ARBORICULTURAL IMPACT ASSESSMENT

KAMBALA GIRLS HIGH SCHOOL, ROSE BAY

28/4/2020

CLIENT: CARMICHAEL TOMKINS PROPERTY GROUP

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Ref: 001498 v1.1

1. CONTENTS

2. INTRODUCTION

This report supports a State Significant Development Application (SSDA) submitted to the Department of Planning, Infrastructure and Environment (DPIE) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act), for the proposed redevelopment of the sports precinct of Kambala School at 794 -796 New South Head Road, Rose Bay.

This application is SSD by way of clause 8 and schedule 1 under *State Environmental Planning Policy (State and Regional Development) 2011* on the basis that the development is for the purpose of an existing school and has a Capital Investment Value of more than $20 million.

This report has been prepared having regard to the Secretary's Environmental Assessment Requirements issued for the project by DPIE, ref no SSD-10385 issued on 24 November 2019.

3. BACKGROUND

Need for a Campus Masterplan

Kambala is an independent day and boarding school for girls up to 18 years. Kambala also has an early learning centre catering for approximately 70 girls and boys aged between 6 months and 5 years. The school was established in the late 1800s and moved to the current campus in 1913. The campus has evolved in an organic and ad-hoc manner over the last 100 years as the school and its demands have grown.

A new campus-wide planning approach offers the opportunity to strategically plan for the future in a sustainable and effective manner and to preserve the unique aesthetic and heritage qualities of the campus. The preparation of a campus-wide planning approach is also consistent with the School's 2019 - 2023 Strategic Plan which identified the need for a broader strategic plan to coordinate renewal and development in a feasible and staged manner.

4. THE SITE

Kambala is located at 794 -796 New South Head Road, Rose Bay and is within the Woollahra Council local government area (LGA). Situated in the eastern suburbs of Sydney, the School is approximately 8km east of the Sydney CBD. The School is located on New South Head Road which is a classified road connecting the City with the eastern beaches. The School is surrounded by predominantly residential uses.

The campus is bound by New South Head (to the east), Bayview Hill Road (to the north) and Tivoli Avenue (to the west). Fernbank Boarding House is located at 1A -3 Bayview Hill Road opposite the Kambala School grounds. No works are proposed to this part of the campus in this DA. The locational context of the School is illustrated at **Figure 1**. **Figure 2** provides an aerial map of the School and its immediate surrounds.

The School campus slopes down from New South Head Road in the east to the west and comprises a series of existing buildings in the western part of the campus that range in height and age. The south western and north western part of the campus accommodates much of the school's existing built form, while the eastern part has the school's sporting fields and courts.

The Kambala School building known as Tivoli House is in the heart of the campus. The house, its interiors, gateposts, gates and flanking walls with railing facing Tivoli Avenue, as well as 2 Norfolk Island Pines are listed as a heritage item in Woollahra Local Environmental Plan 2014 (WLEP 2014).

Within the School campus, the site of this SSDA is illustrated in **Figure 3**. The site proposed for new buildings is on top of the existing sports field and music building, as shown in green. The site proposed for demolition works and associated façade redevelopment and landscaping works is shown in red and is limited to a portion of the existing Hawthorne Building and the Arts building. The site of new landscape works is shown in yellow and includes all external spaces connecting these works. It is anticipated that the construction works will be staged, so the construction site for any given stage will be smaller than the overall site identified in **Figure 3**. The four key main buildings proposed are identified in **Figure 4.**

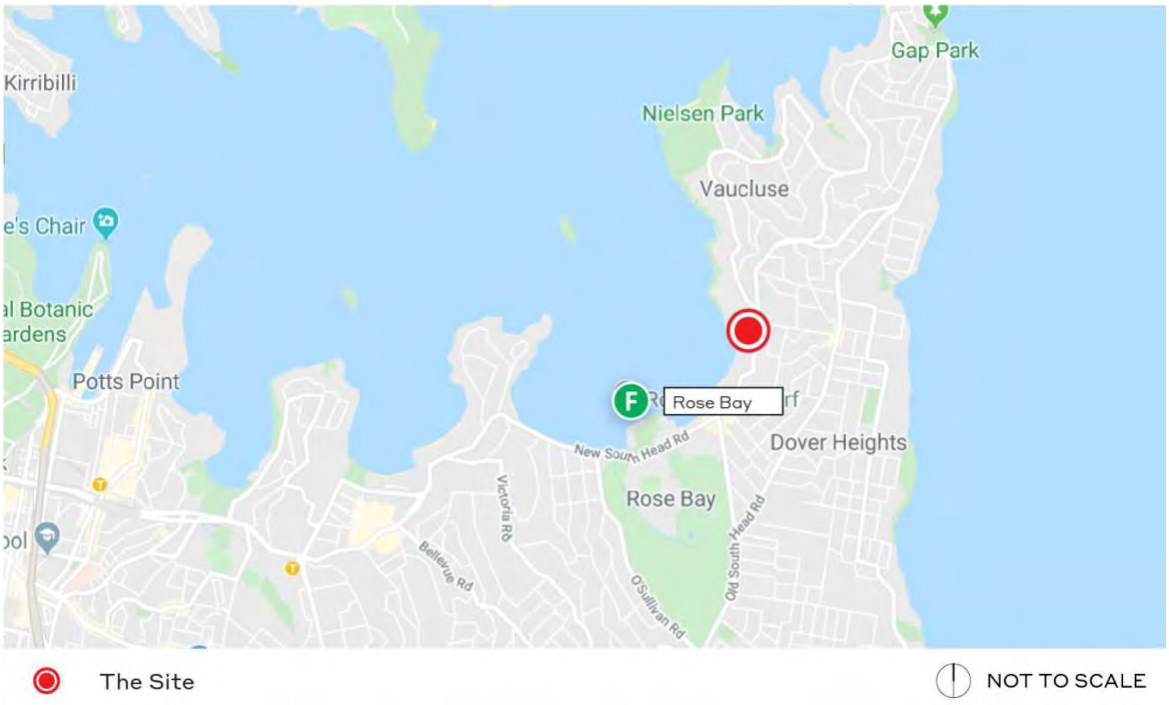

Figure 1 – Kambala School Location Context Plan

Figure 2 – Aerial Map of the Kambala Campus

Source: Near Map

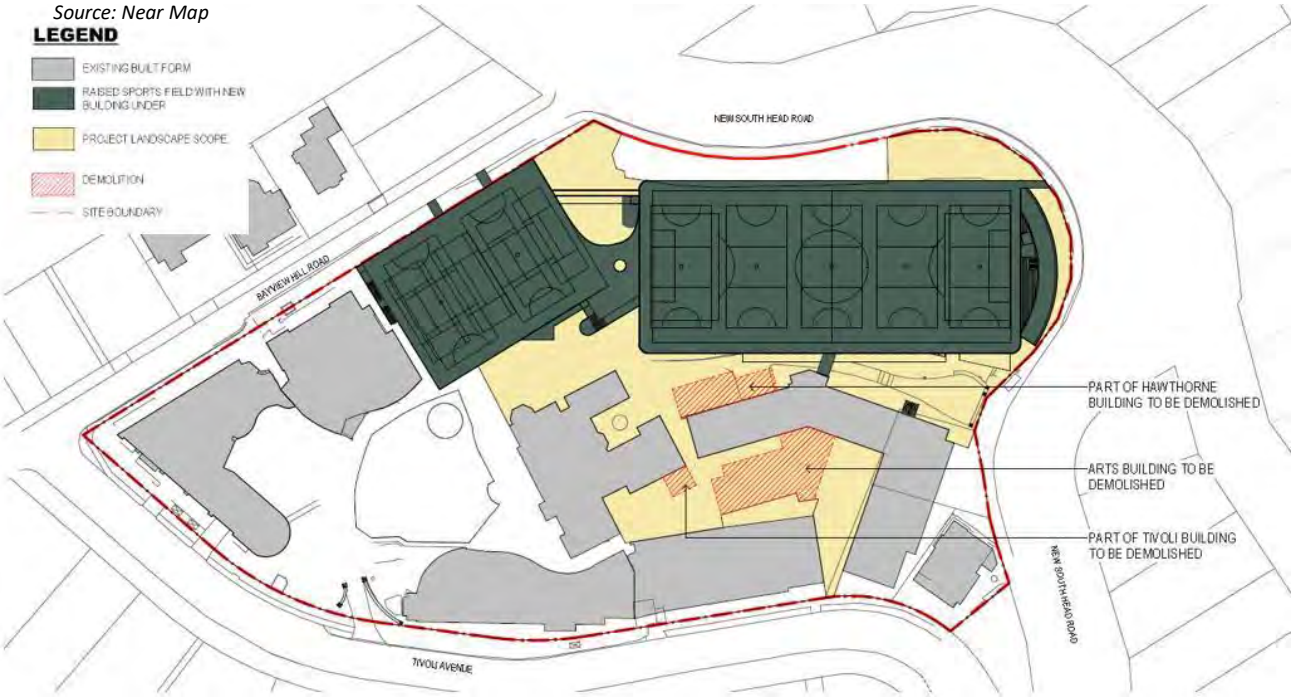

Figure 3 – Project Scope

Source: AJC

Figure 4 – Key Plan

Source: AJC

4.1.1 Legal Description and Ownership

The campus comprises several allotments, the legal descriptions of which are provided in **Table 1** below. The existing campus has a site area of approximately 22511m^2.

Table 1 Legal Description

Address	Lot	Plan
794-796 New South Head Road	Lot 67	DP 2538
	Lot C	DP 210074
	Lot 1	DP 1089403
3 Tivoli Avenue	Null	SP 64653
3 Bayview Hill Road	Lot 1	DP 175832
1A Bayview Hill Road	Lot 45	DP 2538
1 Bayview Hill Road	Lot 46	DP 2538

5. Report Summary

5.1 Overview of proposed development

This SSDA includes detailed plans for a new sport, wellbeing and senior learning precinct. Accordingly, consent is sought for the following:

- The excavation of part of the existing sports field to facilitate the construction of the
  - sports facilities including weights room and dance rooms;
  - indoor multipurpose sports courts for use by up to 1500 people;
  - innovative and flexible teaching and learning spaces;
  - amenities, store rooms, plant, circulation and ancillary spaces
  - reinstatement of the sports field surface on the roof (sports field and perimeter fencing)
  - spectator seating / bleachers;
- The removal of the tennis courts (currently on the roof of the music building), and the construction of the following:
  - a wellbeing centre, called the SHINE centre, to accommodate the Kambala SHINE program
  - a new staff centre, called the KITE centre, to accommodate staff workstations, meeting areas, staff development workshop rooms and amenities
  - reinstatement of the tennis courts, lighting and perimeter fencing on the new roof
- a new eastern forecourt for the school, new external landscaped areas and new courtyards;
- minor works to the existing music building to facilitate a new connection to the new courtyard;
- the partial demolition of the Hawthorne building and the construction of a new façade, roof and landscaping; and
- the demolition of the Arts building and the construction of new facades to adjacent affected buildings, and new landscaping to the footprint of the demolished building

5.2 Scope of Works

Arborlogix Pty Ltd has been contracted by the client to undertake an arboricultural impact assessment of a proposed new development at Kambala Girls High School, Rose Bay. The proposed new development is for a new multi-level sports precinct that will require the complete redevelopment of the central and north-eastern sections of the school right up to the retaining walls that run along Bayview Hill Road to the North and New South Head Road to the East. The majority of the proposed redevelopment works will be located within the current sports oval area and tennis courts, with only some minor redevelopment works on the central buildings in order to integrate with the design. Arborlogix Pty Ltd has been asked to assess the trees within this site, and on any neighbouring properties or council land, that have their TPZs (Tree Protection Zones) within 5m of the proposed development footprint or in areas that could be used as access points to the site for construction vehicles and materials. The numbering for trees surveyed in this report is taken from a previous Arborcultural Risk Assessment Report done by Sydney Tree Solutions Pty Ltd on 3/7/2019 (Ref: 1487 v1.0). Since this report was completed some of the trees have been removed so there may be some numbers missing but these numbers were kept consistent since all trees had already been physically tagged as well. This will prevent confusion in later stages of the project when trees need to be removed or retained and protected as required.

This report is only concerned with trees within the property that are large enough to be considered as potentially more than a low retention value tree. For this scope it was decided that all trees less than 7m in height would be excluded from the report since anything smaller could be replaced with new plantings post construction and would therefore only be considered as a low retention value tree. It does however include trees that are between 5m and 7m in height but have a canopy width greater than 7m since this could be potentially have some retention value to the site. All other trees that do not fall within these categories and all those in areas of the school that will not be impacted by the new development were excluded from this report. Therefore this report includes 35 trees that could be affected by the proposed development.

This report will assess these 35 trees for health, vitality, structural defects, form, pests and diseases, life expectancy, significance and retention value. An assessment will also be made of the likely impacts the proposed development will have on these trees. This will be used to aid with determining whether any of these trees would need to be removed for safety reasons or to accommodate the new development, or whether they should be retained and protected.

If the trees are to be retained this report will provide recommendations to any design modifications, construction techniques and the necessary protection measures that will need to be implemented prior, during and post development to ensure the health, vigour and longevity of these trees. Details of these protection measures will be based on local government regulations and protection measures outlined in AS-4970-2009 (Protection of Trees on Development Sites). Any pruning works that may be required to accommodate this development or improve the health and stability of these trees will also be outlined and detailed as part of the recommendations of this report.

6. SUMMARY OF RECOMMENDATIONS

This arboricultural impact assessment of the proposed development site made the following recommendations.

1. Retention and Protection of Trees 1, 10-12, 14-17, 21, 22, 24, 27, 28, 30, 34-37 and 38 according to AS-4970-2009 (Protection Trees on Development Sites). No roots are to be pruned greater than 40mm diameter within any TPZ and no roots at all within any SRZ without the authorisation of the project arborist. Details of any TPZ encroachment and tree protection required are found in sections 11.1, 11.3, 11.4 and 11.5.

2. Tree 1 will enquire some minor encroachment for the installation of 2 piers for the tennis courts. This will have minimal impact on the health of the tree since it will involve only minor encroachment but it should be done in consultation with the project arborist. No excavations, storage of materials or root pruning is to occur within its TPZ without supervision or consultation with the project arborist. Some minor canopy pruning of the tips of some lower canopy branches may also be required for clearances of the proposed tennis courts but these can again be done in consultation with the project arborist. It will amount to less than 2% of canopy pruning if required.

3. Trees 28, 35, 37 and 38 will require major TPZ encroachment and some canopy pruning to accommodate the development. This will need to be done in consultation with the project arborist.

4. Removal and replacement of Trees 2-8, 18, 18a, 19, 20, 23 25, 29, 31 and 39 will be required to accommodate the new development. Only one high retention value tree (Tree 7) and 4 medium retention value trees (Trees 19, 20, 23 and 29) that will require removal to accommodate the development. The details of the reasons for these removals and any replacement plantings required can be found in section 11.2.

5. Generally all activities involving soil level changes, excavation, storage, excavation, cleaning and refueling are prohibited (a full list is found in section 4.2 of AS-4970-2009) within the TPZ. Some activities may be authorized if required but only by the project arborist. Any additional mulching or irrigation required should be done at the discretion of the project arborist.

6. Branch and Truck protection, if required (only if access into TPZ needed), should be installed as detailed in section 12.2.2 of this report. All other tree protection measures required during construction and detailed in section 11 and 12 of this report are to be complied with.

7. Any tree removal works and tree protection measures should be carried out by an arborist with a minimum qualification of AQF level 3 and certified by the project arborist. The project arborist should have a minimum qualification of AQF level 5 or equivalent.

8. All works on-site should be carried out according to Workcover Authority NSW 2007, *Code of Practice Amenity Tree Industry,* NSW.

9. All works should be carried out according to AS-4373-2007 (Pruning of Amenity Trees) and AS-4970-2009 (Protection trees on development sites).

7. DISCLAIMER

This document in its entirety is for the exclusive use of the client and Arborlogix Pty Ltd only. Arborlogix Pty Ltd will not be held liable for any use or interpretations from any other person or third party. This report remains the intellectual property of Arborlogix Pty Ltd and any individual or company must have written consent prior to its use for any other purpose.

All inspections and assessments were carried out using Visual Tree Assessment methods (VTA)[1] from ground level only and do not include the use of diagnostic devices. Although great care is taken to accurately diagnose the condition of the tree, using accepted industry practices; the arborist is limited in determining the exact structural integrity of the tree by interpreting mainly exterior features. There are multiple factors both physical and environmental such as extreme climactic events and conditions that could lead to possible structural failures in trees which would not have been possible to predict or identify from VTA methods and assessments.

Any protection or preservation methods recommended are not a guarantee of tree survival or safety but have been recommended to improve vigour and reduce risk only. Therefore Arborlogix Pty Ltd does not accept any liability for any future tree failure, illness, damage or injury caused by any undetected or unpredicted faults or failures in any tree or part thereof referred to in this document. Arborlogix Pty Ltd also accepts no responsibility for any failure, loss or decline, damage or injury caused by any tree covered in this document due to any meteorological or other unforeseen event.

It is the client responsibility to maintain ongoing inspections and assessments of trees covered in this document and obtain the services of a suitably qualified arborist to carry out the work where necessary. All work should be carried out according to AS-4373-2007 Pruning of amenity trees[2] and AS-4970-2009 Protection of trees on development sites[3].

Michael Todd - Director

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[1] Mattheck, K and Breloer, H (2007). *The Body Language of Trees* – A handbook for failure

[2] Standards Australia (2007). AS4373:*Pruning of Amenity Trees*

[3] Standards Australia (2009). AS4970: *Protection of Trees on Development Sites*.

8. METHODOLOGY

Tree Assessments were all carried out according to the following methods:

8.1 TREE ASSESSMENTS

- Visual Tree Assessment (VTA) method (Mattheck 2007)) (Appendix 1) was used from ground level to determine tree health, structural integrity and presence of any pests or diseases.
- Sustainable Retention Index Value (SRIV) Version 4 © (IACA 2010) (Appendix 3) is used to provide an index value corresponding to age, vigour and condition.
- The meanings and terminology used to describe and assess each tree are taken from the IACA Dictionary for Managing Trees in Urban Environments (2009). An extract is included as a glossary of terms in Appendix 5 of this report.
- No aerial (climbing) inspections, soil sampling or root excavations were conducted as part of these assessments.
- No additional specialised diagnostics equipment was used to quantitatively determine extent of any decay (i.e. resistographs or non-intrusive tomographic methods such as PICUS)
- All trees were identified using prior knowledge of the species and visual inspection of the subject trees at the time of inspection.
- A Lufkin 10m diameter tape was used to obtain the Diameter at Breast Height (DBH) as recommended at 1.4m unless otherwise stated due to variations in tree form (AS-4970-2009). Diameter at Root Crown (DRC) was also measured to enable calculation of Structural Root Zones.
- Canopy spread was estimated or paced out and the longest span was recorded as the spread.
- Height of each tree was estimated and then cross referenced with photographs.
- Any photographs were taken with an iphone xS (12MP).
- All map data was gathered using www.nearmaps.com.au
- All design work used in this report was completed using Adobe Illustrator and ArborCAD.

8.2 TREE PROTECTION ZONES

This report adopts Australian Standard AS4970-2009 *Protection of trees on development sites* as a point of reference and guide for the recommended minimum setbacks (Appendix 4) from the centre of a tree's trunk to development works. The distances may be increased or decreased by the author in accordance with AS4970 – Section 3.3.4 as a result of other factors providing mitigating circumstances or constraints as indicated by but not restricted to the following:

- Condition of individual trees,
- Tolerance of individual species to disturbance,
- Geology e.g. physical barriers in soil, rock floaters, bedrock to surface
- Topography e.g. slope, drainage,
- Soil e.g. depth, drainage, fertility, structure,
- Microclimate e.g. due to landform, exposure to dominant wind,
- Engineering e.g. techniques to ameliorate impact on trees such as structural soil, gap graded fill, lateral boring,
- Construction e.g. techniques to ameliorate impact on trees such as pier and beam, bridge footings, suspended slabs,
- Root mapping,

- Physical limitations - existing modifications to the environment and any impact to tree/s by development e.g. property boundaries, built structures, houses, swimming pools, road reserves, utility services easements, previous impact by excavation, or construction in other directions, soil
- level changes by cutting or filling, existing landscaping works within close proximity, modified
- drainage patterns,
- Extraneous factors e.g. potential future impacts from development on adjoining land when the tree is located on or near to a property boundary

8.3 Tree Significance, Sustainability and Retention Values

Tree landscape significance rating was calculated using IACA Significance of a Tree, Assessment Rating System (STARS) © (IACA 2010) which is shown in appendix 2. Landscape significance not only takes into account the physical form of the tree but it also assesses other factors such as Heritage, Cultural and Environmental values. These Landscape significance ratings were then combined with the Estimated Life Expectancy values of each specimen to categorise each tree under the Priority Matrix of Retention Values.

This is used in combination with the value obtained from the Sustainable Retention Index Value (SRIV) Version 4 © (IACA 2010) (Appendix 3) to determine whether the tree should be removed for safety and sustainability reasons or whether it should be retained and what remedial works may be required. Tree Sustainability is an important factor since it takes into account not only the life expectancy but also the effect of other economical, social and environmental factors that need to be addressed as part of a tree management plan.

8.4 ISA TRAQ – Tree Risk Assessment Qualification

ISA TRAQ is a Qualitative risk assessment process that uses ratings of likelihood and consequences of an event to determine a risk level and evaluate the level of risk against qualitative criteria. The term *likelihood* is used rather than *probability* because probability would require actual quantitative odds. The ISA TRAQ method uses several risk matrix and arboricultural best practices to determine the likelihood of an event or failure (i.e. branch failure), the likelihood of it impacting a target (i.e. how often are there people underneath a tree) and the consequence of the failure impacting the target (i.e. human injury or asset damage) in order to determine an overall risk rating for the tree. The 2 tables below show the 2 main risk matrix that are used to determine an overall risk rating for the tree.

If there are more than one possible tree parts that could fail the part with the highest risk rating is used (i.e. Complete tree failure or failure of large dead branch – whichever event is more likely to occur and cause the most damage). Although it could be argued that the occupancy rate for a school could be considered *occasional occupancy* since for more than 12 hours of most days and most of the weekends and holidays the grounds are empty of students, it was determined that for the purpose of this report it will be considered as *frequent occupancy* in high traffic areas to ensure that above standard risk mitigation levels are met. A more detailed explanation of the evaluations used to categorise each of this various parameters can be found in Appendix 6.

LIKEIHOOD OF FAILURE	LIKELIHOOD OF IMPACTING TARGET			
	VERY LOW	LOW	MEDIUM	HIGH
IMMINENT	Unlikely	Somewhat likely	Likely	Very Likely
PROBABLE	Unlikely	Unlikely	Somewhat likely	Likely
POSSIBLE	Unlikely	Unlikely	Unlikely	Somewhat likely
IMPROBABLE	Unlikely	Unlikely	Unlikely	Unlikely

TABLE 2 - LIKELIHOOD MATRIX

LIKEIHOOD OF FAILURE & IMPACT	CONSEQUENCE OF FAILURE			
	NEGLIGIBLE	MINOR	SIGNIFICANT	SEVERE
VERY LIKLEY	Low	Moderate	High	Extreme
LIKELY	Low	Moderate	High	High
SOMEWHAT LIKELY	Low	Low	Moderate	Moderate
UNLIKELY	Low	Low	Low	Low

TABLE 3 - RISK RATING MATRIX

8.5 Local Government Documentation Reviewed for Assessment.

In order to ensure all legal requirements are met when determining which trees can be retained or removed on this development site a number of Local Government Area (LGA) Policies and documents were reviewed:

- Significance Tree Register – Tree 1 is listed on Woollahra Significant Tree Register.
- Threatened/Endangered species or communities onsite – No listings for this site were found.
- Local Government Area (LGA) Tree Preservation Order – Woollahra Council

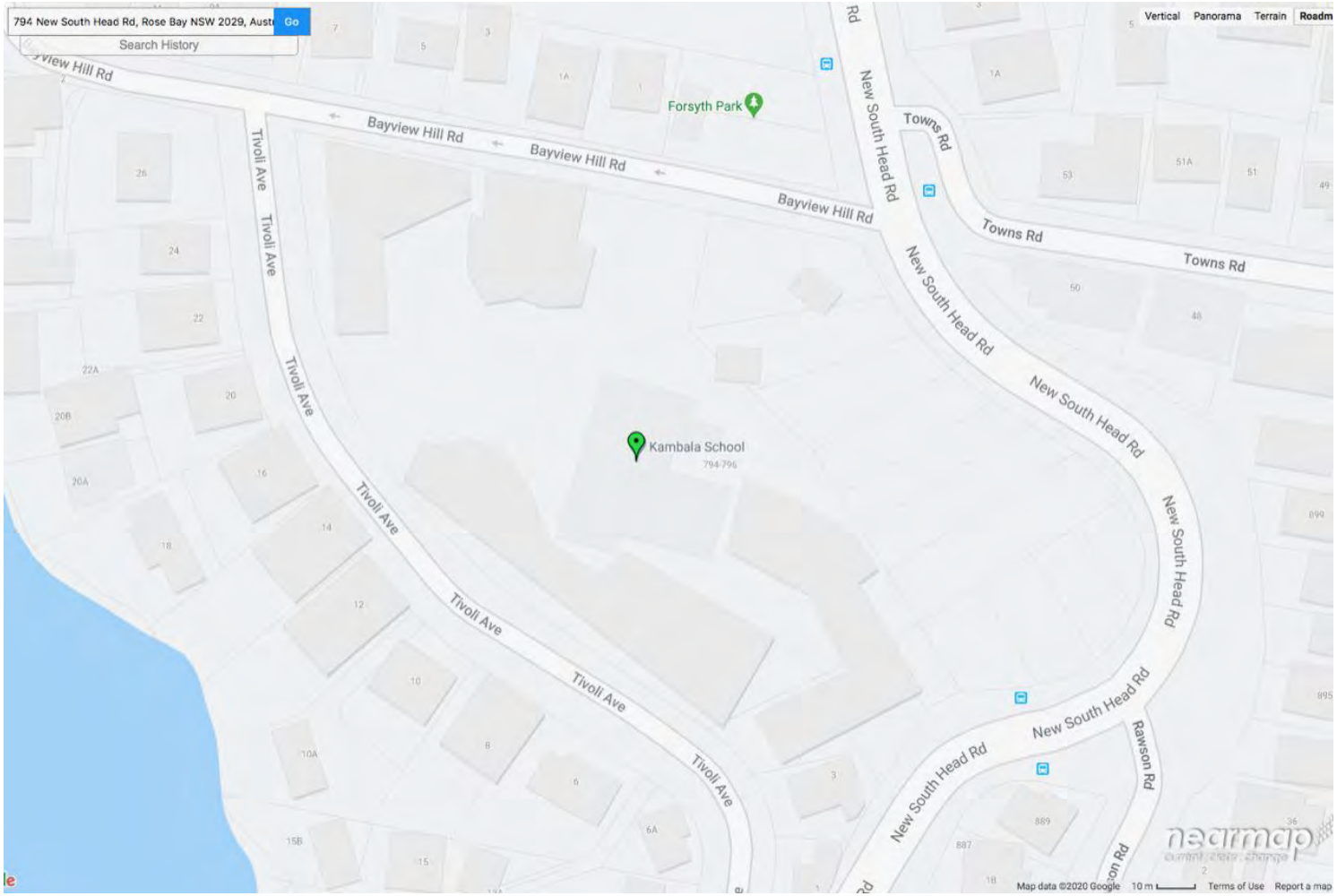
8.6 Additional Documentation used to compile report

The following documents were provided to Arborlogix Pty Ltd to aid with compiling this report.

- Arboricultural Risk Assessment – Sydney Tree Solutions Pty Ltd – 3/7/2019 – Ref 1487 v1.0
- Tree and Utilities Survey – RPS Australia East Pty Ltd – 5/2/2020 – DWG No: PR1 45951-DS-001-A
- Kambala Sports Precinct Proposed Designs – Allen Jack and Cottier – 24/4/2020 – DA2101, DA2102, DA2103

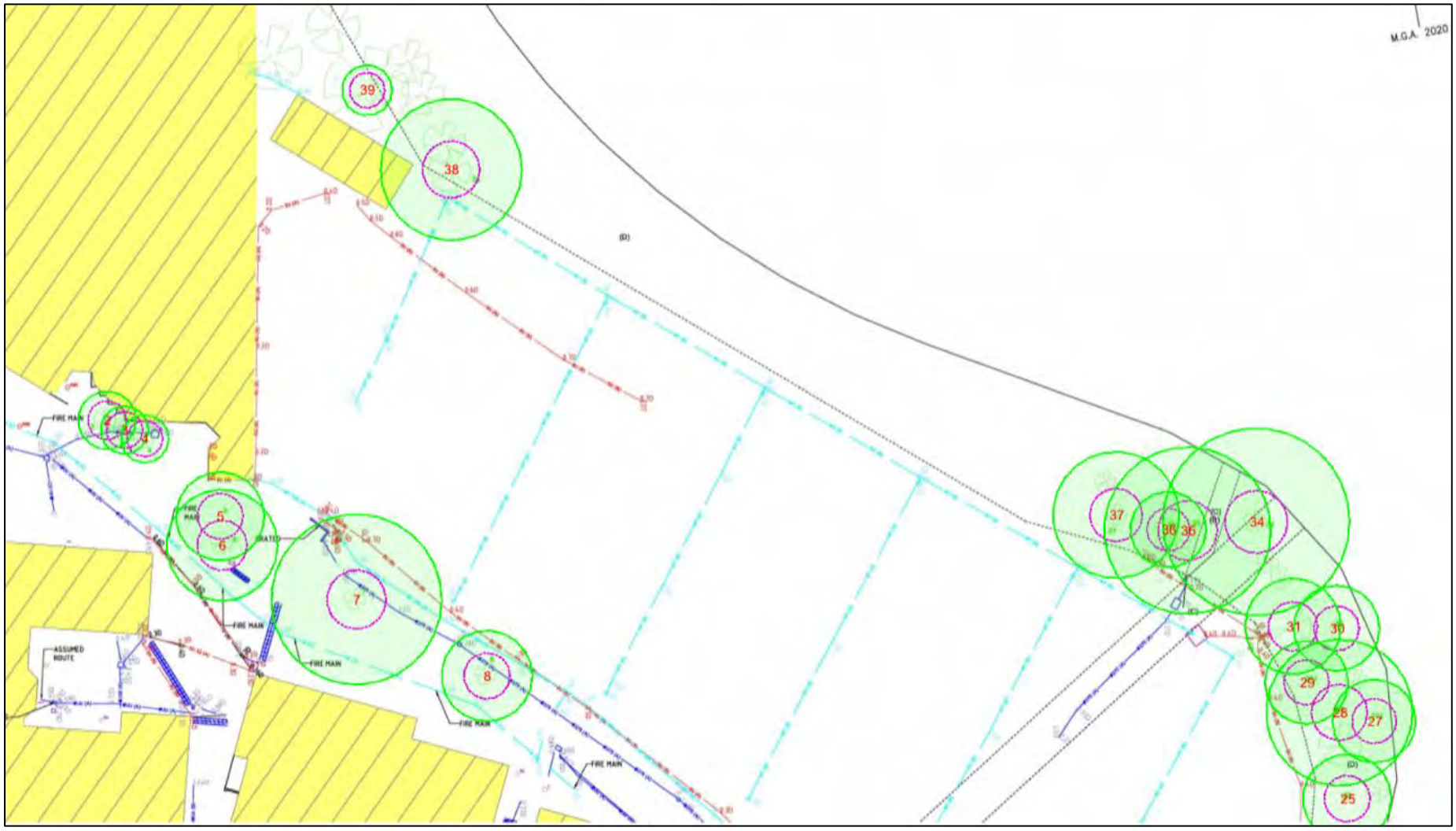
9. Site Location

9.1 Map of Site

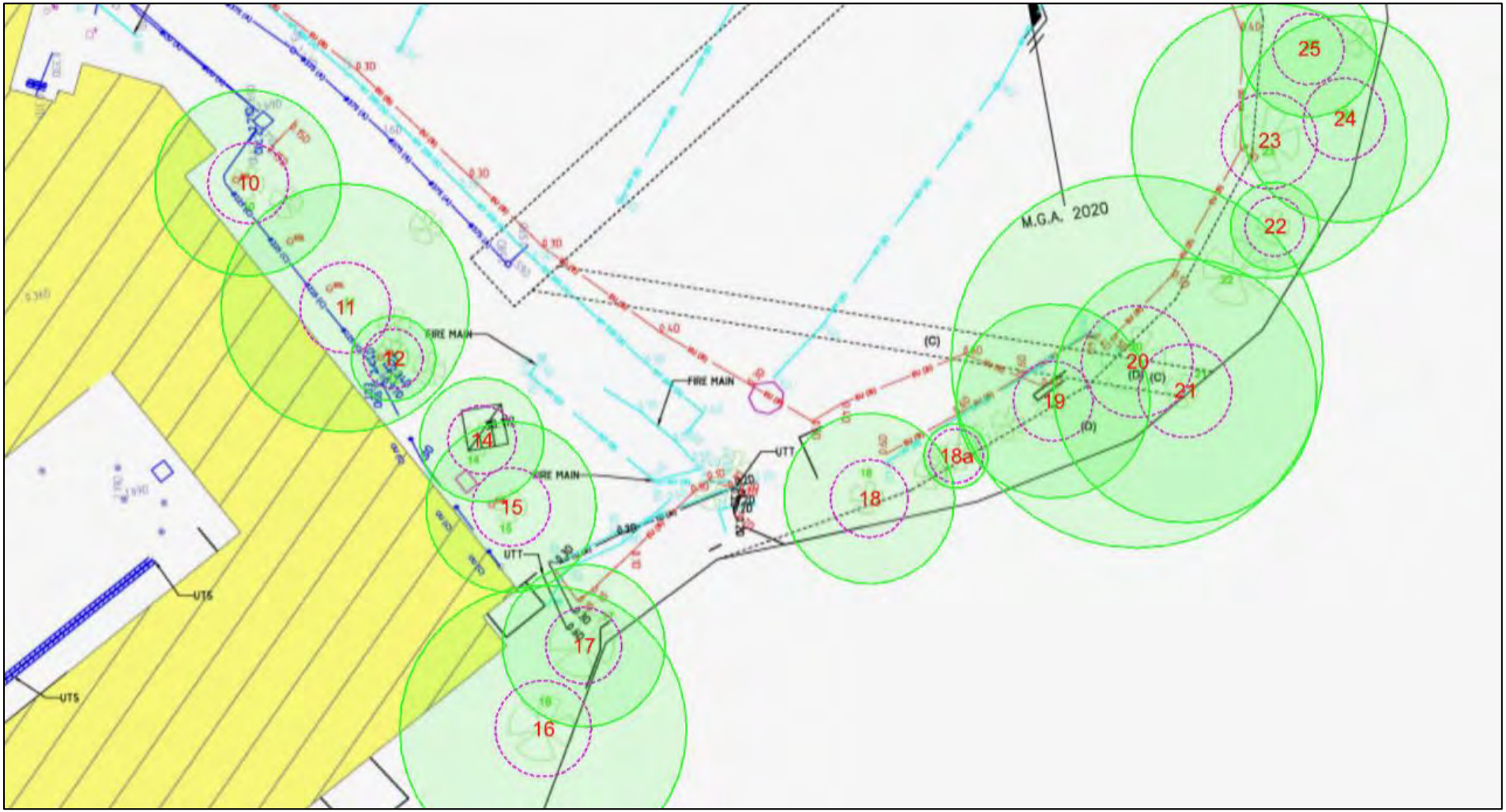


9.2 AERIAL PHOTO OF SITE SHOWING LOCATION OF TREES ASSESSED

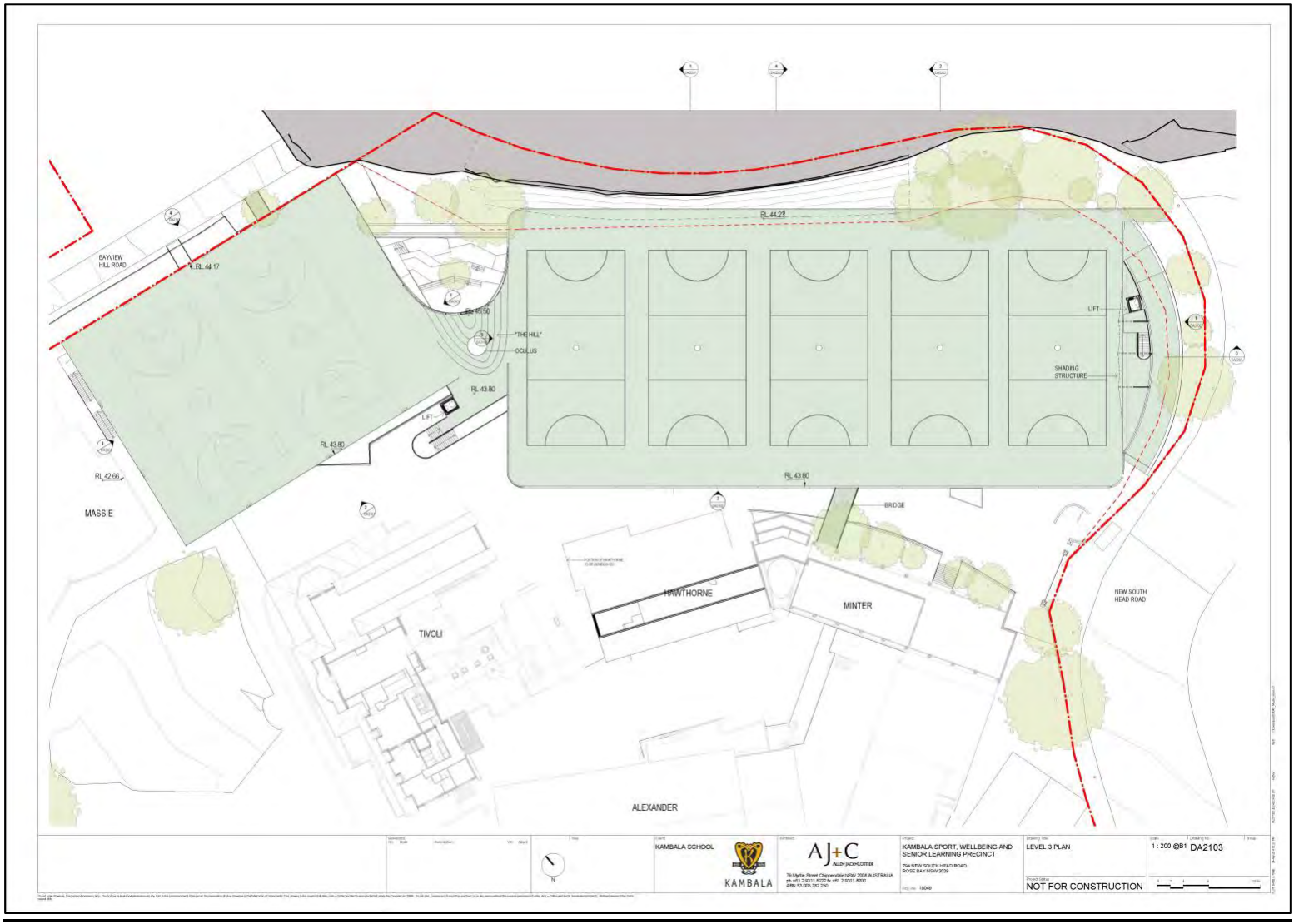
9.3 PLAN OF SITE SHOWING EXISTING SITE AND LOCATION OF TREES AND TPZS – NORTH SECTION OF OVAL



6.4 Plan of site showing existing site and location of trees and TPZs – South Section of Oval



6.5 Plan of site showing proposed development – Level 3



10. TREE ASSSESMENT

10.1 TREE SCHEDULE

KEY FOR TABLE:

AGE - Y = Young, M = Mature, OM = Over Mature D = Dead
DBH – Diameter Breast Height (mm)
SRZ – Structural Root Zone
Risk Rating – LOW, MEDIUM, HIGH, EXTREME (Colour Coded)
HT – Estimated Height (m)
DRC – Diameter above Root Crown (mm)
Health/ Condition – G = Good, F = Fair, P = Poor, D = Dead
SRIV – Sustainable Retention Index Value (Appendix 3)
CS – Estimated Crown Spread (m)
TPZ – Tree Protection Zone

Defects/Comments – NIL = Deadwood <20mm Diameter, Minor D = Minor Deadwood 20-70mm Diameter, Major D = Major Deadwood 70+mm Diameter
Significance/Retention – LOW, MEDIUM, HIGH (Colour Coded according to Retention Value)
SULE – H = High (40+ Yrs), M = Medium (15-40 Yrs), S = Short (5-15 Yrs), R = Remove, S/Y = Small or Young

No.	***Botanical Name*** **(Common Name)**	Age	HT	CS	DBH (mm)	DRC (mm)	TPZ (m)	SRZ (m)	Health/ Cond.	SRIV	Defects / Comments	Risk Rating	SULE	Significance / Retention Value)	Recommendations
1	Araucaria heterophylla (Norfolk pine)	M	35	14	1470	1520	17.6	3.9	G/G	MGVG		LOW	M	HIGH / HIGH	Retain and Protect AS4970-2009
2	Archontophoenix cunninghamiana (Bangalow Palm)	M	9	5	230	250	2.8	1.8	G/G	MGVG	Recently pruned	LOW	M	LOW / LOW	Remove and replace
3	Archontophoenix cunninghamiana (Bangalow Palm)	M	8	5	190	220	2.3	1.8	G/G	MGVG	Recently pruned	LOW	M	LOW / LOW	Remove and replace
4	Archontophoenix cunninghamiana (Bangalow Palm)	M	8	5	190	210	2.3	1.7	G/G	MGVG	Recently pruned	LOW	M	LOW / LOW	Remove and replace
5	Syagrus romanzoffiana (Cocos Palm)	M	10	5	350	370	4.2	2.2	G/G	MGVG	Recently pruned. Exempt Species	LOW	S	LOW / LOW	Remove

No.	*Botanical Name* (Common Name)	Age	HT	CS	DBH (mm)	DRC (mm)	TPZ (m)	SRZ (m)	Health/ Cond.	SRIV	Defects / Comments	Risk Rating	SULE	Significance / Retention Value)	Recommendations
6	Syagrus romanzoffiana (Cocos Palm)	M	10	5	440	460	5.3	2.4	G/G	MGVG	Recently pruned, Exempt Species	LOW	S	LOW / LOW	Remove
7	Ulmus parvifolia (Chinese Elm)	M	12	14	675	675	8.1	2.8	G/G	MGVG	Difficult to transplant such large tree.	LOW	M	HIGH / HIGH	Remove and replace
8	Callistemon sp. (Bottlebrush)	M	8	6	360	380	4.3	2.2	F/F	MGVF	Sparse canopy	LOW	M	LOW / LOW	Remove and replace
10	Melaleuca styphelioides (Prickly leaved Paperbark)	M	10	9	480	520	5.8	2.5	G/G	MGVG		LOW	M	MED / MED	Retain and Protect AS4970-2009
11	Melaleuca quinquenervia (Broad-leaved Paperbark)	M	10	8	640	680	7.7	2.8	G/G	MGVG	Co-dominant stem, low risk	LOW	M	MED / MED	Retain and Protect AS4970-2009
12	Howea foresteriana (Kentia Palm)	Y	8	4	220	250	2.6	1.8	G/G	MGVG		LOW	M	LOW / LOW	Retain and Protect AS4970-2009
14	Syagrus romanzoffiana (Cocos Palm)	M	10	5	320	350	3.8	2.1	G/G	MGVG	Recently pruned, exempt species	LOW	S	LOW / LOW	Retain and Protect AS4970-2009
15	Melaleuca styphelioides (Prickly leaved Paperbark)	M	10	7	440	480	5.3	2.4	G/G	MGVG		LOW	M	MED / MED	Retain and Protect AS4970-2009
16	Angophora costata (Sydney Red Gum)	M	20	16	740	780	8.9	3.0	G/G	MGVG	Crossing branches mid canopy	LOW	L	HIGH / HIGH	Retain and Protect AS4970-2009
17	Angophora costata (Sydney Red Gum)	M	11	10	420	450	5.0	2.4	G/G	MGVG	Suppressed form, crossing branches	LOW	L	MED / MED	Retain and Protect AS4970-2009
18	Robinia pseudoacacia (Robinia)	M	10	10	440	470	5.3	2.4	F/F	MGVF		LOW	S	LOW / LOW	Remove and replace

No.	*Botanical Name* (Common Name)	Age	HT	CS	DBH (mm)	DRC (mm)	TPZ (m)	SRZ (m)	Health/ Cond.	SRIV	Defects / Comments	Risk Rating	SULE	Significance / Retention Value)	Recommendations
18 a	Syzygium smithii (Lillypilly)	M	8	8	150	200	1.8	1.7	G/G	MGVG	Screening from street	LOW	M	LOW / LOW	Remove and replace
19	Lagerstromia indica (Crepe Myrtle)	M	20	6	500	500	6.0	2.5	G/F	MGVF		LOW	M	MED / MED	Remove and replace
20	Quercus robur (English Oak)	O	12	14	960	111 2	11.5	3.5	F/F	MGVF		LOW	M	MED / MED	Remove and replace
21	Grevillea robusta (Silky Oak)	M	18	12	680	730	8.2	2.9	G/G	MGVG	Lower limb included	LOW	M	MED / MED	Retain and Protect AS4970-2009
22	Magnolia grandiflora (Southern Magnolia)	Y	6	6	230	250	2.8	1.8	G/G	YGVG		LOW	L	MED / MED	Retain and Protect AS4970-2009
23	Jacaranda mimosifolia (Jacaranda)	M	15	15	710	780	8.5	3.0	G/F	MGVF		LOW	M	MED / MED	Remove and replace
24	Casuarina cunninghamiana (She Oak)	M	12	8	535	535	6.4	2.5	G/F	MGVF		LOW	M	MED / MED	Retain and Protect AS4970-2009
25	Glochidion ferdinandi (Cheese Tree)	Y	8	6	350	380	4.2	2.2	G/G	YGVG		LOW	M	LOW / LOW	Remove and replace
27	Eucalyptus saligna (Sydney Blue Gum)	Y	9	8	330	350	4.0	2.1	G/G	YGVG		LOW	L	MED / MED	Retain and Protect AS4970-2009
28	Casuarina cunninghamiana (She Oak)	M	12	20	580	600	7.0	2.7	G/F	MGVF		LOW	M	MED / MED	Retain and Protect AS4970-2009
29	Corymbia maculata (Spotted gum)	M	12	6	330	360	4.0	2.2	G/F	MGVF	Trunk has some recent aboriginal artwork	LOW	L	MED / MED	Remove and replace

No.	*Botanical Name* (Common Name)	Age	HT	CS	DBH (mm)	DRC (mm)	TPZ (m)	SRZ (m)	Health/ Cond.	SRIV	Defects / Comments	Risk Rating	SULE	Significance / Retention Value)	Recommendations
30	Agathis robusta (Kauri Pine)	Y	10	5	340	360	4.1	2.2	G/G	MGVG		LOW	L	MED / MED	Retain and Protect AS4970-2009
31	Corymbia citriodora (Lemon scented Gum)	M	10	6	380	440	4.6	2.3	G/P	MGVP	Recently lopped, storm damage	LOW	S	LOW / LOW	Remove and replace
34	Banksia integrifolia (Coast Banksia)	M	12	12	740	780	8.9	3.0	F/F	MGVF	Recently lopped for views, poor form	LOW	M	MED / MED	Retain and Protect AS4970-2009
35	Toona ciliata (Australian Red Cedar)	M	13	15	660	690	7.9	2.8	G/G	MGVG	Heavily lopped for views, poor form	LOW	M	MED / MED	Retain and Protect AS4970-2009
36	Eucalyptus microcorys (Tallowood)	M	9	6	300	320	3.6	2.1	G/P	MGVP	Poor form	LOW	S	LOW / LOW	Retain and Protect AS4970-2009
37	Glochidion ferdinandi (Cheese Tree)	M	8	9	500	520	6.0	2.5	G/F	MGVF		LOW	M	LOW / LOW	Retain and Protect AS4970-2009
38	Pinus halepensis (Allepo pine)	M	11	12	560	630	6.7	2.7	G/F	MGVF	Heritage Significance, Anzac Memorial Tree	LOW	L	HIGH / HIGH	Retain and Protect AS4970-2009
39	Strelitzia reginae (Stand of Strelitzia)	M	8	8	200	200	2.4	1.7	G/G	MGVG		LOW	M	LOW / LOW	Remove and replace

TABLE 4 - RISK RATING MATRIX

11. IMPACT OF PROPOSED DEVELOPMENT

11.1 TREES TO BE RETAINED ONSITE AND ASSOCIATED PROTECTION ZONES

All trees that scored HIGH as priority for retention are good specimens and should be protected throughout any stages of development to ensure there are no detrimental effects to the health of the trees. Trees that have scored MEDIUM for retention should also be protected where possible without impacting the development. If it is not possible to construct the new development without seriously impacting the tree then those trees with MEDIUM retention value should be considered for removal. Trees with LOW retention value should be removed if required to accommodate the new development.

A review of the designs for the proposed development showed that there will be a need to remove at least 16 trees within the site to accommodate the development although there would only be one high retention tree and 4 medium retention trees that will require removal. The remaining 11 trees recommended for removal were all ranked as low retention trees. These are discussed further in the next section.

Of the remaining 19 trees surveyed onsite it should be possible to retain and protected them according to AS-4970-2009 (Protection of Trees on Development Sites) with some guidance from the project arborist despite some of these trees requiring major TPZ encroachments as determined by AS-4970-2009. This is primarily due to the topography of the site whereby the trees are located further up the slope from the proposed building footprint and the presence of the current retaining wall around the oval at the base of the slope that will have prevented a lot of the lateral root growth towards the oval and the proposed new development works. This coupled with the design of the sports field which has a cantilevered structure and piered construction for some of its footings and retaining walls will all limit the encroachment into the root zone for trees located around the north eastern side of the oval. There is likely to be a need for some canopy pruning in the form of crown raising of at least 20% canopy coverage for Trees 28, 35 and 37 to accommodate the proposed development. If Tree 37 requires too much pruning to maintain a good structure and form, or the root encroachment is significant, then this tree should just be removed and replaced since this tree is only ranked as a low retention tree.

All initial excavations with the TPZ should be done in consultation with the project arborist and using non-destructive techniques (air spade or hydrovac) to ensure no major roots will be damaged as part of the demolition or construction stages. Once it is apparent no roots are present in an area that requires further excavations then standard methods of excavation can be used. This is particularly important for Tree 38 that is a high retention value tree and will require some major TPZ encroachment. Tree 1 will enquire some minor encroachment for the installation of 2 piers for the tennis courts. This will have minimal impact on the health of the tree since it will involve only minor encroachment but it should be done in consultation with the project arborist. No excavations, storage of materials or root pruning is to occur within its TPZ without supervision or consultation with the project arborist.

With all trees to be retained and protected onsite, no roots greater than 40mm diameter are to pruned within the TPZ and no roots at all within the SRZ without consultation with the project arborist. TPZ fencing for some trees can only extend to the edge of the proposed development footings or adjacent footpaths but all restrictions regarding activities within the TPZ still apply to any area within the distances listed below in Table 3 even though they may be outside the fenced area. Table 3 below lists the actual TPZ and SRZ radius's and any encroachments that will be required. The tree protection and removals plan shown in sections 11.3 and 11.4 below shows details of any encroachments and the location of each TPZ. TPZ fencing should run along the edge of the TPZ zones and take into account the space required for the proposed development footings. This should be setup in coordination

with the project arborist since the topography of the site may make the setup of regular TPZ fencing quite difficult. If access into the TPZs for construction traffic is required then the location of TPZ fencing and/or trunk protection and ground protection should be done in consultation with the project arborist.

Tree No.	Species	Canopy Spread (m)	DBH (mm)	DRC (mm)	TPZ radius (m)	SRZ radius (m)	TPZ Encroachment required
1	Araucaria heterophylla (Norfolk pine)	14	1470	1520	17.6	3.9	Minor TPZ encroachment required for pier locations of tennis courts. All excavations to be supervised or done in consultation with project arborist. No root pruning at all to occur without consultation project arborist.
10	Melaleuca styphelioides (Prickly leaved Paperbark)	9	480	520	5.8	2.5	No TPZ encroachment required
11	Melaleuca quinquenervia (Broad-leaved Paperbark)	8	640	680	7.7	2.8	No TPZ encroachment required
12	Howea foresteriana (Kentia Palm)	4	220	250	2.6	1.8	No TPZ encroachment required
14	Syagrus romanzoffiana (Cocos Palm)	5	320	350	3.8	2.1	No TPZ encroachment required
15	Melaleuca styphelioides (Prickly leaved Paperbark)	7	440	480	5.3	2.4	No TPZ encroachment required
16	Angophora costata (Sydney Red Gum)	16	740	780	8.9	3.0	No TPZ encroachment required
17	Angophora costata (Sydney Red Gum)	10	420	450	5.0	2.4	No TPZ encroachment required
21	Grevillea robusta (Silky Oak)	12	680	730	8.2	2.9	Minor TPZ encroachment required (<10%) – acceptable according to AS-4970-2009
22	Magnolia grandiflora (Southern Magnolia)	6	230	250	2.8	1.8	No TPZ encroachment required
24	Casuarina cunninghamiana (She Oak)	8	535	535	6.4	2.5	No TPZ encroachment required
27	Eucalyptus saligna (Sydney Blue Gum)	8	330	350	4.0	2.1	No TPZ encroachment required
28	Casuarina cunninghamiana (She Oak)	20	580	600	7.0	2.7	Major TPZ encroachment required (>10%) but slope should limit the lateral spread of roots. Initial excavations in TPZ done using non-destructive techniques. No roots to be pruned within TPZ without consultation project arborist.

Tree No.	Species	Canopy Spread (m)	DBH (mm)	DRC (mm)	TPZ radius (m)	SRZ radius (m)	TPZ Encroachment required
30	Agathis robusta (Kauri Pine)	5	340	360	4.1	2.2	No TPZ encroachment required
34	Banksia integrifolia (Coast Banksia)	12	740	780	8.9	3.0	No TPZ encroachment required
35	Toona ciliata (Australian Red Cedar)	15	660	690	7.9	2.8	Major TPZ encroachment required (>10%) but slope and retaining wall should limit the lateral spread of roots towards the oval. All initial excavations with the TPZ will need to be done using non-destructive techniques and done in consultation with project arborist. No roots greater than 40mm diameter pruned within the TPZ and no roots at all to be pruned within the SRZ without consultation with the project arborist. Approx 20% canopy reduction pruning required.
36	Eucalyptus microcorys (Tallowood)	6	300	320	3.6	2.1	Minor TPZ encroachment required (<10%) – acceptable according to AS-4970-2009
37	Glochidion ferdinandi (Cheese Tree)	9	500	520	6.0	2.5	Major TPZ encroachment required (>10%) but slope and retaining wall should limit the lateral spread of roots towards the oval. All initial excavations with the TPZ will need to be done using non-destructive techniques and done in consultation with project arborist. No roots greater than 40mm diameter pruned within the TPZ and no roots at all to be pruned within the SRZ without consultation with the project arborist. Approx 20-25% canopy reduction pruning required.
38	Pinus halepensis (Allepo pine)	12	560	630	6.7	2.7	Major TPZ encroachment required (>10%) but slope and retaining wall should limit the lateral spread of roots towards the oval. All initial excavations with the TPZ will need to be done using non-destructive techniques and done in consultation with project arborist. No roots greater than 40mm diameter pruned within the TPZ and no roots at all to be pruned within the SRZ without consultation with the project arborist. Approx 15-20% canopy reduction pruning required.

TABLE 5 – TPZ FOR RETAINED TREES AND ASSOCIATED ENCROACHMENTS

11.2 TREES TO BE REMOVED ONSITE

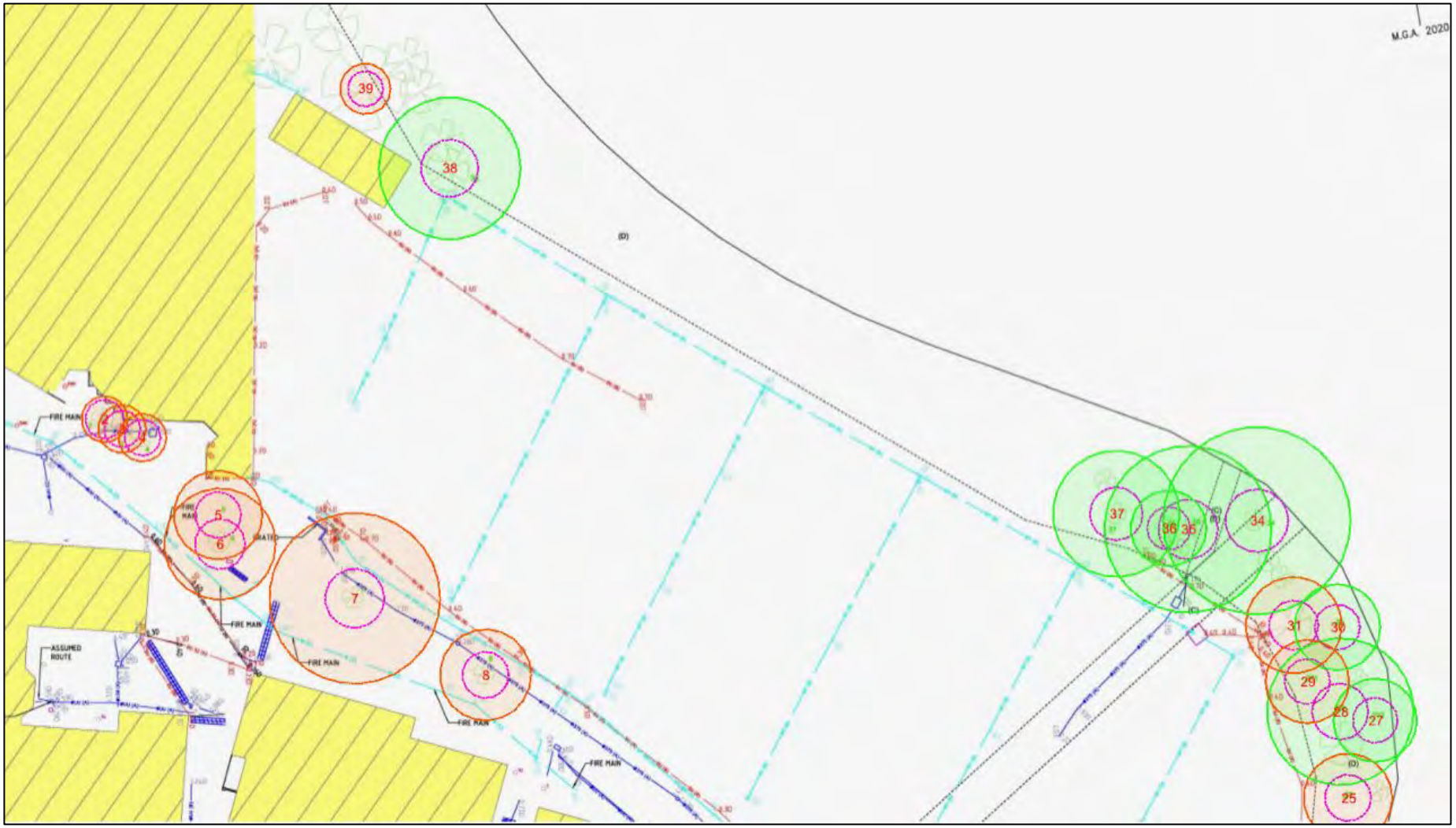
The table below lists the trees onsite that have been recommended for removal together with reasons and any additional details. There was only one high retention value tree (Tree 7) and 4 medium retention value trees (Trees 19, 20, 23 and 29) that will require removal to accommodate the development. The remainder were all classified as low retention value trees. It should be noted that Tree 29 has some aboriginal art work on the trunk although this was done in recent years by a local artist and is the property of Kambala School.

Tree No.	Species	Details / Specifications.
2	Archontophoenix cunninghamiana (Bangalow Palm)	Remove and replace. LOW retention value. Conflict with development.
3	Archontophoenix cunninghamiana (Bangalow Palm)	Remove and replace. LOW retention value. Conflict with development.
4	Archontophoenix cunninghamiana (Bangalow Palm)	Remove and replace. LOW retention value. Conflict with development..
5	Syagrus romanzoffiana (Cocos Palm)	Remove and replace. LOW retention value. Exempt Species. Conflict with development.
6	Syagrus romanzoffiana (Cocos Palm)	Remove and replace. LOW retention value. Exempt Species. Conflict with development
7	Ulmus parvifolia (Chinese Elm)	Remove and replace. HIGH retention value. Not possible to integrate with the new design.
8	Callistemon sp. (Bottlebrush)	Remove and replace. LOW retention value. Conflict with development
18	Robinia pseudoacacia (Robinia)	Remove and replace. LOW retention value. Conflict with development
18a	Syzygium smithii (Lillypilly)	Remove and replace. LOW retention value. Conflict with development
19	Lagerstromia indica (Crepe Myrtle)	Remove and replace. MEDIUM retention value. Conflict with development

Tree No.	Species	Details / Specifications.
20	Quercus robur (English Oak)	Remove and replace. MEDIUM retention value. Conflict with development
23	Jacaranda mimosifolia (Jacaranda)	Remove and replace. MEDIUM retention value. Conflict with development
25	Glochidion ferdinandi (Cheese Tree)	Remove and replace. LOW retention value. Conflict with development
29	Corymbia maculata (Spotted gum)	Remove and replace. MEDIUM retention value. Conflict with development. Aboriginal artwork by local artist on trunk of tree.
31	Corymbia citriodora (Lemon scented Gum)	Remove and replace. LOW retention value. Recent storm damage has resulted in lopping works. Conflict with development
39	Strelitzia reginae (Stand of Strelitzia)	Remove and replace. LOW retention value. Conflict with development

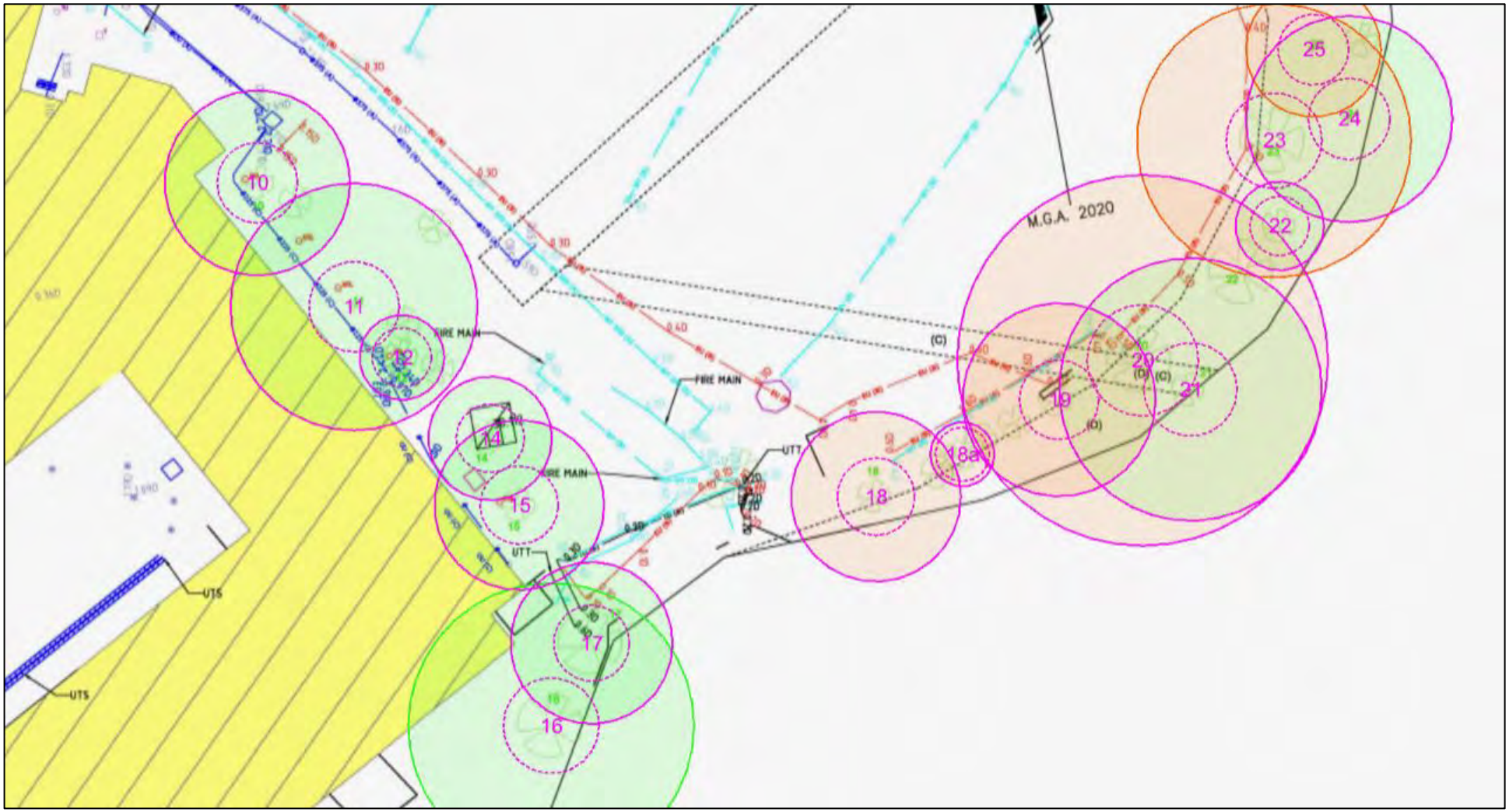
TABLE 6 – TREES TO BE REMOVED

11.3 TREE RETENTION AND REMOVALS PLAN – NORTH SECTION OF OVAL



PLAN OF SITE SHOWING TREES TO BE RETAINED (GREEN) AND TREES RECOMMENDED FOR REMOVAL (RED) TO ACCOMMODATE DEVELOPMENT.

11.4 TREE RETENTION AND REMOVALS PLAN – SOUTH SECTION OF OVAL



PLAN OF SITE SHOWING TREES TO BE RETAINED (GREEN) AND TREES RECOMMENDED FOR REMOVAL (RED) TO ACCOMMODATE DEVELOPMENT.

11.5 PROPOSED DEVELOPMENT PLAN AND TREES TO BE RETAINED SHOWING TPZS / SRZS

PLAN OF SITE SHOWING TREES TO BE PROTECTED (TPZ OUTER GREEN CIRCLE, SRZ DASHED INNER CIRCLE) - TPZ FENCING INSTRUCTIONS IN SECTION 11.1.

12. TREE PROTECTION DURING DEVELOPMENT

12.1 PROJECT ARBORIST

A project arborist with a minimum of 5 years experience within the arboriculture industry, demonstrated management of trees on construction sites and a minimum certification of AQF-Level 5 (Diploma Level) should be appointed to oversee all areas of the project regarding any activities that may occur close to or within any TPZs of tree that are to be retained.

They should be involved in all stages of early planning to prevent any damage to the trees to be retained and any unnecessary hold ups for the development if certain conditions and requirements have not been addressed.

The project arborist should complete regular inspections and monitoring of the site to ensure all tree protection measures are being adhered to, any additional protection measures are implemented if tree health appears to be in decline and all monitoring is documented for compliance certification.

It is very important that communications channels between planners, architects, builders and the project arborist are kept open to ensure that the trees are protected throughout every stage of the development. Remediation measures are far less likely to be successful than careful planning with regards to tree protection. All site personnel must be properly briefed before any work starts.

12.2 TREE PROTECTION WORKS – PRIOR TO DEMOLITION

All TPZs (Tree Protection Zones) will need to be constructed as shown in a Tree Protection Plan produced by the project arborist prior to any demolition. Any encroachments or setbacks required to accommodate the new development need to be done in consultation with the project arborist.

12.2.1 GENERAL TPZ – NO ACCESS AUTHORISED

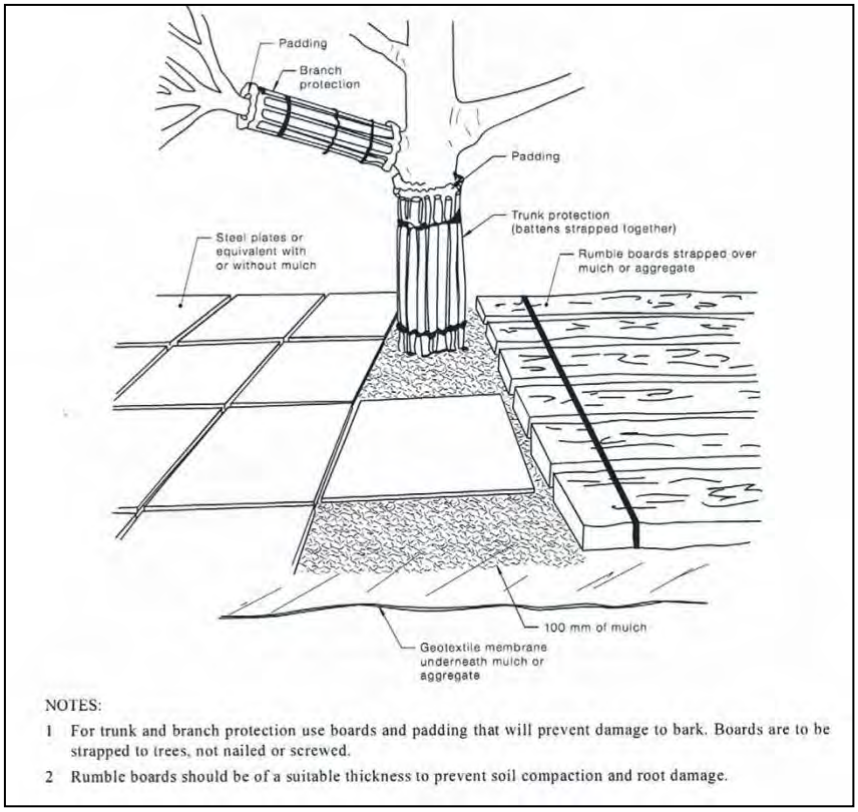
The Protective fencing, signage and area within the TPZ should be constructed according to AS-4970-2009.

- Protective Fencing – The fencing delineates the boundary of the TPZ and should be positioned in accordance with Site Plan – Tree Protection zones and in consultation with the project arborist. Section 4, 4.3 of AS-4970 states " Fencing should be erected before any machinery or materials are brought onto the site and before the commencement of works including demolition. Once erected, protective fencing must not be removed or altered without approval by the project arborist. The TPZ should be secured to restrict access. AS-4687 specifies applicable fencing requirements. Shade cloth or similar should be attached to reduce the transport of dust, other particulate matter and liquids into the protected area. Fence posts and supports should have a diameter greater than 20mm and be located clear of roots.
- TPZ encroachment – If encroachment is required to accommodate the building footprint then consideration should be given to the fact that the TPZ does actually extend outside of the fenced area and the rules regarding activities prohibited in the TPZ (Section 12.3) should apply to the distances presented in table 5 section 11.1 above and not just inside the fenced TPZ area.
- Signage – Signs identifying the TPZ should be placed around the edge of the TPZ and be visible from the development site.
- Mulching – Mulch installation across the surface of the TPZ should be carried out at the discretion of the project arborist. If required it should be applied to a depth of 100mm, consisting of approximately 75% leaf litter and 25% wood, and preferably from the same genus and species of tree to which they are protecting.
- Irrigation – At the discretion of the project arborist a timed drip irrigation system can be installed prior to any demolition works if it is deemed necessary.

12.2.2 ACCESS TO TPZ – TEMPORARY OR PERMANENT

The client has not detailed the exact location of logistical vehicular traffic and/or pedestrian traffic required during the construction phase. In general no access or any works are authorized inside a TPZ although pedestrian and vehicular access should still be allowed on roads and pavements already in place. If it is determined that entry into or through any of the TPZs are required then additional protection measures will be required. These are outlined in AS-4970-2009 in section 4.5 and listed below:

- Trunk and Branch Protection
  If access into the TPZ area is required for any scaffolding, or machinery, within 2m of the trees, then trunk and branch protection will need to be installed on limbs up to those above the height of tallest vehicle/scaffold. This should be installed by wrapping 2 layers of hessian (or similar material) around the branches and then securing hardwood battens (75x50x2000mm) at 100mm centers as shown in figure 9 below.



TPZ TEMPORARY ACCESS – PROTECTION MEASURES

- Ground Protection.
  If machinery or pedestrian access is required within the TPZ then ground protection measures will be required to prevent any compaction or root damage. These measures require a permeable membrane such as geotextile fabric beneath a 100mm layer of mulch with rumble boards or steel plates laid above.

12.3 TREE PROTECTION MEASURES – DURING CONSTRUCTION

Some activities may be authorized by the project arborist but generally all activities involving soil level changes, excavation, storage, excavation, cleaning and refueling are prohibited (a full list is found in section 4.2 AS-4970). There are some additional guidelines that do allow certain activities within the TPZ during construction but all of these need to be supervised and determined by the project arborist.

EXCAVATION AND FILL IN TPZ

Guidelines for excavation within the TPZ:

- All works must be carried out under the supervision of the project arborist.
- Root mapping for any encroachment greater than 10% of the TPZ will need to be carried out by the project arborist to determine the extent of root growth within the area designated for development. All root mapping will need to be done with none destructive techniques such as an air spade, water laser, manual digging (taking care not to damage roots or bark) or ground penetrating radar. The root mapping exercise should determine the extend of woody structural roots greater than 50mm diameter within the proposed development footprint and determine the amount of root pruning that would be possible. When the project arborist identifies roots to be pruned (>50mm) they should be cut with sharp tools such as pruners or chainsaws and back to undamaged wood. No 'pruning' is to be done by machinery.
- Root protection during works – Some approved works such as regrading, installation of piers or landscaping may have potential to damage roots. Where roots are exposed within the TPZ, temporary root protection should be installed to prevent them drying out. This may include jute matting or hessian sheeting as multiple layers. This should be pegged in place and kept moist during period that the root zone is exposed.

Guidelines for adding fill within the TPZ:

- Any material used as fill should be approved by the project arborist and consist of a course, gap-graded material to provide aeration and infiltration to the root zone. Clays and any sort of fines should not be used since this will seriously impact the future health of the tree.
- No grade changes greater than 250mm should be done without approval of the project arborist and any compaction should be done with a non-vibrating roller.

DEMOLITION AND INSTALLATION OF STRUCTURES IN TPZ

- All demolition and installation of structures within the TPZ will need to be done under the instruction of the project arborist.
- Great care should be taken to ensure no roots are damaged as structures or surfaces are removed since roots are often very close to the surface. No heavy machinery is allowed within any TPZs and any removal of structures and surfaces should be done using appropriate hand and power tools to ensure roots are not damaged underneath the surface being removed.
- Installation of new surfaces should be semi permeable to allow water and gaseous exchange to the root zone underneath. There are several specialised surface materials and technologies that can allow for this whilst ensure adequate loading is still possible without any additional compaction. The project arborist will need to determine which of these will be suitable for the application.
- Installation of building structures within the TPZ may require piled supports that are located between the larger structural roots and enable the structure to be suspended. This is an engineering solution that will

require the collaboration of the project arborist and the architect to develop the correct designs. above the root zone and therefore limit the detrimental affects of the encroachment into this area.

- Installing underground services – If services must be routed through a TPZ they should be installed by directional drilling (at least 600mm deep) or in manually excavated trenches (supervised by project arborist)
- Scaffolding – When it is essential to erect scaffolding within a TPZ it should be designed to minimize any branch removal. Branches should be tied back or when unavoidable pruned as required according to AS-4373. These works may require authority from LGA. Ground protection as detailed in section 12.2 above may also be required.

SOFT LANDSCAPING IN TPZ

Guidelines for Soft Landscaping within the TPZ:

- Soft landscaping involves the addition of soil, trees and plants, lawns and mulch. These all have the potential to be extremely damaging to trees if not done according to directions of the project arborist.
- No significant excavations, turfing, plantings, grade changes, soil addition or removal, addition of fertilisers or mulching should be done without consultation with project arborist
- Areas too close to tree trunks should not be have grade changes or be excessively mulched

MONITORING DURING CONSTRUCTION

All the TPZs for the retained trees are to be monitored and maintaining throughout the construction phase of development. Areas that may require maintenance include:

- Mulching – mulch (if required) must be maintained to a depth of 50-100mm. Where the existing landscape within the TPZ is to remain unaltered mulch may not be required.
- Irrigation – Soil moisture levels may need to be monitored by the project arborist. Temporary irrigation or watering may be required within the TPZ upon discretion of project arborist.

The project arborist should monitor at regular intervals all construction works and excavations on site that are within the proximity of any TPZ to ensure that protection measures are being adhered to and no works are likely to affect the health of the protected trees.

12.4 POST CONSTRUCTION

At completion of all construction works the project arborist should assess the tree conditions and provide certification for tree protection with a condition that outstanding works or landscaping must not injure the trees. After this all tree protection measures should be removed from site.

Following the final inspection and completion of remedial works the project arborist should certify the completed works have been carried out in compliance with the approved plans and specifications according to AS-4970-2009. Monitoring documentation and any deviations should also be provided.

13. RECOMMENDATIONS

This arboricultural impact report recognizes that as a consequence of development in some cases certain trees may need to be removed to accommodate new constructions despite some of the specimen trees being of good health. This report has based its recommendations on ensuring that all trees that can be retained and integrated into this future development will be protected throughout all stages of development. The recommendations of this report include:

1. Retention and Protection of Trees 1, 10-12, 14-17, 21, 22, 24, 27, 28, 30, 34-37 and 38 according to AS-4970-2009 (Protection Trees on Development Sites). No roots are to be pruned greater than 40mm diameter within any TPZ and no roots at all within any SRZ without the authorisation of the project arborist. Details of any TPZ encroachment and tree protection required are found in sections 11.1, 11.3, 11.4 and 11.5.

2. Tree 1 will enquire some minor encroachment for the installation of 2 piers for the tennis courts. This will have minimal impact on the health of the tree since it will involve only minor encroachment but it should be done in consultation with the project arborist. No excavations, storage of materials or root pruning is to occur within its TPZ without supervision or consultation with the project arborist. Some minor canopy pruning of the tips of some lower canopy branches may also be required for clearances of the proposed tennis courts but these can again be done in consultation with the project arborist. It will amount to less than 2% of canopy pruning if required.

3. Trees 28, 35, 37 and 38 will require major TPZ encroachment and some canopy pruning to accommodate the development. This will need to be done in consultation with the project arborist.

4. Removal and replacement of Trees 2-8, 18, 18a, 19, 20, 23 25, 29, 31 and 39 will be required to accommodate the new development. Only one high retention value tree (Tree 7) and 4 medium retention value trees (Trees 19, 20, 23 and 29) that will require removal to accommodate the development. The details of the reasons for these removals and any replacement plantings required can be found in section 11.2.

5. Generally all activities involving soil level changes, excavation, storage, excavation, cleaning and refueling are prohibited (a full list is found in section 4.2 of AS-4970-2009) within the TPZ. Some activities may be authorized if required but only by the project arborist. Any additional mulching or irrigation required should be done at the discretion of the project arborist.

6. Branch and Truck protection, if required (only if access into TPZ needed), should be installed as detailed in section 12.2.2 of this report. All other tree protection measures required during construction and detailed in section 11 and 12 of this report are to be complied with.

7. Any tree removal works and tree protection measures should be carried out by an arborist with a minimum qualification of AQF level 3 and certified by the project arborist. The project arborist should have a minimum qualification of AQF level 5 or equivalent.

8. All works on-site should be carried out according to Workcover Authority NSW 2007, *Code of Practice Amenity Tree Industry,* NSW.

9. All works should be carried out according to AS-4373-2007 (Pruning of Amenity Trees) and AS-4970-2009 (Protection trees on development sites).

14. QUALIFICATIONS

- **Master Science Degree (MSc Hons)** – Information Technology (Sheffield Hallam University, UK)
- **Graduate Diploma (Arboriculture) – AQF Level 8** - (University of Melbourne) – 1st Class Hons
- **Bachelor Science Degree (BSc Hons)** - Environmental Science (Leeds University, UK)
- **Diploma Horticulture (Arboriculture)** – **AQF Level 5** - (Kurri Kurri TAFE) – Distinction
- **Certified Tree Risk Assessor** –QTRA Certified and ISA TRAQ Certified Risk Assessor
- **Arboriculture AQF Level 3** – Horticulture (Arboriculture) (Ryde TAFE)
- Member Arboriculture Australia – 12 Years
- 20 years arboriculture industry experience - Tree contractor and consulting arborist

15. REFERENCES

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8. Tree Retention Values Table. A.Morton from: Couston, Mark and Howden, Melanie (2001). Footprint Green Pty Ltd, Sydney Australia.
9. City of Sydney Council Tree Preservation Order
10. IACA Significance of a Tree, Assessment Rating System (STARS) © (IACA 2010) http://www.iaca.org.au/home/index.php/publications
11. Sustainable Retention Index Value (SRIV) Version 4 © (IACA 2010) http://www.iaca.org.au/home/index.php/publications

16. APPENDICES

16.1 APPENDIX 1 – VISUAL TREE ASSESSMENT (VTA) METHOD

THE PRINCIPLES OF RECOGNIZING PREDICTABLE TREE FAILURES

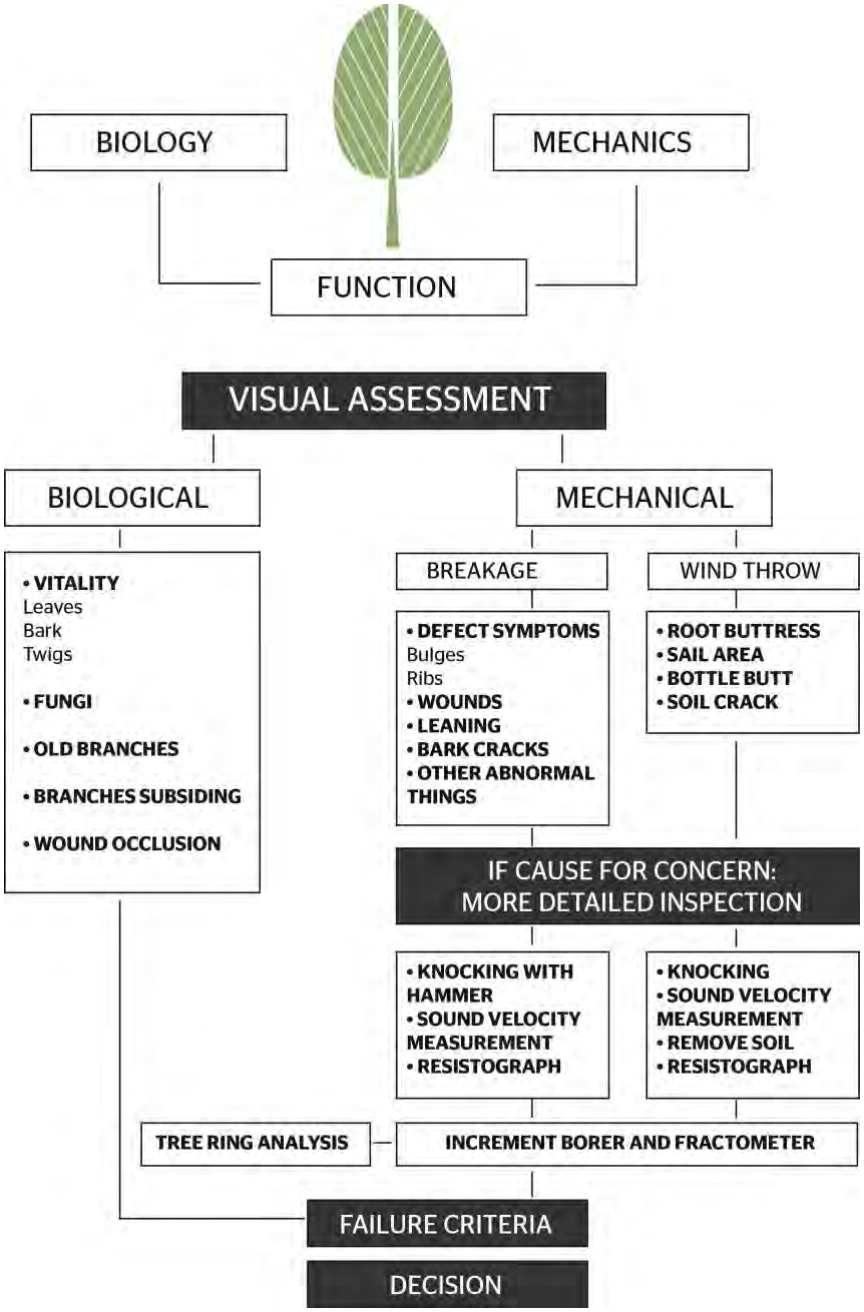


FIGURE 1 - SCHEMATIC REPRESENTATION OF THE PROCEDURE FOR EVALUATING A TREE WITH THE VTA SYSTEM

Source: Mattheck and Breloer "The body Language of Trees" 2007 p.196

16.2 APPENDIX 2 – (IACA 2010)© IACA SIGNIFICANCE OF A TREE, ASSESSMENT RATING SYSTEM (STARS)

Institute of Australian Consulting Arboriculturists, Australia, **www.iaca.org.au**. In the development of this document IACA acknowledges the contribution and original concept of the Footprint Green Tree Significance & Retention Value Matrix, developed by Footprint Green Pty Ltd in June 2001.

The landscape significance of a tree is an essential criterion to establish the importance that a particular tree may have on a site. However, rating the significance of a tree becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the retention value for a tree. To assist this process all definitions for terms used in the *Tree Significance - Assessment Criteria* and *Tree Retention Value - Priority Matrix*, are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009.

This rating system will assist in the planning processes for proposed works, above and below ground where trees are to be retained on or adjacent a development site. The system uses a scale of *High, Medium and Low significance* in the landscape. Once the landscape significance of an individual tree has been defined, the retention value can be determined.

Tree Significance - Assessment Criteria

1. High Significance in landscape

- The tree is in good condition and good vigour; - The tree has a form typical for the species; - The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age; - The tree is listed as a Heritage Item, Threatened Species or part of an Endangered ecological community or listed on Councils significant Tree Register; - The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity; - The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values; - The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa in situ - tree is appropriate to the site conditions.

2. Medium Significance in landscape

- The tree is in fair-good condition and good or low vigour; - The tree has form typical or atypical of the species; - The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area - The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street, - The tree provides a fair contribution to the visual character and amenity of the local area, - The tree's growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa in situ.

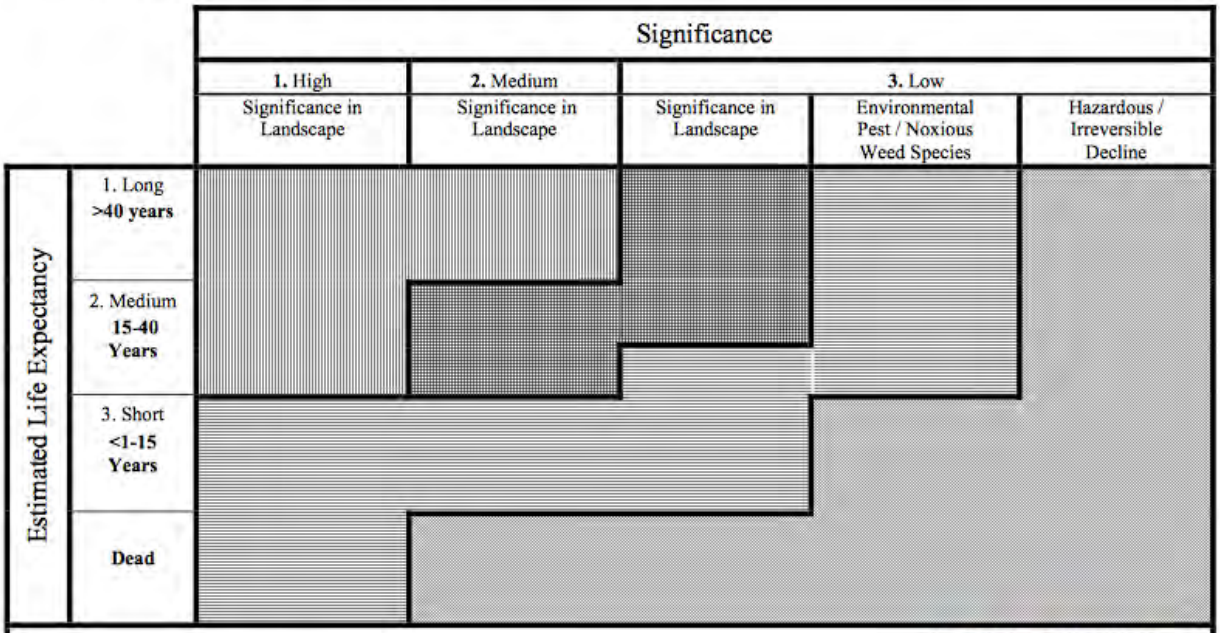
3. Low Significance in landscape

- The tree is in fair-poor condition and good or low vigour; - The tree has form atypical of the species; - The tree is not visible or is partly visible from surrounding properties as obstructed by other vegetation or buildings, - The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area, - The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation orders or similar protection mechanisms and can easily be replaced with a suitable specimen, - The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa in situ - tree is inappropriate to the site conditions, - The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms, - The tree has a wound or defect that has potential to become structurally unsound. Environmental Pest / Noxious Weed Species - The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties, - The tree is a declared noxious weed by legislation. Hazardous/Irreversible Decline - The tree is structurally unsound and/or unstable and is considered potentially dangerous, - The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in full or part in the immediate to short term.

The tree is to have a minimum of three (3) criteria in a category to be classified in that group.
Note: The assessment criteria are for individual trees only, however, can be applied to a monocultural stand in its entirety.

Table 1.0 below shows how to use the significance ratings to provide a value for the Tree Retention Value – Priority Matrix.

Table 1.0 Tree Retention Value - Priority Matrix.



Legend for Matrix Assessment

INSTITUTE OF AUSTRALIAN CONSULTING ARBORICULTURISTS ®

Priority for Retention (High) - These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard AS4970 *Protection of trees on development sites*. Tree sensitive construction measures must be implemented e.g. pier and beam etc if works are to proceed within the Tree Protection Zone.

Consider for Retention (Medium) - These trees may be retained and protected. These are considered less critical; however their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.

Consider for Removal (Low) - These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.

Priority for Removal - These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

REFERENCES

Australia ICOMOS Inc. 1999, *The Burra Charter – The Australian ICOMOS Charter for Places of Cultural Significance*, International Council of Monuments and Sites, www.icomos.org/australia

Draper BD and Richards PA 2009, *Dictionary for Managing Trees in Urban Environments*, Institute of Australian Consulting Arboriculturists (IACA), CSIRO Publishing, Collingwood, Victoria, Australia.

Footprint Green Pty Ltd 2001, *Footprint Green Tree Significance & Retention Value Matrix*, Avalon, NSW Australia, www.footprintgreen.com.au

16.3 APPENDIX 3 - IACA, 2010, SUSTAINABLE RETENTION INDEX VALUE (SRIV)©

The matrix is to be used with the value classes defined in the Glossary for Age / Vigour / Condition. An index value is given to each category where ten (10) is the highest value.

Age Class	Vigour Class and Condition Class					
	Good Vigour & Good Condition (GVG)	**Good Vigour & Fair Condition (GVF)**	**Good Vigour & Poor Condition (GVP)**	**Low Vigour & Good Condition (LVG)**	**Low Vigour & Fair Condition (LVF)**	**Low Vigour & Poor Condition (LVP)**
	Able to be retained if sufficient space available above and below ground for future growth. No remedial work or improvement to growing environment required. May be subject to high vigour. Retention potential - Medium - Long Term.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work may be required or improvement to growing environment may assist. Retention potential - Medium Term. Potential for longer with remediation or favourable environmental conditions.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work unlikely to assist condition, improvement to growing environment may assist. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	Retained if sufficient space available above and below ground for future growth. No remedial work required, but improvement to growing environment may assist vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment may assist condition and vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	Unlikely to be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing env. unlikely to assist condition or vigour. Retention potential - Likely to be removed immediately or retained for Short Term. Potential for longer with remediation or favourable environmental conditions.
(Y) Young	**YGVG - 9 Index Value 9** Retention potential - Long Term. Likely to provide minimal contribution to local amenity if height Retain, move or replace.	**YGVF - 8 Index Value 8** Retention potential - Short - Medium Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height Medium-high potential for future growth and adaptability. Retain, move or replace.	**YGVP - 5 Index Value 5** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height Low-medium potential for future growth and adaptability. Retain, move or replace.	**YLVG - 4 Index Value 4** Retention potential - Short Term. Potential longer with improved growing conditions. Likely provide minimal contribution to local amenity Medium potential future growth and adaptability. Retain, move or replace	**YLVF - 3 Index Value 3** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m. Low-medium potential for future growth and adaptability. Retain, move or replace.	**YLVP - 1 Index Value 1** Retention potential - Likely to be removed immediately or retained for Short Term. Likely to provide minimal contribution to local amenity if height
(M) Mature	**MGVG - 10 Index Value 10** Retention potential - Medium - Long Term.	**MGVF - 9 Index Value 9** Retention potential - Medium Term. Potential for longer with improved growing conditions.	**MGVP - 6 Index Value 6** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVG - 5 Index Value 5** Retention potential - Short Term. Potential for longer with improved conditions.	**MLVF - 4 Index Value 4** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVP - 2 Index Value 2** Retention potential - Likely to be removed immediately or retained for Short Term.
(O) Over-mature	**OGVG - 6 Index Value 6** Retention potential - Medium - Long Term.	**OGVF - 5 Index Value 5** Retention potential - Medium Term.	**OGVP - 4 Index Value 4** Retention potential - Short Term.	**OLVG - 3 Index Value 3** Retention potential - Short Term. Potential for longer with improved conditions.	**OLVF - 2 Index Value 2** Retention potential - Short Term.	**OLVP - 0 Index Value 0** Retention potential - Likely to be removed immediately or retained for Short Term.

16.4 APPENDIX 4 ULE CATEGORIES

ULE categories (after Barrell 1996, Updated 01/04/01) The five categories and their sub-groups are as follows:

Long ULE - tree appeared retainable at the time of assessment for over 40 years with an acceptable degree of risk, assuming reasonable maintenance:

a) Structurally sound trees located in positions that can accommodate future growth
b) Trees which could be made suitable for long term retention by remedial care
c) Trees of special significance which would warrant extraordinary efforts to secure their long term retention

Medium ULE - tree appeared to be retainable at the time of assessment for 15 to 40 years with an acceptable degree of risk, assuming reasonable maintenance:

a) Trees which may only live from 15 to 40 years
b) Trees which may live for more than 40 years but would be removed for safety or nuisance reasons
c) Trees which may live for more than 15 years but would be removed to prevent interference with more suitable individuals or to provide space for new planting
d) Trees which could be made suitable for retention in the medium term by remedial care

Short ULE - tree appeared to be retainable at the time of assessment for 5 to 15 years with an acceptable degree of risk, assuming reasonable maintenance:

a) Trees which may only live from 5 to 15 years
b) Trees which may live for more than 15 years but would be removed for safety or nuisance reasons
c) Trees which may live for more than 15 years but would be removed to prevent interference with more suitable individuals or to provide space for new planting
d) Trees which require substantial remediation and are only suitable for retention in the short term.

Removal - trees which should be removed within the next 5 years:

a) Dead, dying, suppressed or declining trees because of disease or inhospitable conditions
b) dangerous trees through instability or recent loss of adjacent trees
c) Dangerous trees because of structural defects including cavities, decay, included bark, wounds or poor form
d) Damaged trees that are clearly not safe to retain
e) Trees which may live for more than 5 years but would be removed to prevent interference with more suitable individuals or to provide space for new planting
f) Trees which are damaging or may cause damage to existing structures within the next 5 years
g) Trees that will become dangerous after removal of other trees for the reasons given in (a) to (f)
h) Trees in categories (a) to (g) that have a high wildlife habitat value and, with appropriate treatment, could be retained subject to regular review

Small, young or regularly pruned - Trees that can be reliably moved or replaced:

a) small trees less than 5m in height
b) young trees less than 15 years old but over 5m in height
c) formal hedges and trees intended for regular pruning to artificially control growth

16.5 APPENDIX 4 – EXTRACT FROM AUSTRALIAN STANDARD AS4970 2009 PROTECTION OF TREES ON DEVELOPMENT SITES

Section 3 - Determining the tree protection zones of the selected trees

3.1 Tree protection zone (TPZ)

"The tree protection zone (TPZ) is the principal means of protecting trees on development sites. The TPZ is a combination of the root area and crown area requiring protection. It is an area isolated from construction disturbance, so that the tree remains viable.

The TPZ incorporates the structural root zone (SRZ) (refer to Clause 3.3.5)."

3.2 Determining the TPZ

The radius of the TPZ is calculated for each tree by multiplying its DBH x 12

Where TPZ = DBH x 12

DBH = trunk diameter measured at 1.4 m above ground (DBH = Diameter at Breast Height)

Radius is measured from the centre of the stem at ground level.

3.3 Structural root zone (SRZ)

"The SRZ is the area required for street stability. A larger area is required to maintain a viable tree. The SRZ only needs to be calculated when a major encroachment into a TPZ is proposed. Root investigation may provide more information on the extent of these roots."

Determining the SRZ

SRZ radius = (DRC x 50) 0.42 x 0.64

Where

DRC = trunk diameter, in metres, measured above the root crown (DRC = Diameter Above Root Crown)

Note: The SRZ for trees with trunk diameters (DRC) less than 0.15 m will be 1.5 m (see Figure 1).

16.6 Appendix 6 – ISA TRAQ – International Society Arboriculture Tree Risk Assessment Qualification

Risk vs Hazard

In the past, arborsits have often used the term *Hazard Risk Assessment* to describe the process of inspecting and evaluating the structural condition of a tree and the harm it could occur if it failed. The more accurate and appropriate term *Risk Assessment* is now becoming standard. A Hazard is a likely source of harm and in relation to trees it is the tree part that may fail. Risk is the combination of the likelihood of an event and the severity of the potential consequences. In assessing the likelihood there are many other factors to consider such as target type and occupancy rate, as well as the nature of the failure itself.

Qualitative Risk assessment.

ISA TRAQ uses qualitative risk assessment. This is the process of using ratings of the likelihood and consequence of an event to determine the risk level and evaluate the level of risk against qualitative criteria. The term *likelihood* is used rather than *probability* because probability may imply quantative odds. ISA TRAQ uses ratings combined in a matrix to categorise risk. This approach is a recognised and respected method of risk assessment used internationally by many governments and businesses.

ISA TRAQ Risk Categorisation Details

In deriving an estimate of risk you must consider the targets, the likelihood of tree failure impacting a target and the consequence of the failure. It order to determine the likelihood of tree failure you must consider 2 factors.

1. Likelihood of tree failure occurring within a specified time frame.
2. Likelihood of failed part impacting the specified target.

Once we have determined these 2 factors we can then use the Likelihood matrix (see below) and the Risk Matrix (see below) to determine the risk category

Likelihood of Tree Failure

The arborist uses expertise to determine significance of any defects, site conditions and response growth to determine likelihood of any failures. The matrix used to determine this is categorised using the following guidelines

Improbable – The tree or branch is not likely to fail during normal weather conditions and may not fail in many severe weather conditions within the specified time frame.

Possible – Failure could occur, but it is unlikely during normal weather conditions within the specified time frame.

Probable – Failure may be expected under normal weather conditions within the specified time frame.

Imminent – Failure has started or is most likely to occur in the near future, even if there is no significant wind or increased load. This is an infrequent occurrence for a risk assessor to encounter and may require immediate action to protect people.

Likelihood of failed part impacting the specified target

Firstly we need to consider the occupancy rate of the specified target which could be a static target (i.e. buildings, powerlines) or a mobile target (i.e. people, vehicles).

Constant Occupancy – Target present at nearly all times, 24hrs a day, 7 days a week i.e. buildings, powerlines.

Frequent Occupancy – Target zone occupied for large portion of a day or week.

Occasional Occupancy – Target zone occupied by people or targets infrequently or irregularly.

Rare Occupancy – Target zone is not commonly used by people.

We then use these occupancy rates in combination with other site factors to determine the likelihood of the failed part impacting the target. The description of each categorisation used in the table is shown below.

Very Low – The likelihood of failed tree or part impacting the specified target is remote. This is the case in a rarely used site fully exposed to the assessed tree (rare occupancy, no protection) or an aoccasionally used site that is partially protected by trees or structures (occasional occupancy, moderate protection) e.g. rarely used trail or occasionally used area that is protected from failure by adjacent trees.

Low – It is not likely that the failed tree or part will impact the target. This is case in an occasionally used area that is fully exposed to the assessed tree, a frequently used area that is partially exposed to the assessed tree, or a constant target that is well protected from eth assessed tree. e.g little used service road next to assessed tree or frequent used public street protected by another tree between it and the assessed tree.

Medium – The failed tree or part is as likely to impact the target as not. This is the case in frequently used area that is fully exposed on one side to the assessed tree or a constantly occupied area that is partially protected from the assessed tree. e.g. suburban street next to assessed tree or a house that partially protected from assessed tree by an intervening tree.

High – The failed tree or part will most likely impact the target. This is the case when a fixed target is fully exposed to the likely failure (constant occupancy, no protection) or the likely failure is over a high-use road or walkway with an adjacent tree (frequent occupancy).

Likelihood Matrix

After determining the likelihood of failure and the likelihood of impacting the target we can then categorise the possible tree failure into the likelihood matrix shown below.

LIKEIHOOD OF FAILURE	LIKELIHOOD OF IMPACTING TARGET			
	VERY LOW	LOW	MEDIUM	HIGH
IMMINENT	Unlikely	Somewhat likely	Likely	Very Likely
PROBABLE	Unlikely	Unlikely	Somewhat likely	Likely
POSSIBLE	Unlikely	Unlikely	Unlikely	Somewhat likely
IMPROBABLE	Unlikely	Unlikely	Unlikely	Unlikely

Consequence of a failure

It order to determine the risk categorisation we next need to determine the consequence of a failure to the target. An explanation of these categories is shown below.

Negligible – Consequences involve low-value property damage or disruption that can be repaired or replaced: they do not involve personal injury e.g. branch striking a fence.

Minor – Consequences involve low to moderate property damage, small disruptions to traffic or a communications utility, or very minor injury e.g. temporary disruption traffic on neighbourhood street.

Significant – Consequences involve property damage of moderate to high value, considerable disruption, or personal injury e.g. medium sized part striking an unoccupied new vehicle from a high height.

Severe – Consequences involve serious injury or death, damage to high-value property, or disruption of important activities e.g. injury to a person that may result in hospitalisation.

Risk Matrix

Now we can now finally categorise the overall risk of a whole tree failure or tree part failure by combining the result from the Likelihood matrix with that from the consequence of a failure categorisation shown above. The risk Matrix shown below is used to combine these 2 categories to provide a final risk assessment rating (Low, Moderate, High or Extreme).

LIKEIHOOD OF FAILURE & IMPACT	CONSEQUENCE OF FAILURE			
	NEGLIGIBLE	MINOR	SIGNIFICANT	SEVERE
VERY LIKLEY	Low	Moderate	High	Extreme
LIKELY	Low	Moderate	High	High
SOMEWHAT LIKELY	Low	Low	Moderate	Moderate
UNLIKELY	Low	Low	Low	Low

13.7 GLOSSARY

From Dictionary for Managing Trees in Urban Environments
Institute of Australian Consulting Arboriculturists (IACA) 2009.

Age of Trees

Age Most trees have a stable biomass for the major proportion of their life. The estimation of the age of a tree is based on the knowledge of the expected lifespan of the taxa in situ divided into three distinct stages of measurable biomass, when the exact age of the tree from its date of cultivation or planting is unknown and can be categorized as Young, Mature and Over-mature (British Standards 1991, p. 13, Harris et al, 2004, p. 262).

Young Tree aged less than <20% of life expectancy, in situ. **Mature** Tree aged 20-80% of life expectancy, in situ.

Over-mature Tree aged greater than >80% of life expectancy, in situ, or senescent with or without reduced vigour, and declining gradually or rapidly but irreversibly to death.

Condition of Trees

Condition A tree's crown form and growth habit, as modified by its environment (aspect, suppression by other trees, soils), the stability and viability of the root plate, trunk and structural branches (including structural defects such as wounds, cavities or hollows, crooked trunk or weak trunk/branch junctions and the effects of predation by pests and diseases. These may not be directly connected with vigour and it is possible for a tree to be of normal vigour but in poor condition. Condition can be categorized as Good Condition, Fair Condition, Poor Condition and Dead.

Good Condition Tree is of good habit, with crown form not severely restricted for space and light, physically free from the adverse effects of predation by pests and diseases, obvious instability or structural weaknesses, fungal, bacterial or insect infestation and is expected to continue to live in much the same condition as at the time of inspection provided conditions around it for its basic survival do not alter greatly. This may be independent from, or contributed to by vigour.

Fair Condition Tree is of good habit or misshapen, a form not severely restricted for space and light, has some physical indication of decline due to the early effects of predation by pests and diseases, fungal, bacterial, or insect infestation, or has suffered physical injury to itself that may be contributing to instability or structural weaknesses, or is faltering due to the modification of the environment essential for its basic survival. Such a tree may recover with remedial works where appropriate, or without intervention may stabilise or improve over time, or in response to the implementation of beneficial changes to its local environment. This may be independent from, or contributed to by vigour.

Poor Condition Tree is of good habit or misshapen, a form that may be severely restricted for space and light, exhibits symptoms of advanced and irreversible decline such as fungal, or bacterial infestation, major die-back in the branch and foliage crown, structural deterioration from insect damage e.g. termite infestation, or storm damage or lightning strike, ring barking from borer activity in the trunk, root damage or instability of the tree, or damage from physical wounding impacts or abrasion, or from altered local environmental conditions and has been unable to adapt to such changes and may decline further to death regardless of remedial works or other modifications to the local environment that would normally be sufficient to provide for its basic survival if in good to fair condition. Deterioration physically, often characterised by a gradual and continuous reduction in vigour but may be independent of a change in vigour, but characterised by a proportionate increase in susceptibility to, and predation by pests and diseases against which the tree cannot be sustained. Such conditions may also be evident in trees of advanced senescence due to normal phenological processes, without modifications to the growing environment or physical damage having been inflicted upon the tree. This may be independent from, or contributed to by vigour.

Dead Tree is no longer capable of performing any of the following processes or is exhibiting any of the following symptoms;
Processes
Photosynthesis via its foliage crown (as indicated by the presence of moist, green or other coloured leaves);
Osmosis (the ability of the root system to take up water);
Turgidity (the ability of the plant to sustain moisture pressure in its cells);
Epicormic shoots or epicormic strands in Eucalypts (the production of new shoots as a response to stress, generated from latent or adventitious buds or from a lignotuber);
Symptoms
Permanent leaf loss;
Permanent wilting (the loss of turgidity which is marked by desiccation of stems leaves and roots);
Abscission of the epidermis (bark desiccates and peels off to the beginning of the sapwood).

Removed No longer present, or tree not able to be located or having been cut down and retained on a site, or having been taken away from a site prior to site inspection.

Deadwood

Deadwood Dead branches within a tree's crown have been categorised into 3 categories for the purpose of this report:

Nil – There are no dead branches or they are less than 20mm in diameter so not significant.
Minor – Dead branches are 20-75mm in diameter.
Major – Dead branches are 75mm in diameter and above.

Deadwooding Removing of dead branches by pruning. Such pruning may assist in the prevention of the spread of decay from dieback or for reasons of safety near an identifiable target.

Dieback

Dieback The death of some areas of the crown. Symptoms are leaf drop, bare twigs, dead branches and tree death, respectively. This can be caused by root damage, root disease, bacterial or fungal canker, severe bark damage, intensive grazing by insects, abrupt changes in growth conditions, drought, water-logging or over-maturity. Dieback often implies reduced resistance, stress or decline which may be temporary. Dieback can be categorized as Low Volume Dieback, Medium Volume Dieback and High Volume Dieback.

Low Volume Dieback Where <10% of the crown cover has died. See also Dieback, High Volume Dieback and Medium Volume Dieback.

Medium Volume Dieback Where 10-50% of the crown cover has died.

High Volume Dieback Where >50% of the crown cover has died.

Form of Trees

Crown Form The shape of the crown of a tree as influenced by the availability or restriction of space and light, or other contributing factors within its growing environment. Crown Form may be determined for tree shape and habit generally as Dominant, Codominant, Intermediate, Emergent, Forest and Suppressed. The habit and shape of a crown may also be considered qualitatively and can be categorized as Good Form or Poor Form.

Good Form Tree of typical crown shape and habit with proportions representative of the taxa considering constraints such as origin e.g. indigenous or exotic, but does not appear to have been adversely influenced in its development by environmental factors in situ such as soil water availability, prevailing wind, or cultural practices such as lopping and competition for space and light.

Poor Form Tree of atypical crown shape and habit with proportions not representative of the species considering constraints and appears to have been adversely influenced in its development by environmental factors in situ such as soil water availability, prevailing wind, cultural practices such as lopping and competition for space and light; causing it to be misshapen or disfigured by disease or vandalism.

Crown Form Codominant Crowns of trees restricted for space and light on one or more sides and receiving light primarily from above e.g. constrained by another tree/s or a building.

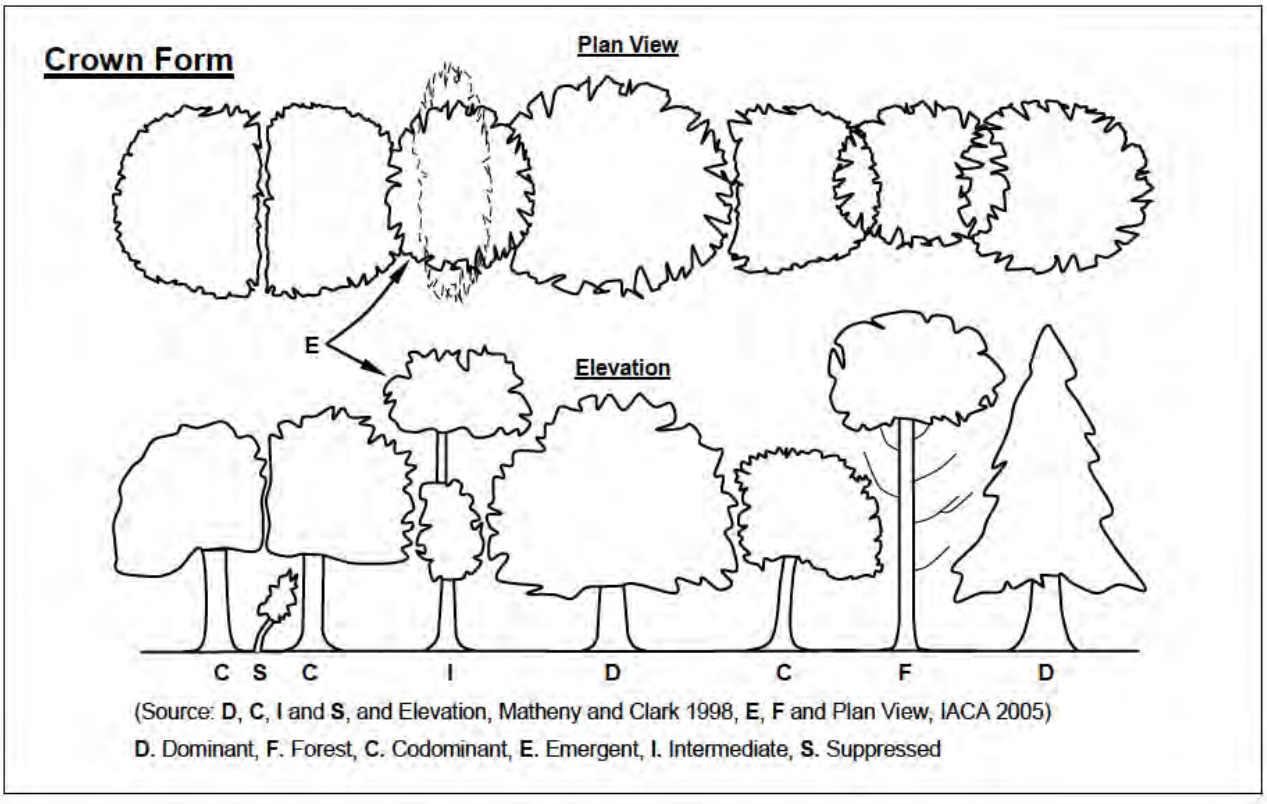
Crown Form Dominant Crowns of trees generally not restricted for space and light receiving light from above and all sides.

Crown Form Emergent Crowns of trees restricted for space on most sides receiving most light from above until the upper crown grows to protrude above the canopy in a stand or forest environment. Such trees may be crown form dominant or transitional from crown form intermediate to crown form forest asserting both apical dominance and axillary dominance once free of constraints for space and light.

Crown Form Forest Crowns of trees restricted for space and light except from above forming tall trees with narrow spreading crowns with foliage restricted generally to the top of the tree. The trunk is usually erect, straight and continuous, tapering gradually, crown often excurrent, with first order branches becoming structural, supporting the live crown concentrated towards the top of the tree, and below this point other first order branches arising radially with each inferior and usually temporary, divergent and ranging from horizontal to ascending, often with internodes exaggerated due to competition for space and light in the lower crown.

Crown Form Intermediate Crowns of trees restricted for space on most sides with light primarily from above and on some sides only.

Crown Form Suppressed Crowns of trees generally not restricted for space but restricted for light by being overtopped by other trees and occupying an understorey position in the canopy and growing slowly.



(Source: **D**, **C**, **I** and **S**, and Elevation, Matheny and Clark 1998, **E**, **F** and Plan View, IACA 2005)

D. Dominant, **F**. Forest, **C**. Codominant, **E**. Emergent, **I**. Intermediate, **S**. Suppressed

Symmetry Balance within a crown, or root plate, above or below the axis of the trunk of branch and foliage, and root distribution respectively and can be
categorized as Asymmetrical and Symmetrical.

Asymmetrical Imbalance within a crown, where there is an uneven distribution of branches and the foliage crown or root plate around the vertical axis of the trunk. This may be due to Crown Form Codominant or Crown From Suppressed as a result of natural restrictions e.g. from buildings, or from competition for space and light with other trees, or from exposure to wind, or artificially caused by pruning for clearance of roads, buildings or power lines. An example of an expression of this may be, crown asymmetrical, bias to west.

Symmetrical Balance within a crown, where there is an even distribution of branches and the foliage crown around the vertical axis of the trunk. This usually applies to trees of Crown Form Dominant or Crown Form Forest. An example of an expression of this may be crown symmetrical.

Crown Spread Orientation Direction of the axis of crown spread which can be categorized as Orientation Radial and Orientation Non-radial.

Crown Spread Orientation Non-radial Where the crown extent is longer than it is wide, e.g. east/west or E/W. Further examples, north/south or N/S, and may be Crown Form Codominant, e.g. **A** or **B**, Crown Form Intermediate e.g. **A**, or Crown Form Suppressed e.g. **B**, and crown symmetry is symmetrical e.g. **A**, or asymmetrical e.g. **B**.

Crown Spread Orientation Radial Where the crown spread is generally an even distance in all directions from the trunk and often where a tree has Crown Form Dominant and is symmetrical.

Crown Projection (CP) Area within the dripline or beneath the lateral extent of the crown (Geiger 2004, p. 2). See also Crown spread and Dripline.

Dripline A line formed around the edge of a tree by the lateral extent of the crown. Such a line may be evident on the ground with some trees when exposed soil
is displaced by rain shed from the crown. See also Crown Projection.

Epicormic Shoots Juvenile shoots produced at branches or trunk from epicormic strands in some Eucalypts (Burrows 2002, pp. 111-131) or sprouts produced from dormant or latent buds concealed beneath the bark in some trees. Production can be triggered by fire, pruning, wounding, or root damage but may also be as a result of stress or decline. Epicormic shoots can be categorized as Low Volume Epicormic Shoots, Medium Volume Epicormic Shoots and High Volume Epicormic Shoots.

- **Low Volume Epicormic Shoots** Where <10% of the crown cover is comprised of live epicormic shoots.
- **Medium Volume Epicormic Shoots** Where 10-50% of the crown cover is comprised of live epicormic shoots.
- **High Volume Epicormic Shoots** Where >50% of the crown cover is comprised of live epicormic shoots.

Trunk A single stem extending from the root crown to support or elevate the crown, terminating where it divides into separate stems forming first order branches. A trunk may be evident at or near ground or be absent in acaulescent trees of deliquescent habit, or may be continuous in trees of excurrent habit. The trunk of any caulescent tree can be divided vertically into three (3) sections and can be categorized as Lower Trunk, Mid Trunk and Upper Trunk. For a leaning tree these may be divided evenly into sections of one third along the trunk.

- **Acaulescent** A trunkless tree or tree growth forming a very short trunk. See also Caulescent.

- **Caulescent** Tree grows to form a trunk. See also Acaulescent

Leaning Trees

Leaning A tree where the trunk grows or moves away from upright. A lean may occur anywhere along the trunk influenced by a number of contributing factors e.g. genetically predetermined characteristics, competition for space or light, prevailing winds, aspect, slope, or other factors. A leaning tree may maintain a static lean or display an increasingly progressive lean over time and may be hazardous and prone to failure and collapse. The degrees of leaning can be categorised as Slightly leaning, Moderately Leaning, Severely leaning and Critically leaning.

Slightly Leaning – A leaning tree where the trunk is growing at an angle within 0-15 degrees from upright.

Moderately leaning - A leaning tree where the trunk is growing at an angle within 15-30 degrees from upright.

Severely Leaning - A leaning tree where the trunk is growing at an angle within 30-45 degrees from upright.

Critically leaning - A leaning tree where the trunk is growing at an angle greater than 45 degrees from upright.

Progressively Leaning – A tree where the degree of leaning appears to increase over time

Static Leaning A leaning tree whose lean appears to have stabilized over time.

Roots

First Order Roots (FOR) Initial woody roots arising from the root crown at the base of the trunk, or as an adventitious root mass for structural support and stability. Woody roots may be buttressed and divided as a marked gradation, gradually tapering and continuous or tapering rapidly at a short distance from the root crown. Depending on soil type these roots may descend initially and not be evident at the root crown, or become buried by changes in soil levels. Trees may develop 4-11 (Perry 1982, pp. 197-221), or more first order roots which may radiate from the trunk with a relatively even distribution, or be prominent on a particular aspect, dependent upon physical characteristics e.g. leaning trunk, asymmetrical crown; and constraints within the growing environment from topography e.g. slope, soil depth, rocky outcrops, exposure to predominant wind, soil moisture, depth of water table etc.

Orders of Roots The marked divisions between woody roots, commencing at the initial division from the base of the trunk, at the root crown where successive branching is generally characterised by a gradual reduction in root diameters and each gradation from the trunk and can be categorized numerically, e.g. first order roots, second order roots, third order roots etc. Roots may not always be evident at the root crown and this may be dependent on species, age class and the growing environment. Palms at maturity may form an adventitious root mass.

Root Plate The entire root system of a tree generally occupying the top 300-600mm of soil including roots at or above ground and may extend laterally for distances exceeding twice the height of the tree (Perry 1982, pp. 197-221). Development and extent is dependent on water availability, soil type, soil depth and the physical characteristics of the surrounding landscape.

Root Crown Roots arising at the base of a trunk.

Zone of Rapid Taper The area in the root plate where the diameter of structural roots reduces substantially over a short distance from the trunk. Considered
to be the minimum radial distance to provide structural support and root plate stability. See also Structural Root Zone (SRZ).

Structural Roots Roots supporting the infrastructure of the root plate providing strength and stability to the tree. Such roots may taper rapidly at short distances from the root crown or become large and woody as with gymnosperms and dicotyledonous angiosperms and are usually 1st and 2nd order roots, or form an adventitious root mass in monocotyledonous angiosperms (palms). Such roots may be crossed and grafted and are usually contained with the area of crown projection or extend just beyond the dripline.

Significance

Significant Tree A tree considered important, weighty or more than ordinary. Example: due to prominence of location, or in situ, or contribution as a component of the overall landscape for amenity or aesthetic qualities, or curtilage to structures, or importance due to uniqueness of taxa for species, subspecies, variety, crown form, or as an historical or cultural planting, or for age, or substantial dimensions, or habit, or as remnant vegetation, or habitat potential, or a rare or threatened species, or uncommon in cultivation, or of aboriginal cultural importance, or is a commemorative planting.

Sustainable Retention Index Value (SRIV) - A visual tree assessment method to determine a qualitative and numerical rating for the viability of urban trees for development sites and management purposes, based on general tree and landscape assessment criteria using classes of age, condition and vigour. SRIV is for the professional manager of urban trees to consider the tree in situ with an assumed knowledge of the taxon and its growing environment. It is based on the physical attributes of the tree and its response to its environment considering its position in a matrix for age class, vigour class, condition class and its sustainable retention with regard to the safety of people or damage to property. This also factors the ability to retain the tree with remedial work or beneficial modifications to its growing environment or removal and replacement. SRIV is supplementary to the decision made by a tree management professional as to whether a tree is retained or removed (IACA - Institute of Australian Consulting Arboriculturists 2005).

Vigour

Vigour - Ability of a tree to sustain its life processes. This is independent of the condition of a tree but may impact upon it. Vigour can appear to alter rapidly with change of seasons (seasonality) e.g. dormant, deciduous or semi-deciduous trees. Vigour can be categorized as Normal Vigour, High Vigour, Low Vigour and Dormant Tree Vigour.

Good Vigour Ability of a tree to maintain and sustain its life processes. This may be evident by the typical growth of leaves, crown cover and crown density, branches, roots and trunk and resistance to predation. This is independent of the condition of a tree but may impact upon it, and especially the ability of a tree to sustain itself against predation.

High Vigour Accelerated growth of a tree due to incidental or deliberate artificial changes to its growing environment that are seemingly beneficial, but may result in premature aging or failure if the favourable conditions cease, or promote prolonged senescence if the favourable conditions remain, e.g. water from a leaking pipe; water and nutrients from a leaking or disrupted sewer pipe; nutrients from animal waste, a tree growing next to a chicken coop, or a stock feed lot, or a regularly used stockyard; a tree subject to a stringent watering and fertilising program; or some trees may achieve an extended lifespan from continuous pollarding practices over the life of the tree.

Low Vigour Reduced ability of a tree to sustain its life processes. This may be evident by the atypical growth of leaves, reduced crown cover and reduced crown density, branches, roots and trunk, and a deterioration of their functions with reduced resistance to predation. This is independent of the condition of a tree but may impact upon it, and especially the ability of a tree to sustain itself against predation.

Dormant Tree Vigour Determined by existing turgidity in lowest order branches in the outer extremity of the crown, with good bud set and formation, and where the last extension growth is distinct from those most recently preceding it, evident by bud scale scars. Normal vigour during dormancy is achieved when such growth is evident on a majority of branches throughout the crown.