

Arboricultural Assessment Report



Prepared 31st January 2017

Site Location

Urban Block 5UB5E
130-150 Bunnerong Road
Pagewood, NSW 2035

Client

Meriton Group

DISCLAIMER

The author and Tree & Landscape Consultants 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.

Peter Richards

Tree & Landscape Consultants

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1. INTRODUCTION

This report has been prepared by Tree & Landscape Consultants for Meriton Group. The site was inspected by the author and the subject trees and their general growing environment evaluated on the 12th March, 19th December 2016 & 23rd January 2017.

All of the trees in this area of the site have been previously assessed and as a result of the latest inspection 13 trees have been identified as landscape elements requiring retention. The location of the trees to be retained is indicated in Appendix F and this report details recommendations for their retention.

2.0 AIMS & OBJECTIVES

Aims

Detail the condition of the trees on the site or on adjoining sites where such trees may be affected by the proposed works, by assessment of individual specimens or stands, and indicate remedial works or protection measures for their retention in a safe and healthy condition, or a condition not less than that 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 able to be applied, and will consider the location and condition of the trees in relation to the proposed building works, or recommend removal and replacement where appropriate.

Provide as an outcome of the assessment, the following: a description of the trees, observations made, discussion of the effects the location of the proposed building works may have on the trees, and make recommendations required for remedial or other works to the trees, if and where appropriate.

Determine from the assessment a description of the works or measures required to ameliorate the impact upon the trees to be retained, by the proposed 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.

Objectives

Assess the condition of the subject trees.

Provide recommendations for management of the subject trees.

3. METHODOLOGY

- 3.1 The method of assessment of tree/s is applied from the ongoing knowledge and development of the author and considers but is not confined to:
- Tree health and subsequent stability, both long and short term
 - Sustainable Retention Index Value (S.R.I.V.)© IACA 2009)
 - Amenity values
 - Significance
- 3.2 This assessment is undertaken using a 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.
- 3.3 In this report the dimensions of the tree recorded by the author for the trunk *diameter at breast height* (DBH) measurement is calculated at 1.4m above ground from the base of the tree. Where a tree is trunkless or branches at or near ground such as a mallee formed tree, an average diameter is determined by recording the radial extent of the stem mass at its narrowest and widest dimensions, adding the two dimensions together and dividing them by 2 to record an average.
- 3.4 Crown spreads are expressed as length by breadth measurements to accurately record their dimensions. Where appropriate, *crown spread orientation* is described along the length of the crown spread e.g. North/South, or as *radial* if the crown is distributed at an approximately even radius from the trunk e.g. 6x6m.
- 3.5 The Australian Standard AS 4970-2009 “Protection of trees on development sites, where applicable is applied to trees to be retained in this report as a point of reference and guide for the recommended minimum clearances from the centre of tree trunks to development works and is applied as a generalised benchmark and the distances may be increased or decreased by the author as a result of other factors providing mitigating circumstances or constraints as indicated by but not restricted to the following:
- *Tolerance of individual species to disturbance,*
 - *Geology e.g. physical barriers in soil, floaters, bedrock to surface*
 - *Topography e.g. slope, drainage,*
 - *Soil e.g. depth, drainage, fertility, structure,*
 - *Microclimate e.g. due to landform, exposure to dominant wind,*
 - *Engineering e.g. techniques to ameliorate impact on trees such as structural soil, lateral boring,*
 - *Construction e.g. techniques to ameliorate impact on trees such as pier and beam, bridge footings, suspended slabs*
 - *Arboriculture e.g. exploration trenches to map location of roots,*
 - *Physical limitations - existing modifications to the environment and any impact to tree/s by development e.g. property boundaries, road reserves, previous impact by excavation in other directions, soil level changes by cutting or filling, existing landscaping works within close proximity, modified drainage patterns.*

4. TREE ASSESSMENTS

Table 1

	Genus & species Common Name	Age S-Sapling Y-Young M-Mature O-Overmature	Condition D-Dead P-Poor F-Fair G-Good	Pest & Diseases N = No or Y = Yes (If yes see comments)	Branch Bark Included N = No or Y = Yes (If yes see comments)	Canopy Orientation A-Asymmetrical Sy-Symmetrical N.S.E.W. Orientation	DBH (mm) @ 1.4 metres from ground	Height/Spread (m)	Vigour L-Low G-Good A- Abnormal	Trunk Lean X-Straight or Slightly Leaning A-Acaulescent M-Moderate S-Severe C-Critical	SRIV Age,Vigour,Condi on/ Index Rating (See Appendix A)
27	Eucalyptus microcorys <i>Tallowwood</i>	M	F	N	N	Sy	450	17 6x6	G	X	MGVF9
Comments: Indigenous evergreen specimen appearing free of insect predation or disease. Crown co-dominant with adjoining Tallowwood.											
28	Eucalyptus microcorys <i>Tallowwood</i>	M	F	N	N	Sy	450	17 6x6	G	X	MGVF9
Comments: Indigenous evergreen specimen appearing free of insect predation or disease. Crown co-dominant with adjoining Tallowwood.											
29	Eucalyptus microcorys <i>Tallowwood</i>	M	F	N	N	Sy	450	17 6x6	G	X	MGVF9
Comments: Indigenous evergreen specimen appearing free of insect predation or disease. Crown co-dominant with adjoining Tallowwood.											
30	Eucalyptus punctata <i>Grey Gum</i>	M	P	N	N	Sy	500	18 5x5	L	X	MLVP2
Comments: Indigenous evergreen supporting dieback of lower order leaders throughout the crown.											
47	Eucalyptus botryoides <i>Bangalay</i>	M	P	N	N	Sy	350	15 7x7	G	A	MGVP6
Comments: Indigenous evergreen specimen appearing free of insect predation or disease. Dieback of lower order leaders is evident.											
50	Eucalyptus botryoides <i>Bangalay</i>	M	F	N	N	Sy	350	16 7x7	G	X	MGVF9
Comments: Indigenous evergreen specimen appearing free of insect predation or disease. Dieback throughout the crown evident.											
51	Eucalyptus microcorys <i>Tallowwood</i>	M	F	N	N	Sy	500	17 8x8	G	X	MGVF9
Comments: Indigenous evergreen specimen appearing free of insect predation or disease.											
52	Eucalyptus microcorys <i>Tallowwood</i>	M	F	N	N	Sy	350	16 7x7	G	X	MGVF9
Comments: Indigenous evergreen specimen appearing free of insect predation or disease.											
54	Eucalyptus microcorys <i>Tallowwood</i>	M	F	N	N	Sy	480	15 6x6	G	X	MGVF9
Comments: Indigenous evergreen specimen appearing free of insect predation or disease.											
55	Eucalyptus microcorys <i>Tallowwood</i>	M	F	N	N	Sy	300	9 6x6	G	X	MGVF9
Comments: Indigenous evergreen specimen with crown suppressed.											
56	Eucalyptus microcorys <i>Tallowwood</i>	M	F	N	N	Sy	300	16 6x6	G	X	MGVF9
Comments: Indigenous evergreen specimen appearing free of insect predation or disease.											
57	Eucalyptus microcorys <i>Tallowwood</i>	M	F	N	N	Sy	700	17 6x6	G	X	MGVF9
Comments: Indigenous evergreen specimen appearing free of insect predation or disease.											
58	Eucalyptus microcorys <i>Tallowwood</i>	M	F	N	N	Sy	100	6 6x6	G	X	MGVF9
Comments: Indigenous evergreen specimen appearing free of insect predation or disease.											

Table 2 Setbacks for Tree Protection Zones (Trees to be retained)

A	B	C	D	E	F	G	H
Tree No.	Trunk Diameter (1.4m above root buttress in mm)	Trunk Diameter (above root buttress)	Tree Vigour L = Low G= Good A= Abnormal	Age of Tree Y = Young M = Mature O = Over-Mature (Senescent)	Calculated Structural Root Zone (SRZ) (radius in meters)	Distance of Tree Protection Zone (TPZ) (radius in meters)	Recommended Distance of Tree Protection Fence/Zone (radius in meters)
27	450	470	G	M	2.5	5.4	4.86
28	450	470	G	M	2.5	5.4	4.86
29	450	470	G	M	2.5	5.4	4.86
30	500	520	G	M	2.6	6	5.4
47	350	370	G	M	2.2	4.2	3.78
50	350	370	G	M	2.2	4.2	3.78
51	500	520	G	M	2.6	6	5.4
52	350	370	G	M	2.2	4.2	3.78
54	480	500	G	M	2.5	5.76	5.184
55	300	320	G	M	2.1	3.6	3.24
56	300	320	G	M	2.1	3.6	3.24
57	700	720	G	M	2.9	8.4	7.56
58	100	120	G	M	1.5	1.5	1.35

5. DISCUSSION

As part of the previous assessment all trees within this area of the land were proposed for removal to be replaced with new trees, shrubs and ground covers as part of landscape works for the development application for Urban Block UB5E.

As a result of the latest site inspection with the LGA “13” trees have been identified for retention located along Westfield Drive as level changes along this frontage could be kept at a minimum to reduce potential impacts upon the subject trees with recommendations for their retention provided. Other trees adjoining Westfield Drive to be removed (*See Appendix F-cont.*) numbered, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 53, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75 & 76 are predominately trees of either of smaller dimensions or She-Oaks

Removal of the trees along the Bunnerong Road frontage numbered 3-26 will be required to construct the buildings in accordance with the masterplan approval. The most substantial size trees along this frontage are numbered 22,23 & 24 (*See Appendix F-cont.- tree locations all trees*) as they are directly affected by level changes, pedestrian entrances and suitable location for the crane loading platform (*Westfield Drive is a private road and can't be utilised for crane or construction access*).

A majority of the trees along Bunnerong Road & Westfield Drive to be removed are either in poor condition particularly numbers 3,18,20,21,23,26,30,43,44,45,46,47,50,60,61,62, or are She-Oaks (approximately 40) that dominate the area. She-Oaks release chemicals from foliage, roots & stems that inhibits the growth of surrounding vegetation (*Allelopathy*). She - Oaks drop excess foliage and fruit which is hard and slippery for pedestrians and their retention would only be problematic for the establishment of new landscape. The excess foliage produced by She-Oaks blocks up gutters and drains creating water to flow back into roofing causing damage to building structures, blocking up storm-water drainage systems creating unnecessary expensive maintenance of Council infrastructure. Also the blockage of Council stormwater can create back flows into the development which cannot be soaked up naturally, potentially damaging property.

The removal of trees associated with this stage of the development is to be compensated for through the introduction of new plantings of trees shrubs and ground covers as part of final landscape works for Urban Block UB5E to provide replacement landscape elements and ongoing amenity for the immediate and broader community.

6. RECOMMENDATIONS

- a. That trees 27,28,29,30,47,48,49,50,51,52,54,55,56,57 & 58 be retained and protected.
- b. Physical protection for the trees is to be achieved through the erection of Tree Protection Zone (TPZ) fencing in accordance with **Appendix E** and the Australian Standard AS 4970-2009 “Protection of trees on development sites at setbacks identified within table 2 to be erected within the development site boundary only prior to commencement of any site works.
- c. If any access is required near to trees to be retained, ground protection is to be established internal to the site to prevent root damage and soil compaction near to the trees during demolition and construction within the prescribed TPZs (*See table 2 and Appendix G*) and is to include a permeable membrane such as geotextile fabric

beneath a layer of mulch or crushed rock below rumble boards where appropriate. These measures may be applied to root zones beyond the TPZ if required.

- d. That removal works for trees , 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 53, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75 & 76 be undertaken by a qualified Arborist 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 and in accordance with Work Cover NSW 2007, Code of Practice Tree Works.

A handwritten signature in black ink, appearing to read 'Peter Richards', with a stylized, flowing script.

Peter Richards

Tree & Landscape Consultants

Appendix A

Matrix - Sustainable Retention Index Value (S.R.I.V.)©

Developed by IACA – Institute of Australian Consulting Arboriculturists www.iaca.org.au (2009)

To be used with the values defined in the Glossary.
An Index value as indicated where ten (10) is the highest value.

Age Class	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 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 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 unlikely to assist condition, 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)	Index Value 9 Retention potential - Long Term. Likely to provide minimal contribution to local amenity if height <5m. High potential for future growth and adaptability. Retain, move or replace.	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 <5m. Medium-high potential for future growth and adaptability. Retain, move or replace.	Index Value 5 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.	Index Value 4 Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m. Medium potential for future growth and adaptability. Retain, move or replace.	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.	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 <5m. Low potential for future growth and adaptability.
Mature (M)	Index Value 10 Retention potential - Medium - Long Term.	Index Value 9 Retention potential - Medium Term. Potential for longer with improved growing conditions.	Index Value 6 Retention potential - Short Term. Potential for longer with improved growing conditions.	Index Value 5 Retention potential - Short Term. Potential for longer with improved growing conditions.	Index Value 4 Retention potential - Short Term. Potential for longer with improved growing conditions.	Index Value 2 Retention potential - Likely to be removed immediately or retained for Short Term.
Over-mature (O)	Index Value 6 Retention potential - Medium - Long Term.	Index Value 5 Retention potential - Medium Term.	Index Value 4 Retention potential - Short Term.	Index Value 3 Retention potential - Short Term. Potential for longer with improved growing conditions.	Index Value 2 Retention potential - Short Term.	Index Value 0 Retention potential - Likely to be removed immediately or retained for Short Term.

Appendix B

Definitions & Terminology

From
Dictionary for Managing Trees in Urban Environments
Institute of Australian Consulting Arboriculturists (IACA) 2009.

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*.

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.

Description of Tree Dimensions

Height The distance measured vertically between the horizontal plane at the lowest point at the base of a tree, which is immediately above ground, and the horizontal plane immediately above the uppermost point of a tree.

Spread The furthest expanse of the crown when measured horizontally from one side of the tree to the other, generally through the centre of the trunk. Where the crown is not circular a measurement should be an average of the narrowest and widest diameters and this is dependent upon crown form and to a lesser extent its symmetry.

Crown Cover Percent of the homogenous distribution of foliage across the entire crown based upon that expected for a specimen of that species in good condition and of normal vigour, depending on form in situ, e.g. this may be influenced by crown die-back, proximity to other trees or structures, moisture stress, or overshadowing.

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 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 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.

Dormant Tree Vigour Determined by existing turgidity in lowest order branches in the outer extremity of the crown, with good bud set and formation, and where the last extension growth is distinct from those most recently preceding it, evident by bud scale scars. Normal vigour during dormancy is achieved when such growth is evident on a majority of branches throughout the crown.

Poor Vigour See low vigour

Good Vigour See Normal Vigour

Age of Trees

Age of Trees 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. These increments are Young, Mature and Overmature.

Young Tree aged less than 20% of life expectancy.

Mature Tree aged 20-80% of life expectancy.

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

Sapling A young tree, early in its development with small dimensions.

Senescent Advanced old age, over-mature.

General Terms

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, 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.

Excurrent Tree where the crown is comprised of one (1) dominant first order structural branch which is usually an extension of the trunk, erect, straight and continuous, tapering gradually, with the main *axis* clear from base to apex, e.g. *Araucaria heterophylla* - Norfolk Island Pine. Note: some tree species of *typical* excurrent habit may be altered to deliquescent by physical damage of the *apical meristem*, or from top lopping, or from the propagation of inferior quality stock. However, *formative pruning* may be able to correct a *crown* to excurrent if undertaken when a tree is *young*.

Sustainable Retention Index Value (SRIV) A visual method of rating the viability of urban trees for development sites and management, based on general tree and landscape assessment criteria. SRIV© is for the professional manager of urban trees to consider the tree in situ with an assumed knowledge of the taxa and its growing environment and is based on the physical attributes of the tree and its response to its environment considering its age class, vigour class, condition class and its sustainable retention with regard to the safety of people or damage to property and the ability to retain the tree with remedial work or beneficial modifications to its growing environment or removal and replacement. (IACA 2005)

Crown Spread Orientation Direction of the *axis* of *crown spread* which can be categorized as *Orientation Radial* and *Orientation Non-radial*.

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 at half way 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.

Structural Root Zone (SRZ) The minimal area around the base of a tree, generally circular, required for its *stability* in the ground. The section of *root plate* within this area and subsequent soil cohesion necessary to hold the tree upright against *wind throw*, therefore the entire depth of the *root zone* must be included.

Appendix C

Extract from Australian Standard AS 4970-2009

“Protection of trees on development sites

“Calculating the Structural Root Zone”

STANDARDS AUSTRALIA

Amendment No. 1
to
AS 4970—2009
Protection of trees on development sites

CORRECTION

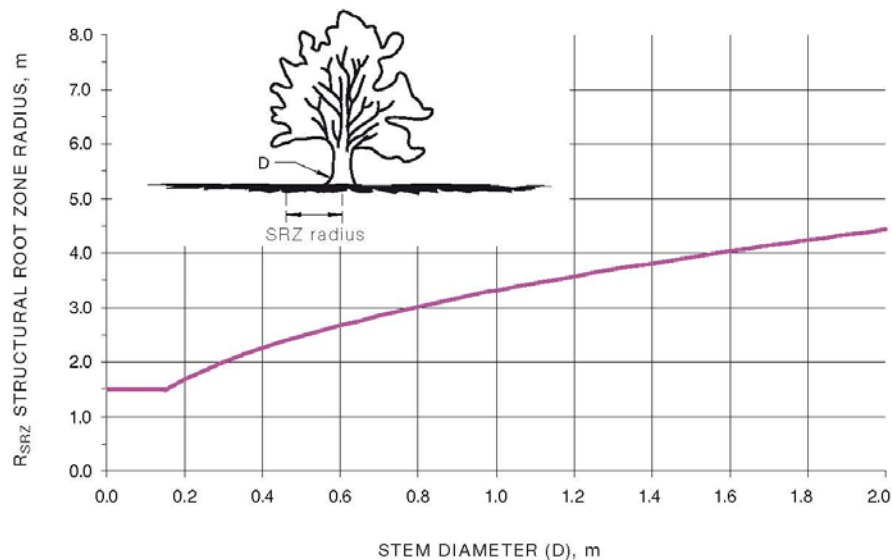
The 2009 edition of AS 4970 is amended as follows; the amendment should be inserted in the appropriate place.

SUMMARY: This Amendment applies to Figure 1.

Published on 26 March 2010.

Page 13, Figure 1

Delete Figure 1 and insert the following figure:



The curve can be expressed by the following formula:
 $R_{SRZ} = (D \times 50)^{0.42} \times 0.64$

NOTES:

- 1 R_{SRZ} is the calculated structural root zone radius (SRZ radius).
- 2 D is the stem diameter measured immediately above root buttress.
- 3 The R_{SRZ} for trees less than 0.15 m diameter is 1.5 m.
- 4 The R_{SRZ} formula and graph do not apply to palms, other monocots, cycads and tree ferns.
- 5 This does not apply to trees with an asymmetrical root plate.

FIGURE 1 STRUCTURAL ROOT ZONE CALCULATION

Appendix D

TREE PROTECTION GUIDELINES

1.1 GENERAL NOTES

- 1.1.1 The application of measures for the protection of trees on development sites is determined by the species characteristics, and the existing physical constraints of the growing environment on site both above and below ground.
- 1.1.2 This report considers where applicable, Australian Standard AS 4970-2009 "Protection of trees on development sites." as a guide for the management of trees on development sites.
- 1.1.3 This report applies the ***Tree Protection Zone - Standard Procedure*** as developed and continually improved by the Consultant Arboriculturist for the effective protection of trees on development sites over time. (See Appendix E) Additional or alternative conditions are applied where it is deemed appropriate by the author for the protection of trees. Such additional or alternative conditions may be founded upon professional judgement based on:
- the experience of the Consulting Arboriculturist
 - scientific research
 - new technology
 - industry best practice
 - consideration of the individual tree species and its relative tolerance to development impacts
 - the individual or cumulative factors present or proposed to impact upon the growing environment essential for the trees' survival

1.2 PRECAUTIONS TO PROTECT TREES

1.2.1 *Demolition of landscape structures*

The demolition of walls, driveways, paths etc. near trees to be retained should be undertaken manually using hand tools. Use of light machinery can occur by utilising the driveway or a paved area as a stable platform to prevent soil compaction. The volume of space previously occupied by the driveway or paved area must be replaced with local top soil from the site or otherwise a loamy sand, to replace the mass 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.

1.2.2 *Demolition of existing buildings*

The demolition of the 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 100mm layer of Eucalyptus 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. similar to ramps used to load vehicles onto the backs of trucks. Trunks of trees are to be protected from vehicular damage as per appendix E section 4 of this report.

1.2.3 *Removal of trees near to trees to be retained*

Removal of a tree within 6m of a tree to be retained should be undertaken only by cutting down such a tree without damaging the trees to be retained, and by grinding out its stump. Where possible the structural roots of 20mm diameter or greater of the tree to be cut down should not be removed, to minimise soil disturbance and to reduce the impact on the roots of any tree to be retained nearby. Where structural roots are to be removed this should be

undertaken manually by the use of non-motorized hand tools after the stump has been ground out when such roots are often easier to locate from the site of the stump from which they have been severed.

1.2.4 Structural Soil to accommodate compacted subgrade and root growth

To further protect woody roots with a diameter of 40mm or greater outside the area of the tree protection zone (see table 2), structural soil as a fill material or a subgrade should be used where appropriate and as detailed in the report recommendations. Structural soil addresses the issue of how to increase soil rooting volume whilst maintaining structural support for pavement. Structural soil maximises rock to rock contact utilising durable rock. Pore spaces are on average 8mm in size of which approximately 60% is taken up by the filler soil - the horticultural component, depending on the product utilised. The product is used for new tree planting in pavements, courtyards, carparks and kerbsides, planter boxes and raising levels around existing trees providing increased available soil volume to trees in pavements, structural properties for pavement support, increased root depth and high permeability for both air and water.

1.2.5 Root location and protection where structures are to be positioned near a retained tree

A: If walls, driveways or other structures are to be constructed near a protected tree or within a tree protection zone (see table 2 column G), careful excavation is to be undertaken manually by using hand tools or light machinery to determine the location of structural woody roots with a diameter of 40mm or greater, without damaging them. These roots are to be protected from physical damage by utilising pier & beam type footings to reduce excessive disturbance of existing soil profile supporting tree roots. Placement of piers are to be positioned so as to clear any structural root by at least 100mm to allow for future radial expansion of the tree root within the soil profile. Any roots 40mm or less may be clean cut with final cuts to undamaged woody tissue.

B: Where structural woody roots outside of the Tree Protection Zone or as otherwise indicated are to be pruned they are to be excavated manually first by using hand tools to adequately expose the root. Once located those roots to be severed are to be cut cleanly with a final cut to undamaged woody tissue. This will prevent tearing damage to the roots from excavation equipment which can extend beyond the point of excavation back towards the tree. Severed roots are to be treated with a root growth hormone stimulant.

1.2.6 Location of Services

If a utility service is to be located within the area of the dripline of a protected tree or within the Tree Protection Zone, the Australian Standard AS 4970-2009 "Protection of trees on development sites" provides the following:

"4.5.5. If underground services must be routed within the TPZ, they should be installed by directional drilling or in manually excavated trenches. The directional drilling bore should be at least 600mm deep. The project arborist should assess the likely impacts of boring and bore pits on retained trees. For manual excavation of trenches the project arborist should advise on roots to be retained and should monitor the works. Manual excavation may include the use of pneumatic and hydraulic tools."

1.2.7 Precautions in respect of temporary work

For Precautions in respect of temporary work, Australian Standard AS 4970-2009 "Protection of trees on development sites." provides the following:

4.5.6 Scaffolding

Where scaffolding is required it should be erected outside the TPZ. Where it is essential for scaffolding to be erected within the TPZ, branch removal should be minimized. This can be achieved by designing scaffolding to avoid branches or tying back branches. Where pruning is unavoidable it must be specified by the project arborist in accordance with AS 4373. NOTE: Pruning works may require approval by determining authority. Ground below

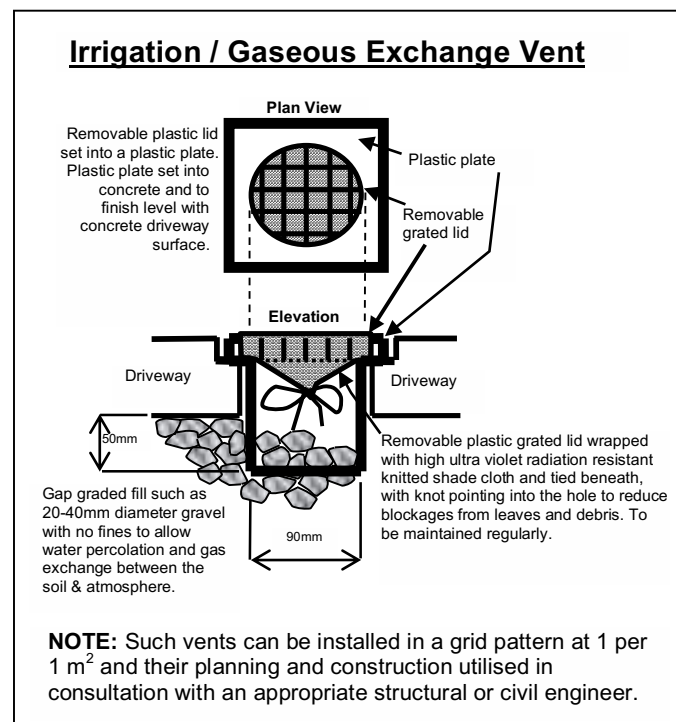
the scaffolding should be protected by boarding (e.g. scaffold board or plywood sheeting) as shown in Figure 5. Where access is required, a board walk or other surface material should be installed to minimize soil compaction. Boarding should be placed over a layer of mulch and impervious sheeting to prevent soil contamination. The boarding should be left in place until the scaffolding is removed. NOTE: Excavation required for the insertion of support posts for tree protection fencing should not involve the severance of any roots greater than 20 mm in diameter, without the prior approval of the project arborist.

“4.5.3 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.”

1.2.9 Water / Gaseous Exchange Vents

Watering / Gaseous exchange vents are to be installed in the area of the driveway that passes within the dripline of the tree or the prescribed Tree Protection Zone area and the number and location are to be determined by a Consultant Arboriculturist and the driveway design approved by a Certified Engineer. Exposed edges of the path are to be concealed with the finished level beside the path equivalent to the top of the path by minimal filling with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation, or other landscape treatments as appropriate.



1.2.10 Pruning/Removal Guidelines

- 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 for the Amenity Tree Industry, 1998

- 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), or applicable consent conditions.
- Tree maintenance work is specialised and in order to be undertaken safely and to ensure the works carried out are not detrimental to the survival of the tree or surrounding vegetation, all works 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.
- Any pruning near electricity wires should be undertaken in accordance with relative Electrical Safety Rules and be performed by persons individually authorised by Energy Australia

Appendix E

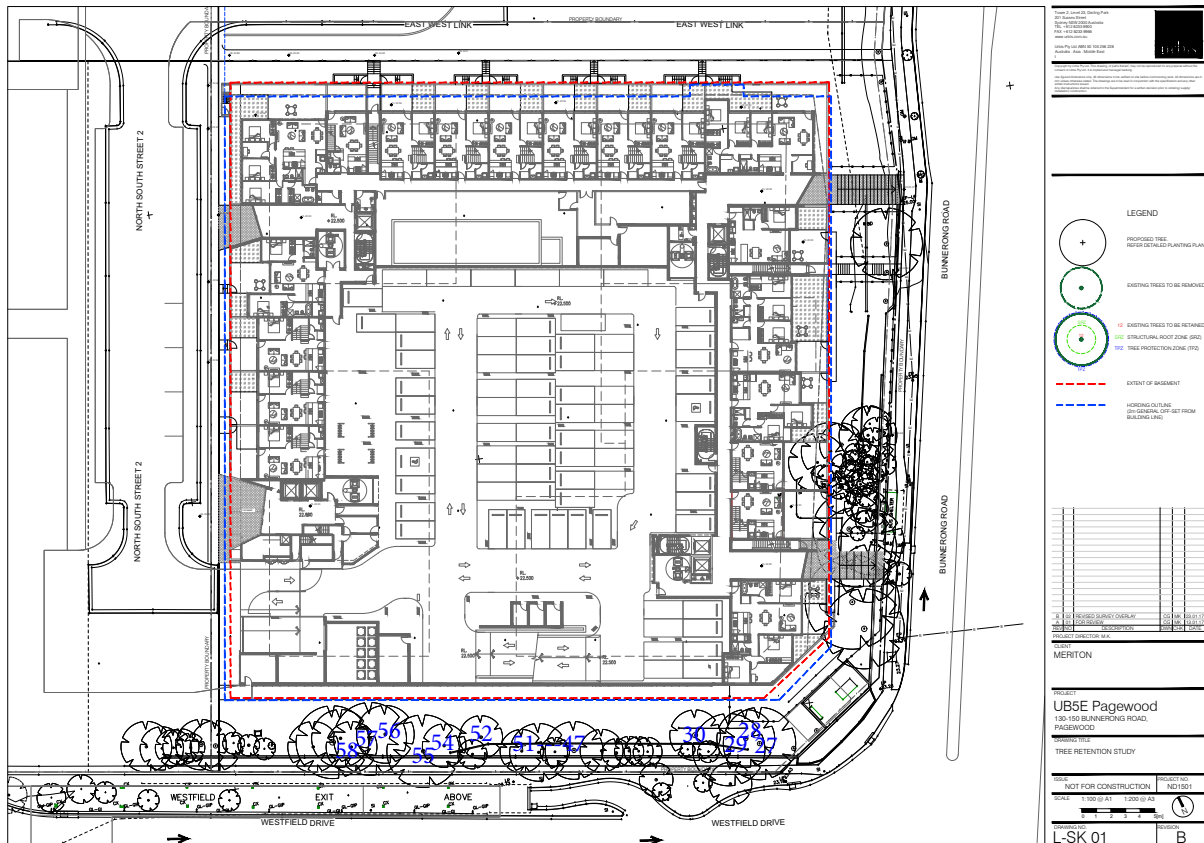
TREE PROTECTION ZONE STANDARD PROCEDURE

1. Each tree to be retained is to have its dripline fenced off, except where otherwise indicated, to create a Tree Protection Zone, and this may include one enclosure to protect a single or multiple tree/s, or multiple enclosures separated over the site. The area contained is the Tree Protection Zone, and is to exclude any activity, except where otherwise stated. The Tree Protection Zone is to exclude: modification of existing soil levels, storage of materials, site sheds and machinery; preparation of building materials e.g. concrete, or chemical treatments; the movement of pedestrian or vehicular traffic; or the temporary or permanent location of services, or the works required for their installation, e.g. trenches, holes or canals. The above list is not meant to be exhaustive, and is intended as a guide to the types of activities that are excluded from within the Tree Protection Zone, except where otherwise stated.
2. The Protective fencing where required may delineate the **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."*
3. Tree Protection signage is to be attached to each **Tree Protection Zone** and displayed from within the development site in accordance with AS4970 2009 *Protection of trees on development sites*, Section 4.4 and lettering to comply with AS1319.
4. Where a tree is to be retained and a **Tree Protection Zone** cannot be adequately established due to restricted access e.g. tree located along side an access way, the trunk and branches in the lower crown will be protected by wrapping 2 layers of hessian or carpet underfelt around the trunk and branches for a minimum of 2 m or as lower branches permit, then wire or rope secures 75x50x2000 mm hardwood battens together around the trunk (do not nail or screw to the trunk or branches). The number of battens to be used is as required to encircle the trunk and the planks are to extend to the base of the tree (AS4970 2009 *Protection of trees on development sites*, Figure 4 .
5. If a tree is growing down slope from an excavation, a silt fence located along the contours of the site in the area immediately above the **Tree Protection Zone** fencing may need to be installed and regularly maintained to prevent burial and asphyxiation of the roots of the tree. To allow for the maintenance of both fences, the silt fence must be constructed separately to the tree protection fence and the 2 fences must be constructed independently of each other and standalone. To reduce competition with the tree the area within the **Tree Protection Zone** is to be kept free of weeds. These are best removed by the application of foliar herbicide with Glyphosate as the active constituent. This is the preferred method rather than removal by cultivation of the soil within the dripline, to minimise root disturbance to the tree. The removal of woody weeds such as Privet should use the cut and paint method of herbicide application. Weeds to be controlled within the **Tree Protection Zone**, for the duration of the project.

6. The area of the **Tree Protection Zone** to be mulched to a depth of 100 millimetres 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. The depth of mulch and type as indicated, to be maintained for the duration of the project.
7. No services either temporary or permanent are to be located within the **Tree Protection Zone**. If services are to be located within the **Tree Protection Zone**, special details will need to be provided by a qualified Consulting Arboriculturist for the protection of the tree regarding the location of the service/s.
8. A tree will not be fertilised during its protection within the **Tree Protection Zone**, as this may hasten its decline if it were to decline. If a tree is to be fertilised this should be in consultation with a qualified Consulting Arboriculturist.
9. In the event of prolonged dry periods, or where a tree has been transplanted, or where excavation nearby, especially up slope, leads to drying out of soil profiles closest to the tree/s, the tree/s is to be deep root watered thoroughly at least twice a week. The need for such watering is determined readily by observing the dryness of the soil surface within the dripline of the tree by scraping back some mulch. Mulch to be reinstated afterwards. In the event of disrupted ground or surface water flows to the tree due to excavation, filling or construction, an irrigation system may be required to be installed within the **Tree Protection Zone**. If an irrigation system is to be installed, consideration must be given to volume, frequency, and drainage of water delivered, and this should be in consultation with a qualified Consulting Arboriculturist.

Appendix F

Site Plan /Trees to be retained



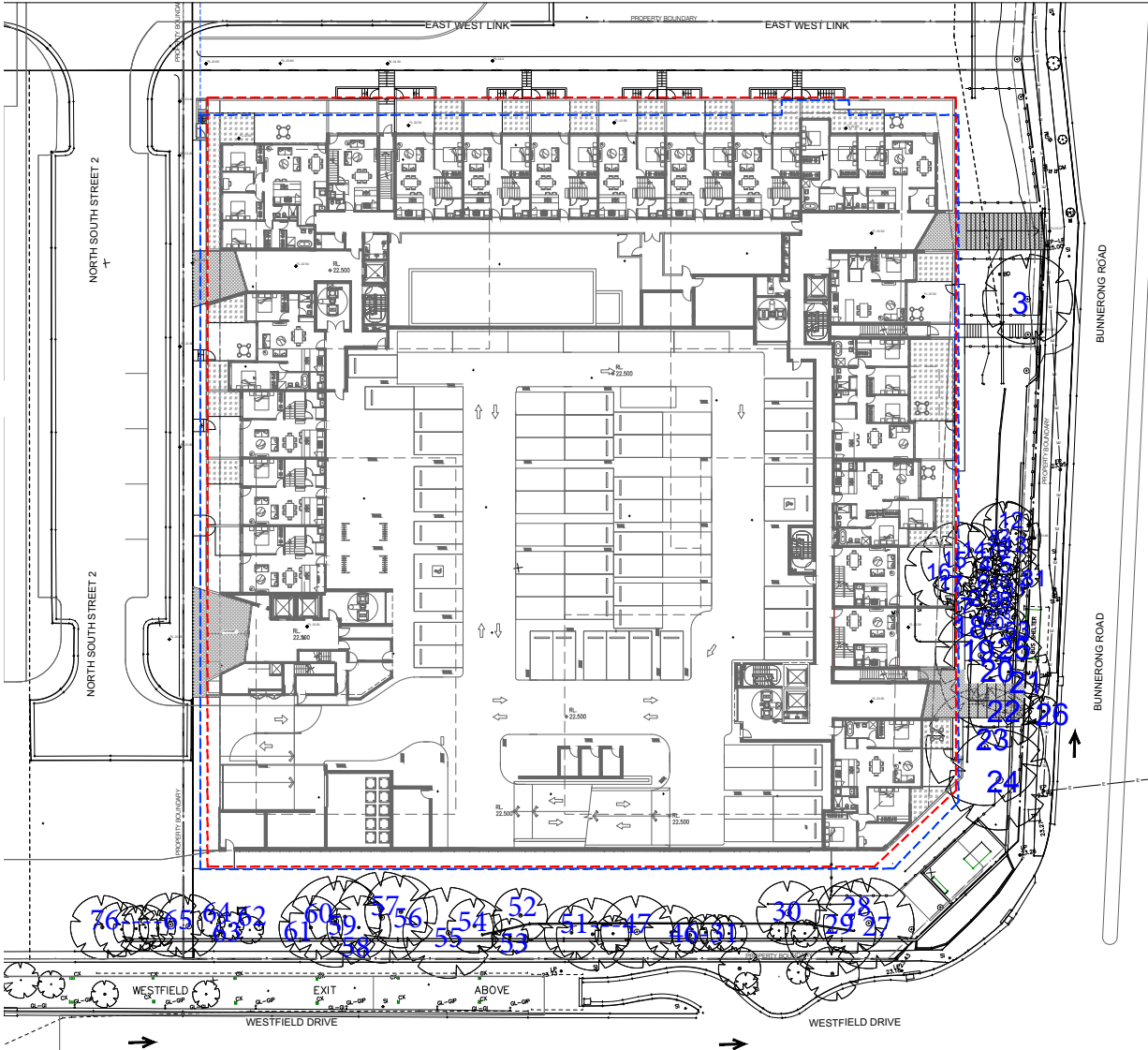
Protection Notes:

That trees 27,28,29,30,47,50,51,52,54,55,56,57 & 58 be retained and protected.

Physical protection for the trees is to be achieved through the erection of Tree Protection Zone (TPZ) fencing in accordance with **Appendix E** and the Australian Standard AS 4970-2009 "Protection of trees on development sites" at setbacks identified within table 2 to be erected within the development site boundary only prior to commencement of any site works.

If any access is required near to trees to be retained, ground protection is to be established internal to the site to prevent root damage and soil compaction near to the trees during demolition and construction within the prescribed TPZs (See table 2 and Appendix G) and is to include a permeable membrane such as geotextile fabric beneath a layer of mulch or crushed rock below rumble boards where appropriate. These measures may be applied to root zones beyond the TPZ if required.

Appendix F – Cont. **Site Plan /Tree Locations-All trees**



Appendix G

References

REFERENCES

1. IACA (2009), Sustainable Retention Index Value, Institute of Australian Consulting Arboriculturists, www.iaca.org.au .
2. Australian Standard® AS 4373 – 2007 Pruning of amenity Trees.
3. Draper BD and Richards PA 2009, *Dictionary for Managing Trees in Urban Environments*, Institute of Australian Consulting Arboriculturists (IACA), CSIRO Publishing, Collingwood, Victoria, Australia.
4. Work Cover NSW 2007, *Code of Practice Tree Work*, New South Wales Government, Australia.