**EARTHSCAPE HORTICULTURAL SERVICES**
Arboricultural, Horticultural and Landscape Consultants

**ABN 36 082 126 027**

# DEVELOPMENT IMPACT ASSESSMENT REPORT

## PROPOSED ZONE SUBSTATION

## ROYAL NORTH SHORE HOSPITAL

## June 2008

**Prepared for:** Diana Charteris
Consultant – Environmental Services
EnergyAustralia
GPO Box 4009
SYDNEY NSW 2000

Ph:- 02 9394 6659

**Prepared by:** Andrew Morton
B.App.Sci (Horticulture)
A.. Dip.App.Sci. (Landscape)
Dip. (Arboriculture)

EARTHSCAPE HORTICULTURAL SERVICES
Ph: - 0402 947 296

*Member of the National Arborist's Association of Australia (NAAA)*
*Member International Society of Arboriculture - Australian Chapter (ISAAC)*
*Member Local Government Tree Resources Association (LGTRA)*

PO Box 364, BEROWRA NSW 2081
Ph: (02) 9456 4787 Mobile: 0402 947 296 Fax: (02) 9456 5757
Email: andrewgmorton@bigpond.com

## 1 INTRODUCTION:-

1.1.1 This report was commissioned by EnergyAustralia to assess the health and condition of forty-two (42) trees located within or immediately adjacent to Royal North Shore Hospital. The report has been prepared to aid in the development assessment for the construction of a new zone sub-station within the property. The study area was limited to the site of the proposed sub-station and immediate environs (immediately north-west of the Royal North Shore Private Hospital) together with the access road (Saville Street) extending from Westbourne Street to the proposed sub-station site and cable route to Reserve Road.

1.1.2 The purpose of this report is to assess the potential impact of the proposed development on the subject trees, together with recommendations for amendments to the design or construction where necessary to minimise any adverse impact. The report also provides recommended tree protection measures to ensure the long-term preservation of the trees to be retained where appropriate.

## 2 THE SITE:-

2.1.1 The site of the proposed sub-station contains an existing brick cottage and brick building forming part of Royal North Shore Hospital. The buildings are surrounded by established gardens containing a number of mature and semi-mature trees. These are mostly planted non-local native species. Saville Street (site of the proposed easement & Right of Way) is flanked by narrow grassed verges and garden areas containing a number of mature and semi-mature trees, mainly on the south-western side of the carriageway. There are also a few trees planted in a narrow median on the north-eastern side of the roadway. The majority of these trees are also planted non-local native species.

2.1.2 Soils of this area are typical of the Glenorie Soil Landscape Group (as classified in the Soil Landscapes of the Sydney 1:100,000 Sheet), consisting of "shallow to moderately deep (less than 1000mm) *Red Podzolic Soils* on crests, moderately deep (700 – 1500 mm) *Red & Brown Podzolic Soils* on upper slopes and deep (greater than 2000mm) *Yellow Podzolic Soils* on lower slopes*"*. Soil materials are derived from Wianamatta shales. The landscape of the area generally consists of undulating to rolling low hills with slopes of 5-20%. [1]

2.1.3 The original vegetation of this area consisted of tall open forest (Blue Gum High Forest) which was logged early in the nineteenth century then cleared for agricultural and later residential & commercial development.[2] Dominant locally-indigenous tree species formerly found in this area included *Eucalyptus saligna* (Sydney Blue Gum), *Eucalyptus paniculata* (Grey Ironbark) and *Eucalyptus pilularis* (Blackbutt). Other species occurring in this association may include *Syncarpia glomulifera* (Turpentine), *Angophora floribunda* (Rough Barked Apple), *Eucalyptus acmenoides* (White Mahogany) and *Eucalyptus resinifera* (Red Mahogany).

## 3 SUBJECT TREES:-

3.1.1 The subject trees were inspected by Earthscape Horticultural Services (EHS) on the 22nd May 2008. Each tree has been provided with an identification number for reference purposes denoted on the attached Tree Location Plan (Appendix 6). The numbers used on this plan correlate with the Tree Assessment Schedule (Appendix 4). Trees 9a, 9b, 9c, 9d, 10a, 11a, 11b, and 30a were not shown on the original survey and have been plotted on the drawing in their approximate positions by taking offsets from existing features.

# 4 HEALTH AND CONDITION ASSESSMENT:-

## 4.1 Methodology

4.1.1 An assessment of each tree was made using the Visual Tree Assessment (VTA) procedure. [3] All of the trees were assessed in view from the ground. No aerial inspection or destructive testing has been undertaken as part of this assessment.

4.1.2 The following information was collected for each tree:-

- Tree Species (Botanical & Common Name);
- Approximate height;
- Canopy spread; measured using a metric tape and an average taken.
- Trunk Diameter measured at Breast Height (DBH) (1.4 metres from ground level);
- Live Crown Size; (measured by subtracting the total height of the tree from the lowest point of the crown and multiplying by the average crown spread to give a value in square metres).
- Health & vigour; using foliage size, colour, extension growth, presence of disease or pest infestation, canopy density, presence of deadwood, dieback and epicormic growth as indicators,
- Condition; using visible evidence of structural defects, instability, evidence of previous pruning and physical damage as indicators.
- Suitability of the tree to the site and its existing location; in consideration of damage or potential damage to services or structures, available space for future development and nuisance issues.

This information is presented in a tabulated form in **Appendix 4.**

## 4.2 Remaining Life Expectancy

4.2.1 The estimated Remaining Life Expectancy of each tree is shown in Appendix 4. The remaining life expectancy is an estimate of the sustainability of the tree in the landscape, based on an estimate of the average age of the species in an urban area in Sydney, less its estimated current age. The longevity of each tree has been further modified where necessary in consideration of its current health and vigour, condition and suitability.

4.2.2 The following ranges have been allocated to each tree:-

- Greater than 40 years (Long)
- Between 15 and 40 years (Medium)
- Between 5 and 15 years (Short)
- Less than 5 years (Transient)
- Dead or immediately hazardous (defective or unstable)

# 5 LANDSCAPE SIGNIFICANCE

## 5.1 Methodology for Determining Landscape Significance

5.1.1 The significance of a tree in the landscape is a combination of its aesthetic, environmental and heritage values. Whilst these values may be fairly subjective and difficult to assess consistently, some measure is necessary to assist in determining the retention value of each tree. To ensure in a consistent approach, the assessment criterion shown in **Appendix 1** have been used in this assessment.

5.1.2 A rating has been applied to each tree to give an understanding of the relative significance of each tree in the landscape and to assist in determining priorities for retention, in accordance with the following categories:-

1. **Significant**
2. **Very High**
3. **High**

4. **Moderate**
5. **Low**
6. **Very Low**
7. **Insignificant**

## 5.2 Environmental Significance

5.2.1 A Tree and Bushland Preservation Order (TBPO) exists within the City of Willoughby, pursuant to the Willoughby Local Environment Plan (LEP) 1995 and Sydney Regional Environmental Plan (SREP) No. 5 made by resolution of Council dated 26th March 2006. The TBPO generally protects all trees with a height of four (4) metres or greater and/or with a trunk circumference exceeding 600 mm (i.e. 200 mm diameter) and/or a canopy spread exceeding three (3) metres. Some exemptions apply. The following trees are exempt (not protected) under the provisions of Willoughby City Council's Tree Preservation Order:-

| Tree No. | Species | Exemption |
|---|---|---|
| **12** | *Acacia saligna* (Golden Wreath Wattle) | Environmental Weed Species |

5.2.2 The remainder of the trees are protected under Council's TPO.

5.2.3 Tree 7, 9, 9b & 22 (all Blackbutts) are locally-indigenous species, representative of the original vegetation of the area and would be of benefit to native wildlife. However, none of the trees contain cavities suitable as nesting hollows for arboreal mammals or birds or other visible signs of wildlife habitation. All of these trees appear to have been planted within the site.

5.2.4 None of the trees assessed are scheduled as Noxious Weeds under the meaning of *Noxious Weeds Act* (NSW) 1993.

5.2.5 None of the other trees are listed as Threatened or Vulnerable Species or form part of Endangered Ecological Communities under the provisions of the *Threatened Species Conservation Act* 1995 (NSW) or the *Environmental Protection and Biodiversity Conservation Act* 1999. The National Parks and Wildlife Service (NPWS) 1:25000 Mapping Series (Native Vegetation of the Cumberland Plain) does not indicate any remaining native vegetation community in this area.

## 5.3 Heritage Significance

5.3.1 None of the trees within the site are listed as Heritage Items under Schedule 6 or 7 of the Willoughby Local Environment Plan (November 1995). Most of the trees within the site and Saville Street appear to have been planted post 1980. Tree 30 (a large Forest Red Gum) is significantly older, perhaps c. 1900-1920. Whilst this tree is native to the Sydney Region it is generally found within the Cumberland Plain, or occasionally near to the harbour foreshore, and is not generally associated with the original vegetation community in this area. As such, it may be an old planting but is unlikely to be a remnant tree.

## 5.4 Aesthetic Value

5.4.1 Criteria for the assessment of aesthetic values are incorporated into Appendix 1. The aesthetic value of a tree is a measure of its live crown size, visual appearance (form, habit, crown density), visibility and position in the landscape and contribution to the visual character of an area. Generally the larger and more prominently located the tree, and the better its form and habit, the higher its aesthetic value.

## 6 TREE PROTECTION ZONES

6.1.1 Tree Protection Zones and Minimum Set-back Distances to construction for each tree are shown in Appendix 5. These have been determined using the methodology shown in Appendix 3.

## 7 PROPOSED DEVELOPMENT

7.1.1 The proposed development includes the demolition of the existing cottage and brick building and construction of a new zone substation within the site. The facility will be enclosed by a palisade fence. A 15 metre wide Electric and Magnetic Field (EMF) exclusion zone will be located on the south-eastern side of the facility. A 10 metre wide easement will also be provided between the site and Westbourne Street (in the alignment of Saville Street) to provide a Right of Carriageway and services corridor for underground utilities.

## 8 IMPACT ASSESSMENT

8.1.1 The intention of this assessment is to determine the incursions to the root zone and canopies created by the proposed development and evaluate the likely impact of the proposed works on the trees. Details shown on the Site Plan, Demolition Plan (Dwg Ref. No.s 08:5001/DA2 May 2008), and Right of Way and Easement Concept Plan prepared by EnergyAustralia were used in this assessment.

8.1.2 A summary of the impact of the proposed development on each tree within the site is shown in **Appendix 5**. The following criteria have been examined as part of this assessment:-

- Relative Level (R.L.) at base of tree;
- Optimum Tree Protection Zone (TPZ);
- Critical Root Zone (CRZ);
- Incursions to the TPZ, CRZ and tree canopy, including estimated cut & fill and offset from the tree;
- Assessment of the likely impact of the works;
- Recommendations for retention or removal.

8.1.3 The proposed development will necessitate the removal of nine (9) trees of low and very low retention value. These include Tree No.s 11b & 14 (Flooded Gums), 12 (Golden Wreath Wattle), 13 (Scribbly Gum), 15 & 16 (New England Peppermint), 32 (Brushbox) and 26 & 30a (Old Man Banksia). None of these trees are considered significant or worthy of special measures to ensure their preservation. It should be noted that Tree 12 is exempt from Council's Tree Preservation Order.

8.1.4 The proposed development will necessitate the removal of a further five (5) trees of moderate retention value. These include Tree 24a (Swamp Oak), Tree 27 (Flooded Gum) Tree 28 (Wattle) Tree 33 (Spotted Gum) and Tree 29 (Small-leaf Lillypilly). These trees are not considered significant, but are in good health and condition and make a fair contribution to the amenity of the site and surrounding properties. In order to compensate for loss of amenity, consideration should be given to replacement planting elsewhere within the property (hospital grounds) or adjacent the proposed easement.

8.1.5 The proposed development will also necessitate the removal of four (4) trees of high retention value. These include Tree 24 (River Oak), Trees 25 & 31 (both Eucalypts) and Tree 30 (Forest Red Gum). These trees are in good health and condition and make a positive contribution to the amenity of the site and surrounding properties. Given the nature of the proposed development, there are no feasible alternatives that can be implemented that would permit the retention of these trees. In order to compensate for loss of amenity, consideration should be given to replacement planting elsewhere within the property (hospital grounds) or adjacent the proposed easement.

8.1.6 Trenching for any proposed utilities within the easement may be located within the Tree Protection Zones of Trees 11, 11a, 17, 19, 20, 21 & 22. All of these trees are considered worthy of preservation. To minimise any adverse impact, all trenching for proposed utilities should be located outside the specified Minimum Setback Distance for each tree (refer Appendix 5) and all excavations should be undertaken in accordance with Section 12.7. Where trenching within the minimum setback distance is unavoidable, and large woody roots are encountered during excavations, consideration should be given to the removal of these trees.

8.1.7 The crowns of Trees 11, 11a, 10 & 10a currently project within the area of the easement and therefore pruning may be required to provide adequate clearance for high vehicles and movement of plant and equipment. Where pruning is required, all such work should be undertaken in accordance with Section 12.10. Where significant pruning is required that is likely to cause disfigurement or loss of structural integrity, removal of the entire tree should be considered.

8.1.8 No other trees will be adversely affected by the proposed development.

## 9 REPLACEMENT PLANTING

9.1.1 Where compromises to tree retention are proposed, consideration should be given to replanting new trees within the property (i.e. other areas of the hospital grounds) to compensate for loss of amenity. Replacement trees should preferably include some locally indigenous species. These will be most appropriate to the site conditions and be most valuable in terms of preserving the landscape character and wildlife habitat of the area.

## 10 CONCLUSIONS:-

10.1.1 A total of forty-two (42) trees stand within the site and in close proximity to the boundaries on adjoining properties. These are a mostly non-local native species in fair to good health and condition.

10.1.2 The proposed development will necessitate the removal of nine (9) trees of low and very low retention value. These include Tree No.s 11b, 12, 13, 14, 15, 16, 26, 30a & 32. None of these trees are considered significant or worthy of special measures to ensure their preservation. It should be noted that Tree 12 is exempt from Council's Tree Preservation Order.

10.1.3 The proposed development will necessitate the removal of a further five (5) trees of moderate retention value. These include Tree 24a, 27, 28, 29 & 33. These trees are not considered significant, but are in good health and condition and make a fair contribution to the amenity of the site and surrounding properties.

10.1.4 The proposed development will also necessitate the removal of four (4) trees of high retention value. These include Tree 24, 25, 31 & 30. These trees are in good health and condition and make a positive contribution to the amenity of the site and surrounding properties. Given the nature of the proposed development, there are no feasible alternatives that can be implemented that would permit the retention of these trees.

10.1.5 Trenching for any proposed utilities within the easement may be located within the Tree Protection Zones of Trees 11, 11a, 17, 19, 20, 21 & 22. All of these trees are considered worthy of preservation. Any adverse impact can be mitigated by placing any required trenching outside the specified Minimum Setback Distance for each tree as specified in Appendix 5.

10.1.6 The crowns of Trees 11, 11a, 10 & 10a currently project within the area of the easement and therefore pruning may be required to provide adequate clearance for high vehicles and movement

of plant and equipment. Any adverse impact can be minimised by undertaking any required pruning works in accordance with the following recommendations.

10.1.7 No other trees will be adversely affected by the proposed development.

## 11 RECOMMENDATIONS:-

11.1.1 The following Tree Protection Measures (Appendix 2) should be implemented to ensure the long term survival of all trees within the site to be retained as part of the development

11.1.2 Consideration should be given to replacement planting elsewhere within the property (hospital grounds) or adjacent the proposed easement in order to compensate for loss of amenity resulting from removal of trees to accommodate the proposed development

11.1.3 To minimise any adverse impact, all trenching for proposed utilities within the proposed easement should be located outside the specified Minimum Setback Distance for each tree (refer Appendix 5) and all excavations should be undertaken in accordance with Section 12.7. Where trenching within the Minimum Setback Distance is unavoidable, and large woody roots are encountered during excavations, consideration should be given to the removal of these trees.

11.1.4 Where pruning of Trees 11, 11a, 10 & 10a is required to provide adequate clearance, all such work should be undertaken in accordance with Section 12.10. Where significant pruning is required that is likely to cause disfigurement or loss of structural integrity, removal of the entire tree should be considered.

**Andrew Morton**
EARTHSCAPE HORTICULTURAL SERVICES
10th June 2008

## REFERENCES:-

[1] GA Chapman & CL Murphy (1989)
**Soil Landscapes of the Sydney 1:100,000 Sheet**
Soil Conservation Service of NSW. Sydney

[2] Benson, Doug & Howell, Jocelyn (1990)
**Taken for Granted: the Bushland of Sydney and its Suburbs.**
Kangaroo Press & The Royal Botanic Gardens, Sydney, NSW

[3] Mattheck, Dr. Claus & Breloer, Helge (1994) – Sixth Edition (2001)
**The Body Language of Trees – A Handbook for Failure Analysis**
The Stationery Office, London, England

# APPENDIX ONE
# CRITERIA FOR ASSESSMENT OF LANDSCAPE SIGNIFICANCE

The level of landscape significance has been determined using the following key criteria as a guide:

**1. SIGNIFICANT**

- The subject tree is listed as a Heritage Item under the Local Environment Plan (LEP) with a local, state or national level of significance; or
- The subject tree forms part of the curtilage of a Heritage Item (building /structure /artefact as defined under the LEP) and has a known or documented association with that item; or
- The subject tree is a Commemorative Planting having been planted by an important historical person (s) or to commemorate an important historical event; or
- The subject tree is scheduled as a Threatened Species or is a key indicator species of an Endangered Ecological Community as defined under the *Threatened Species Conservation Act* 1995 (NSW) or the *Environmental Protection and Biodiversity Conservation Act* 1999; or
- The tree is a locally indigenous species, representative of the original vegetation of the area and is known as an important food, shelter or nesting tree for endangered or threatened fauna species; or
- The subject tree is a Remnant Tree, being a tree in existence prior to development of the area; or
- The subject tree has a very large live crown size exceeding 300m² with normal to dense foliage cover, is located in a visually prominent in the landscape, exhibits very good form and habit typical of the species and makes a significant contribution to the amenity and visual character of the area by creating a sense of place or creating a sense of identity; or
- The tree is visually prominent in view from surrounding areas, being a landmark or visible from a considerable distance.

**2. VERY HIGH**

- The tree has a strong historical association with a heritage item (building/structure/artefact/garden etc) within or adjacent the property and/or exemplifies a particular era or style of landscape design associated with the original development of the site; or
- The subject tree is listed on Council's Significant Tree Register; or
- The tree is a locally-indigenous species and representative of the original vegetation of the area and the tree is located within a defined Vegetation Link / Wildlife Corridor or has known wildlife habitat value;
- The subject tree has a very large live crown size exceeding 200m²; a crown density exceeding 70% Crown Cover (normal-dense), is a very good representative of the species in terms of its form and branching habit or is aesthetically distinctive and makes a positive contribution to the visual character and the amenity of the area.

**3. HIGH**

- The tree has a suspected historical association with a heritage item or landscape supported by anecdotal or visual evidence; or
- The tree is a locally-indigenous species and representative of the original vegetation of the area; or
- The subject tree has a large live crown size exceeding 100m²; and
- The tree is a good representative of the species in terms of its form and branching habit with minor deviations from normal (eg crown distortion/suppression) with a crown density of at least 70% Crown Cover (normal); and
- The subject tree is visible from the street and surrounding properties and makes a positive contribution to the visual character and the amenity of the area.

**4. MODERATE**

- The subject tree has a medium live crown size exceeding 40m²; and
- The tree is a fair representative of the species, exhibiting moderate deviations from typical form (distortion/suppression etc) with a crown density of more than 50% Crown Cover (thinning to normal); and
- The tree makes a fair contribution to the visual character and amenity of the area; and
- The tree is visible from surrounding properties, but is not visually prominent – view may be partially obscured by other vegetation or built forms.
- The tree has no known or suspected historical association

**5. LOW**

- The subject tree has a small live crown size of less than 40m² and can be replaced within the short term with new tree planting; or
- The tree is a poor representative of the species, showing significant deviations from the typical form and branching habit with a crown density of less than 50% Crown Cover (sparse); and
- The subject tree is not visible from surrounding properties (visibility obscured) and makes a negligible contribution or has a negative impact on the amenity and visual character of the area.

**6. VERY LOW**

- The subject tree is listed as an Environment Weed Species in the relevant Local Government Area, being invasive, or is a known nuisance species.
- The subject tree is scheduled as exempt (not protected) under the provisions of the local Council's Tree Preservation Order due to its species, nuisance or position relative to buildings or other structures.

**7. INSIGNIFICANT**

- The tree is a declared Noxious Weed under the *Noxious Weeds Act* (NSW) 1993

# APPENDIX TWO
# 12 TREE PROTECTION MEASURES

## 12.1 Tree Protection Zones

12.1.1 The Tree Protection Zones are recommended for all trees within the site to be retained shall be equivalent to the Tree Protection Zone as specified in Appendix 5. This is a radial distance measured from the centre of the trunk of the subject tree.

12.1.2 The following activities should be avoided within specified Tree Protection Zones:-

- Excavations and trenching (with exception of the approved foundations and underground services);
- Ripping or cultivation of soil;
- Mechanical removal of vegetation;
- Soil disturbance or movement of natural rock;
- Soil level changes including the placement of fill material (excluding any suspended floor or slab);
- Movement and storage of plant, equipment & vehicles;
- Erection of site sheds;
- Affixing of signage or hoardings to trees;
- Storage of building materials, waste and waste receptacles;
- Disposal of waste materials and chemicals including paint, solvents, cement slurry, fuel, oil and other toxic liquids;
- Other physical damage to the trunk or root system; and
- Any other activity likely to cause damage to the tree.

## 12.2 Tree Protection Fencing

12.2.1 All trees within the site to be retained shall be protected prior to and during construction from all activities that may result in detrimental impact by erecting a suitable protective fence beneath the canopy to the full extent of the Tree Protection Zone (excluding the footprint of the proposed works and areas within adjoining properties). As a minimum the fence should consist temporary chain wire panels 1.8 metres in height, supported by steel stakes as required and fastened together and supported to prevent sideways movement. The fence shall be erected prior to the commencement of any work on-site and shall be maintained in good condition for the duration of construction. Where tree protection zones merge together a single fence encompassing the area is deemed to be adequate.

12.2.2 Appropriate signage shall be installed on the fencing to prevent unauthorised movement of plant and equipment or entry to the Tree Protection Zone.

12.2.3 A 50mm layer of woodchip mulch shall be installed to the full extent of the Tree Protection Zone of all trees to be retained. Mulch shall be installed and spread by hand to avoid soil disturbance and compaction within the root zone.

## 12.3 Trunk Protection

12.3.1 Where provision of tree protection fencing is in impractical due to its proximity to the proposed building envelope, trunk protection shall be erected around the tree to avoid accidental damage. As a minimum, the trunk protection shall consist of two metre lengths of hardwood timbers (100 x 50mm) spaced at 100-150mm centres secured together with 2mm galvanised wire. These shall be strapped around the trunk (not fixed in any way) to avoid mechanical injury or damage. Trunk protection should be installed prior to any site works and maintained in good condition for the duration of the construction period.

## 12.4 Tree Damage

12.4.1 In the event of any tree becoming damaged for any reason during the construction period a consulting arborist shall be engaged to inspect and provide advice on any remedial action to minimise any adverse impact. Such remedial action shall be implemented as soon as practicable and certified by the arborist.

## 12.5 Demolition Works within Tree Protection Zones

***Demolition of Pathways and Pavements***

12.5.1 Demolition of pathways and paved areas within the Tree Protection Zone of trees to be retained shall be undertaken under the supervision of the Site Arborist. The pavement surface and sub-base shall be stripped-

off in layers of no greater than 50mm thick using a small rubber tracked excavator or alternative approved method to avoid damage to underlying roots and minimise soil disturbance. The machine shall work within the footprint of the existing pathway to avoid compaction of the adjacent soil. The final layer of sub-base material shall be removed using hand tools were required to avoid compaction of the underlying soil profile and damage to woody roots.

12.5.2 Following removal of the pavement surface and sub-base, clean, friable topsoil shall be used to fill in the excavated area and bring flush with surrounding levels. Soil shall only be imported and spread when the underlying soil conditions are dry to avoid compaction of the soil profile.

***Demolition of Retaining Walls or other Structures***

12.5.3 Demolition of low masonry walls within the Tree Protection Zone of trees to be retained shall be undertaken under the supervision of the Site Arborist. The walls shall be demolished using equipment on the street side of the wall. Care shall be taken to avoid the root systems, trunks and lower branches of trees in the vicinity of the existing walls.

**12.6 Excavations within Tree Protection Zones**

12.6.1 Excavations within the Tree Protection Zone of any tree to be retained shall be avoided wherever possible.

12.6.2 Excavations for foundations and pavement sub-grade within the Tree Protection Zone of any tree to be retained shall be undertaken by hand or using an Air-spade® device to locate and expose roots along the perimeter of the foundation or pavement prior to any mechanical excavation. All care shall be undertaken to preserve root systems intact and undamaged. Any roots less than 50mm in diameter shall be cleanly severed with clean sharp pruning implements at the face of the excavation. The root zone in the vicinity of the excavation shall be kept moist following excavation for the duration of construction to minimise stress on the tree.

12.6.3 Where large woody roots (greater than 50mm diameter) are encountered during excavations, further advice from a qualified arborist shall be sought prior to severance. Where necessary, (to avoid severing large woody roots) consideration should be given to the installation of an elevated structure (e.g. pier and beam footing, suspended slab or floor on piers, cantilevered slab, etc) in preference to structures requiring a deep edge beam or continuous perimeter strip footing. The beam section of any pier and beam footing should be placed **above** grade to avoid excavation within the CRZ.

12.6.4 For masonry walls or fences it may be acceptable to delete continuous concrete strip footings and replace with suspended in-fill panels (eg steel or timber pickets, lattice etc) fixed to pillars.

12.6.5 For paved areas, consideration should be given to raising the proposed pavement level and using a porous fill material in preference to excavation.

**12.7 Underground Services**

12.7.1 All proposed stormwater lines and other underground services should be located as far away as practicable, or suspended beneath the floor of the building where possible, to avoid excavation within the Tree Protection Zone of trees to be retained.

12.7.2 For underground services, where the incursion to the Root Zone is less than 20% of the total TPZ (i.e. beyond the Minimum Setback Distance), a chain trenching device may be used. A backhoe or skid steer loader is unacceptable due to the potential for excessive compaction and root damage. Where large woody roots (greater than 50mm in diameter) are encountered during excavation or trenching, these shall be retained intact wherever possible (eg by sub-surface boring beneath roots or re-routing the service etc).

12.7.3 Excavations required for underground services within the Critical Root Zone of any tree to be retained should only be undertaken by sub-surface boring. The Invert Level of the pipe, plus the pipe diameter, must be lower than the estimated root zone depth as specified. This will depend on the soil conditions at the site. Where this is not practical and root pruning is the only alternative, proposed root pruning should be assessed by the arborist to determine continued health and stability of the subject tree.

12.7.4 If trees show signs of stress or deterioration, remedial action shall be taken to improve the health and vigour of the subject tree (s) in accordance with best practice arboricultural principles

**12.8 Pavements**

12.8.1 Pavements should be avoided within the Tree Protection Zone of trees to be retained where possible. Proposed paved areas within the Tree Protection Zone of trees to be retained should be placed above grade to minimise excavations within the root zone and avoid root severance and damage. Pavement sub-base material should be as per Section 12.8.

**12.9 Fill Material**

12.9.1 Placement of fill material within the Tree Protection Zone of trees to be retained should be avoided where possible. Where placement of fill cannot be avoided, the material should be a coarse, gap-graded material such as 20 – 50mm crushed basalt (Blue Metal) or equivalent to provide some aeration to the root zone. Note that Roadbase or crushed sandstone or other material containing a high percentage of fines is unacceptable for this purpose. The fill material should be consolidated with a non-vibrating roller to minimise compaction of the underlying soil. A permeable geotextile may be used beneath the sub-base to prevent migration of the stone into the sub-grade. No fill material should be placed in direct contact with the trunk.

**12.10 Canopy & Root Pruning**

12.10.1 All pruning work required shall be carried out in accordance with Australian Standard No 4373-2007 – Pruning of Amenity Trees. Written approval from Council may be required under the Tree Preservation Order prior to undertaking this work. All pruning work shall be carried out by a qualified and experienced arborist or tree surgeon in accordance with the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998).

12.10.2 Care shall be taken when operating cranes, drilling rigs and similar equipment near trees to avoid damage to tree canopies (foliage and branches). Under no circumstances shall branches be torn-off by construction equipment. Where there is potential conflict between tree canopy and construction activities, the advice of the Site Arborist must be sought.

12.10.3 Where root pruning is required, roots shall be severed with clean, sharp pruning implements and retained in a moist condition during the construction phase using Hessian material or mulch where practical. Severed roots shall be treated with a suitable root growth hormone containing the active constituents Indol-3-yl-Butric Acid (IBA) and 1-Naphthylacetic Acid (NAA) to stimulate rapid regeneration of the root system.

**12.11 Tree Removal**

12.11.1 The approval of Willoughby City Council shall be obtained prior to the removal or pruning of any tree protected under the Tree Preservation Order.

12.11.2 Tree removal work shall be carried out by an experienced tree surgeon in accordance with the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998). Care shall be taken to avoid damage to other trees during the felling operation.

12.11.3 Stumps shall be grubbed-out where required using a mechanical stump grinder without damage to the root system of other trees. Where trees to be removed are in close proximity to trees to be retained, consideration should be given to cutting the stump close to ground level and retaining the root crown intact. Stumps within the Tree Protection Zone of other trees to be retained should **not** be removed using excavation equipment or similar.

# APPENDIX THREE
# 13 METHODOLOGY FOR DETERMINING TREE PROTECTION ZONES

13.1.1 In order to provide adequate protection for trees nominated as suitable for preservation, Tree Protection Zones (TPZ) are required to provide adequate setbacks from buildings and other infrastructure to minimise adverse impact. The Tree Protection Zone is a radial distance measured from the centre of the trunk of the tree as specified in Appendix 5 (refer also Figure 4). The intention of the Tree Protection Zone is to minimise incursions to the root system and canopy to ensure the long-term health and stability of each tree to be retained. Incursions to the root zone may occur due to changes in ground levels, (either lowering or raising the grade), trenching or other forms or soil disturbance such as ripping, grading or inverting the soil profile.

13.1.2 A commonly used delineation for the Tree Protection Zone is the drip-line (extent of the crown spread projected to the ground plane). However, this may not provide adequate protection for trees that have prominent leans or distorted, imbalanced or narrow crowns. A more appropriate guideline is the trunk diameter.[4]

13.1.3 The TPZ has been determined from Table 3, based on guidelines prepared by the British Standards Institute (1991) using the following parameters:-

- The trunk diameter;
- The sensitivity/tolerance of the species to construction impacts;
- The level of maturity;
- The health, vigour and structural integrity of the tree (refer to Section 4); and
- The trees root and crown formation.

**13.2 Trunk Diameter**

13.2.1 The trunk diameter of each tree was measured at 1.4 metres from ground level using a metric diameter tape. For the purpose of calculating the tree protection zone, the diameter of twin-trunked trees has been added then multiplied by 75%. For multi-trunked trees, the diameter of each trunk has been added then multiplied by 60%. This gives a more realistic measurement for an equivalent sized single-trunked tree.

**13.3 Construction Tolerance**

13.3.1 The Construction Tolerance of each tree has been divided into the following categories:-

- **GGood –** good tolerance to construction impacts
- **M** **Moderate –** moderate tolerance to construction impacts
- **P** **Poor –** poor tolerance to construction impacts

13.3.2 As there is very little documentary record of the construction tolerance of species under Australian conditions, the trees have been categorized according to our field observation and experience. The above classifications are also used as criteria to determine appropriate setback distances to trenching (together with Maturity Class).

**13.4 Maturity Class.**

13.4.1 The Maturity Classification of each tree has been divided into the following categories:-

- **OM** **Overmature –** greater than 80% of the life expectancy for the species
- **M** **Mature –** 50-80% of the life expectancy for the species
- **SM** **Semi-mature –** 20-50% of the life expectancy for the species
- **Y** **Immature –** less than 20% of the life expectancy for the species

**13.5 Root and Crown Formation**

13.5.1 The distribution of the canopy and branches of each tree was recorded in the field from visual observation and is shown in **Appendix 4**. This is also reflected in the tree location plans in **Appendix 6**. Based on the information available, it has been assumed that the soil conditions are fairly uniform and therefore a uniform radial root system has also been assumed. Existing incursions (due to existing underground services, adjacent structures or grade differences) to the root zone were also noted in the field. Where appropriate the Tree Protection Zones take account of existing incursions and canopy distribution.

**TABLE THREE – GUIDELINES FOR OPTIMUM TREE PROTECTION ZONES**

| Species Tolerance | Tree Maturity Class | Distance from Trunk (m) per Unit Trunk Diameter (cm) |
|---|---|---|
| Good | Young | 0.06 |
| | Mature | 0.09 |
| | Overmature | 0.12 |
| | | |
| Moderate | Young | 0.09 |
| | Mature | 0.12 |
| | Overmature | 0.15 |
| | | |
| Poor | Young | 0.12 |
| | Mature | 0.15 |
| | Overmature | 0.18 |

| KEY (Maturity Class) |
|---|
| Young (<20% Life Expectancy) |
| Mature (20-80% Life Expectancy) |
| Overmature (>80% Life Expectancy) |

Modified from the British Standards Institute (1991)
Guidelines are for trees of average to excellent vigour

REF:- Harris, R.W., Clark, J.R. & Matheny, NP (1999)
Arboriculture - Integrated Management of Landscape Trees, Shrubs & Vines (Third Edition)
Prentice Hall, New Jersey, USA

**13.6 Minimum Set-back Distance.**

13.6.1 Where construction work within the TPZ is unavoidable, the proposed incursion should be limited to a radial offset equivalent to no greater than 20% of the TPZ, on one side only (refer to **Figure 4**). It is generally accepted that healthy, vigorous trees can withstand incursions of this amount without any significant adverse impact on their health and long-term preservation. Incursions of greater amounts are likely to result in an adverse impact and significant incursions may lead to the demise or destabilization of the tree. Minimum Setback Distances to construction have been specified in **Appendix 5**.

**13.7 Critical Root Zone.**

13.7.1 The diameter of the root plate, which provides the bulk of mechanical support and anchorage for a tree, is related to the distance from the trunk at which rapid taper of tree roots ceases. [5] This has been defined as the tree's "Critical Root Zone". Based on field studies of root plate sizes of windthrown (overturned) trees, it has been established that there is a relationship between the Critical Root Zone (Root Plate Diameter) and the trunk diameter. The Critical Root Zone for each tree has been shown in **Appendix 5**. Incursions within the Critical Root Zone are not recommended as they are likely to result in the severance of woody roots which may lead to the destabilisation and/or demise of the tree.

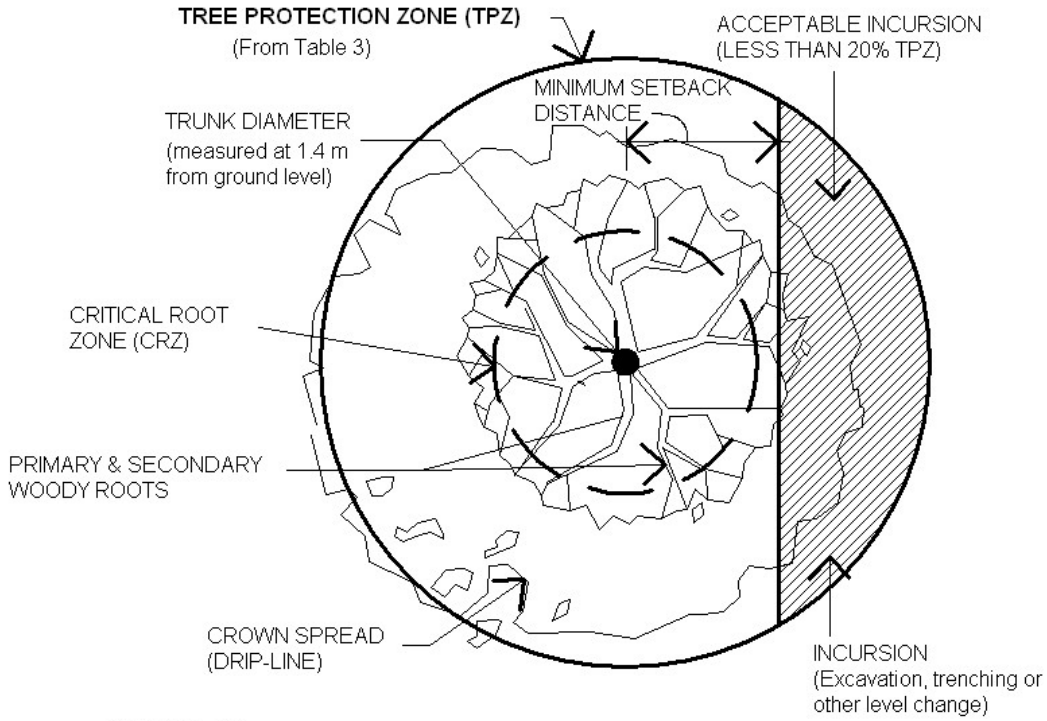



**FIGURE 4**

**METHODOLOGY TO CALCULATE MINIMUM SETBACK DISTANCE**

**13.8 Acceptable Incursions to the Root Zone.**

13.8.1 Incursions within the TPZ and CRZ may be acceptable only where special construction methods are adopted to avoid any adverse impact on the trees root system. Fully elevated construction methods incorporating suspended flooring, isolated piers or pier and beam type footing construction are generally acceptable within the TPZ / CRZ, provided all excavations are undertaken by hand and roots are adequately protected.

**REFERENCES**

[4] Harris, R.W., Clark, J.R. & Matheny, N.P. (2004)
**Arboriculture – Integrated Management of Landscape Trees, Shrubs and Vines** (4th Edition)
Prentice Hall, New Jersey, USA

[5] Culter, David F. (1995)
**Interactions between Tree Roots and Buildings**
Proceedings of and International Workshop on Trees and Buildings
International Society of Arboriculture, Illinois, USA

## APPENDIX 4 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

| Id. No. | Species | Height | Spread | DBH (mm) | Live Crown Size ($m^2$) | Maturity Class | Condition | Previous Pruning | Health | | Remaining Life Expectancy | Landscape Significance Rating | Retention Value | Location |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Vigour | Pest & Disease | | | | |
| 1 | ***Casuarina glauca*** (Swamp Oak) | 10 | 3 | 200 | 24 | SM | Appears stable with sound branching structure. | No Evidence | Good | No Evidence | Medium 15-40 Years | 5 | **low** | On-site |
| 2 | ***Casuarina glauca*** (Swamp Oak) | 15 | 10 | 400 | 120 | M | Appears stable with fair branching structure. Exhibits a low bark inclusion at 6 metres. | Crown lifted to 3 metres | Good | No Evidence | Medium 15-40 Years | 3 | **moderate** | On-site |
| 3 | ***Casuarina glauca*** (Swamp Oak) | 14 | 3 | 220 | 36 | SM | Appears stable with sound branching structure. | No Evidence | Good | No Evidence | Medium 15-40 Years | 5 | **low** | On-site |
| 4 | ***Casuarina glauca*** (Swamp Oak) | 8 | 3 | 180 | 18 | SM | Appears stable with sound branching structure. | No Evidence | Good | No Evidence | Medium 15-40 Years | 5 | **low** | On-site |
| 5 | ***Casuarina glauca*** (Swamp Oak) | 16 | 5 | 300 | 70 | M | Appears stable with sound branching structure. Suppressed on SE side due to crowding. | No Evidence | Good | No Evidence | Long - more than 40 years | 4 | **moderate** | On-site |
| 6 | ***Liquidambar styraciflua*** (Liquidamber) | 13 | 10 | 500 | 105 | M | Appears stable with sound branching structure. Exhibits a low bark inclusion at 5 metres. Crown suppressed on SW side due to building | Crown lifted at 2 metres | Good | No Evidence | Long - more than 40 years | 3 | **high** | On-site |
| 7 | ***Eucalyptus pilularis*** (Blackbutt) | 20 | 10 | 550 | 160 | M | Appears stable with fair branching structure. Exhibits a moderate bark inclusion at 8 metres. Moderate axial wound at 4 metres. | Lower limbs selectively removed | Good | Low borer infestion | Medium 15-40 Years | 3 | **moderate** | On-site |
| 8 | ***Corymbia citriodora*** (Lemon scented Gum) | 16 | 8 | 300 | 48 | M | Appears stable with sound branching structure. Crown suppressed on SW side due to building | No Evidence | Good | No Evidence | Medium 15-40 Years | 4 | **moderate** | On-site |
| 9 | ***Eucalyptus pilularis*** (Blackbutt) | 20 | 9 | 400 | 135 | M | Appears stable with sound branching structure. Crown suppressed on SW side due to building | No Evidence | Good | No Evidence | Long - more than 40 years | 3 | **high** | On-site |
| 9a | ***Casuarina glauca*** (Swamp Oak) | 14 | 3 | 180 | 33 | SM | Appears stable with sound branching structure. Crown suppressed on NW side due to crowding | No Evidence | Good | No Evidence | Long - more than 40 years | 5 | **moderate** | On-site |

## APPENDIX 4 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

| Id. No. | Species | Height | Spread | DBH (mm) | Live Crown Size ($m^2$) | Maturity Class | Condition | Previous Pruning | Health | | Remaining Life Expectancy | Landscape Significance Rating | Retention Value | Location |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Vigour | Pest & Disease | | | | |
| 9b | ***Eucalyptus pilularis*** (Blackbutt) | 14 | 7 | 320 | 63 | SM | Appears stable with sound branching structure. Exhibits a prominent lean to the NE. Suppressed on NW side due to crowding. 10% epicormic growth. | No Evidence | Very Good | No Evidence | Medium 15-40 Years | 4 | **moderate** | On-site |
| 9c | ***Angophora floribunda*** (Rough Barked Apple) | 12 | 6 | 250 | 60 | SM | Appears stable with sound branching structure. Upper crown suppressed due to overshadowing. | Selectively pruned | Fair | No Evidence | Medium 15-40 Years | 4 | **moderate** | On-site |
| 9d | ***Eucalyptus robusta*** (Swamp Mahogany) | 13 | 9 | 300 | 90 | SM | Appears stable with sound branching structure. Crown suppressed on SW side due to building | No Evidence | Good | No Evidence | Medium 15-40 Years | 4 | **moderate** | On-site |
| 10 | ***Eucalyptus robusta*** (Swamp Mahogany) | 7 | 9 | 250 | 45 | SM | Appears stable with sound branching structure. Supressed on SW side due to crowding | Lower limbs selectively pruned | Good | Moderate Psyllid infestation (Brown lace lerp) | Medium 15-40 Years | 4 | **moderate** | On-site |
| 10a | ***Eucalyptus robusta*** (Swamp Mahogany) | 11 | 6 | 240 | 48 | SM | Appears stable with sound branching structure. Exhibits a prominent lean to the NE. Most of the crown distributed to the NE due to crowding. | No Evidence | Good | Moderate Psyllid infestation (Brown lace lerp) | Medium 15-40 Years | 4 | **moderate** | On-site |
| 11 | ***Eucalyptus robusta*** (Swamp Mahogany) | 11 | 8 | 250 | 72 | SM | Appears stable with sound branching structure. | Lower limbs selectively pruned | Good | Low Psyllid infestation (Brown lace lerp) | Long - more than 40 years | 4 | **moderate** | On-site |
| 11a | ***Eucalyptus grandis*** (Flooded Gum) | 18 | 15 | 500 | 225 | M | Appears stable with sound branching structure. Extended lateral branching habit. | Crown lifted to 2 metres | Good with slightly thinning crown | No Evidence | Long - more than 40 years | 3 | **high** | On-site |
| 11b | ***Eucalyptus grandis*** (Flooded Gum) | 7 | 6 | 200 | 24 | SM | Appears stable with fair branching structure. | Lower limbs selectively removed | Fair with thinning crown | No Evidence | Short 5-15 Years | 5 | **low** | On-site |
| 12 | ***Acacia saligna*** (Golden Wreath Wattle) | 7 | 9 | 280 + 150 | 45 | M | Appears stable with fair branching structure. Exhibits a moderate bark inclusion at ground level. | No Evidence | Fair | No Evidence | Short 5-15 Years | 6 | **very low** | On-site |

## APPENDIX 4 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

| Id. No. | Species | Height | Spread | DBH (mm) | Live Crown Size ($m^2$) | Maturity Class | Condition | Previous Pruning | Health | | Remaining Life Expectancy | Landscape Significance Rating | Retention Value | Location |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Vigour | Pest & Disease | | | | |
| 13 | ***Eucalyptus haemastoma*** (Scribbly Gum) | 6 | 4 | 300 | 16 | M | Appears stable with sound branching structure. | Lower limbs selectively pruned | Good | No Evidence | Long - more than 40 years | 4 | **moderate** | On-site |
| 14 | ***Eucalyptus grandis*** (Flooded Gum) | 9 | 9 | 450 | 63 | SM | Appears stable with fair branching structure. Poor habit with restricted soil volume for future root development | Lower limbs selectively removed | Good | No Evidence | Short 5-15 Years | 4 | **low** | On-site |
| 15 | ***Eucalyptus nicholii*** (New England Peppermint) | 9 | 7 | 450 | 49 | M | Unstable with poor branching structure. Exhibits a small axial wound in trunk at 2 metres. Root plate lifting. Very prominent lean to south-east. | No Evidence | Fair with slight thinning crown | No Evidence | Potentially hazardous | 4 | **very low** | On-site |
| 16 | ***Eucalyptus nicholii*** (New England Peppermint) | 10 | 12 | 200x3 | 84 | M | Appears stable with fair branching structure. Small wound on lower trunk due to mechanical injury. Growing within narrow median. | Crown lifted to 3 metres | Good | No Evidence | Short 5-15 Years | 4 | **low** | On-site |
| 17 | ***Casuarina glauca*** (Swamp Oak) | 13 | 8 | 300 | 88 | SM | Appears stable with sound branching structure. Suppressed on north side due to crowding. | Crown lifted to 2 metres | Good | No Evidence | Long - more than 40 years | 4 | **moderate** | On-site |
| 18 | ***Casuarina glauca*** (Swamp Oak) | 16 | 5 | 350 | 65 | M | Appears stable with fair branching structure. Exhibits a moderate bark inclusion at 5 metres. | Crown lifted to 2 metres | Good | No Evidence | Long - more than 40 years | 4 | **moderate** | On-site |
| 19 | ***Casuarina glauca*** (Swamp Oak) | 14 | 6 | 360 | 75 | M | Appears stable with sound branching structure. | No Evidence | Good | No Evidence | Long - more than 40 years | 4 | **moderate** | On-site |
| 20 | ***Casuarina glauca*** (Swamp Oak) | 17 | 6 | 340 | 72 | M | Appears stable with fair branching structure. Crown suppressed on north-east side due to crowding. | Crown lifted to 4 metres | Fair with thinning crown | No Evidence | Medium 15-40 Years | 4 | **moderate** | On-site |
| 21 | ***Eucalyptus grandis*** (Flooded Gum) | 20 | 14 | 400 | 210 | M | Appears stable with sound branching structure. | No Evidence | Good | No Evidence | Long - more than 40 years | 3 | **high** | On-site |

## APPENDIX 4 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

| Id. No. | Species | Height | Spread | DBH (mm) | Live Crown Size ($m^2$) | Maturity Class | Condition | Previous Pruning | Health | | Remaining Life Expectancy | Landscape Significance Rating | Retention Value | Location |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Vigour | Pest & Disease | | | | |
| 22 | ***Eucalyptus pilularis*** (Blackbutt) | 16 | 8 | 270 | 88 | SM | Appears stable with sound branching structure. | Crown lifted to 4 metres | Good | No Evidence | Long - more than 40 years | 4 | **moderate** | On-site |
| 23 | ***Eucalyptus crebra*** (Narrow-leaved Ironbark) | 15 | 8 | 300 | 88 | SM | Appears stable with sound branching structure. | Crown lifted to 4 metres | Very Good | No Evidence | Long - more than 40 years | 4 | **moderate** | On-site |
| 24 | ***Casuarina cunninghamiana*** (River Oak) | 13 | 10 | 450 | 110 | M | Appears stable with sound branching structure. | Crown lifted to 3 metres | Good | No Evidence | Long - more than 40 years | 3 | **high** | On-site |
| 24a | ***Casuarina glauca*** (Swamp Oak) | 12 | 6 | 260 + 320 | 54 | M | Appears stable with fair branching structure. Exhibits a high bark inclusion at Ground Level. Small wound at 6 metres due to branch loss. | No Evidence | Good | No Evidence | Medium 15-40 Years | 4 | **moderate** | On-site |
| 25 | ***Eucalyptus sp.*** (Gum) | 17 | 9 | 450 | 135 | M | Appears stable with fair branching structure. Co-dominant leaders with low bark inclusion at 5 metres. | No Evidence | Very Good | No Evidence | Long - more than 40 years | 3 | **high** | On-site |
| 26 | ***Banksia serrata*** (Old Man Banksia) | 6 | 4 | 250 | 24 | SM | Appears stable with sound branching structure. Located close to existing building. | No Evidence | Very Good | No Evidence | Short 5-15 Years | 5 | **low** | On-site |
| 27 | ***Eucalyptus grandis*** (Flooded Gum) | 14 | 10 | 350 | 120 | SM | Appears stable with sound branching structure. Located close to existing kerb and building. Insufficient space for future growth. Lifting & cracking kerb. | No Evidence | Very Good | No Evidence | Short 5-15 Years | 3 | **moderate** | On-site |
| 28 | ***Acacia sp.*** (Wattle) | 14 | 6 | 380 | 60 | M | Appears stable with sound branching structure. | No Evidence | Very Good | No Evidence | Medium 15-40 Years | 4 | **moderate** | On-site |
| 29 | ***Syzygium leuhmannii*** (Small-leaf Lilly Pilly) | 7 | 5 | 300 | 35 | M | Appears stable with sound branching structure. | No Evidence | Very Good | No Evidence | Long - more than 40 years | 4 | **moderate** | On-site |

## APPENDIX 4 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

| Id. No. | Species | Height | Spread | DBH (mm) | Live Crown Size ($m^2$) | Maturity Class | Condition | Previous Pruning | Health | | Remaining Life Expectancy | Landscape Significance Rating | Retention Value | Location |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Vigour | Pest & Disease | | | | |
| 30 | ***Eucalyptus tereticornis*** (Forest Red Gum) | 22 | 16 | 850 | 272 | M | Appears stable with sound branching structure. Exhibits a small wound at 7 metres due to previous branch loss | Lower limbs selectively removed | Fair with thinning crown | No Evidence | Medium 15-40 Years | 2 | **high** | On-site |
| 30a | ***Banksia serrata*** (Old Man Banksia) | 6 | 4 | 180 | 20 | SM | Appears stable with sound branching structure. Immediately adjacent an existing crib-lock retaining wall | No Evidence | Very Good | No Evidence | Short 5-15 Years | 5 | **low** | On-site |
| 31 | ***Eucalyptus sp.*** (Gum) | 17 | 9 | 500 | 99 | M | Appears stable with sound branching structure. Exhbits a low bark inclusion at 3 metres. Small wound at 6 metres due crossing/rubbing limbs. | No Evidence | Very Good | No Evidence | Long - more than 40 years | 3 | **high** | On-site |
| 32 | ***Lophostemon confertus*** (Brushbox) | 10 | 8 | 300 + 260 | 64 | M | Appears stable with fair branching structure. Exhibits a high bark inclusion at ground level. Moderate interior dieback with 10% deadwood. | Crown lifted to 2 metres | Fair with thinning crown | No Evidence | Short 5-15 Years | 4 | **low** | On-site |
| 33 | ***Corymbia maculata*** (Spotted Gum) | 14 | 7 | 350 | 42 | SM | Appears stable with sound branching structure. Crown suppressed on | No Evidence | Very Good | No Evidence | Long - more than 40 years | 5 | **high** | On-site |

## APPENDIX 5 - IMPACT ASSESSMENT SCHEDULE

| Id. No. | Species | Construction Tolerance | Tree Protection Zone (m R) | Critical Root Zone (m R) | Minimum Setback Distance (tangent to root plate) | Incursions To Root Zone &/or Canopy | Likely Impact | Recommendation |
|---|---|---|---|---|---|---|---|---|
| **1** | ***Casuarina glauca*** (Swamp Oak) | M | 3.0 | 1.6 | 2.0 | No proposed works within TPZ. | No adverse impact | To be retained |
| **2** | ***Casuarina glauca*** (Swamp Oak) | M | 6.0 | 2.4 | 4.1 | No proposed works within TPZ. | No adverse impact | To be retained |
| **3** | ***Casuarina glauca*** (Swamp Oak) | M | 3.3 | 1.6 | 2.2 | No proposed works within TPZ. | No adverse impact | To be retained |
| **4** | ***Casuarina glauca*** (Swamp Oak) | M | 2.7 | 1.6 | 1.8 | No proposed works within TPZ. | No adverse impact | To be retained |
| **5** | ***Casuarina glauca*** (Swamp Oak) | M | 3.6 | 2.1 | 2.4 | Proposed easement offset 4.5 metres NE. No proposed works within TPZ. | No adverse impact | To be retained |
| **6** | ***Liquidambar styraciflua*** (Liquidamber) | M | 6.0 | 2.6 | 4.1 | No proposed works within TPZ. | No adverse impact | To be retained |
| **7** | ***Eucalyptus pilularis*** (Blackbutt) | M | 6.6 | 2.7 | 4.5 | No proposed works within TPZ. | No adverse impact | To be retained |
| **8** | ***Corymbia citriodora*** (Lemon scented Gum) | M | 4.5 | 2.1 | 3.1 | No proposed works within TPZ. | No adverse impact | To be retained |
| **9** | ***Eucalyptus pilularis*** (Blackbutt) | P | 4.8 | 2.4 | 3.3 | No proposed works within TPZ. | No adverse impact | To be retained |
| **9a** | ***Casuarina glauca*** (Swamp Oak) | M | 2.7 | 1.6 | 1.8 | No proposed works within TPZ. | No adverse impact | To be retained |

## APPENDIX 5 - IMPACT ASSESSMENT SCHEDULE

| Id. No. | Species | Construction Tolerance | Tree Protection Zone (m R) | Critical Root Zone (m R) | Minimum Setback Distance (tangent to root plate) | Incursions To Root Zone &/or Canopy | Likely Impact | Recommendation |
|---|---|---|---|---|---|---|---|---|
| **9b** | ***Eucalyptus pilularis*** (Blackbutt) | P | 4.8 | 2.25 | 3.3 | No proposed works within TPZ. | No adverse impact | To be retained |
| **9c** | ***Angophora floribunda*** (Rough Barked Apple) | M | 3.8 | 1.85 | 2.6 | No proposed works within TPZ. | No adverse impact | To be retained |
| **9d** | ***Eucalyptus robusta*** (Swamp Mahogany) | M | 4.5 | 2.1 | 3.1 | No proposed works within TPZ. | No adverse impact | To be retained |
| **10** | ***Eucalyptus robusta*** (Swamp Mahogany) | P | 4.5 | 1.85 | 3.1 | Proposed easement offset 4.1 metres NE. No proposed works within TPZ. Canopy projects into ROW. | Some crown pruning may be required to provide clearance for high vehicles | To be retained. Undertake any required pruning in accordance with Section 12.10 |
| **10a** | ***Eucalyptus robusta*** (Swamp Mahogany) | P | 3.6 | 1.85 | 2.4 | Proposed easement offset 4.9 metres NE. No proposed works within TPZ. Canopy projects into ROW. | Some crown pruning may be required to provide clearance for high vehicles | To be retained. Undertake any required pruning in accordance with Section 12.10 |
| **11** | ***Eucalyptus robusta*** (Swamp Mahogany) | M | 4.0 | 1.85 | 2.7 | Proposed easement offset 0.5 metres NE. Canopy projects into ROW. Services trenches may be required within TPZ. | Some crown pruning may be required to provide clearance for high vehicles. Trenching for services may result in root severance/damage resulting in an adverse impact. | Retain in accordance with recommended tree protection measures. Undertake any required pruning in accordance with Section 12.10. Locate services outside MSD (2.7 metres) where possible. |
| **11a** | ***Eucalyptus grandis*** (Flooded Gum) | M | 7.5 | 2.6 | 5.1 | Proposed easement offset 4.6 metres NE. Canopy projects into ROW. Services trenches may be required within TPZ. | Trenching for services may result in root severance/damage resulting in an adverse impact. | Retain in accordance with recommended tree protection measures. Undertake any required pruning in accordance with Section 12.10. Locate services outside MSD (5.1 metres) where possible. |
| **11b** | ***Eucalyptus grandis*** (Flooded Gum) | M | 3.0 | 1.6 | 2.0 | Proposed easement offset 1 metres NE. Canopy projects into ROW. Services trenches may be required within TPZ. | Some crown pruning may be required to provide clearance for high vehicles. Trenching for services may result in root severance/damage resulting in an adverse impact. | Remove tree |
| **12** | ***Acacia saligna*** (Golden Wreath Wattle) | M | 4.8 | 2.25 | 3.3 | Located within easement. Canopy projects into ROW. Services trenches may be required within TPZ. | The proposed works are likely to necessitate the removal of this tree. | Remove tree |

## APPENDIX 5 - IMPACT ASSESSMENT SCHEDULE

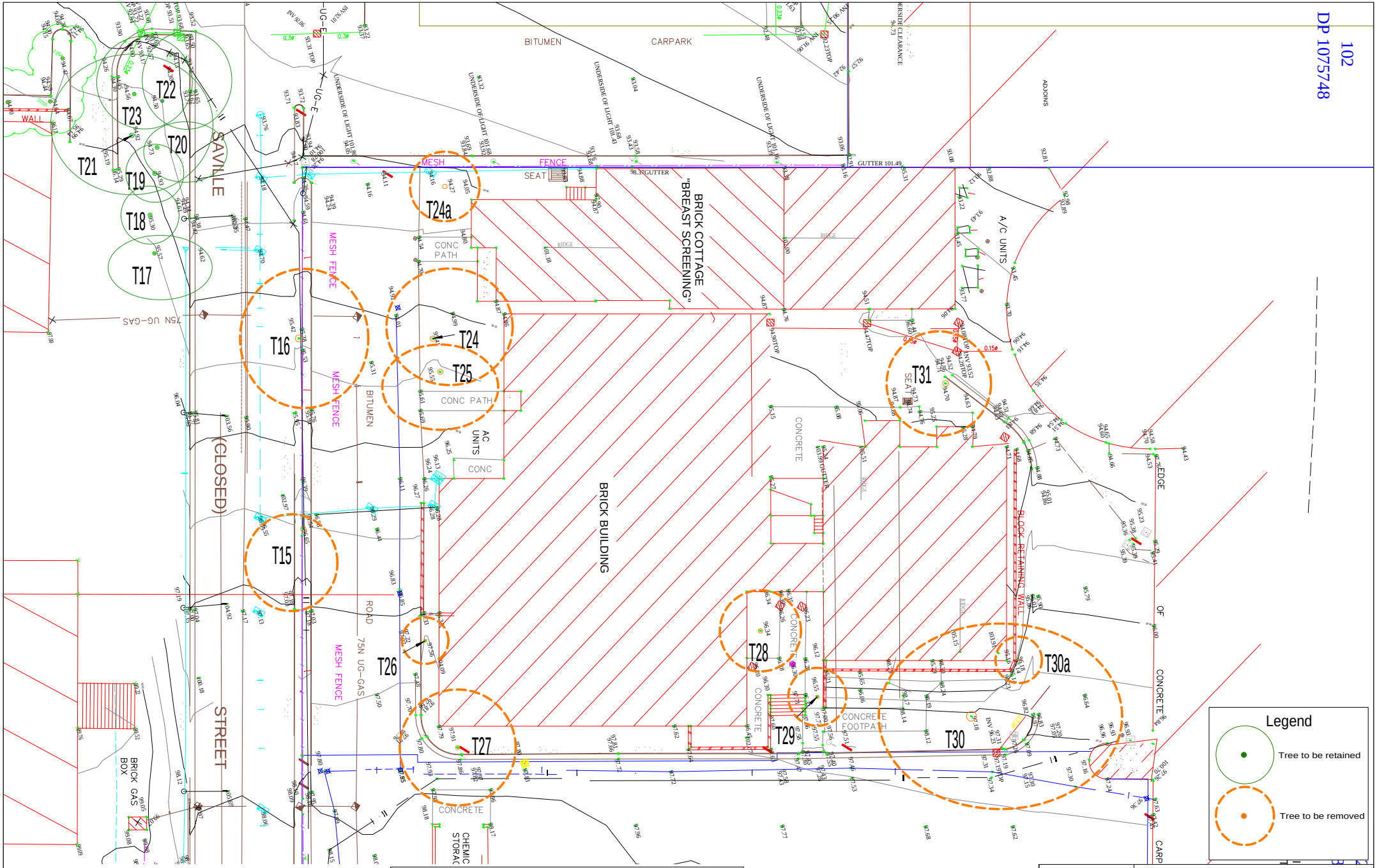
| Id. No. | Species | Construction Tolerance | Tree Protection Zone (m R) | Critical Root Zone (m R) | Minimum Setback Distance (tangent to root plate) | Incursions To Root Zone &/or Canopy | Likely Impact | Recommendation |
|---|---|---|---|---|---|---|---|---|
| **13** | ***Eucalyptus haemastoma*** (Scribbly Gum) | P | 4.5 | 2.1 | 3.1 | Located within easement. Canopy projects into ROW. Services trenches may be required within TPZ. | The proposed works are likely to necessitate the removal of this tree. | Consider removal and replacement with a new tree elsewhere within the site to compensate for loss of amenity |
| **14** | ***Eucalyptus grandis*** (Flooded Gum) | M | 5.4 | 2.5 | 3.7 | Located within easement. Canopy projects into ROW. Services trenches may be required within TPZ. | The proposed works are likely to necessitate the removal of this tree. | Remove tree |
| **15** | ***Eucalyptus nicholii*** (New England Peppermint) | P | 5.4 | 2.5 | 3.7 | Located within footprint of proposed sub-station. | The proposed works will necessitate the removal of this tree. | Remove tree |
| **16** | ***Eucalyptus nicholii*** (New England Peppermint) | M | 6.0 | 2.4 | 4.1 | Located within footprint of proposed sub-station. | The proposed works will necessitate the removal of this tree. | Remove tree |
| **17** | ***Casuarina glauca*** (Swamp Oak) | M | 4.5 | 2.1 | 3.1 | Proposed easement offset 2.6 metres NE. Services trenches may be required within TPZ. | Trenching for services may result in root severance/damage resulting in an adverse impact. | Retain in accordance with recommended tree protection measures. Locate services outside MSD (3.1 metres) where possible. |
| **18** | ***Casuarina glauca*** (Swamp Oak) | M | 4.2 | 2.25 | 2.9 | Proposed easement offset 3.0 metres NE. Services trenches may be required within TPZ. | Trenching for services within easement is unlikely to result in any adverse impact. | Retain in accordance with recommended tree protection measures. |
| **19** | ***Casuarina glauca*** (Swamp Oak) | M | 4.3 | 2.3 | 2.9 | Proposed easement offset 2.6 metres NE. Services trenches may be required within TPZ. | Trenching for services may result in root severance/damage resulting in an adverse impact. | Retain in accordance with recommended tree protection measures. Locate services outside MSD (2.9 metres) where possible. |
| **20** | ***Casuarina glauca*** (Swamp Oak) | M | 4.1 | 2.25 | 2.8 | Proposed easement offset 2.4 metres NE. Services trenches may be required within TPZ. | Trenching for services may result in root severance/damage resulting in an adverse impact. | Retain in accordance with recommended tree protection measures. Locate services outside MSD (2.8 metres) where possible. |
| **21** | ***Eucalyptus grandis*** (Flooded Gum) | M | 6.0 | 2.4 | 4.1 | Proposed easement offset 4.5 metres NE. Services trenches may be required within TPZ. | Trenching for services may result in root severance/damage resulting in an adverse impact. | Retain in accordance with recommended tree protection measures. Locate services outside MSD (4.1 metres) where possible. |

## APPENDIX 5 - IMPACT ASSESSMENT SCHEDULE

| Id. No. | Species | Construction Tolerance | Tree Protection Zone (m R) | Critical Root Zone (m R) | Minimum Setback Distance (tangent to root plate) | Incursions To Root Zone &/or Canopy | Likely Impact | Recommendation |
|---|---|---|---|---|---|---|---|---|
| **22** | ***Eucalyptus pilularis*** (Blackbutt) | M | 4.1 | 2 | 2.8 | Proposed easement offset 1.9 metres NE. Services trenches may be required within TPZ. | Trenching for services may result in root severance/damage resulting in an adverse impact. | Retain in accordance with recommended tree protection measures. Locate services outside MSD (2.8 metres) where possible. |
| **23** | ***Eucalyptus crebra*** (Narrow-leaved Ironbark) | P | 4.5 | 2.1 | 3.1 | Proposed easement offset 4.3 metres NE. Services trenches may be required within TPZ. | Trenching for services within easement is unlikely to result in any adverse impact. | Retain in accordance with recommended tree protection measures. |
| **24** | ***Casuarina cunninghamiana*** (River Oak) | M | 5.4 | 2.5 | 3.7 | Located within footprint of proposed sub-station. | The proposed works will necessitate the removal of this tree. | The proposed works will necessitate the removal of this tree (High Retention Value). Consider replacement planting with a new tree elsewhere within the site to compensate for loss of amenity |
| **24a** | ***Casuarina glauca*** (Swamp Oak) | M | 5.2 | 2.5 | 3.5 | Located within footprint of proposed sub-station. | The proposed works will necessitate the removal of this tree. | Consider replacement planting with a new tree elsewhere within the site to compensate for loss of amenity |
| **25** | ***Eucalyptus sp.*** (Gum) | M | 5.4 | 2.5 | 3.7 | Located within footprint of proposed sub-station. | The proposed works will necessitate the removal of this tree. | The proposed works will necessitate the removal of this tree (High Retention Value). Consider replacement planting with a new tree elsewhere within the site to compensate for loss of amenity |
| **26** | ***Banksia serrata*** (Old Man Banksia) | M | 3.8 | 1.85 | 2.6 | Located within footprint of proposed EMF exclusion zone | The proposed works will necessitate the removal of this tree. | Remove tree |
| **27** | ***Eucalyptus grandis*** (Flooded Gum) | M | 5.3 | 2.25 | 3.6 | Located within footprint of proposed EMF exclusion zone | The proposed works will necessitate the removal of this tree. | Consider replacement planting with a new tree elsewhere within the site to compensate for loss of amenity |
| **28** | ***Acacia sp.*** (Wattle) | M | 4.6 | 2.4 | 3.1 | Located within footprint of proposed EMF exclusion zone | The proposed works will necessitate the removal of this tree. | Consider replacement planting with a new tree elsewhere within the site to compensate for loss of amenity |
| **29** | ***Syzygium leuhmannii*** (Small-leaf Lilly Pilly) | M | 3.6 | 2.1 | 2.4 | Located within footprint of proposed EMF exclusion zone | The proposed works will necessitate the removal of this tree. | Consider replacement planting with a new tree elsewhere within the site to compensate for loss of amenity |

## APPENDIX 5 - IMPACT ASSESSMENT SCHEDULE

| Id. No. | Species | Construction Tolerance | Tree Protection Zone (m R) | Critical Root Zone (m R) | Minimum Setback Distance (tangent to root plate) | Incursions To Root Zone &/or Canopy | Likely Impact | Recommendation |
|---|---|---|---|---|---|---|---|---|
| **30** | ***Eucalyptus tereticornis*** (Forest Red Gum) | P | 10.2 | 3.15 | 6.9 | Located within footprint of proposed EMF exclusion zone | The proposed works will necessitate the removal of this tree. | The proposed works will necessitate the removal of this tree (High Retention Value). Consider replacement planting with a new tree elsewhere within the site to compensate for loss of amenity |
| **30a** | ***Banksia serrata*** (Old Man Banksia) | M | 2.7 | 1.6 | 1.8 | Located within footprint of proposed EMF exclusion zone | The proposed works will necessitate the removal of this tree. | Remove tree |
| **31** | ***Eucalyptus sp.*** (Gum) | P | 6.0 | 2.6 | 4.1 | Located within footprint of proposed sub-station. | The proposed works will necessitate the removal of this tree. | The proposed works will necessitate the removal of this tree (High Retention Value). Consider replacement planting with a new tree elsewhere within the site to compensate for loss of amenity |
| **32** | ***Lophostemon confertus*** (Brushbox) | M | 5.0 | 2.5 | 3.4 | Located within alignment of proposed cable trench | The proposed works will necessitate the removal of this tree. | Remove tree |
| **33** | ***Corymbia maculata*** (Spotted Gum) | P | 4.2 | 4.6 | 2.9 | Located within alignment of proposed cable trench | The proposed works are will necessitate the removal of this tree. | Consider replacement planting with a new tree elsewhere within the site to compensate for loss of amenity |

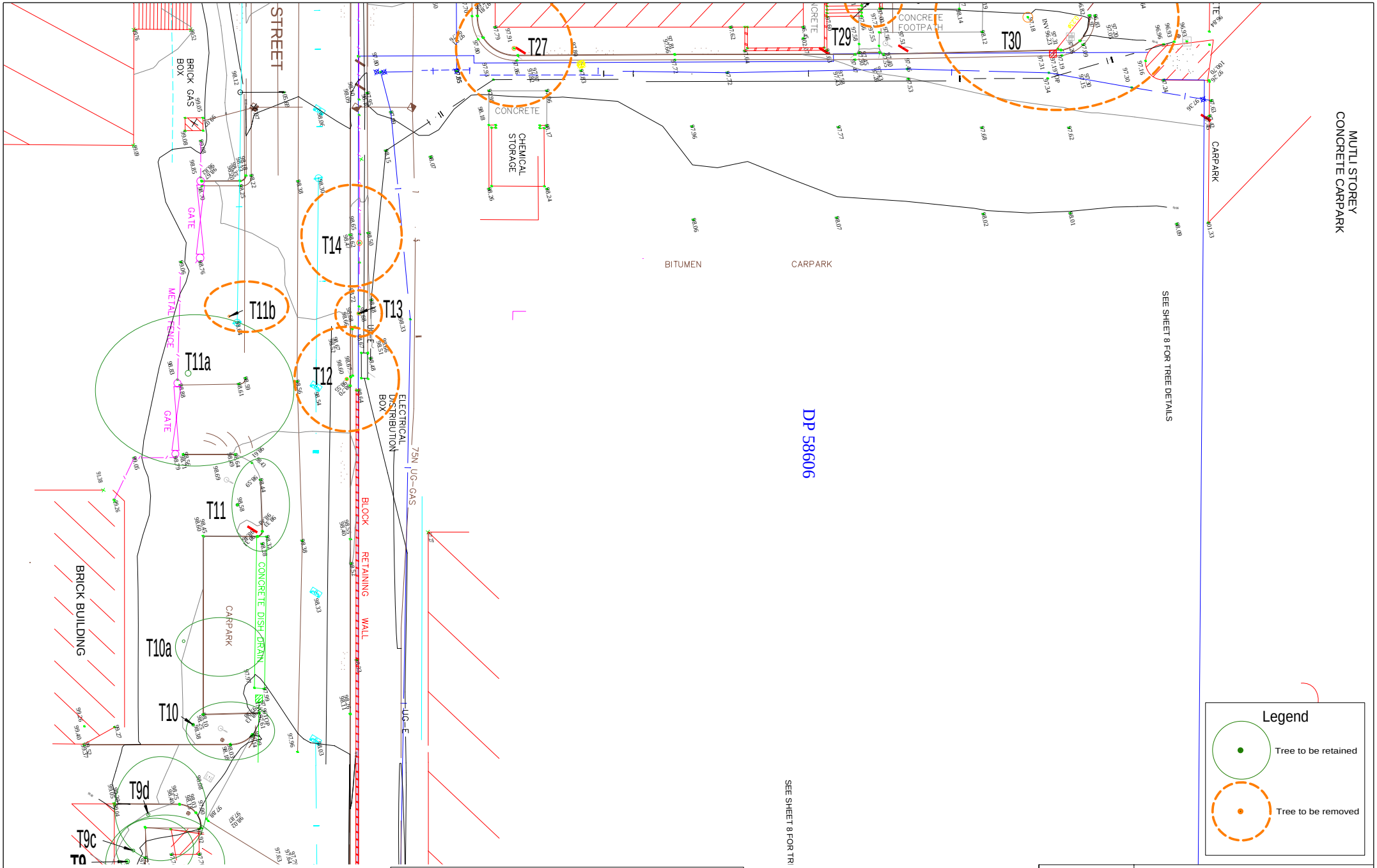



**APPENDIX 6**
**TREE LOCATION PLAN**

Royal North Shore Hospital
Westbourne Street, ST. LEONARDS


Earthscape Horticultural Services
Arboricultural & Landscape Consultants
PO Box 364
BEROWRA NSW 2081
Tel: 02 9456 4787
Fax: 02 9456 5757
e: ama59142@bigpond.net.au


| | | |
|---|---|---|
| Drawing No. | EHS/TLP/4620 | SHEET 1 |
| DATE | 30/05/2008 | |
| | 0 2 4 6 8 10 | |

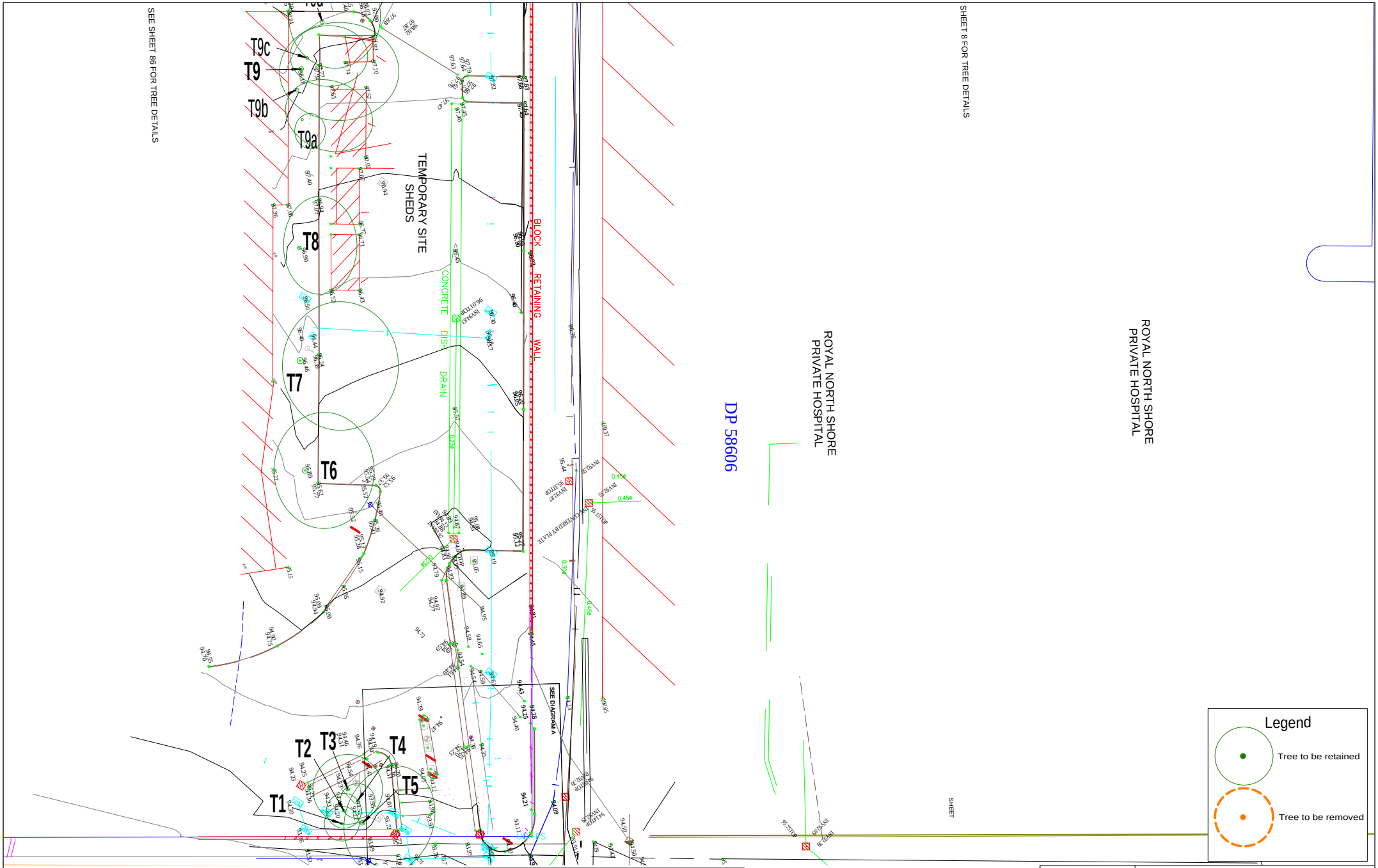



# APPENDIX 6
# TREE LOCATION PLAN

Royal North Shore Hospital
Westbourne Street, ST. LEONARDS


Earthscape Horticultural Services
Arboricultural & Landscape Consultants
PO Box 364
BEROWRA NSW 2081
Tel: 02 9456 4787
Fax: 02 9456 5757
e: ama59142@bigpond.net.au


| | | |
|---|---|---|
| Drawing No. | EHS/TLP/4620 | SHEET 2 |
| DATE | 30/05/2008 | |
| | 0 2 4 6 8 10 | |

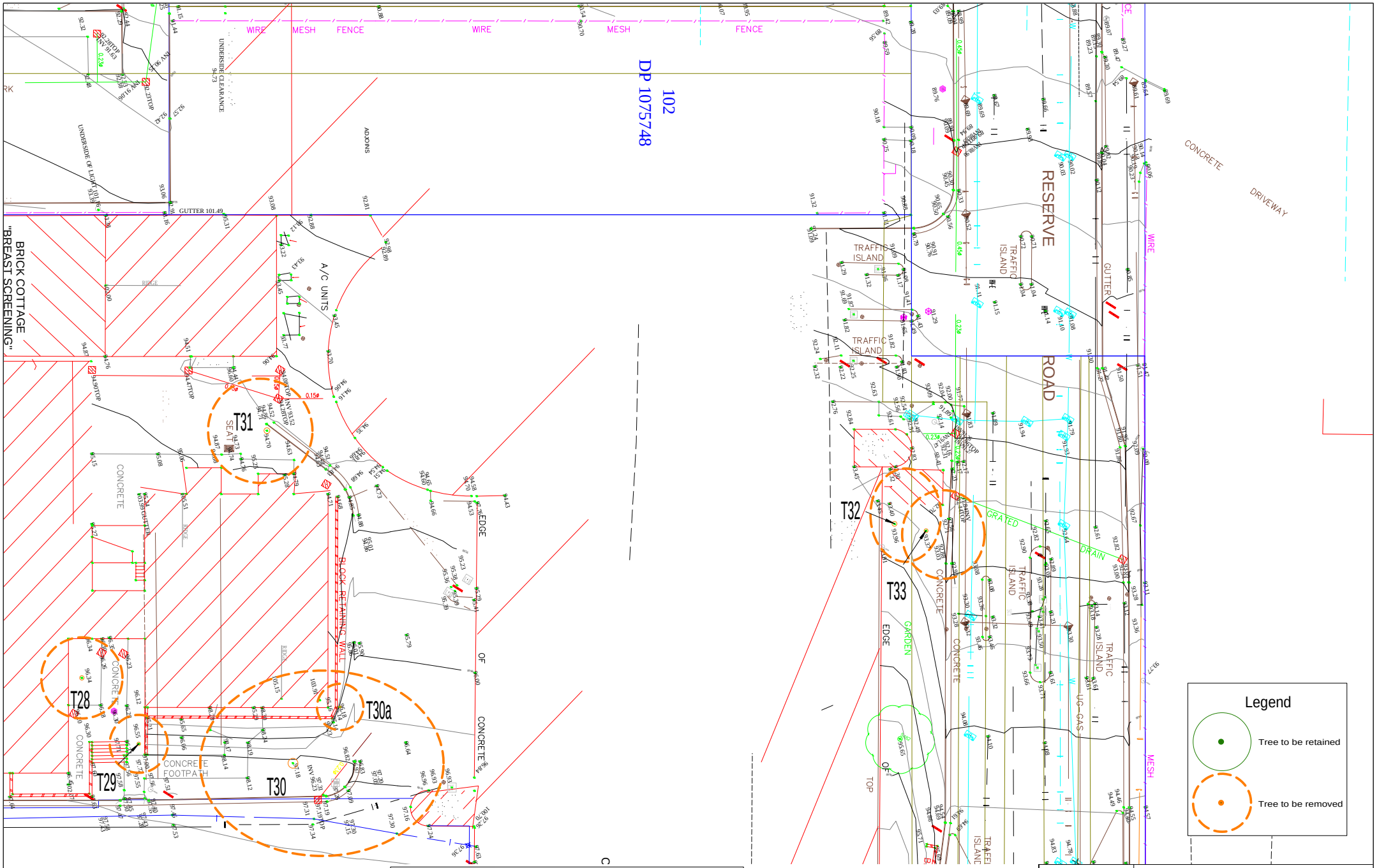



# APPENDIX 6
# TREE LOCATION PLAN

Royal North Shore Hospital
Westbourne Street, ST. LEONARDS


Earthscape Horticultural Services
Arboricultural & Landscape Consultants
PO Box 364
BEROWRA NSW 2081
Tel: 02 9456 4787
Fax: 02 9456 5757
e: ama59142@bigpond.net.au


| | | |
|---|---|---|
| Drawing No. | EHS/TLP/4620 | SHEET 3 |
| DATE | 30/05/2008 | |
| | 0 2 4 6 8 10 | |




# APPENDIX 6
# TREE LOCATION PLAN

Royal North Shore Hospital
Westbourne Street, ST. LEONARDS


Earthscape Horticultural Services
Arboricultural & Landscape Consultants
PO Box 364
BEROWRA NSW 2081
Tel: 02 9456 4787
Fax: 02 9456 5757
e: ama59142@bigpond.net.au


| | |
|---|---|
| Drawing No. | EHS/TLP/4620 SHEET 4 |
| DATE | 30/05/2008 |
| | |