Maroondah City Council

Minimum Standards for Canopy Tree Provision

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Client

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Contents

1. Context

> ‘In 2040, more people are deriving the health and wellbeing benefits, and more plants and animals are deriving the habitat benefits, of living amongst abundant and diverse vegetation in Maroondah.’
> Maroondah Vegetation Strategy 2020–2030.

This is a strong and positive vision for the future Maroondah – a vision that will help to create a resilient and healthy urban forest that contributes to the health and wellbeing of the Maroondah community.

Maroondah City Council has a strong policy framework that aligns with broader statewide policies such as the Victorian Government’s *Plan Melbourne 2017-2050* and Resilient Melbourne’s *Living Melbourne: our metropolitan urban forest(2019)*.

Central to achieving this vision will be the contribution of the private realm to retaining and increasing tree canopy cover. An analysis of vegetation cover change between 2014 and 2018 in Melbourne led by RMIT demonstrates a significant decline in tree canopy cover in the private realm between, in particular in the southern and eastern suburbs including Maroondah (Note: in these areas the baseline vegetation cover is high compared to the Melbourne average).

Notably, Maroondah had one of the highest canopy tree cover percentages of the urbanised municipalities included in the study (fourth highest of thirty-one), but also one of the highest canopy tree cover percentage losses (second highest of thirty-one).
(*Hurley et al (2019) Urban Vegetation Cover Change in Melbourne 2014 — 2018*)

Urban Melbourne is facing the cumulative pressures from densification, urban heating, extreme weather events. The establishment, development and growth of a thriving urban forest is essential to increasing resilience and providing a healthy legacy for future generations.

As change takes place through densification, greening of the urban environment is an integral component. The provision of trees that will contribute to Maroondah’s tree canopy cover is fundamental to this, and in order to enable this, it is critical to provide the conditions necessary for these trees to be able to establish, grow and live a long and healthy life at maturity.

Intent of Provision

To ensure that trees have the airspace and underground space that is necessary for it to achieve its full growth and reach its adult dimensions.

The minimum standards described in this document are intended to provide the baseline requirements for healthy canopy tree establishment and growth in the private realm through:

- Categorisation of tree types;
- Categorisation of tree dimensions
- Species selection
- Reference material for size dimensions;
- Above and below ground conditions to provide for healthy maturity;
- Consistency with contemporary standards; and
- Resources and guidance on species selection.

2. Categorisation of tree types

For the purposes of this document, the following categories of tree species origin apply:

- **Indigenous**: indigenous to Maroondah and have been naturally occurring since the recording of flora commenced;

- **Victorian native**: indigenous to Victoria, including trees, shrubs, herbs, and grasses (equates to the definition of 'Native vegetation' in the Victorian Planning Provisions - Operational provision 73.01 - General Terms) and have been naturally occurring since the recording of flora commenced;

- **Australian native**: indigenous to Australia and have been naturally occurring since the recording of flora commenced; or

- **Exotic**: not indigenous to any part of Australia.

3. Categorisation of tree dimensions at maturity

Available space is a crtical element in the consideration of what canopy tree to plant. Before you plant, it is important to know the expected mature dimensions of the tree and ensure there is sufficient space above and below ground for the tree to grow to a healthy adult size. It is critical to consider its height, crown spread, and root space.

For the purposes of this document, the following standard industry size categories, based on average mature heights and widths, apply:

Tree height categories
Small Trees - 5m to <9m
Medium Trees - 9m to <15m
Large Trees 15m +

Canopy spread categories
Narrow Trees – 2m to <6m
Average Trees – 6m to <12m
Wide Trees – 12m+

4. Species Selection

Decisions on which species of canopy tree to plant are dependent upon the desired outcomes to be achieved in any given location and their suitability to local and future conditions. In Maroondah the primary factors will include:

- contribution to neighbourhood and landscape characteristics
- contribution to indigenous flora and fauna habitat and wildlife movement
- suitability of a species to local soil and topographic conditions
- suitability of a species for the predicted climate over its expected lifespan

Selecting species to contribute to desired outcomes for a location.

Neighbourhood character

> 'The character of Maroondah is intrinsically linked to its natural landscape and vegetation cover. These elements are cherished by the local community, provide environmental, aesthetic and health benefits, and unify the otherwise diverse residential neighbourhoods.'

(*Scott, C. (2019) Maroondah Neighbourhood Character Study Review - Recommendations Report)*

Within Maroondah, the natural landscape and vegetation coverage are integral to residential character. And while neighbourhoods may vary in relation to the layout of streets or the era of dwellings, it is the undulating topography, native tree canopy cover, presence of significant waterways and views to the iconic Dandenong Ranges that unifies the community's connection to place.
In locations where the landscape and neighbourhood character is strongly influenced by a canopy cover of predominantly native trees, then it is expected that Victorian or Australian native trees will be prescribed as part of landscaping requirements.

Biodiversity

Within Maroondah, 109 sites of biological significance have been identified (*Lorimer, G (2020) Biodiversity in Maroondah Volumes 1 & 2*) that are predominantly comprised of indigenous vegetation and of primary importance for Maroondah's biodiversity.

The protection, expansion and connecting of these sites will contribute to achievement of the outcome "More nature throughout Maroondah" set out in the Maroondah Vegetation Strategy 2020-2030.

In locations where proximity to sites of biological significance or habitat corridor routes can influence the protection, extension and/or connecting of sites of biological significance, then it is expected that indigenous trees will be prescribed as part of landscaping requirements.

Selecting species that are well-suited to local and future conditions

Different tree species have evolved over time to flourish in particular conditions, particularly the soils, climate and topography they grow in and on, and in some cases have become specialised to thrive in certain localised conditions. With respect to indigenous and Victorian native tree species, they can be explicitly linked to one or more of the Victorian Government's defined Ecological Vegetation Classes (EVCs) based on their natural places of origin within Victoria. As the classification of EVCs is heavily influenced by the underlying topography, geology and soils, they provide a useful surrogate for interpreting these factors for a location. It is expected that landscaping requirements will avoid the use of tree species that are not suitably matched to the location's soils, climate or topography, and in the case of indigenous species, they will be matched to the modelled EVC(s) for the locations they are to be planted.
(https://www.environment.vic.gov.au/biodiversity/bioregions-and-evc-benchmarks)

Climate projections for the eastern region of Melbourne suggest that by 2055 the average annual surface temperature will increase by between 0.8^0C -1.5^0C, and the average annual rainfall will reduce by between 5.1% to 7.5%. In addition, droughts are expected to be more severe and last longer, the number of hot days is expected to increase, and although expected to be fewer in number, rainfall events are expected to be more extreme with more intense floods (*CSIRO (2013) Climate Futures for Eastern Melbourne - study for the Eastern Alliance for Greenhouse Action's Bushland and Urban Biodiversity Management in a Changing Climate*).

Changing climate and urbanisation is resulting in increased urban temperatures, reduced rainfall, reduced infiltration into soils, and increases in extreme weather events. Some tree species are becoming increasingly vulnerable to these changes with temperature being one of the strongest determinants of geographical distribution. Healthy growth of trees occurs within a 'temperature envelope' and the predicted increases in temperature can shift the environment to the edge or outside of some species' envelopes.

Research undertaken at the Clean Air and Urban Landscapes Hub has investigated this issue and provides a means to predict the performance of existing and future trees in urban settings. As we grow the future urban forest, species selection will become increasingly important to ensure we leave a healthy legacy for future generations. (*Kendal, D. et al (2017) Risks to Australia's urban forest from climate change and urban heat*) https://nespurban.edu.au/wp-content/uploads/2018/11/CAULRR07_RisksAustralianUrbanForest_Oct2017.pdf

Regular review and updating of the pallete of canopy tree species for Maroondah will be vital to this process. The Which Plant Where research program conducted by Macquarie University in association with Housing Industry Australia, Western Sydney University and the Office of Environment and Heritage (NSW) has developed an interactive online tool containing information about which species of plants will thrive in urban spaces under particular soil, water, aspect and climatic conditions, in specific geographical areas. A key component of the program is to assess species attributes and climatic tolerance to demonstrate species suitability to current and future climates. (https://www.whichplantwhere.com.au)

It is expected that canopy tree species that are not suited to future climatic conditions predicted to occur during that species normal lifespan will be avoided in landscaping requirements.

5. Reference material for tree selection

The following references are the preferred sources of information to guide species selection, species growing requirements and mature height and canopy spread dimensions to inform deep soil volumes.

Indigenous to Maroondah and Victoria

Flora of Melbourne: A Guide to the Indigenous Plants of the Greater Melbourne Area (2014) Marilyn Bull

Leon Costermans, (2009) Native Trees and Shrubs of South-Eastern Australia

Native to Australia and Exotic

City of Melbourne (2011) Urban Forest Diversity Guidelines – Tree Species Selection Guidelines for the City of Melbourne

City of Moreland Tree Finder Tool https://www.moreland.vic.gov.au/environment-bins/trees/tree-finder/

Dirr, M & Warren, K S (2019) The Tree Book: Superior Selection for Landscapes, Streetscapes and Gardens. Timber Press.

Dean Nicolle, (2016) Smaller Eucalypts for Planting in Australia. Their Selection, Cultivation and Management.

Dean Nicolle, (2016) Taller Eucalypts for Planting in Australia. Their Selection, Cultivation and Management.

6. Above and below ground conditions to provide for healthy maturity

6.1 Positioning

Newly planted canopy trees should be sited such that the necessary above and below ground space is available to them to enable full growth and reach a healthy mature canopy size. To ensure tree stability and effective root development, trees planted in deep soil require roots to extend through the topsoil. Preferably, the tree should be centrally planted within the available deep soil area to allow the roots to extend in all directions.

Along with soil volume provision, planting areas should be as radially symmetrical as possible to provide ideal growing conditions for development of tree root systems and healthy tree growth.

Buildings and other infrastructure such as fences, pathways and driveways located too close to newly planted canopy trees run the risk of causing damage and other issues both to and from these trees as they grow and mature.

Therefore minimum distances between buildings/infrastructure and a newly planted canopy tree are requirements to be met as part of provision of a canopy tree.

Buildings need to be sited to provide a distance of at least 50% of the minimum mature canopy width (diameter) of the tree between the building and the tree stem.

Other infrastructure such as fences, pathways and driveways need to be sited to provide a distance of at least 25% of the minimum mature canopy width (diameter) of the tree between the building and the tree stem.

To maximise cooling benefits trees should be positioned to shade large areas of hard surfacing exposed to the northern and western sun within the urban environment, such as the walls of buildings, roofing, driveways, roads and footpaths. Shading from trees within secluded private open spaces could extend to walls and ground floor roofing and has the potential to provide shading to hard surfaces on abutting lots.

Where feasible, locate new canopy trees near to existing high-quality trees on site, street trees, or those in adjoining public open space. Tree clusters will provide increased urban cooling and reduction of the urban heat island effect.

6.2 Deep soil areas

The extent to which a tree will grow large and robust depends on a variety of factors including species, soil quality, site hydrology, and more. There is clear evidence that shows that the amount of available soil influences the size of the tree. In urban situations the amount of soil trees can access is critical to their long-term success. (*Grabosky, Bassuk, & Towbridge (2002) Structural soils: a new medium to allow urban trees to grow in pavement).*

Therefore minimum deep soil volumes and areas for a canopy tree species are requirements to be met as part of provision of a canopy tree.

Deep soil area – is a soft landscape area on lot with no impeding building structure or feature above or below, which supports growth of canopy trees and meets a stated minimum dimension.

Calculating minimum deep soil volume and surface area requirements

Minimum soil volume requirements can be derived from the expected dimensions of a tree species at maturity. The two methods described below are recommended for calculating the minimum deep soil volume and surface area for any given tree species.

1. **Crown projection methodology** (CP) is a recognised international approach to determine soil volume requirements for urban trees using the area of tree crown (canopy) spread. It works well for the majority of species that have an average canopy spread but may provide insufficient soil volumes for species with narrow canopy spread, or excessive volumes for species with wide canopy spread. Generally, this approach arrives at a recommendation that equates to around 0.6m3 of soil per m2 of crown area.

2. **Field Size Index** (FSI) compensates for variations in form (ie species with narrow or wide canopy spread relative to height) and is a suitable alternative for non-regular tree forms. It uses tree height and trunk Diameter at Breast Height to calculate the volume and area of deep soil needed. However as this method is designed more for existing mature trees rather than newly planted trees, it often requires a calculated estimate of DBH.

Determining Methodology for calculating deep soil volumes
The significant majority of canopy trees have an 'average' canopy spread where the ratio of height to width ranges between 1:1 and 2:1. The DSV requirement for these trees is calculated using the Crown Projection Methodology.

The DSV requirements for 'narrow' canopy trees which have height to width ratio of greater than 2:1 is calculated using the Field Size Index.

The DSV requirements for species with a 'wide' canopy spread with a ratio of less than 1:1 is calculated using the Field Size Index.

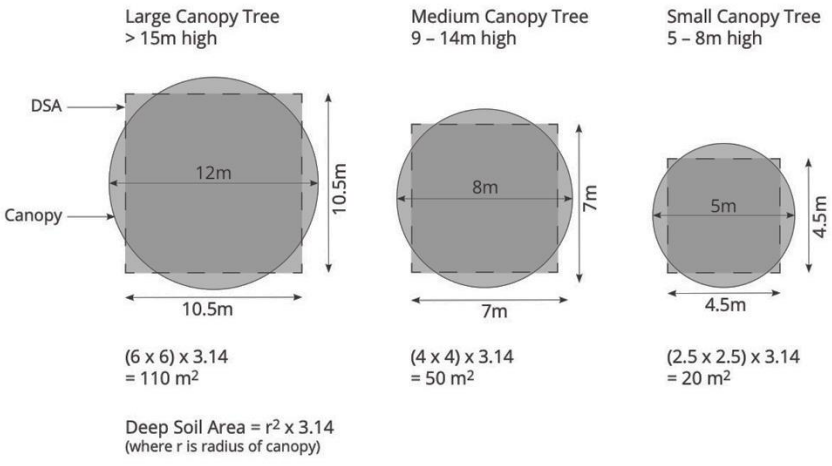

Figure 1 Deep soil areas related to tree canopy (crown) area.

Calculating Crown projection methodology

To calculate how much deep soil needs to be provided for a given size tree, the Urban Horticulture Institute (2003) based at Cornell University in the United States has developed a step-by step methodology. The following is a shortcut version of that methodology that can be used to determine minimum soil volume requirements.

1. Consult a reputable reference source to find the expected average mature canopy (crown) spread range for the tree species you are considering. Take half of the dimension of the average expected canopy width, which is the radius (r).

2. Calculate 3.1416 x r2. That's the crown projection area, ie, the area under the tree's expected canopy spread, to the outer dripline of the tree.

3.For every square metre of crown projection, provide at least 0.6m3 of deep soil. Example: *Ulmus procera* (English Elm) has the ability to reach 20m height x 16m canopy width (average).

The canopy radius ('r') would be 8.0m.

The crown projection would be (3.14) x (8.0 x 8.0) = 200.96

The minimum volume of deep soil needed would be 200.96m2 x 0.6 = 120.58 cubic metres.

Watson & Himelick (1997) (http://www.hort.cornell.edu/department/faculty/bassuk/ uhi/walk5.html) also use the crown projection method and suggest as a general guide that the deep soil within the projected crown area should be at least 60cm deep to provide adequate root space. This method is also supported in part by the notion that fine root density is usually greater beneath the canopy than beyond (Gilman, 1997).

By applying this requirement, the minimum surface area of deep soil for a given crown projection can also be calculated:

For the example above, the minimum surface area of deep soil needed would be 120.58m3/0.6m = 200.96m2 (which is the same as the crown projection area)

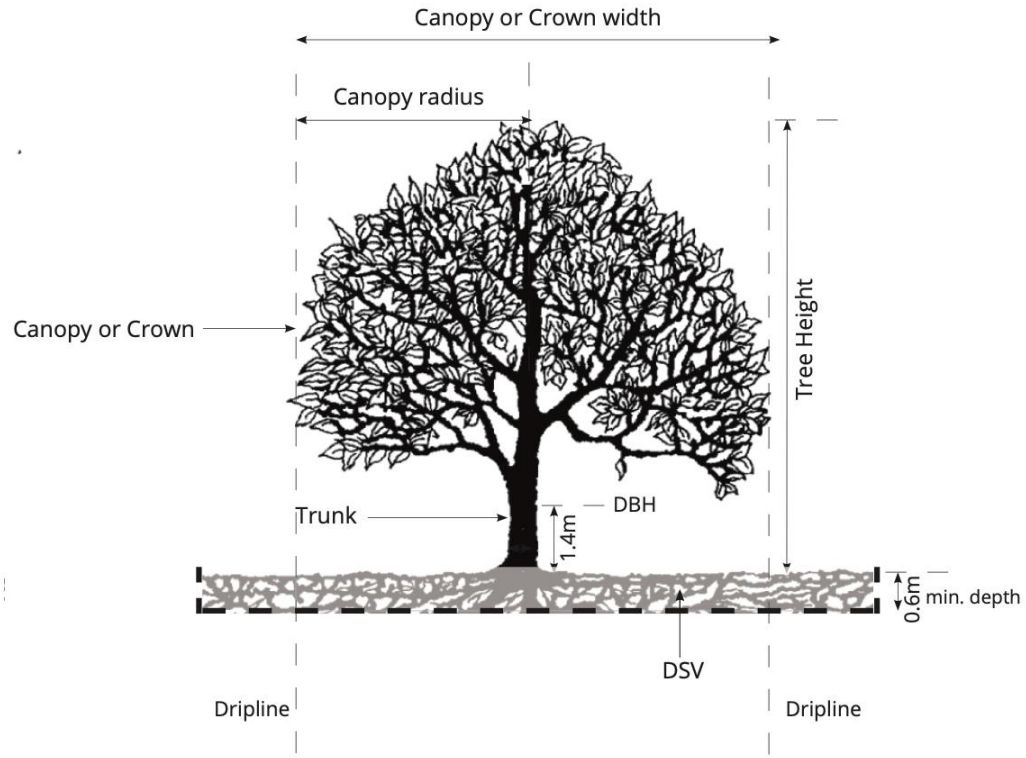

Figure 2 Canopy Tree Structure

Calculating Field Size Index

This index calculates deep soil volume requirements for tree species with non-regular forms, ie species with narrow or wide canopy spread for their height. The Field Size Index: (FSI) where FSI = Height (m) x (Trunk) Diameter at Breast Height (DBH) (mm), compensates for variations in form.

Note: To use the formula above, you will need to consult a reputable reference source to find the expected average dimensions at maturity for that species, and where available the expected average DBH at maturity. In the absence of reliable information on the DBH of a species, use the following calculations for non-regular forms:

- For narrow canopy spread species (ie the ratio of average height at maturity to average width at maturity is > 2:1), use 2.5% of minimum height at maturity as the DBH;
- For wide canopy spread species (ie the ratio of average height at maturity to average width at maturity is < 1:1), use 5.5% of average height at maturity as the DBH.

Example: Consider a tree species with a wide canopy spread with an estimated average height at maturity of 10m

The estimated (Trunk) Diameter at Breast Height = 5.5% of 10m = 550mm

Required deep soil volume (m^3) = (10 x 550)/100

Required deep soil volume = $55m^3$

Required deep soil surface area (m^2) = 55/0.6

Required deep soil surface area -= $92m^2$

Minimum dimensions for deep soil surface area

As tree roots naturally grow radially outwards from the tree in all directions, providing an area of deep soil that is too long and narrow can restrict root development to the detriment of the tree's development, to the detriment of adjacent infrastructure and also restrict the stability of the tree as it gets larger.

The minimum dimension for deep soil surface area is calculated at half (50%) of the average canopy spread at maturity for any given species, Minimum dimensions for the required deep soil surface area for a canopy tree species is a requirement to be met as part of provision of a canopy tree.

Multiple trees sharing deep soil

For more than one tree sharing the same deep soil, the required deep soil surface area per tree is less, reducing by 5% for every additional tree up to a maximum of 25% for 6 or more trees. The minimum dimension for soil surface area for deep soil shared by multiple trees is the largest of the minimum dimension requirements of the trees to be planted.

No. of canopy trees in shared deep soil	**Deep soil surface area reduction**
1	0%
2	5%
3	10%
4	15%
5	20%
6 or more	25%

Example:

Three trees are to be planted together in one area of shared deep soil with each tree requiring 100m2, 64m2 and 36m2 of deep soil surface area respectively.

The total deep soil surface area requirement is 100m2 + 64m2 + 36m2 = 200m2.

However, as the deep soil is shared, the minimum deep soil surface area required can be reduced by the 10% reduction allowance for three trees (being 20m2).

Therefore the total minimum deep soil surface area required for planting these three canopy trees in shared deep soil is 180m2.

The minimum soil surface area dimension is 50% of the average canopy spread at maturity for the largest species.

Soil attributes

For the effective development of a canopy tree, its tree roots require access to a sufficient volume of 'healthy' soil with minimum attributes of:

- non-compacted
- well-drained
- accessible oxygen and water
- a surface area at least that of the minimum required for a given species as described above,
- a depth of at least 600mm.

Sites with natural soil profiles typically provide all these attributes, and the best option for providing deep soil for supporting the establishment and development of canopy trees is to avoid disturbing and damaging the natural soils present.

However excavation, vehicle traffic and other factors can disturb the quality of soils leading to poor soil structure and/or compaction. As a result, these soils may not be able to support healthy tree growth. In such cases, soil amelioration or importing of soils may be needed and should be undertaken as per AS4419:2018 – Soils for Landscaping and Garden Use.

Additional rootable soil zone.

These are areas made up of engineered, load bearing soils under impervious paved areas that support tree root penetration adjacent to the available deep soil. This is achieved by the use of structural soils and structural cells that provide a "rootable soil zone". Where the deep soil area (DSA) is located adjacent to a rootable soil zone (RSZ), the RSZ can contribute to achieving the minimum dimensions of the DSA, provided the RSZ is contiguous.

The provision of RSZ does not contribute to overall DSA requirements.

The RSZ may contribute up to a maximum of 33 per cent of the minimum DSA dimension where it is demonstrated that it is not possible to achieve the required minimuml DSA width dimension.

Table 1 Deep Soil Area of Canopy Trees in Supplimentary Information provides minimum width dimensions for the DSA to ensure healthy root distribution and provides the minimum width dimension reductions where additional RSZ is contiguous and adjacent to the DSA.

Depth of RSZ shall be a minimum of 0.6m.

7. Consistency with contemporary standards

Development of these standards has considered a range of related standards presented in other documents with the aim to align and provide consistency wherever possible.

Reviewed contemporary standards:

Moreland City Council (2019) Canopy Tree Planting in Residential Areas

Bayside City Council (2016) Landscape Guidelines

https://www.knox.vic.gov.au/files/Planning/Landscape_Guidelines.PDF

https://www.tccs.act.gov.au/__data/assets/pdf_file/0011/796088/Available-Soil-Volume-Context.pdf

https://sesl.com.au/blog/structural-soil-for-urban-tree-planting/#:~:text=This%20goes%20some%20way%20to,to%20lift%20and%20crack%20pavements.

8. Resources

- Victorian Planning Provisions - Reformed Residential Zones (2012)
- Victorian Planning Provisions - Amendment VC148
- Maroondah Neighbourhood Character Review 2018
- Maroondah Residential Character Assessment and Identification of Community Values (2018) and Recommendations Report (2019)
- Maroondah 2040
- Maroondah Vegetation Strategy 2020-2030
- Plan Melbourne 2017-2050
- Greening and Cooling Melbourne DELWP (2019)
- Living Melbourne: our metropolitan urban forest strategy (2018)
- City of Melbourne (2011) Urban Forest Diversity Guidelines – Tree Species Selection Guidelines for the City of Melbourne.
- Gilman, E. F. (1997) Trees for urban and suburban landscapes. Delmar Publishing.
- Urban Horticulture Institute – Cornell University http://www. hort.cornell.edu/department/faculty/bassuk/uhi/walk5.html
- Grabosky, Bassuk, & Towbridge (2002).Structural soils: a new medium to allow urban trees to grow in pavement.
- Moreland City Council (2019) Canopy Tree Planting in Residential Areas
- Watson, G. W. & Himelick, E. B. (1997). Principals and Practices of Planting Trees and Shrubs International Society of Arboriculture.
- https://nespurban.edu.au/wp-content/uploads/2018/11/CAULRR07_RisksAustralianUrbanForest_Oct2017.pdf
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- Flora of Melbourne: A Guide to the Indigenous Plants of the Greater Melbourne Area (2014) Marilyn Bull.
- Living Melbourne: our Metropolitan Urban Forest Strategy (2018)
- Lorimer, G. (2020) Biodiversity in Maroondah Volume 1
- Maroondah Neighbourhood Character Study Review 2018 Stage 2: Residential Character Assessment
- Maroondah Neighbourhood Character Study Review 2018 Recommendations Report
- Dean Nicolle, (2016) Smaller Eucalypts for Planting in Australia. Their Selection, Cultivation and Management.
- Dean Nicolle, (2016) Taller Eucalypts for Planting in Australia. Their Selection, Cultivation and Management.

Glossary

Deep Soil Area (DSA)

Deep soil area - soft landscape area on lot with no impeding building structure or feature above or below, which supports growth of small, medium to large canopy trees and meets a stated minimum dimension. Used primarily for landscaping and open to the sky, deep soil areas exclude basement car parks, services, swimming pools, tennis courts and impervious surfaces including car parks, driveways and roof areas.

Rootable Soil Zone (RSZ)

Rootable soil zone / space - areas beyond the primary deep soil area under adjacent impervious pavements that are engineered and constructed to support tree root penetration. This is achieved by the use of structural soil and structural cells which are materials for creation of rootable soil zone beneath pavements and other structures. Structural soil involves the use of structural materials, such as rock, that interlock under specified compaction loads while leaving macro spaces that provide rootable soil zone for tree roots. Structural cells are similar but utilise a plastic cell structure to meet the required compaction and loading.

Canopy Tree

This term is refers to trees that are specifically grown for their canopy for shade and the myriad benefits provided by trees.

Canopy Cover

The area of ground covered by the canopy of the tree, usually measured in M2, or as a % of coverage of a given area.

Crown or Canopy Spread

A part of tree measurement is measurement of the crown of a tree, which consists of the mass of foliage and branches growing outward from the trunk of the tree. The average crown spread is the average horizontal width of the crown, taken from dripline to dripline as one moves around the crown.

Deep Soil Volume (DSV)

The deep soil volume is the cubic volume of soil requird for a canopy tree to grow to a health mature size. It is calculated by multiplying the deep soil area (m2) by the depth of .6m

Diameter at Breast Height (DBH)

Diameter at breast height, or DBH, is a standard method of expressing the diameter of the trunk or bole of a standing tree. DBH is one of the most common dendrometric measurements.

Tree trunks are measured at the height of an adult's breast, which is measured at 1.4m above ground.