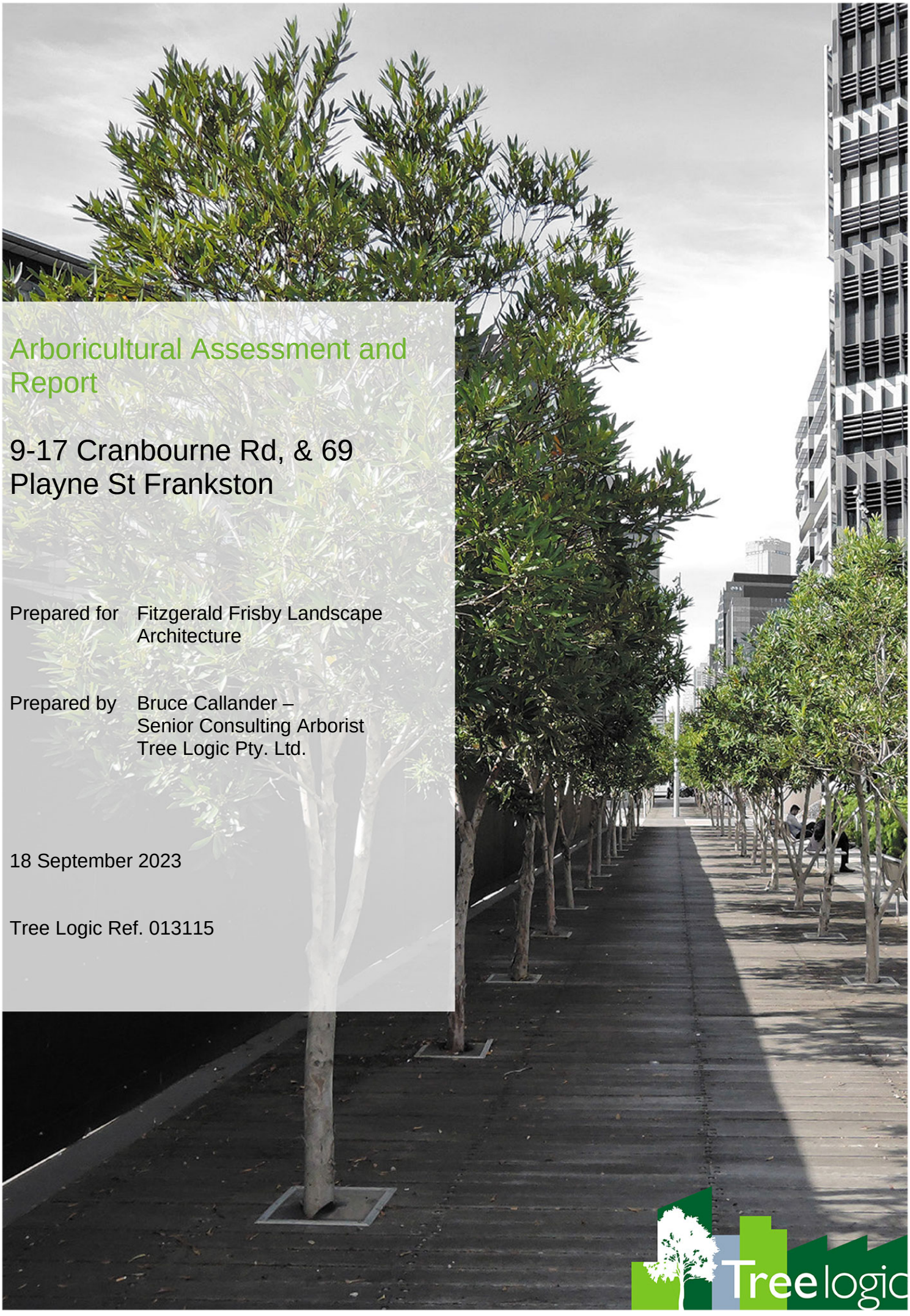

Arboricultural Assessment and Report

9-17 Cranbourne Rd, & 69 Playne St Frankston

Prepared for Fitzgerald Frisby Landscape Architecture

Prepared by Bruce Callander –
Senior Consulting Arborist
Tree Logic Pty. Ltd.

18 September 2023

Tree Logic Ref. 013115

Contents

TL Report_13115_9-17 Cranbourne Rd & 69 Playne St Frankston

File No.	Version	Author	Issue date	Edits	Issued by.
13115	V1	Bruce Callander	18/09/2023	Preliminary report	BC

1 Executive Summary

1.1 Tree Logic was engaged by Fitzgerald Frisby Landscape Architecture to undertake an arboricultural assessment and prepare a report for trees associated with a vacant with the vacant land at 9-17 Cranbourne Rd & 69 Playne St Frankston. The primary objectives of the arboricultural report are to provide a preliminary assessment which includes;

- Assess up to 35 trees in the study area including street trees and trees in neighbouring properties, collecting information on species, tree dimensions, condition (health and structure), and growing environment.
- Determine the Tree Protection Zones (TPZ) and Structural Root Zone (SRZ) for trees compliant with AS4970 'Protection of trees on development sites' and calculate potential TPZ incursions and impacts.
- Provide any relevant recommendations for tree management or pruning requirements.
- Identify if trees trigger permit requirement under City of Frankston Local Law.

1.2 Forty seven (47) tree features were assessed including 45 individual trees and 2 groups of suckering vegetation. The assessed trees included 9 tree features within the site boundary, 28 semi-mature to maturing trees within the neighbouring properties and 10 young roadside trees fronting the site along Cranbourne Road.

1.3 The trees were growing within a highly modified landscape comprising adjoining allotments which appear to have been vacant for approximately 15 years with periodic maintenance applied to keep the site generally clear of weeds and long grass.

1.4 Seventeen (17) different tree species were recorded comprised of an assortment of Victorian native, Australian native and exotic species all planted for garden and amenity purposes or growing as self-sown weed trees.

1.5 All trees were attributed an arboricultural rating which reflects the retention value of the trees.

- One (1) trees were attributed an arboricultural rating of Moderate B, being middle of the range and typical of the species.
- Thirty one (31) trees were rated Moderate C, being either maturing trees that are developing health and structural deficiencies and tending towards being of Low arboricultural value or being of small size.
- Fourteen (14) trees were rated Low, being either declining or defective trees or weed species.
- One (1) tree was rated Very Low, due to its poor structure and suckering nature

1.6 Permit requirement would apply to Trees 2, 16, 19, 20, 21, 22, 26, 28, 29, 35 under City of Frankston Tree Protection Local Law-22 were they to be removed, pruned more than 1/3 of its existing canopy or have their TPZ's encroached by more than 10 percent.

- However, all of these trees are under 3rd party ownership and should be appropriately protected to ensure they remain viable.
- Council street trees are all of a sufficiently small size that they could be readily transplanted or replaced if necessary, however, council permission would be required before undertaking any such work.

2 Method

2.1 A site inspection was carried out on Monday, September 11th, 2023 during mild conditions by Bruce Callander (Dip. Hort. Cert 5 Arboriculture) and Ethan Lua (ISA Certified Arborist)

2.2 The trees were inspected from the ground and observations were made of the growing environment and surrounding area.
Each tree feature was plotted on a ruggedized mobile field computer using a combination of aerial imagery, feature survey plan tree points in conjunction with an inbuilt GPS & measuring tool.
Where trees were growing in neighbouring properties an extension ladder was used to view the trees from the best available vantage points and estimate the trunk dimensions required to determine the TPZ and SRZ.
The location of each tree is indicated in Appendix 2 using GIS mapping displayed on aerial imagery of the site and is colour coded based on arboricultural value.

2.3 Observations were made of the assessed trees to determine the species, origin, age class 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).

2.4 Tree assessment details are provided in Appendix 1 and a copy of the tree location plans can be seen in Appendix 2. Descriptors used in the assessment can be seen in Appendix 3.

2.5 Photographs of trees and the environs were taken for further reference when preparing the report.

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. 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 are provided in Appendix 1 and displayed on the tree location plan in Appendix 2.

2.8 Documents reviewed:

- Planning Property report for 9-17 Cranbourne Rd & 69 Playne St Frankston. Department of Planning & Community Development, 11/09/2023
  - Commercial 1 Zone (C1Z) apply to site.
- City of Frankston Tree Protection Local Law-22
- Native Vegetation – Clause 52.17 pertaining to naturally occurring trees native to Victoria (not planted specimens) on land greater than 4,000 square metres.
- Neighbourhood Character & Description (Mornington Peninsula Specialist Hospital. Clarke Hopkins Clarke. Proj: 220088 . TP01. 28/8/23 Pages from plans 220088_MPSH_TP_Package_b

3 Permit requirements

3.1 The study site is within the City of Frankston council area.

- The site is zoned as Commercial 1 Zone (C1Z).

3.2 No specific tree controls apply under any environmental overlays applicable to the site.

3.3 City of Frankston has a Tree Protection Local Law – 22, effective since 8 April 2016. Council intends to;

- protect our community forest by maintaining tree canopy on private land
- require a minimum standard of tree pruning for the protection of trees and public safety
- protect and enhance the amenity and environment of Frankston

3.4 Permit requirement would apply to Trees 2, 16, 19, 20, 21, 22, 26, 28, 29, and 35 under City of Frankston Tree Protection Local Law-22 were they to be removed or pruned by more than 1/3 of the outer canopy.

- Trees in Groups 1 and 2 are undersized woody weed species that are exempt from permit requirements.
- Street trees and neighbour's trees must be considered in any design response to ensure they remain viable.

3.5 Refer to Table 1 for a list of trees sorted by permit requirement and ownership.

Location	Permit	Status	Total
On site	No	Undersize	1, 5, 6, 7, 9, 10, 12, G1, G2
Neighbour's	Undersize	Protect	3, 4, 8, 11, 13, 14, 15, 17, 18, 23, 24, 25, 30, 31, 32, 33, 34, 36
Neighbour's	Yes	Protection req'd	2, 16, 19, 20, 21, 22, 26, 28, 29, 35
Street	Undersize	Council permission req'd	37, 38, 39, 40, 41, 42, 43, 44, 45, 46

4 Observations

4.1 The subject tree study included assessment of 47 tree feature including 45 individual trees and 2 groups of suckering vegetation associated with vacant land plots at 9-17 Cranbourne Rd, & 69 Playne St Frankston. The trees included trees 1, 5, 6, 7, 9, 10, 12 growing within the site along with two suckering tree clusters G1 and G2, while the remaining trees are growing within multiple neighbour properties to the South east and West abutting the common fence line.
A dense patch of Golden bamboo (*Phyllostachys aurea*) was also growing around the south base of Tree cluster G1.
The site is a vacant, grassed fenced area that features multiple suckering species within the site due to its lack of landscaping maintenance. The rest of the canopy trees reflected on the site aerial plate 1 below exist in neighboring properties. There are no natural creeks or drainage lines in the vicinity of the site. Refer to Plate 1 below for view of existing site conditions.

Plate 1: Aerial view of the tree study area at 9-17 Cranbourne road and 69 Playne Street, Frankston, indicated by pale blue rectangle within the subject site (Red line). The dashed lines indicate easements within the site.

4.2 **Tree population**

Forty five (45) trees and two clusters of Suckering tree species were inspected, comprising a total of 17 different species.

- Tree 2 is a species that is native to the local area and a neighbour's tree, however it is declining due to its overall over-mature age.
- Trees in G1 and G2 are introduced and potentially self-sown weed trees.
- Trees 13 -23 are palm species on the east neighboring property.

Refer to Table 1 for tree numbers sorted by species and origin.

Table 1.

Botanic name	Common Name	Origin	Count	Tree numbers
Robinia pseudoacacia	Locust	Exotic deciduous	1	1
Acacia longifolia var. sophorae	Coast Wattle	Victorian native	1	2
Liquidambar styraciflua	Liquidamber	Exotic deciduous	9	3, 4, 5, 6, 7, 8, 9, 10, 11
Fraxinus angustifolia subsp. angustifolia	Desert Ash	Exotic deciduous	1	12
Syagrus romanzoffiana	Queen Palm	Exotic palm	8	13, 14, 15, 16, 19, 20, 21, 22
Archontophoenix cunninghamiana	Bangalow Palm	Exotic palm	3	17, 18, 23
Radermachera sinica	Asian Bell Tree	Exotic evergreen	1	24
Persea americana	Avocado	Exotic evergreen	1	25
Lagunaria patersonia	Norfolk Island Hibiscus	Australian native	1	26
Agonis flexuosa	Willow Myrtle	Australian native	1	28
Cinnamomum camphora	Camphor Laurel	Exotic evergreen	1	29
Pittosporum eugenioides 'Variegatum'	Variegated Tarata	Exotic evergreen	2	30, 31
Eriobotrya japonica	Loquat	Exotic evergreen	1	32
Ligustrum lucidum	Shining Privet	Exotic evergreen	1	33
Juniperus sp.	Juniper	Exotic conifer	1	34
Callistemon viminalis	Weeping Bottlebrush	Australian native	1	35
Lagerstroemia indica	Crape Myrtle	Exotic deciduous	11	36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46

- Tree Group G1 was the initial tree group identified at the northwest sector of the vacant site. This group extends 40 metres along the west boundary fence, featuring numerous multi-stemmed suckering *Robinia pseudoacacia* (Locust). While the health of the trees in the group is Fair, they exhibited poor structure having been previously lopped to ground level and are now re-shooting and suckering across the western parts of the site. Due to its woody weed nature, the majority of these were rated from Low to Very Low and could be removed for sound environmental reasons.
- Tree Group G2, along with Tree 3, 4, 5, 6, 7, 8, 9, 10, 11 represent a group of *Liquidambar styraciflua* (Liquidambar) a similar deciduous species like G1. The trees at this south west end occur on both sides of the boundary fence line. There was clear evidence as well of these trees having been previously lopped and are now suckering along this boundary. Given the nature of this species to become a large specimen it would not be appropriate to retain all or any of these trees in this location.
- On the south east corner of the assessed site, the majority of the trees assessed were primarily on the neighbour's side of the fence, featuring a mix of *Syagrus romanzoffiana* (Queen palm) and *Archontophoenix cunninghamiana* (Bangalow palm). The TPZs for these Palms has been adjusted to comply with the Australian Standard for calculating TPZs for Palms.

- The east sector of the site is where a variety of tree species occur from tree 25 to tree 31, all of which are neighbouring trees attributed with a Mod B to Low value due to the overall maturing forms and possum affected canopies.
- Tree 26 is a neighbour planted *Lagunaria patersonia* (Norfolk Island Hibiscus) which was attributed an arboricultural rating of Moderate B, which reflected Fair health and structure.
- Trees 36-46 are trees at the north front of the property along the nature strip, all of which are young, newly planted species of *Lagerstroemia indica* (Crape Myrtles) attributed with a Mod C rating.

4.3 **Tree health** was assessed based on foliage colour, size and density as well as shoot initiation and elongation where possible. The majority of trees in the site displayed Fair to poor health with typical or better foliage colour, size and density and shoot extension.

- The trees in G1 and G2 displayed Fair to poor health that is considered typical for the species growing in this environment.
- Tree 2 displayed some decline and dieback in the upper south canopy.
- Tree 24 featured overall canopy decline and dieback thus reflecting its low health and Arb rating.
- Tree 25- 31 on the east middle sector of the site feature a wider range of species, all within neighbour properties. Most of the trees have dieback and possum damage in their upper canopies and sparse foliage reflecting their fair to poor health.

4.4 **Tree structure** was assessed for structural defects and deficiencies and likelihood of failures.

- Trees in G1 and G2 displayed fair to poor structure, typical due to their woody weed species nature and multi stemmed arrangement.
- Tree 2 exhibited fair to poor structure due to its decline in both age and health, as well as the wide branching from its low union.
- Majority of the palms on the south east quadrant of the site are of fair structure with the exception of tree 14 which was observed lopped with no canopy/fronds.

4.5 **Arboricultural Rating**

The assessed trees were attributed an arboricultural rating. This rating relates to the combination of tree condition factors, including health and structure (arboricultural merit), and which conveys an amenity value.

It should be noted that the arboricultural rating is different to the conservation/ecological values placed on trees by other professions.

Refer to Table 2 for Tree numbers sorted by Arboricultural ratings.

Table 2: Arboricultural rating	Count of trees	Tree numbers
Moderate B	1	26
Moderate C	30	4, 5, 7, 8, 10,13,15,16, 17, 18, 19, 20, 21, 22, 23, 25, 29, 30, 31, 32, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46
Low	15	2, 3, 6, 9, 11, 12, 14, 24, 28, 33, 34, 35, 36, G1, G2
Very Low	1	1
Total	47	

- Trees rated Moderate B are typical examples of the species growing in this setting under prevailing conditions.
- Trees attributed a rating of Moderate C are maturing trees with health or structural deficiencies and that are trending towards becoming of Low arboricultural value.
- Tree 1 and trees in group G1 are rated Very Low as they are virulent woody weed species that can be removed, along with the patch of Bamboo within the west site boundary itself, for sound environmental reasons and without the requirement of a permit.

5 Tree Protection Zones

The Tree Protection Zones (TPZs) provided for each tree in the Tree Assessment Table in Appendix 1 are calculated using the formula provided in the Australian Standard AS4970 where the Radial TPZ = Trunk diameter (DBH) measured in metres 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.
The method for calculating, applying and managing the tree protection zone is described in Appendix 4.

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.

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. Refer to Figure 2A and 2B.

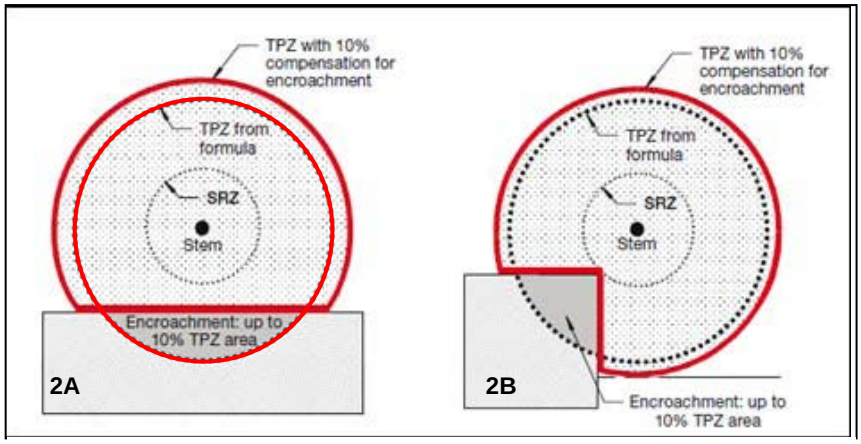

Figure 2: 2A & 2B - Examples of minor encroachment into a TPZ.
Extract from: AS4970-2009, Appendix D, pg. 30 of 32

Existing built form or other landscape elements that are present within the TPZ that may have either restricted root development or have effectively shut out water and oxygen to any underlying tree roots should be considered when allocating TPZ and any level of TPZ encroachment by new works.

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.
See Appendix 4 for TPZ establishment and types of encroachment.

Trees that are under third party ownership must be afforded due consideration and minimum tree protection requirements during any construction works to ensure they are successfully sustained.
All TPZ measurements are provided in the tree assessment data in Appendix 1.

6 Design review and Tree impact assessment

The pre – development arboricultural inspection report provides planners and designers with information on whether trees are worthy or not of being a constraint on the proposed repurposing of the site.

It also provides a basis on which to identify when and where potential impacts to trees will occur from various design elements and evaluates the possible severity of the impact during the design phase of any site redevelopment.

Trees grow in a delicate balance with their environment and any changes to that balance must be minimised if a tree is to remain in a healthy state and fulfil its potential.
It is rarely possible to repair stressed and injured trees, so damage needs to be avoided during all stages of development and construction.
Tree protection cannot be achieved without a proactive approach. The planning and design stages of any construction project can be instrumental and determine the success of tree preservation.

The hierarchy of principles for tree protection are:

- Avoid damage to the subject trees
- Minimize damage to the subject trees
- Replace the subject trees and improve the landscape (as a last resort).

6.1 At the time of preparing the report no development plans were available to be reviewed.
In the absence of specific site design plans, it is not appropriate to speculate on which trees are most appropriate for retention, beyond the general guide provided by the arboricultural ratings attributed to each tree feature. Retention suitability will be dependent on the proposed landscape setting in which trees are intended to be retained. The following recommendations are provided for consideration in the design process.

On the basis of future site safety and potential amenity, preference should be given to retaining trees of High and Moderate arboricultural value in built areas, or areas of increased target potential.

- Small trees of Low arboricultural value that are otherwise in reasonable condition (Fair-poor or better Health and /or Structure) may offer a potential established tree resource, even if only as an interim measure.
- Trees of Low arboricultural value should not compromise reasonable design intent.
- Low rated trees with health or structural deficiencies (Poor or worse Health and/or Structure) or trees recognized as environmental weed species should generally be considered for removal based on sound arboricultural opinion.
- Trees attributed and arboricultural rating of None are not suitable to retain and should be removed.

- Trees under third party ownership such as street trees must be duly protected unless the council, tree owner or manager of the tree authorises works to occur to the tree or within the TPZ.

All trees that are to be retained in the vicinity of any proposed works will require Tree Protection Zones to be established prior to commencing any works onsite including demolition, bulk earthworks, trenching, construction, landscaping activity, delivery and storage of materials or placement of site sheds.

Appropriate tree protection fencing must be established and maintained around all trees to be retained.

Trees under third party ownership such as neighbour's trees 4 and 5 must be duly protected to ensure the trees remain viable post construction. .

Where the trees exist in adjacent properties the part of the TPZ that exists within the subject site must still be protected to avoid adversely affecting the tree or compacting the soil within the root zone of neighbour's trees.

Appropriate ground buffering materials should be installed on the TPZ area that extends into the subject site to prevent root damage and soil compaction.

No form of excavation or trenching for installation of underground services is permitted within the nominated TPZ areas of any retained trees without prior consultation with the council and / or site arborist, to avoid or minimise severing roots that could be vital to the continued sustainability and stability of the retained trees.

Design should ensure appropriate growing space is allocated for all trees that are to be retained. If infrastructure is constructed too close to any of the retained trees, there is potential for damage to occur resulting from incremental root growth.
Damage to paving from root activity is most likely to occur within 2 m of the trunk base of a tree where the large woody structural root zone may contributes to upheaval. It is recommended that a minimum 2 metre clearance is provided from any tree to any hard paved surface.

TPZs for council street trees should be fenced to the back of kerb, edge of the foot path and the radial distance of the TPZ within the nature strip to prevent storage of materials or spoil or vehicular access damaging the trees or compacting soil within the TPZ.
The TPZ fencing should not hinder pedestrian access unless an alternative arrangement has been approved by the relevant authorities.

All TPZ and SRZ radius distances are provided in Appendix 1.

6.2 No form of excavation for trenching for installation of underground services is permitted within the nominated TPZ areas for any retained trees without prior consultation with the council and / or site arborist, to avoid severing roots that could be vital to the stability and continued sustainability of the retained trees.

- Trenching for the installation of any and all underground services must be designed to avoid encroaching the TPZ of any retained trees.

- If it is unavoidable that an underground service must pass through a defined TPZ, the service must be installed via directional boring at a minimum depth of 750mm to the top of the bore head.
  All entry and exit points for the boring must be located beyond the TPZ radius.
- Lubricants or waste water from the boring process must not be permitted to enter or contaminate the soils within the TPZ.

6.3 The TPZ fencing must be in the form of either temporary fencing panels with concrete block feet and locked together, water filled barriers with locking pins installed or 2 metre tall star pickets at 2 metre spacing with top wire supporting fluro para-webbing.
Whichever TPZ fencing is used, it must be sufficiently robust to withstand knocks and bumps from plant and machinery, delivery vehicles and effectively exclude or prevent any storage of materials dumping of spoil or waste products being disposed of in the Tree Protection Zone.

6.4 Appropriate signage stating 'Tree Protection Zone- No access' is to be fixed to the fencing to alert people as to importance of the tree protection zone. Refer to Figure 1 for fencing example.

Figure 1. Above left - Example of TPZ fencing above right -Example of TPZ signage.

6.5 The following activities must be excluded from or controlled within the Tree Protection Zones (TPZ) unless otherwise approved by the relevant authority or the Project Arborist.

- Machine excavation (including trenching) for continuous strip footings or installation of underground services or road base.
- Alteration of soil levels including placement of fill unless specified by design & project arborist.
- Storage of wastes or materials (including fuels, oils or chemicals)
- Preparation of or cleaning of any cement products
- Storage and or parking of vehicles or any plant/machinery within TPZ
- Washing down of equipment
- Installation of utilities

- Physical damage of any kind to the tree (including direct attachment of anything into the tree)
- Soil cultivation unless specified by design & project arborist.

6.6 Temporary facilities and site sheds may be established on existing hard stand / car park already present within the TPZ providing there is no physical impacts to the trees and no requirement to penetrate the surface within the TPZ for installation of footings or underground services.

Refer to Appendix 1 for all tree data, Appendix 2 for Tree Location and TPZ maps and Appendix 3 for Tree Descriptors.

7 Conclusion

7.1 Tree Logic was engaged to undertake an inspection and impact assessment of forty seven (47) trees associated as a preliminary assessment to to ascertain the current status, condition and arboricultural value of any trees on site or in neighbouring properties adjacent to the site, 9-17 Cranbourne Road and 69 Playne St, Frankston

7.2 They comprise 2 tree clusters of *Robinia pseudoacacia* (Locust) and *Liquidambar styraciflua* (Liquidambar) respectively. Neighbour trees featured a wider range; a Victorian Native Coast Wattle, Australian native Norfolk island Hibiscus, Willow Myrtle and Weeping Bottlebrush, while the rest were various deciduous and palm species. Refer to Section 4 for observations of the trees' attributes and a description of existing site conditions.

7.3 Trees 2, 16, 19, 20, 21, 22, 26, 28, 29, and 35 are subject to permit requirement under City of Frankston Tree Protection Local Law-22 were they to be removed, pruned by more than 1/3 of the outer canopy or have their TPZ encroached by more than 10% from any land development works. Refer to Section 3 – Tree Permits.

7.4 The trees were assigned an arboricultural rating that summarises the landscape and retention value of the assessed trees. Refer to Section 4.

7.5 Tree Protection Zone measures must be implemented prior to commencing any works onsite, including demolition, bulk earthworks, construction, landscaping activity, delivery and storage of materials or placement of site sheds.
Recommendations and guidelines on TPZ establishment and management are provided in Section 6 and Appendix 4

7.6 The tree protection zones for all trees to be retained within the site must be clearly shown on all design drawings and plans with appropriate notations so that all staff and contractors are aware of the responsibility to protect trees throughout the design, development and delivery of the project.

~~7.7~~ The tree assessment data is attached in Appendix 1 in tabular form.
The tree location and numbering plans are attached as Appendix 2 with separate colours sorted by Arboricultural rating.

7.8 Tree condition can change rapidly because of environmental and other influences. It is recommended that regular inspections are undertaken to identify changes to tree condition on a 3-to-5-year cycle or following local severe or damaging weather events.

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

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

Signed

Bruce Callander  ant Arborist Treelogic P/L

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treeid	Tree species	Common Name	age_class	origin_type	dbh_cm	Basal Ø cm	Height_m	Width_m	Health	Structure	arb_rating	ULE_yrs	Location	Permit	Comments	tpz_rad_m	srz_rad_m
1	*Robinia pseudoacacia*	Locust	Early-mature	Exotic deciduous	12	16	2	2	Fair	Poor	Very Low	<1 y	On site	No	Lopped, Weed infested	2	1.5
2	*Acacia longifolia var. sophorae*	Coast Wattle	Over-mature	Victorian native	27	37	5	8	Fair to Poor	Fair to Poor	Low	1-5 y	Neighbour's	Yes	Declining, Neighbour's tree, Tree east canopy growing over fence line	3.2	2.2
3	*Liquidambar styraciflua*	Liquidamber	Semi-mature	Exotic deciduous	13,13,11	30	7	4	Fair	Fair to Poor	Low	6-10 y	Neighbour's	No	Crossing branches, Multi-stemmed, Neighbour's tree	2.6	2
4	*Liquidambar styraciflua*	Liquidamber	Semi-mature	Exotic deciduous	15	20	7	4	Fair	Fair	Mod.C	21-40 y	Neighbour's	No	Neighbour's tree, Suckering, Canopy growing along fence line	2	1.7
5	*Liquidambar styraciflua*	Liquidamber	Semi-mature	Exotic deciduous	14	18	8	4	Fair	Fair to Poor	Mod.C	11-20 y	On site	No	Suckering, appears to have been lopped at base. Basal stem in contact with boundary fence	2	1.6
6	*Liquidambar styraciflua*	Liquidamber	Semi-mature	Exotic deciduous	10,9	23	6	4	Fair	Fair to Poor	Low	6-10 y	On site	No	Co-dominant stems, Suckering	2	1.8
7	*Liquidambar styraciflua*	Liquidamber	Semi-mature	Exotic deciduous	12	15	8	3	Fair	Fair to Poor	Mod.C	6-10 y	On site	No	Suckering, base in contact with fenceline	2	1.5
8	*Liquidambar styraciflua*	Liquidamber	Semi-mature	Exotic deciduous	13	18	8	4	Fair	Fair	Mod.C	6-10 y	Neighbour's	No	Neighbour's tree, Suckering	2	1.6
9	*Liquidambar styraciflua*	Liquidamber	Semi-mature	Exotic deciduous	13,9	25	8	4	Fair	Fair to Poor	Low	6-10 y	On site	No	Co-dominant stems, Included bark, Suckering	2	1.8
10	*Liquidambar styraciflua*	Liquidamber	Semi-mature	Exotic deciduous	18	22	8	5	Fair	Fair	Mod.C	11-20 y	On site	No	Suckering	2.2	1.8
11	*Liquidambar styraciflua*	Liquidamber	Semi-mature	Exotic deciduous	12	16	8	4	Fair	Fair to Poor	Low	6-10 y	Neighbour's	No	Neighbour's tree, Suckering	2	1.5
12	*Fraxinus angustifolia subsp. angustifolia*	Desert Ash	Semi-mature	Exotic deciduous	7	16	3	4	Fair	Fair to Poor	Low	6-10 y	On site	No	Weed infested, self-sown	2	1.5
13	*Syagrus romanzoffiana*	Queen Palm	Maturing	Exotic palm	30	35	10	5	Fair	Fair	Mod.C	11-20 y	Neighbour's	No	Neighbour's tree, dead fronds	3.5	2.1
14	*Syagrus romanzoffiana*	Queen Palm	Maturing	Exotic palm	30	35	4	1	Dead	Poor	Low	11-20 y	Neighbour's	No	Lopped, Neighbour's tree	1.5	2.1
15	*Syagrus romanzoffiana*	Queen Palm	Maturing	Exotic palm	28	35	12	5	Fair	Fair	Mod.C	11-20 y	Neighbour's	No	Neighbour's tree	3.5	2.1
16	*Syagrus romanzoffiana*	Queen Palm	Maturing	Exotic palm	35	40	12	5	Fair	Fair	Mod.C	11-20 y	Neighbour's	Yes	Neighbour's tree	3.5	2.3
17	*Archontophoenix cunninghamiana*	Bangalow Palm	Maturing	Exotic palm	14	18	8	5	Fair	Fair	Mod.C	11-20 y	Neighbour's	No	Neighbour's tree	3.5	1.6
18	*Archontophoenix cunninghamiana*	Bangalow Palm	Maturing	Exotic palm	14	18	8	5	Fair	Fair	Mod.C	11-20 y	Neighbour's	No	Neighbour's tree	3.5	1.6
19	*Syagrus romanzoffiana*	Queen Palm	Maturing	Exotic palm	35	40	9	6	Fair	Fair	Mod.C	11-20 y	Neighbour's	Yes	Neighbour's tree	4	2.3
20	*Syagrus romanzoffiana*	Queen Palm	Maturing	Exotic palm	32	38	9	6	Fair	Fair	Mod.C	11-20 y	Neighbour's	Yes	Neighbour's tree	4	2.2
21	*Syagrus romanzoffiana*	Queen Palm	Maturing	Exotic palm	37	42	8	6	Fair	Fair	Mod.C	11-20 y	Neighbour's	Yes	Neighbour's tree	4	2.3
22	*Syagrus romanzoffiana*	Queen Palm	Maturing	Exotic palm	37	42	12	6	Fair	Fair	Mod.C	11-20 y	Neighbour's	Yes	Neighbour's tree	4	2.3
23	*Archontophoenix cunninghamiana*	Bangalow Palm	Early-mature	Exotic palm	20	27	7	4	Fair	Fair	Mod.C	11-20 y	Neighbour's	No	Neighbour's tree	3	1.9
24	*Radermachera sinica*	Asian Bell Tree	Maturing	Exotic evergreen	16	20	5	4	Poor	Poor	Low	1-5 y	Neighbour's	No	Neighbour's tree	2	1.7
25	*Persea americana*	Avocado	Early-mature	Exotic evergreen	20	22	6	5	Fair to Poor	Fair to Poor	Mod.C	1-5 y	Neighbour's	No	Dieback, Neighbour's tree, Sun burn	2.4	1.8
26	*Lagunaria patersonia*	Norfolk Island Hibiscus	Maturing	Australian native	30,29	68	12	9	Fair	Fair	Mod.B	11-20 y	Neighbour's	Yes	Multi-stemmed, Neighbour's tree	5	2.8
28	*Agonis flexuosa*	Willow Myrtle	Maturing	Australian native	38,22,18	55	6	6	Fair to Poor	Fair to Poor	Low	6-10 y	Neighbour's	Yes	Foliage sparse, Foliage sparse - possums, Neighbour's tree, Partly suppressed - crown bias	5.7	2.6
29	*Cinnamomum camphora*	Camphor Laurel	Maturing	Exotic evergreen	38,22,18	55	6	6	Fair	Fair	Mod.C	11-20 y	Neighbour's	Yes	Foliage sparse, Neighbour's tree	5.7	2.6
30	*Pittosporum eugenioides 'Variegatum'*	Variegated Tarata	Early-mature	Exotic evergreen	13	18	4	4	Fair	Fair	Mod.C	11-20 y	Neighbour's	No	Neighbour's tree	2	1.6
31	*Pittosporum eugenioides 'Variegatum'*	Variegated Tarata	Early-mature	Exotic evergreen	11,7	18	4	4	Fair	Fair	Mod.C	11-20 y	Neighbour's	No	Neighbour's tree	2	1.6
32	*Eriobotrya japonica*	Loquat	Early-mature	Exotic evergreen	15 est.	18	4	4	Fair	Fair	Mod.C	11-20 y	Neighbour's	No	Foliage sparse - possums, Ivy vine, Neighbour's tree	2	1.6
33	*Ligustrum lucidum*	Shining Privet	Early-mature	Exotic evergreen	17 est.	20	4	4	Fair to Poor	Fair to Poor	Low	6-10 y	Neighbour's	No	Deadwood, Ivy vine, Neighbour's tree, Woody weed sp.	2	1.7
34	*Juniperus sp.*	Juniper	Early-mature	Exotic conifer	6,6 est.	10	3	4	Fair to Poor	Fair to Poor	Low	6-10 y	Neighbour's	No	Deadwood, Dieback, Neighbour's tree	2	1.5
35	*Callistemon viminalis*	Weeping Bottlebrush	Maturing	Australian native	25,15	50	4	4	Fair	Fair	Low	6-10 y	Neighbour's	Yes	Deadwood, Dieback, Lopped, Neighbour's tree	3.5	2.5

treeid	Tree species	Common Name	age_class	origin_type	dbh_cm	Basal Ø _cm	Height_m	Width_m	Health	Structure	arb_rating	ULE_yrs	Location	Permit	Comments	tpz_rad_m	srz_rad_m
36	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	6,6,6,6,6	10	4	4	Fair	Fair	Low	6-10 y	Neighbour's	No	Lopped, Neighbour's tree	2	1.5
37	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	4	5	2	1	Fair	Fair	Mod.C	21-40 y	Street	No		2	1.5
38	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	4	5	2	1	Fair	Fair	Mod.C	21-40 y	Street	No		2	1.5
39	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	4	5	2	1	Fair	Fair	Mod.C	21-40 y	Street	No		2	1.5
40	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	4	5	2	1	Fair	Fair	Mod.C	21-40 y	Street	No		2	1.5
41	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	4	5	2	1	Fair	Fair	Mod.C	21-40 y	Street	No		2	1.5
42	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	4	5	2	1	Fair	Fair	Mod.C	21-40 y	Street	No	Mechanical damage	2	1.5
43	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	4	5	2	1	Fair	Fair	Mod.C	21-40 y	Street	No		2	1.5
44	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	4	5	2	1	Fair	Fair	Mod.C	21-40 y	Street	No		2	1.5
45	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	4	5	2	1	Fair	Fair	Mod.C	21-40 y	Street	No		2	1.5
46	*Lagerstroemia indica*	Crape Myrtle	Early-mature	Exotic deciduous	4	5	2	1	Fair	Fair	Mod.C	21-40 y	Street	No		2	1.5
G1	*Robinia pseudoacacia*	Locust	Early-mature	Exotic deciduous	12	15	5	6	Fair	Fair to Poor	Low	1-5 y	On site	No	Multi-stemmed, Suckering, Woody weed sp.	2	1.5
G2	*Liquidambar styraciflua*	Liquidamber	Semi-mature	Exotic deciduous	8	11	6	3	Fair	Fair to Poor	Low	6-10 y	On site	No	Suckering	2	1.5

Appendix 2: Tree Location & TPZ Plan: 9-17 Cranbourne Rd & 69 Playne St Frankston

Refer to following page

APPENDIX 2 — TREE LOCATIONS AND PROTECTION ZONES

PROJECT
9-17 Cranbourne Rd, & 69 Playne St Frankston

DATA SOURCES

TL REF.	MAP NO.	DATE	CLIENT
	1 / 1	2023-09-19	Tim Fitzgerald | fitzgerald frisby

LEGEND

Trees Arb Rating
- Mod-B
- Mod-C
- Low
- Very Low

Groups Arb rating
- Low

- easement
- cadastre
- Tree Protection Zone
- Structural Root Zone

NOTES
Insert comments here

TREE LOCATION DISCLAIMER
Tree locations are approximate

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

0 20 40m

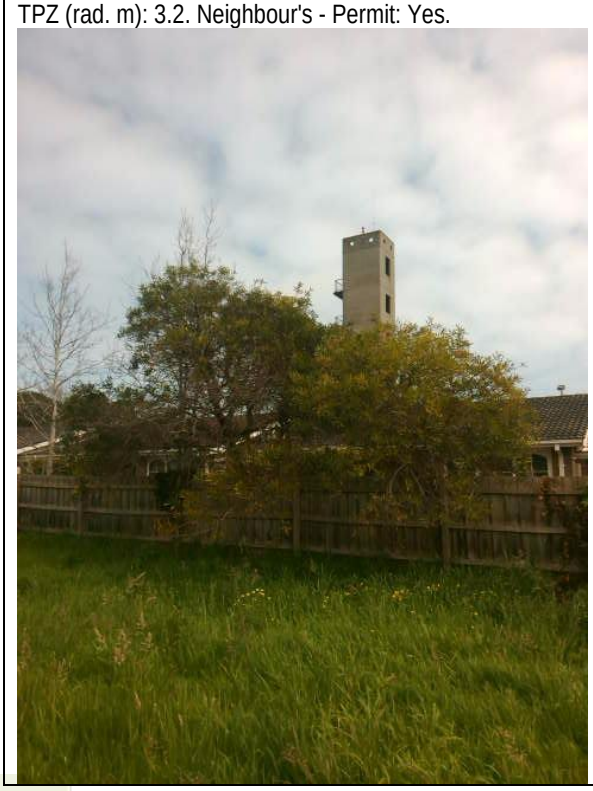
ABN: 95 080 021 610
TEL: 1300 656 926
TREELOGIC PTY LTD
4 / 21 Eugene Tce
Ringwood, VIC
Australia 3134

Treelogic
Plan, manage, protect

Tree Pictures

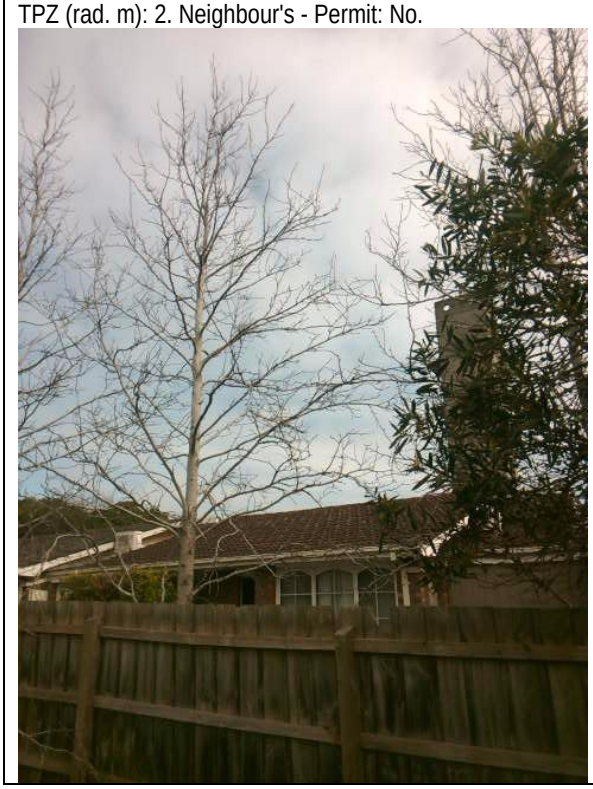
Tree ID: 1. *Robinia pseudoacacia* (Locust), Early-mature, Exotic deciduous. Arb. Rating: Very Low. Lopped, Weed infested.
TPZ (rad. m): 2. On site - Permit: No.

Tree ID: 2. *Acacia longifolia var. sophorae* (Coast Wattle), Over-mature, Victorian native. Arb. Rating: Low. Declining, Neighbour's tree, Tree east canopy growing over fence line.
TPZ (rad. m): 3.2. Neighbour's - Permit: Yes.



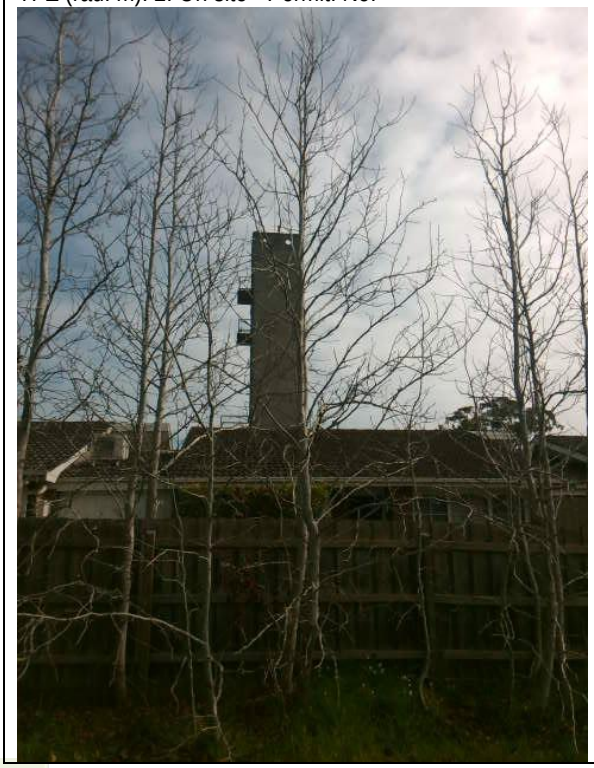
Tree ID: 3. *Liquidambar styraciflua* (Liquidamber), Semi-mature, Exotic deciduous. Arb. Rating: Low. Crossing branches, Multi-stemmed, Neighbour's tree.
TPZ (rad. m): 2.6. Neighbour's - Permit: No.

Tree ID: 4. *Liquidambar styraciflua* (Liquidamber), Semi-mature, Exotic deciduous. Arb. Rating: Mod.C. Neighbour's tree, Suckering, Canopy growing along fence line.
TPZ (rad. m): 2. Neighbour's - Permit: No.

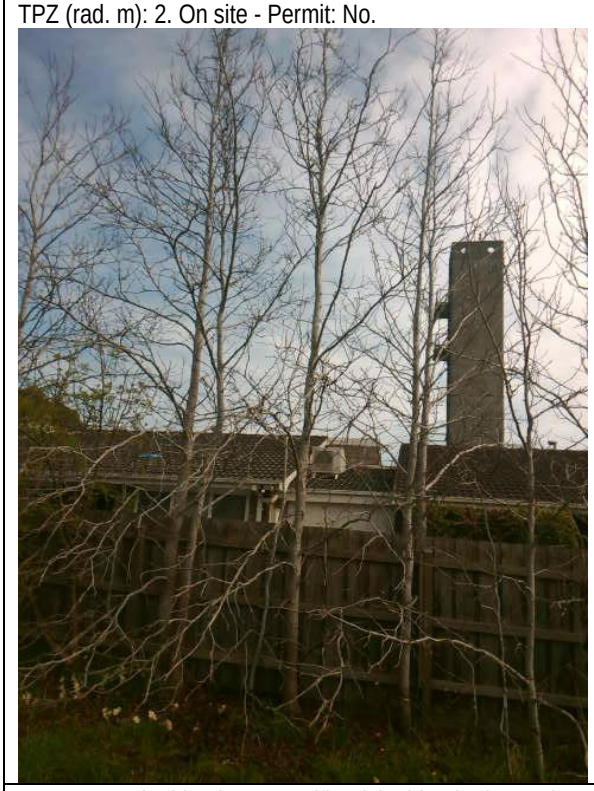


Tree ID: 5. *Liquidambar styraciflua* (Liquidamber), Semi-mature, Exotic deciduous. Arb. Rating: Mod.C. Suckering, appears to have been lopped at base. Basal stem in contact with boundary fence.
TPZ (rad. m): 2. On site - Permit: No.

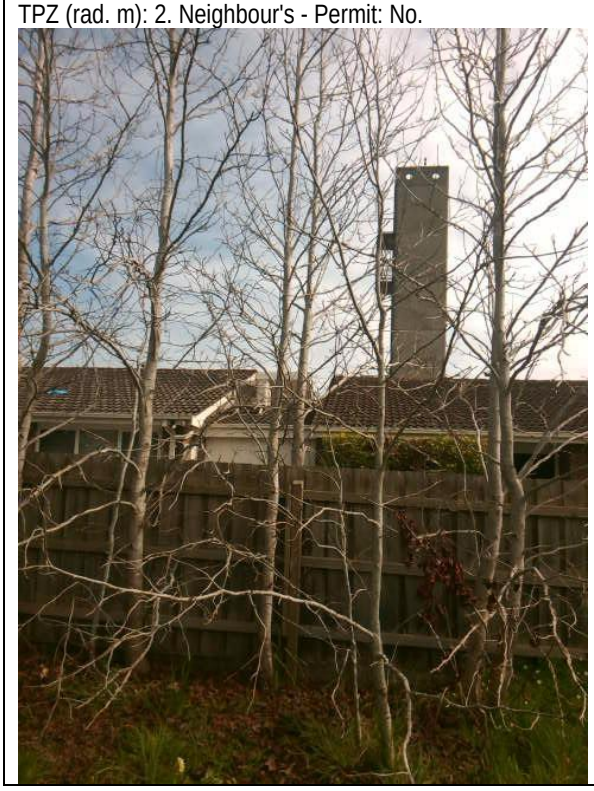
Tree ID: 6. *Liquidambar styraciflua* (Liquidamber), Semi-mature, Exotic deciduous. Arb. Rating: Low. Co-dominant stems, Suckering.
TPZ (rad. m): 2. On site - Permit: No.



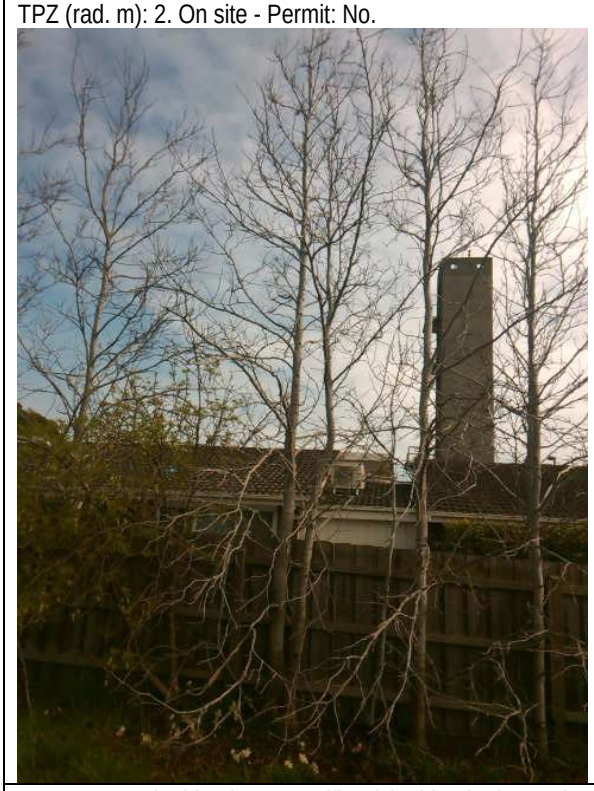
Tree ID: 7. *Liquidambar styraciflua* (Liquidamber), Semi-mature, Exotic deciduous. Arb. Rating: Mod.C. Suckering, base in contact with fenceline.
TPZ (rad. m): 2. On site - Permit: No.



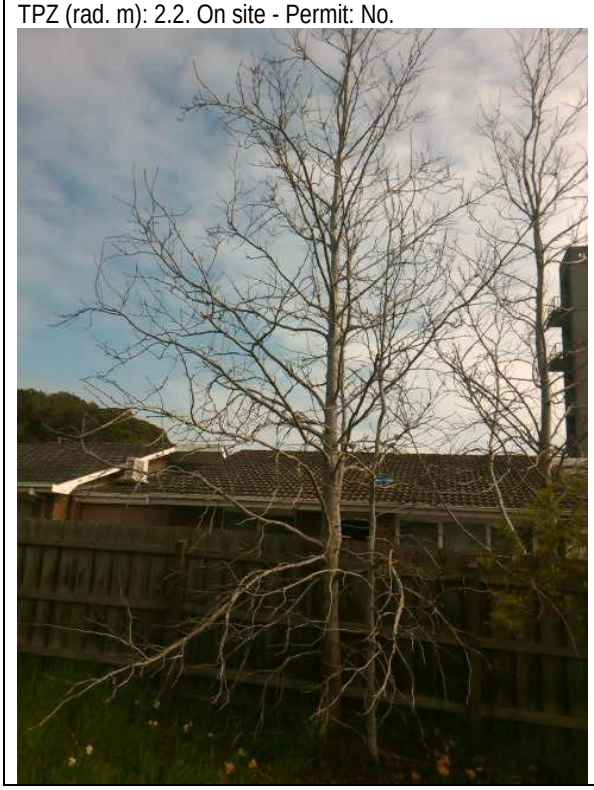
Tree ID: 8. *Liquidambar styraciflua* (Liquidamber), Semi-mature, Exotic deciduous. Arb. Rating: Mod.C. Neighbour's tree, Suckering.
TPZ (rad. m): 2. Neighbour's - Permit: No.



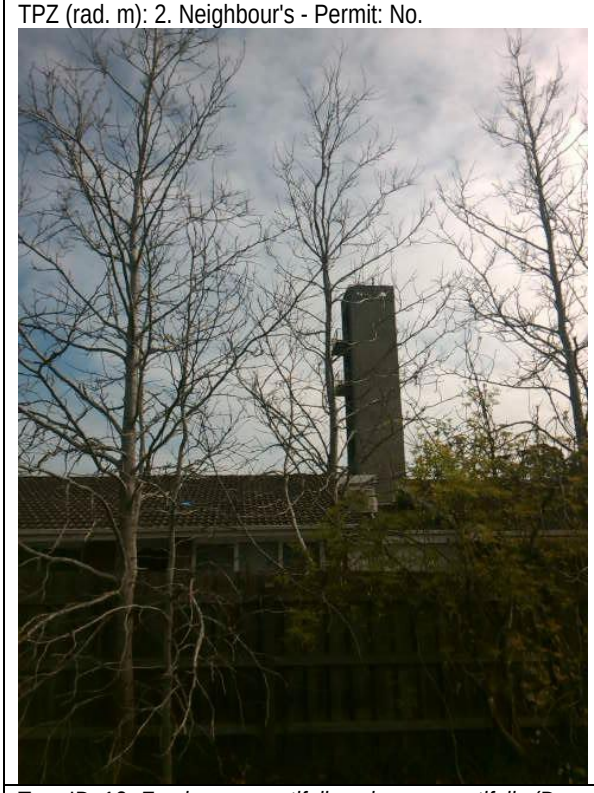
Tree ID: 9. *Liquidambar styraciflua* (Liquidamber), Semi-mature, Exotic deciduous. Arb. Rating: Low. Co-dominant stems, Included bark, Suckering.
TPZ (rad. m): 2. On site - Permit: No.



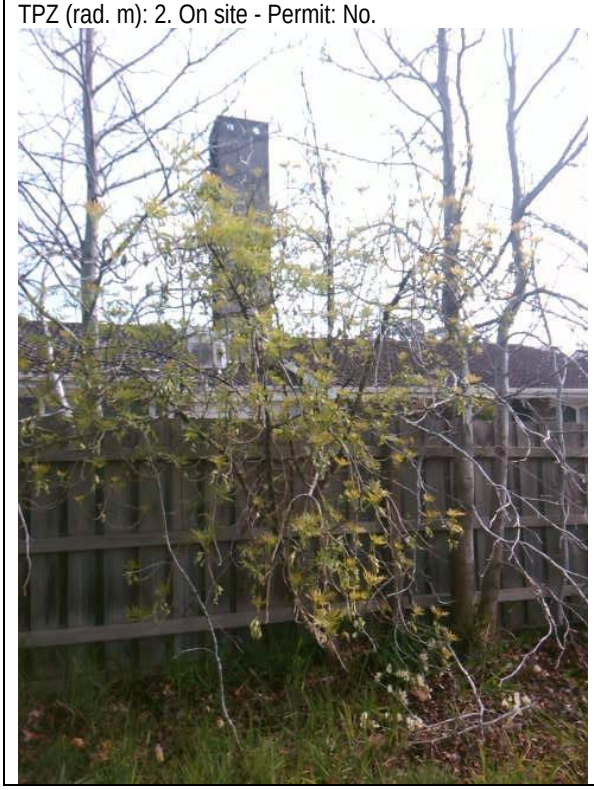
Tree ID: 10. *Liquidambar styraciflua* (Liquidamber), Semi-mature, Exotic deciduous. Arb. Rating: Mod.C. Suckering.
TPZ (rad. m): 2.2. On site - Permit: No.



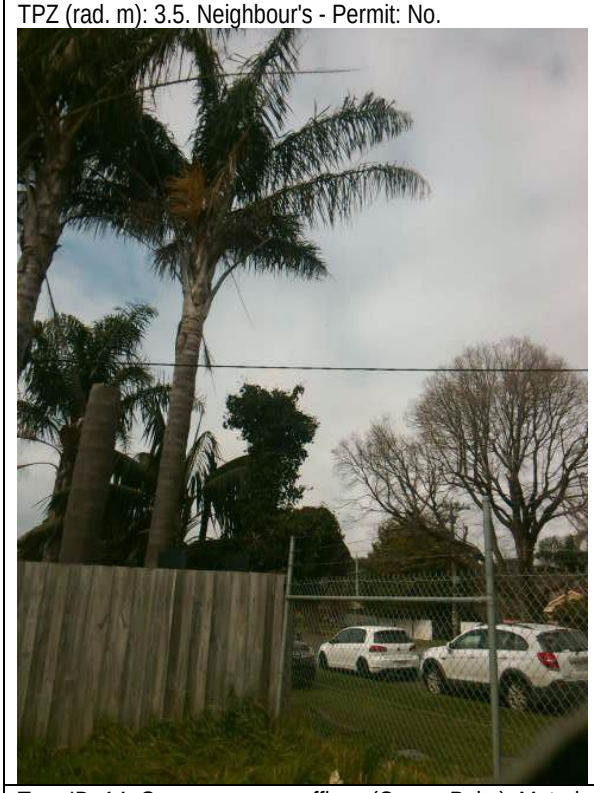
Tree ID: 11. *Liquidambar styraciflua* (Liquidamber), Semi-mature, Exotic deciduous. Arb. Rating: Low. Neighbour's tree, Suckering.
TPZ (rad. m): 2. Neighbour's - Permit: No.



Tree ID: 12. *Fraxinus angustifolia subsp. angustifolia* (Desert Ash), Semi-mature, Exotic deciduous. Arb. Rating: Low. Weed infested, self-sown.
TPZ (rad. m): 2. On site - Permit: No.



Tree ID: 13. *Syagrus romanzoffiana* (Queen Palm), Maturing, Exotic palm. Arb. Rating: Mod.C. Neighbour's tree, dead fronds. TPZ (rad. m): 3.5. Neighbour's - Permit: No.



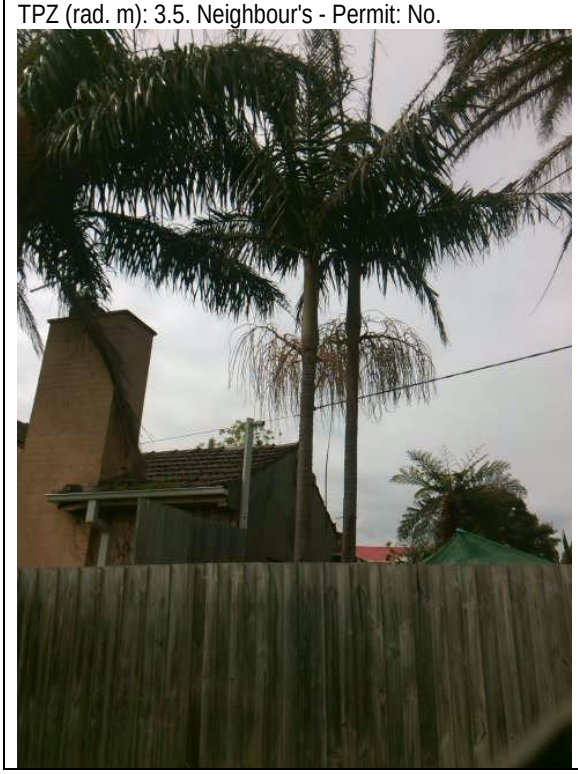
Tree ID: 14. *Syagrus romanzoffiana* (Queen Palm), Maturing, Exotic palm. Arb. Rating: Low. Lopped, Neighbour's tree. TPZ (rad. m): 1.5. Neighbour's - Permit: No.

Tree ID: 15. *Syagrus romanzoffiana* (Queen Palm), Maturing, Exotic palm. Arb. Rating: Mod.C. Neighbour's tree. TPZ (rad. m): 3.5. Neighbour's - Permit: No.

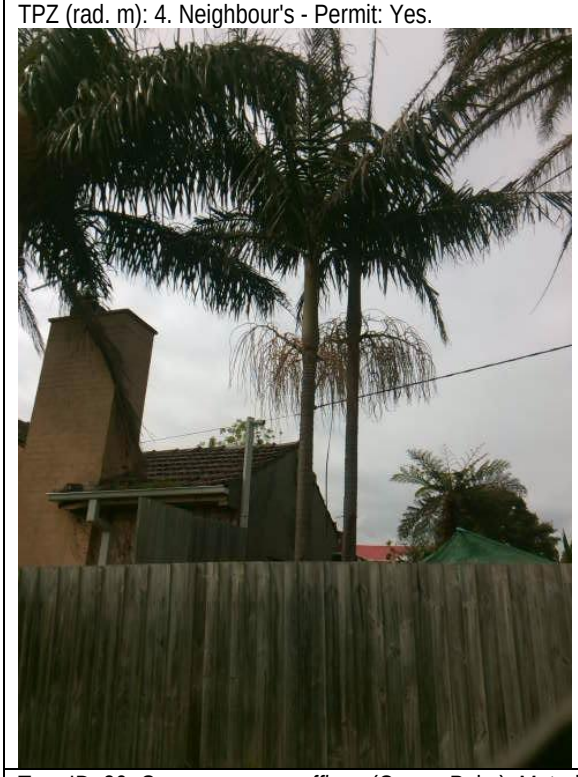
Tree ID: 16. *Syagrus romanzoffiana* (Queen Palm), Maturing, Exotic palm. Arb. Rating: Mod.C. Neighbour's tree. TPZ (rad. m): 3.5. Neighbour's - Permit: Yes.

Tree ID: 17. *Archontophoenix cunninghamiana* (Bangalow Palm), Maturing, Exotic palm. Arb. Rating: Mod.C. Neighbour's tree. TPZ (rad. m): 3.5. Neighbour's - Permit: No.

Tree ID: 18. *Archontophoenix cunninghamiana* (Bangalow Palm), Maturing, Exotic palm. Arb. Rating: Mod.C. Neighbour's tree. TPZ (rad. m): 3.5. Neighbour's - Permit: No.

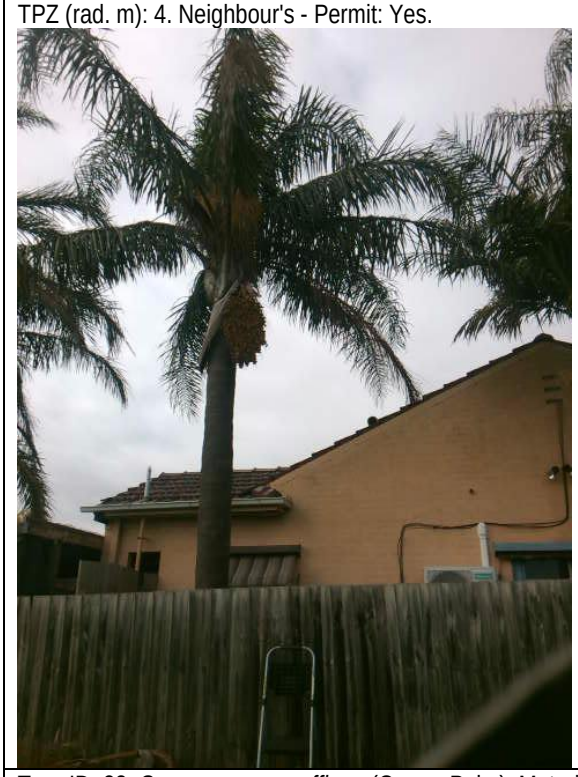


Tree ID: 19. *Syagrus romanzoffiana* (Queen Palm), Maturing, Exotic palm. Arb. Rating: Mod.C. Neighbour's tree. TPZ (rad. m): 4. Neighbour's - Permit: Yes.

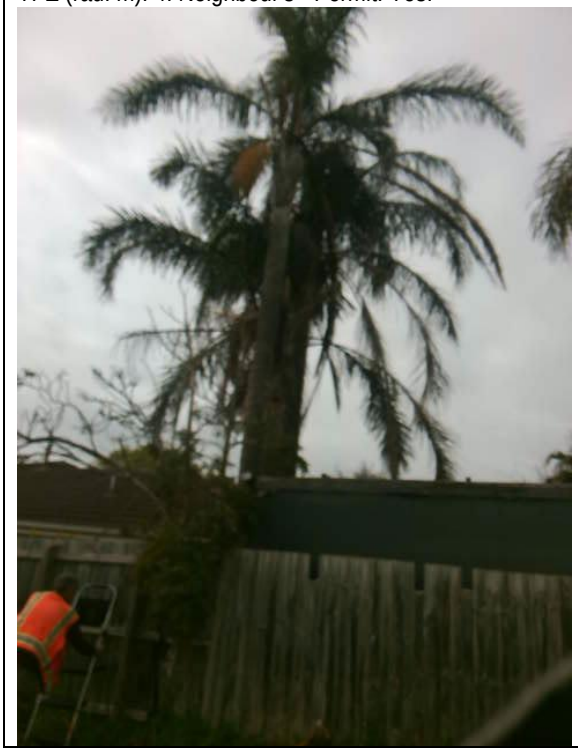


Tree ID: 20. *Syagrus romanzoffiana* (Queen Palm), Maturing, Exotic palm. Arb. Rating: Mod.C. Neighbour's tree. TPZ (rad. m): 4. Neighbour's - Permit: Yes.

Tree ID: 21. *Syagrus romanzoffiana* (Queen Palm), Maturing, Exotic palm. Arb. Rating: Mod.C. Neighbour's tree.
TPZ (rad. m): 4. Neighbour's - Permit: Yes.



Tree ID: 22. *Syagrus romanzoffiana* (Queen Palm), Maturing, Exotic palm. Arb. Rating: Mod.C. Neighbour's tree.
TPZ (rad. m): 4. Neighbour's - Permit: Yes.



Tree ID: 23. *Archontophoenix cunninghamiana* (Bangalow Palm), Early-mature, Exotic palm. Arb. Rating: Mod.C. Neighbour's tree.
TPZ (rad. m): 3. Neighbour's - Permit: No.

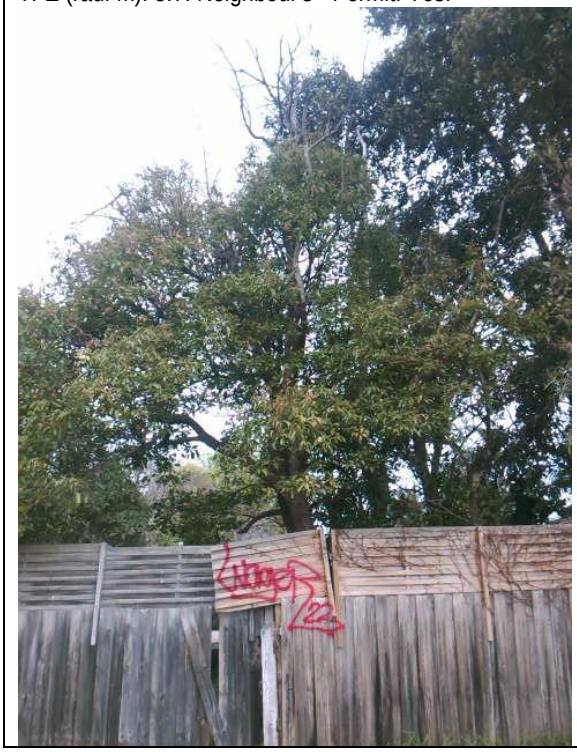
Tree ID: 24. *Radermachera sinica* (Asian Bell Tree), Maturing, Exotic evergreen. Arb. Rating: Low. Neighbour's tree.
TPZ (rad. m): 2. Neighbour's - Permit: No.

Tree ID: 25. *Persea americana* (Avocado), Early-mature, Exotic evergreen. Arb. Rating: Mod.C. Dieback, Neighbour's tree, Sun burn.
TPZ (rad. m): 2.4. Neighbour's - Permit: No.

Tree ID: 26. *Lagunaria patersonia* (Norfolk Island Hibiscus), Maturing, Australian native. Arb. Rating: Mod.B. Multi-stemmed, Neighbour's tree.
TPZ (rad. m): 5. Neighbour's - Permit: Yes.

Tree ID: 28. *Agonis flexuosa* (Willow Myrtle), Maturing, Australian native. Arb. Rating: Low. Foliage sparse, Foliage sparse - possums, Neighbour's tree, Partly suppressed - crown bias.
TPZ (rad. m): 5.7. Neighbour's - Permit: Yes.

Tree ID: 29. *Cinnamomum camphora* (Camphor Laurel), Maturing, Exotic evergreen. Arb. Rating: Mod.C. Foliage sparse, Neighbour's tree.
TPZ (rad. m): 5.7. Neighbour's - Permit: Yes.



Tree ID: 30. *Pittosporum eugenioides 'Variegatum'* (Variegated Tarata), Early-mature, Exotic evergreen. Arb. Rating: Mod.C. Neighbour's tree.
TPZ (rad. m): 2. Neighbour's - Permit: No.

Tree ID: 31. *Pittosporum eugenioides 'Variegatum'* (Variegated Tarata), Early-mature, Exotic evergreen. Arb. Rating: Mod.C. Neighbour's tree.
TPZ (rad. m): 2. Neighbour's - Permit: No.

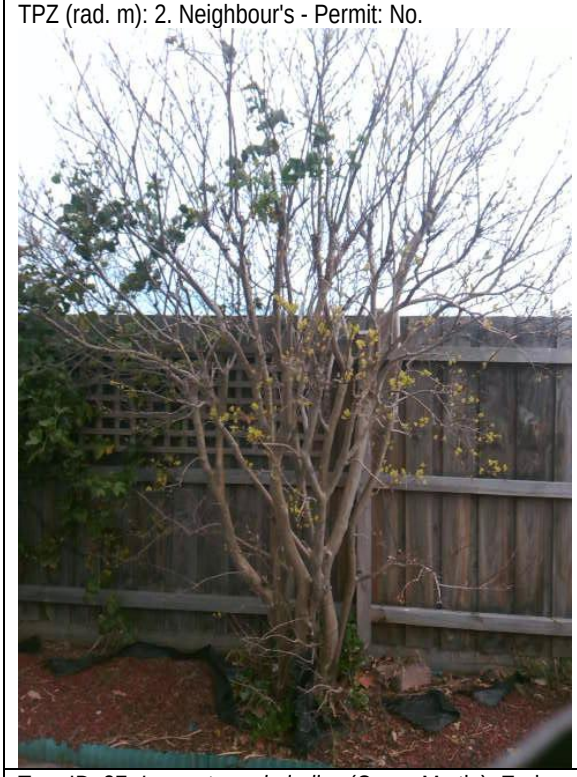
Tree ID: 32. *Eriobotrya japonica* (Loquat), Early-mature, Exotic evergreen. Arb. Rating: Mod.C. Foliage sparse - possums, Ivy vine, Neighbour's tree.
TPZ (rad. m): 2. Neighbour's - Permit: No.

Tree ID: 33. *Ligustrum lucidum* (Shining Privet), Early-mature, Exotic evergreen. Arb. Rating: Low. Deadwood, Ivy vine, Neighbour's tree, Woody weed sp..
TPZ (rad. m): 2. Neighbour's - Permit: No.

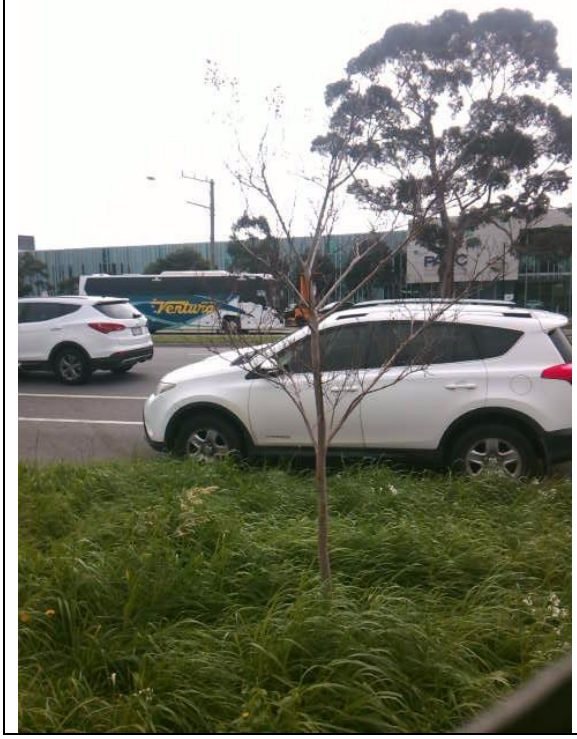
Tree ID: 34. *Juniperus sp.* (Juniper), Early-mature, Exotic conifer. Arb. Rating: Low. Deadwood, Dieback, Neighbour's tree.
TPZ (rad. m): 2. Neighbour's - Permit: No.

Tree ID: 35. *Callistemon viminalis* (Weeping Bottlebrush), Maturing, Australian native. Arb. Rating: Low. Deadwood, Dieback, Lopped, Neighbour's tree.
TPZ (rad. m): 3.5. Neighbour's - Permit: Yes.

Tree ID: 36. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Low. Lopped, Neighbour's tree.
TPZ (rad. m): 2. Neighbour's - Permit: No.

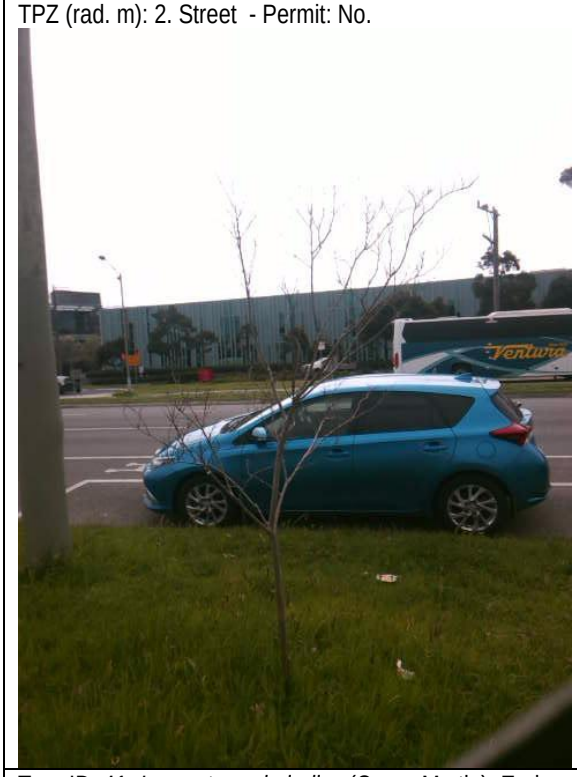


Tree ID: 37. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Mod.C. .
TPZ (rad. m): 2. Street - Permit: No.



Tree ID: 38. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Mod.C. .
TPZ (rad. m): 2. Street - Permit: No.

Tree ID: 40. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Mod.C. .
TPZ (rad. m): 2. Street - Permit: No.



Tree ID: 39. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Mod.C. .
TPZ (rad. m): 2. Street - Permit: No.

Tree ID: 41. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Mod.C. .
TPZ (rad. m): 2. Street - Permit: No.

Tree ID: 42. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Mod.C. Mechanical damage.
TPZ (rad. m): 2. Street - Permit: No.

Tree ID: 44. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Mod.C. .
TPZ (rad. m): 2. Street - Permit: No.

Tree ID: 43. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Mod.C. .
TPZ (rad. m): 2. Street - Permit: No.

Tree ID: 45. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Mod.C. .
TPZ (rad. m): 2. Street - Permit: No.

Tree ID: 46. *Lagerstroemia indica* (Crape Myrtle), Early-mature, Exotic deciduous. Arb. Rating: Mod.C. .
TPZ (rad. m): 2. Street - Permit: No.

Tree ID: G1. *Robinia pseudoacacia* (Locust), Early-mature, Exotic deciduous. Arb. Rating: Low. Multi-stemmed, Suckering, Woody weed sp..
TPZ (rad. m): 2. On site - Permit: No.

Tree ID: G2. *Liquidambar styraciflua* (Liquidamber), Semi-mature, Exotic deciduous. Arb. Rating: Low. Suckering.
TPZ (rad. m): 2. On site - Permit: No.

Appendix 3: Arboricultural Descriptors (June 2017)

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.

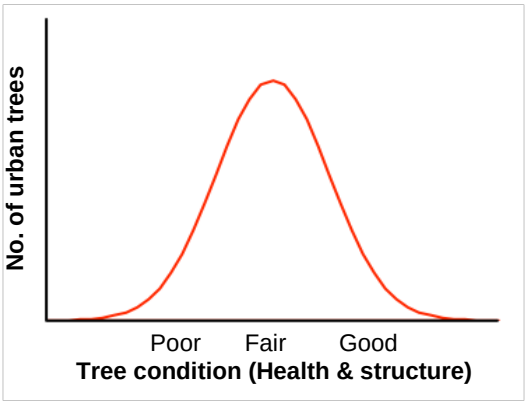


Diagram 1: Indicative normal distribution curve for tree condition

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. 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.

7. Health

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

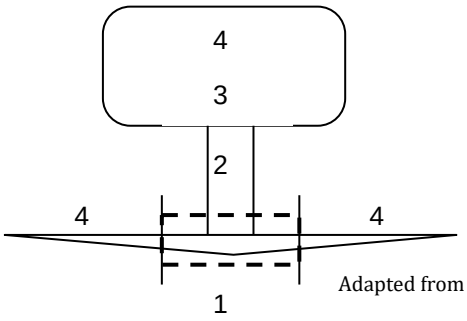
Health Category	Vigour, Extension growth	Decline symptoms, Deadwood, Dieback	Foliage density, colour, size, intactness	Pests and or disease
Good	Above typical. Excellent. Full canopy density	Negligible	Better than typical	Negligible
Fair	Typical vigour. >80% canopy density	Minor or expected. Little or no dead wood	Typical. Minor deficiencies or defects could be present.	Minor, within damage thresholds
Fair to Poor	Below typical - low vigour	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	Exhibiting severe deficiencies. Thinning foliage, generally smaller or deformed	Extreme and contributing to decline
Dead	N/A	N/A	N/A	N/A

8. Structure

Assesses principal components of tree structure (Diagram 2).
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.

Diagram 2: Tree structure zones

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



Adapted from Coder (1996)

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 take into account the combination of likelihood of failure and impact, including the perceived importance of the target(s). See table over page.

Structure Category	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.

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). See table over page.

Useful Life Expectancy category	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). 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. 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.). 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 vigour is likely to be reduced (bud development, extension growth etc.). 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. 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, which can either increase or decrease, or sudden changes to a tree's growing environment creating an acute stress.

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 be extend a tree's ULE.

9. Arboricultural Rating

Relates to the combination of tree condition factors, including health and structure (arboricultural merit), and also conveys an amenity value. 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 taken into account. See table over page.

Arboricultural rating Category	Description
High	Tree of high quality in good to fair condition; good vigour. Generally a prominent arboricultural/landscape feature. Particularly good example of the species; rare or uncommon. Tree may have significant conservation or other cultural value. These trees have the potential to be a medium- to long-term components of the landscape (moderately long to long ULE) if managed appropriately. Retention of these trees is highly desirable.
Moderate	*General -* Tree of moderate quality, in fair or better condition. Tree may have a condition, and or structural problem that will respond to arboricultural treatment. These trees have the potential to be a moderate- to long-term component of the landscape (moderate to long ULE) if managed appropriately. Retention of these trees is generally desirable. The following sub-categories relate predominately to age and size and amenity.
	A. Moderate to large, maturing tree. Contributes to the landscape character. Tree may have conservation or other cultural value.
	B. Moderate sized, established tree, > 50% of attainable age/size. Contributes to the landscape character. Maturing tree with amenity value but with identified deficiencies
	C. Small and/or semi-mature tree, established, >5 years in the location. May not be a dominant canopy. No special qualities. Maturing tree, accumulating deficiencies, trending towards being of Low arboricultural value.
Low	Unremarkable tree of low quality or little amenity value. Tree in either poor health or with poor structure or a combination. Short to transitory useful life expectancy. Tree is not significant because of either its size or age, such as young trees with a stem diameter below 15 cm. Trees regularly pruned to restrict size. These trees are easily replaceable. Tree (species) is functionally inappropriate to specific location and would be expected to be problematic if retained. Retention of such trees may be considered if not requiring a disproportionate expenditure of resources for a tree in its condition and location.
None	Trees of low quality with an estimated remaining life expectancy of less than 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 would be expected in the short term. Trees that are dead or are showing signs of significant, immediate, and irreversible overall decline. Tree infected with pathogens of significance to either the health or safety of the tree or other adjacent trees. Tree whose retention would not be viable after the removal of adjacent trees (includes trees that have developed in close spaced groups and would not be expected to acclimatise to severe alterations to surrounding environment – removal of adjacent shelter trees). Tree has a detrimental effect on the environment, for example, the tree is a recognised environmental woody weed with potential to spread into waterways or natural areas. Unremarkable tree of no material landscape, conservation or other cultural value.

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 criterion 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.

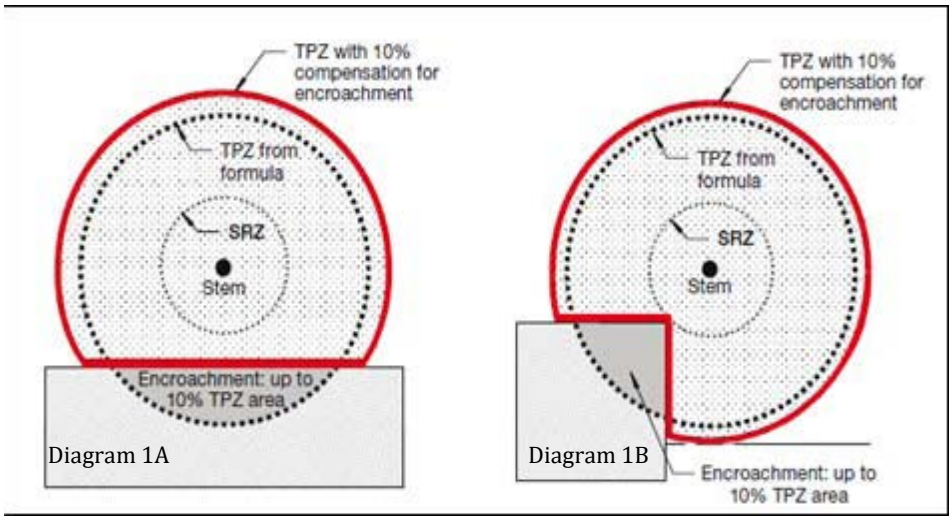


Diagram 1: Examples of minor encroachment into a TPZ.

(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.

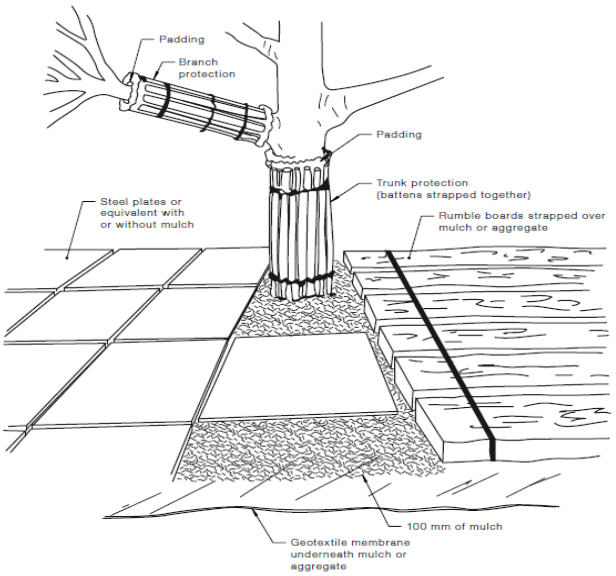
Table 1: Estimated significant root sizes outside SRZ

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.



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

(Extract from: AS4970-2009, Appendix D, pg17)

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. Watering should continue from October until April.

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Appendix 5: Permeable paving & Root Sensitive Pavement Treatments

Hard pavement construction adjacent to or within the root zone of retained trees should be laid at existing grade after the removal of organic matter (no more than 100mm depth). Consideration must be given to the amount and depth of excavation to limit root loss and the type and installation of the paving surface to reduce long-term impact on the trees.

Permeable pavements are particularly useful where a hard surface is required in close proximity to trees and other planting as water flow and aeration to roots can be maintained (Interpave, 2003).

The extent and severity of root damage arising from the excavation for pavement is dependent on the depth required for the sub-base. The depth of the sub-base is also dependent on the intended use of the paved area. If driveways are to enter an allocated TPZ they can also be ramped so as to raise the pavement above the root system, which would allow the appropriate depth of sub-grade. Some edge treatment will be required to retain the pavement section. The pavement will be higher than surrounding grade and if this is of concern, mulch can be placed on the soil surface to meet the grade of the pavement. The ramping will also affect the gradient of the pavement resulting in more runoff.

Modified sub grades utilising geotextiles and open graded sub-bases stabilized with cement can increase structural capacity and reduce the thickness requirement of the sub-base. To maintain high void space only enough cement to coat the aggregate should be used and care taken not to fill the voids with excessive paste. The amount of cement to achieve this is typically 170kg/m^3.

The design for the pavement system must be developed by an engineer to ascertain appropriate system for the site conditions and load requirements; however the following points should be considered (Adapted from Shackel, 2001):

Materials

- Bedding & Jointing material shall comprise a clean 2mm to 5mm aggregate passing a 4.75mm sieve with 100% retained on a 1.18mm sieve. The bedding material shall be free from deleterious soluble salts or other contaminants likely to cause affect tree health. Sand must not be used as the bedding layer or to blind the pavement.
- Permeable base material should be a graded crushed rock derived from the crushing of solid unweathered quarried rock. It should have the following particle size distribution:

  Table. Particle size distribution – Aggregate Base Material

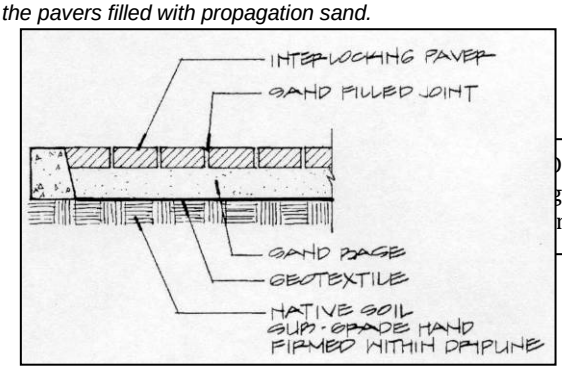
Sieve Size (mm)	%
25	100
19.0	65-100
13.2	35-70
4.57	20-45
2.00	8-25
0.423	2-10
0.150	0-3
0.075	0

Base construction

- Once the organic matter layer has been excavated (no more than 100mm depth) and trimmed an approved filter fabric shall be installed from edge to edge over entire permeable pavement area. The geotextile fabric shall comprise Bidim U34 filter fabric or equivalent.
- The base material will be 200mm thick (Thickness may vary dependent on intended use). The material should be laid in 100mm or less layers and so as to avoid damage to filter fabric. After spreading the base shall be brought to suitable moisture content for compaction. Compaction with appropriate machinery to achieve minimum dry density not less than 96% of modified maximum dry density to AS 1289.
- The bedding layer should be spread loose and at such density to give a depth of no more than 40mm following compaction of the pavement (between 20mm and 40mm).

- Pavers should be laid so as to achieve joints nominally 2mm to 5mm wide between pavers. After laying the pavers shall be compacted to achieve consolidation and achieve design levels by not less than 3 passes with a flat plate vibrator. The aggregate for filling joints will be the same as for the bedding layer.
- A permeable paving system like Rocla Ecoloc® and Ecotrihex® interlocking permeable paving (see photograph below) would allow natural drainage patterns to be maintained and have been used around established trees. Boral Hydrapave® is another paver suitable for the purpose and is a more traditional rectangular clay paver.

Detail of Rocla Ecotrihex® as laid showing gaps between the pavers filled with propagation sand.



…ig' paving system
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Permeable pavement can infiltrate up to the first 12mm of precipitation. Provisions e.g. storm water overflows, must be made to handle the runoff from larger storms. If the pavement is ramped then spoon drains should be installed in pavement system outside the allocated TPZ to capture excess runoff.

The permeable pavement system must extend to the extents of the nominated TPZ of the subject trees.

The depth of the total pavement system would be approximately 290mm. Excavation of organic layer would be no more than 100mm. Therefore approximately 190mm of the pavement system would be above existing grade. The difference in levels between natural grade and the pavement system should be battered up with mulch (20mm particle size).

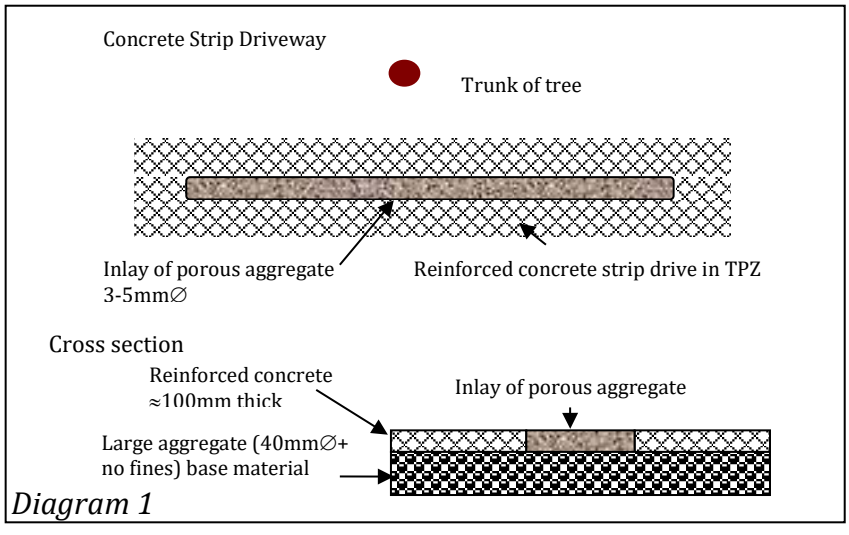
The depth of base material could be reduced if it was strengthened. Sub-bases stabilized with cement can increase structural capacity and reduce the thickness requirement of the sub-base. To maintain high void space only enough cement to coat the aggregate should be used and care taken not to fill the voids with excessive paste. The amount of cement to achieve this is typically 170kg/m^3.

Concrete strip pavement

Another option to the permeable pavement system could be a reinforced concrete strip configuration utilising a 'no dig' approach similar to that outlined above.

The reinforced concrete strips are laid on top of a base course of 40mm+ aggregate that forms a matrix to support the pavement system and associated loads while maintaining voids that will allow diffusion of gases and percolation of water through the inlay of porous aggregate.

Diagram 1. Concrete strip driveway



It is important with any pavement system that the installation is undertaken by contractors who have a clear understanding of the desired outcomes for such a pavement system.

Another engineering consideration for the protection of the root system of the subject trees would be to lay a concrete slab above existing grade. This would not be a permeable system as described above, instead it would be a concrete slab placed onto bored piers that would hold the slab above existing grade. This would require some ramping over the root zone, however it should not be pronounced.

This method would require the following considerations:

- It would possibly be more expensive than the permeable pavement system
- The piers would have to be placed so as to avoid major roots, i.e. roots with a diameter equal to or greater than 80mm∅
- A design should be sought that allows the greatest span between the piers
- The area underneath the slab would possibly dry out and be less conducive to on-going root development, although would protect existing roots travelling across the proposed driveway alignment
- The subsoil excavated for the piers must be moved away from the root zone

See following photographs for an example of a raised Bridge used near remnant indigenous Yellow Box and Silver-leaf Stringy bark in Glen Waverley.

Detail of raised concrete bridge near indigenous trees in Holmes Way, Glen Waverley. Note gap between grade and bottom edge of bridge (Yellow arrow).

Other Permeable paving systems:

Permapave Permeable Pavers provide a hard surface while allowing storm water to pass through the substrate to be utilised by the tree.

See http://permapave.com.au/products/pavers.htm

Gravel Paver System

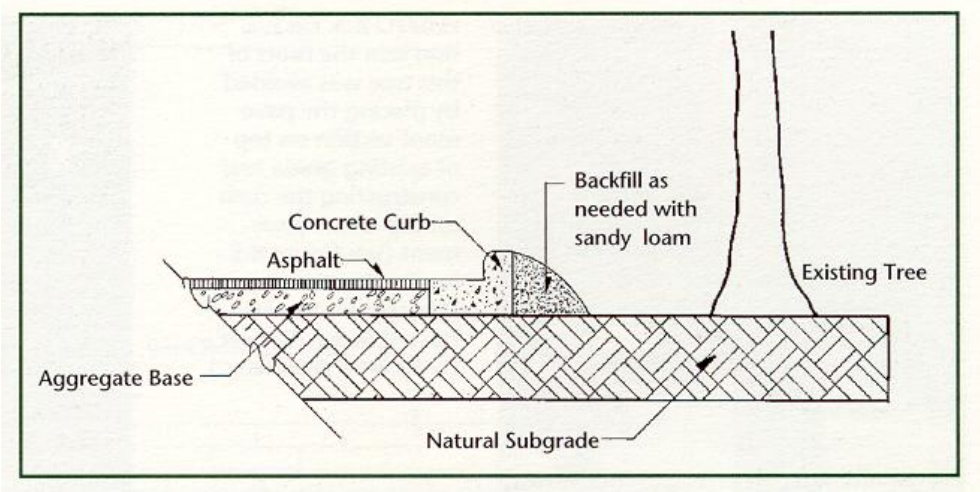
These systems generally consist of integrated plastic or brick cell pavers that may be filled with the desired paving surface. Initially designed to accommodate soil and turf in trafficked areas, these systems can also utilise gravels as the filling material. Alternative systems are available but the concept is generally the same. The cell system maintains the stability of the gravel while spreading the load of traffic above. The system is generally laid upon sand or a gravel base. This system is also porous and could be considered a permeable ground surface for planning purposes.

See www.invisiblestructures.com.au

3) Impervious pavement system

The likelihood of root damage can be reduced by installing a paving section that requires a minimum amount of excavation e.g. extra reinforced concrete. It may be beneficial to increase the strength of the pavement material to allow a reduction in the strength requirement, and depth of the sub-base. The use of geotextile fabric between the sand base and the finished surface can increase the stability of the pavement and limit root disturbance.

A reinforced concrete slab laid on expansion joint material within the root plate zone will also offset potential root conflicts with the pavement system.



The 'no dig' style places the pavement section on top of the natural existing grade. This can reduce root disturbance and compaction. Extra reinforcing in the pavement and the use of geotextile under the base material can be used to increase the stability of the pavement (Matheny & Clark, 1998).

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