MOORE TREES
Consulting Arborist

Picus Sonic Tomograph Test Report

Beecroft Village shops carpark

Prepared for

Hornsby Shire Council, PO Box 37, Hornsby NSW 1630

Prepared by

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Moore Trees

February 2023

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Summary

This report has been commissioned by Gareth Hambridge, Tree Management Officer, Parks & Recreation, Hornsby Shire Council, PO Box 37, Hornsby NSW 1630. The report concerns one (1) mature tree located at Beecroft Village shops car park (Map 1). The subject tree is a Narrow-leaved Ironbark *(Eucalyptus crebra).*

For this report I have conducted a single ultrasound test on the subject tree. This test has been undertaken with the use of the Picus® Sonic Tomograph. This instrument uses the velocity of sound waves to calculate the area of sound wood within the test site of the subject tree. Test results are shown as a colour coded two dimensional image. This report is known as a Structural Test Report.

The site visit and test were undertaken on the 8th February 2023 on the subject tree.

One (1) ultrasound test has been conducted on this tree. Test 1 was conducted at one hundred (100) millimetres from ground level (Plate 3 and 4). The test was undertaken to assess the structural integrity of the base of the tree due to the presence of the wound and fruiting body.

The test results show that the tree has 36% sound wood at the test location and 55% is showing as damaged wood (Plate 5).

The subject tree is becoming structurally compromised at the base. It is unlikely an area of decay this large will compartmentalize completely due to the extent of decay involved. Due to the decay being within the basal area it is also possible that the roots of this tree have been affected by the decay fungi. Due to the element of risk that this tree could fail at the root plate or main stem, I have recommended this tree be removed.

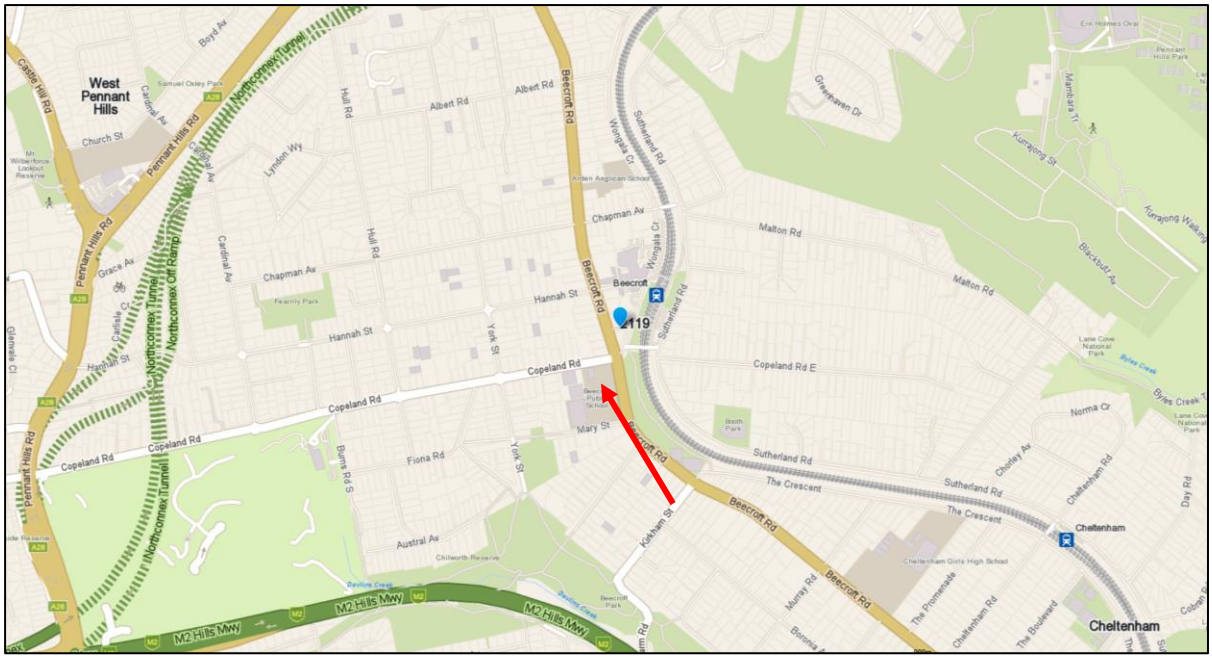
Table of Contents

1. Introduction

This report has been commissioned by Gareth Hambridge, Tree Management Officer, Parks & Recreation, Hornsby Shire Council, PO Box 37, Hornsby NSW 1630. The report concerns one (1) mature tree located at Beecroft Village shops car park (Map 1). The subject tree is a Narrow-leaved Ironbark *(Eucalyptus crebra)*.

For the purpose of this report an ultrasound test has been conducted on the subject tree. This test has been undertaken with the use of the Picus® Sonic Tomograph. This instrument uses the velocity of sound waves to calculate the area of sound wood within a tree. Test results are shown as a colour coded two dimensional image.

A visual tree assessment (VTA) was performed on the subject tree however no root excavations were conducted as a part of this report.



Map 1: Red arrow is the approximate location of the subject tree. (whereis.com.au, 2023)

2. Methodology

2.1 The Picus® Sonic Tomograph

The Picus® Sonic Tomograph was developed by The Company Argus Electronics GmbH, Germany. It is a device created to measure decay within trees. The device has been accepted worldwide as a leading method of near nondestructive testing of trees. This instrument uses the velocity of sound waves to calculate the area of decay within a tree. These sound waves are activated from sensors placed around the tree.

Image of a typical test set up.

Ultrasonic velocity has been demonstrated to be very sensitive to the early stages of wood degradation (Wilcox, 1988). Test results are shown as a colour coded two dimensional image (Plate 3). The lower limit to the size of defect that the Picus can detect depends on the size of the tree, number of sensors, and type of wood. The higher density of the wood, the smaller the defect that can be detected (Gilbert & Smiley, 2004).

To date, Moore Trees has conducted numerous destructive tests (where the subject tree has been cut down) on many species of trees, both native and exotic. These tests have confirmed the accuracy of the Picus® Sonic Tomograph. Other independent studies have also confirmed the accuracy of this device (Schwarze, Rabe, Ferner & Fink, 2004). Ultrasonic tomography has been compared with other Tomographic techniques (Nicolotti, 2003) and has been found to be very effective in finding small structural anomalies within a tree.

Unlike other instruments used for decay detection the Picus® Sonic Tomograph does not drill into the tree and breach the tree's barrier zones that are created to help confine and slow the spread of decay. Studies have confirmed that other invasive decay detection devices, such as drilling devices, can aid the spread of pre-existing decay within a tree (Kersten and Schwarze, 2005).

2.1.2 Analysing the Picus® Report

Please read the following points to help you understand the Picus Sonic Tomograph Report.

1. Sensor 1, unless otherwise stated, is located on the northern side of the tree.
2. The test height is always measured at sensor 1.
3. Depending on some species of fungi, the active fungus that has colonized cells will not be visible to the human eye.
4. In most cases the altering wood from the fungus cannot be seen by the human eye.
5. The circumference measurement of the Tomogram is created from the location of the tips of the pins.
6. With some readings the 'Sound wood' and 'Damaged wood' quantities will not total 100%. The unspecified quantity is wood density that cannot be measured. That means that it may be sound or it may not. It is considered to be altering wood.

The Tomogram produced by the Picus® Sonic Tomograph may at times vary to what will visually be observed when the test area is revealed. It is important that only trained professionals make comments and recommendations regarding any test results.

2.2 The t/R ratio

The t/R ratio is based on many years of study of over 1200 tree failures of broad leaved and coniferous trees (Mattheck & Breloer, 2003). This ratio is based on a 70:30 rule. The study found that when most trees achieved a decay linear measurement of greater than 70% (i.e. less than 30% sound wood) the tree had a high likelihood of failure. The theory and this study can be read in more detail in the book '*The Body Language of Trees', 2003* by Claus Mattheck and Helge Breloer, *pages 36-37.*

This t/R ratio has been used in combination with the Picus® Sonic Tomograph to assess the structural integrity and make recommendations for the future management of the subject tree.

Note: If a tomogram reading is at 51% sound wood this will indicate that the sound wood quantity has reached the limit of 30% of the t/R ratio (See Appendix 2).

2.3 Location of test

The test area was conducted at one hundred (100) millimetres, measured from ground level. This test height was taken as the lowest test point possible (within equipment limitations). The area is selected due to the wound and fruiting body location.

2.4 Report limitations

This report does not include root excavation or aerial inspection.

2.5 Testing System

The structural testing system used for this report is the Picus 3 system running 12 sensors on software version Q74.

3. Test results

PICUS test by: Paul Vezgoff
Test Height at sensor one (1), north: 100mm
Botanical Name: Narrow-leaved Iron bark *(Eucalyptus crebra)*
Location: Beecroft Village shops carpark
Date of test: 08/02/2023

Plate 1: *The subject tree,* Narrow-leaved Ironbark *(Eucalyptus crebra). P. Vezgoff.*

Summary

The subject tree is located in a public car park associated with the Beecroft Village shops. The tree is one of two (2) large mature specimens growing within the car park area, within a cut out of asphalt. Although no fruit could be found, or flowers seen, the tree appears to be a Narrow-leaved Ironbark *(Eucalyptus crebra)*. The tree is approximately nineteen (19) metres in height with a symmetrical spread of fifteen (15) metres. There is no deadwood greater than 20-30mm diameter within the canopy. There is a wound between sensors 9-11 and another smaller wound slightly above sensors 12 and 1. The wounding appears to have been happening over a number of years causing extensive cambial dieback. Wound wood is developing, however a decay pathogen has established within the wound as evidenced by the large fruiting body that is approximately one hundred and forty (140) millimetres wide between sensors 7 and 8. Another fruiting body is located on the south side of the trunk at approximately eleven (11) metres from ground level near a first order limb (Plate 3).

The asphalt surface is quite newly laid and relatively free of damage, indicating that the asphalt carpark has possibly been resurfaced in the last 10 years. It is possible that root damage has occurred in this process allowing decay pathogens to enter the heartwood of the woody surface roots and into the main stem of the tree.

The canopy of this tree is dominant in the surrounding area, and from the road to the south you can clearly see that a secondary crown has formed.

The target area below the canopy currently consists of public car park, roads and shops. It was noted that the area was continuously busy through the midday part of the day, at the time of testing.

One (1) ultrasound test has been conducted on this tree. Test 1 was conducted at one hundred (100) millimetres from ground level (Plate 3 and 4). The test was undertaken to assess the structural integrity of the base of the tree due to the presence of the wound and fruiting body.

The test results show that the tree has 36% sound wood at the test location and 55% is showing as damaged wood (Plate 5).

Plate 2: *Image showing a second fruiting body (red arrow) near the first order limb. P. Vezgoff.*

Plate 3: *North side of test area. Red line is the approximate location of the test. P. Vezgoff.*

Plate 4: *South side of test area. Red line is the approximate location of the test. P. Vezgoff.*

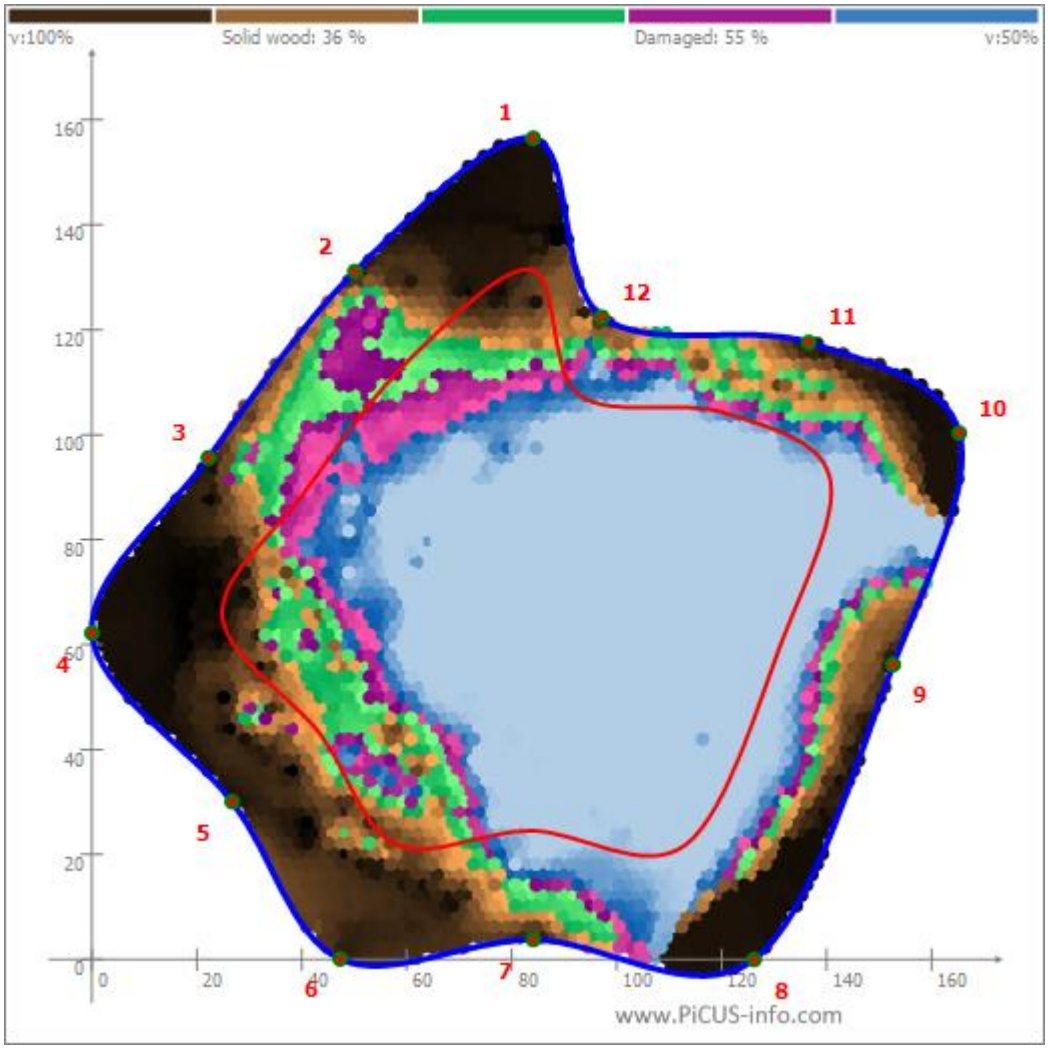


Plate 5: *Tomogram of the test location. Sensor 1 is north. The red line is indicative of the 70/30 ratio taken as a radial measurement from the centre of the trunk to each sensor. The area of damaged wood has reached the t/R limit of the red line.*

4. Conclusions

The tree has clear evidence of decay caused from either the stem wound or damaged roots. What is a decay fungus? A wood-decay fungus is any species of fungus that digests moist wood, causing it to rot losing its structural integrity. Some decay fungi can be evidenced by fruiting bodies such as "brackets" that are the reproductive system of the decay pathogen they may appear on trunks limbs or woody roots another decay pathogens such as the parasitic Armillaria is evidenced by small mushrooms that will appear between May and June around the base of the affected tree. Some fruiting bodies only grow on dead wood (saprophytes) and are of no danger to the long term health or structure of the tree.

The heartwood of a tree being the central area under the bark and cambium layer is also present in the root system. Although the heartwood is no longer conductive to xylem but does provide important structural support for the tree or root. If a decay pathogen colonises the heart wood it is known to travel much quicker through that portion of the tree.

The following conclusions can be made from the test results.

1) The subject tree has stem wounds and shows evidence of decay within these wounds.

2) The subject tree is in fair health.

3) The subject tree is not exposed to new wind forces that it has not been in the past.

4) The subject tree has 36% sound wood at the test location.

5) The subject tree will not recover from this extent of decay being present.

6) The target area would be considered a high use area for long parts of the day and week.

7) A secondary fruiting body is located further up the trunk.

8) A secondary crown has developed. A secondary crown is often a result of senescence or can occur due to severe stress. Where the epicormic shoots are produced proximally from the first and lower order branches usually in the mid crown to lower the crown, it is presumed this process occurs to save energy remnants of the original crown usually remain protruding above the new crown, as can be seen on the subject tree.

9) The wind loads for the subject tree would be reasonably high, as the tree has an exposed canopy in relation to surrounding trees and buildings.

5. Recommendations

Based on the tomogram and assessment of the test site, I have made the following recommendations for this tree.

The subject tree is becoming structurally compromised at the base. It is unlikely an area of decay this large will compartmentalize completely due to the extent of decay involved. Due to the decay being within the basal area it is also possible that the roots of this tree have been affected by the decay fungi. Due to the element of risk that this tree could fail at the root plate or main stem, I have recommended this tree be removed.

If you have any questions in relation to this report, please do not hesitate to contact me.

Yours sincerely,

Paul Vezgoff
Consulting Arborist
Dip Arb (Dist), Arb III, Hort cert, AA, ISA

14th February 2023

Moore Trees

Glossary

Barrier zone - A chemically defended tissue formed by the still living cambium, after a tree is wounded or invaded by pathogens, to inhibit the spread of decay into new annual growth rings.

Branch attachment - The structural linkage between branch and stem.

Branch Collar - The area of raised tissue around a branch.

Cellulose - Complex carbohydrate found in the cellular walls of most plants.

Decay - The process of degradation of woody tissues by fungi and bacteria through the decomposition of cellulose and lignin.

Epicormic shoot -A shoot that arises from latent or adventitious buds that occur on stems branches or the bases of trees

Flush cut - Pruning cut through / or removing the branch collar, causing unnecessary injury to the trunk or parent stem.

Hazard - A hazard is anything with the potential to harm health, life or property. (WorkCover NSW 1996)

Infrastructure - Permanent manmade installations that could consist of footpaths, buildings, underground pipes or services.

Lean - Departure of trunk from the vertical or near vertical position.

Lignin - An organic substance that impregnates certain cell walls to thicken and strengthen the cell to reduce susceptibility to decay and pest damage.

Risk - Is the likelihood or probability that a hazard will cause damage to health, life or property. (WorkCover NSW 1996)

Target Area - The area below a tree, usually within the drip zone.

Vigor - Overall health; capacity to grow and resist physiological stress.

Visual Tree Assessment - (VTA) Where a qualified Arborist will complete a detailed assessment of the tree.

Windthrow - The forces of wind pushing a tree followed by upheaval of the root plate.

Extract from the International Society of Arboriculture -
Glossary of Arboricultural Terms 2005

Appendix 1
Explanatory Notes

- **Mathematical abbreviations:** > = Greater than; < = Less than.

- **Measurements/estimates:** All dimensions are estimates unless otherwise indicated. Measurements taken with a tape or clinometer are indicated with a '*'. 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 indicate it 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 measure 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 2
t/R v Area% explanation

Percentage of area calculation

The t/R ratio is based on many years of study of over 1200 tree failures of broad leaved and coniferous trees (Mattheck & Breloer, 2003). This ratio is based on a 70:30 rule. The study found that when most trees achieved a decay linear measurement of greater than 70% (i.e. less than 30% sound wood) the tree had a high likelihood of failure. This is shown on the Diagram A below with the blue area showing the 70% and the red area showing the 30% of the radial measurement.

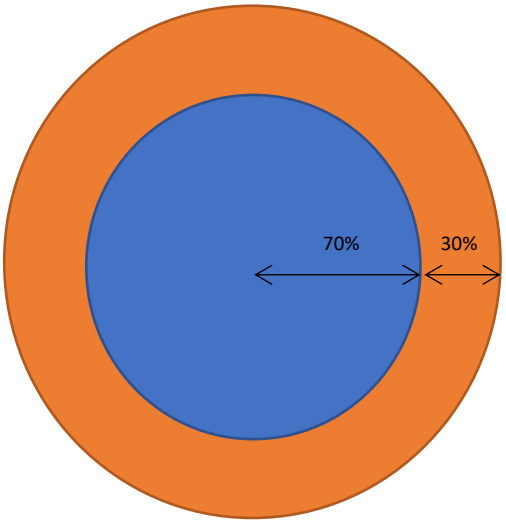
The percentage of sound wood that is shown in the colour coded tomogram image is not related to the t/R ratio. The red line in the tomogram is showing the 70/30 t/R ratio. The percentage of wood quantities in the top right corner of the tomogram are area calculations.

The following calculation can be applied to realize the percentage of the red area of the Diagram A, below.

$A = \pi r^2$ let complete radius = 10cm
Therefore let 70% of the radius=7cm
30% of the radius=3cm
Therefore $\pi\ x\ 10^2 - \pi\ x\ 7^2 =$ ` 30% of radius
$\pi\ x\ 10^2 - \pi x 7^2 \quad = 3.141592654 - 153.93804$
=160.2212254
To find the percentage $= \frac{x}{y}$ x 100
Therefore percentage $= \frac{160.2212254}{314.1592654}\ x\ 100$
=50.99
=51%
Therefore the percentage of the red area is 51%.

Thus, if a tomogram reading is at 51% sound wood this will indicate that the sound wood quantity has reached the limit of 30% of the t/R ratio.

Diagram A



Appendix 3
Bibliography

Draper D B & Richards P A (2009) *Dictionary for managing trees in urban environments*
CSIRO Publishing
Collingwood, Vic

Gilbert E. A, & Smiley E. T. (2004) *Picus Sonic Tomography for the quantification of decay in White Oak (Quercus alba) and Hickory (Carya app).* .Journal of Arboriculture 30 (5): September 2004.
Illinois.

Harris R.W, Clark J.R, Matheny N.P (2004). *Arboriculture.* Third edition.
Prentice Hall
New Jersey.
p.417

James K. (2005) *Dynamic Wind Loads on Trees*
Research Engineer
Burnley College
University of Melbourne

Kersten W & Schwarze F.W.M.R (2005) *Development of decay in the sapwood of trees wounded by the use of decay-detecting devices.* Arboriculture Journal 28.
Illinois.
p 165-181

Matheny N.P & Clark J.R. (1994) *Evaluation of hazard trees in Urban areas*
Second edition, International Society of Arboriculture
Illinois.

Mattheck C & Breloer H (2003) *The Body Language of Trees: A handbook for failure analysis.* Research for Amenity Trees No. 4,
Seventh edition, The Stationary Office, London.
p34, 37, 38, 108, 185, 186

Nicolotti G. (2003) *Application and comparison of three tomographic techniques for detection of decay in trees.* Journal of Arboriculture 29: March 2003,
Illinois.
p. 66-77.

Schwarze F.W.M.R, Rabe C, Ferner D, & Fink S (2004) *Detection of decay in trees with stress waves and interpretation of acoustic tomograms.*

Schwarze, F.W.M.R, Engels, J. Mattheck. C (2000) *Fungal strategies of wood decay in trees*
Springer-Verlag Berlin Heidelberg
Germany

Shigo A.L. (2002) *A New Tree Biology.*
Shigo and Trees, Associates, Durham, New Hampshire.

Wilcox W. W (1988) *Detection of early stages of wood decay with ultrasonic pulse velocity.* For. Pro. J. 38 (5)
p 68-73

Curriculum Vitae

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EDUCATION and QUALIFICATIONS

- 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 **Oct 1995 to February 2008**
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
September 2000 – January 2003
HORTICULTURALIST
October 1995 – September 2000

Northern Landscape Services **July to Oct 1995**
Tradesman for Landscape Construction business

Paul Vezgoff Garden Maintenance (London, UK) **Sept 1991 to April 1995**

CONFERENCES AND WORKSHOPS ATTENDED

- TRAQ Conference, Auckland NZ, Sydney (October 2013/2018)
- International Society of Arboriculture Conference (Canberra 2017)
- QTRA Conference, Sydney (November 2016)
- International Society of Arboriculture Conference (Brisbane 2008)
- Tree related hazards: recognition and assessment by Dr David Londsdale (Brisbane 2008)
- Tree risk management: requirements for a defensible system by Dr David Londsdale (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).