

ARBORICULTURAL IMPACT ASSESSMENT & TREE PROTECTION PLAN

Project

The Wash Factory Development

Site Address

87 Rawson Road
Woy Woy NSW 2256

Date

October 2025

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Acknowledgement of Country

We acknowledge Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of this land – Australia; and we acknowledge the Traditional Custodians of this particular locale, recognising their continued connection to the land and their primary custodial care obligations.

Preface

The planting of trees in urbanised areas for their nutritional, aesthetic and spiritual value has been commonplace for centuries. Historical documents show that trees were planted for their known benefits along the main thoroughfares of Egypt approximately 4000 years ago, and in the communal areas of China during the Qin Dynasty, 221-206 B.C. (Gerhold. 2007). Closer to home, trees in Australia have always been, and will continue to be celebrated. Especially by the Aboriginal peoples, as trees represent significant connections to Country, their ancestry and lore (Long. 2005).

Nowadays the benefits of urban forests are considered to span environmental, economic, cultural and socio-political domains alike. Communities around the world regard trees as critical urban infrastructure. Thus, this 'Green Infrastructure' is considered to be as important to the day-to-day functionality of an urban locale as the roads, public transport and its other 'Grey Infrastructure'.

However, trees grow in a delicate balance with their environment and any changes to that balance must be minimized if the tree is to remain healthy and fulfil its potential. Therefore, tree protection is of critical importance, and especially when it comes to the root system. Tree roots not only physically anchor the tree to the ground but are the critical supply lines of water and minerals and are essential for both carbohydrate storage and hormonal signalling. This in turn governing tree functionality, vigour and longevity.

Ergo, the aim of this Arboricultural Report is to pragmatically guide the proposed development works around any retained tree(s) so arboricultural impact is minimised. This through the formulation and implementation of best management practice tree protection methodologies.



Qualitative and Quantifiable Tree Benefits (Wang. 2024).

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Executive Summary

Active Green Services Pty Ltd (AGS) has been engaged to author an Arboricultural Impact Assessment (AIA) and a Tree Protection Plan (TPP) per AS 4970-2025 *Protection of trees on development sites*. This regarding any tree that may foreseeably be impacted upon during the demolition and subsequent construction works associated with a new commercial car wash development (The Wash Factory) at 87 Rawson Road, Woy Woy 2256. Hence during September 2025 a site inspection was conducted, and Visual Tree Assessments (VTA) carried out on the relevant tree population by a suitably qualified AGS arborist.

The following arboricultural recommendations in this Report are based on the VTA data. This includes the trees biometrics, biomechanics, vitality, pedology and landscape significance *in situ*. In addition, the identified trees were specifically assessed with regard to their calculated Structural Root Zone (SRZ)¹, Notional Root Zone (NRZ)², Tree Protection Zone (TPZ)³ and the provided design plans. This so arboricultural impact could be calculated to objectively determine tree viability post-development; and a site-specific TPP formulated for any tree ear-marked for retention. On review seven (7) trees of particular relevance were assessed, whereby it was concluded:

- Six (6) trees will be in direct conflict with the proposed development works, with their NRZ encroachments calculated as 'Major'⁴. Under the current design proposal, it is foreseeable that these trees will not remain viable post-development. Therefore, unless tree sensitive design modifications are made, these trees will need to be removed pre-construction. (Notably, none of these trees has an adjudged 'High' Retention Value per the *Significance of a Tree Assessment Rating System*).
- One (1) tree will have a 'Minor'⁵ NRZ encroachment. As it is anticipated that this subject tree will remain viable post-construction, it is to be retained, afforded protection and incorporated into the final landscaping design.

Please note: one of the trees ear-marked for removal is growing on a boundary fence line, so is likely to be all 'jointly owned'. Therefore, permission to remove this tree will need to be obtained from the adjacent property owner prior to submitting a tree removal application to Council. Albeit, if permission is not given, the client will need to consider tree sensitive design modifications and adopt tree sensitive construction practices to mitigate arboricultural impact. These tree sensitive practices can be referenced in the Appendix.

The arboricultural rationale supporting this summary follows.

¹ AS 4970-20025 *Protection of trees on development sites* s.1.3.17 Structural Root Zone (SRZ) - "theoretical area around the base of a tree required for the trees stability in the ground".

² AS 4970-20025 *Protection of trees on development sites* s.1.3.11 Notional Root Zone (NRZ) - "zone enclosed by a radius of 12 times the trees Diameter at Standing Height (DSH) that is a primary trigger for arboricultural input on a development site. (DSH – trunk diameter at 1.4m above ground level).

³ AS 4970-2025 *Protection of trees on development sites* s.1.3.19 Tree Protection Zone (TPZ) - "specified zone above and below ground and at given offsets from the trunk set aside to protect a tree's roots and crown where these might be damaged by development".

⁴ AS 4970-2025 s.3.3.6 Major NRZ Encroachment: "the proposed encroachment is considered 'Major' if it is >20% of the area of the NRZ or inside the SRZ".

⁵ AS 4970-2025 s.3.3.4: Minor NRZ Encroachment (<10%): "If the proposed encroachment is less than or equal to 10% of the area of the NRZ, has not had recent NRZ encroachments and is outside of the SRZ".

PART 1: ARBORICULTURAL IMPACT

1 Introduction

1.1 Overview

- i. AGS has been engaged to author an AIA and a site-specific TPP per *AS 4970-2025 Protection of trees on development sites* ('Report'). This Report regarding any trees that may foreseeably be impacted upon during the proposed demolition and construction activities associated with a commercial carwash development at 87 Rawson Road, Woy Woy 2256. Pursuant to the aforementioned Australian Standard the following key elements are highlighted and addressed in this Report:
 - The geo-location and visual assessment data of any tree that is growing in or is within close proximity of the proposed construction footprint and any associated infrastructure works.
 - The calculated encroachment level of the proposed development works on the assessed trees. This so Tree Sensitive Urban Design (TSUD) alternatives can be candidly discussed; and practicable tree retention or pragmatic tree removal objectively decided.
 - A site-specific TPP authored per *AS 4970-2025 Protection of trees on development sites*. This outlining practicable 'tree-sensitive' methodologies and protections that need to be enacted to mitigate foreseeable arboricultural impact during the development works.

1.2 Objective

- i. The objective of this Report is to provide all parties with an objective and unbiased arboricultural assessment of the trees within the proposed development area. This so prior to the commencement of works tree viability can be ascertained; where tree sensitive practices will need to be adopted; and mandated tree protection erected to mitigate arboricultural impact.

1.3 Limitations

- i. All arboricultural reasonings that have been discussed and provided in this Report are based on extensive empirical arboricultural knowledge, the internationally recognised Visual Tree Assessment (VTA) methodology (Dunster. 2019), the *Significance of a Tree Assessment Rating System (STARS)* and *AS 4970-2025 Protection of trees on development sites*.
- ii. Albeit whilst this Report is evidence-based, it should be noted that trees are dynamic living organisms exposed to both unforeseeable biotic and abiotic variables which on occasion can be harsh and severe. Therefore, the provided arboricultural reasonings and recommendations consider "on the balance of probabilities" the most likely outcome(s), as opposed to those which could, may or fancifully occur.

1.4 References

- i. As a progressive arboricultural company AGS keeps abreast of research data relating to all aspects of arboriculture and urban forestry. Therefore, the following arboricultural reasonings, conclusions and recommendations in this Report are founded on current research and industry standards.
- ii. For interest, additional material has been appended to aid in furthering both Arboricultural and Urban Forestry knowledge per Best Management Practices and promote biophilic design.

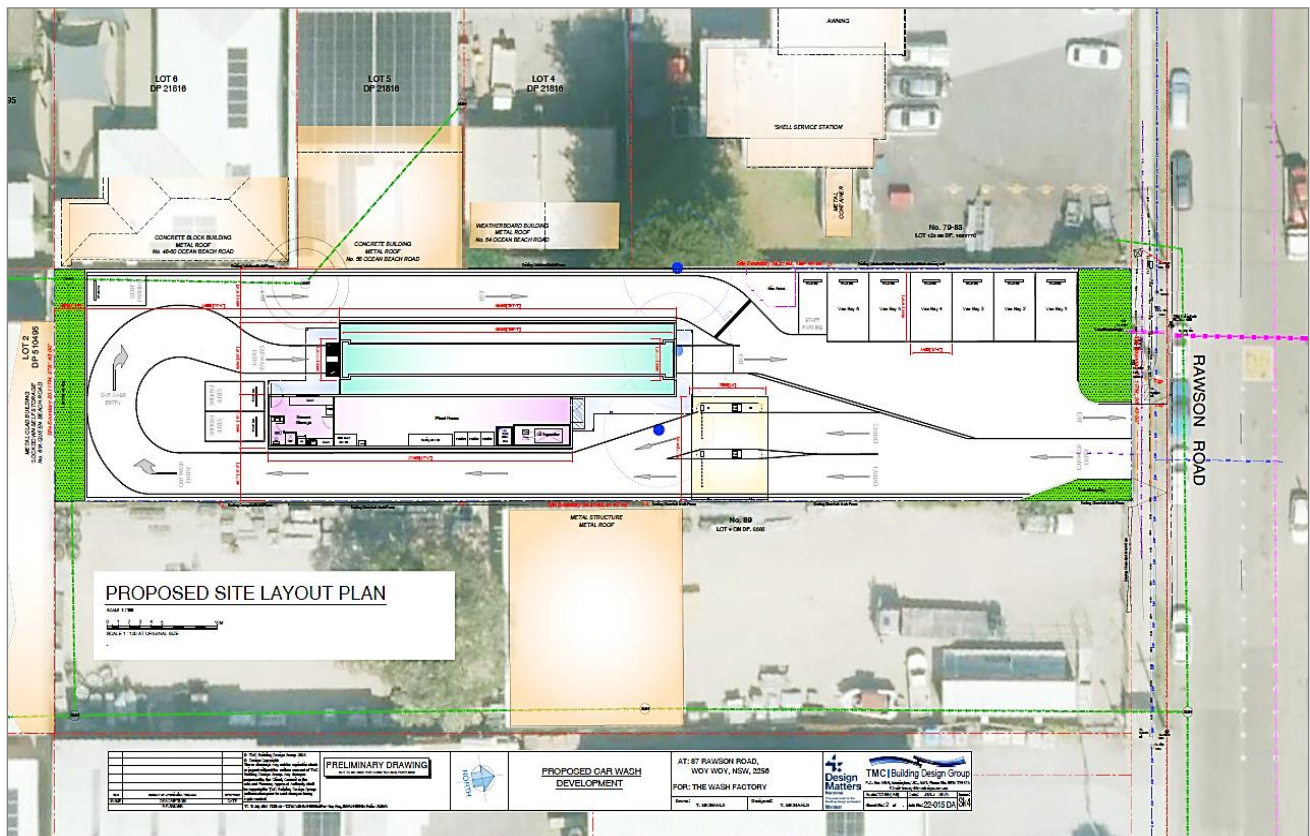
1.5 Development site geo-location



Proposed development site: 87 Rawson Road, Woy Woy 2256

1.6 Scope of Works

- i. A new carwash is proposed for 87 Rawson Road, Woy Woy 2256. The proposed works associated with development will include the demolition of existing structures and infrastructure; and the subsequent construction of a new carwash structure, vehicular thoroughfares and landscaping (hard and soft).
- ii. A full set of design plans can be made available upon request courtesy of TMC Building Design Group.



Proposed development plan (courtesy of TMC Building Design Group)

2 Aerial Mapping

2.1 Indicative tree location and root zones

- i. The below aerial map indicatively shows the locations of the assessed trees in relation to the proposed works for the new carwash development per the supplied design plans.
- ii. In addition, the aerial map denotes the calculated Structural Root Zone (SRZ) and Notional Root Zone (NRZ) of the assessed trees. This to aid in the visualisation of what trees will need to be removed pre-construction, where tree sensitive practices will need to be adopted (NDRE and Construction), and the location of tree protection as outlined in the site-specific TPP.
- iii. Notably, the starting point (default) for the erection of the tree protection is the delineated NRZ. However, the TPZ may be extended outside the NRZ at the discretion of the appointed Project Arborist per the considerations listed in *AS 4970-2025 Protection of trees on development sites*, s.3.3.2.



North :



Scale :

1:700

Spatial Reference :

GDA2020 MGA Zone 56

Project :

Legend

Tree Encroachment

- Major
- Moderate
- Minor
- N/A

- Structural Root Zone (SRZ)
- Notional Root Zone (NRZ)
- ▨ Proposed Build Footprint
- ▨ Proposed Vehicle Entry/Exit
- ▨ Proposed Landscaping
- Property Boundaries

THE WASH FACTORY
87 RAWSON ROAD, WOY WOY NSW 2256

3 Tree Assessment Methodology

3.1 Visual Tree Assessment Methodology

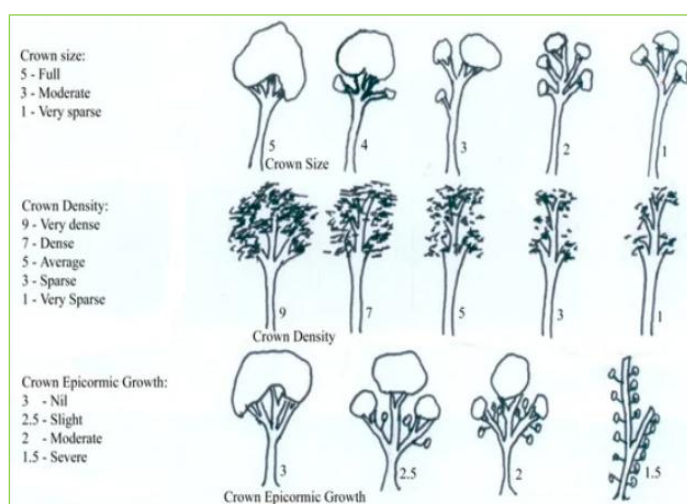
- i. Visual Tree Assessments (VTA) consistent with modern arboricultural practices and the International Society of Arboriculture standards were conducted by a suitably qualified and experienced arborist on the subject tree population. These assessments were conducted at ground level and therefore classified as *Level 2: Basic Assessment* (Dunster et al. 2019).
- ii. The tools used onsite to gather the necessary VTA data were a nylon percussion hammer, mobile phone, and an iPad. Tree height and canopy spread were recorded using a digital laser range finder (Nikon Forestry Pro). The trunk diameter and DBH height measurements were made by using a forestry DBH measuring tape. No dendrological diagnostics, soil analysis, tissue sampling and/or geological investigations were conducted at that time. For ease of identification the subject trees have been GPS located and photographed.

3.2 Visual Tree Assessment attributes

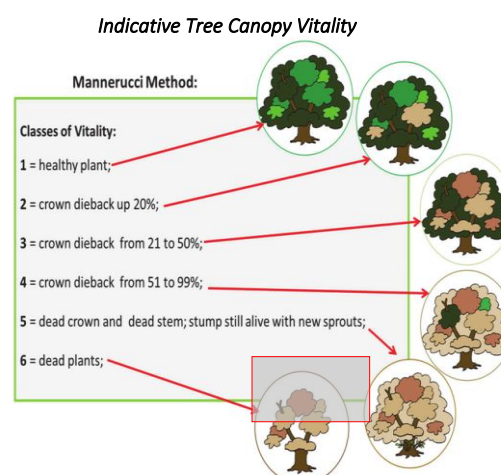
- i. The following descriptors are used to visually assess a tree. These parameters relate to the tabled Visual Tree Assessment data below.

Tree Vitality: is categorised through a visual determination using:

- leaf, twig or needle size, shape, and colour.
- seasonal growth rates.
- reaction wood development.
- foliage density & foliage coverage throughout the crown.
- branch architecture & ecophysiology.
- species specific traits & biomechanics.
- branch-tip dieback.
- typical branch senescence.



Visual vitality index for mature trees (Callow. 2018)



Pedology: a visual assessment of the general health and condition of the soil within the trees root zone. For example, such considerations such as soil porosity, compaction level, topography, hydrology, soil profile and root zone growth frustrations both infrastructural and/or otherwise.

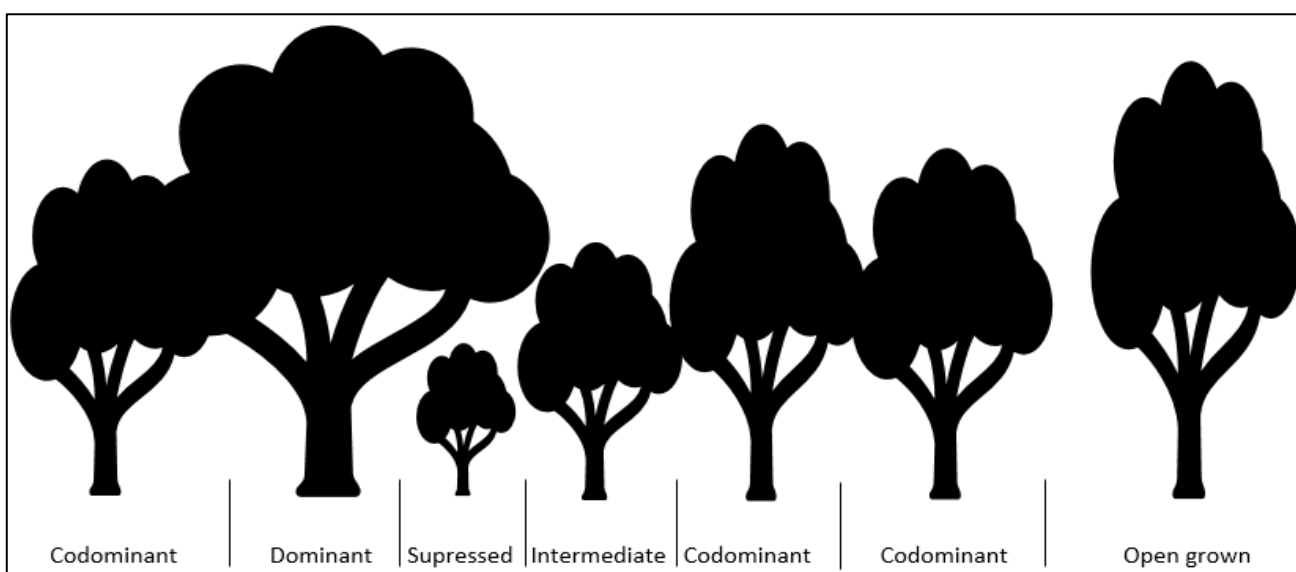
Structure and Biomechanics: a general evaluation of a tree's branch union formation, growth formation and architecture (this may affect branch weight and/or mass damping). This assessment is species-specific as it is derived from the typical structure and branch formation of the subject species.

Form: 'Trunk Form' is an assessment of the trees basal flare, taper, decay, cavities, formation of multi-stems that develop near and/or at ground level, girdling roots and growing angles. Whilst general 'Tree Form' is an indication of crown shape. Crown shapes are influenced by their surroundings, light availability and branch loss, which can have varying impacts on their symmetry. A tree is assessed on its individual crown shape. However, as the tree may be growing within a group environment, this could lead to the individual shape being assessed further down the scale. Although a poor rating may be attributed to the tree, the tree's contribution to the setting may be high through association within the group canopy. This can be generally recognised through the Crown Class rating.

Function: this assesses the site-specific usefulness of the tree *in situ*. Examples include soil retention, stormwater attenuation and mitigation of the Urban Heat Island. This is weighed up against any negative issues the tree(s) may be causing regarding persons, utilities and/or infrastructure.

Impediments: (rootzone & canopy) are structures that impede or suppress normal tree development and/or function. This can include hard impervious surfaces within the rootzone or powerlines and other structures within or adjacent to the canopy.

Crown Class: this rating provides an indication on the tree's relationship with other trees in the subject environment. The categories used include Dominant, Codominant, Intermediate, Suppressed and Open grown, as shown in the below diagram.



Indicative Crown Class (adapted from the International Society of Arboriculture)

Estimated Life Expectancy: An Estimated Life Expectancy (ELE) rating is determined by using the adapted Safe Useful Life Expectancy (SULE) and TreeAZ methodologies (Barrell. 1996; 2000). The aim of these two systems is to convert what amounts to a complex arboricultural assessment into a few broad categories that are more logically understood. An ELE rating provides an estimate of a tree's expected remaining lifespan after considering the current condition, vigour, and vitality of the subject tree(s) *in situ*. The main aim is the establishment of a tree Retention Value. The objective of a calculated ELE assessment is to contribute to the relative value of individual trees for the purpose of informing future management options and residual risk. This calculated ELE rating will be inserted into the below-mentioned *STARS Matrix* (please refer to the Appendix section for further information).

Retention Value: The *Significance of a Tree Assessment Rating System (STARS)* provides the Retention Value of a tree and/or group of trees by balancing a combination of environmental, cultural, physical, amenity and social values. The Landscape Significance of a tree is an essential criterion to establish the importance that a particular tree may have on a site. However, rating the significance of a tree becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the Retention Value for a tree. Therefore, a tree retention assessment is undertaken in accordance with the *Institute of Australian Consulting Arboriculturalists (IACA) Significance of a Tree Assessment Rating System (STARS)*. The system uses a scale of *High*, *Medium*, and *Low* significance in the landscape. Once the landscape significance of a tree has been defined, the Retention Value can be determined congruent with the trees' abovementioned Estimated Life Expectancy (ELE).

P	Prioritise for Retention (High) - These trees are considered important for retention and must be retained and protected. Design modification or re-location of building(s) should be considered to accommodate the setbacks as prescribed by the Australian Standard AS 4970-2025 <i>Protection of trees on development sites</i> . Tree sensitive construction measures must be implemented (i.e., Pier and Beam cantilever, Screw Piling, Structural Confinement Cells) if works are to proceed within the NRZ).
C	Consider for Retention (Medium) - These trees should be retained and protected where practicable. Albeit they are considered less critical; however, their retention should remain a priority with removal considered only if adversely affecting the proposed building/works; and all other alternatives have been considered and exhausted.
C	Consider for Removal (Low) - These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
P	Priority for Removal (Removal) - These trees are considered hazardous, in irreversible decline and/or a listed Weed Species. Therefore, they should be removed irrespective of development.

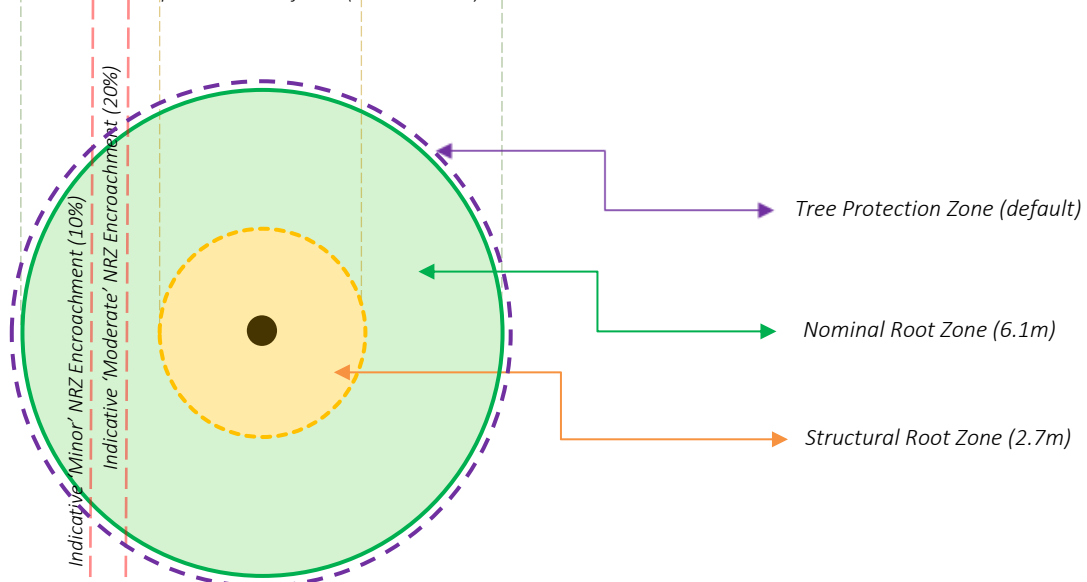
3.3 Root Zone Encroachment

- i. Root depth and extension can be severely limited and highly irregular in urban settings. When root restrictions are minimal, root spread shows a strong relationship with trunk diameter, which is a more reliable predictor than canopy diameter ('dripline') or tree height (Day et al. 2010). Therefore, all arboricultural recommendations and conclusions contained in this AIA with regard to proactive tree root protection/retention were based upon and determined in accordance with AS 4970-2025 *Protection of Trees on Development Sites*.

- ii. An infographic indicative of a calculated NRZ, a SRZ and an Encroachment is included below to aid in the visualisation of the 'No-Dig' zones; and where initial Non-Destructive Root Exploration (NDRE) must be carried out under the direct supervision of the Project Arborist (if a tree is to be retained). Notably, the infographic and the below formula can be used to portray the SRZ and NRZ of any tree. This along with where tree protection is likely to be erected, as the NRZ is the starting point (default).



Tree 1724 *Lophostemon confertus* (Qld Brush-box)



- Whilst working within the Notional Root Zone (NRZ) of any retained tree it is recommended that initial Non-Destructive Root Exploration (NDRE) is utilised under the guidance of an appointed Project Arborist; and
- Any retained tree within 5m of development works requires tree protection. The tree protection must be erected prior to the commencement of works as per the considerations and infographics in the TPP. The starting point being the NRZ. On satisfactory completion, the appointed Project Arborist will inspect and issue a Compliance Memorandum.

Root Zone Calculations

- The radius of the NRZ is calculated for each tree by multiplying its Diameter at Standing Height measured @ 1.4m from ground level ($DSH \times 12 = NRZ$). ($DSH = \text{Trunk Girth @ 1.4m} \div \pi$).
- To calculate the SRZ: Radius SRZ = Diameter above Root Crown ($DRC \times 50$) $^{0.42 \times 0.64}$. If the DRC is less than 0.15m the SRZ will be 1.5m. (Please note that the SRZ should be no less than 1.5m; and a NRZ should not be less than 2m).
- Please Note: The NRZ of palms, other monocots, cycads and tree ferns should not be less than 2m.

4 Visual Tree Assessment Data

Visual Tree Assessment Data: September 2025 (all measurements are shown in metres)

Tree No.	Botanical Name Common Name	Age Class	Height	Canopy Spread	SRZ	NRZ	Form	Structure	Vitality	ELE	Landscape Significance	Retention Value	Ench %	Ench AS4970-2025	Photo Link
T1	<i>Araucaria heterophylla</i> Norfolk Island Pine	Mature	31	EW:10 NS:10	3.9	14.5	Fair	Fair	Fair	Long	Medium	Medium	>20%	● Major	
T2	<i>Araucaria heterophylla</i> Norfolk Island Pine	Mature	32	EW:8 NS:8	3.4	10.7	Fair	Fair	Fair	Long	Medium	Medium	>20%	● Major	
T3	<i>Araucaria heterophylla</i> Norfolk Island Pine	Mature	34	EW:8 NS:8	3.5	11.9	Fair	Fair	Fair	Long	Medium	Medium	>20%	● Major	
T4*	<i>Erythrina x sykesii</i> Common Coral Tree	Mature	9	EW:6 NS:10	2.7	4.8	Poor	Poor	Fair	Medium	Low	Remove	>20%	● Major	
T5	<i>Glochidion ferdinandi</i> Cheese Tree	Semi Mature	4	EW:1 NS:1	1.5	2.0	Fair	Poor	Fair	Medium	Low	Low	>20%	● Major	
T6	<i>Jacaranda mimosifolia</i> Jacaranda	Mature	8	EW:5 NS:6	2.8	6.0	Poor	Fair	Poor	Medium	Low	Low	>20%	● Major	
T7	<i>Callistemon citrinus</i> Crimson Bottlebrush	Mature	3	EW:3 NS:4	2.4	3.6	Poor	Fair	Fair	Medium	Low	Low	<10%	● Minor	

Key

- **Measurements:** all measurements shown are in Metres (m).
- **Age Class, Form, Structure & Vitality:** per the International Society of Arboriculture descriptors.
- **Canopy Spread:** estimation of canopy spread to the four (4) cardinal points in metres. (North-South) & (East-West)
- **Diameter at Standing Height (DSH):** per AS 4970-2025 *Protection of trees on development sites*; and calculated per the *as4970smartcalculator.au*
- **Diameter above Root Collar (DRC):** per AS 4970-2025 *Protection of trees on development sites*; and calculated per the *as4970smartcalculator.au*
- **Structural Root Zone (SRZ):** per AS 4970-2025 *Protection of trees on development sites*; and calculated per the *as4970smartcalculator.au*
- **Notional Root Zone (NRZ):** per AS 4970-2025 *Protection of trees on development sites*; and calculated per the *as4970smartcalculator.au*
- **Estimated Life Expectancy (ELE):** adapted per (Barrell, 1996) & (Barrell, 2000).
- **Landscape Significance:** *Significance of a Tree, Assessment Rating System (STARS), Institute of Australian Consulting Arboriculturists, Australia (2010).*
- **Retention Value:** *Significance of a Tree, Assessment Rating System (STARS) matrix, Institute of Australian Consulting Arboriculturists, Australia (2010).*
- **Encroachment (Ench %) & Level:** categorised per AS 4970-2025 *Protection of trees on development sites*; and calculated per the ProofSafe Calculator.

Supplementary Notes:

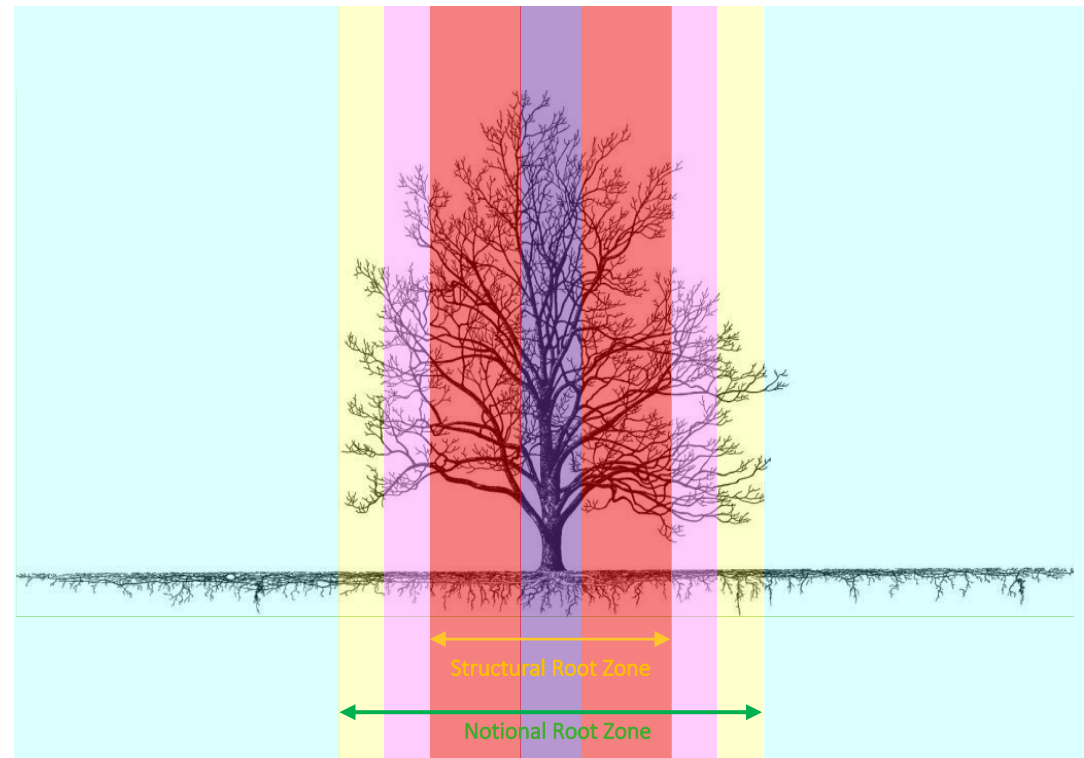
- *A tree highlighted in light purple will not remain viable under the proposed works footprint. Ergo it will need to be removed pre-construction with consent from the Tree Owner and with Council permission. Notably, Compensatory Replanting should be adopted to offset tree canopy loss (refer Appendix).*
- *Prior to the removal of any tree, written permission will need to be obtained from Central Coast Council. In addition, permission to remove Tree (1) will also need to be obtained from the property owner of 50-52 Rawson Road. This because the tree is growing on the boundary fence line and joint ownership is likely.*
- *A tree marked with an Asterix (*) is a listed weed species per NSW DPI Weedwise and should be removed with Council consent regardless of arboricultural impact.*

Encroachments within the Notional Root Zone

● **No Encroachment:** No likely or foreseeable encroachment within the NRZ. (Albeit Tree Protection is to be installed around any tree(s) within five (5) metres of development works).

● **Minor:** The proposed encroachment is considered 'Minor' if it is less than or equal to 10% of the area of the NRZ, has not had recent NRZ encroachments, and is outside of the SRZ. Generally, it is unlikely that there will be significant impact to tree health, longevity or structure. Tree Protection is to be implemented during site works. To avoid a net loss of soil area and volume, an area equivalent to the encroachment shall be incorporated into the TPZ, unless the Project Arborist demonstrates that the tree will remain viable.

● **Moderate:** The proposed encroachment is considered 'Moderate' if it is greater than 10%, and less than or equal to 20% of the area of the NRZ and is outside of the SRZ. A project arborist shall be engaged to review the proposed impact and undertake any other necessary investigation to address the factors listed in Clause 3.3.2 to demonstrate how the tree will remain viable. This may be through the implementation of suitable design measures and construction controls to mitigate impacts during the development process as part of a TPP. To avoid a net loss of soil area and volume, an area equivalent to the encroachment shall be incorporated into the TPZ, unless the Project Arborist demonstrates that the tree will remain viable.



Indicative Root Zone Encroachment

● **Major (NDRE):** The proposed encroachment is considered 'Major' if it is greater than 20% of the area of the NRZ or inside the SRZ. The Project Arborist shall be engaged to explore alternatives designs with the design team and/or demonstrate that the tree will remain viable. Relevant factors listed in Clause 3.3.2 should be considered. Additionally, for a 'Major Encroachment' a more detailed investigation is necessary. This can include research such as root investigation (non-destructive), soil analysis, historical records of the tree or site, relevant literature and examples of similar encroachments. A TPP should be prepared to support the retention of the tree. To avoid a net loss of soil area and volume, an area equivalent to the encroachment shall be incorporated into the TPZ, unless the Project Arborist demonstrates that the tree will remain viable.

● **Major (Non-Viable Total Encroachment):** Subject tree is located wholly or significantly within the construction footprint and cannot be practicably retained.

5 Summary

5.1 Key Findings

- i. Seven (7) trees of relevance were assessed per the provided design plan and proposed scope of works for the new carwash development at 87 Rawson Road, Woy Woy 2256. Whereby it was concluded:
 - Tree Removal (Non-Viable): Trees (1) to (6) will be in direct conflict with the proposed works. If tree sensitive design modifications are not implemented these six (6) trees will need to be removed pre-construction. (Notably, none of these trees have a 'High' Retention Value and transplanting is not a practicable option).
 - Tree Retention (Viable): Tree (7) trees will have no significant NRZ encroachment ('Minor') that is foreseeable. Therefore, as it is expected that this tree will remain viable post-development, it is to be retained, afforded protection per the site-specific TPP and incorporated into the landscaping plan.
- ii. Of note, Tree (1)* is growing on the western boundary fence line, so 'joint ownership' of this tree is likely. Therefore, consent to remove this tree will need to be obtained from both the Council and the property owner of 50-52 Rawson Road, Woy Woy 2256. If it is determined that the subject tree is to be retained, the client will need to discuss and adopt tree sensitive practices to reduce arboricultural impact. These practices are to include initial NDRE to map significant root location; and the installation of tree sensitive construction mediums such as Structural Confinement Cells and the utilisation of permeable surface mediums (*refer Appendix*).

5.2 Conclusion

- i. Under the current design proposal, it is of a reasonable arboricultural belief that six (6) identified trees will need to be removed pre-construction to accommodate the development. Albeit the final tree retention number will depend on Council consent, whether tree sensitive design modifications can be incorporated (if required), and the priorities of the Tree Owners.
- ii. The overarching caveat for the development being that the following site-specific TPP and its mitigation measures are enacted for any tree that is ear-marked for retention. This concurrent with the adoption of planned Compensatory Replanting to offset tree canopy loss.

5.3 Mitigation Measures

- i. The below table summarises the core mitigation measures required for protecting any retained tree(s) during the proposed development at 87 Rawson Road, Woy Woy 2256 per *AS 4970-2025 Protection of trees on development sites*. Technical commentary and bespoke infographics regarding these mitigation measures and their implementation can be referenced in *Part 2 Tree Protection Plan*.

5.4 Mitigation Measures Table

Stage*	Mitigation Measures	Reason for Mitigation Measure	Section
1	<i>Appoint a Project Arborist (AQF 5 min.)</i> To provide arboricultural consultation, oversee all tree protection measures and approved works within a trees TPZ, and complete compliance certification as outlined in the TPP.	To ensure tree protection is afforded, and safeguard against arboricultural impact during the undertaking of the projects proposed activities.	s.6
1	<i>Tree Removal</i> Any tree ear-marked for removal per the AIA is to be clearly identified by the appointed Project Arborist prior to its removal (i.e., tape, paint or tag).	To safeguard against errant or misguided tree removal.	s.8
1	<i>Tree Protection</i> Tree protection for any retained tree is to be erected per the TPP prior to the commencement of works. The Project Arborist will inspect and certify the Tree Protection and issue a Tree Protection Compliance Certificate.	To protect trees from direct and indirect impact (above and below ground) for the duration of the project.	s.7
1 & 2	<i>Adopt Tree Sensitive Practices</i> As per the AIA, NDRE is to be initiated prior to any earthworks being conducted within the NRZ of a tree. The Project Arborist will oversee and document the NDRE findings in a Root Mapping Report.	To prevent root damage, root loss and subsequent biotic and/or abiotic secondary infection.	s.7 & s.13
2 & 3	<i>Arboricultural Inspections</i> - Monthly inspections of the retained tree population during the development works and Arboricultural Memorandums provided. - A VTA is to be conducted on any retained tree by the Project Arborist on completion of the development works. A Completion of Arboricultural Works Memorandum, which includes a site-specific Tree Management Plan is then to be issued.	To enable the formulation and implementation of evidence-based Tree Management Plans.	s.6
3	<i>Compensatory Replanting</i> Finalise Compensatory Replanting numbers, tree species and planting locations under consultation with an Urban Forester (AQF 8 min.).	To offset tree canopy loss and grow an urban forest which bestows social, economic and environmental benefits for the well-being and betterment of the community.	s.13

* **Project Stages:** (1) Pre-construction. (2) During Construction. (3) Post-construction.

PART 2: TREE PROTECTION PLAN

6 Tree Protection Control Framework

6.1 Disclaimer

- i. The following site-specific Tree Protection Plan (TPP) is to be used for the duration of the project. Although the framework includes monitoring controls operated by the appointed Project Arborist, compliance to the TPP is the responsibility of the 'Client,' and as such AGS cannot accept liability for any adverse effects arising from 'non-compliance' to documented controls and/or any subsequent changes to the scope or methods documented in the TPP provided to the 'Client.'

6.2 Overview

- i. Trees are dynamic living organisms and as such are susceptible to development impact either direct and/or indirect - biotic and/or abiotic. Arboricultural impact due to development encroachment, especially within the calculated SRZ, NRZ or TPZ, causes 'dendrological stress' in varying degrees. This stress has the potential to heavily impact upon tree vitality and ultimately tree longevity (Boddy. 1983). Therefore, the Australian Standard *AS 4970-2025 Protection of trees on development sites* must always be adhered to. Whereby the objective of this Standard is to provide guidance through the use of science-based methodologies to arborists, other professionals concerned with the care and protection of trees on development sites, and anyone that is interested in the general integration between trees and construction in both the peri-urban and urban realm.
- ii. This Tree Protection Plan (TPP) includes both activity specific controls as well as a range of generic tree protection controls. The control framework pre-dominantly focuses on identifying and mitigating aspects of the design and construction process that can adversely affect tree vitality, stability and/or useful life expectancy. Additionally, it includes preventative controls (designed to prevent adverse outcomes), directive controls (designed to promote desired outcomes) and detective controls (designed to monitor compliance with any statutory requirements and the agreed control framework).
- iii. Notably, the engagement of a Project Arborist is a key element of the control framework and is a multi-faceted control in terms of providing guidance, practicable tree sensitive alternatives and detecting areas of non-compliance/improvement. Also, of note and great importance are the Tree Protection Specifications (TPS) outlined in the TPP. All of which must be strictly adhered to both pre-development and for the duration of the project.

6.3 Project Arborist

- i. In accordance with the *AS 4970-2025 Protection of Trees on Development Sites*, inspections are to be conducted by the appointed Project Arborist at the following key project stages:

- Prior to any work commencing on-site (including demolition, earthworks, or site clearing) and following the installation of tree protection.
- During any excavations, building works, and any other activities carried out within the Tree Protection Zone (TPZ) of any tree to be retained and protected.
- A minimum of once per month during the construction phase.
- After all major construction has ceased, following the removal of tree protection. It shall be the responsibility of the project manager to notify the project arborist prior to any works within the TPZ of any protected tree at a minimum of forty-eight (48) hours' notice. To ensure the tree protection plan is implemented, hold points have been specified in the following table.

Proposed Project Arborist Schedule

Development Stage	Hold Point	Description
Pre-Construction	1	• Appoint a Project Arborist (AQF Level 5 min.) • Prior to any development works, any tree earmarked for removal is to be clearly marked (tape, paint, tag etc.) by the Project Arborist.
	2	• Scheduled 'Pre-Start' meeting. • Tree Protection for any retained tree(s) must be installed prior to demolition and/or site establishment. The Project Arborist will inspect and certify the tree protection per the Tree Protection Plan; and issue a Tree Protection Compliance Memorandum.
During Construction	3	• Monthly scheduled site inspections of the retained tree population will be conducted (if works are outside the TPZ) and memorandum provided.
	4	• The Project Arborist will oversee and document all works carried out within the NRZ of any retained tree. A weekly Works Memorandum is to be provided with the findings.
	5	• Visual tree inspection conducted by the Project Arborist of the retained tree population once the major works have been completed and the tree protection has been removed.
Post Construction	6	• Final visual tree inspection of the retained tree population; and a Completion of Arboricultural Works Memorandum issued. • Ongoing Monthly Inspections & Memorandums issued at the discretion of the Tree Manager/Owner and after consultation of the Project Arborist.
Plant Health Care (PHC)	7	• The adoption of a Plant Health Care post-development (at the discretion of the Tree Owner/Manager and after consultation with the Project Arborist). • This Plan may include a top dressing of organic mulch over the trees TPZ (e.g., mulch ring), a liquid solution of Organic Botanicals, remedial & formative pruning and/or the scheduling of cyclic Visual Tree Assessments and included Tree Management Plans.

6.4 Summary

- i. A pre-commencement of work or 'Pre-Start Meeting' must be held onsite with the appointed Project Arborist and all Managers overseeing/involved in carrying out the proposed development site works (e.g., Site Managers, Foreman, Leading Hands etc).
- ii. Proactive canopy modifications (pruning) options with regards to the facilitation of machinery and/or pedestrian access should be considered, discussed and if deemed necessary scheduled prior to the commencement of the main development works.
- iii. Tree Protection Fencing is to be erected around any tree within five (5) metres of the development works; and temporary hard surfaces are to be made readily available and onsite whilst working within close proximity of any trees calculated Tree Protection Zone (i.e., rumble boards & track-mats). *Refer s.8 Tree Protection Specifications.*
- iv. The appointed onsite Project Arborist is to guide/supervise any works within close proximity of the tree(s) Tree Protection Zone. Whilst working within the Notional Root Zone (NRZ) of any tree, the excavations must be undertaken by initial Non-Destructive Root Exploration (NDRE) through the use of Hand-digging, Air -Spade, Air- Vac or a combination thereof under the direct supervision/guidance of the appointed onsite Project Arborist.
- v. The Project Arborist is to author and issue a Completion of Arboricultural Works Memorandum at the end of the works/project.
- vi. At the discretion of the Tree Owner/Manager a Plant Health Care (PHC) regimen is to be undertaken post-development and a memorandum issued. *(Recommended).*
- vii. The caveat for the abovementioned project proceeding and its continuance is that the site-specific Tree Protection Plan provided must be strictly adhered to at all times.

6.5 Supplementary Commentary

- i. All construction work within the TPZ of any retained tree must be authorised and supervised by the appointed Project Arborist and the Tree Manager/Owner.
- ii. The use of 'strip-style' excavation adjacent to and/or within the TPZ of any retained tree is strictly prohibited.
- iii. When removing an existing surface (concrete or similar hardscape), excavation must occur from above the existing surface; the removal work is to be carried out with a straight batter bucket; a 'lifting motion' is to be adopted; and the machinery is to move in a backward direction toward the extremity of the trees TPZ. In addition, all due care must be taken to ensure that the TPZ of any adjacent tree(s) are isolated and protected from vehicular entry (both above and below ground); and soil compaction is minimised within the TPZ by utilising ground protection as outlined in the Tree Protection Installation protocols.
- iv. On completion of the hardscape removal, the onsite Project Arborist is to document any significant root

observations; and where applicable carry out NDRE (root mapping) with regards to future construction, arboricultural impact. TSUD options and alternatives are also to be provided where applicable.

- v. With regards to the reinstatement of ground, the addition and application of any new soil (or replanting mediums) must be carried out with all due care (e.g., root collar, topography and hydrology considerations), and with prior express consent from the Project Arborist. All new mediums are to comply with *AS 4454-2003 Composts, soil conditioners and mulches*.
- vi. Where fencing is to be replaced, it is preferable to use existing post holes when they located within TPZs. New pier holes are to be hand dug or by air-vac excavation under the supervision/guidance of the Project Arborist.
- vii. It is imperative that TPZ fencing, or main stem, branch and ground protection measures are installed for the protection of all retained trees prior to the commencement of the future Construction Phase, and that it remains *in situ* for the duration and until completion of proposed construction works.
- viii. TPZ fencing and other measures must be fixed so that they cannot be moved either by accidental physical impact or other inadvertent means. There shall be no entry within any TPZ by any construction crew or other persons during the construction phase without authorisation and/or attendance of the Project Arborist. That includes, no storage of builders' materials, machinery, pedestrian traffic, disposal of waste paints, fuels etc as listed below.

6.6 Restricted activities within the Tree Protection Zone

- i. As per *AS 4970-2025 Protection of trees on development sites* the following activities are excluded from the delineated TPZ include, but are not limited to:
 - a) Excavation, cultivation or disturbance of the soil, including scraping of the surface.
 - b) Equipment and material storage.
 - c) Preparation of chemicals, including preparation of cement products.
 - d) Movement or the parking of vehicles and plant.
 - e) Dumping of waste.
 - f) Spreading or stockpiling of fill.
 - g) Refuelling.
 - h) Wash down and cleaning of equipment or hard surfaces.
 - i) Fires.
 - j) Physical damage to the tree.

7 Tree Protection Specifications: Control Framework

7.1 Compliance and Reporting

- a) The generic tree protection controls in this section are designed to be used in conjunction with the recommendations of this site-specific Arboricultural Report.
- b) All relevant standards, specifications, policies, and resource conditions of consent are incorporated into the TPP.
- c) The Project Arborist will undertake scheduled and unscheduled site visits to monitor compliance with all aspects of the TPP.
- d) Any deviations from the TPP must be approved by the Council Arborist. Non-compliance issues must be reported to the Project Management immediately.
- e) An Arboricultural Completion Memorandum must be prepared by the Project Arborist including but not limited to comments and observations about any root pruning/root retention and compliance to the TPP.
- f) The TPP must always be available on site and be included in site inductions and 'toolbox' sessions.
- g) Any damage to tree protection fencing or trees must be reported to the Project Arborist immediately (including damage not caused by activities associated with the project).
- h) Non-compliance issues must be documented and addressed at daily pre-start meetings/toolbox sessions.

7.2 Root Collar Management and Protection

- i. The Root Collar⁶ of a tree requires the movement of oxygen and carbon dioxide (in and out of the phloem) to survive. Planting too deep or adding excess material (i.e., soil, mulch, grass-clippings) to an extent that the root collar is buried inhibits this gaseous exchange and subsequently kills the phloem cells which in turn interferes with the downward movement of food (photosynthate) to the roots. This results in root dieback and a reduced uptake of water and micro-nutrients, which stresses tree and can ultimately result in premature tree mortality. Other concerns associated with Root collar burial are Root-girdling⁷, Collar-rot and nutrient and moisture deficiencies due to the 'sealing-off'⁸ of the root-ball. In addition, secondary biotic infectors such as insect borers and pathogenic fungi (*Phytophthora spp* and *Armillaria spp*), which can stress and cause premature mortality. Therefore, it is critical to both the functionality and longevity

⁶ Root collar (or root crown, root flare, trunk flare) - is the flared area at the tree trunk base where the roots and trunk come together. This area is typified by a flare leading to the major buttress roots" (Draper.2009).

⁷ Root Girdling - When the root crown is buried, roots grow upwards into this new layer of media haphazardly. Commonly, those new roots at the base of the stem benefit from extra water due to stem flow and grow vigorously around the base of the stem. This can result in 'girdled' roots at the base of the trunk. As the roots and trunk expand, the result can be fatal (Clark. 2015).

⁸ Sealing off - The texture of the site soils is almost invariably finer than that of the potting mix in the root ball. This means capillary tension will be greater in the site soils than in the root ball. If trees are planted too deeply, the finer site soils on top of the root ball hold water 'perched' above the root ball, with any excess moisture draining away to the sides. Similarly, even a very thin cap of site soil washed across the root ball can seal the top causing water to run off without penetrating. The root balls can then dry out, resulting in stressed, dying, or dead trees (Clark. 2015).

of a tree that when tree planted the root collar is at the correct height (at ground level), stays at the correct level and remains relatively unfettered (Smiley. 2012).

- ii. With regards to best managing a tree's root zone and root collar post-development, any excess soil or other medium should be removed from around the root collar carefully (i.e., Non-Destructive Root Exploration). Once the excess debris is removed the roots can be inspected and proactive recommendations made by a Consulting Arborist per Arboricultural Best Management Practice.

7.3 Root Protection

- i. Root pruning should be kept to the absolute minimum and should only be completed by the Project Arborist. All root pruning assessments should be made initially by the Project Arborist, and the Council Arborist contacted where approval is required. All roots larger than 25mm in diameter are to be retained in an undamaged state and protected, unless the Council Arborist gives permission for them to be pruned. Irrespective of size, any roots which have a significant effect on the health and stability of a tree shall not be removed without the prior approval of the Council's Arborist, and this may include tree roots that are less than 25mm in diameter.
- ii. If root pruning is deemed necessary, they must be pruned/severed with a sharp pruning saw/tool to create a clean cut that is flush with the face of the completed excavations. Retained roots and cut surfaces should be protected from desiccation and physical/frost damage. The method will depend on the seasonal weather conditions and length of time expected between completing the excavations and reinstatement works and should be determined by the Project Arborist. Typically, retained roots must be wrapped in a suitable wool much or hessian product that is secured in place using bio-degradable string and kept moist, however supplementary watering may be required depending on the weather conditions based on the Project Arborist's discretion.

7.4 Soil Protection

- i. All machines shall only operate from either formed surfaces, surfaces that will be excavated or from an appropriate load bearing protective matting. The area covered by the protective matting shall be sufficient to allow ground protection for all vehicle movements, including the turning of any vehicles. (Please refer to Branch, Trunk & Ground Protection in the Appendix).
- ii. No chemicals, re-fuelling operations, spoil, fill, soil, materials of any kind, or equipment will be stored, emptied, disposed of, or temporarily placed in areas that the tree's root system could be utilizing unless approved by the Project Arborist and this is on an existing hard impermeable surface.
- iii. Water used for washing down machinery must not be allowed to runoff and contaminate soil volumes/water sources that are either currently or are likely to be utilised by the tree.
- iv. The risk of soil borne infections being introduced to the site from equipment, tools and footwear must be assessed by the Project Arborist and mitigated as necessary (mitigation will typically involve cleaning the equipment before it is used on the site with a sterilizing agent, such as Trigene or Sterigene).

7.5 Tree Canopy Protection

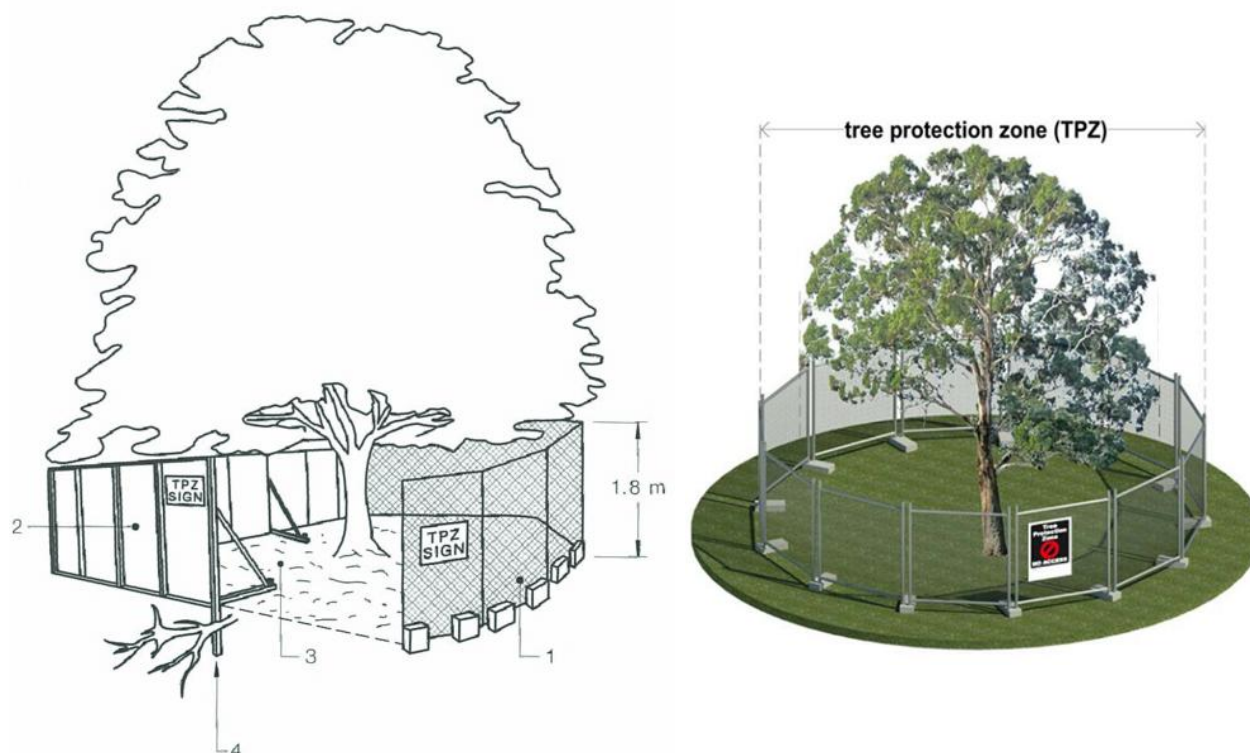
- i. Tree Canopy Protection may include the following measures:
 - a) Locating the tree protection fence outside of the crown in the affected area.
 - b) Target Pruning of individual or specific branches (*refer s.8.6 Tree Canopy Modifications*).
 - c) Tying back of branches.
 - d) Use of flagging to make branches more visible.
 - e) Branch protection (*refer Alternative Trunk, Branch & Ground Protection*).

7.6 Tree Protection Zones

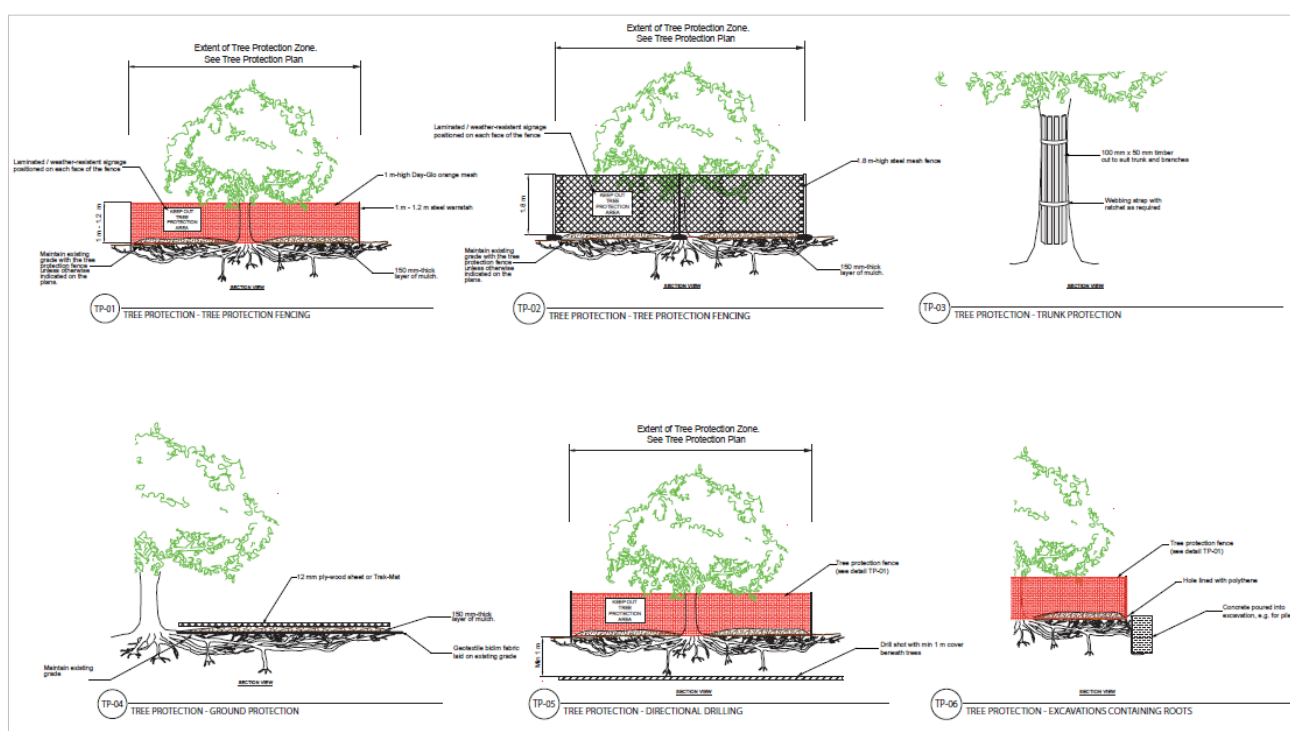
- i. Tree Protection Zones are Exclusion Zones and must be created using tree protection fencing that is consistent with the requirements of *AS 4970-2025 Protection of trees on development sites*. The position of the fencing is determined by the Project Arborist, with the starting point being the calculated NRZ of the tree. However, additional site-specific and species-specific factors will be taken into consideration when determining the final delineation of the TPZ (*refer AS 4970-2025 Protection of trees on development sites, s3.3.2*). Albeit once the final position of the tree protection has been decided upon it shall not be altered without the prior consent from the Project Arborist.
- ii. If it is not pragmatic to use the abovementioned tree protection fencing then individual trunk, branch and ground protection must be installed to any retained tree located within five (5) metres of any proposed work zone. (*refer to the Alternative Trunk, Branch & Ground Protection infographic*).
- iii. Tree protection zones must be clearly labelled displaying the words 'Tree Protection Zone'. Signs will be placed on fencing of individual trees or every 10 linear metres on groups of trees. Where the work site is only on one side of the tree, the barrier may be erected along the face of the tree adjacent to the work site.
- iv. Tree Protection Barriers must be erected before any site works commence and shall not be removed or moved closer to the trunk of the tree, until after site works are complete. No person, vehicle or machinery may enter the Tree Protection Zone unless otherwise authorised to do so by the Project Arborist.
- v. Operating plant must be positioned to avoid the expellant of exhaust fumes and radiant operating heat damaging the physiological functions of the tree.

7.7 Tree Protection Installations

- i. Tree Protection **must** be erected around any tree within five (5) metres of development per *AS4970-2025 Protection of trees on development sites*. Please refer to the following infographics that depict the correct installation.

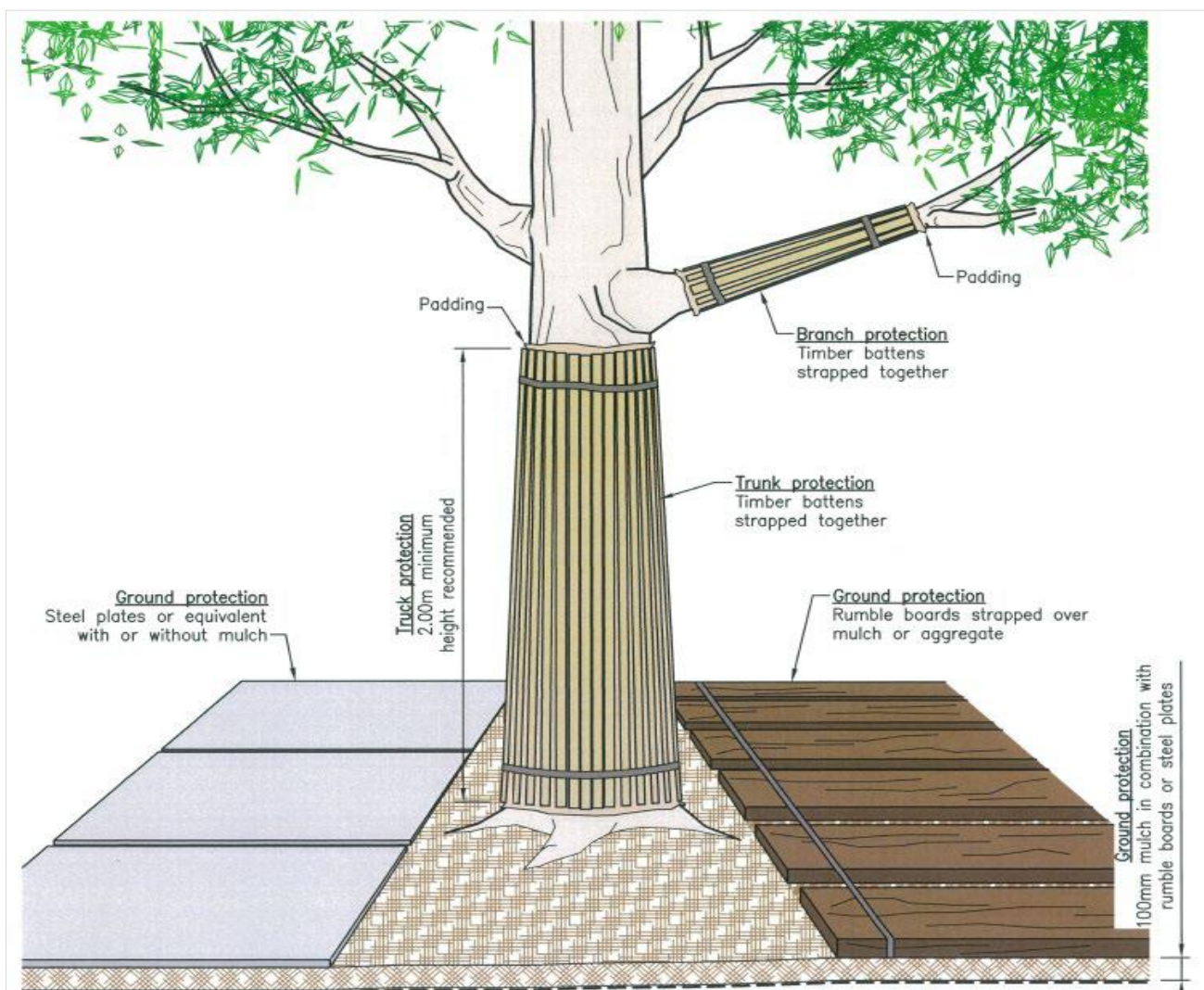
**LEGEND:**

- 1 Chain wire mesh panels with shade cloth (if required) attached, held in place with concrete feet.
- 2 Alternative plywood or wooden paling fence panels. This fencing material also prevents building materials or soil entering the TPZ.
- 3 Mulch installation across surface of TPZ (at the discretion of the project arborist). No excavation, construction activity, grade changes, surface treatment or storage of materials of any kind is permitted within the TPZ.
- 4 Bracing is permissible within the TPZ. Installation of supports should avoid damaging roots.



Alternative Trunk, Branch & Ground Protection

- i. When tree protection fencing cannot be installed or requires temporary removal, other tree protection measures should be used. Where necessary, install protection to the trunk and branches of trees as pictured below.
- ii. The materials and positioning of protection are to be specified by the Project Arborist and are to include:
 - For the trunk and branch protection use boards and padding that will prevent damage to the bark. For the trunk boards a minimum height of two (2) metres is recommended. Boards are to be strapped to trees, not nailed or screwed. Do not attach temporary powerlines, stays or guys to the tree.
 - If temporary access for machinery is required within the Tree Protection Zone (TPZ) such as site access, ground protection measures will be required. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ. Measures may include a permeable membrane such as geotextile fabric beneath a layer of mulch or crushed rock below rumble boards. (These measures may be applied to root zones beyond the TPZ).
 - Rumble boards should be of a suitable thickness to prevent soil compaction and root damage and a top dressing of Organic Mulch (60mm-70mm deep) is to be applied where pragmatically possible.



8 Additional Site-Specific Tree Protection Considerations

8.1 Demolition of Existing Buildings

- i. The demolition of buildings should be undertaken with access restricted to the driveway and the building footprint for any existing building, areas of land where no trees are growing and/or access is outside the TPZ of a retained tree. Where access or space for a safe working environment is restricted, or where the area of the 5m setback must be compromised, a 100mm layer of organic wood mulch must be laid over the area of encroachment. Where vehicular access is required across the mulch layer further root protection should be provided by laying a temporary pathway over the mulch. The temporary pathway should be constructed of a grated steel material capable of supporting the vehicles used during demolition (similar to ramps used to load vehicles onto the backs of trucks), and the tree protection erected as outlined above (*refer Alternative Tree Protection infographic above*).

8.2 Demolition of Infrastructure

- i. When the demolition of hard landscaping and infrastructure (e.g., walls, driveways retaining walls, paths, pools etc), is within the TPZ or within 5m of a tree to be retained is to be undertaken initially by using hand tools (i.e., manually). Additionally, if the removal of an existing hardscape surface (e.g., concrete driveway or path) is required, it must occur from above the existing surface or a stable platform; and the removal work is to be carried out with a straight batter bucket with the machinery operated in a backward direction toward the extremity. As above-mentioned, all due care must be taken to ensure that the TPZ of adjacent trees are isolated and protected from vehicular entry to prevent soil compaction within the TPZ of any retained tree.

8.3 Excavation and Construction close to Tree Protection Zones

- i. Where structural woody roots with a diameter of 20mm or greater are to be pruned outside the area of the Tree Protection Zone, they are to be excavated manually first by using hand tools to determine their location. An AirVac/AirSpade can be used as a mechanised alternative to locate such structural woody roots. Once located those roots to be severed are to be cut cleanly with a final cut to undamaged woody tissue and this will prevent tearing damage to the roots from excavation equipment which can extend beyond the point of excavation back towards the tree.
- ii. Where a large vigorous tree is to be retained near to a built structure, and dependent upon its taxa, age class and propensity for its roots system to regenerate, it may be prudent to install a root barrier immediately adjacent to the footing of the new building, or to deepen and strengthen the footings themselves to act as a root barrier, but for such structural advice an appropriately qualified chartered structural engineer should be consulted.
- iii. If walls or a driveway or other structures are to be constructed near a protected tree, careful excavation is to be undertaken manually by using non-motorized hand tools to determine the location of first order and lower order structural roots with a diameter of 20mm (structural woody roots) or greater, without

damaging them. Boundary walls or fences should use columns or posts within fill panels, or a wall to be constructed with suspended sections 100mm clear above or beside any structural woody root or further as required, or any new wall to be built only to the depth of that existing. Structural woody roots to be further protected by utilising the construction techniques of pier or bridge footings, or screw piles between or over them with a minimum clearance above or beside of 100mm, or further as required to allow for future and on-going growth. (For additional information please refer to the appendix – *Non Destructive Root Exploration & Root Mapping* and *Tree Sensitive Urban Design*).

8.4 Driveway and Footpath Construction

- i. After demolition of an existing driveway the level of the base for the new driveway should be located at the same existing level as that of the base of the previous driveway and should extend for a distance past the tree equivalent to the lateral spread of the crown of that tree alongside the driveway. To prevent excavation from damaging the existing roots which may be located at, near or above the surface of the soil beneath the base of the previous driveway, the new driveway may need to be raised by constructing it on pier or bridge footings between or over them, or based on a gap graded fill and the driveway constructed with any exposed edges concealed to the top of the driveway by minimal filling with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation, or other landscape treatments as appropriate. Where roots have grown to occupy the soil between the concrete strips of a concrete, stone or brick strip driveway, they and the soil may be excavated to the level of the base of the concrete strips, but where such roots have a diameter of 20mm or greater a Consulting Arborist should be contacted prior to such works being undertaken. Where roots are to be severed, they are to be cut cleanly with a final cut to undamaged woody tissue.
- ii. Where a driveway or footpath is to pass by the tree a suspended slab is to be constructed or approved similar, to protect the roots that may be encountered at, near, or above ground, and may be constructed on gap graded fill. Where such a driveway or footpath is to be constructed the edge of the structure closest to the tree is to terminate no closer than 0.5 m from the closest edge of trunk, or further depending on the species and its likely further growth to allow for future development and expansion of the trunk, buttresses, and first order and lower order roots as may be advised by a Consultant Arboriculturist. The side of the driveway closest to a tree is to be edged with a concrete kerb of minimum dimensions of 150 x 150mm, to prevent vehicular collision with the trunk. Here an AirVac/AirSpade can be used as a mechanised alternative to locate first order and lower order structural woody roots. (For additional information please refer to the appendix – *Non Destructive Root Exploration & Root Mapping* and *Tree Sensitive Urban Design*).

8.5 Tree Canopy Modifications

- i. Trees are complex living organisms and the intervention in the natural growth of a tree should only occur where the biology and the physiology of the organism are understood to such a level that intervention will have clear and predictably beneficial outcomes.
- ii. However, proactive pruning may be required to accommodate construction, plant and equipment and/or vehicles. Thus, any pruning assessments pertaining to the development must be visually made by an AQF

Level 5 arborist; and if pruning is deemed necessary a Pruning Specifications Report is to be authored *per AS4373-2007 Pruning of amenity trees* by an AQF Level 5 arborist and provided to the relevant Tree Manager/Owner and Council representative. Once the Pruning Specifications Report is formerly approved by the appropriate authority the requested the pruning can be carried out by a minimum AQF Level 3 arborist pursuant to *AS4373-2007 Pruning of amenity trees*.

- iii. In addition, the risk of damaging agents being introduced from pruning saws/tools must be assessed by the Project Arborist and mitigated as necessary (mitigation will typically involve cleaning the equipment before it is used on the site with a sterilizing agent, such as Trigene or Sterigene). It may be necessary to clean pruning tools during work on the site if there is the potential of transmitting a damaging biotic agent between trees on the same site.

8.6 Removal of Trees

- i. Written permission must be obtained from both the Tree Owner and the governing body that regulates tree removal. This document is then to be made available to the Project Arborist. Once the Project Arborist is satisfied, any tree ear marked for removal is to be clearly identified (tape, paint, tag etc.) by the Project Arborist prior to its removal.
- ii. Any tree removal must be undertaken without damaging any tree ear-marked for retention and per Best Management Practice. In addition, any structural roots >20mm in diameter of the tree that is cut down should be retained where practicable. This to minimise soil disturbance and reduce the impact on the roots of any tree that is to be retained nearby (i.e., grafting). If any structural roots are to be removed, this should be undertaken manually and/or after main stump of the removed tree has been ground out as it is often easier to locate these roots.

9 Plant Health Care

9.1 Overview

- i. It is well documented that even minor encroachments due to urban development and construction pressures can 'stress' a tree, which in turn can result in a reduced useful life expectancy (Watson, 2014). Therefore, it is strongly recommended that a proactive species-specific Plant Health Care Plan is formulated and implemented with regards to any development and tree vitality. Plant Health Care (PHC) is a holistic approach to best management practice with regards to urban tree care and the understanding of the various interactions within the environment in which they grow. The core objectives being the management and enhancement of the tree(s) biological, physiological, and aesthetic traits whilst maintaining and/or improving the surrounding landscape's appearance. As PHC is science-based it involves routine arboricultural monitoring, proactive soil, and plant treatments, along with the identification and mitigation of foreseeable arboricultural risks to person and/or property.

9.2 Post Development Plant Health Care Recommendations

- i. With an educated understanding of the functions of tree roots and the potentially negative effects of development impact it is strongly recommended that a post-development Plant Health Care regimen is formulated by the Project Arborist and enacted. This should include:
 - a) *An application of Organic Botanicals:* Organic materials are essential components which stimulate vitality leading to root development and thus development of new tissue. This whilst enacting a tree's defence system improving resistance to disease and increasing defence responses and capabilities.
 - b) *Top-dressing of Organic Mulch:* It is strongly recommended that a top-dressing of organic composted mulch or woodchips is applied to the TPZ of all retained trees post-development (and where possible pre-development). This layer should be added to a depth of 60-70mm (Urban. 2010). A composted mulch application will:
 - Reduce the Urban Heat Island effect (*refer s.13.5 Tree Sensitive Surfaces*).
 - Prevent soil compaction and minimise future root damage.
 - Assist with stormwater attenuation (erosion control).
 - Ameliorate the soil structure by reducing moisture loss, whilst improving the water-holding capacity.
 - Lower the TPZ temperature.
 - Suppress pioneer plants, whilst adding fertility by affecting soil texture, porosity and structure.
 - Promote root proliferation and increase soil organic matter and avail micronutrients to the tree.
 - Stimulate soil microflora and microfauna activity that enhances tree longevity by maintaining and ensuring optimum vitality. This maximising pest and disease resistance (Watson et al. 2014).

10 Evaluation of Environmental Impacts statement

10.1 Arboricultural Matters

- i. As per section 5.7 of the Environmental Planning and Assessment Act 1979 (EP&A Act):
 - a) The extent and nature of potential impacts are moderate, and will not have significant impact on the locality, community and/or the environment.
 - b) Potential impacts can be appropriately mitigated or managed to ensure that there is minimal impact on the locality, community and/or the environment.
- ii. In summation, it is of a reasonable arboricultural belief that with all due care shown, and the implementation of a pre-determined tree sensitive ideology, the project scope can be achieved with only the trees identified for removal. The caveat for the above statement regarding the proposed development works is - "that the proposed development works are carried out concurrently with the arboricultural findings and reasonings of the Arboricultural Impact Assessment; and with strict adherence to the provided site-specific Tree Protection Plan for the duration of the project".

11 References

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Publications & Online Sources

- Barrell, J.D. (1996). 'Pre-planning Tree Surveys: Safe Useful Life Expectancy (SULE) is the Natural Progression'. Arboricultural Journal, Vol 17 pp 33-46.
- Barrell, J.D. (2009). 'Tree AZ. Detailed guidance on its use'. Version 10.10 – ANZ. United Kingdom.
- Breloer, H. and Mattheck, C. (1994), 'The Body Language of Trees: A Handbook for Failure Analysis'. Stationary Office Books, London, England, UK.
- Boddy, L., and A.D.M Rayner. (1983). 'Origins of Decay in living deciduous trees: The role of moisture content and re-appraisal of the expanded concept of tree decay'. New Phytology 94: 623-641.
- Callow, C., May, P. and Johnstone, D. (2018). 'Tree vitality assessment in urban landscapes'. Forests. 9(5), 279.
- Draper, D. B and Richards, P.A. (2009). 'Dictionary for Managing Trees in Urban Environments'. CSIRO Publishing, Victoria, Australia.
- Dobbertin, M. (2005). 'Tree growth as indicator of tree vitality and of tree reaction to environmental stress: a review'. European Journal of Forest Research 124: 319-333.
- Dunster, J., Smiley, E., Matheny, N. and Lily S. (2013). 'Tree Risk Assessment-Manual'. International Society of Arboriculture, Champaign, IL.
- Gilman, E. and Lily, S. (2002). 'Best Management Practices Tree Pruning'. International Society of Arboriculture, Champaign IL. Pp 35.
- Harris, R.W., Clark, J.R. and Matheny, N.P. (2004). 'Arboriculture: Integrated management of landscape trees, shrubs and vines, 4th edition'. Prentice Hall, New Jersey, USA.
- Hitchmough, J.D. (1994) 'Urban Landscape Management'. Inkata Press. Australia.
- IACA. (2010). 'Significance of a Tree, Assessment Rating System (STARS)'. Institute of Australian Consulting Arboriculturists. Australia, www.iaca.org.au
- Lily, S., Matheny, N. and Smiley, E. (2011). 'Best Management Practices - Tree Risk Assessment'. International Society of Arboriculture. Champaign, IL 61826-3129.
- Lonsdale, D. (2010). 'Principles of Tree Hazard Assessment and Management'. 9th impression, TSO, Norwich.
- Mattheck, C. and Breloer, H. (1994). 'The Body Language of Trees, Research for Amenity Trees No. 4'. The Stationery Office, London.
- Matheny, N. and Clark, J. (1998). 'A Technical Guide to Preservation of Trees during Land Development'. International Society of Arboriculture. USA.
- Matheny, N. and Clark, J. (2004). 'Arboriculture'. Fourth Edition. Pearson Education Incorporated. New Jersey, USA.
- Niklas, K. (1992). 'Plant Biomechanics: An Engineering Approach to Plant Form and Function'. The University of Chicago Press, Illinois, USA.
- The University of Melbourne. (2016). 'Burnley Plant Guide'. The University of Melbourne.
- Trowbridge, P. J. and N. L. Bassuk (2004). 'Trees in the Urban Landscape: Site Assessment, Design and Installation'. Hoboken, New Jersey, John Wiley & Sons, Inc.
- Urban, J. (2008). 'Up by the Roots'. Healthy soils and trees in the built environment'. International Society of Arboriculture.
- Watson, G., Hewitt, A., Custic, M. and Lo, M. (2014). 'The Management of Tree Root Systems in Urban and Suburban Settings II: A Review of Strategies to Mitigate Human Impacts'. Arboriculture & Urban Forestry 2014. 40(5): 249–271.

12 Glossary

The following definitions are stated in the Glossary of Arboricultural Terms, International Society of Arboriculture 2020, unless otherwise stated.

Abiotic: plant ailment caused by non-living, environmental, or man-made agents

Adaptive Growth: or Response Growth is new wood produced in response to damage or loads, which compensates for higher strain (deformation) in marginal fibres; it includes reaction wood (compression & tension) and wound wood.

Barrier Zone: chemically defended tissue formed by the still living cambium, after a tree is wounded or invaded by pathogens to inhibit the spread of decay into new annual growth rings. Wall 4 in CODIT model. Contrast with reaction zone

Bifurcation: Natural division of a branch or stem into two or more stems or parts

Biotic: pertaining to non-human living organism/ biotic agent: a living organism capable of causing disease/ biotic disorder: disorder caused by a living organism.

Bracket: British English term for fruiting body of a decay fungus. See *Conk*.

Canker: Localised dead or diseased areas (lesions or sunken areas) on tree bark, caused by opportunistic fungal or bacterial pathogens often associated with wounds and/or stressors (secondary infectors). Cankers kill the bark and the underlying tissue, manifesting as discoloured, sunken or cracked areas on the bark, sometimes with oozing sap or fungal fruiting bodies.

Codominant Structure: Stems or trunks of about the same size originating from the same position from the main stem⁵². When the stem bark ridge turns upward the union is strong; when the ridge turns inward the union is weak, a likely point of failure in storm or windy weather conditions or where increasing weight causes undue stress on the defective union.

CODIT: acronym for Compartmentalisation of Decay/Disease In Trees (refer Compartmentalisation).

Compartmentalisation: Dynamic tree defence process involving protection features that resist the spread of pathogens and decay causing organisms. Natural defence process in trees by which chemical and physical boundaries are created that act to limit the spread of disease and decay organisms.

Compaction: Results from loads or stress forces applied to the soil as well as shear forces. Both foot traffic and vehicle traffic exert both forces on soils. Vehicle traffic may cause significant compaction at depths of 150–200 mm (the area in which most absorbing roots are located). The degree of compaction will depend on weight of vehicles, number of movements, soil moisture levels and clay content. Soil handling, stockpiling, and transporting also tend to lead to the breakdown of soil structure and thus to compaction. Vibration as a result of frequent traffic or adjacent construction activities will also compact soils.

Compression wood: (1) in mechanics, the action of forces to squeeze, crush or push together any material (s) or substance(s): contrast with tension. (2) the ability of an internal combustion engine to contain or pressurized a combustible fuel - air mixture.

Conk: Fruiting body or non-fruiting body (sterile conk) of a fungus. Often associated with decay.

Crown/Canopy: The main foliage bearing section of the tree, these terms are interchangeable.

Crown damage: The canopy of trees can be directly or indirectly damaged. Incorrect techniques of pruning such as lopping or flush cutting may produce wounds that are susceptible to infection by wood decay organisms. Similarly, mechanical damage to branches by machinery, etc. will also create wounds. Trees automatically respond to wounding and in doing so use stored sugars. Any wound places an additional load on trees that will inevitably be stressed during construction.

Damping: Damping occurs where energy is dissipated. In trees, damping occurs naturally in three main ways with aerodynamic damping of the leaves, internal damping in the wood and root zones, and with mass damping of the branches.

Deadwood: Dead branches within the canopy of tree. Deadwood is a naturally occurring feature of most tree species and comprises dead or decaying branches within the canopy of a tree. Deadwood may have habitat value and require removal only according to the considered risk of its location, i.e. high use pedestrian area or damage to adjacent infrastructure.

Removal of deadwood is generally recommended only where it represents an unacceptable level of hazard. Consideration of the need for deadwood removal should take into account the occupancy of the target zone, i.e. high use pedestrian area or presence of infrastructure, possible damage to the tree during its removal as well as its conservation for habitat value. In some instances,

retention of a reduced tree structure for habitat purposes maybe considered appropriate, especially when hollows are present.

Further reference: *Principles of Tree Hazard Assessment. Lonsdale, David. TSO, (2009).*

Dead wooding: (Crown cleaning): The removal of dead branches⁶⁰. Recommendation to remove deadwood is for removal of all dead branches within tree canopy > 30mm diameter in trees which overhang pedestrian or vehicular areas and removal of all dead branches within tree canopy > 50mm diameter if trees are located in a Parkland or similar area.

Decay: The process of degradation of woody tissues by micro-organisms.

Desiccation: Severe drying out. Dehydration.

Drip Line: Is the imaginary perimeter line at soil surface level which is directly below the outermost edge of the tree's foliage or canopy.

Estimated Life Expectancy (ELE): Assessed on trees of particular species in the urban environment, including health and structural conditions which may exist.

Epicormic bud: Latent or adventitious bud located at the cambium and concealed by the bark.

Epicormic shoots: Shoots produced from epicormic buds at the cambium of trunks or branches.

Field Capacity: Maximum soil moisture content following the drainage of water due to the force of gravity.

Hollow: is a semi-enclosed cavity which has naturally formed in the trunk or branch of a tree.

Included bark: Inwardly formed bark within the junction of branches or codominant stems.

Kino: Dark red to brown resin-like substance produced by trees in the genera Eucalyptus, Pterocarpus and Butea and related genera. Kino forms in the barrier zones. Large kino veins form in some tree in response to injury and infection.

Leaves: The main function of leaves is photosynthesis, that is, the production of sugars and oxygen. The sugars produced by the leaves (and any other green tissue) are the source of chemical energy for all living cells in the entire plant and as such are essential for the normal functioning and survival of the tree. Anything that directly or indirectly damages the leaves will interfere with photosynthesis.

Non-Destructive Root Exploration (NDRE): is the most reliable way to conscientiously locate tree roots pre-development; and thus, assist in TSUD options and the subsequent determination of tree viability. Therefore, all excavations that are calculated as a 'Major' Encroachment must be initiated by non-destructive means (Hand-digging, Air Vac and/or Air -Spade) under the guidance of the Project Arborist. Machine excavations will only be permitted within the TPZ if and when the Project Arborist is satisfied that the excavation envelope is free of any significant root biomass.

Non-woody part of tree: 'organs that increase the surface area of vascular plants, thereby capturing more solar energy for photosynthesis'. ... maybe classified as microphylls (usually spine-shaped leaves with a single vein) or megaphylls (leaves with a highly branched vascular system). Needles and leaves are major energy trapping organs of a tree. Flowers are modified leaves as they fit the definition of an organ (Shigo.2003).

Macropore: Relatively larger space between soil particles that is usually air-filled and allows for water movement and root penetration. Contrast with micropore.

Major Encroachment: AS 4970-2025 s3.3.6 Major NRZ Encroachment: "the proposed encroachment is considered 'Major' if it is >20% of the area of the NRZ or inside the SRZ".

Minor Encroachment: AS 4970-2025 s3.3.4: Minor NRZ Encroachment (<10%): "If the proposed encroachment is less than or equal to 10% of the area of the NRZ, has not had recent NRZ encroachments and is outside of the SRZ".

Moderate Encroachment: AS 4970-2025 s3.3.5 Moderate NRZ Encroachment: "the proposed encroachment is considered 'Major' if it is >10% and less than or equal to 20% of the area of the NRZ and is outside the SRZ".

Micropore: Space between soil particles that is relatively small and likely to be water filled.

Mortality Spiral: Sequence of stressful events or conditions causing the decline and eventual death of a tree. Once in a mortality spiral trees are more likely to succumb to any further or additional stress factors such as drought, pest infestation or disease. (See definition Stress)

Notional Root Zone (NRZ): per AS 4970-20025 *Protection of trees on development sites s.1.3.11 Notional Root Zone (NRZ)* - “zone enclosed by a radius of 12 times the trees Diameter at Standing Height (DSH) that is a primary trigger for arboricultural input on a development site. (DSH – trunk diameter at 1.4m above ground level).

Occlusion (See wound): Shut in or out. Occlusion is the process of trees forming callus and clear wood over wounds.

Pathogen: A disease-causing organism.

Phototropism: Influence of light on the direction of plant growth. Tendency of plants to grow towards light.

Phloem: Plant vascular tissue that transports photosynthates and growth regulators. Situated on the inside of the bark, just outside the cambium. Is bidirectional (transports up and down). Contrast with xylem.

Photosynthesis: Process in green plants (and in algae and some bacteria) by which light energy is used to form glucose (chemical energy) from water and carbon dioxide.

Reaction wood: Wood forming in leaning or crooked stems or on lower or upper sides of branches as a means of counteracting the effects of gravity. See compression wood and tension wood.

Shrub: A woody plant similar to a tree except it is usually several-stemmed and smaller than a tree.

Significance: The quality of being worthy of attention; importance.

Stem / Trunk: Organ which supports branches, leaves, flowers and fruit; may also be referred to as ‘the trunk’.

Stress: In Plant Health Care, (1) a factor that negatively affects the health of a plant; a factor that stimulates a response. (2) mechanics, a force per unit area.

Stress – acute: Disorder or disease that occurs suddenly and over a short period of time.

Stress – chronic: Disorder or disease occurring over a longer time.

Structural Root Zone (SRZ): per AS 4970-20025 *Protection of trees on development sites s.1.3.17 Structural Root Zone (SRZ)* - “theoretical area around the base of a tree required for the trees stability in the ground”.

Tree: Long lived woody perennial plant greater than (or usually greater than) 3 m in height with one or relatively few main stems or trunks. A tree has 3 major organs – roots, stem and leaves.

Tree Protection Zone (TPZ): per AS 4970-2025 *Protection of trees on development sites s.1.3.19 Tree Protection Zone (TPZ)* - “specified zone above and below ground and at given offsets from the trunk set aside to protect a tree’s roots and crown where these might be damaged by development”.

Vigour: Ability of a tree to sustain its life processes. The term ‘vigour’ in this document is synonymous with commonly used terms such as ‘health’ and ‘vitality’. Inherent genetic capacity of a plant to deal with stress. Physical strength and health. A tree with good vigour has the ability to sustain life processes and synonymous with good health.

Visual Tree Inspection (VTA): Is a detailed visual inspection of a tree and surrounding site.

Vitality: Ability of plant to deal effectively with stress.

Watersprouts/ Epicormic growth (Usually multiple shoots): Shoots produced from epicormic buds at the cambium of trunks or branches. Grows ‘from the stub ends and only grows from the outermost living tissue layer of that year’s growth. They are weakly attached and prone to falling out or being blown off with the risk increasing markedly as they increase in size. When epicormic shoots arise from stub ends that are decaying, the chances of them falling out are significantly greater’.

Wound: An opening that is created when the bark is cut, removed, or injured.

Xylem: Main water and mineral-conducting (unidirectional, up only) tissue in trees and other plants. Provides structural support. Arises (inward) from the cambium and becomes wood after lignifying. Contrasted with phloem.

Zone of Rapid Taper: The area within 1–2m of the trunk on larger trees is frequently referred to as the ‘Zone of Rapid Taper’ because structural roots found there often exhibit considerable secondary thickening- not present on roots farther from the trunk (Wilson 1964). Wilson (1964) additionally reviews the development of this zone and its relation to mechanical stability.

13 Appendix A: Tree Sensitive Practices

13.1 Non-Destructive Root Exploration & Root Mapping

- i. Non-Destructive Root Exploration (NDRE) or Root Mapping is the most reliable way to locate tree roots pre-development and therefore should always be implemented when a tree is to be retained and impending earthworks are to be undertaken within the TPZ. This NDRE should consist of Hand-digging and/or AirSpade under the guidance of the Project Arborist (Watson et. al. 2014).
- ii. NDRE will often be initiated with the excavation of a 'Slot-Trench' on the edge of the TPZ and/or the required excavation footprint. This will assist in determining the extent of the tree root architecture and provide accurate root location(s) along with additional morphological data. This objective root mapping data can then be utilised to explore and/or implement pragmatic tree sensitive design modifications regarding site-specific tree protection; tree retention and Plant Health Care regimens post development.
- iii. Please note that the Root Mapping findings will ultimately determine foreseeable tree viability and whether tree sensitive design modifications and/or tree removal will need to be undertaken on this Project. (All of the findings from the NDRE should be paroled by the appointed Project Arborist and made available to all parties with *locus standii* upon request. This in the form of a Root Mapping Report).

13.2 Tree Sensitive Urban Design

- i. The fundamental biological needs of an urban tree are the same as those of a tree growing in an unfettered natural forest environment. The key natural processes are photosynthesis, respiration, and transpiration and therefore the following six requirements above and/or below ground, are needed to sustain tree life and growth – Oxygen, Carbon dioxide, Light, Water, Nutrients and Appropriate Temperatures (Trowbridge and Bassuk. 2004). In summary, Tree Sensitive Urban Design (TSUD) for both new and existing projects simply aims to provide adequate space for desirable tree growth (above & below ground), whilst safeguarding against infrastructure and root damage from potential conflict alike. Within reason, concerns caused by tree roots and/or root impact can be mitigated by utilising proactive Tree Sensitive Urban Design options. Some of these proactive solutions include:
 - Irrigation, Tree Root Trenches & Paths, Root Barrier, Root Deflectors and Root Directors in combination with soil de-compaction or compaction to direct root growth. Please note that tree roots travel the 'path of least resistance' and like most living organisms require oxygen and water (aerobic soil with good moisture levels). Therefore, by providing ideal levels of these essential resources (water, friable aerobic soil and organic nutrients), in an area away from infrastructure, tree roots can be encouraged to grow in that direction. Alternatively, the opposite methodology can be used to deter root growth from specific areas (Urban. 2008).
 - Permeable Pavers, Asphalt, Concrete and/or Resin Bound Aggregates (P3 or Soft fall) in combination with innovative joints such as TripStop. These providing benefits such as reduced stormwater volumes and runoff, availed moisture to the tree, reduces trip hazards due to elasticity and flex, allows root growth, urban heat island mitigant and is durable as they are designed for large volumes

of pedestrian traffic.

- Structural Confinement System installations with structural soil. There are now several cellular confinement systems that can be implemented into a project. Some of these include Silva Cell, Strata Vault & Strata Pit, Geo Cell, and Terra Vault.

Please Note: All of these TSUD cell structures can be installed in an urban scape to provide space for root growth limit soil and root compaction. This whilst accommodating any necessary infrastructure installations.

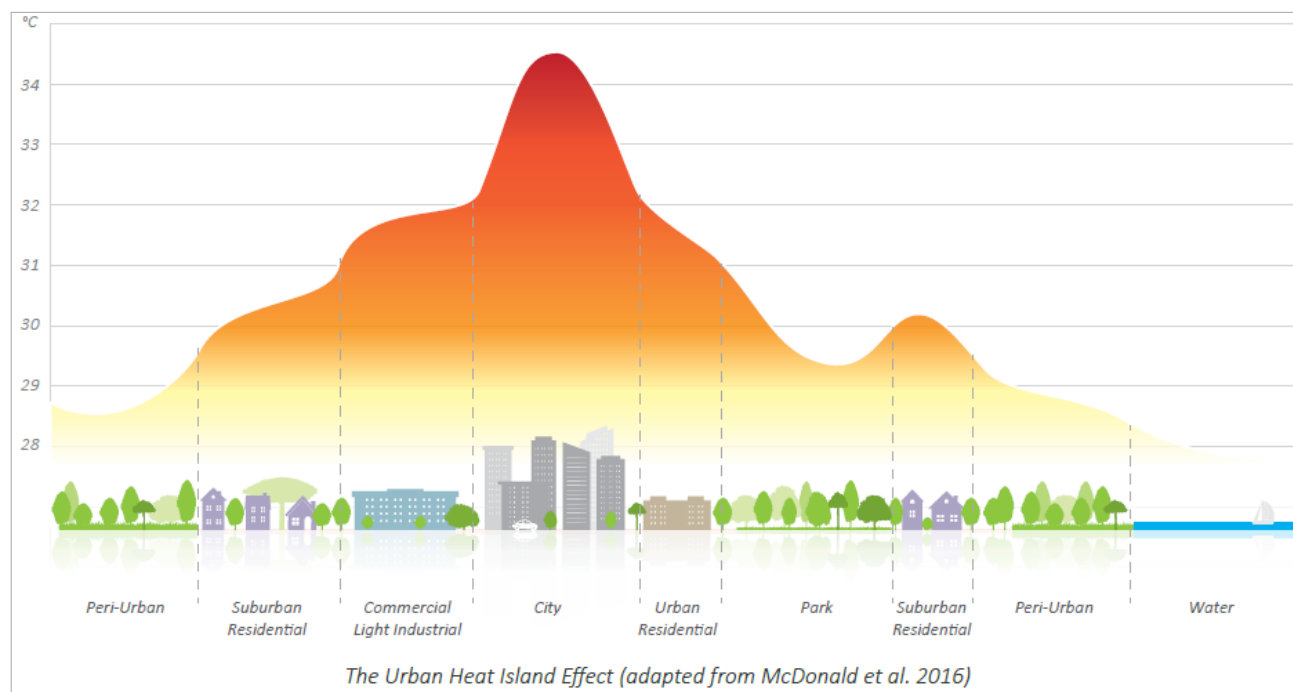
- Tree Sensitive Construction Techniques: Directional-drilling or Underground Boring, Pipe-thrusting, Screw-Piling, Cantilevers, Pier & Beam, 'Buildouts' and 'Build-overs'.

Please Note: Screw Piling combined with Pier & Beam is often a robust practicable option. Unlike a dug-out or excavated continuous cement foundation, a pier foundation through the use of Screw Piles has proven to be the least damaging to soil and tree root biomass during and after the installation process (Matheny. 2004). Whereby the combination of initial Non-Destructive Root Exploration to Root Map; and then implementing Screw Piling makes it possible to construct new buildings near trees, without adversely affecting their health. After the initial root mapping, Screw Piles can either be drilled or banged into the soil with very little disturbance to the existing roots and root biomass. The Screw Piles then support the base of the building just above ground level with a framework of narrow diameter piles. Hence why Screw Piling is a preferred tree sensitive method as the buildings base is then constructed above ground level. This avails air and water to the roots which in turn promotes tree vitality and tree viability. Other benefits of Screw Piling include the prevention of macropore collapse and the proliferation of micropores in the soil profile due to compaction. Compaction of soil containing tree roots by traditional foundations has been shown to have a detrimental effect on the continued health of the tree. Compaction of soil reduces the passage of oxygen to roots during wet weather and can cause the soil to become so dense that roots are no longer able to penetrate through it (Craul. 1999). Screw piles overcome this by supporting load directly on their constituent helices. These are placed well below the tree roots to ensure the root ball does not experience any loading influence or disturbance.

13.3 Tree Sensitive Surfacing Options

- Impermeable surfaces play a significant role in the urban landscape. Studies have shown that one of the major contributors to an Urban Heat Island (UHI) are artificial surfaces such as impermeable concrete and asphalt. Due to their low albedo, they store more heat (95% approx.) and cool down more slowly (Yamamoto. 2006). For example, *"the surface temperature of an unshaded asphalt road on a sunny day is on average 25C hotter"* (Akbari et. al. 2001). In addition, impervious surfaces adversely alter a trees immediate microclimate both above and below ground (i.e., temperature is increased due to solar radiation absorption, so additional water and nutrients are needed).
- Albeit research has shown that trees are extremely effective at alleviating extreme heat and reducing the negative effects of an Urban Heat Island (UHI) through shade-cast and evapotranspiration (Hirons. 2022). Therefore, both new tree plantings and more so well-established larger trees should be incorporated into

the landscape. However, impervious surfaces can adversely alter a trees immediate microclimate both above and below ground (increased temperatures due to solar radiation absorption, so additional water and nutrients are needed). Therefore, a permeable surface medium such as a resin-bound aggregate, paver, asphalt and concrete with a 'soft edge' finish should always be considered for roading, carparks, footpaths and other thoroughfares. Of note, open-graded or porous asphalt is now widely used over impervious surfaces as it reduces traffic noise and water ponding, whilst improving stormwater quality and quantity (Scott et.al. 1999). In addition, a porous medium is a good option for tree surrounds as they provides more 'flex', minimising the incidence of footpath damage by tree roots ('root heave'), reduce stormwater runoff and filter pollution loads from surrounding urban areas (Lucke et al. 2011), and avail moisture and micronutrients to the roots, resulting in a healthy tree with a larger, denser canopy which in turn provides greater shade-cast, evapotranspiration and importantly reduces the Urban Heat Island effect. (McPherson. 2007). Therefore, a permeable surface construction medium should always be considered and incorporated into the design where practicable.



13.4 Compensatory Replanting

- i. As abovementioned, Compensatory Replanting should not be exclusively relied upon to secure good tree outcomes. However, understandably tree retention is not always practicable, so replanting to offset tree loss is required. By definition Compensatory Replanting simply refers to the planting of trees or vegetation to offset or compensate for the loss of existing trees or vegetation. The key goals of Compensatory Replanting include:
 - *Replacement of lost canopy cover & increase Canopy Coverage where possible* - Replanting helps restore the canopy coverage and its associated benefits such as shade-cast and urban heat island mitigation, oxygen production, carbon sequestration erosion control, stormwater reduction and

ecological services. Therefore, understandably a tree species with a potentially 'large' or 'larger' canopy spread is always preferred over a species with a smaller canopy spread.

- *Restores aesthetic appeal* - Where tree Remove has significantly impacted neighbourhood aesthetics or property appeal, Compensatory Replanting helps re-green the area and return it to a naturalized state. Species selected should complement the surrounding landscape.
- *Meet statutory & regulatory requirements* – Many Councils and other regulatory bodies have tree protection ordinances that requires Compensatory Replanting when removing trees. Thus, Compensatory Replanting ensures compliance with these local regulations and policies.

ii. The key considerations for Compensatory Replanting regimes include:

- *Species selection* – The 'best-suited' tree with the largest canopy spread for the planting opportunity is paramount. (Biodiversity Modelling to prevent challenges with monocultures also considered).
- *Size of Plant Stock* - While smaller stock may establish more quickly, replanting with a larger, more advanced tree has an instant impact and helps offset the canopy lost from mature tree removals.
- *Site Preparation & Aftercare* - Proper site preparation including soil assessment and amelioration which will promote tree vitality and growth of newly planted trees; and the adoption of a holistic Plant Health Care regimen, which includes cyclic inspections, pruning (remedial & formative), applications of organic botanicals, mulching and pest and disease management.

iii. Of note, a Compensatory Replanting ratio as outlined by a local Council or government department can be referenced or adopted in whole or in part thereof (as shown below). The final tree selection can then be made with a suitably qualified Urban Forester per a site-specific Preferred Tree Species Selection Matrix.

A Guide to Compensatory Planting on a Development Site: Newcastle City Council Technical Manual 2018

	Total Area of Crown Projection Removed	Number of Standard Trees to be Planted
1	Up to 20m ²	One (1) Standard Tree
2	21m ² to 40m ²	Two (2) Standard Trees
3	41m ² to 60m ²	Three (3) Standard Trees
4	61m ² to 80m ²	Four (4) Standard Trees
5	81m ² to 100m ²	Five (5) Standard Trees

Notes

- Crown Projection (m²): average canopy radius x π
- A Standard Tree is a minimum 45L container volume, a minimum Crown Projection at maturity of 20m² and of a desirable species.

14 Appendix B: Arboricultural Impact Methodology

14.1 Root Morphology Considerations

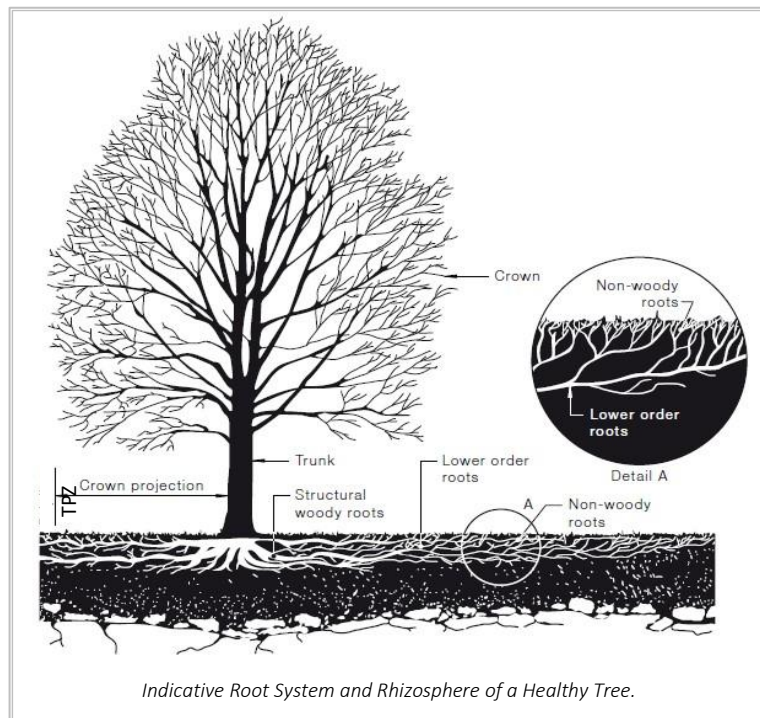


Image credit: AS 4970-2009 Protection of trees on development sites

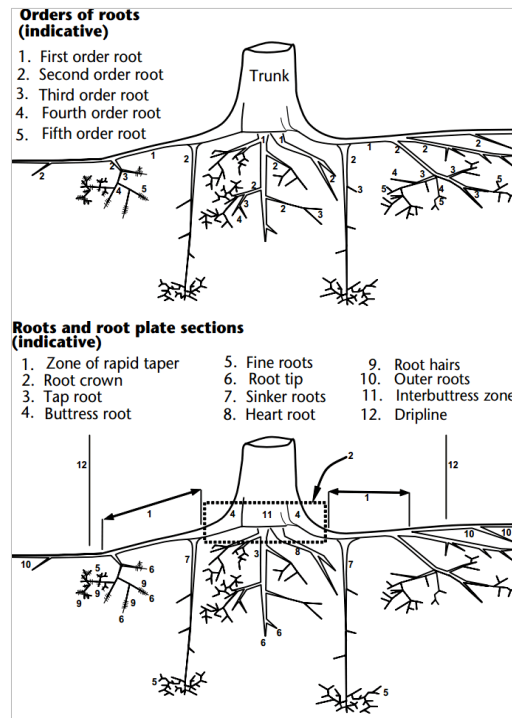
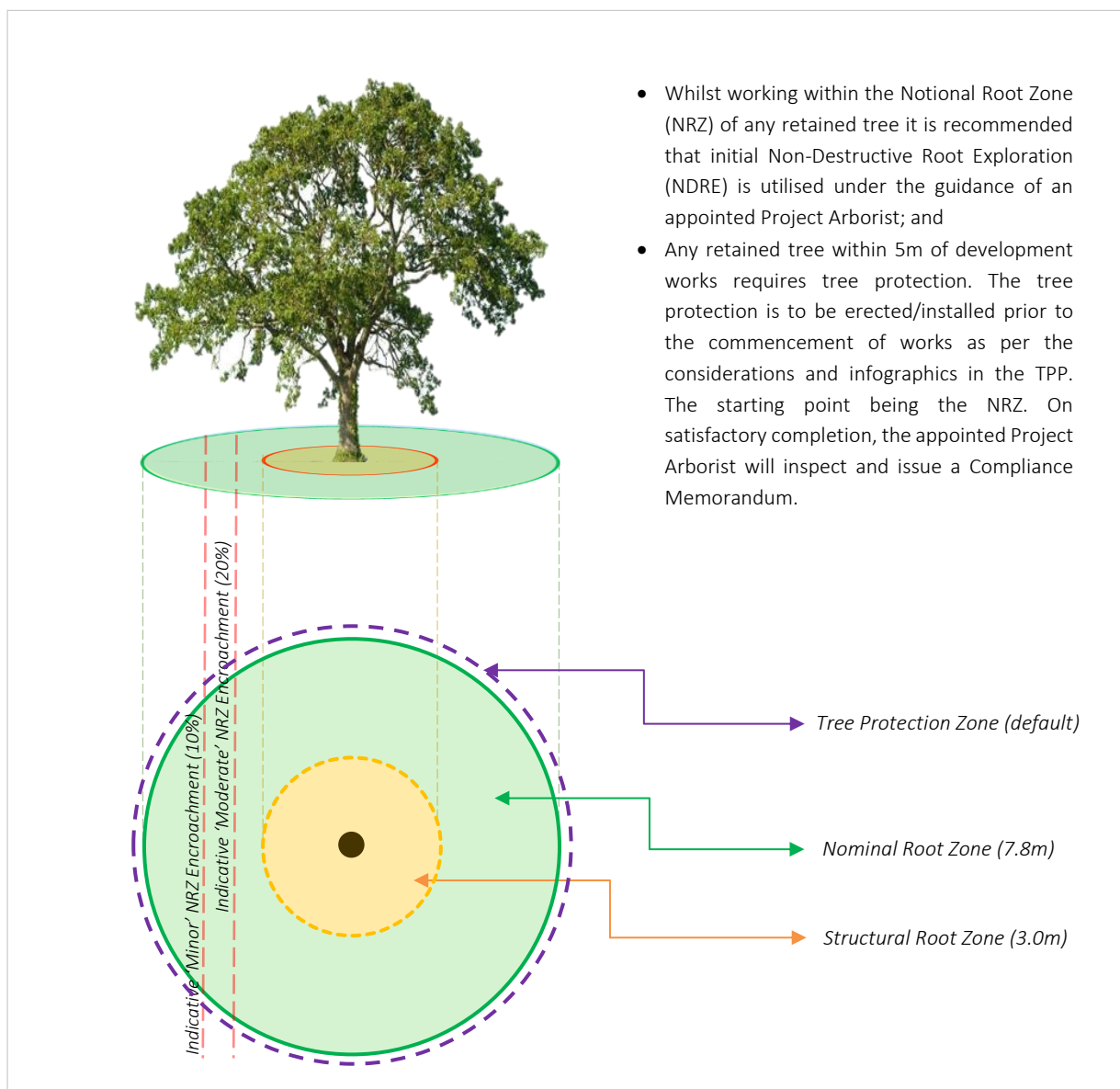


Image credit: Perry. 1992

- i. The main functions of roots include the uptake of water and nutrients, anchorage, storage of sugar reserves and the production of some plant hormones required by the shoots. For roots to function, they must be supplied with oxygen from the soil. The root system of trees consists of several 'types' of roots found in different parts of the soil and is generally much more extensive than commonly thought. The importance of roots is easily overlooked because they are not visible, that is 'out of sight, out of mind'. Damage to the root system is a common cause of tree decline and death and is the most common form of damage associated with development sites (Matheny et. al, 1998).
- ii. Root systems consist of three main parts: (Sutton and Tinus, 1983).
 - The structural woody roots (anchorage, storage and transport);
 - Lower order roots (anchorage, storage and transport); and
 - Non-woody roots (absorption of water and nutrients, extension, synthesis of amino acids and growth regulators) (please refer to Drawing above).
- iii. In addition to lateral root spread being underestimated, root depth in trees has also been grossly exaggerated. Deep root systems or taproots are the exception rather than the rule. Most roots of most trees are found in the very top of the soil. The vast majority of these roots are small non-woody absorbing roots which grow upward into the very surface layers of the soil and leaf litter. This delicate, non-woody system, because of its proximity to the surface, is very vulnerable to injury (Watson et. al, 2014).

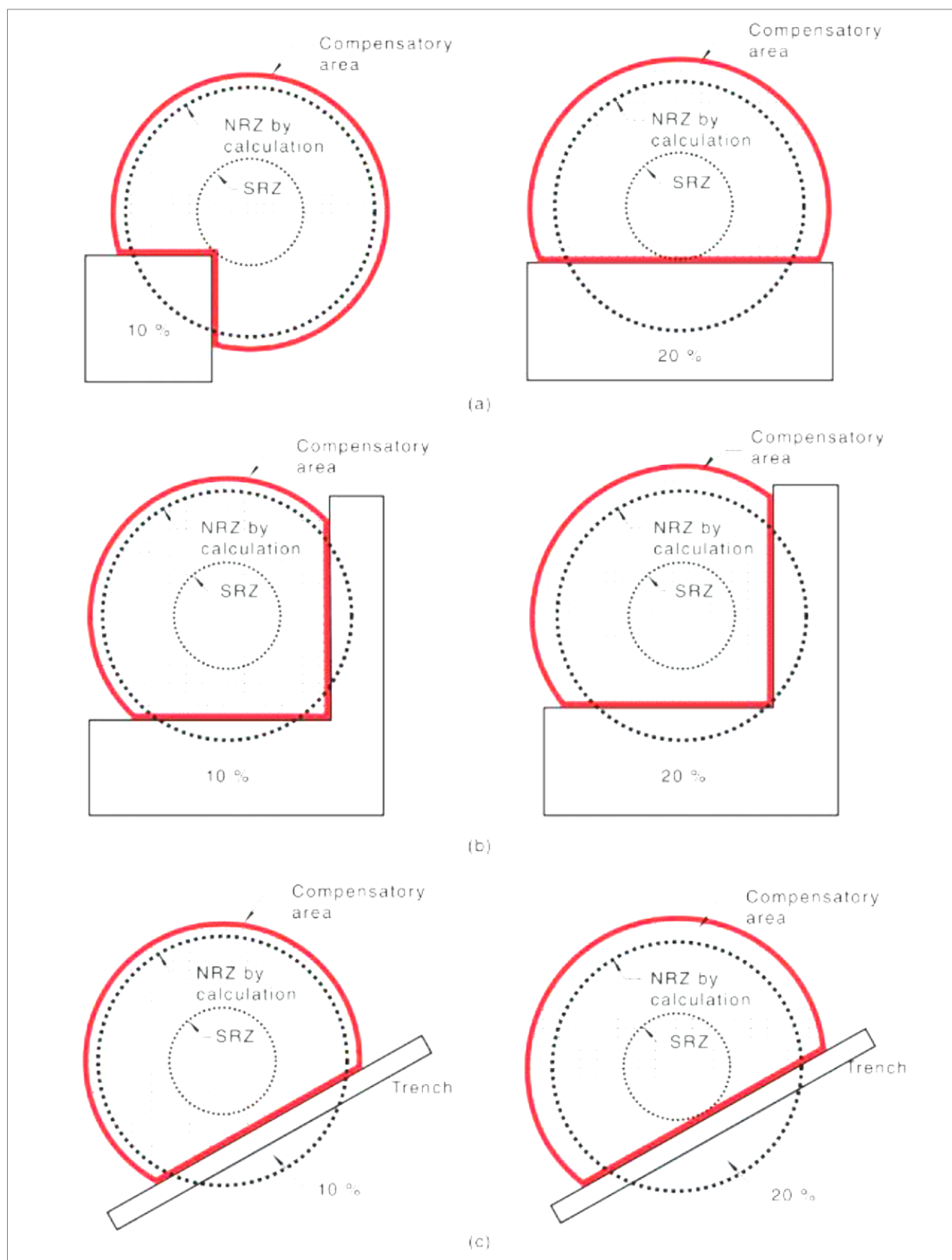
14.2 Structural Root Zone (SRZ) and Notional Root Zone (NRZ)

- i. The below infographic depicts the Notional Root Zone (NRZ), Structural Root Zone (SRZ) and Encroachment level(s). This to aid in the visualisation of the 'No-Dig' zones, and where initial Non-Destructive Root Exploration (NDRE) must be carried out under the supervision of the Project Arborist for any tree retained tree. To calculate the encroachment percentage these formulas are used:
- **NRZ:** The radius of the NRZ is calculated for each tree by multiplying its **Diameter at Standing Height (DSH)** measured @ 1.4m from ground level ($DSH \times 12 = NRZ$). ($DSH = \text{Trunk Girth @ 1.4m} \div \pi$).
*For example, if the DSH = 0.65m, then the NRZ = 7.8m (as per the infographic).
 - **SRZ:** Radius SRZ = **Diameter above Root Crown (DRC)** $\times 50$ ^ 0.42×0.64 . If the DRC is less than 0.15m the SRZ will be 1.5m.
*For example, if the DRC = 0.8m, then the SRZ = 3.0m (as per the infographic).
 - Notably, the NPZ should not be less than 2m; and no more than 15m unless otherwise demonstrated. The SRZ should be no less than 1.5m. For palms, cycads and tree ferns the NPZ should not be less than two (2) metres unless otherwise demonstrated.



14.3 Compensation for Tree Protection Zone Encroachment

- i. Encroachments ('Minor' and 'Moderate') into the Notional Root Zone (NRZ) is sometimes unavoidable. The below images are analogous to the abovementioned works scenario and indicate how encroachment within the tree protection zone can be compensated for elsewhere - per AS 4970-2025 *Protection of Trees on Development Sites*.



14.4 Visual Tree Assessment Descriptors

(Age Class relates to the ecophysiological stage of the trees life cycle – UK Veteran Trees & Forestry Commission)

TREE AGE CLASS

Life Cycle Stage	Category & Descriptor
Formative Stage	Young or Juvenile: Recently planted or approximately 1-7 years.
Maturing or Mature Stage	Semi-mature: Tree actively growing in size and yet to achieve the expected size <i>in situ</i> . Mature: Tree is approaching the expected size or has reached the expected size <i>in situ</i>
Senescent Stage	Over Mature: Tree is full-size and has started to decline (possible crown retrenchment)

TREE VITALITY

Good	Foliage of the tree is entire, with good colour, very little sign of pathogens and of good density. Growth indicators are good i.e., Extension growth of twigs and wound wood development. Minimal or no canopy dieback (deadwood).
Fair	Tree is showing one or more of the following symptoms: <25% dead wood, minor canopy dieback, foliage generally with good colour though some imperfections may be present. Minor pathogen damage present, with growth indicators such as leaf size, canopy density and twig extension growth typical for the species in this location.
Poor	Tree is showing one or more of the following symptoms of decline; >25% deadwood, canopy dieback is observable, discoloured or distorted leaves. Pathogens present, stress symptoms are observable as reduced leaf size, extension growth and canopy density.
Very Poor	The tree appears to be in a state of decline. The tree is not growing to its full capacity. The canopy may be very thin and sparse. A significant volume of deadwood may be present in the canopy and/or pest and disease problems may be causing a severe decline in tree vitality.
Serious Decline or Dead	Tree is in severe decline; >55% deadwood, very little foliage, possibly Epicormic shoots and minimal extension growth or the tree is completely dead and exhibits no new growth or live tissue.

**Please note that tree vitality cannot be measured directly, hence growth and physiological parameters that indicate tree vitality are used. Health or Vitality of a tree is evidenced by the general appearance of crown density, leaf colour, presence of epicormic shoots, ability to withstand disease invasion including pathogens and presence of dieback in crown at the time of inspection. Vigour may vary according to seasonal weather patterns and rainfall received (Dobbertin, 2005).*

***Tree Condition: The assessment of a tree(s) condition evaluates factors of tree vitality, form and structure. These descriptors of vitality, form and structure attributed to a tree evaluate the individual specimen to what could be reasonably considered by the arborist as typical for that species growing in situ. It is well documented that specific tree species can display inherently poor biomechanics, such as acute branch attachments with included bark, co-dominant leaders and other poor branch and root architecture. Whilst these 'structural defects' may be deemed arboriculturally flawed, they are typical for the species and may not constitute a foreseeable increased risk. These trees may be assigned a 'structural rating' of 'fair-poor' (as opposed to poor) at the arborist's discretion*

TREE STRUCTURE

Good: Trunk and scaffold branches show good taper and attachment with minor or no structural defects. Tree is a good example of species with well-developed form showing no obvious root problems or pests and diseases.

Fair/Fair-Poor: Tree shows minor structural defects or minor damage to trunk e.g., bark missing, there could be cavities present. Minimal damage to structural roots. Tree could be seen as typical for this species.

Poor/Very Poor: There are major structural defects, damage to trunk or bark missing. Co-dominant stems could be present with likely points of failure. Girdling or damaged roots obvious. Tree is structurally problematic.

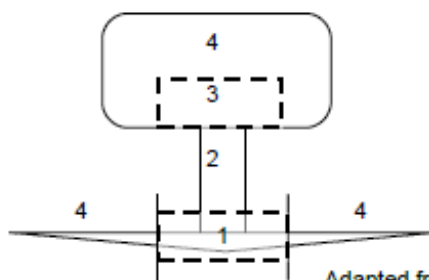
Hazardous: Tree is immediate hazard with potential to fail; this should be rectified as soon as possible.

Tree Structure Matrix

Descriptor	Zone 1 - Root plate & lower stem	Zone 2 - Trunk	Zone 3 - Primary branch support	Zone 4 - Outer crown and roots
Good	No damage, disease or decay; obvious basal flare / stable in ground	No damage, disease or decay; well tapered	Well formed, attached, spaced and tapered	No damage, disease, decay or structural defect
Fair	Minor damage or decay. Basal flare present.	Minor damage or decay	Typically formed, attached, spaced and tapered	Minor damage, disease or decay; minor branch end-weight or over-extension
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
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 resprout	Decayed, cavities or has acute branch attachments with included bark; excessive compression flaring; failure likely	Major damage, disease or decay; fungal fruiting bodies present; major branch end-weight or over-extension
Very Poor	Excessive damage, disease or decay; unstable / loose in ground; altered exposure; failure probable	Excessive damage, disease or decay; cavities. Excessive lean. Stump resprout	Decayed, cavities or branch attachments with active split; failure imminent	Excessive damage, disease or decay; excessive branch end-weight or over-extension

Diagram 2: Tree structure zones

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



Adapted from Coder (1996)

Structure ratings will also take into account general tree architecture which considers aspects of stem taper, live crown ratio, branch distribution or crown bias and position such as a tree being suppressed amongst more dominant trees.

Estimated Life Expectancy (ELE)

The ELE is adapted from (*Barrell, 2001*). The objective of an ELE assessment is to determine the relative value of individual trees for the purpose of informing future management options.

Estimated Life Expectancy Assessment Criteria			
Dead / Serious Decline	Short	Medium	Long
Trees with a high level of risk that would need removing within the next 5 years. Dead trees. Trees that should be removed within the next 5 years. Dying or suppressed or declining trees through disease or inhospitable conditions. Dangerous trees through instability or recent loss of adjacent trees. Dangerous trees through structural defects including cavities, decay, included bark, wounds or poor form. Damaged trees that considered unsafe to retain. Trees that could live for more than 5 years but may be removed to prevent interference with more suitable individuals or to provide space for new planting. Trees that will become dangerous after removal of other trees for the reasons.	Trees that appear to be retainable with an acceptable level of risk for 5-15 years. Trees that may only live between 5 and 15 more years. Trees that may live for more than 15 years but would be removed to allow the safe development of more suitable individuals. Trees that may live for more than 15 years but would be removed during the course of normal management for safety or nuisance reasons. Storm damaged or defective trees that require substantial remedial work to make safe and are only suitable for retention in the short term.	Trees that appear to be retainable with an acceptable level of risk for 15-40 years. Trees that may only live between 15 and 40 more years. Trees that may live for more than 40 years but would be removed to allow the safe development of more suitable individuals. Trees that may live for more than 40 years but would be removed during the course of normal management for safety or nuisance reasons. Storm damaged or defective trees that require substantial remedial work to make safe and are only suitable for retention in the short term.	Trees that appear to be retainable with an acceptable level of risk for more than 40 years. Structurally sound trees located in positions that can accommodate future growth. Storm damaged or defective trees that could be made suitable for retention in the long term by remedial tree surgery. Trees of special significance for historical, commemorative or rarity reasons that would warrant extraordinary efforts to secure their long-term retention

IACA Significance of Tree Assessment Rating System (STARS)

Institute of Australian Consulting Arboriculturists: Significance of a Tree Assessment Rating System (STARS)		
<i>The tree is to have a minimum of three (3) criteria in a category to be classified in that group</i>		
Low	Medium	High
The tree is in fair-poor condition and good or low vigour. The tree has form atypical of the species. The tree is not visible or is partly visible from the surrounding properties or obstructed by other vegetation or buildings. The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area. The tree is a young specimen which may or may not have reached dimensions to be protected by local Tree Preservation Orders or similar protection mechanisms and can easily be replaced with a suitable specimen. The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa in situ – tree is inappropriate to the site conditions. The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms. The tree has a wound or defect that has the potential to become structurally unsound.	The tree is in fair to good condition. The tree has form typical or atypical of the species. The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area. The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street. The tree provides a fair contribution to the visual character and amenity of the local area. The tree's growth is Mediumly restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa in situ.	The tree is in good condition and good vigour. The tree has a form typical for the species. The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age. The tree is listed as a heritage item, threatened species or part of an endangered ecological community or listed on councils' significant/notable tree register. The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity. The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values. The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa in situ – tree is appropriate to the site conditions.
<u>Remove</u> <u>ENVIRONMENTAL PEST/NOXIOUS WEED</u> The tree is a listed environmental weed species. This due to invasiveness or its poisonous/allergenic properties/ declared noxious weed. <u>HAZARDOUS / IRREVERSIBLE DECLINE</u> The tree is structurally unsound unstable and considered potentially dangerous. The tree is dead or in irreversible decline with the potential to fail/collapse.		

Significance of a Tree Assessment Rating System (STARS) - Priority Matrix

		Landscape Significance				
		High	Medium	Low		
		<i>Significance in Landscape</i>	<i>Significance in Landscape</i>	<i>Significance in Landscape</i>	<i>Environmental Pest or Noxious Weed Species</i>	<i>Hazardous or Irreversible Decline</i>
Estimated Life Expectancy	Long <i>>40 Years</i>					
	Medium <i>15-40 Years</i>					
	Short <i><1-15 Years</i>					
	Dead					
	Priority for Retention (High) - These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard <i>AS4970-2025 Protection of trees on development sites</i> . Tree sensitive construction measures must be implemented (pier and beam cantilever, Structural Confinement Cells etc if works are to proceed within the NRZ).					
	Consider for Retention (Medium) - These trees may be retained and protected. These are considered less critical; however, their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.					
	Consider for Removal (Low) - These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.					
	Priority for Removal - These trees are considered hazardous, are in irreversible decline, or are listed weed species. Therefore, they should be removed irrespective of development.					

15 Appendix C: AGS Document Register

15.1 AGS Document Control

Document

File reference	File type	Modifications	Date
JN158647	AR	Original document	02/10/2025

Reviewed Report(s)

Date	File reference	Report Type	Company
N/A	N/A	N/A	N/A

Communication Register

Date	Type	From	To	Description
04/10/2025	PDF	AGS	TMC	AIA & TPP

Review Register

Date	File reference	Reviewer	Qualification	Company
03/10/2025	JN158647	A.Dandan	Dip of Arb (AQF 5)	AGS