EARTHSCAPE HORTICULTURAL SERVICES
Arboricultural, Horticultural and Landscape Consultants

ABN 36 082 126 027

PRE-DEVELOPMENT TREE ASSESSMENT REPORT

BUNGARRIBEE INDUSTRIAL ESTATE RUDDERS LANE, EASTERN CREEK

April 2009

Prepared for: Goodman International
c/- Tract Consultants
Level 8, 80 Mount Street
NORTH SYDNEY NSW

Ph:- 02 9954 3733

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: earthscape@iinet.net.au

TABLE OF CONTENTS

1 INTRODUCTION

1.1.1 This report was commissioned by Tract Consultants on behalf of Goodman International to assess the health and condition of approximately two hundred and forty (240) trees located within the proposed Bungarribee Industrial Estate, Rudders Lane, Eastern Creek.

1.1.2 The purpose of this report is to identify the trees within the site, provide information on their current health and condition, determine their remaining life expectancy and assess their suitability for retention/preservation. The report also provides recommended tree protection measures and setback distances to ensure the long-term preservation of the trees to be retained where appropriate. The aim of the report is to provide information on the constraints imposed by trees to assist the future planning and development of the site

1.1.3 In addition to the arboricultural assessment of individual trees, large stands and copses of trees have been assessed as groups, particularly where these groups contain trees of similar size, age and species.

2 THE SITE

2.1.1 The subject property is a semi-rural area of land located between the Great Western Highway to the north, M4 Motorway to the south, Western Sydney Regional Park (Eastern Creek) to the west and Horsley Road to the east. For the purposes of this report the subject allotment will be referred to as "the Site". The site is vacant, with remnants of former rural homesteads and other structures most of which have been demolished. The total area of the site is approximately 57.3 hectares. The site has a slight to moderate westerly gradient, falling from Horsley Road in the east toward Eastern Creek in the west. The majority of the site is has been cleared and appears to have been previously used for pastoral activity.

2.1.2 Soils of this area are typical of the Blacktown Soil Landscape Group (as classified in the Soil Landscapes of the Sydney 1:100,000 Sheet), consisting of shallow to moderately deep (< 1000 mm) *Red & Brown Podzolic Soils* on crests, upper slopes and well drained areas. Soils on lower slopes and areas of poor drainage consist of deep (1500-3000 mm) *Yellow Podzolic Soils and Soloth Soils* derived Wianamatta Group & Hawkesbury Shales.[1] The landscape generally consists of undulating rises with slopes ranging usually less than 5% grade

2.1.3 The original vegetation of this area consisted of woodland typical of the Cumberland Plain.[2] Most of the locally indigenous vegetation has been cleared from surrounding areas for residential development and industrial development. Dominant locally-indigenous tree species occurring in this area include *Eucalyptus moluccana*, (Grey Box), *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus fibrosa ssp. fibrosa* (Broad-leaved Ironbark) & *Eucalyptus crebra* (Narrow-leaved Ironbark). Other species found in this association may include *Eucalyptus globoidea (*White Stringybark) with *Melaleuca decora* (Paperbark) and *Casuarina glauca* (Swamp Oak) occuring in low lying areas or along drainage lines

2.1.4 The existing vegetation on the site includes isolated copses and stands of predominant locally-indigenous tree species, most of which are saplings or semi-mature trees likely to be re-growth, together with a number of isolated individual trees, some of which may be remnant. There is also the some planted exotic and non-local species associated with former homesteads on the site. Large areas of the site contain a mixture of predominantly exotic grasses.

3 SUBJECT TREES

3.1.1 The subject trees were inspected by Earthscape Horticultural Services (EHS) in January & February 2009. Individual tree have been provided with an identification number for reference purposes denoted on the attached Tree Location Plan (**Appendix 3**), based on the survey prepared by Hard &

Forester, Dwg. Ref No. 112643003 Rev 00 dated 13th October 2008. The numbers used on this plan correlate with the Tree Assessment Schedule (**Appendix 4**).

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);
- Maturity Class;
- Approximate height;
- Average canopy spread;
- Trunk diameter measured at 1.4 metres from ground level;
- 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.

This information is presented in a tabulated form in **Appendix 4.** The following codes have been used in the schedule:-

4.2 Maturity Class.

4.2.1 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. These trees are senescent, being in a state of gradual decline.
- **M** **Mature –** 50-80% of the life expectancy for the species;
- **SM** **Semi-mature –** 20-50% of the life expectancy for the species;
- **I** **Immature –** less than 20% of the life expectancy for the species.

4.3 Health and Vigour

4.3.1 The health and vigour of each tree has been divided into the following categories:-

- **VG** **Very Good –** The specimen displays very good health and vigour with normal foliage size, colour and density for the species with less than 5% deadwood, no epicormic growth, good extension growth, little or no evidence of pest or disease infestation.
- **G** **Good –** The specimen displays good health and vigour with normal foliage size, colour and density for the species with less than 5% deadwood, little or no epicormic growth, fair to good extension growth, no significant pest or disease infestation.
- **F** **Fair –** The specimen displays fair health and vigour with fair foliage size, colour for the species, may be slightly thinning to thinning crown, with up to 20% deadwood, up to 30% epicormic growth, fair extension growth, and low to moderate pest & disease infestation.
- **P** **Poor –** The specimen exhibits poor health and vigour with abnormal foliage size & colour for the species, may be thinning to sparse crown, with up to 90% deadwood, up to 90% epicormic growth, poor extension growth, and moderate to severe pest & disease infestation.

4.3.2 The following codes in the health & vigor column serve to provide more detail on specific issues and their severity:-

1. Foliar insect infestation
2. Borer
3. Termite activity
4. Ivy or other vines
5. Parasitic plants (e.g. Mistletoe, Devil's Twine etc)
6. Root rot disease (e.g. Armillaria sp., Ganoderma sp.)
7. Pathogenic fungal infection (trunk or branches) – e.g. Phellinus sp.
8. Crown dieback (e.g. due to moisture stress, defoliation etc)
9. Epicomic growth (percentage of overall crown estimated)
10. Sparse Canopy
11. Deadwood (percentage of overall crown estimated)

4.3.3 The severity of each of these factors is further expressed with an alpha suffix, as follows:

- **s** Severe
- **h** High
- **m** Moderate
- **l** Low

4.4 Condition

4.4.1 The Condition (structural integrity) of each tree has been divided into the following categories:-

- **VG** **Very Good –** The specimen displays very good structural integrity, with no evidence of instability, no visible structural defects or faults and no visible damage to the crown or roots.
- **G** **Good –** The specimen displays good structural integrity, stable with minor faults or structural defects that can be successfully remediated if necessary with an acceptable level of risk.
- **F** **Fair –** The specimen displays fair structure containing minor to moderate defects that could be remediated to provide an acceptable level of risk.
- **P** **Poor –** The specimen exhibits poor structure, with evidence of instability or suspect stability or contains high to severe level defects that cannot be successfully remediated and render the tree potentially hazardous or prone to failure.

4.4.2 The following codes in the health & vigor column serve to provide more detail on specific issues and their severity:-

1. Bark inclusion;
2. Unstable, evidence of instability (soil heaving & cracking, root plate lifted);
3. Root damage;
4. Previously lopped (branches cut to an internodal pointy) or topped (main leader removed);
5. Elite Epicormic Sprouts (dominant epicormic sprouts arising from a wound site);
6. Storm damage (loss of branches due to high wind or storm events);
7. Cavity;
8. Mechanical damage to the trunk, buttress or limbs.
9. Other Structural Defect;
10. Canopy distortion (due to severe crowding or overshadowing);
11. Soil Level Changes;
12. Decay;
13. Wound;
14. Branch loss;
15. Fracture;
16. Lightning Strike;
17. Prominent lean;
18. Previously cut close to ground level;

19. Stability suspect (due to restricted root plate development, underlying rock, prominent lean, soil movement etc).

4.4.3 The severity of each of these factors is further expressed with an alpha suffix, as follows:

- **s** Severe
- **h** High
- **m** Moderate
- **l** Low

4.5 Safe Useful Life Expectancy (SULE)

4.5.1 The remaining life expectancy of each tree is shown in **Appendix 4**. The remaining life expectancy is a measure of the sustainability of the tree in the landscape, based on an estimate of the average age of the species 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 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.

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

- **L** = Greater than 40 years (Long)
- **M** = Between 15 and 40 years (Medium)
- **S** = Between 5 and 15 years (Short)
- **T** = Less than 5 years (Transient)
- **H**= Hazardous (severely 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 criteria 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 Preservation Order (TPO) exists within the City of Blacktown, made under Clause 25 of the Blacktown Local Environment Plan 1988. The TPO protects all tree species regardless of their dimensions. All of the trees assessed are protected under the provisions of Council's Tree Preservation Order.

5.2.2 The majority of the trees assessed are locally-indigenous species, representative of the original vegetation of the area and would be of benefit to native wildlife. Locally indigenous tree species found on the site include *Casuarina glauca* (Swamp Oak), *Corymbia maculata* (Spotted Gum), *Eucalyptus amplifolia* (Cabbage Gum), *Eucalyptus fibrosa subsp. fibrosa* (Broad-leaved Ironbark), *Eucalyptus longifolia* (Woolybutt), *Eucalyptus moluccana* (Grey Box), *Eucalyptus sp.* [*parramattensis*] (Gum), *Eucalyptus tereticornis* (Forest Red Gum), and *Melaleuca decora* (White Feather Honey Myrtle). A number of the trees assessed contained cavities that would be suitable as nesting hollows for arboreal mammals or birds, however there were no visible signs of wildlife habitation.

5.2.3 None of the trees assessed are scheduled as Noxious Weeds under the meaning of *Noxious Weeds Act* (NSW) 1993. However, *Salix babylonica* (Weeping Willow) (T18, T19, T20, T28 & T29) and *Morus nigra* (Mulberry) (T42 & T43) are considered Environmental Weed Species within most Local Government Areas in Sydney.

5.2.4 T101, a *Eucalyptus scoparia* (Willow Gum) is listed as Endangered Species in Schedule 2 of the *Threatened Species Conservation Act* 1995 (NSW) and listed as a Vulnerable Species under the *Environmental Protection and Biodiversity Conservation Act* 1999. Whilst this species is listed as endangered & vulnerable, it is a commonly planted ornamental tree in parks, gardens and streetscapes. The species is not endemic to this area and therefore does not have any ecological significance in this context.

5.2.5 *Eucalyptus moluccana* (Grey Box) and *Eucalyptus tereticornis* (Forest Red Gum) are both dominant Canopy Species of Shale Plains Woodland, which formerly occupied this area. Shale Plains Woodland (a sub-group of Cumberland Plain Woodland), is listed as an Endangered Ecological Community under the *Threatened Species Conservation Act* 1995 (NSW) and 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) confirms that the dominant remnant native vegetation community within the site is Cumberland Plain Woodland (Shale Plains Woodland). Figure 1 shows an extract from the map indicating the approximate site boundaries.

5.3 Heritage Significance

5.3.1 None of the trees within the site are listed as Heritage Items under Schedule 2 of the Blacktown Local Environment Plan 1988. There is no known or suspected historical significance of any of the planted trees within the site

5.3.2 Trees T2, T6, T7 & T45 *Eucalyptus tereticornis* (Forest Red Gum), T15 & T16, *Eucalyptus moluccana* (Grey Box) and T22 *Eucalyptus fibrosa* (Broad-leaved Ironbark) are likely to be remnants of the original woodland given the size species and estimated age of these trees.

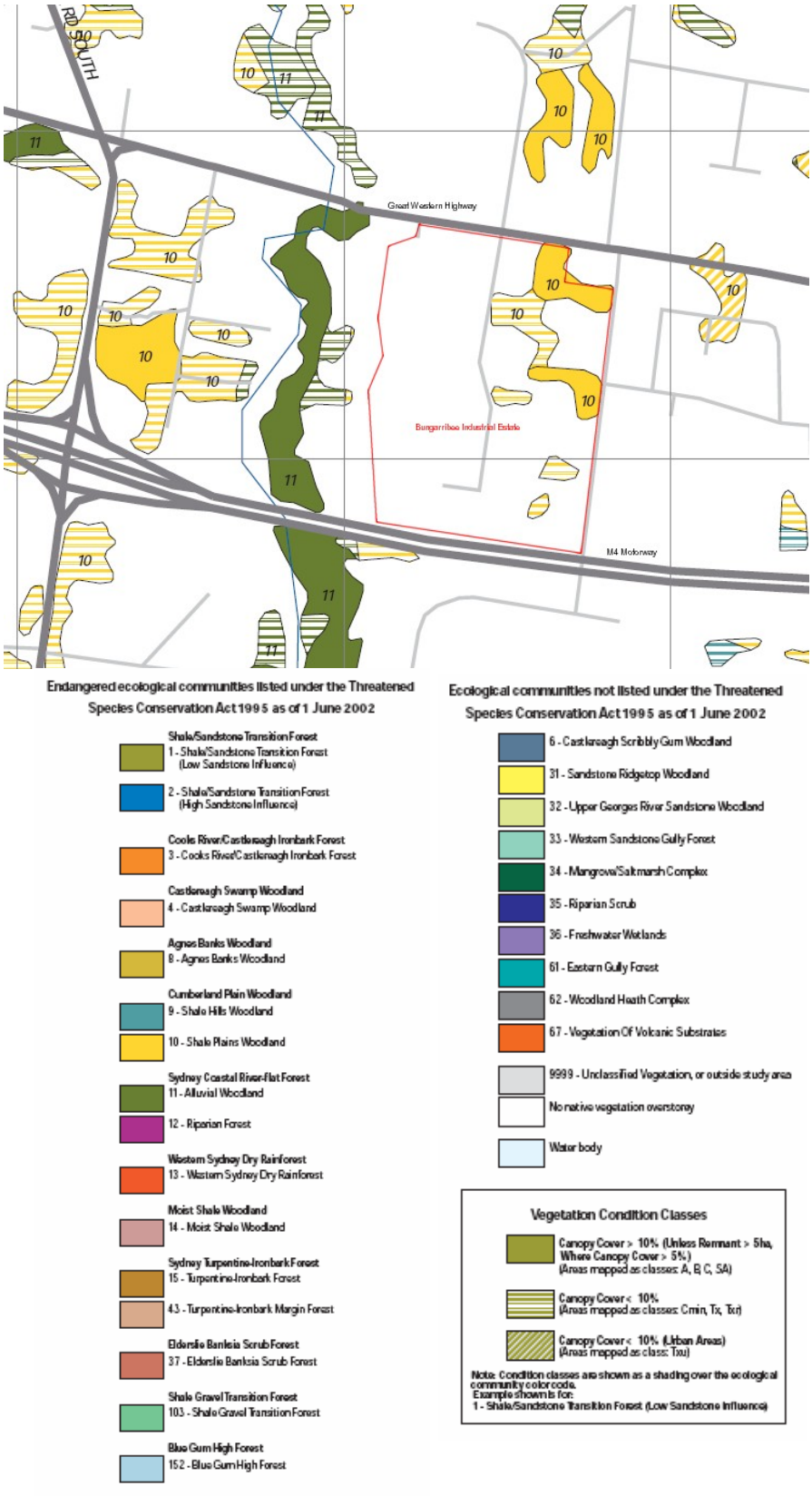

Figure 1 – Extract from NPWS 1:25000 Mapping Series (Native Vegetation of the Cumberland Plain) shown the subject site

.

5.4 Amenity Value

5.4.1 The amenity 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 amenity value. Criteria for the assessment of amenity values are incorporated into Appendix 1.

6 RETENTION VALUES

6.1.1 The Retention Values shown in **Appendix 4** have been determined on the basis of the estimated longevity of the trees and their landscape significance rating, in accordance with **Table One**. Together with guidelines contained in **Section 7** (Tree Protection Zones) this information should be used to determine the most appropriate position of building footprints and other infrastructure within the site, with due consideration to other site constraints, to minimise the impact on trees considered worthy of preservation.

TABLE 1 – TREE RETENTION VALUES – ASSESSMENT METHODOLOGY

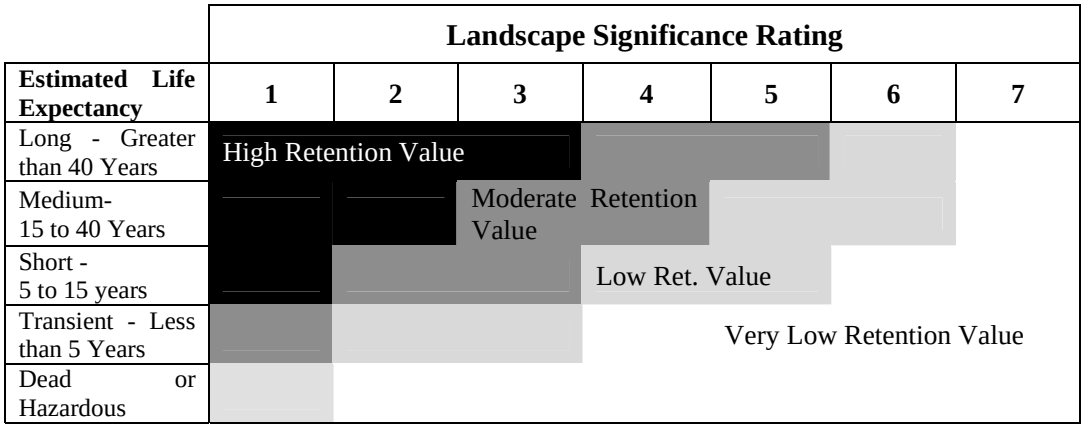

TABLE 2 – TREE RETENTION PRIORITES.

RETENTION VALUE	RECOMMENDED ACTION
"High"	• These trees are considered worthy of preservation, it is unlikely that Council will approve their removal as part of any proposed development. • Careful consideration should be given to the retention of these trees. • Proposed site design and placement of buildings and infrastructure should consider the recommended setbacks as discussed in the following section to minimise any adverse impact. • In addition to Minimum Setback Distances, the extent of the canopy should also be considered, particularly in relation to high rise developments. Significant pruning of the trees to accommodate the building envelope will generally not be supported.
"Moderate"	• The retention of these trees is desirable but not critical. • These trees should be retained as part of any proposed development if possible, however these trees are considered less critical for retention. • If these trees must be removed, replacement planting should be considered in accordance with Council's Tree Replenishment Policy.

"Low"	• These trees are not considered worthy of any special measures to ensure their preservation, due to current health, condition and longevity. • These trees should not be considered as a constraint to the future development of the site.
"Very Low"	• These trees are considered potentially hazardous or very poor specimens, or may be environmental or noxious weeds. • The removal of these trees is therefore recommended regardless of the implications of the proposed development.

7 TREE PROTECTION ZONES

7.1.1 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 4** (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.

7.1.2 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]

7.1.3 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.

TABLE 3 – 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

7.2 Trunk Diameter

7.2.1 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.

7.3 Construction Tolerance

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

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

7.3.2 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).

7.4 Maturity Class.

7.4.1 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
- **I** **Immature –** less than 20% of the life expectancy for the species

7.5 Root and Crown Formation

7.5.1 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 Plan in **Appendix 3**. 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.

7.6 Minimum Set-back Distance.

7.6.1 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 (Harris 2004). 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.

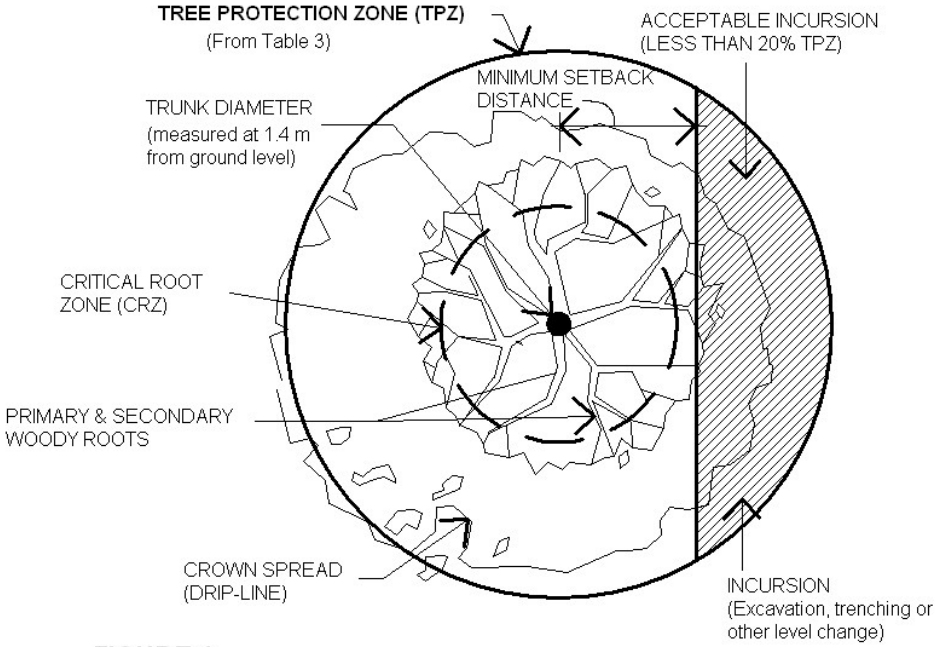

FIGURE 4

METHODOLOGY TO CALCULATE MINIMUM SETBACK DISTANCE

7.7 Critical Root Zone.

7.7.1 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.[9] 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.

7.8 Acceptable Incursions to the Root Zone.

7.8.1 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.

8 RECOMMENDATIONS:-

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.

2. Trees noted in **Appendix 4** as significant or of high retention value are considered worthy of preservation. Careful consideration should be given to their retention. Proposed site design and placement of buildings and infrastructure should consider the recommended Tree Protection Zones (**Section 7**) to minimise any adverse impact.

3. Tree noted in **Appendix 4** as being of moderate retention value should be retained wherever possible. These trees are considered to be worthy of preservation but are less critical for retention.

4. Trees noted in **Appendix 4** as being of low or very low retention value are not considered to be worthy of any special measures to ensure their preservation. These trees should not be viewed as a constraint to the development.

Andrew Morton
EARTHSCAPE HORTICULTURAL SERVICES
3rd April 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

[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 1 - 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 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, representative of the original vegetation of the area and forms part of the assemblage of species of an Endangered Ecological Community;
- 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 and the tree is located within a defined Vegetation Link / Wildlife Corridor or has known wildlife habitat value;
- 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; or
- The tree is completely dead and has no visible habitat value.

9 APPENDIX 2 - TREE PROTECTION MEASURES

9.1 Tree Protection Zones

9.1.1 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.

9.1.2 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.

9.2 Tree Protection Fencing

9.2.1 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.

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

9.2.3 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.

9.3 Trunk Protection

9.3.1 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.

9.4 Tree Damage

9.4.1 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.

9.5 Demolition Works within Tree Protection Zones

9.5.1 Demolition of Pathways and Pavements

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.

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.

9.5.2 Demolition of Retaining Walls or other Structures

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.

9.6 Excavations within Tree Protection Zones

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

9.6.2 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.

9.6.3 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.

9.6.4 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.

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

9.7 Underground Services

9.7.1 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.

9.7.2 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).

9.7.3 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.

9.7.4 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

9.8 Pavements

9.8.1 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.

9.9 Fill Material

9.9.1 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.

9.10 Canopy & Root Pruning

9.10.1 All pruning work required shall be carried out in accordance with Australian Standard No 4373-1996 – 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).

9.10.2 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.

9.10.3 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.

9.11 Tree Removal

9.11.1 The approval of Ku-ring-gai Council shall be obtained prior to the removal or pruning of any tree protected under the Tree Preservation Order.

9.11.2 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.

9.11.3 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 3

TREE LOCATION PLANS

SHEETS 1-7