

ARBORICULTURAL IMPACT ASSESSMENT

**24 Cabarita Road,
Avalon Beach
NSW**



TABLE OF CONTENTS

1. DISCLAIMER.....	3
2. SCOPE OF WORKS.....	4
3. EXECUTIVE SUMMARY	5
4. METHODOLGY	9
5. SITE DETAILS.....	10
5.1 SITE LOCATION MAP.....	10
5.2 AERIEL IMAGE: TREE LOCATION.....	11
6. TREE SCHEDULE.....	11
7. DISCUSSIONS	13
7.1 DEVELOPMENT PROPOSAL.....	13
7.2 LEGISLATION REVIEWED FOR ASSESSMENT.....	13
7.3 TREE VALUE & SIGNIFICANCE	13
7.4 CONSTRUCTION IMPACTS	14
7.5 ROOT CONSIDERATIONS	15
7.6 TREE PROTECTION ZONES.....	17
7.7 TREE PROTECTION METHODS	17
8. CONCLUSIONS.....	19
9. RECOMMENDATIONS.....	20
10. REFERENCES.....	20
11. APPENDICES.....	21
APPENDIX 1- DEFINITION OF HEALTH CLASSIFICATIONS	21
APPENDIX 2 - DEFINITIONS OF TREE AGE CLASSIFICATIONS	21
APPENDIX 3 - DEFINITION CATEGORIES OF TREE STRUCTURE.....	22
APPENDIX 4 - USEFUL LIFE EXPECTANCY (ULE) CATEGORIES.....	22
APPENDIX 5 - LANDSCAPE SIGNIFICANCE CATEGORIES.....	23
APPENDIX 6 - DEVELOPMENT IMPACT CATEGORIES.....	25
APPENDIX 7 - USEFUL LIFE EXPECTANCY (ULE) CATEGORIES.....	25
APPENDIX 8 - CALCULATING THE DBH.....	26
APPENDIX 9 - CALCULATING THE SRZ	26
APPENDIX 10 - CALCULATING THE TPZ.....	26
APPENDIX 11 - TPZ ENCROACHMENT	26
APPENDIX 12 - TREE PROTECTION GUIDELINES.....	28
APPENDIX 13 - SITE SURVEY: TREE LOCATION	30
APPENDIX 14 - LEVEL 4 PLAN: CALCULATED SRZ & TPZ	31
APPENDIX 15 - LEVEL 4 PLAN: TREE PROTECTION PLAN	32
APPENDIX 16 - TREE IMAGES	33
12. AUTHORS QUALIFICATIONS & EXPERIENCE	36

1. DISCLAIMER

This document in its entirety is for the exclusive use of the client of Treerepairs only.

Treerepairs will not be held liable for any use or interpretations from any other person or third party.

This report remains the intellectual property of Treerepairs and any individual or company must have written consent prior to its use for any other purpose.

All inspections and assessments were carried out using Visual Tree Assessment methods (VTA) from ground level only and do not include the use of diagnostic devices.

Although great care is taken to accurately diagnose the condition of the tree, using accepted industry practices; the arborist is limited in determining the exact structural integrity of the tree by interpreting mainly exterior features.

There are multiple factors both physical and environmental such as extreme climatic events and conditions that could lead to possible structural failures in trees which would not have been possible to predict or identify from VTA methods and assessments.

Any protection or preservation methods recommended are not a guarantee of tree survival or safety but have been recommended to improve vigour or reduce risk only.

Treerepairs does not accept any liability for any tree failure, illness, damage or injury caused by any undetected or unpredicted faults or failures in any tree or part thereof referred to in this document.

Treerepairs also accepts no responsibility for any failure, loss or decline, damage or injury caused by any tree covered in this document due to any meteorological or other unforeseen events.

It is the clients' responsibility to maintain on going inspections and assessments of trees covered in this document and obtain the services of suitably qualified arborists to carry out the work where necessary.

All work should be carried out according to the Australian Standard 'AS:4373-2007 Pruning of Amenity Trees'.

This document and its recommendations are only valid for twelve months beyond the document's submission date.

2. SCOPE OF WORKS

On the 25th May 2022, Bruce and Libby MacDiarmid commissioned Treerepairs to prepare an Arboricultural Impact Assessment (AIA) for the proposed development works at 24 Cabarita Road, Avalon Beach.

As part of this AIA, a standard arboricultural survey was conducted on ten trees. The survey identified each tree species while assessing tree condition and estimating their age.

Each tree's physical parameters were measured, and each tree had its heritage, ecological and amenity value determined. Based on these findings an unbiased retention value was able to be awarded to each tree surveyed.

The combined collected data from the survey was used together with formulas outlined in the Australian Standard 'AS:4970-2009 Protection of Trees on Development Sites' to calculate each trees Structural Root Zone (SRZ) and the Tree Protection Zone (TPZ).

The SRZ has been provided to identify areas where subterranean encroachments will compromise structural roots and weaken the trees anchoring to the ground.

The TPZ has been provided so that trees to be retained for the long term are adequately protected throughout the development.

SRZ and TPZ calculations can then be overlaid on proposed development plans to identify potential demolition or construction works which will compromise either the trees' health and/or stability.

Certain demolition and construction activities, the area they will occur in, and the degree of arboricultural impact which may occur, have been examined for this report.

By considering the potential construction or demolition impacts that could occur, specific recommendations for protection measures, including possible design modifications, can then be made. The recommendations are intended for long term tree retention and are outlined for individual trees as part of this impact assessment.

Specific and generic guidelines stipulating tree protection strategies are detailed within this report. The protection measures provided use AS:4970-2009 as a guide for reference. These guidelines must be strictly followed to maintain the current health, vigour and vitality of every tree designated for retention.

Through the combination of establishing an appropriate tree protection system and good site communication procedures, the successful long-term retention of specific trees on development sites is feasible.

3. EXECUTIVE SUMMARY

This Arboricultural Impact Assessment (AIA) has been prepared for the proposed development of 24 Cabarita Road, Avalon Beach. This site lies in the Local Government Area (LGA) of Northern Beaches Council.

In accordance with the Environmental Planning and Assessment Act 1979, the trees assessed for this report are subject to the requirements of the Pittwater 21 Development Control Plan (DCP).

An arboricultural survey was conducted on 31st May 2022 and concerned ten trees. A summary of each trees impact assessment is as follows:

Tree 1: Dwarf Jade (*Portulacaria afra*)

Tree 1 is a succulent growing on the south-western corner of the subject site.

Tree 1 is not actually a tree by definition. Refer to Image 1 for further details.

Tree 1 is to be removed to facilitate the proposed 'rubbish bin storage location'.

Tree 1 can be removed at any stage without consent from local council.

Tree 2: Silky Oak (*Grevillea robusta*)

Tree 2 is a tree growing on the south-western corner of the subject site.

Tree 2 is to be removed to facilitate the proposed 'rubbish bin storage location'.

Tree 2 is considered an 'Exempt Species' using 'Northern Beaches Council Exempt Species List' as a guide for reference and can be removed at any stage without council consent.

Tree 3: African Olive (*Olea europaea* *spp.* *cuspidata*)

Tree 3 is a tree growing on the south-western corner of the subject site.

Tree 3 is to be removed to facilitate the proposed 'rubbish bin storage location'.

Tree 3 is considered an 'Exempt Species' using 'Northern Beaches Council Exempt Species List' as a guide for reference and can be removed at any stage without council consent.

Tree 4: Cheese Tree (*Glochidion ferdinandi*)

Tree 4 is a part of a multi-species hedgerow growing on the southern adjacent properties fence line.

Tree 4's canopy has been pruned back in the past so that the tree does not overhang the subject site.

Tree 4's calculated SRZ and TPZ extends into the subject site. Significant surface roots can be seen adjacent to the site's boundary fence, which extend underneath the existing external wooden staircase.

Protection methods also include arborist supervision during demolition or excavation works within the calculated TPZ to avoid damage to significant roots and to ensure roots are properly pruned if necessary.

Tree 5: Sasanqua Camellia (*Camellias sasanqua*)

Tree 5 is a part of a multi-species hedgerow growing on the southern adjacent properties fence line.

Tree 5's canopy has been pruned back in the past so that the tree does not overhang the subject site.

Tree 5's calculated SRZ and TPZ extends into the subject site. Significant surface roots can be seen adjacent to the site's boundary fence, which extend underneath the existing external wooden staircase.

Protection methods also include arborist supervision during demolition or excavation works within the calculated TPZ to avoid damage to significant roots and to ensure roots are properly pruned if necessary.

Tree 6: Sasanqua Camellia (*Camellias sasanqua*)

Tree 6 is a part of a multi-species hedgerow growing on the southern adjacent properties fence line.

Tree 6's canopy has been pruned back in the past so that the tree does not overhang the subject site.

Tree 6's calculated SRZ and TPZ extends into the subject site. Significant surface roots can be seen adjacent to the site's boundary fence, which extend underneath the existing external wooden staircase.

Tree 6 will require protection considerations for both its surface roots and subterranean roots within its calculated TPZ. Site tree protection methods are to include the installation of strapped 'rumble boards' over the top of either mulch or aggregate, with a geo-tech membrane base, constructed over the exposed root system. Refer to Appendix 12 and Appendix 15 for further details.

Protection methods also include arborist supervision during demolition or excavation works within the calculated TPZ to avoid damage to significant roots and to ensure roots are properly pruned if necessary.

Tree 7: Sasanqua Camellia (*Camellias sasanqua*)

Tree 7 is a part of a multi-species hedgerow growing on the southern adjacent properties fence line.

Tree 7's canopy has been pruned back in the past so that the tree does not overhang the subject site.

Tree 7's calculated SRZ and TPZ extends into the subject site. Significant surface roots can be seen adjacent to the site's boundary fence, which extend underneath the existing external wooden staircase.

Tree 7 will require protection considerations for both its surface roots and subterreanean roots within its calculated TPZ. Site tree protection methods are to include the installation of strapped 'rumble boards' over the top of either mulch or aggregate, with a geo-tech membrane base, constructed over the exposed root system. Refer to Appendix 12 Appendix 15 for further details.

Protection methods also include arborist supervision during demolition or excavation works within the calculated TPZ to avoid damage to significant roots and to ensure roots are properly pruned if necessary.

Tree 8: Small Leaved Lilly Pilly (*Syzygium luehmannii*)

Tree 8 is a part of a multi-species hedgerow growing on the southern adjacent properties fence line.

Tree 8's canopy has been pruned back in the past so that the tree does not overhang the subject site.

Tree 8's calculated SRZ and TPZ extends into the subject site. Significant surface roots can be seen adjacent to the site's boundary fence, which extend underneath the existing external wooden staircase.

Tree 8 will require protection considerations for both its surface roots and subterreanean roots within its calculated TPZ. Site tree protection methods are to include the installation of strapped 'rumble boards' over the top of either mulch or aggregate, with a geo-tech membrane base, constructed over the exposed root system. Refer to Appendix 12 Appendix 15 for further details.

Protection methods also include arborist supervision during demolition or excavation works within the calculated TPZ to avoid damage to significant roots and to ensure roots are properly pruned if necessary.

Tree 9: Small Leaved Lilly Pilly (*Syzygium luehmannii*)

Tree 9 is a part of a multi-species hedgerow growing on the southern adjacent properties fence line.

Tree 9's canopy has been pruned back in the past so that the tree does not overhang the subject site.

Tree 9's calculated SRZ and TPZ extends into the subject site. Significant surface roots can be seen adjacent to the site's boundary fence, which extend underneath the existing external wooden staircase.

Tree 9 will require protection considerations for both its surface roots and subterranean roots within its calculated TPZ. Site tree protection methods are to include the installation of strapped 'rumble boards' over the top of either mulch or aggregate, with a geo-tech membrane base, constructed over the exposed root system. Refer to Appendix 12 Appendix 15 for further details.

Protection methods also include arborist supervision during demolition or excavation works within the calculated TPZ to avoid damage to significant roots and to ensure roots are properly pruned if necessary.

Tree 10: Small Leaved Lilly Pilly (*Syzygium luehmannii*)

Tree 10 is a part of a multi-species hedgerow growing on the southern adjacent properties fence line.

Tree 10's canopy has been pruned back in the past so that the tree does not overhang the subject site.

Tree 10's calculated SRZ and TPZ extends into the subject site. Significant surface roots can be seen adjacent to the site's boundary fence, which extend underneath the existing external wooden staircase.

Tree 10 will require protection considerations for both its surface roots and subterranean roots within its calculated TPZ. Site tree protection methods are to include the installation of strapped 'rumble boards' over the top of either mulch or aggregate, with a geo-tech membrane base, constructed over the exposed root system. Refer to Appendix 12 for further details.

Protection methods also include arborist supervision during demolition or excavation works within the calculated TPZ to avoid damage to significant roots and to ensure roots are properly pruned if necessary.

4. METHODOLOGY

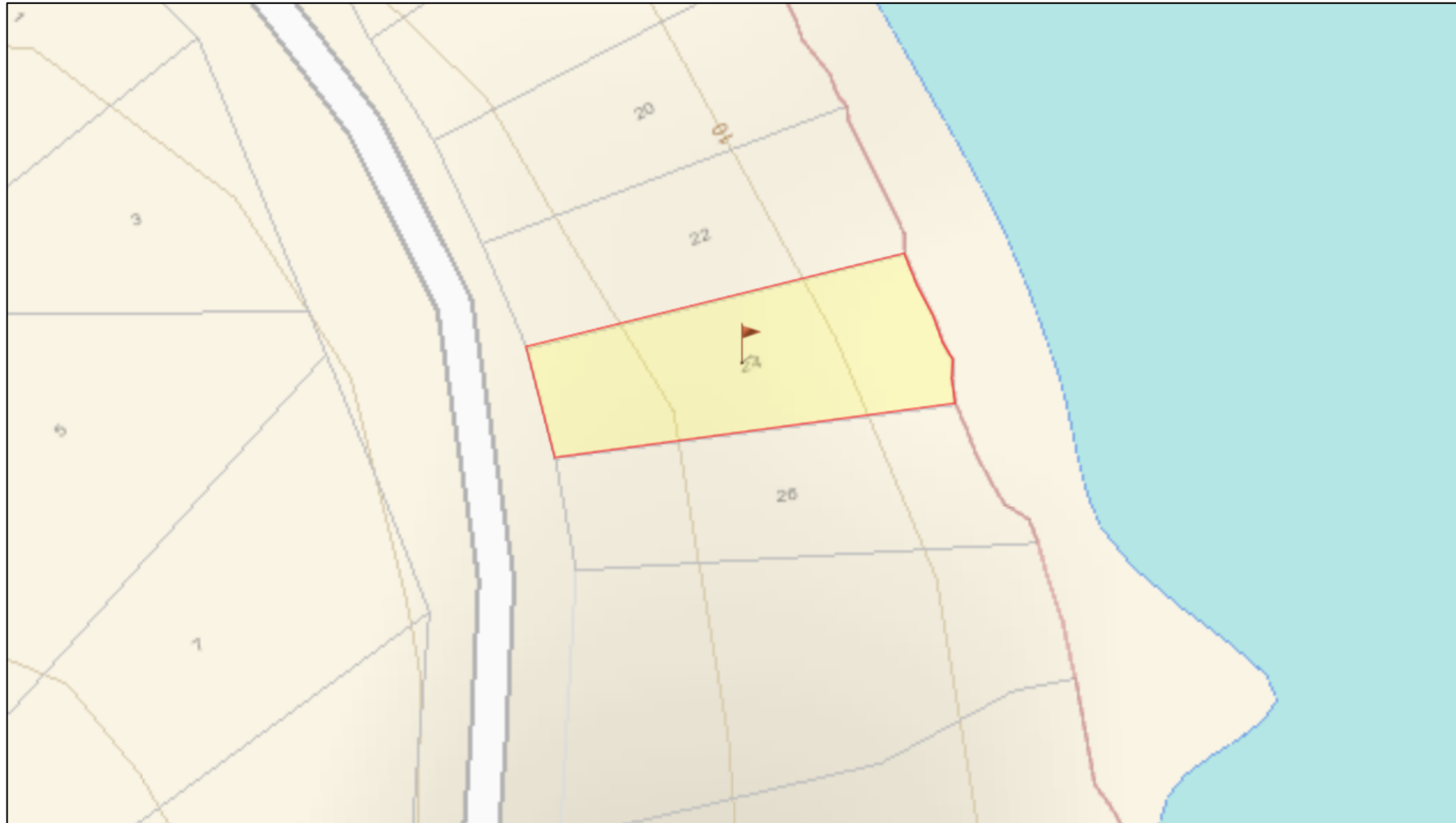
This report is based on the tree data collected from the subject site, and where possible, adjoining Third-Party sites. An arboricultural survey/assessment was performed on the 31st May 2022.

All data and arboricultural observations presented within this Arboricultural Impact Assessment were collected using the following methods:

- Site plans supplied on behalf of the client on the 4th May 2022 and 12th December 2022,
- No root mapping, ground excavations, soil sampling, woody tissue testing or dissecting, or any other kind of invasive testing was performed for this report,
- Tree inspections were conducted by means of Visual Tree Assessment (VTA),
- All inspections and measuring tasks were performed from ground level,
- All trees are provided with an identification number for reference purposes,
- Trees were identified using NSW Flora Online (The National Herbarium of NSW, Royal Botanical Gardens, Sydney),
- Observations of tree health, vigour and condition were made by using canopy spread, canopy cover, canopy density, foliage size, foliage colour, extension growth, epicormic growth, presence of dieback, presence and volume of deadwood and the presence of any major pests or diseases as indicators,
- Each tree was visually inspected for the presence of wildlife, existing wildlife habitat, and any wildlife habitat opportunities,
- Tree diameter at Breast Height (DBH) was calculated by measuring tree stem circumference at 1.4m above ground level, then dividing that by Pi,
- Tree canopy spread was measured in meters in all cardinal directions,
- Height of all trees was estimated from extensive prior experience,
- Useful Life Expectancy (ULE) methodology was used to find relative ratings for each tree within and around the site,
- Landscape Significance for each tree within and around the site was determined by assessing their Heritage, Ecological and Amenity values,
- Retention Values were determined for site trees only using the determined ULE and Landscape Significance rating results as a primary consideration,
- Site Maps and Aerial Images were sourced through NSW Six Maps 2022,
- Site photographs were taken on 31st May 2022 by N. Maynard.

5. SITE DETAILS

5.1 SITE LOCATION MAP



MAP 1: Site location (NSW Sixmaps June 2022).

5.2 AERIEL IMAGE: TREE LOCATION



AERIEL IMAGE 1: Tree Location (NSW Sixmaps June 2022).

6. TREE SCHEDULE

	GENUS & SPECIES	COMMON NAME	AGE CLASS	HT (m)	DBH (cm)	CANOPY SPREAD (m)				HEALTH & VIGOUR	GENERAL STRUCTURE & FORM	USEFUL LIFE EXPECTANCY (ULE)	LANDSCAPE SIGNIFICANCE			RETENTION VALUE	SRZ RADIUS (m)	TPZ RADIUS (m)	PROPOSED ACTION
						N	E	S	W				HERITAGE	ECOLOGICAL	AMENITY				
1	<i>Portulacaria afra</i>	Dwarf Jade	Mature	4	15	2	0	0	1	Good / Good	Good / Fair	Under 5 Years	Low	Low	Low	Low	1.50	2.0	Remove
2	<i>Grevillea robusta</i>	Silky Oak	Young	6	8	2	0	1	1	Good / Good	Good / Good	Under 5 Years	Low	Low	Low	Low	1.50	2.0	Remove
3	<i>Olea europaea</i> ssp.	African Olive	Mature	7	14	4	4	2	3	Good / Good	Good / Good	Under 5 Years	Low	Low	Low	Low	1.50	2.0	Remove
4	<i>Glochidion ferdinandi</i>	Cheese Tree	Semi - Mature	6	7	1	1	1	1	Good / Fair	Fair / Fair	10 - 20 Years	Low	Low	Low	Third-party Owned	1.50	2.0	Retain & Protect
5	<i>Camellias sasanqua</i>	Sasanqua Camellia	Mature	7	8	1	1	1	2	Good / Fair	Fair / Fair	10 - 20 Years	Low	Low	Low	Third-party Owned	1.50	2.0	Retain & Protect
6	<i>Camellias sasanqua</i>	Sasanqua Camellia	Mature	7	10	1	2	1	1	Good / Fair	Fair / Fair	10 - 20 Years	Low	Low	Low	Third-party Owned	1.50	2.0	Retain & Protect
7	<i>Camellias sasanqua</i>	Sasanqua Camellia	Mature	7	5	0	1	1	1	Good / Fair	Fair / Fair	10 - 20 Years	Low	Low	Low	Third-party Owned	1.50	2.0	Retain & Protect
8	<i>Syzygium luehmannii</i>	Small Leaved Lilly-pilly	Mature	7	8	0	0	1	4	Good / Fair	Fair / Fair	10 - 20 Years	Low	Low	Low	Third-party Owned	1.50	2.0	Retain & Protect
9	<i>Syzygium luehmannii</i>	Small Leaved Lilly-pilly	Mature	9	20	0	4	2	2	Good / Fair	Fair / Fair	10 - 20 Years	Low	Low	Low	Third-party Owned	1.68	2.4	Retain & Protect
10	<i>Syzygium luehmannii</i>	Small Leaved Lilly-pilly	Semi - Mature	5	10	0	2	1	0	Good / Fair	Fair / Fair	10 - 20 Years	Low	Low	Low	Third-party Owned	1.50	2.0	Retain & Protect

TABLE 1: Tree schedule (Data collected by N.Maynard May 2022).

7. DISCUSSIONS

7.1 DEVELOPMENT PROPOSAL

The proposed development of 24 Cabarita Road, Avalon Beach includes extensions to the existing dwelling, extensions to the existing driveway, the removal of three trees and the construction of a swimming pool in the rear yard.

Following construction activities, a new 'landscaping plan' including new tree and shrub plantings will be implemented throughout the site.

7.2 LEGISLATION REVIEWED FOR ASSESSMENT

To ensure all legal requirements are met when determining which trees can be retained or removed on this development site several Local Government Area (LGA) Policies and documents were reviewed:

- Pittwater Local Environment Plan (LEP) 2014.
- Pittwater 21c Development Control Plan (DCP) 2014.
- Environmental Planning and Assessment Act 1979.
- NSW Biodiversity Conservation Act 2016.

7.3 TREE VALUE & SIGNIFICANCE

7.31 Useful Life Expectancy (ULE)

Each tree assessed has had their Useful Life Expectancy (ULE) rated. The method used to determine tree was developed by Jeremy Barrell in 1996. ULE is the (safe with an acceptable level of risk) life expectancy of a tree modified by economic considerations, impacts on a tree with a longer ULE and the retention of the amenity of the wider landscape.

The objective of a ULE assessment is to determine the relative value of individual trees for the purpose of informing future management options. Trees that remain in an amenity landscape can have their ULE managed by regular tree maintenance and inspections.

7.32 Landscape Significance

Each tree assessed has had their Landscape Significance value rated. These values can be subjective and have known to be assessed inaccurately for deceptive purposes. To ensure a consistent evaluation approach the assessment criteria tabled in Appendix 5 has been used in this report.

The determined value helps give an understanding of the relative significance each tree holds in a particular area. The significance of an individual tree within a certain landscape is determined by combination of amenity, environmental and heritage factors, which include the importance and value it offers the local area and the community.

It has been determined that no trees on this site hold heritage value, heritage significance or any association with a heritage item.

It has also been determined that there are site trees that can have been classified as being part of a vulnerable, threatened, or endangered ecological community that provides or has the potential to provide habitat for native fauna or fauna classified as vulnerable or threatened under the NSW Biodiversity Conservation Act 2016.

7.33 Retention Value

Each tree assessed has been assigned a retention value. The retention value of a tree is increased or diminished based on its sustainability in the landscape, which is expressed within a tree's ULE. Refer Appendix 7 for retention category table.

A tree that has a high Landscape Significance rating, but low remaining ULE, has a diminished value for retention and therefore has appropriate Retention Value assigned. Conversely trees with low Landscape Significance rating even with a long remaining ULE is also considered to have a diminished value for retention.

All 'Third Party' trees are to be retained, and appropriately protected if needed. This will apply to each third-party tree unless otherwise specified, regardless of their retention value status.

7.4 CONSTRUCTION IMPACTS

7.41 General Information

Despite the best intentions and most stringent tree protection measures, trees may still be injured during construction. During construction, trees can be damaged by causes such as soil compaction, water/petroleum pollution, grade changes, root crushing and pruning, damage to the bark, improper pruning of branches, incorrect storage of construction machine/equipment/materials, and dumping of construction wastes.

A tree's response to construction related impacts can be varied and can often take years to visibly notice any symptoms and damage can be permanent and often irreversible. Some trees decline slowly over years while others may die instantly.

Sometimes tree foliage may wilt or change color and often twig and branch dieback will occur. Trees can slowly lose growth vigor and become more susceptible to pests and diseases. Remedial treatments for injured trees are few, and trees generally don't recover from this point and slowly continue to decline until they eventually die.

Tree age, health and vigor all play roles in how tolerant a tree will be to construction site impacts. Mature trees and over mature trees suffer more from construction related impacts than a young or semi-mature tree at its peak growing stage of life.

7.42 Site Activities Impacting Trees

The best method of tree protection is in the prevention of impacts such as compaction, contamination, and other soil disturbances. Protection to any tree on a construction site is detrimental to its preservation.

The following construction site activities will require constant consideration from contractors:

- Mechanical damage from plant/machinery; The direct wounding and damage of stems and branches by large plant and machinery, including excavator, bob cat, crane, etc., during construction. These activities cause cambium damage/abrasion to tree trunks and branch tearing well into collar attachments in turn exposing live woody tissue and predisposing the tree to pest and disease. Similarly, plant/machinery is also responsible for soil compaction.
- Indirect root injury from soil compaction; When soil is compacted either via building materials/debris stockpiled on the TPZ or TPZ is utilized as a thoroughfare for heavy plant and machinery, the soil inevitable becomes compacted and impacts on the air and moisture uptake. Ultimately affecting the gaseous exchange within the drip line that is vital for the tree's health.
- Soil contamination; Where chemicals, cement, and paint products etc., get washed or spilled into the soil and the tree absorbs the soluble content through its roots, in addition limes from cement wash off can alter the soil PH. Sometimes symptoms can be discovered in trees far from the source contamination source. Above and below ground, natural, or unnatural drainage courses can transport for contaminants leeching into the ground.
- Soil grade changes; When the topsoil cover down to a depth of approximately 150mm is striped it can eliminate vital feeder roots and can temporarily shock the tree. This process is common particularly during the landscape process, in addition these fine roots if exposed can prematurely dehydrate and die. Raising or reducing soil levels or surface sealing can lead to reduced soil oxygen and water levels which can also lead to tree decline and often death (Harris, Clarke & Matheny 2004).
- Landscaping Impact; Side paths and driveways comprised of concrete and non-porous materials can deprive roots of air and water and affect gaseous exchange. This is particularly true when there has been lack of consideration for trees located on adjacent properties and within proximity to the building envelope.

7.5 ROOT CONSIDERATIONS

7.51 Root Spread

Roots grow where roots want to grow. The actual spread depends on several deciding factors; tree species, soil type, natural drainage courses, land topography, location to structures both natural and handmade, and other factors affecting a trees microclimate.

Generally, tree roots will extend beyond tree canopy line and the majority are within 600mm from the ground surface, but occasionally they will penetrate deeper in search of water and nutrients. When the conditions are uniform around a tree, roots systems can be predicted with a degree of accuracy. When conditions are variable the extent of the root systems can be irregular and asymmetrical.

7.52 Anchor Roots

Demolition, and construction works associated with this development proposal can be performed successfully without the disturbance to retained trees anchor roots if protection guidelines are followed.

A trees anchor roots are generally located closest to the basal area. This area can be referred to as the trees 'root plate' or 'root ball' and is comprised of a large subterranean woody root mass that provides the tree with structural support and anchoring to the ground. These roots should never be severed or disturbed as it will weaken the trees stability dramatically.

7.53 Transport Roots

Beyond the anchor roots, are smaller woody roots known as transport roots. These smaller diameter roots branch off from anchor roots (hydrotropic). Their main function is to conduct water and nutrients from the non-woody feeder roots to the tree.

7.54 Feeder Roots

The main area for surface feeding roots to occur is from the tree trunk to the outer canopy known as the drip zone. These fibrous roots are less likely to occur under or near other buildings, as there is little surface moisture or soil air presence for root survival.

Feeder roots have two major functions, which are to obtain water and minerals from the soil and to help give anchorage support to the tree. Off the smaller diameter woody transport root system is where a mass of non-woody, fine feeder roots develop. These roots are very fine in structure, typically sensitive, less than 0.5mm diameter and short lived.

Feeder roots are vulnerable to damage, and once it occurs, water and nutrient uptake will be restricted until new ones are produced. Vigorous young trees will be capable of rapid regeneration, but more mature to over mature trees will respond much slower.

7.55 Importance of Protecting Roots

Root damage from construction activities is a leading cause of decline for trees in amenity areas. Major causes of soil compaction are due to vehicular movements and the storage of heavy machinery/equipment/materials near a preserved tree.

It is important to prevent soil compaction by diverting traffic routes and designating storage areas away from trees. Mechanical damage of tree trunk or surface roots or spillage of chemicals can also cause irreparable damage.

A healthy tree may be able to sustain a loss of between 30% and 50% of absorbing roots (Harris, Clark, Matheny, 1999). It should be reiterated that this figure refers to the fine roots responsible for the absorption of water and nutrients and not the major roots closer to the trunk that are responsible for the structural integrity of the tree. However, the loss of absorbing root system will immediately affect the water

status of the tree and may, depending on season and water availability, create a water stress for the tree.

7.55 Tree Dripline

A tree's dripline is an area where a tree is most vulnerable to construction activities and needs to be treated as if a TPZ.

The perimeter of a tree dripline is where the important feeder roots are generally more prolific. It is where they are absorbing the most in water and nutrients and need to be left as undisturbed as possible. These delicate feeder roots are extremely sensitive, and their vitality will have a reflection on a tree's health and vigour.

Each tree to be retained shall have a designated TPZ identifying the area sufficiently large enough to protect it and its roots from disturbance. To ensure root impact to retained trees is kept to an absolute minimum TPZ guidelines outlined in AS:4970-2009 must be adhered to.

7.6 TREE PROTECTION ZONES

7.61 General Information

The SRZ is the area required for tree stability. It exists inside the TPZ. The SRZ not to be disturbed in anyway without Project Arborist approval.

TPZ distances are designed to preserve sufficient root mass to avoid any (permanent) reduction of tree health resulting from development works, and therefore, allowing the tree to be retained in similar condition as it currently exists.

7.62 TPZ Encroachment

It can be possible to slightly encroach, or make minor variations to the standard TPZ. A minor TPZ encroachment area is considered less than 10% of the entire TPZ area and is outside the SRZ.

In almost all cases, where intrusion into a TPZ is intended it is usual practice to require the extension of TPZ by a similar amount in other directions. In this case the proposed encroachments for both trees can be comfortably compensated for.

7.7 TREE PROTECTION METHODS

7.71 General Information

Any tree that has been nominated for retention, will require protection considerations regardless of its retention value. This includes site trees, council trees and private trees on and around the construction site.

Tree protection normally starts by first calculating the size and location of a tree's SRZ and TPZ. Each tree is individually assessed against possible construction related impacts from the proposed development proposal.

The results are then used to recommend appropriate and feasible solutions with tree protection being one of the primary factors used in development considerations.

The tree schedule provided in this report provides the TPZ & SRZ dimensions of each tree utilising calculation methodology set out in the AS:4970-2009 The TPZ for any retained trees should be included on all site plans.

Contractors are required to familiarise themselves and made aware of the importance of retained trees calculated SRZ and TPZ. (Tree 4 to Tree 10).

Installation of physical tree protection will be required before demolition or construction commences.

All root protection used must comply with AS:4970-2009.

If modification to tree protection placement or position is required or any mechanical excavation works, canopy pruning, root pruning or other identified impact activities within the TPZ, supervision shall be required by a suitably qualified arborist.

7.72 TPZ & Excavation

To minimize the root loss any excavation within the calculated TPZ of retained trees (Tree 4 to Tree 10) is to be performed under the supervision of a suitably qualified arborist. Refer to Appendix 15 for further details.

Contractors are to be made aware that root spread may not necessarily be uniform or follow a trees dripline and the spread of roots may experience degrees of deflection and concentration. This generally occurs along hard barrier surfaces such as concrete curbing and pavements.

7.73 Root Pruning

In some circumstances, where there is no other option available, remedial root zone works may be required (possibly for Tree 4 to Tree 10).

Root pruning within a TPZ should only be performed by, or under supervision of a suitably qualified arborist.

Root loss of between 5% - 10% from a mature tree is likely to cause some die-back in the crown and make the tree more prone to attack by pest and disease.

Where root pruning is necessary, trees should only be pruned that are not weak or stressed and pruning should not extend to a depth deeper than 300mm.

8. CONCLUSIONS

The Arboricultural Impact Assessment prepared for 24 Cabarita Road, Avalon Beach concerns ten trees only.

Each tree assessed is subject to requirements of the Pittwater Local Environment Plan (LEP) 2014, Pittwater 21c Development Control Plan (DCP) 2014 and NSW Biodiversity Conservation Act 2016.

Each tree assessed has been identified as growing in an area considered to be at risk of possible construction impacts from the proposed developments demolition and/or construction activities.

The assessment includes three site trees and seven third-party owned trees growing in a hedgerow on the southern adjacent property's boundary.

The three site trees proposed for removal have been identified as 'exempt species' using Pittwater 21c Development Control Plan (DCP) 2014 as a guide for reference (Tree 1, Tree 2, and Tree 3). These trees can be removed at any stage without need for council consent.

Several third-party owned trees are expected to have their calculated TPZ encroached by proposed above ground and possibly subterranean demolition and construction activities (Tree 4 to Tree 10). As these trees that are to be retained as part of the subject site's development proposal, they will require root protection considerations for 'Surface Level' and 'Subterranean' impacts.

Each tree which is expected to experience TPZ encroachments (Tree 4 to Tree 10) can be successfully retained providing guidelines outlined in Appendix 12 and Appendix 15 are strictly adhered to.

Protection Guidelines for each tree have been provided in this document. The recommendations outlined conform to AS:4970-2009.

9. RECOMMENDATIONS

Recommendations made in this report are based on conclusions which have been made in accordance with AS:4970-2009.

- All legal requirements regarding trees on this site must constantly be adhered to.
- It is recommended that replenishment for removed trees using a 1:2 ratio would be considered acceptable as the trees proposed for removal are considered exempt species.
- TPZ root protection must be installed prior to the commencement of demolition activities. All physical protection is to remain in place and undisturbed for the duration of proposed demolition and construction activities.
- TPZ and SRZ dimensions for retained trees should be included on site plans. Plans must also include designated zones for arborist supervised excavation.
- Necessary excavation within any trees calculated TPZ must be supervised by a suitably qualified Arborist.
- All contractors engaged in onsite activities, and especially earth works, must be made aware of the importance of tree protection zones and their role in preserving retained site trees and third-party trees.
- In order to maintain high arboricultural standards and high site safety standards any tree work performed on this site must comply with AS:4373-2007 Pruning of Amenity Trees. Any contractor undertaking tree works on this site must have appropriate qualifications and expertise in relation to removing or pruning trees.

10. REFERENCES

1. Standards Australia - Pruning of Amenity Trees (AS:4373-2007).
2. Matheny, N.P & Clark, J.R (1994). A photographic Guide to the Evaluation of Hazard Trees in Urban Areas. International Society Arboriculture (ISA).
3. Barrell, J. (1996), Safe Useful Life Expectancy of Trees (SULE). Barrell Tree Care. UK.

11. APPENDICES

APPENDIX 1- DEFINITION OF HEALTH CLASSIFICATIONS

TERM	DEFINITION
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	The tree is demonstrating good or exceptional growth. The tree should exhibit a full canopy of foliage and have only minor pest or disease problems.
FAIR	The tree is in reasonable condition and growing well. The tree should exhibit an adequate canopy of foliage. There may be some deadwood present in the crown. Some grazing by insects or possums may be evident.
POOR	The tree is not growing to its full capacity; extension growth of the laterals is minimal. The canopy may be thinning or sparse. Large amounts of deadwood may be evident throughout the crown. Significant pest & disease problems may be evident or symptoms of stress indicating tree decline.
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 or pest and disease problems may be causing a severe decline in tree health.
DEAD	The tree is completely dead; exhibits no new growth or live tissue.

TABLE 2: Definitions of tree health class.

APPENDIX 2 - DEFINITIONS OF TREE AGE CLASSIFICATIONS

AGE CLASS	DEFINITION
YOUNG	Tree being in its early life stages of existence, progress, growth, development, or maturity. Approximately 0 – 5 years old.
SEMI-MATURE	Tree is around halfway complete in its natural growth and development stages. It is beginning to take on the characteristic of a fully development tree of the same species, taking into consideration of its growing environment. Approximately 5 – 15 years.
MATURE	Tree is complete in its major natural growth and development. As plant it is pertaining to, or characteristic of full development. Approximately. 15 – 60 years.
OVER MATURE	Tree has completed its natural growth or development. Tree has been maturing for some time and exhibits signs of decline or structural weakening due to its age. Approximately. 30 – 120 years
DECLINE	Tree has completed its life cycle and is dying. Approx. Less than 5 years to live.

TABLE 3: Definitions used in categorising Tree Age Class.

APPENDIX 3 - DEFINITION CATEGORIES OF TREE STRUCTURE

TERM	DEFINITION
GOOD	The tree has a well-defined and balanced crown. Branch unions appear to be strong, with no defects evident in the trunk or the branches. Major limbs are well defined. The tree is considered a good example of the species.
FAIR	The tree has some minor problems in the structure of the crown. The crown may be slightly out of balance, and some branch unions may be exhibiting minor structural faults. If the tree has a single trunk, it may be on a slight lean or exhibiting minor defects.
POOR	The tree may have a poorly structured crown. The crown may be unbalanced or exhibit large gaps. Major limbs may not be well defined. Branches may be rubbing or crossing over. Branch unions may be poor or faulty at the point of attachment. The tree may have suffered root damage.
VERY POOR	The tree has a poorly structured crown. The crown is unbalanced or exhibits large gaps with possibly large sections of deadwood. Major limbs may not be well defined. Branches may be rubbing or crossing over. Branch unions may be poor or faulty at point of attachment. Branches may exhibit large cracks that are likely to fail in the future. Tree may have suffered major root damage.
FAILED	The tree has a very poorly structured crown. A section of the tree has failed or is in imminent danger of failure.

TABLE 4: Definitions used in categorising tree structure.

APPENDIX 4 - USEFUL LIFE EXPECTANCY (ULE) CATEGORIES

CATEGORY	DEFINITION
UNSAFE & REMOVE	The tree is considered dangerous in the location and has no significant amenity value.
LESS THAN 5 YEARS	The tree, under normal circumstances and without extra stresses being imposed on it, should be safe and have value for up to five years, but will need to be replaced. During this period, normal inspections and maintenance will be required. If possible, replacement trees should be planted.
5 – 10 YEARS	The tree, under normal circumstances and without extra stresses being imposed on it, should be safe and of value for up to ten years. During this period, normal inspections and maintenance will be required.
10 – 20 YEARS	The tree, under normal circumstances and without extra stresses being imposed on it, should be safe and of value for up to twenty years. During this period, normal inspections and maintenance will be required.
20 – 40 YEARS	The tree, under normal circumstances and without extra stresses being imposed on it, should be safe and of value for up to forty years. During this period, normal inspections and maintenance will be required.
GREATER THAN 40 YEARS	The tree, under normal circumstances and without extra stresses being imposed on it, should be safe and of value for greater than forty years. During this period, normal inspections and maintenance will be required.

TABLE 5: Categories for Useful Life Expectancy (ULE)

APPENDIX 5 - LANDSCAPE SIGNIFICANCE CATEGORIES

CATEGORY	HERITAGE VALUE	ECOLOGICAL VALUE	AMENITY VALUE
SIGNIFICANT	The subject site is listed as a Heritage Item under the Local Environment Plan (LEP) with a local, state or national level of significance or is listed as a Significant Tree.	The subject tree is scheduled as a Threatened Species as defined under the Biodiversity Conservation Act 2016.	The subject tree has a very large live crown size exceeding 100m ² with normal to dense foliage cover, is located in a visually prominent position in the landscape, exhibits very good form and habit typical of the species.
	The subject tree is a Commemorative Planting having been planted by an important historical person(s) or to commemorate an important historical event.	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.	The subject tree makes a significant contribution to the amenity and visual character of the area by creating a sense of place or creating a sense of identity.
		The subject tree is a Remnant Tree, being a tree in existence prior to development of the area.	The tree is visually prominent in view from surrounding areas, being a landmark or visible from a considerable distance.
HIGH	The tree has a strong historical association with a Heritage Item (building/structure/art efact/garden 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.	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 (EEC) formerly occurring in the area occupied by the site.	The subject tree has a very large live crown exceeding 60m ² ; crown density exceeding 70%, very good representative of the species in terms of form & branching habit, is aesthetically distinctive and makes positive contribution to the visual character and the amenity of value of the area.

MODERATE	The tree has a suspected historical association with a heritage item or landscape supported by anecdotal or visual evidence.	The tree is a locally indigenous species and representative of the original vegetation of the area and the tree is located within a defined Vegetation Link / Wildlife Corridor or has known wildlife habitat value.	The tree is a good representative of the species in terms of its form and branching habit with minor deviations from normal with a crown density of at least 70% (normal); the subject tree is visible from the street and/or surrounding properties and makes a positive contribution to the visual character and the amenity of the area.
LOW	The subject tree detracts from heritage values or diminishes the value of a Heritage Item.	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.	The subject tree has a small live crown size of less than 25m ² and can be replaced within the short term (5- 10 years) with new tree planting.
VERY LOW	The subject tree is causing damage to a Heritage Item.	The subject tree is listed as an Environment Weed Species in the Local Government Area, being invasive, or is a known nuisance species.	The subject tree is not visible from surrounding properties and has a negative impact on the amenity and visual character of the area. The tree is a poor representative of the species, showing significant deviations from the typical form and branching habit with a crown density of less than 50%.

TABLE 6: Landscape significance categories.

APPENDIX 6 - DEVELOPMENT IMPACT CATEGORIES

GOOD	The tree has a well-defined and balanced crown. Branch unions appear to be strong, with no defects evident in the trunk or the branches. Major limbs are well defined. The tree is considered a good example of the species.
FAIR	The tree has some minor problems in the structure of the crown. The crown may be slightly out of balance, and some branch unions may be exhibiting minor structural faults. If the tree has a single trunk, it may be on a slight lean or exhibiting minor defects.
POOR	The tree may have a poorly structured crown. The crown may be unbalanced or exhibit large gaps. Major limbs may not be well defined. Branches may be rubbing or crossing over. Branch unions may be poor or faulty at the point of attachment. The tree may have suffered root damage.
VERY POOR	The tree has a poorly structured crown. The crown is unbalanced or exhibits large gaps with possibly large sections of deadwood. Major limbs may not be well defined. Branches may be rubbing or crossing over. Branch unions may be poor or faulty at point of attachment. Branches may exhibit large cracks that are likely to fail in the future. Tree may have suffered major root damage.
FAILED	The tree has a very poorly structured crown. A section of the tree has failed or is in imminent danger of failure.

TABLE 7: Development impact categories.

APPENDIX 7 - USEFUL LIFE EXPECTANCY (ULE) CATEGORIES

CATEGORY	DEFINITION
UNSAFE & REMOVE	The tree is considered dangerous in the location and has no significant amenity value.
LESS THAN 5 YEARS	The tree, under normal circumstances and without extra stresses being imposed on it, should be safe and have value for up to five years, but will need to be replaced. During this period, normal inspections and maintenance will be required. If possible, replacement trees should be planted.
5 – 10 YEARS	The tree, under normal circumstances and without extra stresses being imposed on it, should be safe and of value for up to ten years. During this period, normal inspections and maintenance will be required.
10 – 20 YEARS	The tree, under normal circumstances and without extra stresses being imposed on it, should be safe and of value for up to twenty years. During this period, normal inspections and maintenance will be required.
20 – 40 YEARS	The tree, under normal circumstances and without extra stresses being imposed on it, should be safe and of value for up to forty years. During this period, normal inspections and maintenance will be required.
GREATER THAN 40 YEARS	The tree, under normal circumstances and without extra stresses being imposed on it, should be safe and of value for greater than forty years. During this period, normal inspections and maintenance will be required.

TABLE 8: Tree retention categories

APPENDIX 8 - CALCULATING THE DBH

To determine the Diameter at Breast Height (DBH) of a tree, measure its Circumference at Breast Height (CBH) at 1.4m above the ground. The trees circumference is then divided by π (3.1415) to give the trees DBH.

$$DBH = CBH \div \pi$$

DBH for multi-stemmed trees = Measure DBH for all stems. Consolidate all calculated DBHs into a single index then square root of the final DBH.

APPENDIX 9 - CALCULATING THE SRZ

The SRZ is the area required for tree stability. A larger area is required to maintain a viable tree. There are many factors that affect the size of the SRZ (e.g., tree height, crown area, soil type, soil moisture). The SRZ may also be influenced by natural or built structures, such as rocks and footings.

It is important to note that the SRZ is not related to tree health. It refers to the physical volume of roots required for the tree to remain stable in the ground. It is in no way related to the physiological requirements of the tree but is the minimum volume of roots required for a tree to remain standing (Mattheck & Breloer 1994).

$$SRZ \text{ radius} = (DBH \times 50)^{0.42} \times 0.64$$

APPENDIX 10 - CALCULATING THE TPZ

Calculating and defining a TPZ is the principal means of protecting trees on development sites. It is a combination of both root and crown area that is requiring protection. It is an area isolated from construction disturbance, so that a tree can remain viable.

The TPZ will always incorporate the structural root zone within it. A TPZ should not be less than 2m nor greater than 15m (except where crown protection is required).

The TPZ for palms, cycads and tree is not calculated using this method. For these plants, the TPZ should not be less than 1 meter outside the crown spread.

$$TPZ \text{ Radius} = DBH \times 12$$

APPENDIX 11 - TPZ ENCROACHMENT

General

In some circumstances, it may be possible to encroach into or make variations to the standard TPZ. Encroachment includes excavation, compacted fill and machine trenching.

Minor TPZ Encroachment

Minor TPZ encroachment is considered less than 10% of the area of the TPZ and is outside the SRZ. Detailed root investigations should not be required. The area lost

to this encroachment should be compensated for elsewhere and contiguous with the TPZ. The project arborist may make variations after considering the circumstances.

The compensation for a minor encroachment is a guideline, and even if the encroachment may be less than 10%, it may not always be an option. Each encroachment must be assessed independently and on its own merit. Examples of minor TPZ encroachment, and the required compensation for that encroachment have been provided in Figure 1.

Major TPZ Encroachment

If the proposed encroachment is greater than 10% of the TPZ or inside the SRZ, the project arborist must demonstrate that the tree(s) would remain viable.

The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ. This may require root investigation by non-destructive methods.

TPZ Compensation Examples for Minor Encroachment

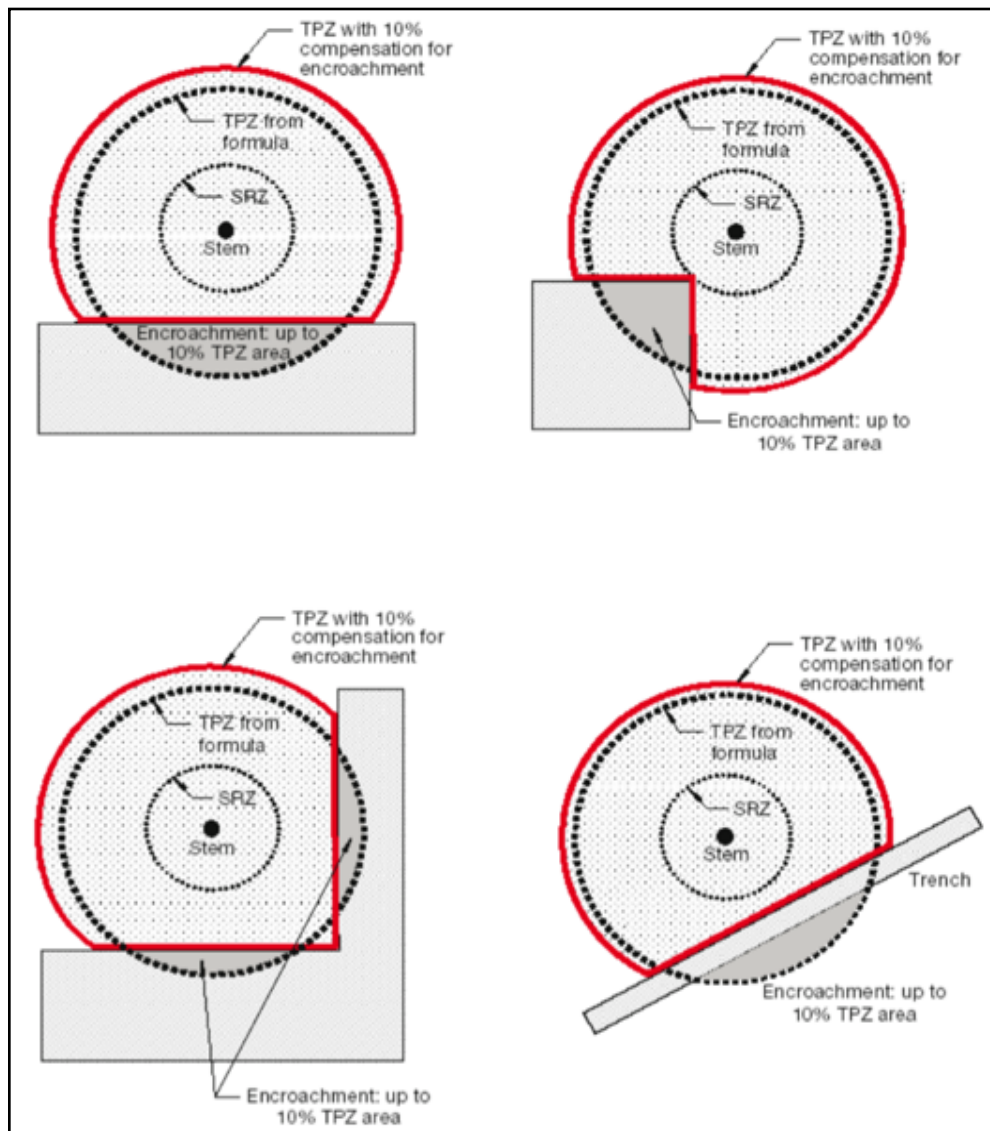


FIGURE 1: Examples of minor TPZ encroachment (Sourced AS:4970-2009).

APPENDIX 12 - TREE PROTECTION GUIDELINES

Guidelines for TPZ root protection have been detailed in Figure 2. Tree protection measures shall be implemented prior to commencement of site works and shall remain in place for the development duration.

The TPZ for any retained trees shall be clearly defined and marked out on all relevant site plans. Warning signs shall be attached to the outside of the existing fencing with the contact details of the project arborist. Refer to Figure 3.

Root Protection

Temporary access within the TPZ will require the use of ground protection to prevent surface root damage and soil compaction. If planned excavation encroaches the SRZ, or any other specified zone outlined in this report, it will require supervision by the Project Arborist.

If any roots are damaged advice must be sought from the Project Arborist regarding removal of these roots or whether other alternate solutions are needed to be found.

Any trees suffer damage or show signs of decline in health or vigour, advice must be sought from the Project Arborist for the implementation of remedial action.

If planned excavation encroaches the TPZ, or any other specified zones outlined in this report, it will require supervision by the project arborist. If significant tree roots are encountered, further excavations must be performed using non-destruction excavation technics i.e. Water jetting, air spades or hand excavation.

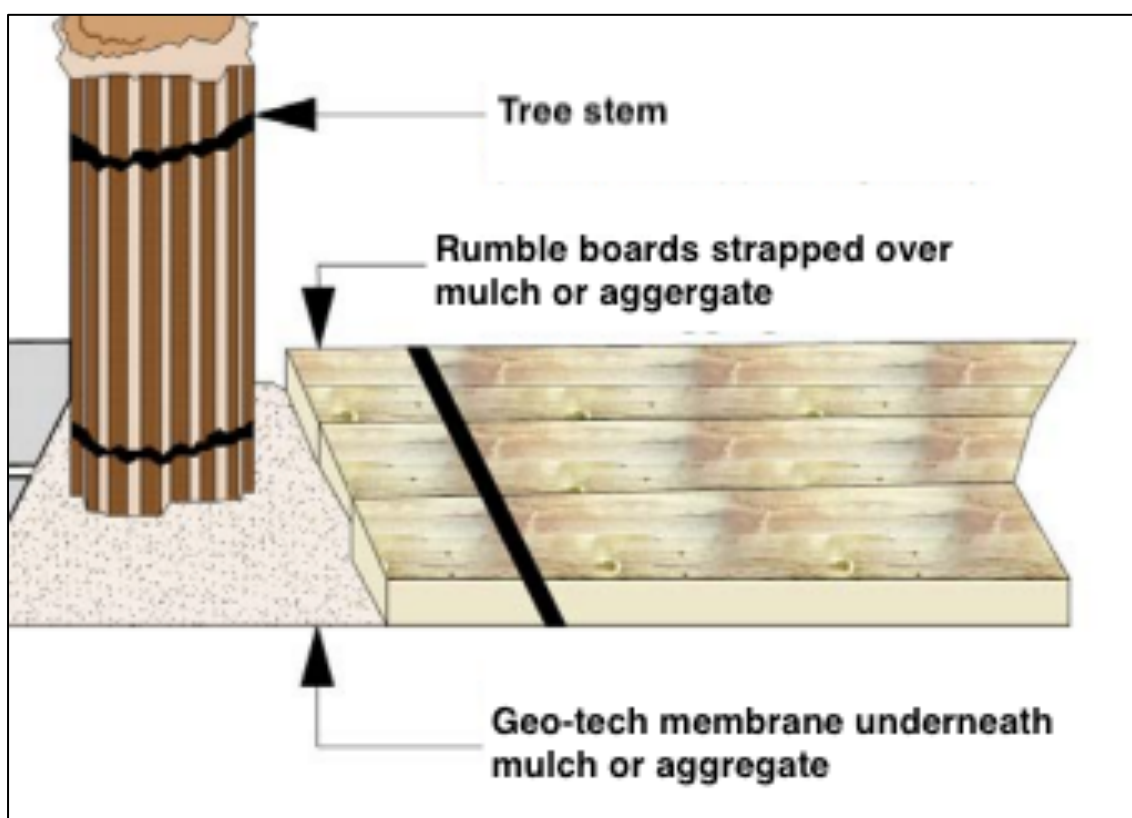


FIGURE 2: TPZ root protection guidelines (Modified AS 2470-2009).

Encroaching Unfenced TPZ Area:

Temporary access for machinery required within the TPZ may require the use of ground protection to prevent surface root damage and soil compaction. If planned excavation encroaches the TPZ, or any other specified zone outlined in this report, it will require supervision by the Project Arborist,

If large roots are damaged advice must be sought from the Project Arborist regarding removal of these roots or whether other alternate solutions are needed to be found.

Any trees suffer damage or show signs of decline in health or vigour, advice must be sought from the Project Arborist for the implementation of remedial action.

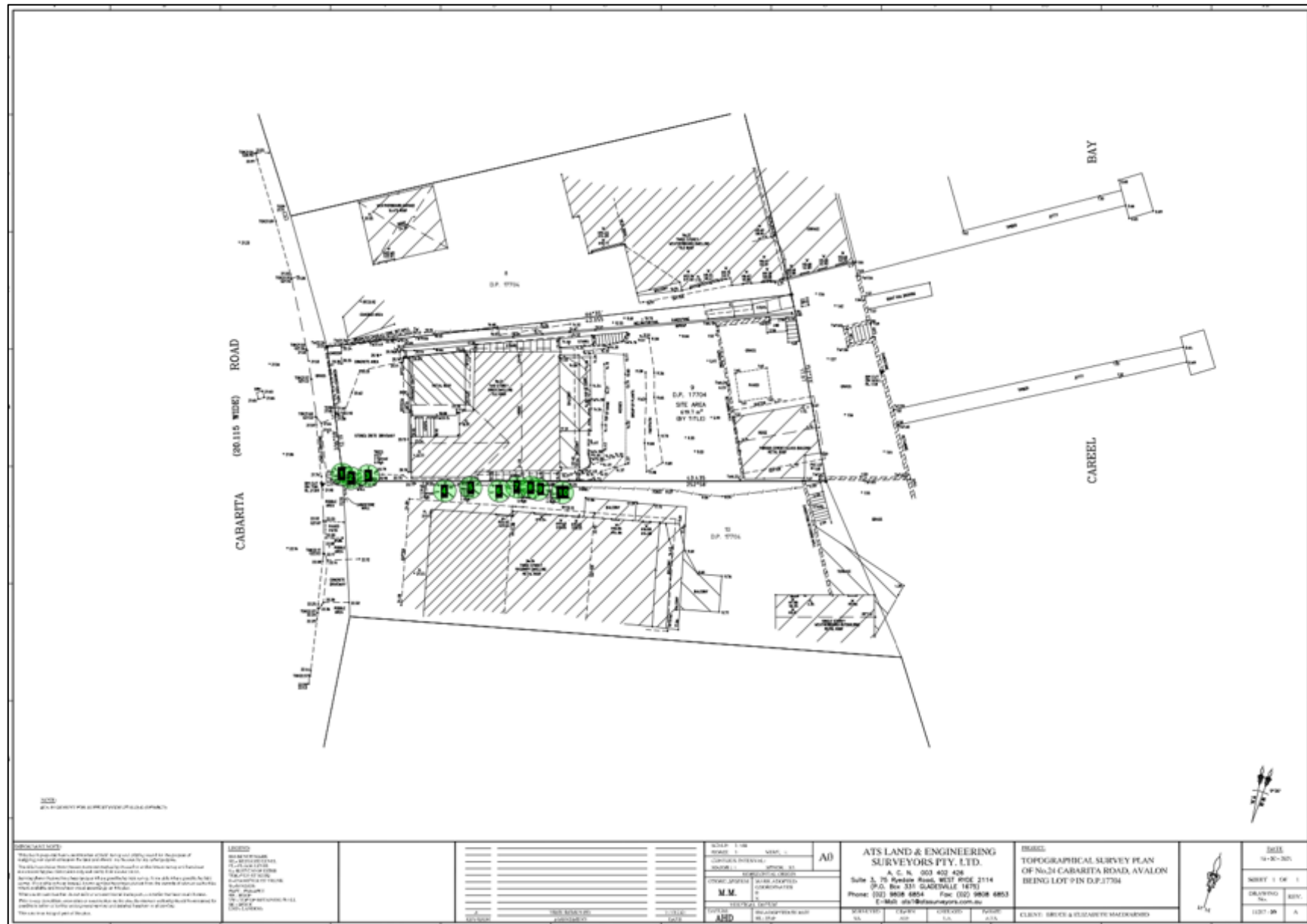
The following activities are prohibited inside the TPZ fence area:

- Excavation, demolition or cultivation using machinery,
- Stockpiling of equipment, materials or spoils,
- Changes to soil levels,
- Installations of site sheds or amenities, erection of hoarding/scaffolds
- Disposal of waste materials and substances,
- Access tracks for vehicles/machinery or
- Any other activities that may cause damage to the tree or its root system.



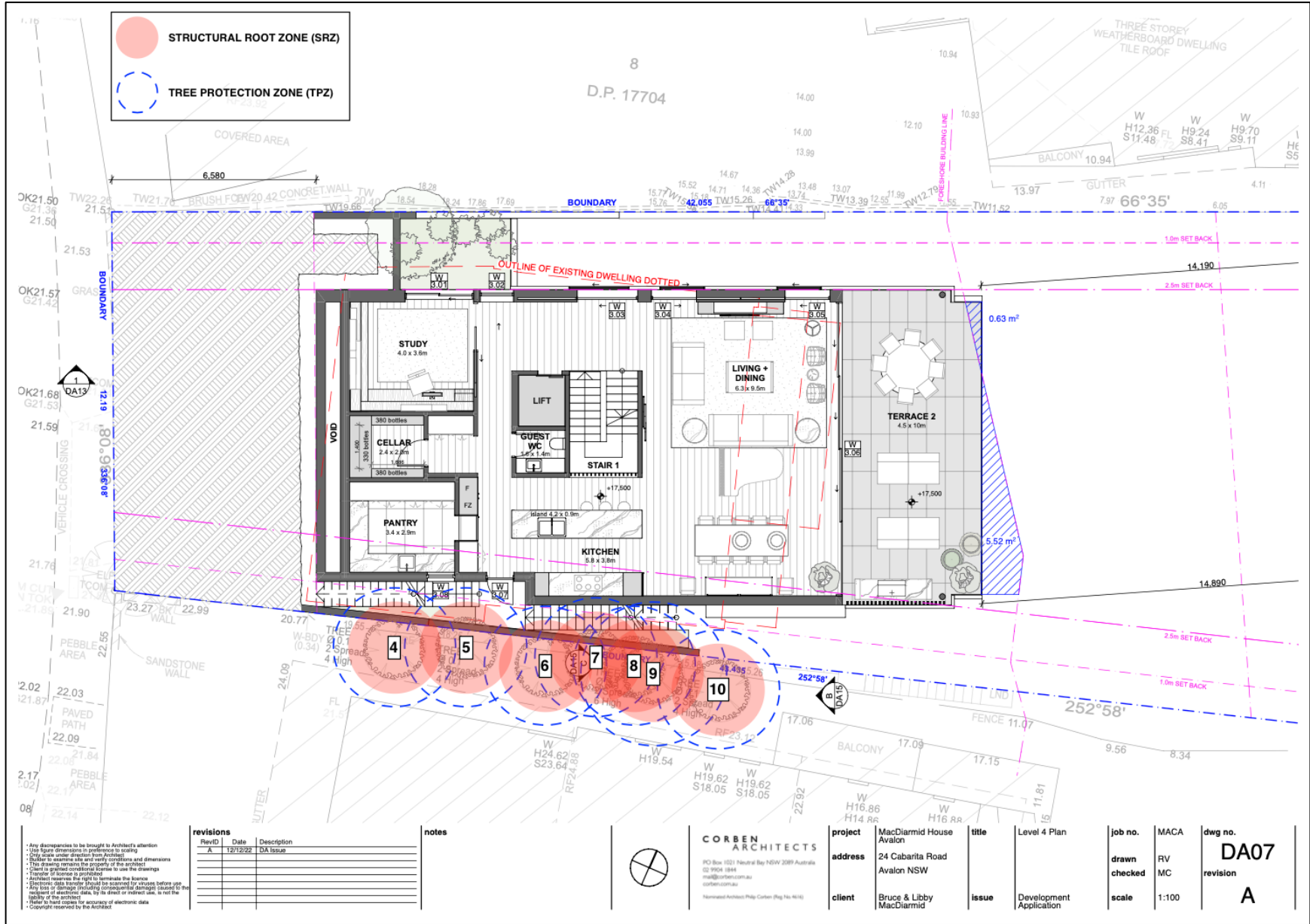
FIGURE 3: Example TPZ sign outlining possible construction site impacts (Richmond CA 2016).

APPENDIX 13 - SITE SURVEY: TREE LOCATION



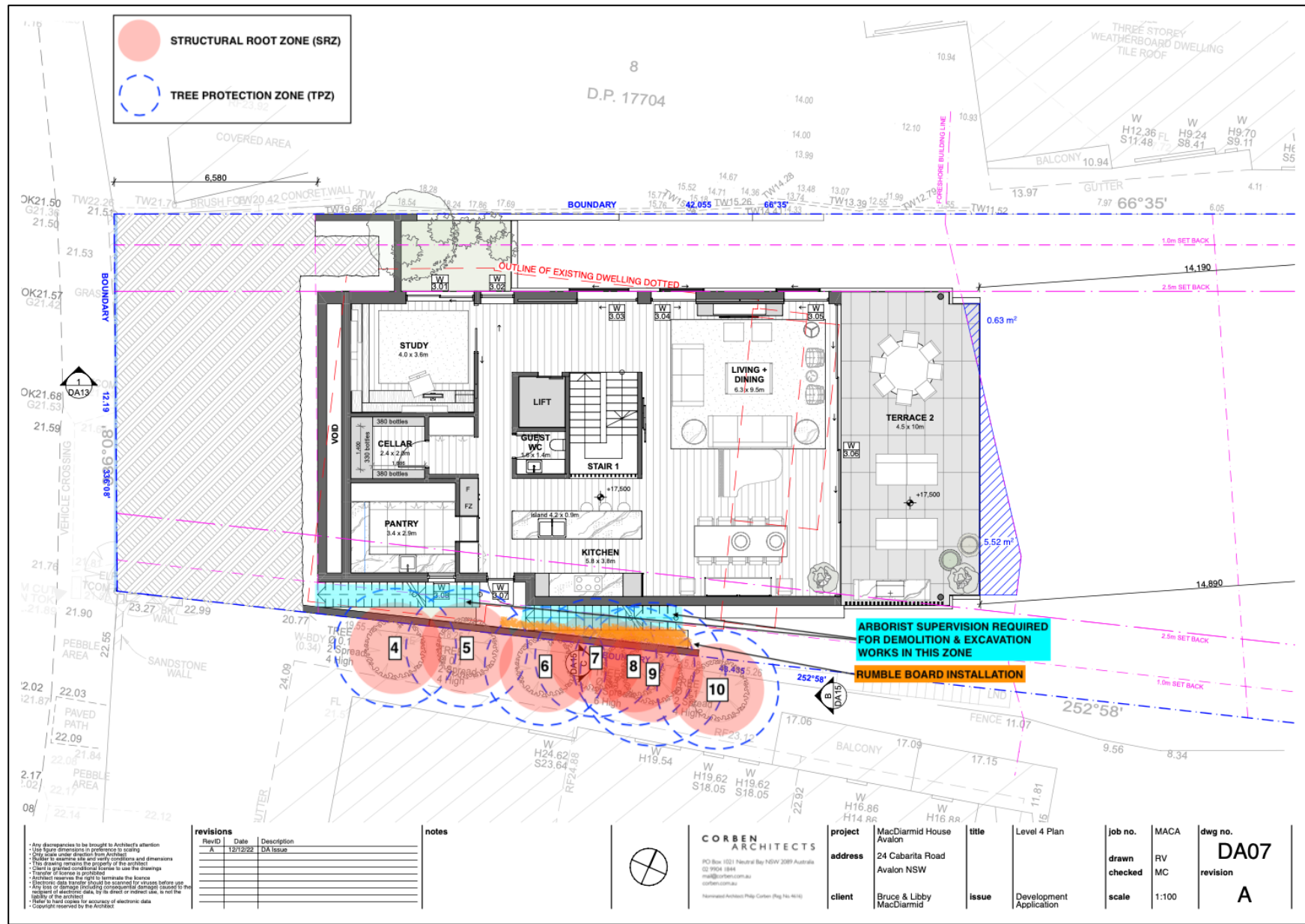
PLAN 1: Site Survey – Tree Location (Plan supplied by client May 2022).

APPENDIX 14 - LEVEL 4 PLAN: CALCULATED SRZ & TPZ



PLAN 2: Level 4 Plan – Calculated SRZ & TPZ for retained third-party trees (Plan supplied by client December 2022).

APPENDIX 15 - LEVEL 4 PLAN: TREE PROTECTION PLAN



PLAN 3: Tree Protection Plan – Physical Tree Protection (Plan supplied by client December 2022).

APPENDIX 16 - TREE IMAGES







12. AUTHORS QUALIFICATIONS & EXPERIENCE

- Diploma of Arboriculture
- AQF Level 5 Arborist
- Director - Treerepairs - 10 years
- Over 20 years arboricultural experience – tree contractor & consulting arborist
- 18 years Climbing Arborist with national & international experience

If further information relating to the content of this report is required, please phone Nick Maynard on 0449 610 919.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Nick Maynard', with a long horizontal flourish extending to the right.

Nick Maynard