

**Urban Tree Management
Australia Pty Ltd**
ACN 098 599 805
ABN 56 098 599 805

**65 Excelsior Street
Merrylands NSW 2160**

**Phone 02 9760 1389
Facsimile 02 9760 1102
admin@utma.com.au
www.utma.com.au**

MEMBER OF
INSTITUTE OF AUSTRALIAN

CONSULTING ARBORICULTURISTS

REPORT:

ARBORICULTURAL ASSESSMENT

Darling Walk Darling Harbour SYDNEY NSW

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SUMMARY

This report considers a total of one hundred and sixty one (161) trees, which were assessed as part of the proposed Darling Walk construction works. One hundred and nine (109) trees are proposed for removal, with the retention and protection of fifty two (52) tree.

The removal of trees will be undertaken in stages to correspond with the construction phase at the time.

The stand of *Melaleuca quinquenervia* – Broad-leaved Paperbark (Trees 1 – 109) will be retained in part, with the removal of trees only to accommodate the stormwater diversion works and design works.

Trees 128 – 134 are street trees and are proposed to be removed during the remediation works.

Trees 9, 11-14, 14a, 16-25, 29-36, 48-61, 67-73, 97, 98, 107-109, 139-146 are proposed to be retained in situ and will not be impacted by the proposed construction works as suitable set backs have been provided; the trees will be adequately retained and protected.

Trees 147-150 have been omitted from the report due to amendments to the design and therefore no reference to these trees is detailed.

Trees 1-8, 10, 15, 26-28, 37-42a, 43-47, 61a, 71a, 74-96, 99-106, 110-138 and 151 – 162 are proposed to be removed to accommodate the Darling Walk construction works and are unable to be retained. Compensatory replanting is recommended.

Tree 163 is proposed to be transplanted elsewhere on site as per the landscape plan.

The general condition of the trees affected by the proposed development is listed below in Table 1.0 and a summary of works in Table 2.0.

Table 1.0 General condition of trees. Trees described in greater detail in section 5.0.

UTM Tree No.	Genus and species	Common name	Condition G = Good F = Fair P = Poor D = Dead
1	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
2	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
3	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
4	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
5	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
6	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
7	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
8	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
9	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
10	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
11-14a Stand 1	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G-F
15	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
16	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G

Table 1.0 Continues

UTM Tree No.	Genus and species	Common name	Condition G = Good F = Fair P = Poor D = Dead
17	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
18	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
19	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
20-25 Stand 2	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G-F
26	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
27	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
28	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
29	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
30	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
31	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
32-35 Stand 3	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G-F
36	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
37	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
38	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
39	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
40	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	P
41	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
42	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
42a	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
42b	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
43	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
44	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
45	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
46	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
47	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	P
48-65 Stand 4	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G,F,P
66-73 Stand 5	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G,F,P
74	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
75	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
76	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
77	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
78	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
79	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
80	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
81	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	P
82	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
83	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
84	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
85	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
86	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
87	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
88	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
89	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
90	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F

Table 1.0 Continues

UTM Tree No.	Genus and species	Common name	Condition G = Good F = Fair P = Poor D = Dead
91	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
92	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
93	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
94	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
95	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
96	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
97	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
98	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
99	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
100	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
101	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
102	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
103	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
104	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
105	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
106	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
107	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
108	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	G
109	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	F
110	<i>Platanus x hispanica</i>	London plane Tree	G
111	<i>Platanus x hispanica</i>	London plane Tree	G
112	<i>Platanus x hispanica</i>	London plane Tree	G
113	<i>Platanus x hispanica</i>	London plane Tree	G
114	<i>Platanus x hispanica</i>	London plane Tree	G
115	<i>Platanus x hispanica</i>	London plane Tree	G
116	<i>Platanus x hispanica</i>	London plane Tree	G
117	<i>Platanus x hispanica</i>	London plane Tree	F
118	<i>Platanus x hispanica</i>	London plane Tree	G
119	<i>Platanus x hispanica</i>	London plane Tree	G
120	<i>Platanus x hispanica</i>	London plane Tree	G
121	<i>Platanus x hispanica</i>	London plane Tree	G
122	<i>Platanus x hispanica</i>	London plane Tree	G
123	<i>Platanus x hispanica</i>	London plane Tree	F
124	<i>Platanus x hispanica</i>	London plane Tree	G
125	<i>Platanus x hispanica</i>	London plane Tree	G
126	<i>Platanus x hispanica</i>	London plane Tree	G
127	<i>Platanus x hispanica</i>	London plane Tree	G
128	<i>Platanus x hispanica</i>	London plane Tree	G
129	<i>Platanus x hispanica</i>	London plane Tree	G
130	<i>Platanus x hispanica</i>	London plane Tree	G

Table 1.0 Continues

UTM Tree No.	Genus and species	Common name	Condition G = Good F = Fair P = Poor D = Dead
131	<i>Platanus x hispanica</i>	London plane Tree	G
132	<i>Platanus x hispanica</i>	London plane Tree	G
133	<i>Platanus x hispanica</i>	London plane Tree	G
134	<i>Platanus x hispanica</i>	London plane Tree	G
135	<i>Ficus microcarpa var. hillii</i>	Hills Weeping Fig	G
136	<i>Ficus microcarpa var. hillii</i>	Hills Weeping Fig	G
137	<i>Ficus microcarpa var. hillii</i>	Hills Weeping Fig	G
138	<i>Ficus microcarpa var. hillii</i>	Hills Weeping Fig	G
139	<i>Platanus x hispanica</i>	London plane Tree	G
140	<i>Platanus x hispanica</i>	London plane Tree	G
141	<i>Platanus x hispanica</i>	London plane Tree	F
142	<i>Platanus x hispanica</i>	London plane Tree	G
143	<i>Platanus x hispanica</i>	London plane Tree	G
144	<i>Platanus x hispanica</i>	London plane Tree	F
145	<i>Platanus x hispanica</i>	London plane Tree	G
146	<i>Platanus x hispanica</i>	London plane Tree	G
147-150	Omitted from report	-	-
151	<i>Stenocarpus sinuatus</i>	Queensland Firewheel Tree	P
152	<i>Eucalyptus punctata</i>	Grey Gum	F
153	<i>Corymbia maculata</i>	Spotted Gum	G
154	<i>Corymbia maculata</i>	Spotted Gum	G
155	<i>Eucalyptus punctata</i>	Grey Gum	G
156	<i>Corymbia 'Summer Red'</i>	Flowering Gum	F
157	<i>Stenocarpus sinuatus</i>	Queensland Firewheel Tree	G
158	<i>Stenocarpus sinuatus</i>	Queensland Firewheel Tree	F
159	<i>Stenocarpus sinuatus</i>	Queensland Firewheel Tree	P
160	<i>Eucalyptus robusta</i>	Swamp Mahogany	G
161	<i>Eucalyptus robusta</i>	Swamp Mahogany	G
162	<i>Eucalyptus robusta</i>	Swamp Mahogany	P
163	<i>Phoenix canariensis</i>	Canary Island Date Palm	G

Table 2.0 Schedule of works and trees affected. Trees described in greater detail in section 5.0.

UTM Tree No.	Common name	Description of work to be done
1-10	Broad-leaved Paperbark	Propose to remove to accommodate stormwater diversion works; replace with new plantings as per Landscape Plan.
11-14a	Broad-leaved Paperbark	Retain and protect within a Tree Protection Zone.
15-19	Broad-leaved Paperbark	Propose to remove to accommodate stormwater diversion works; replace with new plantings as per Landscape Plan.
20-25	Broad-leaved Paperbark	Retain and protect within a Tree Protection Zone.
26-31	Broad-leaved Paperbark	Propose to remove to accommodate stormwater diversion works; replace with new plantings as per Landscape Plan.
32-35	Broad-leaved Paperbark	Retain and protect within a Tree Protection Zone.
36-47	Broad-leaved Paperbark	Propose to remove to accommodate stormwater diversion works; replace with new plantings as per Landscape Plan.
48-74	Broad-leaved Paperbark	Retain and protect within a Tree Protection Zone.
75-109	Broad-leaved Paperbark	Propose to remove to accommodate remediation works; replace with new plantings as per Landscape Plan.
110-113	London Plane Tree	Propose to remove to accommodate remediation works; replace with new plantings as per Landscape Plan.
114-119	London Plane Tree	Propose to remove to accommodate remediation works; replace with new plantings as per Landscape Plan.
120-127	London Plane Tree	Propose to remove to accommodate remediation works; replace with new plantings as per Landscape Plan.
128-134	London Plane Tree	Propose to remove to accommodate remediation works; replace with new plantings as per Landscape Plan.
135-138	Hills Weeping Fig	Propose to remove to accommodate remediation works; replace with new plantings as per Landscape Plan.
139-146	London Plane Tree	Retain and protect within a Tree Protection Zone.
147-150	Omitted from report	-
151 -162	Queensland Firewheel Tree Swamp Mahogany Spotted Gum Grey Gum Flowering Gum	Propose to remove to accommodate design works; replace with new plantings as per Landscape Plan.
163	Canary Island Date Palm	Propose to transplant elsewhere on site as per the landscape plan.

1.0 PREFACE

URBAN TREE MANAGEMENT © has prepared this report for Lend Lease Development.

The proposed works incorporates the demolition, construction, remediation and design of the existing area known as the Darling Walk, Darling Harbour (*the site*).

The trees are protected under the Sydney Harbour Foreshore Authority Tree Policy 2006 within the site, City of Sydney Tree Preservation Order for Street trees along Harbour Street, with tree selection (street trees) governed by the City of Sydney Street Tree Master Plan 2004.

This report has been prepared to accompany a series of planning applications for the Darling Walk Project.

2.0 INTRODUCTION

Mr Laurie Dorfer (*the author*) attended *the site* on Tuesday 4 March 2008 and Tuesday 22 April 2008 the trees and their growing environment were examined.

This report has been divided into five (5) parts to reflect the proposed construction stages; being demolition, stormwater diversion, remediation, design and replacement trees. The tree assessments will be divided into their corresponding stage with comments regarding tree removal, retention, protection, impact etc provided. Some stages will overlap in their duration; therefore the current works at the time will need to address the corresponding stages.

The proposed building design and its configuration and infrastructure were arrived at prior to the undertaking of an arboricultural assessment of the trees on the site to determine their significance by URBAN TREE MANAGEMENT ©.

The trees are indicated in Appendix G - Site Plan – UTM Survey of Subject Tree/s and Tree Protection, including Tree Protection Zone fencing and corresponding works.

Aims

Detail the condition of the trees on the site or on adjoining sites where such trees may be affected by the proposed works, by assessment of individual specimens or stands, and indicate remedial works or protection measures for their retention in a safe and healthy condition, or a condition not less than that at the time of initial inspection for this report, or in a reduced but sustainable condition due to the impact of the development but ameliorated through tree protection measures able to be applied, and will consider the location and condition of the trees in relation to the proposed building works, or recommend removal and replacement where appropriate.

Provide as an outcome of the assessment, the following: a description of the trees, observations made, discussion of the effects the location of the proposed building works may have on the trees, and make recommendations required for remedial or other works to the trees, if and where appropriate.

Determine from the assessment as detailed in 1.2 a description of the works or measures required to ameliorate the impact upon the trees to be retained, by the proposed building works or future impacts the trees may have upon the new building works if and where appropriate, or the benefits of removal and replacement if appropriate for the medium to long term safety and amenity of the site.

Objectives

Assess the condition of the subject trees.

Determine impact of development on the subject trees.

Provide recommendations for retention or removal of the subject trees.

3.0 METHODOLOGY

Note: Individual methodologies applied as applicable.

- 3.1 The method of assessment of tree/s applied is adapted from the principles of visual tree assessment undertaken from the ground, which considers:
 1. Tree health and subsequent stability, both long and short term
 2. Sustainable Retention Index Value (SRIV) (IACA 2005)©
 3. Hazard potential to people and property
 4. Amenity values
 5. Habitat values
 6. Significance

- 3.2 This assessment is undertaken using standard tree assessment criteria for each tree based on the values above and is implemented as a result of at least one comprehensive and detailed site inspection to undertake a visual tree assessment of each individual tree, or stand of trees, or a representative population sample.

- 3.2 Any dimensions recorded as averages, or by approximation are noted accordingly.

- 3.3 In the absence of an Australian Standard, the British Standard BS 5837 Guide for “Trees in relation to construction.” Is applied to trees in this report as a point of reference and guide for the recommended minimum clearances from the centre of trees trunks to development works and is applied as a generalized benchmark and the distances may be increased or decreased by the author as a result of other factors providing mitigating circumstances or constraints as indicated by but not restricted to the following:
 1. Condition of individual trees,
 2. Tolerance of individual species to disturbance,
 3. Geology e.g. physical barriers in soil, rock floaters, bedrock to surface
 4. Topography e.g. slope, drainage,
 5. Soil e.g. depth, drainage, fertility, structure,
 6. Microclimate e.g. due to landform, exposure to dominant wind,
 7. Engineering e.g. techniques to ameliorate impact on trees such as structural soil, gap graded fill, lateral boring,
 8. Construction e.g. techniques to ameliorate impact on trees such as pier and beam, bridge footings, suspended slabs,
 9. Arboriculture e.g. exploration trenches to map location of roots,
 10. Physical limitations – existing modifications to the environment and any impact to tree/s by development e.g. property boundaries, built structures, houses, swimming pools, road reserves, utility services easements, previous impact by excavation, or construction in other directions, soil level changes by cutting or filling, existing landscaping works within close proximity, modified drainage patterns,
 11. Extraneous factors e.g. potential future impacts from development on adjoining land when the tree is located on or near to a property boundary.

- 3.6 Trees in groups may be referred to as stands and a stand may exclusively contain specimens to be either retained or removed or a combination of both. A stand may be used to discuss all the trees on a given site to expedite their assessment, or refer to trees growing proximate to one another or within a defined space. Stands may be comprised by mass boundary or screen plantings, to form a group of the same or a mixture of taxa. Each stand is considered as a single unit with each component tree assessed and expressed in tabular form, or indicated by a given percentage as a population sample of each stand. Where it is appropriate for a stand of trees to be retained in full or part, the location and setback of Tree Protection Zone fences or works, are prescribed to provide for the preservation of the stand or selected component trees, in a condition not less than that at the time of initial inspection for its incorporation into the landscape works for the site, or in a reduced but sustainable condition due to the impact of the development but ameliorated through tree protection measures.
- 3.7 The trees/s have been allocated a significance rating as determined by the UTM Rating Systems for Tree Significance – Appendix A which allows the retention value to be determined.

4.0 PRUNING STANDARDS

- 4.1 Any pruning recommended in this report is to be to the Australian Standard® AS4373 'Pruning of amenity trees', and conducted in accordance with the NSW Work Cover Authority Code of Practice for the Amenity Tree Industry, 1998.
- 4.2 All pruning or removal works are to be in accordance with the appropriate Tree Management Policy where applicable, or Tree Management Order (TMO), or Tree Preservation Order (TPO).
- 4.3 Tree maintenance work is specialised and in order to be undertaken safely to ensure the works carried out are not detrimental to the survival of a tree being retained, and to assist in the safe removal of any tree, should be undertaken by a qualified arboriculturist with appropriate competencies recognised within the Australian Qualification Framework, with a minimum of 5 years of continual experience within the industry of operational amenity arboriculture, and covered by appropriate and current types of insurance to undertake such works.

5.0 Observations

- 5.1 *The site* supports planted, indigenous and exotic, evergreen and deciduous trees. The trees are predominantly young specimens, ≤ 15 years old which had been planted for amenity value and shading purposes.
- 5.2 The stand of *Melaleuca quinquenervia* – Broad-leaved Paperbark, is to represent a typical grove along the lake, as would naturally occur. These have been closely planted to provide a continuous canopy whereby individual crowns have developed, pre-dominantly with intermediate crown forms. The surrounding area is surfaced with decomposed granite.
- 5.3 The *Platanus x hispanica* – London Plane Trees within *the site* have been planted in linear stands for greater visual impact when the canopies form by the merging crowns. Crown modification has been undertaken to Trees 110 – 119 by reduction pruning; likely to restrict size. Some lopping has also occurred whereby epicormic growth has emerged. Paving surrounds the trees, whereby maintenance works was already observed to have been undertaken adjacent to Trees 114 – 119; heaving as caused by roots is the likely cause.
- 5.4 Trees 128 – 134 are young street trees, ≤ 8 years old which form part of the local streetscape.
- 5.5 No trees were identified as a Threatened Species or part of a Threatened Community or Heritage Item.

Tree Significance

- 5.6 The significance of *the trees* at *the site* is typically contributed to their amenity value as provided by the screening affect and street tree location as a landscape element. The significance of Trees 1 – 109 (*Melaleuca quinquenervia*) was contributed to the overall canopy affect, not as individual specimens; this would alter individually.

Significant Trees for *the site* (*the trees*) as established by URBAN TREE MANAGEMENT ®© using the **UTM Ratings System**.

Significant Scale

- 1 – High
 2 – Moderate
 3 – Low
 4-Environmental
 Pest/Noxious Weed
 5 – Hazardous

	1	2	3	4	5
	1-109, 139-147, 157, 163	120-138, 152-155, 158, 160, 161,	110-119, 151, 156, 159, 162		

Tree Retention Value - See Methodology part 3.4 Priority Matrix

Retention Value

- High** – Priority for Retention
Medium – Consider for Retention
Low – Consider for Removal
Remove – Priority for Removal

	High Priority for Retention	Medium Consider for Retention	Low Consider for Removal	Remove Priority for Removal
	1-109, 139-147, 157, 160, 161, 163	110 – 119, 120 - 138, 152-155, 158	151, 156, 159, 162	

Stage 1

Demolition

- 6.0 No trees are proposed to be removed during the demolition stage.
- 6.1 All remaining trees are recommended to be retained in situ with suitable Tree Protection Zones and fencing installed. The trees are all to be incorporated into the demolition works for the site with Tree Protection Zones provided as shown in Table 3.0 below.
- 6.2 The trees will be protected within their stands, with the set back provided in Table 3 from the outermost trees within the stand; where applicable. The largest diameter at breast height (DBH) within the stand has been used to determine the collective set back.

Table 3.0 This table applies to all trees during the demolition stage. Tree Protection Zone fencing locations as measured from the centre of each tree and the actual distances for the side closest to the building/ construction works e.g. excavation (see explanatory notes below). Tree Protection Zone fences and setbacks where applicable are indicated in Appendix A.

1. Tree No.	2. Trunk Diameter (See Section 5) (mm)	3. Age of tree Y = Young M = Mature O = Over- mature (Senescent)	4. Tree Vigour Normal Vigour = 1 or Low Vigour = 2	5. British Standard BS 5837:1991 Recommended distance per DBH in metres (see Appendix C) (m)	6. Reduced distance by British Standard (one third on one side only) (m)
1-109	280	Y	1	3	2
110-113	170	Y	1	2	1
114-119	240	Y	1	3	2
120-127	240	Y	1	3	2
128-134	190	Y	1	2	1*
135-138	140	Y	1	2	1
139-146	320	M	1	4	2.5
151-156	290	Y	1	3	2
157-162	340	M	1	4	2.5
163	700	M	1	6	4

* Street trees with set backs further reduced to accommodate pedestrian traffic.

Explanatory notes for Table 3.0.

This table is based upon British Standard BS 5837: 1991 Guide for "Trees in relation to construction" (Appendix B) for suitable set backs (**British Standard – Column 5**). However, these set backs can be reduced by up to one third on one side only while retaining suitable set backs in other directions (**Reduced – Column 6**).

- 6.3 The Tree Protection Zone for each stand is to be incorporated into the demolitions works for the site and the protection fencing to be located as indicated in Appendix A – Survey of Subject Trees & Tree Protection Zones. The Tree Protection Zone fencing may only be further reduced from Table 3 Column 6, where existing constraints may already exist which may have altered or limited the distribution or roots in that direction; confirmation is required by the consulting Arboriculturist. The TPZ fencing for street trees should be of minimal width to allow for pedestrian access along the road reserve area.
- 6.4 Tree Protection Zones are to be constructed as described here and detailed in Appendix C and in Appendix A and installed prior to any demolition works. The TPZ fencing is to be left in situ for the duration of demolition works and only removed upon the commencement of their consecutive construction stages.

Stage 2

Stormwater Diversion

(Trees 1 – 109, 139 – 146)

7.0 TREE ASSESSMENT Darling Walk South – Trees at South/West Side of Lake

UTM Tree No.	Genus & species / Common Name	Age Y = Young M = Mature O = Over-mature	Condition G = Good F = Fair P = Poor D = Dead	Crown Form D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	Ht. Approx. metres	Crown spread approx. metres / Orientation R = Radial	Crown Symmetry 1 = symmetrical 2 = asymmetrical / Orientation	Crown cover / Crown density % D = dominant	DBH in mm @ 1.4m, or other as indicated / trunk orientation other than R = radial, e.g. NS	Trunk Lean 1. = Upright-Slight 2. = Moderate 3. = Severe 4. = Critical. 5. = Acaulescent / Orientation / ST = Static P = Progressive	Pests & diseases 1 = No or 2 = Yes (if 2, see comments)	Branch Bark included 1 = No or 2 = Yes or 3 = N/A	Vigour 1 = Normal Vigour 2 = Low Vigour	Form 1 = Good form 2 = Poor form	SRV Age, Vigour, Condition/ Index Rating	SULE 1. Long 2. Medium 3. Short 4. Remove
1	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	C	8	4X3 E/W	2N	90/90	220 R	1.	1	1	1	1	YNVG 9	1
2	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	I	7.5	3X2 E/W	1	90/90	170 R	1.	1	2	1	1	YNVG 9	1
3	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	I	7	2X2 R	2W	80/90	130 R	1.	1	1	1	1	YNVG 9	2
4	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	I	7	2X1 N/S	2E	85/90	140 R	1.	1	1	1	1	YNVG 9	2
5	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	8	2X2 R	2W	80/90	170 R	1. TO E	1	1	1	1	YNVF 8	2
6	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	7	3X2 N/S	2E	80/90	130 R	1. TO E	1	1	1	1	YNVF 8	2
7	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	C	8	3X3 R	2E	85/90	120 R	1.	1	1	1	1	YNVG 9	1
8	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	C	8	3X3 R	1	80/90	180 R	1.	1	2	1	1	YNVF 8	2
9	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	7.5	2X2 R	2W	80/90	130 R	1.	1	1	1	1	YNVF 8	1
10	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	I	8	3X1 E/W	1	85/90	120 R	1.	1	1	1	1	YNVG 9	1
No.	Comments															
1	-															
2	Minor inclusion at second order structural branch junction (SOSB) at mid to upper crown.															
3	-															
4	-															
5	-															
6	-															
7	Previously pruned at lower crown to E; stubs remaining reaching approx. 40mm in length.															
8	Included at SOSB and third order structural branch (TOSB) junction.															
9	-															
10	-															

7.0 TREE ASSESSMENT – continues **Darling Walk South – Trees at South/West Side of Lake**

UTM Tree No.	Genus & species / Common Name	Age Y = Young M = Mature O = Over-mature	Condition G = Good F = Fair P = Poor D = Dead	Crown Form D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	Ht. Approx. metres	Crown spread approx. metres / Orientation R = Radial	Crown Symmetry 1 = symmetrical 2 = asymmetrical / Orientation	Crown cover / density % D = dominant	DBH in mm @ 1.4m, or other, as indicated / trunk orientation other than R = radial, e.g. N/S	Trunk Lean 1. = Upright-Slight 2. = Moderate 3. = Severe 4. = Critical. 5. = Acaulescent / Orientation / ST = Static P = Progressive	Pests & diseases 1 = No or 2 = Yes (If 2 see comments)	Branch Bark included 1 = No or 2 = Yes or 3 = N/A	Vigour 1 = Normal 2 = Low Vigour	Form 1 = Good form 2 = Poor form	SRIV Age, Vigour, Condition/ Index Rating	SULE 1. Long 2. Medium 3. Short 4. Remove
29	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	C	8	7X3 N/S	1	85/85	250 R	1.	1	2	1	1	Y/NV/F 8	1
30	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	7	4X2 N/S	1	80/85	170 R	1. TON	1	2	1	1	Y/NV/F 8	2
31	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	C	7	3X2 N/S	1	85/85	140 R	1.	1	2	1	1	Y/NV/F 8	1
32-35 Stand 3	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G-F	S, I, C	6-8	1-4 N/S 2-3	-	70-90	130-200	1.	1	1-2	1	1-2	-	1-2
36	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	7	3X2 N/S	1	80/90	90 R	1.	1	1	1	1	Y/NV/F 8	2
37	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	I	7	4X2 N/S	1	80/90	110 R	1.	1	1	1	1	Y/NV/G 9	2
38	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	C	8	5X2 N/S	2 N	85-90	210 R	1	1	2	1	1	Y/NV/G 9	1
39	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	C	7	4X2 N/S	1	85/85	160 R	1.	1	1	1	1	Y/NV/G 9	1
40	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	P	S	5	2X2 R	1	80/85	90 R	2. N	1	1	1	2	Y/NV/P 5	3
41	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	C	7	4X2 N/S	1	85/90	120 R	1.	1	1	1	1	Y/NV/F 8	1
No.	Comments															
29	Included at FOSB & SOSB junction.															
30	Included at FOSB junction.															
31	-															
32-35	Tree 32, 33, 35 – Included at FOSB junction. Tree 32 – Suppressed poor when adjacent trees removed.															
36	-															
37	-															
38	Included at SOSB junction.															
39	-															
40	Branch tear wound at mid trunk to N from inclusion at FOSB junction.															
41	-															

7.0 TREE ASSESSMENT – continues **Darling Walk South – Trees at South/West Side of Lake**

UTM Tree No.	Genus & species / Common Name	Age Y = Young M = Mature O = Over-mature	Condition G = Good F = Fair P = Poor D = Dead	Crown Form D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	Ht. Approx. metres	Crown spread approx. metres Orientation R = Radial	Crown Symmetry 1 = symmetrical 2 = asymmetrical Orientation	Crown cover / density % D = dominant	DBH in mm @ 1.4m, or other, as indicated / trunk orientation other than R = radial, e.g. N/S	Trunk Lean 1. = Upright-Slight 2. = Moderate 3. = Severe 4. = Critical 5. = Acaulescent / Orientation / ST = Static P = Progressive	Pests & diseases 1 = No or 2 = Yes (if 2, see comments)	Branch Bark included 1 = No or 2 = Yes or 3 = N/A	Vigour 1 = Normal Vigour 2 = Low Vigour	Form 1 = Good form 2 = Poor form	SRIV Age, Vigour, Condition/ Index Rating	SULE 1. Long 2. Medium 3. Short 4. Remove
42	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	C	8	5X3 N/S	1	80/90	180 R	1.	1	1	1	1	YNVG 9	1
42a	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	S	6	3X2 N/S	1 N	80/90	130 R	1.	1	2	1	1	YNVF 8	2
42b	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	7	3X3 R	1	80/90	170 R	1.	1	1	1	1	YNVF 8	2
43	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	S	6	2X1 N/S	1	80/90	130 R	1.	1	2	1	1	YNVF 8	2
44	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	C	8	4X2 N/S	1	80/90	270 R	1.	1	2	1	1	YNVF 8	1
45	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	I	8.5	3X2 N/S	1	80/90	160 R	1.	1	2	1	1	YNVG 9	1
46	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	C	8.5	6X2 N/S	2 S	80/80	230 @ 1M R	1.	1	2	1	1	YNVF 8	1
647	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	P	S	6	3X2 N/S	1	50/70	150 R	1.	1	1	2	1	YVNP 5	3
48 – 65 Stand 4	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G, F, P	C, I, S	6-8	2-6 N/S 2-3	-	60 – 90	110 – 280 R	1	1	1-2	1	1	-	1-3
66 – 73 Stand 5	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G, F, P	C, I, S	7-8	2-6 N/S 2-3	-	40 – 90	110 – 280 R	1-2	1	1-2	1	1-2	-	1-3
No.	Comments															
42	-															
42a	-															
43b	-															
43	High volume small deadwood.															
44	Included at FOSB junction.															
45	-															
46	Included at FOSB junction.															
47	High volume dieback, high volume small deadwood throughout															
48 - 65	Tree 51, 52, 53, 54, 58, 59, 65 - Included at FOSB junction.															
66 - 73	Tree 70, 72, 73 - Included at FOSB junction. Tree 68 - suppressed, remove when adjacent trees removed.															

7.0 TREE ASSESSMENT - continues **Darling Walk South – Trees at South/West Side of Lake**

UTM Tree No.	Genus & species Common Name	Age Y = Young M = Mature O = Over-mature	Condition G = Good F = Fair P = Poor D = Dead	Crown Form D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	Ht. Approx. metres	Crown spread approx. metres Orientation R = Radial	Crown Symmetry 1 = symmetrical 2 = asymmetrical Orientation	Crown cover / Crown density % D = dominant	DBH in mm @ 1.4m, or other, as indicated / trunk orientation other than R = radial, e.g. N/S	Trunk Lean 1 = Upright/Slight 2 = Moderate 3 = Severe 4 = Critical 5 = Acaulescent / Orientation / ST = Static P = Progressive	Pests & diseases 1 = No or 2 = Yes (if 2, see comments)	Branch Bark included 1 = No or 2 = Yes or 3 = N/A	Vigour 1 = Normal 2 = Low Vigour	Form 1 = Good form 2 = Poor form	SRIV Age, Vigour, Condition/ Index Rating	SULE 1. Long 2. Medium 3. Short 4. Remove
74	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	I	7	3X2 N/S	2 S	70/85	210 R	1. NW	1	2	1	1	YNVG 9	2
75	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	I	8	4X2 N/S	2 S	75/90	180 R	1. SW	1	1	1	1	YNVG 9	2
76	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	C	8	5X2 N/S	1	85/85	180 R	1.	1	2	1	1	YNVF 8	2
77	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	8	3X1 N/S	1	60/70	180 R	1.	1	2	1	1	YNVF 8	3
78	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	6	4X2 N/S	1	65/70	120 R	1.	1	1	1	1	YNVF 8	3
79	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	S	7	3X2 N/S	1	70/85	130 R	1.	1	1	1	1	YNVF 8	2
80	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	7	5X3 N/S	1	70/85	190 @ 1M R	1.	1	1	1	1	YNVF 8	1
81	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	P	S	6	1X1 N/S	1	10/70	130 @ 1M R	1.	1	1	2	1	YNVP 5	4
82	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	D	8	5X5 R	1	90/90	240 R	1	1	1	1	1	YNVG 9	1
83	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	C	6	6X5 N/S	2 E	90/90	170 R	2. E	1	1	1	1	YNVG 9	1
No.	Comments															
74	Included at SOSB junction															
75	High volume small deadwood.															
76	Branch tear wound at mid trunk to W from inclusion.															
77	Included at FOSB junction. High volume deadwood and moderate volume epicormic growth throughout crown.															
78	High volume dieback throughout, low volume epicormic.															
79	-															
80	-															
81	High volume dieback throughout.															
82	-															
83	-															

7.0 TREE ASSESSMENT - continues **Darling Walk South – Trees at South/West Side of Lake**

UTM Tree No.	Genus & species / Common Name	Age Y = Young M = Mature O = Over-mature	Condition G = Good F = Fair P = Poor D = Dead	Crown Form D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	Ht. Approx. metres	Crown spread approx. metres / Orientation R = Radial	Crown Symmetry 1 = symmetrical 2 = asymmetrical / Orientation	Crown cover / density % D = dominant	DBH in mm @ 1.4m, or other, as indicated / trunk orientation other than R = radial, e.g. N/S	Trunk Lean 1. = Upright-Slight 2. = Moderate 3. = Severe 4. = Critical. 5. = Acaulescent / Orientation / ST = Static P = Progressive	Pests & diseases 1 = No or 2 = Yes (If 2 see comments)	Branch Bark included 1 = No or 2 = Yes or 3 = N/A	Vigour 1 = Normal 2 = Low Vigour	Form 1 = Good form 2 = Poor form	SRIV Age, Vigour, Condition/ Index Rating	SULE 1. Long 2. Medium 3. Short 4. Remove
84	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	C	5.5	3X3 R	2 E	80/85	140 R	1. E	1	1	1	1	Y/N/V 8	1
85	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	5.5	2X1 N/S	1	80/80	120 R	1.	1	1	1	1	Y/N/V 8	1
86	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	I	5	4X2 N/S	1	80/85	120 R	1.	1	1	1	1	Y/N/V 9	1
87	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	S	6	3X1 N/S	1	80/80	90 R	1.	1	1	1	1	Y/N/V 8	2
88	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	I	7	4X1 N/S	1	85/90	140 R	1.	1	1	1	1	Y/N/V 9	1
89	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	8	3X2 N/S	1	85/85	140 R	1.	1	1	1	1	Y/N/V 8	1
90	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	7	3X2 N/S	1	85/85	150 R	1.	1	1	1	1	Y/N/V 8	1
91	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	C	6	4X3 N/S	2 E	90/90	190 R	1.	1	1	1	1	Y/N/V 9	1
92	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	G	C	7	5X3 N/S	2 SE	90/90	180 R	1. E	1	1	1	1	Y/N/V 9	1
93	<i>Melaleuca quinquenervia</i> Broad-leaved Paperbark	Y	F	I	7	4X2 N/S	1	90/90	120 R	1.	1	1	1	1	Y/N/V 8	1
No.	Comments															
84	-															
85	Inferior FOSB at lower crown failed; stub remaining reaching 700mm in length.															
86	Duel trunks.															
87	-															
88	-															
89	-															
90	-															
91	-															
92	-															
93	-															

***Melaleuca quinquenervia* - Broad-leaved Paperbarks (Trees 1 - 109)**

- 7.1 Tree removals for the stormwater diversion works are proposed only within the stand of *Melaleuca quinquenervia* - Broad-leaved Paperbarks (Trees 1 - 109), to accommodate excavation of the stormwater culvert.
- 7.2 Trees 76, 77, 78, 79, 88, 89, 90, 95, 96, 97 and 98 are proposed for removal due to the open excavation works and are unable to be retained.
- 7.3 Trees 1-75, 80-87, 91-94 and 99-109 are proposed to be retained in situ and all incorporated into the construction works for the site.
- 7.4 The TPZ fencing surrounding the stand of *Melaleuca quinquenervia* - Broad-leaved Paperbark should be re-located only post demolition, for the commencement of the stormwater diversion works to accommodate tree removal. The trees to be retained are to be incorporated into the construction works for the site with Tree Protection Zone set backs provided as shown in Table 3.0. The TPZ fencing is to be located as indicated in Appendix G - Survey of Subject Trees & Tree Protection Zones.
- 7.5 Removal of trees within 6m of a tree to be retained should be undertaken only by cutting down such a tree without damaging the trees to be retained. The removed trees should be undertaken manually by aerial sectioning and the grinding out of its stumps.
- 7.6 Trees 1- 109 were determined to have high significance and retention value respectively. Although, young in age and of small dimensions individually, they form a prominent canopy collectively when viewed from various directions within the landscape.

***Platanus x hispanica* - London Plan Tree (Trees 139 - 146)**

- 7.7 The proposed excavation set back is 5m from Trees 139 to 146; a 4m set back has been recommended (Table 3). However, as their roots are expected to have been deflected by the adjacent concrete wall (pedestrian bridge), an increased volume of roots is expected towards the excavation. Therefore, the 5m set back should be accepted as the recommended Tree Protection Zone (TPZ).
- 7.8 Access within the site will be required; however this will be limited to the area adjacent to Trees 139-146. Therefore, the area within the Tree Protection Zone will be required to support access; modified tree protection measures are therefore required.
- 7.9 The TPZ fencing is to be situated at the garden edge (1.2m from the wall); this will protect the trunks. The existing paving should remain in situ for the entire duration of works while this area is intended to be used as access which will prevent soil compaction and impact on roots.
- 7.10 Tree 143 will require pruning to prevent truck/plant conflict. Abrasion wounds are already present; although minor. Selective pruning is to be undertaken of the lowest first order structural branch to north. This branch supports approximately 30% of the live crown, with a 220mm diameter; this will temporarily impact the tree condition and vigour. However, the tree should re-establish a suitable crown within the short term.

7.11 Resistograph testing should be undertaken to Tree 144 at the basal wound. This will ascertain the trees structural integrity.

General Protection Works

7.12 During excavation, the culvert walls adjacent to trees should be maintained at or near vertical with no batter. This will reduce excavation encroachment towards the adjacent tree/s to be retained, thus minimising root impact.

7.13 The TPZ fencing is to remain in situ for the duration of the stormwater diversion works and only removed post remediation works.

7.14 All remaining trees within and adjacent to the site will remain in situ, including Tree Protection Zones.

Stage 3

Remediation works

(Trees 110 - 138)

8.0 TREE ASSESSMENT - continues **Darling Walk South – Trees Adjacent to Pedestrian Bridge**

UTM Tree No.	Genus & species / Common Name	Age Y = Young M = Mature O = Over-mature	Condition G = Good F = Fair P = Poor D = Dead	Crown Form D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	Ht. Approx. metres	Crown spread approx. metres / Orientation R = Radial	Crown Symmetry 1 = symmetrical 2 = asymmetrical Orientation	Crown cover / Crown density % D = dormant	DBH in mm @ 1.4m or other, as indicated / trunk orientation other than R = radial, e.g. NS	Trunk Lean 1. = Upright-Slight 2. = Moderate 3. = Severe 4. = Critical 5. = Acaulescent / Orientation / ST = Static P = Progressive	Pests & diseases 1 = No or 2 = Yes (if 2, see comments)	Branch Bark included 1 = No or 2 = Yes or 3 = N/A	Vigour 1 = Normal 2 = Low Vigour	Form 1 = Good form 2 = Poor form	SRIV Age, Vigour, Condition/ Index Rating	SULE 1. Long 2. Medium 3. Short 4. Remove
120	<i>Platanus x hispanica</i> London Plane Tree	Y	G	C	10	6X6 R	1	90/90	190 R	1.	1	1	1	1	YNVG 9	1
121	<i>Platanus x hispanica</i> London Plane Tree	Y	G	C	10	8X8 R	1	90/90	190 R	1.	1	1	1	1	YNVG 9	1
122	<i>Platanus x hispanica</i> London Plane Tree	Y	G	C	12	6X6 R	1	90/90	200 AV EW	1.	1	1	1	1	YNVG 9	1
123	<i>Platanus x hispanica</i> London Plane Tree	Y	F	I	9	4X2 N/S	1	90/90	110 R	1.	1	1	1	1	YNVF 8	2
124	<i>Platanus x hispanica</i> London Plane Tree	Y	G	C	12	6X2 N/S	1	90/90	200 R	1.	1	1	1	1	YNVG 9	1
125	<i>Platanus x hispanica</i> London Plane Tree	Y	G	C	12	7X5 N/S	1	90/90	240 R	1.	1	1	1	1	YNVG 9	1
126	<i>Platanus x hispanica</i> London Plane Tree	Y	G	C	13	6X6 R	1	90/90	210 R	1. N	1	1	1	1	YNVG 9	1
127	<i>Platanus x hispanica</i> London Plane Tree	Y	G	C	12	7X5 R	1	90/90	200 R	1. N	1	1	1	1	YNVG 9	1
No.	Comments															
120	-															
121	-															
122	-															
123	-															
124	-															
125	-															
126	-															
127	-															

- 8.1 Remediation works will require the removal of Trees 110 - 138. The TPZ fencing should only be removed at the commencement of remediation works.
- 8.2 The TPZ fencing should remain in situ around 1-75, 80-87, 91-94, 99-109 and 139-163. These trees are proposed to be retained in situ and all incorporated into the remediation works for the site.
- 8.3 The TPZ fencing is to remain in situ for the duration of the remediation works and only removed at post remediation.
- 8.4 Trees 110 - 119 (*Platanus x hispanica* - London Plane Tree) have been pruned; likely for the reason to restrict crown size. Reduction pruning was observed throughout the entire crown of each tree to restrict height and width. Some branches had been lopped whereby epicormic growth was emerging in response. This disfigures the internal branch structure, which is most noticeable during their dormancy and may pre-dispose the tree to defects. If such large trees are not the desired outcome, alternative species should be considered.

Stage 4

Design

(Trees 151 - 163)

10.0 TREE ASSESSMENT

Darling Walk North –Northern/west side of Lake

UTM Tree No.	Genus & species Common Name	Age Y = Young M = Mature O = Over -mature	Condition G = Good F = Fair P = Poor D = Dead	Crown Form D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	Ht. Approx. metres	Crown spread approx. metres Orientation R = Radial	Crown Symmetry 1 = symmetrical 2 = asymmetrical Orientation	Crown cover / Crown density % D = dormant	DBH in mm @ 1.4m, or other, as indicated / trunk orientation other than R = radial, e.g. NS	Trunk Lean 1. = Upright-Slight 2. = Moderate 3. = Severe 4. = Critical 5. = Acaulescent / Orientation / ST = Static P = Progressive	Pests & diseases 1 = No or 2 = Yes (If 2. see comments)	Branch Bark included 1 = No or 2 = Yes or 3 = N/A	Vigour 1 = Normal Vigour 2 = Low Vigour	Form 1 = Good form 2 = Poor form	SRV Age, Vigour, Condition/ Index/ Rating	SULE 1. Long 2. Medium 3. Short 4. Remove	
151	<i>Stenocarpus sinuatus</i> Queensland Firewheel Tree	Y	P	D	5.5	2X1 SW/NE	2 NE	65/90	95 R	1. N	1	2	1	2	Y/NVP 5	3	
152	<i>Eucalyptus punctata</i> Grey Gum	Y	F	D	7	4X3 E/W	2 W	85/90	160 R	1.	1	1	1	1	Y/NVF 8	1	
153	<i>Corymbia maculata</i> Spotted Gum	Y	G	D	8	8X5 N/S	1	90/90	250 R	1.	1	1	1	1	Y/NVG 9	1	
154	<i>Corymbia maculata</i> Spotted Gum	Y	G	C	8	4X4 R		90/90	140 R	1.	1	1	1	1	Y/NVG 9	1	
155	<i>Eucalyptus punctata</i> Grey Gum	Y	G	D	11	6X3 E/W	2 E	90/90	290 R	1. W	1	1	1	1	Y/NVG 9	1	
156	<i>Corymbia 'Summer Red'</i> Flowering Gum	Y	F	D	1.8	1.5X1.5 R	2 SE	90/90	40 R	1.	1	1	1	1	Y/NVF 8	1	
157	<i>Stenocarpus sinuatus</i> Queensland Firewheel Tree	M	G	C	9	7X5 E/W	1	90/90	270 AV E/W	1.	1	1	1	1	MN/VG 10	1	
158	<i>Stenocarpus sinuatus</i> Queensland Firewheel Tree	Y	F	D	7	6X4 N/S	1	90/90	190 AV E/W	1.	1	1	2	1	Y/NVF 8	2	
159	<i>Corymbia maculata</i> Spotted Gum	Y	P	C	7	2X3 R	1	55/75	100 R	1.	1	1	1	1	Y/LVP 1	3	
160	<i>Eucalyptus robusta</i> Swamp Mahogany	Y	G	D	9	4X3 N/S	2 NE	90/90	210 R	1.	1	1	1	1	Y/NVG 9	1	
No.	Comments																
151	Bifurcates at 2m, inferior first order structural branch to SW 80% dead with epicormics emerging proximally. Dieback wound emerging at upper trunk to tear out wound reaching basally to SE.																
152	Low volume epicormic growth emerging at mid trunk, low volume dieback at lower outer crown to N and W.																
153	-																
154	-																
155	Mechanical wound at mid trunk to SW, 400mmx120mm, vigorous wound wood about wound perimeters.																
156	Upper crown damaged.																
157	-																
158	Inferior FOSB to NW included, supports approx. 30% of the live crown. Crossing branches at inner mid crown.																
159	Moderate volume dieback throughout. Circumferential mechanical damage basally by brushcutter.																
160	-																

- 10.1 Design works will require the removal of Trees 151 – 162 as they are unable to be retrained by the proposed design. Additionally, Trees 1-18, 10, 15, 26-28, 37-42a, 43-47, 61a, 71a, 74-96 and 99-106 within the stand of Melaleuca's will also require removal.
- 10.2 The TPZ fencing should again be modified around trees to remain within the stand of Melaleuca's being Trees 9, 11-14, 14a, 16, 17, 25, 29-36, 48-73, 97, 98 and 107-109. Suitable set backs should be provided as detailed in Table 3 for retained trees during the undertaken of design works. Fencing is to remain in situ until completion of all construction works.
- 10.3 The removal of trees within the stand should be undertaken manually by aerial sectioning and the grinding out of its stumps. Consideration should be given to the protection of retained trees against damage during tree removal.
- 10.4 The close proximity of each planting within the stand of Melaleuca's has achieved the landscape element intended of a natural forest grove. However, such close plantings have compromised the crown forms with most being intermediate with some suppressed. Although, this being suitable in the growing environment provided, removing adjacent trees will open the crowns of individual specimens exposing them to unaccustomed environmental loads. This may predispose them to crown failure due to the branch bark inclusions present. Also, the aesthetic appearance of the trees will be reduced as only the upper crowns typically supports foliage of the intermediate specimens.
- 10.5 It is recommended that the remaining stand is re-assessed once the trees are removed whereby additional trees are expected to require removal. Most intermediate trees are expected to develop more aesthetically pleasing crowns in the later short term; however suppressed specimens should be removed.
- 10.6 Additionally, for this reason, small fragmented sections of the stand may need to be also considered for removal; being Trees 97-98.
- 10.7 Tree 163 *Phoenix canariensis* – Canary Island Date Palm is proposed to be transplanted by re-locating elsewhere on site (as per the Landscape Plan). The palm should be located elsewhere on site before design construction commences and a Tree Protection Zone fencing of 2m x 2m installed.
- 10.8 Tree transplantation work is specialised and any works for the preparation, carrying out, and maintenance after relocation, should be undertaken by a fully qualified arboricultural or horticultural contractor specialising in tree transplanting who has a record of successful tree transplantation, relocation and re-establishment with a minimum of 5 consecutive years of experience within this field of horticultural operation and is currently practicing such undertakings on a regular basis as the major part of their business activities.
- 10.9 Due to the proximity of works to the remaining stand of *Phoenix canariensis* – Canary Island Date Palm (not assessed), these should be protection within a TPZ with fencing at 4m set backs from the centre of the trunks (see Appendix G).

11.0 Stage 5 - Replacement Trees

- 11.1 The removal of Trees 1-8, 10, 15, 26-28, 37-42a, 43-47, 61a, 71a, 74-96, 99-106, 110-138 and 151 – 162 will have some impact on the local amenity, but the opportunity being provided allows for the planting of new specimens selectively chosen which will renew the vegetation cover on the site with undamaged stock.
- 11.2 The replacement trees should be advanced specimens in 200, 400 and/or 600 litre containers and having been propagated to the standards of Natspec Guide to *Specifying Trees* by Ross Clark 2003, or approved similar.
- 11.3 The replacement *Melaleuca quinquinervia* - Broad-leaved Paperbark should be of an advanced size as to minimise the height difference with the existing trees, thus maintaining the visual impact. Availability of stock at the time of compiling this report was sourced from Trees Impact Pty Limited, Ph: 02 48 611 611, fax: 02 48 622 133 - 400 litre at approximately 4.5m high, cost \$860 + GST. Depending on numbers, they currently have a large number of 75litre which if pre-ordered would be in 400litre containers in 2 years.
- 11.4 Replacement *Platanus x hispanica* - London Plane Tree (from the same source) are generally available in 200 litre @ \$430.00, 500 litre @ \$1075.00 and 800 litre @ \$1720.00. Prices are as of 2008 and may vary to this in 2 years.
- 11.5 For such large specimens, it is always recommended to pre-order the size and quantity, as availability will vary. For certainty of size and availability, at least 1 to 2 years in advance should be allocated.
- 11.6 The planting container size for street trees will be dependent on the availability of underground space as affected by services etc. 200 litre to 400litre would be most favourable by Council.
- 11.7 The chosen species for Harbour Street is *Lophostemon confertus* – Brushbox (personal communiqué Mr Andy Clarke -Street Tree Contract Coordinator 2008). The *Platanus x hispanica* - London Plane Tree as dubiously detailed within the Street Tree Master Plan 2004 has been modified due to the recent occurrence of Sycamore Lace Bug.
- 11.8 The selection criteria for large trees (*Platanus x hybrida* - London Plane Trees) within the paved area of the site should consider the available soil space to be allocated to the tree first. Heaving of pavers and future ongoing maintenance are generally expected, such as has already occurred with these young trees. Displacement of pavement becomes a trip hazard resulting in possible liability. Furthermore, pavement repairs often have detrimental affect on the tree with significant damage and removal of roots, resulting in possible decline. An alternative is to create a load-bearing soil (structural soil) which consists of well-graded aggregate mixed with soil and compacted so that it is stable and can carry light traffic. As a suitable growing environment is supplied at depth, roots are encouraged to establish deep root growth away from the pavement surface thus minimising trip hazards. Another technique is to install a root barrier to deflect roots, however no pavement is to occur between the area of the root barrier and the tree; sufficient growing space must be provided.

6.0 CONCLUSION

This report has examined one hundred and sixty one (161) trees within and adjacent to *the site* and considers the retention of fifty two (52) trees, including, one (1) for transplanting. The trees to be retained are to be protected through the implementation of adequate measures for their integration into the development as detailed in the recommendations of this report.

The trees will be removed during their corresponding construction stage, however will be retained and protected until that time.

Where appropriate, the Landscape Plan will include planting with new trees including street tree/s.

If all the recommendations and procedures detailed herein are adhered to, all trees to be retained will continue to grow and develop as an important landscape component providing elements of long term amenity for the property and its owners or occupants, and the local community.

The recommendations made in this report are subject to approval by the consent authority.

7.0 RECOMMENDATIONS

- 7.1 **Stage 1 - Demolition**, all trees are to be retained and protected within a Tree Protection Zone and these to be installed as detailed in 6.1 - 6.4 and Appendices D, E and G and maintained until each relevant stage is completed.
- 7.2 **Stage 2 - Stormwater diversion**, re-establish TPZ fencing to enable the removal of Trees 76, 77, 78, 79, 88, 89, 90, 95, 96, 97 and 98. Remaining trees are to be retained and protected.
- 7.3 Trees 139-146 should be further protected within a Tree Protection Zone of 5m; the adjacent paving is to be retained in situ for the duration of vehicular access within the TPZ.
- 7.4 Trees 143 should be pruned as detailed in 7.10 and to be undertaken in accordance with section 4.0, parts 4.1 - 4.3.
- 7.5 Tree 144 should be further examined with a Resistograph to determine the structural integrity as detailed in 7.11.
- 7.6 Excavation for the culvert walls adjacent to retained trees should be maintained at or near vertical with no batter.
- 7.7 **Stage 3 - Remediation works**, remove Trees 110 - 138 as detailed in 8.1. Maintain TPZ fencing around Trees 1-75, 80-87, 91-94, 99-109 and 139-163.
- 7.8 **Stage 4 – Design**, remove Trees 1-8, 10, 15, 26-28, 37-42a, 43-47, 61a, 71a, 74-96 and 99-106 and 151 – 162.
- 7.9 Trees 9, 11-14, 14a, 16, 17, 25, 29-36, 48-73, 97, 98 and 107-109 should be retained and protected, with suitable tree protection fencing as detailed in 10.2.
- 7.10 Tree 163 is to be transplanted elsewhere on site as detailed in 10.7 & 10.8.
- 7.11 Tree removal is to be undertaken during each corresponding stage in accordance with section 4.0, parts 4.1.
- 7.12 The replacement trees to be planted as per the Landscape Plan in 200 litres to 600 litre containers.
- 7.13 Where Tree Protection Zone fences are to be moved or relocated this must be undertaken in consultation with the Consultant Arboriculturist to ensure that tree protection is maintained.



Laurie Dorfer
Senior Consultant

REFERENCES

1. IACA (2005), Sustainable Retention Index Value, Institute of Australian Consulting Arboriculturists, www.iaca.org.au .
2. Australian Standard® AS 4373 – 2007 Pruning of amenity Trees.
3. Work Cover NSW (1998), Code of Practice for the Amenity Tree Industry, New South Wales Government.

DISCLAIMER

The author and Urban Tree Management take no responsibility for actions taken and their consequences, contrary to those expert and professional instructions given as recommendations pertaining to safety by way of exercising our responsibility to our client and the public as our duty of care commitment, to mitigate or prevent hazards from arising, from a failure moment in full or part, from a structurally deficient or unsound tree or a tree likely to be rendered thus by its retention and subsequent deterioration from modification/s to its growing environment either existing or proposed, either above or below ground, contrary to our advice.

Appendix A

UTM Rating System for Tree Significance

The significance of a tree is highly subjective and difficult to ascertain in a consistent and repetitive fashion. However, it is necessary to determine a rating to assist in determining the retention value for each tree. URBAN TREE MANAGEMENT © has developed a significance rating whereby the retention values can be determined.

Many variables can be taken into consideration by individuals undertaking assessments which include but are not limited to; exposure of location, contribution as a component of the overall landscape for amenity or aesthetic qualities, importance due to uniqueness of taxa for species, subspecies, variety, form, or as an historical or cultural planting, or for age, or substantial dimensions, or habit, or as remnant vegetation, or habitat potential, or a rare or threatened species, or uncommon in cultivation, or of Aboriginal cultural importance, or is a commemorative planting. *Note: Where a tree is considered significant this must be expressed clearly and defined by a methodology and balanced against diminishing factors such as nuisance, as any tree will be of some significance but not every tree can be significant.*

Once the actual significance of an individual tree has been defined by the criteria, the retention value can then be determined (Table 1.0 in this Appendix).

Tree Significance - Assessment criteria

1. High Significance in landscape

- The tree is in good condition, or normal vigour and form typical of the species,
- The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of grand age.
- The tree is listed as a Heritage Item, Threatened Species or part of a Threatened Community or listed on Councils significant Tree Register.
- The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape by bulk and scale and makes a positive contribution to the local amenity.
- The tree has been influenced by historic figures, events or part of the heritage development of the place.
- The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values.
- The growing environment supports the tree to its full dimensions above and below ground without conflict or constraint.

2. Medium Significance in landscape

- The tree is in fair-good condition, or normal or low vigour and form typical or atypical of the species,
- The tree is a planted locally indigenous or a common species with its taxa readily planted in the local area,
- The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street,
- The tree provides a fair contribution to the visual character and amenity of the area,
- The tree is moderately constrained by above or below ground influences of the built environment to reach full dimensions.

3. Low Significance in landscape

- The tree is in fair-poor condition, or normal or low vigour and form typical or atypical of the species,
- The tree is not visible or is partly from surrounding properties as obstructed by other vegetation or buildings.
- The tree provides a minor contribution or has a negative impact on the visual character and amenity of the area.
- The tree is severely constrained by above or below ground by influences of the built environment and therefore will not reach full dimensions; tree is inappropriate to the site conditions.
- The tree is listed as exempt under the provisions of the local Council Tree Preservation Order.
- The tree has a wound or defect that has potential to become structurally unsound.

4. Environmental Pest/Noxious Weed Species

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

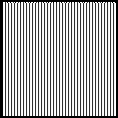
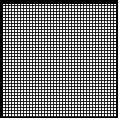
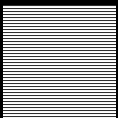
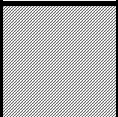
5. Hazardous/Irreversible Decline

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

The tree is to correspond with at least three (3) of the criteria in categories 1, 2 and 3, and one (1) criteria only is required in categories 4 and 5 to be classified in that group.

Note: The assessment criteria are for individual trees only and are not to be applied to stands of trees.

Table 1.0 Tree Retention Value - Priority Matrix.

Estimated Life Expectancy	Environmental & Landscape Significance				
	1. High Significance in Landscape	2. Medium Significance in Landscape	3. Low Significance in Landscape	4. Environmental Pest / Noxious Weed Species	5. Hazardous / Irreversible Decline
Long > 40 years	Priority for Retention (High)	Consider for Retention (Medium)	Consider for Removal (Low)	Priority for Removal (Remove)	
Medium 15 to 40 Years					
Short <1-15 Years					
Dead					
<u>Legend for Matrix Assessment</u>					
	Priority for Retention (High) - These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the set backs as detailed in Table 3. Special construction works must be implemented e.g. pier and beam etc if works are to proceed within the Tree Protection Zone.				
	Consider for Retention (Medium) - These trees may be retained and protected. These are considered less critical; however their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.				
	Consider for Removal (Low) – These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.				
	Priority for Removal – These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.				

Appendix B

Modified extract from British Standard BS 5837: 1991 Guide for “Trees in relation to construction.”

Table 1. Protection of trees: minimum distances for protective fencing around trees			
Tree age	Tree vigour	Trunk diameter	Minimum distance
Young trees (age less than 1/3 life expectancy)	Normal vigour	mm	m
		< 200	2.0
		200 to 400	3.0
Young trees	Low vigour	> 400	4.0
		< 200	3.0
		200 to 400	4.5
Mature trees	Normal vigour	> 400	6.0
		< 350	4.0
		350 to 750	6.0
Mature trees and overmature trees	Low vigour	> 750	8.0
		< 350	6.0
		350 to 750	9.0
		> 750	12.0

Note 1. It should be emphasized that this table relates to distances from centre of tree to protective fencing. Other considerations particularly the need to provide adequate space around the tree including allowances for future growth (see 6.3), and also working space (see 6.7), will usually indicate that structures should be further away.

Note 2. With appropriate precautions, temporary site works can occur within the protected area, e.g. for access or scaffolding (see 8.3).

Appendix C

Matrix - Sustainable Retention Index Value (S.R.I.V.)©

Developed by IACA – Institute of Australian Consulting Arboriculturists www.iaca.org.au

To be used with the values defined in the Glossary.
An Index value as indicated where ten (10) is the highest value.

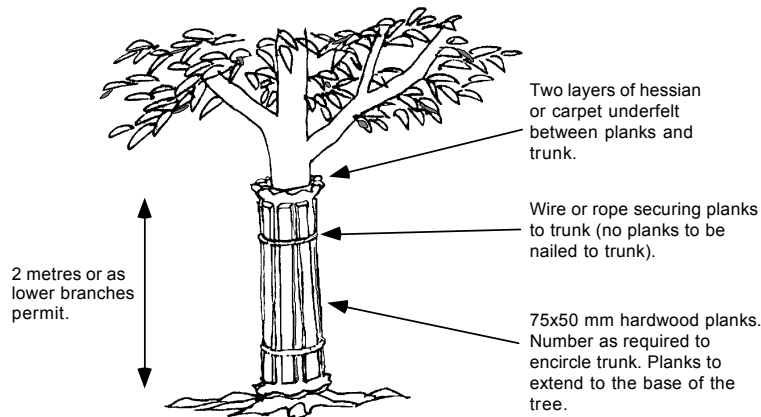
Age Class	Vigour Class and Condition Class					
	Normal Vigour & Good Condition (NVG)	Normal Vigour & Fair Condition (NVF)	Normal Vigour & Poor Condition (NVP)	Low Vigour & Good Condition (LVG)	Low Vigour & Fair Condition (LVF)	Low Vigour & Poor Condition (LVP)
	Able to be retained if sufficient space available above and below ground for future growth. No remedial work or improvement to growing environment required. May be subject to abnormal vigour. Retention potential - Medium – Long Term.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work may be required or improvement to growing environment may assist. Retention potential - Medium Term. Potential for longer with remediation or favourable environmental conditions.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work unlikely to assist condition, improvement to growing environment may assist. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. No remedial work required, but improvement to growing environment may assist vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment may assist condition and vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	Unlikely to be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment unlikely to assist condition or vigour. Retention potential - Likely to be removed immediately or retained for Short Term. Potential for longer with remediation or favourable environmental conditions.
Young (Y)	Index Value 9 Retention potential - Long Term. Likely to provide minimal contribution to local amenity if height <5m. High potential for future growth and adaptability. Retain, move or replace.	Index Value 8 Retention potential - Short – Medium Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m. High-moderate potential for future growth and adaptability. Retain, move or replace.	Index Value 5 Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m. Moderate-low potential for future growth and adaptability. Retain, move or replace.	Index Value 4 Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m. Moderate potential for future growth and adaptability. Retain, move or replace.	Index Value 3 Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m. Moderate-low potential for future growth and adaptability. Retain, move or replace.	Index Value 1 Retention potential - Likely to be removed immediately or retained for Short Term. Likely to provide minimal contribution to local amenity if height <5m. Low potential for future growth and adaptability.
Mature (M)	Index Value 10 Retention potential - Medium - Long Term.	Index Value 9 Retention potential - Medium Term. Potential for longer with improved growing conditions.	Index Value 6 Retention potential - Short Term. Potential for longer with improved growing conditions.	Index Value 5 Retention potential - Short Term. Potential for longer with improved growing conditions.	Index Value 4 Retention potential - Short Term. Potential for longer with improved growing conditions.	Index Value 2 Retention potential - Likely to be removed immediately or retained for Short Term.
Over-mature (O)	Index Value 6 Retention potential - Medium - Long Term.	Index Value 5 Retention potential - Medium Term.	Index Value 4 Retention potential - Short Term.	Index Value 3 Retention potential - Short Term. Potential for longer with improved growing conditions.	Index Value 2 Retention potential - Short Term.	Index Value 0 Retention potential - Likely to be removed immediately or retained for Short Term.

Appendix D

1.0 TREE PROTECTION ZONES - STANDARD PROCEDURE

- 1.1 Each tree to be retained is to have its dripline fenced off, except where otherwise indicated, to create a **Tree Protection Zone**, and this may include one enclosure to protect a single or multiple tree/s, or multiple enclosures separated over the site. The area contained is the **Tree Protection Zone**, and is to exclude any activity, except where otherwise stated. **Tree Protection Zone** works may extend beyond the fenced area or replace a fence if appropriate. The **Tree Protection Zone** is to exclude: modification of existing soil levels, storage of materials including waste, site sheds and machinery; preparation of building materials e.g. concrete, or chemical treatments; the movement of pedestrian or vehicular traffic; or the temporary, or permanent location of services, or the works required for their installation, e.g. trenches, holes or canals. The above list is not meant to be exhaustive, and is intended as a guide to the types of activities that are excluded from within the **Tree Protection Zone**, except where otherwise stated.
- 1.2 The Tree Protection Fence that defines the **Tree Protection Zone** is to be 1.8m high steel chain link with galvanised steel pipes, or approved similar, located around the dripline of the tree except where otherwise stated, as a minimum distance from the tree for its protection and should be made larger where possible. The perimeter of the **Tree Protection Zone** to be further delineated by the attachment of shade cloth material to the outside surface area of the fence facing the inside of the site to reduce the movement of dust and other air borne residue from building activities that may be phytotoxic to plants or plant parts. The fence is to be installed prior to the commencement of any works on site, (except weed removal and tree maintenance, e.g. pruning, irrigation and mulching), and is to be maintained for the duration of the project. The fence must have a lockable opening for access to, and the security of the enclosed area. A temporary TPZ fence or fence section may be required to be established initially, where demolition of existing structures is required to provide an area of sufficient space for the full extent of the Tree Protection Zone to be installed.
- 1.3 Tree Protection signage is to be attached to each **Tree Protection Zone** and displayed in a prominent position and the sign repeated at 10m intervals or closer where the fence changes direction. The lettering for each sign to be a minimum of 72 point and printed in Arial font. The signs to be a minimum size of 600mm x 500mm. Each sign to advise as minimum details, the following:
 1. **Tree Protection Zone** (title)
 2. (TEXT) "This fence has been installed to prevent damage to the tree and their growing environment both above and below ground, and access is restricted."
 3. (TEXT) "If encroachment or incursion into this Tree Protection Zone is deemed to be essential the Consulting Arboriculturist should be informed prior to the undertaking of such works."
 4. (TEXT) **Name, Address and Telephone number** of the *developer* (to enable enquiries concerning the trees to be directed to the developer).

- 1.4 Where a tree is to be retained and a **Tree Protection Zone** can not be adequately established due to restricted access e.g. tree located along side an access way, the trunk will be protected by wrapping 2 layers of hessian or carpet underfelt around the trunk for a minimum of 2m or as lower branches permit, then wire or rope secures 75x50x2000mm hardwood planks to the trunk (do not nail to the trunk). The number of planks to be used is as required to encircle the trunk and the planks are to extend to the base of the tree. (Diagram courtesy G. Clublely)



- 1.5 If a tree is growing down slope from an excavation, a silt fence located along the contours of the site in the area immediately above the **Tree Protection Zone** fencing may need to be installed and regularly maintained to prevent burial and asphyxiation of the roots of the tree. To allow for the maintenance of both fences, the silt fence must be constructed separately to the tree protection fence and the 2 fences must be constructed independently of each other and standalone. To reduce competition with the tree the area within the **Tree Protection Zone** is to be kept free of weeds. These are best removed by the application of foliar herbicide with Glyphosate as the active constituent. This is the preferred method rather than removal by cultivation of the soil within the dripline, to minimise root disturbance to the tree. The removal of woody weeds such as Privet should use the cut and paint method of herbicide application. Weeds to be controlled within the **Tree Protection Zone**, for the duration of the project.
- 1.6 The area of the **Tree Protection Zone** to be mulched to a depth of 100 millimetres with organic material being 75% leaf litter and 25% wood, and this being composted material preferably from the same genus and species of tree as that to where the mulch is to be applied, i.e. species specific mulch. The depth of mulch and type as indicated, to be maintained for the duration of the project.
- 1.7 No services either temporary or permanent are to be located within the **Tree Protection Zone**. If services are to be located within the **Tree Protection Zone**, special details will need to be provided by a qualified Consulting Arboriculturist for the protection of the tree regarding the location of the service/s.
- 1.8 A tree will not be fertilised during its protection within the **Tree Protection Zone**, as this may hasten its decline if it were to decline. If a tree is to be fertilised this should be in consultation with a qualified Consulting Arboriculturist.

- 1.9 In the event of prolonged dry periods, or where a tree has been transplanted, or where excavation nearby, especially up slope, leads to drying out of a soil profile, or modification to ground water flow, or flows across an existing ground surface to the tree and its growing environment; deep root watering thoroughly at least twice a week is to be undertaken to irrigate the tree. The need for such watering is determined readily by observing the dryness of the soil surface within the dripline of the tree by scraping back some mulch. Mulch to be reinstated afterwards. In the event of disrupted ground or surface water flows to the tree due to excavation, filling or construction, a reticulated irrigation system may be required to be installed within the **Tree Protection Zone**. If an irrigation system is to be installed, consideration must be given to volume, frequency, and drainage of water delivered, and this should be in consultation with a qualified Consulting Arboriculturist.

Appendix E

1.0 TREE PROTECTION ON CONSTRUCTION SITES

Note: Individual protection measures to be applied where stated as applicable.

1.1.0 General notes

1.2.0 Cautionary notes for the protection of retained trees

1.3.0 Demolition of built structures - precautions to protect trees

1.4.0 Excavation and construction close to Tree Protection Zones

1.1.0 General notes

1.1.1 The application of any measures for the protection of trees on development sites is determined by the species characteristics of the subject tree, and the existing physical constraints of the growing environment on site both above and below ground.

1.1.2 This report considers where applicable, British Standard BS 5837 : 1991 Guide for “Trees in relation to construction.” as no Australian Standard currently exists for the protection of trees on development sites.

1.1.3 This report applies the **Tree Protection Zone - Standard Procedure** as developed and continually improved over time by URBAN TREE MANAGEMENT ® © for the effective protection of trees on development sites (see Appendix C). However, this does not restrict the author from applying additional or alternative conditions where it is deemed appropriate by the author for the protection of trees on development sites. Such additional or alternative conditions may be founded upon professional judgement based on:

- the experience of the Consulting Arboriculturist
- scientific research
- new technology
- industry best practice
- consideration of the individual tree species and its relative tolerance to development impacts
- the individual or cumulative factors present or proposed to impact upon the growing environment essential for the trees' survival

1.1.4 Where this report makes reference to the retention of subject trees it is for their incorporation into the landscaping works for the site, and they are to be documented on a Landscape Plan for the site (*the Landscape Plan*).

1.2.0 Cautionary notes for the protection of retained trees

1.2.1 Location of services

If a utility service is to be located within the area of the dripline of a protected tree or within the Tree Protection Zone, the British Standard BS 5837 : 1991 Guide for "Trees in relation to construction." provides the following: "7.5.8 An alternative solution is to excavate a narrow trench passing directly towards the tree along a radius to not closer than 1m from the trunk, tunnel straight beneath the tree, preferably not less than 750mm deep, and exit on the opposite side along another radius (see figure 3, see Appendix F in this report). Provided the trench is kept as narrow as possible, the amount of root severance will be minimal, and will be far less than if a trench passes close beside the tree. It may be necessary to sleeve a service where it passes beneath a tree in order to reduce the risk of damage to the service and facilitate future servicing and repair." The tunneling could be achieved by the use of horizontal directional drilling to link the two trenches, being a horizontal steerable drilling system. Such a system has capabilities of installing pipeline ranging from 100mm, up to 1100mm diameters for lengths of just over 1000m and has little to no disruption to tree roots. Such tunneling is usually undertaken beneath structural woody roots radiating away from the trunk and not just under the center of the tree.

1.2.1.1

Location of services Option B (Driveway Construction)

If a service is to be located within the area of the dripline of a protected tree or within the Tree Protection Zone, and site conditions such as shallow bed rock or if mass rooting has occurred from multiple trees growing in close proximity to each other, the service trench is to be elevated and positioned above natural ground level within the new driveway structure. The existing driveway surface is to be scabbled and a reinforced concrete topping is to be provided with down turned thickened edges constructed under the kerb edging to prevent lateral movement. A suitable subgrade material to manufacturers' recommendations is to be utilised if and where appropriate. Construction is to occur in a manner so as not to cause damage to the subject trees root system. All works to be in accordance with engineers' details.

1.2.2 Precautions in respect of temporary work

For Precautions in respect of temporary work, British Standard BS 5837 Guide for “Trees in relation to construction.” provides the following:

“8.3.1 if temporary vehicle access is required through the protected area, a reinforced concrete slab should be laid over the existing soil surface, with appropriate protection along the road edge.

8.3.2 If it is essential for scaffolding to be erected within a protected area, fencing in accordance with 8.2.2 or 8.2.3 should be erected to provide just sufficient space for scaffolding. The ground between this fence and the building should be protected by boarding (e.g. scaffold boards) as shown in figure 6. (see Appendix E in this report) A single thickness of boarding laid on the soil surface will provide sufficient protection for pedestrian loads, but more substantial boarding sufficient to spread the load should be used for heavier traffic. The ground beneath the boarding should be left undisturbed and should be protected with a porous geotextile fabric. If necessary, sand should be laid on the fabric to level the ground. When required, the building scaffolding should be erected. The boarding should be left in place until the building works are finished.”

1.3.0 Demolition of built structures - precautions to protect trees

1.3.1 Demolition of existing Buildings

The demolition of the buildings should be undertaken with access restricted to the driveway and the building platform for each of the existing buildings, or to areas of the land where no trees are growing within 6m of any tree to be retained. Where access or space for a safe working environment is restricted, or where the area of the 6m set back must be compromised, a 100mm layer of Eucalyptus wood mulch must be laid over the area of encroachment. Where vehicular access is required across the mulch layer further root protection should be provided by laying a temporary pathway over the mulch. The temporary pathway should be constructed of a grated steel material capable of supporting the vehicles used during demolition e.g. similar to ramps used to load vehicles onto the backs of trucks. Trunks of trees are to be protected from vehicular damage as per section 6.4 of this report.

1.3.2 Demolition of landscape structures

The demolition of walls, driveways retaining walls, paths and pools etc. within 6m of a tree to be retained should be undertaken manually using hand tools. Where a driveway is to be demolished being of concrete strip or slab type construction, it should be undertaken by working from the end of the driveway closest to the building back towards the street by utilising the driveway as a stable platform to prevent soil compaction. Where a concrete slab driveway passes less than 1m from the base of a tree and the area beneath the driveway is to be undisturbed and incorporated into the landscape works for the site, the volume of space previously occupied by the driveway must be replaced with local top soil from the site or otherwise a loamy sand, to replace the mass of the concrete on the root plate which may be critical to the ballast and centre of mass for the stability of the tree. If the tree becomes unstable immediately contact the Consultant Arboriculturist.

1.3.3 Removal of existing trees near trees to be retained

Removal of a tree within 6m of a tree to be retained should be undertaken only by cutting down such a tree without damaging the trees to be retained, and by grinding out its stump. Where possible the structural roots of 20mm diameter or greater of the tree to be cut down should not be removed, to minimise soil disturbance and to reduce the impact on the roots of any tree to be retained nearby. Where structural roots are to be removed this should be undertaken manually by the use of non-motorized hand tools after the stump has been ground out when such roots are often easier to locate from the site of the stump from which they have been severed.

1.4.0 Excavation and construction close to Tree Protection Zones

1.4.1 Excavation close to Tree Protection Zones

1.4.1.1

Where structural woody roots with a diameter of 20mm or greater are to be pruned outside the area of the Tree Protection Zone, they are to be excavated manually first by using hand tools to determine their location. A Waterknife or Airknife can be used as a mechanised alternative to locate such structural woody roots. Once located those roots to be severed are to be cut cleanly with a final cut to undamaged woody tissue and this will prevent tearing damage to the roots from excavation equipment which can extend beyond the point of excavation back towards the tree.

1.4.1.2

Where a large vigorous tree is to be retained near to built structure, and dependent upon its taxa, age class and propensity for its roots system to regenerate, it may be prudent to install a root barrier immediately adjacent to the footing of the new building, or to deepen and strengthen the footings themselves to act as a root barrier, but for such structural advice an appropriately qualified chartered structural engineer should be consulted.

1.4.2 Root location and protection where structures are to be positioned near a retained tree

1.4.2.1

If walls or a driveway or other structures are to be constructed near a protected tree, careful excavation is to be undertaken manually by using non-motorized hand tools to determine the location of first order and lower order structural roots with a diameter of 20mm (*structural woody roots*) or greater, without damaging them. Boundary walls or fences should use columns or posts with in fill panels, or a wall to be constructed with suspended sections 100mm clear above or beside any structural woody root or further as required, or any new wall to be built only to the depth of that existing. Structural woody roots to be further protected by utilising the construction techniques of pier or bridge footings, or screw piles between or over them with a minimum clearance above or beside of 100mm, or further as required to allow for future and ongoing growth.

1.4.2.2

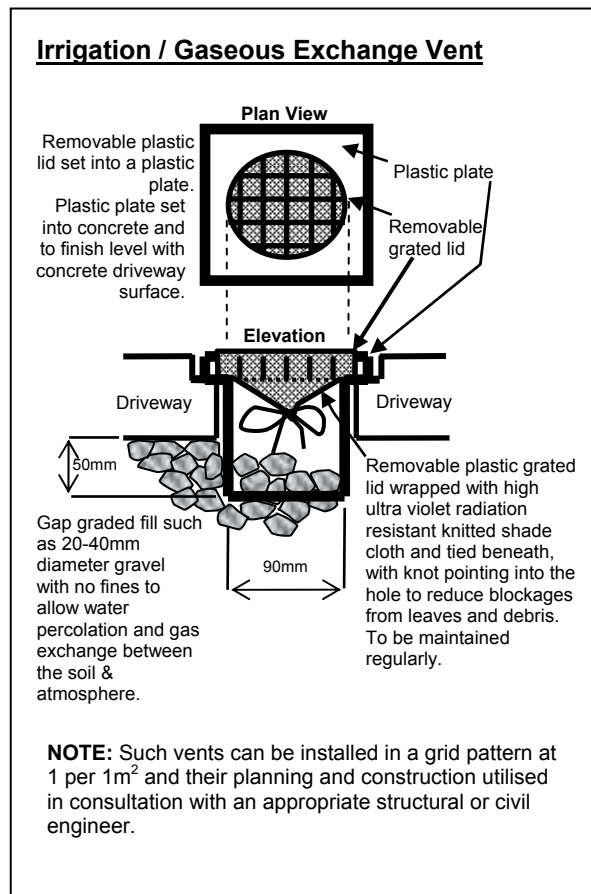
Where a driveway or footpath is to pass by the tree a suspended slab is to be constructed or approved similar, to protect the roots that may be encountered at, near, or above ground, and may be constructed on gap graded fill. Where such a driveway or footpath is to be constructed the edge of the structure closest to the tree is to terminate no closer than 0.5m from the outside edge of the trunk, or further depending on the species and its likely further growth to allow for future development and expansion of the trunk, buttresses, and first order and lower order roots as may be advised by a Consultant Arboriculturist.

1.4.2.3

Alternatively a footpath or driveway may be constructed at ground level without any excavation, removing turf by raking, having sprayed with herbicide first if time permits. Here the path or driveway section is to extend for a distance past the tree equivalent to the lateral spread of the crown of that tree alongside the footpath, or driveway.

1.4.2.4

Watering / Gaseous exchange vents are to be installed in the area of the driveway that passes within the dripline of the tree or the prescribed **Tree Protection Zone** area and the number and location are to be determined by a Consultant Arboriculturist and the driveway design approved by a Certified Engineer. Exposed edges of the path are to be concealed with the finished level beside the path equivalent to the top of the path by minimal filling with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation, or other landscape treatments as appropriate. On the side of a driveway closest to a tree, a drive way is to be edged with a concrete kerb of minimum dimensions of 150 x 150mm and the driveway edge to terminate 500mm from the trunk of the tree, or approved similar, to prevent vehicular collision with the trunk. Here a *Waterknife* or an *Airknife* can be used as a mechanised alternative to locate first order and lower order structural woody roots.



1.4.3 Root protection where a driveway close to a tree is to be demolished and a new driveway constructed in a similar location to a previous driveway.

After demolition of an existing driveway as per 5.3.2, the level of the base for the new driveway should be located at the same existing level as that of the base of the previous driveway, and should extend for a distance past the tree equivalent to the lateral spread of the crown of that tree alongside the driveway. To prevent excavation from damaging the existing roots which may be located at, near or above the surface of the soil beneath the base of the previous driveway, the new driveway may need to be raised by constructing it on pier or bridge footings between or over them (see 5.4.2 for minimum clearances), or based on a gap graded fill and the driveway constructed with any exposed edges concealed to the top of the driveway by minimal filling with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation, or other landscape treatments as appropriate. Where roots have grown to occupy the soil between the concrete strips of a concrete, stone or brick strip driveway, they and the soil may be excavated to the level of the base of the concrete strips, but where such roots have a diameter of 20mm or greater, a Consulting Arboriculturist should be contacted prior to such works being undertaken. Where roots are to be severed, they are to be cut cleanly with a final cut to undamaged woody tissue.

1.4.4 Root protection where a footpath is to be constructed close to a tree.

1.4.4.1

A footpath may be constructed at ground level without any excavation, by first killing with herbicide the plants to be removed from the pathway area, and then removing that plant material by cutting the trunks of woody shrubs to ground level and by raking all other plant material to expose the top soil surface without organic matter. This will remove the need for physically disturbing the soil and the roots of the tree. The path section is to extend for a distance past each tree equivalent to the lateral spread of the crown of that tree where it extends alongside the footpath.

1.4.4.2

To prevent excavation from damaging the existing roots which may be located at, near, or above the surface of the soil, a gap graded fill as a fill material of a media as appropriate, to a depth of 100mm above the soil surface, or above the top of the root of any tree to be retained, or above the soil surface may be utilised as a base treatment to construct the foot path. Any exposed edges to be concealed to the top of the edges of the footpath and tapering back to the base of the trunk of each tree by minimal filling at each trunk of no greater than 100mm with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation with ground covers, or other landscape treatments as appropriate. A Consultant Arboriculturist should be contacted prior to such works being undertaken or if any structural roots are considered appropriate to be severed being those roots of 20mm diameter or greater.

1.4.5 ***Structural Soil to accommodate load bearing conditions***

A structural soil should only be considered as a new media into which the trees could be planted if the planting was into a new area where the area surrounding was to be load bearing such as a footpath, driveway or road.

1.4.6 ***Gap graded fill to accommodate compacted sub grade and root growth***

To further protect woody roots with a diameter of 20mm or greater, a gap graded fill with no fines such as gravel 40mm diameter should only be considered as a fill media above existing grade when soil levels are to be increased near existing trees and the roots can utilise the new media to develop ongoing and future root growth and provide for gaseous exchange between the soil and the atmosphere.

Appendix F

Glossary

Vigour

Vigour Ability of a tree to sustain its life processes. This is independent of the condition of a tree but may impact upon it. Vigour can appear to alter rapidly with change of seasons (seasonality) e.g. dormancy of deciduous or semi-deciduous trees.

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

Low Vigour Reduced ability of a tree to sustain its life processes. This may be evident as a decline in the growth of leaves, branches, roots and trunk, and a deterioration of their functions. This is independent of the condition of a tree but may impact upon it.

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

Abnormal Vigour Accelerated growth of a tree due to incidental or deliberate artificial changes to its growing environment that are seemingly beneficial, but may result in *premature aging* or failure if the favourable conditions cease, or promote *prolonged senescence* if the favourable conditions remain, e.g.

- water from a leaking pipe;
- water and nutrients from a leaking or disrupted sewer pipe;
- nutrients from animal waste;
- a tree growing next to a chicken coop, or a stock feed lot, or a regularly used stockyard;
- a tree subject to a stringent watering and fertilising program.

Age

Age Most trees have a stable biomass for the major proportion of their life. The estimation of the age of a tree is based on the knowledge of the expected lifespan of the taxa in situ divided into three distinct stages of measurable biomass, when the exact age of the tree from its date of cultivation or planting is unknown. These increments are Young, Mature and Over-mature.

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

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

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

Periods of Time

Periods of Time The life span of a tree in the urban environment may often be reduced by the influences of encroachment and the dynamics of the environment and as a result the values of Short Term, Medium Term and Long Term have been applied.

Short Term Period of time less than 1 – 15 years.

Medium Term Period of time 15 – 40 years.

Long Term Period of time greater than 40 years.

Trunk

Trunk A single stem extending from the *root crown* to support or elevate the *foliage crown*, terminating where it divides into separate *stems* forming *first order branches*. A trunk may be evident at or near ground or be absent in trees of *deliquescent* habit, or may be continuous in trees of *excurrent* habit.

Acaulescent Tree grows forming a very short trunk, or tree is trunkless.

Caulescent Tree grows forming a trunk.

Condition

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

Fair Tree is of good habit or misshapen, a form not severely restricted for space and light, has some physical indication of decline due to the early effects of predation by pests and diseases, fungal, bacterial, or insect infestation, or has suffered physical injury to itself that may be contributing to instability or structural weaknesses, or is faltering due to the modification of the environment essential for its basic survival. Such a tree may recover with remedial works where appropriate, or without intervention may stabilise or improve over time, or in response to the implementation of beneficial changes to its local environment. This may be independent from, or contributed to by vigour.

Poor Tree is of good habit or misshapen, a form that may be severely restricted for space and light, exhibits symptoms of advanced and irreversible decline such as fungal, or bacterial infestation, major die-back in the branch and foliage crown, structural deterioration from insect damage e.g. termite infestation, or storm damage or lightning strike, ring barking from borer activity in the trunk, root damage or instability of the tree, or damage from physical wounding impacts or abrasion, or from altered local environmental conditions and has been unable to adapt to such changes and may decline further to death regardless of remedial works or other modifications to the local environment that would normally be sufficient to provide for its basic survival if in good to fair condition. Deterioration physically, often characterised by a gradual and continuous reduction in vigour but may be independent of a change in vigour, but characterised by a proportionate increase in susceptibility to, and predation by pests and diseases against which the tree cannot sustain it. Such conditions may also be evident in trees of advanced senescence due to normal phenological processes, without modifications to the growing environment or physical damage having been inflicted upon the tree. This may be independent from, or contributed to by vigour.

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

Processes

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

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

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

Epicormic shoots (the production of new shoots as a response to stress, generated from latent or adventitious buds or from a lignotuber - an at ground or underground stem);

Symptoms

Permanent leaf loss;

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

Shedding of the epidermis (bark desiccates and peels off to the beginning of the sapwood).

Leaning Trees

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

Slight Lean A tree growing at a lean within 0-15° from upright.

Moderate Lean A tree growing at a lean within 15-30° from upright.

Severe Lean A tree growing at a lean within 30-45° from upright.

Critical Lean A tree growing at a lean of greater than 45° from upright.

Progressive Lean A tree where the degree of leaning appears to be increasing over time.

Static Lean A tree where the degree of leaning appears to have stabilized over time.

Self-correcting *Atypical* stem growth subsequently influenced and modified by tropisms, e.g. *gravitropism* and *phototropism*, where *reaction wood* attempts to return it to a more *typical* habit or *form*, e.g. a trunk with a *butt sweep* where it is returning to upright.

Form of Trees

Crown Form The shape of the crown of a tree as influenced by the availability or restriction of space and light, or other contributing factors within its growing environment. Crown Form may be determined for tree shape and habit generally as *Dominant*, *Codominant*, *Intermediate*, *Emergent*, *Forest* and *Suppressed*. The habit and shape of a crown may also be considered qualitatively as *Good Form* or *Poor Form*.

Good Form Tree of typical crown shape and habit with proportion representative of the taxa considering constraints such as origin e.g. indigenous or exotic, but does not appear to have been adversely influenced in its development by environmental factors in situ such as soil water availability, prevailing wind, or cultural practices such as lopping and competition for space and light.

Poor Form Tree of *atypical* crown shape and habit with proportions not representative of the species considering constraints and appears to have been adversely influenced in its development by environmental factors in situ such as soil water availability, prevailing wind, cultural practices such as lopping and competition for space and light; causing it to be misshapen or disfigured by disease or vandalism.

Crown Form Codominant Crowns of trees restricted for space and light on one or more sides and receiving light primarily from above e.g. constrained by another tree/s or a building.

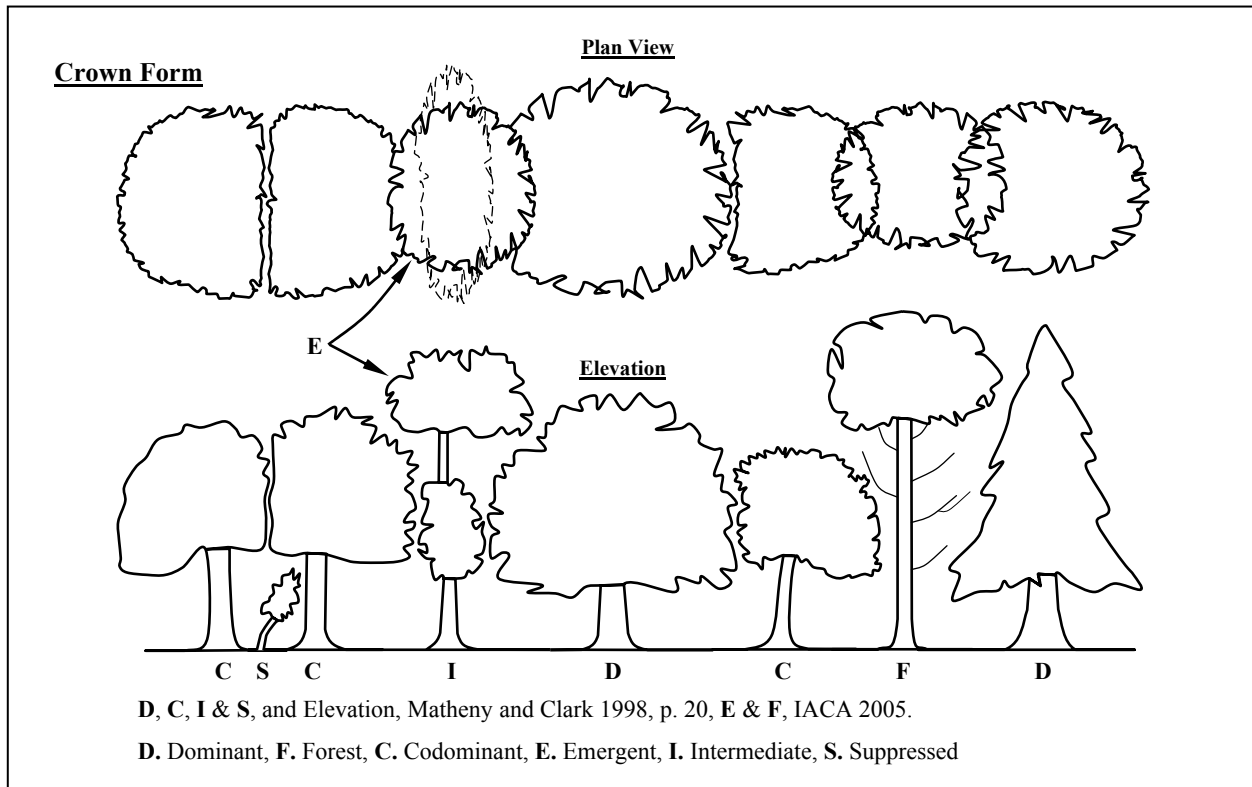
Crown Form Dominant Crowns of trees generally not restricted for space and light receiving light from above and all sides. See also *Crown Form Emergent* and *Open Grown*.

Crown Form Emergent Crowns of trees restricted for space on most sides receiving most light from above until the *upper crown* grows to protrude above the canopy in a stand or forest environment. Such trees may be *crown form dominant* or transitional from *crown form intermediate* to *crown form forest* asserting both *apical dominance* and *axillary dominance* once free of constraints for space and light.

Crown Form Forest Crowns of trees restricted for space and light except from above forming tall trees with narrow spreading crowns with foliage restricted generally to the top of the tree. The trunk is usually erect, straight and continuous, tapering gradually, crown often excurrent, with first order branches becoming structural, supporting the live crown concentrated towards the top of the tree, and below this point other first order branches arising radially with each *inferior* and usually temporary, divergent and ranging from horizontal to ascending, often with internodes exaggerated due to competition for space and light in the *lower crown*. See also *Forest Grown*.

Crown Form Intermediate Crowns of trees restricted for space on most sides with light primarily from above and on some sides only. See also *Crown Form Emergent*.

Crown Form Suppressed Crowns of trees generally not restricted for space but restricted for light by being *overtopped* by other trees and occupying an understorey position in the canopy and growing slowly.



Symmetry Within The Crown

Symmetry Balance within a *crown*, of trunk, branch and foliage distribution.

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

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

Crown Spread Orientation Direction of the axis of crown spread divided into *Orientation Radial* and *Orientation Non-radial*.

Orientation Radial Where the crown spread is generally an even distance in all directions from the trunk and often where a tree has *Crown Form Dominant* and is *symmetrical*.

Orientation (non-radial) Where the crown extent is longer than it is wide, e.g. east/west or E/W.

Significant Important, weighty or more than ordinary.

Significant Tree A tree considered important, weighty or more than ordinary. Example: due to exposure of location, or in situ, or contribution as a component of the overall landscape for amenity or aesthetic qualities, or curtilage to structures, or importance due to uniqueness of taxa for species, subspecies, variety, form, or as an historical or cultural planting, or for age, or substantial dimensions, or habit, or as remnant vegetation, or habitat potential, or a rare or threatened species, or uncommon in cultivation, or of aboriginal cultural importance, or is a commemorative planting. *Note: Where a tree is considered significant this must be expressed clearly and attributed to any of the above criteria and balanced against diminishing factors such as nuisance, as any tree will be of some significance but not every tree can be significant.*

Sustainable Retention Index Value (SRIV) A visual method of rating the viability of urban trees for development sites and management, based on general tree and landscape assessment criteria using classes of *age*, *condition* and *vigour*. SRIV© is for the professional manager of urban trees to consider the tree in situ with an assumed knowledge of the taxa and its growing environment and is based on the physical attributes of the tree and its response to its environment considering its position in a matrix for age class, vigour class, condition class and its sustainable retention with regard to the safety of people or damage to property and the ability to retain the tree with remedial work or beneficial modifications to its growing environment or removal and replacement. SRIV is supplementary to the decision made by a tree management professional as to whether a tree is retained or removed (IACA 2005).

Diameter at Breast Height (DBH) Measurement of trunk width calculated at a given distance above ground from the base of the tree often measured at 1.4m. The trunk of a tree is usually not a circle when viewed in section, due to the presence of *reaction wood* or adaptive growth, therefore an average diameter is determined with a *diameter tape* or by recording the trunk along its narrowest and widest axes, adding the two dimensions together and dividing them by 2 to record an average and allowing the orientation of the longest axis of the trunk to also be recorded. Where a tree is growing on a lean the distance along the top of the trunk is measured to 1.4m and the diameter then recorded from that point perpendicular to the edge of the trunk. Where a leaning trunk is crooked a vertical distance of 1.4m is measured from the ground. Where a tree branches from a trunk that is less than 1.4m above ground, the trunk diameter is recorded perpendicular to the length of the *trunk* from the point immediately below the base of the flange of the *branch collar* extending the furthest down the trunk, and the distance of this point above ground recorded as *trunk length*. Where a tree is located on sloping ground the DBH should be measured at half way along the side of the tree to average out the angle of slope. Where a tree is *acaulescent* or *trunkless* branching at or near ground such as a mallee or sprout mass as regrowth, an average diameter is determined by recording the radial extent of the trunk at or near ground.

Deadwood

Deadwooding Pruning to remove a dead branch. Such pruning may assist in the prevention of the spread of decay from dieback or for reasons of safety near an identifiable target.

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

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

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

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

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

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

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

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

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

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

Dieback The death of some areas of the *crown* and considered as *Low Volume Dieback*, *Moderate Volume Dieback* and *High Volume Dieback*. Symptoms are leaf drop, bare twigs, dead branches and tree death, in order of progression from the *distal* end. This can be caused by root damage, root disease, severe bark damage, intensive grazing by insects, abrupt changes in growth conditions, drought, water-logging or over-maturity. Dieback often implies reduced *resistance*, stress or decline.

Low Volume Dieback Where ≤10% of the *crown cover* has died.

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

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

Pseudo-street Tree A tree not growing in the *road reserve* but in adjoining private or public land and grows so that its crown develops and extends to substantially contribute to the streetscape as a false street tree (Draper 1997, p. 6-10).

Crown Projection (CP) Area within the *dripline* or beneath the lateral extent of a tree (Geiger 2004, p. 2).

Dripline A line formed around the edge of a tree by the lateral extent of the *crown*. Such a line may be evident on the ground with some trees when exposed soil is displaced by rain shed from the crown.

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

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

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

Root Crown Roots arising at the base of a trunk.

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

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

Such roots may be crossed and grafted and are usually contained within the area of *crown projection* or extend just beyond the *dripline*.

Deadwood

Deadwooding Pruning to remove a dead branch. Such pruning may assist in the prevention of the spread of decay from dieback or for reasons of safety near an identifiable target.

Deadwood Branches that have died categorised as *Small Deadwood* and *Large Deadwood* according to diameter, length and subsequent *risk* potential, the volume of dead branches on a tree may be *Low Volume Deadwood*, *Moderate Volume Deadwood* and *High Volume Deadwood*.

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

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

Low Volume Deadwood Where <5 dead branches occur that should be removed.

Moderate Volume Deadwood Where 5-10 dead branches occur that should be removed.

High Volume Deadwood Where >10 dead branches occur that should be re

Appendix G – Trees 1 - 109

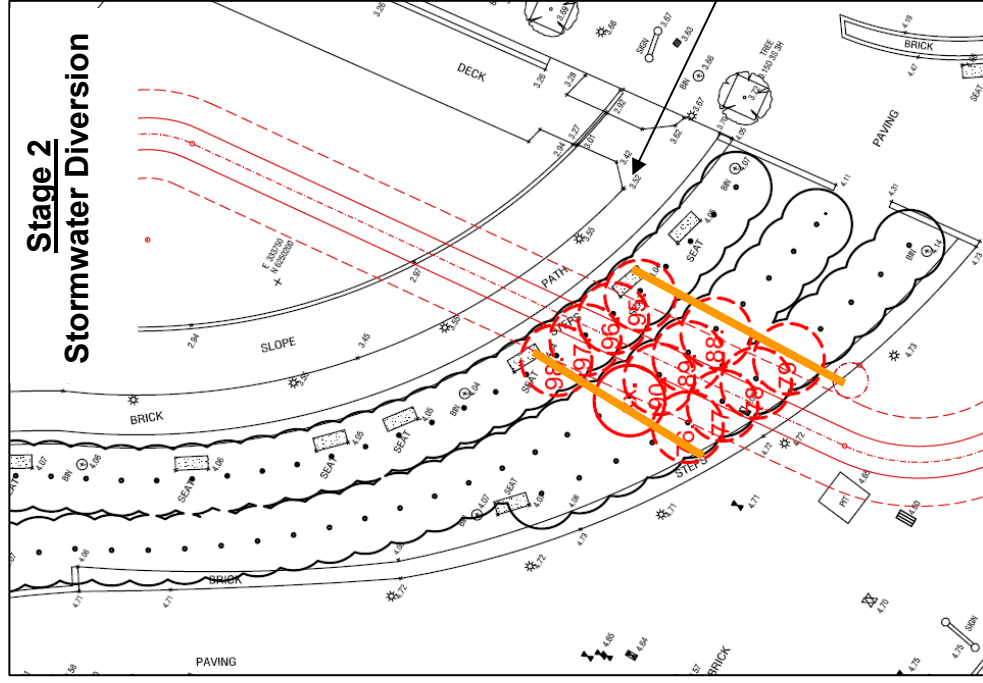
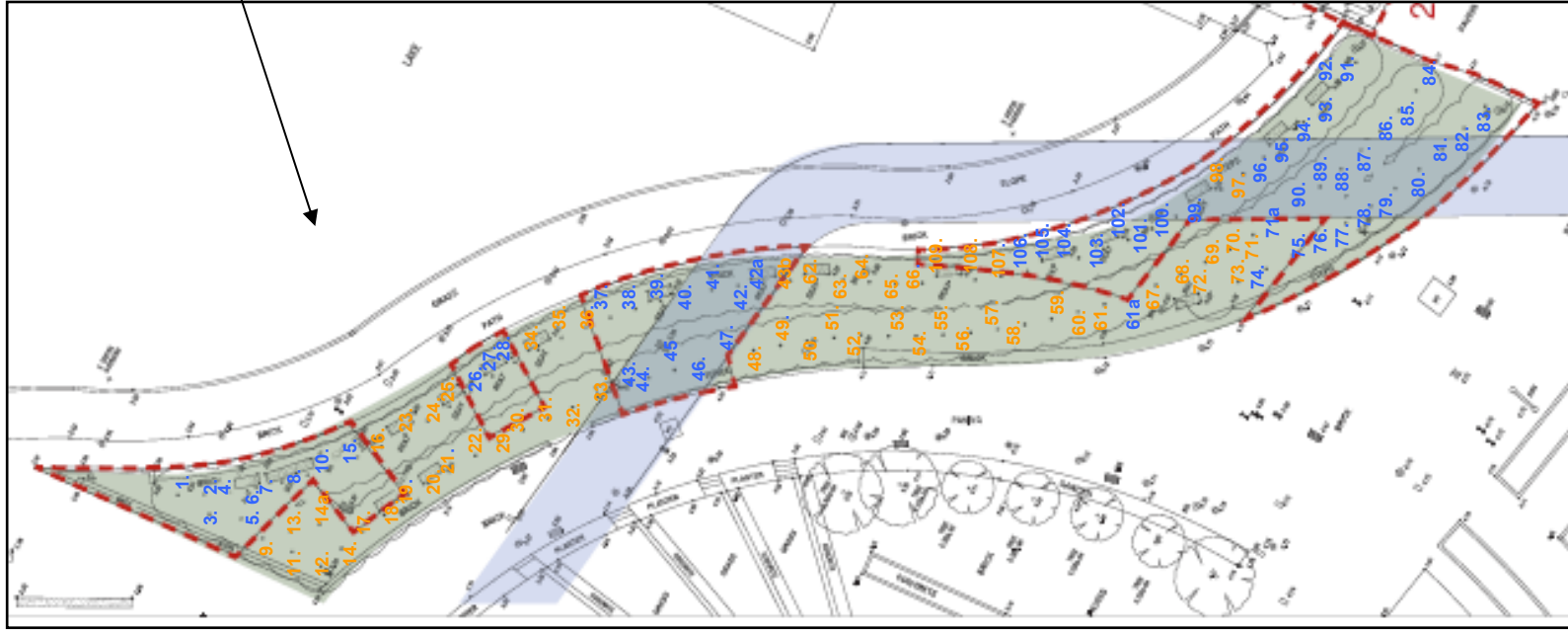
Survey of Subject Trees and Tree Protection Zones

From Plans as provided by Bovis Lend Lease & Aspect Landscapes. Plans reproduced and no longer to original scale.



Legend

- Tree Protection Zone (TPZ), fencing/enclosures as indicated, or other protection measures or works as indicated.
- Approximate line of excavation for stormwater diversion.
- Trees numbered in orange are proposed for retention.
- Trees numbered in blue are recommended for removal.



Trees 1 - 109

Stage 1 - Demolition

All trees to be retained & protected within a TPZ during demolition; fencing to follow edge of planting area as shown by green shaded area.

Stage 2 - Stormwater Diversion Works

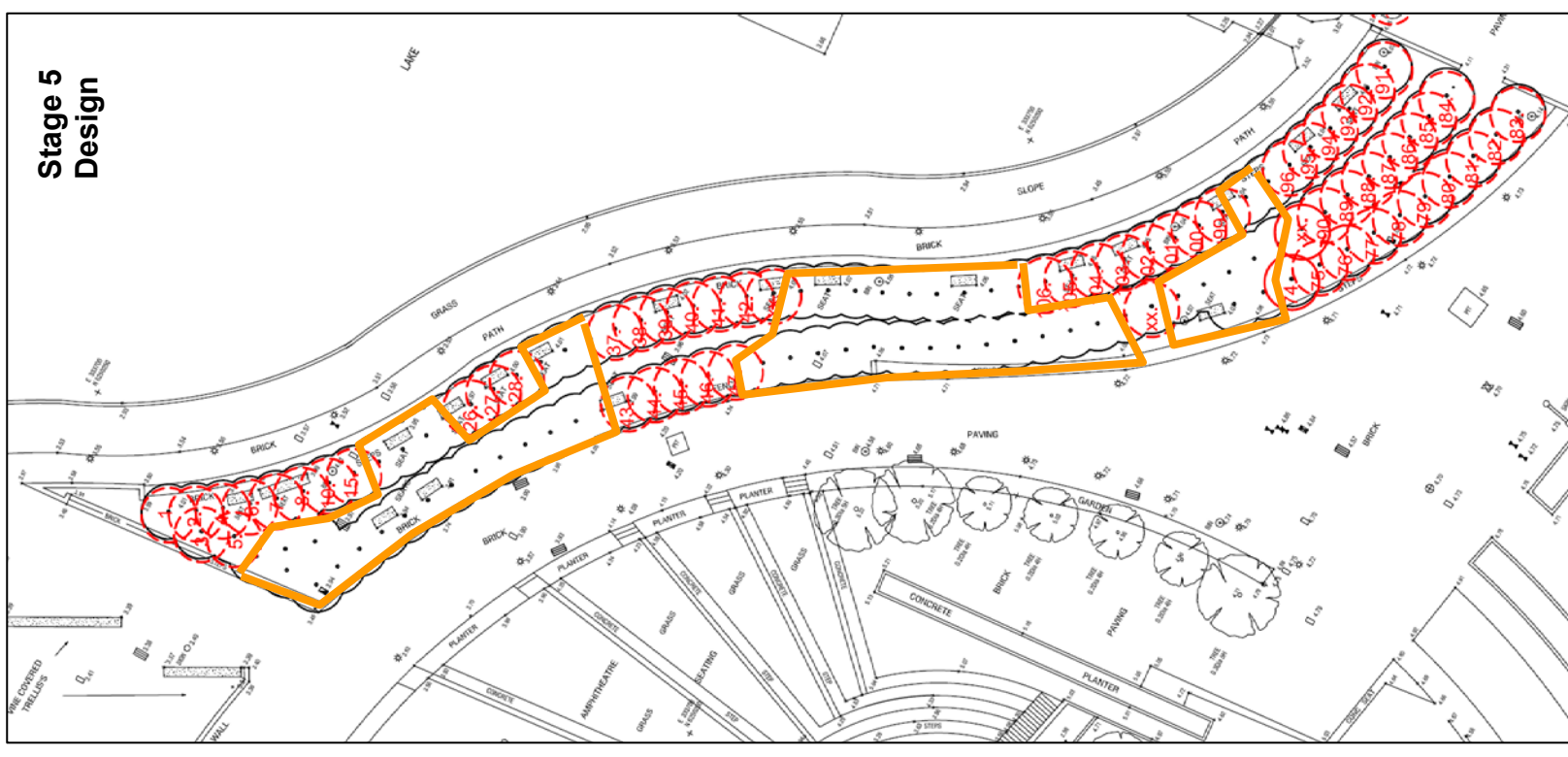
TPZ fencing to be re-located and established only around trees to be retained during the stormwater diversion works at set backs as prescribed in Table 3 or edge of existing garden area.

Stages 3 & 4 – Remediation and Post Remediation Works

TPZ 's are to be maintained in situ as prescribed by Stage 2 for the duration of works.

Stage 5 – Design

TPZ fencing to be re-located and established only around trees to be retained during the designs works at set backs as prescribed in Table 3 or edge of existing garden area.



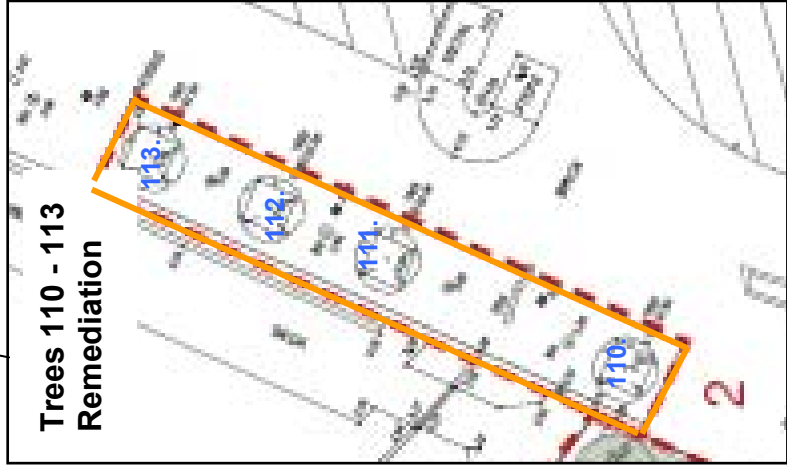
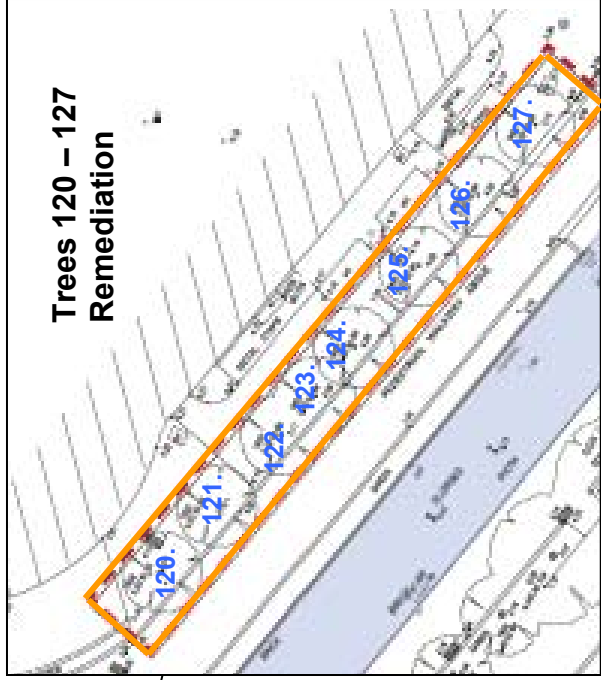
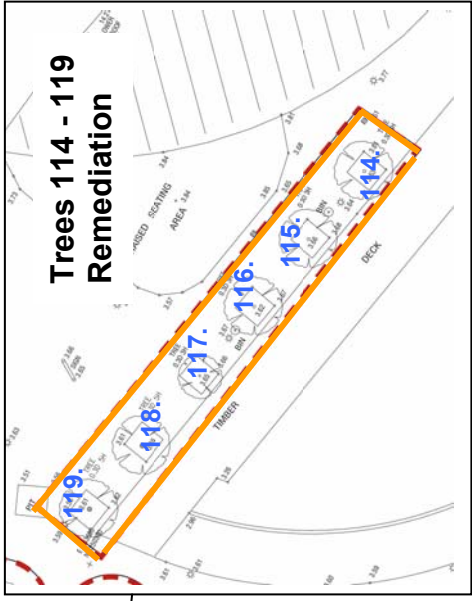
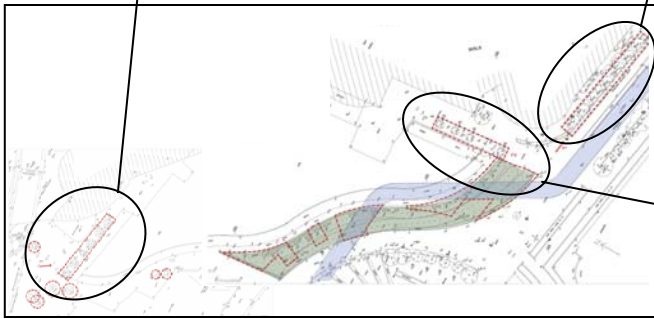
Appendix G – Trees 110 - 138

Survey of Subject Trees and Tree Protection Zones

From Plans as provided by Bovis Lend Lease & Aspect Landscapes. Plans reproduced and no longer to original scale.



- Legend**
- Tree Protection Zone (TPZ), fencing/enclosures as indicated, or other protection measures or works as indicated.
 - 10. Trees numbered in orange are proposed for retention.
 - 11. Trees numbered in blue are recommended for removal.



Trees 110 - 113 Remediation

Trees 110 - 127

Stage 1 - Demolition Works

All trees to be retained protected within a TPZ during demolition; fencing to follow edge of planting areas as shown.

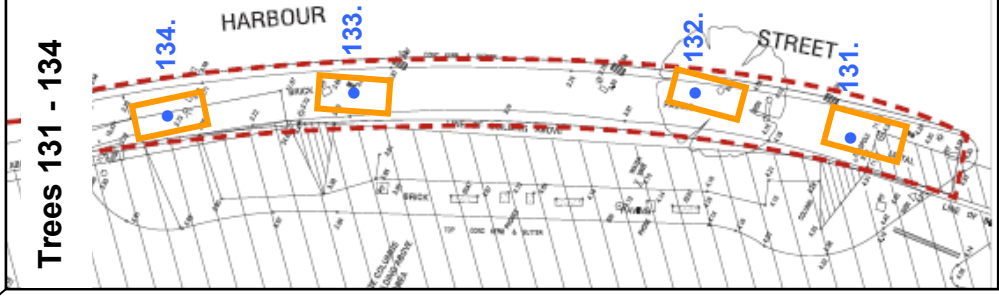
Stage 2 - Stormwater Diversion Works

TPZ fencing to remain in situ.

Stage 3 – Remediation Works

Trees 110 - 127 proposed for removal.

Trees 135 - 138



Trees 131 - 134

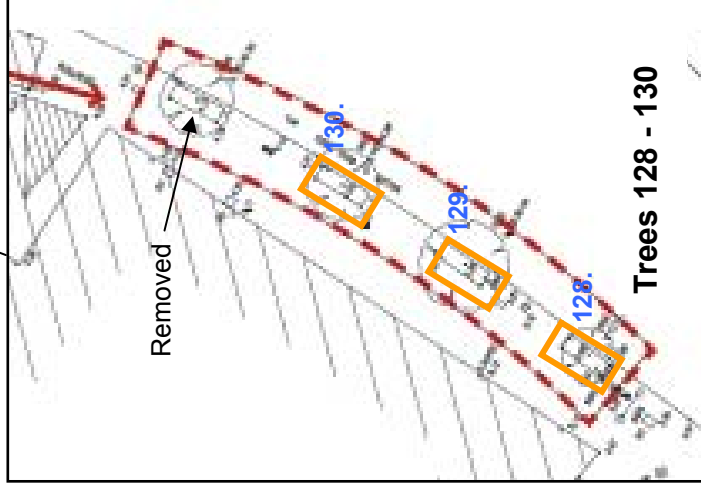
Trees 128 - 138

Stage 1 & 2 - Demolition and Stormwater Diversion Works

All trees to be retained protected within a TPZ during demolition and stormwater diversion. TPZ for street trees (Trees 128-134) to be further reduced (2m x 1m) for pedestrian access along footpath.

Stage 3 - Remediation Works

Trees 128 - 138 to be removed at remediation works. TPZ fencing to remain in situ for Trees 128 - 134.



Trees 128 - 130

Appendix G – Trees 139-146 & 151- 163

Survey of Subject Trees and Tree Protection Zones

From Plans as provided by Bovis Lend Lease & Aspect Landscapes. Plans reproduced and no longer to original scale.



Legend

- Tree Protection Zone (TPZ), fencing/enclosures as indicated, or other protection measures or works as indicated.
- Approximate line of excavation for stormwater diversion.
- 10. Trees numbered in orange are proposed for retention.
- 11. Trees numbered in blue are recommended for removal.

Trees 139 - 146

Stage 1 - Demolition Works

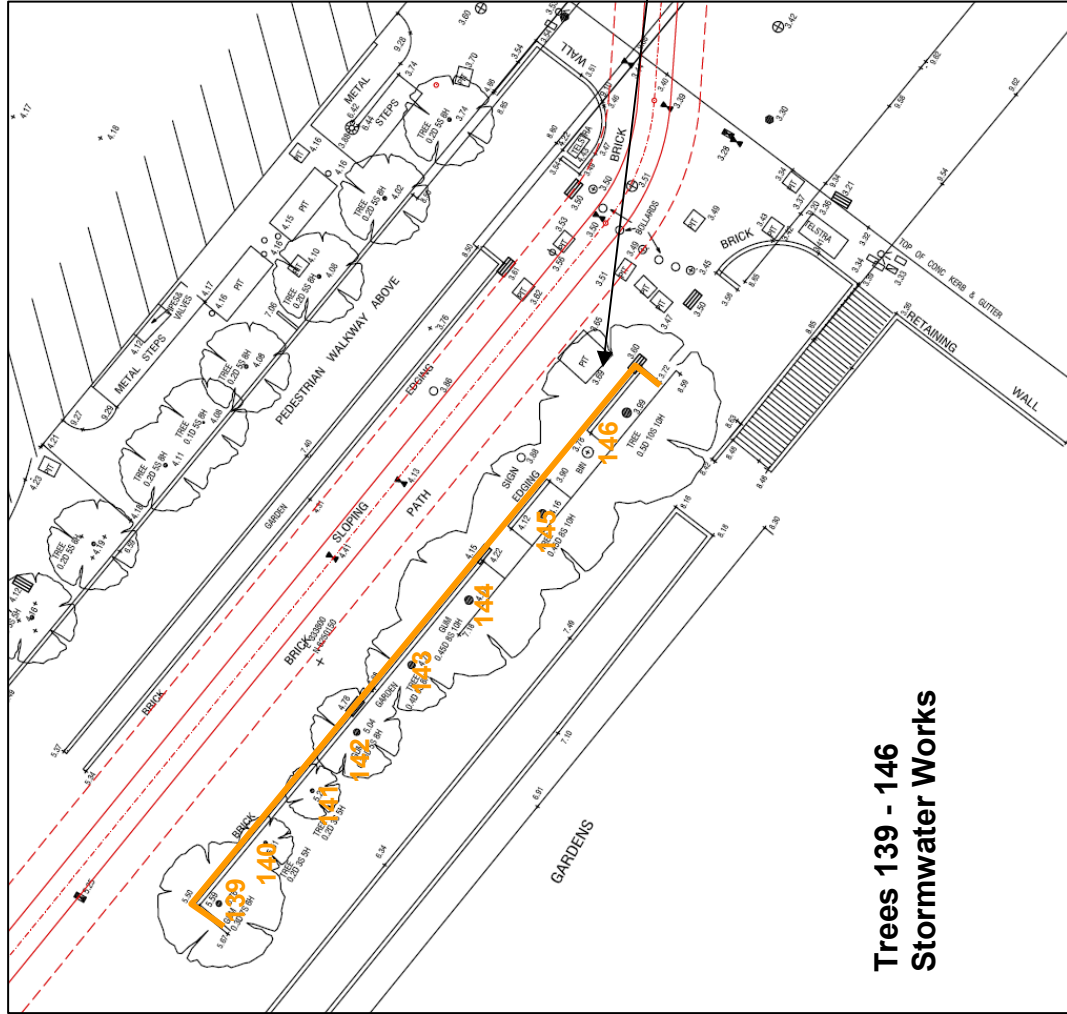
All trees to be retained. Trees 139 and 146 should be protected within a TPZ during demolition; fencing to be located garden edge to allow for access to site.

Stage 2 - Stormwater Diversion Works

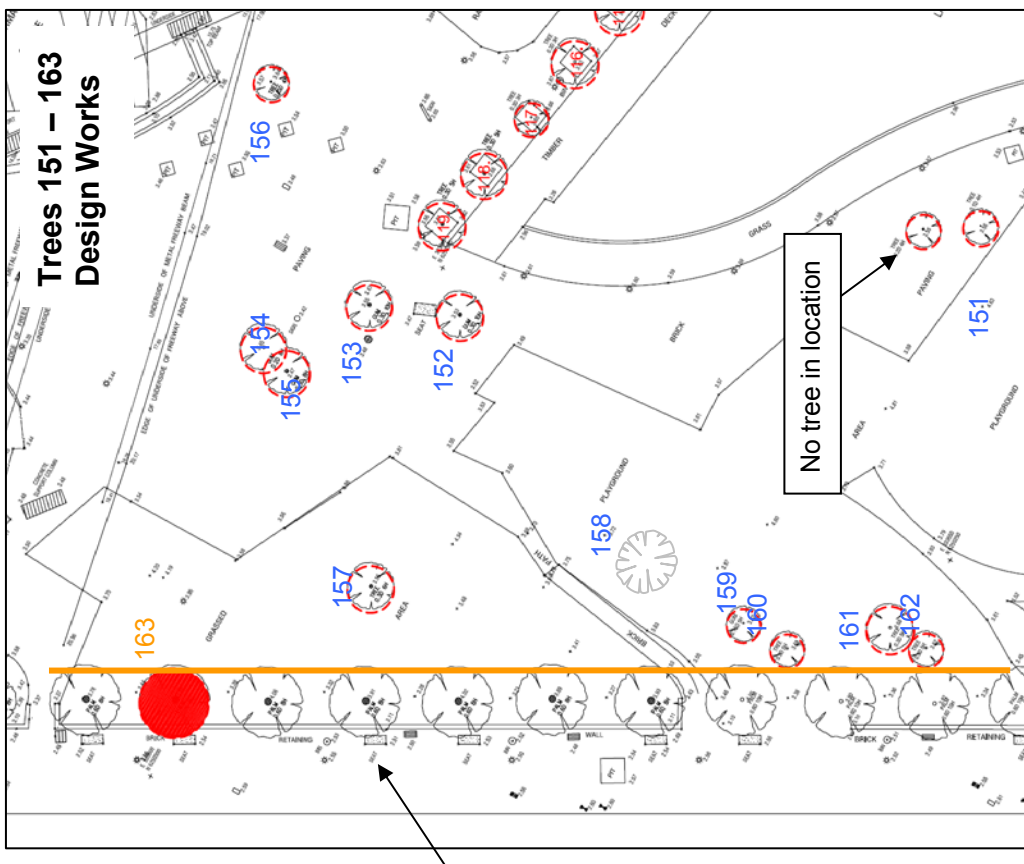
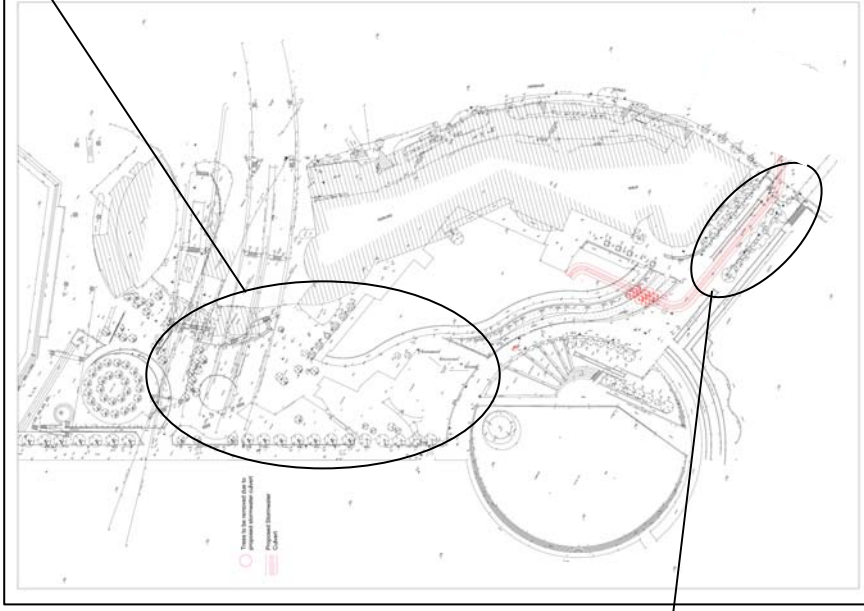
TPZ fencing to remain in situ around Trees 139 – 146; a TPZ of 5m should be provided. To prevent compaction, paving within this area is to be retained in situ. Tree 143 should be selectively pruned to remove the lowest first order structural branch to north.

Stage 3 and 4 – Remediation & Design Works

TPZ fencing should remain in situ around Trees 139 – 146 until completion.



Trees 139 - 146
Stormwater Works



Trees 151 - 163

Stages 1, 2 & 3 – Demolition, Stormwater Diversion and Remediation

All trees to be retained in situ and protected within a TPZ during each stage.

Stage 4 – Design Works

Trees 151 – 162 to be removed. Tree 163 to be transplanted elsewhere on site prior to the construction of design works. A TPZ fence of 2m square should be established around Tree 163. The remaining Date Palms (not assessed) should also be protected within a TPZ with a set back of 4m during the design works.