



REPORT:
SECTION 4.55 APPLICATION
DA2020/0096

ARBORICULTURAL IMPACT
ASSESSMENT
TREE PROTECTION PLAN

26 Ralston Street,
Palm Beach NSW

Notice of Determination - DA2020/0096
Dated 09/09/2020.

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Appendix B Matrix - Sustainable Retention Index Value (S.R.I.V.), Version 4, (IACA) 2010 ©

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Appendix D Glossary of terminology

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PREFACE

Redgum Horticultural has prepared this report for and on behalf of Tony Nassif (*the applicant*), 281 Morrison Road, Ryde NSW. Mr. Neville Shields (*the author*) attended 26 Ralston Street, Palm Beach NSW (*the site*), on 02 August 2019 and again on the 24 October 2023, and the trees and their growing environment were examined. The site is subject to an approved Development Application (DA2020/0096), this report and any works recommended herein that require approval from the consenting authority forms part of that Development application. This report takes into consideration the trees within front of the existing residence and on the road reserve impacted by the current proposal.

INTRODUCTION

The land is situated in the Northern Beaches Council (*the Council*) Local Government Area (LGA) and the trees are protected under Councils Development Control Plan (DCP) 2011. The Council is the consenting authority for development works on the site. This report involves 8 trees (*the trees*), as indicated on Site Plan A - Survey of Subject Trees (Appendix E) and considers the retention of the trees within the property, neighbouring properties and on the road reserve. The Tree/s will be considered as 1 stand to encompass all trees within and immediately adjacent to the site, where appropriate, as marked on Appendix E, Site Plan A – Survey of Subject Trees. **Tree Protection Zone** fences or works are marked on Appendix F, Site Plan B - Trees to be Retained and Tree Protection Zones.

The approved development consists of demolition of a dwelling house and construction of two dwelling houses with proposed modification to the new access driveway levels. The initial building design and its configuration and infrastructure were arrived at following the undertaking of an arboricultural assessment of the trees on the site to determine their significance by Redgum Horticultural.

Setbacks for the new works and associated infrastructure should provide sufficient space to protect the existing growing environments both above and below ground for trees to be retained, and so that trees within the property and on adjoining properties will not be adversely affected.

The approved design has considered the spatial requirements for the trees to be retained based on the information available or provided at the time of compiling this report, and those areas to be protected will be discussed further. The Summary lists the general condition of trees and a summary of works in Table 1.0. In section 5.0 each individual tree is described in greater detail including protective or remedial works. Tree maintenance works including pruning, removal or transplantation are detailed in section 4.0.

SUMMARY

This report considers 8 trees, 5 trees within the site and 3 trees on the road reserve identified as Tree 2, 3, 4, 5, 6, 7, 8 & 9 and recommends its retention and protection. For Tree 2, 3, the alignment of the existing driveway is a major encroachment to this specimen with the current proposal for installation of a retaining wall and cut of up to 0.5m within the TPZ of these specimens. To minimise the impact to this specimen we recommend that the section of the driveway within the SRZ is retained at or above existing natural ground level (NGL) with the retaining wall within the TPZ of the specimen be constructed using tree sensitive construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites such as porous paving at NGL to reduce any impact on the stability of the specimen and assist in its protection with work to be undertaken in consultation with the project arborist. **The approved development has a stormwater pit and pipe within the structural root zone of Tree 3 with the pipe within the SRZ of Tree 2 which will impact the stability and long-term viability of the specimen. To reduce the impact to these specimens, we recommend the pit is located outside the SRZ and is to be installed by hand with non-motorised machinery. If structural roots are found within the trench, they are to be left intact and dug around retaining these specimen's structural integrity with works to be undertaken in consultation with the project arborist.** Tree 4, the alignment of the development is sufficiently setback to not affect this specimen. Trees 5, 8 & 9, the alignment of the pathway will be a major encroachment to these specimens. The section of the pathway within the TPZ of these specimens is to be constructed at or above existing natural ground level using tree sensitive construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites such as either porous paving to reduce any impact on the stability of these specimens and assist in their protection with work to be undertaken in consultation with the project arborist. **Tree 6, the alignment of the pathway will be an unacceptable major encroachment to this specimen.** We recommend that the section of the pathway be located outside the SRZ is to be constructed at or above existing natural ground level within the TPZ of the specimen using tree sensitive construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites such as porous paving to reduce any impact on the stability of the specimen and assist in its protection with work to be undertaken in consultation with the project arborist.

Tree 7, the alignment of the development will be a major encroachment to this specimen. To our knowledge the recommended root mapping investigation along the building footprint closest to the specimen has not been undertaken to ascertain the potential root loss due to the approved development. **Due to the surface roots evident at the time of inspection, we recommend root mapping adjacent to the driveway to ascertain the extent of root growth in the direction of the proposed excavation and retaining wall.** If the results are supportive of the proposed development in its current design, then the alignment of the excavation for the proposed garage and driveway extension will be a major encroachment to this specimen. The section of the excavation for the driveway and garage within the TPZ of this specimen is to be undertaken using tree sensitive excavation and construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites to reduce any impact on the stability of this specimen with works to be undertaken under the supervision of the project arborist. The plans provided show a retaining wall but the cut and fill plan does not indicate the extent of cut required. We recommend the existing natural ground levels are retained within the TPZ of this specimen with the proposed pathway installed at or above ground level within the TPZ of the specimen using tree sensitive construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites such as porous paving to reduce any impact on the stability of the specimen and assist in its protection with work to be undertaken in consultation with the project arborist.

If the boundary fences within the tree protection zone of the retained specimens are to be replaced, they are to be constructed using tree sensitive excavation and construction techniques such as post and rail construction with suspended panels to reduce any impact on their stability, with posts to be dug by hand using non-motorised machinery to further assist in their protection.

Where associated infrastructure (pipe works) is to be installed within the Tree Protection Zone of any retained specimen, they are to be installed by hand with non-motorised machinery. If structural roots are found within the trench, they are to be left intact and dug around retaining this specimen's structural integrity with works to be undertaken in consultation with the project arborist.

There will be no impact by the proposed development to Trees 2, 3, 4, 5, 6, 8 & 9 while Tree 7 will be subject to major encroachment which are to be retained and protected as per AS 4970 (2009) Section 3, 3.3.3 Major Encroachments from development works within >10% of the area of the Tree Protection Zone and as per discussion points in section 14 in part B of this report. Any excavations must be supervised and certified by the Project Arborist in accordance with AS4970 (2009).

Documentation Referenced for the Preparation of this Report.

Architectural – Ground Floor Plan – Project No. 19031, Issue 07, Date 06/11/2023, Drawing No. A201

Cut & Fill Plan – S4.55, Drawing No. A100, Issue 01, Date 06/11/2023.

Issue 06, Date 29/09/2023, Drawing Nos – A201, A202, A203, A300, A301, A302, A310

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Northern Beaches Council

Civil Works Site Plan –

Project No. SW19162, Drawing No. CIVL010, Revision 01, Date 21/09/2021.

Stormwater Plan Set – SW19162, Revision 03, Dated 20/08/2021

Structural Works Plan Set –

Project No. STR21009, Revision A, Date 09/06/2021

Cover Page – Sheet No. S000,

Garage Plan, Section and Details - Sheet No. S100,

Wall & Column Schedules / Retaining Wall Details / Stair Details – Sheet No. S101,

Pad Footing and OS&D Tank Sections and Details – Sheet No. S102,

Ground Floor Plan, Sections and Details – Sheet No. S200, & S201,

Swimming Pools Plan, Sections and Details – Sheet No. S210,

First Floor Plan, Sections and Details – Sheet No. S300,

Roof Plan, Sections and Details – Sheet No. S400

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Landscape Plan – DA Revised 025, Date 29/05/2020.

Stephen Lesiuk Architect

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DRAWING REGISTER		
NUMBER	NAME	REVISION
SWDP01	COVER SHEET	03
SWDP02	EROSION & SEDIMENT CONTROL PLAN	03
SWDP03	GARAGE PLAN & DETAILS	03
SWDP04	SITE STORMWATER PLAN & DETAILS	03
SWDP05	FIRST FLOOR, ROOF PLANS & DETAILS	03
SWDP06	DETAILS SHEET	03

1.0 AIMS

- 1.1 Detail the condition of the trees on the site, adjoining properties or adjacent road reserve where such trees may be affected by the development works, by assessment of individual trees or stands of trees, and indicate protection measures or remedial works for their retention and protection pre, during and post construction. Consider the location and condition of the trees in relation to the building works and recommend retention and protection or removal and replacement where appropriate. The retained specimens are to remain in a safe and healthy condition, not less than at the time of initial inspection for this report, or in a reduced but sustainable condition due to the impact of the development but ameliorated through tree protection measures recommended to be applied.
- 1.2 Provide as an outcome of the assessment, the following: a description of the trees, observations made, discussion of the effects the location of the building works may have on the trees and make recommendations required for remedial or other works to the trees, if and where appropriate. *(See section 5 - Tree Assessment.)*
- 1.3 Determine from the assessment as detailed in 1.2 a description of the works or measures required to ameliorate the impact upon the trees to be retained, by the building works or future impacts the trees may have upon the new building works if and where appropriate, or the benefits of removal and replacement if appropriate for the medium to long term safety and amenity of the site.

2.0 OBJECTIVES

- 2.1 Assess the condition of the subject trees.
- 2.2 Determine impact of development on the subject trees.
- 2.3 Provide recommendations for retention or removal of the subject trees.

3.0 METHODOLOGY

Note: Individual methodologies applied as applicable.

- 3.1 The method of assessment of tree/s applied is adapted from the principles of visual tree assessment undertaken from the ground, which considers:
 1. Tree health and subsequent stability, both long and short term
 2. Sustainable Retention Index Value (SRIV) Version 4 (IACA 2010) ©
 3. Hazard potential to people and property
 4. Amenity values
 5. Habitat values
 6. Significance
- 3.2 This assessment is undertaken using standard tree assessment criteria for each tree based on the values above and is implemented as a result of at least one comprehensive and detailed site inspection to undertake a visual tree assessment from the ground of each individual tree, or stand of trees, or a representative population sample. Any dimensions recorded as averages, or by approximation are noted accordingly.

- 3.3 This report adopts Australian Standard AS4970 2009 *Protection of trees on development sites* as a point of reference and guide for the recommended minimum setbacks (Appendix C) from the centre of a tree's trunk to development works and the distances may be increased or decreased by the author in accordance with AS4970 – Section 3.3.4 as a result of other factors providing mitigating circumstances or constraints as indicated by but not restricted to the following:
1. Condition of individual trees,
 2. Tolerance of individual species to disturbance,
 3. Geology e.g., physical barriers in soil, rock floaters, bedrock to surface
 4. Topography e.g., slope, drainage,
 5. Soil e.g., depth, drainage, fertility, structure,
 6. Microclimate e.g., due to landform, exposure to dominant wind,
 7. Engineering e.g., techniques to ameliorate impact on trees such as structural soil, gap graded fill, lateral boring,
 8. Construction e.g., techniques to ameliorate impact on trees such as pier and beam, bridge footings, suspended slabs,
 9. Root mapping,
 10. Physical limitations - existing modifications to the environment and any impact to tree/s by development e.g., property boundaries, built structures, houses, swimming pools, road reserves, utility services easements, previous impact by excavation, or construction in other directions, soil level changes by cutting or filling, existing landscaping works within close proximity, modified drainage patterns,
 11. Extraneous factors e.g., potential future impacts from development on adjoining land when the tree is located on or near to a property boundary.
- 3.4 Trees in groups may be referred to as stands and a stand may exclusively contain specimens to be either retained or removed or a combination of both. A stand may be used to discuss all the trees on a given site to expedite their assessment or refer to trees growing proximate to one another or within a defined space. Stands may be comprised by mass boundary or screen plantings, to form a group of the same or a mixture of taxa. Each stand is considered as a single unit with each component tree assessed and expressed in tabular form or indicated by a given percentage as a population sample of each stand. Where it is appropriate for a stand of trees to be retained in full or part, the location and setback of Tree Protection Zone fences or works, are prescribed to provide for the preservation of the stand or selected component trees, in a condition not less than that at the time of initial inspection for its incorporation into the landscape works for the site, or in a reduced but sustainable condition due to the impact of the development but ameliorated through tree protection measures.
- 3.5 The meanings for terminology used herein are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009. An extract from the IACA Dictionary forms a glossary of terms included as Appendix D.

4.0 PRUNING STANDARDS

- 4.1 Any pruning recommended in this report is to be to the Australian Standard® AS4373 *Pruning of amenity trees* and conducted in accordance with the NSW Work Cover Authority Code of Practice, Tree Work, 2007.
- 4.2 All pruning or removal works are to be in accordance with the appropriate Tree Management Policy where applicable, or Tree Management Order (TMO), or Tree Preservation Order (TPO).
- 4.3 Tree maintenance work is specialised and in order to be undertaken safely to ensure the works carried out are not detrimental to the survival of a tree being retained, and to assist in the safe removal of any tree, should be undertaken by a qualified arboriculturist with appropriate competencies recognised within the Australian Qualification Framework, with a minimum of 5 years of continual experience within the industry of operational amenity arboriculture, and covered by appropriate and current types of insurance to undertake such works.

Table 1.0 General condition of trees and Schedule of works. Trees described in greater detail in section 5.0.

Tree No.'s	Genus and species	Common name	Condition G = Good, F = Fair P = Poor, D = Dead W= Weed	Description of work to be done
2	<i>Eucalyptus saligna</i>	Sydney Blue Gum	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan. – <i>Road reserve specimen</i>
3	<i>Eucalyptus saligna</i>	Sydney Blue Gum	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan. – <i>Road reserve specimen</i>
4	<i>Camellia sasanqua</i>	Camellia	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan. – <i>Road reserve specimen</i>
5	<i>Afrocarpus falcatus</i>	Yellowwood	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan.
6	<i>Eucalyptus saligna</i>	Sydney Blue Gum	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan.
7	<i>Eucalyptus saligna</i>	Sydney Blue Gum	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan.
8	<i>Eucalyptus saligna</i>	Sydney Blue Gum	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan.
9	<i>Glochidion ferdinandi</i>	Cheese Tree	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan.

5.0 TREE ASSESSMENT – 5.1 - Assessment of a stand of Trees

Tree / Stand No.	Genus & Species Common Name	Age Y = Young M = Mature O = Overmature	Vigour GV = Good Vigour LV = Low Vigour	Condition G = Good F = Fair P = Poor D = Dead	1. SRIV Age, Vigour, Condition / Index Rating www.iaca.org.au / 2. Estimated Life Expectancy 1. Long 2. Medium 3. Short	Crown Form D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	Ht. Approx. metres	Crown Spread approx. metres / Orientation N= north S= South E= East W=West				Crown Cover % / Crown Density % / D = dormant	DBH in mm @ 1.4m, or other, as indicated. / Trunk Orientation other than R = radial, e.g., N/S g = ground	Trunk Lean 1 = Upright-Slight 2 = Moderate 3 = Severe 4 = Critical. 5 = Acaulescent / Orientation / ST = Static P = Progressive Sc = Self-correcting	Roots Evident at Root Crown 1. = None 2. = Adventitious 3. = Basal Flare 4. = Buttresses 5. = First Order Roots (FOR), No. & distribution e.g., R = radial, or one each to N, S, E and W	Pests, Diseases & Damage No or Yes If Yes see comments	Branch Bark Included No or Yes or N/A	Form G = Good Form P = Poor Form	Significance scale 1=High 2=Medium 3=Low / Retention Value 1=High 2=Medium 3=Low 4=Remove
2	<i>Eucalyptus saligna</i>	M	GV	F	MGVF - 9 1	D	12	2 N	2 S	2 E	2 W	70 70	400 R	1/R ST	1	YES	NO	P	1 1
	Sydney Blue Gum	Comments: Trunk erect, straight, gradually tapering & continuous, crown excurrent. Storm damage evident in upper canopy. – Road reserve specimen																	
3	<i>Eucalyptus saligna</i>	M	GV	F	MGVF - 9 1	D	16	2 N	2 S	5 E	7 W	70 70	600 R	1/R ST	1	YES	NO	G	1 1
	Sydney Blue Gum	Comments: Trunk to 4 metres then bifurcate, crown deliquescent, orientation E/W, asymmetrical bias to west. Storm damage evident in upper canopy. – Road reserve specimen																	
4	<i>Camellia sasanqua</i>	M	GV	F	MGVF - 9 1	D	4	1.5 N	1.5 S	1.5 E	1.5 W	70 70	200#@g R	5/R ST	1	NO	NO	G	2 2
	Camellia	Comments: Acaulescent or short trunk @ or near ground, crown deliquescent, orientation radial, symmetrical. – Road reserve specimen																	
5	<i>Afrocarpus falcatus</i>	M	GV	F	MGVF - 9 1	C	5	3 N	3 S	3 E	5 W	70 70	400 R	1/R ST	5 1-SW	NO	NO	P	2 2
	Yellowwood	Comments: Trunk to 300 metres, crown deliquescent, orientation E/W, asymmetrical bias to west.																	
6	<i>Eucalyptus saligna</i>	M	GV	F	MGVF - 9 1	D	16	7 N	4 S	4 E	3 W	70 70	700 R	1/R ST	4 & 5 to S & SW	YES	NO	G	1 1
	Sydney Blue Gum	Comments: Trunk to 5 metres, crown deliquescent, orientation N/S, asymmetrical bias to north. Canopy predominantly epicormic regrowth due to exposure. Major root plate evident sandstone outcrop. Prune second order structural branch to west back to trunk for site access.																	
7	<i>Eucalyptus saligna</i>	M	GV	F	MGVF - 9 1	D	16	4 N	4 S	4 E	4 W	70 70	700 R	1/R ST	1	YES	NO	G	1 1
	Sydney Blue Gum	Comments: Trunk erect, straight, gradually tapering & continuous, crown excurrent. Storm damage evident in upper canopy.																	
8	<i>Eucalyptus saligna</i>	M	GV	F	MGVF - 9 1	D	16	5 N	5 S	5 E	5 W	70 70	700 R	1/R ST	1	YES	NO	G	1 1
	Sydney Blue Gum	Comments: Trunk to 3 metres, crown deliquescent, orientation radial, symmetrical. Storm damage evident in upper canopy.																	
9	<i>Glochidion ferdinandi</i>	M	GV	F	MGVF - 9 1	C	5	4 N	3 S	3 E	3 W	60 70	400 R	1/R ST	1	NO	NO	G	2 1
	Cheese Tree	Comments: Trunk to 1 metre, crown deliquescent, orientation N/S, asymmetrical bias to north.																	

Observations / Discussion

- 5.2 The site has a stand of mature, remnant and planted endemic and non-locally indigenous or exotic evergreen taxa within the current proposal growing along the Hawkesbury sandstone ridgeline. The approved design requires the retention and protection of the specimens within the site and the road reserve as they are considered significant for their contribution as landscape elements to the property and the retention of these trees allows them as components of the current curtilage to be transferred to the new proposal, maintaining elements of a continuous landscape, providing a more harmonious integration and transition of the use of the land.

Tree Significance

- 5.3 Significant Trees as established by the Rating System for Tree Significance – IACA Stars (2010), Appendix A.

Significance Scale

1 – High
2 – Medium
3 – Low

Significance Scale	1	2	3
Redgum Tree No.	2, 3, 6, 7, 8	4, 5, 9	

Tree Retention Value

- 5.4 See Appendix A for Retention Value Matrix.

Retention Value

High – Priority for Retention
Medium – Consider for Retention
Low – Consider for Removal
Remove - Priority for Removal

Retention Value	High Priority for Retention	Medium Consider for Retention	Low Consider for Removal	Remove Priority for Removal
Redgum Tree No.	2, 3, 6, 7, 8, 9	4, 5		

* Trees located within the neighbouring property and should be retained and protected. Consent required from owner if removal required.

- 5.5 AS4970 (2009) section 3, 3.3.3 requires the Project Arborist to demonstrate that where a retained tree is subject to a major encroachment (>10% of area of TPZ) it can be protected to remain viable.
- 5.6 Tree 2 & 3 *Eucalyptus saligna* - Sydney Blue Gum, these road reserve specimens were found in fair condition & good vigour at time of assessment.

- Trees viability to development; these specimens are impacted by the approved development. The project arborist is to certify the installation of protection measures as per D/A conditions prior to commencement of works and to be monitored throughout the project at approx. 3 mthly intervals depending on the length of the development. The specimens MAY remain viable beyond completion of development provided recommended installation & protection measures are adhered to.
- Development Impacts: AS4970 (2009) section 3 requires a Tree Protection Zone (TPZ) setback of 4.8 metres (m) for Tree (T)2 & 7.2m for T3 radial from centre of trunk (COT), the setback for the proposed driveway and retaining wall adjacent to this specimen is estimated at 2.8m & 1.3m respectively from COT, which is an estimated at 15.1% & 38.6% encroachment into the TPZ by the proposed development.

The alignment of the existing driveway is a major encroachment to this specimen with the current proposal for installation of a retaining wall and cut of up to 0.5m within the TPZ of these specimens. To minimise the impact to this specimen we recommend that the section of the driveway within the SRZ is retained at or above existing natural ground level (NGL) with the retaining wall within the TPZ of the specimen be constructed using tree sensitive construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites such as porous paving at NGL to reduce any impact on the stability of the specimen and assist in its protection with work to be undertaken in consultation with the project arborist.

The approved development has a stormwater pit and pipe within the structural root zone of Tree 3 with the pipe within the SRZ of Tree 2 which will impact the stability and long-term viability of the specimen. To reduce the impact to these specimens, we recommend the pit is located outside the SRZ and is to be installed by hand with non-motorised machinery. If structural roots are found within the trench, they are to be left intact and dug around retaining these specimen's structural integrity with works to be undertaken in consultation with the project arborist.

5.7 Tree 4 Camellia sasanqua – Camellia, this road reserve specimen was found in fair condition & good vigour at time of assessment.

- Trees viability to development: this specimen is not impacted by the proposed development. The project arborist is to certify the installation of protection measures as per D/A conditions prior to commencement of works and to be monitored throughout the project at approx. 3 mthly intervals depending on the length of the development. The specimen should remain viable beyond completion of development provided recommended installation & protection measures are adhered to.
- Development Impacts: AS4970 (2009) section 3 requires a TPZ setback of 2.4m radial from COT, the setback for the proposed development adjacent to this specimen is estimated at 5.5m from COT, which is not an encroachment by the proposed development. The specimen is sufficiently setback from the development to not be affected.

5.8 Tree 5 Afrocarpus falcatus – Yellowwood, this specimen was found in fair condition & good vigour at time of assessment.

- Trees viability to development: this specimen is impacted by the proposed development. The project arborist is to certify the installation of protection measures as per D/A conditions prior to commencement of works and to be monitored throughout the project at approx. 3 mthly intervals depending on the length of the development. The specimen should remain viable beyond completion of development provided recommended installation & protection measures are adhered to.
- Development Impacts: AS4970 (2009) section 3 requires a TPZ setback of 4.8m radial from COT, the setback for the proposed pathway adjacent to this specimen is estimated at 2.7m from COT, which is an estimated 11.1% encroachment into the TPZ by the proposed development.

The alignment of the pathway will be a major encroachment to this specimen. The section of the pathway within the TPZ of the specimen is to be constructed at or above existing natural ground level using tree sensitive construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites such as porous paving to reduce any impact on the stability of the specimen and assist in its protection with work to be undertaken in consultation with the project arborist.

5.9 Tree 6 Eucalyptus saligna - Sydney Blue Gum, this road reserve specimen was found in fair condition & good vigour at time of assessment.

- Trees viability to development: this specimen is impacted by the proposed development. The project arborist is to certify the installation of protection measures as per D/A conditions prior to commencement of works and to be monitored throughout the project at approx. 3 mthly intervals depending on the length of the development. Given the proposed development impacts, the specimen **may not** remain viable beyond completion of development.
- Development Impacts: AS4970 (2009) section 3 requires a TPZ setback of 8.4m radial from COT, the setback for the proposed pathway and retaining wall adjacent to this specimen is estimated at 0.6m & 2.5m respectively from COT, which is within the structural root zone (SRZ) and an estimated 32.8% encroachment into the TPZ by the proposed pathway.

The alignment of the pathway will be an unacceptable major encroachment to this specimen. We recommend that the section of the pathway be located outside the SRZ is to be constructed at or above existing natural ground level within the TPZ of the specimen using tree sensitive construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites such as porous paving to reduce any impact on the stability of the specimen and assist in its protection with work to be undertaken in consultation with the project arborist.

5.10 Tree 7 Eucalyptus saligna - Sydney Blue Gum, this specimen was found in fair condition & good vigour at time of assessment.

- Trees viability to development; this specimen is impacted by the proposed development. The project arborist is to certify the installation of protection measures as per D/A conditions prior to commencement of works and to be monitored throughout the project at approx. 3 mthly intervals depending on the length of the development. Given the current proposed development impacts the specimen **may not** remain viable beyond completion of development.

- Development Impacts – residence, driveway and garage: AS4970 (2009) section 3 requires a TPZ setback of 8.4 m radial from COT, the setback for the proposed garage excavation adjacent to this specimen is estimated at 6.8m to the south and 4.4m to the southwest with the existing driveway 4.4m to the west from COT, which is an approximate additional encroachment estimated at 15% by the proposed garage and driveway extension excavation. The current proposal requires excavation of 0.6m to 1.8m to the north and west and construction of a retaining wall along the driveway edge.

- Development Impacts – pathway and retaining wall to the east: the setback for the proposed pathway and retaining wall to the east of this specimen is estimated at 4.5m & 5.5m respectively to the east from COT, which is an approximate additional encroachment estimated at approximately 12% by the proposed pathway and retaining wall. The plans provided show a retaining wall but the cut and fill plan does not indicate the extent of cut required. We recommend the existing natural ground levels are retained within the TPZ of this specimen with the proposed pathway installed at or above ground level within the TPZ of the specimen using tree sensitive construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites such as porous paving to reduce any impact on the stability of the specimen and assist in its protection with work to be undertaken in consultation with the project arborist.

The alignment of the development will be a major encroachment to this specimen. To our knowledge the recommended root mapping investigation along the building footprint closest to the specimen has not been undertaken to ascertain the potential root loss due to the approved development. Due to the surface roots evident at the time of inspection, we recommend root mapping adjacent to the driveway to ascertain the extent of root growth in the direction of the proposed excavation and retaining wall. If the results are supportive of the proposed development in its current design, then the alignment of the excavation for the proposed garage and driveway extension will be a major encroachment to this specimen. The section of the excavation for the driveway and garage within the TPZ of this specimen is to be undertaken using tree sensitive excavation and construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites to reduce any impact on the stability of this specimen with works to be undertaken under the supervision of the project arborist.



5.11 Trees 8 & 9 *Eucalyptus saligna* - Sydney Blue Gum & *Glochidion ferdinandi* - Cheese Tree, these specimens were found in fair condition & good vigour at time of assessment.

- Trees viability to development; these specimens are impacted by the proposed development. The project arborist is to certify the installation of protection measures as per D/A conditions prior to commencement of works and to be monitored throughout the project at approx. 3 mthly intervals depending on the length of the development. The specimens should remain viable beyond completion of development provided recommended installation & protection measures are adhered to.
- Development Impacts: AS4970 (2009) section 3 requires a TPZ setback of 8.4m for T8 & 4.8m for T9 radial from COT, the setback for the proposed pathway adjacent to these specimens is estimated at 4.4m & 2.5m respectively from COT, which is an estimated 14.5% & 18.4% encroachment into the TPZ by the proposed development.

The alignment of the pathway will be a major encroachment to these specimens. The section of the pathway within the TPZ of these specimens is to be constructed at or above existing natural ground level using tree sensitive construction techniques to comply with AS4970 2009 Protection of Trees on Development Sites such as either porous paving to reduce any impact on the stability of these specimens and assist in their protection with work to be undertaken in consultation with the project arborist.

If the boundary fences within the tree protection zone of the retained specimens are to be replaced, they are to be constructed using tree sensitive excavation and construction techniques such as post and rail construction with suspended panels to reduce any impact on their stability, with posts to be dug by hand using non-motorised machinery to further assist in their protection.

If associated infrastructure (pipe works) is to be installed within the Tree Protection Zone of any retained specimen, they are to be installed by hand with non-motorised machinery. If structural roots are found within the trench, they are to be left intact and dug around retaining this specimen's structural integrity with works to be undertaken in consultation with the project arborist.

There will be no impact by the proposed development to Tree 4 while Trees 2, 3, 5, 6, 7, 8 & 9 will be subject to major encroachment which are to be retained and protected as per AS 4970 (2009) Section 3, 3.3.3 Major Encroachments from development works within >10% of the area of the Tree Protection Zone and as per discussion points in section 14 in part B of this report. Any excavations must be supervised and certified by the Project Arborist in accordance with AS4970 (2009).

General – Tree Protection works – Prior to Demolition

- 5.12 Tree Management Plan – Prior to demolition works, a site arborist shall be appointed to supervise all tree protection procedures detailed in this specification. The Site Arborist shall have a minimum level 5 AQF qualification in Arboriculture. Milestones are to be adhered to throughout the duration of this development and all relevant documentation is to be submitted to the local authority.
- 5.13 The Tree Protection Zone for each tree/s is to be incorporated into the construction works for the site and the protection fencing or works to be located as indicated on the Appendix F – Tree Protection Plan. The setbacks from building works on the side closest to each tree are to be carried out as indicated in Table 2.0, and Tree Protection Zones be constructed as described here and detailed in Appendix C. The trees will be sustained within the constraints of the modifications to the site by the development works.
- 5.14 Trees 2, 3, 4, 5, 6, 7, 8 & 9 to be retained and protected and incorporated into the landscape works for the site, and Tree Protection Zone fencing to be marked accordingly on the Landscape Plan, where appropriate and installed prior to any demolition or construction.
- 5.15 Ground protection - If temporary access for machinery is required within the TPZ ground protection measures will be required. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ. Measures may include a permeable membrane such as geotextile fabric beneath a layer of mulch or crushed rock below rumble boards. These measures may be applied to root zones beyond the TPZ.
- 5.16 Where applicable, any excavation for the establishment of a batter slope or benching for reasons of safety and to comply with Work Cover Authority safety regulations should be restricted as far as is safely possible near to trees to be retained to prevent root damage. If the excavations cannot be undertaken near vertically, the stability of these trees and their long-term viability may be compromised and their retention in a safe and healthy condition jeopardized, and they may need to be revised and possibly removed.

Specific - Tree Protection Works - Prior to Demolition and Tree Removal

- 5.17 All trees/shrubs; these trees/s are to be placed within a Tree Protection Zone with protective fencing and maintained and retained until the completion of all building works. Protective fencing is to be installed as shown in Appendix F - Tree Protection Plan.
- *The Protective fencing where required may delineate the **Tree Protection Zone (TPZ)** and should be located as determined by the project arborist in accordance with AS4970 Protection of trees on development sites, Section 4, 4.3. "Fencing should be erected before any machinery or materials are brought onto the site and before the commencement of works including demolition. Once erected, protective fencing must not be removed or altered without approval by the project arborist. The TPZ must be secured to restrict access. AS4687 Temporary fencing and hoardings specifies applicable fencing requirements. Shade cloth or similar should be attached to reduce the transport of dust, other particulate matter, and liquids into the protected area. Fence posts and supports should have a diameter greater than 20 mm and be located clear of roots. Existing perimeter fencing and other structures may be suitable as part of the protective fencing" or similar.*
 - *Tree Protection signage is to be attached to each **TPZ** and displayed from within the development site in accordance with AS4970 2009 Protection of trees on development sites.*
 - *The area of the Tree Protection Zone to be mulched to a depth of 100 mm with organic material being 75% leaf litter and 25% wood, and this being composted material preferably from the same genus and species of tree as that to where the mulch is to be applied, i.e., species-specific mulch where possible. The depth of mulch and type as indicated, to be maintained for the duration of the project. Where deep excavation will expose the soil profile to drying out the root plate is to be protected by pegging jute matting across the ground surface 2 m back from the edge of the profile and 2 m down the face of the profile and is to be in one continuous sheet or layers up to 5 mm thick and overlapped 300 mm and pegged. Pegs are to be a minimum length of 200 mm and spaced at 500 mm increments in a grid pattern. Once installed mulch is to be placed on top of the jute matting previously described.*
- 5.18 There is to be no storage of materials, rubbish, soil, equipment, structures or goods of any type to be kept or placed within 5 metres from the trunk or within the dripline of any tree for the duration of the development. This will ensure protection of the tree/s to be retained on or adjacent to site.
- 5.19 Milestone - Project/Site arborist is to inspect/assess all retained specimens prior to demolition to inspect tree protection measures have been carried out as per the approved D/A conditions for the site. Documentation is to be submitted to the consenting authority after each inspection.

Specific - Tree Protection works – During Demolition

- 5.20 Demolition of Existing Buildings should be undertaken with access restricted to the driveway and the building platform for each of the existing buildings, or to areas of the land where no trees are growing within 6m of any tree to be retained. Where access or space for a safe working environment is restricted, or where the area of the 6m set back must be compromised, a 100 mm layer of wood mulch must be laid over the area of encroachment. Where vehicular access is required across the mulch layer further root protection should be provided by laying a temporary pathway over the mulch. The temporary pathway should be constructed of a grated steel material capable of supporting the vehicles used during demolition e.g., ramps used to load vehicles onto the backs of trucks. Trunks of trees may require protection from vehicular damage.
- 5.21 Demolition of landscape structures: the demolition of walls, driveways retaining walls, paths, and pools etc. within 6 m of a tree to be retained should be undertaken manually using hand tools. Where a driveway is to be demolished being of concrete strip or slab type construction, it should be undertaken by working from the end of the driveway closest to the building back towards the street by utilising the driveway as a stable platform to prevent soil compaction. Where a concrete slab driveway passes less than 1 m from the base of a tree and the area beneath the driveway is to be undisturbed and incorporated into the landscape works for the site, the volume of space previously occupied by the driveway must be replaced with local top soil from the site or otherwise a loamy sand, to replace the mass of the concrete on the root plate which may be critical to the ballast and centre of mass for the stability of the tree. If the tree becomes unstable immediately contact the Consultant Arboriculturist.

Specific - Tree Protection works – Prior to Construction

- 5.22 Location of underground utilities within a Tree Protection Zone of a retained specimen.
Any utility services to be located underground within the TPZ are to be undertaken utilising excavation techniques that prevent or minimise damage to structural roots (roots greater than >20 mm diameter). Such works should be conducted with non-motorised hand tools or with an air knife or water knife and vacuum truck or with directional drilling to prevent soil compaction and root damage.
- 5.23 Re-grading of site near retained trees; Grading &/or re-grading of sites/slopes within Tree Protection Zones or near retained specimens is to be undertaken **only** if at all, after consultation with the Project Arborist. This is to protect all structural roots systems from damage or compaction from machinery.
- 5.24 Placement of relocatable buildings; consideration should be given to tree sensitivity such as the buildings being placed on pier and beam or skids construction as they are to be positioned on their driplines within the Tree Protection Zone (TPZ). The area of the Tree Protection Zone under the buildings is to be mulched to a depth of 200 mm (*if installed on skids*) with organic material to further reduce compaction. The mulch is to be composted material, i.e., species-specific mulch. Alternatively, if installed on a pier & beam construction, piers are to be undertaken manually by using non-motorised hand tools to determine the location of first order and lower order structural roots with a diameter of 20 mm (*structural woody roots*) or greater, without damaging them.

Specific - Tree Protection works – During Construction

- 5.25 Milestone - Project/Site arborist is to inspect/assess all retained specimens during construction in relation to tree protection measures have been carried out as per the approved D/A conditions for the site. Documentation is to be submitted to the consenting authority after each inspection.
- 5.26 Where any structural roots (roots with a diameter of greater than >20 mm) encountered by excavation are to be pruned and it is to be undertaken with clean sharp pruning tools, with a final cut to undamaged wood to prevent infestation by pathogens and assist continued root growth and undertaken in consultation with the Consulting Arboriculturist. Tree Protection Zone fences are to be maintained during these works. Ground protection in accordance with AS4970 section 4, 4.5.3 may require steel plates to protect the ground surface from compaction to protect roots between the stages of demolition and construction of the new pavement.
- 5.27 All Tree Protection Zones of retained trees are to be monitored for the duration of the construction phase of the development. The three main areas requiring monitoring are mulching - mulch must be maintained to a depth of 50–100 mm using material that complies with AS 4454. Where the existing landscape within the TPZ is to remain unaltered (e.g., garden beds or turf) mulch may not be required, watering - soil moisture levels should be regularly monitored by the project arborist. Temporary irrigation or watering may be required within the TPZ. An above-ground irrigation system could be installed and maintained by a competent individual and weeding - weeds should be removed by hand without disturbing soil or should be controlled with weedicide.

Specific - Tree Protection works – Post Construction

- 5.28 At completion of construction work the Site/Project Arborist should carry out an assessment of all trees retained &/or affected by works. This assessment is to document any required on-going remedial care needed to ensure viable retention of trees affected. Documentation is to be submitted to the consenting authority.

6.0 CONCLUSION

As these trees are to be preserved, they will be retained and protected through the implementation of adequate measures for the integration into the development by the application of appropriate technology as detailed in this report.

The retention and protection of existing trees on site is a significant aspect of the development process, allowing those trees as components of the current curtilage to be transferred to the new dwellings for incorporation into the landscaping works for the site. The retention of the existing trees contributes to the preservation of local amenity, screening of views to and from the site, and a balance to the scale and bulk of buildings, while maintaining elements of a continuous landscape, providing a more harmonious integration and transition of the use of the land.

If all the recommendations and procedures detailed herein are adhered to, some or all of the trees the subject of this report will continue and will grow to develop as important landscape components providing elements of long-term amenity for the property and its owners or occupants, and the local community.

The recommendations made in this report are subject to approval by the consent authority.

As a renewable and dynamic natural resource, the urban tree, and the growing environment essential for its survival must be understood and carefully managed to balance its needs with those of people. It is crucial that as required: this resource be planned for, planted, nurtured, protected, maintained and replaced, to ensure appropriateness and suitability of new plantings and trees retained, for safety and viability, so that it remains vital, and is sustainable in continuity.

7.0 RECOMMENDATIONS

- 7.1 Trees 2, 3, 4, 5, 6, 7, 8 & 9 are to be retained in situ within the site and on the road, reserve is to be protected as detailed in 5.6 - 5.28 Tree protection fences, or works, to be situated in accordance with *Site Plan B - Trees to be Retained and Tree Protection Zones* (Appendix F).
- 7.2 Where Tree Protection Zone fences are to be moved or relocated this must be undertaken in consultation with the Consultant Arboriculturist for the project to ensure that tree protection is maintained. If the fences are relocated areas are to be mulched in accordance with 5.17 of this report to reduce compaction to the root system of the retained specimens.
- 7.3 To minimise damage to retained crowns, all Tree Protection Zones are to be adhered to. This must be undertaken in consultation with the Consultant Arboriculturist for the project to ensure that tree protection is maintained. Minor pruning may be required if damage occurs, work is to be undertaken in accordance with section 4 of this report.
- 7.4 Milestone/s - Project/Site arborist is to inspect/assess all retained specimens prior to Demolition, Post Demolition, Prior to Construction during Construction and on completion in relation to trees protected and the protection measures have been carried out as per the approved D/A conditions for the site. Documentation is to be submitted to the consenting authority after each inspection.
- 7.5 Any work to be undertaken within Tree Protection Zones is to be undertaken in accordance with 7.2 of this report.
- 7.6 There is to be no storage of materials, rubbish, soil, equipment, structures or goods of any type to be kept or placed within 5 metres from the trunk or within the dripline of any tree for the duration of the development. This will ensure protection of the tree/s to be retained on or adjacent to site.

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DISCLAIMER

The author and Redgum Horticultural take no responsibility for actions taken and their consequences, contrary to those expert and professional instructions given as recommendations pertaining to safety by way of exercising our responsibility to our client and the public as our duty of care commitment, to mitigate or prevent hazards from arising, from a failure moment in full or part, from a structurally deficient or unsound tree or a tree likely to be rendered thus by its retention and subsequent modification/s to its growing environment either above or below ground contrary to our advice.

REFERENCES

1. Draper BD and Richards PA 2009, *Dictionary for Managing Trees in Urban Environments*, Institute of Australia Consulting Arboriculturists (IACA), CSIRO Publishing, Collingwood, Victoria, Australia.
2. IACA 2005, Sustainable Retention Index Value, *Institute of Australia Consulting Arboriculturists*, Australia, www.iaca.org.au.
3. Standards Australia 2007, *Australian Standard 4373 Pruning of amenity trees*, Standards Australia, Sydney, Australia.
4. Standards Australia 2009, *Australian Standard 4970 Protection of trees on development sites*, Standards Australia, Sydney, Australia.
5. Safe Work Australia, *Guide to Managing Risk from Tree Trimming and Removal Works*.

Appendix A

IACA Significance of a Tree, Assessment Rating System (STARS) © (IACA 2010) ©

In the development of this document IACA acknowledges the contribution and original concept of the Footprint Green Tree Significance & Retention Value Matrix, developed by Footprint Green Pty Ltd in June 2001.

The landscape significance of a tree is an essential criterion to establish the importance that a tree may have on a site. However, rating the significance of a tree becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the retention value for a tree. To assist this process all definitions for terms used in the *Tree Significance - Assessment Criteria* and *Tree Retention Value - Priority Matrix*, are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009.

This rating system will assist in the planning processes for development works, above and below ground where trees are to be retained on or adjacent a development site. The system uses a scale of *High*, *Medium*, and *Low* significance in the landscape. Once the landscape significance of an individual tree has been defined, the retention value can be determined.

Tree Significance - Assessment Criteria



1. High Significance in landscape

- The tree is in good condition and has good vigour.
- The tree has a form typical for the species.
- The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age.
- The tree is listed as a Heritage Item, Threatened Species or part of an Endangered ecological community or listed on Councils Significant Tree Register.
- The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity.
- The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group, or has commemorative values.
- The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa *in situ* - tree is appropriate to the site conditions.

2. Medium Significance in landscape

- The tree is in fair-good condition and good or low vigour.
- The tree has forms typical or atypical of the species.
- The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area.
- The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street.
- The tree provides a fair contribution to the visual character and amenity of the local area.
- The tree's growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa *in situ*.

3. Low Significance in landscape

- The tree is in fair-poor condition and good or low vigour.
- The tree has form atypical of the species.
- The tree is not visible or is partly visible from surrounding properties as obstructed by other vegetation or buildings.
- The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area.
- The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation orders or similar protection mechanisms and can easily be replaced with a suitable specimen.
- The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa *in situ* - tree is inappropriate to the site conditions.
- The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms.
- The tree has a wound or defect that has potential to become structurally unsound.

Environmental Pest / Noxious Weed Species

- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties.
- The tree is a declared noxious weed by legislation.


Hazardous/Irreversible Decline

- The tree is structurally unsound and/or unstable and is considered potentially dangerous.
- The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in full or part in the immediate to short term.

The tree is to have a minimum of three (3) criteria in a category to be classified in that group.

Note: The assessment criteria are for individual trees only, however, can be applied to a monocultural stand in its entirety e.g., hedge

Table 1.0 Tree Retention Value - Priority Matrix.

		Significance				
		1. High	2. Medium	3. Low		
		Significance in Landscape	Significance in Landscape	Significance in Landscape	Environmental Pest / Noxious Weed Species	Hazardous / Irreversible Decline
Estimated Life Expectancy	1. Long >40 years					
	2. Medium 15-40 Years					
	3. Short <1-15 Years					
	Dead					
Legend for Matrix Assessment 						
	Priority for Retention (High) - These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard AS4970 <i>Protection of trees on development sites</i> . Tree sensitive construction measures must be implemented e.g., pier and beam etc. if works are to proceed within the Tree Protection Zone.					
	Consider for Retention (Medium) - These trees may be retained and protected. These are considered less critical; however, their retention should remain a priority with removal considered only if adversely affects the building/works and all other alternatives have been considered and exhausted.					
	Consider for Removal (Low) - These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.					
	Priority for Removal - These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.					

REFERENCES

Australia ICOMOS Inc. 1999, *The Burra Charter – The Australian ICOMOS Charter for Places of Cultural Significance*, International Council of Monuments and Sites, www.icomos.org/australia

Draper BD and Richards PA 2009, *Dictionary for Managing Trees in Urban Environments*, Institute of Australian Consulting Arboriculturists (IACA), CSIRO Publishing, Collingwood, Victoria, Australia.

Footprint Green Pty Ltd 2001, *Footprint Green Tree Significance & Retention Value Matrix*, Avalon, NSW Australia, www.footprintgreen.com.au


Appendix B

Matrix - Sustainable Retention Index Value (SRIV) ©

Version 4, 2010

Developed by IACA – Institute of Australian Consulting Arboriculturists www.iaca.org.au

The matrix is to be used with the value classes defined in the Glossary for Age / Vigour / Condition.
An index value is given to each category where ten (10) is the highest value.

Age Class	<div style="text-align: right;"> <small>INSTITUTE OF AUSTRALIAN CONSULTING ARBORICULTURISTS</small>  </div> Vigour Class and Condition Class					
	Good Vigour & Good Condition (GVG)	Good Vigour & Fair Condition (GVF)	Good Vigour & Poor Condition (GVP)	Low Vigour & Good Condition (LVG)	Low Vigour & Fair Condition (LVF)	Low Vigour & Poor Condition (LVP)
	Able to be retained if sufficient space available above and below ground for future growth. No remedial work or improvement to the growing environment required. May be subject to high vigour. Retention potential - Medium – Long Term.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work may be required or improvement to the growing environment may assist. Retention potential - Medium Term. Potential for longer with remediation or favourable environmental conditions.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work is unlikely to assist conditions, improvement to growing environment may assist. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. No remedial work required, but improvement to growing environment may assist vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment may assist condition and vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	Unlikely to be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment unlikely to assist condition or vigour. Retention potential - Likely to be removed immediately or retained for Short Term. Potential for longer with remediation or favourable environmental conditions.
Young (Y)	YGVG - 9 Index Value 9 Retention potential - Long Term. Likely to provide minimal contribution to local amenity if height <5 m. High potential for future growth and adaptability. Retain, move, or replace.	YGVF - 8 Index Value 8 Retention potential - Short – Medium Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Medium-high potential for future growth and adaptability. Retain, move, or replace.	YGVP - 5 Index Value 5 Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Low-medium potential for future growth and adaptability. Retain, move, or replace.	YLVG - 4 Index Value 4 Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Medium potential for future growth and adaptability. Retain, move, or replace.	YLVF - 3 Index Value 3 Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m. Low-medium potential for future growth and adaptability. Retain, move, or replace.	YLVP - 1 Index Value 1 Retention potential - Likely to be removed immediately or retained for Short Term. Likely to provide minimal contribution to local amenity if height <5 m. Low potential for future growth and adaptability.
Mature (M)	MGVG - 10 Index Value 10 Retention potential - Medium - Long Term.	MGVF - 9 Index Value 9 Retention potential - Medium Term. Potential for longer with improved growing conditions.	MGVP - 6 Index Value 6 Retention potential - Short Term. Potential for longer with improved growing conditions.	MLVG - 5 Index Value 5 Retention potential - Short Term. Potential for longer with improved growing conditions.	MLVF - 4 Index Value 4 Retention potential - Short Term. Potential for longer with improved growing conditions.	MLVP - 2 Index Value 2 Retention potential - Likely to be removed immediately or retained for Short Term.
Over-mature (O)	OGVG - 6 Index Value 6 Retention potential - Medium - Long Term.	OGVF - 5 Index Value 5 Retention potential - Medium Term.	OGVP - 4 Index Value 4 Retention potential - Short Term.	OLVG - 3 Index Value 3 Retention potential - Short Term. Potential for longer with improved growing conditions.	OLVF - 2 Index Value 2 Retention potential - Short Term.	OLVP - 0 Index Value 0 Retention potential - Likely to be removed immediately or retained for Short Term.

Appendix C

Extract from Australian Standard AS4970 2009 Protection of trees on development sites

Section 3, Determining the tree protection zones of the selected trees.

3.1 Tree protection zone (TPZ)

"The tree protection zone (TPZ) is the principal 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 TPZ incorporates the structural root zone (SRZ) (refer to Clause 3.3.5)."

3.2 Determining the TPZ

The radius of the TPZ is calculated for each tree by multiplying its DBH x 12.

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

where

DBH = trunk diameter measured at 1.4 m above ground

Radius is measured from the centre of the stem at ground level.

Section 3, Determining the protection zones of the selected trees.

3.3.5 Structural root zone (SRZ)

"The SRZ is the area required for street stability. A larger area is required to maintain a viable tree. The SRZ only needs to be calculated when a major encroachment into a TPZ is proposed. Root investigation may provide more information on the extent of these roots."

Determining the SRZ

The radius of the TPZ is calculated for each tree by multiplying its DBH x 12.

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

where

D = trunk diameter, in metres, measured above the root buttress.

Note: The SRZ for trees with trunk diameters less than 0.15 m will be 1.5 m (see Figure 1).

Appendix D

Glossary

From

*Dictionary for Managing Trees in Urban Environments by Draper BD and Richards PA 2009,
Institute of Australian Consulting Arboriculturists (IACA), CSIRO Publishing, Collingwood, Victoria, Australia.*

Age of Trees

Age Most trees have a stable biomass for the major proportion of their life. The estimation of the age of a tree is based on the knowledge of the expected lifespan of the taxa *in situ* divided into three distinct stages of measurable biomass, when the exact age of the tree from its date of cultivation or planting is unknown and can be categorized as *Young*, *Mature* and *Over-mature* (British Standards 1991, p. 13, Harris *et al*, 2004, p. 262).

Young Tree aged less than <20% of life expectancy, *in situ*.

Mature Tree aged 20-80% of life expectancy, *in situ*.

Over-mature Tree aged greater than >80% of life expectancy, *in situ*, or *senescent* with or without reduced *vigour*, and declining gradually or rapidly but irreversibly to death.

Condition of Trees

Condition A tree's *crown form* and growth habit, as modified by its *environment* (aspect, suppression by other trees, soils), the *stability* and *viability* of the *root plate*, trunk and structural branches (first (1st) and possibly second (2nd) order branches), including structural defects such as wounds, cavities or hollows, *crooked* trunk or weak trunk/branch junctions and the effects of predation by pests and diseases. These may not be directly connected with *vigour*, and it is possible for a tree to be of *normal vigour* but in *poor condition*. Condition can be categorized as *Good Condition*, *Fair Condition*, *Poor Condition* and *Dead*.

Good Condition Tree is of good habit, with *crown form* not severely restricted for space and light, physically free from the adverse effects of *predation* by pests and diseases, obvious instability or structural weaknesses, fungal, bacterial or insect infestation and is expected to continue to live in much the same condition as at the time of inspection provided conditions around it for its basic survival do not alter greatly. This may be independent from or contributed to by *vigour*.

Fair Condition Tree is of good habit or *misshapen*, a form not severely restricted for space and light, has some physical indication of *decline* due to the early effects of *predation* by pests and diseases, fungal, bacterial, or insect infestation, or has suffered physical injury to itself that may be contributing to instability or structural weaknesses, or is faltering due to the modification of the *environment* essential for its basic survival. Such a tree may recover with remedial works where appropriate, or without intervention may stabilise or improve over time, or in response to the implementation of beneficial changes to its local environment. This may be independent from or contributed to by *vigour*.

Poor Condition Tree is of good habit or *misshapen*, a form that may be severely restricted for space and light, exhibits symptoms of advanced and *irreversible decline* such as fungal, or bacterial infestation, major die-back in the branch and *foliage crown*, *structural deterioration* from insect damage e.g. termite infestation, or storm damage or lightning strike, ring barking from borer activity in the trunk, root damage or instability of the tree, or damage from physical wounding impacts or abrasion, or from altered local environmental conditions and has been unable to adapt to such changes and may decline further to death regardless of remedial works or other modifications to the local *environment* that would normally be sufficient to provide for its basic survival if in *good* to *fair* condition. Deterioration physically, often characterised by a gradual and continuous reduction in *vigour* but may be independent of a change in *vigour*, but characterised by a proportionate increase in susceptibility to, and *predation* by pests and diseases against which the tree cannot be sustained. Such conditions may also be evident in trees of advanced senescence due to normal phenological processes, without modifications to the growing environment or physical damage having been inflicted upon the tree. This may be independent from or contributed to by *vigour*.

Senescent / Moribund Advanced state of decline, dying or nearly dead.

Dead Tree is no longer capable of performing any of the following processes or is exhibiting any of the following symptoms.

Processes

Photosynthesis via its foliage crown (as indicated by the presence of moist, green, or other coloured leaves).

Osmosis (the ability of the root system to take up water).

Turgidity (the ability of the plant to sustain moisture pressure in its cells).

Epicormic shoots or *epicormic strands* in Eucalypts (the production of new shoots as a response to stress, generated from latent or adventitious buds or from a *lignotuber*).

Symptoms

Permanent leaf loss.

Permanent wilting (the loss of turgidity which is marked by desiccation of stems leaves and roots).

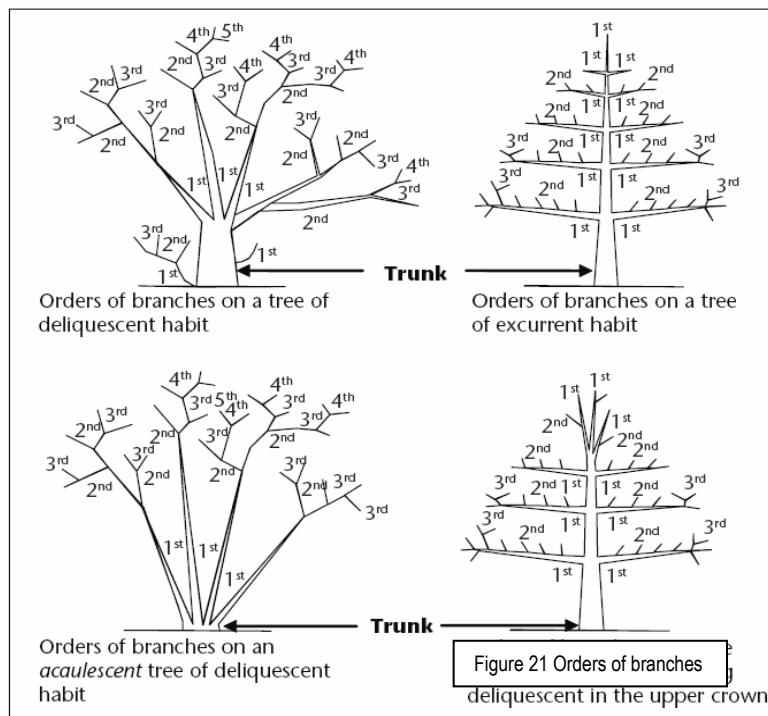
Abscission of the *epidermis* (bark desiccates and peels off to the beginning of the sapwood).

Removed No longer present, or tree not able to be located or having been cut down and retained on a site or having been taken away from a site prior to site inspection.

Branch

Branch An elongated woody structure arising initially from the trunk to support leaves, flowers, fruit, and the development of other branches. A branch may itself fork and continue to divide many times as successive *orders of branches* with the length and taper decreasing incrementally to the *outer extremity* of the crown. These may develop initially as a gradually tapering continuation of the *trunk* with minimal division as in a *young tree* or a tree of *excurrent habit*, or in a *sapling*, or may arise where the trunk terminates at or some distance from the *root crown*, dividing into *first order branches* to form and support the *foliage crown*. In an *acaulescent* tree, branches arise at or near the *root crown*. Similarly, branches may arise from a *sprout mass* from damaged *roots*, *branches*, or *trunk*.

Orders of branches – the marked divisions between successively smaller branches (James 2003, p. 168) commencing at the initial division where the trunk terminates on a *deliquescent* tree or from *lateral branches* on an *excurrent* tree. Successive branching is generally characterised by a gradual reduction in branch diameters at each division, and each gradation from the trunk can be categorised numerically, e.g., first order, second order, third order etc. (See Figure 21.)



Crown

Canopy 1. of multiple trees, the convergence, or merging in full or part, of the crowns of two or more trees due to their proximity, or where competition for light and space available in a forest environment is limited as each tree develops forming a continuous layer of foliage. 2. Used as a plural for crown. 3. Sometimes synonymously used for crown (USA).

Crown of an individual tree all the parts arising above the trunk where it terminates by its division forming branches, e.g., the branches, leaves, flowers, and fruit; or the total amount of foliage supported by the branches. The crown of any tree can be divided vertically into three sections and can be categorised as *lower crown*, *mid crown*, and *upper crown* (Figure 8). For a *leaning* tree these can be divided evenly into crown sections of one-third from the *base* to *apex*. The volume of a crown can be categorised as the *inner crown*, *outer crown*, and *outer extremity of crown*.

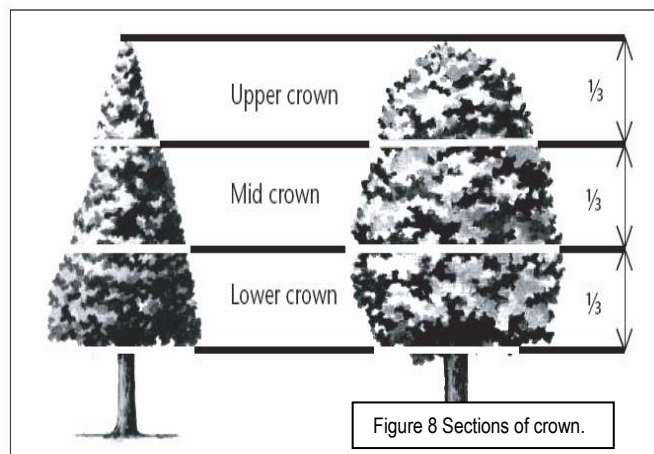
Lower crown - the *proximal* or lowest section of a crown when divided vertically into one-third ($\frac{1}{3}$) increments. See also *Crown*, *Mid crown*, and *Upper crown*.

Mid crown - the middle section of a crown when divided vertically into one-third ($\frac{1}{3}$) increments. See also *Crown*, *Lower crown*, and *Upper crown*.

Upper crown - the *distal* or highest section of a crown when divided vertically into one-third ($\frac{1}{3}$) increments. See also *Crown*, *Mid crown*, and *Lower crown*.

Crown Projection (CP) Area within the *dripline* or beneath the lateral extent of the *crown* (Geiger 2004, p. 2). See also *Crown spread* and *Dripline*.

Dripline A line formed around the edge of a tree by the lateral extent of the *crown*. Such a line may be evident on the ground with some trees when exposed soil is displaced by rain shed from the crown. See also *Crown Projection*.



Crown Form of Trees

Crown Form The shape of the crown of a tree as influenced by the availability or restriction of space and light, or other contributing factors within its growing environment. Crown Form may be determined for tree shape and habit generally as *Dominant*, *Codominant*, *Intermediate*, *Emergent*, *Forest* and *Suppressed*. The habit and shape of a *crown* may also be considered qualitatively and can be categorized as *Good Form* or *Poor Form*.

Good Form Tree of *typical* crown shape and habit with proportions representative of the taxa considering constraints such as origin e.g. indigenous or exotic but does not appear to have been adversely influenced in its development by environmental factors in situ such as *soil water* availability, prevailing wind, or cultural practices such as lopping and competition for space and light.

Poor Form Tree of *atypical* crown shape and habit with proportions not representative of the species considering constraints and appears to have been adversely influenced in its development by environmental factors in situ such as *soil water* availability, prevailing wind, cultural practices such as lopping and competition for space and light; causing it to be *misshapen* or disfigured by disease or vandalism.

Crown Form Codominant Crowns of trees restricted for space and light on one or more sides and receiving light primarily from above e.g., constrained by another tree/s or a building.

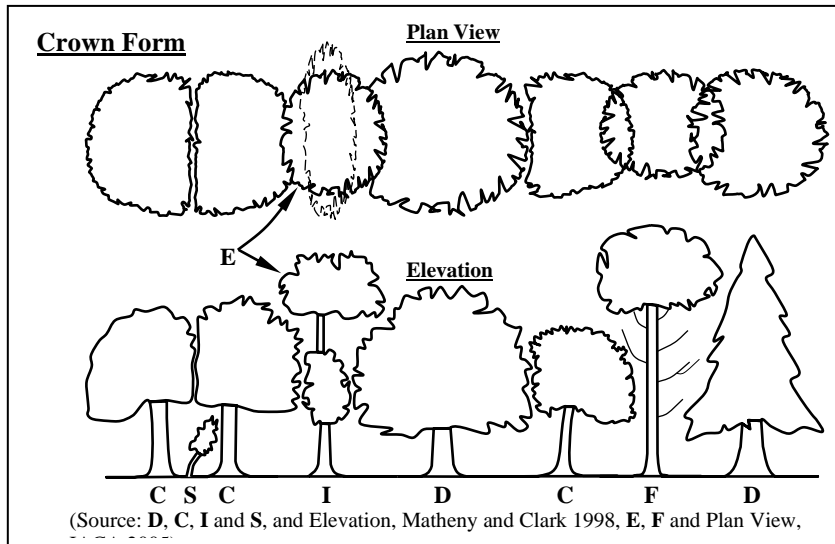
Crown Form Dominant Crowns of trees generally not restricted for space and light receiving light from above and all sides.

Crown Form Emergent Crowns of trees restricted for space on most sides receiving most light from above until the *upper crown* grows to protrude above the canopy in a stand or forest environment. Such trees may be *crown form dominant* or transitional from *crown form intermediate* to *crown form forest* asserting both *apical dominance* and *axillary dominance* once free of constraints for space and light.

Crown Form Forest Crowns of trees restricted for space and light except from above forming tall trees with narrow spreading crowns with foliage restricted generally to the top of the tree. The trunk is usually erect, straight and continuous, tapering gradually, crown often excurrent, with first order branches becoming structural, supporting the live crown concentrated towards the top of the tree, and below this point other first order branches arising radially with each *inferior* and usually temporary, divergent and ranging from horizontal to ascending, often with internodes exaggerated due to competition for space and light in the *lower crown*.

Crown Form Intermediate Crowns of trees restricted for space on most sides with light primarily from above and on some sides only.

Crown Form Suppressed Crowns of trees generally not restricted for space but restricted for light by being *overtopped* by other trees and occupying an understorey position in the canopy and growing slowly.



Deadwood

Deadwood Dead branches within a tree's crown and considered quantitatively as separate to *crown cover* and can be categorised as *Small Deadwood* and *Large Deadwood* according to diameter, length, and subsequent *risk* potential. The number of dead branches on a tree can be categorized as *Low Volume Deadwood*, *Medium Volume Deadwood* and *High-Volume Deadwood*. See also *Dieback*.

Deadwooding Removing of dead branches by *pruning*. Pruning may assist in the prevention of the spread of *decay* from *dieback* or for reasons of safety near an identifiable target.

Small Deadwood A dead branch up to 10mm diameter and usually <2 metres long, generally considered of low-risk potential.

Large Deadwood A dead branch >10mm diameter and usually >2 metres long, generally considered of high-risk potential.

High Volume Deadwood High Volume Deadwood Where >10 dead branches occur that may require *removal*.

Medium Volume Deadwood Where 5-10 dead branches occur that may require *removal*.

Low Volume Deadwood Where <5 dead branches occur that may require *removal*.

Dieback

Dieback The death of some areas of the *crown*. Symptoms are leaf drop, bare twigs, dead branches, and tree death, respectively. This can be caused by root damage, root disease, bacterial or fungal canker, severe bark damage, intensive grazing by insects, *abrupt changes* in growth conditions, drought, water-logging or over-maturity. Dieback often implies reduced *resistance*, *stress* or *decline* which may be temporary. Dieback can be categorized as *Low Volume Dieback*, *Medium Volume Dieback* and *High-Volume Dieback*.

High Volume Dieback Where >50% of the *crown cover* has died.

Medium Volume Dieback Where 10-50% of the *crown cover* has died.

Low Volume Dieback Where <10% of the *crown cover* has died. See also *Dieback*, *High Volume Dieback* and *Medium Volume Dieback*.

Epicormic shoots

Epicormic Shoots Juvenile shoots produced at branches or trunks from *epicormic strands* in some Eucalypts (Burrows 2002, pp. 111-131) or sprouts produced from dormant or latent buds concealed beneath the bark in some trees. Production can be triggered by fire, pruning, wounding, or root damage but may also be because of *stress* or *decline*. Epicormic shoots can be categorized as *Low Volume Epicormic Shoots*, *Medium Volume Epicormic Shoots* and *High Volume Epicormic Shoots*.

High Volume Epicormic Shoots Where >50% of the *crown cover* is comprised of live *epicormic shoots*.

Medium Volume Epicormic Shoots Where 10-50% of the *crown cover* is comprised of live *epicormic shoots*.

Low Volume Epicormic Shoots Where <10% of the *crown cover* is comprised of live *epicormic shoots*.

General Terms

Cavity A usually shallow void often localized initiated by a *wound* and subsequent *decay* within the trunk, branches, or roots, or beneath bark, and may be enclosed or have one or more opening.

Decay Process of degradation of wood by microorganisms (Australian Standard 2007, p. 6) and fungus.

Hazard The threat of danger to people or property from a tree or tree part resulting from changes in the physical condition, growing environment, or existing physical attributes of the tree, e.g., included bark, soil erosion, or thorns or poisonous parts, respectively.

Included bark 1. The bark on the inner side of the *branch union* or is within a concave *crotch* that is unable to be lost from the tree and accumulates or is trapped by *acutely divergent* branches forming a *compression fork*. 2. Growth of bark at the interface of two or more branches on the inner side of a branch union or in the crotch where each branch forms a branch collar, and the collars roll past one another without forming a graft where no one collar is able to subsume the other. The risk of failure is worsened in some taxa where branching is *acutely divergent* or *acutely convergent* and ascending or erect.

Hollow A large void initiated by a *wound* forming a *cavity* in the trunk, branches or roots and usually increased over time by *decay* or other contributing factors, e.g., fire, or fauna such as birds or insects e.g., ants or termites. A hollow can be categorized as an *Ascending Hollow* or a *Descending Hollow*.

Risk The random or potentially foreseeable possibility of an episode causing harm or damage.

Significant Important, weighty, or more than ordinary.

Significant Tree A tree considered important, weighty, or more than ordinary. Example: due to prominence of location, or *in situ*, or contribution as a component of the overall landscape for *amenity* or aesthetic qualities, or *curtilage* to structures, or importance due to uniqueness of taxa for species, subspecies, variety, *crown form*, or as an historical or cultural planting, or for age, or substantial dimensions, or habit, or as *remnant vegetation*, or habitat potential, or a rare or threatened species, or uncommon in cultivation, or of aboriginal cultural importance, or is a commemorative planting.

Substantial A tree with large dimensions or proportions in relation to its place in the landscape.

Sustainable Retention Index Value (SRIV) A visual tree assessment method to determine a qualitative and numerical rating for the viability of urban trees for development sites and management purposes, based on general tree and landscape assessment criteria using classes of *age*, *condition* and *vigour*. SRIV is for the professional manager of urban trees to consider the tree *in situ* with an assumed knowledge of the *taxon* and its growing environment. It is based on the physical attributes of the tree and its response to its environment considering its position in a matrix for age class, vigour class, condition class and its sustainable retention with regard to the safety of people or damage to property. This also factors the ability to retain the tree with remedial work or beneficial modifications to its growing environment or removal and replacement. SRIV is supplementary to the decision made by a tree management professional as to whether a tree is retained or removed (IACA - Institute of Australian Consulting Arboriculturists 2005).

Visual Tree Assessment (VTA) A visual inspection of a tree from the ground based on the principle that, when a tree exhibits apparently superfluous material in its shape, this represents repair structures to rectify *defects* or to reinforce weak areas in accordance with the *Axiom of Uniform Stress* (Mattheck & Breloer 1994, pp. 12-13, 145). Such assessments should only be undertaken by suitably competent practitioners.

Leaning Trees

Leaning A tree where the *trunk* grows or moves away from upright. A lean may occur anywhere along the *trunk* influenced by several contributing factors e.g., genetically predetermined characteristics, competition for space or light, prevailing winds, aspect, slope, or other factors. A *leaning* tree may maintain a *static lean* or display an increasingly *progressive lean* over time and may be hazardous and prone to *failure* and *collapse*. The degrees of leaning can be categorized as *Slightly Leaning*, *Moderately Leaning*, *Severely Leaning* and *Critically Leaning*.

Slightly Leaning A leaning tree where the trunk is growing at an angle within 0°-15° from upright.

Moderately Leaning A leaning tree where the trunk is growing at an angle within 15°-30° from upright.

Severely Leaning A leaning tree where the trunk is growing at an angle within 30°-45° from upright.

Critically Leaning A leaning tree where the trunk is growing at an angle greater than >45° from upright.

Progressively Leaning A tree where the degree of *leaning* appears to be increasing over time.

Static Leaning A leaning tree whose lean appears to have stabilized over time.

Periods of Time

Periods of Time The life span of a tree in the urban environment may often be reduced by the influences of encroachment and the dynamics of the environment and can be categorized as *Immediate*, *Short Term*, *Medium Term* and *Long Term*.

Immediately An *episode* or occurrence, likely to happen within a twenty-four (24) hour period, e.g., tree failure or collapse in full or part posing an imminent danger.

Short Term A period less than <1 – 15 years.

Medium Term A period 15 – 40 years.

Long Term A period greater than >40 years.

Roots

First Order Roots (FOR) Initial woody roots arising from the *root crown* at the base of the *trunk*, or as an *adventitious root mass* for structural support and *stability*. Woody roots may be buttressed and divided as a marked gradation, gradually tapering and continuous or tapering rapidly at a short distance from the root crown. Depending on soil type these roots may descend initially and not be evident at the root crown or become buried by changes in soil levels. Trees may develop 4-11 (Perry 1982, pp. 197-221), or more first order roots which may radiate from the trunk with a relatively even distribution, or be prominent on a particular aspect, dependent upon physical characteristics e.g. leaning trunk, *asymmetrical crown*; and constraints within the growing *environment* from topography e.g. slope, soil depth, rocky outcrops, exposure to predominant wind, soil moisture, depth of *water table* etc.

Orders of Roots The marked divisions between woody roots, commencing at the initial division from the base of the trunk, at the *root crown* where successive branching is generally characterised by a gradual reduction in root diameters and each gradation from the trunk and can be categorized numerically, e.g. *first order roots*, second order roots, third order roots etc. Roots may not always be evident at the *root crown*, and this may be dependent on species, age class and the growing environment. Palms at maturity may form an adventitious root mass.

Root Plate The entire root system of a tree generally occupying the top 300-600mm of soil including roots at or above ground and may extend laterally for distances exceeding twice the height of the tree (Perry 1982, pp. 197-221). Development and extent are dependent on water availability, soil type, *soil depth* and the physical characteristics of the surrounding landscape.

Root Crown Roots arising at the base of a trunk.

Zone of Rapid Taper The area in the *root plate* where the diameter of *structural roots* reduces substantially over a short distance from the *trunk*. Considered to be the minimum radial distance to provide structural support and *root plate* stability. See also *Structural Root Zone* (SRZ).

Structural Roots Roots supporting the infrastructure of the *root plate* providing strength and *stability* to the tree. Such roots may taper rapidly at short distances from the *root crown* or become large and woody as with gymnosperms and dicotyledonous angiosperms and are usually 1st and 2nd order roots or form an *adventitious root mass* in monocotyledonous angiosperms (palms). Such roots may be crossed and grafted and are usually contained within the area of *crown projection* or extend just beyond the *dripline*.

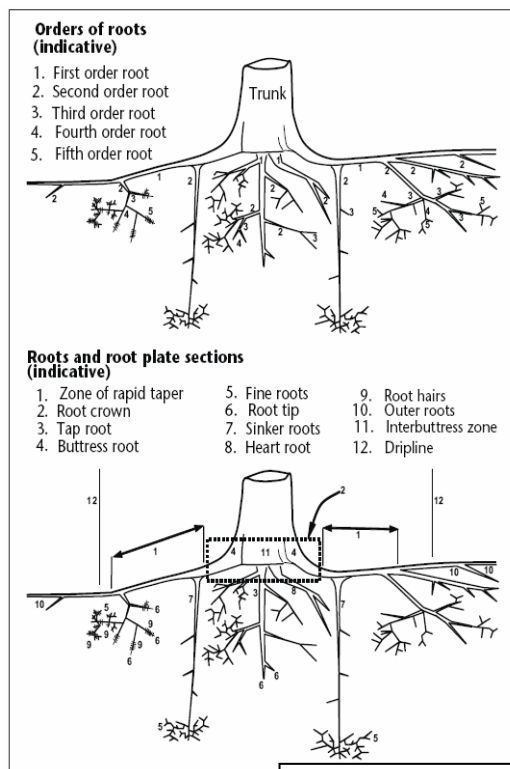


Figure 22 Orders of Roots.

Symmetry

Symmetry Balance within a *crown*, or *root plate*, above or below the *axis* of the trunk of branch and foliage, and root distribution respectively and can be categorized as *Asymmetrical* and *Symmetrical*.

Asymmetrical Imbalance within a crown, where there is an uneven distribution of branches and the foliage *crown* or *root plate* around the vertical *axis* of the trunk. This may be due to *Crown Form Codominant* or *Crown Form Suppressed* as a result of natural restrictions e.g., from buildings, or from competition for space and light with other trees, or from exposure to wind, or artificially caused by pruning for clearance of roads, buildings or power lines. An example of an expression of this may be, crown asymmetrical, bias to west.

Symmetrical Balance within a crown, where there is an even distribution of branches and the foliage *crown* around the vertical *axis* of the trunk. This usually applies to trees of *Crown Form Dominant* or *Crown Form Forest*. An example of an expression of this may be crown symmetrical.

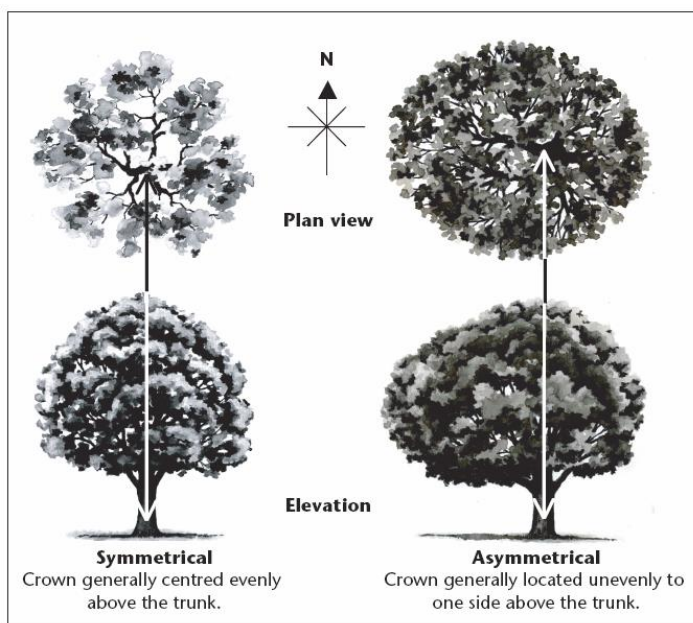


Figure 27 Symmetry within crown

Trunk

Trunk A single stem extending from the *root crown* to support or elevate the *crown*, terminating where it divides into separate *stems* forming *first order branches*. A trunk may be evident at or near ground or be absent in *acaulescent* trees of *deliquescent* habit or may be continuous in trees of *excurrent* habit. The trunk of any *caulescent* tree can be divided vertically into three (3) sections and can be categorized as *Lower Trunk*, *Mid Trunk* and *Upper Trunk*. For a *leaning* tree these may be divided evenly into sections of one third along the trunk.

Acaulescent A *trunkless* tree or tree growth forming a very short *trunk*. See also *Caulescent*. (See Fig. 21)

Caulescent Tree grows to form a *trunk*. See also *Acaulescent*. (See Fig. 21)

Lower trunk Lowest, or *proximal* section of a trunk when divided into one-third ($\frac{1}{3}$) increments along its *axis*. See also *Trunk*, *Mid trunk*, and *Upper trunk*.

Mid trunk A middle section of a trunk when divided into one-third ($\frac{1}{3}$) increments along its *axis*. See also *Trunk*, *Lower trunk*, and *Upper trunk*.

Upper trunk Highest, or *distal* section of a trunk when divided into one-third ($\frac{1}{3}$) increments along its *axis*. See also *Trunk*, *Lower trunk*, and *Mid trunk*.

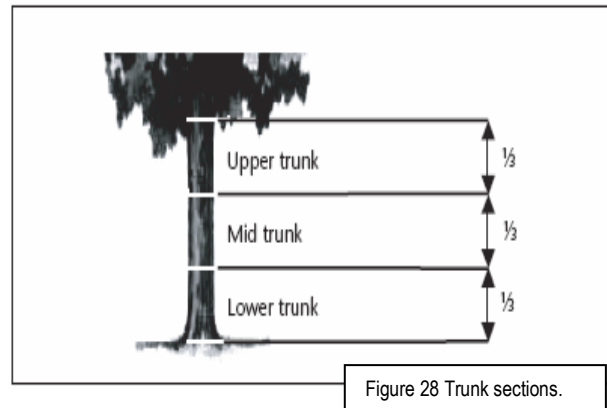


Figure 28 Trunk sections.

Diameter at Breast Height (DBH) Measurement of trunk width calculated at a given distance above ground from the base of the tree often measured at 1.4 m. The trunk of a tree is usually not a circle when viewed in cross section, due to the presence of *reaction wood* or *adaptive wood*, therefore an average diameter is determined with a *diameter tape* or by recording the trunk along its narrowest and widest axes, adding the two dimensions together and dividing them by 2 to record an average and allowing the orientation of the longest axis of the trunk to also be recorded. Where a tree is growing on a lean the distance along the top of the trunk is measured to 1.4m and the diameter then recorded from that point perpendicular to the edge of the trunk. Where a *leaning* trunk is *crooked* a vertical distance of 1.4m is measured from the ground. Where a tree branches from a trunk that is less than 1.4m above ground, the trunk diameter is recorded perpendicular to the length of the *trunk* from the point immediately below the base of the flange of the *branch collar* extending the furthest down the trunk, and the distance of this point above ground recorded as *trunk length*. Where a tree is located on sloping ground the DBH should be measured halfway along the side of the tree to average out the angle of slope. Where a tree is *acaulescent* or *trunkless* branching at or near ground an average diameter is determined by recording the radial extent of the trunk at or near ground and noting where the measurement was recorded e.g., at ground.

Vigour

Vigour Ability of a tree to sustain its life processes. This is independent of the *condition* of a tree but may impact upon it. Vigour can appear to alter rapidly with change of seasons (seasonality) e.g., *dormant*, *deciduous*, or *semi-deciduous* trees. Vigour can be categorized as *Normal Vigour*, *High Vigour*, *Low Vigour* and *Dormant Tree Vigour*.

Normal Vigour Ability of a tree to maintain and sustain its life processes. This may be evident by the *typical* growth of leaves, *crown cover* and *crown density*, branches, roots and trunk and *resistance to predation*. This is independent of the *condition* of a tree but may impact upon it, and especially the ability of a tree to sustain itself against predation.

High Vigour *Accelerated growth* of a tree due to incidental or deliberate artificial changes to its growing *environment* that are seemingly beneficial, but may result in *premature aging* or failure if the favourable conditions cease, or promote *prolonged senescence* if the favourable conditions remain, e.g. water from a leaking pipe; water and nutrients from a leaking or disrupted sewer pipe; nutrients from animal waste, a tree growing next to a chicken coop, or a stock feed lot, or a regularly used stockyard; a tree subject to a stringent watering and fertilising program; or some trees may achieve an extended lifespan from continuous *pollarding* practices over the life of the tree.

Low Vigour Reduced the ability of a tree to sustain its life processes. This may be evident by the *atypical* growth of leaves, reduced *crown cover* and reduced *crown density*, branches, roots and trunk, and a deterioration of their functions with reduced *resistance to predation*. This is independent of the *condition* of a tree but may impact upon it, and especially the ability of a tree to sustain itself against predation.

Appendix E – Survey of Subject Tree/s

This report has relied upon the following plan/s and documents which have been reproduced from electronic transmission and no longer to original scale. The trees which are the subject of this report are marked on the plans in the following appendices and are numbered as listed below.

Redgum Tree / Stand No.	Genus and species	Common name	Recommendation
2	<i>Eucalyptus saligna</i>	Sydney Blue Gum	Retain and protect. – <i>Street tree</i> .
3	<i>Eucalyptus saligna</i>	Sydney Blue Gum	Retain and protect. – <i>Street tree</i> .
4	<i>Camellia sasanqua</i>	Camellia	Retain and protect. – <i>Street tree</i> .
5	<i>Afrocarpus falcatus</i>	Yellowwood	Retain and protect.
6	<i>Eucalyptus saligna</i>	Sydney Blue Gum	Retain and protect.
7	<i>Eucalyptus saligna</i>	Sydney Blue Gum	Retain and protect.
8	<i>Eucalyptus saligna</i>	Sydney Blue Gum	Retain and protect.
9	<i>Glochidion ferdinandi</i>	Cheese Tree	Retain and protect.

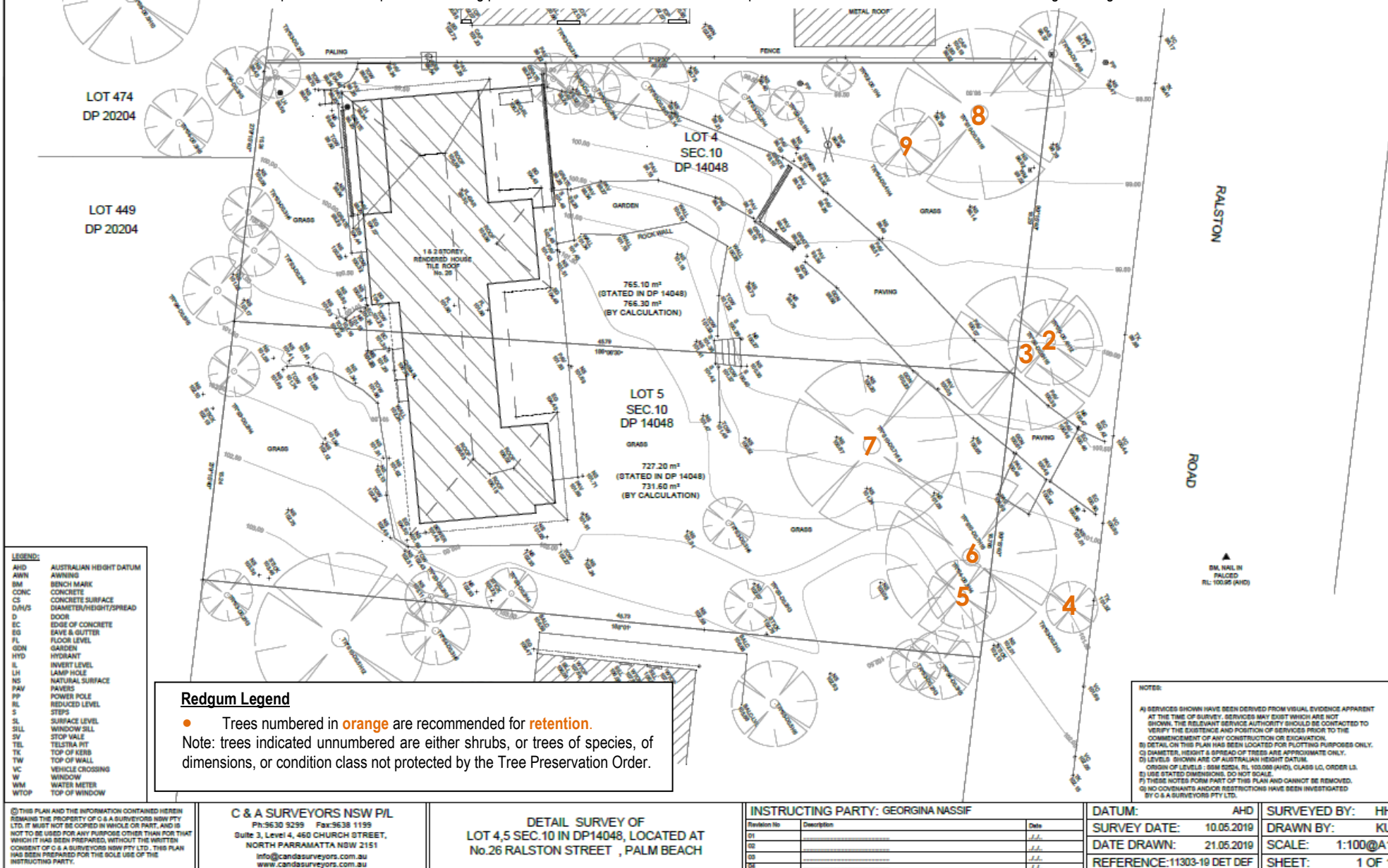
Table 2.0 This table only applies to trees being retained. Tree Protection Zone fencing locations as measured from the centre of each tree and the recommended distances for the side closest to the building construction works e.g., excavation (see explanatory notes below). Tree Protection Zone fences and setbacks where applicable are indicated in Appendix F.

1. Redgum Tree No.	2. Structural Root Zone SRZ (DARB) From centre of trunk (COT) Diameter Above Root Buttress AS4970 2009 Section 3, 3.3.5 (see Appendix D) where applicable (Minimum 1.5 metres)	3. Trunk Diameter at Breast Height DBH 1.4m above ground, AS4970 2009, or mm or m above ground where indicated. # = average. g = ground	4. Tree Protection Zone (TPZ) = 12 x DBH From centre of trunk (COT) in metres AS4970 2009 Section 3 (see Appendix D) (Minimum 2.0 metres)	5. Distance of tree protection fence/works on the side closest to building construction ² , in metres by Redgum Horticultural.
2	2.3	400	4.8	2.8 (15.2% existing driveway- retaining wall & cut) 2.7 & 2.0 (approved pit & pipe)
3	2.7	600	7.2	1.3 (38.6% existing driveway- retaining wall & cut) 1.1 & 0.7 (approved pit & pipe)
4	1.7	200# @g	2.4	2.4
5	2.3	400	4.8	2.7 (11.1% pathway to west)
6	2.8	700	8.4	0.6 (32.8% pathway to west) 6.0 (8.8% existing driveway) 5.1 (approved pit and pipe to south)
7	2.8	700	8.4	4.5 (15.5% - 1-1.6m cut to west) 4.5 & 5.5 (12.0% pathway and retaining wall to east - upslope)
8	2.8	700	8.4	4.4 (14.5% pathway to east) 2.4 (approved pipe to west) 3.0 (approved pipe to north) 4.1 (approved pit to northwest)
9	2.3	400	4.8	2.5 (18.4% pathway to east) 3.8 (approved pipe to west)
Descriptors for modified setbacks as per above table. 1 Special condition apply to protect the roots of trees generally. 2 Additional protective fencing information is detailed in attached plans. 3 Acceptable due to the good relative tolerance of the species to development impacts. 4 Range of setbacks for the trees at each end of a linear stand are to be calculated if required. 5 Acceptable as fence located at a substantial distance beyond dripline or may also include the location of a smaller tree in proximity to a larger tree to be retained and the smaller tree being protected well within the protective fencing for that larger tree. 6 Acceptable due to additional special protection works, see Section 5.0 for this tree. 7 Acceptable as pre-existing site conditions were conducive to having restricted the development of root growth in this direction. 8 Street trees with protective fencing of minimal width to allow for pedestrian access along road reserve. 9 Acceptable as tree transplanted reducing the area of the root zone. 10 Acceptable as not effected by development works. 11 Young trees not expected to have established a substantially expansive root system and able to re-establish or modify growth to be sustainable due to age and good vigour. 12 Set back prescribed by the consent authority.			13 Acceptable as tree growing on a lean and encroachment on compression wood side where root growth is of reduced structural importance. 14 Acceptable as root mapping has indicated extent of structural woody roots with a diameter of 20 mm or more. 15 Acceptable as a specimen of palm taxa tolerant of encroachment. 16 Acceptable as excavation on down slope or across slope side of tree. 17 Acceptable as encroachment into growing area below ground minor, with one corner of building or excavation works extending to within the radius of the dripline. 18 Acceptable as encroachment by pier, including screw piles, with minimal disturbance. 19 Acceptable as encroachment above grade without excavation or sub-base compaction. 20 Acceptable as located within 0.5 m from edge of dripline. 21 Acceptable as encroachment with gap graded fill that can accommodate gaseous exchange between roots/soil and the atmosphere and ongoing root growth. 22 Minimum setback 2 m, AS4970 (2009) section 3, 3.2. 23 Maximum setback 15 m, AS4970 (2009) section 3, 3.2. 24 Tree is a palm, other monocot, cycad, or tree fern TPZ is to be 1 m outside crown projection AS4970 (2009) section 3, 3.2. 25 Minimum Structural Root Zone (SRZ) for trees less than 0.15 m diameter is 1.5 m, AS4970 (2009) section 3, 3.5.	
Explanatory notes for Table 2.0. This table is based upon Australian Standard AS4970 2009 <i>Protection of trees on development sites</i> , Section 3 Determining the protection zone of the selected trees (see Appendix D), where the approved building works should be no closer, including excavation, than the dimensions stated above. "3.3 Variations to the TPZ" 3.3.2 Minor Encroachment - If the encroachment is less than 10% of the area of the TPZ and is outside the SRZ, detailed root investigations should not be required. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ.			3.3.3 Major Encroachment <i>If the encroachment is greater than 10% of the area of the TPZ or inside the SRZ the project arborist must demonstrate that the tree(s) would remain viable. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ."</i>	

Appendix E

Site Plan A - Survey of Subject Trees

This report has relied upon the following plan/s and documents which have been reproduced from electronic transmission and no longer to original scale.



Appendix F

Site Plan - Survey of Subject Trees to be Retained & Tree Protection Zones

This report has relied upon the following plan/s and documents which has been reproduced from electronic transmission and no longer to original scale.
All Tree Protection Zones are to be measured on site.

