



Arboricultural Impact Assessment Report

Site Location:

461-473 Pacific Highway
Asquith NSW

Prepared for: Calder Flower Architects
c/- Chinese Australian Services Society
Limited

Prepared by: Jack Williams
Urban Arbor Pty Ltd
Ref: 18/08/23/461PHA
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Table of Contents

1. INTRODUCTION	3
2. SCOPE OF THE REPORT	3
3. LIMITATIONS	4
4. METHODOLOGY	5
5. SITE LOCATION AND BRIEF DESCRIPTION	6
6. GENERAL INFORMATION IN RELATION TO PROTECTING TREES ON DEVELOPMENT SITES	6
7. OBSERVATIONS	8
8. ASSESSEMENT OF CONSTRUCTION IMPACTS	9
9. CONCLUSIONS	17
10. RECOMMENDATIONS	18
11. TREE PROTECTION REQUIREMENTS	19
12. CONSTRUCTION HOLD POINTS FOR TREE PROTECTION	27
13. BIBLIOGRAPHY/REFERENCES	28
14. LIST OF APPENDICES	28

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1. INTRODUCTION

1.1 Urban Arbor have been instructed by Calder Flower Architects, on behalf of the Chinese Australian Services Society Limited, to provide an Arboricultural Impact Assessment Report for trees located at the site and adjoining neighbouring sites in relation to a proposed development.

1.2 Below is a list of all documents and information provided for assessment in this report;

- A) Survey, Calder Flower Architects, Project No. 16180, 12 September 2016.
- B) Proposed Plans, Calder Flower Architects, Project No. 16180, Issue A - 12 March 2018, Including the following Drawings;

DA DRAWING LIST	
DRAWING NO.	DRAWING NAME
A000	TITLE PAGE
A001	SITE PLAN
A002	SITE PLAN-DEMOLITION
A003	SITE ANALYSIS
A004	SITE AREAS
A005	BUILDING SETBACKS
A100	PLAN-LEVEL 1
A101	PLAN-LEVEL 2
A102	PLAN-LEVEL 3
A103	PLAN-LEVEL 4

- C) Landscape Plan, Taylor Brammer, Revision A - 8 March 2018, Including the following sheet numbers; 00, 01, 02, 03, 04, 05, D1.
- D) Arboricultural Root Investigation Report, Urban Arbor Pty Ltd, Ref: 19/06/26/467PHA, 26 June 2019 (Appendix 4).

1.3 The site and tree inspections were carried out on 17 August 2018. Urban Arbor completed the root investigations for tree 40 on the 25 June 2019. Access was available to the subject site and adjoining public areas only.

2. SCOPE OF THE REPORT

2.1 This report has been undertaken to meet the following objectives.

- 2.1.1 Conduct a visual assessment of all significant trees located within 5 metres of development works from ground level. For the purpose of this report, a significant tree is a tree with a height equal to or greater than 5 metres.
- 2.1.2 Determine the trees estimated contribution years and remaining, useful life expectancy and award the trees a retention value.
- 2.1.3 Provide an assessment of the potential impact the proposed development is likely to cause to the condition of the subject trees in accordance with AS4970 Protection of trees on development sites (2009).
- 2.1.4 Specify tree protection measures for trees to be retained in accordance with AS4970-2009.

3. LIMITATIONS

- 3.1 The observations and recommendations are based on the site inspections identified in the introduction (section 1) and the access available at the time of inspection. Findings of this report are based on the observations and site conditions at the time inspection.
- 3.2 All of the observations were carried out from ground level and none of the surrounding surfaces were lifted or removed during the inspection. No tests were carried out to the subject trees or surrounding area during the inspection.
- 3.1 Root decay can sometimes be present with no visual indication above ground. It is also impossible to know the extent of any root damage caused by mechanical damage such as underground root cutting during the installation of services without undertaking detailed root investigation. Any form of tree failure due to these activities is beyond the scope of this assessment.
- 3.2 The report reflects the subject tree(s) as found on the day of inspection. Any changes to the growing environment of the subject tree, or tree management works beyond those recommended in this report may alter the findings of the report. There is no warranty, expressed or implied, that problems or deficiencies relating to the subject tree, or subject site may not arise in the future.
- 3.3 Tree identification is based on accessible visual characteristics at the time of inspection. As key identifying features are not always available the accuracy of identification is not guaranteed. Where tree species is unknown, it is indicated with an *spp.*
- 3.4 All diagrams, plans and photographs included in this report are visual aids only, and are not to scale unless otherwise indicated.
- 3.5 Urban Arbor neither guarantees, nor is it responsible for, the accuracy of information provided by others that is contained within this report.
- 3.6 While an assessment of the subject trees estimated useful life expectancy is included in this report, no specific tree risk assessment has been undertaken for any of trees at the site.
- 3.7 The ultimate safety of any tree cannot be categorically guaranteed. Even trees apparently free of defects can collapse or partially collapse in extreme weather conditions. Trees are dynamic, biological entities subject to changes in their environment, the presence of pathogens and the effects of ageing. These factors reinforce the need for regular inspections. It is generally accepted that hazards can only be identified from distinct defects or from other failure-prone characteristics of a tree or its locality.
- 3.8 Alteration of this report invalidates the entire report.

4. METHODOLOGY

- 4.1 The following information was collected during the assessment of the subject tree(s).
- 4.1.1 Tree common name
 - 4.1.2 Tree botanical name
 - 4.1.3 Tree age class
 - 4.1.4 DBH (Trunk/Stem diameter at breast height/1.4m) - millimetres.
 - 4.1.5 Estimated height - metres
 - 4.1.6 Estimated crown spread (diameter of crown) - metres
 - 4.1.7 Health
 - 4.1.8 Structural condition
 - 4.1.9 Amenity value
 - 4.1.10 Estimated remaining contribution years (SULE)¹
 - 4.1.11 Retention value (Tree AZ)²
 - 4.1.12 Notes/comments
- 4.2 An assessment of the trees condition was made using the visual tree assessment (VTA) model (Mattheck & Breloer, 1994).³
- 4.3 Tree diameter was measured using a DBH tape or in some cases estimated. Tree height and tree canopy spread was measured with a clinometer or in some cases estimated. All other measurements were estimations unless otherwise stated. The other tools used during the assessment were a nylon mallet, compass, camera and a steel probe.
- 4.4 All information was imported into our computerised geographical information system (GIS) PT-mapper pro. This software was used to measure/calculate all encroachment estimates included in this report.
- 4.5 All DBH measurements, tree protection zones, and structural root zones were calculated in accordance with methods set out in AS4970 Protection of trees on development sites (2009).⁴
- 4.6 Details of how the observations in this report have been assessed are listed in the appendices.

¹ Barrell, J. (2001), 'SULE: Its use and status in the new millennium' in *Management of Mature Trees proceedings of the 4th NAAA Workshop*, Sydney, 2001. Barrell.

² Barrell Tree Consultancy, *Tree AZ version 10.10-ANZ*, <http://www.treeaz.com/>.

³ Mattheck, C. & Breloer, H., *The body language of trees - A handbook for failure analysis*, The Stationary Office, London, England (1994).

⁴ Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009).

5. SITE LOCATION AND BRIEF DESCRIPTION

5.1 The site is located in the suburb of Asquith, New South Wales, which is located in the Hornsby Shire Council area. All trees at the site are subject to protection under the Hornsby Local Environmental Plan (LEP) 2013⁵ and Development Control Plan (DCP) 2013.⁶ The site is not located inside a Heritage Conservation Area or identified as a heritage item in the LEP heritage maps.⁷ None of the site is identified as 'biodiversity' in the LEP terrestrial biodiversity maps.⁸

6. GENERAL INFORMATION IN RELATION TO PROTECTING TREES ON DEVELOPMENT SITES

6.1 **Tree protection zone (TPZ):** The TPZ is the principle means of protecting trees on development sites and is an area required to maintain the viability of trees during development. It is commonly observed that tree roots will extend significantly further than the indicative TPZ, however the TPZ is an area identified in AS4970-2009 to be the area where root loss or disturbance will generally impact the viability of the tree. The TPZ is identified as a restricted area to prevent damage to trees either above or below ground during a development. Where trees are intended to be retained proposed developments must provide an adequate TPZ around trees. The TPZ is set aside for the tree's root zone, trunk and crown and it is essential for the stability and longevity of the tree. The TPZ also incorporates the SRZ (see below for more information about the SRZ). The TPZ is calculated by multiplying the DBH by twelve, with the exception of palms, other monocots, cycads and tree ferns, the TPZ of which have been calculated at one metre outside the crown projection. Additional information about the TPZ is included in appendix 3.

6.2 **Structural Root Zone (SRZ):** This is the area around the base of a tree required for the trees stability in the ground. An area larger than the SRZ always needs to be maintained to preserve a viable tree. The SRZ is calculated using the following formula; $(DAB \times 50)^{0.42} \times 0.64$. There are several factors that can vary the SRZ which include height, crown area, soil type and soil moisture. It can also be influenced by other factors such as natural or built structures. Generally, work within the SRZ should be avoided. Soil level changes should also generally be avoided inside the SRZ of trees to be retained. Palms, other monocots, cycads and tree ferns do not have an SRZ. See the appendices for more information about the SRZ.

⁵ Hornsby Local Environmental Plan 2013, <https://www.legislation.nsw.gov.au/#/view/EPI/2013/569>.

⁶ Hornsby Development Control Plan 2013, <http://www.hornsby.nsw.gov.au/property/development-applications/hornsby-development-control-plan>.

⁷ Hornsby LEP Heritage Maps - Sheet Her_017, https://www.legislation.nsw.gov.au/maps/69cf7cb6-e376-4be1-8bcf-cfcd78415b/4000_COM_HER_017_020_20140820.pdf, accessed 20 August 2018.

⁸ Hornsby LEP Terrestrial Biodiversity Maps - Sheet BIO_017, https://www.legislation.nsw.gov.au/maps/bf98b48c-c3d3-e08d-c85f-f0ec2b0951a2/4000_COM_BIO_017_020_20130805.pdf, accessed 20 August 2018.

6.3 Minor encroachment into TPZ: Sometimes encroachment into the TPZ is unavoidable. Encroachment includes but is not limited to activities such as excavation, compacted fill and machine trenching. Minor encroachment of up to 10% of the overall TPZ area is normally considered acceptable, providing there is space adjacent to the TPZ for the tree to compensate and the tree is displaying adequate vigour/health to tolerate changes to its growing environment.

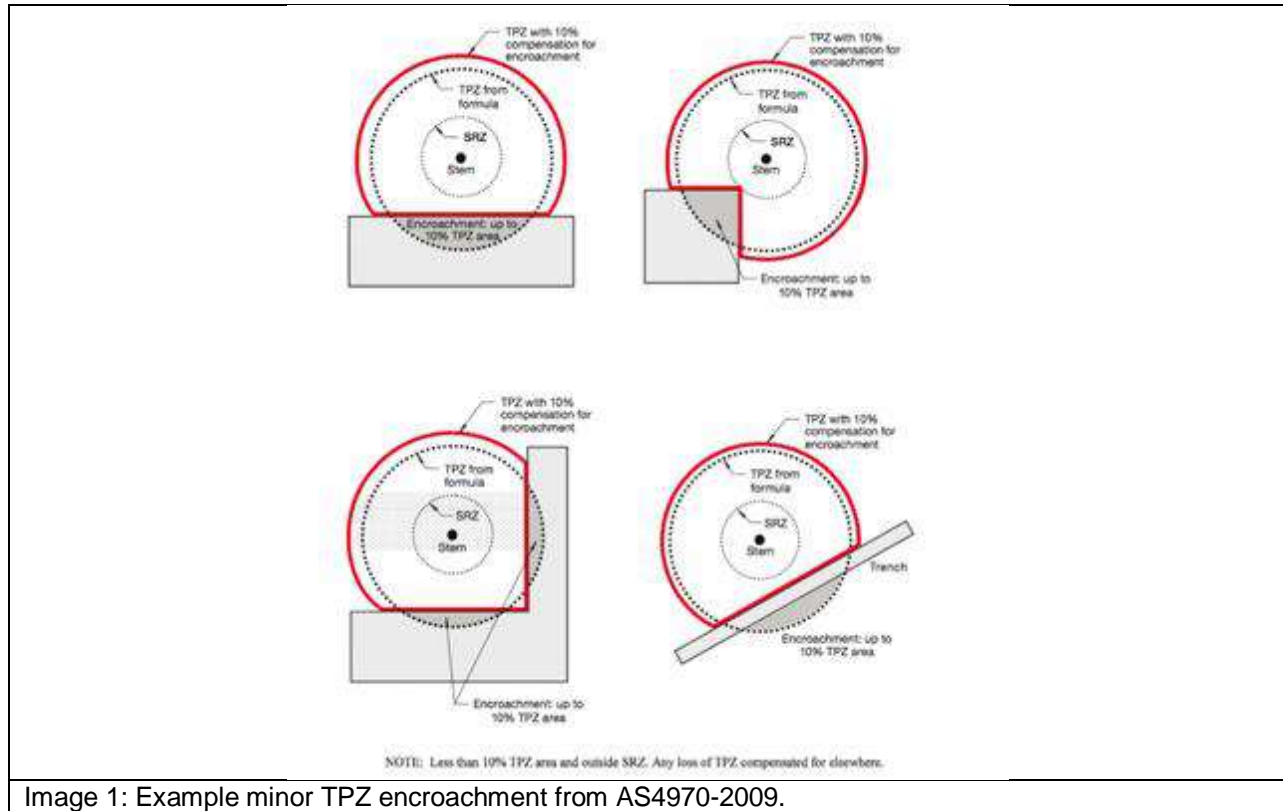


Image 1: Example minor TPZ encroachment from AS4970-2009.

6.4 Major encroachment into TPZ: Where encroachment of more than 10% of the overall TPZ area is proposed the project Arborist must investigate and demonstrate that the tree will remain in a viable condition. In some cases, tree sensitive construction methods such as pier and beam footings, suspended slabs, or cantilevered sections, can be utilised to allow additional encroachment into the TPZ by bridging over roots and minimising root disturbance. Major encroachment is only possible if it can be undertaken without severing significant size roots, or if it can be demonstrated that significant roots will not be impacted. Root investigations may be required to identify roots that will be impacted during major TPZ encroachment (see appendix 3 for more information in relation to root investigations).

7. OBSERVATIONS

- 7.1 **Tree information:** Details of each individual tree assessed, including the observations taken during the site inspection, can be found in the tree inspection schedule in appendix 2, where the indicative tree protection zone (TPZ) and Structural Root Zone (SRZ) has been calculated for each of the subject trees. The TPZ and SRZ should be measured in radius from the centre of the trunk. Each of the subject trees have been awarded a retention value based on the observations using the Tree AZ method. Tree AZ is used to identify higher value trees worthy of being a constraint to development and lower value trees that should generally not be a constraint to the development. The Tree AZ categories sheet (Barrell Tree Consultancy) has been included in appendix 3 to assist with understanding the retention values. The retention value that has been allocated to the subject trees in this report is not definitive and should only be used as a guideline.
- 7.2 **Site plan:** In appendix 1 three site plans have been prepared, where the tree information including canopy spread, TPZ and SRZ have been overlaid onto the site plans. The following plans are included in appendix 1;
- Appendix 1A: Existing Site Plan
 - Appendix 1B: Proposed Ground Level Site Plan
 - Appendix 1C: Proposed Basement Level Site Plan

8. ASSESSMENT OF CONSTRUCTION IMPACTS

8.1 Table 1: In the table below the impact of proposed development to all trees included in the report has been discussed. The TPZ encroachment includes proposed structures and hard landscaping only. The proposed footpath that surrounds the building to the North/South/West within the site has not been included in the TPZ encroachment percentages. Providing that the footpaths are constructed above existing soil grades in accordance with section 11, the footpaths will not significantly impact the trees.

Tree ID	Botanical Name	Retention value	TPZ radius (m)	TPZ area (m ²)	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
1	<i>Eucalyptus resinifera</i>	Z9	6.0	113.1	2.6	Major	A retaining wall for a courtyard encroaches into the TPZ of the tree by 17% (19.5m ²) and significantly into the SRZ, indicating that the stability of the tree may be impacted.	Remove
2	<i>Eucalyptus resinifera</i>	A1	4.9	76.0	2.4	Major	A retaining wall for a courtyard encroaches into the TPZ of the tree by 12% (9m ²). This is major TPZ encroachment, however it is only just over the threshold of minor TPZ encroachment. The root system of tree 1, the trunk of which is located between the courtyard and trunk of tree 2, is likely to have reduced root growth into the TPZ encroachment area, reducing the impact to tree. The tree will be viable for retention.	Retain and protect
3	<i>Eucalyptus eugenioides</i>	A2	8.8	241.1	3.0	Footprint	Trunk within footprint of proposed courtyard/hard surfacing.	Remove
4	<i>Eucalyptus paniculata</i>	A1	9.0	254.5	3.1	None	No encroachment into the TPZ.	Retain and protect
5	<i>Angophora costata</i>	Z4	3.0	28.3	1.9	None	No encroachment into the TPZ.	Retain and protect
6	<i>Eucalyptus paniculata</i>	A1	6.4	127.1	2.7	None	No encroachment into the TPZ.	Retain and protect
7	<i>Eucalyptus resinifera</i>	A2	7.0	152.2	2.8	None	No encroachment into the TPZ.	Retain and protect

Tree ID	Botanical Name	Retention value	TPZ radius (m)	TPZ area (m ²)	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
8	<i>Angophora costata</i>	A1	6.2	122.3	2.6	None	No encroachment into the TPZ.	Retain and protect
9	<i>Araucaria heterophylla</i>	A1	8.0	203.1	3.0	Footprint	Trunk within footprint of a proposed building.	Remove
10	<i>Banksia integrifolia</i>	Z1	2.0	12.6	1.6	None	No encroachment into the TPZ.	Retain and protect
11	<i>Angophora costata</i>	A2	6.7	141.9	2.7	Footprint	Trunk within footprint of a proposed electricity sub-station.	Remove
12	<i>Angophora costata</i>	A1	9.0	254.5	3.1	Footprint	Trunk within footprint of a proposed building.	Remove
13	<i>Jacaranda mimosifolia</i>	A1	5.6	98.3	2.6	Footprint	Trunk within footprint of a proposed footpath.	Remove
14	<i>Angophora costata</i>	A1	7.3	167.2	2.8	Minor	The driveway crossover encroaches into the TPZ by less than 5%, which will not impact the tree.	Retain and protect
15	<i>Hakea salicifolia</i>	Z4	2.1	14.2	1.9	None	No encroachment into the TPZ.	Retain and protect
15a	<i>Callistemon viminalis</i>	Z1	2.8	23.9	1.9	Major	A proposed driveway encroaches into the TPZ of the tree by 26% (6.1m ²) and significantly into the SRZ, indicating that the stability and health of the tree may be impacted.	Remove
16	<i>Syagrus romanzoffianum</i>	Z3	3.0	28.3	N/A	Footprint	Trunk within footprint of proposed generator padmount.	Remove
17	<i>Syagrus romanzoffianum</i>	Z3	3.0	28.3	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
17a	<i>Cinnamomum camphora</i>	Z3	2.0	12.6	1.8	Footprint	Trunk within footprint of the proposed driveway.	Remove
18	<i>Syagrus romanzoffianum</i>	Z3	3.5	38.5	N/A	Footprint	Trunk within footprint of the proposed driveway.	Remove

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Tree ID	Botanical Name	Retention value	TPZ radius (m)	TPZ area (m ²)	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
19	<i>Archontophoenix alexandrae</i>	Z2	2.5	19.6	N/A	Footprint	Trunk within footprint of the proposed driveway.	Remove
20	<i>Syagrus romanzoffianum</i>	Z3	3.5	38.5	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
21	<i>Syagrus romanzoffianum</i>	Z3	3.0	28.3	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
22	<i>Syagrus romanzoffianum</i>	Z3	3.5	38.5	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
22a	<i>Syagrus romanzoffianum</i>	Z3	2.0	12.6	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
23	<i>Syagrus romanzoffianum</i>	Z3	2.0	12.6	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
24	<i>Syagrus romanzoffianum</i>	Z3	2.0	12.6	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
24a	<i>Hakea salicifolia</i>	Z1	2.6	21.9	1.9	Footprint	Trunk within footprint of a proposed building.	Remove
25a	<i>Archontophoenix alexandrae</i>	A1	2.0	12.6	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
25	<i>Archontophoenix alexandrae</i>	A1	3.5	38.5	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
26	<i>Archontophoenix alexandrae</i>	A1	4.0	50.3	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
27	<i>Archontophoenix alexandrae</i>	A1	3.0	28.3	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
28	<i>Syagrus romanzoffianum</i>	Z3	3.0	28.3	N/A	Footprint	Trunk within footprint of a proposed building.	Remove

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29	<i>Archontophoenix alexandrae</i>	A1	3.0	28.3	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
30	<i>Syagrus romanzoffianum</i>	Z3	2.0	13.1	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
31	<i>Syagrus romanzoffianum</i>	Z3	2.0	12.6	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
32	<i>Cyathea cooperi</i>	Z1	2.0	12.6	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
33	<i>Syagrus romanzoffianum</i>	Z3	2.5	19.6	N/A	Footprint	Trunk within footprint of a proposed building.	Remove
34	<i>Archontophoenix alexandrae</i>	A1	3.0	28.3	N/A	Major	The proposed building/basement encroaches into the TPZ by 25% (7m ²), indicating that the tree will be impacted.	Remove
35	<i>Washingtonia robusta</i>	A1	3.0	28.3	N/A	None	No encroachment into the TPZ.	Retain and protect
36	<i>Syagrus romanzoffianum</i>	Z3	3.0	28.3	N/A	Footprint	Trunk within footprint of a proposed footpath.	Remove
37	<i>Syagrus romanzoffianum</i>	Z3	3.0	28.3	N/A	Footprint	Trunk within footprint of a proposed footpath.	Remove
38	<i>Prunus spp</i>	Z9	3.5	39.1	2.1	None	No encroachment into the TPZ.	Retain and protect
39	<i>Eucalyptus resinifera</i>	A1	7.7	185.3	2.9	Major	A proposed driveway encroaches into the TPZ by 23% (42.1m ²), but not into the SRZ. The landscape plan indicates that the majority of this area will be a permeable surface. To minimise the impact to the tree, the driveway should be constructed above existing soil grades in the TPZ. This will allow for the root system to be retained below the driveway and water, air and nutrients to filter to the root system below, and the tree will remain viable for retention.	Retain and protect*
40	<i>Eucalyptus resinifera</i>	A1	8.4	221.7	3.0	Major	The proposed building/basement will encroach into the TPZ by 17% (38.3m ²), but not into the SRZ. Urban Arbor completed root investigations for tree 40 on 25 June 2019. Root investigations were completed in the	Retain and protect

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Tree ID	Botanical Name	Retention value	TPZ radius (m)	TPZ area (m ²)	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
							location of the proposed basement excavations within the TPZ of tree 40. No significant roots were identified within the root investigations trench. Therefore the proposed basement excavations will not significantly impact the condition of tree 40. See appendix 4 for the Arboricultural Root Investigations Report.	
41	<i>Macadamia spp</i>	Z1	2.2	14.7	1.7	None	No encroachment into the TPZ.	Retain and protect
42	<i>Syncarpia glomulifera</i>	A1	8.3	216.3	3.4	Minor	The proposed building/basement encroach into the TPZ by 10% (20.8m ²), but not into the SRZ, which will not significantly impact the tree.	Retain and protect
43	<i>Cupressus sempervirens</i>	A1	2.0	12.6	1.5	Major	A proposed driveway encroaches into the TPZ by 17% (2.2m ²), and also into the SRZ. The landscape plan indicates that the majority of this area will be a permeable surface. To minimise the impact the tree, the driveway should be constructed above existing soil grades in the TPZ. This will allow for the root system to be retained below the driveway and water, air and nutrients to filter to the root system below, and the tree will remain viable for retention.	Retain and protect*
44	<i>Eucalyptus paniculata</i>	A1	9.8	299.7	3.5	Footprint	Trunk within footprint of a proposed waste storage area.	Remove
45	<i>Angophora costata</i>	A2	7.7	185.3	2.9	Footprint	Trunk within footprint of a proposed driveway.	Remove
46	<i>Angophora costata</i>	A1	7.6	179.6	2.9	Footprint	Trunk within footprint of a proposed waste storage area.	Remove
47	<i>Pinus radiata</i>	A1	5.9	108.6	2.6	Major	The proposed building/basement encroach into the TPZ by 13% (13.7m ²) and significantly into the SRZ, indicating that the stability of the tree may be impacted. The crown shape is asymmetric and weighted towards the building location, and significant canopy pruning will be required to accommodate the building. Due to the species of the tree, there are minimal suitable growth points to where the branches could be reduced, and the majority of the affected	Remove

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							primary branches will have to be removed, which will unbalance the shape of the tree. This tree will not be viable for retention. The trunk is also within the footprint of a proposed footpath.	
48	<i>Syncarpia glomulifera</i>	A1	5.8	104.2	2.6	Minor	The proposed building/basement encroaches into the TPZ by 10% (10m ²) but not into the SRZ, which will not significantly impact the root system of the tree. Canopy pruning will be required to accommodate the building, sufficient growth points are present to minimise the pruning to removing less than 10% of the overall canopy, which will not impact the tree. The pruning can be undertaken in accordance with AS4373-2007.	Retain and protect
49	<i>Cupressus sempervirens</i>	Z9	3.1	30.6	2.0	None	No encroachment into the TPZ.	Retain and protect
49a	<i>Morus nigra</i>	Z1	2.1	14.2	1.7	Footprint	Trunk within footprint of a proposed building.	Remove
50	<i>Jacaranda mimosifolia</i>	Z1	3.3	34.4	2.2	Footprint	Trunk within footprint of a proposed driveway.	Remove
51	X <i>Cupressocyparis leylandii</i> 'Castlewellan Gold'	A1	4.7	68.8	2.3	Footprint	Trunk within footprint of a proposed driveway.	Remove
52	<i>Camellia Sasanqua</i>	Z1	4.9	76.0	2.3	Footprint	Trunk within footprint of a proposed driveway.	Remove
53	<i>Photinia spp</i>	Z1	6.0	113.1	2.5	Major	A proposed driveway encroaches into the TPZ by 17% (19.2m ²), but not into the SRZ. This is a low value tree displaying reduced health. It is recommended that the tree is removed and replaced with a higher value tree that will contribute to the landscape for a longer time period.	Remove
53a	<i>Ceratopetalum gummiferum</i>	A1	3.0	27.7	2.0	Major	The trunk is located directly adjacent to the basement.	Remove

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Tree ID	Botanical Name	Retention value	TPZ radius (m)	TPZ area (m ²)	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
54a	<i>Citris spp</i>	Z3	2.5	20.0	1.8	Footprint	Trunk within footprint of a proposed building.	Remove
54	<i>Jacaranda mimosifolia</i>	A1	4.2	55.4	2.3	Footprint	Trunk within footprint of a proposed building.	Remove
55	<i>Acer palmatum</i>	Z1	3.1	30.6	2.0	Footprint	Trunk within footprint of proposed stairs.	Remove
56	<i>Angophora costata</i>	A1	7.0	152.2	2.8	Footprint	Trunk within footprint of a proposed building.	Remove
57	<i>Syncarpia glomulifera</i>	A1	7.6	179.6	2.9	Major	The proposed building/basement will encroach into the TPZ by 25% (29.5m ²), but not into the SRZ. As the basement will be located within this area, it will not be possible to incorporate tree sensitive measures to minimise the impact to the trees root system. The proposed TPZ encroachment is therefore considered to be of high impact to the trees health and it is recommended for removal.	Remove
57a	<i>Araucaria heterophylla</i>	Z1	2.0	12.6	1.6	Footprint	The trunk is located within the footprint of a proposed footpath.	Remove
58	<i>Eucalyptus scoparia</i>	A2	8.0	203.1	3.0	Minor	The proposed building/basement will encroach into the TPZ by less than 5%, which will not significantly impact the tree.	Retain and protect
59	<i>Melaleuca linarifolia</i>	Z1	2.0	13.1	1.6	Major	The trunk is located directly adjacent to the basement.	Remove
60	<i>Eucalyptus microcorys</i>	Z4	10.4	342.4	3.3	Major	The trunk is located directly adjacent to the basement.	Remove
61	<i>Schinus molle</i>	A1	4.4	61.9	2.3	Major	The trunk is located directly adjacent to the basement.	Remove
62	<i>Schinus molle</i>	A1	7.3	166.9	3.0	Footprint	Trunk within footprint of a proposed building.	Remove
63	<i>Eucalyptus microcorys</i>	A1	7.4	173.9	2.8	Minor	The proposed building/basement will encroach into the TPZ by less than 5%, which will not significantly impact the tree.	Retain and protect

 Site Address: 461-473 Pacific Highway, Asquith, NSW.

Prepared for: Calder Flower Architects c/- Chinese Australian Services Society Limited.

Prepared by: Jack Williams, Urban Arbor Pty Ltd, sales@urbanarbor.com.au, (02) 8004 2802.

Date prepared: 26 June 2019. Revision: A

Tree ID	Botanical Name	Retention value	TPZ radius (m)	TPZ area (m ²)	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
64	<i>Eucalyptus saligna</i>	A1	6.7	141.9	2.7	Minor	The proposed building/basement will encroach into the TPZ by less than 5%, which will not significantly impact the tree.	Retain and protect
65	<i>Eucalyptus haemastoma</i>	A1	3.5	38.0	2.1	None	No encroachment into the TPZ.	Retain and protect
66	<i>Eucalyptus microcorys</i>	A1	8.4	221.7	3.0	Minor	The proposed building/basement will encroach into the TPZ by less than 5%, which will not significantly impact the tree.	Retain and protect
67	<i>Eucalyptus microcorys</i>	A1	6.0	113.1	2.6	None	No encroachment into the TPZ.	Retain and protect
68	<i>Eucalyptus microcorys</i>	A1	7.0	152.2	2.8	None	No encroachment into the TPZ.	Retain and protect
69	<i>Eucalyptus microcorys</i>	A1	6.7	141.9	2.8	None	No encroachment into the TPZ.	Retain and protect
70	<i>Eucalyptus microcorys</i>	A1	2.6	21.9	1.8	None	No encroachment into the TPZ.	Retain and protect

Notes:

- Retain and protect* = Tree sensitive design and construction methods required, or further investigation of impact to the trees root system.
- The locations of tree 20-34 do not appear to have been plotted accurately on the site survey.
- Trees numbered with an 'a' have not been identified on the survey and their location has been estimated.

9. CONCLUSIONS

9.1 **Table 2:** Summary of the impact to trees by the development;

Impact	Reason	Category A	Category Z
		A	Z
Trees recommended to be removed	Building construction, new surfacing and/or proximity, trees in poor condition or low value trees to be removed and replaced.	3, 9, 11, 12, 13, 25, 25a, 26, 27, 29, 34, 44, 45, 46, 47, 51, 53a, 54, 56, 57, 61, 62 (Twenty-two trees)	1, 15a, 16, 17, 17a, 18, 19, 20, 21, 22, 22a, 23, 24, 24a, 28, 30, 31, 32, 33, 36, 37, 49a, 50, 52, 53, 54a, 55, 57a, 59, 60 (Thirty trees)
Trees recommended to be retained subject to major TPZ encroachment greater than 10%	Removal of existing surfacing/structures and/or installation of new surfacing/structures	2, 39, 40, 43 (Four trees)	None
Trees recommended to be retained subject to minor TPZ encroachment of 10% or less	Removal of existing surfacing/structures and/or installation of new surfacing/structures will not impact the trees viability	4, 6, 7, 8, 14, 35, 42, 48, 58, 63, 64, 65, 66, 67, 68, 69, 70 (Seventeen trees)	5, 10, 15, 38, 40a, 49 (Six trees)

10. RECOMMENDATIONS

- 10.1 This report assesses the impact of a proposed development at the subject site to all significant trees located inside or adjoining the site. Seventy-nine trees have been identified and assessed.
- 10.2 In appendix 1 three site plans has been prepared, where the tree information including canopy spread, TPZ and SRZ have been overlaid onto the site plans. The following plans are included in appendix 1;
- Appendix 1A: Existing Site Plan
 - Appendix 1B: Proposed Ground Level Site Plan
 - Appendix 1C: Proposed Basement Level Site Plan
- 10.3 Fifty-two trees have been recommended for removal due to impact from the proposed development, including tree 1, 3, 9, 11, 12, 13, 15a, 16, 17, 17a, 18, 19, 20, 21, 22, 22a, 23, 24, 24a, 25, 25a, 26, 27, 28, 29, 30, 31, 32, 33, 34, 36, 37, 44, 45, 46, 47, 49a, 50, 51, 52, 53, 53a, 54, 54a, 55, 56, 57, 57a, 59, 60, 61 and 62. Twenty-two of these trees have been awarded higher category A retention values, including tree 3, 5, 9, 10, 11, 12, 13, 15, 25, 25a, 26, 27, 29, 34, 38, 41, 44, 45, 46, 47, 49, 51, 53a, 54, 56, 57, 57a, 61 and 62. All other trees recommended for removal are lower value category Z retention value tree.
- 10.4 Root investigations were completed in the location of the proposed basement excavations within the TPZ of tree 40 on 25 June 2019. No significant roots were identified within the root investigations trench. Therefore the proposed basement excavations will not significantly impact the condition of tree 40 and the tree can be retained in a viable condition. See appendix 4 for the Arboricultural Root Investigations Report.
- 10.5 The other twenty-six trees assessed can be retained in a viable condition, including tree 2, 4, 5, 6, 7, 8, 10, 14, 15, 35, 38, 39, 41, 42, 43, 48, 49, 58, 63, 64, 65, 66, 67, 68, 69 and 70. To minimise the impact to tree 39 and 43, the proposed driveway in the TPZ should be constructed with a permeable surface as indicated in the landscape plan, and above existing soil grades.
- 10.6 A new footpath has been proposed around the building to the North/South/West within the site. This footpath must be constructed above existing soil grades in the TPZ of trees to be retained. The location of the footpath within the site should be flexible to minimise the impact to the trees.
- 10.7 All trees to be retained must be protected in accordance with AS4970-2009, details of which are included in section 11.
- 10.8 No services plan has been assessed in this report, all services plans should be subject to review by a consulting Arborist. Where possible underground services should be located outside the TPZ of trees to be retained. All underground services located inside the TPZ of any tree to be retained must be installed via tree sensitive techniques. This should include either directional drilling methods or manual excavations to minimise the impact to trees identified for retention.

11. TREE PROTECTION REQUIREMENTS

- 11.1 Use of this report:** All contractors must be made aware of the tree protection requirements prior to commencing works at the site. This report and a copy of the site plans (Appendix 1) drawing must also be made available to any contractor prior to works commencing and during any on site operations.
- 11.2 Project Arborist:** Prior to any works commencing at the site a project Arborist should be appointed. The project Arborist should be qualified to a minimum AQF level 5 and/or equivalent qualifications and experience, and should assist with any development issues relating to trees that may arise. If at any time it is not feasible to carryout works in accordance with this, an alternative must be agreed in writing with the project Arborist.
- 11.3 Tree work:** All tree work should be carried out by a qualified and experienced Arborist with a minimum of AQF level 3 in arboriculture, in accordance with NSW Work Cover Code of Practice for the Amenity Tree Industry (1998) and AS4373 Pruning of amenity trees (2007).
- 11.4 Initial site meeting/on-going regular inspections:** The project Arborist is to hold a pre-construction site meeting with principle contractor to discuss methods and importance of tree protection measures and resolve any issues in relation to tree protection that may arise. In accordance with AS4970-2009, the project Arborist should carryout regular site inspections to ensure works are carried out in accordance with this document throughout the development process. Site inspections are recommended on a monthly frequency throughout the development.
- 11.5 Site Specific Tree Protection Recommendations:** It is the responsibility of the principle contractor to install tree protection prior to works commencing at the site (prior to demolition works) and to ensure that the tree protection remains in adequate condition for the duration of the development. The tree protection must not be moved without prior agreement of the project Arborist. The project Arborist must inspect that the tree protection has been installed in accordance with this document and AS4970-2009 prior to demolition works commencing. If access is required within the fenced areas for demolition works, this should occur under approval/supervision of the project Arborist only. The tree protective should be relocated for construction and landscaping phases as required under the guidance of the project Arborist. See section 11.6 for requirements of tree protection. See appendix 1A for indicative tree protection location.
- Tree 2 and 4: Protective fencing to create combined exclusion zone for the trees at the extent of the TPZ within the site. Fencing to be realigned adjacent to building footprint after demolition. After the fence is realigned for construction, ground protection is required in areas of the TPZ between the fence and building footprint. TPZ signage on fencing. Mulch in TPZ.
 - Tree 5, 6, 7 and 8: No tree protection required, the boundary fence will protect the trees during the whole development.

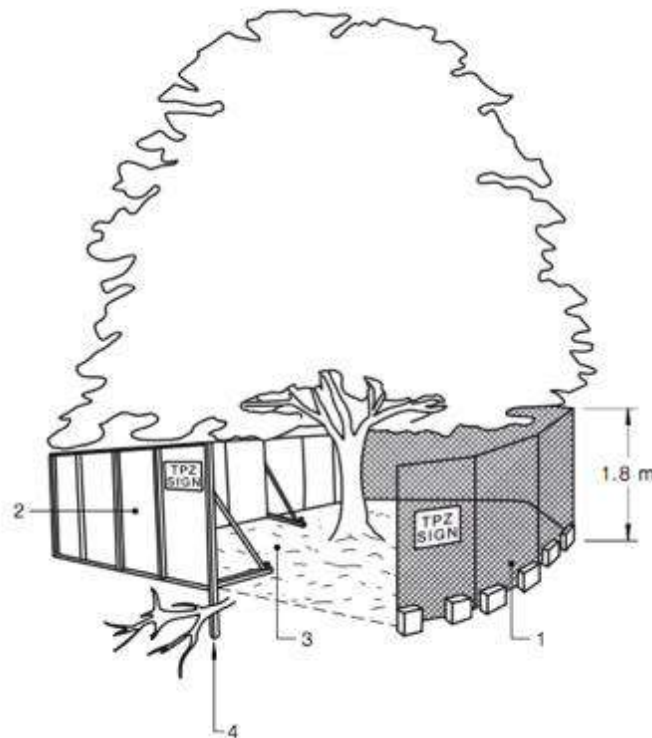
- Tree 10: Protective fencing to protect area of TPZ outside subject site only. TPZ signage on fencing. Mulch in TPZ.
- Tree 14 and 15: Protective fencing to protect area of TPZ outside subject site only. The fencing should be aligned to allow use of the public footpath if required. TPZ signage on fencing. Mulch in TPZ.
- Tree 38: Protective fencing to protect area of TPZ on nature strip only. TPZ signage on fencing.
- Tree 39 and 43: Prior to demolition, TPZ fencing to aligned adjacent to edge of existing driveway in TPZ and at extent of all other areas of the TPZ within the site. After demolition, fencing to be realigned at extent of TPZ area within the site. TPZ signage on fencing. Mulch in TPZ.
- Tree 58: Protective fencing should be aligned to protect areas of TPZ on nature strip not covered by existing hard surfaces, and at extent of TPZ within the site. The fencing should only be moved for demolition of hard surfaces in the TPZ under the approval/supervision of the project Arborist. Fencing to be realigned within site adjacent to building footprint after demolition. After the fence is realigned for construction, ground protection is required in areas of the TPZ between the fence and building footprint. TPZ signage on fencing.
- Tree 35, 40, 41, 42, 48, 49, 63, 64, 65, 66, 67, 68, 69 and 70: Protective fencing should be installed near to the West boundary to create a combined exclusion zone for the trees at the extent of the TPZ within the site. Fencing to be realigned adjacent to building footprint after demolition. After the fence is realigned for construction, ground protection is required in areas of the TPZ between the fence and building footprint. TPZ signage on fencing. Mulch in TPZ within site only.

11.6 Tree Protection Specifications:

- 11.6.1 Protective fencing: The protective fencing must be constructed of 1.8 metre 'cyclone chainmesh fence'. The fencing should only be removed for the landscaping phase and this should be approved by the project Arborist. Where it is not feasible to install fencing at the specified location due to factors such restricting access to areas of the site or for constructing new structures, an alternative location and protection specification must be agreed with the project Arborist. Any modifications to the fencing locations must be approved by the project Arborist.
- 11.6.2 TPZ signage: Tree protection signage is to be attached to the protective fencing, displayed in a prominent position and the sign repeated at 10 metres intervals or closer where the fence changes direction. Each sign shall contain in a clearly legible form, the following information:
- Tree protection zone/No access.

- This fence has been installed to prevent damage to the tree/s and their growing environment both above and below ground. Do not move fencing or enter TPZ without the agreement of the project Arborist.
- The name, address, and telephone number of the developer/builder and project Arborist

- 11.6.3 Trunk and Branch Protection: The trunk must be protected by wrapped hessian or similar material to limit damage. Timber planks (50mm x 100mm or similar) should then be placed around tree trunk. The timber planks should be spaced at 100mm intervals, and must be fixed against the trunk with tie wire, or strapping and connections finished or covered to protect pedestrians from injury. The hessian and timber planks must not be fixed to the tree in any instance. The trunk and branch protection shall be installed prior to any work commencing on site and shall be maintained in good condition for the entire development period.
- 11.6.4 Mulch: Any areas of the TPZ located inside the subject site must be mulched to a depth of 75mm with good quality mulch. Mulch must not be built-up around the trunk the trees as it can cause collar rot.
- 11.6.5 Ground Protection: Ground protection is required to protect the underlying soil structure and root system in areas where it is not practical to restrict access to whole TPZ, while allowing space for construction. Ground protection must consist of good quality composted wood chip/leaf mulch to a depth of between 150-300mm, laid on top of geo textile fabric, with timber/plywood boards overlaid. If vehicles are to be using the area, additional protection will be required such as rumble boards or track mats to spread the weight of the vehicle and avoid load points. Ground protection is to be specified and approved by the project Arborist as required.
- 11.6.6 Temporary irrigation: Temporary irrigation should distribute water evenly throughout the area of the TPZ. The irrigation should be used for at minimum one hour daily throughout all stages of the development.

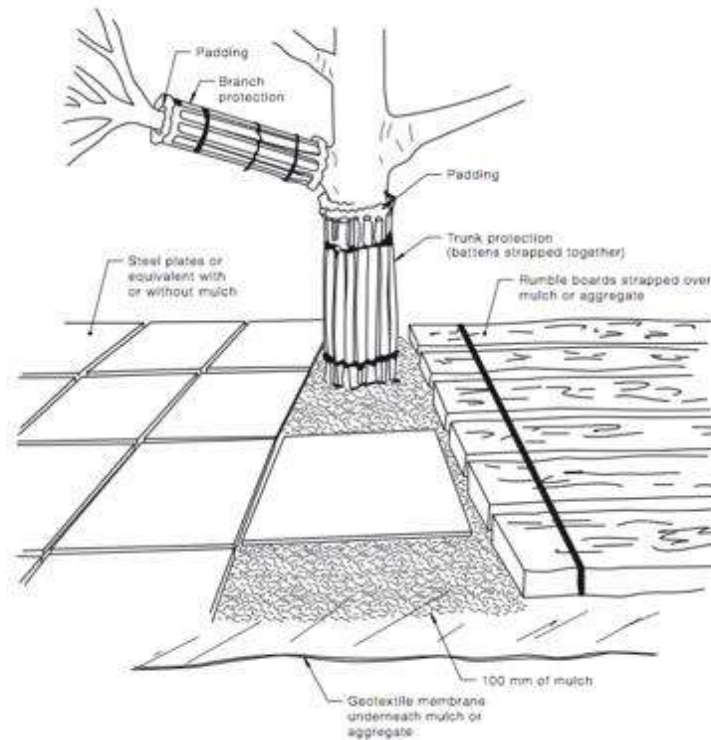


LEGEND:

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

An image from AS4970-2009,⁹ with example tree protection.

⁹ Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009), page 16.

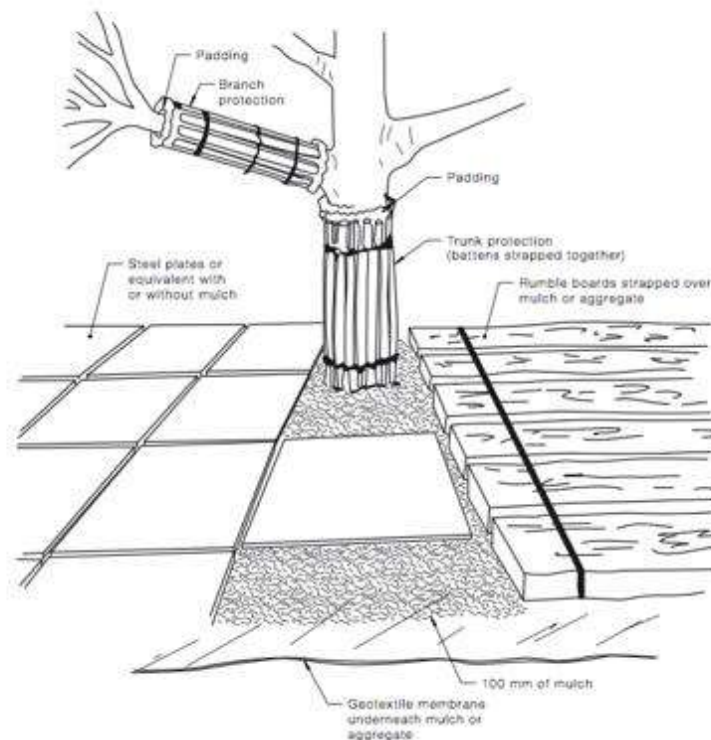


NOTES:

1. For trunk and branch protection use boards and padding that will prevent damage to bark. Boards are to be strapped to trees, not nailed or screwed.
2. Rumble boards should be of a suitable thickness to prevent soil compaction and root damage.

An image from AS4970-2009,¹⁰ with example tree protection.

¹⁰ Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009), page 17.



NOTES:

1. For trunk and branch protection use boards and padding that will prevent damage to bark. Boards are to be strapped to trees, not nailed or screwed.
2. Rumble boards should be of a suitable thickness to prevent soil compaction and root damage.

An image from AS4970-2009,¹¹ with example tree protection.

11.7 Restricted activities inside TPZ: The following activities must be avoided inside the TPZ of all trees to be retained unless approved by the project Arborist. If at any time these activities cannot be avoided an alternative must be agreed in writing with the project Arborist to minimise the impact to the tree.

- A) Machine excavation.
- B) Ripping or cultivation of soil.
- C) Storage of spoil, soil or any such materials
- D) Preparation of chemicals, including preparation of cement products.
- E) Refueling.
- F) Dumping of waste.
- G) Wash down and cleaning of equipment.
- H) Placement of fill.
- I) Lighting of fires.
- J) Soil level changes.
- K) Any physical damage to the crown, trunk, or root system.
- L) Parking of vehicles.

¹¹ Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009), page 17.

- 11.8 Demolition:** The demolition of all existing structures inside or directly adjacent to the TPZ of trees to be retained must be undertaken in consultation with the project Arborist. Any machinery is to work from inside the footprint of the existing structures or outside the TPZ, reaching in to minimise soil disturbance and compaction. If it is not feasible to locate demolition machinery outside the TPZ of trees to be retained, ground protection will be required. The demolition should be undertaken inwards into the footprint of the existing structures, sometimes referred to as the 'top down, pull back' method.
- 11.9 Excavations:** The project Arborist must supervise and certify that all excavations and root pruning are in accordance with AS4373-2007 and AS4970-2009. For continuous strip footings, first manual excavation is required along the edge of the structures closest to the subject trees. Manual excavation should be a depth of 1 metre (or to unfavourable root growth conditions such as bed rock or heavy clay, if agreed by project Arborist). Next roots must be pruned back in accordance with AS4373-2007. After all root pruning is completed, machine excavation is permitted within the footprint of the structure. For tree sensitive footings, such as pier and beam, all excavations inside the TPZ must be manual. Manual excavation may include the use of pneumatic and hydraulic tools, high-pressure air or a combination of high-pressure water and a vacuum device. No pruning of roots greater 30mm in diameter is to be carried out without approval of the project arborist. All pruning of roots greater than 30mm in diameter must be carried out by a qualified Arborist/Horticulturalist with a minimum AQF level 3. Root pruning is to be a clean cut with a sharp tool in accordance with AS4373 Pruning of amenity trees (2007).¹² The tree root is to be pruned back to a branch root if possible. Make a clean cut and leave as small a wound as possible.
- 11.10 Landscaping:** All landscaping works within the TPZ of trees to be retained are to be undertaken in consultation with a consulting Arborist to minimize the impact to trees. General guidance is provided below to minimise the impact of new landscaping to trees to be retained.
- Replacement planting for all trees recommended for removal should be incorporated into the landscape plan. It is recommended that at minimum one tree for each tree proposed to be removed are planted to maintain/increase overall canopy cover at the site when mature. Any replacement tree must be selected in accordance with AS2303-2015 Tree stock for landscape use.
 - The location of new plantings inside the TPZ of trees to be retained should be flexible to avoid unnecessary damage to tree roots greater than 30mm in diameter.
 - Level changes should be minimised. The existing ground levels within the landscape areas should not be lowered by more than 50mm or increased by more 100mm without assessment by a consulting Arborist.

¹² Council Of Standards Australia, AS 4373 *Pruning of amenity trees* (2007) page 18

- New retaining walls should be avoided. Where new retaining walls are proposed inside the TPZ of trees to be retained, they should be constructed from tree sensitive material, such as timber sleepers, that require minimal footings/excavations. If brick retaining walls are proposed inside the TPZ, considerer pier and beam type footings to bridge significant roots that are critical to the trees condition. Retaining walls must be located outside the SRZ and sleepers/beams located above existing soil grades.
- New footpaths and hard surfaces should be minimised, as they can limit the availability of water, nutrients and air to the trees root system. Where they are proposed, they should be constructed on or above existing soil grades to minimise root disturbance and consider using a permeable surface. Footpath should be located outside the SRZ.
- Where fill/sub base is used inside the TPZ, fill material should be a coarse granular material that does not restrict the flow of water and air to the root system below. This type of material will also reduce the impact of soil compaction during construction.

- 11.11 **Sediment and Contamination:** All contamination run off from the development such as but not limited to concrete, sediment and toxic wastes must be prevented from entering the TPZ at all times.
- 11.12 **Tree Wounding/Injury:** Any wounding or injury that occurs to a tree during the construction process will require the project Arborist to be contacted for an assessment of the injury and provide mitigation/remediation advice. It is generally accepted that trees may take many years to decline and eventually die from root damage. All repair work is to be carried out by the project Arborist, at the contractor's expense.
- 11.13 **Completion of Development Works:** After all construction works are complete the project Arborist should assess that the subject trees have been retained in the same condition and vigour. If changes to condition are identified the project Arborist should provide recommendations for remediation.

12. CONSTRUCTION HOLD POINTS FOR TREE PROTECTION

12.1 Hold Points: Below is a sequence of hold points requiring project Arborist certification throughout the development process. It provides a list of hold points that must be checked and certified. All certification must be provided in written format upon completion of the development. The final certification must include details of any instructions for remediation undertaken during the development. The principle contractor should be responsible for implementing all tree protection requirements.

Hold Point	Stage	Date Completed and Signature of Project Arborist Responsible
Project Arborist to hold pre construction site meeting with principle contractor to discuss methods and importance of tree protection measures and resolve any issues in relation to feasibility of tree protection requirements that may arise. Project Arborist to mark all trees approved for removal under DA consent.	Prior to development work commencing	
Project Arborist to assess and certify that tree protection has been installed in accordance with AS4970-2009 prior to works commencing at site.	Prior to development work commencing.	
In accordance with AS4970-2009 the project arborist should carryout regular site inspections to ensure works are carried out in accordance with the recommendations. Site inspection are recommended on a monthly frequency.	On-going throughout the development	
The removal of existing structures inside the TPZ of any tree to be retained, such as the existing buildings and hard surfaces must be supervised by the project Arborist.	Demolition	
Project Arborist to supervise all manual excavations and root pruning inside the TPZ of any tree to be retained. Project Arborist to approve all pruning of roots greater than 30mm inside TPZ. All root pruning of roots greater than 30mm in diameter must be carried out by a qualified Arborist/Horticulturalist with a minimum AQF level 3.	Construction	
Project Arborist to certify that all underground services including storm water inside TPZ of any tree to be retained have been installed in accordance with AS4970-2009.	Construction	
Project Arborist to approve relocation of tree protection for landscaping. All landscaping works within the TPZ of trees to be retained are to be undertaken in consultation with the project Arborist to minimise the impact to trees.	Construction/ Landscape	
After all demolition, construction and landscaping works are complete the project Arborist should assess that the subject trees have been retained in the same condition and vigour. If changes to condition are identified the project Arborist should provide recommendations for remediation.	Upon completion of development	

13. BIBLIOGRAPHY/REFERENCES

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14. LIST OF APPENDICES

The following are included in the appendices:

- Appendix 1A: Existing Site Plan
- Appendix 1B: Proposed Site Plan
- Appendix 2: Tree Inspection Schedule
- Appendix 3: Further Information of Methodology
- Appendix 4: Arboricultural Root Investigations Report



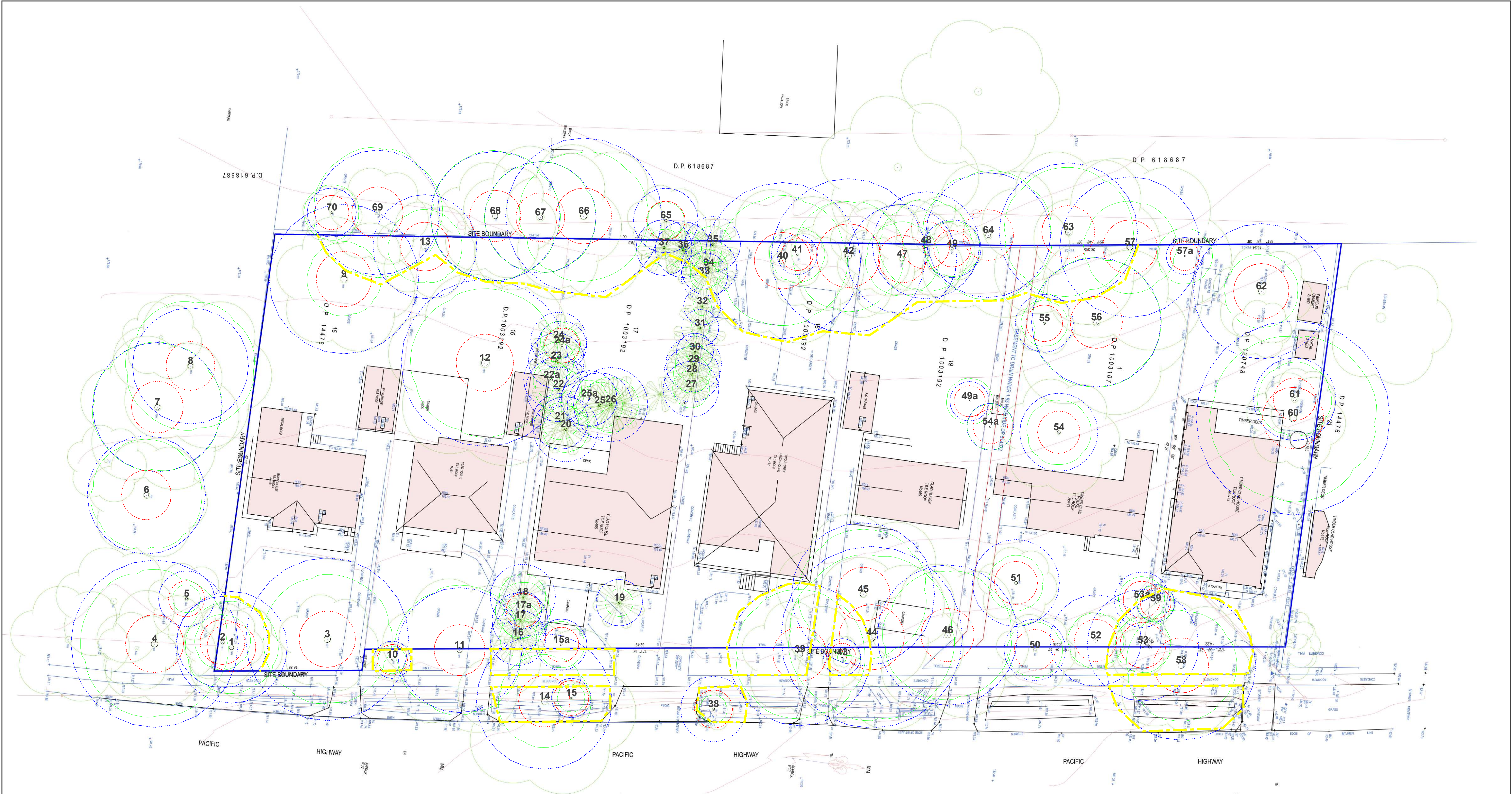
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Prepared for: Calder Flower Architects c/- Chinese Australian Services Society Limited.

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Date prepared: 26 June 2019. Revision: A



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Site Location: 461-473 Pacific Highway
Asquith NSW

SCALE :
1 : 200 @ A1

DATE :
8/23/2018

URBAN ARBOR
The Trusted Name in Tree Management

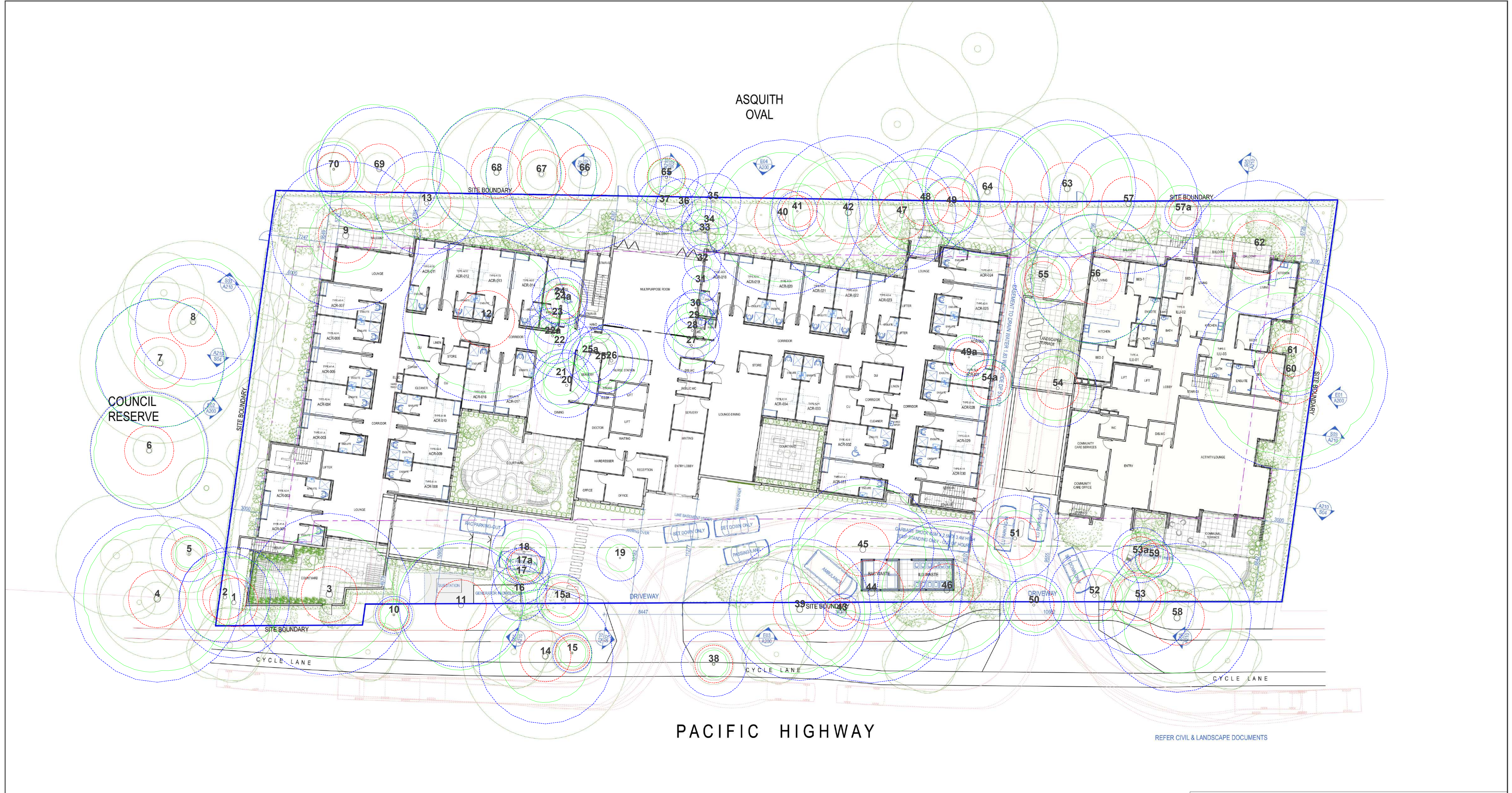
Plan Title: Appendix 1A - Existing

Prepared by: Jack Williams, Urban Arbor Pty Ltd

Map Legend

- Fencing
- Tree Crown
- Tree Protection Zone
- Structural Root Zone

0 30m



Urban Arbor Pty Ltd

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sales@urbanarbor.com.au

Site Location: 461-473 Pacific Highway
Asquith NSW

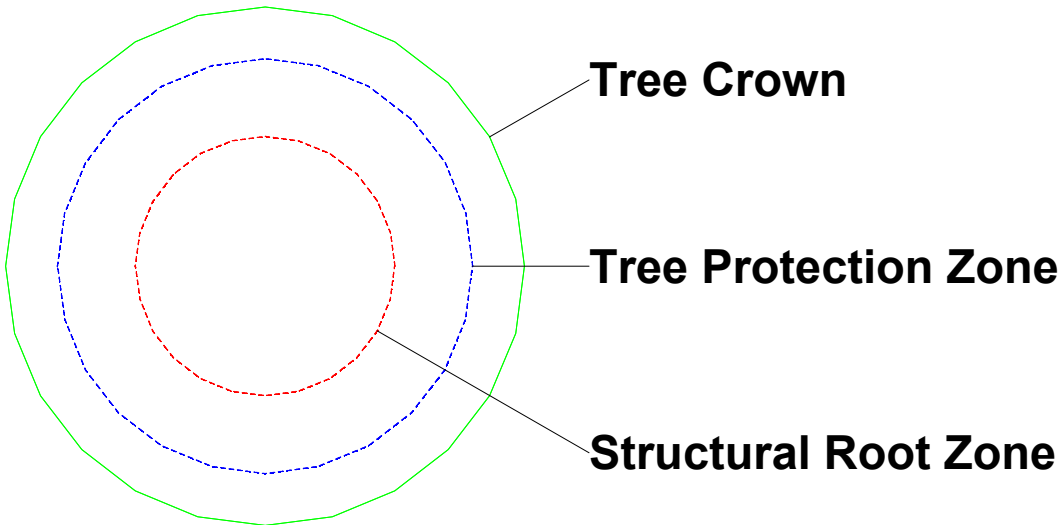
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8/23/2018

URBAN ARBOR
The Trusted Name in Tree Management

Plan Title: Appendix 1B - Proposed Ground Level

Prepared by: Jack Williams, Urban Arbor Pty Ltd

Map Legend





PACIFIC HIGHWAY

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Site Location: 461-473 Pacific Highway
Asquith NSW

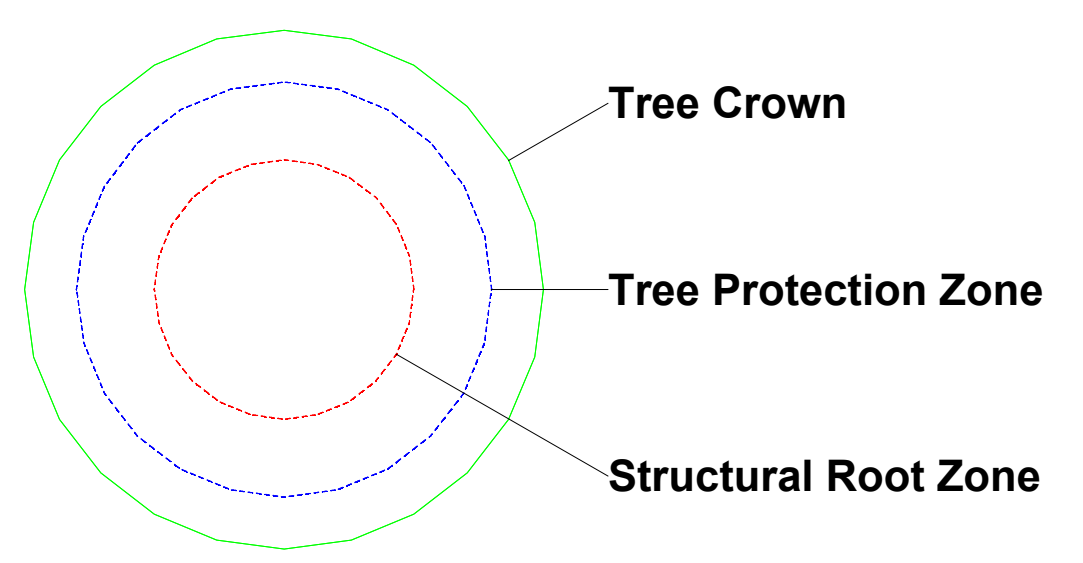
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Plan Title: Appendix 1C - Proposed Basement Level

Prepared by: Jack Williams, Urban Arbor Pty Ltd

Map Legend



Appendix 2 - Tree Inspection Schedule

Tree ID	Common Name	Botanical Name	Age Class	Height (m)	Canopy Spread Radius (m)	Stem 1	Stem 2	Stem 3	Stem 4	DBH (mm)	DAB (mm)	Health	Structure	Amenity Value	SULE	Retention Value	TPZ Radius (m)	SRZ Radius (m)	Notes
1	Red Mahogany	<i>Eucalyptus resinifera</i>	Mature	16	5	500				500	580	Fair	Fair	Very High	3. Short	Z9	6.0	2.6	Trunk/ main stem previously failed at 5m, decay has formed at point of failure. Heavily pruned for power lines.
2	Red Mahogany	<i>Eucalyptus resinifera</i>	Mature	17	3	410				410	470	Good	Fair	Very High	2. Medium	A1	4.9	2.4	Significant pruned for power lines. Slender upright form.
3	Thin-leaved Stringybark	<i>Eucalyptus eugenioides</i>	Mature	21	7	730				730	810	Good	Good	Very High	1. Long	A2	8.8	3.0	Significant deadwood in lower crown. Significantly pruned for power lines.
4	Grey Ironbark	<i>Eucalyptus paniculata</i>	Mature	27	8	750				750	870	Good	Good	Very High	1. Long	A1	9.0	3.1	None.
5	Smooth Barked Apple	<i>Angophora costata</i>	Mature	8	1.5	250				250	280	Fair	Fair	Medium	4. Remove	Z4	3.0	1.9	Upper crown has died back. Poor overall suppressed form.
6	Grey Ironbark	<i>Eucalyptus paniculata</i>	Mature	21	6	530				530	600	Good	Good	Very High	1. Long	A1	6.4	2.7	None.
7	Red Mahogany	<i>Eucalyptus resinifera</i>	Mature	18	7	580				580	660	Good	Good	Very High	1. Long	A2	7.0	2.8	Significant deadwood in lower crown.
8	Smooth Barked Apple	<i>Angophora costata</i>	Mature	16	7	520				520	580	Good	Good	Very High	1. Long	A1	6.2	2.6	None.
9	Norfolk Island Pine	<i>Araucaria heterophylla</i>	Mature	18	4	670				670	780	Good	Good	High	1. Long	A1	8.0	3.0	None.
10	Coastal Banksia	<i>Banksia integrefolia</i>	Semi-mature	5	1.5	140				140	190	Good	Good	Medium	1. Long	Z1	2.0	1.6	None.
11	Smooth Barked Apple	<i>Angophora costata</i>	Mature	17	7	560				560	640	Fair	Good	Very High	2. Medium	A2	6.7	2.7	Reduced foliage density for species. Asymmetric crown shape due to pruning for power lines, crown weighted West.
12	Smooth Barked Apple	<i>Angophora costata</i>	Mature	17	8	750				750	850	Good	Good	Very High	1. Long	A1	9.0	3.1	DBH estimated, no access to property.
13	Blue Jacaranda	<i>Jacaranda mimosifolia</i>	Mature	9	4	430	180			466	580	Good	Good	Medium	1. Long	A1	5.6	2.6	None.
14	Smooth Barked Apple	<i>Angophora costata</i>	Mature	10	5	490	360			608	650	Good	Fair	High	2. Medium	A1	7.3	2.8	Asymmetric crown shape due to pruning for power lines, whole of crown to East of trunk.
15	Hakea	<i>Hakea salicifolia</i>	Mature	4	1.5	130	120			177	260	Poor	Fair	Low	4. Remove	Z4	2.1	1.9	Health in decline. Crown previously topped.
15a	Weeping Bottlebrush	<i>Callistemon viminalis</i>	Mature	5	2.5	230				230	260	Good	Good	Medium	1. Long	Z1	2.8	1.9	Not marked on survey.
16	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	8	2	210				210	N/A	Good	Good	Low	1. Long	Z3	3.0	N/A	Exempt species.
17	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	8	2	200				200	N/A	Good	Good	Low	1. Long	Z3	3.0	N/A	Exempt species.
17a	Camphor Laurel	<i>Cinnamomum camphora</i>	Semi-mature	7	3	110	110			156	240	Good	Good	Low	5. Small/Young	Z3	2.0	1.8	Exempt species. Not marked on survey.
18	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	9	2.5	230				230	N/A	Good	Good	Low	1. Long	Z3	3.5	N/A	Exempt species.
19	Alexander Palm	<i>Archontophoenix alexandrae</i>	Mature	8	1.5	190				190	N/A	Good	Good	Medium	1. Long	Z2	2.5	N/A	Trunk located within 3m of dwelling.
20	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	8	2.5	240				240	N/A	Good	Good	Low	1. Long	Z3	3.5	N/A	Exempt species.
21	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	7	2	230				230	N/A	Good	Good	Low	1. Long	Z3	3.0	N/A	Exempt species.
22	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	8	2.5	250				250	N/A	Good	Good	Low	1. Long	Z3	3.5	N/A	Exempt species.
22a	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	8	2	200				200	N/A	Good	Good	Low	1. Long	Z3	2.0	N/A	Exempt species. Not marked on survey.
23	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	8	2	190				190	N/A	Good	Good	Low	1. Long	Z3	2.0	N/A	Exempt species.
24	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	9	2	180				180	N/A	Good	Good	Low	1. Long	Z3	2.0	N/A	Exempt species.
24a	Hakea	<i>Hakea salicifolia</i>	Mature	5	2	220				220	260	Good	Fair	Medium	2. Medium	Z1	2.6	1.9	Asymmetric crown shape, weighted North. Not marked on survey.
25a	Alexander Palm	<i>Archontophoenix alexandrae</i>	Mature	7	2	190	170	120		282	N/A	Good	Good	Medium	1. Long	A1	3.0	N/A	Not marked on survey.
25	Alexander Palm	<i>Archontophoenix alexandrae</i>	Mature	9	2.5	170	170	160	110	309	N/A	Good	Good	Medium	1. Long	A1	3.5	N/A	None.
26	Alexander Palm	<i>Archontophoenix alexandrae</i>	Mature	9	3	200	210			290	N/A	Good	Good	Medium	1. Long	A1	4.0	N/A	None.
27	Alexander Palm	<i>Archontophoenix alexandrae</i>	Mature	11	2	350				350	N/A	Good	Good	Medium	1. Long	A1	3.0	N/A	None.
28	Cocos Palm	<i>Syagrus romanzoffianum</i>	Semi-mature	6	2	240				240	N/A	Good	Good	Low	1. Long	Z3	3.0	N/A	Exempt species.
29	Alexander Palm	<i>Archontophoenix alexandrae</i>	Mature	10	2	320				320	N/A	Good	Good	Medium	1. Long	A1	3.0	N/A	None.

Appendix 2 - Tree Inspection Schedule

Tree ID	Common Name	Botanical Name	Age Class	Height (m)	Canopy Spread Radius (m)	Stem 1	Stem 2	Stem 3	Stem 4	DBH (mm)	DAB (mm)	Health	Structure	Amenity Value	SULE	Retention Value	TPZ Radius (m)	SRZ Radius (m)	Notes
30	Cocos Palm	<i>Syagrus romanzoffianum</i>	Semi-mature	7	1	170				170	N/A	Good	Good	Low	1. Long	Z3	2.0	N/A	Exempt species.
31	Cocos Palm	<i>Syagrus romanzoffianum</i>	Semi-mature	7	1	190				190	N/A	Good	Good	Low	1. Long	Z3	2.0	N/A	Exempt species.
32	Tree Fern	<i>Cyathea cooperi</i>	Semi-mature	4	1	110				110	N/A	Good	Good	Medium	1. Long	Z1	2.0	N/A	None.
33	Cocos Palm	<i>Syagrus romanzoffianum</i>	Semi-mature	7	1.5	200				200	N/A	Good	Good	Low	1. Long	Z3	2.5	N/A	Exempt species.
34	Alexander Palm	<i>Archontophoenix alexandrae</i>	Mature	8	2	140	100			172	N/A	Good	Good	Medium	1. Long	A1	3.0	N/A	None.
35	Mexican Fan Palm	<i>Washingtonia robusta</i>	Mature	10	2	280				280	N/A	Good	Good	Medium	1. Long	A1	3.0	N/A	None.
36	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	9	2	260				260	N/A	Good	Good	Low	1. Long	Z3	3.0	N/A	Exempt species.
37	Cocos Palm	<i>Syagrus romanzoffianum</i>	Mature	9	2	220				220	N/A	Good	Good	Low	1. Long	Z3	3.0	N/A	Exempt species.
38	Prunus species	<i>Prunus spp</i>	Semi-mature	3	1.5	240	170			294	320	Good	Fair	Low	3. Short	Z9	3.5	2.1	Crown topped at 3m.
39	Red Mahogany	<i>Eucalyptus resinifera</i>	Mature	17	7	640				640	730	Good	Fair	Very High	1. Long	A1	7.7	2.9	Asymmetric crown shape, weighted west due to power line pruning.
40	Red Mahogany	<i>Eucalyptus resinifera</i>	Mature	15	7	700				700	820	Good	Fair	Very High	1. Long	A1	8.4	3.0	Co-dominant stems at 5m.
41	Macadamia	<i>Macadamia spp</i>	Semi-mature	6	3	180				180	210	Good	Good	Low	1. Long	Z1	2.2	1.7	Not marked on survey.
42	Turpentine	<i>Syncarpia glomulifera</i>	Mature	12	6	340	400	450		691	1100	Good	Good	Very High	1. Long	A1	8.3	3.4	None.
43	Italian Cypress	<i>Cupressus sempervirens</i>	Mature	8	0.5	130				130	150	Good	Good	Medium	2. Medium	A1	2.0	1.5	None.
44	Grey Ironbark	<i>Eucalyptus paniculata</i>	Mature	25	9	550	600			814	1150	Good	Good	Very High	1. Long	A1	9.8	3.5	None.
45	Smooth Barked Apple	<i>Angophora costata</i>	Mature	14	7	640				640	730	Good	Fair	Very High	2. Medium	A2	7.7	2.9	Primary branch at centre of crown has significant bark inclusion at union.
46	Smooth Barked Apple	<i>Angophora costata</i>	Mature	14	7	630				630	710	Good	Good	Very High	1. Long	A1	7.6	2.9	None.
47	Monterey Pine	<i>Pinus radiata</i>	Mature	15	4	490				490	550	Good	Good	Medium	1. Long	A1	5.9	2.6	None.
48	Turpentine	<i>Syncarpia glomulifera</i>	Mature	13	5	480				480	550	Good	Good	High	1. Long	A1	5.8	2.6	None.
49	Italian Cypress	<i>Cupressus sempervirens</i>	Mature	8	3	260				260	290	Good	Fair	Medium	3. Short	Z9	3.1	2.0	Trunk topped/failed at 5m, weak regrowth.
49a	Black Mulberry	<i>Morus nigra</i>	Semi-mature	4	2.5	130	120			177	200	Good	Good	Low	1. Long	Z1	2.1	1.7	Not marked on survey.
50	Blue Jacaranda	<i>Jacaranda mimosifolia</i>	Mature	6	3	190	200			276	380	Good	Fair	Medium	2. Medium	Z1	3.3	2.2	Co-dominant stems that cross/rub at 600mm.
51	Cypress 'Castlewellan Gold'	<i>X Cupressocyparis leylandii</i> 'Castlewellan Gold'	Mature	8	3	390				390	430	Good	Good	Medium	2. Medium	A1	4.7	2.3	None.
52	Sasanqua	<i>Camellia Sasanqua</i>	Mature	6	3	410				410	410	Fair	Fair	Medium	2. Medium	Z1	4.9	2.3	DBH measured at ground. Reduced foliage density for species.
53	Photinia	<i>Photinia spp</i>	Mature	5	3	500				500	500	Good	Fair	Medium	2. Medium	Z1	6.0	2.5	DBH measured at ground.
53a	NSW Christmas Bush	<i>Ceratopetalum gummiferum</i>	Mature	6	2.5	180	170			248	300	Good	Good	Medium	1. Long	A1	3.0	2.0	Not marked on survey.
54a	Citrus species	<i>Citris spp</i>	Mature	5	2.5	210				210	250	Good	Good	Low	1. Long	Z3	2.5	1.8	Exempt species. Not marked on survey.
54	Blue Jacaranda	<i>Jacaranda mimosifolia</i>	Mature	8	3.5	350				350	410	Good	Good	Medium	1. Long	A1	4.2	2.3	None.
55	Smooth Japanese Maple	<i>Acer palmatum</i>	Mature	5	2.5	260				260	290	Fair	Fair	Low	2. Medium	Z1	3.1	2.0	Co-dominant stems with significant included bark at union.
56	Smooth Barked Apple	<i>Angophora costata</i>	Mature	14	7	580				580	680	Good	Good	Very High	1. Long	A1	7.0	2.8	None.
57	Turpentine	<i>Syncarpia glomulifera</i>	Mature	15	5	630				630	750	Good	Good	Very High	1. Long	A1	7.6	2.9	None.
57a	Norfolk Island Pine	<i>Araucaria heterophylla</i>	Young	7	3	150				150	170	Good	Good	Low	5. Small/Young	Z1	2.0	1.6	Not marked on survey.
58	Wallangarra White Gum	<i>Eucalyptus scoparia</i>	Mature	17	6	670				670	770	Good	Fair	High	2. Medium	A2	8.0	3.0	Asymmetric crown shape, weighted west due to pruning for power lines.
59	Snow In Summer	<i>Melaleuca linarifolia</i>	Semi-mature	5	2	170				170	190	Good	Good	Medium	1. Long	Z1	2.0	1.6	None.
60	Tallowood	<i>Eucalyptus microcorys</i>	Mature	20	9	870				870	990	Fair	Fair	High	3. Short	Z4	10.4	3.3	Significant deadwood in crown (approximately 15%) and some tip dieback. Health appears to be in early decline.
61	Peppercorn	<i>Schinus molle</i>	Mature	8	4	370				370	420	Good	Fair	Medium	2. Medium	A1	4.4	2.3	None.

Appendix 2 - Tree Inspection Schedule

Tree ID	Common Name	Botanical Name	Age Class	Height (m)	Canopy Spread Radius (m)	Stem 1	Stem 2	Stem 3	Stem 4	DBH (mm)	DAB (mm)	Health	Structure	Amenity Value	SULE	Retention Value	TPZ Radius (m)	SRZ Radius (m)	Notes
62	Peppercorn	<i>Schinus molle</i>	Mature	8	4	510	330			607	780	Good	Good	Medium	1. Long	A1	7.3	3.0	None.
63	Tallowood	<i>Eucalyptus microcorys</i>	Mature	17	7	620				620	700	Good	Good	High	1. Long	A1	7.4	2.8	None.
64	Sydney Blue Gum	<i>Eucalyptus saligna</i>	Mature	19	7	560				560	630	Good	Good	Very High	1. Long	A1	6.7	2.7	None.
65	Broad Leaved Scribbly Gum	<i>Eucalyptus haemastoma</i>	Semi-mature	7	2	290				290	330	Good	Fair	Medium	2. Medium	A1	3.5	2.1	Decay in trunk.
66	Tallowood	<i>Eucalyptus microcorys</i>	Mature	15	7	700				700	800	Good	Good	High	1. Long	A1	8.4	3.0	None.
67	Tallowood	<i>Eucalyptus microcorys</i>	Mature	17	6	500				500	580	Good	Good	High	1. Long	A1	6.0	2.6	None.
68	Tallowood	<i>Eucalyptus microcorys</i>	Mature	17	7	580				580	660	Good	Good	High	1. Long	A1	7.0	2.8	None.
69	Tallowood	<i>Eucalyptus microcorys</i>	Mature	17	7	560				560	650	Good	Good	High	1. Long	A1	6.7	2.8	None.
70	Tallowood	<i>Eucalyptus microcorys</i>	Semi-mature	8	3	220				220	250	Good	Fair	Medium	1. Long	A1	2.6	1.8	Asymmetric crown shape, weighted west.

Appendix 2 - Tree Inspection Schedule Explanatory Notes

Explanatory Notes

Tree Common/Botanical Name: Where species is unknown it is indicated with an '*spp*'.

Age Class: Veteran, Mature, Semi mature, Young, Dead.

Diameter at Breast Height (DBH): Individual stem diameters recorded in 'stem' columns. DBH is combined DBH when calculated in accordance with AS4970-2009 definition for multi stemmed trees. Measured with a DBH tape at approximately 1.4m above ground level, or in some cases estimated.

Diameter Above root Buttresses (DAB): The trunk/stem diameter above buttresses for calculating the SRZ. Measured with a diameter tape unless otherwise indicated. If the DBH is estimated, the DAB has also been estimated.

Height: Height from ground level to top of crown. All heights are estimated unless otherwise indicated.

Spread: Radius of crown at widest section. All tree spreads are estimated unless otherwise indicated.

Tree Protection Zone (TPZ): DBH x 12. Measured in radius from the centre of the trunk. Rounded to nearest 0.1m. For monocots, the TPZ is set at 1 metre outside the crown projection.

Structural Root Zone (SRZ): $(DAB \times 50)^{0.42} \times 0.64$. Measured in radius from the centre of the trunk. Rounded to nearest 0.1m.

Health: Good, Fair, Poor, Dead.

Structure: Good, Fair, Poor.

Safe Useful Life Expectancy (SULE): 1. Long (40+years), 2. Medium (15 - 40 years), 3. Short (5 - 15 years), 4. Remove (under 5 years), 5. Small/young. See appendices for categories.

Amenity Value: Very High, High, Medium, Low, Very Low.

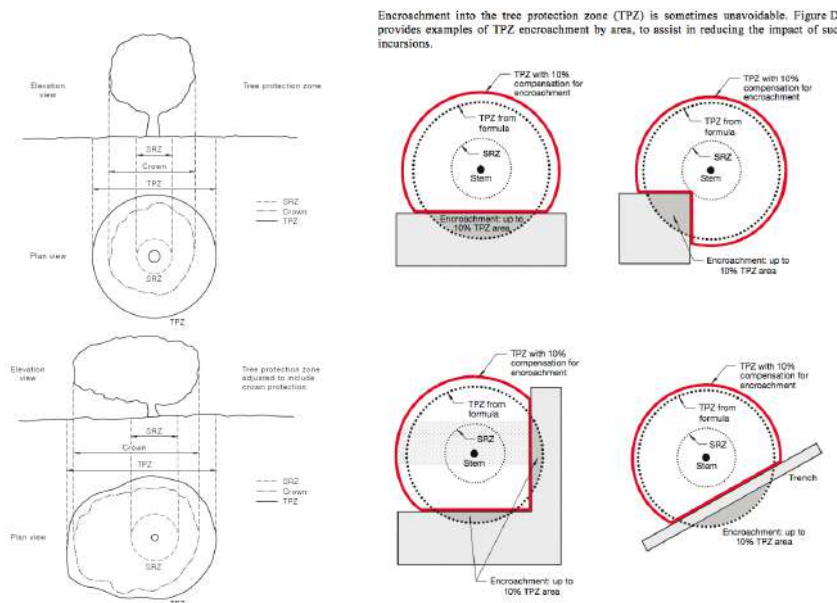
Retention Value: Tree AZ, see appendices for categories.

Appendix 3 - Further Information of Methodology

1. **Tree Protection Zone:** The tree protection zone (TPZ) is the principle means of protecting trees on development sites. The TPZ is a combination of the root area and crown area requiring protection. It is an area isolated from construction disturbance, so that the tree remains viable. The radius of the TPZ is calculated for each tree by multiplying its DBH x 12. The derived value is measured in radius from the centre of the stem/trunk at ground level. A TPZ should not be less than 2.0 metres nor greater than 15 metres (except where crown protection is required). It is commonly observed that tree roots will extend significant further than the indicative TPZ, however the TPZ is an area identified AS4970-2009 to be extent where root loss or disturbance will generally not impact the viability of the tree. The TPZ is identified as a restricted area to prevent damage to trees either above or below ground during a development. Where trees are intended to be retained proposed developments must provide an adequate TPZ around trees. The TPZ is set aside for the tree's root zone, trunk and crown and it is essential for the stability and longevity of the tree. The tree protection also incorporates the SRZ (see below for more information about the SRZ). I have calculated the TPZ of palms, other monocots, cycads and tree ferns at one metre outside the crown projection. See appendices for additional information about the TPZ including information about calculating the TPZ and examples of TPZ encroachment.

Minor encroachment into TPZ: Sometimes encroachment into the TPZ is unavoidable. Encroachment includes but is not limited to activities such as excavation, compacted fill and machine trenching. Minor encroachment of up to 10% of the overall TPZ area is normally considered acceptable, providing there is space adjacent to the TPZ for the tree to compensate and the tree is displaying adequate vigour/health to tolerate changes to its growing environment.

Major encroachment into TPZ: Where encroachment of more than 10% of the overall TPZ area is proposed the project Arborist must investigate and demonstrate that the tree will remain in a viable condition. In some cases, tree sensitive construction methods such as pier and beam footings, suspended slabs, or cantilevered sections, can be utilised to allow additional encroachment into the TPZ by bridging over roots and minimising root disturbance. Major encroachment is only possible if it can be undertaken without severing significant size roots, or if it can be demonstrated that significant roots will not be impacted.



2. **Structural Root Zone:** This is the area around the base of a tree required for the trees stability in the ground. An area larger than the SRZ always need to be maintained to preserve a viable tree as it will only have a minor effect on the trees vigour and health. There are several factors that determine the SRZ which include height, crown area, soil type and soil moisture. It can also be influenced by other factors such as natural or built structures. Generally work within the SRZ should be avoided.

An indicative SRZ radius can be determined from the diameter of the trunk measured immediately above the root buttresses. Root investigation could provide more information about the extent of the SRZ. The following formula should be used to calculate the SRZ.

SRZ radius = $(D \times 50)^{0.42} \times 0.64$ (D = Diameter above root buttress).

3. **Tree Age Class:** It can be difficult to determine the age of a tree without carrying out invasive tests that may damage the tree, so we have categorised there likely age class which is defined below;
 - Young/Newly planted: Young or recently planted tree.
 - Semi Mature: Up to 20% of the usual life expectancy for the species.
 - Early mature/Mature: Between 20%-80% of the usual life expectancy for the species.
 - Over mature: Over 80% of the usual life expectancy for the species.
 - Dead: Tree is dead or almost dead.

4. **Health/Physiological Condition:** Below are examples conditions used when assigning a category for tree health.

Category	Example condition	Summary
Good	<ul style="list-style-type: none"> • Crown has good foliage density for species. • Tree shows no or minimal signs of pathogens that are unlikely to have an effect on the health of the tree. • Tree is displaying good vigour and reactive growth development. 	<ul style="list-style-type: none"> • The tree is in above average health and condition and no remedial works are required.
Fair	<ul style="list-style-type: none"> • The tree may be starting to dieback or have over 25% deadwood. • Tree may have slightly reduced crown density or thinning. • There may be some discolouration of foliage. • Average reactive growth development. • There may be early signs of pathogens which may further deteriorate the health of the tree. • There may be epicormic growth indicating increased levels of stress within the tree. 	<ul style="list-style-type: none"> • The tree is in below average health and condition and may require remedial works to improve the trees health.
Poor	<ul style="list-style-type: none"> • The tree may be in decline, have extensive dieback or have over 30% deadwood. • The canopy may be sparse or the leaves may be unusually small for species. • Pathogens or pests are having a significant detrimental effect on the tree health. 	<ul style="list-style-type: none"> • The tree is displaying low levels of health and removal or remedial works may be required.
Dead	<ul style="list-style-type: none"> • The tree is dead or almost dead. 	<ul style="list-style-type: none"> • The tree should generally be removed.

5. **Structural Condition:** Below are examples conditions used when assigning a category for structural condition.

Category	Example condition	Summary
Good	<ul style="list-style-type: none"> • Branch unions appear to be strong with no sign of defects. • There are no significant cavities. • The tree is unlikely to fail in usual conditions. • The tree has a balanced crown shape and form. 	<ul style="list-style-type: none"> • The tree is considered structurally good with well developed form.
Fair	<ul style="list-style-type: none"> • The tree may have minor structural defects within the structure of the crown that could potentially develop into more significant defects. • The tree may have a cavity that is currently unlikely to fail but may deteriorate in the future. • The tree is an unbalanced shape or leans significantly. • The tree may have minor damage to its roots. • The root plate may have moved in the past but the tree has now compensated for this. • Branches may be rubbing or crossing. 	<ul style="list-style-type: none"> • The identified defects are unlikely cause major failure. • Some branch failure may occur in usual conditions. • Remedial works can be undertaken to alleviate potential defects.
Poor	<ul style="list-style-type: none"> • The tree has significant structural defects. • Branch unions may be poor or weak. • The tree may have a cavity or cavities with excessive levels of decay that could cause catastrophic failure. • The tree may have root damage or is displaying signs of recent movement. • The tree crown may have poor weight distribution which could cause failure. 	<ul style="list-style-type: none"> • The identified defects are likely to cause either partial or whole failure of the tree.

6. **Amenity Value:** To determine the amenity value of a tree we assess a number of different factors, which include but are not limited to the information below.

- The visibility of the tree to adjacent sites.
- The relationship between the tree and the site.
- Whether the tree is protected by any statutory conditions.
- The habitat value of the tree.
- Whether the tree is considered a noxious weed species.

The amenity value is rated using one of the following values.

- Very High
- High
- Moderate
- Low
- Very Low

7. **Safe Useful Life Expectancy (SULE), (Barrel, 2001):** A trees safe useful life expectancy is determined by assessing a number of different factors including the health and vitality, estimated age in relation to expected life expectancy for the species, structural defects, and remedial works that could allow retention in the existing situation.

Category	Description
1. Long - Over 40 years	(a) Structurally sound trees located in positions that can accommodate future growth. (b) Trees that could be made suitable for retention in the long term by remedial tree care. (c) Trees of special significance for historical, commemorative or rarity reasons that would warrant extraordinary efforts to secure their long term retention.
2. Medium - 15 to 40 years	(a) Trees that may only live between 15 and 40 more years. (b) Trees that could live for more than 40 years but may be removed for safety or nuisance reasons. (c) Trees that could live for more than 40 years but may be removed to prevent interference with more suitable individuals or to provide space for new planting. (d) Trees that could be made suitable for retention in the medium term by remedial tree care.
3. Short - 5 to 15 years	(a) Trees that may only live between 5 and 15 more years. (b) Trees that could live for more than 15 years but may be removed for safety or nuisance reasons. (c) Trees that could live for more than 15 years but may be removed to prevent interference with more suitable individuals or to provide space for new planting. (d) Trees that require substantial remedial tree care and are only suitable for retention in the short term.
4. Remove - Under 5 years	(a) Dead, dying, suppressed or declining trees because of disease or inhospitable conditions. (b) Dangerous trees because of instability or recent loss of adjacent trees. (c) Dangerous trees because of structural defects including cavities, decay, included bark, wounds or poor form. (d) Damaged trees that are clearly not safe to retain. (e) Trees that could live for more than 5 years but may be removed to prevent interference with more suitable individuals or to provide space for new planting. (f) Trees that are damaging or may cause damage to existing structures within 5 years. (g) Trees that will become dangerous after removal of other trees for the reasons given in (a) to (f). (h) Trees in categories (a) to (g) that have a high wildlife habitat value and, with appropriate treatment, could be retained subject to regular review.
5. Small/Young	(a) Small trees less than 5m in height. (b) Young trees less than 15 years old but over 5m in height. (c) Formal hedges and trees intended for regular pruning to artificially control growth.

8. **Root investigations:** The root investigations should identify roots greater than 30mm in diameter that are located along the edge of the structures footprint or in the location of footings. Root investigations must be carried out using non-invasive methods (manual excavations). Any excavations for the root investigations must be carried out manually to avoid damaging the roots during excavations. Manual excavation may include the use of a high-pressure air/air knife, or a combination of high-pressure water and a vacuum device. When hand excavating carefully work around roots retaining as many as possible. Take care to not fray, wound, or cause damage to any roots during excavations as this may cause decay or infection from pathogens. It is essential that exposed roots are kept moist and the excavation back filled as soon as possible. The root investigations should be carried out by a qualified Arborist minimum AQF3. Once roots are exposed, a visual assessment can be carried out by a consulting Arborist to evaluate the potential impact of the proposed root loss on the health and stability of the tree. A root map/report should be prepared identifying the findings of investigations, including photographs as supporting evidence in the report.

9. **Retention Value:** The system I have used to award the retention value is Tree AZ. Tree AZ is used to identify higher value trees worthy of being a constraint to development and lower value trees that should generally not be a constraint to the development. The table below provides a brief description of each category.

TreeAZ Categories (Version 10.04-ANZ)

CAUTION: TreeAZ assessments must be carried out by a competent person qualified and experienced in arboriculture. The following category descriptions are designed to be a brief field reference and are not intended to be self-explanatory. They must be read in conjunction with the most current explanations published at www.TreeAZ.com.

Category Z: Unimportant trees not worthy of being a material constraint

Local policy exemptions: Trees that are unsuitable for legal protection for local policy reasons including size, proximity and species

- Z1** Young or insignificant small trees, i.e. below the local size threshold for legal protection, etc
- Z2** Too close to a building, i.e. exempt from legal protection because of proximity, etc
- Z3** Species that cannot be protected for other reasons, i.e. scheduled noxious weeds, out of character in a setting of acknowledged importance, etc

High risk of death or failure: Trees that are likely to be removed within 10 years because of acute health issues or severe structural failure

- Z4** Dead, dying, diseased or declining
- Z5** Severe damage and/or structural defects where a high risk of failure cannot be satisfactorily reduced by reasonable remedial care, i.e. cavities, decay, included bark, wounds, excessive imbalance, overgrown and vulnerable to adverse weather conditions, etc
- Z6** Instability, i.e. poor anchorage, increased exposure, etc
- Excessive nuisance:** Trees that are likely to be removed within 10 years because of unacceptable impact on people
- Z7** Excessive, severe and intolerable inconvenience to the extent that a locally recognized court or tribunal would be likely to authorize removal, i.e. dominance, debris, interference, etc
- Z8** Excessive, severe and intolerable damage to property to the extent that a locally recognized court or tribunal would be likely to authorize removal, i.e. severe structural damage to surfacing and buildings, etc

Good management: Trees that are likely to be removed within 10 years through responsible management of the tree population

- Z9** Severe damage and/or structural defects where a high risk of failure can be temporarily reduced by reasonable remedial care, i.e. cavities, decay, included bark, wounds, excessive imbalance, vulnerable to adverse weather conditions, etc
- Z10** Poor condition or location with a low potential for recovery or improvement, i.e. dominated by adjacent trees or buildings, poor architectural framework, etc
- Z11** Removal would benefit better adjacent trees, i.e. relieve physical interference, suppression, etc
- Z12** Unacceptably expensive to retain, i.e. severe defects requiring excessive levels of maintenance, etc

NOTE: Z trees with a high risk of death/failure (Z4, Z5 & Z6) or causing severe inconvenience (Z7 & Z8) at the time of assessment and need an urgent risk assessment can be designated as ZZ. ZZ trees are likely to be unsuitable for retention and at the bottom of the categorization hierarchy. In contrast, although Z trees are not worthy of influencing new designs, urgent removal is not essential and they could be retained in the short term, if appropriate.

Category A: Important trees suitable for retention for more than 10 years and worthy of being a material constraint

- A1** No significant defects and could be retained with minimal remedial care
- A2** Minor defects that could be addressed by remedial care and/or work to adjacent trees
- A3** Special significance for historical, cultural, commemorative or rarity reasons that would warrant extraordinary efforts to retain for more than 10 years
- A4** Trees that may be worthy of legal protection for ecological reasons (Advisory requiring specialist assessment)

NOTE: Category A1 trees that are already large and exceptional, or have the potential to become so with minimal maintenance, can be designated as AA at the discretion of the assessor. Although all A and AA trees are sufficiently important to be material constraints, AA trees are at the top of the categorization hierarchy and should be given the most weight in any selection process.

TreeAZ is designed by Barrell Tree Consultancy (www.barrelltreecare.co.uk) and is reproduced with their permission

Glossary of Terms

Abiotic - Pertaining to non-living agents; e.g. environmental factors

Adventitious shoots - Shoots that develop other than from apical, axillary or dormant buds; see also 'epicormic'

Anchorage - The system whereby a tree is fixed within the soil, involving cohesion between roots and soil and the development of a branched system of roots which withstands wind and gravitational forces transmitted from the aerial parts of the tree

Bark - A term usually applied to all the tissues of a woody plant lying outside the vascular cambium, thus including the phloem, cortex and periderm; occasionally applied only to the periderm or the phellem

Branch:

- **Primary**. A first order branch arising from a stem
- **Lateral**. A second order branch, subordinate to a primary branch or stem and bearing sub-lateral branches
- **Sub-lateral**. A third order branch, subordinate to a lateral or primary branch, or stem and usually bearing only twigs

Branch collar - A visible swelling formed at the base of a branch whose diameter growth has been disproportionately slow compared to that of the parent stem; a term sometimes applied also to the pattern of growth of the cells of the parent stem around the branch base

Brown-rot - A type of wood decay in which cellulose is degraded, while lignin is only modified

Buckling - An irreversible deformation of a structure subjected to a bending load

Buttress zone - The region at the base of a tree where the major lateral roots join the stem, with buttress-like formations on the upper side of the junctions

Cambium - Layer of dividing cells producing xylem (woody) tissue internally and phloem (bark) tissue externally

Canker - A persistent lesion formed by the death of bark and cambium due to colonisation by fungi or bacteria

Compartmentalisation - The confinement of disease, decay or other dysfunction within an anatomically discrete region of plant tissue, due to passive and/or active defences operating at the boundaries of the affected region

Compressive loading - Mechanical loading which exerts a positive pressure; the opposite to tensile loading

Condition - An indication of the physiological condition of the tree. Where the term 'condition' is used in a report, it should not be taken as an indication of the stability of the tree

Crown/Canopy - The main foliage bearing section of the tree

Crown lifting - The removal of limbs and small branches to a specified height above ground level

Crown thinning - The removal of a proportion of secondary branch growth throughout the crown to produce an even density of foliage around a well-balanced branch structure

Crown reduction/shaping - A specified reduction in crown size whilst preserving, as far as possible, the natural tree shape

DAB (Diameter Above Buttress) - Trunk diameter measured above the root buttress

Defect - In relation to tree hazards, any feature of a tree which detracts from the uniform distribution of mechanical stress, or which makes the tree mechanically unsuited to its environment

Dieback - The death of parts of a woody plant, starting at shoot-tips or root-tips

Disease - A malfunction in or destruction of tissues within a living organism, usually excluding mechanical damage; in trees, usually caused by pathogenic micro-organisms

Dominance - In trees, the tendency for a leading shoot to grow faster or more vigorously than the lateral shoots; also the tendency of a tree to maintain a taller crown than its neighbours

Dormant bud - An axial bud which does not develop into a shoot until after the formation of two or more annual wood increments; many such buds persist through the life of a tree and develop only if stimulated to do so

Dysfunction - In woody tissues, the loss of physiological function, especially water conduction, in sapwood

DBH (Diameter at Breast Height) - Stem diameter measured at a height of 1.4 metres or the nearest measurable point. Where measurement at a height of 1.4 metres is not possible, another height may be specified

Deadwood - Branch or stem wood bearing no live tissues. Retention of deadwood provides valuable habitat for a wide range of species and seldom represents a threat to the health of the tree. Removal of deadwood can result in the ingress of decay to otherwise sound tissues and climbing operations to access deadwood can cause significant damage to a tree. Removal of deadwood is generally recommended only where it represents an unacceptable level of hazard

Epicormic shoot - A shoot having developed from a dormant or adventitious bud and not having developed from a first year shoot

Flush-cut - A pruning cut which removes part of the branch bark ridge and or branch-collar

Girdling root - A root which circles and constricts the stem or roots possibly causing death of phloem and/or cambial tissue

Habit - The overall growth characteristics, shape of the tree and branch structure

Hazard beam - An upwardly curved part of a tree in which strong internal stresses may occur without being reduced by adaptive growth; prone to longitudinal splitting

Heartwood/false-heartwood - The dead central wood that has become dysfunctional as part of the aging processes and being distinct from the sapwood

Heave - A term mainly applicable to a shrinkable clay soil which expands due to re-wetting after the felling of a tree which was previously extracting moisture from the deeper layers; also the lifting of pavements and other structures by root diameter expansion; also the lifting of one side of a wind-rocked root-plate

Included bark (ingrown bark) - Bark of adjacent parts of a tree (usually forks, acutely joined branches or basal flutes) which is in face-to-face contact

Lever arm - A mechanical term denoting the length of the lever represented by a structure that is free to move at one end, such as a tree or an individual branch

Lignin - The hard, cement-like constituent of wood cells; deposition of lignin within the matrix of cellulose microfibrils in the cell wall is termed Lignification

Lions tailing - A term applied to a branch of a tree that has few if any side-branches except at its end, and is thus liable to snap due to end-loading

Loading - A mechanical term describing the force acting on a structure from a particular source; e.g. the weight of the structure itself or wind pressure

Mycelium - The body of a fungus, consisting of branched filaments (hyphae)

Occlusion - The process whereby a wound is progressively closed by the formation of new wood and bark around it

Pathogen - A micro-organism which causes disease in another organism

Photosynthesis - The process whereby plants use light energy to split hydrogen from water molecules, and combine it with carbon dioxide to form the molecular building blocks for synthesizing carbohydrates and other biochemical products

Probability - A statistical measure of the likelihood that a particular event might occur

Pruning - The removal or cutting back of twigs or branches, sometimes applied to twigs or small branches only, but often used to describe most activities involving the cutting of trees or shrubs

Radial - In the plane or direction of the radius of a circular object such as a tree stem

Reactive Growth/Reaction Wood - Production of woody tissue in response to altered mechanical loading; often in response to internal defect or decay and associated strength loss (cf. adaptive growth)

Ring-barking - The removal of a ring of bark and phloem around the circumference of a stem or branch, normally resulting in an inability to transport photosynthetic assimilates below the area of damage. Almost inevitably results in the eventual death of the affected stem or branch above the damage

Root-collar - The transitional area between the stem/s and roots

Sapwood - Living xylem tissues

Soft-rot - A kind of wood decay in which a fungus degrades cellulose within the cell walls, without any general degradation of the wall as a whole

Stem/s - Principle above-ground structural component(s) of a tree that supports its branches

Stress - In plant physiology, a condition under which one or more physiological functions are not operating within their optimum range, for example due to lack of water, inadequate nutrition or extremes of temperature

SRZ (Structural Root Zone) - The area around the base of the tree required for the trees stability in the ground

Subsidence - In relation to soil or structures resting in or on soil, a sinking due to shrinkage when certain types of clay soil dry out, sometimes due to extraction of moisture by tree roots

Taper - In stems and branches, the degree of change in girth along a given length

Targets - In tree risk assessment (with slight misuse of normal meaning) persons or property or other things of value which might be harmed by mechanical failure of the tree or by objects falling from it

Topping - In arboriculture, the removal of the crown of a tree, or of a major proportion of it

Transpiration - The evaporation of moisture from the surface of a plant, especially via the stomata of leaves; it exerts a suction which draws water up from the roots and through the intervening xylem cells

TPZ (Tree Protection Zone) - A specified area above and below ground and at a given distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development

Understory - This layer consists of younger individuals of the dominant trees, together with smaller trees and shrubs which are adapted to grow under lower light conditions

Veteran tree - Tree that, by recognised criteria, shows features of biological, cultural or aesthetic value that are characteristic of, but not exclusive to, individuals surviving beyond the typical age range for the species concerned. These characteristics might typically include a large girth, signs of crown retrenchment and hollowing of the stem

Vigour - The expression of carbohydrate expenditure to growth (in trees)

White-rot - A range of kinds of wood decay in which lignin, usually together with cellulose and other wood constituents, is degraded

Wind exposure - The degree to which a tree or other object is exposed to wind, both in terms of duration and velocity

Wind pressure - The force exerted by a wind on a particular object

Windthrow - The blowing over of a tree at its roots



Arboricultural Root Investigation Report

Site location:

467 Pacific Highway
Asquith NSW

Prepared for:

Calder Flower Architects
c/o Chinese Australian Services Society
Limited

Prepared by: Bryce Claassens
Urban Arbor Pty Ltd PO Box 450
Turramurra NSW 2074

Date Prepared: 26 June 2019

Our Ref: 19/06/26/467PHA

Table of Contents

1. INTRODUCTION.....	3
2. SCOPE OF THE REPORT	3
3. LIMITATIONS	4
4. METHODOLOGY.....	4
5. OBSERVATIONS.....	5
6. PHOTOGRAPHS	6
7. BIBLIOGRAPHY/REFERENCES	7
8. LIST OF APPENDICES	7

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1. INTRODUCTION

- 1.1 Urban Arbor have been instructed by Calder Flower Architects, on behalf of the Chinese Australian Services Society Limited, to carryout root investigations to determine if significant roots are located within areas of proposed construction adjacent to one tree within the site.
- 1.2 Below is a list of all documents and information provided to assist in preparing this report;

- A) Survey, Calder Flower Architects, Project No. 16180, 12 September 2016.
- B) Proposed Plans, Calder Flower Architects, Project No. 16180, Issue A - 12 March 2018, Including the following Drawings;

DA DRAWING LIST	
DRAWING NO.	DRAWING NAME
A000	TITLE PAGE
A001	SITE PLAN
A002	SITE PLAN-DEMOLITION
A003	SITE ANALYSIS
A004	SITE AREAS
A005	BUILDING SETBACKS
A100	PLAN-LEVEL 1
A101	PLAN-LEVEL 2
A102	PLAN-LEVEL 3
A103	PLAN-LEVEL 4

- C) Landscape Plan, Taylor Brammer, Revision A - 8 March 2018, Including the following sheet numbers; 00, 01, 02, 03, 04, 05, D1.
- D) Arboricultural Impact Assessment Report, Urban Arbor Pty Ltd, Ref: 18/08/23/461PHA, 23 August 2018.

- 1.3 Urban Arbor carried out a site inspection and completed the root investigations on 25 June 2019. Access was available to the subject site and adjoining public areas only. The tree information has been duplicated from the Arboricultural Impact Assessment Report by Urban Arbor, dated 23 August 2018.

2. SCOPE OF THE REPORT

- 2.1 This report has been undertaken to meet the following objectives.
- 2.1.1 Conduct root investigations to identify if significant woody roots are present in the location of the proposed basement excavations within the TPZ of tree 40.
 - 2.1.2 For the purpose of the investigations, a significant root is a root with a diameter equal to or greater than 30mm.

3. LIMITATIONS

- 3.1 The observations and recommendations are based on one site inspection. The findings of this report are based on the observations and site conditions at the time of the inspection.
- 3.2 The report reflects the subject tree as found on the day of inspection. Any changes to the growing environment of the subject tree, or tree management works beyond those recommended in this report may alter the findings of the report. There is no warranty, expressed or implied, that problems or deficiencies relating to the subject tree, or subject site may not arise in the future.
- 3.3 All diagrams, plans and photographs included in this report are visual aids only, and are not to scale unless otherwise indicated.
- 3.4 No specific tree risk assessment has been undertaken for the trees at the site.
- 3.5 Alteration of this report invalidates the entire report.

4. METHODOLOGY

- 4.1 The following information was collected during the assessment and root investigations of the subject tree.
 - 4.1.1 Tree common name
 - 4.1.2 Tree botanical name
 - 4.1.3 Location of roots
 - 4.1.4 Diameter of roots
 - 4.1.5 Depth of roots
 - 4.1.6 Notes/comments
- 4.2 All DBH measurements, tree protection zones, and structural root zones were calculated in accordance with methods set out in AS4970 Protection of trees on development sites (2009) ¹ and in some cases estimated.
- 4.3 Non-destructive root investigations were undertaken by the means of hand excavation, using digging shovels, small trowels and a digging knife. Root investigations were completed within the area of the proposed excavations within the TPZ of tree 40 (see appendix 1).
- 4.4 Tree root diameter was measured using a DBH tape or in some cases estimated. The other tools used during the assessment were a nylon mallet, compass, camera, steel tape, wheel tape and a steel probe.

¹ Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009).

5. OBSERVATIONS

5.1 Tree Information

5.1.1 Tree 40 Observations – Red Mahogany

Tree 40 is a mature Red Mahogany (*Eucalyptus resinifera*). The tree is located in the rear garden of the subject site. The tree has a DBH of 700mm and an estimated DAB of 820mm. Tree 40 has a TPZ of 8.4m and an SRZ of 3.0m, both measured in radius from the centre of the trunk.

5.1.2 **Root Information:** Root investigations were completed in the location of the proposed excavations for the basement car park within the TPZ of tree 40 (Image 1). One root investigation trench was completed and is referred to as trench 1. See appendix 1 for a plan showing the location of trench 1.

5.1.3 Trench 1 was 10.0m in length, 300mm in width and 900mm – 1000mm in depth. Trench 1 was set back from the centre of tree 40 by 4.5m at its closest point.

5.2 Observations

5.2.1 No significant roots were identified within root investigation trench 1 (Image 2). Topsoil was identified within the upper 200mm of the trench. The majority of the excavated material below the topsoil was heavily compacted clay and appeared to be introduced fill. These growing conditions appear to be unfavourable for the tree.

5.3 **Site plan:** A site plan has been included in Appendix 1, where the indicative TPZ/SRZ of the tree assessed has been overlaid onto the existing site plan. This plan includes the location of the root investigation trench.

6. PHOTOGRAPHS



Image 1: Looking North West to root investigation trench 1. Showing tree 40 and 4.5m setback from the centre of the tree.



Image 2: Looking North along root investigation trench 1. No roots identified.

Site Address: 467 Pacific Highway, Asquith, NSW.

Prepared for: Calder Flower Architects c/o Chinese Australian Services Society Limited.

Prepared by: Bryce Claassens, Urban Arbor, sales@urbanarbor.com.au, (02) 8004 2802.

Date: 26 June 2019.



Image 3: Looking South along root investigation trench 1. Showing service pipes. No roots identified.

7. BIBLIOGRAPHY/REFERENCES

- Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009).

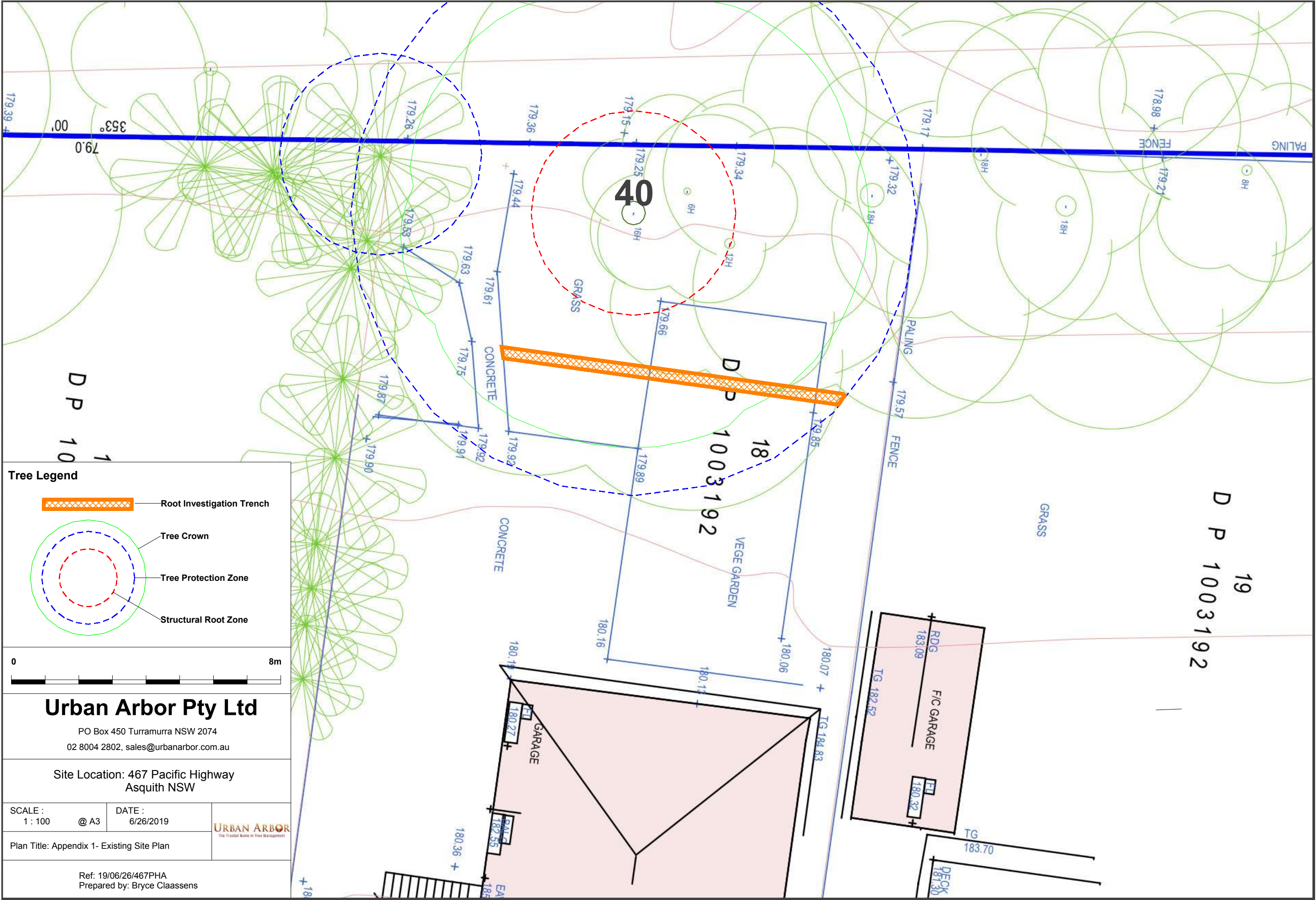
8. LIST OF APPENDICES

The following are included in the appendices:

Appendix 1 - Existing Site Plan

Appendix 2 - Further Information of Methodology

Bryce Claassens
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Tree Legend

- Root Investigation Trench
- Tree Crown
- Tree Protection Zone
- Structural Root Zone

08m

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Site Location: 467 Pacific Highway
Asquith NSW

SCALE :
1 : 100

DATE :
6/26/2019

URBAN ARBOR
The Trusted Name in Tree Management

Plan Title: Appendix 1- Existing Site Plan

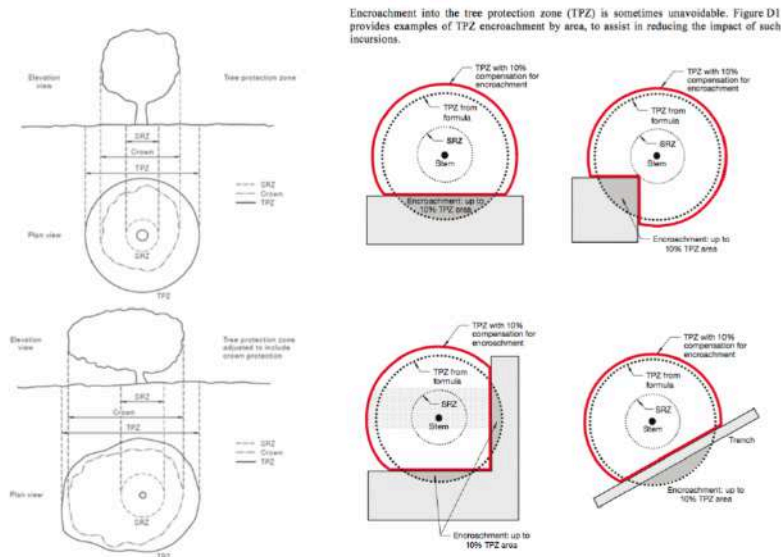
Ref: 19/06/26/467PHA
Prepared by: Bryce Claassens

Appendix 2 - Further Information of Methodology

1. **Tree Protection Zone:** The tree protection zone (TPZ) is the principle means of protecting trees on development sites. The TPZ is a combination of the root area and crown area requiring protection. It is an area isolated from construction disturbance, so that the tree remains viable. The radius of the TPZ is calculated for each tree by multiplying its DBH x 12. The derived value is measured in radius from the centre of the stem/trunk at ground level. A TPZ should not be less than 2.0 metres nor greater than 15 metres (except where crown protection is required). It is commonly observed that tree roots will extend significant further than the indicative TPZ, however the TPZ is an area identified AS4970-2009 to be extent where root loss or disturbance will generally not impact the viability of the tree. The TPZ is identified as a restricted area to prevent damage to trees either above or below ground during a development. Where trees are intended to be retained proposed developments must provide an adequate TPZ around trees. The TPZ is set aside for the tree's root zone, trunk and crown and it is essential for the stability and longevity of the tree. The tree protection also incorporates the SRZ (see below for more information about the SRZ). I have calculated the TPZ of palms, other monocots, cycads and tree ferns at one metre outside the crown projection. See appendices for additional information about the TPZ including information about calculating the TPZ and examples of TPZ encroachment.

Minor encroachment into TPZ: Sometimes encroachment into the TPZ is unavoidable. Encroachment includes but is not limited to activities such as excavation, compacted fill and machine trenching. Minor encroachment of up to 10% of the overall TPZ area is normally considered acceptable, providing there is space adjacent to the TPZ for the tree to compensate and the tree is displaying adequate vigour/health to tolerate changes to its growing environment.

Major encroachment into TPZ: Where encroachment of more than 10% of the overall TPZ area is proposed the project Arborist must investigate and demonstrate that the tree will remain in a viable condition. In some cases, tree sensitive construction methods such as pier and beam footings, suspended slabs, or cantilevered sections, can be utilised to allow additional encroachment into the TPZ by bridging over roots and minimising root disturbance. Major encroachment is only possible if it can be undertaken without severing significant size roots, or if it can be demonstrated that significant roots will not be impacted.



2. **Structural Root Zone:** This is the area around the base of a tree required for the trees stability in the ground. An area larger than the SRZ always need to be maintained to preserve a viable tree as it will only have a minor effect on the trees vigour and health. There are several factors that determine the SRZ which include height, crown area, soil type and soil moisture. It can also be influenced by other factors such as natural or built structures. Generally work within the SRZ should be avoided.

An indicative SRZ radius can be determined from the diameter of the trunk measured immediately above the root buttresses. Root investigation could provide more information about the extent of the SRZ. The following formula should be used to calculate the SRZ.

$SRZ \text{ radius} = (D \times 50)^{0.42} \times 0.64$ (D = Diameter above root buttress).