing trees and designing for longevity and resilience of new and replacement trees on all sites.

The proposal to adopt tree canopy area controls across private residential development typologies is innovative and timely. Woollahra is leading an important shift in the provisions for landscaping on residential development sites that translate the tree canopy goals and guidance from state government into locally relevant controls. Most importantly, the proposed controls align to sustaining and enhancing local tree canopy which is directly related to measurable improvements in environmental, social and economic health. Woollahra is therefore better positioned to guide development outcomes towards the leafy, diverse natural settings so highly valued by the community.

Proposed LEP provisions

New FSR control of 0.5:1, New FSR control of 0.75:1, New sliding scale FSR

New LEP aims
That state the outcomes required in support of the approved LSPS, including urban greening, urban heat island effect reduction and mitigating climate change

New LEP objectives
R2 and R3 - To ensure that development achieves the desired area of tree canopy
B1, B2, B4, SP2, SP3, RE2 - To encourage urban greening

New Additional Local Provision
6.8 Urban Greening
That point to the objective to sustain and enhance tree canopy cover and direct its application to the relevant lands
Ie. land in Zone R2 Low Density Residential and Zone R3 Medium Density Residential (excluding Paddington, Woollahra and Watsons Bays HCAs)
Specific direction to ensure Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development—
(a) is consistent with the objectives of this clause, and
(b) provides an appropriate selection of and location for canopy trees, and minimises disturbance and adverse impacts on existing canopy trees which are to be retained

Proposed DCP amendments – Chapter B3 General Development Controls

Additional objective and controls in B 3.4.1 Streetscape and local character

O. To ensure that development contributes towards reducing Urban Heat Island Effect by encouraging urban greening and retaining, protecting and enhancing tree canopy cover.
C. Development minimises disturbance and adverse impacts on existing Canopy Trees which are to be retained.
C. Development allows sufficient space for the growth of the above and below ground elements of existing and future Canopy Trees (including the root system, trunk and branches).

Additional section and definitions in B 3.6.1 Landscaped areas and private open space

Urban Greening and Tree Canopy
Describing the critical relationship between canopy trees, urban greening and mitigating localised warming and climate change adaptation, plus a number of environmental, social and economic benefits.
And defining important terms used in the provisions, including:
A Tree Crown, A Canopy Tree and **Tree Canopy and how it is to be calculated** (including diagrams)

Additional controls in B 3.6.1 Landscaped areas and private open space

Minimum Tree Canopy Area for all residential development in the R2 and R3 zones
Including development that alters the existing building footprint and/or building envelope or impacts upon existing landscapes and Distinguishing the Tree canopy % required across two types of housing and levels for all general development separate to Wolseley Road area.

Housing Type	Detached dwellings, dual occupancies, dwelling houses, semi-detached development and attached dwellings	Multi dwellings, Residential Flat Buildings
Minimum Tree Canopy Area	40% of site area for all general residential development 35% of site area for the Wolseley Road area	30% of site area

Plus diagram to assist interpretation and a specified list of acceptable variations will be considered to strengthen the provision

Minimum Deep Soil Landscaped Area to support the achievement of Tree Canopy at maturity, including (plus diagram to assist interpretation)
35% of site area for all general residential development
30% of site area for the Wolseley Road area

Table 2. Summary of proposed LEP and DCP amendments

1. Introduction

Woollahra Council is seeking to enhance landscaping outcomes from private development as an important component of retaining and improving tree canopy cover. Unlike numbers of trees, tree canopy cover is directly linked to the environmental, economic and social functions and values that urban trees provide (Figure 1).

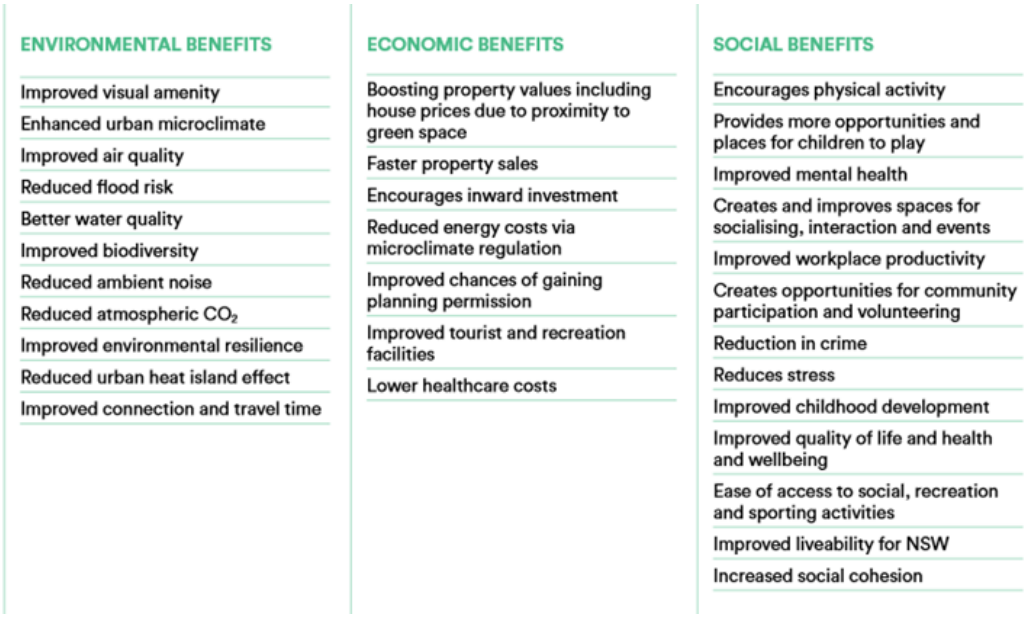

Figure 1. Range of environmental, economic and social benefits of urban trees (From: Greener Places _ NSW Government Architect)

Air-quality improvement, rainfall interception and cooling functions of trees is proportional to tree canopy area, tree height and canopy density. Likewise, many of the associations between green cover and mental health, well-being, walkability and business vitality are related to tree canopy cover (Ely and Pitman 2014). There is also overwhelming "home-grown" evidence of environmental and human health and well-being benefits of urban tree cover. In the Sydney region, neighbourhoods with a tree canopy of 30% or more, adults had 31% lower odds of developing psychological distress, and 33% lower odds of rating their general health as "fair" or "poor" (Astell-Burt et al., 2019).

Canopy cover has consequently become an important indicator for local government authorities and regional agencies to benchmark and monitor the extent, distribution and beneficial services provided by urban trees. Tree canopy cover is measured from analyses of aerial or satellite imagery and canopy targets are set from benchmark studies and analyses of the local factors and trends influencing canopy cover. An increase from 16.8% tree canopy in 2011 to 40% canopy cover is proposed for Greater Sydney by 2036 (Greater Sydney Regional Plan 2018). Several metropolitan Sydney councils have also included tree canopy targets as performance indicators in their urban forest strategies (City of Sydney,

North Sydney Council, City of Canada Bay).

Both Council and the community recognise the value of Woollahra's leafy local character as integral to the future vision outlined in the Community Strategic Plan and the Woollahra Local Strategic Planning Statement 2020 (LSPS). While over 17,000 trees in public parks and streets are actively managed by Council, the future of many thousands of existing trees and new tree plantings on private property is dependent on appropriate planning controls for residential development.

Council has already explored a range of possible improvements to the existing set of controls and is now seeking to translate Australian and international best practice for protecting and enhancing urban tree canopy to the Woollahra context. This project will recommend specific amendments to planning controls and practices that align with Woollahra's future vision and the goals and guidance offered at regional and state government level in NSW.

1.1 Project Aim and Objectives

1.1.1 Project aim:

To enhance Council's policies, procedures and planning controls to facilitate additional landscaping in private development – especially to retain and improve tree canopy cover.

1.1.2 Project objectives:

- Report on the current status, aspirations and trends in tree canopy cover in Woollahra
- Report on Council's current approach to controlling landscaping and private tree canopy cover in Woollahra – low density residential (R2), medium density residential (R3) and Heritage Conservation Areas (HCAs), identified in the Woollahra LEP 2014
- Identify relevant Australian and international best practices for protecting and enhancing private tree cover
- Recommend amendments to controls and practices in R2 and R3 development, that reflect best practice, relevant to Woollahra

1.2 Methodology

Recommended changes to Woollahra planning controls were developed from an initial review of baseline canopy cover levels at whole of local government area and within the low density residential (R2) and higher density residential (R3) zones. Current planning controls and opportunities for improvement were then reviewed with internal Council officers.

Best national and international practices were consequently drawn upon to inform a proposed level of tree canopy cover and the below ground growing space required to support those levels of tree canopy. Proposed levels of tree canopy and deep soil space were then tested across a range of recent approved development sites and locations of various sizes, development types, constraint levels and Floor Space Ratios (FSRs).

Approved landscape plans allowed the capacity for improved canopy cover levels, and the factors of most influence on the achievement of improved canopy levels to be tested. The hypothesis was that:

a) if approved landscape plans and their deep soil landscaped areas could achieve the proposed level of canopy cover at tree maturity, then tree canopy controls were feasible, and

b) the factors of greatest influence over achieving improved tree canopy would become the detail within the wording of the planning scheme amendment.

An important issue to also resolve during the testing was, which parts of tree canopy areas should be counted towards canopy cover on the subject site. The issue of whether to consider overlapping canopies of trees and or portions of canopies overhanging neighbouring properties was therefore explored in detail.

Finally, in close collaboration with the Woollahra planning team, specific amendments and additions to the LEP and DCP were proposed and feedback sought from relevant council officers and Councillors. A summary of the methodology is shown in Figure 2. Detailed results of each phase in the methodology is presented in sections 2, 3 and 4.

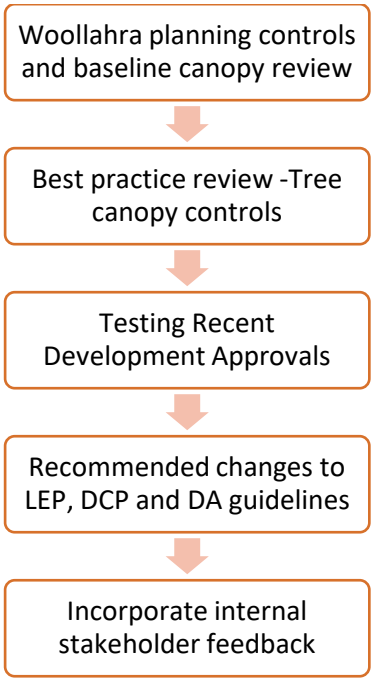

Figure 2. Phases of the methodology used to derive recommended amendments to landscape planning controls.

1.3 Current approach to tree and landscape controls

Current inputs, processes, planning controls and outputs for trees on private property in Woollahra were identified during a workshop with the project working group. These sources of information, guidance, planning controls and processes can be collective labelled as the "Toolkit".

Elements of the "Toolkit" are grouped sequentially through three stages:

- Stage 1 – Pre-lodgement
- Stage 2 – Application, Assessment and Decision
- Stage 3 – Construction and compliance

Elements of the current "Toolkit", rated as most important by workshop participants, to the improvement of tree canopy and landscape outcomes, in order of importance, included:

- Woollahra Local Environmental Plan LEP 2014
- DCP Part E: General Controls for All Development, E3 Tree management - triggered by SEPP (Vegetation in Non-Rural Areas) 2017
- Reactive compliance between certification milestones and post construction
- DCP Part B, General Development Controls within General Residential, especially B3.7 External areas – deep soil provision
- Consent conditions for ongoing landscape maintenance
- Woollahra Development Application Guide, including Tree Protection and Management Plan Report guidance
  Woollahra "Trees" website content

The hierarchy of statutory and non-statutory planning tools that apply to trees and landscape outcomes in Woollahra is shown in Figure 3.

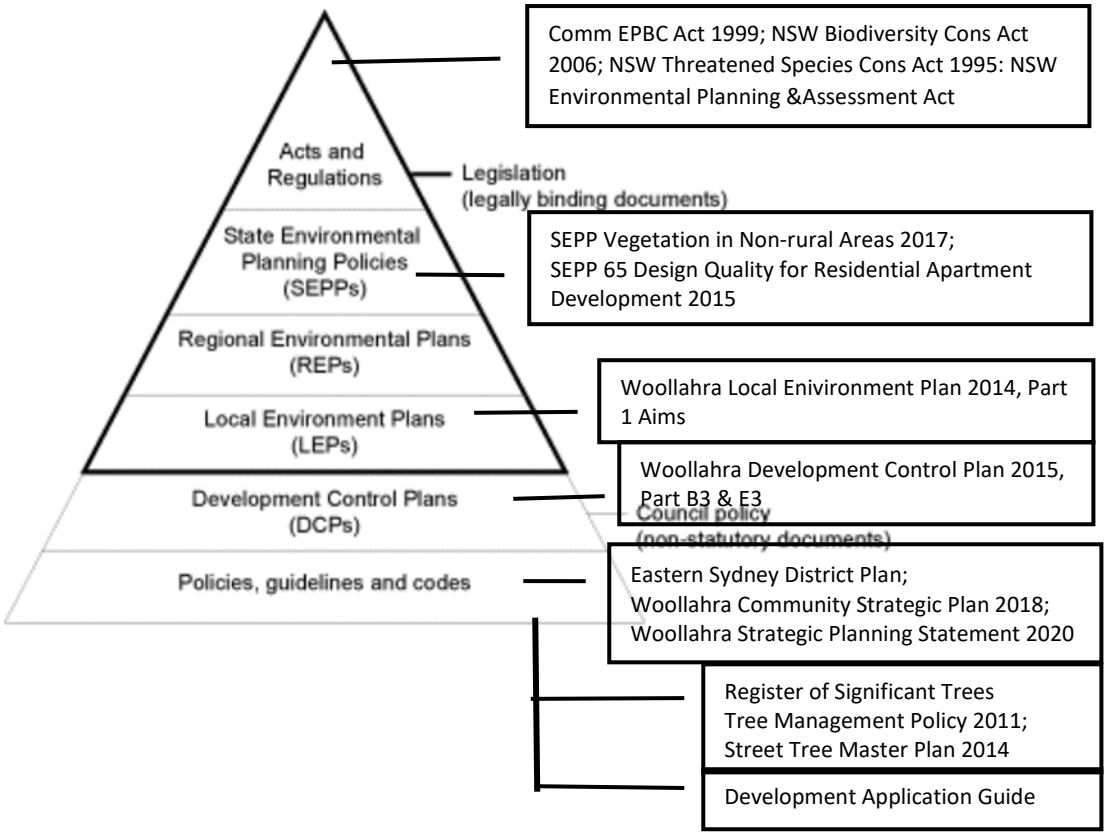

Figure 3. Hierarchy of regulatory (bold outline) and non-regulatory tools that apply to development in Woollahra municipality (adapted from Woollahra Building and Development website

Other observations noted in the process mapping exercise include:

- Clause 5.9A and 5.9AA of the Woollahra Local Environmental Plan "Protection of Private trees" were repealedin 2017 with the introduction of the State Environmental Planning Policy (SEPP) (Vegetation in Non-Rural Areas) 2017 which applies throughout metropolitan Sydney. Part 3, section 9, of the SEPP points directly to DCP provisions. ie. "…vegetation in any non-rural area of the State that is declared by a development control plan to be vegetation to which this Part applies".
- Provision of deep soil zones (WDCP Ch B3.7.1) relate to secondary areas, such as front and rear setback areas, which in turn relate to external areas, and not site area ie.
    - *C1 For development in the R2 and R3 residential zones—at least 50% of the site area outside the buildable area is deep soil landscaped area.*
    - *C2 At least 40% of the front setback comprises deep soil landscaped area, and: for a residential flat building or multi dwelling housing in the Wallaroy, Manning Road, Darling Point, Bellevue Hill South, Bellevue Hill North or Rose Bay precinct—at least one consolidated area of the deep soil area is at least 20m^2; and for a residential flat building or multi dwelling housing in the Double Bay or Point Piper precinct—at least one consolidated area of the deep soil landscaped area is at least 12m^2.*
    - *C3 Control C2 above does not apply to land in Rose Bay between Caledonian Road and Vickery Avenue zoned R3 Medium Density Residential.*

    - *C4 At least 50% of the rear setback comprises deep soil landscaped area.*
- No specific provisions for numbers and types of trees for replacement and new plantings
- No additional tree or landscape requirements for Heritage Conservation Areas, aside from DCP E3 requirement for all impacts on trees in HCAs to trigger a Development Application, other than minor works.

It is also important to recognize that for R3 residential flat development of three or more storeys, and four or more dwellings, Clause 6A of SEPP No. 65 makes the requirements of eight specific matters contained in Parts 3 and 4 of the Apartment Design Code 2015, take precedence in the assessment and determination of a development application, over any inconsistent provisions in local DCPs.

The eight specific matters are:

- Visual privacy (Part 3F)
- Solar and daylight access (Part 4A)
- Natural ventilation (Part 4B)
- Ceiling heights (Part 4C)
- Apartment size and layout (Part 4D)
- Private open space and balconies (Part 4E)
- Common circulation and spaces (Part 4F)
- Storage (Part 4G

While SEPP No.65 requirements relate specifically to those eight matters, the *Apartment Design Guide* also includes guidance on retention of trees (2A) and provision of deep soil zones (3E) to support retained or new tree plantings and plantings on structures (4P). The complete *Guide* is intended to be used in the preparation of local controls, design guidelines and the assessment of development proposals to achieve better design and planning for residential apartment development in NSW. Principles of the guidance offered in the Apartment Design Guide have therefore been applied to the full range of residential development types- ie. detached dwellings, dual occupancy (attached and detached), multi-dwelling housing and residential flat buildings.

Most importantly, amendments to tree and landscape controls have taken into account local and regional aspirations for sustaining and enhancing tree canopy cover and have been developed and tested to ensure integration with desired built form outcomes that support community aspirations and the vision for land use planning in Woollahra.

2. Context for change

2.1 Tree canopy cover in Woollahra

Baseline measures of vegetation cover in 2016 across Greater Sydney sourced from analysis of high resolution (0.3m) vegetation imagery and digital aerial photography, were made available by the state government of NSW. Trees greater than 3 metres in height, at that time, covered approximately 28% of public and private lands across the Woollahra Local Government Area (LGA) (Figure 2).

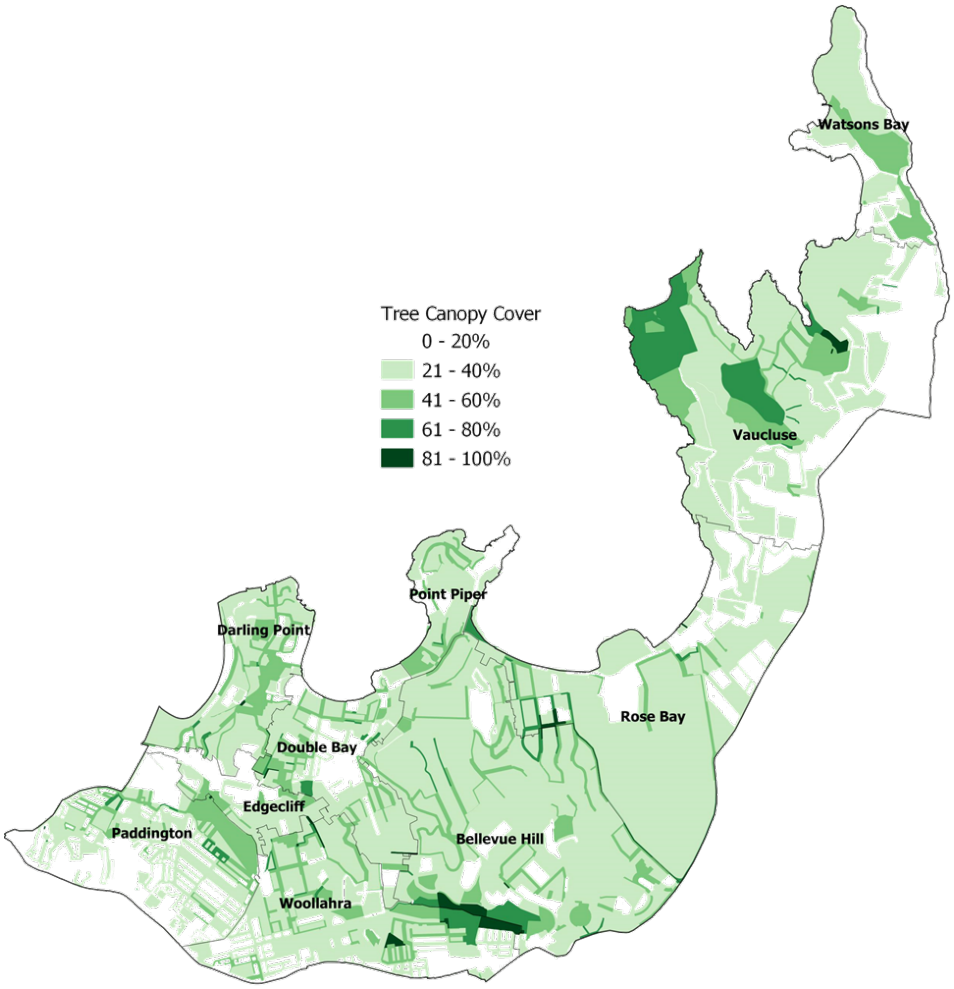

Figure 4. Tree canopy cover on public and private land in Woollahra 2016: source NSW SEED Open Data Portal: Greater Sydney Region urban vegetation cover to modified Mesh Block 2016 (SEED 2016)

Woollahra is within the Top 5 in tree canopy cover of other non CBD Sydney harbourside council areas (North Sydney, Hunters Hill, Ryde, Lane Cove and Mosman), and was one of few councils surveyed across NSW that made small

gains in canopy cover between 2009 and 2016 ("Where should all the trees go?" Report – Green Spaces Better Places).

In 2016, approximately 32% of the Woollahra LGA was public land, including all roads, Council parks and Council facilities. This land was contributing approximately 35% to the total tree canopy in the LGA.

Approximately 64% of the land in the Woollahra LGA was private land (including private sporting venues, the Royal Sydney Golf Course, White City, schools and hospitals). This land was contributing approximately 57% to the total tree canopy in the LGA. The remaining land area (4%), at that time, included national parks, defence land and public schools, contributing around 6% of total tree canopy coverage.

Per unit land area, trees on public land, including Council controlled lands, were contributing more to Woollahra's tree cover than private lands. However, collectively, low density residential (R2) lands and medium density residential (R3) lands make up over 70% of Woollahra's private lands and contribute significantly to it's leafy character. In 2016, tree canopy coverage on R2 lands at 27.3% contributed almost 12% of the LGAs total tree canopy compared to R3 lands at a similar 27.7 % tree canopy cover, were contributing just 7.6% of the LGA's tree cover (Table 3). It is possible that many of the land holdings in both the R2 and R3 zones had not been developed to the potential permitted by the planning scheme when the 2016 canopy cover measures were acquired. Ongoing contributions of these land holdings to Woollahra's leafy character and environmental qualities require robust and relevant planning controls which focus on tree canopy cover.

	Total	R2	R2-HCA	R3	R3-HCA	HCA-R2/R3
Tree canopy cover	**Council controlled public + private land**	**Private land**				
Bellevue Hill	32	29.38		26.63	22.22	22.15
Darling Point	32	37.59	26.6	29.45	28.48	28.34
Double Bay	28	26.67		28.44		
Edgecliff	23		26.79	30.28	30.96	28.87
Paddington	23		15.06		24	16.72
Point Piper	24	23.28		24.06		
Rose Bay	24	24.67		24.21	21.81	21.81
Vaucluse	31	26.42	27.49	9.1		27.49
Watsons Bay	28	23.22	23.96		24.98	24.16
Woollahra	30		19.22	31.13	24.47	22.81
Av.	**28**	**27.32**	23.19	**27.74**	25.27	24.03

Table 3. Tree canopy cover distribution in Woollahra across low density residential (R2), higher density residential (R3) and Heritage Conservation Areas (HCAs) (2016 measures using SEED 2016).

Tree cover in Heritage Conservation Areas within both R2 and R3 zones was consistently less than average tree cover averages for those zones (Table 3). HCAs in Woollahra typically contain historical terrace/row housing on very small lots with limited capacity for trees. 23-24% tree canopy cover across these areas, generally consists of one small to medium sized tree at the rear of the property. adds to the landscape qualities of this historic style of housing. Community expectations for protecting heritage values and buildings (Community Satisfaction Survey 2018) are high. However, there is a pattern of stability of this historic housing style and its leafy streets, compared to the level of change in R2 and R3 areas outside of HCAs. Therefore attention has focused on improvements to tree canopy controls outside of Heritage Conservation Areas.

2.2 Tree canopy cover targets

In 2018 the Greater Sydney Commission proposed a 40% canopy cover target by 2036 and launched the "Five Million Trees for Greater Sydney" initiative. Five Million Trees is part of the NSW Government's commitment to creating a greener city to improve Sydney's health, climate, economy and environment.

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draft NSW Urban Tree Canopy Guide suggesting at least 40% canopy cover targets for low density residential lands and 25% canopy cover for medium and higher density residential lands (Figure 5).

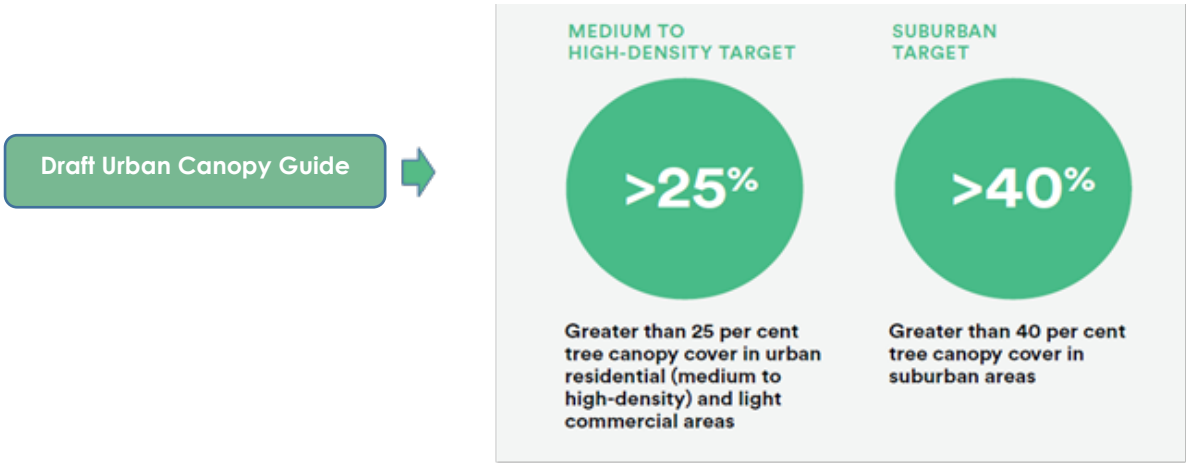


Figure 5. Extract from draft Urban Canopy Guide (NSW Government Architect 2018)

As shown in Table 4, the average 28% tree canopy cover for R3 private land in Woollahra already exceeds the canopy target for higher density zones suggested in the draft NSW Urban Tree Canopy Guide. However, the average of 27% tree cover for R2 private lands is well below the suggested 40% canopy target for low density residential.

Zone	Canopy Target
R1 General Residential	**40%**
R2 Low Density Residential	
R3 Medium Density Residential	**25%**
R4 High Density Residential	
Business zones (**B1** Neighbourhood Centre, **B2** Local Centre)	**15%**
B4 Mixed Use	
B5 Business Development	
B6 Enterprise Corridor	
B7 Business Park	
IN1 General Industrial	**25%**
IN2 Light Industrial	

Woollahra	
R2	27%
R3	28%

Table 4. Woollahra R2 and R3 average tree canopy cover compared to NSW Urban Tree Canopy Guide targets – (Extract from May 2019 Councillor presentation pg 26)

Local Planning Priorities expressed in the draft Woollahra Local Strategic Planning Statement under the Sustainability theme, include:

Planning Priority 11, *conserving, enhancing and connecting diverse and healthy green spaces and habitat, including bushland, **tree canopy**, gardens and parklands*.

It is suggested that to align to both the aspirations in the Local Strategic Planning Statement and the Greater Sydney and NSW Government Architect guidance, Woollahra could propose a "sustain and enhance" approach to tree canopy cover in planning controls for development in R2 and R3 zones (Figure 6). Such an approach not only recognises the important contribution that urban trees on private property make to the environment and quality of life, but also allows Woollahra's leafy canopy to keep pace with growth and greater density.

This proposal is further explored in the review of best practice for improving tree canopy and landscape outcomes in private development, summarised in the following section.

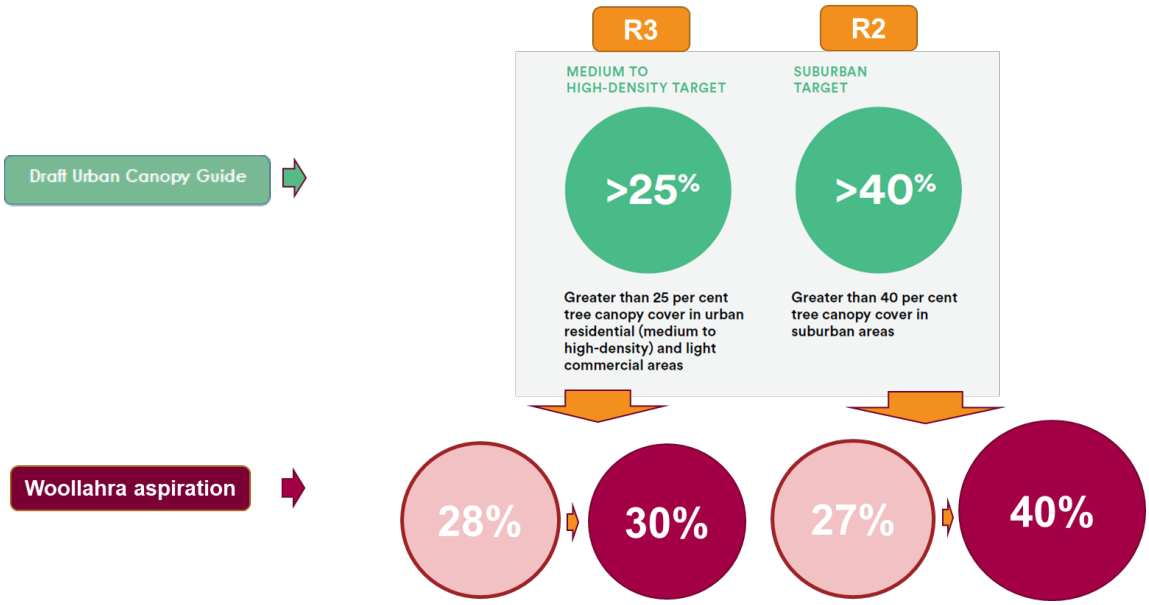


Figure 6. Potential aspirational canopy cover targets for R2 and R3 zoned lands in Woollahra

2.3 Floor Space Ratio (FSR) controls

Woollahra Council has resolved to progress a 0.5:1 FSR for low density residential development. Additional information has been requested from the Department of Planning, Infrastructure and Environment.

While new tree canopy controls are proposed for both low and medium density development, testing of the 0.5:1 FSR in conjunction with the proposed tree canopy controls explored potential evidence about the role of the FSR in achieving a significant increase in tree canopy cover in low density residential development. The results of that testing is provided in section 4.

3. Best practice review and potential improvements

3.1 Best and emerging practices

Best and emerging practices were sourced from other Greater Sydney local government authorities (LGAs), other NSW LGAs, NSW state government policies and guides, other Australian LGAs, international examples and published research. These sources are listed in Table 1 of Appendix B.

Table 2 in Appendix B is a comparison of better and emerging practices relevant to tree protection, tree canopy, deep soil and landscape planning provisions at local government scale. A summary of best practices from the collective sources applied to the three phases of development is provided in Table 5.

Pre-lodgement

- A shared vision for built and natural form and function across the LGA
- A specific strategy for urban forest quantity, quality, values and priorities
- Evidence based, land-use (Mincey, et al., 2013) and tenure specific urban tree canopy cover targets (aligned with state level targets and design guidance)
- A tree protection planning instrument plus clear and publicly accessible advice on inclusions & exemptions
- Tree retention as a priority, supported by controls and reference to AS 4970 metrics (Hunters Hill)
- Tree cover, tree replacement and new tree planting targets and design guidance on tree types, deep soil and water sensitive design requirements
- "Self" assessable landscape quality tools linked to targets eg. Green Factor (City of Melbourne) Tree & Landscape Quality Points (City of Savannah 2017)

Application, Assessment & Decision

- Application and consultant reports align with tree cover targets and tree space quantity and quality
- Integrated assessment, including street tree impacts/outcomes, against clear tree cover, landscape quantity and quality requirements – including tree spaces and locations linked to tree types
- Consent conditions triggering ongoing role for consulting arborist

Post approval (Construction & Compliance)

- Council compliance and project arborist involvement in compliance to avoid potential encroachment on tree space
- Recognition for exemplar development outcomes

Table 6. Summary of best and emerging practice across the three phases of the development process relevant to the Woollahra context and aspirations

Both international and Australian studies have reinforced the role of effective land-use policies, not just tree protection regulations, have on preserving tree canopy (Hill et al., 2010) and reducing tree canopy loss (Daniel, et al., 2016). A recent Australian review suggests that opportunities to revise, strengthen and provide a clear line of sight between land-use planning regulations at state and local level have the greatest potential for positive outcomes for existing and potential tree cover on private property (Phelan et al., 2018).

The best practice review supports the "sustain" and "enhance" approach to tree canopy controls suggested in section 2.2 . Two elements of support for canopy cover in landscape controls also emerge from the review- quantity of growing space and quality of growing area conditions and tree types. Both quantity and quality elements are required to optimise the benefits and performance of the trees while reducing tree maintenance and negative impacts of trees on property owners.

The review also informs elements of a broader strategy of Greening our LGA and monitoring tree canopy cover, discussed further in the recommendations section 5.

3.2 Deep soil landscaped area requirements

To develop tree canopy quantity controls which align to the aspirational land-use canopy cover targets, first requires confirmation of the minimum dedicated Deep Soil Landscape Areas (DSAs) required for small, medium and large canopied trees.

"*Deep soil zones have important environmental benefits, such as allowing infiltration of rainwater to the water table, and reducing stormwater runoff, promoting healthy growth of large trees wih large canopies and protecting existing mature trees which assist with temperature reduction in urban environments*" (NSW Apartment Design Guide, pp60).

The Deep Soil Zones, suggested in section 3E of the Apartment Design Guide, are based on a "rule of thumb" that a minimum of 0.6m3 of soil volume per 1m^2 of tree canopy area is required to support the health and stability of trees. Although widely reported, more recent reviews by Leake and Haege (2014) challenge this "rule of thumb" and suggest that soil volumes, and consequent Deep Soil Landscaped Areas, should account for site soil conditions, soil moisture conditions or the suitability of tree species for the site. Some of these factors are influenced by planning controls and therefore DSAs recommended for Woollahra were based on the best practice, Haege/Leake On-line Soil Volume Simulator and are summarised in Figure 7.

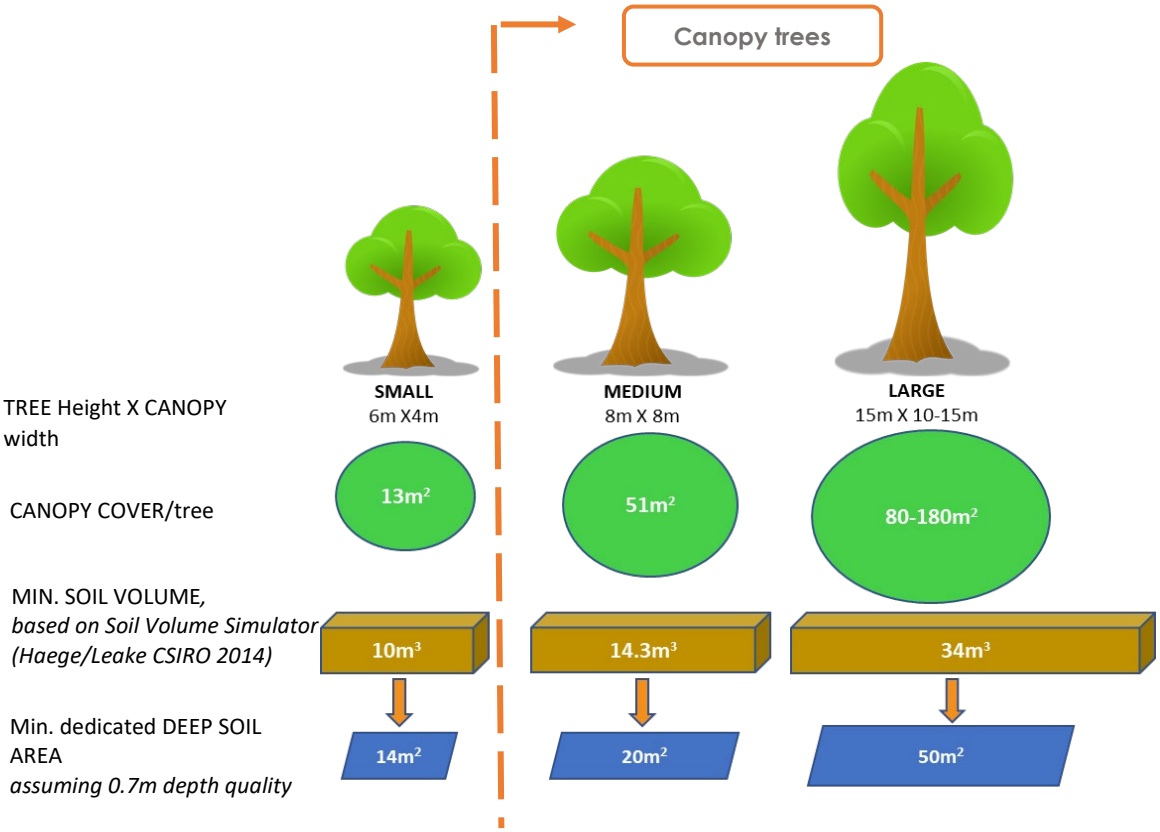


Figure 7. Minimum dedicated deep soil landscaped areas (DSAs), based on calculations from Haege's soil volume simulator, required to support small (6m X 4m), medium (8m X 8m) and large (15m X 10-15m) Canopy trees.

While larger Canopy trees require larger spaces to grow, they also provide exponentially greater benefits than small trees. Larger trees provide more shade and cooling in summer, plus homes for a wide range of native animals. Their larger leaf area traps more air pollutants and intercepts and retains more rainfall, cleaning and slowing down peak stormwater runoff. Longer lived, larger trees also provide stronger links to the past and place, contribute to wayfinding and provide silent witness to local events and stories.

Dedicated deep soil spaces also require a minimum dimension that supports retention of existing worthy trees, plus new and replacement larger growing trees. Minimum dimensions that were determined from structural root zone requirements from Australian Standard 4970- Tree protection on construction sites (Table 6). In this way the minimum dimensions were those required to ensure stability of the tree and less likelihood for the primary root zone to impact on nearby structures. Those dimensions are shown in Table 6.

Tree size	Height (m)	Spread (m)	Canopy area (m^2)	Min. DSLA area (m^2)	Min. DSLA dimension (m)
Small	6	4	13	14	3
Medium	8	8	51	20	4
Large	15	10-15	80-180	50	6

Table 7. Proposed minimum deep soil landscaped area dimensions

4. Testing potential tree canopy controls

4.1 Three stages of testing

Three stages of tree canopy quantity control testing were undertaken, with the Woollahra project team, across a range of completed R2 and R3 developments of varying site areas and locations (Figure 8). The purpose of the testing was assess the feasibility of achieving proposed tree canopy areas across the range of residential dwelling types permitted within the R2 and R3 zones. The testing also assessed the extent of influence of limiting factors such as deep soil landscaped area dimensions and Floor Space Ratios on the achievement of proposed tree canopy cover. Results were therefore be considered conservative estimates of feasibility, yet more robust than simple scenario planning on mock sites.

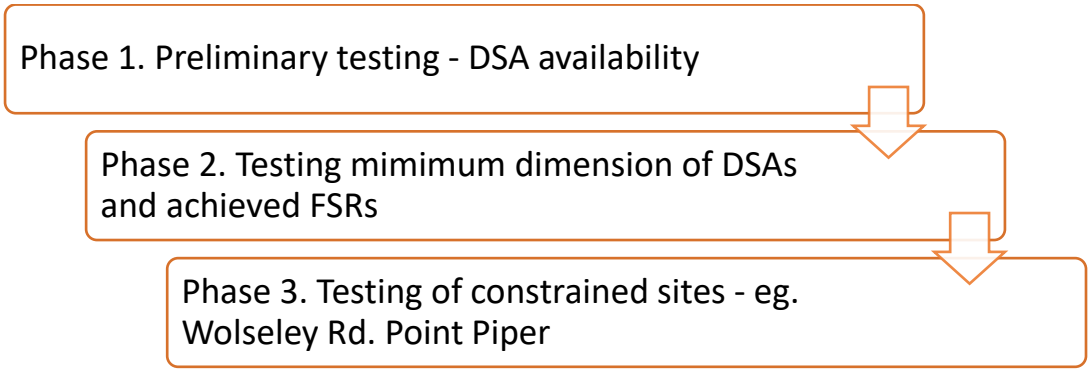


Figure 8. Three phases of site testing for proposed tree canopy controls

The first stage of preliminary testing included three R2 developments and one R3 development. Estimated tree canopy cover at maturity, based on the dimensions of the deep soil landscaped areas and tree species shown on the approved Landscape Plan, was compared to improved tree canopy cover using tree sizes which those approved DSAs could have supported.

Preliminary testing showed that approved total DSA on the sites ranged from 30% to 55%. On each of those sites, the improved scenario using new or replacement tree canopy sizes which the individual approved DSAs supported, forecast a greater canopy area result. The major difference between approved and improved canopy area was therefore not in the total DSA area available for tree planting, but in the tree species chosen for new or replacement trees. The tree species listed in the approved landscape plan were generally small or occasionally medium growing species, even though some of the DSAs were large enough to support the growth of larger Canopy tree types. In addition, a large proportion of total DSA was less than 3m in its smallest dimension and therefore not suited to growing anything more than very small trees or large shrubs.

A second stage of testing incorporated four additional elements across all testing sites:

1) Estimated tree canopy sizes at maturity developed by Woollahra's tree management team, of more than 100 tree species encountered on private properties across Woollahra. This refined the accuracy of estimates of improved canopy cover.
2) Minimum dimensions of the DSAs required to support small, medium and larger canopy trees were applied.
3) Reporting of the achieved Floor Space Ratio
4) An analysis of options to include or exclude both overlapping and overhanging canopies from total site canopy cover estimates (Figure 8).

It should be noted that trees growing on the subject site and supported by the DSAs on the subject site, contribute to landscape functions both on the site and beyond the site boundaries. Overhanging portions but not overlapping portions of trees growing on the subject site, were therefore included in the calculations of tree canopy cover in both area and as a percentage of site area. It was also noted that in some cases existing significant trees growing on adjacent sites require a portion of the subject site DSA to contribute to the continued health and growth of that tree. The latter scenario was added to considerations for acceptable variations to tree canopy control provisions.

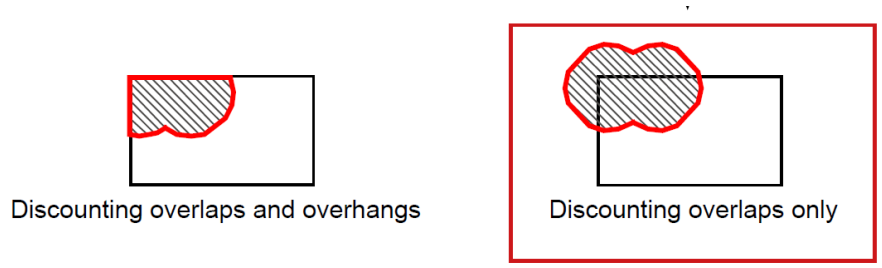


Figure 9. Preferred approach to calculating total tree canopy area and consequent tree canopy area as proportion of site are, including overhanging canopy, but not overlapping canopy.

In parallel, the Woollahra strategic planning team reported on comparisons in tree canopy cover outcomes between current DSA controls and potential DSA controls, using a range of mock 0.5:1 FSR scenarios on sites of 400-500m^2. This testing showed that the combination of minimum 35% total DSA plus consolidated DSA areas of minimum dimensions that suited canopy trees, could achieve desired canopy areas on 0.5:1 FSR sites.

Examples of detached dwelling, dual occupancy and residential flat development site testing is shown in Figure 10 a, b and c.

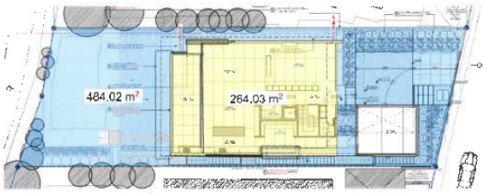
Across 14 test sites, average existing DSLA was 35.9%. Across the 12 test sites, canopy cover outcomes on detached dwellings and dual occupancy developments were improved from average 29.6% to 39% by proposing canopy trees in existing DSLAs

which supported such larger trees. Across 2 test sites of residential flat developments, canopy cover outcomes were improved from 13.6% to 32.2% by again proposing canopy trees in existing DSAs which supported such larger Canopy trees.

Property information

Zone	R2
Access	Dual street frontage
Housing type	Detached Dwelling

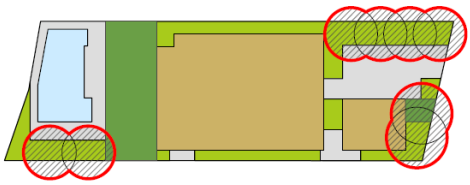
Approved Landscape Plan



Test Result- Approved

Site Coverage	38.81%
Deep Soil Area	34.92%
Consolidated Deep Soil Area	13.59%
Tree Canopy Area	26.04%
Not calculated as Deep Soil	

Approved Tree Canopy



Test Result- Improved

Tree Canopy Area (% of site)	46.12%
Not calculated as Deep Soil	

Improved Tree Canopy

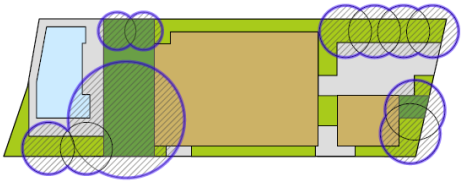
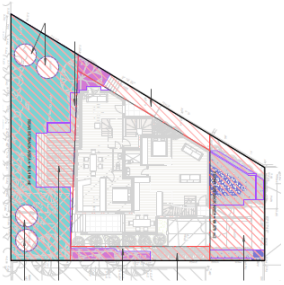


Figure 10a. Test site 10 – Detached dwelling on 790m² R2 site (*Woollahra Council diagram*)

Property information

Zone	R3
Access	Single street frontage
Housing type	Dual occupancy

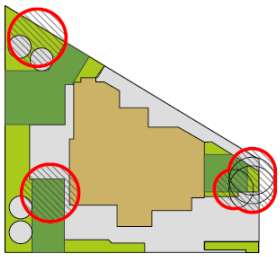
Approved Landscape Plan



Test Result- Approved

	Site Coverage (% of site)	32.00%
	Deep Soil Area (% of site)	33.99%
	Consolidated Deep Soil (% of site)	16.50%
	Tree Canopy Area (% of site)	18.88%
	Not calculated as Deep Soil	

Approved Tree Canopy



Test Result- Improved

	Tree Canopy Area (% of site)	30.82%
	Not calculated as Deep Soil	

Improved Tree Canopy

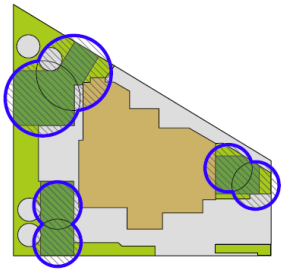
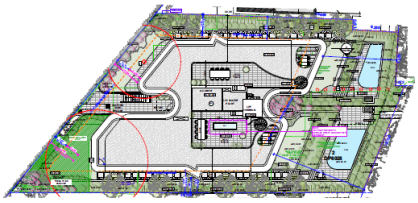


Figure 10b. Test site 4 – Dual occupancy dwelling on 504m² R3 site (*Woollahra Council diagram*)

Property information

Zone	R3
Access	Single street frontage
Housing type	Residential flat building

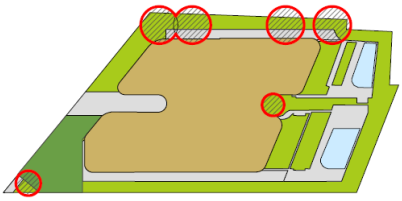
Approved Landscape Plan



Test Result- Approved

	Site Coverage	42.59%
	Deep Soil Area	33.66%
	Consolidated Deep Soil Area	6.73%
	Tree Canopy Area	9.65%
	Not calculated as Deep Soil	

Approved Tree Canopy



Test Result- Improved

	Tree Canopy Area (% of site)	23.29%
	Not calculated as Deep Soil	

Improved Tree Canopy

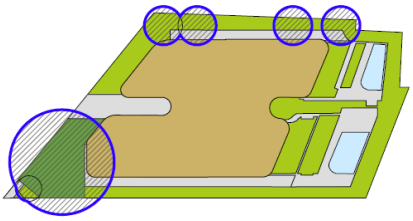


Figure 10c. Test site 14 – Residential flat development on 900m^2 + site area (*Woollahra Council diagram*)

Figures 11, 12 and 13 summarise the relationships between lot sizes, deep soil landscaped areas, floor space ratio and site coverage across the test sites. Deep soil landscaped areas, as a proportion of site area, required to achieve proposed tree canopy areas, were not dependent on site area (Figure 11). The greater the FSR, the greater the site coverage and the less space available for deep soil landscaped areas and canopy trees (Figure 12). An FSR of 0.5:1 supports total deep soil landscaped area of 35% of site area, which in turn, supports achievement of the 40% tree canopy target in low density residential development (Figure 13).

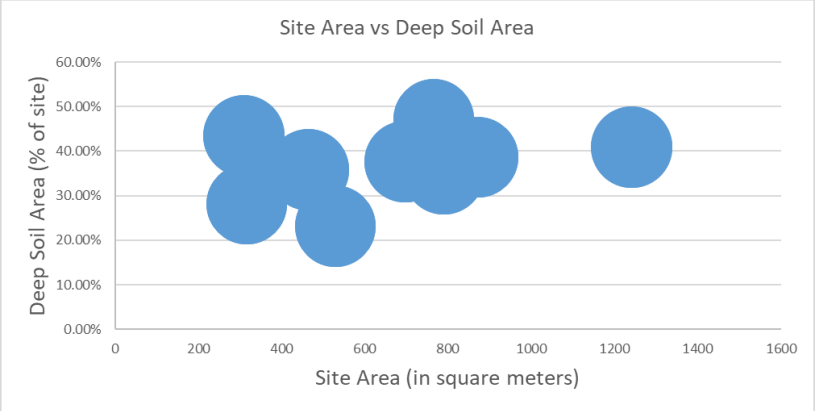


Figure 11. Relationship between site area and Deep soil landscaped area

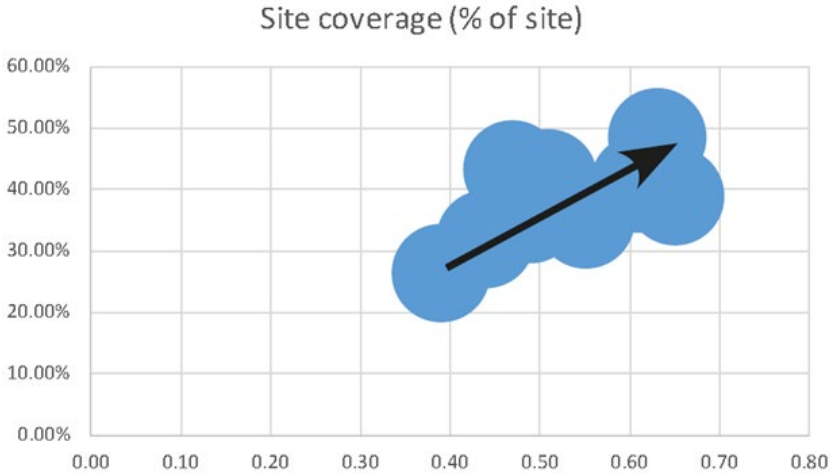


Figure 12. Relationship between site coverage and floor space ratio across R2 tested sites

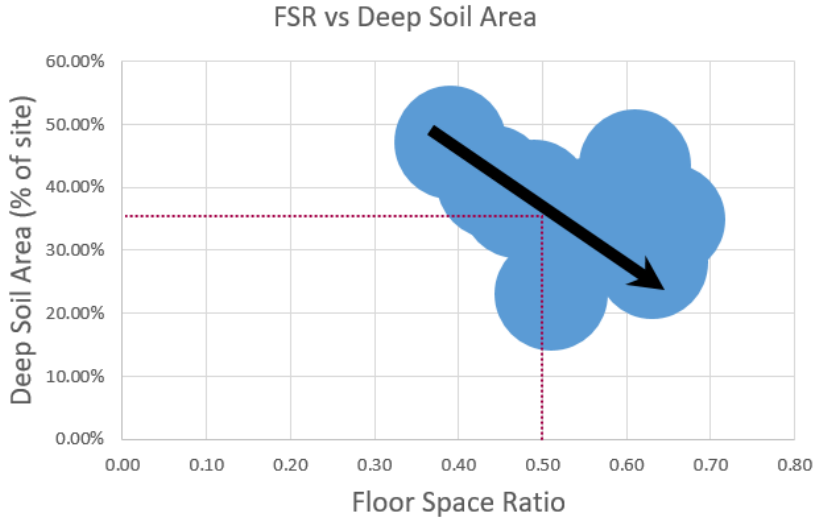


Figure 13. Relationship between floor space ratio and Deep soil landscaped area across R2 tested sites

A third stage of testing focused on highly constrained sites where achieving deep soil landscape areas and minimum dimensions would be challenging. For example, sites on significant slopes, battle axe shaped lots, foreshore topography and sites where the retention or replacement of larger trees could compromise harbour views. Five previously approved detached dwelling developments and one dual occupancy development along Wolseley Rd. Point Piper, were chosen for testing as examples of constrained sites. Approved deep soil landscaped areas varied from 9 – 33% of site area and supported an equally varied range of canopy coverage from 0- 42%. Separate tree canopy controls were considered appropriate for the Wolseley Rd. area.

4.2 Implications of tree canopy area testing

The testing showed that achieving proposed 40% and 30% tree canopy cover across a range of site areas for low and medium density dwellings respectively, is possible when:

- total deep soil landscaped area is at least 35% of site area, and
- consolidated deep soil landscaped areas are at least 20 m^2 with a minimum of 4m in its narrowest dimension, to support the growth of medium to large growing ("canopy") trees of preferred species, to be retained or planted.

Site testing did not support a limit for % canopy area for smaller lots, nor a sliding scale of % canopy area based on site area, although only two sites greater than 800m^2 retained existing canopy trees. The number and size of canopy trees required to achieve % canopy areas for the building typologies will automatically vary as a consequence of the site area.

Approved landscape plans were dominated by smaller/cosmetic trees on residential properties of all scales, eventhough larger trees could be accommodated within existing deep soil landscaped areas (Figure 14). It is not clear to what extent existing design outcomes such as solar access and private view sharing may be compromising the choice of "canopy tree" types. Preliminary feedback suggests that these outcomes could be achieved with careful canopy tree siting. A requirement for more "canopy trees" would need to shift current attitudes and preferences based on the important contributions of these trees to local landscape character, liveability and Greener Cooler Sydney aspirations.

The protection of existing trees before and during the development application process is well covered by existing SEPP, LEP and consequent DCP requirements, however the retention of existing trees that contribute to canopy area were less commonly observed in testing. It is suggested that the combination of proposed tree canopy area controls and minimum dimensions of deep soil landscaped areas could improve the consideration of existing canopy trees and Significant Trees on the subject site during design stages and their likelihood of long term contributions to local landscape character. An example of the significant contribution of a large existing tree on the front boundary of a site is shown in Figure 15.

Specific guidance on a short-list of "canopy tree" types, categorised by both their forecast canopy dimensions and minimum deep soil dimension requirements would provide consistent advice at pre-lodgement plus support for development assessment.

Figure 14. Cosmetic small trees/shrubs and some succulent planting on roof top of dual occupancy dwelling.

Figure 15. Large canopy tree retained on frontage of residential flats.

Testing confirmed that the proposed 0.5:1 FSR for low density residential supports the capacity to achieve 40% tree canopy cover on a broad range of R2 sites

There are sites that are highly constrained. Some consideration for lesser tree canopy requirements in more specific housing typologies, precincts or topographies such as Wolseley Rd. Point Piper, is appropriate.

Aligning tree canopy area and associated deep soil landscaped areas requirements to dwelling typologies rather than land-use zones is more appropriate given there is no valid reason why a detached dwelling or dual occupancy development in an R3 zone should require any less canopy area than such development in an R2 zone

4.3 Tree canopy quality outcomes

The General Development Controls for External Areas (Chapter B3.7) for Part B General Residential in the Woollahra Development Control Plan 2015, already include some landscape quality elements. These include a requirement that at least 50% of landscape water use be sourced from non-potable sources, including harvested rainwater. The concept of supporting landscape, green cover and tree canopy quantity with additional quality elements is already best practice internationally in cities such as Seattle, Savannah and London. The City of Melbourne is also progressing towards a "Green Factor" style of Tree Canopy/Landscape control that combines quantity and quality elements into a rating tool. The aim of the "Green Factor" tool is to drive developments towards design and inclusion of green infrastructure elements, including trees, green walls and roofs and water sensitive elements that optimise the delivery of multiple ecosystem services.

Woollahra will be well placed to advance a similar approach, when the Green Factor has been adapted for application beyond Melbourne, by considering some additional quality elements within the General Development Controls for External Areas and others in the Development Application Guide. More importantly a better balance of Tree Canopy/Landscape quantity and quality elements can improve the health, longevity and functionality of new tree plantings and retained trees, leading to less likelihood of premature tree failure and tree removal.

Table 8, in the Recommendations section, lists potential Tree Canopy/Landscape quality elements, suggested benchmarks and suggested fit within the Woollahra planning control "toolkit".

5. Recommendations

5.1 Amendments to planning controls and Development Application Guide

The following recommendations for amendments to planning controls are drawn from a review of Woollahra's current controls, best practices and testing of proposed canopy area requirements. The collective of proposed amendments to the hierarchy of planning tools listed in Table 8 emerged from expert drafting of proposed provisions by Woollahra's strategic planning team, and discussion with development assessment and tree management specialists following the testing stage.

The proposed canopy area requirement approach aligns well with state government and metropolitan Sydney aspirations and Woollahra's 20 year vision. The specific metrics of those controls are based on referenced, peer reviewed publications, rather than "rule of thumb" approaches reported in other guides. Amendments which address both quantity and quality of landscape and tree cover outcomes also align well with international best practice for the retention and enhancement of greener, healthier neighbourhoods.

There is no doubt that some of the greatest challenges to the proposed amendments will be in taking private property owners on the journey towards living with larger canopy trees and designers and the development community toward a balance of canopy trees, built form and local context. The strong links between canopy trees and the high values placed by the community on the leafy landscape character of Woollahra must continue to be promoted. Equally important is the message that Canopy trees and landscaping must be considered at the initial building design phase and not as an afterthought at the landscape design phase.

The recommended tree canopy controls include amendments to the Local Environment Plan Aims and Floor Space Ratios, and amendments to the Development Control Plan – Chapter B3 – General Development Controls (Table 8). Operational changes in support of the controls include the requirement for development application Landscaping Plans to be accompanied by tree canopy area calculations and be assessed by the Tree Management team. This team will continue to be responsible for compliance with development consent conditions and occupancy certifications. The Development Application Guide will also include the list of indicative Canopy Trees and their canopy areas and deep soil landscaped area requirements.

Table 9 lists potential Tree Canopy/Landscape quality elements, suggested benchmarks and suggested fit within the Woollahra planning control "toolkit".

Proposed LEP provisions

New FSR control of 0.5:1, New FSR control of 0.75:1, New sliding scale FSR

New LEP aims
That state the outcomes required in support of the approved LSPS, including urban greening, urban heat island effect reduction and mitigating climate change

New LEP objectives
R2 and R3 - To ensure that development achieves the desired area of tree canopy
B1, B2, B4, SP2, SP3, RE2 - To encourage urban greening

New Additional Local Provision
6.8 Urban Greening
That point to the objective to sustain and enhance tree canopy cover and direct its application to the relevant lands
Ie. land in Zone R2 Low Density Residential and Zone R3 Medium Density Residential (excluding Paddington, Woollahra and Watsons Bays HCAs)
Specific direction to ensure Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development—
(a) is consistent with the objectives of this clause, and
(b) provides an appropriate selection of and location for canopy trees, and minimises disturbance and adverse impacts on existing canopy trees which are to be retained

Proposed DCP amendments – Chapter B3 General Development Controls

Additional objective and controls in B 3.4.1 Streetscape and local character

O. To ensure that development contributes towards reducing Urban Heat Island Effect by encouraging urban greening and retaining, protecting and enhancing tree canopy cover.
C. Development minimises disturbance and adverse impacts on existing Canopy Trees which are to be retained.
C. Development allows sufficient space for the growth of the above and below ground elements of existing and future Canopy Trees (including the root system, trunk and branches).

Additional section and definitions in B 3.6.1 Landscaped areas and private open space

Urban Greening and Tree Canopy
Describing the critical relationship between canopy trees, urban greening and mitigating localised warming and climate change adaptation, plus a number of environmental, social and economic benefits.
And defining important terms used in the provisions, including:
A Tree Crown, A Canopy Tree and **Tree Canopy and how it is to be calculated** (including diagrams)

Additional controls in B 3.6.1 Landscaped areas and private open space

Minimum Tree Canopy Area for all residential development in the R2 and R3 zones
Including development that alters the existing building footprint and/or building envelope or impacts upon existing landscapes and Distinguishing the Tree canopy % required across two types of housing and levels for all general development separate to Wolseley Road area.

Housing Type	Detached dwellings, dual occupancies, dwelling houses, semi-detached development and attached dwellings	Multi dwellings, Residential Flat Buildings
Minimum Tree Canopy Area	40% of site area for all general residential development 35% of site area for the Wolseley Road area	30% of site area

Plus diagram to assist interpretation and a specified list of acceptable variations will be considered to strengthen the provision

Minimum Deep Soil Landscaped Area to support the achievement of Tree Canopy at maturity, including (plus diagram to assist interpretation)
35% of site area for all general residential development
30% of site area for the Wolseley Road area

Table 8 Suggested landing point in Woollahra planning controls

Landscape Element	Benchmark		Landing point within Woollahra planning controls
	Detached dwellings, dual occupancies	Multi-dwellings, Residential Flats	
CLIMATE RESILIENCE			
% of climate-ready tree/plant species choices	≥50%		Add to DCP Ch B3
Landscape water needs met by harvested or passive stormwater sources	≥50%		Existing DCP Ch B3
DSAs integrated with on-site stormwater management – incl permeable paving	YES		Add to DCP Ch B3
TREE CANOPY LONGEVITY			
DSA site soil conditioning specified	YES		DA Guide
Tree & Landscape Establishment & Management Plan for 2 years post-construction, at Occupancy Certificate	YES		DA Guide
OPTIMISE FUNCTION & ECOSYSTEM SERVICES (ES)			
Location and preferred canopy trees offering shade in summer and sun in winter + private view sharing	DCP 2015, Ch B3		Existing DCP Ch B3
% Landscape Area delivering ground + mid + canopy strata to support habitat/biodiversity	≥25%		DA Guide
Provision of food garden elements in Communal Open Space	-	YES	DA Guide
Green Cover (including Canopy trees, Green Walls and or Green Roof)	-	≥40% site area	DA Guide

Table 9. Potential Tree Canopy/ Landscape quality elements

5.2 Monitoring and evaluating outcomes

In the absence of timely updates to the NSW Government Open Data SEED Canopy cover monitoring for metropolitan Sydney, it is suggested that Woollahra explore options to acquire high resolution remotely sensed data for analysing tree canopy cover change at least every 2 years. One option is to partner with City of Sydney who are acquiring updated imagery and analyses annually.

In addition to monitoring canopy cover change at land-use scale, such high-resolution canopy cover analysis also allows monitoring at approved development site scale over time. A review of the Register of Significant Trees can also be assisted by the analysis of the tallest canopy strata from the dataset.

5.3 Tree canopy targets beyond private land – Woollahra Urban Forest Strategy

The evidence from many studies also supports sustaining and enhancing tree canopy cover on public land using a similar evidence based approach to canopy target setting across the range of public lands. These targets should support thresholds of access to greenspace and the contribution of leafy streets to increased uptake of active and public transport, social cohesion and business centre vitality. including:

- Rates of Type2Diabetes were 1.1% lower in neighbourhoods greater than 40% public greenspace, cf.0-20%, within 1km (Astell-Burt et al., 2014). T2D costs $6 billion, annual healthcare costs to Australian economy
- Residents are more likely to choose walking as a primary commuting mode in neighbourhoods with leafier streets (Wang and Qui, 2018).
- The odds of walking further are also enhanced by the density of street trees as much as street network connectivity (Sarker et al., 2015).
- Walks through green space have been shown to reduce blood pressure, improve mental acuity, boost memory recall and reduce feelings of anxiety (Shanahan et al., 2016).

The future of leafy Woollahra is dependent on clearly articulated and celebrated outcomes for trees and other vegetation on both public and private property. An important component of other local government approaches to planning and management of the collective tree or urban forest resource is development of an urban forest or urban canopy strategy (City of Canada Bay 2019). A similar balance between quantity and quality elements, as applied to the subset of private lands in

Woollahra reviewed in this project, is recommended in the development of an urban forest strategy.

The LSPS proposal to develop and implement an Urban Forest Strategy is not only supported, it is highly recommended. This Strategy may also consider a hierarchy of canopy cover targets across public and private lands, beyond the residential lands considered in this project. Specific urban greening controls across other land-use types such as centres and walkable catchments of public transport nodes could be explored. Other forms of green infrastructure to enhance urban cooling such as green walls and roofs and signature tree places also need to be considered. Such a Strategy would therefore fill an important gap between high level community aspirations, regulatory controls, and non-regulatory tree management policies, practices and promotions.

6. Acknowledgements

This project was an intensely collaborative effort between Woollahra strategic planning leadership in Allan Coker and Chris Bluett and senior staff, especially Anne White Team Leader- Strategic Planning and Deeksha Nathani, Strategic Planner. Other highly skilled project team members made important contributions including Nick Economou, Andrew Simpson - Tree management Team Leader. Wilson Perdigao - Senior Assessment Officer assisted greatly in the site testing selection, document recovery and approved deep soil landscaped area review, and Jonathan Chan - Spatial Information Systems Coordinator provided tree canopy data analysis.

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Appendix A

Table A1. Process map of inputs, toolkit and outputs for current tree and landscape controls in Woollahra

Table A1. Process map of inputs, toolkit and outputs for current tree and landscape controls in Woollahra

Number of *show parts of the current process, instruments, etc. rated as most important, by workshop participants, to the improvement of tree canopy and landscape outcomes

Inputs	Toolkit – info sources, planning instruments, strategic documents, procedures, etc.	Outputs
Stage 1 Pre-lodgement		
Existing trees on development site	Self-help info sources of tree info for applicants: - "Trees" website ** - DA Guide *** - DCP Part E3 *** - Significant Tree Register - Community Plan – Woollahra 2030 relevant vision/desired outcomes?	Which trees are protected What can and cannot be done with protected trees, ie.: Permit activities Development App activities
Visit DA Duty Planner Seeking more info/clarification re -site trees -neighbours trees -street trees	Duty Planners – toolkit Relevant LEP & DCP provisions ** (including LEP- Cl. 5.9 Protection of private trees, DCP E3 *****) SEPP – Apartment Design Guide (re 3 storeys+) DA Guide – including Tree Report info requirement	Location oriented advice - directed to the set of planning "rules" that require further investigation, plus types of professional advice that may be required
Pre-lodgement meeting Concept plan Photos Few calculations	Development Assessment team – toolkit Specific LEP, DCP provisions	Development potential, Considerations, limitations, more specifics re type of professional support
Stage 2 Application, Assessment & Decision		
Dev Application & Tree Application in conjunction	Notification process DA web tracker entry	Letters to residents & site notice Note: Tree Permit Apps also trigger notification to adjacent properties and other impacted
	Preliminary Dev Assessment check – for relevant info	Requests for more information from applicant
Tree Report Landscape Plan	Dev Assessment internal meeting – existing trees - referred to TMteam -new trees/landscaping – referred to Landscape team	Requests for more information from applicant
	TM team works with Dev Ass team, Landscape team (+ Ecology) and applicants team re optimizing tree retention for high value trees, new and replacement tree * requirements (soil volumes for podium plantings, deep soil provision****) and new tree planting size and species preferences	Optimal tree retention, replacement and new tree planting outcomes that fit with planning controls – including on-site trees and adjacent street, park

Inputs	Toolkit – info sources, planning instruments, strategic documents, procedures, etc.	Outputs
	Integrated merit based assessment within rule set for built elements and tree/landscape elements for respective development type, lot size and location Planning controls include: (LEP- R2, R3, HCAs, Floor Space ratio, min Lot size, Hgt, Parts 3&4 of Apartment Design Guide) LEP- Cl. 5.9 Protection of private trees) DCP Part B- General Res. B1 – Residential precincts B2- Neighbourhood Heritage Conservation Areas B3- General Development Controls Building envelopes – setbacks Rear setback – determined by site depth, building depth and site area B 3.3 Floorplate – buildable area B 3.4 Excavation B 3.5 Built Form and context – private view sharing B 3.7 External Areas (Landscape & POS) – for R2 & R3 require 50% of site area outside of buildable area to be Deep Soil Landscape Area (DSLA), including 40% of front setback, and 50% of the rear setback area, including some consolidated min areas of DSLA POS – B 3.7.1- min 35m^2 per dwelling R2; min 8m^2 per dwelling R3 B 3.7.1 O7 To retain important existing mature trees, vegetation and other landscape features. C16 Existing trees and vegetation of landscape value are incorporated into the landscape area and treatment. C20 The landscape design: uses vegetation types and landscaping styles which contribute to the streetscape and desired future character objectives for the locality Part C- Heritage Conservation Areas additional tree or landscape requirements? Part E – incl. E3 Tree Management SEPP (Exempt & Complying Codes) 2008 can override	and private trees- each application treated on its alignment and merits **Draft consent conditions** NOTE: No specific tree replacement or canopy cover outcomes prescribed in planning controls NOTE: Green Grid – public and private land – aspirational
	Green walls **& green roof *proposals Separate to trees, Landscape Ass Team inputs , some info for Rose Bay	Additional requests for info from appropriate consultants

Inputs	Toolkit – info sources, planning instruments, strategic documents, procedures, etc.	Outputs
Stage 3 Construction & Compliance		
Tight consent conditions Consulting/Project Arborist involvement Attitude of developers, contractors and private certifiers	Neighbours complaints Constr Cert amends by private certifier – may include excavation (which impacts tree retention) TMO responses – compliance notifications, etc. Breach proceedings – tested in court	**Construction certificate** which supports high value tree retention, space for new and or replacement trees Reactive compliance between certification milestones and post construction ****** **Occupancy Certificate** NOTE: Tree protection and performance bonds permitted for public trees but not private trees or landscaping (re state SEPP) NOTE: Ongoing maintenance ***conditioned, no specific Plan for new residents/body corp and reactive compliance

Appendix B

Table B1. Sources of best practice landscape and tree planning controls

Greater Sydney LGAs

City of Sydney
- Urban Forest Strategy 2013
- LEP 2012
- DCP 2012

Mosman
- LEP 2012
- DCP 2018

Hunters Hill
- LEP 2012
- DCP 2013

Sutherland Shire
- DCP 2015

North Sydney
- Urban Forest Strategy 2019
- DCP 2013

Lane Cove
- DCP 2010

Ku-ring-gai
- LEP 2015
- DCP 2016
  Thinking outside the box- Apartment Design Guide

Other NSW LGAs

Newcastle
- Urban Forest Strategy & Technical Manual

NSW Government

Dept Planning, Industry and Environment
- 5 million trees for Greater Sydney
- Technical Guidelines for Urban Green Cover in NSW
- Urban Heat and Green Cover Project data is made available through the NSW Government's Sharing and Enabling Environmental Data portal (SEED)
- State planning policies

Greater Sydney Commission
- A Metropolis of Three Cities – a greater Sydney regional plan

NSW Government Architect
- Greener Places policy
- Draft Urban Tree Canopy Guide
- Sydney Green Grid

Other Australian LGAs

Brisbane City Council
- Natural Assets Local Law
- City Plan 2014

City of Melbourne
- Urban Forest Strategy 2014
- Greening our City Action Plan 2017
- Green Factor 2020

Best and emerging practices were also sourced from:

International LGAs

Portland, USA

Seattle, USA

Savannah, USA

+ Australian research

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+ international research

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Table B2. Comparative planning controls and supporting documents for R2, R3 and Heritage Conservation Areas or equivalent

Municipality	Canopy cover target	Tree protection private	POS/Landscape areas	Deep soil	Tree replacement
City of Sydney	Urban Forest Strategy 2013 22% by 2030 city wide Min. 15% on development sites	Clause 5.9 and 5.10 Preservation of trees or vegetation of the Sydney LEP 2012 DCP 2012 ≥ 5m hgt, or canopy spread o 5m; or trunk diameter of more than 300mm, measured at ground level; or listed in the Register of Significant Trees.	Landscape Code Vol 2, DCP 2016 Primary landscape requirements- all dev- incl demonstrate min. 15% tree canopy cover at maturity with trees located appropriately + other specifics by development type	Landscape Code V2 Repeats Apartment Design Guide	Primary landscape requirements- all dev- incl demonstrate min.15% tree canopy cover at maturity
Nth Sydney	Urban Forest Strategy 2019 Overall target 34.4%, 28.2% in 2017	DCP 2013 Trees and Veg Mgt ≥10m height (DCP amendment package includes change to ≥5m based on Greater Sydney average)	DCP Resi Dev 1. 3 Env Criteria; 1.4.3 Streetscape;1.56 Landscape Area;1.5.8 Landscaping Building site coverage % set by resi type 45-50%; Landscape area set 30-40% of site area. 50% Tree canopy cover in landscaped area Min POS at ground level 35m^2 multi-dw + 25-30% of site area Common OS	Min 50% unexcavated area at rear of site and 30% at front- to allow for tree retention and new veg.	50% Tree canopy cover in landscaped area Largest growing/longest lived appropriate to the site
Mosman	32% cover in 2016, target	LEP 2012 DCP 2018 ≥ 5m or greater than 450mm circumfr.and trees listed in Urban Forest Management Policy. 2m or more if in Heritage Cons Area	Landscape area = 40-50% of site area, depending on FSR (mapped). Some exceptions closer to public transport/services	Must support retention of existing trees and replacement – details in consent conditions??	
Lane Cove	38% tree canopy cover 2016, target	DCP 2010 ≥ 4m hgt and/or 150mm diam at ground + all Moreton Bay & Port Jackson figs + sig tree register	25% landsc area on ground plus 15% on structure for resi flats; 35% of site for dual occ, attached and townhouses	Refers to Apartment Design Guide	Refers to Apartment Design Guide

Municipality	Canopy cover target	Tree protection private	POS/Landscape areas	Deep soil	Tree replacement
Hunters Hill	33% cover in 2016- target??	HH LEP 2012 Cl 6.7 conserving existing trees along river front Cl 5.9 trigger for dev consent or permit req for works on prescribed veg, unless exempt HH DCP 2013 Ch 2.3 ≥ 4m hgt or ≥200mm DBH, plus… Refers to AS 4970 definition of high retention value trees, and describes how these trees should be considered re TPZ and CRZ setbacks, no ground level altering	LEP 2012 Cl 5.9 trigger for dev consent or permits for veg works Cl 6.7 Conservation of existing trees; Landscape Areas (defined in Cl 6.9 DCP Ch 3.3 secondary dw 50-60% site area depending on riverfront or other At least two thirds of min. L'Scape Area to trees, shrubs and lawn, not pools, etc. Located to accom natural features Planted with compatible species, including canopy trees (12m hgt maturity) at rate of 1 <400m^2; 3- 400 to 900 m^2; 5 – 900-1200 m^2; 7> 1200m^2 3.4 Multi unit res 3.4.4 40-45% of site area, No less than 2m wide	??	DCP Ch 3.3. and 3.4 min. number of tall canopy trees (12m at maturity) X site area
Ku-ring-gai	51% canopy cover 2016, target??	pursuant to Clause 5.9 and Clause 5.10 of the KLEP 2015 DCP 2015 "prescribed veg" -trees- 5m or more, 150mm diam at ground level, and "other veg"- repr of natural vegetation? + certain tree work on Heritage items or trees in HCAs	In multi-dw housing DCP sA Pt6A site design- want tree canopy to link public and private domain and integration with surrounding sites FSB – 10m front, 3-6m side, 6m rear	Deep soil min 40% of site area in multi-dw, takes precedence over site cover max 40%	Expressed in nos. of tall trees (10-13m) for lots greater than 1200m^2 (1 tall tree per 400m^2) within deep soil landscaped areas, plus preferred locations- 30% at front, and 50% indigenous species
Woollahra	Recognize Greater Sydney target = 40% by 2046	DCP 2015 ≥ 5m hgt or ≥ 3m spread + sig trees + Sch 5 Heritage LEP + bushland SEPP19 + ≥ 50mm diam roots	DCP B 3.7 External areas Determined by site depth/building depth, FSR, POS 35m^2 -for each dwelling – semi-detached, attached 8m^2 for each in multi-dwell	DCP B 3.7 For R2 & R3 DSA Min.50% of total area outside of buildable area	Set on site by site basis in consent conditions

Municipality	Canopy cover target	Tree protection private	POS/Landscape areas	Deep soil	Tree replacement
				Incl- 40% of front setback area; 50% of rear setback & at least one 20m^2 consolidated area in some precincts – 12m^2 in others	
Sutherland			Min 36m^2 POS, min 5m dimension and 9 m^2 paved, sunlight access etc.	DCP 2015 R2 Front/street setbacks 7.5m incl DSA for planting canopy trees 2 indigenous canopy trees that grow to >5m within 3m of front boundary + another 2 within 2m of rear boundary	
Newcastle	Urban Forest Policy 2008	DCP 2012 "declared veg" includes replacement trees on development sites, plus ≥3m hgt, circumfr ≥450mm, but not within 3m of principal building	Min 30% of site landscape R2 25% in R2 mod growth area and 25% R3, Min 25% of front setback landscaped, then distributed throughout site to take advantage of existing sig site features	Min deep soil 50% of landscape area Min 1 large or 2 medium trees provided for every 90 m^2 of landscape area. Min 1 medium tree in front setback, when greater than 3m	Newcastle Urban Forest Technical Manual includes Tree Retention Value Assessment + Designing for new trees, Best practice site prep. Etc.
Brisbane	50% tree shade cover for public pathways, OS areas & adjacent footpath frontage within multi-dw dev and outdoor carpark pathways No net canopy area loss for SLTs on private prop;	Natural Assets Local Law- incl mapped Sig Landscape Trees + Biodiversity Overlay etc. City Plan 2014 _MultiDw-Code, SLT O'Lay & Code 1 large tree (15m) retained or provided per 20m site frontage Planning Sch Pol guiding veg retention	City Plan Multi-dw Code Site cover 40-45% or as per N'Hood Plan Communal Open Space min 5% site area or 40m^2 whichever greater- and must accom 25% of landscape area incl 25% tree shade within 5 yrs Tree species in OS areas to support 50% shade cover within 10 years Incl Pl Sch Pol – Landscape Design Guidelines for Water Conservation – to guide	10% site area multi-dw res Frontage must have 1 deep planting area to support 50% shade cover over verge within 5 years	Can require no net canopy area loss within 3 years for SLTs, NALL permit conditions. Other tree planting or retention outcomes point to tree shade/canopy cover req in Dw Codes.

Municipality	Canopy cover target	Tree protection private	POS/Landscape areas	Deep soil	Tree replacement
			landscape form, infiltration, soils and composition to be supported by min 50% rainfall sources, then opt balance from compliant harvested/reuse sources		
City of Melbourne	Increase canopy cover to 40 per cent on public land across the catchment by 2040	Exceptional Tree Register – private property Tree Retention and Removal Policy for trees on public land Greening our City Action Plan 2017 -Establishing Green Cover targets for private land	Victorian Planning Provisions apply Vic Apartment Design Guidelines offer guidance to VPPs re Landscaping and Deep Soil. Provides a Table from which CoMs B5 is drawn	Apartment Developments Cl 55.07-4 Deep Soil Areas and canopy trees objective Table B5 Site area X Min Deep soil provision by % site area = min tree provision. (shortfall can be canopy trees or climbers in planter pits, green wall or green roof areas) Recommends deep soil area as 7% of site area when existing tree over 8m tall is retained (irrespective of site area)	Min. tree provision X site area and deep soil % Urban Forest Fund includes compensation payments for shortfalls in tree replacement for public trees lost to development/other works Progressing Green Factor – on-line tool to guide achievement of green cover targets for private development, green elements scored & weighted by form & function to align with ecosystem services (ES), local conditions & socio-ecological priorities
Savannah, Georgia, USA	36% existing Tree canopy at county scale in 2017. Recommended Target= 40% re SE US Cities	Landscape & Tree Protection Ordinance Applies to public and private.	Min g'space 20% of site area Tree Quality Pts min. 1,600 with template of factors and elements – includes tree retention pts X dbh^2 PLUS min. Landscape Quality Point depending on development type. Assessed before Approval and checked before Cert of Occupancy	Soil depths X planting types included in Tree and Lscape Quality Pts system TQPts also apply to street trees, separately	Same species can't be more than set% of trees Temp Tree & L'Scape Bonds may be required at Cert of Occupancy + 2 yr Tree & L'Scape establishment bond
Portland, Oregon, USA	33% tree canopy cover (currently 26%)	Tree Code &	On-site Tree Density Standards based on		On-site Tree Density Standards

Municipality	Canopy cover target	Tree protection private	POS/Landscape areas	Deep soil	Tree replacement
	Includes: 35-40% for resi lands 15% for comm/industrial 30% for parks/OS 35% for streets	Tree Preservation Standards – define protected veg and limits of interference , with exemptions "An applicant shall preserve and protect at least 1/3 of the non-exempt trees 12 inches and larger in diameter located completely or partially on the development site, unless mitigation occurs"	Tree Area = 40% of site for 1-2 dwellings; and 20% of site for multi-dw res Required Tree Density based on Tree Area avail + Trees retained on site contribute to Tree Density Credits depending on dbh, street trees may also add to credits.		Shortfalls attract compensation payment based on cost of defined number of replacement trees Performance guarantees required when deferring any planting requirement-can be cost of planting and maintenance for 2 yrs