



ARBORICULTURAL IMPACT ASSESSMENT

27 Alan Avenue, Seaforth.

Prepared for: Nick Bell Architects

Prepared by: Tom Hare
AQF Level 5 Consulting Arborist
Truth About Trees
tom@truthabouttrees.com.au

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Executive Summary

The proposed development at 27 Alan Avenue will require the removal of two (2) trees of low and very low retention value (trees 4 & 5).

Tree one (1) is a council owned street tree specimen of *Lophostemon confertus*- Brush Box. This tree is encroached upon by the driveway crossing, pedestrian access and works to remove and replace the existing front wall. Ground protection and trunk and branch protection will be required.

Tree two (2) is a *Ficus rubiginosa*- Port Jackson Fig. This tree is encroached upon by the driveway retaining wall and the pedestrian stairs. Ground protection and trunk and branch protection will be required.

Tree three (3) is a *Lophostemon confertus*- Brush Box in the neighbour's property. This tree receives minor encroachment from the driveway retaining wall and works to remove and replace the existing front wall. This will be a minor encroachment and will be unlikely to impose any significant impacts upon tree health.

Tree four (4) is a *Melaleuca armillaris*- Bracelet Honey Myrtle. The tree is providing limited amenity value and is of low retention value. The tree will be heavily impacted by grade level changes and swimming pool construction and will require removal.

Tree five (5) is a mature *Eucalyptus nicholii*- Narrow-leaved Black Peppermint. The tree is structurally defective and providing limited amenity value and is of very low retention value due to being an exempt species. The tree will be heavily impacted by grade level changes and swimming pool construction and will require removal.

Tree six (6) is a neighbours *Macadamia integrifolia*- Macadamia tree. The tree is encroached upon by less than 10% and is unlikely to be affected by the development.

Trees 1, 2, 3, 6 are currently proposed for retention and protection.

Tree protection fencing and signage must be installed in accordance with AS4970-2009 and located as depicted in the tree protection plan (appendix 3) of this report.

The removal of tree four (4) will result in the need for at least one replacement planting. Appendix 4 shows the preferred species list for replanting and at least one of the three (3) proposed plantings will need to be a species from this list.

All tree protection measures must be completed in accordance with AS4970-2009 and appendix 2 & 3 of this report.

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Introduction

Truth about trees have been engaged by Nick Bell Architects to provide an Arboricultural Impact Assessment (AIA) in relation to a proposed development at 27 Alan Ave, Seaforth.

The existing dwelling is proposed for demolition to enable the construction of two new dwellings which will incorporate underground car parking as shown in figure 1 below.

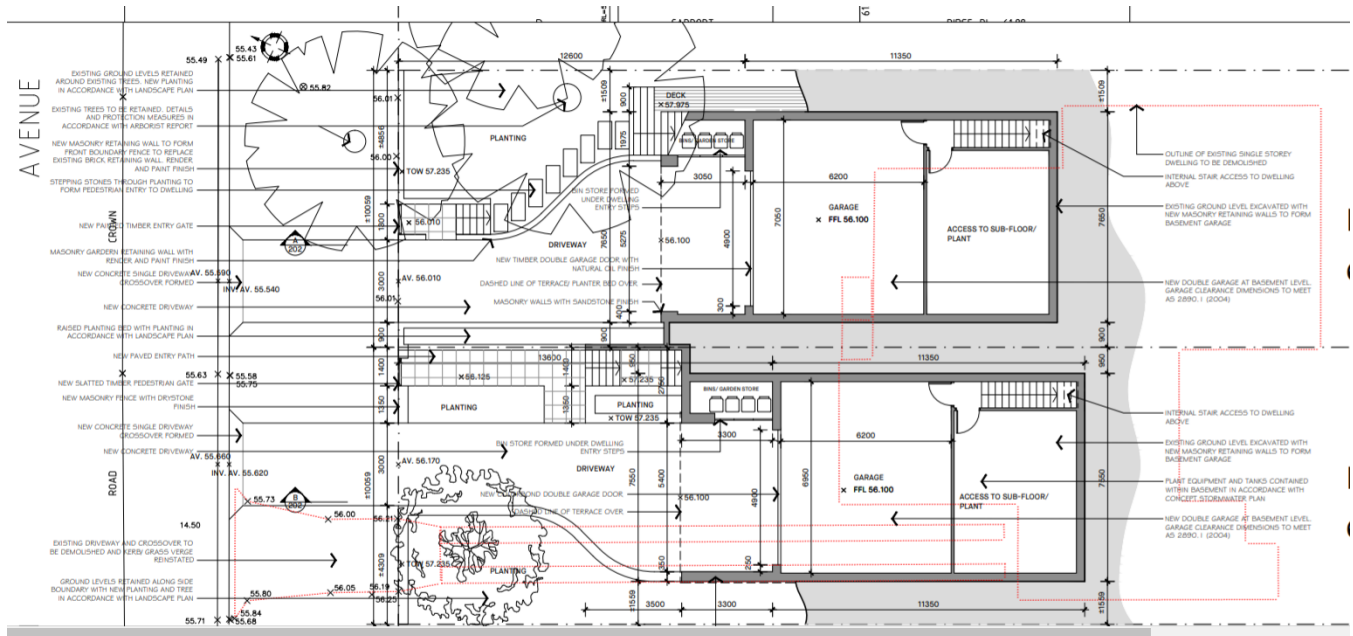


Figure 1- Plan showing the proposed basement car parking

The rear of the properties will include a swimming pool and terrace as shown in figure 2 below.

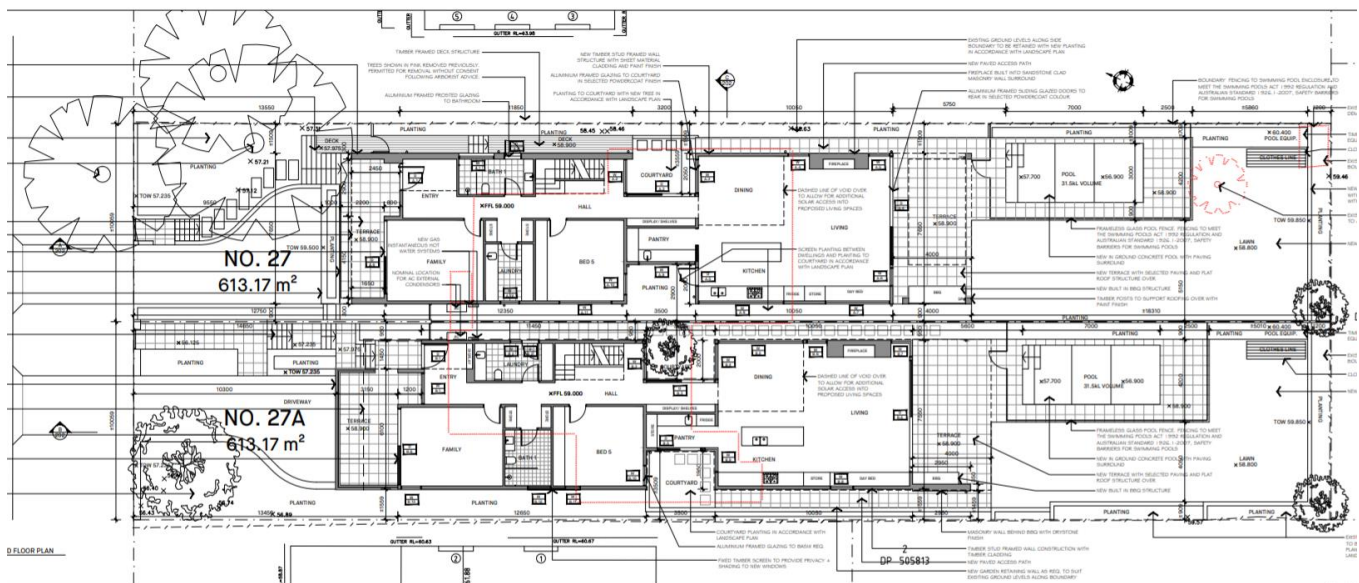


Figure 2- The ground floor plan showing swimming pool and terrace area.

This report will identify and assess all trees within and directly adjacent to the subject site which may be impacted upon by the proposed development.

Methodology

A site visit was conducted on Tuesday 8th October 2019.

Assessment was undertaken of all trees within the subject property and properties directly adjacent, which had the potential to be impacted upon by the proposed development.

Assessment of the trees was undertaken using the framework of the visual tree assessment procedure (VTA) as prescribed by Mattheck & Broeler 1994.¹

- No internal diagnostic testing has been completed.
- No sub surface root testing or soil testing has been completed.
- All observations were made from the ground only.
- Tree heights have been estimated and diameters have been measured with a diameter tape where access allowed.

Tree Protection Zones and Structural Root Zones were calculated in accordance with AS4970-2009- The Protection of Trees on Development Sites ²(see Section 1.2). Tree Retention Values were determined using the landscape significance process from Manly councils DCP shown in figure 3 (below). This report will discuss the current structural condition and health of the trees and will provide recommendations regarding their viability relative to proposed works.

Tree Assessment requirements

Step 1. Assess the Sustainability of the tree.

The tree or group of trees are to be categorised into the following groups:

- Greater than 40 years
- from 15 to 40 years
- from 5 to 15 years
- less than 5 years
- Dead or hazardous

The table below titled 'Landscape Significance' demonstrates how a tree's sustainability is to be determined.

Step 2. Identifying landscape significance

This step involves allocating each tree to be removed or retained, a Landscape Significance rating. This is to be obtained through the categories and identifiers contained within the Table ahead. This rating is to then be contrasted against the Sustainability rating of the tree as shown in Figure 1 – Assessment of Sustainability ahead, resulting in a retention value of each tree.

Step 3. Categorise each tree on its Retention value

Through the use of the Landscape Significance Rating and Tree Sustainability Rating, each tree to be removed or impacted upon by development is to be allocated a Retention Value.

	Landscape Significance Rating										
Tree Sustainability	1	2	3	4	5	6	7				
Greater than 40 Years	High retention value			Moderate							
15 to 40 years											
5 to 15 Years			Low								
Less than 5 Years											
Dead or Hazardous			Very low retention value								

Figure 3- Landscape significance table-Taken from Manly DCP

¹ Mattheck & Broeler 1994- The Body Language of Trees.

² Standards Australia- AS4970-2009- The Protection of Trees on Development Sites

Table: Landscape Significance

1. Significant

- The tree is listed as a Heritage Item within the LEP with a local, state or national significance;
- The tree forms part of the curtilage of a Heritage Item and has a known or documented association with the item;
- The tree is a Commemorative Planting having been planted by an important historical person(s), or to commemorate an important historical event;
- The tree is scheduled as a Threatened Species or is a key indicator species of an Endangered Ecological Community as defined under the Threatened Species Conservation Act 1995 (NSW) of the Environmental Protection and Biodiversity Conservation Act (1999);
- 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 an endangered or threatened fauna species; or
- The tree is a remnant tree, being a tree in existence prior to development of the area; or
- The tree has a very large live crown size exceeding 300sqm with 70 to 100 percent foliage cover, is visible against the skyline, exhibits very good form and habitat typical of the species and 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; or
- The tree is visually prominent in a view from surrounding areas, being a landmark or visible from a considerable distance.

2. Very High

- The tree has a strong historical association with a heritage item within or adjacent to the property and/or exemplifies a particular era or style of landscape design associated with the original development of the site; or
- The tree is a locally-indigenous species and representative of the original vegetation of the area and the tree is located within a defined Wildlife Corridor or has known wildlife habitat value;
- The tree has a very large live crown size exceeding 200sqm, a crown density exceeding 70 percent crown cover, is very good representative of the species in terms of its form and branching habitat or is aesthetically distinctive and makes a positive contribution to the visual character and the amenity of the area.

3. High

- The tree has a suspected historical association with a heritage item or landscape supported by anecdotal or visual evidence;
- The tree is a local indigenous species and representative of the original vegetation of the area; or
- The tree has a large crown size exceeding 100sqm and is a good representative of the species in terms of its form and branching habitat with minor deviations from the normal (e.g. crown distortion/suppression) with a crown density of at least 70 percent Crown Cover, and
- The subject tree is visible from the street and surrounding properties and makes a positive contribution to the visual character and the amenity of the area.

4. Moderate

- The tree has a medium live crown size exceeding 40sqm, and
- The tree is a fair representative of the species, exhibiting moderate deviations from typical form (e.g. distortion/suppression) with a crown density of more than 50percent crown cover, and
- The tree makes a fair contribution to the visual character and amenity of the area, and
- The tree is visible from surrounding properties, but is not visually prominent – view may be partially obscured by other vegetation or built forms; or
- The tree has known or suspected historical association.

5. Low

- The tree has a small live crown size of less than 40sqm and can be replaced within the short term with a new tree planting; or
- 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 percent crown cover; and
- The tree is not visible from the surrounding properties and makes a negligible contribution or has a negative impact on the amenity and visual character of the area.

6. Very Low

- The tree is listed as an Environment Weed Species in the Local Government Area, being invasive, or a nuisance species; or
- The tree is of a species listed in Figure 7A of this plan.

7. Insignificant

- The tree is declared a Priority Weed/ Biosecurity Matter under the Biosecurity Act 2015; or
- The tree poses a threat to human life or property.

Figure 4- Tree significance categories taken from Manly council DCP.

- Can be removed under the [10/50 Legislation](#). Some clearing of vegetation is allowed if your property is mapped in the [10/50 entitlement area](#).
- Removed by Rural Fire Services because they pose or will pose a significant threat to access along required fire trails or to human life, buildings or other property during a bushfire
- Placed where the base of the trunk of the tree at ground level, is located within two metres of an existing approved building (not including decks, pergolas, sheds, patios or the like, even if they are attached to a building).
- Is considered a high risk/imminent danger certified by a Level 5 qualified arborist. These trees can be removed without Council consent by the owner of the tree subject to the owner obtaining written confirmation from the arborist that clearly states:

a) The arborist qualifications: AQF Level 5 Arborist or equivalent

b) That the tree(s) is declared a 'high risk' or is an imminent danger to life and property

c) That immediate removal of the tree(s) is recommended

d) A copy of the report must be sent to Council for record keeping purpose

- Any tree on the bio security species listing
- Dead - photographic evidence recommended
- Has fallen or partially fallen as a result of a storm and still present a danger (photos required)
- Part of the pruning or removal of hedges (unless hedge is conditioned to be retained in a development consent). "Hedge" means groups of two or more trees that:

(a) are planted (whether in the ground or otherwise) so as to form a hedge, and

(b) rise to a height of at least 2.5 metres (above existing ground level).

Pruning and Clearing

You can prune trees or clear vegetation in the following circumstances:

- Reasonable pruning of up to 10% of a tree's canopy within 12 calendar months. Pruning must be in accordance with Australian Standards AS 4373 – 2007
- The removal of deadwood from a tree
- Removal of any species of parasite mistletoe or parasitic plant from any part of a tree
- It meets the criteria of other legislation eg under [10/50 Legislation](#) some clearing of vegetation is allowed if your property is mapped in the [10/50 entitlement area](#).

Note: Public and private bushland is protected under Council's Development Control plan and requires consent to remove or clear understorey vegetation.

The following tree species are exempt and may be removed without council permission.

SPECIES NAME	COMMON NAME
<i>Acacia baileyana</i>	Cootamundra Wattle
<i>Acacia saligna</i>	Golden Wreath Wattle, Golden Willow Wattle
<i>Acer negundo</i>	Box Elder
<i>Alnus altissima</i>	Tree of Heaven
All <i>Ficus</i> spp. (except <i>F. macrophylla</i> , <i>F. rubiginosa</i> , <i>F. coronata</i>)	All <i>Ficus</i> spp. (except Moreton Bay Fig, Port Jackson Fig, Sandpaper Fig)
<i>Alnus jorullensis</i>	Evergreen Alder
<i>Araucaria bidwillii</i> (Not Norfolk Island Pines)	Bunya Bunya Pine
<i>Brachychiton acerifolius</i>	Illawarra Flame Tree
<i>Cassia</i> spp.	Cassia
<i>Castanospermum australe</i>	Black Bean, Moreton Bay Chestnut
<i>Celtis australis</i>	Hackberry
<i>Cinnamomum camphora</i>	Camphor laurel
<i>Citharexylum spinosum</i>	Fiddlewood
<i>Cotoneaster glaucophyllus</i>	Cotoneaster
<i>Cupaniopsis laurina</i>	Tuckeroo
<i>Cupressus</i> spp. <i>Cupressocyparis</i> spp. <i>Chamaecyparis</i> spp.	Cypress Pine
<i>Eriobotrya japonica</i> , <i>Carica papaya</i> , <i>Citrus</i> spp., <i>Fortunella</i> spp. <i>Malus</i> spp. <i>Morus</i> spp. <i>Persea</i> spp. <i>Prunus</i> spp.	All non-native fruit producing trees (Loquat, Paw Paw, Citrus, Kumquat, Apple, Mulberry, Avocado, Apricot, Almond, Cherry, Plum, Peach, Mango)
<i>Erythrina</i> spp.	Coral Tree
<i>Eucalyptus nicholii</i>	Peppermint Gum
<i>Eucalyptus scoparia</i>	Wallangarra White Gum
<i>Fraxinus griffithii</i>	Himalayan Ash
<i>Gleditsia triacanthos</i>	Honey Locust
<i>Grevillea robusta</i>	Silky Oak
<i>Harpephyllum caffrum</i>	Kaffir Plum
<i>Jacaranda mimosifolia</i>	Jacaranda
<i>Lagerstroemia</i>	Crepe Myrtle
<i>Lagunaria patersonia</i>	Norfolk Island Hibiscus
<i>Ligustrum</i> spp.	Large and Small leaf Privet
<i>Liquidambar styraciflua</i>	Liquidambar
<i>Nerium oleander</i>	Oleander
<i>Olea</i> spp.	Olive
Palms (other than <i>Livistona australis</i>)	Palms other than Cabbage Tree Palm
<i>Paraserianthes lophantha</i>	Crested Wattle
<i>Pinus</i> spp.	Pine
<i>Pittosporum</i> spp. (up to 8m)	Pittosporum
<i>Populus</i> spp.	Poplar
<i>Pyracantha angustifolia</i>	Orange Fire Thorn
<i>Raphiolepis indica</i>	Indian Hawthorn
<i>Robinia pseudoacacia</i>	False Acacia
<i>Salix</i> spp.	Willow
<i>Sapium sebiferum</i>	Chinese Tallow
<i>Schefflera actinophylla</i>	Umbrella Tree
<i>Spathodea campanulata</i>	African Tulip Tree
<i>Syagrus (Arecastrum) romanzoffiana</i>	Cocos Palm
<i>Ulmus parvifolia</i>	Chinese Elm

Figure 6- Exempt tree list taken from Manly DCP.

Site Details

The site is at 27 Alan Avenue, Seaforth.



Figure 7- The subject site and the surrounding area- Image taken from Google Maps 2019.

Document schedule

The following drawings and resources were considered when completing the assessment:

Document name	Provided by
Alan-DA-100- Rev. B	Nick Bell Architects
Alan-DA-101- Rev. B	Nick Bell Architects
Alan-DA-200- Rev. B	Nick Bell Architects
Alan-DA-201- Rev. B	Nick Bell Architects
Alan-DA-202- Rev. B	Nick Bell Architects
AS4970-2009- The Protection of Trees on Development Sites	Standards Australia
Manly DCP	Northern Beaches Council
Survey- 19220001-03	Axiom Spatial

Figure 8- Document schedule showing all drawings and plans assessed in the preparation of this report

The Proposal

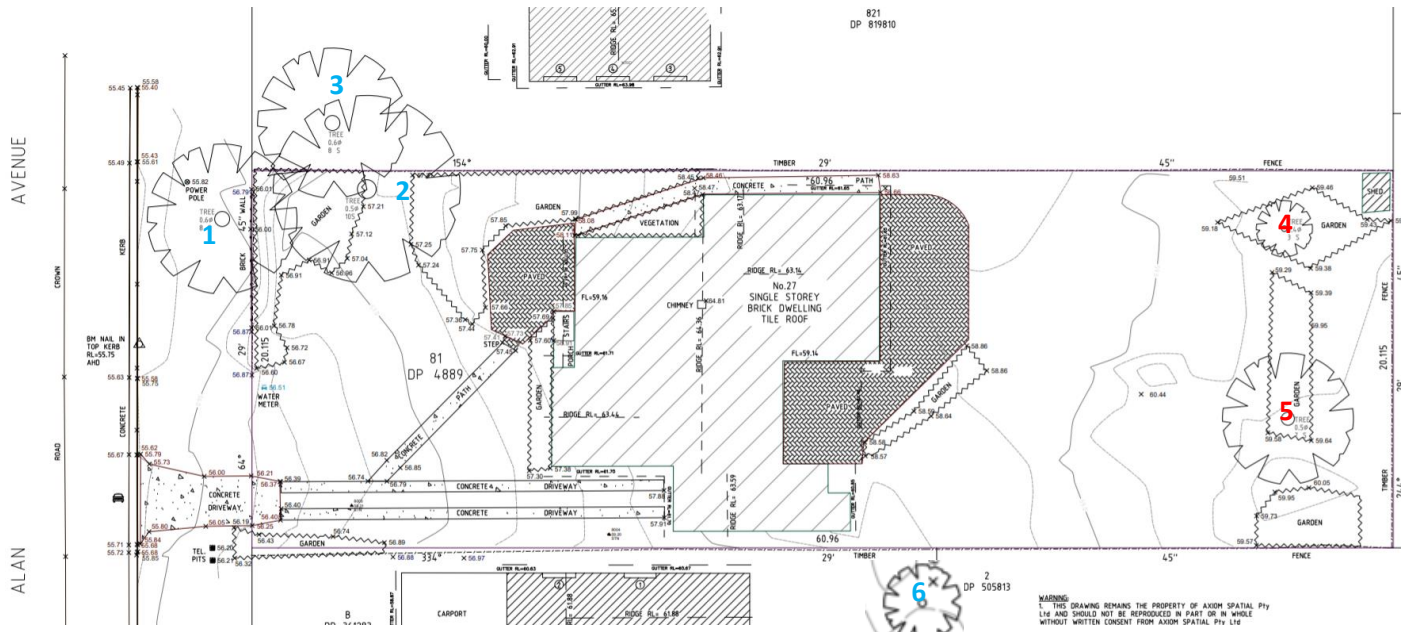


Figure 9-Site survey showing existing dwelling and trees to be retained (blue) and removed (red).

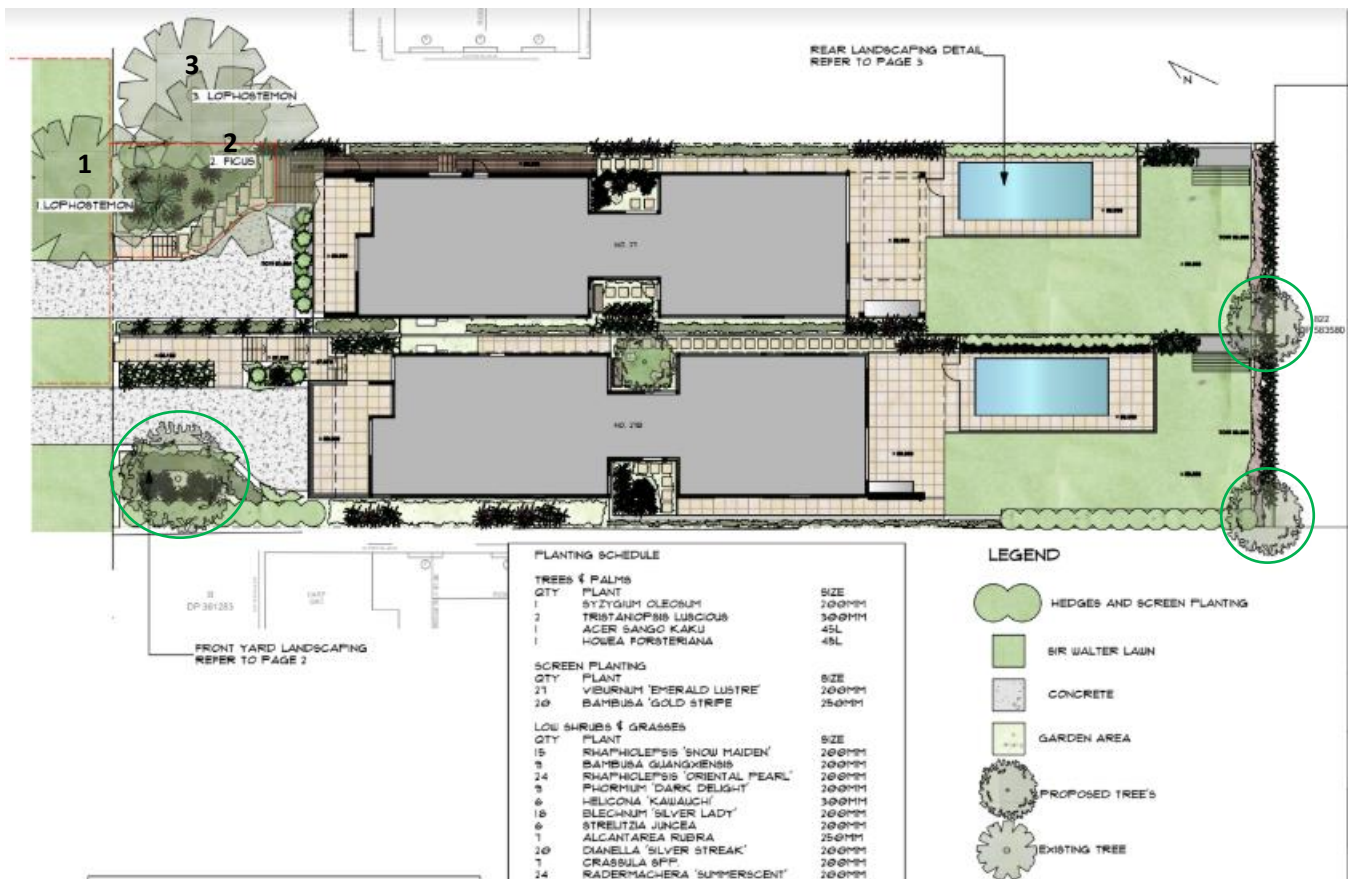


Figure 10-Proposed development showing some of the trees to be retained (numbered) and proposed plantings (green circles).

Tree schedule

Tree #	Species	Height/ spread	TPZ/ SRZ	Health & vigour	Structure	Defects	Sig.	U.L.E	Comments
1	<i>Lophostemon confertus</i> - Brush Box	10m 14x8m	8.0m 2.8m	Good	Poor	Poor pruning for power lines	Moderate	15-40 years	Council street tree. Moderate retention value. Driveway crossing 3.6m from centre of tree. May require pruning for driveway clearance.
2	<i>Ficus rubiginosa</i> - Port Jackson Fig	7m 10x8m	4.3m 2.4m	Good	Good	No significant defects	Moderate	15-40 years	2.6m from proposed retaining wall for driveway.
3	<i>Lophostemon confertus</i> - Brush Box	12m 10x9m	7.2m 2.8m	Fair	Good	No significant defects	Moderate	15-40 years	Neighbours tree. 6.6m from proposed retaining wall for driveway.
4	<i>Melaleuca armillaris</i> - Bracelet Honey Myrtle	9m 4 x 4m	3.0m 2.1m	Fair	Fair	Recently exposed by removal of adjacent trees	Low	5-15 years	Poor specimen providing minimal amenity. Would be negatively impacted by the swimming pool area.
5	<i>Eucalyptus nicholii</i> - Narrow-leaved Black Peppermint	8m 10x9m	5.2m 3.0m	Fair	Poor	Dominant stem is dead, remaining leaders poorly attached	Very Low	Hazardous	Exempt species
6	<i>Macadamia integrifolia</i> - Macadamia	8m 6 x 6m	4.9m 2.2m	Good	Poor	Multi- stemmed at 0.5m	Moderate	15-40 years	Neighbours tree. 3.5m back from fence.

Retention values

Retention value	
High	N/A
Medium	1, 2, 3, 6
Low	4
Very low	5

Figure 11- Tree retention values using rating system from Manly DCP.

Trees proposed for removal/retention

Proposed for	Tree number
Trees proposed for removal	4, 5
Trees proposed for retention	1, 2, 3, 6

Figure 12- Table showing trees for removal or retention.

Impact schedule



Figure 13- Drawing showing the encroachments upon retained trees (blue numbering) and trees proposed for removal (red numbering).

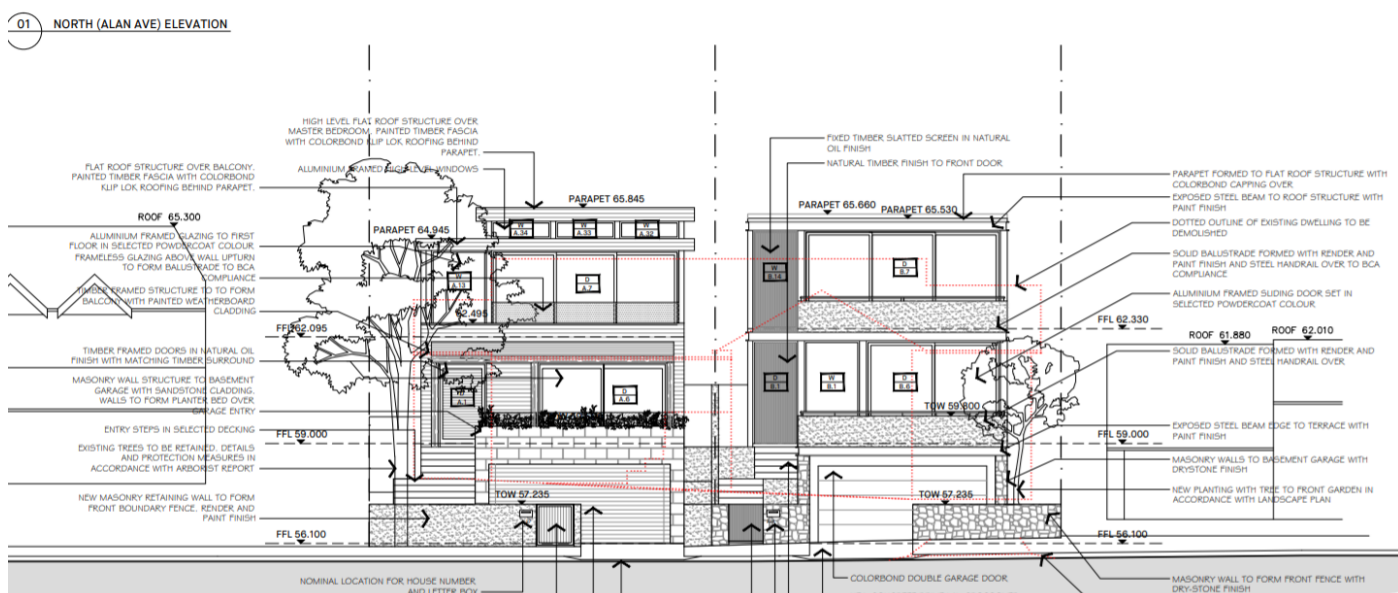


Figure 14-Drawing showing the front of the proposed properties where some encroachments occur.

Tree #	Impacted by
1	Driveway crossing / New masonry front fence /pedestrian entry / Driveway retaining wall
2	Driveway retaining wall / Entry stairs
3	New masonry front fence / Driveway retaining wall / Entry stairs
4	Swimming pool area
5	Swimming pool area
6	Planter boxes / dwelling

Figure 15- Impact table

Discussion of impacts

Tree one (1) is a council street tree specimen of *Lophostemon confertus*- Brush Box which will be encroached upon by the proposed driveway crossing and retaining wall into lot A and the removal and replacement of the existing front brick fence/retaining wall. The driveway bisects the tree protection zone (TPZ) of tree #1 at 3.6m from the centre of the tree, resulting in a calculated encroachment of around 22%. The front boundary fence is already an established structure so there will be no new encroachment to this area, however tree protection measures to mitigate any potential impacts will be required. The pedestrian entry and driveway retaining wall provide further minor encroachments, however these are relatively minor and given the raised soil levels inside the property boundary, significant tree roots from tree one are unlikely to be impacted. This species of tree is considered as being very tolerant of root disturbance, but non-destructive excavation will be required to assess the roots that will be impacted by the driveway crossing. The front wall will need to be carefully demolished by hand and reinstated using pier and beam or other sensitive construction methods to bridge over and retain any significant roots which are discovered. The demolition of the existing wall and reinstatement of a new wall will require Arborist supervision. Minor pruning of the tree canopy may be required to provide clearance over driveway crossing.

Tree two (2) is a semi-mature *Ficus rubiginosa*- Port Jackson Fig which will suffer an encroachment of approximately 15% from the retaining wall adjacent to the driveway and the steps into the property. The entry steps are to be constructed of timber decking or of lightweight structure to minimise impacts upon tree #2. The footings for the stairs must be individual hand-dug piers and must be supervised by an AQF level 5 Consulting Arborist. All piers must be located a minimum of 200mm from any significant tree root greater than 50mm in diameter. The portion of the driveway retaining wall which imposes the encroachment to tree two (2) will require non-destructive excavation to assess the number and size of roots that will be affected by the wall. Ficus trees are considered as being tolerant of root disturbance and given its current condition, this level of encroachment is unlikely to have any significant impact upon the tree.

Tree three (3) is a neighbour's *Lophostemon confertus*- Brush Box and will receive a minor encroachment of approximately 4% for the driveway retaining wall and entry stairs and a further 5% for the front boundary wall. This level of encroachment is well within the tolerances for this species of tree and there are unlikely to be any significant impacts.

Tree four (4) is a mature *Melaleuca armillaris*- Bracelet Honey Myrtle. This tree suffers a major encroachment from the pool terrace area and is unsustainable due to the soil level changes to enable the rear yard to be levelled. This tree will require removal.

Tree five (5) is a poorly structured *Eucalyptus nicholii*- Narrow-leaved Black Peppermint which will suffer a major encroachment for the swimming pool terrace and also for the levelling of the rear yard. This tree is an exempt species and also has hazardous structure. This tree will require removal.

Tree six (6) is a neighbour's *Macadamia integrifolia*- Macadamia Tree, this tree will receive a minor encroachment of less than 10% and is unlikely to be affected.

Conclusions

Tree one (1) is a council owned street tree located within the council verge. The tree is encroached upon by the proposed driveway crossing with an encroachment of around 20%. Non-destructive excavation should be completed along the driveway alignment to determine the size and number of roots to be affected. If significant roots are discovered, building the driveway crossing at grade using piers and elevated slab would mitigate the impacts upon the roots. The rendered masonry wall at the front of the property is replacing an existing retaining wall. The existing wall is within the SRZ of tree one (1) and will need to be carefully demolished by hand, without the use of machinery. The new wall must be constructed using pier and beam construction or other sensitive construction methods in order to retain any significant tree roots greater than 40mm which are discovered. Ground and trunk protection will be required when conducting this work and works must be supervised by an AQF level 5 Consulting Arborist.

Tree two (2) is a semi-mature *Ficus rubiginosa*- Port Jackson Fig which will suffer an encroachment of approximately 15% from the retaining wall adjacent to the driveway and the steps into the property. The entry steps are to be constructed of timber decking or of lightweight structure to minimise impacts upon tree #2. The footings for the stairs must be individual hand-dug piers and must be supervised by an AQF level 5 Consulting Arborist. All piers must be located a minimum of 200mm from any significant tree root greater than 50mm in diameter. The portion of the driveway retaining wall which imposes the encroachment to tree two (2) will require non-destructive excavation to assess the number and size of roots that will be affected by the wall. Ficus trees are considered as being tolerant of root disturbance and given its current condition, this level of encroachment is unlikely to have any significant impact upon the tree.

Trees one (1) and two (2) are both subject to 'major encroachment' (encroachment of greater than 10% of the TPZ). In accordance with AS4970-2009- The Protection of Trees on Development Sites, *'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 encroachment must be compensated for elsewhere and contiguous with the TPZ. This may require root investigation by non-destructive methods and consideration of relevant factors listed in clause 3.3.4.'*⁴

Tree three (3) is a mature *Lophostemon confertus*- Brush Box in the neighbour's property. This tree will be subject of minor encroachment of less than 10% of the TPZ and the tree is unlikely to suffer any significant impacts from the proposed development.

The proposed development at 27 Alan Avenue, Seaforth will require the removal of two (2) trees of low and very low retention value (trees 4 & 5).

Tree four (4) is a poorly formed *Melaleuca armillaris* which is providing very limited visual amenity and has a short remaining lifespan. This tree will be heavily impacted by grade level changes and the swimming pool construction.

Tree five (5) is a poorly structured *Eucalyptus nicholii* with major structural defects. This tree is exempt from the Northern Beaches DCP and can be removed without a council permit. This tree will be heavily impacted by grade level changes and the swimming pool construction.

Tree six (6) is a mature *Macadamia integrifolia*- Macadamia tree in the neighbour's property. This tree will be subject of minor encroachment of less than 10% of the TPZ and the tree is unlikely to suffer any significant impacts from the proposed development.

⁴ Standards Australia- AS4970-2009- The Protection of Trees on Development Sites

Recommendations

1. Trees 4 & 5 should be removed to enable the development to proceed.
2. Trees 1, 2, 3, 6 are currently proposed for retention and protection.
3. Tree protection fencing and signage must be installed in accordance with AS4970-2009 and located as depicted in appendix 3- Tree protection plan.
4. Ground protection and trunk and branch protection will be required for trees 1 & 2, as shown in appendix 3- Tree protection plan
5. The removal of tree four (4) will result in the need for at least one replacement planting.
6. Three replacement plantings are proposed and at least one should be one of the replacement species shown in appendix 4- Native tree selection.
7. All tree protection measures must be completed in accordance with AS4970-2009, appendix 2 of this report and appendix 3- Tree protection plan.

References

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Disclaimer:

The information contained within this report is to be used solely for the purposes that were specified at the time of engagement.

All attempts have been made to ensure the legitimacy of any information which has been gathered in the process of compiling this report, however Truth About Trees cannot be held liable for inaccurate or misleading information which has been provided by others.

Any tree inspections or assessments which have been carried out for the purposes of this report are valid only at the time of inspection and are based on what could reasonably be seen or diagnosed from a visual inspection carried out from ground level.

All inspections, unless otherwise stated, are based upon Visual Tree Assessment (VTA) techniques, industry best practice and applied knowledge. No internal diagnostic testing or below ground investigation has been carried out, unless otherwise stated.

Trees are a dynamic living organism and as such they have a finite lifespan the end of which cannot always be predicted or understood, even apparently healthy trees can die suddenly or fall without warning. As such there is no warranty or guarantee provided, or implied, regarding the future risks associated with any tree.

Please feel free to contact me either via telephone or email if you have any questions regarding this report.

Kind regards

Tom Hare- AQF level 5 Consulting Arborist

Truth About Trees

tom@truthabouttrees.com.au

0414 369 660

Appendix 1: Tree assessment methodology

1.1 Visual Tree Assessment (VTA)

The VTA system is based on the theory of tree biology and physiology, as well as tree architecture and structure. This method is used by arborists to identify visible signs on trees that indicate good health, or potential problems. Symptoms of decay, growth patterns and defects are identified and assessed as to their potential to cause whole-tree, part-tree and/or branch failure. This system is based around methods discussed in *'The Body Language of Trees'*⁵. For the purpose of this report, elements of the VTA system will be used, along with industry standard literature, and other relevant studies that provide an insight into potential hazards in trees. This assessment is a snapshot of what could be reasonably seen or determined from a basic visual inspection. The VTA system is generally used as a means to identify hazardous trees; however it is important to realize that for a tree to be hazardous there must be a target; a hazard poses no risk if there is no exposure to the hazard.

1.1.1 Health and Vigour Assessment

The health and vigour of a tree is assessed by looking at the tree canopy and how it is performing. Certain indicators provide information on which to base the assessment. Abnormally small leaves, chlorosis (yellowing), sparse crown, wilting, and die-back can be signs of ill-health or decline but may also be related to a temporary imbalance due to drought or pest infestations. Epicormic growth can be a sign of stress and low energy reserves but can also be related to increased light levels through the removal or pruning of adjacent trees. Extension growth can be a good indicator of vigour but this can vary greatly between species and under differing climatic conditions. For these reasons, each individual symptom or observation needs to be assessed with objectivity and consideration of all available information.

1.1.2 Structural Assessment

The structural assessment of trees is carried out using the basic framework of Visual Tree Assessment. Signs and symptoms of defects are assessed to gauge the likelihood of failure, because not every defect constitutes a hazard e.g. *"...co-dominant stems are a structural defect. The severity of the defect is increased by included bark, large crowns and strong wind."*⁶ If trees were removed purely on the basis that there were defects present without assessing the likelihood of failure or whether practical mitigation measures are available, the urban forest would cease to exist. A basic visual tree assessment is undertaken from ground level, if defects are suspected further investigation may be required and recommended. *"[When using] the Visual Tree Assessment (VTA) procedure for assessing trees, as the suspicion increases that defects are present, the examination becomes more thorough and searching."*¹

*"Some defects, especially some forms of decay, do not give rise to external signs and therefore tend to escape detection in a purely visual survey. If there is no reason for suspecting a hidden defect to occur within a particular part of the tree, there is no reasonable basis for carrying out a detailed internal assessment. Although in theory an unsuspected defect might be detectable by the use of specialized diagnostic devices, this would be impracticable in the absence of some external sign to indicate the place which should be probed. Also, internal examination without good reason is undesirable, as it usually causes injury to the tree and is unreasonably time consuming and costly."*⁷

⁵ Mattheck, C. & Broeler, H. 1994. *The Body Language of Trees*.

⁶ Matheny, N. & Clark, J. 1994. *A Photographic Guide to the Evaluation of Hazard Trees in Urban Areas*.

⁷ Lonsdale. 1999. *Principles of Tree Hazard Assessment and Management*.

1.2 Tree Protection Zone (TPZ) & Structural Root Zone (SRZ) Calculations

In accordance with Australian Standard *AS4970-2009 Protection of trees on development sites*⁸, Tree Protection Zone (TPZ) radius is calculated using the following procedure. Diameter of the trunk is measured at approximately 1.4m above ground level; this measurement is referred to as DBH (Diameter at Breast Height). $R_{TPZ} = DBH \times 12$. For multi-stemmed trees the formula used is $R_{TPZ} = \sqrt{[(DBH1)^2 + (DBH2)^2 + (DBH3)^2]}$. The TPZ is measured radially from the centre of the stem and must be protected on all sides.

The Structural Root Zone (SRZ) radius is calculated by measuring the diameter of the stem close to ground level, just above the basal flare. This measurement is taken as **D** and then used in the following formula: $R_{SRZ} = (D \times 50)^{0.42} \times 0.64$ and becomes the Structural Root Zone, measured radially from the centre of the stem.

It is important to realize that these calculations provide a notional figure only and tree dynamics, form and site conditions will greatly affect these zones, and it is the job of the arborist to interpret the information correctly.

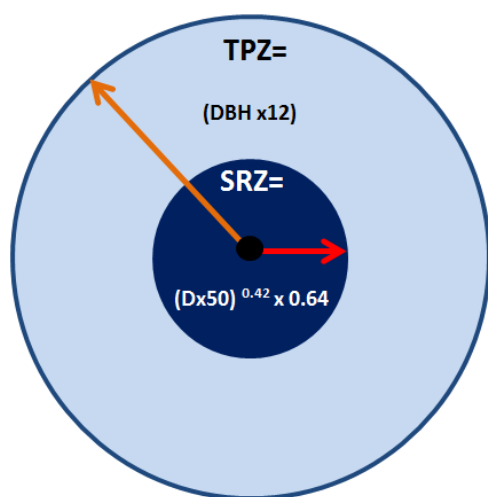


Figure 16- TPZ and SRZ calculations in accordance with AS4970-2009.

For palms, cycads, tree ferns, and similar monocots, the TPZ is positioned at least 1m outside the crown projection. SRZs are not applicable to these plant types.

*AS4970-2009*³ states “a TPZ should not be less than 2m nor greater than 15m (except where crown protection is required)” and the minimum radius for an SRZ is 1.5m.

⁸ Standards Australia. 2009. *AS4970-2009 Protection of trees on development sites*.

Appendix 2- Tree protection

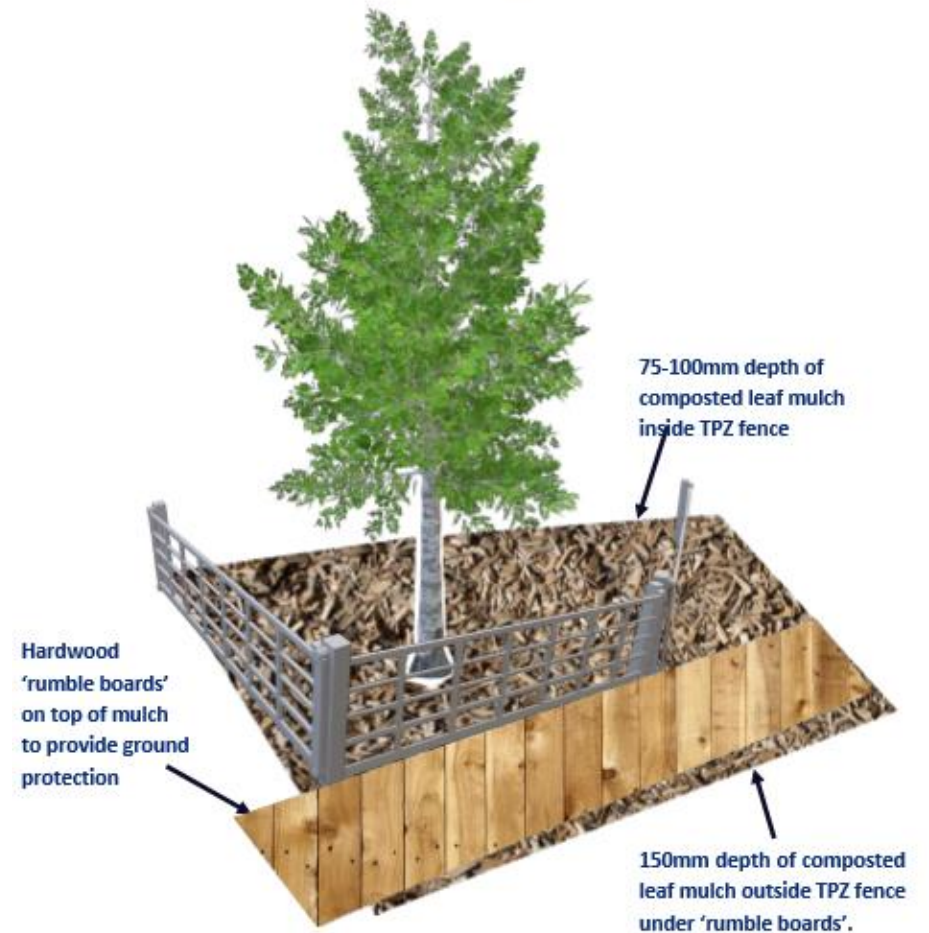
Tree protection measures are used to isolate the calculated tree protection zone from the impacts of construction activities. Tree protection measures come in many different forms and types depending on the type of protection required for the situation. The protection measures can be broadly considered as tree root protection, canopy protection or trunk and branch protection.

Tree root protection: TPZ Fencing- Figure 1

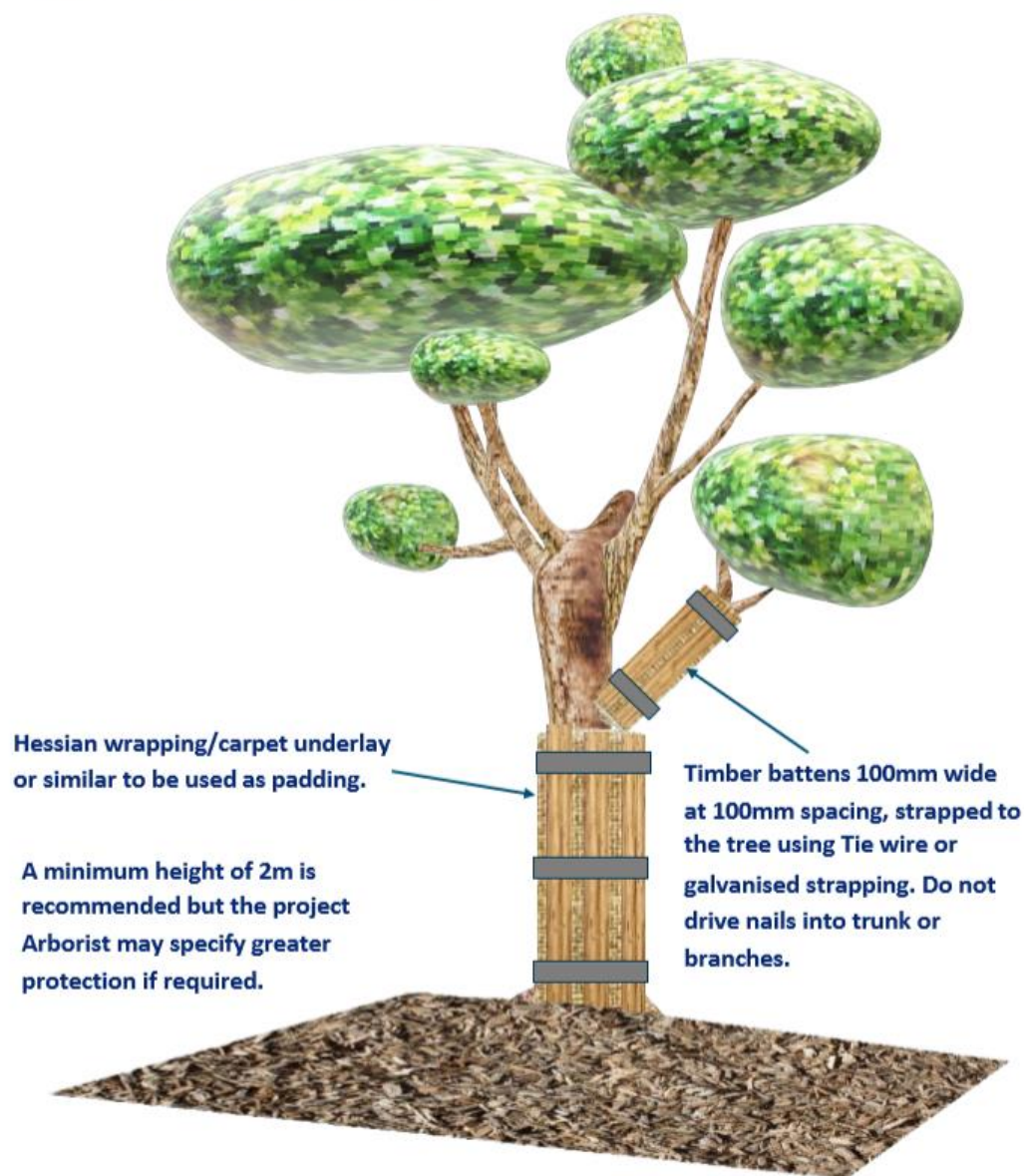
Tree root protection is generally achieved with the allocation and delineation of a tree protection zone (TPZ) in accordance with AS4970-2009- The Protection of Trees on Development Sites. Temporary fencing is used to isolate the area from construction activity and restrict unauthorized access. Where access into the TPZ is required and unavoidable, ground protection measures may be recommended to ensure that the tree roots which are to be protected remain undamaged during works within the TPZ. Any works within the allocated tree protection zones must be directly supervised by a project Arborist with a minimum AQF level 5 qualification. In situations where there are low lying tree branches to be protected, the TPZ may be extended beyond the calculated TPZ in order to incorporate canopy protection as shown below.



Ground protection: Access road within TPZ- Figure 2.



Trunk and branch protection- Figure 3.



Tree protection specifications:

In accordance with AS4970-2009- The Protection of Trees on Development Sites, activities restricted within the TPZ include but are not limited to:

- Machine excavation including trenching.
- Excavation for silt fencing.
- Cultivation.
- Storage of materials or machinery.
- Preparation of chemicals, including cement products.
- Parking of vehicles and plant.
- Refuelling of machinery.
- Dumping of waste.
- Wash down and cleaning of equipment.
- Placement of fill.
- Lighting fires.
- Soil level changes.
- Temporary or permanent installation of utilities and signs.
- Physical damage to the tree.

Tree protection fencing:

Tree protection fencing is to be installed prior to site establishment, demolition or commencement of any works on site.

All fencing must be chainmesh fencing 1.8m in height, secured with concrete 'feet' and in accordance with AS4678-Temporary Fencing and Hoardings. Depending on the type of development, shade cloth or similar may be recommended to reduce the spread of dust, particulate matter and liquids into the protected area. Silt fencing may also be required and may be incorporated into the TPZ fencing if required. Once the TPZ fencing has been installed the site Arborist must provide a letter of certification of tree protection measures to the client which may be forwarded on to the private certifier or council. Tree protection fencing is not to be moved, realigned, dismantled or tampered with in any way and shall only be relocated under instruction of the project Arborist. (See Figure 1) If the protective fencing requires temporary removal, trunk, branch and ground protection must be installed and must comply with AS 4970-2009 - Protection of trees on development sites. Existing fencing and site hoarding may be used as tree protection fencing, providing the TPZ remains isolated from construction activities. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ. Ground protection may include a permeable membrane such as geotextile fabric beneath a layer of mulch, crushed rock or rumble boards.

Any additional construction activities within the TPZ of the subject trees must be assessed and approved by the project arborist and must comply with AS 4970- 2009 - Protection of trees on development sites.

Tree protection signage:

Tree protection zone signage must be installed and clearly visible from all angles within the site stating, "NO ENTRY TREE PROTECTION ZONE" and phone numbers for the site Arborist and site supervisor/foreman must be provided. TPZ signage must be laminated or otherwise protected to ensure that it remains legible for the duration of the project. (See Figure 1)

Ground protection:

Where access into the TPZ of a tree is necessary and unavoidable, the project Arborist must specify the methods of additional protection required. This may be ground protection in the form of 150mm depth of composted mulch beneath hardwood 'rumble boards' alternatively track mats or road plates may be used (See figure 2). Tree roots are essential for the uptake/absorption of water, oxygen and mineral ions (solutes). It is essential to prevent the disturbance of the soil beneath the dripline and within the TPZ of trees that are to be retained. Soil compaction within the TPZ will adversely affect the ability of roots to function correctly.

Generally, soil level changes within the TPZ of a tree is not recommended and is contrary to AS4970-2009 The Protection of Trees on Development Sites. Certain circumstances can arise where this may be necessary, and the requirements must be carefully considered by the project Arborist. If the grade is to be raised within the TPZ, the material should be coarser or more porous than the underlying material and the suitability of this action must be assessed by the project Arborist.

Trunk and branch protection:

Where there is the risk of accidental mechanical damage due to narrow access paths or large machinery movements, trunk and branch protection may also be recommended (see figure 3). The removal of bark or branches allows the potential ingress of micro-organisms which may cause decay. Furthermore, the removal of bark restricts the trees' ability to distribute water, mineral ions (solutes), and glucose.

Trunk protection shall consist of a layer of either Hessian wrapping, carpet underlay, geotextile fabric or similar wrapped around the trunk, followed by softwood timbers approximately 100mm wide, aligned vertically and spaced evenly around the trunk (with an approx. 100 mm gap between the timbers).

The timbers must be secured using galvanized hoop strapping or tie wire. The timbers shall be wrapped around the trunk but not fixed to the tree with nails, screws or other means, as this will cause injury/damage to the tree.

Crown protection:

Tree crowns/canopy may be injured or damaged by machinery such as; excavators, drilling rigs, trucks, cranes, plant and vehicles. Where crown protection is required, it will usually be located at least one meter outside the perimeter of the crown.

Crown protection may include the installation of a physical barrier, pruning selected branches to establish clearance, or the tying/bracing of branches.

Supervision of works within the TPZ:

If incursion/excavation amounting to greater than 10% of the TPZ is unavoidable, exploratory excavation (under the supervision of the Project Arborist) using non-destructive methods may be considered to evaluate the extent of the root system affected and determine if the tree can remain viable.

If the project arborist identifies conflicting roots that require pruning, they must be pruned with a sharp implement such as; secateurs, pruners, handsaws or a chainsaw back to undamaged tissue. All works within the TPZ of any tree to be retained must be completed under the direct supervision of the project Arborist. This may include non-destructive excavation or hand digging to locate individual piers or fence posts.

The project Arborist is to recommend measures to protect and preserve any roots uncovered during these activities, this may include wrapping the tree roots in hessian or similar and keeping them moist to prevent desiccation.

Any tree roots which are damaged are to be assessed by the supervising Arborist who is to determine the best course of action. If root pruning is recommended, the project Arborist should sever the damaged roots cleanly back to undamaged tissue and cover the exposed portion of root to prevent desiccation.

Where significant roots have been pruned, the project Arborist should complete a letter of certification including a root mapping report explaining the number and diameter of roots which were severed, what impacts are likely and provide recommendations for mitigation of such impacts if required.

All supervision works must be completed by an Arborist with a minimum AQF level 5 in Arboriculture.

Hold points/ certification:

Arborist involvement will be required throughout the development process at key milestones, at a minimum these are:

1. Certification of tree protection installation prior to site establishment
2. Monthly inspection of trees to ensure tree protection measures are effective.
3. Supervision and certification of any works within tree protection zones.
4. Removal of tree protection measures and final certification.

The approved tree protection plan must be available onsite prior to the commencement of works, and throughout the entirety of the project. To ensure the tree protection plan is implemented, hold points have been specified in the schedule of works for Arborist involvement. It is the responsibility of the principal contractor to complete each of the tasks. Once each stage is reached, the work will be inspected and certified by the project arborist and the next stage may commence. Alterations to this schedule may be required due to necessity. However, this shall be through consultation with the project arborist only.

A recommended schedule of works for Arborist involvement is as follows:

Pre-construction: Prior to demolition and site establishment indicate clearly (with spray paint on trunks) trees marked for removal only.

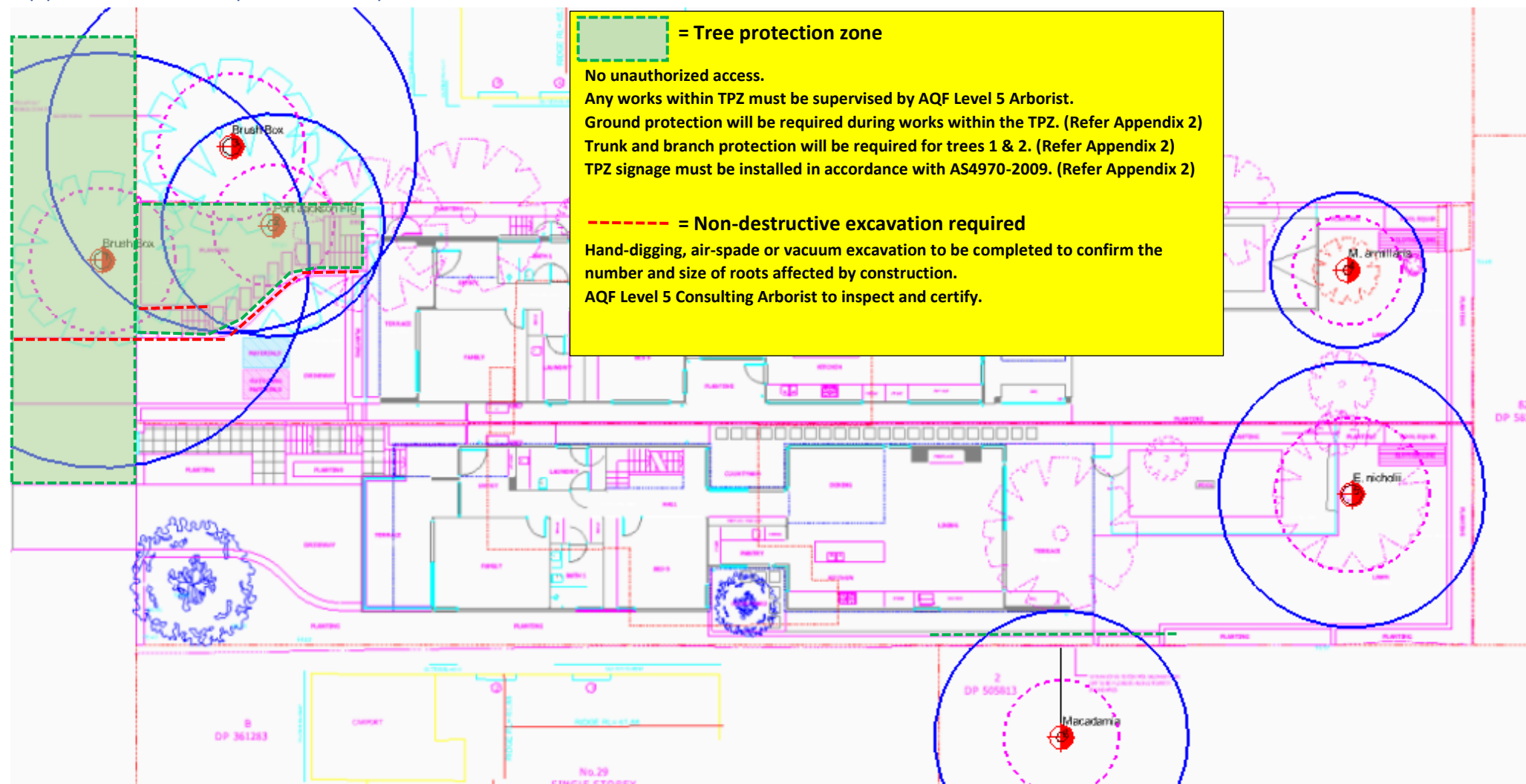
Tree protection (for trees that will be retained) shall be installed prior to demolition and site establishment, this will include mulching of areas within the TPZ.

Scheduled inspection of trees by the project arborist should be undertaken monthly during the construction period.

During Construction: Inspection of trees by project arborist after all major construction has ceased, following the removal of tree protection measures.

Post Construction: Final inspection of trees by project arborist to confirm tree condition and provide final letter of certification.

Appendix 3- Tree protection plan



27 Alan Avenue, Seaforth

Truth About Trees
3/265 Gympie Bay Rd, Gympie Bay.
tom@truthabouttrees.com.au
0414 369 660

Appendix 4- Replacement planting options

Schedule 4 - Part B - Native Tree Selection

Figure: Native Tree Selection to satisfy paragraph 4.1.5.2.c - Minimum Tree Plantings

Species Name	Typical height in cultivation	Common name	Situation
<i>Acmena smithii</i>	12m	Lilly Pilly	South Slopes; Creek banks
<i>Angophora costata</i>	20-25m	Smooth Barked Apple	Coastal (salt tolerant); Open forest (sun & shade, some shelter)
<i>Ceratopetalum apetalum</i>	15-20m	Coachwood	Creek banks
<i>Ceratopetalum gummiferum</i>	8-10m	NSW Christmas Bush	South Slopes; Coastal (salt tolerant); Open forest (sun and shade, some shelter)
<i>Eucalyptus botryoides</i>	15-25m	Bangalay	Coastal (salt tolerant); Open forest (sun & shade, some shelter)
<i>Eucalyptus gummifera</i>	15-25m	Red Bloodwood	Open forest (sun and shade, some shelter); heath (poor soil, sunny, open position)
<i>Eucalyptus haemastoma</i>	12-15m	Scribbly Gum	Open forest (sun and shade, some shelter); heath (poor soil, sunny, open position)
<i>Eucalyptus piperita</i>	12-20m	Peppermint	Open forest (sun and shade, some shelter)
<i>Eucalyptus punctata</i>	10-25m	Grey Gum	Open forest (sun and shade, some shelter)
<i>Ficus rubiginosa</i>	4-10m	Rusty Fig	Coastal (salt tolerant)
<i>Glochidion ferdinandii</i>	8-12m	Cheese <u>Tree</u>	Coastal (salt tolerant); Open forest (sun and shade, some shelter)
<i>Melaleuca quinquinervia</i>	8-12m	Broad-Leafed Paperbark	Wet/moist areas; Coastal (salt tolerant); Open forest (sun & shade, some shelter); Creek bank
<i>Tristaniopsis laurina</i>	4-10m	Water Gum	Wet/moist areas; Creek bank
<i>Syzygium paniculatum</i>	8-10m	Magenta Lilly Pilly	Open forest (sun and shade, some shelter); Creek bank; Wet/moist areas
<i>Syzygium oleosum</i>	8-10m	Blue Cherry	Creek bank; Wet/moist areas