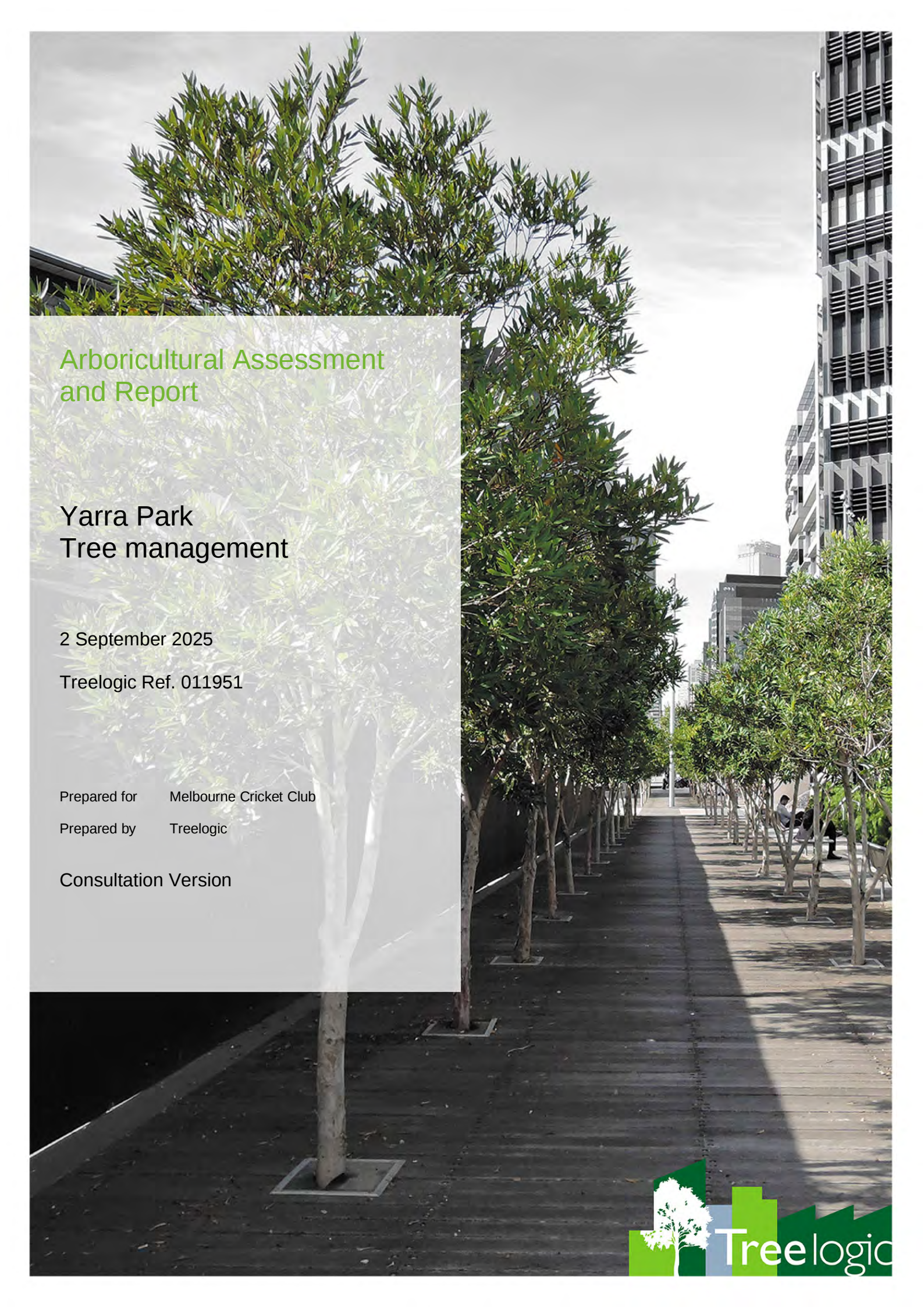




Arboricultural Assessment and Report

Yarra Park Tree management

2 September 2025

Treelogic Ref. 011951

Prepared for Melbourne Cricket Club

Prepared by Treelogic

Consultation Version

Contents

1. Yarra Park – Tree Management.....	1
i) Key points.....	1
2. Overview of existing trees	2
Tree regulations	4
3. Tree avenue renewal	5
i) Proposed tree avenue renewals	7
4. Tree risk – Yarra Park.....	10
i) Tree risk management programs	10
ii) Tree risk management recommendations	11
5. Proactive tree pruning program and other tree maintenance.....	11
i) Tree pruning considerations.....	12
ii) Pruning cycle.....	13
iii) Recommended existing tree works.....	14
iv) Recommendation for tree pruning programs.....	15
6. Tree selection considerations.....	16
i) Climate change and tree selection	16
ii) Tree selections for Yarra Park.....	17
7. Tree protection	24
8. Understorey planting	25
9. Tree Management and Replacement Strategy	27
10. References & bibliography	28
APPENDIX 1 – Proposed tree avenue renewal works.	30

1. Yarra Park – Tree Management

i) Key points

The trees within Yarra Park were reassessed in 2021 as a component of the development of the Yarra Park Master Plan. The assessment was undertaken in conjunction with data supplied by the current arboricultural contractor based on scheduled inspections. One thousand one hundred and forty-two (1,142) trees were assessed (there were 1,212 in 2012 and 1,230 trees in 2009).

The majority of the 1,142 trees within the park, in particular most of the treed avenues, are an aging population. Eighty-three percent of the tree population displayed fair (considered typical of the species) or better health. Whereas approximately 47% of the tree population displayed fair to poor or worse structure (various structural deficiencies).

As of 2018 (<https://discover.data.vic.gov.au/dataset/tree-cover>), the canopy coverage provided by all trees and shrubs in Yarra Park was 28.51%.

There are significant numbers of the elm trees (*Ulmus* spp.) within Yarra Park that are approximately 120 years of age. A reasonable useful life expectancy for most elm trees in Australia is 100 to 150 years (Spencer Hawker & Lumley, 1991). It is presumed that the majority of these trees will begin to decline over the next few decades.

As most of the trees are along avenues, which attracts the highest concentration of targets (people and vehicles), particularly during events, there is a heightened risk presented by the trees from possible failures.

In order to rejuvenate the treed avenues, 10 sections of Avenues and pathways have been identified for potential removal and replacement works.

At the time of the assessment, although tree maintenance works are in place, the trees were not being proactively managed. Tree works are currently undertaken in an *ad hoc*, reactive basis. COVID-19, which caused a suspension of tree works, and recent storm events have also impacted the ability to implement more scheduled, cyclic works.

The assessment identified 595 trees that require some form of maintenance over the next 2-years, work primarily comprise pruning and the removal of 56 trees due to poor health and/or structure (some of these tree removals fall within the nominated avenue renewal sections).

Due to the prominence of the park and the target rating and the associated duty of care, the trees must be visually assessed on an annual basis.

Scheduled work programs would be developed from the annual inspection. Other programs would include, formative pruning of recently planted trees, reactive maintenance due to storm events or damage and any approved removal and replacement program for aging/deteriorating treed avenues. There is an expectation that tree maintenance costs will decrease over time as the trees become actively managed.

Owing to the irrigation supplied to the landscape by the water recycling plant, the impacts to the trees from predicted climate changes, particularly expected extended dry periods, can be mitigated. The existing palette of tree taxa could be sustained with the aid of irrigation; however, some more climate-ready tree taxa have been recommended.

Existing maturing trees need to be protected during any proposed development or maintenance works within the park. The tree protection distances and methods outlined in Australian Standard AS 4970-2009 *Protection of trees on development sites*. (Reconfirmed 2020) must be applied.

2. Overview of existing trees

A review of the existing trees and associated data from the 2012 'Yarra Park - Tree assessment and tree management plan' took place over February 2022. The review assessment comprised a visual, ground-based arboricultural assessment of the tree population within Yarra Park. The updated data reflects the trees current condition and those trees removed and planted since the 2012 audit. The data also reflects the ongoing data updated by maintenance activities undertaken by the arboricultural contractor.

The area of Yarra Park is approximately 28 Hectares (280,000m²). As of 2018 (<https://discover.data.vic.gov.au/dataset/tree-cover>), the canopy coverage provided by all trees and shrubs in Yarra Park was 28.51%. Based on the Victorian Governments *Living Melbourne: our metropolitan urban forest* the proposed canopy coverage targets for the inner metropolitan region in 2040 is 23% and 28% in 2050. The City of Melbourne set a 40% canopy coverage by 2040 in its 2012 *Urban Forest Strategy*.

There are 1,142 trees comprising 64 different species and cultivars. A breakdown of the most common trees growing within the park can be seen in Table 1.

Table 1. List of the most common tree species and cultivars growing in Yarra park (>10 specimens).

Species	Number
<i>Ulmus procera</i> (English Elm)	418
<i>Eucalyptus camaldulensis</i> (River Red Gum)	110
<i>Corymbia citriodora</i> (Lemon-scented Gum)	53
<i>Ulmus x hollandica</i> (Dutch Elm)	48
<i>Platanus x acerifolia</i> (London Plane)	45
<i>Eucalyptus sideroxylon</i> (Red Ironbark)	42
<i>Corymbia maculata</i> (Spotted Gum)	34
<i>Ficus macrophylla</i> (Moreton Bay Fig)	29
<i>Eucalyptus melliodora</i> (Yellow Box)	28
<i>Acacia implexa</i> (Lightwood)	25
<i>Fraxinus angustifolia</i> (Narrow-leaved Ash)	25
<i>Acacia melanoxylon</i> (Blackwood)	24
<i>Quercus robur</i> (English Oak)	21
<i>Araucaria cunninghamii</i> (Hoop Pine)	21
<i>Phoenix canariensis</i> (Canary Island Date Palm)	18
<i>Eucalyptus cladocalyx</i> (Sugar Gum)	16
<i>Ulmus glabra</i> 'Lutescens' (Golden Elm)	16
<i>Eucalyptus polyanthemos</i> (red Box)	16
<i>Allocasuarina verticillata</i> (Drooping She-oak)	14
<i>Araucaria bidwillii</i> (Bunya Pine)	12
<i>Eucalyptus botryoides</i> (Southern Mahogany)	11
<i>Eucalyptus microcorys</i> (Tallowwood)	11

Exotic deciduous tree species, such as Elms (*Ulmus procera* and *U. x hollandica*), with 422 and 47 specimens respectively, and London Plane (*Platanus X acerifolia*), with 45 specimens, were the dominant trees used in the avenues.

Eucalypts dominated the specimen plantings in the open grassed areas. The most significant eucalypts, particularly in terms of conservation value, were the remnant River Red Gums (*Eucalyptus camaldulensis*) with 110 specimens. The significance of the River Red Gums also relates to the aboriginal heritage of the site with the three scar trees being testament to the Wurundjeri people of the Kulin nation as traditional custodians of the land.

Eucalypts, such as Lemon-scented Gum (*Corymbia citriodora*) along Pavilion Walk and the Red Ironbark (*Eucalyptus sideroxylon*) avenue leading to Gate 5, are being utilised in more contemporary avenue plantings.

Eighty-three percent of the tree population displayed fair (considered typical of the species) or better health. The high health rating could be attributable to the increase in irrigation over the last decade and a reduction in car parking, which reduces the potential for soil compaction.

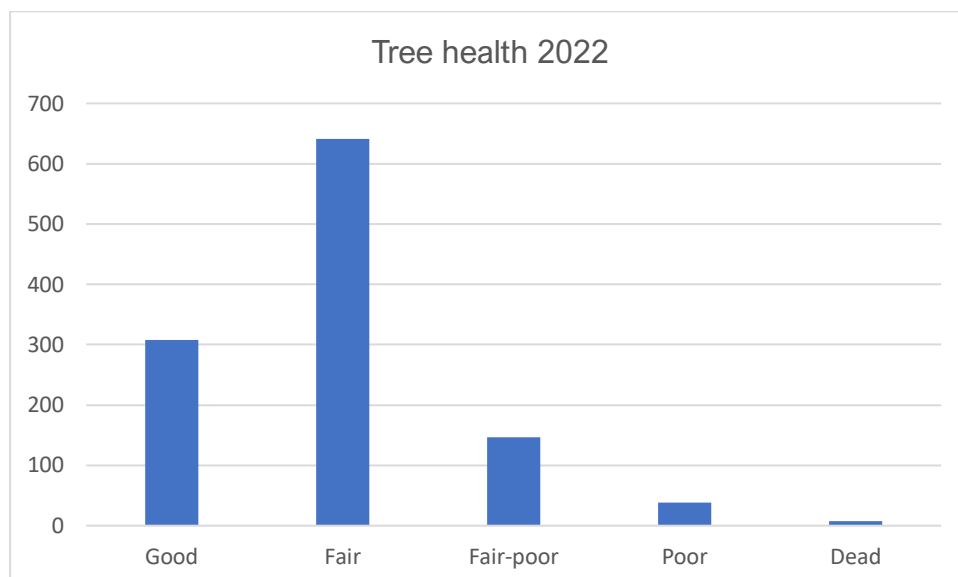


Figure 1. Health ratings of the assessed trees. Most trees are in fair or better health.

Whereas approximately 47% of the tree population displayed fair to poor or worse structure (comprising various structural deficiencies). A healthy tree is not necessarily a structurally sound one. With the best of intentions at the time, in hindsight, many of the elms have received poor pruning practices which has resulted in large wounds and decay and regrowth that is poorly attached.

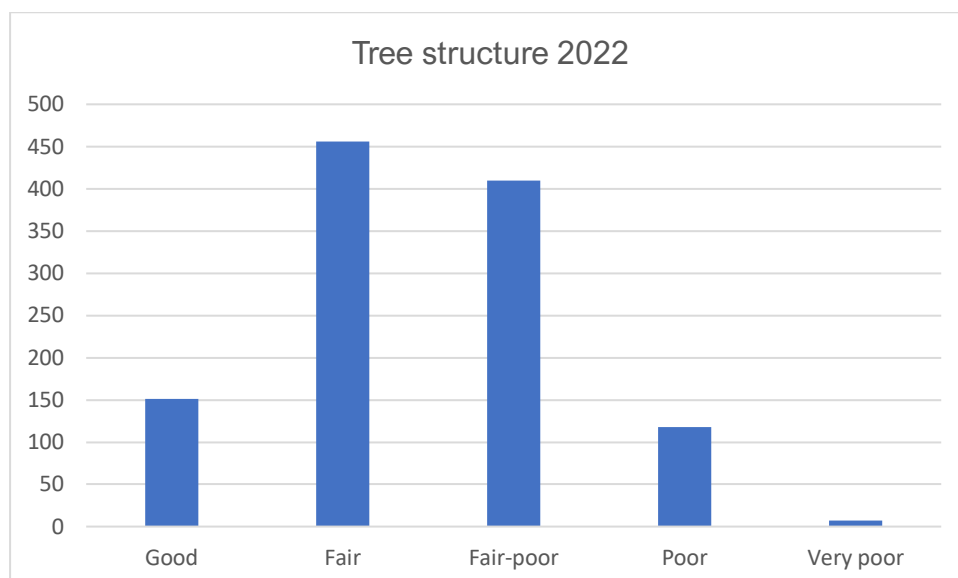


Figure 2. Structure ratings of the assessed trees. There is a higher percentage trees with some form of structural deficiency.

There are significant numbers of the elm trees (*Ulmus* spp.) within Yarra Park that are approximately 120 years of age. A reasonable useful life expectancy for most elm trees in Australia is 100 to 150 years (Spencer Hawker & Lumley, 1991). It is presumed that the majority of these trees will begin to decline over the next few decades.

As of 2018 (<https://discover.data.vic.gov.au/dataset/tree-cover>), the canopy coverage provided by all trees and shrubs in Yarra Park was 28.51%.

Tree regulations

The site is covered by the Melbourne Planning Scheme and is subject to Schedule 2 of the Environmental Significance Overlay (ESO2) Exceptional Trees. Specifically the 74 English Elm (*Ulmus procera*) along Queens Walk (Group 11 (G11): *Ulmus procera*, Yarra Park Brunton Avenue, East Melbourne). The River Red Gum (*Eucalyptus camaldulensis*) which is a living Scarred tree with Aboriginal significance. The location of the trees covered by ESO2 can be seen in Figure 3.

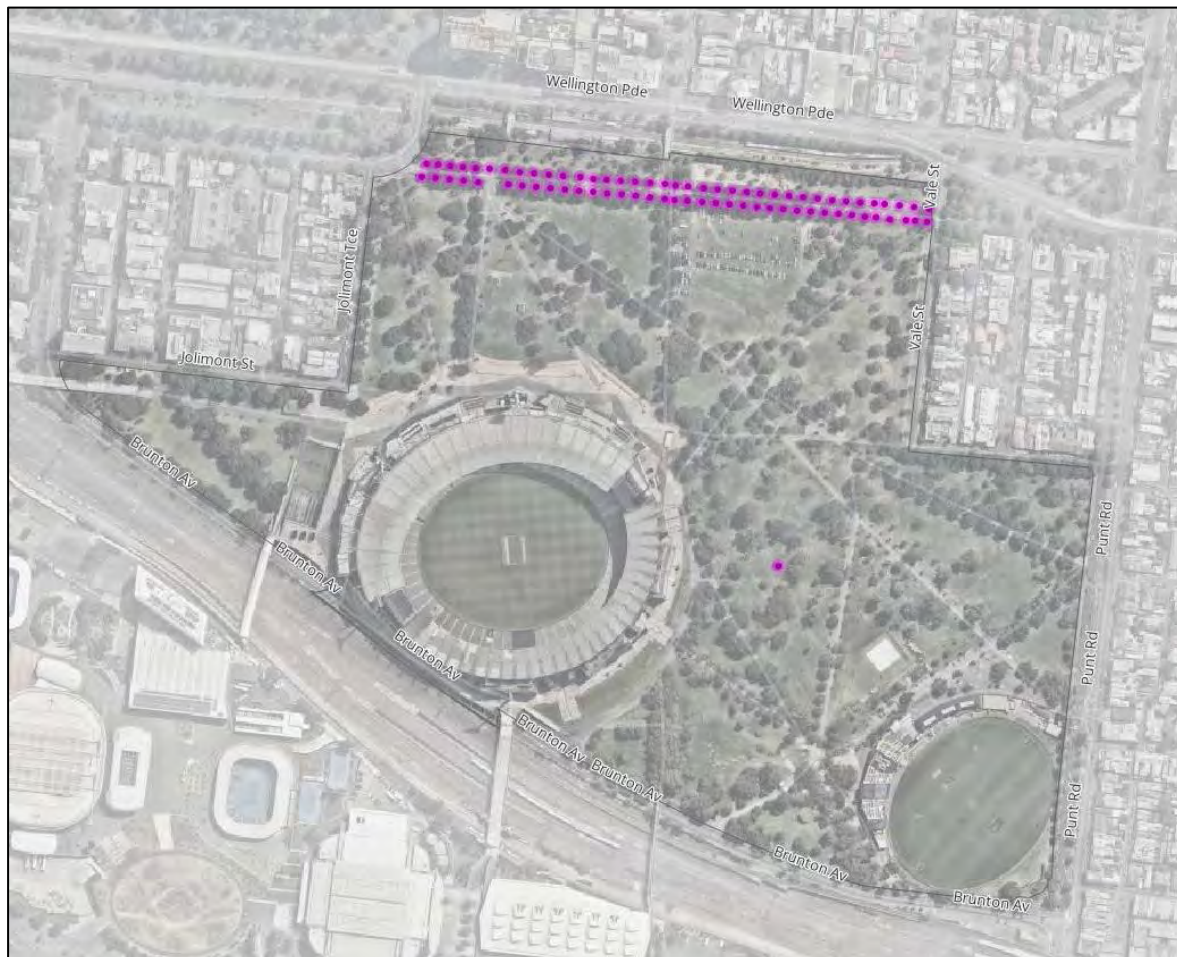


Figure 3 – shows the 74 trees in Queens Walk (ETR register No 175) and the Scar Tree (ETR tree 176).

Yarra Park is also listed on the Victorian Heritage Register (VHR) Number H2251 and Heritage Overlay Numbers HO194 (Melbourne Planning Scheme). There is a requirement for new or replacement planting that conserves the historic landscape character including specimen trees, avenues, rows, shrubberies, beds, and lawns. Management of trees must be in accordance with Australian Standard AS 4373 *Pruning of amenity trees*. Installation, removal or replacement of garden watering and drainage systems must be outside the canopy edge of significant trees.

3. Tree avenue renewal

The goal of the tree management is based on an understanding of the dynamic nature of the resource, its aesthetic and safety requirements, and public attitude and perception. To sustain the landscape and meet public needs, trees require to be planted, maintained and removed. Planning is required to facilitate each of the processes to the benefit of the landscape and public requirements.

The term 'avenue' can have broad applications, but in terms of treed avenues, it can generally be described as a regular and linear planting of trees whose grandeur often results from the overall uniformity of the trees, which give the impression of all having been planted at the same time with the same taxa. An avenue could comprise a single line of trees, but the popular perception is of a double row of trees.

Given the visually homogenous nature of an avenue, its integrity can be diminished if one or more trees decline or fail or when an avenue succumbs to old age.

The avenues within Yarra Park have historical significance and their ability to maintain that purpose needs to be conserved. The general management decision for avenue tree replacement has been to plant failed trees with new trees on an as need basis. Over time, this will result in uneven ages, dimensions and potential crown shapes within the avenue.

All avenues and stands of trees have a finite lifespan and at some point, trees need to be removed and replaced. As trees age, they require increasing management to maintain them in a safe and attractive condition. Hitchmough (1994) suggests that the aesthetic return of a tree in the landscape increases as it ages. It reaches a plateau for a period and then begins to fall away as a tree enters its decline phase. Conversely to this management costs increase as a tree ages as it requires more arboricultural input to maintain it in a safe, attractive manner (See Figure 4).

At some point a difficult decision must be made about how to manage mature avenues, including how, when and over what period to replace old or declining trees.

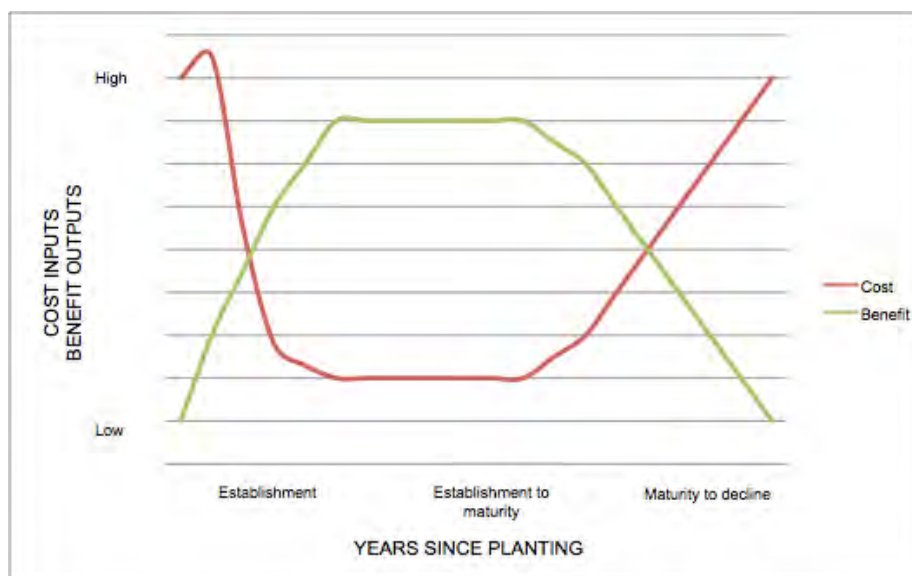


Figure 4. Relationship between time since planting and the aesthetic returns and management costs generated by a tree (from Hitchmough, 1994).

There are significant numbers of the elm trees within Yarra Park that are approximately 120 years of age. A reasonable useful life expectancy for most elm trees in Australia is 100 to 150 years (Spencer Hawker & Lumley, 1991). It is presumed that the majority of these trees will begin to decline over the next few decades.

It has been recommended that identified avenues requiring rejuvenation due to deteriorating trees be removed and replaced in sections. This is a common approach to significant avenues such as Hotham Walk in Fitzroy Gardens or the Ballarat Avenue of Honour.

Significant reductions of mature trees would not be generally considered as good practice or acceptable. It is also not good practice to artificially keep trees that are declining and are in a position that they are clearly unsuitable for or pose an unacceptable risk potential. A proactive approach to removal and replacement of these trees is required.

This report proposes sections of treed avenues for renewal. Recommendations for renewal sections are based on deteriorating tree condition (health and/or structure), or to reinforce already existing renewal programs. There are no specific timeframes listed for initiating the tree avenue renewal works.

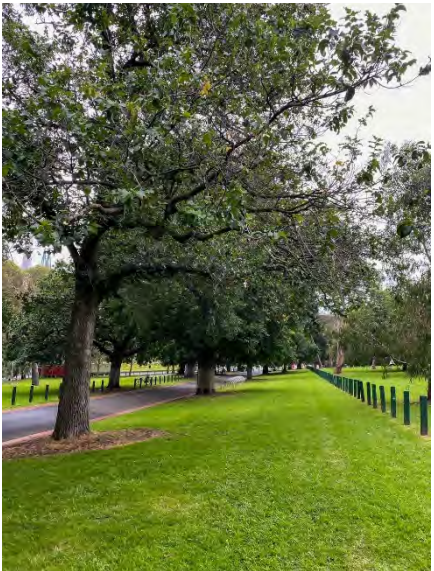
Queens Walk has two sections nominated for renewal works and has several trees with poor structure. A tree within the avenue failed from the root plate in 2021.

i) Proposed tree avenue renewals

Plans of proposed tree avenue renewal can be seen in Appendix 1.

Avenue	Section	Dominant species	Number of trees	Image
Queens Walk (two sections). Elms listed in ESO2 and subject to permit conditions.	Continuation west of recently replaced section (eastern extent) Next to Paddocks 17 & 18	English Elm Trees showing decline symptoms.	9 x elm Three other single elms along Queens Walk have been recommended for removal due to poor structure.	
	West of main N/S path (path from Light Tower 2 to Wellington Pde) to recently failed tree space. Next to Paddocks 20 & 22	English Elm Trees with poor structure and/or decline symptoms.	13 x elm Three other single elms are recommended for removal along Queens Walk due to poor structure (see Yarra Park renewal map in the appendix).	
Jolimont Street	Western extent (west of Gate 1), south side	English Elm and Camphor Laurel Decline symptoms and/or poor structure.	3 trees. 2 x elms and 1 x Camphor Laurel	
MCC Avenue	Western side – selected elms with structural defects	English Elm Primarily due to poor structure.	5 x elm	

Avenue	Section	Dominant species	Number of trees	Image
Olympic Promenade	Eastern side – remaining poorly pruned elms	English Elm. Poor structure (previously lopped). Continue to remove and replace with new elms.	4 x elms.	
Marathon Way	Between main N/S path and Police Paddock Lane. Next to Paddocks 16 & 17	1 x <i>Eucalyptus nicholii</i> (Willow-leaved Peppermint). Disjunct section of Marathon Way. Replace with English Elm to connect to east and western sections.	1 x Willow-leaved Peppermint	
Police Paddock Lane	Between Marathon Way & Queens Walk	<i>Fraxinus angustifolia</i> (Narrow-leaved Ash). Poor condition	15 x Narrow-leaved Ash. Could start at northern section.	
Main north-south path from Light tower 2 to Wellington Pde. (southern extent)	Southern section of main N/S path from Light Tower 2 to Marathon Way. Between Paddocks 16 & 19.	Elm species. Decline symptoms. Continue to remove older elms and replace.	3 x elms	
Marathon Way	Eastern Extent. Paddock 1. Near Gate 6.	English Elm. Overall poor condition)	5 x elms	

Avenue	Section	Dominant species	Number of trees	Image
AFL Way	From Brownlow Way to Brunton Avenue. Two sections; northern (towards MCG concourse) & southern (towards Punt Road oval)	Predominately Elms. Recommendation pending design to widen AFL Way as a main connector to Richmond Station	Northern TBD (Poss. 8 trees) Removal of selected trees on the northern side of the path next to Paddock 10. Replace with deciduous trees.	
			Southern TBD (Poss. 8 trees) Removal of selected trees on the southern side of the path (in granitic gravel path) next to Paddock 5. Reinforce eucalypts to connect to Ironbark path (Paddocks 6 & 9) Ability to plant new trees in open space to the north of the northern row in western section next to Paddock 10	
				

4. Tree risk – Yarra Park

Risk from trees, even in naturalistic urban landscapes, is typically very low and in most instances is no more than a routine and recognised risk of life, which most people accept without question (NTSG, 2011). Trees in the urban landscape provide many benefits and their importance is accepted. However, trees cannot be maintained free of risks.

Tree owners and managers have a duty of care to manage the risk from their trees. But that duty also says we should be reasonable, proportionate, and reasonably practicable when managing the risk. What this means is, there is a balance we need to strike between the many benefits trees provide, the risk from them, and the costs of managing the risk. By taking a balanced approach, tree managers and owners do not waste resources by reducing risk, while potentially losing the benefits, where the risk is already acceptable or tolerable (VALID, 2020).

Public safety is not the only concern when deciding how to manage trees. Other broader concerns, such as heritage, ecological, landscape, and aesthetic values are also taken into consideration.

The basic premise of risk management is that it is possible to establish a rational and cost-effective framework of activity in which risks are anticipated and actions taken to mitigate their effects so that risk is reduced to a tolerable or an acceptable level (this acceptable level is dependent on the level of risk acceptance by the organisation). We cannot eliminate all the risk posed by trees, there will always be residual risk after implementation of risk treatments. Some risk must be accepted in order to enjoy the many benefits that trees provide.

Risks that are not tolerable or acceptable are most probable where the likelihood of occupation is very high or high. This is further exacerbated by the presence of large or aging trees. Such high use zones are where management should focus its attention and resources.

Due to the unique factors present in urban areas (i.e. density of population, age of the landscapes) the proportion of high-risk zones based on target ratings and occupancy would be very high. Consequently, management focus needs to be astute and proactive.

Establishing scheduling of tree assessment and work programs would form the basis of a tree risk management program.

i) Tree risk management programs

The development of a tree risk management framework and associated processes is critical to a best practice tree management program, and it should form the basis from which all other tree management programs are established.

Tree risk management is the application of policies, procedures and practices used to identify, evaluate, mitigate, monitor, and communicate tree risk (Dunster, et al, 2017).

The risk management framework should include:

- An inventory of all the trees for which the MCC are responsible for within Yarra Park, identifying the species and its location.
- Categorisation of risk zones based on target ratings, tree species, tree condition and age, or formula combinations of these.
- A computer maintenance program that is linked to the inventory that records assessment and maintenance work details, including dates.
- A clearly documented procedure for inspection of trees detailing relevant information as to the location, species, size, health, and structure of trees within MCC's area of control, to identify specimens requiring further assessment.
- A documented system of logging complaints or notification of problems with respect to trees.

- A documented system for assessing the risk posed by trees identified and prioritising the risk posed by such trees.
- A documented system for addressing the risks posed through appropriate procedures, including dates for abating risks identified, consistent with the general financial constraints upon the authority having regard to its general responsibilities.
- A monitor and review cycle, to improve or modify where required.

Many of the above processes were also included in the recommendations from the coronial inquest (Court Reference: 2013 / 6032) into the death of four-year-old Patiya Schreiber killed by a falling tree branch in Bendigo's Rosalind Park in Central Victoria in December 2013.

In order to improve the current process of tree risk management within Yarra Park the MCC could refine their processes by:

- Setting cyclic inspection and maintenance priorities, and
- Developing a documented system for the assessing and prioritising of tree risk and mitigation works. This could include records being kept and maintained by the nominated contractor as well as within MCC's asset management systems.

Considering tree risk management as being fundamental for urban tree management, the following broad tree management principles should be incorporated into a comprehensive tree risk management framework.

- Properly maintained trees develop fewer hazardous defects and pose less risk to public safety. Any pruning is to be carried out in-line with standards and best practice, including a formative pruning program to enhance form and improve structure, or to directionally shape the young tree. Proactive, cyclic tree maintenance programs can improve the safety of the trees.
- Select appropriate species, suitable for site conditions and constraints. Allow adequate space for trees to attain expected mature size.
- Select good quality nursery stock (refer to *AS 2303-2018 Tree stock for landscape use*) and implement post-planting maintenance of trees to match site conditions.
- Undertake scheduled tree inspections by qualified, experienced arborist(s). Implement scheduled inspections. Establish level of risk assessment appropriate for tree resource and location.
- Implement appropriate tree protection during construction activities. Refer to Australian Standard AS 4970-2009 Protection of trees on development sites for guidelines.
- Maintain documentation on tree maintenance and inspection activities.

ii) Tree risk management recommendations

- Undertake annual visual assessment of all trees within Yarra Park under the MCC's management.
- Develop a proactive tree maintenance program based on the annual visual assessment. This may include tree removals.
- Document works to be undertaken and works completed.

5. Proactive tree pruning program and other tree maintenance

Avenue and urban landscape trees require an investment.

The long-term goal of urban tree management is sustainability, the maintenance of social, ecological, and economic functions for the duration of a tree's useful life.

While the Avenue trees provide numerous benefits, they also incur some costs. The most significant costs incurred include the initial tree purchase and establishment, ongoing maintenance pruning and the disposal of debris and branches and ultimately, tree removal.

Maintenance-related direct costs begin at the time of planting and continue throughout a tree's useful life through to the time of removal. Maintenance costs vary throughout a tree's lifetime and by species and location (Vogt, Hauer & Fischer, 2015). Tree pruning is typically the most expensive maintenance item (20-30%) in a tree budget (Kielbaso et al. 1982; Kielbaso, 1990; Hauer, et. al. 2015).

However, even though tree pruning typically receives the greatest budget allocation of all urban tree maintenance activities, it is still often underfunded in comparison to needs (Vogt, Hauer, & Fischer, 2015). For this reason, efficient allocation of resources for pruning is important (Vogt, Hauer, & Fischer, 2015). The challenge is to capitalise on worker productivity by developing standards for different operations and collecting data that can be used to make appropriate and timely management decisions.

Tree survival, growth, and condition are closely connected to one another and to the sustainability of the tree and the composition of the avenue. Thriving trees affect the sustainability and function of the avenues and ultimately the level of benefits generated. Conversely, less-than optimal maintenance may lead to decreased benefits produced by the Avenue trees (Vogt, Hauer & Fischer, 2015).

i) Tree pruning considerations

In order to obtain maximum benefits from urban trees, it is essential for tree managers to properly maintain trees. Tree pruning is beneficial for the trees and for the city (or park, landscape, facility, etc) itself.

Having continuous good pruning practices increases the lifespan of the tree and allows for the correction of future problems. The landscape management also benefits from proactive tree pruning cycles because it can decrease the overall cost of maintaining trees. By working proactively rather than reactively, it is possible to cut some of the costs of replanting, removals, and general tree maintenance activities.

When done well, pruning can be very beneficial to trees. When started at an early age, tree pruning can ensure the development of good structure, branch architecture and form that assists the tree to functionally perform in its given location. Pruning helps to remove injured, wounded, crossing, dead, or broken branches that can lead to failure or be conduits for infection by fungi and insect pests (Hannusch, 2021).

Overall, regular pruning over the life of a tree can significantly enhance its health and thus its lifespan (Ryder and Moore, 2013).

Of all urban tree maintenance activities, pruning is the most essential for long-term tree safety and survival (Miller, Hauer & Werner, 2015). Pruning extends the functional benefits derived from trees and maintains amenity. Properly maintained trees develop fewer hazardous defects and pose less risk to public safety. Cyclic pruning programs allows tree crews to inspect all trees on a regular basis, which is an important risk management consideration.

Any pruning is to be carried out in-line with standards and best practice, including a formative pruning program to enhance form and improve structure, or to directionally shape the young tree.

A good pruning program can:

- Enhance the safety of the trees and the environment they reside in

- Direct growth appropriate for the site constraints
- Improve the health of the urban forest
- Reduce premature tree removals
- Lower the overall costs and increase the benefits of the urban forest and associate maintenance programs by getting the maximum useful lifespan out of each tree.

To ensure that pruning is appropriate for the species and tree/site conditions, it is important to have a clear understanding of the specific needs of the tree and the objectives for pruning.

Pruning objectives include the following:

- Improve structural strength and reduce failure potential (including dead branch removal)
- Improve aesthetic characteristics
- Provide clearance for pedestrians, vehicles, overhead services and structures
- Improve safety (visibility) and security for road users
- Repair structural damage from wind loading
- Reduce maintenance costs (i.e., when applied to young trees)
- Prevent or mitigate a pest problem.

ii) Pruning cycle

The length of pruning cycles varies widely and is dependent on species (genetic and age diversity), climatic variations, available resources, workloads, and objectives. There is no one optimum pruning cycle that caters for all urban landscape areas. However, what is clear, is that systematic or cyclic pruning programs, particularly initiated early in the life of a tree, enhances tree health and structural condition (Matheny & Clark, 2008).

The annual visual assessment of all trees within Yarra Park under the MCC's management will usually generate the pruning cycle for the next 12-months. Tree maintenance staff would determine from the ground what limbs need to be removed to meet the objectives of the pruning program, achieve or enhance a tree's structural integrity, appearance, or desired size. The visual risk assessment and development of works program will identify individual trees requiring works.

There may be other times when the pruning of all trees within an avenue for crown maintenance (deadwood, diseased branches) or crown modification (to meet clearance requirements) may be necessary.

Reactive pruning and other works will also be required to attend to any damaged trees, such as via a storm event.

A major concern to introducing a cyclical tree pruning program is the upfront cost of running the program. This study (Miller & Sylvester, 1981) found a significant correlation between a decrease in tree condition class and the number of years since pruning. Increasing the length of the pruning cycle, or the number of years between pruning events, is a way to reduce pruning costs up front. In the short term, deferring the cost of pruning solves the immediate problem of a limited budget. However, future costs will likely be greater from increased responses to park user requests, storm damage susceptibility, tree risk from deadwood, and development of poor structure that may require excessive pruning to rectify in mature trees. Structural defects, such as decay, poor branch attachments, deadwood, and cracked branches, become more frequent as the numbers of years since last pruned increases (Vogt, Hauer, & Fischer, 2015).

Deferring maintenance on younger trees would have long-term cost ramifications. According to Ryder and Moore (2013) formative pruning costs averaged \$2.79 per tree, while structural pruning for a mature tree averaged \$44.59 (Ryder and Moore 2013). By applying inflation rates of 3%–5%, the authors calculated that trees not formatively pruned today would cost \$78 to \$112 to structurally prune in 20 years (Ryder and Moore 2013). Therefore, the cost of not performing formative pruning on recently planted trees can be calculated as the difference between the costs of formative pruning plus normal structural pruning (~\$48) and structural pruning for non-formatively pruned trees (\$78–\$112), or between \$30 and \$64.

There could be two separate tree pruning programs; one for younger, smaller trees that primarily concentrates on formative/structural pruning to develop good branch architecture and to shape trees to desired clearances, and an annual program generated from the annual visual inspection for specific pruning requirements for all trees within a given area/zone could be undertaken during the scheduled pruning program.

As a general guideline, structural (or formative) pruning of newly-planted trees should be done twice within the first ten years to develop an appropriate form of the tree. For mature trees, other than works ascertained during the annual inspection, routine pruning can occur every five years or so afterwards to keep the crown of the tree in a healthy and structurally sound state.

Using contractors can improve flexibility and efficiency of tree care operations. A key to successful incorporation of private contractors is developing definitive specifications that are inspected for compliance and enforced by tree managers (Vogt, Hauer, & Fischer, 2015).

Funding will still be required for reactive pruning works such as request, emergency and storm event pruning. If a scheduled pruning program is implemented, then the costs of reactive pruning should decrease over time as pruning cycles are completed.

iii) Recommended existing tree works

At the time of the assessment, although tree maintenance works are in place, the trees were not being proactively managed. Tree works are currently undertaken on a reactive basis. COVID-19, which resulted in a suspension of tree maintenance works resulting in a backlog of work, and recent storm events have also impacted the ability to implement more scheduled, cyclic works.

The 2022 assessment identified 595 trees that require some form of maintenance over the next 2-years. Recommended tree works primarily comprise pruning and the removal of 56 trees due to poor health and/or structure (some of these tree removals fall within the nominated avenue renewal sections).

Table 2 outlines the priority for nominated works.

Priority	Number
<6 mths	11
<1 yr	213
<2 yrs	370

A spreadsheet of the tree assessment and recommended works will be forwarded to MCC.

iv) Recommendation for tree pruning programs

- Review budget allocation to ensure resources are aligned to tree maintenance requirements.
- Develop a proactive tree maintenance program based on the annual visual assessment. This may include tree removals.
- Undertake scheduled pruning programs for:
 - i) Young trees. Structural or formative pruning program undertaken in years 2, 4 and 6 after planting
 - ii) Mature trees. Undertake tree maintenance pruning to remove major deadwood (>25mm Ø), broken, or diseased branches. Maintain appropriate clearances for vehicle and pedestrian access and around lights and other infrastructure. Yarra Park could be broken up into zones (suggest three) to normalise budget

6. Tree selection considerations

i) Climate change and tree selection

The increased frequency and duration of water stress conditions and dealing with higher temperatures appear to be determinant factors for plant performance under climate change scenarios.

Water, temperature, and nitrogen are usually the most limiting environmental factors for plant growth. Temperature is often identified as a key factor with regard to the performance of trees in urban environments (Jenerette et al., 2016; Kendal et al., 2018; Burley, et. al., 2019). Where temperature and nutrients are optimal, the quantity and quality of growth depends primarily on water supply. Water is the single most limiting essential resource for tree survival and growth. Water shortages severely damage young and old trees alike and predispose healthy trees for other problems. Prolonged drought conditions can lead to tree decline, inciting pest problems, and non-recoverable damage.

Irrigation provided to the Yarra Park landscape from the Yarra Park Water Recycling Facility will provide a sustainable water supply for the future maintenance and upkeep of the park and the trees and will help offset the effects of climate change, in particular reduced rainfall. This will mitigate the impacts of climate change on the trees, particularly reduced rainfall, increased temperatures and more extreme heat days.

Yarra Park's landscape character is primarily defined by a series of long, straight pathways bordered by avenues of trees. These pathways frame open, spacious lawns.

Yarra Park is dominated by avenues of deciduous trees (predominately English Elm, *Ulmus procera*), with eucalyptus, figs and conifers used as specimen plantings in the adjacent grassed areas. The avenue trees provide seasonal variation and change to the character of the open spaces with cool green canopies in the warmer months and a distinctly yellow-gold coloration in autumn.

The range of species is typical of parks in Melbourne planted in the 19th century, except for the relatively strong visual impact of eucalypts and conifers and the inclusion of a few specimen species such as Tallow-wood (*Eucalyptus microcorys*) that are not found in the other parks.

The following tree selections take into consideration complementing or enhancing the pervading landscape character of Yarra Park, ability to grow in the

The list is not exhaustive nor definitive and is not reflective of the total tree diversity existing in Yarra park.

ii) Tree selections for Yarra Park

Avenue trees

Name: English Elm (*Ulmus procera*)

Height: 15-25 metres

Width: 12-20 metres

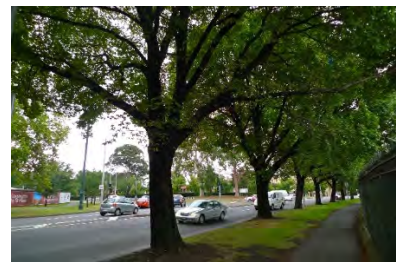
Description:

A compact densely branched tree with an ovoid to broad crown. Rounded, dark green, serrate leaves of varying sizes, turning yellow in autumn (typically, smaller more rounded leaves than Dutch Elm). The flowers are insignificant; the fruit are rounded samaras that are rarely fertile; and the bark of the trunk and large branches is deeply ridged with vertical fissures. This tree can sucker from the roots when disturbed by cultivation.

Tolerates a wide range of soil conditions including both well drained and clay soils. Best in fertile, moist, well-drained soil. Requires regular irrigation during establishment period and during drought but avoid water logging.

An adaptable species often planted as shade, specimen or avenue tree in urban areas. Prone to attack by Elm Leaf Beetle in areas where pest is present. May require formative pruning in early stages of development and weight reduction of outer canopy during maturity.

Currently the most common avenue tree in Yarra Park.



Name: Lemon-scented Gum (*Corymbia citriodora*)

Height: 15-20 metres

Width: 10-15 metres

Description:

Corymbia citriodora grows on undulating country in open forests and woodlands, on dry ridges and plateaux of coastal sub-tropical Queensland.

A narrow- to broad-domed, canopy. Smooth trunk can vary grey to pale grey, light pink or beige rarely white in Victoria. It sheds bark in thin curly flakes in spring through to early summer. Fresh green foliage that has a distinctive citrus smell. Terminal, clustered small white flowers.

Formative pruning is required. Older, larger specimens can shed limbs. Adaptable species that grows in a range of soils. Requires space to take full advantage of its beautiful form.

Used as avenue and specimen plantings in Yarra Park.



Name: Scentuous Lemon-scented Gum (*Corymbia citriodora* 'Scentuous')

Height: 6-8 metres

Width: 3-4 metres

Description:

Small to medium evergreen tree with aromatic narrow lanceolate foliage. Smooth white to pinky salmon bark. White/cream flowers in summer.

Adaptable tree that grows in a range of soils and grows rapidly with or without moisture. Prefers well-drained soils in full sun position. Has moderate to high drought tolerance.

Plants grafted onto specially selected rootstock ensures viability for growing in a wide range of soil types, improves disease resistance, guarantees flower colour and limits mature size.

Care must be taken to remove all growth below the graft union, or these shoots will grow through the grafted canopy and eventually overrun your plant.

This cultivar should be used instead of the larger species of *Corymbia citriodora* where space restrictions are present.



Name: Red Stringybark (*Eucalyptus nidroxyzones*)

Height: 18-25 metres

Width: 12-18 metres

Description:

Narrow tending to spread into a rounded open crown with age. Dark rough bark hard and furrowed which is typical of Ironbark's. The bark is persistent and deep brown to black in colour. The foliage is dull, greyish-green to blue-green in colour. White or pink flowers in winter/spring. Species adaptable to a wide range of soil conditions, from heavy clay to sand. Tolerates alkaline soils and poor, shallow soils, typical of its natural range. Prefers well-drained soils, no tolerant of waterlogged soils. High drought tolerance.

Currently used as an avenue and specimen tree in Yarra park.



Name: Canary Island Date Palm (*Phoenix canariensis*)

Height: 8-15 metres

Width: 8 metres

Description:

A medium sized palm with large deep green fronds with extremely sharp spines at the bases. The species is dioecious, with separate male and female trees. The fruit are orange, 2 cm long and 1 cm diameter, with a large seed. They are produced on long, densely branched panicles. Thick dull brown trunk, marked with broad, diamond-shaped leaf base scars. Canary Island Date Palm is adapted to more habitats and soils than almost any other palm. Suited to cooler climates. Best in Mediterranean climates. It can tolerate a wide range of exposures, including deep shade, and a wide range of soil types, including sand and heavy clay. It has a unique ability to tolerate both severe drought and waterlogged soil conditions.

Used along Vale Street to the north-east.



Alternative Avenue trees

Name: European Nettle Tree (*Celtis australis*)

Height: 10-15 metres

Width: 6-12 metres

Description:

Smooth grey bark. Alternating leaves are narrow and sharp-toothed on margins. Dark green and rough above, pubescent, grey-green below. Foliage turns yellow in autumn. Small, green flowers, either singly or in small clusters followed by a small, dark-purple berry-like drupe. Adapts to most soils. Prefers light well-drained, sandy, and loamy soils, including those nutritionally poor; it can tolerate drought but not shade. A tree with high tolerance of drought and heat. Although not as large as the English Elm, it could be considered as an alternative avenue tree due to its tolerances and pest resistance.



Name: Cimmarron Green Ash (*Fraxinus pennsylvanica* 'Cimmzam' Cimmarron™)

Height: 12-18 metres

Width: 8-12 metres

Description:

Pyramidal (while young), narrow domed to rounded tree with dense, lustrous foliage, which turns burgundy to red in autumn, which it can hold well into autumn. Attractive dark grey bark which becomes deeply furrowed. Reportedly seedless variety.

An impressive, ornamental feature tree which provides great summer shade and is capable of withstanding relatively extreme climatic conditions, being tolerant of frost as well as drought.

Suitable for a range of conditions, including clay and compacted soils. Transplants readily.

Potential for use in new avenues (or as a replacement for ash in Police Paddock Lane)



Name: Urbanite Green Ash (*Fraxinus pennsylvanica* 'Urbdel' Urbanite™)

Height: 12-18 metres

Width: 8-10 metres

Description:

Broadly conical to narrow-domed crown with strong branch architecture and little-to-no seed set. Dense, lustrous foliage turns pale yellow to deep bronze in autumn. Attractive dark grey-brown bark which becomes deeply furrowed as it matures.

Prefers well-drained, moist soils, however, it is very adaptable to poor soils, rocky soils, various soil pHs, compacted soils, wet sites, dry sites, pollution, and salt spray; an extremely urban tolerant cultivar (as the cultivar name suggest). Transplants readily.

Potential for use in new avenues (or as a replacement for ash in Police Paddock Lane).



Name: Willow Oak (*Quercus phellos*)

Height: 20-25 metres

Width: 15-20 metres

Description:

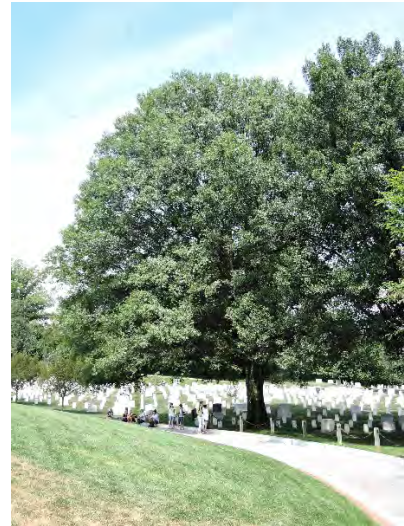
Medium to large, deciduous tree of the red oak group with an oval to rounded crown that is noted for its willow-like leaves. Pyramidal form when young.

Smooth-edged, bristle-tipped, narrow, green willow-like leaves that turn a yellow-brown or dull gold in autumn. Dark grey to grey-brown, irregularly-furrowed bark.

Prefers moist well-drained loams but adapts to a wide range of soil conditions including clays with somewhat poor drainage.

Species well adapted to urban conditions. Moderate tolerance of waterlogged conditions. Moderate to high drought tolerance. Generally tolerant of urban pollution. Generally considered to have good resistance to pests and to be a low-maintenance, long-lived tree.

Strongly recommended for new avenues or as a specimen tree.



Name: Algerian Oak (*Quercus canariensis*)

Height: 18-25 metres

Width: 12-30 metres

Description:

Algerian Oak is tree growing broader than tall with a dense canopy of large, shallow-lobed leaves and dark brown bark. Tree is frequently evergreen but can also be semi-deciduous to fully-deciduous (marcescent). The large, shallow lobed green leaves turning yellow-brown in autumn.

Algerian Oak is more tolerant of dry skeletal soils than other Oak species. Prefers well-drained soils. Adapts to most soils, even heavy clays; grows in soils ranging from a pH of 4.5 (extremely acidic ranges from 0 to 5.1) to 7.5 (neutral ranges from 6.6 to 7.5). It is adapted to calcareous, clay, clay loam, sandy clay loam and sandy loam soils, and prefers medium fertility. Tree can withstand periods of drought. One of the best exotic trees to grow in dry climates on a range of soil types. Great shade tree. Only limited in its use by its ultimate size. Long-lived tree with good tolerances, particularly drought and clay soils, suggest that this oak should be more widely used in urban landscapes.

If space permits, it can be an impressive, long-lived shade tree for the urban landscape.

Easy to transplant.

Use as an avenue and specimen tree.



Name: Allee Chinese Elm (*Ulmus parvifolia* 'Emer II' Allee)

Height: 12-15 metres

Width: 8-12 metres

Description:

Vase-shaped to broad domed tree with ascending branches. Small, glossy, dark green leaves. Orange-brown flaking bark.

Adaptable to most soils and can cope with extreme conditions. Tolerates compaction and a restricted root zone.

Good avenue tree.

Could also use the cultivars:

Ulmus parvifolia 'Todd'.

Ulmus parvifolia 'Burnley Select'.

Could be used as an alternative to English Elm in the development of new avenues. Chinese elm is resistant to elm leaf beetle infestation.



Name: Turkey Oak (*Quercus cerris*)

Height: 15-20 metres

Width: 15-20 metres

Description:

Slender while young, it usually develops a broad pyramidal form with age.

Narrow, oval or oblong deep pointed lobed dark-green leaves. Leaves remain on the tree into late autumn, usually developing little autumn colour. The acorns are up to 4cm long, and the cups covered in bristly-fringed scales. Attractive, ridged bark. Flowers inconspicuous.

Adapts to most soil textures, from slightly alkaline to acidic, prefers well drained. Tolerant of drought and temporary inundation.



Specimen trees

Name: Hoop Pine (*Araucaria cunninghamii*)

Height: 20-30 metres

Width: 10-18 metres

Description:

Large symmetrical, cone-shaped tree that grows up to 60 m in height and gets its common name from the outer layer of bark which forms scale-like horizontal hoops.

Bark rough, in horizontal bands, exfoliating in fine circular bands.

Branches long, branchlets in tufts at the ends.

Hoop Pine is an adaptable tree that is capable of growing on a variety of soils provided the annual rainfall exceeds 750mm. It is a slow-growing tree that can live for up to 450 years.

Currently used as a specimen tree in Yarra Park.

Could also use *Araucaria bidwillii* (Bunya Pine).



Name: River Red Gum (*Eucalyptus camaldulensis*)

Height: 18-25 metres

Width: 12-18 metres

Description:

Large, broad-domed tree on a solitary trunk. Attractive smooth white, cream and pale grey bark. White flowers summer. Extensive on grey heavy clay soils along riverbanks and on floodplains subject to frequent or periodic flooding. Grows in a range of soils. Moderate drought tolerance and high tolerance of waterlogged soils (temporary inundation). Endemic to area.

Important remnant tree to Yarra Park



Name: Yellow Box (*Eucalyptus melliodora*)

Height: 18-25 metres

Width: 12-18 metres

Description:

Large narrow-domed tree, with ascending branches on a solitary trunk. Box like bark can vary from smooth to rough all the way down the trunk often in different colourings from grey, yellow to brown. Sometimes very dark and rough. Light green to grey or bluish, narrow foliage. White flowers in spring to summer.

Adaptable to a range of soils, including heavy clay. Prefers well-drained, not tolerant of waterlogged soils. Species usually found on lower slopes and plains, on sandy or loamy alluvial soils. High drought tolerance. Common species in the grassy woodlands of the tablelands and western slopes of the Great Dividing Range.

Currently used as a specimen tree in Yarra Park.



Name: Port Jackson Fig, Rusty Fig (*Ficus rubiginosa*)

Height: 10-15 metres

Width: 10-18 metres

Description:

Medium to large broad-domed tree. Dense canopy on stout trunk often buttressed at the base. Leaves are thick and tough, upper surface hairless, lower surface brownish or rusty hairy, sometimes becoming almost hairless. Figs usually paired, yellow turning red, usually prominently warty, more or less round, 7–20 mm in diameter, on stalks. The bark remains smooth and is a yellow-brown in colour.

Prefers relatively fertile, well-drained soil but can adapt to a wide range of soil textures. Tolerant of acid or alkaline soils. Port Jackson Fig has been successfully grown in urban landscapes where air pollution, poor drainage, compacted soil, and/or drought are common.

Used as a specimen tree in Yarra Park.

Could also use the larger:

Moreton Bay Fig (*Ficus macrophylla*).



Name: Scarlet Oak (*Quercus coccinea*)

Height: 15-20 metres

Width: 12-15 metres

Description:

Scarlet Oak has a pyramidal crown while young forming a broad crown with branches growing horizontally. In the autumn the leaves turn a deep scarlet red. Once they have become brown, they remain on the tree until halfway through the winter. Adapts to a range of well-drained soil types, from rocky to sandy to clay-based. Established trees have high heat and drought tolerances. Low flammability. Similar to *Q. palustris* but with better branching structure, particularly lower branches.



This tree species library has been compiled by Tree Logic for the sole purpose and use of MCC. Images are owned by Tree Logic, unless otherwise indicated, and not to be used for any other purpose than that intended under the Yarra Park master plan and associated programs.

7. Tree protection

The Australian Standard AS 4970-2035 *Protection of Trees on Development Sites* must be used as a guide in the allocation of Notional Root Zones (NRZs) for the trees within Yarra Park and this method is also included in Schedule 2 to the Environmental Significance Overlay (ESO2) of the Melbourne Planning Scheme (the elms in Queens Walk are included in ESO2). The TPZ for individual trees is calculated based on trunk (stem) diameter measured in metres at standard height of 1.4 metres from ground level (DSH). The radius of the NRZ is calculated by multiplying the trees DSH by 12. The maximum NRZ should be no more than 15 m radius and the minimum NRZ should be no less than 2 m radius.

The method provides a NRZ that addresses both the stability and growing requirements of a tree. NRZ distances are measured as a radius from the centre of the trunk at (or near) ground level.

Encroachment into the NRZ is permissible under certain circumstances though is dependent on both site conditions and tree characteristics. Minor encroachment, up to 10% of the NRZ area, is generally permissible. Ideally, this loss of area should be compensated for by recruitment of an equal area contiguous with the NRZ. The 10% encroachment on one side only equates to a reduction of approximately $\frac{1}{3}$ radial distance. Examples are provided in Figure 5. Encroachment greater than 10% is considered Moderate or Major encroachment under AS4970-2025 and is only permissible if it can be demonstrated that after such encroachment the tree would remain viable.

Tree root growth is opportunistic and occurs where the essentials to life (primarily air and water) are present. Heterogeneous soil conditions, existing barriers, hard surfaces and buildings may have inhibited the development of a symmetrically radiating root system. Existing infrastructure around some trees may be within the NRZ or root plate radius. The roots of some trees may have grown in response to the site conditions and therefore if existing hard surfaces and building alignments are utilised in new designs the impacts on the trees should be minimal.

Any deviation or major encroachment into the NRZ should take account of the following factors whilst still providing adequate protection for the root system:

- a) the morphology and disposition of the roots, when influenced by past or existing site conditions (e.g. the presence of roads, structures and underground apparatus).
- b) topography and drainage.
- c) the soil type and structure.

the likely tolerance of the tree to root disturbance or damage, based on factors such as species, age, condition and past management.

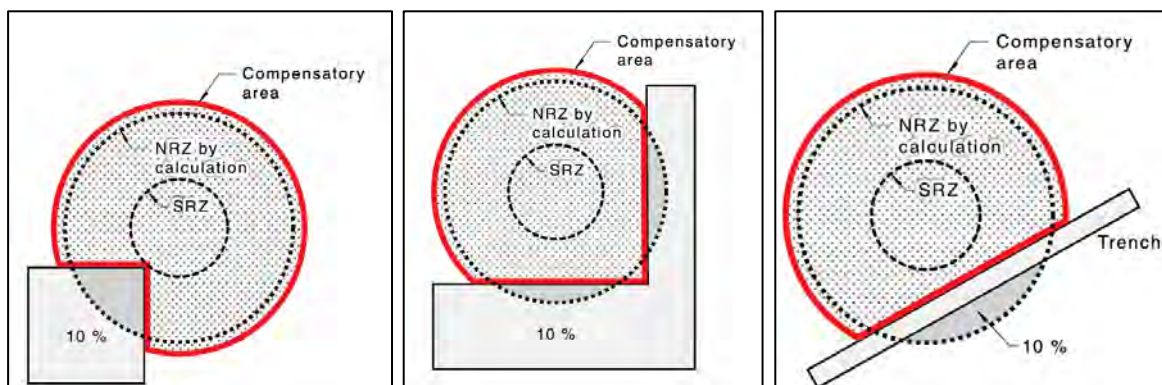


Figure 5. Examples of minor encroachment into a NRZ. Extract from: AS4970-2025, p13

The most reliable way to estimate root disturbance is to find out where the roots are in relation to the demolition, excavation or construction works that will take place (Matheny & Clark, 1998).

If major encroachment (>10% of total NRZ area) is to occur, then non-destructive exploratory excavation prior to commencement of construction can help establish the extent of the root system and where it may be appropriate to excavate or build.

The tree protection zone should also consider the canopy and overall form of the tree. If the canopy requires severe pruning to accommodate a building and in the process the form of the tree is diminished, it may be worthwhile considering altering the design or removing the tree.

Implement tree sensitive design principles to protect existing and new trees – tree sensitive design is site responsive design. Implement best practice guidance for the design, placement and installation of tree root sensitive infrastructure.

Any proposed encroachment into the NRZ of a retained tree must be inspected and assessed by an arborist to determine the tolerance levels and specific needs of the given tree species, and to assist with the development of strategies for ongoing tree viability and safety.

Structural Root Zone (SRZ)

A Structural Root Zone (SRZ) comprises the area around the base of a tree where structural roots required to maintain the tree's stability in the ground are typically located. The SRZ is calculated using the formula provided in AS4970-2025.

According to AS 4970 the SRZ is "The area around the base of a tree required for the tree's stability in the ground. The woody root growth and soil cohesion in this area are necessary to hold the tree upright. The SRZ is nominally circular with the trunk at its centre and is expressed as a radius in metres."

The SRZ for trees with trunk diameters less than 0.15 metres will be 1.5 metres.

It is important to note that the SRZ relates to a tree's structural stability only, it does not include the absorbing root system involved with maintaining the tree's vigour and long-term viability.

8. Understorey planting.

There are many benefits that can be derived from introducing indigenous understorey plantings that compliment the existing native trees in the park. Introducing understorey plants can assist in

- defining and restricting access within the tree protection zone,
- providing another layer of texture, colour and interest that is often closer to eye level than the tree canopy,
- attracting native birds, insects and beneficial mycorrhizae that can improve tree health and reduce some pest infestations,
- can more readily intercept rainfall runoff and hold soil moisture levels around the tree root zone
- and provide information and inspiration to site visitors about the attraction and benefits of using locally native plants and trees in the urban gardens and landscapes.

A number of discreet areas within the park where native trees already exist have been identified around the park that would be suitable for and enhanced by the introduction of more native shade trees and native understorey plantings. Each discreet site ranges between 110 square metres to 1,100 square metres with a total area of approximately 1.1 hectares across the park.

These areas would allow for many thousands on new plantings including small understorey trees, shrubs, groundcovers and grasses.

Refer to Figure 6 (overpage) for possible sitings of indigenous under-story plantings.

Understorey plantings would include

- Native grasses, tussocks and rushes such as *Dianella* spp, *Lomandra* spp, *Poa*, spp. *Stipa* and *Themedia* spp.
- Groundcovers such as *Atriplex* spp, *Brachiscome* spp, *Goodenia* spp, *Helichrysum* spp,
- Shrubs such as *Allocasuarina littoralis*, *Acacia acinacea*, *Acacia myrtifolia*, *Bursaria spinulosa*, *Banksia spinosa*, *Banksia marginata*, *Olearia* spp. *Pomaderris racemosa*, *Pultanea* spp.

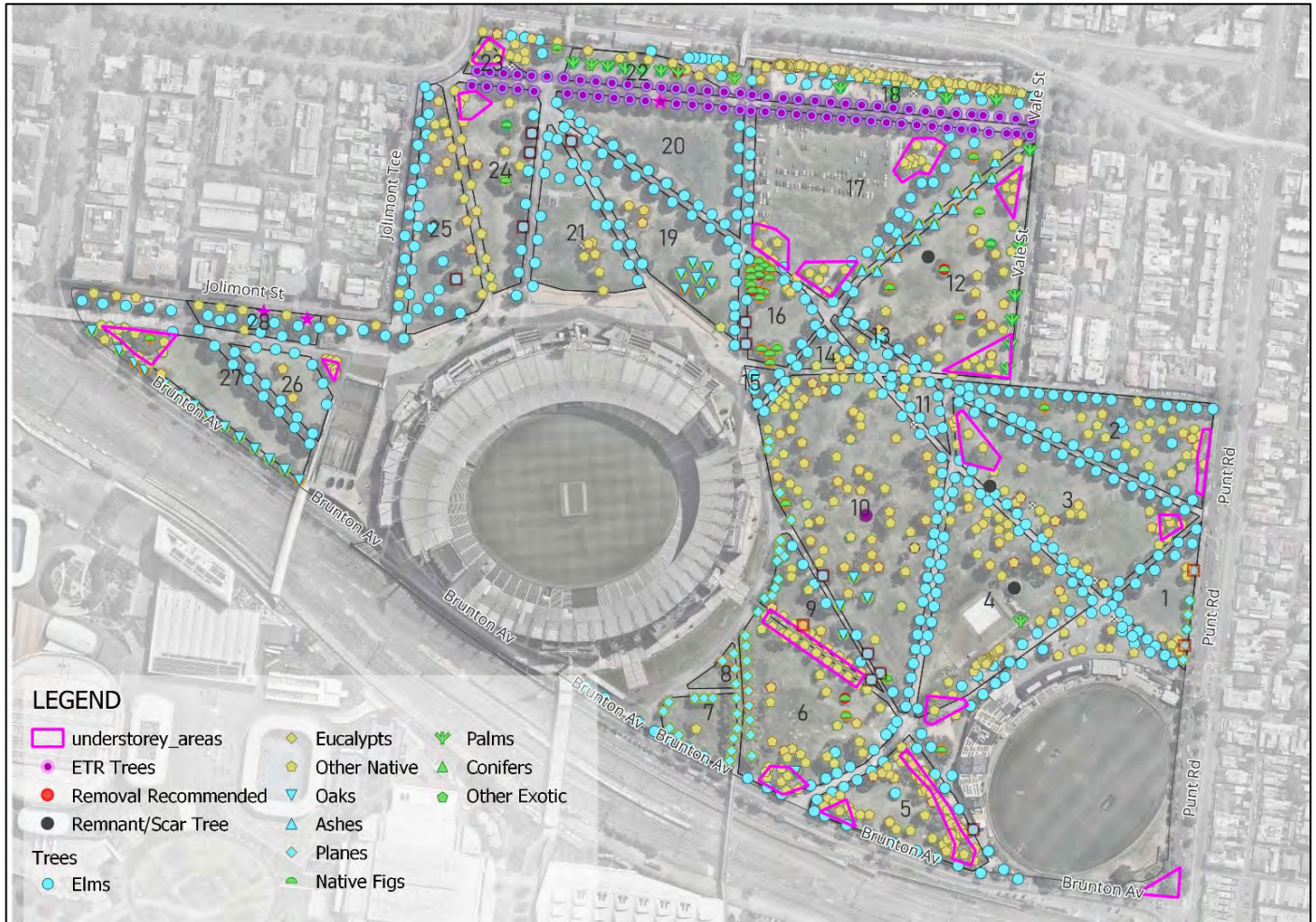


Figure 6. Recommended locations for native understorey plantings around and beneath existing native tree specimens.

It is expected that this aspect of the Masterplan will be developed further as implementation of the various aspects are ratified and implemented as appropriate.

9. Tree Management and Replacement Strategy

The Yarra Park 2025 Master Plan includes the opportunity to 'Prepare a Tree Management and Replacement Strategy'.

There is a need for a detailed replacement plan for trees audited as most likely to need replacing over the next 10 years.

The Tree Management and Replacement Strategy should:

- Establish ongoing proactive management processes that utilise best practice.
- Develop a tree removal and replacement plan for Yarra Park. As part of this work, review tree population and develop prioritisation approach for tree removals.
- Review the palette of species used within the park with the aim to plant the right tree in the right place.
- Include a short list of options for 'climate resilient' species, which can be used as replacement options where required.
- Develop a tree avenue maintenance schedule to monitor tree avenue health, age, condition, and ongoing landscape value.
- Maintain an asset management system that relies on data collection and analysis to inform decisions about tree care, ensuring efficient resource allocation and cost-effectiveness.

This strategy, when undertaken, will draw on the work completed in this assessment.

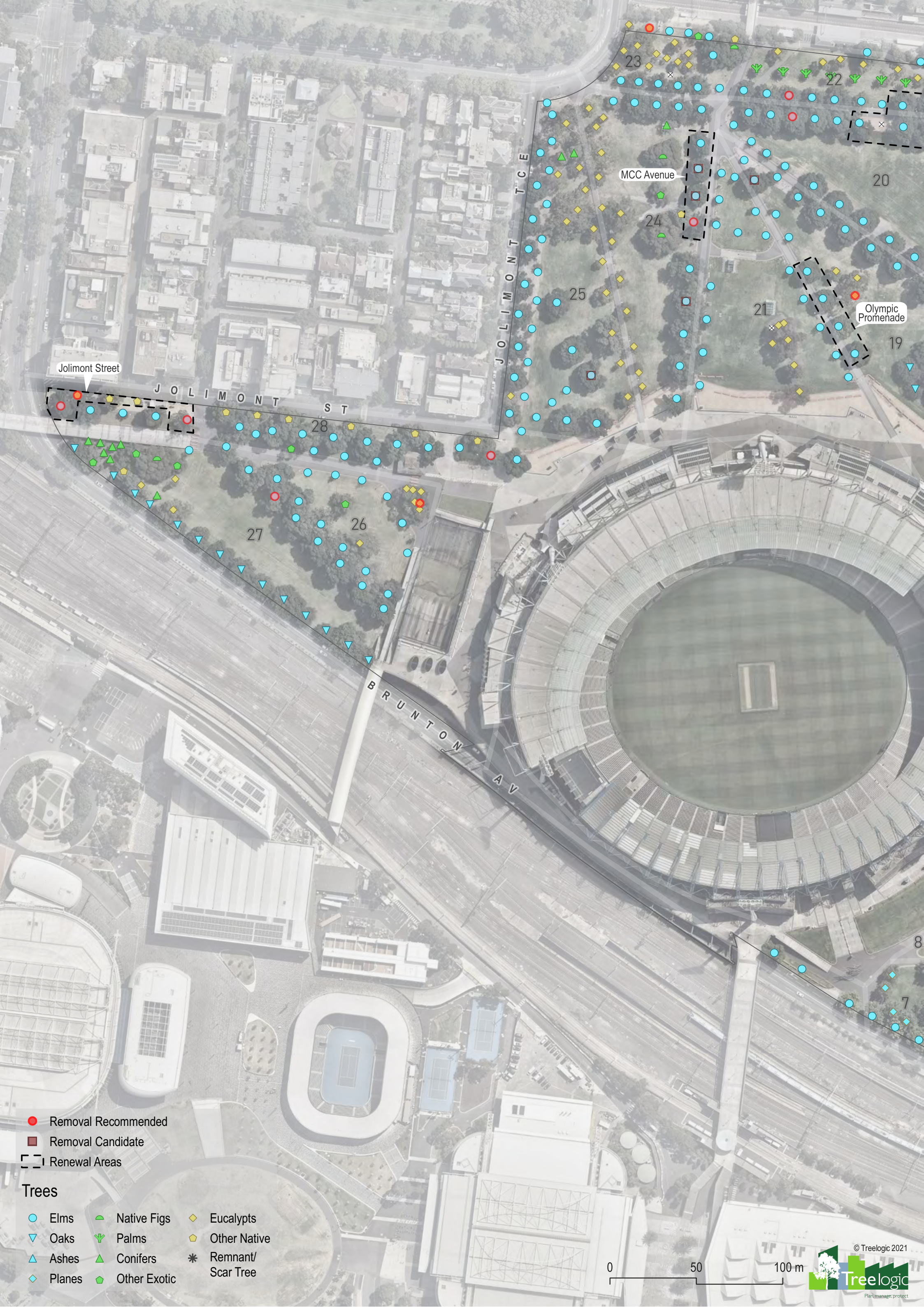
10. References & bibliography

- Bassuk, N. (2017) Site assessment. the key to sustainable urban landscape establishment. In: Ferrini, F. Konijnendijk, C. C., & Fini, A. (Eds.), *Routledge Handbook of Urban Forestry*. London, United Kingdom. Henry Ling Limited.
- Benedikz, T., Ferrini, F., Garcia-Valdecantos, J. L., Tello, M. L. (2005). Plant quality and establishment. In Konijnendijk, Nilsson, Randrup, Schipperijn (Eds.) *Urban forests and trees* (pp. 231-256). Frederiksberg, Denmark. Springer, Berlin, Heidelberg.
- Browning, D.M., and Wiant, H. V. (1997). The economic impacts of deferring electric utility tree maintenance. *Journal of Arboriculture* 23(3):106–112.
- Brune, M. (2016). Urban trees under climate change. Potential impacts of dry spells and heat waves in three German regions in the 2050s. Climate Service Center, Report 24. Retrieved from <https://www.climate-service-center.de/imperia/md/content/csc/report24.pdf>
- Churack, P. L., Miller, R. W., Ottman, K., and Koval, C. (1994). Relationship between street tree diameter growth and projected pruning and waste wood management costs. *Journal of Arboriculture* 20(4): July 1994.
- Craul, P.J. (1999). *Urban soils: applications and practices*. New York, USA. Wiley.
- Goh, C. L., Rahim, R. A., Rahiman, M. H. F., Talib, M. T. M., & Tee, Z. C. (2017). Sensing wood decay in standing trees: A review. *Sensors and Actuators A: Physical*, 269, 276-282. doi: 10.1016/j.sna.2017.11.038
- Handreck, K. & Black, N. (2005). *Growing media for ornamental plants and turf. Third edition*. UNSW Press.
- Hannusch, K. E. (2021). Implementing a tree pruning cycle into the City of Thunder Bay. HBScF thesis, Faculty of Natural Resources Management, Lakehead University, Thunder Bay, Ontario.
- Innes, J. L. (1990). Field Book 12. Assessment of tree condition. Forestry Commission. London, United Kingdom: HSMO.
- Johnstone, D., Moore, G., Tausz, M., & Nicolas, M. (2013). The measurement of plant vitality in landscape trees. *Arboricultural Journal*, 35(1), 18-27. doi: 10.1080/03071375.2013.783746
- Kendal, D., & Baumann, J. (2016). *The City of Melbourne's Future Urban Forest* (1st ed.) The City of Melbourne, Australia.
- Koeser, A. K., Gilman, E. F., Paz, M., & Harchick, C. (2014). Factors influencing urban tree planting program growth and survival in Florida, United States. *Urban forestry & urban greening*, 13(4), 655-661. doi: 10.1016/j.ufug.2014.06.005
- Koslowski, T. T., Kramer, P. J., & Pallardy, S. G. (1991). *The physiological ecology of woody plants*. Academic Press
- Leake, S. and Haeger, H. (2014). *Soils for landscape development. Selection, specification and validation*. CSIRO Publishing.
- Matheny, N. P. Clark, J. R. (2008). *Municipal specialist. Certification study guide*. International Society of Arboriculture.
- McPherson, E. G., Berry, A. M., & van Doorn, N. S. (2018). Performance testing to identify climate-ready trees. *Urban Forestry & Urban Greening*, 29, 28-39. doi: 10.1016/j.ufug.2017.09.003
- Miller, R. W. and Sylvester, W. A. (1981) An economic evaluation of the pruning cycle. *Journal of Arboriculture* 7(4). April 1981.
- Miller R. W., Hauer, R. J. & Werner, L. P. (2015). *Urban forestry. Planning and managing urban greenspaces. Third Edition*. Waveland Press, Inc.
- Roloff, A., Korn, S., & Gillner, S. (2009). The climate-species-matrix to select tree species for urban habitats considering climate change. *Urban Forestry & Urban Greening*, 8(4), 295-308. doi: 10.1016/j.ufug.2009.08.002
- Roman, L. A., Walker, L. A., Martineau, C. M., Muffly, D. J., MacQueen, S. A., & Harris, W. (2015). Stewardship matters: Case studies in establishment success of urban trees. *Urban Forestry & Urban Greening*, 14(4), 1174-1182.

- Ryder, C.M., and G.M. Moore. (2013). The arboricultural and economic benefits of formative pruning street trees. *Arboriculture & Urban Forestry* 39(1):17–24.
- Sanders, J. R., Grabosky, J. C. (2014). 20 years later: Does reduced soil area change overall tree growth?. *Urban forestry & Urban Greening*, 13(2), 295-303.
- Sanders, J., Grabosky, J., & Cowie, P. (2013). Establishing maximum size expectations for urban trees with regard to designed space. *Arboriculture & Urban Forestry*, 39(2), 68-73.
- Scharenbroch, B. C., & Catania, M. (2012). Soil quality attributes as indicators of urban tree performance. *Arboriculture and Urban Forestry*, 38(5), 214.
- Standards Australia (2013) Tree stock for landscape use (AS 2303:2015).
- Trowbridge, P. J., Bassuk, N. L. (2004). *Trees in the urban landscape: site assessment, design, and installation*. John Wiley & Sons.
- van Doorn, N. S., Roman, L. A., McPherson, E. G., Scharenbroch, B. C., Henning, J. G., Östberg, J. P. A., Mueller, L. S., Koeser, A. K., Mills, J. R., Hallet, R. A., Sanders, J. E., Battles, J., Boyer, D. J., Fristensky, J. P., Mincey, S. K., Peper, P. J.,; and Vogt, J. M. (2020). Urban tree monitoring: a resource guide. USDA Forest Service. Pacific Southwest Research Station. General Technical Report PSW-266
- Vogt, J. M., Mincey, S. K., Burnell, C. F., Patterson, M. (2014) Planted tree re-inventory protocol. Developed by Bloomington Urban Forestry Research Group at CIPEC. 49 p.
- Vogt, J., Hauer, R. J., and Fischer, B. C. (2015). The costs of maintaining and not maintaining the urban forest: A review of the urban forestry and arboriculture literature. *Arboriculture & Urban Forestry* 41(6): November 2015
- Wahid, A., Gelani, S., Ashraf, M., Foolad, M. R. (2007) Heat tolerance in plants: an overview. *Environmental and Experimental Botany* 61, 199-233.
- Watson, G. W., & Himelick, E. B. (2013). *The practical science of planting trees*. International Society of Arboriculture.
- Watt, S. (2005, September). Treenet: New Tree Variety Assessment. In STREET TREE SYMPOSIUM (p. 106).
- Xiao, Q., McPherson, E. G. (2005). Tree health mapping with multispectral remote sensing data at UC Davis, California. *Urban Ecosystems*, 8(3-4), 349-361

APPENDIX 1 – Proposed tree avenue renewal works.

Refer to following 2 pages

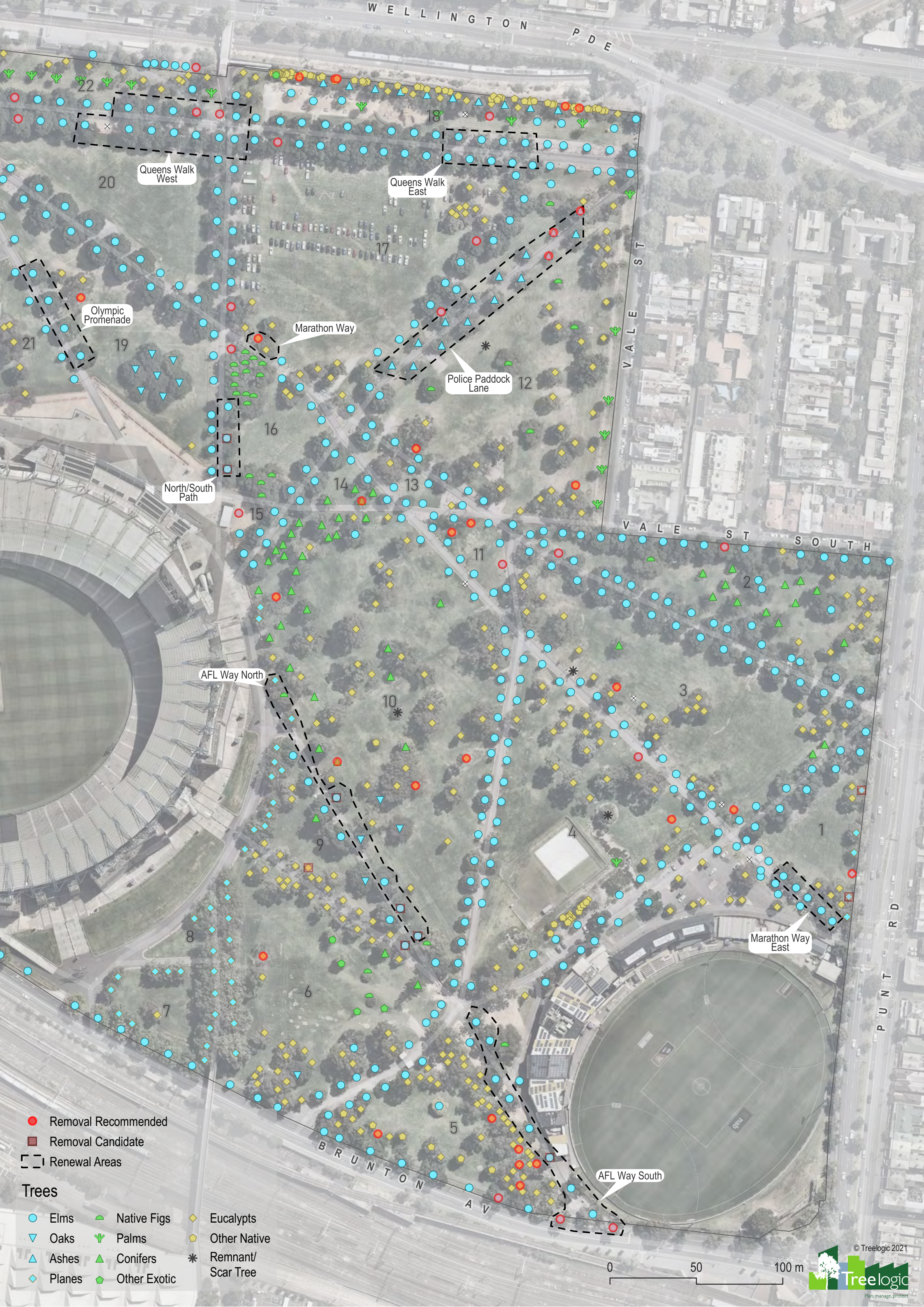


- Removal Recommended
- Removal Candidate
- Renewal Areas

Trees

- | | | |
|----------|----------------|---------------------|
| ● Elms | ▲ Native Figs | ◆ Eucalypts |
| ▼ Oaks | ▼ Palms | ◆ Other Native |
| ▲ Ashes | ▲ Conifers | * Remnant/Scar Tree |
| ◆ Planes | ◆ Other Exotic | |





- Removal Recommended
- Removal Candidate
- Renewal Areas

Trees

- | | | |
|----------|----------------|---------------------|
| ● Elms | ▲ Native Figs | ◆ Eucalypts |
| ▼ Oaks | ▼ Palms | ◆ Other Native |
| ▲ Ashes | ▲ Conifers | * Remnant/Scar Tree |
| ◆ Planes | ◆ Other Exotic | |

