Arboricultural Assessment and Report

Sion College, Box Hill

9 June 2022
Tree Logic Ref. 011899

Prepared for Dervla Larkin – William Ross Architects
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1 Summary

Reason for Assessment

Tree Logic was engaged by Dervla Larkin of William Ross Architects to undertake an arboricultural assessment and prepare a report for trees that may be impacted by a proposed development at Sion College, Box Hill. The requirements of the arboricultural report include;

- To provide a preliminary arboricultural assessment and report to inform potential future development.
- To provide information on the species, origin, dimensions, health and structure of the trees and their appropriateness for retention
- Determine the Tree Protection Zones (TPZ) for trees compliant with AS4970 'Protection of trees on development sites'.
- To conduct a design review and tree impact assessment in the context of a proposed development, offering advice on maximising tree retention and survivability within the proposal.

Overview

Thirty-three (33) trees were growing within the study area, including nineteen (19) on school grounds and fourteen (14) street trees. The species palette was dominated by exotic deciduous tree types, including an avenue of High to Mod.A rated Plane trees along Maroondah Highway, a group of semi to early mature Pin Oaks and an ash (Mod.A to Mod.B rated) within a carpark traffic island and a trio of High to Mod.A rated oaks in a western courtyard area. These were complemented by a small group of semi to early mature natives (mostly eucalypts) growing on the eastern boundary. A development proposal within the southern part of the school was reviewed. Elements of the design include building removal and replacement, a new driveway and carpark area along the southern

boundary and associated landscaping works. Most of the southernmost trees within the school grounds (including a High rated oak, three Mod.B and one Low rated Pin oak), as well as the group of natives on the eastern boundary would need to be removed under the proposal. The tree impact assessment determined that one of the natives need not necessarily be removed (judging from the projected TPZ incursion), while all of the other trees proposed for removal are either within the footprint or have major TPZ incursion. All trees within the study area trigger permit requirement under SLO9 of the Whitehorse Planning Scheme. Recommendations are made to assist with planning around retained trees that will optimise the trees' tolerance to rootzone incursions.

2 Method

2.1 A site inspection was carried out on Tuesday 16 November, 2021. The trees were inspected from the ground and observations were made of the growing environment and surrounding area. The trees were not climbed and no samples of the tree or soil were taken.

2.2 Observations were made of the assessed trees to determine the species, age category, and condition with measurements taken to establish tree crown height (measured with a height meter) and crown width (paced) and trunk dimensions (measured 1.4 metres above ground level with a diameter tape unless otherwise stated). Descriptors used in the assessment can be seen in Appendix 3.

2.3 Assessment details of individual trees are listed in Appendix 1 and a copy of the tree location plan can be seen in Appendix 2.

2.4 Some photographs of the trees and the environs were taken for further reference and inclusion in the report.

2.5 Only trees were assessed and data collected. A tree is generally a plant with a height greater than 5 metres on a single trunk with a single trunk (stem) diameter (DBH) being greater than 150 mm at a height of 1.4 metres above ground level.

2.6 Each of the assessed trees was attributed an 'Arboricultural Rating'. The arboricultural rating correlates the combination of tree condition factors (health and structure) with tree amenity value. It should be noted that the arboricultural rating is different to the conservation/ecological values placed on trees by other professions. Definitions of arboricultural ratings can be seen in Appendix 3.

2.7 The assessed trees have been allocated tree protection zones (TPZ). The Australian Standard, AS 4970-2009, has been used as a guide in the allocation of TPZs for the assessed trees. This method provides a TPZ that addresses both the stability and growing requirements of a tree. TPZ distances are measured as a radius, from the centre of the trunk at (or near) ground level. All TPZ measurements for retained trees are provided in Appendix 1.

Documents viewed;

- Planning Property Report for Sion College, Box Hill (www.dtpli.vic.gov.au/planning, cited 22/11/2021).
- Architectural drawing 'Existing & Demolition Site Plan', OLSC Stage 2, prepared by Williams Ross Architects, dated July 2021.

- Architectural drawing 'Proposed site plan, OLSC STEAMD & Administration Centre, prepared by Williams Ross Architects, dated March 2022.
- Level 1 Landscape Concept Plan, prepared by ACLA Consultants, Project no 2143, DWG no 2143-SD3, REV 3, dated 07.04.22.
- Typical Section Southern Boundary, prepared by ACLA Consultants, Project no 2143, DWG no 2143-SD9, REV 1, dated 01.06.22.

3 Observations

3.1 The tree study area comprised the southern portion of Sion College (Figure 1). This part of the school included a central carpark area, landscaped gardens and courtyards, several school buildings and the Whitehorse Road school frontage. Two street trees adjacent to the northeast corner of the site were also assessed. The site was flat in topography.

***Figure 1**. Study area given by dotted red line.*

3.2 The vegetation within the study area comprised ornamentals of both native and exotic origins. In the western and central part of the school grounds were various oaks (*Quercus* spp.) of different ages and sizes. Along the eastern boundary (adjacent Dorking Road) were an assortment of native trees (mostly *Eucalyptus* spp.). In terms of street trees, an avenue of maturing Plane trees (*Platanus Xacerifolia*) were growing along Whitehorse Road, while two relatively young trees were growing on Dorking Road and Graham Place.

3.3 Thirty-three (33) trees were growing within the study area. Of these:

- Fourteen (14) were council-managed street trees. These included:
  - Nine (9) Mod.A to High rated London Planes.

- Five (5) Brush Box (*Lophostemon confertus*) including one Mod.A rated tree on Whitehorse Road, two Mod.B rated trees adjacent to the northeast corner of the site (on Dorking Road), along with two smaller, Mod.C rated trees near the southeast corner of Dorking Rd and Graham place.

***Image 1**. Looking east along Whitehorse Road showing some of the Plane street trees at the western end of the school.*

***Image 2**. Looking northeast showing school ground (left) and avenue of Planes (right). Patch of trees in the centre are the Pin Oaks and Claret Ash in the traffic Island.*

***Image 3**. Two Brush Box street trees growing adjacent to the northeast site boundary (Trees 32 & 33).*

- Three (3) were in the western courtyard area. These included:
    - A High rated Turkey Oak (*Quercus Cerris*), which was surrounded by raised pavers and decking.
    - Two (2) English Oaks (*Quercus robur*), growing in designated garden beds and surrounded by gravel paths and a lawn area. One (the southern of the two) was High rated, while the other was somewhat younger and was Mod.A rated.

***Image 4**. Looking northeast toward two English Oaks in western courtyard area. High rated Tree 28 (right), Mod.A rated Tree 29 (left).*

***Image 5**. Looking east at growing environment around Tree 30, the High rated Turkey Oak.*

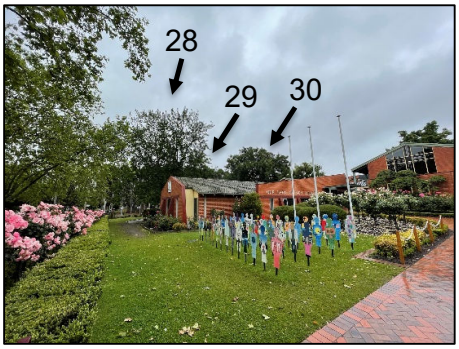

***Image 6** Looking northwest toward school buildings and Trees 28-30 behind.*

***Image 7**. Looking east from southeast corner of site showing High-rated Tree 28 (left) and row of Planes along Whitehorse Road (right).*

- Three (3) were in the central courtyard area. These included:
    - Two (2) relatively young Pin Oaks (*Quercus palustris*) growing in open turf area. They were both Low rated due to small size.
    - A Mod.B rated Japanese Cherry (*Prunus serrulata*) growing in a garden bed at the front of a school building.
- Eight (8) were in the traffic island in the centre of the carpark. These included:
    - Seven (7) Pin Oaks; two (2) of which were larger trees approaching maturity and were Mod.A rated, while five (5) were established semi-mature trees and were Mod.B rated.
    - One (1) Mod.A rated Claret Ash (*Fraxinus* 'Raywood').

***Image 8**. Looking northeast toward trees in carpark traffic island. Tree 22 (Mod.A rated Claret Ash) marked for reference.*

***Image 9**. Looking south toward Trees 20 and 21 (both Mod.A rated Pin Oaks) and Tree 22 (Mod.A rated Claret Ash).*

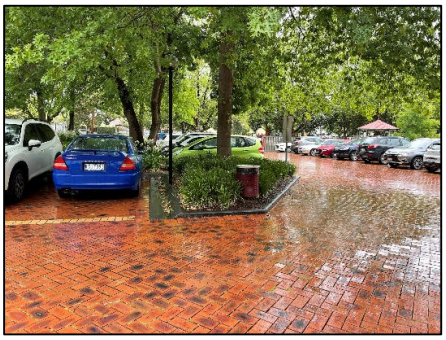

***Image 10**. Showing growing environment around the base of Tree 21 (foreground) and Tree 22 (rearground).*

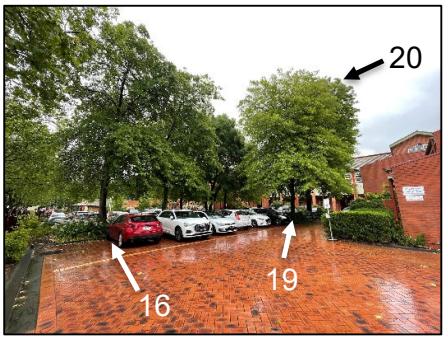

***Image 11**. Looking northwest toward trees in traffic island. Trees 16 & 19 (both Mod.B Pin Oaks) and Tree 20 (Mod.A Pin Oak) marked for reference.*

- Five (5) were in the eastern courtyard and garden bed next to Dorking Road. These included:
    - An early mature Red Ironbark (*Eucalyptus sideroxylon*) that was Mod.B rated.
    - Two (2) Narrow-leaved Black Peppermints (*Eucalyptus nicholii*); one of which was early-mature, in reasonable condition and Mod.B rated, while the other was maturing, in reduced condition and Mod.C rated.
    - Two (2) Yellow Gums (*Eucalyptus leucoxylon*); one larger, early mature tree being Mod.B rated, while a smaller tree in reduced health was Mod.C rated.

***Image 12**. Looking southeast toward (left to right), Tree 25 (Mod.C Yellow Gum), Tree 24 (Mod.C Narrow-leaved Black Peppermint) and Tree 23 (Mod B rated Red Ironbark)/*

***Image 13**. Looking east toward Tree 27, a Mod.C rated Narrow-leaved Black Peppermint.*

3.3.1 See the tree assessment table attached as Appendix 1 for details of each tree feature. See Appendix 2 for tree numbers and locations.

3.4 The assessed tree population comprised ten (10) different species. These are listed in Table 1 below.

***Table 1**. Tree species and origin*

Common name (*species*)	Origin	No. of trees
Pin Oak *(Quercus palustris)*	Exotic deciduous	9
London Plane *(Platanus Xacerifolia)*	Exotic deciduous	9
Brush Box *(Lophostemon confertus)*	Australian native	5
English Oak *(Quercus robur)*	Exotic deciduous	2
Narrow-leaved Black Peppermint (*Eucalyptus nicholii*)	Australian native	2
Yellow Gum (*Eucalyptus leucoxylon*)	Victorian native	2
Red Ironbark (*Eucalyptus sideroxylon*)	Australian native	1
Claret Ash (*Fraxinus* 'Raywood').	Exotic deciduous	1
Turkey Oak (*Quercus cerris*)	Exotic deciduous	1
Japanese Cherry (*Prunus serrulata*)	Exotic deciduous	1

3.5 Each of the assessed trees was attributed an 'Arboricultural Rating'. The arboricultural rating correlates the combination of tree condition factors (health, structure & form) with tree amenity value. Amenity relates to the trees biological, functional and aesthetic characteristics within an urban landscape context

and its ability to continue to provide these qualities into the medium to long term future. The arboricultural rating in combination with other factors can assist the project team and planners in nominating trees suitable for retention. It should be noted that the arboricultural rating is different to the conservation/ecological values placed on trees by other professions. Definitions of arboricultural ratings can be seen in Appendix 3.

Trees may be considered significant to the landscape because of their size, dominance within the site, presence within outlooks and general amenity in terms of shade, screen, foliage and flowers and historic, cultural or horticultural characteristics. The key to successful tree retention is to identify the trees that represent the best opportunity for retention and implement tree protection and design amendments before any site works commence.

Figure 2 summarises the assessed tree population in each arboricultural category.

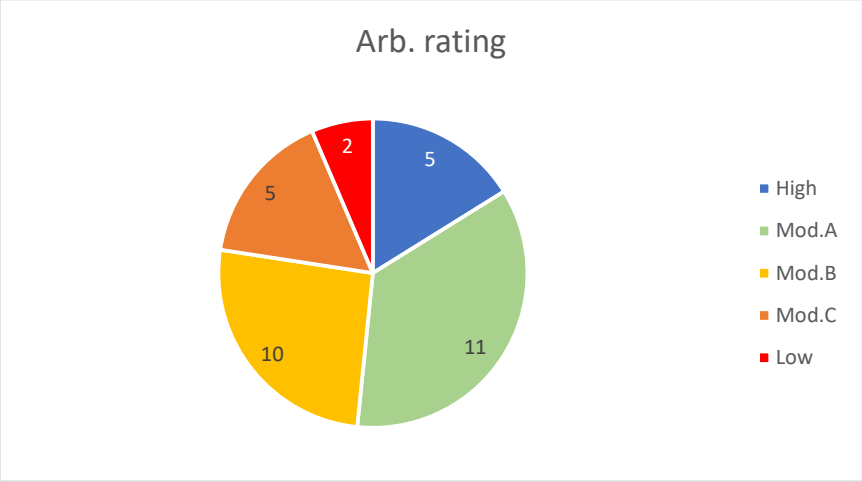

***Figure 2**. Breakdown of Arb. rating*

4 Tree protection zones

4.1 The Tree protection zones (TPZs) provided for each tree in the Tree Assessment Table in Appendix 1 and referred to in this statement, are calculated using the formula provided in the Australian Standard AS4970 where the Radial TPZ = Trunk diameter (DBH) measured at 1.4m above grade and multiplied by 12. TPZ distances are measured as a radius from the centre of the trunk at (or near) ground level. A TPZ should not be less than 2m nor greater than 15m. The method for calculating, applying and managing the tree protection zone is described in Appendix 4.

4.2 The TPZ forms an area around a tree or group of trees that addresses both the stability and growing requirements of a tree. Construction and worksite activities within the TPZ need to be determined to assess their impacts in order to preserve tree condition.

4.3 Minor encroachment, up to 10% of the TPZ area, is generally permissible provided encroachment is compensated for by recruitment of an equal area contiguous with the TPZ. Encroachment greater than 10% is considered major encroachment under AS4970 and is only permissible if it can be demonstrated that after such encroachment the tree would remain viable.

4.4 The structural root zone (SRZ) provided for each tree has been calculated using the method provided in AS4970. The SRZ is the area in which the larger woody roots required for tree stability are found close to the trunk and which then generally taper rapidly. This is the minimum area recommended to maintain tree stability but does not reflect the area required to sustain tree health. No works should occur within the SRZ radius as tree stability could be compromised.

4.5 See Appendix 4 for TPZ establishment and types of encroachment

5 Permit requirements

5.1 The school falls within the Whitehorse Planning Scheme and is zoned general residential (GRZ1 & GRZ3).

5.2 Schedule 9 to the Significant Landscape Overlay (SLO9) applies to the entire site. Under the overlay, permits are required to remove, destroy or lop trees over a certain size, i.e. a tree that has either:

- A height of ≥5m; or
- A single trunk circumference ≥1m measured at 1m above ground level (i.e. ~32cm stem diameter).

There are various other conditions that exempt trees from permit requirement, e.g.:

- Various environmental weed species.
- A tree which is dead or dying or has become dangerous to the satisfaction of the responsible authority.
- Trees located less than 3m from the wall of an existing dwelling or an existing dependent person's unit.
- A tree required to be removed, destroyed or lopped in order to construct or carry out buildings or works approved by a Building Permit issued prior to 8 February 2018.
- A tree that may require separate approval to remove, destroy or lop as part of an existing permit condition, a plan endorsed under a planning permit or an agreement under section 173 of the *Planning and Environment Act 1987*

None of the assessed trees appear to qualify for exemptions under any of the above, i.e. they are all at least 5m in height and/or have stem diameters greater than 32cm, none were listed environmental weed species, none were assessed as dead, dying or dangerous, and, though two trees (Trees 14 & 27) are within 3m of an adjacent building, those buildings are not dwellings.

5.3 No trees were indigenous or naturally occurring so permits do not apply under Clause 52.17 – Native Vegetation.

6 Design review and tree impact assessment

Architectural plans

6.1 Architectural drawings prepared by Williams Ross Architects were reviewed. Plans show:

- Demolition of large building on eastern side of study area along with smaller buildings to the west. Demolition of existing carpark area (Figure 3).
- Construction of new buildings to replace those demolished, construction of a new carpark area with new street access from the western part of site and several car spaces along the southern boundary, some new landscaping elements e.g. new courtyard north of existing traffic island, new footpaths along the western boundary and along western edge of new eastern building and a new services on the eastern boundary (Figure 4).

6.2 Plans indicate that nine (9) trees are to be removed, all located within the school grounds (Figure 3). Removal and retention intentions are collated in Tables 3 & 4.

***Figure 3**. Extract of demolition plan with trees overlaid. Trees colour coded by arb rating; Blue diamonds = High, Green circle = Mod.A, Yellow circle = Mod.B, Orange circle = Mod.C, Red Circle = Low. Light blue circles = TPZs. Red stars = intent to remove.*

***Table 3**. Tree removals (within school grounds)*

Tree no.	Species	Arb Rating
12	*Quercus palustris*	Low
15	*Quercus palustris*	Mod B
16	*Quercus palustris*	Mod B
17	*Quercus palustris*	Mod B
23	*Eucalyptus sideroxylon*	Mod B
24	*Eucalyptus nicholii*	Mod C
25	*Eucalyptus leucoxylon*	Mod C
27	*Eucalyptus nicholii*	Mod C
28	*Quercus robur*	High
Count: 9		

***Table 4.** Trees for retention (within school grounds)*

Tree no.	Species	Arb Rating
13	*Quercus palustris*	Low
14	*Prunus serrulata*	Mod B
18	*Quercus palustris*	Mod B
19	*Quercus palustris*	Mod B
20	*Quercus palustris*	Mod A
21	*Quercus palustris.*	Mod A
22	*Fraxinus* 'Raywood'	Mod A
26	*Eucalyptus leucoxylon*	Mod B
29	*Quercus robur*	Mod A
30	*Quercus cerris*	High
Count: 10		

***Figure 4**. Impact assessment showing areas of TPZ encroachment (shaded in magenta) from the proposed Site Plan.*

6.3 Table 5 (below) lists TPZ incursions and incursion type, which correlate to the TPZ incursions highlighted on the plans in Figure 4 above. Each of the incursions are discussed over the following page.

***Table 5**. TPZ incursions from design proposal.*

Tree ID	Arb. Rating	Impact area	Impact type	TPZ incursion (%)
5	Mod.A	Carpark - 2.05%	TPZ	2.05
6	Mod.A	Carpark - 2.3%	TPZ	2.3
7	High	Carpark - 6.41%	TPZ	6.41
8	Mod.A	Carpark - 1.89%	TPZ	1.89
9	Mod.A	Carpark - 1.97%	TPZ	1.97
10	Mod.A	Carpark - 0.25%,New path - 2.49%	TPZ	2.73
12	Low	Carpark - 59.47%	Within	59.47
13	Low	Carpark - 2.35%	SRZ	2.35
15	Mod.B	Carpark - 93.89%	Within	93.89
16	Mod.B	Carpark - 86.11%	Within	86.11
17	Mod.B	Carpark - 99.01%	Within	99.01
18	Mod.B	Carpark - 1.28%	TPZ	1.28
19	Mod.B	Carpark - 0.32%	TPZ	0.32
23	Mod.B	New building - 14.18%	TPZ	14.18
24	Mod.C	New building - 2.14%,New services - 18.52%	SRZ	20.66
25	Mod.C	New services - 51.15%	Within	51.15
27	Mod.C	New building - 61.21%,New services - 2.73%	Within	63.95
28	High	Carpark - 59.81%	Within	59.81

6.4 Trees 5-10: Some of the Plane street trees will have minor TPZ incursion from the southern edge of the proposed carpark. The trees are expected to tolerate this level of incursion although it is recommended that the area of TPZ incursion is non-destructively excavated so that any roots in the area can be cut cleanly.

6.5 Trees 12-13: The two small Pin oaks in the central courtyard are partially impacted. Tree 12 is within the footprint and would need to be removed. Tree 13 has minor incursion and can be retained.

6.6 Trees 15-17: The three Mod.B rated Pin Oaks are all within the footprint and would need to be removed.

6.7 Trees 18-22: The remaining trees within the traffic island may have minor TPZ incursion (Trees 18-19) or no additional incursion from the design (Trees 20-22). However, root systems from the trees will require management during construction to ensure they are not damaged by the driveway demolition and re-establishment.

6.8 Trees 23-27: The eucalypts on the eastern boundary would be partially impacted.

- Trees 25 & 27 are both within the footprint and would need to be removed,
- Tree 24 would have SRZ incursion from the new services and would also likely need to be removed, while Tree 26 is unimpacted by works.
- Tree 23 has a projected ~14% TPZ incursion from the new building although part of this incursion is within the footprint of the existing building so total incursion is probably <10%. The tree can likely be retained as long as the permeable portion of the tree's TPZ (i.e. the raised garden bed) remains uninterrupted by the proposal. Furthermore, it is recommended that the foundations for the eastern edge of the building are non-destructively excavated so that any underlying roots can be cut cleanly.

6.9 Trees 28-30: The three oaks on the western side of the school will be partially impacted.

- Tree 28, the High-rated English Oak is within the footprint of the new carpark / driveway and would need to be removed.
- Tree 29 may have impacts from the new building construction to its east, although there does not appear to be any additional TPZ incursion from the existing footprint.
- Tree 30 does not appear to be impacted by the proposal.

6.10 Trees 32-33: Design being drafted, impacts not yet reviewed.

Southern Boundary Landscape Plans

6.11 Landscape plans prepared by ACLA Consultants were reviewed as per the RFI request (Ref PA2201594, dated 11/05/2022). Plans (as seen in Figures 5 & 6) show:

- A 2m wide garden bed along the southern site boundary.
- A 2m wide concrete footpath abutting the southern edge of the proposed new 'Steam Buiding'
- A retaining wall between the garden bed (existing grade) and the footpath (below existing grade). The cut requirement for the retaining wall varies but can be expected to exceed 1000mm in areas.

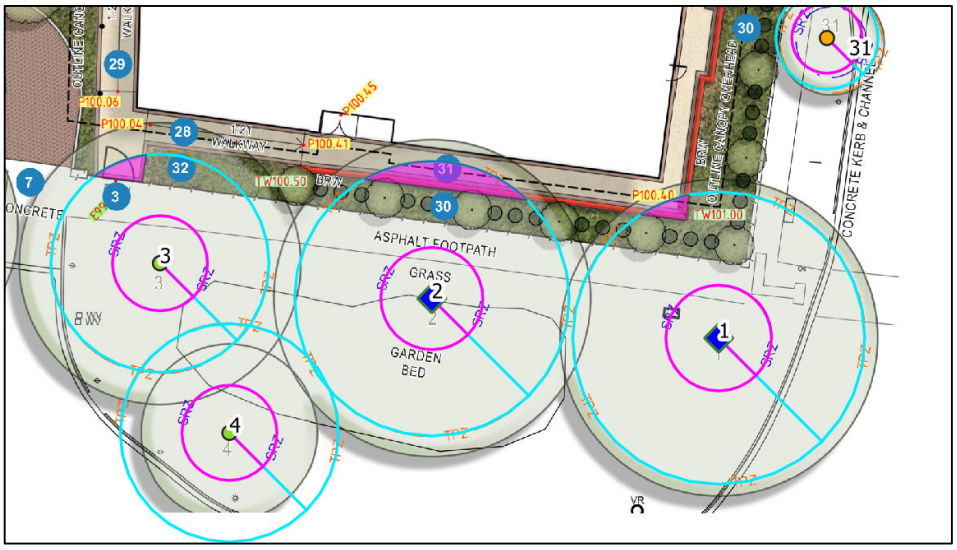

Figure 5. *Impact assessment showing areas of TPZ encroachment (shaded in magenta) from the proposed Landscape Plan. Light blue circles = TPZs, magenta circles = SRZs.*

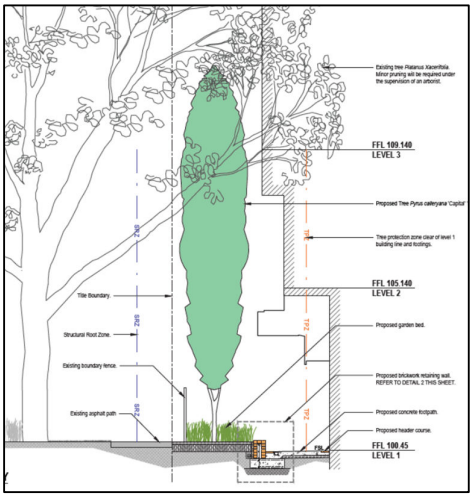

Figure 6*. Typical section showing relative location of garden bed, retaining wall, footpath and steam building from Tree 2.*

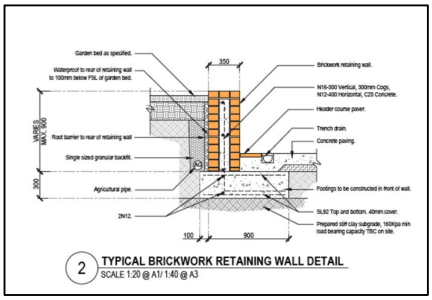

Figure 7*. Detail of retaining wall.*

6.12 Table 6 (below) lists TPZ incursions and incursion type, which correlate to the TPZ incursions highlighted on the plans in Figure 5 above. Each of the incursions are discussed over the following page.

Table 6*. TPZ incursions from southern boundary landscape plans.*

Tree ID	Arb. Rating	Impact area	Impact type	TPZ incursion (%)
1	High	Retaining wall - 1.0%	TPZ	1
2	High	Retaining wall - 5.24%	TPZ	5.24
3	Mod.A	Walkway - 2.15%	TPZ	2.15

6.13 Tree 1: Minor (1%) TPZ incursion from retaining wall and no anticipated pruning requirements.

6.14 Tree 2: Minor (5.2%) TPZ incursion from retaining wall and some minor canopy reduction expected in the outer northern canopy to enable construction of steam building (including scaffolding). Works expected to be achievable with <10% total live crown reduction and pruning wounds <80mm Ø (see Figure 8). The anticipated pruning requirements are minor and are not expected to adversely impact tree condition.

- Pruning works must be undertaken by a council or council approved arborist in accordance with AS4373 – *Pruning of Amenity Trees*.
- It is recommended that the area of TPZ incursion is non-destructively excavated so that any roots in the area can be cut cleanly.

***Figure 8**. Likely canopy reduction required (yellow dashed line) to provide clearance for building construction (including scaffolding requirements).*

6.15 Tree 3: Minor (2.2%) TPZ incursion from the walkway and no anticipated pruning requirements.

7 Conclusions

7.1 Thirty-three (33) trees were growing within the study area, including nineteen (19) within school grounds and fourteen (14) street trees growing on Maroondah Highway, Dorking Road and Graham Place.

7.2 The trees within the study area were mostly exotic deciduous species including London Planes, various oaks species, an ash and a cherry. There were also eight native trees included some mixed eucalypts on the eastern boundary and some Brush Box street trees.

7.3 All trees were attributed an arboricultural rating that reflects their individual retention value.

- Five (5) trees (including two oaks in the subject site and three London Plane street trees) were of High arboricultural value and were the most outstanding tree resources in the study area in terms of size and quality.
- Eleven (11) trees were Moderate-A rated (five within the subject site and six street trees). These trees were generally large, established trees with landscape presence but were somewhat smaller / younger than their High-rated counterparts.
- Ten (10) trees were Mod-B rated. These trees were generally in fair overall condition but were smaller / younger again, compared with the Mod.A trees.
- Five (5) trees were Mod.C rated. These were either small and semi-mature trees with relatively modest landscape presence or were larger, established trees that were exhibiting health/structural issues.
- Two (2) small trees (<10cm DBH) were Low-rated.

7.4 A design review was undertaken to determine implications to the existing tree population. Under the design nine (9) trees within school grounds are proposed for removal and ten (10) are to be retained. All street trees are to be retained.

Based on provided designs, it appears that one of the trees proposed for removal (Tree 23) had relatively minor TPZ incursion and the tree could potentially be retained.

TPZ encroachment details are provided in Figure 4 and Table 5.

7.5 It is advised that any excavations or building activities within a TPZ (including pavement renewal or footpath, kerb or driveway establishment) are undertaken with NDD (either by hand or using hydro-vac / airspade) to minimise damage to retained trees.

7.6 Permits are required to remove all of the assessed tree population under SLO9.

7.7 To successfully retain any trees, tree protection measures must be incorporated into the design and implemented prior to undertaking works on site and maintained for the duration of the development works. Recommended TPZ distances are provided in Appendix 1.

- All trees that are to be retained will require Tree Protection Zones to be established prior to commencing any works onsite including demolition, bulk earthworks, construction, landscaping activity, delivery and storage of materials or placement of site sheds.
- Trenching for installation of services or the placement of soil fill greater than 100mm must not occur within the TPZ of any retained trees.
- All underground services including power, telecommunication, gas, water, drainage must be designed to avoid the nominal TPZ of any retained trees.

I am available to answer any questions arising from this report.

No part of this report is to be reproduced unless in full.

Signed

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Appendix 1: Tree Assessment Table

Refer to the following 2 pages.

- DBH = Diameter at Breast Height (measured 1.4m above ground unless otherwise stated)
- ULE = Useful Life Expectancy
- Arb. rating = arboricultural rating
- TPZ = Tree Protection Zone.
- SRZ = Structural Root Zone
- TPZ & SRZ measurements are radius in metres from the centre of the trunk per AS 4970-2009.

Definitions of the descriptor categories used in the assessment can be seen in Appendix 3.

Tree ID	Species	Common Name	Age	Origin	DBH (cm)	Basal (cm)	Height x Width (m)	Health	Structure	Arb. Rating	ULE (years)	Comments	TPZ (m radius)	SRZ (m radius)	Location
1	*Platanus Xacerifolia*	London Plane	Maturing	Exotic deciduous	69	78	18x18	Fair	Fair	High	>40 y		8.3	3	Street tree
2	*Platanus Xacerifolia*	London Plane	Maturing	Exotic deciduous	65	73	18x18	Fair	Fair	High	>40 y		7.8	2.9	Street tree
3	*Platanus Xacerifolia*	London Plane	Early-mature	Exotic deciduous	52	61	16x16	Fair	Fair	Mod.A	>40 y		6.2	2.7	Street tree
4	*Lophostemon confertus*	Brush Box	Early-mature	Australian native	52	60	10x10	Good	Fair	Mod.A	>40 y		6.2	2.7	Street tree
5	*Platanus Xacerifolia*	London Plane	Maturing	Exotic deciduous	54	62	16x16	Fair	Fair	Mod.A	>40 y		6.5	2.7	Street tree
6	*Platanus Xacerifolia*	London Plane	Maturing	Exotic deciduous	54	62	16x16	Fair	Fair	Mod.A	21-40 y	Cavity	6.5	2.7	Street tree
7	*Platanus Xacerifolia*	London Plane	Maturing	Exotic deciduous	64	73	16x16	Fair	Fair	High	21-40 y	Cavity; 1m high fence between tree and footpath. footpath heave	7.7	2.9	Street tree
8	*Platanus Xacerifolia*	London Plane	Maturing	Exotic deciduous	53	61	16x16	Fair	Fair	Mod.A	21-40 y	Cavity; footpath heave	6.4	2.7	Street tree
9	*Platanus Xacerifolia*	London Plane	Early-mature	Exotic deciduous	54	63	16x16	Fair	Fair	Mod.A	21-40 y	footpath heave	6.5	2.7	Street tree
10	*Platanus Xacerifolia*	London Plane	Early-mature	Exotic deciduous	57	65	16x16	Fair	Fair	Mod.A	21-40 y	Past powerline clearance; footpath heave	6.8	2.8	Street tree
11	*Lophostemon confertus*	Brush Box	Semi-mature	Australian native	18	24	7x4	Good	Fair	Mod.C	>40 y		2.2	1.8	Street tree
12	*Quercus palustris*	Pin Oak	Semi-mature	Exotic deciduous	8	11	5x4	Good	Fair	Low	>40 y		2	1.5	School
13	*Quercus palustris*	Pin Oak	Semi-mature	Exotic deciduous	8	11	6x4	Good	Fair	Low	>40 y		2	1.5	School
14	*Prunus serrulata*	Japanese Cherry	Maturing	Exotic deciduous	35	40	4x6	Fair to Poor	Fair	Mod.B	11-20 y	Tip dieback	4.2	2.3	School
15	*Quercus palustris*	Pin Oak	Semi-mature	Exotic deciduous	34	43	15x9	Good	Fair	Mod.B	>40 y		4.1	2.3	School
16	*Quercus palustris*	Pin Oak	Semi-mature	Exotic deciduous	36	46	15x9	Good	Fair	Mod.B	>40 y		4.3	2.4	School
17	*Quercus palustris*	Pin Oak	Semi-mature	Exotic deciduous	33	42	14x8	Good	Fair	Mod.B	>40 y		4	2.3	School
18	*Quercus palustris*	Pin Oak	Semi-mature	Exotic deciduous	30	39	15x8	Fair	Fair	Mod.B	21-40 y	Hangers;Past branch failure	3.6	2.2	School
19	*Quercus palustris*	Pin Oak	Semi-mature	Exotic deciduous	38	45	17x10	Fair	Fair	Mod.B	>40 y		4.6	2.4	School
20	*Quercus palustris*	Pin Oak	Early-mature	Exotic deciduous	53	64	19x13	Fair	Fair	Mod.A	21-40 y	minor pavement heave	6.4	2.7	School
21	*Quercus palustris*	Pin Oak	Early-mature	Exotic deciduous	43	53	17x14	Fair	Fair	Mod.A	21-40 y	minor pavement heave	5.2	2.5	School
22	*Fraxinus* 'Raywood'	Claret Ash	Early-mature	Exotic deciduous	41,38,29	83	16x14	Fair	Fair	Mod.A	21-40 y	checking/readjustment. stem unions are sound, not needed.	7.6	3.1	School
23	*Eucalyptus sideroxylon*	Red Ironbark	Early-mature	Australian native	56	69	13x11	Fair	Fair to Poor	Mod.B	21-40 y	Acute forks; minor pavement heave. dynamic brace fitted	6.7	2.8	School
24	*Eucalyptus nicholii*	Narrow-leaved Black Pepp	Early-mature	Australian native	38	45	11x9	Fair to Poor	Fair to Poor	Mod.C	11-20 y	Acute forks	4.6	2.4	School
25	*Eucalyptus leucoxylon*	Yellow Gum	Early-mature	Victorian native	32	39	11x9	Fair to Poor	Fair	Mod.C	11-20 y	Foliage sparse - possums	3.8	2.2	School
26	*Eucalyptus leucoxylon*	Yellow Gum	Early-mature	Victorian native	35	44	11x9	Fair	Fair	Mod.B	21-40 y		4.2	2.3	School
27	*Eucalyptus nicholii*	Narrow-leaved Black Pepp	Maturing	Australian native	59	66	14x10	Fair to Poor	Fair to Poor	Mod.C	11-20 y	Acute forks; pavement heave	7.1	2.8	School
28	*Quercus robur*	English Oak	Maturing	Exotic deciduous	77	89	18x16	Good	Fair	High	>40 y	surrounded by hedge	9.2	3.2	School
29	*Quercus robur*	English Oak	Early-mature	Exotic deciduous	46	55	14x13	Good	Fair	Mod.A	>40 y	surrounded by hedge	5.5	2.6	School

Tree ID	Species	Common Name	Age	Origin	DBH (cm)	Basal (cm)	Height x Width (m)	Health	Structure	Arb. Rating	ULE (years)	Comments	TPZ (m radius)	SRZ (m radius)	Location
30	*Quercus cerris*	Turkey Oak	Maturing	Exotic deciduous	71	79	18x18	Good	Fair	High	>40 y	decking	8.5	3	School
31	*Lophostemon confertus*	Brush Box	Semi-mature	Australian native	24	29	7x6	Good	Fair	Mod.C	>40 y		2.9	2	Street tree
32	*Lophostemon confertus*	Brush Box	Semi-mature	Australian native	24	32	8x6	Fair	Fair	Mod.B	>40 y		2.9	2.1	Street tree
33	*Lophostemon confertus*	Brush Box	Semi-mature	Australian native	23	31	6x7	Fair	Fair	Mod.B	>40 y		2.8	2	Street tree

LEGEND

Trees
- High
- Mod-A
- Mod-B
- Mod-C
- Low

TPZs
- TPZ
- SRZ

APPENDIX 2

TREE LOCATIONS AND PROTECTION ZONES

PROJECT
Sion College, Box Hill

TL REF.
011899

MAP NO.
1 / 1

CLIENT
Williams Ross Architects

DATE
2022-03-28

DATA SOURCES
Feautre & Level Survey prepared by Cardno, DWG. 20433-01-RFL-2D, Rev D, dated 15.01.20

COORDINATE REFERENCE SYSTEM
EPSG:28355 | GDA 94 MGA Zone 55

0 10 20m

TREELOGIC PTY LTD
ABN: 95 080 021 610
TEL: 1300 656 926

4 / 21 Eugene Toe
Ringwood, VIC
Australia 3134

Treelogic
Plan, manage, protect...

Arboricultural Descriptors (February 2019)

Note that not all of the described tree descriptors may be used in a tree assessment and report. The assessment is undertaken with regard to contemporary arboricultural practices and consists of a visual inspection of external and above-ground tree parts.

1. Tree Condition

The assessment of tree condition evaluates factors of health and structure. The descriptors of health and structure attributed to a tree evaluate the individual specimen to what could be considered typical for that species growing in its location under current climatic conditions. For example, some species can display inherently poor branching architecture, such as multiple acute branch attachments with included bark. Whilst these structural defects may technically be considered arboriculturally poor, they are typical for the species and may not constitute an increased risk of failure. These trees may be assigned a structural rating of fair-poor (rather than poor) at the discretion of the assessor.

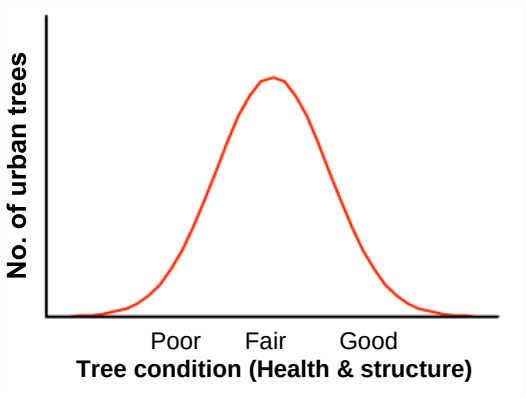


Diagram 1: Indicative normal distribution curve for tree condition

Diagram 1, provides an indicative distribution curve for tree condition to illustrate that within a normal tree population the majority of specimens are centrally located within the condition range (normal distribution curve). Furthermore, that those individual trees with an assessed condition approaching the outer ends of the spectrum occur less often.

2. Tree Name

Provides botanical name, (genus, species, variety and cultivar) according to accepted international code of taxonomic classification, and common name.

3. Tree Type

Describes the general geographic origin of the species and its type e.g. deciduous or evergreen.

Category	Description
Indigenous	Occurs naturally in the area or region of the subject site. Remnant.
Victorian native	Occurs naturally within some part of the State of Victoria (not exclusively) but is not indigenous (component of EVC benchmark). Could be planted indigenous trees.
Australian native	Occurs naturally within Australia but is not a Victorian native or indigenous
Exotic deciduous	Occurs outside of Australia and typically sheds its leaves during winter
Exotic evergreen	Occurs outside of Australia and typically holds its leaves all year round
Exotic conifer	Occurs outside of Australia and is classified as a gymnosperm
Native conifer	Occurs naturally within Australia and is classified as a gymnosperm
Native Palm	Occurs naturally within Australia. Woody monocotyledon
Exotic Palm	Occurs outside of Australia. Woody monocotyledon

4. Height and Width

Indicates height and width of the individual tree; dimensions are expressed in metres. Crown heights are measured with a height meter where possible. Due to the topography of some sites and/or the density of vegetation it may not be possible to do this for every tree. Tree heights may be estimated in line with previous height meter readings in conjunction with assessor's experience. Crown widths are generally paced (estimated) at the widest axis or can be measured on two axes and averaged. In some instances the crown width can be

measured on the four cardinal direction points (North, South, East and West).

Crown height, crown spread are generally recorded to the nearest half metre (crown spread would be rounded up) for dimensions up to 10 m and the nearest whole metre for dimensions over 10 m. Estimated dimensions (e.g. for off-site or otherwise inaccessible trees where accurate data cannot be recovered) shall be clearly identified in the assessment data.

5. Trunk diameters

The position where trunk diameters are captured may vary dependent on the requirements of the specific assessment and an individual trees specific characteristics. DBH is the typical trunk diameter captured as it relates to the allocation of tree protection distances. The basal trunk diameter assists in the allocation of a structural root zone. Some municipalities require trunk diameters be captured at different heights, with 1.0 m above grade being a common requirement. The specific planning schemes will be checked to ascertain requirements.

Stem diameters shall be recorded in centimetres, rounded to the nearest 1 cm (0.01 m).

Diameter at Breast Height (DBH)

Indicates the trunk diameter (expressed in centimetres) of an individual tree measured at 1.4m above the existing ground level or where otherwise indicated, multiple leaders are measured individually. Plants with multiple leader habit may be measured at the base. The range of methods to suit particular trunk shapes, configurations and site conditions can be seen in Appendix A of Australian Standard *AS 4970-2009 Protection of trees on development site*s. Measurements undertaken using foresters tape or builders tape.

Basal trunk diameter

The basal dimension is the trunk diameter measured at the base of the trunk or main stem(s) immediately above the root buttress. Used to ascertain the Structural Root Zone (SRZ) as outlined in AS4970.

6. Health

Assesses various attributes to describe the overall health and vitality of the tree.

Category	Vitality, Extension growth	Decline symptoms, Deadwood, Dieback	Foliage density, colour, size, intactness	Pests and or disease
Good	Above typical. Excellent. Full canopy density	Negligible	Better than typical	Negligible
Fair	Typical vitality. >80% canopy density	Minor or expected. Little or no dead wood	Typical. Minor deficiencies or defects could be present.	Minor, within damage thresholds
Fair to Poor	Below typical - low vitality	More than typical. Small sub-branch dieback	Exhibiting deficiencies. Could be thinning, or smaller	Exceeds damage thresholds
Poor	Minimal - declining	Excessive, large and/or prominent amount & size of dead wood. Significant dieback	Exhibiting severe deficiencies. Thinning foliage, generally smaller or deformed	Extreme and contributing to decline
Dead	N/A	N/A	N/A	N/A

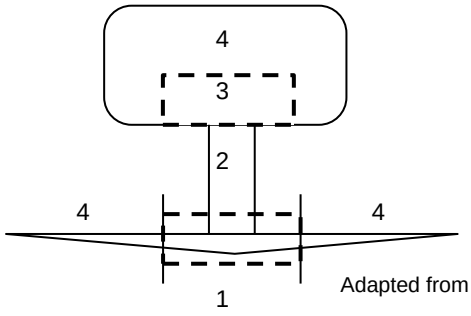
7. Structure

Assesses principal components of tree structure (Diagram 2).

Descriptor	Zone 1 - Root plate & lower stem	Zone 2 - Trunk	Zone 3 - Primary branch support	Zone 4 - Outer crown and roots
Good	No obvious damage, disease or decay; obvious basal flare / stable in ground	No obvious damage, disease or decay; well tapered	Well formed, attached, spaced and tapered. No history of failure.	No obvious damage, disease, decay or structural defect. No history of failure.
Fair	Minor damage or decay. Basal flare present.	Minor damage or decay	Generally, well attached, spaced and tapered branches. Minor structural deficiencies may be present or developing. No history of branch failure.	Minor damage, disease or decay; minor branch end-weight or over-extension. No history of branch failure.
Fair to Poor	Moderate damage or decay; minimal basal flare.	Moderate damage or decay; approaching recognised thresholds	Weak, decayed or with acute branch attachments; previous branch failure evidence.	Moderate damage, disease or decay; moderate branch end-weight or over-extension. Minor branch failure evident.
Poor	Major damage, disease or decay; fungal fruiting bodies present. Excessive lean placing pressure on root plate	Major damage, disease or decay; exceeds recognised thresholds; fungal fruiting bodies present. Acute lean. Stump re-sprout	Decayed, cavities or has acute branch attachments with included bark; excessive compression flaring; failure likely. Evidence of major branch failure.	Major damage, disease or decay; fungal fruiting bodies present; major branch end-weight or over-extension. Branch failure evident.
Very Poor	Excessive damage, disease or decay; unstable / loose in ground; altered exposure; failure probable	Excessive damage, disease or decay; cavities. Excessive lean. Stump re-sprout	Decayed, cavities or branch attachments with active split; failure imminent. History of major branch failure.	Excessive damage, disease or decay; excessive branch end-weight or over-extension. History of branch failure.

Diagram 2: Tree structure zones

1. Root plate & lower stem
2. Trunk
3. Primary branch support
4. Outer crown & roots



Adapted from Coder (1996)

Structure ratings will also take into account general branching architecture, stem taper, live crown ratio, crown symmetry (bias or lean) and crown position such as tree being suppressed amongst more dominant trees.

The lowest or worst descriptor assigned to the tree in any column could generally be the overall rating assigned to the tree. The assessment for structure is limited to observations of external and above ground tree parts. It does not include any exploratory assessment of underground or internal tree parts unless this is requested as part of the investigation. Trees are assessed and then given a rating for a point in time. Generally, trees with a poor or very poor structure are beyond the benefit of practical arboricultural treatments.

The management of trees in the urban environment requires appropriate arboricultural input and consideration of risk. Risk potential will consider the combination of likelihood of failure and impact, including the perceived importance of the target(s).

8. Age class

Relates to the physiological stage of the tree's life cycle.

Category	Description
Young	Sapling tree and/or recently planted. Approximately 5 or less years in location.
Semi-mature	Tree increasing in size and yet to achieve expected size in situation. Primary developmental stage.
Early-mature	Tree established, generally growing vigorously. > 50% of attainable age/size.
Mature	Specimen approaching expected size in situation, with reduced incremental growth.
Over-mature	Mature full-size with a retrenching crown. Tree is senescent and in decline. Significant decay generally present.

9. Useful life expectancy

Assessment of useful life expectancy provides an indication of health and tree appropriateness and involves an estimate of how long a tree is likely to remain in the landscape based on species, stage of life (cycle), health, amenity, environmental services contribution, conflicts with adjacent infrastructure and risk to the community. It would enable tree managers to develop long-term plans for the eventual removal and replacement of existing trees in the public realm. It is not a measure of the biological life of the tree within the natural range of the species. It is more a measure of the health status and the trees positive contribution to the urban landscape.

Within an urban landscape context, particularly in relation to street trees, it could be considered a point where the costs to maintain the asset (tree) outweigh the benefits the tree is returning.

The assessment is based on the site conditions not being significantly altered and that any prescribed maintenance works are carried out (site conditions are presumed to remain relatively constant and the tree would be maintained under scheduled maintenance programs).

Useful Life Expectancy	Typical characteristics
<1 year (No remaining ULE)	Tree may be dead or mostly dead. Tree may exhibit major structural faults. Tree may be an imminent failure hazard. Excessive infrastructure damage with high risk potential that cannot be remedied.
1-5 years (Transitory, Brief)	Tree is exhibiting severe chronic decline. Crown is likely to be less than 50% typical density. Crown may be mostly epicormic growth. Dieback of large limbs is common (large deadwood may have been pruned out). Major structural defects that cannot be remedied. Tree may be over-mature and senescing. Infrastructure conflicts with heightened risk potential. Tree has outgrown site constraints.
6-10 years (Short)	Tree is exhibiting chronic decline. Crown density will be less than typical and epicormic growth is likely to present. The crown may still be mostly entire, but some dieback is likely to be evident. Dieback may include large limbs. Structural defects present that influence the tree's risk rating, amenity or vitality. Over-mature and senescing or early decline symptoms in short-lived species. Early infrastructure conflicts with potential to increase regardless of management inputs.
11-20 years (Moderate)	Tree not showing symptoms of chronic decline, but growth characteristics are likely to be reduced (bud development, extension growth etc.). Developing structural defects that reduce viability with limited scope for management. Tree may be over-mature and beginning to senesce. Potential for infrastructure conflicts regardless of management inputs.
21-40 years (Moderately long)	Trees displaying normal growth characteristics, but vitality is likely to be reduced (bud development, extension growth etc.). Structural issues relatively minor and manageable with arboricultural input. Tree may be growing in restricted environment (e.g. streetscapes) or may be in late maturity. Semi-mature and mature trees exhibiting normal growth characteristics. Juvenile trees in streetscapes.

>40 years (Long)	Generally juvenile and semi-mature trees exhibiting normal growth characteristics within adequate spaces to sustain growth, such as in parks or open space. Could also pertain to maturing, long-lived trees. No observable major structural defects. Tree well suited to the site with negligible potential for infrastructure conflicts.

Note that ULE may change for a tree dependent on the prevailing climatic conditions, sudden changes to a tree's growing environment creating an acute stress or impact by pathogens.

The ULE may not be applicable for trees that are manipulated, such as topiary, or grown for specific horticultural purposes, such as fruit trees.

There may be instances where remedial tree maintenance could extend a tree's ULE.

10. Arboricultural Rating

Relates to the combination of assigned tree condition factors, including health and structure (arboricultural merit) and ULE, and conveys an amenity value (An amenity tree can occupy a site that complements its surroundings in a useful manner which culminates in the aid, protection, comfort and emotional response of humans. Adapted from Coder, 2004). Amenity relates to the trees biological, functional and aesthetic characteristics (Hitchmough, 1994) within an urban landscape context. The presence of any serious disease or tree-related hazards that would impact risk potential are considered.

The arboricultural rating can be used by applying only the main category high, moderate, low or very low without using the sub categories. The sub-categories can assist in differentiating a trees value and/or characteristic in more detail within the specific tree assessment context, such as a development site.

Arboricultural rating			
Category	*Description*		
High	Exemplary specimen due to multiple factors which could include; good condition and vitality, large size/canopy and prominence in the landscape. Likely to be a very long-term component in the landscape with a long ULE. Other factors that could contribute to a high rating: • Particularly good example of the species; rare or uncommon. • Tree has visual importance as a landscape feature; provides substantial contribution to landscape character. • Tree may have significant ecological or conservation value. • *Tree has historical, commemorative or other distinct social/cultural significance. Trees in this category must be considered for retention and/or incorporated within design proposals.		
Category	*Description*	*Sub category*	*Description*
Moderate	Tree of moderate quality, in fair or typical condition. Tree may have a condition, and or structural problem that will respond to arboricultural treatment. These trees have the potential to be moderate- to long-term components of the landscape (moderate to long ULE) if managed appropriately. The sub-categories relate predominately to age, size and amenity. Trees in this category should be considered for retention and/or incorporated within design proposals.	A	Moderate to large, maturing tree. Suited to the site & contributes to the landscape character. Tree may have conservation or other cultural/social value.
		B	Moderate sized, established tree, > 50% of attainable age/size. Suited to the site & contributes to the landscape character (other attributes covered under 'Moderate' description)
		C	• Young to semi-mature, generally a smaller tree, established, >15 cm DBH, >5 years in the location. Not a dominant canopy. No significant qualities currently but has the potential to become a higher value tree & long-term component of the landscape. Replacement of tree is likely to take up to 6 - 10 years to attain similar attributes. • Semi- to mature tree with accumulating deficiencies and reducing ULE, trending towards Low arboricultural value.
Category	*Description*		

Low	Unremarkable tree of low quality or little amenity value. Tree in either poor health and/or with poor structure. Short to transitory useful life expectancy (<10 years). • Tree is not prominent in the landscape due to its size or age, such as young trees with a stem diameter below 15 cm. Tree < 5 years in location. These trees are easily replaceable or capable of being transplanted. • Tree (species) is functionally inappropriate to the specific location. Is causing excessive damage/nuisance to adjacent infrastructure or would be expected to be problematic if retained (i.e. palm tree under power lines). • Unremarkable tree of no material landscape, conservation or other cultural value. Not visible from surrounding landscapes. • Tree infected with pathogens that could lead to its decline. • Tree has potential to be an environmental woody weed (may be dependent on location of tree in an urban landscape). • Tree impacting or suppressing trees of better quality. Retention of such trees may be considered if not requiring a disproportionate expenditure of resources for a tree in its condition and location.
Category	*Description*
Very low	Trees of low quality with a brief to no remaining ULE (<5 years). • Tree has either a severe structural defect or health problem or combination that cannot be sustained with practical arboricultural techniques and the loss of the tree or tree part would be expected in the short term. • Tree whose retention would not be viable after the removal of adjacent trees, such as trees that have developed in close spaced groups and would not be expected to adapt to severe and sudden alterations to environmental & site conditions, e.g. removal of adjacent shelter trees. • Small or young tree, <5m in height, <10cm DBH. Easily replaced in short-term or capable of being transplanted. • Acknowledged environmental woody weed species. Tree has a detrimental effect on the environment, for example, the tree has weed potential and is likely to spread into waterways or natural areas if nearby. • Tree infected with pathogens that will lead to decline and has potential to spread to adjacent trees. • Tree is dead (dead tree may offer habitat values) or is showing signs of significant, immediate, and irreversible overall decline. Tree cannot realistically be retained and should be considered for removal.

Other considerations - Even though a tree may be declining or dead, a tree could be retained for other purposes such as habitat or soil stabilisation. These trees would still need to be managed appropriately to reduce risk.

*A tree may have (attract) a high value by the community for historical, commemorative or other distinct social/cultural significance factors, albeit the tree may not be in good condition. In the context of an assessment, for multiple reasons, but more so for development, if it is a noted 'significant' tree it should receive higher consideration during the planning process.

Trees have many values, not all of which are considered when an arboricultural assessment is undertaken. However, individual trees or tree group features may be considered important community resources because of unique or noteworthy characteristics or values other than their age, dimensions, health or structural condition. Recognition of one or more of the following criteria is designed to highlight other considerations that may influence the future management of such trees.

Significance	**Description**
Horticultural Value/ Rarity	Outstanding horticultural or genetic value; could be an important source of propagating stock, including specimens that are particularly resistant to disease or exposure. Any tree of a species or variety that is rare.
Historic, Aboriginal Cultural or Heritage Value	Tree could have value as a remnant of a particular important historical period or a remnant of a site or activity no longer in action. Tree has a recognised association with historic aboriginal activities, including scar trees. Tree commemorates a particular occasion, including plantings by notable people, or having associations with an important event in local history.

Ecological Value	Tree could have value as habitat for indigenous wildlife, including providing breeding, foraging or roosting habitat, or is a component of a wildlife reserve. Remnant Indigenous vegetation that contribute to biological diversity

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Appendix 4: Tree protection zones

Introduction

In order to sustain trees on a development site consideration must be given to the establishment of tree protection zones.

The physical dimensions of tree protection zones can sometimes be difficult to define. The projection of a tree's crown can provide a guide but is by no means the definitive measure. The unpredictable nature of roots and their growth, differences between species and their tolerances, and observable and hidden changes to the trees growing environment, as a result of development, are variables that must be considered.

Most vigorous, broad canopied trees survive well if the area within the drip-line of the canopy is protected. Fine root density is usually greater beneath the canopy than beyond (Gilman, 1997). If few to no roots over 3cm in diameter are encountered and severed during excavation the tree will probably tolerate the impact and root loss. A healthy tree can sustain a loss of between 30% and 50% of absorbing roots (Harris, Clark, Matheny, 1999), however encroachment into the structural root system of a tree may be problematic.

The structural root system of a tree is responsible for ensuring the stability of the entire tree structure in the ground. A tree could not sustain loss of structural root system and be expected to survive let alone stand up to average annual wind loads upon the crown.

Allocation of tree protection zone (TPZ)

The method of allocating a TPZ to a particular tree will be influenced by site factors, the tree species, its age and developed form.

Once it has been established, through an arboricultural assessment, which trees and tree groups are to be retained, the next step will require careful management through the development process to minimise any impacts on the designated trees. The successful retention of trees on any particular site will require the commitment and understanding of all parties involved in the development process. The most important activity, after determining the trees that will be retained is the implementation of a TPZ.

The intention of tree protection zones is to:

- mitigate tree hazards;
- provide adequate root space to sustain the health and aesthetics of the tree into the future;
- minimise changes to the trees growing environment, which is particularly important for mature specimens;
- minimise physical damage to the root system, canopy and trunk; and
- define the physical alignment of the tree protection fencing

Tree protection

The most important consideration for the successful retention of trees is to allow appropriate above and below ground space for the trees to continue to grow. This requires the allocation of tree protection zones for retained trees.

The Australian Standard AS 4970-2009 Protection of trees on development sites has been used as a guide in the allocation of TPZs for the assessed trees. The TPZ for individual trees is calculated based on trunk (stem) diameter (DBH), measured at 1.4 metres up from ground level. The radius of the TPZ is calculated by multiplying the trees DBH by 12. The method provides a TPZ that addresses

both the stability and growing requirements of a tree. TPZ distances are measured as a radius from the centre of the trunk at (or near) ground level. The minimum TPZ should be no less than 2m and the maximum no more than 15m radius. The TPZ of palms should be not less than 1.0m outside the crown projection.

Encroachment into the TPZ is permissible under certain circumstances though is dependent on both site conditions and tree characteristics. Minor encroachment, up to 10% of the TPZ, is generally permissible provided encroachment is compensated for by recruitment of an equal area contiguous with the TPZ. Examples are provided in Diagram 1. Encroachment greater than 10% is considered major encroachment under AS4970-2009 and is only permissible if it can be demonstrated that after such encroachment the tree would remain viable.

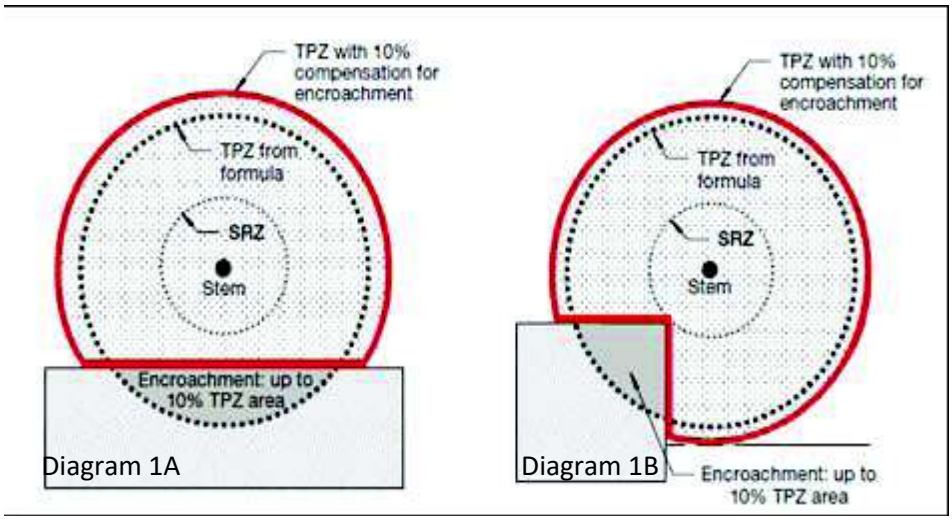


Diagram 1: Examples of minor encroachment into a TPZ.
(Extract from: AS4970-2009, Appendix D, p30 of 32)

The 10% encroachment on one side equates to approximately ⅓ radial distance. Tree root growth is opportunistic and occurs where the essentials to life (primarily air and water) are present. Heterogeneous soil conditions, existing barriers, hard surfaces and buildings may have inhibited the development of a symmetrically radiating root system.

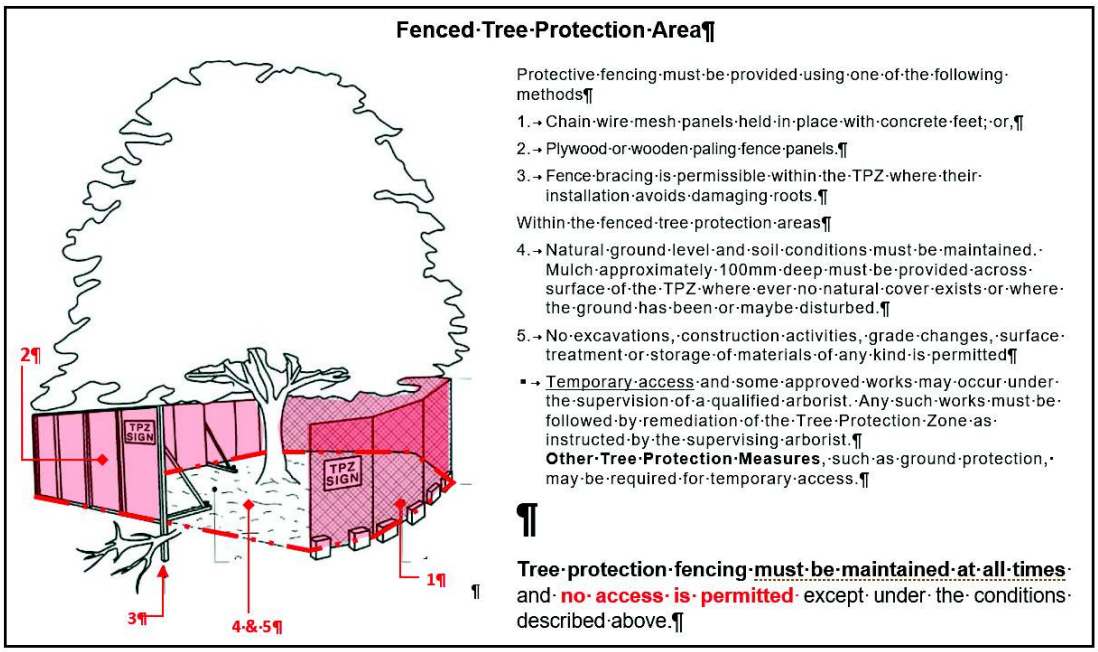
Existing infrastructure around some trees may be within the TPZ or root plate radius. The roots of some trees may have grown in response to the site conditions and therefore if existing hard surfaces and building alignments are utilised in new designs the impacts on the trees should be minimal. The most reliable way to estimate root disturbance is to find out where the roots are in relation to the demolition, excavation or construction works that will take place (Matheny & Clark, 1998). Exploratory excavation prior to commencement of construction can help establish the extent of the root system and where it may be appropriate to excavate or build.

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

General tree protection guidelines

The most important factors are:

- Prior to construction works the trees nominated for tree works should be pruned to remove larger dead wood. Pruning works may also identify other tree hazards that require remedial works.
- Installation of tree protection fencing. Once the tree protection zones have been determined the next step is to mulch the zone with woodchip and erect tree protection fencing. This must be completed prior to any materials being brought on-site, erection of temporary site facilities or demolition/earth works. The protection fencing must be sturdy and withstand winds and construction impacts. The protection fence should only be moved with approval of the site supervisor. Other root zone protection methods can be incorporated if the TPZ area needs to be traversed.
- Appropriate signage is to be fixed to the fencing to alert people as to importance of the tree protection zone.
- The importance of tree preservation must be communicated to all relevant parties involved with the site.
- Inspection of trees during excavation works.



Exploratory excavation

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

Exploratory excavation prior to commencement of construction can help establish the extent of the root system and where it may be appropriate to excavate or build. This also allows management decisions to be made and allows time for redesign works if required.

Any exploratory excavation within the allocated TPZ is to be undertaken with due care of the roots. Minor exploration is possible with hand tools. More extensive exploration may require the use of high pressure water or air excavation techniques. Either hydraulic or pneumatic excavation techniques will safely expose tree roots; both have specific benefits dependent on the situation and soil type. An arborist is to be consulted on which system is best suited for the site conditions.

Substantial roots are to be exposed and left intact.

Once roots are exposed decisions can be made regarding the management of the tree. Decisions will be dependent on the tree species, its condition, its age, its relative tolerance to root loss, and the amount of root system exposed and requiring pruning. Other alternative measures to encroaching the TPZ may include boring or tunnelling.

How to determine the diameter of a substantial root

The size of a substantial root will vary according to the distance of the exposed root to the trunk of the tree. The further away from the trunk of a tree that a root is, the less significant the root is likely to be to the tree's health and stability.

The determination of what is a substantial root is often difficult because the form, depth and spread of roots will vary between species and sites. However, because smaller roots are connected to larger roots in a framework, there can be no doubt that if larger roots are severed, the smaller roots attached to them will die. Therefore, the larger the root, the more significant it may be.

Gilman (1997) suggests that trees may contain 4-11 major lateral roots and that the five largest lateral roots account (act as a conduit) for 75% of the total root system. These large lateral roots quickly taper within a distance to the tree, this distance is identified as the Structural Root Zone (SRZ). Within the SRZ distance, all roots and the soil surrounding the roots are deemed significant.

No root or soil disturbance is permitted within the SRZ.

In the area outside the SRZ the tree may tolerate the loss of one or a number of roots. The table below indicates the size of tree roots, outside the SRZ that would be deemed substantial for various tree heights. The assessment of combined root loss within the TPZ would need to be undertaken by an arborist on an individual basis because the location of the tree, its condition and environment would need to be assessed.

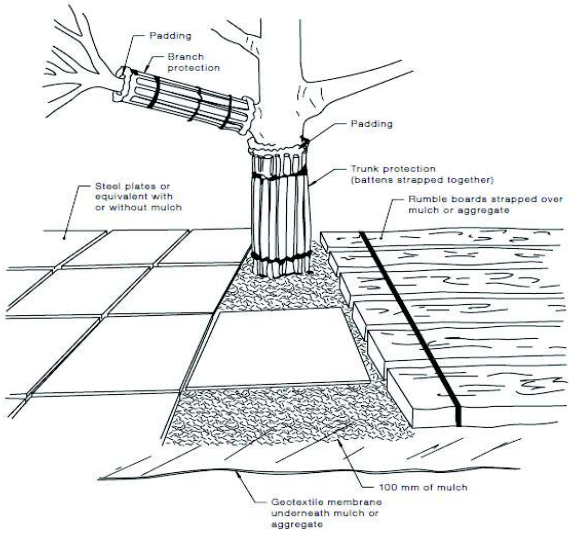
Table 1: Estimated significant root sizes outside SRZ

Height of tree	Diameter of root
Less than 5m	≥ 30mm
Between 5m - 15m	≥ 50mm
More than 15m	≥ 70mm

Ground buffering

Where works are required to be undertaken within the Tree root zone without penetration of the surface, ground buffering and trunk and limb protection must be provided to minimise the potential for soil to become compacted and avoid potential for impact wounds to occur to surface roots, trunk or limbs. Refer below.

Diagram 2: Examples of ground buffering and trunk and limb protection
(Extract from: AS4970-2009, Appendix D, pg17).



NOTES:
1 For trunk and branch protection use boards and padding that will prevent damage to bark. Boards are to be strapped to trees, not nailed or screwed.
2 Rumble boards should be of a suitable thickness to prevent soil compaction and root damage.

FIGURE 4 EXAMPLES OF TRUNK, BRANCH AND GROUND PROTECTION

Construction Guidelines

The following are guidelines that must be implemented to minimise the impact of the proposed construction works on the retained trees.

- The Tree Protection Zone (TPZ) is fenced and clearly marked at all times. The actual fence specifications should be a minimum of 1.2 - 1.5 metres of chain mesh or like fence with 1.8 meter posts (e.g. treated pine or star pickets) or like support every 3-4 metres and a top line of high visibility plastic hazard tape. The posts should be strong enough to sustain knocks from on site excavation equipment. This fence will deter the placement of building materials, entry of heavy equipment and vehicles and also the entry of workers and/or the public into the TPZ. Note: There are many different variations on the construction type and material used for TPZ fences, suffice to say that the fence should satisfy the responsible authority.
- Contractors and site workers should receive written and verbal instruction as to the importance of tree protection and preservation within the site. Successful tree preservation occurs when there is a commitment from all relevant parties involved in designing, constructing and managing a development project. Members of the project team need to interact with each other to minimise the impacts to the trees, either through design decisions or construction practices. The importance of tree preservation must be communicated to all relevant parties involved with the site.
- The consultant arborist is on-site to supervise excavation works around the existing trees where the TPZ will be encroached.
- A layer of organic mulch (woodchips) to a depth of no more than 100mm should be placed over the root systems within the TPZ of trees, which are to be retained so as to assist with moisture retention and to reduce the impact of compaction.
- No persons, vehicles or machinery to enter the TPZ without the consent of the consulting arborist or site manager.
- Where machinery is required to operate inside the TPZ it must be a small skid drive machine (i.e Dingo or similar) operating only forwards and backwards in a radial direction facing the tree trunk and not altering direction whilst inside the TPZ to avoid damaging, compacting or scuffing the roots.
- Any underground service installations within the allocated TPZ should be bored and utility authorities should common trench where possible.
- No fuel, oil dumps or chemicals shall be allowed in or stored on the TPZ and the servicing and re-fuelling of equipment and vehicles should be carried out away from the root zones.
- No storage of material, equipment or temporary building should take place over the root zone of any tree.
- Nothing whatsoever should be attached to any tree including temporary services wires, nails, screws or any other fixing device.
- Supplementary watering should be provided to all trees through any dry periods during and after the construction process. Proper watering is the most important maintenance task in terms of successfully retaining the designated trees. The areas under the canopy drip lines should be mulched with woodchip to a depth of no more than 100mm. The mulch will help maintain soil moisture levels. Testing with a soil probe in a number of locations around the tree will help ascertain soil moisture levels and requirements to irrigate. Water needs to be applied slowly to avoid runoff. A daily watering with 5 litres of water for every 30 mm of trunk calliper may provide the most even soil moisture level for roots (Watson & Himelick, 1997), however light frequent irrigations should be avoided. Irrigation should wet the entire root zone and be allowed to dry out prior to another application.

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Trees should be reassessed on a regular basis; the scheduled period of reassessment will be dependent on the characteristics of the tree, the landscape context and perceived targets, and resources available to maintain them.