

21 November 2022

Adem Abdioglu
Project Engineer
Taylor
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North Sydney NSW 2060

Dear Adem

Ecological certification of arboricultural assessment reports for the First Building, Bradfield City Centre

Project no. 37576

Biosis Pty Ltd was commissioned by Taylor to provide ecological certification of arboricultural assessment reports completed to support the First Building Bradfield City Centre project. This certification is required to satisfy development consent condition B17 from Instrument of Consent SSD- 25452459 which states:

Prior to the commencement of construction, the Applicant is to prepare and submit for the approval of the Planning Secretary, a Tree Retention Plan to identify the existing trees on the site that are to be retained and/ or relocated on the site. The plan must:

(a) be prepared by the Project Arborist identified in condition B16 and in consultation with a qualified ecologist;

(b) identify the trees that are to be retained on site. Where possible, this includes those trees identified as of high retention value and medium retention value, in the Preliminary Arboricultural Report prepared by Active Green Services, Ref: JN 81236 (Appendix P of the RTS); and

(c) identify those trees on site that are capable of being relocated within the site.

The related condition B16, requires that prior to the commencement of construction, a Project Arborist with an Australian Qualifications Framework (AQF) Level 5 in arboriculture is appointed to the works.

To ensure compliance with condition B17 Biosis undertook a review of the *Arboricultural Impact Assessment Report* (Active Green Services 2022a) and the subsequent *Arboricultural Memorandum* (Active Green Services 2022b) that have been prepared for the project. This review confirmed the following:

- The inclusion of a site specific Tree Protection Plan within the *Arboricultural Impact Assessment Report* (Active Green Services 2022a).
- Both reports were prepared by suitably qualified arborists holding an AQF Level 5 or higher in arboriculture (thus satisfying criteria [a] of B17).
- The *Arboricultural Impact Assessment Report* (Active Green Services 2022a) identifies 10 high retention value trees and three medium retention value trees to be retained and afforded necessary protection during construction (thus satisfying criteria [b] of B17). The 10 high retention value trees were subsequently reduced to nine in the *Arboricultural Memorandum* (Active Green Services 2022b) as one tree (tree 1802) is located within a zone to be cleared to allow for the development of water retention

tanks on site. The three medium retention value trees (trees 1730, 1798 and 1799) all occur outside of the development site perimeter fence and therefore will remain unfettered.

- No trees were identified as being capable of relocation within the site within either of the reviewed reports. However juvenile plants have been salvaged from the site (Toolijooa 2022) and habitat material (such as felled trunks, root balls, and existing woody debris) have been identified for salvage (Biosis 2022) once works are able to commence (thus satisfying criteria [c] of B17).

Biosis is therefore able to provide ecological certification that the criteria outlined in B17 have been satisfied.

I trust that this advice is of assistance to you however please contact me if you would like to discuss any elements of this ecological advice further.

Yours sincerely,



Matthew Hyde
Team Leader - Zoology

References

Active Green Services 2022a. *Arboricultural Impact Assessment Report: AMRF First Building, Bringelly*, Authors: Meekins. O, Active Green Services, Sydney, Australia.

Active Green Services 2022b. *Arboricultural Memorandum*, Authors: Dunsmuir. I, Active Green Services, Sydney, Australia.

Biosis 2022. *Ecological certification of juvenile plant salvage, habitat salvage and seed collection for the First Building, Bradfield City Centre*, Author: Hyde. M, Biosis Pty Ltd, Sydney, Australia. Project no. 37576.

Toolijooa 2022. *AMRF Plant Salvage and Seed Collection: Progress Report November 2022*, Toolijooa Nursery, West Hoxton, Australia.

Appendices

Appendix A. Arboricultural assessment reports

ARBORICULTURAL MEMORANDUM

Prepared for

Taylor Construction Group Pty Ltd

Site Address

215 Badgerys Creek Road, Bringelly, NSW 2556

November 2022

Prepared by

Iain Dunsmuir

Diploma of Arboriculture (AQF Level 5)



Report Type	Tree Viability: Preliminary Findings
Location	215 Badgerys Creek Road, Bringelly, NSW 2556
Project	AMRF First Building, Bringelly
Site Attendees	Iain Dunsmuir, Active Green Services Oliver Lord, Taylor Construction Group
Prepared by	Iain Dunsmuir (AQF Level 5 Arborist)
Site Visit	14/11/2022
Version	Approved for distribution

*Please note that this document is to be read in conjunction with *JN89861-Arbicultural Impact Assessment*. However, where applicable, it takes precedence as it contains ‘real time’ onsite observations and findings of the calculated Tree Protection Zones (TPZ) of the ten (10) High Retention Value trees as discussed in *JN89861*. Ergo, the following findings and recommendations in this document supersede previous theories and take precedence with regards to tree retention moving downstream.

1 Introduction

- i. Queries regarding the retention of ten (10) ‘High’ Retention Value trees and the current development plan footprint have been voiced by the Site Engineer from Taylor Construction. Hence, on the 14th of November 2022 an AQF Level 5 Active Green Services arborist attended the Bringelly AMRF First Building development site to address these queries.
- ii. Whilst onsite site-specific arboricultural inspections were conducted with the observations and findings discussed and arboricultural recommendations made. These recommendations predominantly concern the future viability and pragmatic retention of these ten (10) trees under the current design plan.
- iii. As above-mentioned, these provided recommendations are to be read in conjunction with *JN89861 AMRF First Building, Bringelly (AIA) Version 3* with the Non Destructive Root Exploration (NDRE) methodology applied.

2 Objective

- i. Assess and determine foreseeable tree viability *in situ* from an objective and unbiased science-based perspective with regards to the abovementioned developments current design plan.

3 Arboricultural Findings and Recommendations

Tree Number 1731

Recommendation

The subject tree is to be retained and afforded protection per the site-specific Tree Protection Plan.

Tree Numbers 1917 & 1918

Query

“Tree roots will clash with the proposed road works; and the Authority Services will run through this area (excavations at an approximated depth of 1.0m - 1.5m are proposed to accommodate these services)”.

Findings:

The location of the onsite boundary markers indicates that with all due care shown the excavations can be carried out and the two (2) subject trees will remain viable. The covenant being that any works within the provided Tree Protection Zone (TPZ) are under the guidance of the appointed Project Arborist. Therefore, both subject trees are to be retained.

Recommendation:

Both subject trees are to be retained and afforded protection per the site-specific Tree Protection Plan.

Tree Number 1915

Query

“Under the current design plan overlay, the tree roots will clash with the new roadworks”.

Findings:

Inconclusive data. Therefore, further investigation by Non-Destructive Root Exploration (NDRE) is required to accurately determine tree viability and subsequent retention/removal.

Recommendation:

The subject tree is to be retained and afforded protection per the site-specific Tree Protection Plan. NDRE is required to cogently determine tree viability. This NDRE should involve the excavation of a slot trench along the edge of the planned works. This slot trench is to be excavated by Hand-digging and/or Air-Vac under the supervision of the Project Arborist. This so the subject trees root morphology and architecture can be fully assessed, and tree viability determined.

Tree Number 1802

Query

“This tree is in the zone of the OSD tank. This area will be dug up for development water retention”.

Findings:

No pragmatic ‘work-around’ is available under the current design possible.

Recommendation:

Under the current design the tree will not remain viable. Therefore, tree removal is required with Compensatory Replanting.

Tree Number 1737, 1738, 1726, 1727 & 1729

Query

“This area is to be lowered (graded down) so a swale can be formed. Will the trees be impacted upon when the swale is built?”

Findings:

The viability of these five (5) trees cannot be accurately determined at this stage. It is foreseeable that the excavations will impact upon the tree roots, but the extent is unknown. Therefore, further investigation is required by the use of Non-Destructive Root Exploration (NDRE). This will provide an insight into the root morphology and architecture of these trees and hence a final determination can be made with regard to tree retention.

Additional Note: Tree Sensitive Design modifications should be candidly considered and discussed with regards to the location of the trees and the swale build. I.e., the swale design location can be modified to reduce arboricultural impact and/or incorporate the pragmatic retention of these subject trees into the final design.

Recommendation:

The subject five (5) trees are to be retained and afforded protection per the site-specific Tree Protection Plan. NDRE is to be undertaken under the guidance of the Project Arborist to cogently determine tree viability; and Tree Sensitive Design modifications discussed.

*****Please note that Trees 1730, 1798 & 1799 that were identified in JN89861-Arboricultural Impact Assessment are outside of the development site perimeter fence and therefore will remain unfettered.***

ARBORICULTURAL IMPACT ASSESSMENT REPORT

Project

AMRF First Building, Bringelly

Site Address

215 Badgerys Creek Road, Bringelly, NSW 2556

Authored

October 2022

Prepared by

Owen Meekins

Graduate Certificate of Arboriculture (AQF Level 8), LLB.



Preface

Urban tree planting, tree protection and tree maintenance has a long history and was first documented in ancient Egypt around 4000 years ago. The specific use of trees in urbanized landscapes probably began as early as the 1200s, with the term 'Arborist' first being used formerly in England 1578.

Thus, urban trees have been around for generations. However, only recently have they become valued for providing more than aesthetic and recreational value. Now the benefits of urban forests are considered to span environmental, economic, cultural and socio-political domains alike. Today communities around the world regard trees and other vegetation as critical urban infrastructure. Ergo, 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/or its '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 - 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 Impact Assessment is to pragmatically guide the proposed development works around any retained trees whilst mitigating foreseeable arboricultural impact. This through the formulation and implementation of best management practice tree protection methodologies. Thereby, promoting tree resilience and vitality post development.



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Part 1: ARBORICULTURAL IMPACT ASSESSMENT

1 Executive Summary

In March 2022, one hundred and ninety-three (193) individual Visual Tree Assessments (VTA) were conducted by an AQF Level 5 arborist from Active Green Services (AGS) and a Preliminary Arboricultural Report subsequently authored per *AS4970-2009 Protection of trees on development sites* for the AMRF First Building development, Bringelly.

AGS has now been engaged by the Taylor Construction Group Pty Ltd to prepare an Arboricultural Impact Assessment (AIA) which includes a Tree Protection Plan (TPP) pursuant to *AS4970-2009 Protection of trees on development sites*. This with regards to trees that were previously assessed, and the foreseeable impact of construction and infrastructure works associated with the abovementioned development. Please note that the tree assessment data collected for the above-mentioned Preliminary Arboricultural Report provides the necessary arboricultural data required to calculate arboricultural impact and hence tree viability post development per the supplied Project Design Plans for the development. Therefore, the Preliminary Arboricultural - ref. *JN81236* should be read in conjunction with the following Arboricultural Impact Assessment.

On review of the Preliminary Assessment Report tree data it was calculated that under the provided project scope and design plans the required development works will encroach on the Tree Protection Zones (TPZ) of all one hundred and ninety-three (193) trees that were assessed, with these encroachments calculated as 'Major' per *AS4970-2009 Protection of trees on development sites*.

In summary, one hundred and eighty-three (183) trees of the one hundred and ninety-three (193) trees were assessed as having a 'Remove', 'Low' or 'Medium' Retention Value per the recognised *Significance of a Tree, Assessment Rating System (STARS)*. Under the current design footprint these trees will not remain viable and therefore will need to be proactively removed concurrent with Compensatory Replanting to off-set canopy loss*.

With regards to the remaining ten (10) trees, these trees have an adjudged 'High' Retention Value and are considered important for retention. Therefore, these trees are to be retained and afforded the necessary protection per the provided site-specific Tree Protection Plan. Please note that due to the location of these trees Non Destructive Root Exploration (NDRE) may be needed at a later stage to explore tree sensitive design modifications, tree viability and pragmatic tree retention. These findings and the determinations of the NDRE will be made available to all parties with standing in the form of a Root Mapping Report authored by the Project Arborist.

**The Projects boundaries and infrastructure footprints may be modified in the effort to accommodate trees. Therefore, where it is foreseeable that a tree may remain viable, this tree is to be retained until further arboricultural investigation from the appointed Project Arborist can determine viability and subsequent retention. If retained the tree data is to be amended and the tree afforded protection per the site-specific Tree Protection Plan.*

2 Introduction

- i. AGS has been commissioned to prepare an AIA and TPP with regards to trees and the construction of the AMRF Building and its associated infrastructure and landscaping works - 215 Badgerys Creek Road, Bringelly, NSW 2556. This AIA will:
 - Identify trees within the development site that are likely to be impacted upon by any of the proposed works per the provided design plans.
 - Assess the vitality and retention value of these foreseeably impacted trees *in situ*.
 - Assess, calculate and discuss the impacts with regards to tree retention and foreseeable viability.
 - Put forward best practice management recommendations as to effective tree protection and development impact pursuant to *Standards Australia AS4970-2009 Protection of trees on development sites*.

2.1 Objective

- i. The purpose of this AIA is to provide all parties with standing an objective and unbiased arboricultural assessment of the tree population with regards to tree viability and the ensuing impact of the proposed development per the supplied Design Plans.

2.2 Limitations

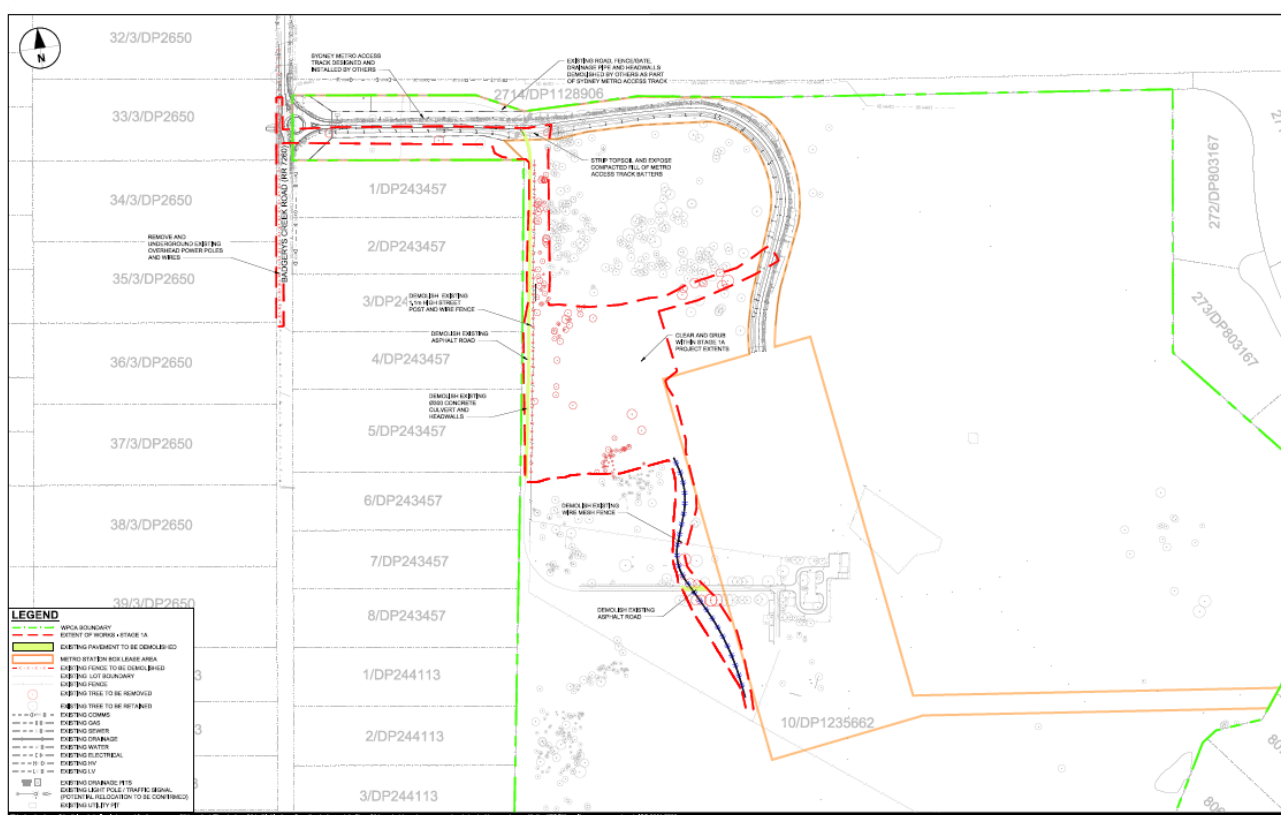
- i. All arboricultural reasonings that have been discussed and provided are based on extensive empirical arboricultural knowledge, the internationally recognised Visual Tree Assessment (VTA) methodology (Lonsdale, 2010), (Dunster et. al, 2017), the recognised Institute of Australian Consulting Arboriculturists (IACA) *Significance of a Tree, Assessment Rating System (STARS)*, and Australian Standards AS 4970-2009 *Protection of trees on development sites*.
- ii. Whilst this arboricultural assessment is thorough 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, this arboricultural assessment will consider on the balance of probabilities the most likely outcome(s) as opposed to those which could, may or fancifully occur.

2.3 Report References

- i. As a progressive arboricultural company AGS keeps abreast of research data relating to all aspects of arboriculture and urban forestry. Hence the following arboricultural observations, reasonings, conclusions and recommendations are founded on industry standards and extensive empirical arboricultural knowledge. The science-based arboricultural survey methodologies and references used can be found in the Appendix.
- ii. Please note that additional educational material has been appended to promote the urban forest through understanding and knowledge.

2.4 Project Background

- i. A Preliminary Arboricultural Report – ref. JN81236 was authored for the development site in March 2022 pursuant to *AS4970-2009 Protection of trees on development sites*. This Report identifies and provides an individual Retention Value per the recognised STARS methodology for all the significant trees within the survey area outlined by Biosis Pty Ltd. Please note that the March 2022 Report is to be read, referenced and/or referred to in conjunction with this October 2022 Report.
- ii. For reference the below Demolition Plan provided by Biosis Pty Ltd shows the EIS boundary (in red) (approximately 3 Ha) which formed the study area for the March 2022 Report. One hundred and ninety-three (193) trees were individually tree tagged and catalogued as per the above-mentioned methodology.



Demolition Plan for 215 Badgerys Creek Road, Bringelly (courtesy of Biosis Pty Ltd)

2.5 Proposed Scope of Works

- i. As above and below outlined in 'Red' - the AMRF First Building development site which includes the construction of a new building, the associated infrastructural works and landscaping (hard and soft) that is proposed for 215 Badgerys Creek Road, Bringelly, NSW 2556.
- ii. A full set of Design Concept Plans can be made available upon request from the Taylor Construction Group design team.

3 Mapping

3.1 AMRF First Building Development Site Location



AMRF First Building Development Site Boundary, Bringelly NSW

3.2 Mapping Methodology

- i. One hundred and ninety-three (193) trees within the above AMRF First Building site plan have been identified as being of particular interest and/or relevance. Subsequently, all these trees were visually assessed, individually numbered and GPS located by using the Esri Field Maps Application.
- ii. Please find the following six (6) satellite sub-maps with the indicative locations of the subject trees. All of these trees have been individually assessed, the Structural Root Zone (SRZ) and Tree Protection Zone (TPZ) calculated, and a Retention Value judiciously assigned per the Institute of Australian Consulting Arboriculturists Significance of a Tree, Assessment Rating System (STARS).
- iii. For convenience digital files can be provided for this Report which includes the tree GPS locations, the tree assessment data and individual photo image hyper-links so all the assessed trees can be viewed.

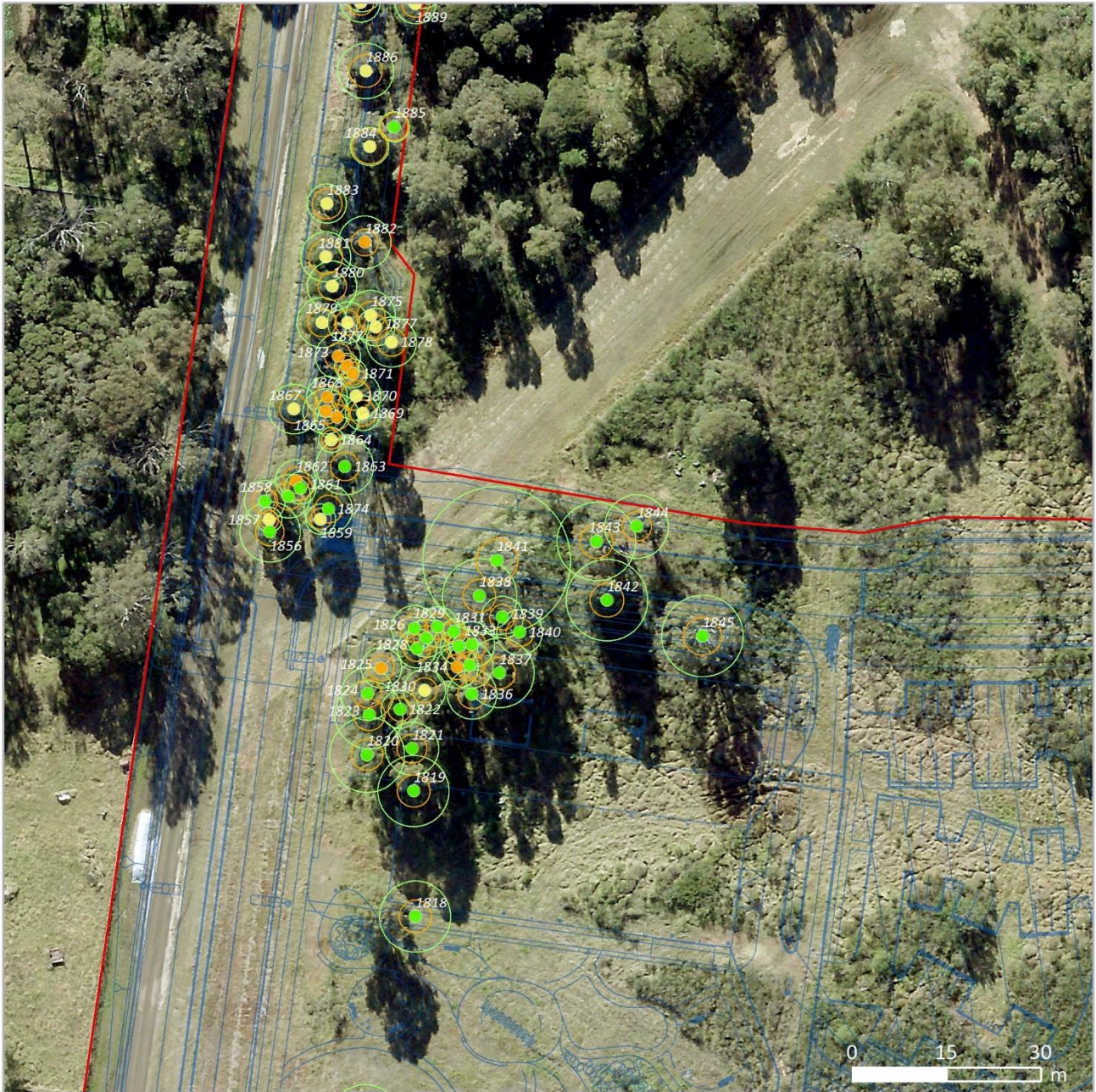
3.3 Tree Location Sub-Maps



	LEGEND	
	<p>Tree Retention Value</p> <ul style="list-style-type: none"> ● High ● Medium ● Low ● Remove 	<ul style="list-style-type: none"> SRZ TPZ Extent of Works Proposed Works
<p>NO 215 BADGERYS CREEK ROAD, BRINGELLY Submap 1 of 6</p>		



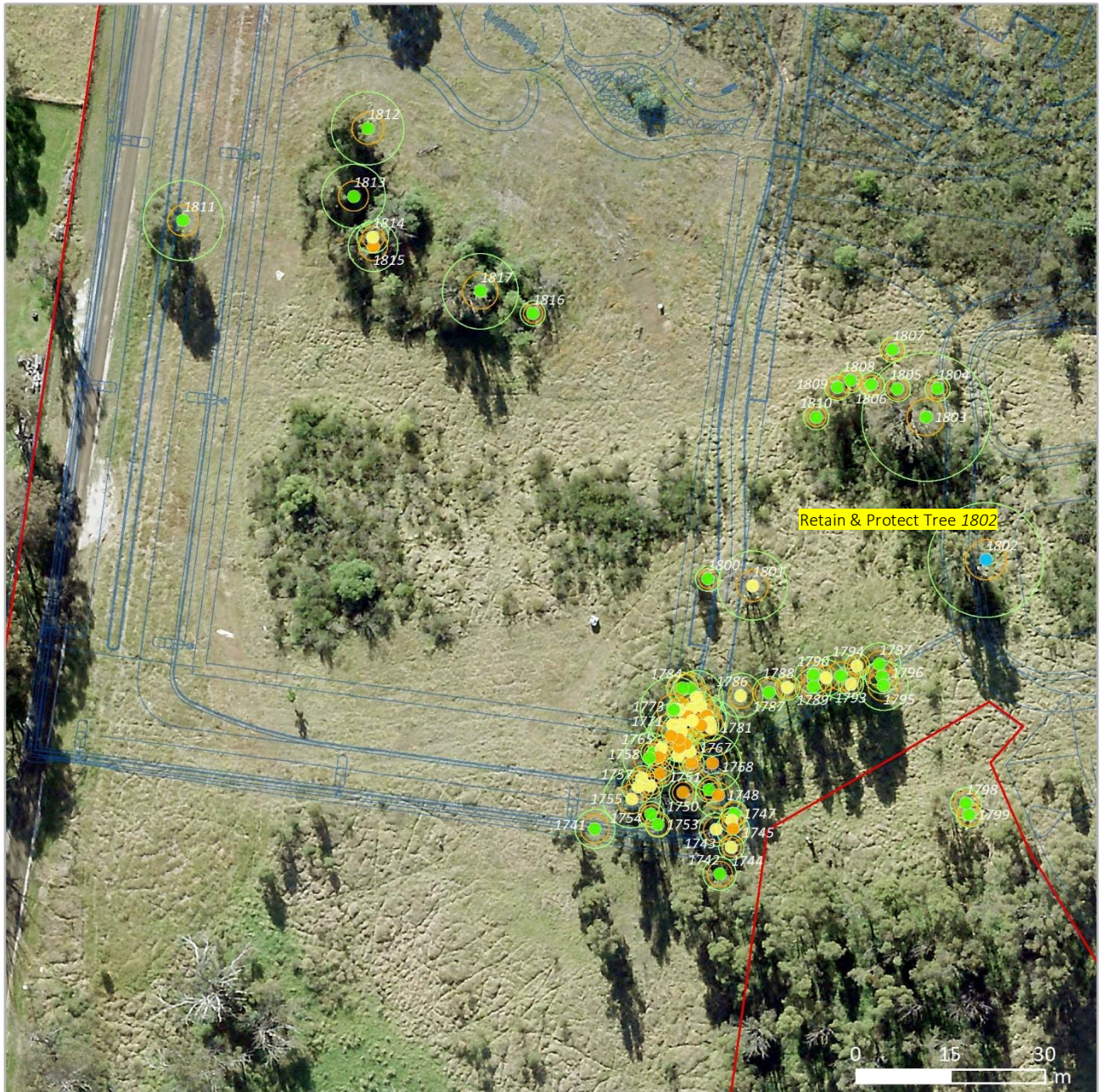
	LEGEND	
	<p>Tree Retention Value</p> <ul style="list-style-type: none"> ● High ● Medium ● Low ● Remove 	<ul style="list-style-type: none"> SRZ TPZ Extent of Works Proposed Works
<p>NO 215 BADGERYS CREEK ROAD, BRINGELLY Submap 2 of 6</p>		



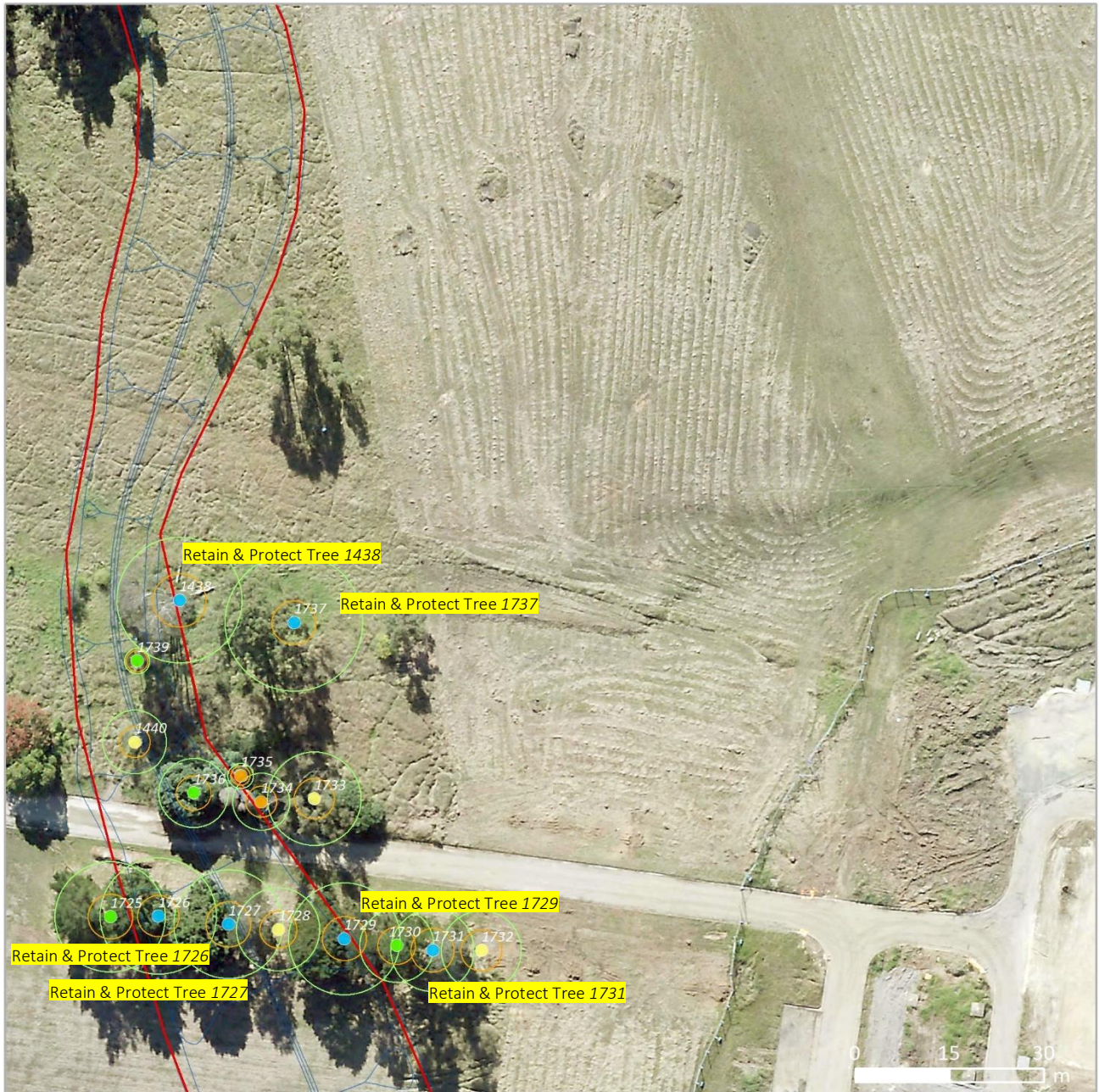
	LEGEND	
	<p>Tree Retention Value</p> <ul style="list-style-type: none"> ● High ● Medium ● Low ● Remove 	<ul style="list-style-type: none"> SRZ TPZ Extent of Works Proposed Works
<p>NO 215 BADGERYS CREEK ROAD, BRINGELLY Submap 3 of 6</p>		



	LEGEND	
	<p>Tree Retention Value</p> <ul style="list-style-type: none"> ● High ● Medium ● Low ● Remove 	<ul style="list-style-type: none"> SRZ TPZ Extent of Works Proposed Works
<p>NO 215 BADGERYS CREEK ROAD, BRINGELLY Submap 4 of 6</p>		



	LEGEND	
	Tree Retention Value ● High ● Medium ● Low ● Remove	● SRZ ● TPZ — Extent of Works — Proposed Works
NO 215 BADGERYS CREEK ROAD, BRINGELLY Submap 5 of 6		



	LEGEND	
	<p>Tree Retention Value</p> <ul style="list-style-type: none"> ● High ● Medium ● Low ● Remove 	<ul style="list-style-type: none"> SRZ TPZ Extent of Works Proposed Works
<p>NO 215 BADGERYS CREEK ROAD, BRINGELLY Submap 6 of 6</p>		

4 Arboricultural Commentary

4.1 Tree Retention

- i. Ten (10) trees were identified as having an adjudged 'High' Retention Value as per the above-mentioned STARS criteria. As shown, a tree with an adjudged 'High' Retention Value is a beneficial community asset and should always be retained where pragmatically possible. This more so, when the tree is an established well-functioning larger tree(s), as a trees benefits increase exponentially with size and increased leaf area. In contrast, a smaller replacement tree provides limited benefits due to its size and is often less cost-effective due to establishment costs (Clark, 2022).
- ii. Under the current design footprint of the AMF First Building the development works will encroach upon the TPZ of these ten (10) 'High' Retention Value trees. However, as per *AS4970-2009* and arboricultural guidelines these trees are to be initially retained and protected per the site-specific Tree Protection Plan. With regards to retaining these trees long-term, Non Destructive Root Exploration may be needed to explore plausible Tree Sensitive Design modifications and/or accurately determine tree viability and subsequent retention.

4.2 Non-Destructive Root Exploration & Root Mapping

- i. Root Mapping by Non-Destructive Root Exploration (NDRE) should be adopted pre-excitation as it is the most reliable way to locate tree roots, determine impact and calculate tree viability (Matheny, 1998). Root Mapping provides accurate root locations and cogent morphological data, which is necessary to discuss and/or implement tree sensitive modifications, whilst providing science-based data so tree viability and pragmatic tree retention (or removal) can be accurately determined.
- ii. NDRE consists of Hand-digging and/or Air-Vac - AirSpade under the guidance of the appointed Project Arborist. All the NDRE findings are documented in a formalised Root Mapping Report which is authored by the Project Arborist. The Root Mapping Report will be made available to all parties with standing.
- iii. In specific circumstances and at the discretion of the appointed Project Arborist initial NDRE may be permitted by pre-approved machinery. This specified machinery and its operation is only to be used within the TPZ whilst under the direct supervision of the Project Arborist concurrent with strict adherence to the site-specific Tree Protection Plan. Further 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.

4.3 Tree Sensitive Design

- i. A commonsensical approach pre-development with regards to tree retention and development should always be adopted around retained trees. I.e., boundary fencing can be moved to accommodate trees, 'work-arounds' discussed, and any excavations within the calculated TPZ of a retained tree initiated with NDRE. However, if during the NDRE a 'significant root' (>30mm in diameter) is encountered candid tree

sensitive design modifications will need to be discussed and/or incorporated into the project where reasonably practicable.

- ii. Tree sensitive design for both new and existing trees simply aims to provide adequate space for desirable root growth, whilst safeguarding against infrastructure and root damage from potential conflict alike. Some of these proactive solutions include:
 - Directional-drilling, Screw-Piling, Cantilevers and 'Build-overs'.
 - Irrigation, Tree Root Trenches & Paths, Root Barrier, Root Deflectors and Root Directors and De-Compaction/Compaction to direct root growth.
 - Permeable Pavers, Asphalt, Concrete and Resin Bound Aggregates.
 - 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. In summary these cells can be installed in an urban scape to provide space for root growth limit soil and root compaction, whilst facilitating necessary infrastructure installations).
- iii. Please note that tree roots travel the 'path of least resistance' and like most living organisms require oxygen and water (an aerobic soil with good moisture levels). Therefore, one of the easiest techniques to keep tree roots from growing in unwanted areas is to remove these two essential elements by heavily compacting the soil. Alternatively, 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.

4.4 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 ('drip-line') or tree height (Day et al., 2010). Therefore, all arboricultural recommendations and conclusions contained in this Report with regards to tree root protection/retention were based upon and determined in accordance with the Australian Standards *AS 4970-2009 Protection of Trees on Development Sites*.
- ii. A diagram indicative of a calculated TPZ and SRZ with regards to encroachment is included below to aid in the visualisation of the 'No-Dig' zones and where initial Non-Destructive Root Exploration must be carried out under the direct supervision of a Project Arborist. This diagram can be used to indicatively portray a SRZ and TPZ of any tree within close proximity to works and thus the necessary 'stair-step' tree protection methodology can be adopted per the Construction Encroachment Descriptors & Categories Table below.

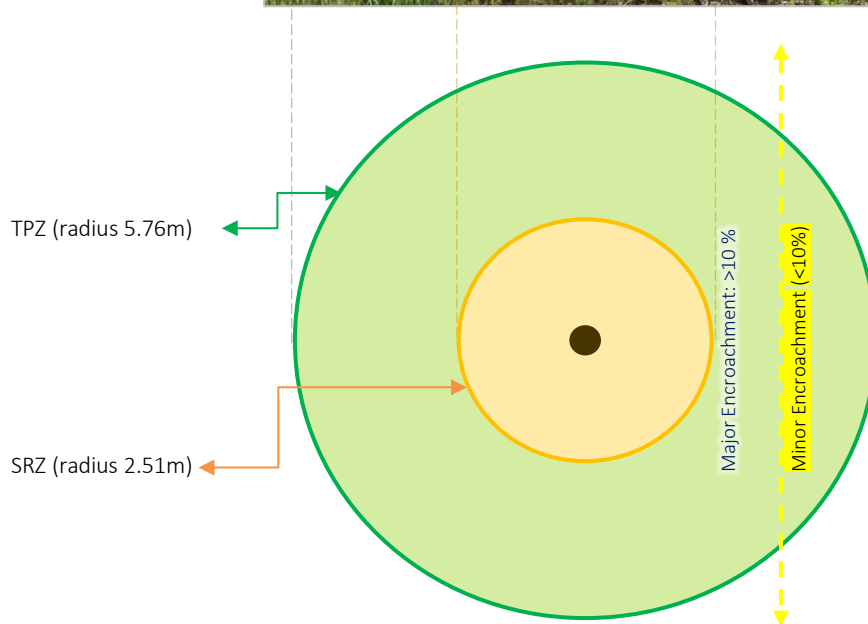


Diagram 1: (Tree 1818) *Eucalyptus moluccana* – Diagrammatical calculated zones

**Please note that whilst working within the Tree Protection Zone (TPZ) of any tree all 'Major' encroachments must be undertaken by initial Non-Destructive Root Exploration through the use of Hand-digging and/or Air -Spade under the guidance of the onsite Project Arborist.*

Construction Encroachment Descriptors & Categories Table: A Stair-step Approach

LEVEL	IMPACT CATEGORY	DESCRIPTION
1	<i>Removal</i>	<i>The design and tree encroach each other to a point that either the design must be modified, or the tree removed.</i>
2	<i>Major: Non- Viable</i>	<p><i>The construction proposal design has an encroachment of greater than 10% of the Tree Protection Zone and/or impacts the Structural Root Zone.</i></p> <p><i>The tree does require immediate removal, though under the current design proposal, the works are expected to impact the tree significantly enough that it is expected to die or fail in the future due to resultant works.</i></p> <p><i>In order to retain the tree, designs modifications are required to reduce construction footprint on tree to an acceptable level. Unless non-destructive root exploration can identify minimal root distribution in area.</i></p>
3	<i>Major: Viable under design constraints</i>	<p><i>The construction proposal designs have an encroachment of greater of 10% of Tree Protection Zone or impacts the Structural Root Zone. These trees can remain viable if the following is applied:</i></p> <ul style="list-style-type: none"> <i>• Tree sensitive construction methods are utilised.</i> <i>• Any works in SRZ are undertaken after non-invasive root exploration.</i> <i>• Exploratory root excavation findings are documented and made available to necessary parties for review.</i> <i>• Pre / during/ post inspections are carried out by Project Arborist, on all trees onsite and adjoining properties.</i> <i>• All underground services are diverted around TPZ, with the exception of underground boring.</i>
4	<i>Major: Viable</i>	<p><i>The construction proposal designs have an encroachment of greater than 10% of Tree Protection Zone and outside the Structural Root Zone. These trees can remain viable if the following applies:</i></p> <ul style="list-style-type: none"> <i>• Alternative tree sensitive design methods are implored.</i> <i>• Site conditions have limited root growth in specific area.</i> <i>• The species is tolerant to development impacts.</i> <i>• Non-destructive root exploration is undertaken and demonstrates minimal root area in TPZ.</i> <p><i>The tree requires a TPZ erected prior to construction or demolition phase of works. Compensation for lost TPZ area should be added.</i></p>
5	<i>Minor</i>	<i>The construction proposal designs have an encroachment of less than 10% of Tree Protection Zone. The tree is expected to remain viable. A TPZ is be erected prior to construction or demolition phase.</i>

5 Summary Findings

5.1 Summary Tree Encroachment Data

- i. Under the current design footprint, it is calculated that the TPZ of one hundred and ninety-three (193) trees will be encroached and impacted upon:
 - Trees in direct conflict with the construction with the Building footprint : (*Trees 1818-1845*)
 - Trees in direct conflict with the Road & Infrastructure: (*Trees 1725-1817*) & (*Tree 1845-1918*)
- ii. With regards to the one hundred and fifty- three (153) trees with an assessed ‘Low’ or ‘Medium’ Retention Value, it is of a reasonable arboricultural belief these trees will not remain viable as they are in direct conflict with the current design. As none of these trees are considered to be viable transplants these trees will need to be proactively removed, along with the thirty (30) trees that were originally recommended for removal. Compensatory Replanting is recommended with regards to off-setting canopy loss. (Please refer to s5.4). **Please note that the Projects boundaries and infrastructure footprints may be modified in the effort to accommodate trees. Therefore, if it is foreseeable that a tree earmarked for removal may remain viable, this tree is to be retained until further arboricultural investigation from the appointed Project Arborist and viability / retention determined.*
- iii. As above-mentioned, ten (10) trees have an adjudged ‘High’ Retention Value and therefore are to be initially retained and afforded protection per the below site-specific Tree Protection Plan. The location of these ten (10) trees is indicated on the above maps. Further investigation by Non Destructive Root Exploration (NDRE) under the guidance of the Project Arborist may be needed at a later date to accurately determine tree viability and whether tree sensitive design modifications can be pragmatically implemented. These findings and the determinations of the NDRE will be made available to all parties with standing in the form of a Root Mapping Report authored by the Project Arborist.

5.2 Retained Trees

- i. The following ten (10) ‘High’ Retention Value trees are to be retained and afforded the necessary protection as outlined in the below site-specific Tree Protection Plan. All of these trees are individually tree tagged with the following numbers on the tags for ease of identification.

High Retention Value Trees (Retain & Protect per the Tree Protection Plan)		
1438 (<i>Corymbia maculata</i>)	1726 (<i>Pinus radiata</i>)	1727 (<i>Pinus radiata</i>)
1729 (<i>Pinus radiata</i>)	1731 (<i>Pinus radiata</i>)	1737 (<i>Eucalyptus tereticornis</i>)
1802 (<i>Eucalyptus moluccana</i>)	1915 (<i>Eucalyptus fibrosa</i>)	1917 (<i>Eucalyptus punctata</i>)
	1918 (<i>Eucalyptus punctata</i>)	

5.3 Tree Removal & Compensatory Replanting




- i. It is strongly recommended that any necessitated tree removal is carried out in conjunction with considered Compensatory Replanting to offset canopy loss. A no net loss of tree canopy is desirable and is achieved by undertaking compensatory planting per a recognised methodology such as the Revised Burnley Method or the Melbourne Valuation Method.
- ii. Please note that tree removal should not always be considered as a negative because it does provide the opportunity to replant with often a 'better suited' species for the locale (Hitchmough, 1994). A list of preferred urban tree species for compensatory planting can be provided from a bespoke Urban Tree Selection Matrix that is formulated by a suitably qualified AQF Level 5+ Arborist and/or Urban Forestry Consultant. This science-based 'best' tree species selection palette will provide the necessary guidance for both Landscape Architects and Planners, whilst importantly taking into consideration recommended biodiversity modelling (Santamour, 2010).

5.4 Afterword

- i. Current research both clinical and empirical has shown that healthy 'High' Retention Value trees usually remain in good health when *AS4970-2009 Protection of trees on development sites* is adhered to. Therefore, the below site-specific Tree Protection Plan is to be adopted pre-development for this Project.

6 Visual Tree Assessment Data

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
1	1725	<i>Pinus radiata</i> Monterey Pine	Mature	13	EW:7 NS:7	0.73	1.18	8.76	3.55	Fair	Fair	Medium	Major	Remove
2	1726	<i>Pinus radiata</i> Monterey Pine	Mature	12	EW:7 NS:8	0.77	0.98	9.24	3.28	Fair	Good	High	Major	Retain & Protect
3	1727	<i>Pinus radiata</i> Monterey Pine	Mature	10	EW:7 NS:7	0.72	1.20	8.64	3.57	Fair	Good	High	Major	Retain & Protect
4	1728	<i>Pinus radiata</i> Monterey Pine	Mature	12	EW:7 NS:7	0.55	0.76	6.60	2.95	Fair	Poor	Low	Minor	Remove
5	1729	<i>Pinus radiata</i> Monterey Pine	Mature	9	EW:10 NS:10	0.74	1.14	8.88	3.50	Fair	Good	High	Major	Retain & Protect
6	1730	<i>Pinus radiata</i> Monterey Pine	Mature	13	EW:6 NS:9	0.49	0.80	5.88	3.01	Fair	Fair	Medium	Minor	Retain & Protect
7	1731	<i>Pinus radiata</i> Monterey Pine	Mature	15	EW:7 NS:8	0.55	1.09	6.60	3.43	Good	Good	High	Minor	Retain & Protect
8	1732	<i>Pinus radiata</i> Monterey Pine	Mature	15	EW:7 NS:8	0.53	0.97	6.36	3.27	Fair	Poor	Low	Minor	Remove
9	1733	<i>Eucalyptus tereticornis</i> Forest Red Gum	Mature	9	EW:10 NS:11	0.62	0.92	7.44	3.20	Fair	Poor	Low	Minor	Remove
10	1734	<i>Cupressocyparis x leylandii</i> Leyland Cypress	Mature	9	EW:6 NS:4	0.38	0.50	4.56	2.47	Poor	Dead	Remove	Major	Remove
11	1735	<i>Olea europaea</i> Olive	Semi Mature	6	EW:5 NS:5	0.09	0.12	2.00	1.50	Poor	Good	Remove	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
12	1737	<i>Eucalyptus tereticornis</i> Forest Red Gum	Mature	23	EW:14 NS:12	0.91	1.12	10.92	3.47	Fair	Good	 High	Minor	Retain & Protect
13	1438	<i>Corymbia maculata</i> Spotted Gum	Mature	20	EW:8 NS:10	0.83	1.80	9.96	4.24	Fair	Fair	 High	Major	Retain & Protect
14	1739	<i>Corymbia maculata</i> Spotted Gum	Semi Mature	9	EW:4 NS:4	0.16	0.21	2.00	1.72	Fair	Fair	 Medium	Major	Remove
15	1440	<i>Callistemon citrinus</i> Crimson Bottlebrush	Mature	5	EW:5 NS:4	0.42	0.50	5.04	2.47	Poor	Poor	 Low	Major	Remove
16	1798	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:6 NS:4	0.21	0.27	2.52	1.91	Fair	Fair	 Medium	Major	Retain
17	1799	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:6 NS:4	0.15	0.21	2.00	1.72	Fair	Fair	 Medium	Major	Retain
18	1741	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:6 NS:6	0.26	0.40	3.12	2.25	Fair	Good	 Medium	Major	Remove
19	1742	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:6 NS:4	0.22	0.30	2.64	2.00	Fair	Good	 Medium	Major	Remove
20	1743	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:6 NS:4	0.22	0.30	2.64	2.00	Fair	Poor	 Low	Major	Remove
21	1744	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:3 NS:3	0.10	0.12	2.00	1.50	Fair	Very Poor	 Low	Major	Remove
22	1745	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:3 NS:3	0.22	0.28	2.64	1.94	Hazardous	Dead	 Remove	Major	Remove
23	1746	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:3 NS:3	0.12	0.15	2.00	1.50	Fair	Very Poor	 Low	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
24	1747	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:3 NS:3	0.15	0.22	2.00	1.75	Fair	Fair	Medium	Major	Remove
25	1753	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:6 NS:8	0.15	0.22	2.00	1.75	Fair	Fair	Medium	Major	Remove
26	1748	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:2 NS:2	0.30	0.32	3.60	2.05	Poor	Dead	Remove	Major	Remove
27	1749	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:6 NS:4	0.14	0.18	2.00	1.61	Fair	Good	Medium	Major	Remove
28	1750	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:3 NS:3	0.18	0.19	2.16	1.65	Poor	Dead	Remove	Major	Remove
29	1751	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:3 NS:3	0.18	0.19	2.16	1.65	Poor	Dead	Remove	Major	Remove
30	1752	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:3 NS:3	0.16	0.16	2.00	1.53	Poor	Very Poor	Low	Major	Remove
31	1754	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:3 NS:3	0.10	0.14	2.00	1.50	Fair	Fair	Medium	Major	Remove
32	1755	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:5 NS:5	0.38	0.44	4.56	2.34	Very Poor	Very Poor	Low	Major	Remove
33	1756	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	10	EW:3 NS:3	0.21	0.26	2.52	1.88	Poor	Poor	Low	Major	Remove
34	1757	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	6	EW:4 NS:2	0.10	0.12	2.00	1.50	Fair	Fair	Low	Major	Remove
35	1758	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	11	EW:7 NS:7	0.34	0.47	4.08	2.41	Fair	Poor	Medium	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
36	1759	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:3 NS:3	0.10	0.16	2.00	1.53	Poor	Dead	Remove	Major	Remove
37	1760	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:3 NS:2	0.10	0.12	2.00	1.50	Fair	Fair	Low	Major	Remove
38	1761	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	13	EW:5 NS:5	0.29	0.40	3.48	2.25	Poor	Fair	Remove	Major	Remove
39	1762	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:1 NS:1	0.12	0.16	2.00	1.53	Very Poor	Dead	Remove	Major	Remove
40	1763	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:2 NS:2	0.20	0.25	2.40	1.85	Very Poor	Dead	Remove	Major	Remove
41	1764	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:2 NS:2	0.25	0.30	3.00	2.00	Very Poor	Dead	Remove	Major	Remove
42	1765	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:4 NS:4	0.10	0.12	2.00	1.50	Fair	Fair	Medium	Major	Remove
43	1766	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:2 NS:5	0.24	0.29	2.88	1.97	Very Poor	Very Poor	Low	Major	Remove
44	1767	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	6	EW:3 NS:5	0.10	0.12	2.00	1.50	Fair	Fair	Low	Major	Remove
45	1769	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:2 NS:2	0.13	0.15	2.00	1.50	Very Poor	Dead	Remove	Major	Remove
46	1768	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	12	EW:6 NS:6	0.38	0.44	4.56	2.34	Very Poor	Dead	Remove	Major	Remove
47	1770	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	13	EW:3 NS:5	0.26	0.32	3.12	2.05	Poor	Poor	Low	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
48	1771	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	12	EW:5 NS:5	0.29	0.35	3.48	2.13	Very Poor	Very Poor	Low	Major	Remove
49	1772	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:3 NS:3	0.12	0.18	2.00	1.61	Fair	Poor	Low	Major	Remove
50	1773	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	14	EW:8 NS:6	0.44	0.53	5.28	2.53	Fair	Fair	Medium	Major	Remove
51	1774	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:3 NS:6	0.13	0.20	2.00	1.68	Fair	Fair	Low	Major	Remove
52	1775	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:3 NS:3	0.10	0.13	2.00	1.50	Fair	Poor	Low	Major	Remove
53	1776	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:2 NS:2	0.10	0.13	2.00	1.50	Poor	Dead	Remove	Major	Remove
54	1777	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	10	EW:3 NS:3	0.20	0.23	2.40	1.79	Poor	Very Poor	Low	Major	Remove
55	1778	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	10	EW:2 NS:2	0.23	0.24	2.76	1.82	Poor	Dead	Remove	Major	Remove
56	1779	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	13	EW:4 NS:4	0.24	0.32	2.88	2.05	Poor	Very Poor	Low	Major	Remove
57	1780	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	13	EW:3 NS:3	0.26	0.30	3.12	2.00	Poor	Dead	Remove	Major	Remove
58	1781	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	14	EW:7 NS:8	0.37	0.37	4.44	2.18	Fair	Poor	Low	Major	Remove
59	1782	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	11	EW:2 NS:2	0.19	0.20	2.28	1.68	Poor	Very Poor	Low	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
60	1783	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	13	EW:7 NS:7	0.35	0.37	4.20	2.18	Poor	Very Poor	Low	Major	Remove
61	1784	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:4 NS:7	0.21	0.40	2.52	2.25	Fair	Fair	Medium	Major	Remove
62	1785	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:4 NS:7	0.21	0.40	2.52	2.25	Fair	Fair	Medium	Major	Remove
63	1786	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	10	EW:7 NS:7	0.29	0.32	3.48	2.05	Fair	Poor	Low	Major	Remove
64	1787	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	9	EW:4 NS:7	0.21	0.36	2.52	2.15	Fair	Fair	Medium	Major	Remove
65	1788	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:4 NS:4	0.14	0.19	2.00	1.65	Fair	Fair	Low	Major	Remove
66	1789	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	13	EW:5 NS:6	0.24	0.29	2.88	1.97	Fair	Fair	Medium	Major	Remove
67	1790	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	13	EW:6 NS:7	0.24	0.29	2.88	1.97	Fair	Fair	Medium	Major	Remove
68	1791	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	13	EW:5 NS:6	0.24	0.29	2.88	1.97	Poor	Very Poor	Low	Major	Remove
69	1702	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	13	EW:5 NS:6	0.30	0.41	3.60	2.28	Fair	Fair	Medium	Major	Remove
70	1793	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	6	EW:3 NS:3	0.10	0.13	2.00	1.50	Fair	Fair	Low	Major	Remove
71	1794	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	6	EW:3 NS:3	0.10	0.13	2.00	1.50	Fair	Fair	Low	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
72	1795	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	10	EW:8 NS:5	0.33	0.49	3.96	2.45	Fair	Fair	Medium	Major	Remove
73	1796	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	10	EW:8 NS:3	0.22	0.30	2.64	2.00	Fair	Fair	Medium	Major	Remove
74	1797	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	10	EW:6 NS:7	0.28	0.34	3.36	2.10	Fair	Fair	Medium	Major	Remove
75	1800	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	6	EW:4 NS:4	0.12	0.14	2.00	1.50	Fair	Good	Medium	Major	Remove
76	1801	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	10	EW:8 NS:8	0.46	0.52	5.52	2.51	Poor	Very Poor	Low	Major	Remove
77	1802	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:6 NS:7	0.76	0.90	9.12	3.17	Fair	Fair	High	Major	Retain & Protect
78	1803	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:6 NS:7	0.85	0.76	10.20	2.95	Fair	Poor	Medium	Major	Remove
79	1736	<i>Syzygium smithii</i> Lilly Pilly	Mature	5	EW:8 NS:9	0.46	0.63	5.52	2.73	Poor	Good	Medium	Major	Remove
80	1810	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:4 NS:4	0.12	0.14	2.00	1.50	Fair	Fair	Medium	Major	Remove
81	1809	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:4 NS:4	0.16	0.19	2.00	1.65	Fair	Fair	Medium	Major	Remove
82	1808	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:4 NS:4	0.16	0.19	2.00	1.65	Fair	Fair	Medium	Major	Remove
83	1806	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:4 NS:4	0.12	0.13	2.00	1.50	Fair	Fair	Medium	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
84	1807	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:4 NS:4	0.16	0.19	2.00	1.65	Fair	Fair	Medium	Major	Remove
85	1805	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:4 NS:4	0.16	0.19	2.00	1.65	Fair	Fair	Medium	Major	Remove
86	1804	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	8	EW:4 NS:4	0.15	0.17	2.00	1.57	Fair	Fair	Medium	Major	Remove
87	1811	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:9 NS:9	0.53	0.50	6.36	2.47	Fair	Fair	Medium	Major	Remove
88	1812	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:9 NS:9	0.48	0.52	5.76	2.51	Fair	Poor	Medium	Major	Remove
89	1813	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:8 NS:7	0.42	0.45	5.04	2.37	Fair	Fair	Medium	Major	Remove
90	1814	<i>Eucalyptus moluccana</i> Grey Box	Mature	9	EW:9 NS:9	0.21	0.22	2.52	1.75	Fair	Poor	Low	Major	Remove
91	1815	<i>Eucalyptus moluccana</i> Grey Box	Mature	9	EW:7 NS:7	0.33	0.42	3.96	2.30	Poor	Dead	Remove	Major	Remove
92	1817	<i>Eucalyptus moluccana</i> Grey Box	Mature	11	EW:9 NS:9	0.50	0.67	6.00	2.80	Fair	Poor	Medium	Major	Remove
93	1816	<i>Grevillea robusta</i> Silky Oak	Semi Mature	6	EW:3 NS:3	0.13	0.14	2.00	1.50	Good	Good	Medium	Major	Remove
94	1818	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:9 NS:10	0.47	0.56	5.64	2.59	Fair	Fair	Medium	Major	Remove
95	1819	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:8 NS:8	0.47	0.56	5.64	2.59	Fair	Fair	Medium	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
96	1820	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:9 NS:10	0.50	0.51	6.00	2.49	Fair	Fair	Medium	Major	Remove
97	1821	<i>Eucalyptus moluccana</i> Grey Box	Mature	13	EW:6 NS:6	0.35	0.42	4.20	2.30	Fair	Fair	Medium	Major	Remove
98	1823	<i>Eucalyptus moluccana</i> Grey Box	Mature	13	EW:9 NS:8	0.45	0.52	5.40	2.51	Fair	Fair	Medium	Major	Remove
99	1824	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:8 NS:8	0.35	0.40	4.20	2.25	Fair	Fair	Medium	Major	Remove
100	1822	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:4 NS:4	0.25	0.26	3.00	1.88	Fair	Fair	Medium	Major	Remove
101	1825	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:3 NS:3	0.27	0.30	3.24	2.00	Poor	Dead	Remove	Major	Remove
102	1826	<i>Eucalyptus moluccana</i> Grey Box	Mature	13	EW:6 NS:7	0.30	0.38	3.60	2.20	Fair	Fair	Medium	Major	Remove
103	1827	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:4 NS:6	0.25	0.30	3.00	2.00	Fair	Fair	Medium	Major	Remove
104	1828	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:7 NS:6	0.26	0.35	3.12	2.13	Fair	Fair	Medium	Major	Remove
105	1829	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:5 NS:5	0.27	0.30	3.24	2.00	Fair	Fair	Medium	Major	Remove
106	1830	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:7 NS:7	0.28	0.30	3.36	2.00	Fair	Poor	Low	Major	Remove
107	1831	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:3 NS:3	0.16	0.20	2.00	1.68	Fair	Fair	Medium	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
108	1832	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:5 NS:3	0.25	0.30	3.00	2.00	Fair	Fair	Medium	Major	Remove
109	1833	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:2 NS:4	0.30	0.40	3.60	2.25	Fair	Fair	Medium	Major	Remove
110	1834	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:4 NS:4	0.28	0.30	3.36	2.00	Poor	Dead	Remove	Major	Remove
111	1835	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:4 NS:7	0.31	0.35	3.72	2.13	Fair	Fair	Medium	Major	Remove
112	1836	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:4 NS:8	0.33	0.42	3.96	2.30	Fair	Fair	Medium	Major	Remove
113	1837	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:9 NS:10	0.46	0.52	5.52	2.51	Fair	Fair	Medium	Major	Remove
114	1838	<i>Eucalyptus moluccana</i> Grey Box	Mature	15	EW:10 NS:10	0.49	0.56	5.88	2.59	Fair	Fair	Medium	Major	Remove
115	1839	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:5 NS:5	0.28	0.30	3.36	2.00	Fair	Fair	Medium	Major	Remove
116	1840	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:7 NS:7	0.30	0.38	3.60	2.20	Fair	Fair	Medium	Major	Remove
117	1841	<i>Eucalyptus moluccana</i> Grey Box	Mature	15	EW:10 NS:10	0.98	1.02	11.76	3.34	Fair	Poor	Medium	Major	Remove
118	1842	<i>Eucalyptus moluccana</i> Grey Box	Mature	15	EW:8 NS:8	0.54	0.60	6.48	2.67	Fair	Fair	Medium	Major	Remove
119	1843	<i>Eucalyptus moluccana</i> Grey Box	Mature	15	EW:9 NS:9	0.52	0.60	6.24	2.67	Fair	Poor	Medium	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
120	1844	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:8 NS:8	0.42	0.43	5.04	2.32	Fair	Fair	Medium	Major	Remove
121	1845	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:10 NS:10	0.54	0.80	6.48	3.01	Fair	Fair	Medium	Major	Remove
122	1846	<i>Eucalyptus moluccana</i> Grey Box	Mature	16	EW:8 NS:8	0.43	0.50	5.16	2.47	Poor	Dead	Remove	Major	Remove
123	1847	<i>Eucalyptus moluccana</i> Grey Box	Mature	19	EW:9 NS:9	0.59	0.64	7.08	2.74	Fair	Fair	Medium	Major	Remove
124	1848	<i>Eucalyptus moluccana</i> Grey Box	Mature	18	EW:8 NS:9	0.44	0.44	5.28	2.34	Fair	Fair	Medium	Major	Remove
125	1850	<i>Eucalyptus moluccana</i> Grey Box	Mature	20	EW:8 NS:9	0.45	0.48	5.40	2.43	Fair	Fair	Medium	Major	Remove
126	1849	<i>Eucalyptus moluccana</i> Grey Box	Mature	20	EW:7 NS:7	0.35	0.42	4.20	2.30	Fair	Fair	Medium	Major	Remove
127	1851	<i>Eucalyptus moluccana</i> Grey Box	Mature	17	EW:8 NS:6	0.30	0.36	3.60	2.15	Fair	Fair	Medium	Major	Remove
128	1852	<i>Eucalyptus moluccana</i> Grey Box	Mature	15	EW:9 NS:9	0.48	0.54	5.76	2.55	Fair	Poor	Low	Major	Remove
129	1854	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:9 NS:9	0.32	0.40	3.84	2.25	Poor	Dead	Remove	Major	Remove
130	1855	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:9 NS:9	0.51	0.60	6.12	2.67	Good	Fair	Medium	Major	Remove
131	1856	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	8	EW:7 NS:7	0.40	0.40	4.80	2.25	Fair	Fair	Medium	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
132	1857	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:2 NS:2	0.12	0.15	2.00	1.50	Fair	Fair	Low	Major	Remove
133	1858	<i>Eucalyptus moluccana</i> Grey Box	Mature	11	EW:6 NS:6	0.27	0.30	3.24	2.00	Fair	Fair	Medium	Major	Remove
134	1859	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.20	0.20	2.40	1.68	Fair	Fair	Low	Major	Remove
135	1860	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:6 NS:6	0.29	0.36	3.48	2.15	Fair	Fair	Medium	Major	Remove
136	1861	<i>Eucalyptus moluccana</i> Grey Box	Mature	11	EW:6 NS:6	0.21	0.26	2.52	1.88	Fair	Fair	Medium	Major	Remove
137	1862	<i>Eucalyptus moluccana</i> Grey Box	Mature	11	EW:5 NS:5	0.27	0.34	3.24	2.10	Poor	Dead	Remove	Major	Remove
138	1863	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:6 NS:8	0.38	0.40	4.56	2.25	Fair	Poor	Medium	Major	Remove
139	1864	<i>Eucalyptus moluccana</i> Grey Box	Semi Mature	7	EW:4 NS:4	0.12	0.15	2.00	1.50	Fair	Fair	Low	Major	Remove
140	1865	<i>Eucalyptus moluccana</i> Grey Box	Mature	13	EW:6 NS:6	0.30	0.30	3.60	2.00	Poor	Dead	Remove	Major	Remove
141	1866	<i>Eucalyptus moluccana</i> Grey Box	Mature	13	EW:6 NS:6	0.30	0.30	3.60	2.00	Poor	Dead	Remove	Major	Remove
142	1868	<i>Eucalyptus moluccana</i> Grey Box	Mature	13	EW:6 NS:6	0.27	0.30	3.24	2.00	Poor	Dead	Remove	Major	Remove
143	1867	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.33	0.40	3.96	2.25	Fair	Fair	Low	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
144	1869	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.23	0.30	2.76	2.00	Fair	Fair	Low	Major	Remove
145	1870	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:7 NS:7	0.33	0.45	3.96	2.37	Fair	Fair	Low	Major	Remove
146	1871	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:4 NS:4	0.19	0.24	2.28	1.82	Poor	Dead	Remove	Major	Remove
147	1872	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:4 NS:4	0.16	0.20	2.00	1.68	Poor	Dead	Remove	Major	Remove
148	1873	<i>Eucalyptus moluccana</i> Grey Box	Mature	14	EW:7 NS:7	0.30	0.34	3.60	2.10	Poor	Dead	Remove	Major	Remove
149	1874	<i>Eucalyptus moluccana</i> Grey Box	Mature	10	EW:6 NS:8	0.32	0.38	3.84	2.20	Fair	Fair	Medium	Major	Remove
150	1877	<i>Eucalyptus moluccana</i> Grey Box	Mature	13	EW:6 NS:7	0.27	0.30	3.24	2.00	Fair	Fair	Low	Major	Remove
151	1878	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.33	0.40	3.96	2.25	Fair	Fair	Low	Major	Remove
152	1877	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.25	0.27	3.00	1.91	Fair	Fair	Low	Major	Remove
153	1875	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.33	0.40	3.96	2.25	Fair	Fair	Low	Major	Remove
154	1879	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.33	0.40	3.96	2.25	Fair	Fair	Low	Major	Remove
155	1880	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.33	0.40	3.96	2.25	Fair	Fair	Low	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
156	1881	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.33	0.60	3.96	2.67	Fair	Fair	Low	Major	Remove
157	1883	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.26	0.45	3.12	2.37	Fair	Fair	Low	Major	Remove
158	1884	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.25	0.64	3.00	2.74	Fair	Fair	Low	Major	Remove
159	1882	<i>Eucalyptus moluccana</i> Grey Box	Mature	12	EW:6 NS:6	0.35	0.36	4.20	2.15	Poor	Very Poor	Remove	Major	Remove
160	1885	<i>Eucalyptus moluccana</i> Grey Box	Mature	10	EW:8 NS:7	0.20	0.37	2.40	2.18	Fair	Fair	Medium	Major	Remove
161	1886	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.37	0.58	4.44	2.63	Fair	Fair	Low	Major	Remove
162	1888	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.26	0.30	3.12	2.00	Fair	Fair	Low	Major	Remove
163	1887	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.26	0.30	3.12	2.00	Fair	Fair	Low	Major	Remove
164	1893	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:5	0.13	0.26	2.00	1.88	Fair	Fair	Low	Major	Remove
165	1892	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	12	EW:10 NS:10	0.50	0.77	6.00	2.97	Fair	Fair	Medium	Major	Remove
166	1891	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	12	EW:9 NS:7	0.46	0.49	5.52	2.45	Fair	Fair	Medium	Major	Remove
167	1890	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	12	EW:8 NS:7	0.33	0.33	3.96	2.08	Fair	Fair	Medium	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
168	1889	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	12	EW:5 NS:5	0.27	0.38	3.24	2.20	Poor	Fair	Low	Major	Remove
169	1894	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:5	0.13	0.20	2.00	1.68	Fair	Fair	Low	Major	Remove
170	1895	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	9	EW:8 NS:7	0.44	0.40	5.28	2.25	Fair	Poor	Low	Major	Remove
171	1896	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	9	EW:8 NS:9	0.51	0.54	6.12	2.55	Fair	Fair	Low	Major	Remove
172	1897	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:3 NS:3	0.26	0.30	3.12	2.00	Poor	Dead	Remove	Major	Remove
173	1898	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:5	0.40	0.40	4.80	2.25	Fair	Fair	Low	Major	Remove
174	1899	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:9 NS:6	0.37	0.46	4.44	2.39	Fair	Poor	Low	Major	Remove
175	1900	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:7 NS:6	0.32	0.37	3.84	2.18	Fair	Fair	Low	Major	Remove
176	1901	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	10	EW:7 NS:8	0.40	0.45	4.80	2.37	Fair	Fair	Medium	Major	Remove
177	1902	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	10	EW:9 NS:8	0.54	0.73	6.48	2.90	Fair	Fair	Medium	Major	Remove
178	1903	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:7 NS:6	0.32	0.37	3.84	2.18	Fair	Fair	Low	Major	Remove
179	1904	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	10	EW:7 NS:7	0.32	0.37	3.84	2.18	Fair	Fair	Medium	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
180	1905	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	12	EW:7 NS:8	0.40	0.49	4.80	2.45	Fair	Fair	Medium	Major	Remove
181	1906	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:4 NS:4	0.21	0.26	2.52	1.88	Fair	Fair	Low	Major	Remove
182	1907	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	9	EW:7 NS:7	0.31	0.40	3.72	2.25	Fair	Fair	Low	Major	Remove
183	1908	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:9	0.32	0.40	3.84	2.25	Fair	Fair	Low	Major	Remove
184	1909	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	10	EW:7 NS:6	0.31	0.32	3.72	2.05	Fair	Fair	Low	Major	Remove
185	1910	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	10	EW:7 NS:5	0.31	0.33	3.72	2.08	Fair	Fair	Low	Major	Remove
186	1911	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	10	EW:5 NS:2	0.32	0.35	3.84	2.13	Fair	Fair	Low	Major	Remove
187	1912	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	10	EW:6 NS:7	0.32	0.36	3.84	2.15	Fair	Fair	Low	Major	Remove
188	1913	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:8 NS:8	0.44	0.46	5.28	2.39	Fair	Fair	Low	Major	Remove
189	1914	<i>Melaleuca styphelioides</i> Prickly-leaved Paperbark	Mature	7	EW:6 NS:6	0.27	0.34	3.24	2.10	Fair	Fair	Low	Major	Remove
190	1915	<i>Eucalyptus fibrosa</i> Broad-leaved Ironbark	Mature	21	EW:15 NS:13	0.78	0.92	9.36	3.20	Fair	Good	High	Major	Retain & Protect
191	1916	<i>Eucalyptus fibrosa</i> Broad-leaved Ironbark	Semi Mature	7	EW:4 NS:4	0.16	0.19	2.00	1.65	Good	Good	Medium	Major	Remove

No.	Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	SRZ (m)	TPZ (m)	Structure	Vitality	Retention Value	Encroachment	Retain Remove
192	1917	<i>Eucalyptus punctata</i> Grey Gum	Mature	22	EW:20 NS:20	1.12	1.15	13.44	3.51	Fair	Fair	High	Major	Retain & Protect
193	1918	<i>Eucalyptus botryoides</i> Southern Mahogany	Mature	23	EW:26 NS:20	1.39	1.90	15.00	4.33	Fair	Poor	High	Major	Retain & Protect

KEY

- **Canopy Spread:** estimation of canopy spread to the four (4) cardinal points. (North-South) & (East-West).
- **DBH (Diameter at Breast Height) & DRC (Diameter above Root Collar), TPZ & SRZ** calculated per *Qld Arboricultural Association & ProofSafe Calculators*.
- **Encroachment % (Ench %):** calculated per *Qld Arboricultural Association & ProofSafe Calculators*. (**Minor** or **Major** per AS4970-2009)
- **Structure & Vitality** per *International Society of Arboriculture (ISA) Tree Condition Rating System (2015) descriptors & (Coder, 2021)*
- **Retention Value:** *Significance of a Tree, Assessment Rating System (STARS), Institute of Australian Consulting Arboriculturists, Australia (2010)*.
 - ❖ **Low:** These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
 - ❖ **Medium:** These trees are moderately important for retention. Their removal should only be considered if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
 - ❖ **High:** These trees are considered important for retention and should be retained and protected. Initial Non-Destructive Root Exploration (Root Mapping) should be implemented. Tree Sensitive Design modification and/or re-location of building/s should be considered to accommodate the setbacks as prescribed per *Standards Australia AS 4970 Protection of trees on development sites*.

*Please note that the Projects boundaries and infrastructure footprints may be modified in the effort to accommodate trees. Therefore, if it is foreseeable that a tree earmarked for removal may remain viable, this tree is to be retained until further arboricultural investigation from the appointed Project Arborist and viability / retention determined.

Part 2: SITE SPECIFIC TREE PROTECTION PLAN

7 Introduction

7.1 Disclaimer

- i. The following site-specific Tree Protection Plan is to be adopted for the duration of the abovementioned 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.'

7.2 Overview

- i. Trees are dynamic living organisms and therefore are susceptible to development impact either direct and/or indirect, biotic and/or abiotic. Arboricultural impact due to development encroachment, especially within the calculated Tree Protection Zone (TPZ), causes 'dendrological stress' in varying degrees. This stress has the potential to heavily impact upon tree vitality and thus tree longevity (Boddy, 1983).
- ii. Therefore, the Australian Standard *AS4970-2009 Protection of trees on development sites* must always be adhered to. The objective of this Standard is to provide guidance through the use of a science-based methodology to arborists and others concerned with the care and protection of trees; and all others interested in the integration between trees and construction. Hence safeguarding community tree assets.
- iii. 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.
- iv. The control framework 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). The engagement of a Project Arborist is a key element of the control framework and is a multi-faceted control, in terms of preventing damage, providing direction and detecting areas of non-compliance/improvement.

7.3 Project Arborist Site Inspection Schedule

- i. In accordance with the Australian Standard *AS4970-2009 Protection of Trees on Development Sites*, inspections must 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 48 hours' notice. To ensure the tree protection plan is implemented, hold points have been specified in the following table.

Schedule of Development Hold Points

Development Stage	Hold Point	Description
Pre-Construction	1	<ul style="list-style-type: none"> • Appoint a Project Arborist (minimum AQF Level 5) • Prior to any development works, any tree for removal is to be marked clearly (tape, paint, tag etc.) by the Project Arborist
	2	<ul style="list-style-type: none"> • Scheduled 'Pre-Start' meeting. • Tree Protection for any retained tree(s) will be installed prior to demolition and/or site establishment. The appointed arborist will inspect and certify the tree protection per the Tree Protection Management Plan. A Tree Protection Compliance Memorandum issued.
During Construction	3	<ul style="list-style-type: none"> • Monthly scheduled site inspections of the retained tree population will be conducted (if works are outside the TPZ) and memorandum provided.
	4	<ul style="list-style-type: none"> • The appointed Project Arborist will oversee, and document all works carried out within the TPZ of any retained tree. A weekly Works Memorandum to be provided.
	5	<ul style="list-style-type: none"> • Visual tree inspection by the appointed arborist of the retained tree population once the major works have been completed and the tree protection has been removed.
Post Construction	6	<ul style="list-style-type: none"> • Final Visual Tree Inspection of the retained tree population and a Completion of Arboricultural Works Memorandum provided. • Ongoing Monthly Inspections & Memorandums issued at the discretion of the Project Arborist.
Plant Health Care (PHC)	7	<ul style="list-style-type: none"> • Top dressing of Organic Mulch – where applicable. • Liquid solution of Organic nutrients (Botanicals). • PHC Memorandum provided.

7.4 Summary

- i. The following Tree Protection Management Plan is to be distributed with the understanding that it shall be adhered to at all times.
- ii. A pre-commencement of work ('Pre-Start') onsite meeting must be held with the appointed Project Arborist and all other parties deemed to have *locus standii*.
- iii. Proactive 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 per a Pruning Specifications Report.
- iv. Tree Protection Fencing is to be erected. Temporary hard surfaces are to be made readily available and on site whilst working within close proximity of the tree(s) Tree Protection Zone. (*Refer Appendix*).
- v. 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 Tree Protection Zone (TPZ) of any tree, the excavations must be undertaken by initial Non-Destructive Root Exploration 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.
- vi. The Project Arborist is to author and provide a Completion of Arboricultural Works Memorandum at the end of the works/project.
- vii. Plant Health Care to be applied post-development with a memorandum provided.
- viii. Monthly inspections to be conducted, the observations documented, and a Monthly Inspection Memorandum issued. (These inspections will conducted per the Tree Management Plan and at the Project Arborist discretion).
- ix. A Completion of Arboricultural Works Memorandum is issued by the Project Arborist. This will include any post completion PHC and Visual Tree Assessment recommendations and the accompanying Arboricultural Memorandums.

7.5 General Comments

- i. All construction work within the TPZ of any retained tree must be authorised & supervised by the appointed Arborist.
- ii. The use of amended construction methodology and air excavation along exposed TPZ perimeter(s) and/or minor areas of proposed incursion will assist to ensure ground disturbance and damage to tree roots is minimised within the TPZ of affected trees.
- iii. If the removal of an existing surface (concrete or similar) must occur from above the existing surface the removal work is to be carried out with a straight batter bucket with the machinery operated in a backward direction toward the extremity. Due care must be taken to ensure that the TPZ of adjacent tree(s) are

isolated and protected from vehicular entry and therefore soil compaction within the TPZ of retained trees.

- iv. The addition of new soil and replanting must be carried out with due care. There shall be no use of strip style excavation adjacent to or within the TPZ of any retained tree.
- v. 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 guidance of the Project Arborist.
- vi. It is imperative that TPZ fencing, or branch /stem 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.
- vii. 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.

7.6 Restricted activities within the Tree Protection Zone per AS4970-2009

- i. Activities generally excluded from the TPZ include but are not limited to:
 - a) Machine excavation including trenching.
 - b) Cultivation.
 - c) Storage.
 - d) Preparation of chemicals, including preparation of cement products.
 - e) Parking of vehicles and plant.
 - f) Refuelling.
 - g) Dumping of waste.
 - h) Wash down and cleaning of equipment.
 - i) Placement of fill.
 - j) Soil level changes.
 - k) Temporary or permanent installation of utilities and signs, and
 - l) Physical damage to the tree.

8 Tree Protection Control Framework

8.1 Compliance and Reporting

- i. The generic tree protection controls in this section are designed to be used in conjunction with the recommendations of the site-specific Arboricultural Impact Assessment.
- ii. All relevant standards, specifications, policies and resource conditions of consent are incorporated into the TPP.
- iii. The Project Arborist will undertake scheduled and unscheduled site visits to monitor compliance with all aspects of the TPP.
- iv. Any deviations from the TPP must be approved by the Council Arborist. Non-compliance issues must be reported to the Project Management immediately.
- v. 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.
- vi. The TPP must always be available on site and be included in site inductions and 'toolbox' sessions.
- vii. 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).
- viii. Non-compliance issues must be documented and addressed at daily pre-start meetings/toolbox sessions.

8.2 Root Pruning

- 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. Roots must be severed using a sharp pruning saw/tool to create a clean cut that is flush with the face of the completed excavations.
- iii. 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.

8.3 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 utilising 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 sterilising agent, such as Trigenene or Sterigene).

8.4 Canopy Modifications

- i. All pruning assessments pertaining to the development should be made by a suitably qualified and experienced Project Arborist (minimum AQF Level 5). If pruning is deemed necessary to accommodate the development works a Pruning Specifications Report is to be authored *per AS4373-2007 Pruning of amenity trees* by the Project Arborist and subsequently provided to the Council.
- ii. Once Council has formerly approved the requested pruning per the Pruning Specifications Report, this pruning can be carried out by a suitably qualified and experienced Arborist (minimum AQF Level 3), under the guidance of the Project Arborist pursuant to *AS4373-2007 Pruning of amenity trees*. Please note that any pruning (planned or reactive in response to damage) must only be completed by suitably qualified Arborist in line with current industry best practice.
- 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 sterilising agent, such as Trigenene 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.

8.5 Tree Protection Zones

- i. Tree Protection Zones are also Exclusion Zones and must be created using tree protection fencing that is consistent with the requirements of *AS4970-2009 Protection of trees on development sites*. The position of the fencing will be determined by the Project Arborist and once positioned 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. *(Please refer to the diagram in the appendix).*

- 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.
- iv. 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.
- v. 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.
- vi. Operating plant must be positioned to avoid the expellant of exhaust fumes and radiant operating heat damaging the physiological functions of the tree.

9 Plant Health Care

9.1 Overview

- i. 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.
- ii. 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, property and/or the environment.
- iii. 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.

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 applied. This should include:
- ii. *(1a) Application of Botanicals:* Organic materials are essential components which stimulate vitality leading to root development and thus development of new tissue whilst enacting a tree's defence system improving resistance to disease and increasing defence responses and capabilities. Therefore, it is

recommended that a mix of organics consisting of composted tea, raw humates, seaweed extracts, oily fish hydrolysate, Biochar and/or a combination of be applied in liquid form to the subject trees rootzone.

iii. *(1b) Organic Mulching:* Any work conducted within the TPZ of a tree can cause ‘dendrological stress’ (Boddy, 1983). Therefore, 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. This layer should be added to a depth of 60-70mm (Gilman, 1997). The use of mulch is a key component of successfully protecting and retaining trees, especially in the urban environment (Bassuk and Day 1993). A composted mulch application will:

- Prevent soil compaction and minimise future root damage.
- Amend soil structure to improve the water-holding capacity and fertility by affecting both texture, porosity and structure.
- Reduce soil moisture loss through lower temperatures & suppress undesirable plant species.
- Promote root generation & increase soil organic matter and avail nutrients to the tree.
- Stimulate soil microflora and micro fauna activity and assist in the survival of affected tree(s) maintaining and ensuring optimum vitality and structural stability so as to maximize its ability to resist pest and diseases (Bassuk and Day, 1993), (Scharenbroch et al., 2013).

iv. Please note that all the above-mentioned materials used are to be supplied per *Standards Australia AS4454-2012 - Composts, Soil Conditioners and Mulches*.



Indicative root growth relating to soil structure (adapted from the International Society of Arboriculture)

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11 Glossary

The following definitions are stated in the Glossary of Arboricultural Terms, International Society of Arboriculture 2011, 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.

Age class: Described as Young, Semi-Mature, Mature, Over Mature or Veteran. All these dimensions should be determined by species and site factors.

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*.

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: Portion of the tree consisting of branches and leaves and any part of the trunk from which branches arise.

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-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.

Minor encroachment (<10%): If the proposed encroachment is less than 10% (total area) of the TPZ, and outside of the SRZ, detailed root investigations should not be required. The area lost to this encroachment should be compensated for elsewhere and be contiguous with the TPZ.

Major encroachment (>10%): If the proposed encroachment is greater than 10% (total area) of the TPZ, the project arborist must demonstrate that the tree(s) remain viable. The area lost to this encroachment should be compensated for elsewhere and be contiguous with the TPZ. Tree sensitive construction techniques may be used for minor works within this area providing no structural roots are likely to be impacted, and the project arborist can demonstrate that the tree(s) remain viable. Root investigation by non-destructive methods may be required for proposed works within this area. All work within the TPZ must be carried out under the supervision of the project arborist.

Mature: Trees are close to their full height and crown size.

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)

Necrosis: Localised death of tissue in a living organism.

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

Over Mature: Associated with crown retrenchment.

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): The SRZ is the area of the root system (as defined by AS 4970-2009) used for stability, mechanical support, and anchorage of the tree. Severance of structural roots (>50 mm in diameter) within the SRZ is not recommended as it may lead to the destabilisation and/or serious decline of the tree.

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): AS 4970-2009 – *Protection of trees on development sites s1.4.7*, Tree Protection Zone (TPZ): A specified area above and below ground and at a given distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage 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.

Young: Trees have not yet reached 1/3 of their expected mature height. They are generally growing vigorously and have high apical dominance.

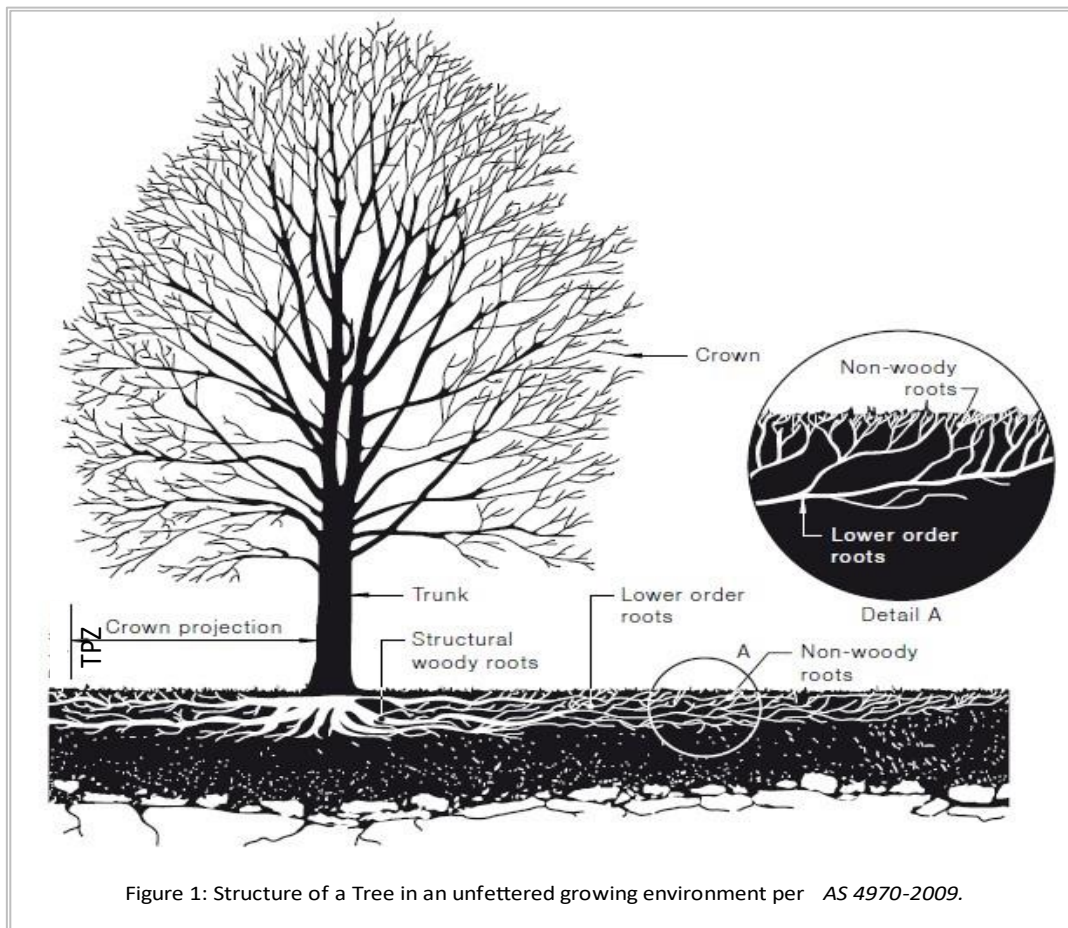
Zone of Rapid Taper: The area within 1–2m of the trunk on larger trees is frequently referred to as the 'Zone of Rapid Taper' because structural roots found there often exhibit considerable secondary thickening- not present on roots farther from the trunk (*Wilson 1964*). *Wilson (1964)* additionally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

Ref: JN 89861
AMRF First Building, Bringelly (AIA).



12 Appendix

12.1 Root Morphology Considerations



Indicative Root System and Rhizosphere of a Healthy Tree.

- 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 1 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 (Perry, 1982) (Watson and Neely, 1994).
- iv. 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).

12.2 Encroachment Descriptors

Tree Protection Zone (TPZ):

The TPZ is the optimal combination of crown and root area (as defined by AS 4970-2009) that requires protection during the construction process so that the tree can remain viable. The TPZ is an area that is isolated from the work zone to ensure no disturbance or encroachment occurs into this zone. Tree sensitive construction measures must be implemented if work is to proceed within the Tree Protection Zone.

Diameter at Breast Height (DBH) measured at 1.4m above ground level. DBH is the circumference divided by π . * Measurement taken by Standard issue DBH Tape.

Tree Protection Zone (TPZ) = DBH x 12 (The radius of the TPZ is calculated for each tree by multiplying its DBH x 12) Note: TPZ - minimum area is 2.0m / maximum area is 15m.

Please Note: The TPZ figure is expressed as a radius measurement which is to be taken from the centre of the stem at ground level and applied in an outwards direction towards the extremities of the branches for the entire circumference of the tree/s.

Structural Root Zone (SRZ):

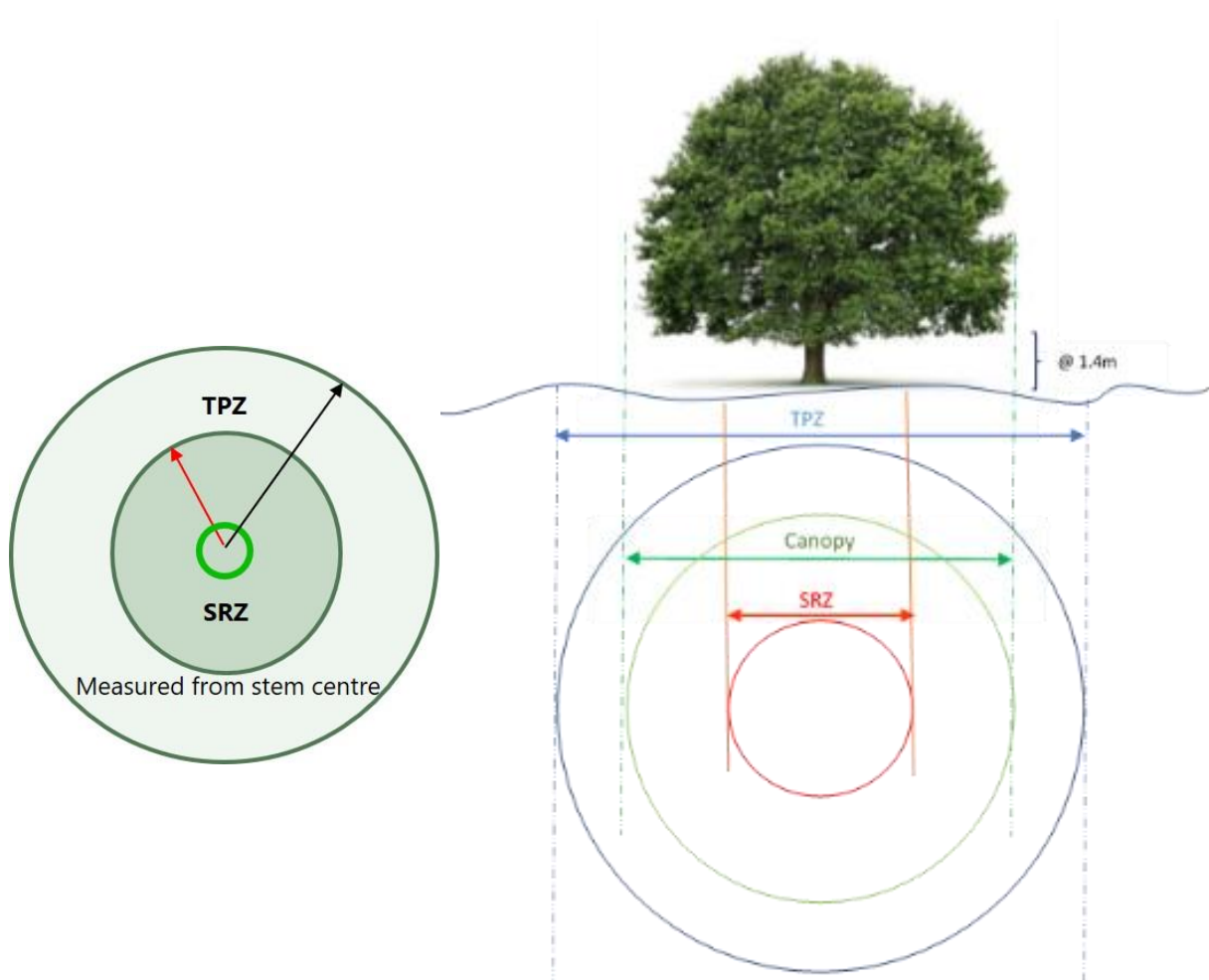
The SRZ is the area of the root system (as defined by AS 4970-2009) used for stability, mechanical support and anchorage of the tree. Severance of structural roots (>50 mm in diameter) within the SRZ is not recommended as it may lead to the destabilisation and/or serious decline of the tree.

Root Investigation:

When assessing the potential impacts of encroachment within the TPZ, consideration will need to be given to the location and distribution of the roots, including above or below ground restrictions affecting root growth. Location and distribution of roots may be determined through non-destructive excavation (NDE) methods such as air spade and manual excavation. Root investigation is used to determine the extent and location of roots within the zone of conflict. Root investigation does not guarantee the retention of the tree.

12.3 Tree Protection Zone (TPZ) & Structural Root Zone (SRZ).

The Australian Standard *AS 4970-2009 - Protection of trees on development sites* is used for the allocation of tree protection zones. This method provides a TPZ that addresses both tree stability and growth requirements. TPZ distances are measured as a radius from the centre of the trunk at ground level.

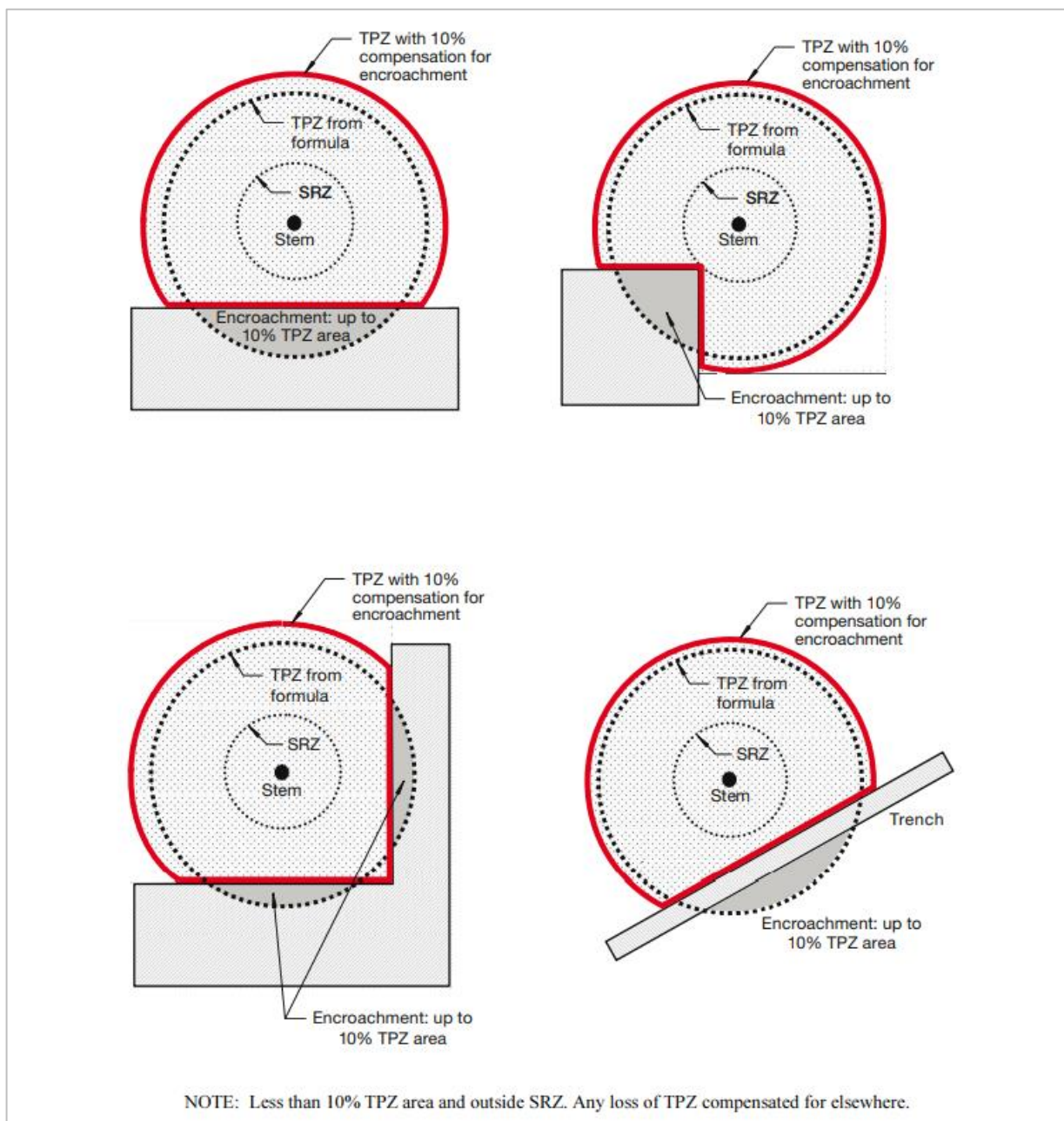


- AS4970-2009, s3: The radius of the TPZ is calculated for each tree by multiplying its Diameter @ Breast Height measured @ 1.4m from ground level ($DBH \times 12 = TPZ$). ($DBH = \text{Trunk Girth @ 1.4m} \div \pi$).
- To calculate the SRZ: Radius SRZ = Diameter Above Root Crown ($DRC \times 50$) $^ 0.42 \times 0.64$. If the DRC is less than 0.15m the SRZ will be 1.5m.
- Note: A TPZ should not be less than 2m or more than 15m from the tree stem.

You do not need to calculate the TPZ of palms, cycads and tree ferns. For these plants, the TPZ should not be less than 1m outside the crown.

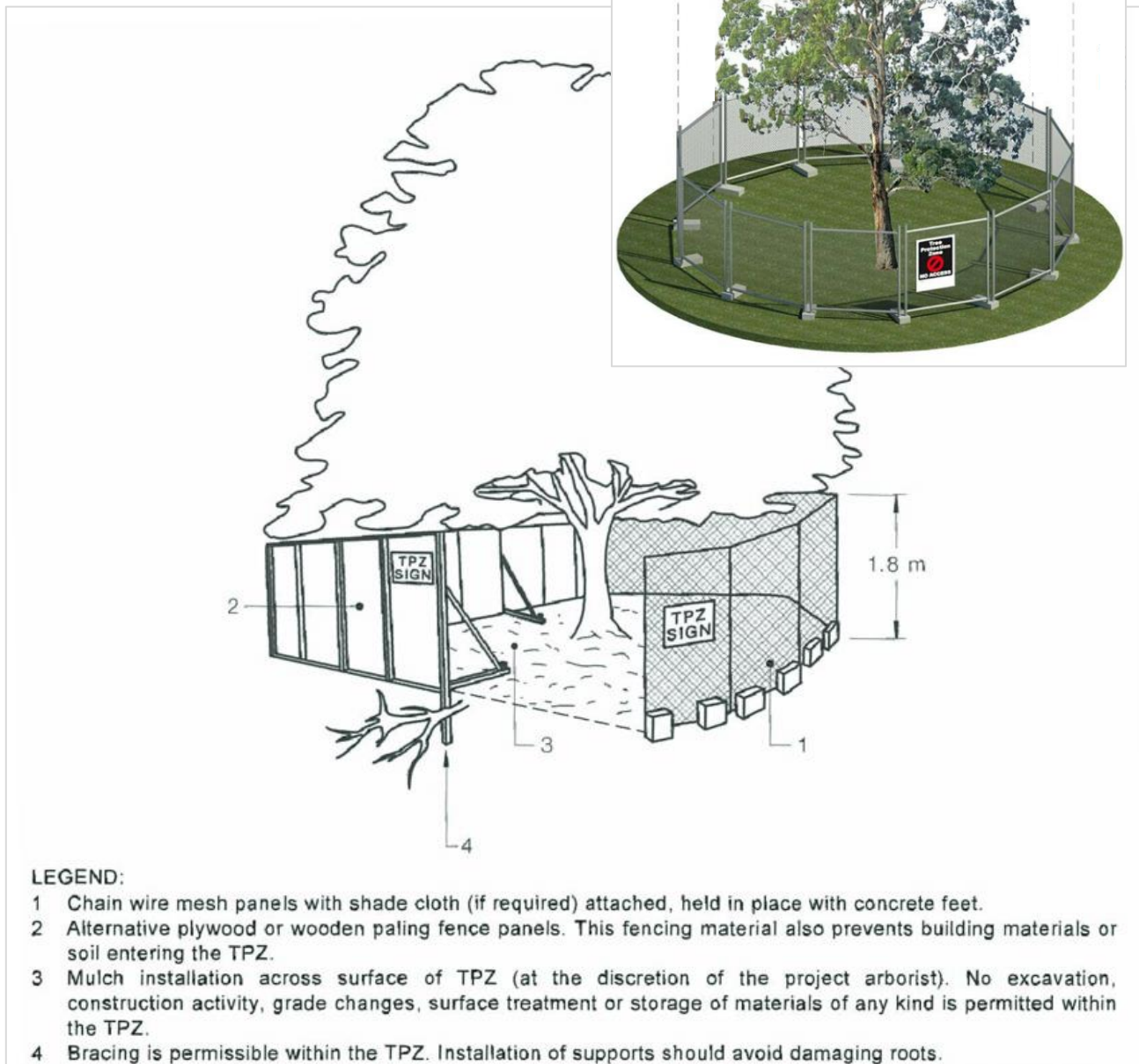
12.4 Compensation for Tree Protection Zone Encroachment

Encroachment into the Tree Protection Zone (TPZ) is sometimes unavoidable. The images above are analogous to the abovementioned works scenario and indicate how encroachment within the tree protection zone can be compensated for elsewhere per *AS 4970-2009 Protection of Trees on Development Sites*.



12.5 Tree Protection Installations

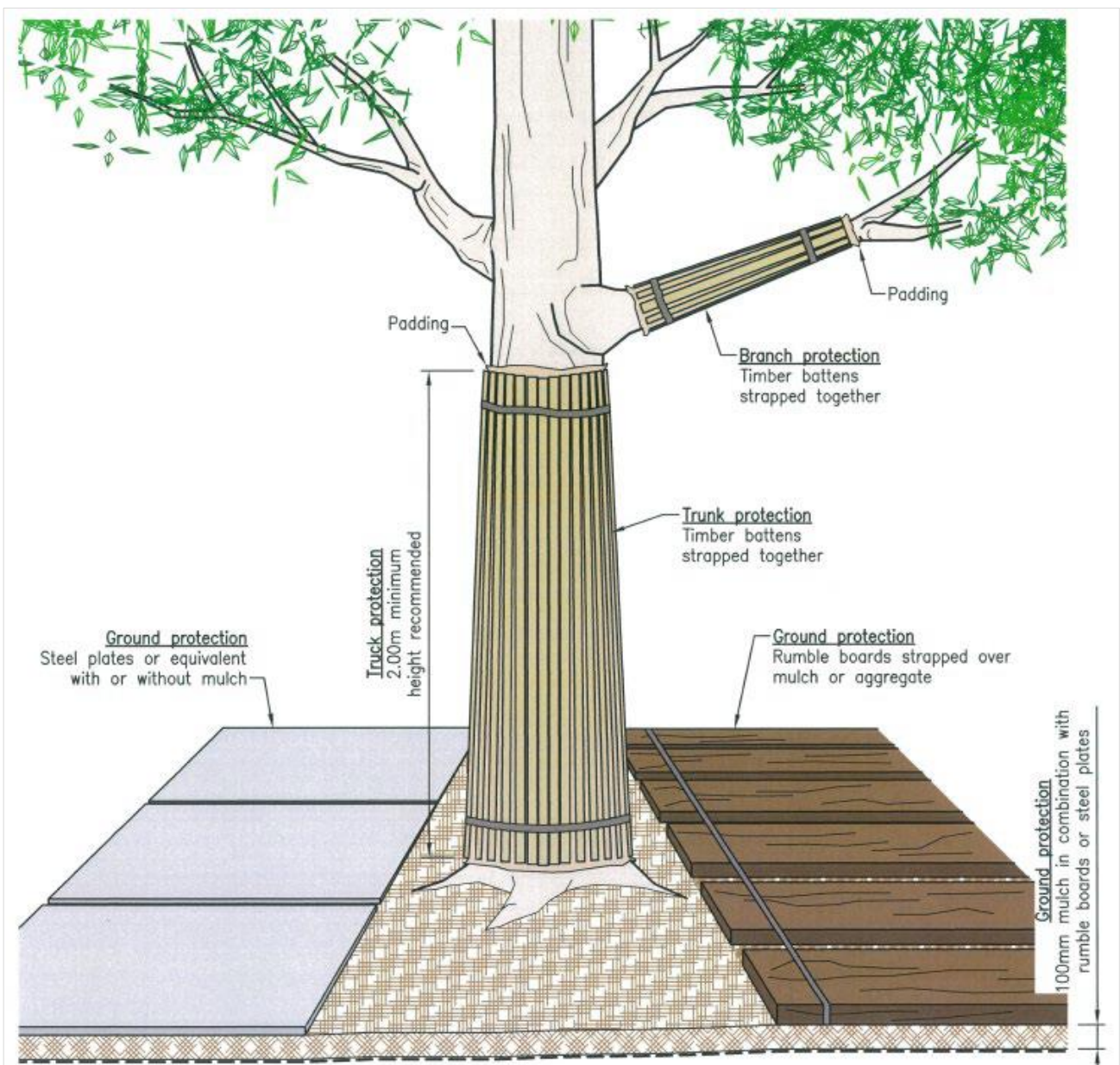
Tree Protection Fencing



Alternative Trunk, Branch & Ground Protection

- 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.
- 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 2m is recommended. Boards are to be strapped to trees, not nailed or screwed.

- Do not attach temporary powerlines, stays, guys and the like 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.
- A Tree Protection Installation Compliance Memorandum is issued by the appointed Project Arborist on satisfactory completion.



AS4970-2009: Branch, Trunk & Ground Protection for retained trees within 5m of development works

12.6 Descriptors: Age, Vitality & Structure

(Per International Society of Arboriculture guidelines)

TREE AGE CLASS

Young Juvenile or recently planted approximately 1-7 years.
Semi-mature Tree actively growing in size and yet to achieve the expected size <i>in situ</i> .
Maturing Tree is approaching the expected size or has reached the expected size <i>in situ</i> .
Senescent Tree is over mature and has started to decline.

TREE VITALITY

Excellent: The tree is demonstrating excellent or exceptional growth. The tree should exhibit a full canopy of foliage and be free of pest and disease problems.
Good: Foliage of 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.
Dead or dying: Tree is in severe decline; >55% deadwood, very little foliage, possibly Epicormic shoots and minimal extension growth.
Dead: 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

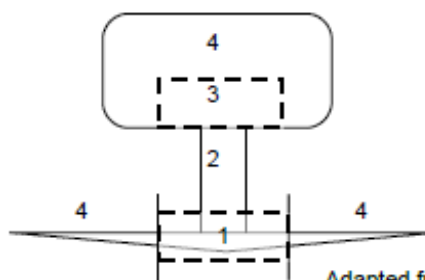
<p>Good: Trunk and scaffold branches show good taper and attachment with minor or no structural defects. Tree is a good example of species with well-developed form showing no obvious root problems or pests and diseases.</p>
<p>Fair/Fair-Poor: Tree shows minor structural defects or minor damage to trunk e.g. bark missing, there could be cavities present. Minimal damage to structural roots. Tree could be seen as typical for this species.</p>
<p>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.</p>
<p>Hazardous: Tree is immediate hazard with potential to fail, this should be rectified as soon as possible.</p>

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



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.

12.7 Descriptors: Estimated Life Expectancy (ELE)

The ELE is adapted from (*Barrell, 2001*). The objective of a 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	Short	Medium	Long
<p>Trees with a high level of risk that would need removing within the next 5 years.</p> <p>Dead trees.</p> <p>Trees that should be removed within the next 5 years.</p> <p>Dying or suppressed or declining trees through disease or inhospitable conditions.</p> <p>Dangerous trees through instability or recent loss of adjacent trees.</p> <p>Dangerous trees through structural defects including cavities, decay, included bark, wounds or poor form.</p> <p>Damaged trees that considered unsafe to retain.</p> <p>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.</p> <p>Trees that will become dangerous after removal of other trees for the reasons.</p>	<p>Trees that appear to be retainable with an acceptable level of risk for 5-15 years.</p> <p>Trees that may only live between 5 and 15 more years.</p> <p>Trees that may live for more than 15 years but would be removed to allow the safe development of more suitable individuals.</p> <p>Trees that may live for more than 15 years but would be removed during the course of normal management for safety or nuisance reasons.</p> <p>Storm damaged or defective trees that require substantial remedial work to make safe and are only suitable for retention in the short term.</p>	<p>Trees that appear to be retainable with an acceptable level of risk for 15-40 years.</p> <p>Trees that may only live between 15 and 40 more years.</p> <p>Trees that may live for more than 40 years but would be removed to allow the safe development of more suitable individuals.</p> <p>Trees that may live for more than 40 years but would be removed during the course of normal management for safety or nuisance reasons.</p> <p>Storm damaged or defective trees that require substantial remedial work to make safe and are only suitable for retention in the short term.</p>	<p>Trees that appear to be retainable with an acceptable level of risk for more than 40 years.</p> <p>Structurally sound trees located in positions that can accommodate future growth.</p> <p>Storm damaged or defective trees that could be made suitable for retention in the long term by remedial tree surgery.</p> <p>Trees of special significance for historical, commemorative or rarity reasons that would warrant extraordinary efforts to secure their long-term retention</p>

12.8 IACA Significance of Tree, Assessment Rating System (STARS)

Institute of Australian Consulting Arboriculturists (IACA) Significance of a Tree, Assessment Rating System (STARS)		
<i>The tree is to have a minimum of 3 criteria in a category to be classified in that group</i>		
Low	Medium	High
<p>The tree is in fair-poor condition and good or low vigour.</p> <p>The tree has form atypical of the species.</p> <p>The tree is not visible or is partly visible from the surrounding properties or obstructed by other vegetation or buildings.</p> <p>The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area.</p> <p>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.</p> <p>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.</p> <p>The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms.</p> <p>The tree has a wound or defect that has the potential to become structurally unsound.</p> <p><u>ENVIRONMENTAL PEST/NOXIOUS WEED</u></p> <p>The tree is an environmental pest species due to its invasiveness and/or poisonous/allergenic, properties/declared noxious weed.</p> <p><u>HAZARDOUS / IRREVERSIBLE DECLINE</u></p> <p>The tree is structurally unsound unstable and considered potentially dangerous.</p> <p>The tree is dead or in irreversible decline with the potential to fail/collapse.</p>	<p>The tree is in fair to good condition.</p> <p>The tree has form typical or atypical of the species.</p> <p>The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area.</p> <p>The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street.</p> <p>The tree provides a fair contribution to the visual character and amenity of the local area.</p> <p>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.</p>	<p>The tree is in good condition and good vigour.</p> <p>The tree has a form typical for the species.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values.</p> <p>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.</p>

12.9 Additional Landscape Significance Considerations

CATERGORY	HERITAGE VALUE	ECOLOGICAL VALUE	AMENITY VALUE
SIGNIFICANT	<p>*The subject site is listed as a Heritage Item at a local, state or National level of significance or is listed as a Significant/Notable tree.</p> <p>* The subject tree is a Commemorative Planting having been planted by an important historical person(s) or to commemorate an important historical event.</p>	<p>*The subject tree is scheduled as a 'Threatened Species' as defined under the Biodiversity Conservation Act 2016.</p> <p>*The tree is a locally indigenous species, representative of the original vegetation of the area and is known as an important food, shelter or nesting tree for endangered or threatened fauna.</p> <p>*The subject tree is a Remnant Tree, being a tree in existence prior to development of the area.</p>	<p>*The subject tree has a very large live crown size exceeding 100m² with normal to dense foliage cover, is located in a prominent position in the landscape, and exhibits very good form typical of the species.</p> <p>*The subject tree makes a significant contribution to the amenity & visual character of the area by creating a sense of identity.</p> <p>*The tree is visually prominent in view from surrounding areas, being a landmark or visible from a considerable distance.</p>
HIGH	<p>The tree has a strong historical association with a Heritage Item (building/structure/etc) within or adjacent the property and/or exemplifies a particular era or style of landscape design associated with the original development of the site.</p>	<p>The tree is a locally indigenous species, representative of the original vegetation of the area and is a dominant or associated canopy species of an Endangered Ecological Community formerly occurring in the area occupied by the site.</p>	<p>The subject tree has a very large live crown exceeding 60m²; crown density exceeding 70%, very good representative of the species in terms of form & branching habit, is aesthetically distinctive & makes a positive contribution to the visual character & the amenity of value of the area.</p>

<p>MODERATE</p>	<p>The tree has a suspected historical association with a heritage item or landscape supported by anecdotal or visual evidence.</p>	<p>The tree is a locally indigenous species & representative of the original vegetation of the area & the tree is located within a defined Vegetation Link/Wildlife Corridor or has well known habitat value.</p>	<p>A good representative of the species in terms of form & branching habit with minor deviations from normal. Crown density at least 70% (normal); the tree is visible from the street and/or surrounding properties & makes a positive contribution to the visual amenity of the area.</p>
<p>LOW</p>	<p>The subject tree detracts from Heritage values or diminishes the value of a Heritage Item.</p>	<p>The subject tree is possibly scheduled as exempt under the provisions of this Development Control Plan due to its species, or tree can be a nuisance or its position problematic – relative to buildings or other structures.</p>	<p>The subject tree has a small live crown size of less than 25m² & can be replaced within the short-term (5-10yrs) with new planting.</p>
<p>VERY LOW</p>	<p>The subject tree is causing damage to a Heritage Item.</p>	<p>The subject tree is listed as an Environmental Weed Species in the Local Government Area, being invasive, or is a known nuisance species.</p>	<p>The subject tree is not visible from surrounding properties & has a negative impact on the amenity & visual character of the area. The tree is a poor representative of the species, showing significant deviations from the typical form & branching habit with a crown density of less than 50%.</p>

(STARS) Tree Retention Value - Priority Matrix

IACA, 2010, IACA Significance of a Tree, Assessment Rating System (STARS), Institute of Australian Consulting Arboriculturists, Australia, (www.iaca.org.au).

		Significance				
		1.High	2.Medium	3.Low		
		Significance in Landscape	Significance in Landscape	Significance in Landscape	Environmental Pest/Noxious Weed Species	Hazardous / Irreversible Decline
Estimated Life Expectancy	1.Long >40 Years	Blue	Green	Yellow	Orange	
	2.Medium 15-40 Years					
	3.Short <1-15 Years	Yellow				
	Dead	Orange				
Blue		<p>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>AS 4970 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 TPZ).</p>				
Green		<p>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.</p>				
Yellow		<p>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>				
Orange		<p>Priority for Removal - These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.</p>				

12.10 Assumptions and Limiting Conditions

- 1) Active Green Services Pty Ltd (herein after referred to as AGS) contracts with you on the basis that you promise that all legal information which you provide, including land title and ownership of other property, are correct. AGS is not responsible for verifying or ascertaining any of these issues.
- 2) AGS contracts with you on the basis that your promise that all affected property complies with all applicable statutes and subordinate legislation.
- 3) AGS will take all reasonable care to obtain necessary information from reliable sources and to verify data. However, AGS neither guarantees nor is responsible for the accuracy of information provided by others.
- 4) If, after delivery of this report, you later require a representative of AGS to attend court to give evidence or to assist in the preparation for a hearing because of this report, you must pay an additional hourly fee at our then current rate for expert evidence.
- 5) Alteration of this report invalidates the entire report.
- 6) AGS retains the copyright in this report. Possession of the original or a copy of this report does not give you or anyone else any right of reproduction, publication or use without the written permission of AGS.
- 7) The contents of this report represent the professional opinion of the consultant. AGS consultancy fee for the preparation of this report is in no way contingent upon the consultant reporting a particular conclusion of fact, nor upon the occurrence of a subsequent event.
- 8) Sketches, diagrams, graphs and photographs in this report are intended as visual aids, are not to scale unless stated to be so, and must not be construed as engineering or architectural reports or as surveys.
- 9) Unless expressly stated otherwise:
 - a. The information in this report covers only those items which were examined and reflects the condition of those items at the time of the inspection.
 - b. Our inspection is limited to visual examination of accessible components without dissection, excavation or probing. There is no warranty or guarantee, express or implied, that even if they were not present during our inspection, problems or defects in plants or property examined may not arise in the future.
- 10) This Report supersedes all prior discussions and representations between AGS and the client on the subject.

12.11 AGS Quality Control

Document control

File reference	File type	Modifications	Date
JN 89861	AR	Original document	14/10/2022
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Review register

Date	File reference	Reviewer	Qualification	Company
14/10/2022	JN 89861 Arboricultural Impact Assessment Report	I. Dunsmuir	Arborist (AQF 5)	Active Green Services
18/10/2022	JN 89861 Arboricultural Impact Assessment Report (V2)	I. Dunsmuir	Arborist (AQF 5)	Active Green Services
27/10/2022	JN 89861 Arboricultural Impact Assessment Report (V3)	I. Dunsmuir	Arborist (AQF 5)	Active Green Services