ABOUT TREES

URBAN TREE & BUSHLAND MANAGEMENT

DRAFT COPY

ARBORICULTURAL

IMPACT ASSESSMENT

AT

53B WARRIEWOOD ROAD

WARRIEWOOD

FOR

LEGENDWAY PTY LTD

(FOR REVIEW PURPOSED ONLY)

TABLE OF CONTENT

ABOUT TREES
URBAN TREE AND BUSHLAND MANAGEMENT

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25/06/19
Ref. # 2075

1.0 INTRODUCTION

A Development Application is to be lodged with Northern Beaches Council seeking consent for the subdivision 53B Warriewood Road, Warriewood.

The proposed subdivision is for 17 lots (including 1 residue lot), together with demolition, drainage, earthworks and the extension of existing Lorikeet Grove and widening of existing Pheasant Place.

About Trees has provided a tree report on 38 trees located within the footprint of the Subdivision Plan. Council has requested the following amendments and additional Arboriculture information be provided

Biodiversity

- *An amended arborist report is also required to correct errors in numbering/identification of these trees and to provide recommendations to facilitate their safe retention."*
- *The proposal is to be amended to ensure the retention of the 3 x Eucalyptus Robusta within the inner creekline corridor.*

1.1 Scope

This report has been commissioned by Jayson Baine, and its purpose is to address the issues raised by Council

1.2 Summary of Report

The original Tree Report has been amended to correct the tree numbering issues, with a recommendation to include tree No. 43 in all relevant Site Plans

In addition, this Arboricultural Impact Assessment (AIA) of the Stormwater Plans (dated 14/03/19) has been prepared to address Councils desire to retain three *Eucalyptus robusta* within the inner creek corridor.

Actually, there are four *Eucalyptus robusta* within the inner creek corridor and they have all been included in this AIA

1.3 Conclusions

- The retention values of tree No's 38 – 41 & 43 are 'over- mature/mature tree with low vigour and in fair to poor condition – Able to be retained in the short term, if sufficient space available above and below ground for future growth.

- The safe life expectancies of No's 38 – 41 & 43 are categorised as Z8 – poor condition with no realistic potential to improve. It is unlikely that treatment and/or tree surgery techniques will significantly increase their safe life expectancies

- Tree No. 42 is listed as a Biosecurity Risk, and is an exempt species under Northern Beaches LEP.

- The proposed excavations for battering within the Tree Protection Zones and Structural Root Zones of tree No's 39 – 43 will have a significant impact on their health and stability.

- The proposed excavations for the 1.1m wide storm water pipes within the south-eastern sides of the Tree Protection Zones and Structural Root Zones of tree No's 39 – 43 will also have a significant impact on their health and stability.

1.4 Recommendations

- The accumulative impacts of the proposed excavations for batters within the south-western side of the Tree Protection Zones and Structural Root Zone of tree No's 39 – 41 & 43 combined with an excavation for a 1.1m wide trench for the Stormwater Pipe along their south-eastern sides will significantly compromise their health and stability**.**

- As no realistic alternative option is available to undertake the proposed works, it is recommended that tree No's 39 – 41 & 43 be removed.

- Tree No. 42 is listed as a Biosecurity Risk, it should also be removed

If you require any further information, please feel free to contact me on 0439 758 658.

Lawrie Smith,
Arboricultural Consultant

2.0 METHODOLOGY AND OTHER INFORMATION

This report has been presented in an accepted industry format and should easily be understood by any person with a reasonable understanding of arboriculture.

2.1 Methodology & Assessment Criteria

- A visual assessment of this tree was undertaken from ground level on the 21 January 2019 in accordance with the Visual Tree Assessment (VTA method of Mattheck and Breloer (1994).
- The assessment took into account the biological state of the tree, as indicated by the health of their foliage, their structural form and their growing environment.
- The terminology used in the assessment is defined in Section 8, with more detailed information provided in the Appendices, which are referenced to recent industry research.
- Unless otherwise stated, no underground sections were examined and no aerial inspection (climbing) was undertaken.
- Tree heights were obtained with a clinometer and canopy spreads were measured.
- Retention Values are based upon the Sustainable Retention Index Value (SRIV) – Refer to the SRIV Matrix in Appendices 9.2
- Safe Life Expectancies are based on Barrell (2006) – Refer to TreeA/Z Categories in Appendices 9.3
- Significance Values are based on numerous concepts used within the Arboricultural Industry – Refer to the Significance Values in Appendices 9.4
- A copy of the tree assessment is include in Section 10
- A Tree Location Plan is included in Section 11, and shows the location of the subject tree/s.

2.2 Curriculum Vitae of Author

The authors Curriculum Vitae is attached as Appendices 9.1 of this report which provides the qualifications, experience and additional training on which any stated opinions and conclusions are based.

2.3 Limitation of Liability

Trees are living organisms and do not remain static over time. Conditions are often hidden within trees and below ground. Unless it has been otherwise stated, observations have been made by eye and from ground level. Tree can be managed, but they cannot be controlled, and to live near a tree is to accept some degree of risk. The only way to eliminate all risks is to remove all trees.

Arborists cannot detect every condition that could possibly lead to the failure of a tree. They cannot guarantee that a tree will be healthy or safe under all circumstances, or for a specified period of time. Likewise remedial treatments, like any medicine, cannot be guaranteed.

Site changes, storms and ongoing growth can alter a tree over time; therefore, tree assessments must occur on a regular basis. Unless stated otherwise, this assessment cycle is based on an annual inspection. This is consistent with and the Land & Environment Courts definition of a tree that is ‘likely to cause damage or injury in the near future’ as ‘likely to cause damage or injury within the next 12 months’.

It should also be noted that any opinions given by the Arborist in relation to the health, condition, desirability or significance of any tree will not necessarily coincide with the opinions of the relevant Council authority or their Tree Management Officers.

The author shall not be required to provide additional information, give testimony or attend Court by reason of this report unless subsequent contractual arrangements are made, including an additional fee for such services.

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2.5 Uniform Civil Procedures Rules (2005)

In order to ensure the reliability of evidence provided by experts, the Courts have provided the Uniform Civil Procedures Rules 2005 (UCPR) and Land & Environment Court Rules 2007 (LECR).

The author of this report has read and understands the Expert Witness Code of Conduct in Schedule 7 to UCPR, and agrees to be bound by it in accordance with UCPR 31.23.

An expert is permitted to provide evidence before a Court in order to assist the Court draw inferences. The primary overriding duty of an expert is to assist the Court impartially on matters relevant to the expert witness's expertise. Any opinions expressed must be based on the persons training, study or expertise.

2.6 Copyright

3.0 TREE LEGISLATION

3.1 Tree Management within Northern Beaches Local Government Area

Trees and vegetation within the Northern Beaches LGA are protected by the Local Environmental Plans.

Exempt Activities

You can remove trees without a permit in the following circumstances if it is:

- Under 5 meters in height
- Exempt Tree Species List
- In an area in which the Council has authorised their removal as part of a hazard reduction program, where that removal is necessary in order to manage risk
- Required to be removed under other legislation (including the NSW Rural Fires Act 1997 and the Environmental Planning and Assessment Act 1979)
- Can be removed under the 10/50 Legislation. Some clearing of vegetation is allowed if your property is mapped in the 10/50 entitlement area.
- Removed by Rural Fire Services because they pose or will pose a significant threat to access along required fire trails or to human life, buildings or other property during a bushfire
- Placed where the base of the trunk of the tree at ground level, is located within two meters of an existing approved building (not including decks, pergolas, sheds, patios or the like, even if they are attached to a building).
- Is considered a high risk/imminent danger certified by a Level 5 qualified arborist. These trees can be removed without Council consent by the owner of the tree subject to the owner obtaining written confirmation from the arborist that clearly states:
    1. The arborist qualifications: AQF Level 5 Arborist or equivalent
    2. That the tree(s) is declared a ‘high risk’ or is an imminent danger to life and property
    3. That immediate removal of the tree(s) is recommended
    4. A copy of the report must be sent to Council for record keeping purpose
- Any tree on the bio security species listing (See Section 3.2)
- Dead - photographic evidence recommended
- Has fallen or partially fallen as a result of a storm and still present a danger (photos required)
- Part of the pruning or removal of hedges (unless hedge is conditioned to be retained in a development consent). “Hedge” means groups of two or more trees that:
    a. are planted (whether in the ground or otherwise) so as to form a hedge, and
    b. rise to a height of at least 2.5 metres (above existing ground level).

Pruning and Clearing
You can prune trees or clear vegetation in the following circumstances:

- Reasonable pruning of up to 10% of a tree's canopy within 12 calendar months. Pruning must be in accordance with Australian Standards AS 4373 – 2007
- The removal of deadwood from a tree
- Removal of any species of parasite mistletoe or parasitic plant from any part of a tree
- It meets the criteria of other legislations eg under 10/50 Legislation some clearing of vegetation is allowed if your property is mapped in the 10/50 entitlement area.

Note: Public and private bushland is protected under Council's Development Control plan and requires consent to remove or clear understorey vegetation.

Permitted With Council Consent

Tree Removal
Council may permit to the removal of trees in the following circumstances:

- A qualified arborist report is delivered with all applications to remove significant trees
- Removing unsuitable or hazardous trees

- Removing trees in conflict with built structures where all engineering alternatives have been considered

Pruning and Crowning
Council may permit to:

- Crown-thinning for views, solar, pedestrian or vehicular access
- Maintenance pruning to remove dead, diseased or dying branches
- Selective pruning to remove branches causing conflict, like building encroachment
- Root pruning to reduce damage to both built and natural structures
- Pruning for service lines, vehicle sight line and Roads and Maritime Services requirements.

A Permit is required for the following:

- Any tree or native vegetation which is a threatened species, threatened species habitat or is part of an Endangered Ecological Community as defined under the NSW Threatened Species Conservation Act 1995
- Any tree which is a heritage item or that is within a heritage conservation area as defined by searching the Planning Rules that may apply to the property
- Any tree specifically identified to be retained as a condition of development consent for building or works or subdivisions

Council will Not Permit

Tree Removal
Council will not approve:

- Tree work without signature of owner or their agent on application
- Removing healthy, stable trees or trees for views
- Removing trees for solar access, leaf, fruit or sap drop, bird or bat droppings, or damage to sewer pipes or built structures
- Removing trees for allergies unless they can be medically linked by a specialist doctor
- Removal of trees for fences, footpaths, or driveways
- Removal of trees in bushland or understorey vegetation without a permit
- Removal of trees where they do not meet the criteria of the permit

Pruning, Clearing and Alteration

- Pruning of trees contrary to Australian Standards 4373
- Pruning beyond what a particular species will tolerate, eg figs pruned by more than 10% are predisposed to sunburn
- Requests for topping of trees
- Alteration of soil levels within a tree’s drip line
- Tree work for emotive reasons

3.2 NSW Biosecurity Act

The NSW Noxious Weed Act (2003) has been superseded by NSW Biosecurity ACT 2015. Any species previously identified as noxious, now called priority weed species, can be removed without Council consent. However some height restriction may apply

The following Tree species can be removed without consent unless identified as a Heritage item or within a Heritage area.

SPECIES NAME COMMON NAME

Acacia baileyana (Cootamundra Wattle)
Acer negundo (Box Elder)
Alnus jorullensis (Evergreen Alder)
Brachychiton acerifolius (Illawarra Flame Tree)
Castanospermum australe (Black Bean)
Cinnamomum camphora (Camphor laurel)
Cotoneaster glaucophyllus (Cotoneaster)
Cupressus spp. (Cupressocyparis spp)
Eriobotrya japonica (Carica papaya)
Eucalyptus nicholii (Peppermint Gum)
Fraxinus griffithii (Himalayan Ash)
Grevillea robusta (Silky Oak)
Jacaranda mimosifolia (Jacaranda)
Lagunaria patersonia (Norfolk Island Hibiscus)
Liquidambar styraciflua (Liquidambar)
Olea spp. (Olive)
Pinus spp. (Pine)
Populus spp. (Poplar)
Raphiolepis indica (Indian Hawthorn)
Salix spp. (Willow)
Schefflera actinophylla (Umbrella Tree)
Syagrus romanzoffiana (Cocos Palm)

Acacia saligna (Golden Wreath Wattle)
Alianthus altissima (Tree of Heaven)
Araucaria bidwillii (Bunya Pine)
Cassia spp (Cassia)
Celtis australis (Hackberry)
Citharexylum spinosum (Fiddlewood)
Cupaniopsis laurina (Tuckeroo)
Chamaecyparis spp. (Cypress Pine)
Erythrina spp. (Coral Tree)
Eucalyptus scoparia (Wallangarra White Gum)
Gleditsia triacanthos (Honey Locust)
Harpephyllum caffrum (Kaffir Plum)
Lagerstroemia indica (Crepe Myrtle)
Ligustrum spp. (Large & Small leaf Prive0
Nerium oleander (Oleander)
Paraserianthes lophantha (Crested Wattle)
Pittosporum spp. (up to 8m) (Pittosporum)
Pyracantha angustifolia (Fire Thorn)
Robinia pseudoacacia (False Acacia)
Sapium sebiferum (Chinese Tallow)
Spathodea campanulata (African tulip tree)
Ulmus parvifolia (Chinese Elm)

All *Ficus* spp. (except *F. macrophylla, F. rubiginosa, F. coronata*

All Palms (other than *Livistona australis* (Cabbage Tree Palm)

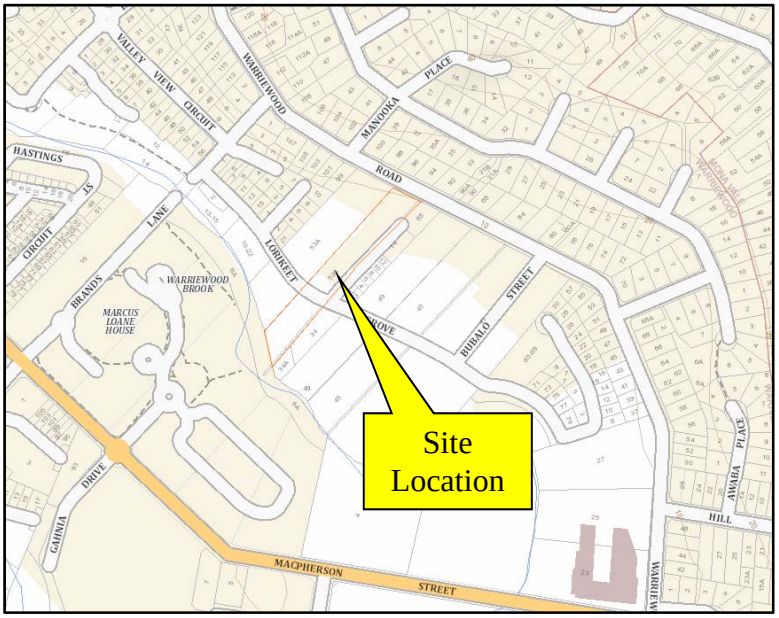
All non-native fruit producing trees

Citrus spp. (Orange, Lemon, Mandarine etc)
Malus, spp. (Apple)
Prunus spp. (Apricot, Almond, Cherry, Plum, Peach)
Fortunella spp. (Kumquat)
Morus spp. (Mulberry)
Persea spp. (Avocado)

(Loquat, Paw Paw Mango)

4.0 OBSERVATIONS

4.1 The site is known as 53b Warriewood Road Warriewood and is bordered on the northwest by large undeveloped lot, on the southwest by Narrabeen Creek, on the southeast by a new development, and on the northeast by Warriewood Road. The surrounding areas are mainly comprised of urban residential development



Map 1 – showing location of subject site (Dept Lands 2019)

Map 2 – showing subject site (Dept Lands 2019)

4.2 The soil landscape of the general area has been described by Chapman & Murphy (1989) as 'Erina'. This unit occurs on rolling hills and footslopes of the Erina Hills at Long Reef, Mona Vale, Whale Beach, Daleys Point, and Bensville and at Boudii National Park.

4.3 Current Condition of the Tree/s

Tree No. 39 is a mature *Eucalyptus robusta* – Swamp Mahogany' is common on the coastal plains of NSW and southern Qld. A Mahogany growing to approximately 20-25 m tall, usually having a single trunk to 1m thick and a vase-shaped branch pattern which supports a broad, leafy crown. It is usually found on heavy moist soils adjacent to permanent water near the sea. It is an important species because of its tolerance of moist soils and salt –laden winds near the coast and is a fine decorative tree for shade and screening in parks and other large-scale plantings (Rowell,1980)

a. **Health & Vitality:** Low – the foliage of this is sparse, with twig and branch dieback through its upper canopy (see Plates 1 & 3). This relates to its reduced ability to sustain its life processes, and is evident by the reduced crown density and a deterioration of their functions with reduced resistance to predation.

b. **Tree Form:** Average – it has formed a single stem with DBH of 450mm, with an asymmetrical canopy towards the northwest that is 16.5m in height, and a crown spread of 10x18xm.

c. **Structural Condition:** Poor – The lower trunk and root crown of this tree have typical symptoms of Armillaria Root Decay, and this has impacted on its health and vitality (see Plate 2)

Tree No. 40 is a mature *Eucalyptus robusta* – See description of tree No. 39

a. **Health & Vitality:** Low – the foliage of this is sparse, with twig and branch dieback through its upper canopy (see Plate 5 & 6). This relates to its reduced ability to sustain its life processes, and is evident by the reduced crown density and a deterioration of their functions with reduced resistance to predation.

b. **Tree Form:** Fair – it has formed a single stem with a DBH of 450mm, with a heavily supressed asymmetrical canopy towards the north which is 22m in height, with a crown spread of 10x22m.

c. **Structural Condition:** Fair – it has a misshapen form misshapen, and some physical indication of decline due to the early effects of predation by pests and diseases, and/or modification of the

Tree No. 41 is a mature *Eucalyptus robusta* – See description of tree No. 39

a. **Health & Vitality:** Low **–** the foliage of this is sparse, with twig and branch dieback through its upper canopy (see Plate 5 & 6). This relates to its reduced ability to sustain its life processes, and is evident by the reduced crown density and a deterioration of their functions with reduced resistance to predation.

b. **Tree Form:** Average **–** Its structure is comprised of a single stem with a DBH of 450mm, and forms a codominant canopy which is 22m in height, with a crown spread of 10x22m.

c. **Structural Condition:** Fair – it has a misshapen form misshapen, and some physical indication of decline due to the early effects of predation by pests and diseases, and/or modification of the environment essential for its basic survival

Tree 42 is a mature *Erythrina x sykesii* – 'Coral-tree; a large deciduous tree, 12 – 18m tall and 10 – 15m wide, with a short main trunk, sometimes massive in old age, and an irregular crown of large branches and foliage providing a dappled, not over dense shade.' (Rowell, R. 1980)

a. **Health & Vitality:** Average – the foliage of this tree appears to be generally healthy and growing vigorously, with no visible symptoms of decline (see Plate 5).

b. **Tree Form:** Fair **–** Its structure is comprised of two codominant stems with a DBH's of 250 and 500mm, and forms a suppressed canopy which is 10m in height, with a crown spread of 6x6m.

c. **Structural Condition:** Average – This tree originated as an opportunistic seedling and is growing against the trunk of Tree No. 43 and its canopy is being heavily suppressed by the more dominant tree.

Tree 43 is a mature *Eucalyptus robusta* – See description of tree No. 39

a. **Health & Vitality:** Low **–** the foliage of this is sparse, with twig and branch dieback through its upper canopy (see Plate 5 & 6). This relates to its reduced ability to sustain its life processes, and is evident by the reduced crown density and a deterioration of their functions with reduced resistance to predation**–**

d. **Tree Form:** Average **–** Its structure is comprised of a single stem with a DBH of 500mm, and forms a significant asymmetrical canopy towards the south which is 23m in height, with a crown spread of 7x17m.

b. **Structural Condition:** Fair **–** it has a misshapen form misshapen, and some physical indication of decline due to the early effects of predation by pests and diseases, and/or modification of the environment essential for its basic survival

4.4 Site Photographs

Plate 1 – decline & dieback in canopy of tree 39 (2019)

Plate 2 – showing large wound on tree No. 39

Plate 3 – decline of canopy of tree No. 39 (2014)

Plate 4 – showing trunk damage on tree No. 40

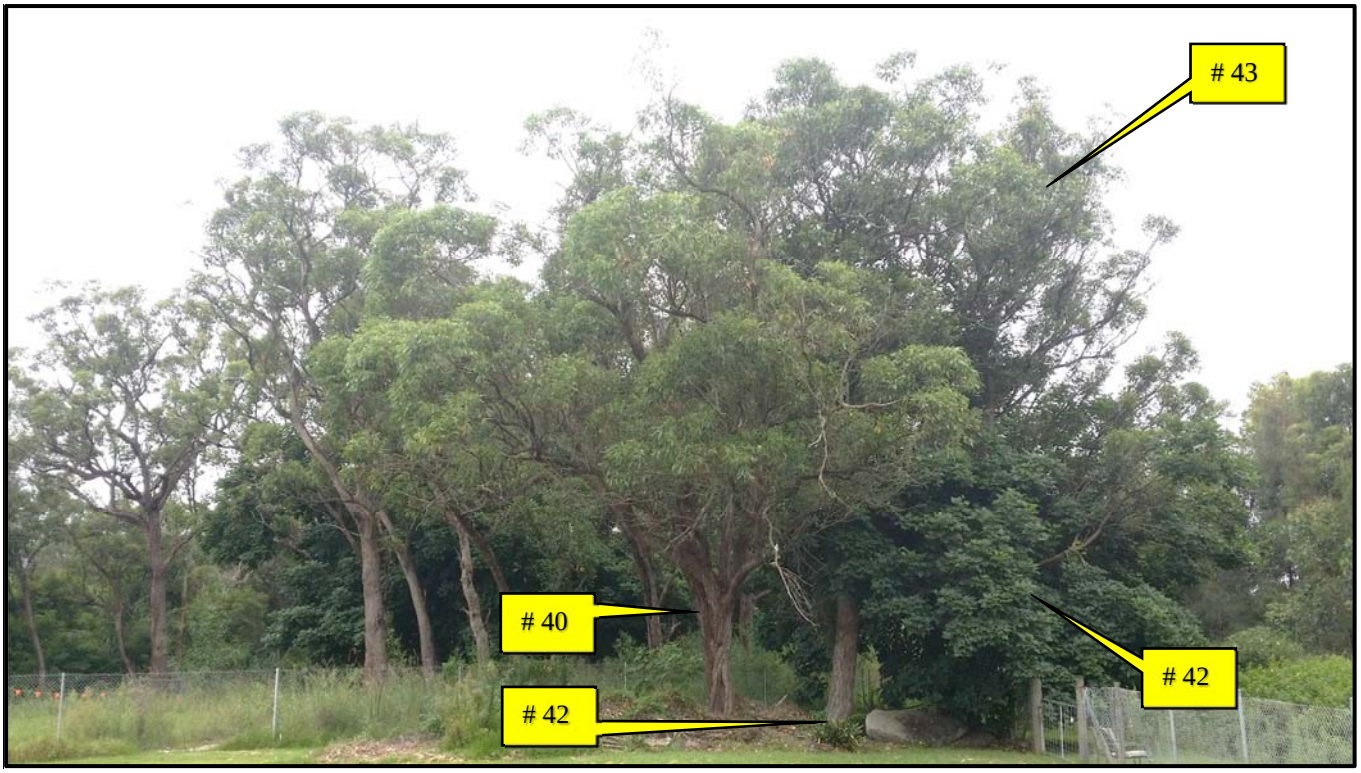
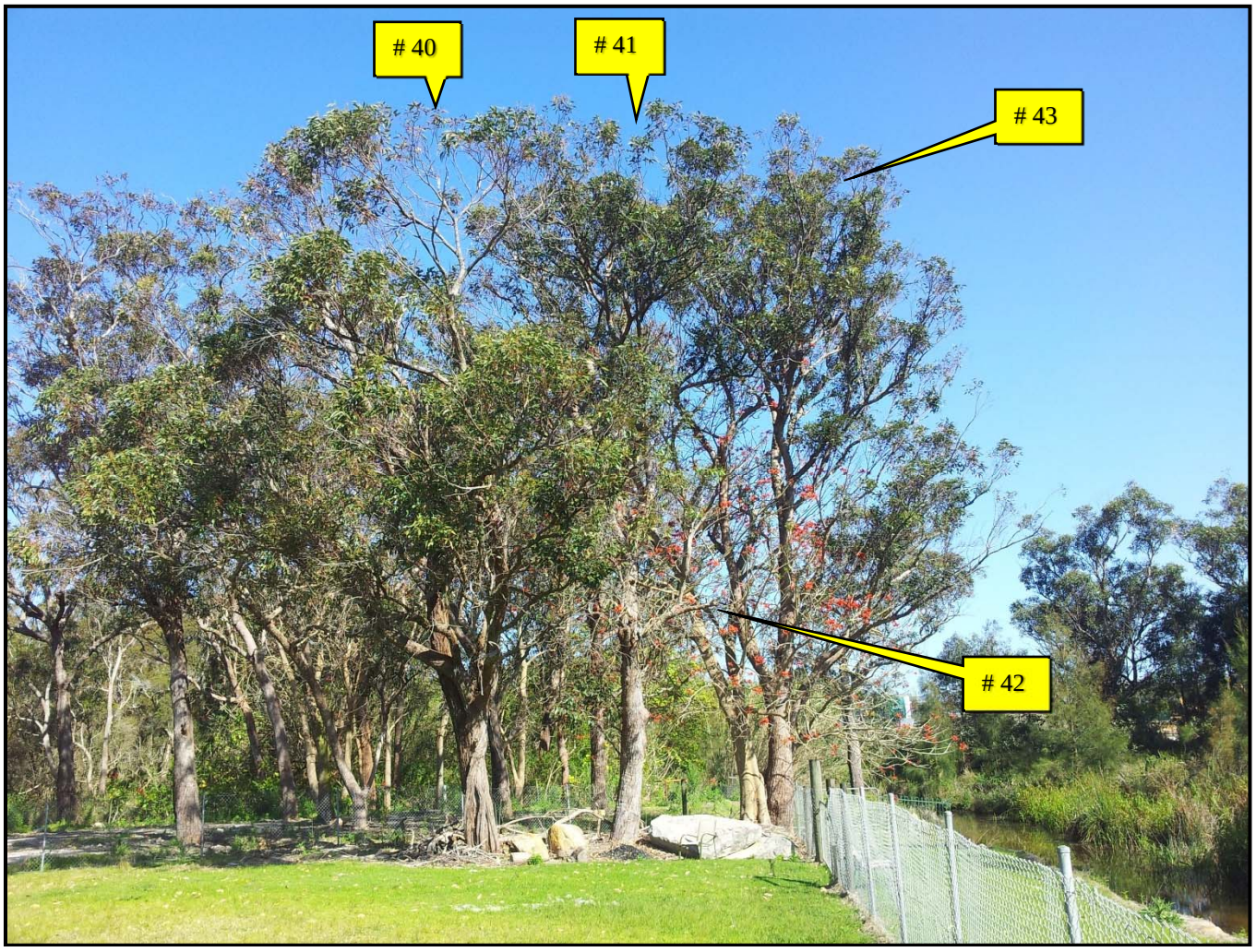


Plate 3 – showing tree No's 40 - 43



4.5 Retention Values

Sustainable Retention Index Value (SRIV©) considers its age class, condition class, vigour class and its sustainable retention with regard to the safety of people or damage to property. The ability to retain the tree with remedial work or beneficial modifications to its growing environment or removal and replacement is also considered (See Matrix in Appendices 9.2).

Unfortunately, like all methodologies used to assess trees, not all trees fit neatly into a category. For example, SRIV doesn't give consider the negative attributes that an individual tree may have, or of its suitability for the location.

- Tree No's 39 has retention value of OLVF (2) 'Over-mature tree with low vigour and poor structural condition with a Retention Index Value of 2 – Able to be retained in the short term, if sufficient space available above and below ground for future growth.

- Tree No's 40 – 41 have retention values of MLVF (4) 'Mature tree with low vigour and in fair condition with a Retention Index Value of 4 – Able to be retained in the short term, if sufficient space available above and below ground for future growth.

- Tree No. 44 is a Coral Tree (an exempt species) and should be removed

- Tree No. 43 have retention values of MFVF (4) 'Mature tree with low vigour and in fair condition with a Retention Index Value of 9 – Able to be retained in the short term, if sufficient space available above and below ground for future growth.

4.6 Safe Life Expectancy of the Tree (TreeA/Z)

'TreeAZ' is a systematic method of assessing whether individual trees are important, and how much consideration should be given to them in management decisions. It views each tree as being worthy of 'consideration' in the planning process, not automatically as a 'constraint' on development. Each tree is considered against a standard list of thirteen (13) negative attributes. If a tree fails any of these tests, it is categorised as 'Z' and further analysis stops. If it passes all attributes, it is categorised as 'A', and is then viewed as a constraint on the development (See Tree A/Z Categories in Appendices 9.3).

- Tree No's 39 – (*Eucalyptus robusta*) is categorised as Z8 – poor condition with no realistic potential to improve

- Tree No's 40 & 41 (*Eucalyptus robusta*) are categorised as Z8 – poor condition with no realistic potential to improve

- Tree No. 42 (Coral Tree) and categorised as Z1. It is listed as a Biosecurity Risk, and is an exempt species under Northern Beaches LEP

- Tree No. 39 (*Eucalyptus robusta*) is categorised as Z8 – poor condition with no realistic potential to improve

4.7 Significance Value

This methodology is based on numerous concepts used in the Arboricultural Industry, i.e. IACA (2009) & Thyer (2006).

Five parameters of a tree are assessed, with each providing a numerical value. Each high significance parameter has a value of 20%, each medium parameter has a value of 14%, each low parameter has a value of 7% and each very low parameter has a value of 0% (Refer to Appendices 9.4)

Only one parameter can selected for each tree, and they are added together to obtain its Significance Value. The highest Significance Value would be 100%, and the lowest would be 0.

Tree No.	Health & Vitality	Structural Condition	Ecological Value	Amenity Value	Visual Prominence	Significance Value
39	7	0	14	7	7	35/100
40	7	7	14	7	7	42/100
41	7	7	14	7	7	42/100
42	14	14	0	7	7	42/100
43	7	7	14	7	7	42/100

4.8 Recommended Setbacks Required Under AS 4970 (2009)

Australian Standard (4970) '*Protection of Trees on development Sites'* (2009) provides the recommended setback that a tree requires from development activities (See Appendices 9.5).

The following table provides a summary of the setbacks required by the subject tree/s in order to minimise impacts on their health and stability.

- Column 2 provided the diameter of the trunk at 1.4m above ground level (DBH)
- Column 3 provides the radius of its Tree Protection Zone (TPZ). It is measured from the centre of the trunk (COT), and is based upon the recommendations in AS 4970 (2009).
- Column 4 provides its Root Crown Diameter (RCD)
- Column 5 provides the radius of its Structural Root Zone (SRZ) and is based on AS 4970 (2009). It represents the mechanical functions of a structural root plate, regardless of species, and the minimum setback between a tree and infrastructure to reduce impacts on its stability.
- Column 6 provides the recommended setbacks of a tree from infrastructure to minimise damage from interactions with main woody transport roots (Cutler, D. 1995).

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Tree No.	DBH (mm)	**TPZ (m)**	RCD (mm)	**SRZ (m)**	Radius of Primary Woody Root Zone	Encroachment into TPZ
39	450	**5.4**	600	**2.7**	9.14	>30%
40	700	**8.4**	750	**2.9**	10.36	>30%
41	450	**5.4**	650	**2.8**	9.44	>30%
42	250/300	**5.5**	900	**3.2**	13.41	>30%
43	500	**6.0**	750	**2.9**	11.58	>30%

Table 1 – showing recommended Tree Protection Zones in accordance with AS 4970 (2009)

5.0 DISCUSSION

5.1 Arboricultural Impacts of the Proposed Development

The Tree Protection Zones were calculated in Table No. 1 and drawn to scale in Diagram 1. Potential impacts on the trees have been calculated by using Table 2

Impacts of Encroachment into a TPZ	
0 – 10% encroachment	No significant impact
10 – 20% encroachment	Low impact
20 – 25% encroachment	Moderate impact
25 – 30% encroachment	High impact
>30%	Significant impact (see SRZ)

Table 2 – Potential Impacts on Subject Trees

Tree No. 39 (*Eucalyptus robusta*)

- According to AS 4970, it will require a Tree Protection Zone (TPZ) with a radius of 5.4m, measured from the centre of its trunk (COT), to reduce impacts of construction on its health and vitality to an acceptable level (see Appendices 9.5). This represents an area of 91.61m².
- It has a Structural Root Zone (SRZ) with a radius of 2.7m COT, and a significant impact is expected
    - **Excavations for Batters:** This tree is located within the area of proposed battering and the necessary excavation works will impact on up to 60% of its TPZ. This is likely to have a significant impact on its health and stability (refer to Table 1)
    - **Stormwater:** It has a setback of 3.5m from the proposed excavations for the 1.1m wide Stormwater Pipe that passes through the south-eastern side of it TPZ. This encroachment is less than 30%, and is likely to have a high impact on its health and vitality

Tree No. 40 (*Eucalyptus robusta*)

- This tree will require a will require a TPZ with a radius of 8.4m COT, to reduce impacts of construction on its health and vitality to an acceptable level. This represents an area of 221.67m².
- It has a SRZ with a radius of 2.9m COT, and a significant impact is expected
    - **Excavations for Batters:** This tree is located within the area of proposed battering and the necessary excavation works will impact on up to 60% of its TPZ. This is likely to have a significant impact on its health and stability (refer to Table 1)
    - **Stormwater:** It has a setback of 2.9m from the proposed excavations for the 1.1m wide Stormwater Pipe that passes through the south-eastern side of it TPZ. This encroachment is greater than 30%, and also included a significant encroachment into the SRZ. As such, excavations for the proposed trench is likely to have a high impact on its health and stability.

- Tree No. 41 (*Eucalyptus robusta*)
- This tree will require a TPZ with a radius of 5.4m COT, this represents an area of 91.61m².
- It has a SRZ with a radius of 2.8m COT, and a significant impact is expected
    - **Excavations for Batters:** This tree is located within the area of proposed battering and the necessary excavation works will impact on up to 60% of its TPZ. This is likely to have a significant impact on its health and stability (refer to Table 1)
    - **Stormwater:** It has a setback of 2m from the proposed excavations for the 1.1m wide Stormwater Pipe that passes through the south-eastern side of it TPZ. This encroachment is greater than 30%, and also included a significant encroachment into the SRZ. As such, excavations for the proposed trench is likely to have a high impact on its health and stability.

Tree No. 42 (*Erythrina sykesii*)

- This tree will require a TPZ with a radius of 5.5m COT, and this represents an area of 95.03m².
- It has a SRZ with a radius of 3.2m COT and a significant impact is expected
    - **Excavations for Batters:** This tree is located within the area of proposed battering and the necessary excavation works will impact on up to 70% of its TPZ
    - **Stormwater:** It has a setback of 2.9m from the proposed excavations for the 1.1m wide Stormwater Pipe that passes through the south-eastern side of it TPZ. This encroachment is greater than 30%, and is considered to be significant (refer to Table 1)

Tree No. 43 (*Eucalyptus robusta*) is located on No.

- This tree will require a TPZ with a radius of 6.0m COT, and this represents an area of 113.1m².
- It has a SRZ with a radius of 2.9m COT, and a significant impact is expected
    - **Excavations for Batters:** This tree is located within the area of proposed battering and he necessary excavation works will impact on 60% of its TPZ
    - **Stormwater:** It has a setback of 2.9m from the proposed excavations for the 1.1m wide Stormwater Pipe that passes through the south-eastern side of it TPZ. This encroachment is greater than 30%, which also included a significant encroachment into the SRZ. As such, excavations for the proposed trench is likely to have a high impact on its health and stability.

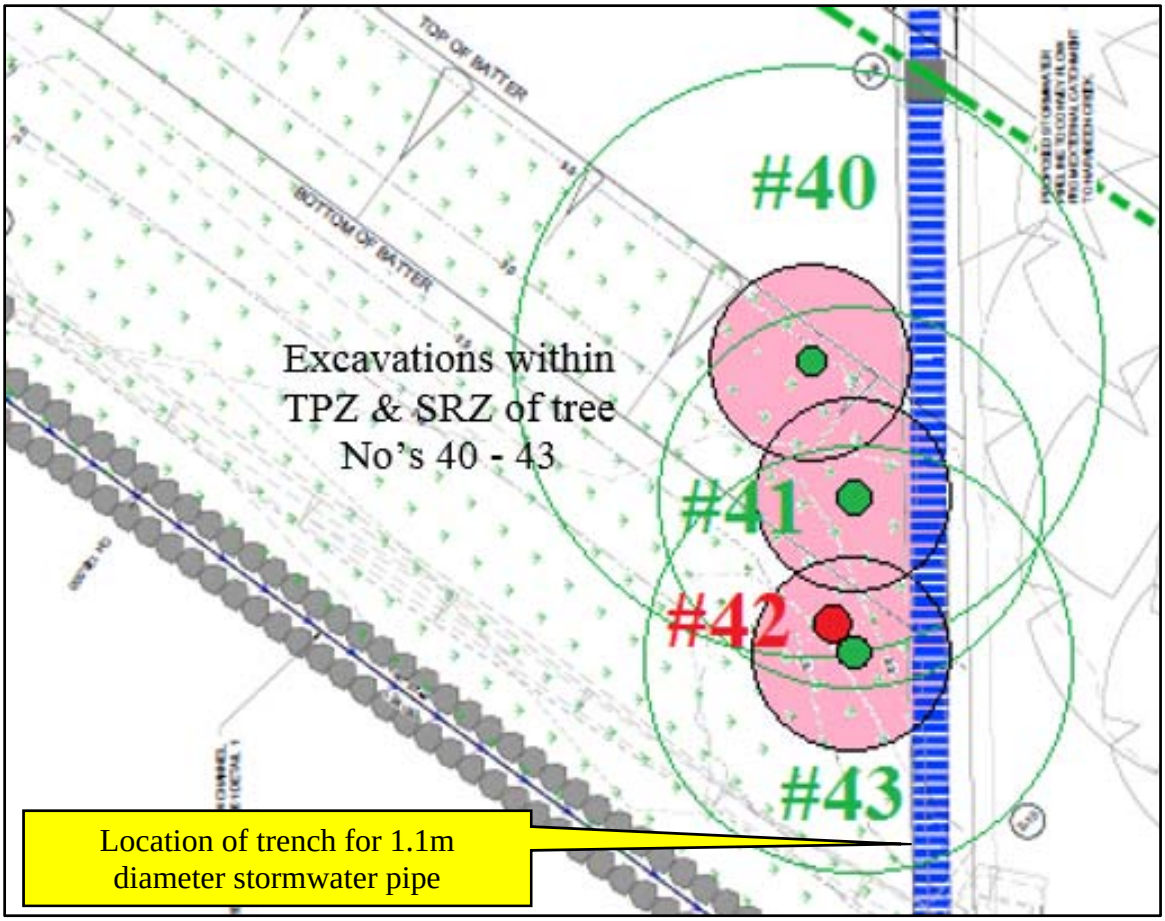


Diagram 1 – showing extent of TPZ's and SRZ's of tree No's 40 – 43

6.0 CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions

- The retention values of tree No's 38 – 41 & 43 are 'over- mature/mature tree with low vigour and in fair to poor condition – Able to be retained in the short term, if sufficient space available above and below ground for future growth.
- The safe life expectancies of No's 38 – 41 & 43 are categorised as Z8 – poor condition with no realistic potential to improve. It is unlikely that treatment and/or tree surgery techniques will significantly increase their safe life expectancies
- Tree No. 42 is listed as a Biosecurity Risk, and is an exempt species under Northern Beaches LEP
- The proposed excavations for battering within the Tree Protection Zones and Structural Root Zones of tree No's 39 – 43 will have a significant impact on their health and stability.
- The proposed excavations for the 1.1m wide storm water pipes within the south-eastern sides of the Tree Protection Zones and Structural Root Zones of tree No's 39 – 43 will also have a significant impact on their health and stability.

6.2 Recommendations

- The accumulative impacts of the proposed excavations for batters within the south-western side of the Tree Protection Zones and Structural Root Zone of tree No's 39 – 41 & 43 combined with an excavation for a 1.1m wide trench for the Stormwater Pipe along their south-eastern sides will significantly compromise their health and stability**.**
- As no realistic alternative option is available to undertake the proposed works, it is recommended that tree No's 39 – 41 & 43 be removed.
- Tree No. 42 is listed as a Biosecurity Risk, it should also be removed

If you require any further information, please feel free to contact me on 0439 758 658.

Lawrie Smith,
Arboricultural Consultant

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8.0 TERMINOLOGY

8.1 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.

- **Young** Tree aged less 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.

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

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

- **Average Vigour –** Normal 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.

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

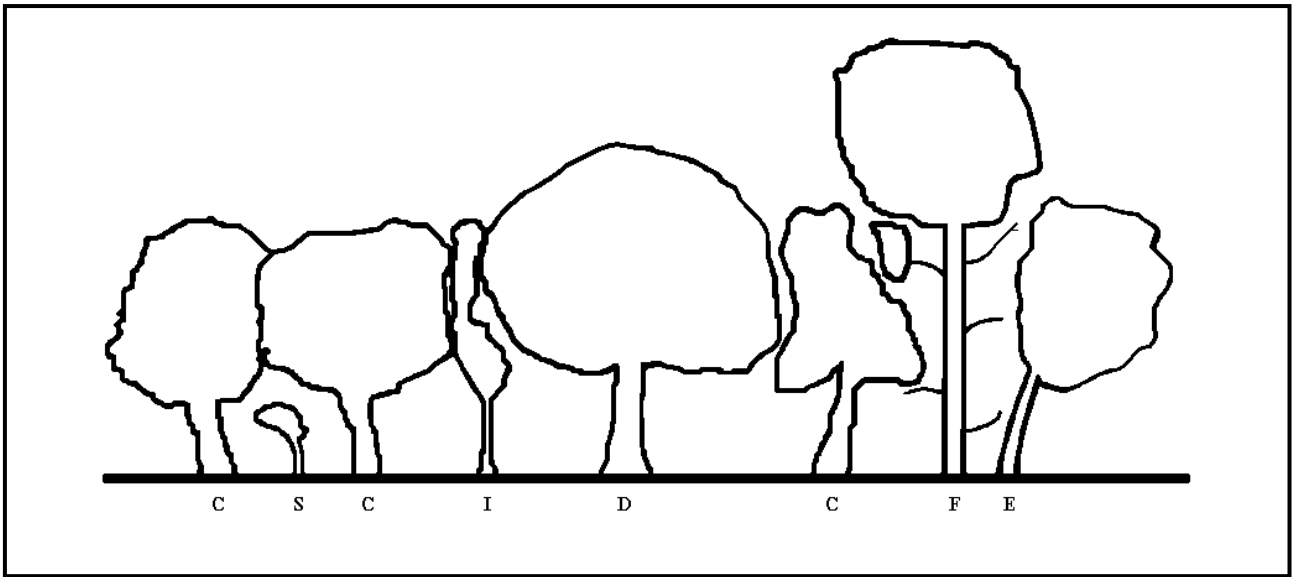
- **Dormant Tree Vigour –** Determined by existing turgidity in lowest order branches in the outer extremity of the crown, with good bud set and formation, and where the last extension growth is distinct from those most recently preceding it, evident by bud scale scars. Normal vigour during dormancy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

8.3 TREE FORM

This refers to the growth habit of a tree, including its trunk and main structural branches, and their potential for failure.

- **Growth Habit** (Modified from Matheny, N. & Clarke, J. 1998)

Co-dominant	Trees that define the general upper edge of the canopy, receiving light primarily from above.
Dominant	Trees with crowns above the upper layer of the canopy and generally receiving light from above and the sides.
Edge-Type	Trees located on the edge of a more dominant canopy, and frequently possessing asymmetrical canopy (heavier on the open side) and trunks that bow out of the stand
Forest-type	Trees that have grown in a forest setting and only have about 1/3 of their canopy located on tall straight trunks
Intermediate	Trees that have been largely overtopped, but may receive some light from above.
Suppressed	Trees that have been overtopped, and become part of the understorey canopy
Understorey	Small trees and shrubs that form the understorey canopy.



D – Dominant I – Intermediate C – Co-dominant F – Forest
S – Suppressed E – Edge U – Forms part of the understorey canopy

8.4 FAILURE POTENTIAL – This refers to the growth habit of a tree, including its trunk and main structural branches, and their potential for failure.

- **Good –** Trees with a single dominant trunk along which evenly spaced branches are spread. Branches have properly formed collars which provide strong attachment to the trunk, and are about 25% of the trunk diameter. Minor structural defects may be present with low failure potentials.
- **Average –** Trees with structural defects with low failure potential
- **Fair –** Trees with structural defects with medium failure potentials and require monitoring on an annual basis.
- **Poor –**Trees with defects which have failed, or have a high risk of failing soon, and corrective action must be taken as soon as possible.

8.5 STRUCTURAL 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 the 1st & 2nd order structural branches, including structural defects such as wounds, cavities or hollows, crooked trunk or weak trunk/branch junctions and the effects of predation by pests and diseases. These may not be directly connected with vigour and it is possible for a tree to be of normal vigour but in poor condition. Condition can be categorized as Good Condition, Fair Condition, Poor Condition and Dead.

- **Good Condition** Tree is of good habit, with crown form not severely restricted for space and light, physically free from the adverse effects of predation by pests and diseases, obvious instability or structural weaknesses, fungal, bacterial or insect infestation and is expected to continue to live in much the same condition as at the time of inspection provided conditions around it for its basic survival do not alter greatly. This may be independent from, or contributed to by vigour.
- **Fair Condition** Tree is of good habit or misshapen, a form not severely restricted for space and light, has some physical indication of decline due to the early effects of predation by pests and diseases, fungal, bacterial, or insect infestation, or has suffered physical injury to itself that may be contributing to instability or structural weaknesses, or is faltering due to the modification of the environment essential for its basic survival.

  Such a tree may recover with remedial works where appropriate, or without intervention may stabilise or improve over time, or in response to the implementation of beneficial changes to its local environment. This may be independent from, or contributed to by vigour.
- **Poor Condition** Tree is of good habit or misshapen, a form that may be severely restricted for space and light, exhibits symptoms of advanced and irreversible decline such as fungal, or bacterial

infestation, major die-back in the branch and foliage crown, structural deterioration from insect damage e.g. termite infestation, or storm damage or lightning strike, ring barking from borer activity in the trunk, root damage or instability of the tree, or damage from physical wounding impacts or abrasion, or from altered local environmental conditions and has been unable to adapt to such changes and may decline further to death regardless of remedial works or other modifications to the local environment that would normally be sufficient to provide for its basic survival if in good to fair condition.

Deterioration physically, often characterised by a gradual and continuous reduction in vigour but may be independent of a change in vigour, but characterised by a proportionate increase in susceptibility to, and predation by pests and diseases against which the tree cannot be sustained. Such conditions may also be evident in trees of advanced senescence due to normal phenological processes, without modifications to the growing environment or physical damage having been inflicted upon the tree. This may be independent from, or contributed to by vigour.

- **Dead TREE** – The 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 roots 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);
    - Shedding of the epidermis (bark desiccates and peels off to the beginning of the sapwood).

8.6 SAFE LIFE EXPECTANCY – 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.

- **Short Term** Period of time less than 15 years.
- **Medium Term** Period of time 15 - 40 years.
- **Long Term** Period of time greater than >40 years.

9.0 APPENDICES

9.1 QUALIFICATIONS & EXPERIENCE OF AUTHOR

QUALIFICATIONS

- Graduate Certificate in Bushfire Design, University of Western Sydney (2012)
- Diploma in Conservation & Land Management (AQF 5), Hortus Australia (2005)
- Advanced Diploma of Horticulture (Arboriculture – AQF 6), Hortus Australia (2002).
- Small Business Enterprise Certificate, Blue Mountains TAFE (1996).
- Certificate in Tree Care, Lynnfield West (1995).
- Tree Surgery Certificate, Ryde School of Horticulture (1990).
- Certificate in Horticulture, Wollongong TAFE (1987).

WORK HISTORY

- 1998 – Present Self-*employed as an Arboricultural Consultant.*
- 2000 – 2002. *Tree Management Officer,* Blue Mountains City Council.
- 1984 – 1998. *Self employed as a Practicing Arborist.*
- 1977 – 1978. *Tree pruning and removal,* SEC Victoria.
- 1975 – 1976. *Tree maintenance*, Queensland Forestry Commission.

FURTHER TRAINING

- Attendance of the following seminars or conferences;
    1. ISA Tree Risk Assessment Qualification (Renewal) Parramatta (2018)
    2. ICAA Concept to Construction, Parramatta (2017)
    3. Introduction to Risk Management –AS/NZS ISO 31000: 2009 (SAI Global 2014)
    4. ISA Tree Risk Assessment Qualification (TRAQ) Melbourne (2013)
    5. EIANZ Environmental Expert Professional Development Course (Sydney 2013)
    6. HEDRA Workshop (Sydney 2012)
    7. ISA National Conference Newcastle (2009)
    8. Tree Roots in the Built Environment, J. Urban (2008)
    9. *Phytophthora cinnamomi* – Workshop (2008)
    10. Trees on Construction Sites Workshop by J. Barrell (2006)
    11. ISA National Conference, Parramatta (2004)
    12. 5 Day Scientific Workshop on Tree Pathology and Wood Decay by F. Schwarze (2004)
    13. Safe Trees Seminar by Ed Hayes (2002)
    14. ISA National Conference, Melbourne (2002)
    15. Advanced Lecture on Visual Tree Assessment by Dr Claus Mattheck (2001)
    16. Trees for Urban Landscapes (2000)
    17. Assessing Hazardous Trees & their Safe Useful Life Expectancy (1997)

PROFESSIONAL ASSOCIATIONS

- International Society of Arboriculture (#152238)
- Fire Protection Association Australia (#26890)

9.2 SUSTAINABLE RETENTION INDEX VALUE (SRIV) ©

SRIV © provides a dual method of objectively rating the viability of urban trees for development sites based on general tree and landscape assessment criteria, and a numeric index for each tree as a tree management tool.

It is designed as an objective system based on set criteria to replace previous subjective systems, and is based on the principle of sustaining trees in the urban environment including remnant forest trees, but does not cover social aspects of trees, or hedges. Dead trees and environmental or noxious weed species are not considered as removal of these trees is generally encouraged.

The Glossary details the definitions for terms to be used with the SRIV© system are provided in Section 8, and are taken from the Institute of Australian Consulting Arboriculturists (IACA) © Dictionary for Managing Trees in Urban Environments[1].

9.2.1 SRIV Matrix

Good Vigour & Good Condition	**Good Vigour & Fair Condition**	**Good Vigour & Poor Condition**	**Low Vigour & Good Condition**	**Low Vigour & Fair Condition**	**Low Vigour & Poor Condition**
(GVG)	**(GVF)**	**(GVP)**	**(LVG)**	**(LVF)**	**(LVP)**
Able to be retained if sufficient space available above and below ground for future growth.	Able to be retained if sufficient space available above and below ground for future growth.	Able to be retained if sufficient space available above and below ground for future growth.	May be able to be retained if sufficient space available above and below ground for future growth.	May be able to be retained if sufficient space available above and below ground for future growth.	Unlikely to be able to be retained if sufficient space available above and below ground for future growth.
No remedial work or improvement to growing environment required. May be subject to high vigour.	Remedial work may be required or improvement to growing environment may assist.	Remedial work unlikely to assist condition, improvement to growing environment may assist.	No remedial work required, but improvement to growing environment may assist vigour.	Remedial work or improvement to growing environment may assist condition and vigour.	Remedial work or improvement to growing environment unlikely to assist condition or vigour.
Medium to Long Term Retention	**Medium Term Retention**	**Short Term Retention**	**Short Term Retention**	**Short Term Retention**	**Short Term Retention**
	Potential for longer with remediation or favourable environmental conditions.	Potential for longer with remediation work, or favourable environmental conditions.	Potential for longer with remediation work, or favourable environmental conditions.	Potential for longer with remediation work, or favourable environmental conditions.	Potential for longer with remediation work, or favourable environmental conditions.

YGVG - 9	YGVF - 8	YGVP - 5	YLVG - 4	YLVF - 3	YLVP - 1
	Index Value 8	Index Value 5	Index Value 4	Index Value 3	Index Value 1
Long Term Retention Potential	Short - Medium Term Retention Potential	Short Term Retention Potential	Short Term Retention Potential	Short Term Retention Potential	Likely to be removed immediately or retained for Short Term.
Likely to provide minimal contribution to local amenity if height <5m.	Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m.	Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m.	Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m.	Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m.	Likely to provide minimal contribution to local amenity if height <5m.
Retain, move or replace.	Medium-high potential for future growth and adaptability. Retain, move or replace.	Low-medium potential for future growth and adaptability. Retain, move or replace.	Medium potential for future growth and adaptability. Retain, move or replace.	Low-medium potential for future growth and adaptability. Retain, move or replace.	Low potential for future growth and adaptability. Retain, move or replace.

MGVG - 10	MGVF - 9	MGVP - 6	MLVG - 5	MLVF - 4	MLVP - 2
Index Value 10	Index Value 9	Index Value 6	Index Value 5	Index Value 4	Index Value 2
	Medium Term.	Short Term.	Short Term.	Short Term.	Zero to Short
Medium - Long Term.	Potential for longer with improved growing conditions.	Potential for longer with improved growing conditions.	Potential for longer with improved growing conditions.	Potential for longer with improved growing conditions.	Likely to be removed immediately or retained for Short term

OGVF - 6	OGVF - 5	OGVP - 4	OLVG - 3	OLVF - 2	OLVP
Index Value 6	Index Value 5	Index Value 4	Index Value 3	Index Value 2	Index Value 0
Retention potential	Retention potential	Retention potential	Retention potential	Retention potential	Retention potential
Medium - Long Term.	Medium Term	Short Term	Short Term Potential for longer with improved growing conditions.	Short Term	Likely to be removed immediately or retained for Short Term.

9.3 SULE CATEGORIES (Safe useful life expectancy)

TreeAZ' is a systematic method of assessing whether individual trees are important, and how much consideration should be given to them in management decisions. Each tree is considered against a standard list of tree removal tests. If a tree fails any of these tests, it is categorised as 'Z' and further analysis stops. If it passes all the tests, it is categorised as 'A'.

'Z' Tree are not suitable for retention for more than 10 years and not considered important or worthy of consideration in management decisions.

Exempt Species: Trees that could be removed under TPO policies

Z1 Exempt species (invasive or noxious species)

Small Trees: Plants that could realistically be easily replaced in the short term

Z2 Less than 5m tall

Z3 Formal hedges or trees regularly pruned to restrict size

High Risk: Trees that would be removed within 10 years because of declining health or poor structural damage

Z4 **Dead, dying, diseased or declining**

Explanation: '*Trees that should be removed despite statutory protection because they are in poor health, poor structural condition or otherwise unstable. The condition must be terminal with no obvious potential to recover, i.e. severe crown dieback related to excavation damage or root decay to the extent that the structural branch framework is compromised. This would also apply to diseases with no practical cure'* (Barrell (2006).

Z5 **Severe damage or structural defects that cannot be properly addressed by remedial care including cavities, decay, weak junctions, wounds and excessively unbalanced**

Explanation: *Severe means that there is no realistic chance of the tree achieving its full potential with an acceptable level of risk. In many cases, acceptable levels of risk can be achieved by dramatic reduction in tree size, but this has severe health, maintenance cost and amenity implications, so it would not be considered to be a sustainable management option*

Z6 **Present or future instability because of poor anchorage or increased exposure**

Explanation: *Alterations to tree exposure to the wind occurs because of changes in the shelter provided by adjacent objects such as buildings or other trees. This primarily applies to maturing and mature trees that have greater sail areas to catch the wind and established root systems that are less able to adapt to changes than younger trees. This often applies to groups of trees where one large dominant tree will be lost because of poor health or a structural problem, dramatically exposing the remaining trees in the group'* (Barrell (2006).

Good Management: Trees that would be probably pruned or removed within 10 years through responsible management

Z7 **Severe damage or structural defects that can be temporarily addressed by remedial care including cavities, decay, weak junctions, wounds and excessively unbalanced**

Z8 **Poor trees with no potential to improve** –

Explanation: It is common to find trees that are obviously unsuitable for long term retention for many reasons, including poor health, sever imbalance, tall, thin forms, or they have no realistic potential to improve. However, the problems are not so severe that they represent an immediate risk, but their removals should not be discounted for this reason.

This subcategory is for these trees and relies on the principle of sustained amenity to justify the allocation. The short term retention of a tree that is obviously not going to improve and will pose an ongoing risk is not good tree management and is just delaying its inevitable removal.

Z9 Adversely interfering with adjacent trees

Z10 Overgrown hedge or row of trees vulnerable to adverse weather events

Z11 Causing unreasonable inconvenience to existing properties (light, dominance, debris, interference)

Explanation: *In its broadest sense inconvenience is the interference with the authorised use of land. In relation to trees, it can be in the form of root disrupting landscaping and hard surfaces, parts of trees physically preventing land use, tree debris such as leaves and fruit falling and tree crowns causing excessive shade. The principles for establishing what are acceptable levels of inconvenience are the same, irrespective of the cause.*

In a community context, it is reasonable for individuals to tolerate some level of inconvenience from their presence. However, the precise location or value of these thresholds is not always obvious and is often a subjective interpretation rather than a definitive point. There will always have to be a balancing of the benefit to the community weighed against the inconvenience suffered by the individual. What is an acceptable, tolerable or reasonable level of inconvenience is often a matter of judgement for each specific situation, tempered by experience and common sense. This in turn should be guided by court, tribunal and planning decisions that have been made informed judgements on these issues.

Lack of sunlight is a common example, especially in regard to solar panels. People generally expect to be able to use a patio for sitting in the sun and if trees shade is to the extent that irt cannot be used as intended, then that is excessive interference. However, if the garden is large and there are other places to do the same thing, then the case for tree removal might be weakened

On an international level, very large trees near existing occupies buildings can dominate to the extent that the dis-benefit from the anxiety of the occupants outweigh the benefit of the tree. Similarly, regular and sever staining caused by fallen debris to a swimming pool surround may be unacceptable because the stark contrast in colours creates a dirty impression whereas the same staining on a path or driveway surface may be more acceptable. In contrast, falling leaves blocking gutters causing them to be cleaned one a year is not that much of a local inconvenience in the extent of the wider benefits that the trees impart.

Assessing inconvenience is almost entirely a subjective judgement, based on experience and understanding of what is perceived as being reasonable and unreasonable for a normal person. As with all these judgements, a simple test is to imagine a TPO appeal situation where an inspector has to decide if the levels of inconvenience are intolerable. If they are, then the tree is a Z11; if they are not that bad, then the tree belongs in another subcategory (Barrel 2006).

Z12 Causing or likely to cause damage to existing structures

Explanation: Damage as opposed to inconvenience – *Where more serious damage occurs to property from root action, then court judgements on liability help to focus on what level of damage is deemed acceptable by society.*

The most common example is direct damage from roots, trunks, and branches to structures and surfacing. Repairs to walls may vary require such extensive excavations and cutting of roots that the tree cannot be retained. However, the use of innovative techniques may reduce root damage but still provide a viable boundary, allowing the tree to be retained.

As a general rule, there would need to be good evidence of or potential for ongoing damage with little scope for remedial works before a tree could reliably allocated to this category (Barrel 2006)

Council tree inspectors are not legal experts, but are often required to follow council policies that tend to put more emphasis on protect trees more than their rate payers and residents when assessing trees under their Tree Preservation Orders. For example, many Councils in the Sydney area do not consider root damage to privately owned fences and paved surfaces as being a valid reason to remove a tree.

A recent court decision in NSW indicates that this is not always consistent with the legal torte of nuisance and negligence. This case sets a president and Councils could now easily find themselves liable for future claims for damages. Refer to Dimitrios Michos & Another v Council of the City of Botany Bay [2012] NSWSC 625 (8 June 2012)

Z13 **Unacceptably expensive to retain**

Explanation: Degree of Cost **–** *This is a matter of judgement and may vary widely. It primarily applies to existing trees that are not suited to their location but there is resistance to their replacement. As a general principle, all trees will incur some management costs and these would normally not be a valid reason for removal. However, as these costs increase, their acceptability decreases to the point where it will be more cost effective to plant a new tree more suited to the location, rather than incur the burden of repeated and excessive costs indefinitely. Typical examples include topped trees with excessive decay, pollarded trees, to reduce subsidence risk, tree beneath powerlines, and trees close to buildings, roads and pathways. All these examples will require high levels of maintenance that may not be financially viable unless the benefits that arise from remaining trees are particularly high*

'A' Trees are suitable for retention for more than 10 years and considered important and worthy of consideration in management decisions.

A1 **No significant defects and could be retained with minimal remedial care**

A2 **Minor defects that could be addressed by limited remedial care or work to adjacent trees**

A3 **Special significance for historical, commemorative or rarity reasons that would warrant extraordinary efforts to retain for more than 10 years**

A4 **Trees that may have legal protection for ecological reasons**

9.4 SIGNIFICANCE ASSESSMENT

The significance of any tree in the landscape is usually based on the personal opinion of the assessor, and can therefore be very subjective. A major drawback of methodologies based on subjective criteria is the difficulty in consistently arriving at the same answer with different assessors. This problem can never be fully addressed, but if a methodology is going to be effective, it must provide the basis to allow an independent person to arrive at the same conclusion.

This methodology is based on numerous concepts used in the Arboricultural Industry (IACA 2009 & Thyer 2006). Five parameters of a tree are assessed, with each providing a numerical value. Each high significance parameter has a value of 20, each medium parameter has a value of 14, each low parameter has a value of 7 and each very low parameter has a value of 0

Only one parameter can selected for each tree, and they are added together to provide its Significance Value. The highest Significance Value would be 100, and the lowest would be 0.

9.4.1 High Significance in the Landscape

- **Health & Vigour**: Tree with average vigour and typical of the species, considering its age, without noticeable decline, and expected to continue to remain so provided conditions around the tree required for its survival do not change.
- **Structural Condition:** Trees with good form; i.e. a single dominant trunk along which evenly spaced branches are spread. Branches have properly formed collars which provide strong attachment to the trunk, and are about 25% of the trunk diameter. Minor structural defects may be present with low failure potentials.
- **Ecological Value:** Indigenous species being an integral part of a natural ecosystem, and may be protected by Threatened Biodiversity Legislation
- **Amenity Value:** Superb, appealing specimen, attractive or interesting in all seasons.
- **Prominence:** Tree is known widely, of local historical importance, and/or listed as, or part of a Heritage Item

9.4.2 Medium Significance in the Landscape

- **Health & Vigour:** Tree is generally vigorous but shows some indications of decline due to pests and diseases or changes to its growing environment
- **Structural Condition:** Trees with structural defects with low failure potential
- **Ecological Value:** Remnant species of native vegetation
- **Amenity Value:** Attractive or interesting for part of the year
- **Prominence:** Tree is known locally or seen by many passers by

9.4.3 Low Significance in the Landscape

- **Health & Vigour:** Tree is in low vigour and in decline
- **Structural Condition:** Trees with structural defects with medium failure potentials and may require monitoring on an annual basis.
- **Ecological Value:** Native or introduced ornamental species - beneficial to fauna, food resource and/or shelter.
- **Amenity Value:** Ordinary or plain
- **Prominence:** Tree is only seen by neighbourhood residents and passers by

9.4.4 Very Low Significance in the Landscape

- **Health & Vigour:** Tree exhibits symptoms of advanced and irreversible decline due to fungal decay, major dieback of branch and crown canopy, predation of pests, storm or lightning damage, root damage, instability of the tree and alterations to its growing environment
- **Structural Condition:** Trees with defects which have failed, or have a high risk of failing soon, and corrective action must be taken as soon as possible.
- **Ecological Value:** Listed as a Priority Weed, Environmental Weed or an exempt species by the Local Council
- **Amenity Value:** Misshapen and/or unattractive, with little or no benefit to the local amenity
- **Prominence:** Tree is only seen by private owners or adjacent residents

9.5 IMPORTANCE OF THE ROOT SYSTEM

The most vulnerable part of a tree is its root system. As it is not visible and is poorly understood, it is frequently ignored, but damage or death of the root system will affect the health stability of the entire tree. When either a cut or fill occurs near trees, the root system is immediately reduced and the soil available for root growth is reduced.

9.5.1 Tree Protection Zone (TPZ)

The Tree Protection Zone (TPZ) is the principle means of protecting trees on development sites. The TPZ is a combination of the root area and crown area that requires protection. It is an area isolated from construction disturbance, so that the tree remains viable (AS – 4970)

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

TPZ = DBH x 12 (DBH = trunk diameter measured at 1.4m above ground level)

The radius of the TPZ is measured from COT (Centre of the trunk).

A sturdy protective fence is required around each tree to prevent damage occurring in the TPZ.

Variations to a TPZ
While TPZ's usually form a circular area under AS 4970, British Standard 5837 allows the area of a TPZ in m² to be converted into a square. This slightly reduces the extent of the TPZ while protecting the same amount of area in m²'s. BS 5837 also allows a 20% variation in the location of the centre of the TPZ, while AS 4970 allows a minor variation of 10%, with any further variation subject to advice from the project Arborist.

9.5.2 Structural Root Zone (SRZ)

The Structural Root Zone (SRZ) is the area around the base of a tree required for its stability. The woody root growth and soil cohesion in this area are necessary to hold the tree upright; therefore there are no variations to its size. The SRZ is normally circular with the trunk at its centre and is expressed by its radius in metres (AS – 4970). Due to the potential of causing instability of a tree, it is highly recommended that no roots within its SRZ are pruned or removed.

9.5.2 References to Appendices 9.5

- AS 4970 (2009) 'Protection of trees on construction sites' Standards Australia, Sydney, Australia

9.6 EXTENT OF THE ROOT SYSTEM

The shape of the main structural root system develops in response to the need to support the tree. Beyond this zone, root growth and development is influenced by the availability of water and nutrients. Unless conditions are uniform around the tree (which would be unusual) the extent of the root-systems can be irregular and difficult to predict. As roots are very opportunistic, they will not generally show the symmetry seen in the aerial parts. The majority is located in the surface 600mm of soil, and it is quite common for it to extend from 1.5 and 2.5 times the spread of the crown (Lonsdale 1999).

9.6.1 Types of Roots

Structural Root Plate: This is referred to in AS 4790 (2009) as the Structural Root Zone (SRZ) and represents the main structural woody root system that provides most of the trees anchorage. It is the central part of the root-system which rotates, and becomes visible, when a tree is wind thrown.

'Between four and eleven major woody roots (primary roots) originate from the base of the stem of most trees, the majority growing horizontally through the soil. Their points of attachment to the trunk are close to ground level and are associated with a marked swelling (root buttress) (Perry 1982). These rapidly subdivide to about 100mm in diameter (zone of rapid taper) and become the main woody, transport roots.

The size of tree's structural root plate varies in accordance to its dimensions, and growing environment. However, the diameter of its root crown can be used to calculate the recommended setback between it and the surrounding infrastructure.

Woody Transport Roots: Beyond the structural root plate the primary roots subdivide into approximately 100mm diameter woody roots. These continue to branch and subdivide into smaller diameter roots which transport water and nutrients from the non-woody roots. Their general direction of growth is radial from the structural root plate and horizontal to the soil surface. In typical clay-loam soils, they are usually located less than 20 to 30cm below the surface and it is not uncommon for them to extend from between 2.5 and 3 times the height of the tree (Stout 1956, Lyford & Wilson 1964)

Little is known about the dimensions and depth of transport roots from about 4m from the trunk outwards to their growing extremities. It can be inferred that for many species, they probably remain at the same depth as where they were recorded near the root plate (Cutler, D. 1995).
Woody transport roots can also be responsible for damage to infrastructure. Column 3 of Table 1 calculates the minimum radius measured from the stem that identifies the area containing the main transport roots. Ideally, this area should not be encroached upon to provide adequate moisture and nutrients needs of a healthy tree, and to minimise the potential of damage to infrastructure (Coder, K. 1996).

Non-Woody Roots:
Feeder Roots; Beyond the woody transport roots, a complex system of smaller non-woody lateral roots develop and these branch 3 to 4 times to form fans or mats of thousands of fine, short non-woody roots. They tend to be 1mm or less in diameter, at least 20cm long and grow predominantly upwards into the top 150mm of soil and leaf litter (Perry 1982 & Craul 1992).
Fine non-woody roots form the major part of a trees surface root system and are often called 'feeder roots' because they are the primary sites of absorption of water and minerals. The combined number of fine root tips of an individual tree has been estimated from 70 to 500 million (Craul 1992).

Root Hairs; The majority of the moisture requirements of a tree is absorbed from the soil into the non-woody roots through root hairs. The number of root hairs on a single plant has been estimated at more than 14 billion, and this can increase at a rate of more than 100 million per day (Robbins & others 1950).

Mycrorrhizal Associations; Many trees die soon after planting because certain fungi are not present to form mycorrhizae associations with their roots. Mycorrhizae (*myco* means fungus and *rhiza* means root) are root structures formed when the non-woody roots are invaded by specific fungi that form a symbiotic relationship beneficial to both organisms (Harris 1983). The fine threads (hyphae) that mycorrhizal fungi send into the soil around roots can increase the effective surface area of the root system by up to 60 times (CSIRO 1979)

9.6.2 References to Appendices 9.6

- Coder, K. (1996) Construction damage assessments: 'Tree and Sites'. University of Georgia Cooperative Extension Service Publication, FOR 96-39 18pp
- Coder, K. (1998) Root Growth Control: Managing Perceptions and Realities in 'The Landscape Below the Ground 2, Proceedings of a Second International Workshop on Tree Root Development in Urban Soils Ed by Neely &Watson
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- Stout, B.A. (1956) 'Studies of the root systems of deciduous trees' Black Rock Forest Bulletin #15. Harvard Black Rock Forest. Cornwall-on-the-Hudson, New York. In cooperation with the Maria Moors Cabot Foundation, Harvard University, Cambridge, Mass

10.0 TREE SURVEY

No.	Species Name	DBH (mm)	RCD (mm)	Height	Crown Spread	Age Class	Crown		
39	*Eucalyptus robusta*	450	600	16.5	N7 S3 E6 W8	O/M	Type D	Form	Lean
Health and Vitality		**Structural Condition**		**Eco**	**Amenity**	**Prom**	**SULE**	**TPZ**	**SRZ**
F		P		3			**Z5**	5.4	2.7
Other Information									

No.	Species Name	DBH (mm)	RCD (mm)	Height	Crown Spread	Age Class	Crown		
40	*Eucalyptus robusta*	700	750	21	N10 S0 E7 W11	M	Type C/E	Form	Lean
Health and Vitality		**Structural Condition**		**Eco**	**Amenity**	**Prom**	**SULE**	**TPZ**	**SRZ**
L		P		3			**A4**	8.4	2.9
Other Information									

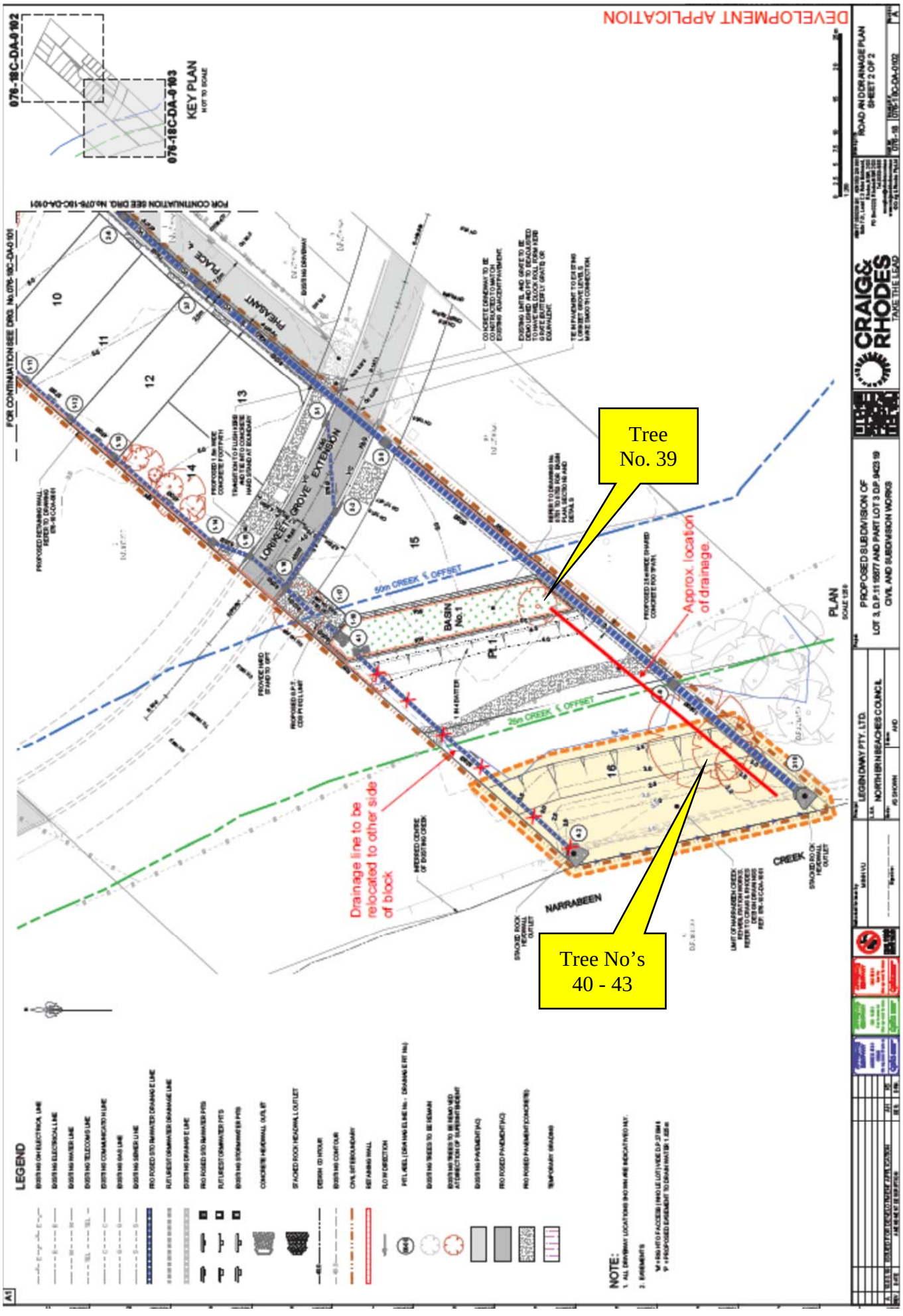
No.	Species Name	DBH (mm)	RCD (mm)	Height	Crown Spread	Age Class	Crown		
41	*Eucalyptus robusta*	450	650	22	N5 S 5 E10 W12	M	Type I	Form	Lean
Health and Vitality		**Structural Condition**		**Eco**	**Amenity**	**Prom**	**SULE**	**TPZ**	**SRZ**
L		P		3			**A4**	5.4	2.8
Other Information									

No.	Species Name	DBH (mm)	RCD (mm)	Height	Crown Spread	Age Class	Crown		
42	*Erythrina sykesii*	250/300	900	10	N6 S6 E6 W6	M	Type C	Form	Lean
Health and Vitality		**Structural Condition**		**Eco**	**Amenity**	**Prom**	**SULE**	**TPZ**	**SRZ**
A		A		0			**Z1**	5.5	3.2
Other Information									

No.	Species Name	DBH (mm)	RCD (mm)	Height	Crown Spread	Age Class	Crown		
43	*Eucalyptus robusta*	500	750	23	N S E W	M	Type C/E	Form	Lean
Health and Vitality		**Structural Condition**		**Eco**	**Amenity**	**Prom**	**SULE**	**TPZ**	**SRZ**
L		A		3			**A4**	6.0	2.9
Other Information									

11.0 PROPOSED SUBDIVISION LAYOUT

12.0 TREE LOCATION PLAN



13.0 ARBORICULTURAL IMPACTS ON THE SUBJECT TREES