

DEVELOPMENT APPLICATION
TREE REMOVAL AND TREE PRUNING

Under section 78A of the Environmental Planning and Assessment Act 1979

Village Park, 1 Park Street, MONA VALE
PO Box 882, MONA VALE NSW 1660
DX 9018, MONA VALE
Telephone: (02) 9970 1111
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Email: pittwater@northernbeaches.nsw.gov.au
Website: www.pittwater.nsw.gov.au

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T no: 0517/16 Property ID: 71403 Amount paid: \$125 Receipt no: 405156
Use TTRE Code

APPLICANT(S) DETAILS

Applicant(s) name: Wade Orth

Owner(s) Name: as above

ADDRESS OF PROPERTY WHERE TREE(S) LOCATED

Address: 24 Wollombi Rd, Bilgola Plateau

Title details : Lot 217 DP 16902
(Lot/DP as shown on rates notice)

INSPECTION FEES (NON-REFUNDABLE)

- 1 tree \$125
- 2 to 4 trees \$180
- 5+ trees \$240
- On site appointment \$85

ARBORIST REPORT attached.

Applications for removal of significant trees will require an arborist's report by an independent qualified arborist. For further information please go to [www.pittwater.nsw.gov.au/property/tree information](http://www.pittwater.nsw.gov.au/property/tree_information). Significant trees include local endemic trees, habitat trees, heritage listed trees or trees of large amenity and visual significance. Replacement trees may be a condition of approval of this application.

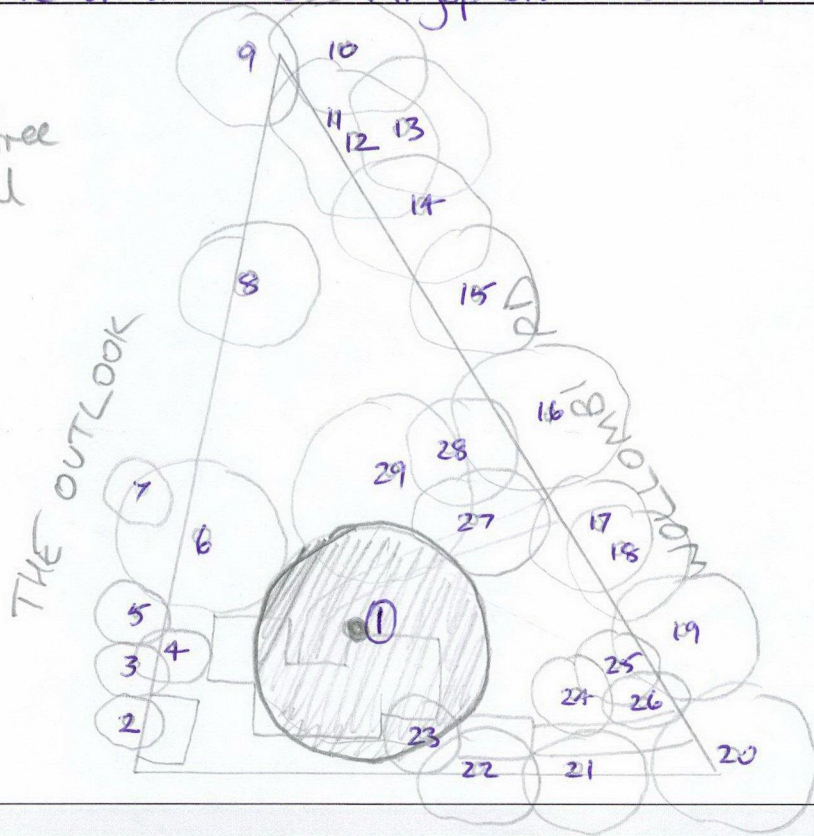
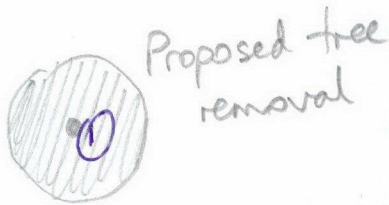
SITE PLAN

Please provide sufficient details to locate tree(s).
Label tree(s) numerically on the plan.
Please tie a marker to tree(s).

Reason for application and outline of proposed work

Over the last few years, several huge branches (< 2 tonnes each) have fallen.
In April 2015 storm, one branch fell onto house. There was significant decay
at branch junction. There is significant likelihood of further branch drop.
Application to remove entire tree - *Angophora costata*.

Sketch



TREE AND SITE INFORMATION

Is the tree(s) on private property? YES NO

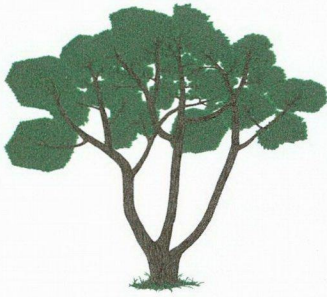
This application is only for trees on private property.

Is there a dog on the property? YES NO

Is there a current development application lodged for this property? YES NO

Tree removal as part of a separate development application is assessed under that application and this application may not be required.

Please list any supporting documents attached to your application eg. engineer's report or arborist report.



**ARBORICULTURAL TREE
SERVICES PTY LTD**

A.B.N. NUMBER: 57 093 391 407

A.C.N. NUMBER: 093 391 407

**P.O. Box 751
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**Graham Brooks dip arb
Arboriculture Australia Consulting Arborist
Tree care and Consultancy**

Tree Risk Assessment Report

Prepared for;

**21 Mr. Wade Orth
38 Wollombi Road
Bilgola Plateau
NSW 2106**

November 2016

Contents

- 1 Introduction**
- 2 Scope of Report**
- 3 Discussion**
- 4 Methodology**
- 5 Data Collection**
- 6 Documents Provided**
- 7 Site Visits**
- 8 Condition and Assessment of the Tree**
- 9 Resistance Tests Results & Risk Rating**
- 10 Recommendations**

Appendix 1 – Significance of a Tree, Assessment Rating System* (IACA 2010) – S.T.A.R.S. ©

Appendix 2 – Resistograph Terminology and Interpretation

Appendix 3 – Glossary of Terms

Appendix 4 – Assumptions and Limiting Conditions

1. Introduction

This Arborist report has been requested by Mr. Wade Orth (Property owner) who has requested my professional opinion on the condition, health and structural integrity of one *Angophora costata* tree (subject tree) located and growing within the front garden of 38 Wollombi Road, Bilgola Plateau, NSW 2106

2. Scope

This report is only concerned with;

Assessing the health and structural condition of 1 x *Angophora costata* tree.

The structural impact and assessment from the subject tree upon any fixed property structure has not been undertaken as this is beyond the field of my expertise. Clearly visual structural damage was photographed, noted and detailed within this report.

This report follows the guidelines within Pittwater 21 Development Control Plan and Local Environmental Plan 2014

3. Discussion

The following narrative serves as a brief discussion on tree risk assessments to inform on some of the considerations required within the context of this assessment.

Concepts of Tree Risk

3.1. Health versus Structure

A brief discussion on tree health and structure is warranted here. The individual components of a tree provide unique and integrated support to maintain a tree's system. Each component's structure and functions are complex in nature. Three roles of wood as one of these components is to provide a transportation system for water and nutrients throughout the tree, storage of starches for later use and a support system for the whole tree.

Sapwood, the outer circle of annual rings, is comprised of living tissue and primarily provides the transportation system and support. Heartwood, the interior annual rings of the tree, is comprised of dead tissue and provides the main support system for the tree.

As decay deteriorates the interior of the tree, its structural integrity is compromised. At the same time, the sapwood may still be fully functioning providing water and nutrients to the system. In essence, a tree can appear healthy yet be structurally unsound.

3.2. Defects Associated with the Trees

There are three issues of significance associated with the two trees in question.

a) Decay – Process of degradation of wood by microorganisms and fungus. (Australian Standard 2007, p. 6)
Decay, in the context of a tree, is a deterioration of wood fibre caused by decay organisms. The decay process is realized in stages, from early discoloration to cellular breakdown and eventual formation of a cavity. A tree can exhibit all stages at the same time. Types of decay can be separated into those that undermine the cellulose, which reduces bending strength, or undermines the lignin, which reduces compressive strength. Any form of decay reduces a tree's structural integrity. The presence of decay does not necessarily mean a tree has a high risk of failure. The extent of decay and additional contributing defects greatly affect risk determination.

b) Strength Retention Formula – The arboricultural profession has relied on a number of strength retention formulas to assist in determining the risk associated with decay. The most common formula in use was devised by Klaus Mattheck ‘The Body Language of Trees’ (Mattheck and Breloer, 1994) and is presented as t/r , where t is the thickness of sound wood and r is the radius of the part being measured. Commonly, a **figure of 30 to 35 percent** for full crown trees is considered a threshold for raising concerns about the integrity of the tree. Numbers below this threshold are an indicator of increasing risk.

These types of formulas have allowed the profession to better understand that decay can be present to a limited extent and structural integrity may be minimally compromised. They have also informed our understanding that a tree that can maintain a healthy cylinder of solid wood, without exceeding strength limits, could also be structurally stable. Complicating factors that certainly compromise this system are associated with the range of mechanical differences between species, irregular decay patterns and additional defects. Any strength loss formulas within this report are used as a guide only.

Note: Many trees have variable canopy and trunk loadings and are often not symmetrical and not ‘Centralised’. Tree’s often produce reaction strengthening wood to compensate for a weakness within its structure. All variable biotic and abiotic conditions have been taken into account in determining the likelihood of failure and Risk Rating as detailed within this report.

c) The most common forms of structural tree defects are:-

Wounds to the trunk and branches;

Damage to roots or disturbance of soil;

Decay within trunks, branches or roots;

Cracks, splits and bulges;

Excessive leans or branch end-weight.

Weak branch attachments and included bark (where the bark of two stems is caught between the two growing stems forming an inherently weak attachment);

Deadwood and hanging branches.

Cracks and Stress - Trees experience two forms of loading. Static loading is constant and is typically conveyed as the stress experienced by a tree from gravity. In other words, the tree must counter the effects of supporting itself while standing. External loading, such as wind, snow, etc. fluctuate over time and effect different parts of the tree at different times and intensities. Trees are adaptive structures that react to both stresses over time by developing reaction wood and adding girth.

Cracks are forms of structural failure. They occur when demands on the tree from stresses exceed the capacity to withstand the loading. Cracks are one of the key factors that compromise efforts by the tree to counter the effects of stresses. Trees require time, measured in years and decades, to react to both static and external stresses. Cracks disrupt this function by compromising the trees ability to respond quickly.

3.3. Assignment of Risk

Current concepts of risk centre on determining the likelihood of a tree part to fail (hazard) and the likelihood of the part then striking a target (risk). The likelihood of failure is determined by numerous variables and can include species, defects, reaction wood, environmental factors, loading, etc. The likelihood of striking a target is mainly determined by occupancy rates, direction of failure and protection factors. The final element of a tree risk assessment is determining consequences. Matrix 1, called the “Likelihood Matrix” provides a likelihood outcome (unlikely to very likely) based on combining the potential of a tree part failing and the potential of that same part then impacting a target.

Matrix 1 – Likelihood matrix (2013 ISA Tree Risk Assessment Manual).

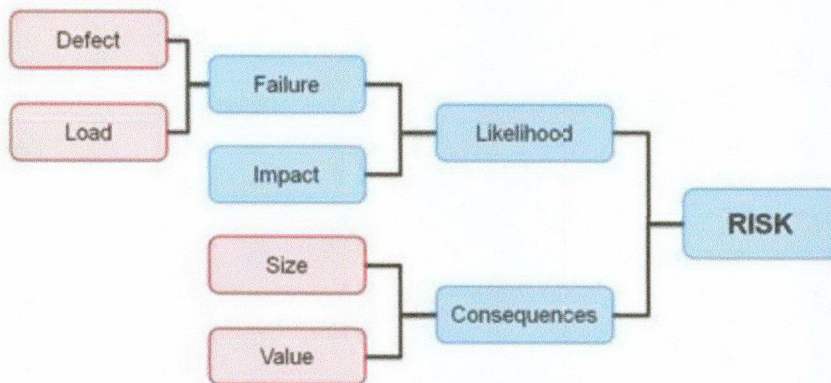
Likelihood of Failure (Tree part)	Likelihood of Impacting Target			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2, called the “Risk Matrix” provides a risk outcome (low to extreme) based on combining the results from the likelihood matrix and the consequences if the likelihood of the event were to occur.

Matrix 2 – Risk rating matrix (2013 ISA Tree Risk Assessment Manual).

Likelihood of Failure and Impact	Consequences			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Flow Chart indicating categories used to determine risk.



4. Methodology

4.1 The method for Tree Risk Assessment used in this report is that which is outlined by the **International Society of Arboriculture (ISA) in their Best Management Practices – Tree Risk Assessment 2011**. This is a companion publication to the American Standard ANSI A300 Part 9: Tree, Shrub and Other Woody Plant Material management – Standard Practices (Tree Risk Assessment a. Tree Structure Assessment).

This method uses a matrix based, qualitative approach to risk assessment.

The assessment of the subject tree was based on a “Level 2” tree assessment;

Followed up with a “level 3” scientific decay analysis and assessment of the subject tree.

A “level 2” assessment involves:-

A detailed visual inspection of the tree and its surrounding site and a synthesis of the information collected. The tree risk assessor walked completely around the tree looking at the buttress roots, trunk and branches.

Review of the trees condition using tools, where necessary, such as binoculars, hand lenses, a nylon sounding mallet, probes and a small shovel or trowel to expose root collars.

A review of the target area and the components of the tree most likely to fail.

4.2 Assessment of whether a “Level 3” or “advanced” assessment is warranted which may entail aerial, internal decay investigative techniques or tree root inspections would be based upon external visual inspection.

Recommendation of level 3 scientific decay investigation would be based upon visual inspection, probing of cavity and acoustic invariants produced from hitting parts of trunk / stem with sounding mallet upon sound and decayed wood / hollow.

Recommendation of a level 3 aerial inspection would be based upon a visual structural fault / decay cavity / poor attachment point visibly located up in the tree canopy but out of reach for inspection from ground level. Canopy areas with decay wounds, cavities or displaying pathogenic activity may also require scientific decay investigation.

Recommendation of a tree root inspection would be based upon visual condition of the tree root plate / exposed lateral tree roots at ground level.

The risk rating guides the arborist in determining the action to be taken and in prioritizing the pruning or removal of high risk trees.

In the assessment and determination of trunk or stem failure of the subject tree the **Mattheck formula** for strength loss has been used.

Diagnostic resistance tests were conducted using an IML Resi PD400 tool.¹

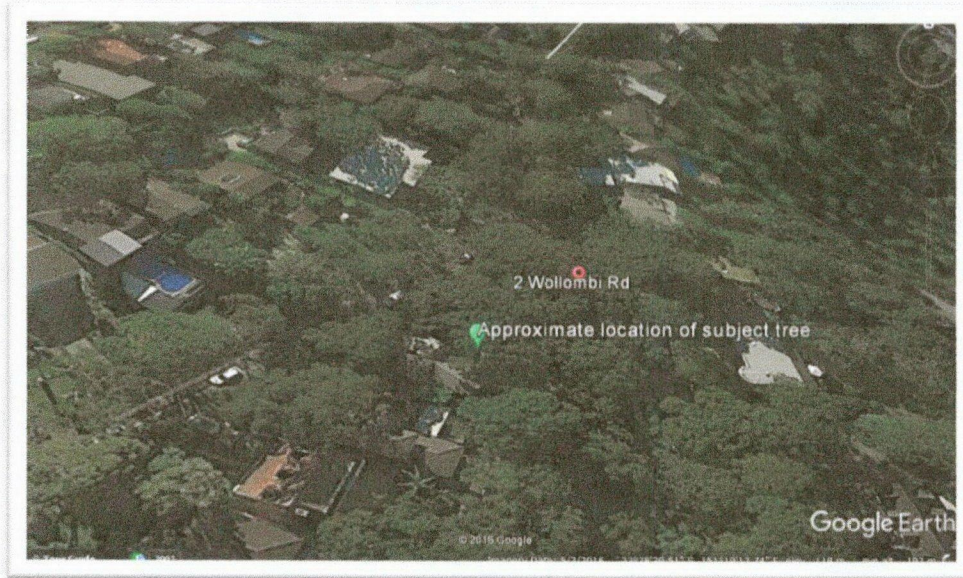
¹ Diagnostic resistance test – A method of measuring internal decay within timber to determine structural integrity.

4.3 Landscape Significance & Retention Value

The methodology used in determining the subject tree's landscape significance has been assessed using;

Significance of a Tree, Assessment Rating System* (IACA 2010) – S.T.A.R.S. ©

Site aerial view and subject tree.



5. Data Collection

Visual tree assessment (VTA)² and decay analysis was conducted from;

- (i) At ground level.
- (ii) Aerial Assessment to 7m

Other specific tree data was recorded in a notebook, PD400 resistograph machines and photographs taken using a digital camera.

6. Documents Provided.

Photographs of recent subject tree structural branch failure and property damage – Provided by Mr. Wade Orth.

7. Site Visits

Site Visits: 15 /11/2016 (1), 16/11/2016 (2)

Time: 2pm – 4pm (1), 8am – 12.30pm (2)

Weather condition: Fine

Present: Mr. Graham Brooks. Consulting & Practicing Arborist. Arborist Assistant.

Analysis Conducted: (1) Visual tree assessment (VTA). Level 2 basic tree risk assessment.

(2) Aerial assessment to 7m. Diagnostic resistance tests were conducted using a resistograph PD400 upon the subject tree's structural stem 6.4m agl. Collection of data.

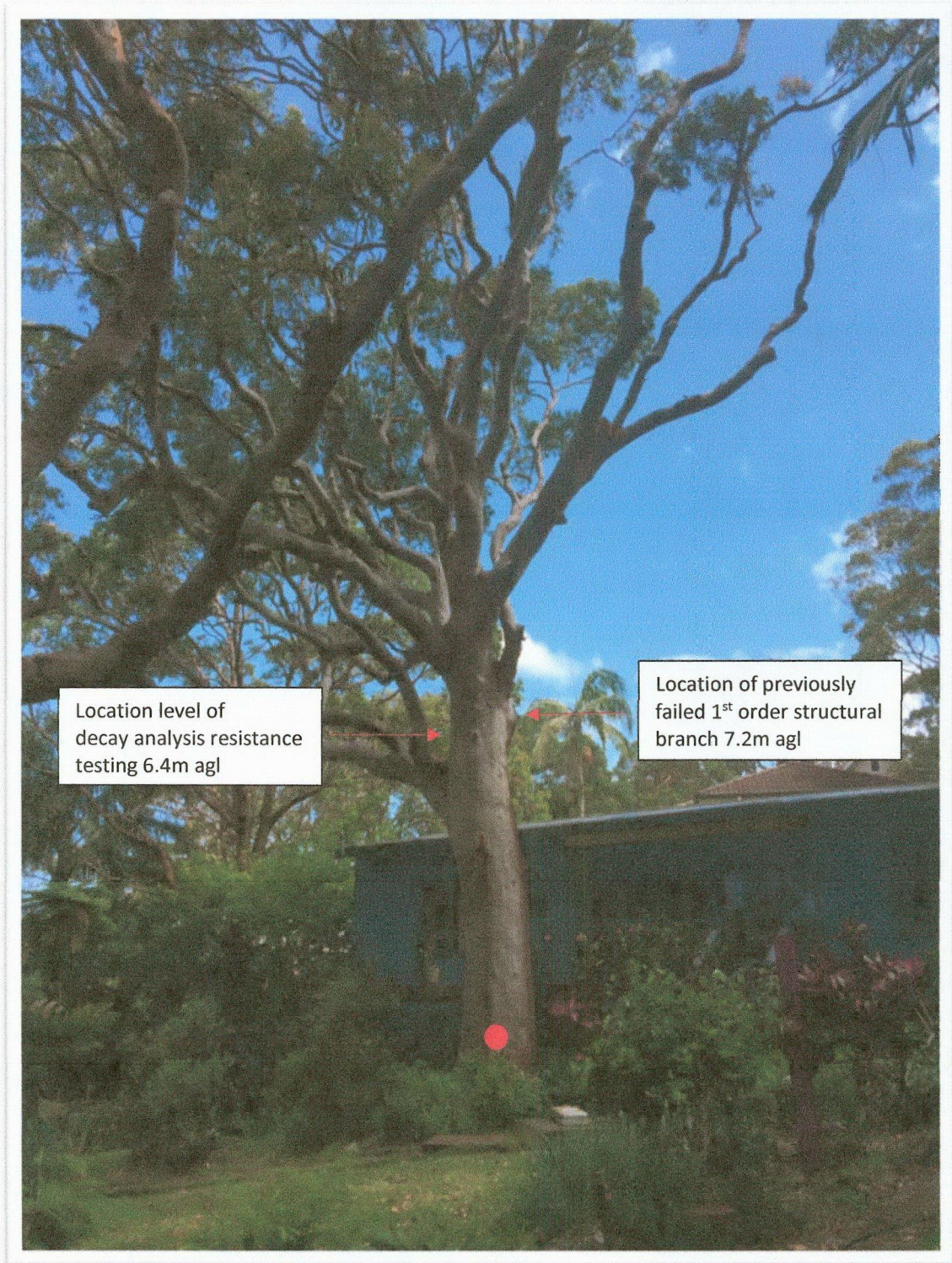
² VTA: Visual Tree Assessment. A systematic methodology identifying tree characteristics and hazard potential. Recognised by International Society of Arboriculture.

8. Condition & Assessment of the subject tree.

Photograph 1. Subject tree. Southern western aspect.



Photograph 2. Subject tree. South eastern aspect



Photograph 3. Previous 1st order structural stem failure. 8m agl. Southern low canopy quadrant 7.2 m agl.



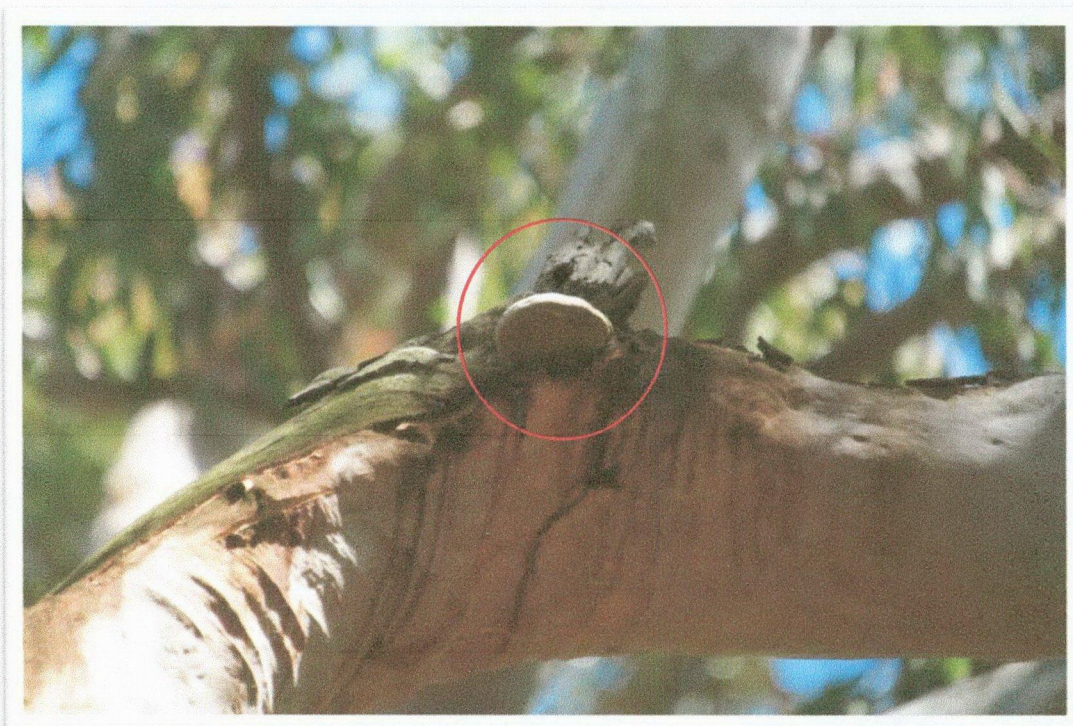
Photograph 4. Decayed timber / cellular structure breakdown. Note: White mycelium – white rot within the timber fibers characteristic of pathogenic fungal pathogen *Ganoderma* spp.



Photograph 5. Consequence of failure. Target structural damage.



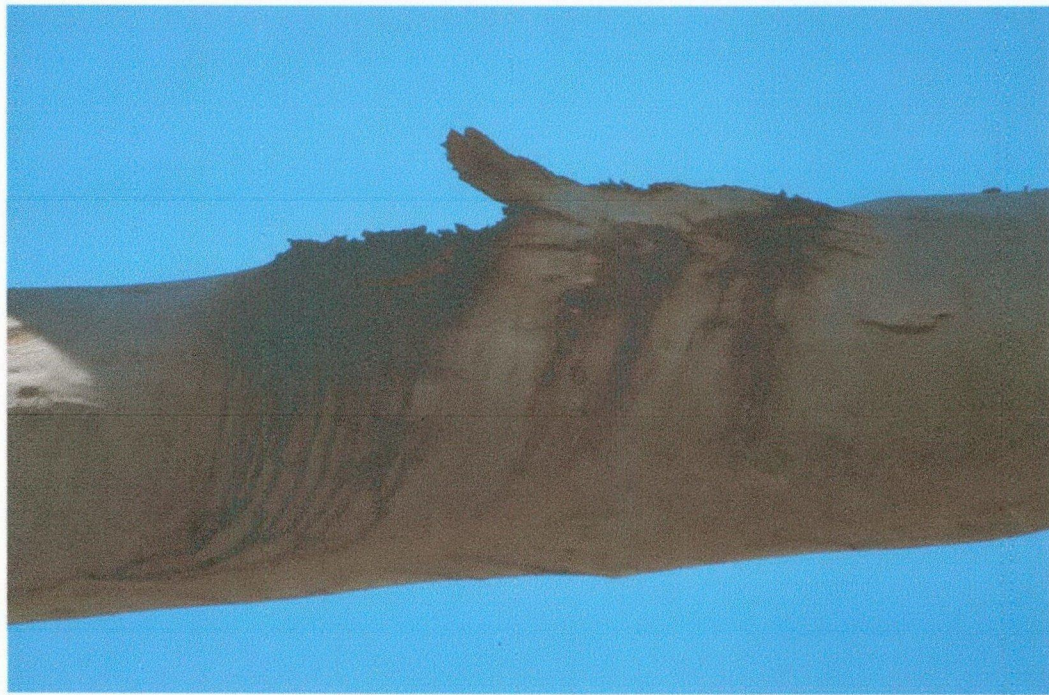
Photograph 6. Pathogenic fungal fruiting body characteristic of *Ganoderma* spp. Located upon 3rd order branch mid canopy northern quadrant.



Photograph 7 Parrot damage – Bark vascular cambium damage 3rd order branch western high canopy quadrant.



Photograph 8 Parrot damage – Bark vascular cambium damage 3rd order branch northern mid canopy quadrant. Kino exudation.



Tree Inventory / Schedule & SULE Category

Tree No	Genus / Species	Common Name	DBH 1.4m above ground level cm	D at Base (above buttress) cm	Height m	Spread m	Vigor	Condition	Canopy Loading	ULE	Sig Rating S.T.A.R.S	Recommendations / Comments
1	Angophora costata	Sydney red gum	119	157	22	N14.5 S4.5 E12.5 W13.4	F/G	P	North	R	Priority for Removal	Remove subject tree. Extensive eccentric decay within tensile and compressive wood at decay analysis level structural stem 6.4m agl Colonisation of pathogenic wood decay fungi characteristic of Ganoderma spp. Previous 1 st OSB failure. Target= Recreational areas. Family home. Risk Rating = High Residual Risk Rating= High Replacement planting to compliment bio-diversity.

Tree Location: Council Beach Reserve. **Tree Height:** Height was estimated and recorded in meters. **Tree Trunk Diameter:** Tree trunk diameter at 1.4 meters above ground level was measured using a tape measure and recorded in meters. **Tree Canopy Spread:** Canopy spread was estimated and recorded in meters. **Vigor:** Good (G), Fair (F), Poor (P). **Condition:** Good (G), Fair (F), Poor (P) **Safe Useful Life Expectancy: ULE.** A pre- planning / Development tree assessment methodology developed by Jeremy Barrell. England 1996 SULE is an acronym for Safe Useful Life Expectancy, which refers to the length of time an arborist assesses an individual tree, can be retained with an acceptable level of risk based upon the information available at the time of inspection. SULE ratings are LONG (retainable for 40 years or more with an acceptable level of risk), Medium (retainable for 15 to 40 years), Short (retainable for 5 to 15 years) and Removal (trees which should be removed immediately due to imminent hazard or within the next five years).

G.Brooks. dip arb ATS Pty Ltd Arboriculture Australia Consulting Arborist No: 1983
Tree Risk Assessment: 38 Wollombi Road. Bilgola Plateau. NSW 2106

At the time of assessment it was evident:

The subject tree was found to be asymmetrical in form. The tree grew dominantly within the garden setting.

The subject tree was considered to provide medium wildlife habitat value.
The canopy loading was in a northerly direction.

Visibly the subject tree's canopy displayed normal foliage chlorophyll pigment colour. The crown density was considered to be at 40% compared to that idealized for the genus and species when in good condition and of normal vigor.

Evident botanical visual and non-visual defects.

- Extensive internal eccentric decay of tensile and compressive wood at structural stem cross section level 6.4m agl.
- Evident parasitic wood decay fungi located / colonized within subject tree identified characteristically as Ganoderma spp - White rot.
- Evident previous 1st order structural branch failure – structural strength compromised by pathogenic wood decay fungi.
- Cockatoo parrot damage / bark vascular cambium damage to 2nd and 3rd order branches western and northern mid - high canopy quadrants.
- 8% deadwood throughout all canopy cardinal quadrants.
- Minimal internal canopy branches - Inappropriately pruned resulting in 'lions tailing' and altered canopy wind damping.

Past pruning events were visibly evident including removal of 1st, 2nd and 3rd order branch(s) removals southern, western and eastern low, mid and high canopy quadrants.

Resonance soundings of the basal trunk indicated no internal decay.

Response wound wood development upon the;

- Damaged bark / vascular cambium parrot damaged branches was considered fair.
- Previously pruned canopy branch collars was considered good.

Response support buttressing roots was considered good.

Diagnostic resistance tests were undertaken upon the structural stem 6.4m agl.

The internal structural condition of the tree part tested were; (Refer resistograph test readings)

- Structural stem – Indicated eccentric internal decay. (Refer cross section)

The target areas included recreational areas and family home.

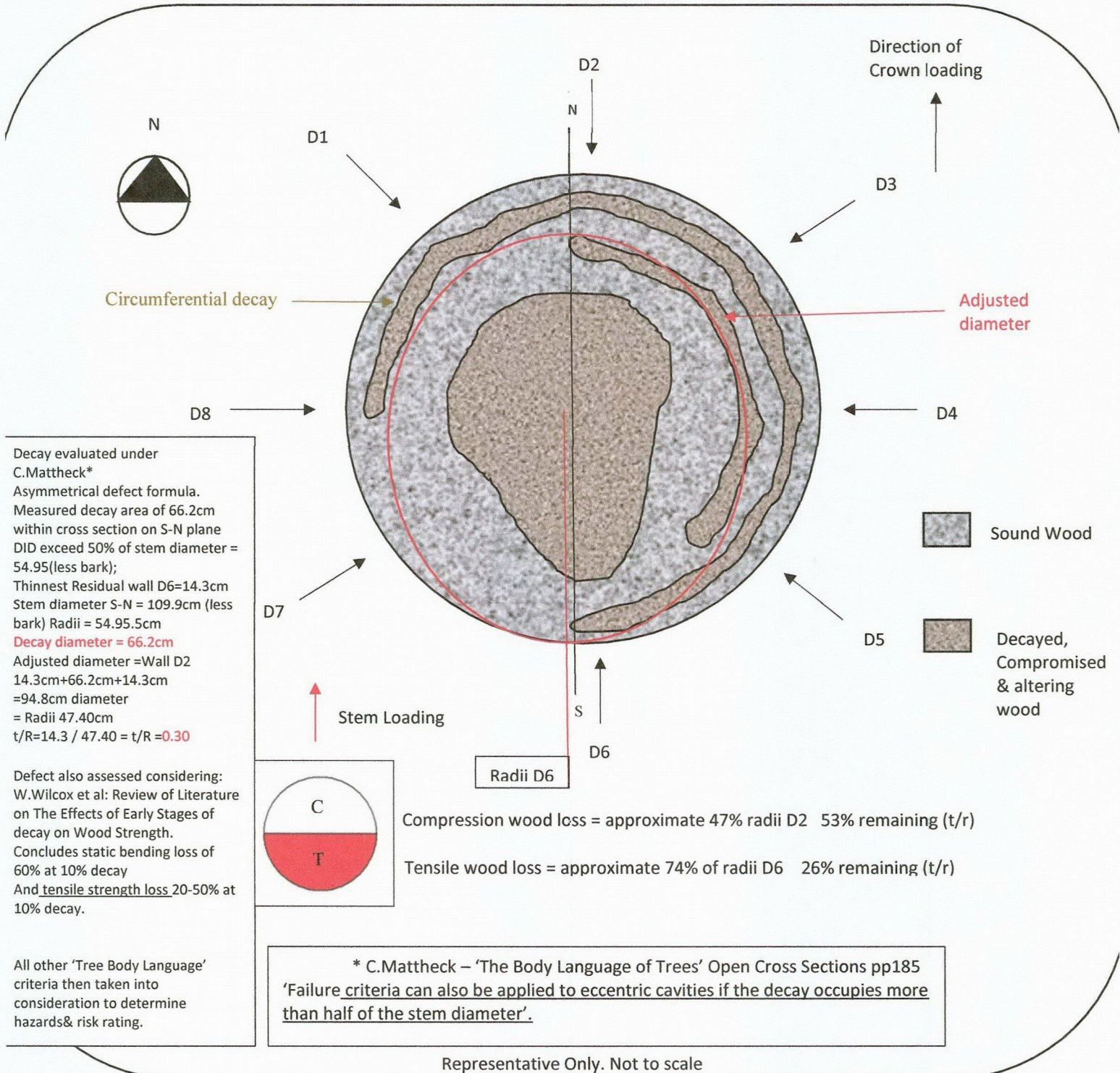
No other botanical abnormalities were evident.

9. Structural trunk stem 6.4m agl. Resistance Test Results & Risk Rating

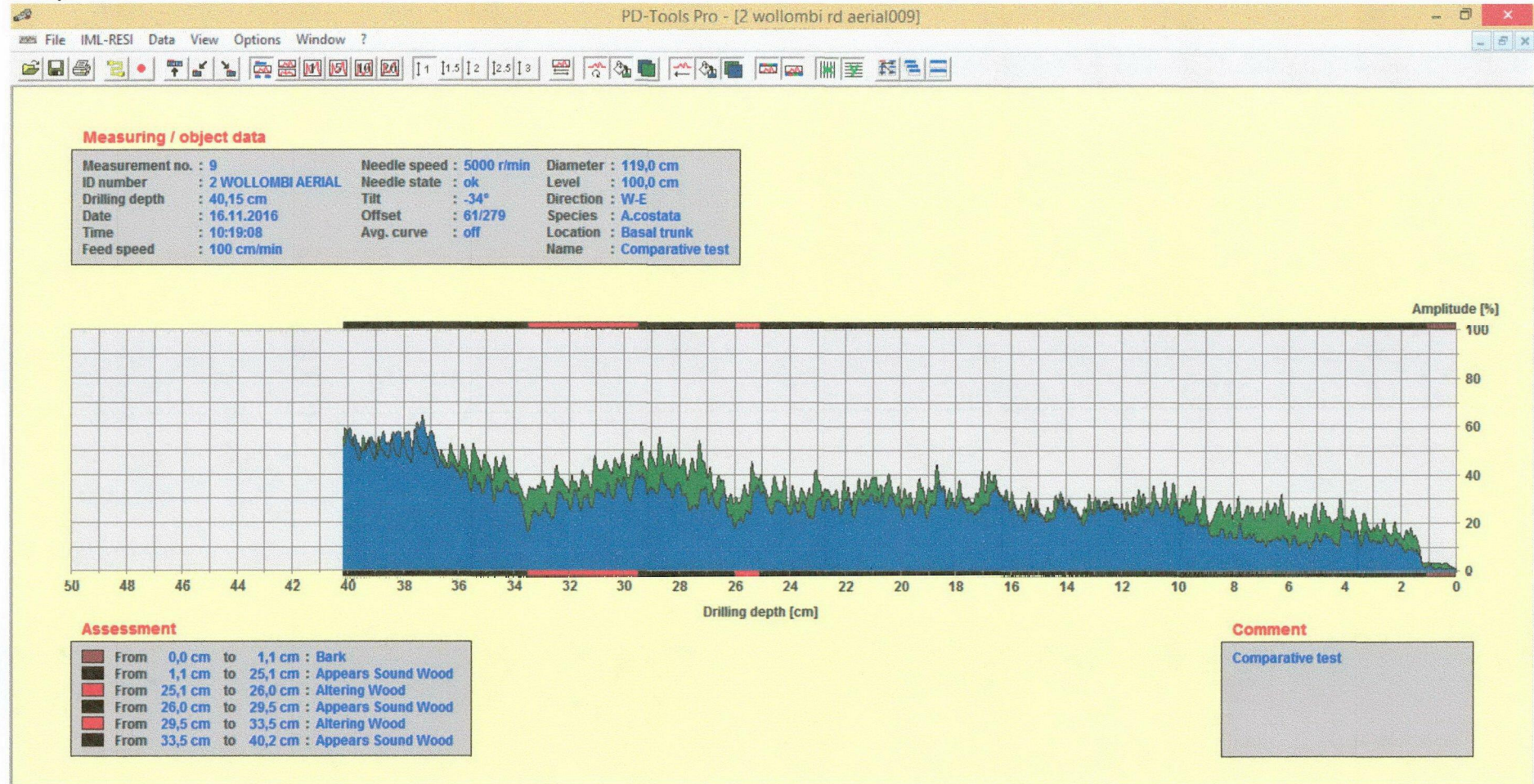
Eight (8) resistance drill tests were undertaken upon the defective 1st order structural stem 6.4m agl within cardinal points.

A map of the internal trunk decayed area can be built by testing in this pattern.

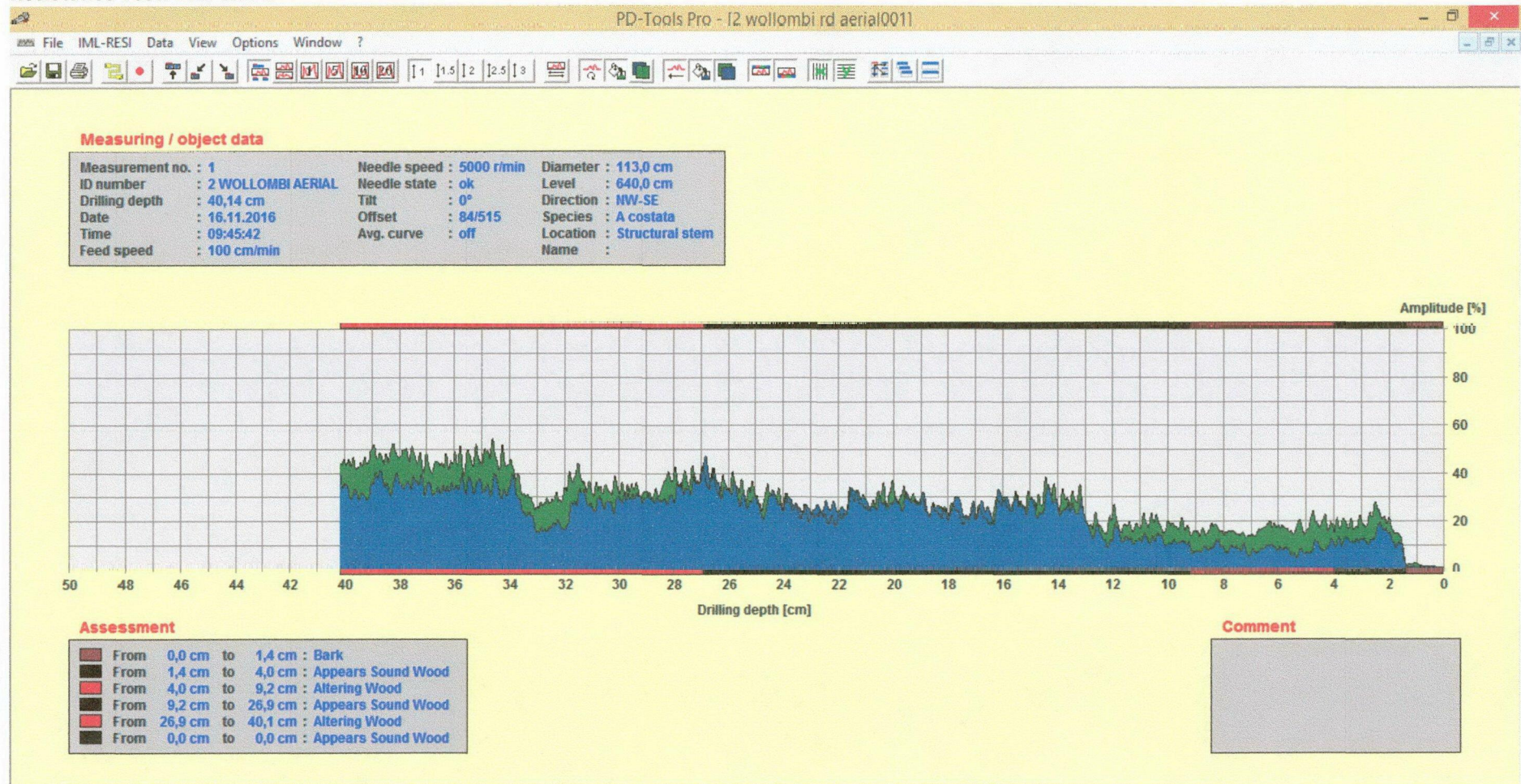
Cross Section of structural trunk stem 6.4m agl



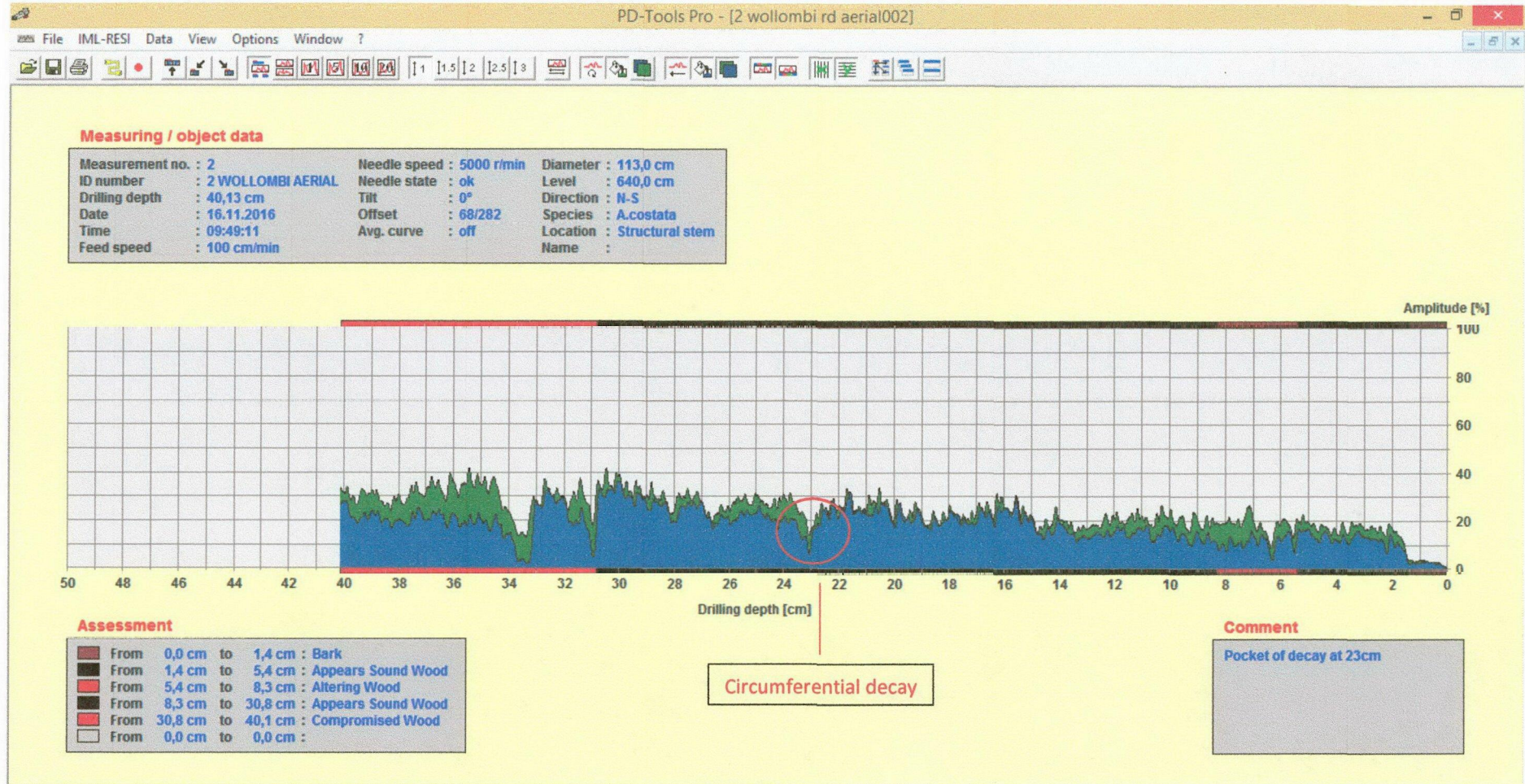
Comparative Resistance test



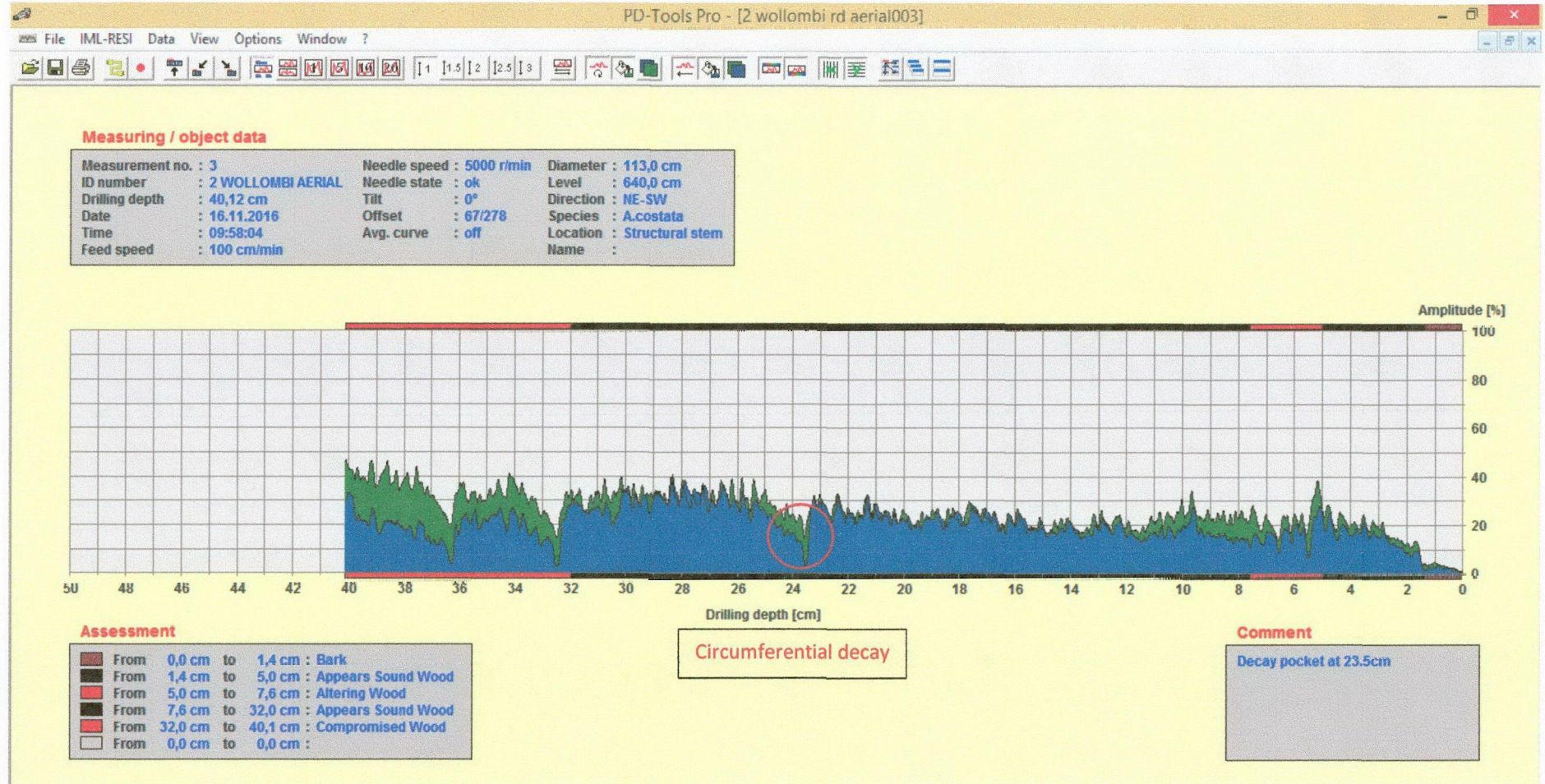
Resistance Test. Drill test 1



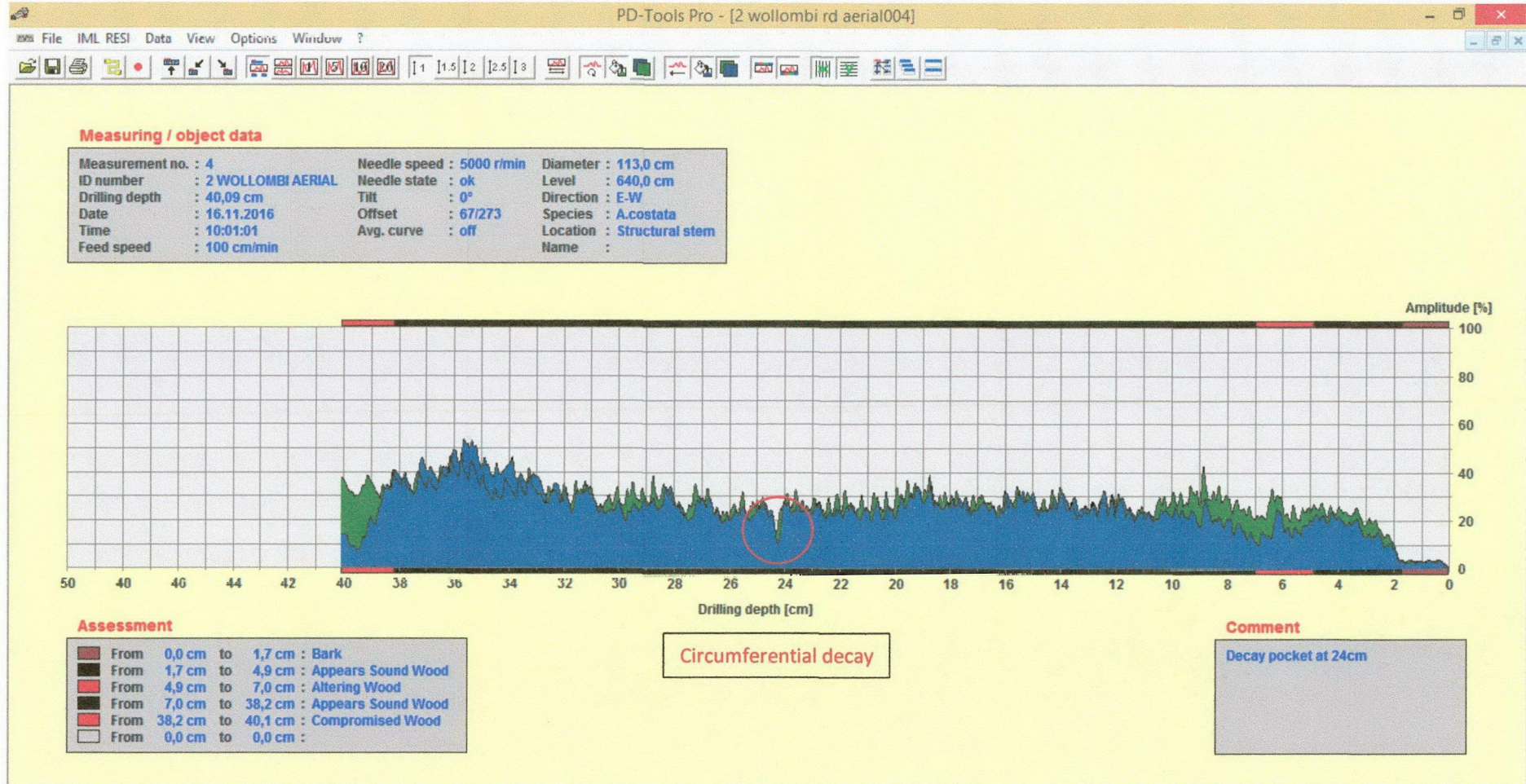
Resistance Test. Drill test 2



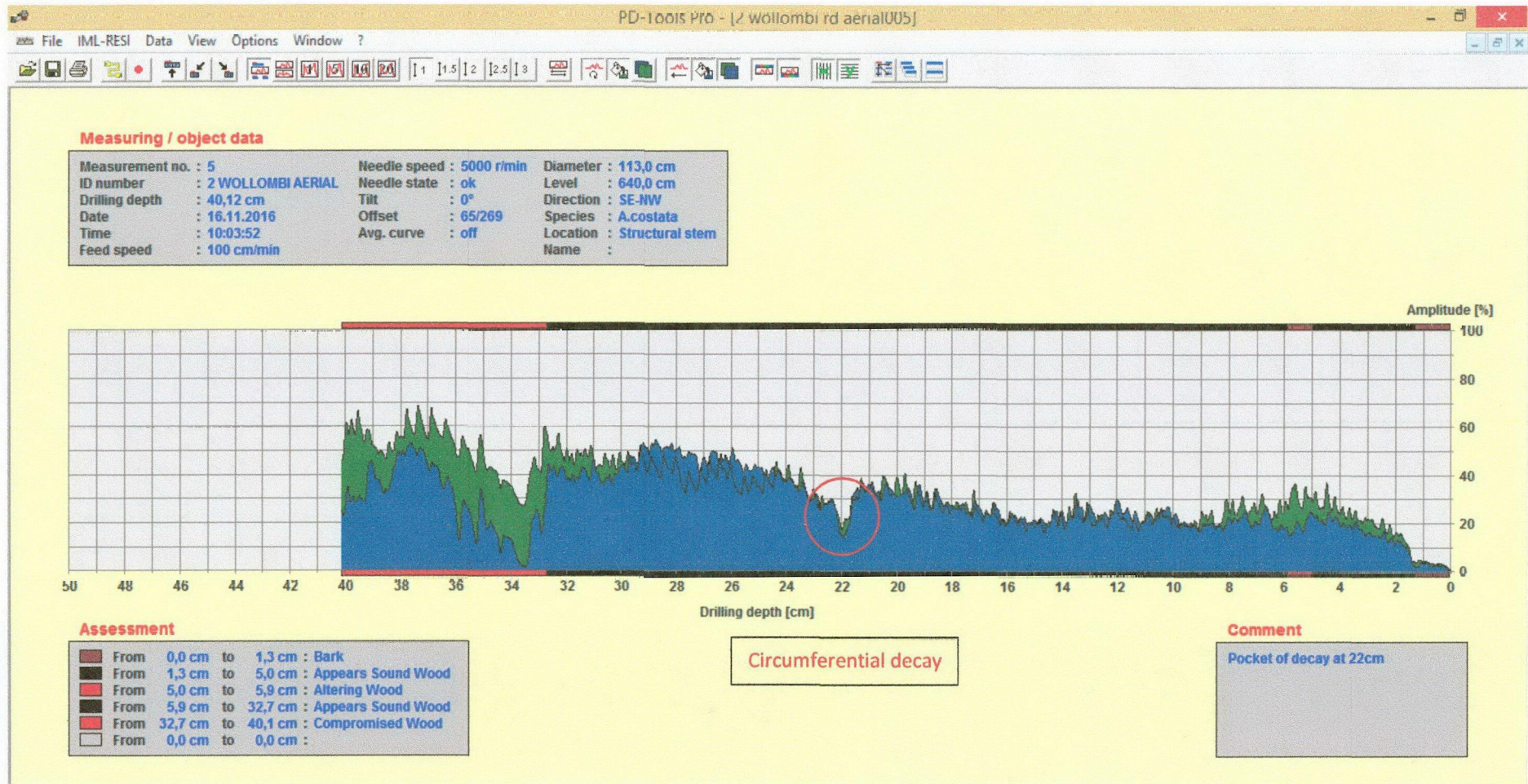
Resistance test. Drill Test 3



Resistance Test Drill Test 4



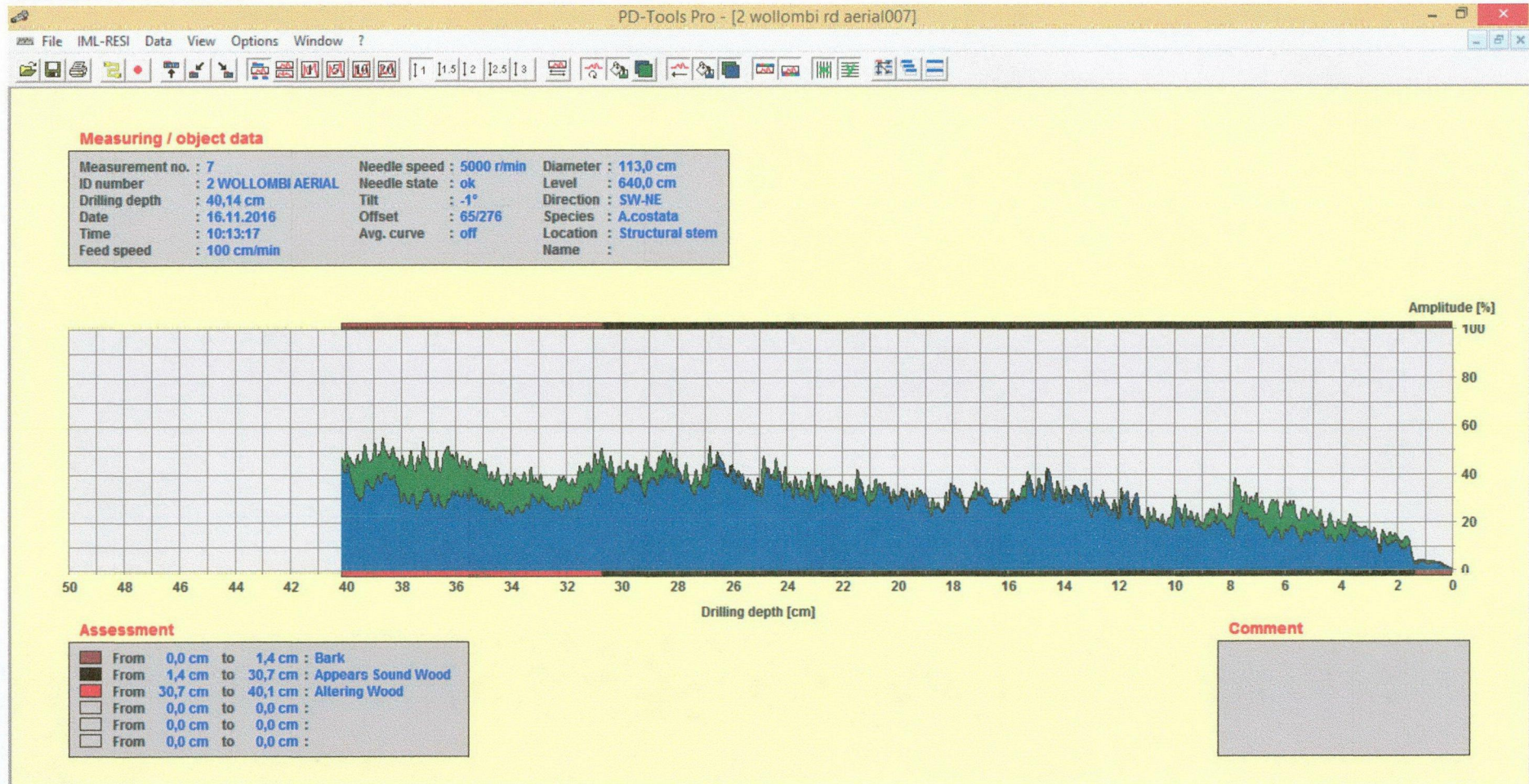
Resistance Test Drill Test 5



Resistance Test Drill Test 6



Resistance Test Drill Test 7



Resistance Test Drill Test 8



Structural branch Resistance Test Results indicated;

The resistance test results and cross section detailed within this report are evaluated against;

- Asymmetrical decay formula – C. Mattheck
- W. W. Wilcox et al: Review of Literature on The Effects of Early Stages of Decay on Wood Strength.
Concludes static bending loss of 60% at 10% decay
And tensile strength loss 20-50% at 10% decay.

Cross Section Decay Observations and wood loss calculations within structural branch

- Estimated compression wood loss 47% and 53% remaining (t) (t/r d2)
- Estimated tensile wood loss 74% and 26% remaining (t) (t/r d6)
- Poor adaptive supporting wood formation.
- Loading of defective structural stem – North
- Significant loss of 'bending moment' and stem strength.

Used as a guide only.

Note: Many trees have variable upper canopy and trunk loadings and are often not symmetrical and 'Centralised'. Tree's often produce reaction strengthening wood to compensate for a weakness within its structure. All variable biotic and abiotic conditions has been taken into account in determining the likelihood of failure as detailed within this report.

Frank Rinn – Excerpt from ISA Arbor February 2011 pg. 52-54 ‘Basic Aspects of Mechanical Stability of Tree Cross-Sections’.

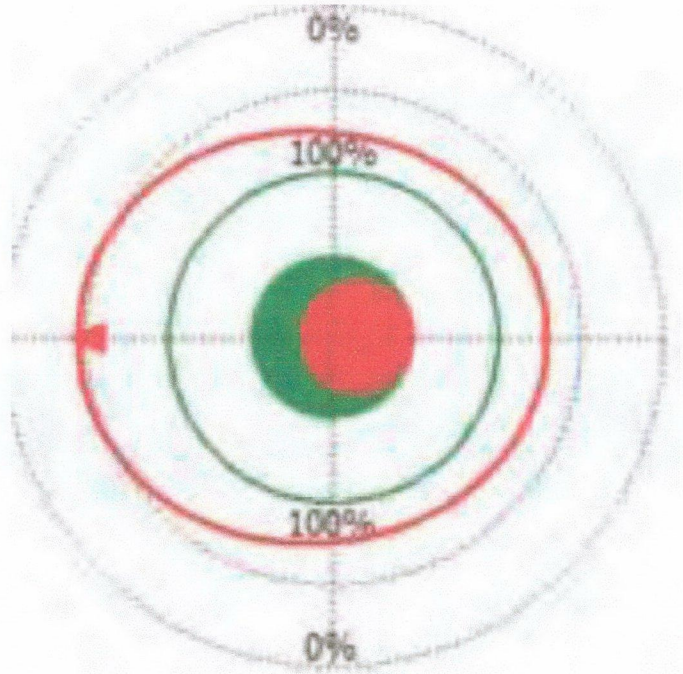


Figure 8. If a cavity covers 50 percent of the cross-section area and is located at the edge, the corresponding relative strength loss is doubled as compared to being located at the center.

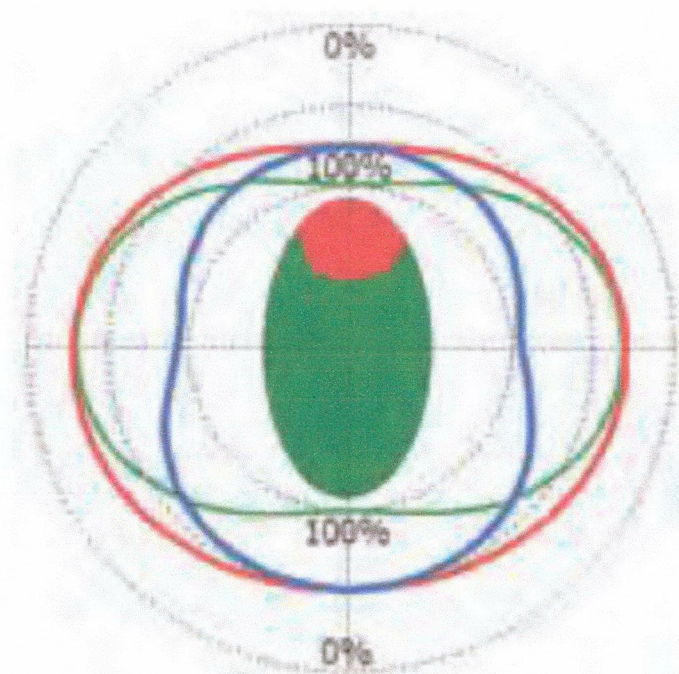


Figure 9. The blue curve reveals the relative strength loss for all load directions due to decay. It is used for evaluating failure potential and as a base for determining risk mitigation strategies, for example a corresponding wind load reduction by pruning.

W. W. Wilcox: Excerpt from research paper 'Review of Literature on The Effects of Early Stages of Decay on Wood Strength'.

TABLE 1. Estimated values for strength losses in softwoods and hardwoods at early stages of decay (indicated by weight loss) by brown-rot and white-rot fungi as a percentage of the values for non-decayed samples*

Approximate weight loss (percent)	Strength property*										
	Toughness	Impact bending	General bending strength	Work to maximum limit	Modulus of rupture	Modulus of elasticity	Compression perpendicular (parallel)	Compression parallel	Tension parallel	Shear parallel	Hardness
Brown rot:											
Softwoods											
1	57	20-38	—	—	—	—	—	—	—	2	—
2	—	20-50	5	27	13-50	4-55	18-24	10	23-49	—	—
4	75	25-55	—	—	—	—	25-35	—	—	6	7
6	—	62-72	16	—	61	66	48	25	60	—	—
8	—	78	—	—	—	—	48-60	—	50	15	21
10	—	85	36	—	70	—	66	45	—	20	—
Hardwoods											
1	—	6-27	—	—	—	—	—	—	—	—	—
2	36	31-50	—	54	32	—	6-10	—	56	—	—
4	—	60-70	—	69	49	—	—	—	—	—	—
6	—	80	—	75	61	—	16-25	—	—	—	—
8	—	9-89	13-34	—	—	—	19	—	82	—	—
10	60	70-92	—	—	—	—	—	—	—	—	—
White rot:											
Softwoods											
1	55	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	10-20	—	4-38	—	—
4	—	—	—	—	—	—	—	—	8-43	—	—
6	75	—	—	—	—	—	32-61	—	10-49	—	—
8	—	—	—	—	—	—	—	—	14-58	—	—
10	85	—	—	—	—	—	—	—	20-63	—	—
Hardwoods											
1	—	21	—	—	—	—	4	—	—	—	—
2	—	26	—	28-35	13-14	4	5	—	22-42	—	—
4	70	41	—	38	20	—	—	—	17-44	—	—
6	75	50	—	45-53	20-27	10	12-27	14	12-58	—	18
8	—	—	—	—	—	—	—	—	14-49	—	—
10	85	60	—	58	24	14	35	20	20-50	—	25

* Values obtained from published experimental results and adjusted to equivalent weight-loss levels.

decay. At 10% weight loss one should expect losses of about 60% in compression perpendicular, 40% in compression parallel, 50-60% in tension parallel, and perhaps 20% in shear and hardness.

Clearly, wood loses most of its ability to withstand shock loads, absorb energy, and support loads in a bending mode at such early stages of decay that they are difficult to detect in all cases and may be overlooked in routine diagnostic procedures. If decay is detectable, the wood should be suspected

of lacking almost all strength in all the properties listed above.

REFERENCES

BROWN, F. L. 1963. A tensile strength test for comparative evaluation of wood preservatives. For. Prod. J. 13(9):405-412.
 CARTWRIGHT, K. ST. G., W. P. K. FINDLAY, C. J. CHAPLIN, AND W. G. CAMPBELL. 1931. The effect of progressive decay by *Trametes serialis* P. on the mechanical strength of the wood of Sitka spruce. Great Britain Dep. Sci. Ind. Res. For. Prod. Res. Bull. No. 11.

Wilcox et al –

Impact bending strength loss (shock loading) (Hardwood)

White rot = 20% at 1%, 50% at 6% and 60% at 9% weight loss (Decay)

Brown rot = 6% at 1%, 50 at 8% and 70% at 9% weight loss (Decay)

Static bending strength loss

White rot = 35% at 2%, 50% at 5% and 60% at 10% weight loss (Decay)

Brown rot = 50% at 2%, 75% at 5% weight loss (Decay)

Strength loss in tension wood; (Hardwood)

White rot = 22%-42% at 2% and 20-50% at 10% weight loss (Decay)

Brown rot = 56% at 2% and 82% at 8% weight loss (Decay)

Risk Rating

Risk Rating

Matrix 1 – Likelihood matrix (2013 ISA Tree Risk Assessment Manual).

Tree Hazard Part – Structural stem 6.4m agl

Likelihood of Failure (Tree part)	Likelihood of Impacting Target			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2 – Risk Rating Matrix. (2013 ISA Tree Risk Assessment Manual).

Structural stem 6.4m agl

Likelihood of Failure and Impact	Consequences			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Risk Rating = High

Residual Risk Rating. Structural stem 6.4m agl

Likelihood of Failure and Impact	Consequences			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Categorised Residual Risk Rating Subject Tree = High

10. Recommendations.

The subject tree has been categorised under the IACA Tree Retention Value (S.T.A.R.S) as 'Priority for Removal'.

The categorised residual risk rating was high.

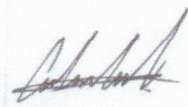
I recommend the following arboricultural management;

- Removal of hazardous tree.
- Replacement planting of two (2) same genus species tree to replenish canopy loss and to compliment / maintain bio-diversity.

Please call me if I may be of further assistance.

Yours faithfully,

Arboricultural Tree Services Pty Ltd



Graham Brooks dip arb

Managing director. Arboriculture Australia Consulting Arborist No: 1983

ISA TRAQ Certified Arborist 2014-2019

Member of ISA & Arb' Australia.

ISA Mem No: 173140

Appendix 1 – Significance of a Tree, Assessment Rating System* (IACA 2010) – S.T.A.R.S. ©

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

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

Tree Significance - Assessment Criteria



High Significance in landscape

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

Medium Significance in landscape

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

Low Significance in landscape

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

Environmental Pest / Noxious Weed Species

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

Hazardous/Irreversible Decline

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

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

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

Institute of Australian Consulting Arboriculturists (IACA 2010), *IACA Significance of a Tree, Assessment Rating System (STARS)*, www.iaca.org.au

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

Tree Retention Value - Priority Matrix

Estimated Life Expectancy	Significance in Landscape			Environmental Pest / Noxious Weed Species	Hazardous / Irreversible Decline
	High	Medium	Low		
Long >40 years	Priority for Retention	Consider for Retention	Consider for Retention	Consider for Removal	Priority for Removal
Medium 15-40 years	Priority for Retention	Consider for Retention	Consider for Removal	Consider for Removal	Priority for Removal
Short <1-15 years	Consider for Removal	Consider for Removal	Consider for Removal	Consider for Removal	Priority for Removal
Dead	Consider for Removal	Priority for Removal	Priority for Removal	Priority for Removal	Priority for Removal

Legend for Matrix Assessment	
Priority for Retention	These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard AS4970 <i>Protection of trees on development sites</i> . Tree sensitive construction measures should be implemented if works are to proceed within the Tree Protection Zone (e.g. use of pier and beam footings).
Consider for Retention	These trees may be retained and protected. These are considered less critical; however their retention should remain a priority with removal considered only if adversely affecting the proposed works and other alternatives have been considered and exhausted.
Consider for Removal	These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
Priority for Removal	These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

*IACA 2010, IACA Significance of a Tree, Assessment Rating System (STARS), Institute of Australian Consulting Arboriculturists, www.iaca.org.au



Appendix 2

Resistograph Terminology and Interpretation



IML Resistograph Testing Standard, Procedures & Audit
IML Australia © 2013

Safe Work method Statement: Attached.

PPE – Personal protection equipment:

(as per attached safe Work Method Statement)

- Ear protection
- Approved safety footwear
- Safety glasses/visors
- Reflective jacket/clothing

Pre Resi Test Checks:

- Ensure batteries are fully charged
- Enter correct ID number on Resi
- Enter the right Feed Speed for the particular species (if unsure, always start with a lower speed – 1 or 2)

- ideal is close to 40% amplitude
- Check and record Cardinal Direction
- Measure and record the height of Measurement
- Ensure needle exit is clean and free of sap etc.
- Ensure a steady and comfortable Position
- Check correct feed speed and RPM for the job

Resistograph Methodology: IML PD-400

The Resistograph inserts a 1.4 mm needle (drill bit) into the tree to measure the resistance of wood. The measurement is then transferred electronically to a graph that clearly shows various stages of decay, as well as white rot, brown rot, termites etc.

The more resistance in the tested area, the higher is the amplitude in the graph and therefore shows sound wood.

If the amplitude drops below a certain level (in reference to good wood) then an experienced operator can determine the extent and stages of decay.

The “**decay analysing software**” helps to show the sound wood and decay clearly by the red and green markings. This ensures easy to understand reports.

This method does NOT harm the tree! (C. Mattheck)

Resi Testing Procedure:

Ensure all operation is carried out in accordance with the relevant Safe Work Method Statement

The Resi test’s should be conducted on the most likely area where decay or defect is suspected.

Therefore a VTA (Visual Tree Assessment) is imperative before commencing any testing.

The operator is looking for general health, wounds, swelling, included bark, fungi and any other obvious or less obvious signs.

- After pressing the Red Start Button at the rear of the Resi it is imperative to maintain weight and pressure during the entire drilling procedure
- It is recommended not to exceed more than 6 cm of hollow to prevent needle deviation (better to measure the amount of sound wood)
- After needle retraction check Needle Check and ensure that the measurement was stored correctly (Resi will indicate this)
- Write down comments and observations on this particular test drill in reference to the ID number
- Conduct as many or few measurements necessary to form an informed opinion on the inside state of the particular tree
- After conclusive testing, ensure the Resi is being carefully laid back into the padded hard case
- Ensure drilling needle is always clean and sharp

Conduct as many or few Resi test’s necessary to give the operator a clear understanding of the inside state of the tree. – There is no direct rule as to how many test’s should be undertaken on a tree. Four test’s (one on each cardinal direction) on the same level provides a reasonable “picture”.

3/6

Resi PD Speed:

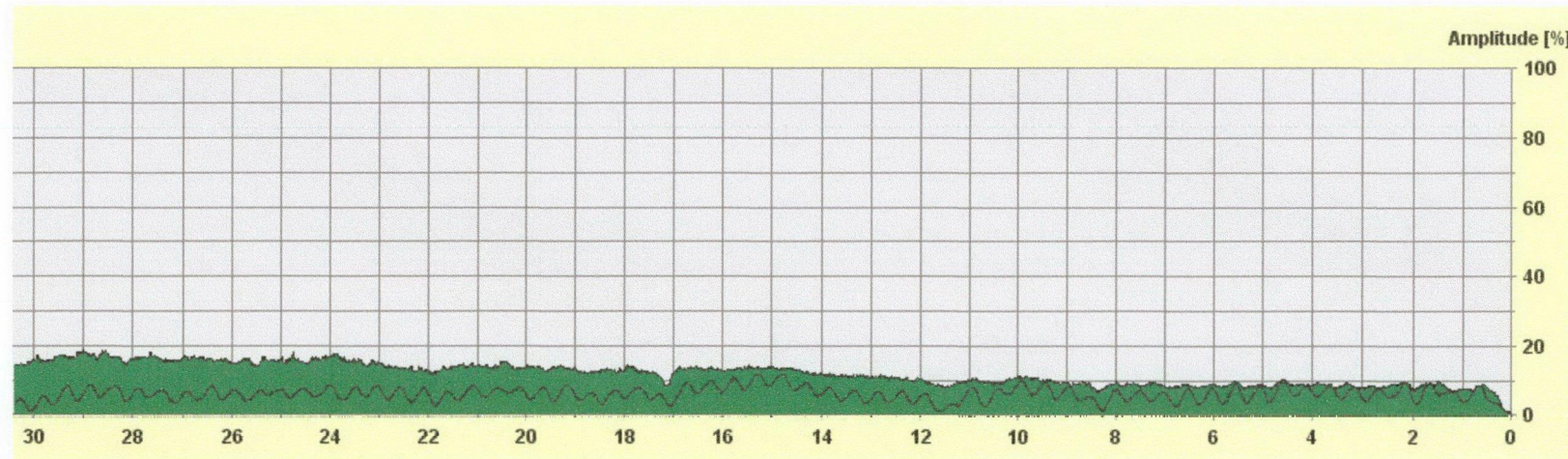
There are 5 feed speed and various needle speed settings available.

- For hard and tropical wood a needle speed of 5000 RPM is recommended
- The harder the wood, the higher the RPM and the lower the feed speed!
- Try to achieve an average drill graph amplitude of around 40 to 60%

Feed Speed # 1 @ 25 cm per minute

Feed Speed # 5 @ 250 cm per minute

Tip: Use 5000 RPM for wood with excessive sap.



Feed Speed # 1 @ 25 cm per minute

Tip: Use 5000 RPM for wood with excessive sap.

Direction:

The software asks for cardinal direction: drilling towards

Example: Drilling direction: North – then the operator drills on the southern trunk.

4/6

Test & Graph interpretation:

As the Resistograph delivers a “relative” measurement, the results are shown in a graph. Basically the higher the amplitude of the graph, the more resistance, therefore the more sound. A low amplitude in the graph or a sudden fall in amplitude indicates decay or hollow. The spikes visible in a sound wood graph indicate growth rings (depending on species – i.e. pine species show distinct growth rings)

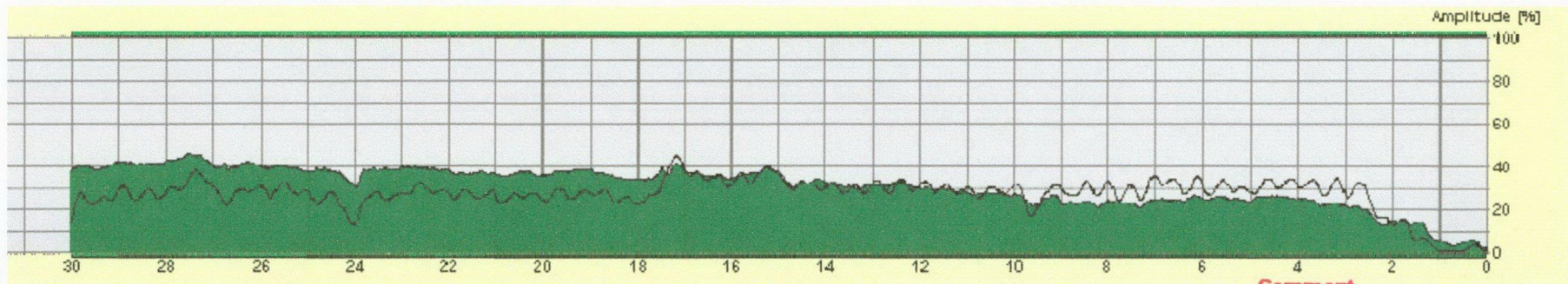
Amplitude of Graph:

Amplitude is shown in percentage and divided into 10 sections each section representing 10 %

Various stages of decay and incipient wood (changing wood)

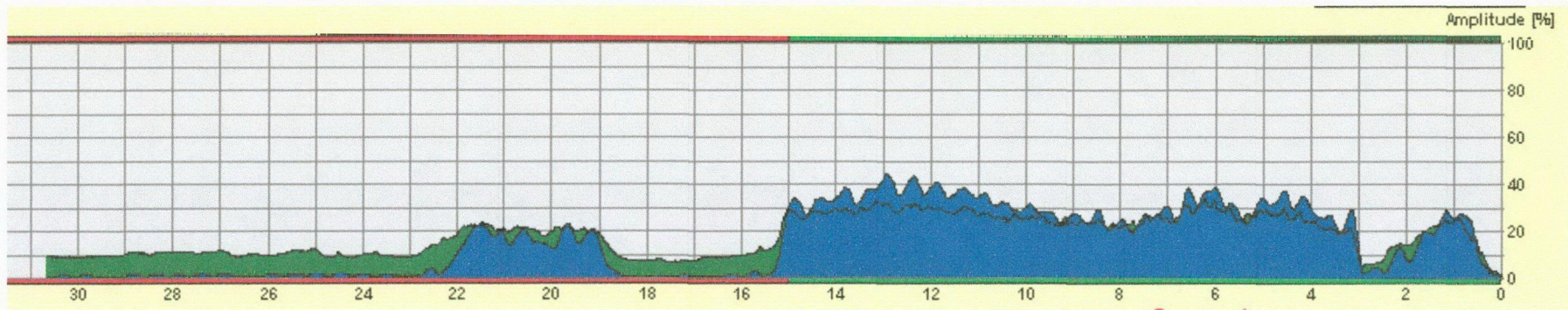
The test can show various stages of decay and incipient wood (changing wood) depending on the position, speed and amplitude of the test graph.

- Graph amplitude below 10 % usually indicates significant decay (very soft) or hollow
 - Graph amplitude between 10% and 20% could mean incipient (changing wood) – no structural strength!
- This is on the assumption that the average amplitude of the reference test drill is between 40% and 55%

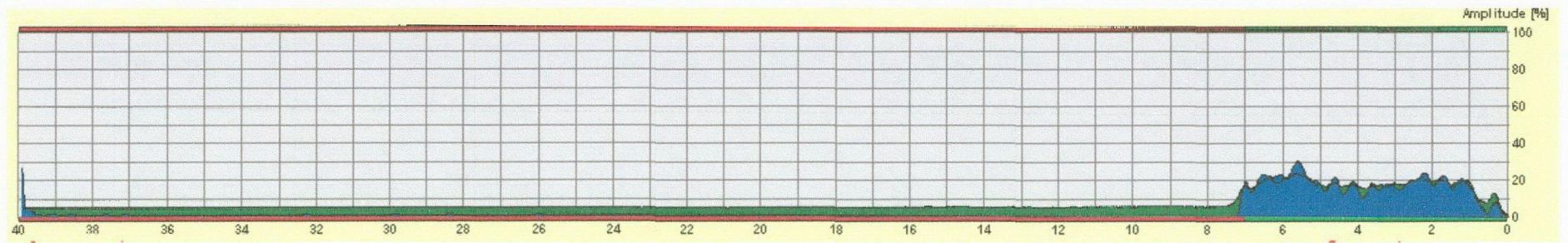


This test graph example shows a sound Silky Oak (*Grevillia robusta*)

Average amplitude around 40%



This test graph example shows decay in a pine species from 15 cm and “free floating wood” at 19 to 22 cm. Please note: “Free Floating” wood is not structurally sound!



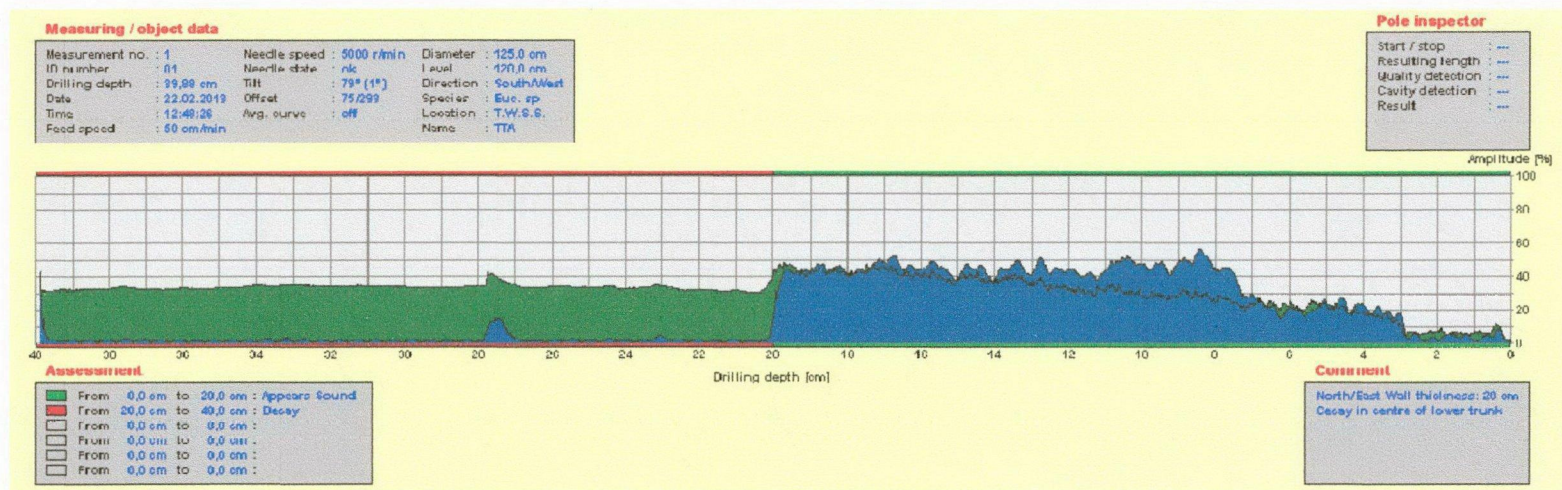
This test graph example shows significant decay leaving 7 cm wall thickness

Reference Test Drill:

To confirm unclear graph and test measurement to the operator, a “reference test” is recommended. The reference test is conducted on the likeliest sound areas of the tree. i.e. sound buttress or muscle on tension side of the tree.

Feed Curve vs. Drilling Curve (PD- Series & Feed Module only)

The high Amplitude in the graph showing “Shaft Friction” can be often mistaken for sound wood. The amplitude continues to increase in the graph due to shaft friction on the needle. Therefore decay is often only a slight drop in amplitude.



This graph example indicates decay from 20 cm onwards (blue = feed curve – green = drill curve)

For further reference we recommend: Basic Decay Detection Manual ISBN 0-646-46859-6 by P.Blank – or contact: imlaustralia@bigpond.com

6/6

Tree management program according to test results and findings:

If no decay is found on the most likely area and the operator is satisfied with the testing a normal “monitor” program would prevail.

Various stages and size of Decay or Hollow:

- Large area of total decay or hollow (amplitude well below 10%) – Immediate action, depending on target area and species!

- Medium size are of total decay or hollow (amplitude well below 10%) – Discretionary action, depending on target area and species!

- Large area of incipient wood (classed as decay due to no structural strength) – Discretionary action, depending on target area and species!

- The recommended action undertaken by the relevant authority or individual on any smaller percentage in size and decay stages is again discretionary depending on target area and species.

Example: A 30% decayed main trunk of a known structural unsound species situated in a children’s playground is obviously of higher priority than a 50% decayed tree in a field with little or no traffic/targets.

Appropriate action in reference to the findings is mostly up to the individual laws and guidelines.

Removal, weight & crown reduction, limb removal or monitor.

Watch the **Reaction zone!**

If there is a definite spike, this means that the tree is creating a barrier and the tree is doing something about it to prevent further decay infestation.

If it is only a gradual graph drop and no definite reaction (barrier) zone then this shows the different stages of decay and the tree is not able to compartmentalise.

Therefore it is advisable to test again in 12 month time to quantify the extend and speed of possible spreading decay.

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If no decay is found on the most likely area and the operator is satisfied with the testing a normal “monitor” program would prevail.

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- Medium size are of total decay or hollow (amplitude well below 10%) – Discretionary action, depending on target area and species !
- Large area of incipient wood (classed as decay due to no structural strength) – Discretionary action, depending on target area and species !
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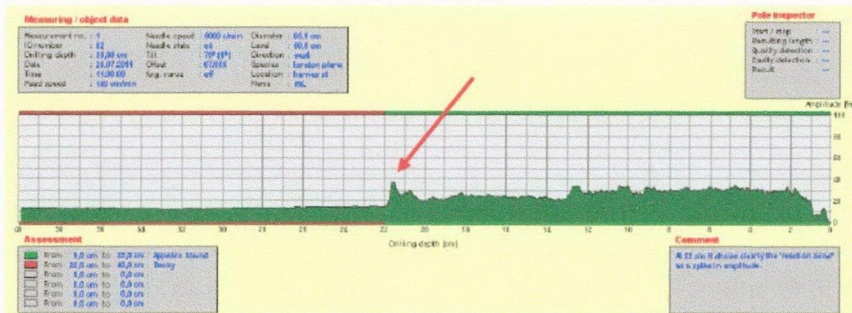
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If there is a definite spike, this means that the tree is creating a barrier and the tree is doing something about it to prevent further decay infestation.

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Therefore it is advisable to test again in 12 month time to quantify the extend and speed of possible spreading decay.



This graph example shows clearly the reaction (barrier) zone before the decay zone at 21.5 cm manifested as a spike in amplitude.

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Appendix 3 Glossary of Terminology

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

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

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

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

Condition of Trees

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

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

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 vigor.

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 vigor but may be independent of a change in vigor, 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 vigor.

Moribund Advanced state of decline, dying or nearly dead.

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

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

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

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

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

Symptoms

Permanent leaf loss;

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

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

Branch

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

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

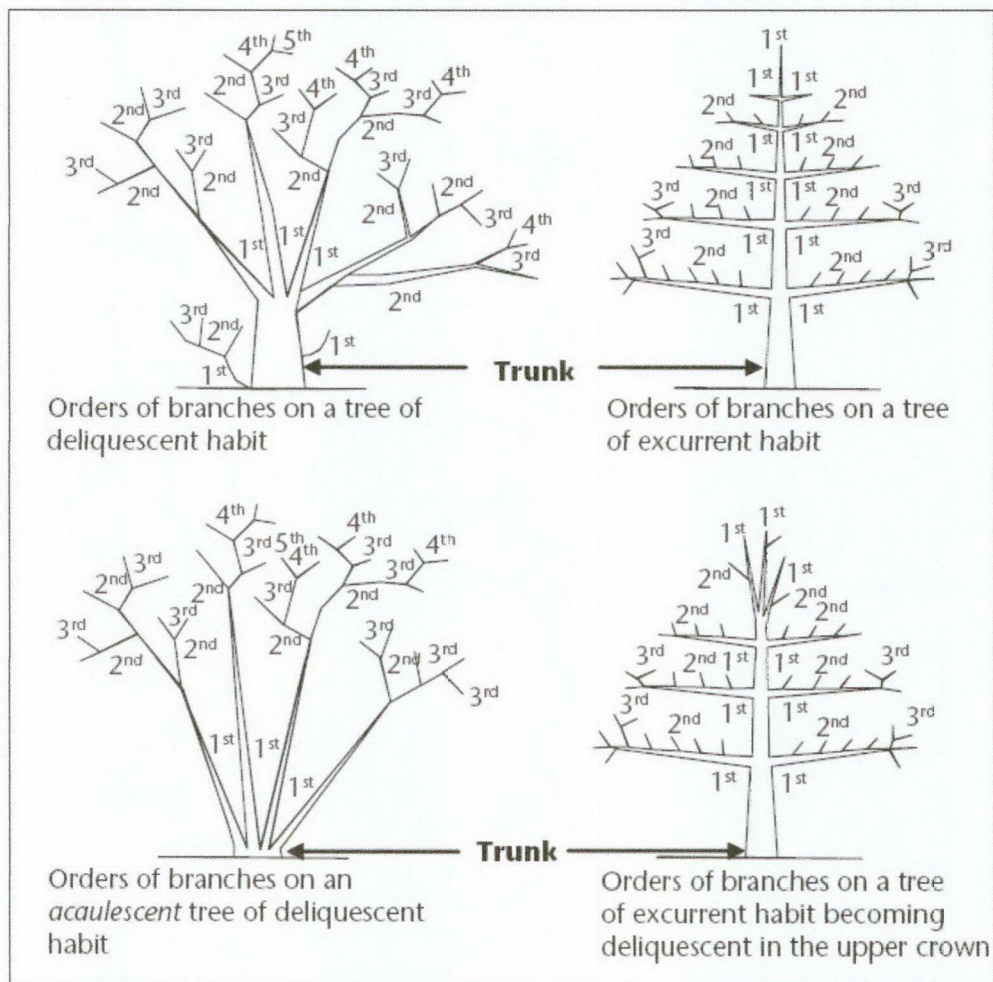


Figure 21 Orders of branches

Crown

Canopy 1. Of multiple trees, the convergence, or merging in full or part, of the crowns of two or more trees due to their proximity, or where competition for light and space available in a forest environment is limited as each tree develops forming a continuous layer

of foliage. 2. Used as a plural for crown. 3. Sometimes synonymously used for crown (USA).

Crown Of an individual tree all the parts arising above the trunk where it terminates by its division forming branches, e.g. the branches, leaves, flowers and fruit; or the total amount of foliage supported by the branches. The crown of any tree can be divided vertically into three sections and can be categorised as *lower crown*, *mid crown* and *upper crown* (Figure 8). For a *leaning* tree these can be divided evenly into crown sections of one-third from the *base* to *apex*. The volume of a crown can be categorised as the *inner crown*, *outer crown* and *outer extremity of crown* (Figure 9).

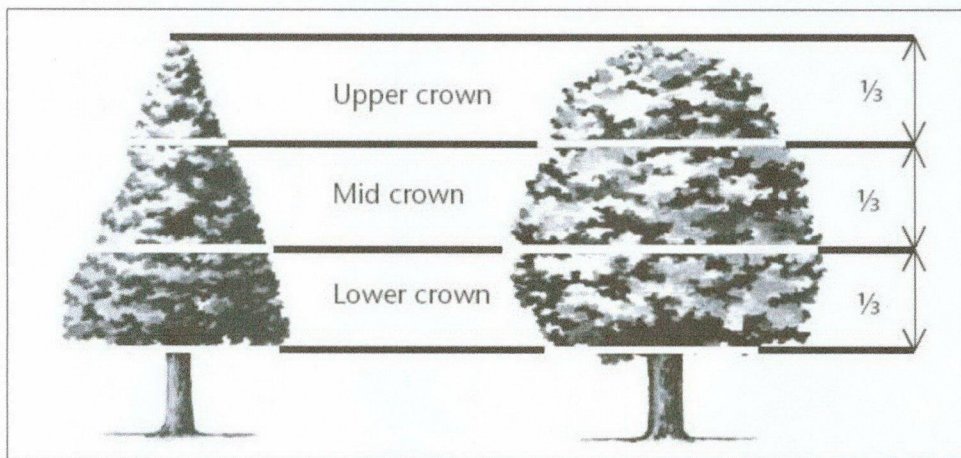


Figure 8 Sections of crown.

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

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

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

Deadwood

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

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

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

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

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

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

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

Dieback

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

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

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

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

Epicormic shoots

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

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

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

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

General Terms

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

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

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

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

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

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

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

Leaning Trees

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

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

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

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

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

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

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

Periods of Time

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

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

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

Medium Term A period of time 15 – 40 years.

Long Term A period of time greater than >40 years.

Trunk

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

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

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

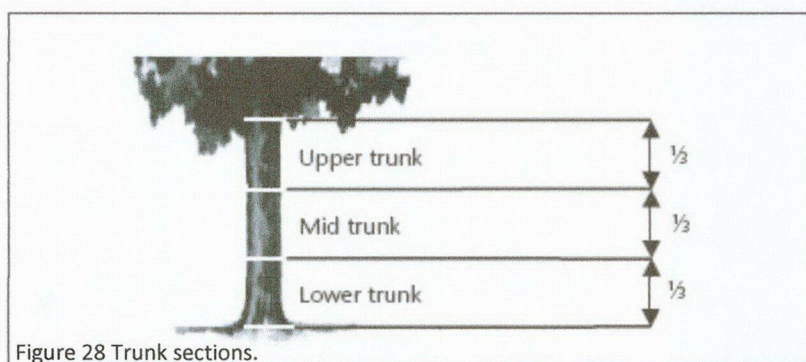


Figure 28 Trunk sections.

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

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

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

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. Vigor can appear to alter rapidly with change of seasons (seasonality) e.g. *dormant*, *deciduous* or *semi-deciduous* trees. Vigor can be categorized as *Normal Vigor*, *High Vigor*, *Low Vigor* and *Dormant Tree Vigor*.

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

High Vigor *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 favorable conditions cease, or promote *prolonged senescence* if the favorable 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 Vigor** **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.**

Symmetry

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

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

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

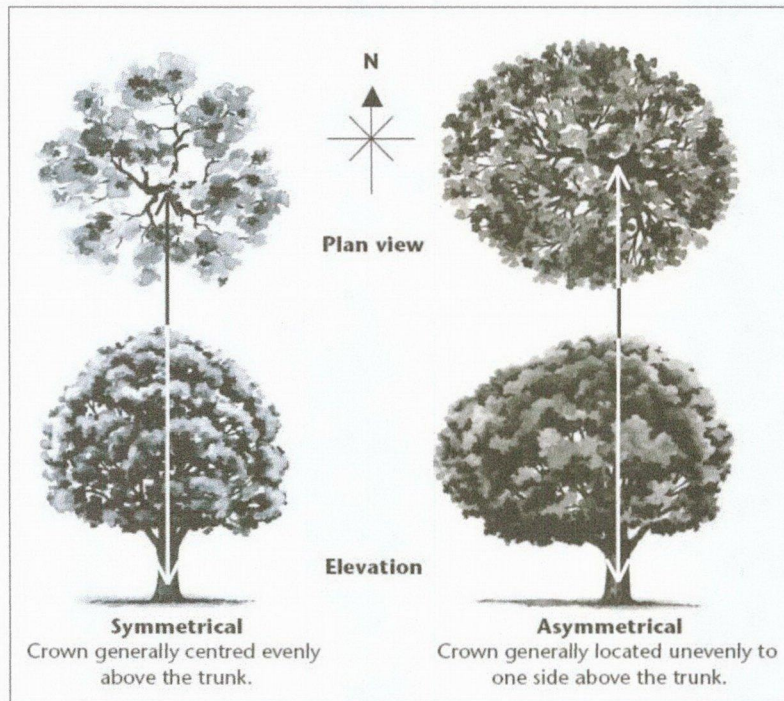


Figure 27 Symmetry within crown

Roots

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

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

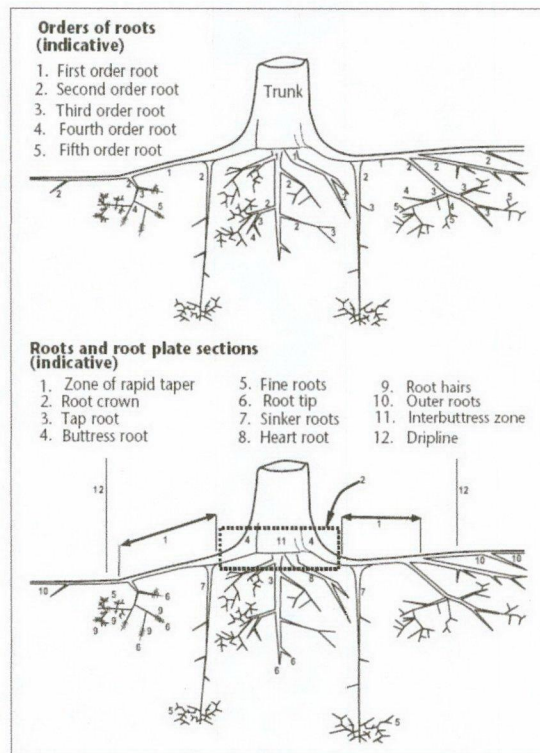


Figure 22 Orders of Roots

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

Root Crown Roots arising at the base of a trunk.

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

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

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Assumptions and Limiting Conditions

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It is assumed that any property is not in violation of any applicable codes, statutes, or any other Local, State or Federal Government regulations.

Care has been taken to obtain all information from reliable sources. All data has been verified insofar as possible; however, the consultant can neither guarantee nor be responsible for the accuracy of information supplied by others.

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An important statement is made at this point that all standing trees are inherently dangerous and require ongoing maintenance for their life span. Regular checks by qualified Arborists should be carried out on all trees to reduce risks.

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Graham Brooks. Senior Principal Arborist

Appendix 4

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