

Arborist development assessment report

Nowra Park
North Street and Scenic Drive
NOWRA NSW 2541
Lot 1 DP 1043088, Lot 1 DP 1128777, Lot 2 DP
1128777, Part 7300 DP 1132679

5 April 2011



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Prepared for: Health Infrastructure
c/o Hassell
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Summary

This report has been compiled for Health Infrastructure c/o Hassell, Level 2, 88 Cumberland Street, Sydney NSW 2000. The report concerns a proposed Development Application for Nowra Park, North Street and Scenic Drive, Nowra NSW 2541. This report refers to one hundred and forty (140) trees, over five (5) metres in height, within the boundaries of the site. Those numbered 40, 88, 130, 133, 138 are groups of various young tree species. All site trees have been tagged to correspond with this report.

This report contains the following information regarding the site trees:-

All trees were assessed for Safe Useful Life Expectancy (SULE).

- 1) Genus and species of each tree.
- 2) Impact of the proposed development on each tree.
- 3) Impact of retaining tree on the proposed development.
- 4) The Tree Protection Zone (TPZ) for trees to be retained.
- 5) Any branch or root pruning that may be required for trees.

There are forty one (41) individual trees and five (5) groups of young saplings which are proposed to be removed for the purpose of the development.

It should be noted that the site survey by Allen, Price & Associates dated 15/9/2010 does not include all of the site trees. The trees numbered as 95-129, 132-137 within this report are not shown on the Tree Protection Plan. This has created some ambiguity as to the exact trees to be removed in the central area of the site.

The trees that are proposed to be retained will require tree protection fencing to be implemented for the duration of the construction process. A Tree Protection Plan, included in this report, shows the trees proposed to be retained; one copy is for construction purposes. This plan is attached in Appendix 1. Signage is recommended for tree protection areas. A sample tree protection sign has been included in Appendix 6.

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1 INTRODUCTION

- 1.1 This report has been conducted to assess the health and condition of one hundred and forty (140) trees located at Nowra Park, North Street and Scenic Drive, Nowra NSW 2541. This report has been prepared for Health Infrastructure c/o Hassell, Level 2, 88 Cumberland Street, Sydney NSW 2000 as required for a Development Application with the Department of Planning and Infrastructure at this site.

The purpose of this report is to collect the appropriate tree related data on the subject trees and to provide advice and recommendations to the design and possible construction alternatives to aid against any adverse impacts on the subject trees' health.

The subject trees were assessed for their health and condition. Also included in this report are tree protection measures that will help retain and ensure that the long term health of the trees to be retained are not adversely affected by the proposed development in the future.

The following data was collected for each tree:

- 1) All trees were assessed for Safe Useful Life Expectancy (SULE), health and amenity value.
- 2) Genus and species of each tree.
- 3) Impact of the proposed development on each tree.
- 4) The Tree Protection Zone (TPZ) for each tree to be retained.
- 5) Any branch or root pruning that may be required for trees.

Also noted for the purposes of this report were:

- Health and Vigour; using foliage colour and size, extension growth, presence of deadwood, dieback and epicormic growth throughout the tree.
- Structural condition using visible evidence of bulges, cracks, leans and previous pruning.
- The suitability of the tree taking into consideration the proposed development.
- Age rating; Over-mature (>80% life expectancy), Mature (20-80% life expectancy), Young, Sapling (<20% life expectancy).
-

- 1.2 **Documents and information provided:** For this Arborist report I was given a site survey of the location, undertaken by Allen. Price & Associates dated 15/9/2010. The plan showed the existing trees and structures on site. I was also provided a plan with the proposed development located in relation to the existing trees. This plan was undertaken by Hassell dated 4/4/2010, Dwg No. MP-L-001. I have not been provided any other plans for the Shoalhaven Cancer Care Centre, engineering specifications or service diagrams for the site.

- 1.3 Location:** The proposed development site is located on the corner of Scenic Drive and North Street, Nowra, known as Lot 1 DP 1043088, Lot 1 DP 1128777, Lot 2 DP 1128777, Part 7300 DP 1132679 (Crown land). The proposed development site from herein will be referred to as "the Site".

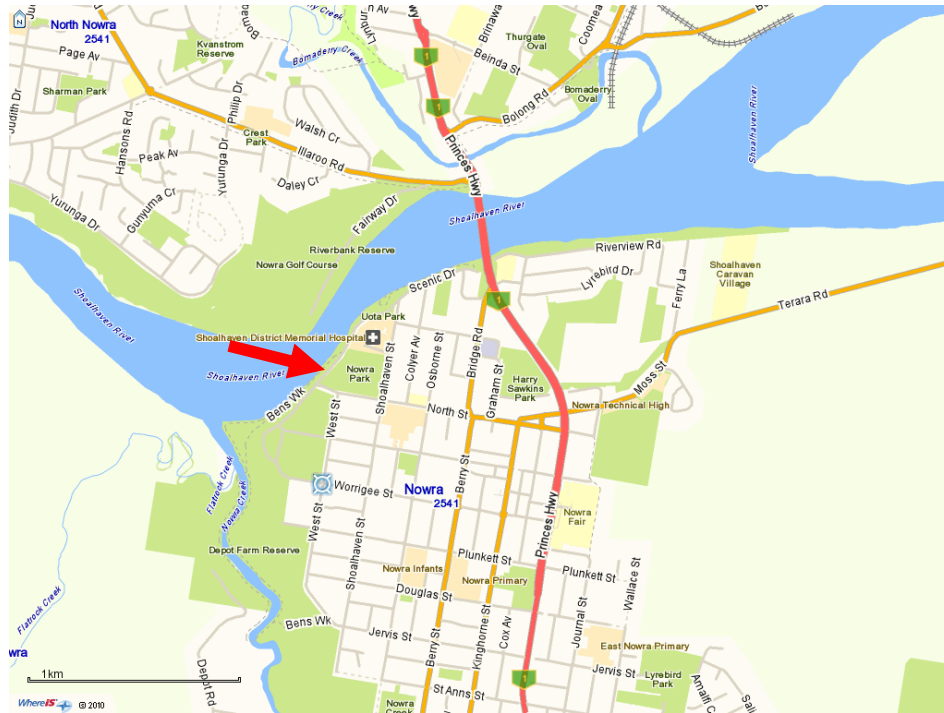


Diagram 1: Location of subject site (Red arrow) (whereis.com.au, 2011)

2 METHODOLOGY

- 2.1 To record the health and condition of the trees, a Visual Tree Assessment (VTA) was undertaken on the subject trees on 28 March, 2011. This method of tree evaluation is adapted from Matheny and Clark, 1994 and is recognised by The International Society of Arboriculture. Individual tree assessments are listed in Appendix 2 of this report. All inspections were undertaken from the ground. No diagnostic devices were used on these trees.
- 2.2 This report is only concerned with trees on the site that come under the Shoalhaven City Council Tree Preservation Order (TPO). It takes no account of any tree or shrub as detailed in section 3.2 of this report.
- 2.3 **Height:** The heights and distances within this report have been measured with a Bosch DLE 50 laser measure.
- 2.4 **Tree Protection Zones (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. TPZ's have been calculated for some of the trees to be retained. The TPZ calculation is based on the Australian Standard *Protection of trees on development sites*, AS 4970, 2009.
- 2.5 **Structural Root Zone (SRZ):** The SRZ is a specified distance measured from the trunk that is set aside for the protection of the trees roots both structural and fibrous. The woody root growth and soil cohesion in this area are necessary to hold the tree upright. The TPZ and SRZ are measured as a radial measurement from the trunk. No roots should be severed within this area. A detailed methodology on the TPZ and SRZ calculations can be found in Appendix 4.
- 2.6 **SULE:** The subject trees were assessed for a Safe Useful Life Expectancy (SULE). The SULE rating for each tree can be seen the Tree Assessment Schedule (Appendix 2). A detailed explanation of SULE can be found in Appendix 3.
- 2.7 **Documents provided:**
Flora & Fauna Assessment by Lesry K Environmental Consultants, dated August 2010.
Site survey by Allen, Price & Associates dated 15/9/2010 Ref No. 25451-01.
- 2.8 **Impact Assessment:** An impact assessment was conducted on the site trees. This was conducted by assessing the site survey and plans provided by Hassell, Level 2, 88 Cumberland Street, Sydney NSW 2000. The plans provided were assessed for the following:
- Reduced Level (R.L.) at base of tree.
 - Incursions into the Tree Protection Zone (TPZ).
 - Assessment of the likely impact of the works.

3 RELEVANT BACKGROUND INFORMATION

- 3.1 The subject property is known as Nowra Park, North Street and Scenic Drive, Nowra NSW 2541. The site consists of tall open eucalypt woodland that has been maintained to a certain extent of large grassed areas. Also present are clumps of regenerating eucalypt saplings and native and weed shrubs.
- 3.2 **Environmental Significance:** A Tree Preservation Order (TPO) applies to the whole of the Shoalhaven Local Government Area. This TPO (2004) protects all trees above five (5) metres in height or with a girth of five hundred (500) centimetres or more, measured at a distance of one hundred (100) centimetres above the ground, or five (5) metres in canopy width. The site is not listed as a heritage item and is not located within a heritage area. The site is not within twenty (20) metres of a lake, creek or waterway.
- 3.3 **The Site Trees:** The site was inspected on 28 March, 2011. Each tree has been given a unique number for this site and can be viewed on the Tree Protection Plan (Appendix 1). This plan is based on the plan provided by Hassell, Level 2, 88 Cumberland Street, Sydney NSW 2000, undertaken by Allen. Price & Associates dated 15/9/2010. All site trees have been tagged to correspond with the Tree Protection Plan and are numbered 1-140.

The canopy trees of the woodland are predominantly Blackbutt (*Eucalyptus pilularis*) and Red Bloodwood (*Corymbia gummifera*), as well as declining Radiata Pine (*Pinus radiata*) (numbered as 3, 5, 6, 7, 8, 9, 11, 17, 18, 22, 23, 24, 25, 26, 27, 45, 51, 93, 112-119, 127, 125). Also present are some isolated Spotted Gum (*Corymbia maculata*) (numbered as 1, 13, 21, 87, 129, 139). There are several clumps of saplings of mixed species that reach a height of ten (10) metres. Common under storey species include Blackthorn (*Bursaria spinosa*), Sweet Pittosporum (*Pittosporum undulatum*) and Fern-leaved Wattle (*Acacia filicifolia*).

- 3.4 **Trees outside the site:** There are no trees outside the site that will be affected by the proposed development. The trees to the east of the site will be fenced away from any construction works. There are numerous other entry points to the site so that the use of the eastern area for access (through Nowra Park) should not be necessary.
- 3.5 **Hollow bearing trees:** The following trees have been identified as having hollows. For the purposes of this report a hollow has been classed as any cavity, split or crack within the trunk or branches of any tree, dead or living that is larger than a golf ball. These trees are listed as Trees 33, 50, 59, 60, 79 and 128. Some of these trees have been identified in the Flora and Fauna Assessment report. Their positions were recorded with the use of a Global Positioning System (GPS). The coordinates of these hollow bearing trees are listed in the Flora and Fauna Assessment report as follows:

- Easting [E]: 279992; Northing [N]: 6138422;
- E: 279941; N: 6138441; and
- E: 279977; N: 6138522.

Although not numbered at the time of the Flora & Fauna Assessment Report the locations of these trees shown in Figure 1 (of the Flora & Fauna Assessment Report) correlate to the trees shown in the Tree Protection Plan as having hollows.

- 3.6 Exempt species:** Several of the site tree species are listed as being exempt from the Shoalhaven TPO (Appendix 1-Exempt species). Exempt species on site include Silky Oak and Sweet Pittosporum. These trees are growing within tree groups numbered as 88, 130 and 140. Radiata Pine (*Pinus radiata*) is also listed on the exempt species list however the subject trees within the site area are over ten (10) metres in height and are still protected by the TPO.

4 RECOMMENDATIONS

- 4.1 It should be noted that the site survey by Allen Price & Associates dated 15/9/2010 does not include all of the site trees. The trees numbered as 95-129, 132-137 within this report are not shown on the Tree Protection Plan. This has created some ambiguity as to the exact trees to be removed in the central area of the site.
- 4.2 In total, forty one (41) individual trees and five (5) groups of young saplings are proposed to be removed for the purpose of the development.
- 4.3 Trees proposed to be removed are numbered as 11-16, 24-28, 32-37, 39, group 40, 68-72, 87, 88, 89, 90, 92, 93, 130, 131, 138, 139, 140 for the actual building envelope. These trees should be clearly marked prior to removal to ensure the correct trees are removed.
- 4.4 The trees located near the site that are in poor or declining health are Trees 3, 5-9 are all Radiata Pine (*Pinus radiata*) and should be removed as part of the works. These trees have a SULE rating of less than 15 years.
- 4.5 **Trees 30, 31 and 86** will not tolerate the extent of excavation within the root zone area. The roots that will be damaged in this area include the lower order roots and woody roots (Appendix 8) that are essential for a mature tree's ongoing health and stability. If possible the two (2) driveway entry points that are near these trees should be moved so that they do not breach the TPZ. Due to excavations and trenching that may occur near **Trees 30, 31 and 86** the area around the base of the tree shall be classed as the Structural Root Zone (SRZ). For distances and specifications for the SRZ see Section 5.3.
- 4.6 Trees proposed to be retained shall be fenced into three (3) separate groups that will still allow site access. Tree protection fencing specifications are detailed in Section 5.2 of this report. This fencing will be located in the approximate areas shown in the Tree Protection Plan (Appendix 1). The specifications for a TPZ are in Section 5.3 of this report.
- 4.7 **Tree removal:** All tree work shall be carried out by a qualified Arborist and work shall be completed following AS 4373 (Pruning of Amenity Trees, 2007).
- 4.8 **Hollow bearing trees:** Trees with hollows include Trees 33, 50, 59, 60, 79 and 128. Trees 33 and 128 are hollow bearing trees required to be removed due to being located within the building envelope. Trees 50, 59, 60 and 79 are structurally sound to retain for the short term however further inspections and possible structural testing will be required in approximately five (5) years. The recommendations within the flora and fauna assessment report will have to be followed regarding the removal of Trees 33 and 128.
- 4.9 **Flora and Fauna Assessment report recommendations:** The recommendations in the Flora and Fauna Assessment report are detailed as follows;

- If feasible (and giving consideration to site operation/occupation safety), a layout for the development should be prepared that results in the retention/inclusion of those hollow bearing trees present into the site's open space areas (e.g. gardens, landscape areas and parklands).
- Similarly, a layout for the development should be prepared that includes a percentage of the remnant vegetation into the site's landscape works.
- Any areas of remnant vegetation proposed to be retained within the developments layout should be temporarily fenced prior to the undertaking of any clearing works. Vehicles and machinery should not be permitted to enter these areas. These areas should be highlighted as "no-go zones" on those construction plans provided to the work's contractor and should be included in any monitoring work.
- If the hollow bearing trees are to be removed as part of the works, an ecologist should be on site during their clearing. The ecologist should:
 - provide information on the most suitable removal method; and be on site during the removal process to check any hollows (once the tree has been felled) for sheltering animals.
 - The loss of the hollow bearing trees should be offset through the erection of suitably designed nesting boxes. The nesting boxes should be erected in the adjacent bushland area prior to the clearing works being commenced. The nesting boxes should be monitored for a period of two (2) years with any damaged boxes, or boxes occupied by exotic species, being replaced.

5 TREE PROTECTION

- 5.1 Trees to be protected:** All trees to be retained shall be required to be fenced for protection. All fencing shall be installed as specified in Section 5.2 (Tree Protection – Implementation of Tree Protection Zone). The locations of the fencing are shown in the Tree Protection Plan (Appendix 1). Trees to be protected are 1, 2, 4, 10, 11-24, 29, 30, 31 33 (fenced as one group). Trees 41-67 (fenced as one group) and Trees 73-86 (fenced as one group).
- 5.2 Implementation of Tree Protection Zone:** All tree protection works should be carried out before the start of demolition or building work. It is recommended that chain mesh fencing with a minimum height of 1.8 metres be erected as shown in the Tree Protection Plan (Appendix 1). Specifications for this fencing are shown in Tree Protection Fencing Specifications (Appendix 5).
- 5.3 The Tree Protection Zone (TPZ) and Structural Root Zone (SRZ):** The TPZ is implemented to ensure the protection of the trunk and branches of the subject tree. The TPZ is based on the Diameter at Breast Height (DBH) of the tree. The SRZ is also a radial measurement from the trunk used to protect and restrict damage to the roots of the tree.

The Tree Protection Zone (TPZ) and Structural Root Zone (SRZ) have been measured from the centre of the trunk. The following activities shall be avoided within the TPZ and SRZ of the trees to be retained;

- Erecting site sheds or portable toilets.
- Trenching, ripping or cultivation of soil (with the exception of approved foundations and underground services).
- Soil level changes or fill material (pier and beam or suspended slab construction are acceptable).
- Storage of building materials.
- Disposal of waste materials, solid or liquid.

Tree No.	TPZ	SRZ
Tree 30	5m	2.3m
Tree 31	5m	2.3m
Tree 86	9m	3m

Table 1: TPZ and SRZ distances

- 5.4 Tree Damage:** If the retained trees are damaged a qualified Arborist should be contacted as soon as possible. The Arborist will recommend remedial action so as to reduce any long term adverse effect on the tree's health.
- 5.5 Signage:** Signage is recommended on tree protection fencing. A sample sign has been attached in Appendix 6. This sign may be copied and laminated then attached to any TPZ fencing.
- 5.6 Root Pruning:** It is likely that excavations for drive ways are required within the TPZ of Trees 30, 31 and 86. This excavation shall be done by hand to expose any roots. Any roots under fifty (50) millimetres in diameter may be pruned cleanly with a sharp saw. Tree root systems are essential for the health and stability of the tree.
- 5.7 Arborist Certification:** It is recommended that the site is inspected with certification three (3) times during the construction phase of the development in order to verify that retained trees have been correctly retained and protected as per the conditions of consent and Arborist's recommendations and that the correct removals have taken place.
- (1) Before the commencement of demolition or construction;
 - (2) At mid point of the construction phase;
 - (3) At completion of the construction phase.
- The inspections shall be conducted by the site Arborist.
- 5.8 Construction Plan:** To assist with the implementation of the Tree Protection Plan a construction version has been provided within this report. This Plan is to be removed from this report and retained at the site office for use in the field. The construction version can be found in Appendix 1.

5.9 Tree works time line: A recommended time line is detailed below to help with the implementation of the recommendations within this report.

Tree works time line		
Works required	Tree No. affected	Implementation phase
Tree removals (marking of the site trees for removal)	11-16, 24-28, 32-37, 39, group 40, 68-72, 87, 88, 89, 90, 92, 93, 130, 131, 138, 139, 140	Prior to construction
Arborist certification (1)TPZ fencing erected	1, 2, 4, 10, 11-24, 29, 30, 31 33 (fenced as one group). Trees 41-67 (fenced as one group) and Trees 73-86 (fenced as one group)	Prior to construction
Arborist certification (2) Tree assessment and inspection of fencing	1, 2, 4, 10, 11-24, 29, 30, 31 33 (fenced as one group). Trees 41-67 (fenced as one group) and Trees 73-86 (fenced as one group)	At the mid point of construction
Removal of all tree protection measures	1, 2, 4, 10, 11-24, 29, 30, 31 33 (fenced as one group). Trees 41-67 (fenced as one group) and Trees 73-86 (fenced as one group)	Upon completion of all construction works
Arborist certification (3)	1, 2, 4, 10, 11-24, 29, 30, 31 33 (fenced as one group). Trees 41-67 (fenced as one group) and Trees 73-86 (fenced as one group)	Upon completion of landscaping

In summary, the proposed development will require the removal of a portion of native trees and several Radiata Pines that are in poor condition. The development does allow for the retention of large groups of trees along the northern, eastern and southern areas of the site. These trees to be retained do provide visual amenity from the streetscape and the proposed design allows adequate space for them to be retained without excessive damage to the root zones, provided the recommendations and tree protection measures within this report are implemented.

If you have any questions in relation to this report please contact me.



Paul Vezgoff

Consulting Arborist
Moore Trees
5th April 2011



www.mooretrees.com.au

6 IMAGES



Plate 1: Image showing the general site vegetation consisting of stands of mature trees growing in a maintained lawn area. P. Vezgoff.



Plate 2: There are several clumps of saplings that various *Eucalyptus* species along with mixed weed species. P. Vezgoff.



Plate 3: Image showing the southern end of the site. P. Vezgoff.



Plate 4: Image showing the general height of most of the site trees. P. Vezgoff.

Appendix 1

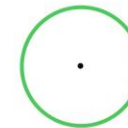
Plan 1

Tree protection plan

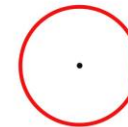


Tree protection plan

MOORE TREES



Tree to be retained



Tree to be removed



Fence. Implementation of tree protection zone (TPZ). All tree protection works should be carried out before the start of demolition or building works. It is recommended that chain mesh fencing with a minimum height of 1.8 metres be erected



Location of possible root pruning. This area is to be excavated by hand to a depth of 400mm to expose any roots. If roots under 50mm are encountered they can be severed cleanly with a sharp saw. If roots over 50mm are encountered then a qualified arborist should be consulted for further advice.



Site access. Recommended site access that will have least impact on site trees.

Date: 2.4.11
Drawn: P.Vezgoff
Site Address: Part of Nowra Park at North Street & Scenic Drive, Nowra.

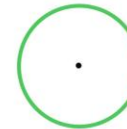


This Tree Protection Plan is based on the site survey by Allen, Price & Associates dated 15/9/2010. Not to scale. For location of fencing distances refer to Tree Protection Section in report

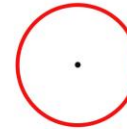


Tree protection plan

MOORE TREES



Tree to be retained



Tree to be removed



Fence. Implementation of tree protection zone (TPZ). All tree protection works should be carried out before the start of demolition or building works. It is recommended that chain mesh fencing with a minimum height of 1.8 metres be erected

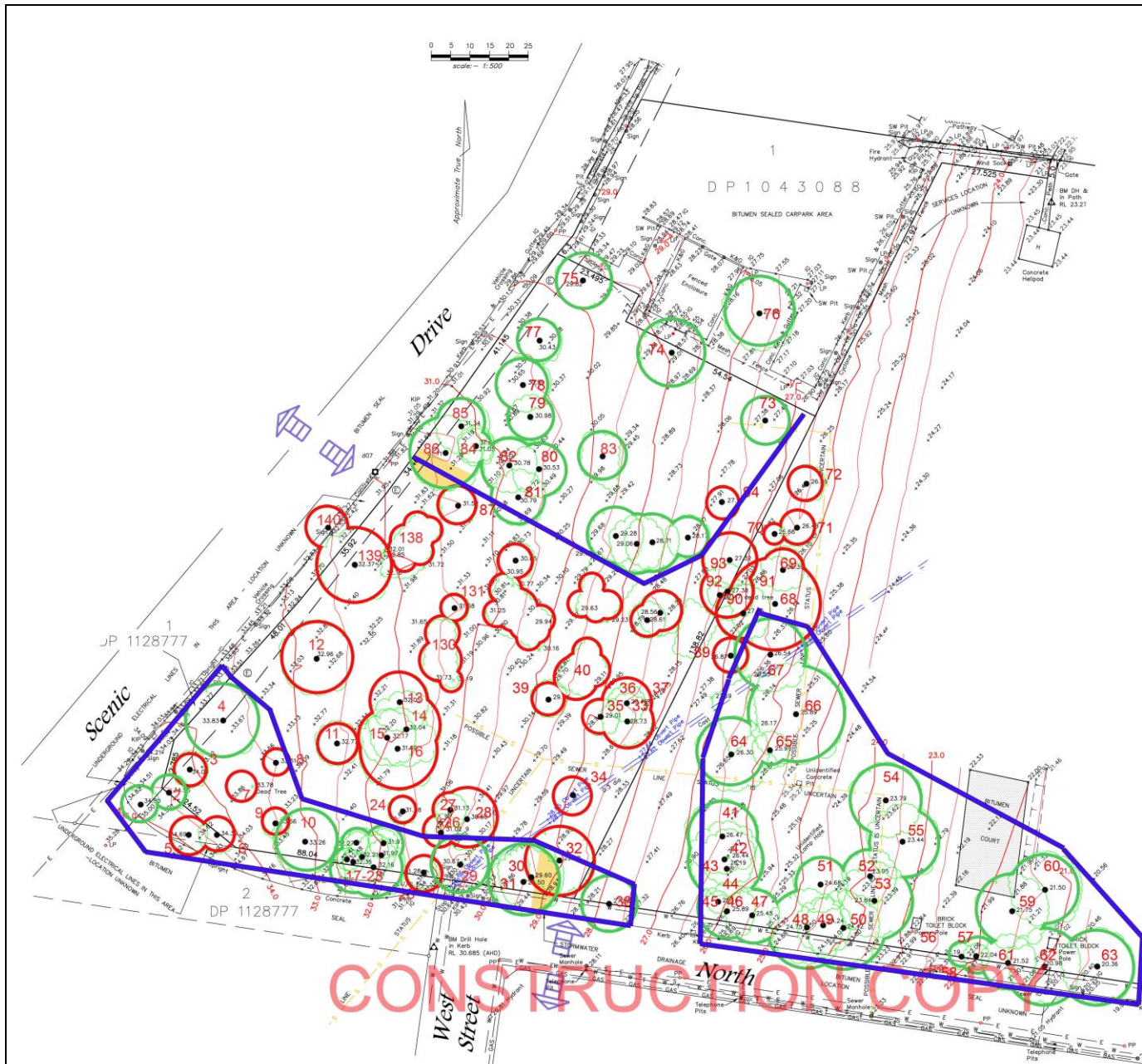


Location of possible root pruning. This area is to be excavated by hand to a depth of 400mm to expose any roots. If roots under 50mm are encountered they can be severed cleanly with a sharp saw. If roots over 50mm are encountered then a qualified arborist should be consulted for further advice.



Site access. Recommended site access that will have least impact on site trees.

Date: 2.4.11
 Drawn: P.Vezgoff
 Site Address: Part of Nowra Park at North Street & Scenic Drive, Nowra.



This Tree Protection Plan is based on the site survey by Allen, Price & Associates dated 15/9/2010. Not to scale. For location of fencing distances refer to Tree Protection Section in report

Appendix 2

Tree health & condition **assessment schedule**

TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE – Nowra Park, North Street and Scenic Drive, Nowra NSW 2541

Tree No.	Species	Height (m)	Spread (m)	DBH (mm)	Live crown ratio %	Age Class	Defects	SULE	TPZ (m)	SRZ (m)
1	Spotted Gum (<i>Corymbia maculata</i>)	18	7	500	90	Mature	Root damage Pruned for services	1a		
2	Blackbutt (<i>Eucalyptus pilularis</i>)	18	8	500	90	Mature	Pruned for services	1a		
3	Monterey Pine (<i>Pinus radiata</i>)	15	5	450	60	Mature		1a		
4	Red Bloodwood (<i>Corymbia gummifera</i>)	19	9	700	80	Mature	Pruned for services	1a		
5+6	Monterey Pine (<i>Pinus radiata</i>)	17	5	400	10	Mature		3c		
7	DEAD									
8+9	Monterey Pine (<i>Pinus radiata</i>)	17	5	400	10	Mature		3c		
10	Blackbutt (<i>Eucalyptus pilularis</i>)	17	8	400	90	Mature		1a		
11	Monterey Pine (<i>Pinus radiata</i>)	20	9	500	20	Mature		3c		
12	Blackbutt (<i>Eucalyptus pilularis</i>)	20	11	700	90	Mature		1a		
13	Spotted Gum (<i>Corymbia maculata</i>)	22	8	700	90	Mature		1a		
14-16	Blackbutt (<i>Eucalyptus pilularis</i>)	20	9	500	90	Mature		1a		
17+18	Monterey Pine (<i>Pinus radiata</i>)	19	5	350	20	Overmature		4a		
19	Blackbutt (<i>Eucalyptus pilularis</i>)	20	7	400	90	Mature		1a		
20	Monterey Pine (<i>Pinus radiata</i>)	19	5	350	20	Overmature		4a		
21	Spotted Gum (<i>Corymbia maculata</i>)	21	8	450	90	Mature		1a		
22+23	Monterey Pine (<i>Pinus radiata</i>)	19	5	350	20	Overmature		4a		
24	Monterey Pine (<i>Pinus radiata</i>)	19	8	400	20	Overmature		4a		
25	Monterey Pine (<i>Pinus radiata</i>)	18	9	600	60	Mature		3c		
26	Monterey Pine (<i>Pinus radiata</i>)	17	4	300	10	Overmature	Deadwood	4a		
27	Monterey Pine (<i>Pinus radiata</i>)	17	5	400	70	Overmature	Deadwood	4a		

28	Red Bloodwood (<i>Corymbia gummifera</i>)	21	8	450	90	Mature		1a
29	Blackbutt (<i>Eucalyptus pilularis</i>)	19	7	400	90	Mature		1a
30+31	Blackbutt (<i>Eucalyptus pilularis</i>)	19	9	400	90	Mature		1a 5m 2.3m
32	Blackbutt (<i>Eucalyptus pilularis</i>)	20	8	600	90	Mature		1a
33	Red Bloodwood (<i>Corymbia gummifera</i>)	18	9	600	60	Mature	Storm damage Deadwood Extensive stem wound Hollows	3c
34+37	Red Bloodwood (<i>Corymbia gummifera</i>)	17	8	400	90	Mature		1a
35+36	Blackbutt (<i>Eucalyptus pilularis</i>)	19	8	500	90	Mature		1a
38	Blackbutt (<i>Eucalyptus pilularis</i>)	23	10	400	90	Mature		1a
39	Blackbutt (<i>Eucalyptus pilularis</i>)	13	3	200x2	90	Young		1a
40	Blackbutt (<i>Eucalyptus pilularis</i>)	16	3	300x3	90	Young	Coppice regrowth	5b
41	Sweet Pittosporum (<i>Pittosporum undulatum</i>) Silky Oak (<i>Grevillea robusta</i>)	12	4	100	90	Young		1a
42+43	Blackbutt (<i>Eucalyptus pilularis</i>)	20	10	500	80	Overmature	Previous failures	4a
44	Camphor Laurel (<i>Cinnamomum camphora</i>)	5	4	100x5	90	Young		4a
45	Monterey Pine (<i>Pinus radiata</i>)	19	5	350	10	Overmature		4a
46	Red Bloodwood (<i>Corymbia gummifera</i>)	18	8	450	90	Overmature	Stem removed	4a
47	Blackbutt (<i>Eucalyptus pilularis</i>)	20	9	450	90	Mature		1a
48	Blackbutt (<i>Eucalyptus pilularis</i>)	19	8	400+500	90	Mature	Storm damage Included bark Main leader failure	1a
49	Red Bloodwood (<i>Corymbia gummifera</i>)	16	8	350	90	Mature		1a
50	Blackbutt (<i>Eucalyptus pilularis</i>)	19	10	850	90	Mature	Hollows	1a
51	Monterey Pine (<i>Pinus radiata</i>)	22	7	950	80	Mature		3c
52	Blackbutt (<i>Eucalyptus pilularis</i>)	23	8	1000	90	Mature		1a
53	Red Bloodwood (<i>Corymbia gummifera</i>)	16	10	600	90	Mature		1a
54	Blackbutt (<i>Eucalyptus pilularis</i>)	13	4	300	90	Young		1a

55	Red Bloodwood (<i>Corymbia gummifera</i>)	18	8	700	60	Mature	Epicormic Fire damage	3c
56	Jacaranda (<i>Jacaranda mimosifolia</i>)	6	2	100	90	Mature		1a
57+58		14	5	300	70	Mature	Hollows	3a
59+60	Blackbutt (<i>Eucalyptus pilularis</i>)	22	10	1000	90	Mature	Hollows	1a
61	Camphor Laurel (<i>Cinnamomum camphora</i>)	14	4	300x2	90	Mature		3c
62	Cheese Tree (<i>Glochidion ferdinandii</i>)	9	4	300	90	Mature		1a
63	Blackbutt (<i>Eucalyptus pilularis</i>)	19	8	500	90	Mature		1a
64	Blackbutt (<i>Eucalyptus pilularis</i>)	20	9	800	90	Mature		1a
65	Blackbutt (<i>Eucalyptus pilularis</i>)	17	5	400	90	Mature		1a
66	Blackbutt (<i>Eucalyptus pilularis</i>)	23	11	1100	90	Mature		1a
67	Blackbutt (<i>Eucalyptus pilularis</i>)	18	6	500	90	Mature		1a
68	Red Bloodwood (<i>Corymbia gummifera</i>)	20	10	400+600	90	Mature		1a
69	Red Bloodwood (<i>Corymbia gummifera</i>)	17	9	300x3	90	Mature	Termites Included bark at base Stem wound	2c
70	Monterey Cypress (<i>Cupressus macrocarpa</i>)	6	3	350	80	Mature	Stem wound, north	3c
71	Port Jackson Fig (<i>Ficus rubiginosa</i>)	8	4	400	40	Mature	Stem wound Decay	2c
72	Port Jackson Fig (<i>Ficus rubiginosa</i>)	7	4	300	30	Overmature	Robinia at base	4a
73	Blackbutt (<i>Eucalyptus pilularis</i>)	18	8	1000	90	Mature		1a
74	Blackbutt (<i>Eucalyptus pilularis</i>)	21	8	900	90	Mature		1a
75	Blackbutt (<i>Eucalyptus pilularis</i>)	18	8	600	95	Mature		1a
76	Red Bloodwood (<i>Corymbia gummifera</i>)	20	9	500	90	Mature		2c
77+78	Red Bloodwood (<i>Corymbia gummifera</i>)	19	8	500	90	Mature	Pruned for wires	1a
79	Blackbutt (<i>Eucalyptus pilularis</i>)	23	11	1200	90	Overmature	Hollows Epicormic	4a
80-83	Red Bloodwood (<i>Corymbia gummifera</i>)	17	6	300	90	Mature		1a
84+85	Red Bloodwood (<i>Corymbia gummifera</i>)	17	5	350	80	Mature	Pruned for wires	1a

86	Blackbutt (<i>Eucalyptus pilularis</i>)	17	8	800	90	Mature		1a	9m	3m
87	Spotted Gum (<i>Corymbia maculata</i>)	14	6	350	90	Mature		1a		
88	Spotted Gum (<i>Corymbia maculata</i>)	13	3	150	80	Saplings		5b		
	Silky Oak (<i>Grevillea robusta</i>)									
	Blackbutt (<i>Eucalyptus pilularis</i>) Group									
89	Blackbutt (<i>Eucalyptus pilularis</i>)	17	5	400	80	Mature		1a		
90	Blackbutt (<i>Eucalyptus pilularis</i>)	19	6	400+300	80	Mature		1a		
91	DEAD									
92	Blackbutt (<i>Eucalyptus pilularis</i>)	18	7	450	80	Mature		1a		
93	Monterey Pine (<i>Pinus radiata</i>)	19	5	500	40	Overmature		3c		
94	Blackbutt (<i>Eucalyptus pilularis</i>)	19	7	700	90	Mature		1a		
95-99	Blackbutt (<i>Eucalyptus pilularis</i>)	18	5	250	90	Mature		1a		
100-102	Red Bloodwood (<i>Corymbia gummifera</i>)	17	6	400	70	Mature		1a		
103	Blackbutt (<i>Eucalyptus pilularis</i>)	18	5	250	90	Mature		1a		
104	Red Bloodwood (<i>Corymbia gummifera</i>)	17	6	400	70	Mature		1a		
105	Blackbutt (<i>Eucalyptus pilularis</i>)	19	5	400	90	Mature		1a		
106	Red Bloodwood (<i>Corymbia gummifera</i>)	19	5	300	90	Mature		1a		
107-111	Blackbutt (<i>Eucalyptus pilularis</i>)	20	6	450	90	Mature		1a		
112-119	Monterey Pine (<i>Pinus radiata</i>)	18	5	350	20	Overmature		4a		
120	Blackbutt (<i>Eucalyptus pilularis</i>)	17	6	350x2	90	Mature	Storm damage Stem wound	2c		
121+122	Red Bloodwood (<i>Corymbia gummifera</i>)	17	6	400	70	Mature		1a		
123+124	Blackbutt (<i>Eucalyptus pilularis</i>)	21	9	900	90	Mature		1a		
125	Monterey Pine (<i>Pinus radiata</i>)	23	6	550	40	Overmature		4a		
126	Red Bloodwood (<i>Corymbia gummifera</i>)	19	6	400	90			1a		
127	Monterey Pine (<i>Pinus radiata</i>)	18	5	350	20	Overmature		4a		
128	Blackbutt (<i>Eucalyptus pilularis</i>)	17	10	400	90	Mature	Hollows	1a		
129	Spotted Gum (<i>Corymbia maculata</i>)	17	4	200	90	Young		1a		

130	Spotted Gum (<i>Corymbia maculata</i>) Silky Oak (<i>Grevillea robusta</i>) Blackbutt (<i>Eucalyptus pilularis</i>) Group	13	3-4	100-150	60-90	Saplings		5b
131	Red Bloodwood (<i>Corymbia gummifera</i>)	16	4	300	80	Mature		1a
132	Spotted Gum (<i>Corymbia maculata</i>) Silky Oak (<i>Grevillea robusta</i>) Blackbutt (<i>Eucalyptus pilularis</i>) Fern-leaved Wattle (<i>Acacia filicifolia</i>) Group	13	3-4	100-150	60-90	Saplings		5b
133	Spotted Gum (<i>Corymbia maculata</i>) Silky Oak (<i>Grevillea robusta</i>) Blackbutt (<i>Eucalyptus pilularis</i>) Fern-leaved Wattle (<i>Acacia filicifolia</i>) Group	13	3-4	100-150	60-90	Saplings		5b
134+135	Blackbutt (<i>Eucalyptus pilularis</i>)	18	8	900	90	Mature		2c
136	Red Bloodwood (<i>Corymbia gummifera</i>)	15	5	350	80	Mature	Red Ash & Camphor at base	1a
137	Blackbutt (<i>Eucalyptus pilularis</i>)	12	3	300	30	Mature	Malformed trunk	2c
138	Spotted Gum (<i>Corymbia maculata</i>)	13	3-4	100-150	60-90	Saplings		1a
139	Spotted Gum (<i>Corymbia maculata</i>)	17	8	500	90	Mature		1a
140	Camphor Laurel (<i>Cinnamomum camphora</i>)	7	3	multi	90	Young		3c

KEY

Tree No: Relates to the number allocated to each tree for the tree location plan.

Height: Height of the tree to the nearest metre.

Spread: The average spread of the canopy measured from the trunk.

DBH: Diameter at breast height. An industry standard for measuring trees at 1.4 metres above ground level, this measurement is used to help calculate Tree Protection Zones.

Live Crown Ratio: Percentage of foliage cover for a particular species.

Age Class: Young:	Recently planted tree	Semi-mature:< 20% of life expectancy
Mature:	20-90% of life expectancy	Over-mature:>90% of life expectancy

SULE: See SULE methodology in the Appendix 3

Tree Protection Zone (TPZ): The minimum area set aside for the protection of the trees trunk, canopy and root system throughout the construction process. Breaches of the TPZ will be specified in the recommendations section of the report.

Structural Root Zone (SRZ): The SRZ is a specified distance measured from the trunk that is set aside for the protection of the trees roots both structural and fibrous.

Appendix 3

SULE categories (after Barrell, 2001)¹

SULE Category	Description
Long	Trees that appeared to be retainable at the time of assessment for more than 40 years with an acceptable level of risk.
1a	Structurally sound trees located in positions that can accommodate for future growth
1b	Trees that could be made suitable for retention in the long term by remedial tree care.
1c	Trees of special significance that would warrant extraordinary efforts to secure their long term retention.
Medium	Trees that appeared to be retainable at the time of assessment for 15-40 years with an acceptable level of risk.
2a	Trees that may only live for 15-40 years
2b	Trees that could live for more than 40 years but may be removed for safety or nuisance reasons
2c	Trees that could live for more than 40 years but may be removed to prevent interference with more suitable individuals or to provide for new planting.
2d	Trees that could be made suitable for retention in the medium term by remedial tree care.
Short	Trees that appeared to be retainable at the time of assessment for 5-15 years with an acceptable level of risk.
3a	Trees that may only live for another 5-15 years
3b	Trees that could live for more than 15 years but may be removed for safety or nuisance reasons.
3c	Trees that could live for more than 15 years but may be removed to prevent interference with more suitable individuals or to provide for a new planting.
3d	Trees that require substantial remedial tree care and are only suitable for retention in the short term.
Remove	Trees that should be removed within the next five years.
4a	Dead, dying, suppressed or declining trees.
4b	Dangerous trees because of instability or loss of adjacent trees
4c	Dangerous trees because of structural defects
4d	Damaged trees not safe to retain.
4e	Trees that could live for more than 5 years but may be removed to prevent interference with more suitable individuals or to provide for a new planting.
4f	Trees that are damaging or may cause damage to existing structures within 5 years.
Small	Small or young trees that can be reliably moved or replaced.
5a	Small trees less than 5m in height.
5b	Young trees less than 15 years old but over 5m in height.

1 (Barrell, J. (2001) "SULE: Its use and status into the new millennium" in *Management of mature trees*, Proceedings of the 4th NAAA Tree Management Seminar, NAAA, Sydney.

Appendix 4

TPZ and SRZ methodology

Determining the Tree Protection Zone (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 metres above ground

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

A TPZ should not be less than 2 metres no greater than 15 metres (except where crown protection is required.). Some instances may require variations to the TPZ.

The TPZ of palms, other monocots, cycads and tree ferns should not be less than 1 metre outside the crown projection.

Determining the Structural Root Zone (SRZ)

The SRZ is the area required for tree stability. A larger area is required to maintain a viable tree.

The SRZ only needs to be calculated when major encroachment into a TPZ is proposed.

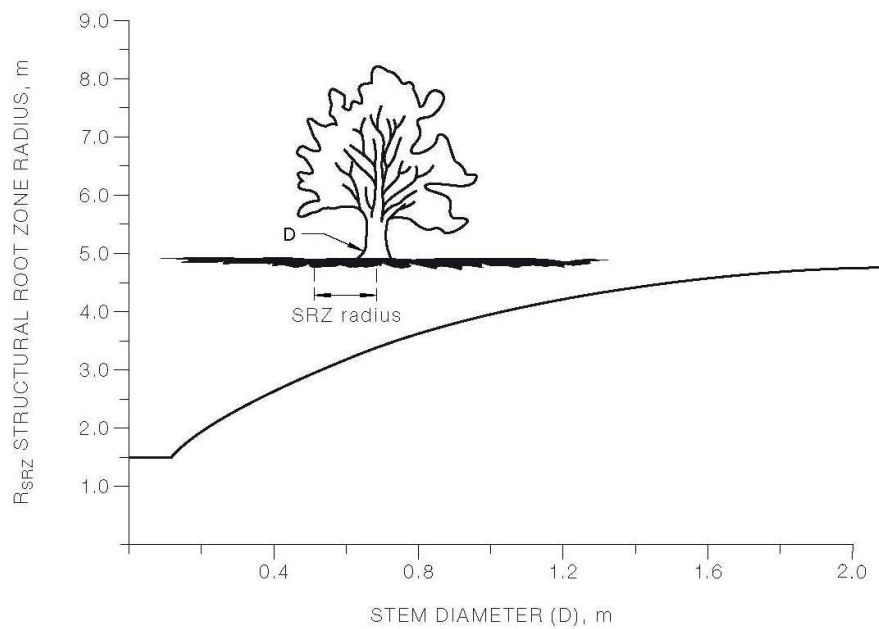
There are many factors that affect the size of the SRZ (e.g. tree height, crown area, soil type, soil moisture). The SRZ may also be influenced by natural or built structures, such as rocks and footings. An indicative SRZ radius can be determined from the trunk diameter measured immediately above the root buttress using the following formula or Figure 1. Root investigation may provide more information on the extent of these roots.

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

Where

D = trunk diameter, in m, measured above the root buttress

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



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

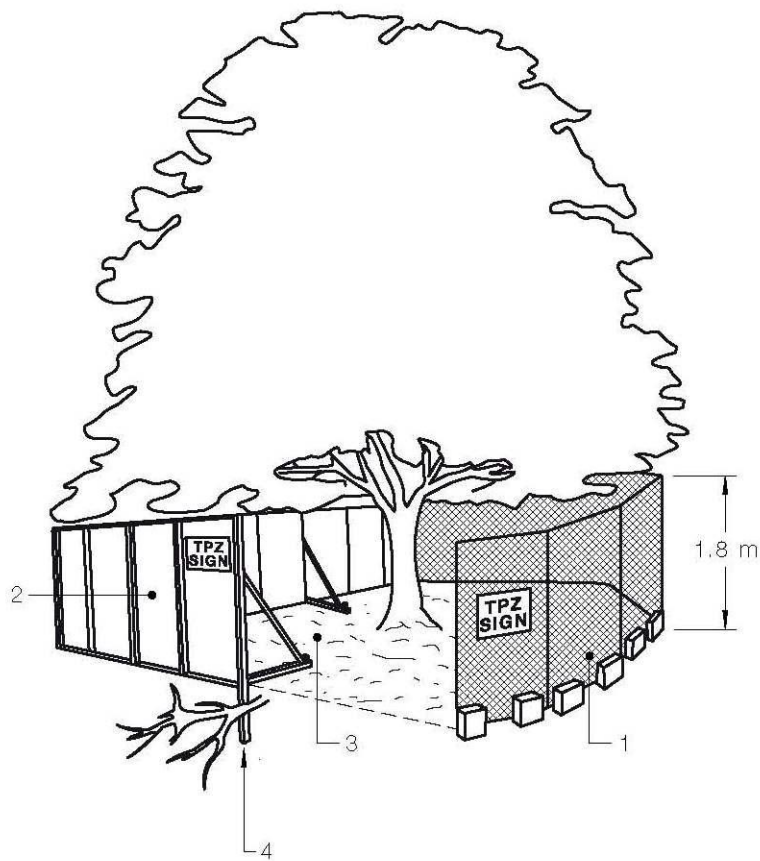
FIGURE 1 - STRUCTURAL ROOT ZONE

Notes:

- 1 R_{SRZ} is the structural root zone radius.
- 2 D is the stem diameter measured immediately above root buttress.
- 3 The SRZ for trees less than 0.15 metres diameter is 1.5 metres.
- 4 The 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.

Appendix 5

Tree protection fencing **specifications**



LEGEND:

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

Figure 1: Protective fencing as specified in AS 4970, 2009.

Appendix 6

Tree protection sign **sign sample**

Tree Protection Zone

Fence not to be moved without approval from Arborist

Within this fence there is to be

NO

Storage of materials

Trenching or excavation

Washing of tools or equipment

Tree Trunk Protection

Protection not to be removed until all construction works completed.

Around the base of this tree there is to be

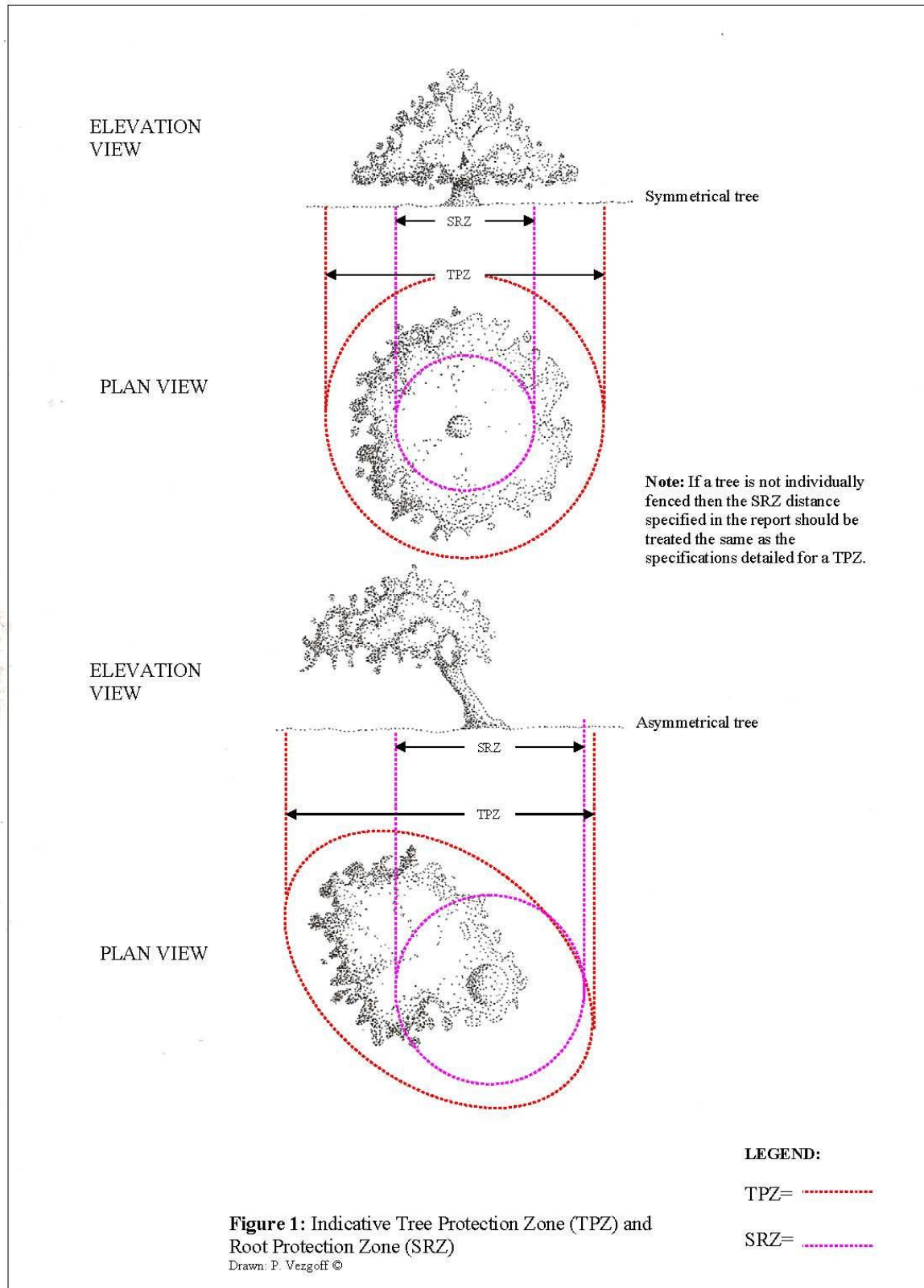
NO

Storage of materials

Trenching or excavation

Washing of tools or equipment

Appendix 7



Appendix 8

Tree structure information diagram

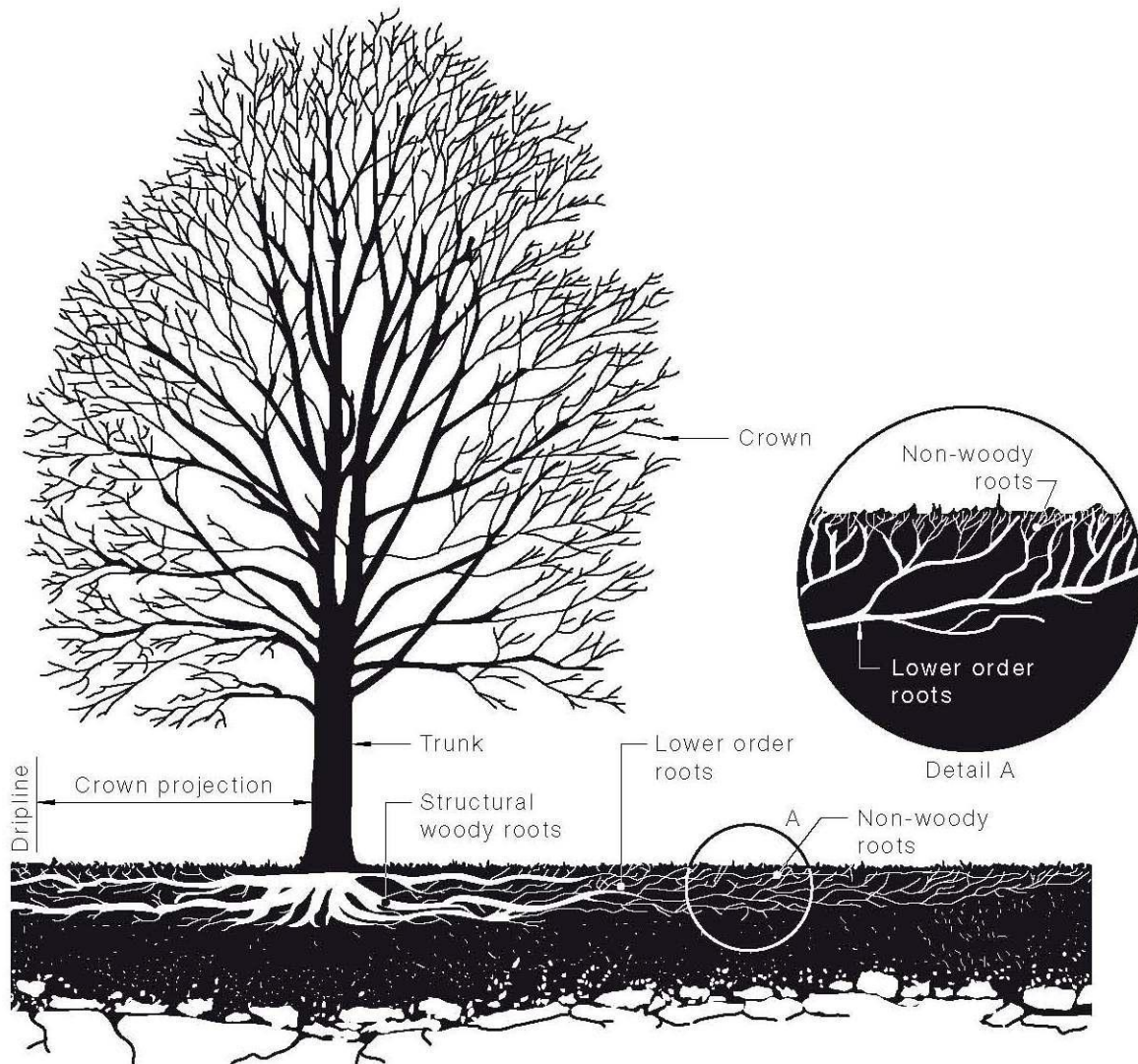


Figure 2: Structure of a tree in a normal growing environment (AS 4970, 2009.).

Appendix 9

Explanatory Notes

- **Mathematical abbreviations:** > = Greater than; < = Less than.
- **Measurements/estimates:** All dimensions are estimates unless otherwise indicated. Less reliable estimated dimensions are indicated with a '?'.
- **Species:** The species identification is based on visual observations and the common English name of what the tree appeared to be is listed first, with the botanical name after in brackets. In some instances, it may be difficult to quickly and accurately identify a particular tree without further detailed investigations. Where there is some doubt of the precise species of tree, it is indicated with a '?' after the name in order to avoid delay in the production of the report. The botanical name is followed by the abbreviation sp if only the genus is known. The species listed for groups and hedges represent the main component and there may be other minor species not listed.
- **Height:** Height is estimated to the nearest metre.
- **Spread:** The maximum crown spread is visually estimated to the nearest metre from the centre of the trunk to the tips of the live lateral branches.
- **Diameter:** These figures relate to 1.4m above ground level and are recorded in centimetres. If appropriate, diameter is measured with a diameter tape. 'M' indicates trees or shrubs with multiple stems.
- **Estimated Age:** Age is estimated from visual indicators and it should only be taken as a provisional guide. Age estimates often need to be modified based on further information such as historical records or local knowledge.
- **Distance to Structures:** This is estimated to the nearest metre and intended as an indication rather than a precise measurement.

Appendix 10

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- 2007 – Diploma of Arboriculture (AQF Cert V) Ryde TAFE. (Distinction)
- 1997 – Completed Certificate in Crane and Plant Electrical Safety
- 1996 – Attained Tree Surgeon Certificate (AQF Cert II) at Ryde TAFE
- 1990 – Completed two month intensive course on garden design at the Inchbald School of Design, London, United Kingdom
- 1990 – Completed patio, window box and balcony garden design course at Brighton College of Technology, United Kingdom
- 1989 – Awarded the Big Brother Movement Award for Horticulture (a grant by Lady Peggy Pagan to enable horticulture training in the United Kingdom)
- 1989 – Attained Certificate of Horticulture (AQF Cert IV) at Wollongong TAFE

INDUSTRY EXPERIENCE

Moore Trees Arboricultural Services

January 2006 to date

Tree Consultancy and tree ultrasound. Tree hazard and risk assessment, Arborist development application reports
Tree management plans.

Woollahra Municipal Council

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ARBORICULTURE TECHNICAL OFFICER

August 2005 – February 2008

Tree asset management, programmed inspection, inventory and condition surveys of council trees, hazard and risk appraisal,
Tree root damage investigation and reporting, assessment of impacts of capital works projects on council trees.

ACTING COORDINATOR OF TREES MAINTENANCE

June – July 2005, 2006

Responsible for all duties concerning park and street trees. Prioritising work duties, delegation of work and staff supervision.

TEAM LEADER

January 2003 – June 2005

TEAM LEADER

September 2000 – January 2003

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October 1995 – September 2000

Northern Landscape Services

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Sept 1991 to April 1995

CONFERENCES AND WORKSHOPS ATTENDED

- International Society of Arboriculture Conference (Brisbane 2008)
- Tree related hazards: recognition and assessment by Dr David Lonsdale (Brisbane 2008)
- Tree risk management: requirements for a defensible system by Dr David Lonsdale (Brisbane 2008)
- Tree dynamics and wind forces by Ken James (Brisbane 2008)
- Wood decay and fungal strategies by Dr F.W.M.R. Schwarze (Brisbane 2008)
- Tree Disputes in the Land & Environment Court – The Law Society (Sydney 2007)
- Barrell Tree Care Workshop- Trees on construction sites (Sydney 2005).
- Tree Logic Seminar- Urban tree risk management (Sydney 2005)
- Tree Pathology and Wood Decay Seminar presented by Dr F.W.M.R. Schwarze (Sydney 2004)
- Inaugural National Arborist Association of Australia (NAAA) tree management workshop- Assessing hazardous trees and their Safe Useful Life Expectancy (SULE) (Sydney 1997).