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Prepared for: Taronga Conservation Society Australia

Arboricultural Impact Assessment

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1 SUMMARY

This report has been commissioned by Taronga Conservation Society Australia, to discuss the health and structural condition of 49 trees located within, and adjacent to, the site.

It is to provide recommendations for their long-term viability within the site in regards to health and structure, particularly in relation to the proposed development of the site.

- The trees were assessed from the ground only on Wednesday October 21st, 2015.
- Trees 5, 9 & 14 are recommended for removal on the grounds that they are hazardous.
- Under current plans, Trees 5-9, 14-18 and 21-48 will require removal for the purposes of construction of the proposed Taronga Institute of Science and Learning.
- In some circumstances trees identified for retention will require further investigation, through non-destructive excavation, to quantify the extent to which their root systems will be compromised by the proposed development.
- Trees 1-4, 19 & 20 are eligible for retention without further investigation.
- Trees in unaffected area of the site named “animal encounters area” are to be retained.
- Replacement plantings should be made up of plant species that are known to be associated with Sydney Red Gum (*Angophora costata*).

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2 INTRODUCTION & AIM

This report has been commissioned by Taronga Conservation Society Australia. The report is to assess the health and structural condition of 49 trees located within, and adjacent to, the area proposed for development. It will discuss tree retention values, and provide recommendations for their long-term viability within the site in regards to health and structure, particularly in relation to the proposed development of the site.

3 METHOD

Assessments of the trees were made using elements of the 'Visual Tree Assessment' (VTA – see Section 3.1) procedure, as well as the 'Safe Useful Life Expectancy' (SULE – see Section 3.2) method. The trees were measured and had Tree Protection Zones and Structural Root Zones calculated (TPZ & SRZ – see Section 3.3). Tree Retention Values were determined using the 'Significance of a Tree, Assessment Rating System (STARS – see Section 3.4). The trees were assessed from the ground only on Wednesday October 21st, 2015. This report will discuss the current structural condition and health of the trees, and will provide recommendations regarding their viability relative to proposed works.

- No internal diagnostic testing has been completed.
- No sub surface root testing or soil testing has been completed.
- All observations were made from the ground only.
- Tree heights have been estimated and stem diameters have been measured with a diameter tape.

3.1 VISUAL TREE ASSESSMENT (VTA)

The VTA system is based on the theory of tree biology and physiology, as well as tree architecture and structure. This method is used by arborists to identify visible signs on trees that indicate good health, or potential problems. Symptoms of decay, growth patterns and defects are identified and assessed as to their potential to cause whole tree, part tree or branch failure. This system is based around methods discussed in *'The Body Language of Trees'*¹. For the purpose of this report, parts of the VTA system will be used along with other industry standard literature and other relevant studies that provide an insight into potential hazards in trees. This assessment is a snapshot of what could be reasonably seen or determined from a basic visual inspection. The VTA system is generally used as a means to identify hazardous trees; however it is important to realize that for a tree to be hazardous there must be a target.

3.1.1 HEALTH AND VIGOUR ASSESSMENT

The health and vigour of a tree is assessed by looking at the tree canopy and how it is performing. Certain indicators provide information on which to base the assessment. Abnormally small leaves, chlorosis (yellowing), sparse crown, wilting, die-back etc. can be signs of ill-health or decline but may also be related to a temporary imbalance due to drought or pest infestations. Epicormic growth can be a sign of stress and low energy reserves but can also be related to increased light levels through the removal or pruning of adjacent trees. For these reasons, each individual symptom or observation needs to be assessed with objectivity and consideration of all available information. Extension growth can be a good indicator of vigour but this can vary greatly between species and under differing climatic conditions.

3.1.2 STRUCTURAL ASSESSMENT

The structural assessment of trees is carried out using the basic framework of visual tree assessment along with other signs and symptoms of defect which can be assessed to gauge the likelihood of failure because every defect does not constitute a hazard. *"By definition co-dominant stems are a structural defect. The severity of the defect is increased by included bark, large crowns and strong wind."*² If trees were removed purely on the basis that there were defects present without assessing the likelihood of failure or whether practical mitigation measures exist, the urban forest would cease to exist. For a tree to be hazardous there must be a target, a hazard poses no risk if there is no exposure to the hazard. A basic visual tree assessment is carried out from ground level, if defects are suspected further investigation may be required and recommended. *"[When using] the Visual Tree Assessment (VTA) procedure for assessing trees, as the suspicion increases that defects are present, the examination becomes more thorough and searching."*¹

*"Some defects, especially some forms of decay, do not give rise to external signs and therefore tend to escape detection in a purely visual survey. If there is no reason for suspecting a hidden defect to occur within a particular part of the tree, there is no reasonable basis for carrying out a detailed internal assessment. Although in theory an unsuspected defect might be detectable by the use of specialized diagnostic devices, this would be impracticable in the absence of some external sign to indicate the place which should be probed. Also, internal examination without good reason is undesirable, as it usually causes injury to the tree and is unreasonably time consuming and costly."*³

¹ Mattheck, C. & Broeler, H. 1994. *The Body Language of Trees*.

² Matheny, N. & Clark, J. 1994. *A Photographic Guide to the Evaluation of Hazard Trees in Urban Areas*.

³ Lonsdale. 1999. *Principles of Tree Hazard Assessment and Management*.

3.2 SAFE USEFUL LIFE EXPECTANCY (SULE)

The remaining Safe Useful Life Expectancy (SULE) of a tree is an estimation of the sustainability of the tree in the landscape. This calculation is based on an estimate of the average lifespan of a particular species, less its estimated current age. The life expectancy of the tree is then further modified (where necessary) in consideration of its natural range of occurrence, climatic preferences, rainfall, micro-climate, soil types, current health and vigour, condition and suitability to the site. This system is the accepted industry standard and was developed by Jeremy Barrell, a highly respected British arborist. It is important to understand that a SULE rating is based upon the trees at the time of inspection and from what could be seen or established at the time of inspection through a reasonable level of examination. Also it should be noted that trees can fail at any time without warning and there is always an inherent risk associated with trees. Table 1 shows the categories of SULE and the associated descriptions are how trees are allocated a rating.

Table 1 - SULE categories⁴.

Category:	Description:
1. Long SULE – Trees that appeared retainable (at the time of assessment) for over 40 years with an acceptable degree of risk, assuming reasonable maintenance.	a. Structurally sound trees located in positions that can accommodate future growth. b. Trees, which could be made suitable for long term retention by remedial care. c. Trees of special significance which would warrant extraordinary efforts to secure their long term retention.
2. Medium SULE – Tree that appeared to be retainable (at the time of assessment) for 15-40 years with an acceptable degree of risk, assuming reasonable maintenance.	a. Trees, which may only live from 15-40 years. b. Trees that may live for more than 40 years but may be removed for safety or nuisance reasons. c. Trees which may live for more than 40 years but would be removed to prevent interference with more suitable individuals or to provide space for new plantings. d. Trees which could be made suitable for retention in the medium term with remedial care.
3 Short SULE - Trees that appeared to be retainable (at the time of assessment) for 5-15 years with an acceptable degree of risk, assuming reasonable maintenance.	a. Trees which may only live from 5 to 15 years. b. Trees that may live for more than 15 years but may be removed for safety or nuisance reasons. c. Trees which may live for more than 15 years but would be removed to prevent interference with more suitable individuals or to provide space for new plantings. d. Trees which require substantial remediation and are only suitable for retention in the short term.
4 Removal - Trees that should be removed within the next 5 years.	a. Dead, dying suppressed or declining trees b. Dangerous trees through instability or recent loss of adjacent trees. Dangerous trees because of structural defects including cavities decay included bark, wounds or poor form. c. Damaged trees that are clearly not safe to retain. d. Trees which may live for more than 5 years but would be removed to prevent interference with more suitable individuals or to provide space for new plantings. e. Trees which are damaging or may cause damage to existing structures within the next 5 years. f. Trees that will become dangerous after the removal of other trees for the reasons given in (A) to (F). g. Trees in categories (A) to (G) that have a high wild life habitat value and with appropriate treatment could be retained subject to regular review.
5 Small, young or regularly pruned - Trees that can be reliably moved or replaced.	a. Small trees less than 5m in height. b. Young trees less than 15 years old but over 5m in height. c. Formal hedges and trees intended for regular pruning to artificially control growth.

⁴ Barrell, J. 2009. *SULE: Its use and status into the new millennium*.

3.3 TREE PROTECTION ZONE (TPZ) & STRUCTURAL ROOT ZONE (TPZ) CALCULATIONS

In accordance with Australian Standard *AS4970-2009 Protection of trees on development sites*⁵, Tree Protection Zone (TPZ) radius is calculated using the following procedure. Diameter of the trunk is measured at approximately 1.4m above ground level; this measurement is referred to as DBH (Diameter at Breast Height). $R_{TPZ} = DBH \times 12$. For multi-stemmed trees the formula used is $R_{TPZ} = \sqrt{[(DBH1)^2 + (DBH2)^2 + (DBH3)^2]}$. The TPZ is measured radially from the centre of the stem and must be protected on all sides.

The Structural Root Zone (SRZ) radius is calculated by measuring the diameter of the stem close to ground level, just above the basal flare. This measurement is taken as D and then used in the following formula: $R_{SRZ} = (D \times 50)^{0.42} \times 0.64$ and becomes the Structural Root Zone, measured radially from the centre of the stem.

It is important to realize that these calculations provide a notional figure only and tree dynamics, form and site conditions will greatly affect these zones, and it is the job of the arborist to interpret the information correctly.

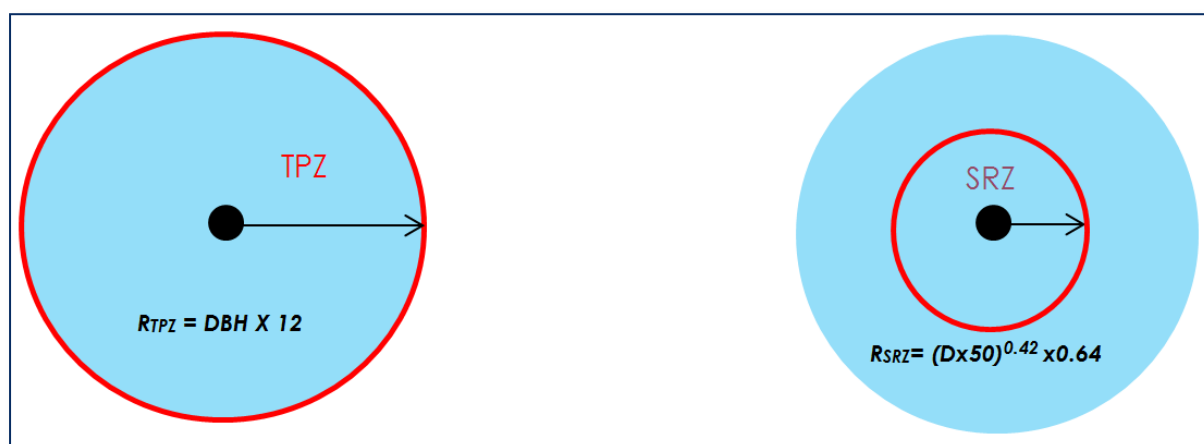


Figure 1 - TPZ & SRZ calculations.

For palms, cycads, tree ferns, and similar monocots, the TPZ is positioned at least 1m outside the crown projection. SRZs are not applicable to these plant types.

*AS4970-2009*³ states “a TPZ should not be less than 2m nor greater than 15m (except where crown protection is required)” and the minimum radius for an SRZ is 1.5m.

It should be noted that, the concept of the Tree Protection Zone is very similar to that of the ‘critical root zone’. Although they are calculated differently, they produce similar results. For the purpose of this report at least, figures for TPZ are essentially interchangeable with those for critical root zone.

It should be noted that, the concept of the Structural Root Zone is very similar to that of the ‘primary root zone’. Although they are calculated differently, they produce similar results. For the purpose of this report at least, figures for SRZ are essentially interchangeable with those for primary root zone.

⁵ Standards Australia. 2009. *AS4970-2009 Protection of trees on development sites*.

3.4 SIGNIFICANCE OF A TREE, ASSESSMENT RATING SYSTEM (STARS)

The STARS⁶ system was developed by IACA, and is useful for determining the retention values of trees, by assessing the trees' significance within the landscape, and expected lifespan. Landscape significance is determined by criteria from Table 2. (Note: a tree must fit a minimum of 3 criteria to be classified in that category.) The assessment criteria are for individual specimens, but can also be applied to tree stands of like species ie. hedges. A tree that is an environmental pest or noxious weed, or that is hazardous or in irreversible decline, is automatically placed in the Low Significance category.

Table 2 outlines the criteria for Tree Significance.

Table 2 - Assessment criteria for Tree Significance using the STARS⁶ system.

Category	Criteria
1. High Significance	a. The tree is in good condition and good vigour
	b. The tree has a form typical for the species
	c. 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 substantial age
	d. The tree is listed as a Heritage Item, Threatened Species or part of an Endangered Ecological Community or listed on Council's Significant Tree Register.
	e. The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity
	f. The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values
	g. The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa <i>in situ</i> – tree is appropriate to the site conditions
2. Medium Significance	a. The tree is in fair-good condition and good or low vigour
	b. The tree has form typical or atypical of the species
	c. The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area
	d. The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street
	e. The tree provides a fair contribution to the visual character and amenity of the local area
	f. The tree's growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa <i>in situ</i>
3. Low Significance	a. The tree is in fair-poor condition and good or low vigour
	b. The tree has form atypical of the species
	c. The tree is not visible or is partly visible from surrounding properties as is obstructed by other vegetation or buildings
	d. The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area
	e. The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation Orders or similar protection mechanisms and can easily be replaced with a suitable specimen
	f. The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa <i>in situ</i> – tree is inappropriate to the site conditions
	g. The tree is listed as exempt under the provisions of the local Council's Tree Preservation Order or similar protection mechanisms
	h. The tree has a wound or defect that has potential to become structurally unsound
3. Environmental Pest/ Noxious Weed Species	i. The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties
	j. The tree is a declared noxious weed by legislation
3. Hazardous/ Irreversible Decline	k. The tree is structurally unsound and/or unstable and is considered potentially dangerous
	l. The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in the immediate or short term

⁶ IACA. 2010. *IACA Significance of a Tree, Assessment Rating System (STARS)*.

Once the tree is placed into a Significance category, an assessment is also made of its Estimated Life Expectancy (ELE). This is an estimate of the sustainability of the tree in the landscape. This calculation is based on an estimate of the average lifespan of the species, less its estimated current age. The life expectancy of the tree is then further modified where necessary in consideration of its natural range of occurrence, climatic preferences, rainfall, microclimate, soil types, current health and vigour, condition and suitability to the site. It should be noted that, for the purpose of this report, figures for ELE are essentially interchangeable with those for SULE.

When both Significance and ELE have been determined, the matrix in Table 3 is used to determine Retention Value. Retention Values are 'Priority for Retention', 'Consider for Retention', 'Consider for Removal' and 'Priority for Removal' (see Table 4).

Table 3 - Tree Retention Values priority matrix⁶.

		Significance				
		1. High	2. Medium	3. Low		
		Significance in Landscape	Significance in Landscape	Significance in Landscape	Environmental Pest/ Noxious Weed Species	Hazardous/ Irreversible Decline
ELE	1. Long >40 years					
	2. Medium 15-40 years					
	3. Short <1-15 years					
	Dead					

Table 4 - Legend for matrix assessment⁶.

	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 setbacks as prescribed by the Australian Standard AS4970-2009 <i>Protection of trees on development sites</i> . Tree sensitive construction measures 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 trees 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.

4 SITE DETAILS

The site subject to the proposed development is within the Taronga Zoo complex, adjacent to the staff car park and entrance, off Whiting Beach Road, Mosman (see Figures 2 & 3). The site has frontage on Bradleys Head Road, but is best accessed from Whiting Beach Road.

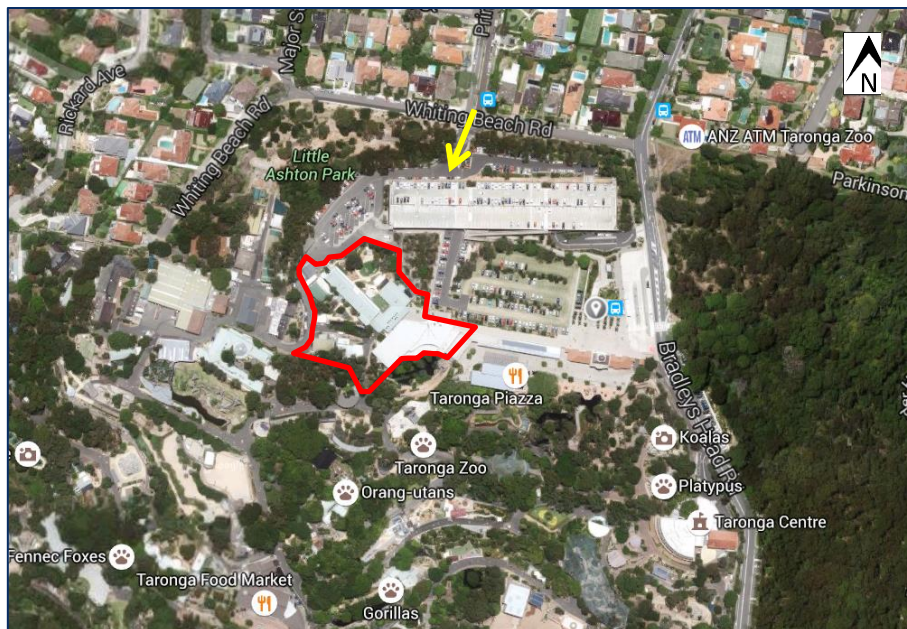


Figure 2 – The site (boundaries marked approximately in red), is best accessed of Whiting Beach Road (yellow arrow). Taken from Google Maps⁷.

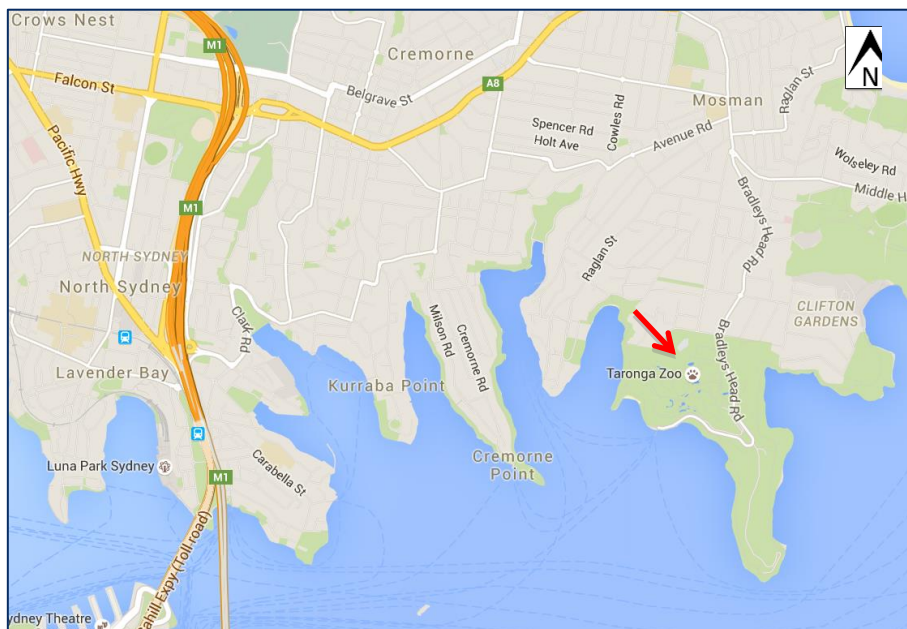


Figure 3 - The site (red arrow) in relation to the surrounding area. Taken from Google Maps⁷.

⁷ Google Maps. 2015. *The location of Taronga Zoo, Mosman.*

4.1 THE PROPOSED DEVELOPMENT

The development proposed for the site involves the construction of a mixed use building which is to be a new research and education facility. The proposal involves a 3-level building comprising of open offices, classrooms and lecture rooms, laboratories and research facilities.

Figures 4 & 5 are taken from plans supplied by Taronga Conservation Society Australia.

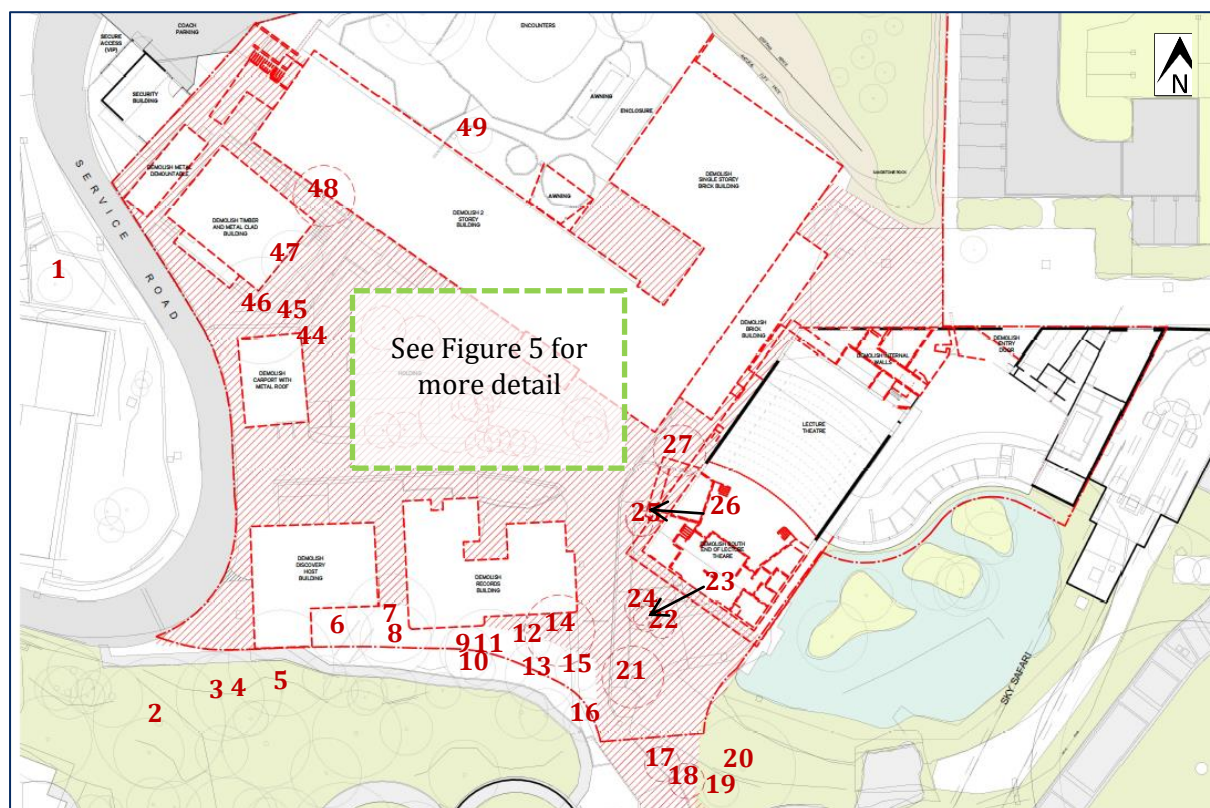


Figure 4 – An excerpt of Drawing 14490 – DD100 *Existing & Demolition Plan* shows the construction footprint for the proposed development, with structures to-be-demolished bounded by dotted red lines, and hard surfaces to-be-demolished shown by red cross-hatching. Approximate tree locations have been numbered. Plans supplied by Taronga Conservation Society Australia.

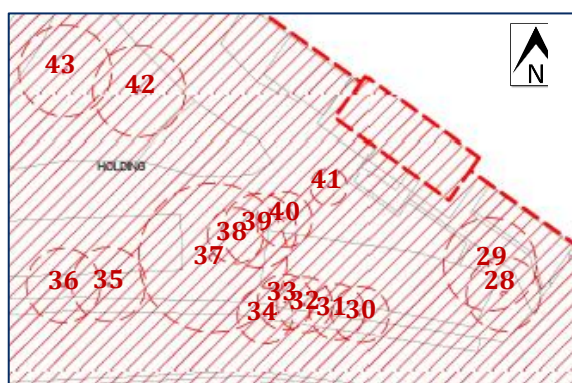


Figure 5 – An excerpt of Drawing 14490 – DD100 *Existing & Demolition Plan* shows Trees 28-43 in more detail. Plans supplied by Taronga Conservation Society Australia.

4.2 HERITAGE DETAILS

As shown in Figure 6, the entire Taronga Zoo site is listed as a Heritage Item (#I34) under the *Mosman Local Environment Plan 2012*⁸. However, the *Mosman Local Environment Plan 2012*⁸ qualifies this listing to the “Rainforest Aviary”, “Elephant House”, bus shelter and office, floral clock and lower entrance gates. Further, none of the trees on the subject site are identified as local heritage items under the *Mosman Local Environment Plan 2012*⁸. Within the Zoo are several items of archaeological significance, and the Zoological Parks Board NSW’s *Section 170 Register* identifies further items of heritage significance within Taronga Zoo itself.

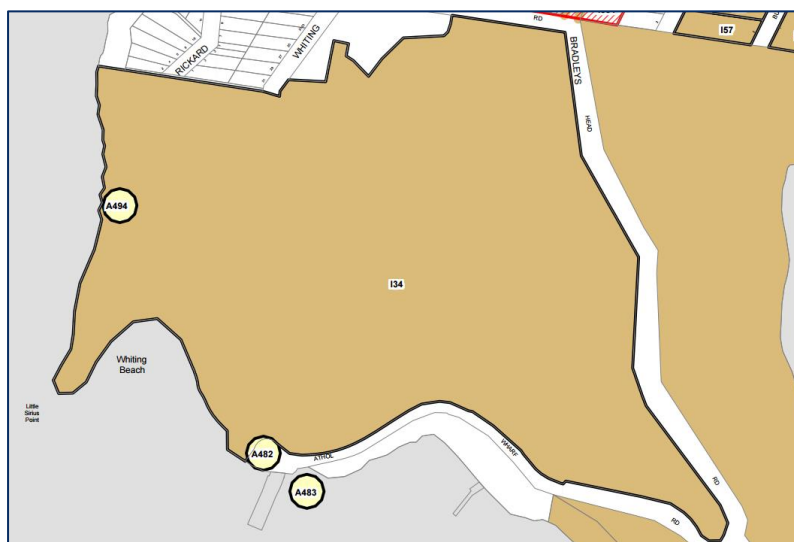


Figure 6 – Taronga Zoo is listed as Item #I34 under the *Mosman Local Environment Plan 2012*⁸.



Figure 7 - An excerpt from the Zoological Parks Board NSW’s *Section 170 Register*, with site boundary marked. Taken from Urbis’ *Taronga Institute of Science & Learning: Request for Secretary’s Environmental Assessment Requirements*⁹. Supplied by Taronga Conservation Society Australia.

⁸ NSW Legislation. 2015. *Mosman Local Environment Plan 2012*.

⁹ Horsfield, S. & Chee, A. 2015. *Taronga Institute of Science & Learning: Request for Secretary’s Environmental Assessment Requirements*.

5 TREE DETAILS

Table 5 Tree Methodology And Condition Audit, shows a range of criteria the subject trees were assessed on during a site visit.

Table 5 – Tree Methodology and Condition Audit

Tree #	Species	Common Name	Height (m)	DBH/D (mm)	TPZ/SRZ (m)	Health & Vigour	Structure	Defects	SULE	Significance	Distance from construction footprint (m)
1	<i>Eucalyptus botryoides</i>	Bangalay	12	600/700	7.2/2.9	Good	Fair	Co-dominance, bark splits	Long	High	
2	<i>Eucalyptus maidenii</i>	Maiden's Gum	14	725/770	8.7/3.0	Fair	Fair	Co-dominance, crossing branches	Medium	High	Candidate for remediation
3	<i>Eucalyptus saligna</i>	Sydney Blue Gum	14	500/550	6.0/2.6	Fair	Fair	Co-dominance, crossing branches	Long	High	
4	<i>Eucalyptus punctata</i>	Grey Gum	8	350/400	4.2/2.3	Fair	Poor	Suppressed	Short	Low	Leaning/Canopy within footprint
5	<i>Eucalyptus punctata</i>	Grey Gum	10	400/450	4.8/2.4	Fair	Poor	Suppressed, Basal lesion	Remove	Low	Leaning/Canopy within footprint
6	<i>Radermachera sp.</i>	-	9	340/440	4.1/2.3	Good	Good		Long	Low	2.9m from structure
7	<i>Eucalyptus robusta</i>	Swamp Mahogany	15	540/680	6.5/2.8	Fair	Fair	Suppressed	Medium	Low	Leaning/Canopy within footprint 1.5m from structure
8	<i>Eucalyptus robusta</i>	Swamp Mahogany	14	335/490	4.0/2.5	Fair	Fair	Co-dominance	Medium	Low	2.0m from structure
9	<i>Eucalyptus robusta</i>	Swamp Mahogany	11	330/490	4.0/2.5	Poor	Poor	Suppressed, twisted leader	Remove	Low	Leaning/Canopy within footprint 3.0m from structure
10	<i>Eucalyptus robusta</i>	Swamp Mahogany	10	250/400	3.0/2.3	Poor	Poor	Suppressed	Medium	Low	4.8m from structure
11	<i>Eucalyptus robusta</i>	Swamp Mahogany	14	500/610	6.0/2.7	Poor	Fair	Over extended branch structures	Short	Low	Leaning/Canopy within footprint 3.6m from structure

12	<i>Eucalyptus robusta</i>	Swamp Mahogany	10	180/250	2.2/1.9	Fair	Fair	Suppressed	Medium	Low	2.9m from structure
13	<i>Acacia binervia</i>	Coast Myall	10	300/390	3.6/2.2	Fair	Poor	Co-dominance, suppressed	Medium	Low	
14	<i>Eucalyptus robusta</i>	Swamp Mahogany	11	500/600	6.0/2.7	Fair	Poor	Co-dominance, Extensive decay from ground level into stem	Remove	Low	Leaning/Canopy within footprint Very poor structure
15	<i>Melaleuca linariifolia</i>	Snow-in-Summer	6	180 +110 /300	2.5/2.0	Fair	Poor	Co-dominance, Suppressed	Short	Low	
16	<i>Melaleuca linariifolia</i>	Snow-in-Summer	5	270/350	3.2/2.1	Fair	Fair	Suppressed	Medium	Low	
17	<i>Banksia integrifolia</i>	Coast Banksia	10	200/240	2.4/1.8	Good	Fair		Medium	Low	200mm from retaining wall
18	<i>Banksia integrifolia</i>	Coast Banksia	8	180/200	2.1/1.7	Fair	Fair	Suppressed	Short	Low	200mm from retaining wall
19	<i>Washingtonia sp.</i>	Mexican Fan Palm	6	350/440	4.2/2.3	Good	Good		Long	Low	
20	<i>Eucalyptus botryoides</i>	Bangalay	19	400/500	4.8/2.5	Good	Fair	Crossing branches, previous failures	Long	Low	
21	<i>Eucalyptus robusta</i>	Swamp Mahogany	9	220/300	2.6/2.0	Fair	Fair	Co-dominance	Medium	Low	
22	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	9	200/330	2.6/2.1	Good	Fair	Co-dominance	Long	Low	
23	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	11	210/290	2.5/2.0	Good	Poor	Co-dominance with inclusion	Short	Low	
24	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	10	260/400	3.1/2.3	Good	Poor	Overly slender	Short	Low	
25	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	9	100/120	2.0/1.5	Good	Poor	Co-dominance	Short	Low	
26	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	12	200/240	2.4/1.8	Fair	Poor	Co-dominance	Short	Low	
27	<i>Cupaniopsis anacardioides</i>	Tuckeroo	6	240 +150 +120/400	3.7/2.3	Good	Poor	Co-dominance	Short	Low	
28	<i>Hakea salicifolia</i>	Willow-leaved Hakea	6	160 +160 /240	2.7/1.8	Fair	Poor	Co-dominance	Short	Low	
29	<i>Hakea salicifolia</i>	Willow-leaved Hakea	7	180 +220 +90/370	3.6/2.2	Fair	Poor	Co-dominance	Short	Low	
30	<i>Syzygium australe</i>	Brush Cherry	6	160/180	2.0/1.6	Good	Fair	Co-dominance	Medium	Low	

31	<i>Hakea salicifolia</i>	Willow-leaved Hakea	6	120 +120/ 200	2.0/1.7	Fair	Fair	Co-dominance	Short	Low	
32	<i>Hakea salicifolia</i>	Willow-leaved Hakea	6	180/220	2.2/1.8	Fair	Poor	Co-dominance	Short	Low	
33	<i>Hakea salicifolia</i>	Willow-leaved Hakea	6	100 +80 +60/200	2.0/1.7	Fair	Poor	Co-dominance	Short	Low	
34	<i>Hakea salicifolia</i>	Willow-leaved Hakea	6	120/200	2.0/1.7	Fair	Fair	Co-dominance	Short	Low	
35	<i>Hakea salicifolia</i>	Willow-leaved Hakea	6	240/280	2.9/1.9	Fair	Fair	Co-dominance	Short	Low	
36	<i>Hakea salicifolia</i>	Willow-leaved Hakea	7	180 +80 /350	2.4/2.1	Good	Fair	Co-dominance	Medium	Low	
37	<i>Glochidion ferdinandi</i>	Cheese Tree	12	420/470	5.0/2.4	Fair	Fair	Co-dominance	Medium	Medium	
38	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	5	100/140	2.0/1.5	Good	Fair	Suppressed	Short	Low	
39	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	13	210/310	2.5/2.0	Good	Fair	Co-dominance	Medium	Low	
40	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	9	160/240	2.0/1.8	Fair	Fair		Medium	Low	
41	<i>Eucalyptus longifolia</i>	Woollybutt	11	130/170	2.0/1.6	Fair	Fair		Long	Low	
42	<i>Acacia podalyriifolia</i>	Queensland Silver Wattle	5	100 +90/240	2.0/1.8	Fair	Fair		Short	Low	
43	<i>Eucalyptus robusta</i>	Swamp Mahogany	9	260/380	3.1/2.2	Good	Poor	Co-dominance with associated defect	Short	Low	
44	<i>Hakea salicifolia</i>	Willow-leaved Hakea	5	140/180	2.0/1.6	Fair	Fair	Co-dominance	Short	Low	
45	<i>Pittosporum undulatum</i>	Sweet Pittosporum	5	610/870	7.3/3.1	Good	Fair	Co-dominance	Medium	Low	
46	<i>Casuarina cunninghamiana</i>	River She Oak	20	180 +60 /230	2.3/1.8	Good	Poor	Co-dominance	Long	Medium	Lateral branch over car port has poor form
47	<i>Hymenosporum flavum</i>	Native Frangipani	12	230/290	2.8/2.0	Good	Fair		Medium	Medium	
48	<i>Grevillea robusta</i>	Silky Oak	13	300/400	3.6/2.3	Good	Fair	Co-dominance	Short	Low	
49	<i>Hakea salicifolia</i>	Willow-leaved Hakea	5	400/340	4.8/2.1	Good	Fair	Lopped	Short	Low	

5.1 TREE RETENTION VALUES (FROM STARS⁶)

As outlined in Section 3.4, the tree population at the site was assessed for desirability of retention, according to IACA's STARS⁶ method. The results are set out in Table 6.

Technically, all the trees at the site would have high significance, being that they form part of the curtilage of a Heritage Item (#I34 – see Section 4.2). This would skew the Retention Values, and is not very useful for distinguishing the value of trees relative to their neighbours.

Also, the proposed demolition of *Section 170 Register* heritage items (78B and 15M⁹) would render the curtilage less significant, and so heritage implications have been disregarded.

While decisions regarding tree retention or removal will largely be determined by the design of the proposed development, Retention Values are provided as a way of quantifying what will be lost, which can then be offset with replacement plantings.

Table 6 – Tree Retention Values (from STARS⁶).

Tree	Estimated Life Expectancy	Significance	Retention Value
1	Long	High	High (Priority for Retention)
2	Medium	High	High (Priority for Retention)
3	Long	High	High (Priority for Retention)
4	Short	Low	Low (Consider for Removal)
5	Remove	Hazardous	Very Low (Priority for Removal)
6	Long	Low	Medium (Consider for Retention)
7	Medium	Low	Low (Consider for Removal)
8	Medium	Low	Low (Consider for Removal)
9	Remove	Hazardous	Very Low (Priority for Removal)
10	Medium	Low	Low (Consider for Removal)
11	Short	Low	Low (Consider for Removal)
12	Medium	Low	Low (Consider for Removal)
13	Medium	Low	Low (Consider for Removal)
14	Remove	Hazardous	Very Low (Priority for Removal)
15	Short	Low	Low (Consider for Removal)
16	Medium	Low	Low (Consider for Removal)
17	Medium	Low	Low (Consider for Removal)
18	Short	Low	Low (Consider for Removal)
19	Long	Low	Medium (Consider for Retention)
20	Long	Low	Medium (Consider for Retention)
21	Medium	Low	Low (Consider for Removal)
22	Long	Low	Medium (Consider for Retention)
23	Short	Low	Low (Consider for Removal)
24	Short	Low	Low (Consider for Removal)
25	Short	Low	Low (Consider for Removal)
26	Short	Low	Low (Consider for Removal)
27	Short	Low	Low (Consider for Removal)
28	Short	Low	Low (Consider for Removal)
29	Short	Low	Low (Consider for Removal)
30	Medium	Low	Low (Consider for Removal)

31	Short	Low	Low (Consider for Removal)
32	Short	Low	Low (Consider for Removal)
33	Short	Low	Low (Consider for Removal)
34	Short	Low	Low (Consider for Removal)
35	Short	Low	Low (Consider for Removal)
36	Medium	Low	Low (Consider for Removal)
37	Medium	Medium	Medium (Consider for Retention)
38	Short	Low	Low (Consider for Removal)
39	Medium	Low	Low (Consider for Removal)
40	Medium	Low	Low (Consider for Removal)
41	Long	Low	Medium (Consider for Retention)
42	Short	Low	Low (Consider for Removal)
43	Short	Low	Low (Consider for Removal)
44	Short	Low	Low (Consider for Removal)
45	Short	Low	Low (Consider for Removal)
46	Long	Medium	High (Priority for Retention)
47	Medium	Medium	Medium (Consider for Retention)
48	Short	Low	Low (Consider for Removal)
49	Short	Low	Low (Consider for Removal)

5.2 TPZ & SRZ ENCROACHMENTS

Trees 1-49 stand close enough to the construction footprint to be impacted by the works. Tree Protection Zones (TPZ) and Structural Root Zones (SRZ) have been determined in accordance with *AS4970-2009 Protection of trees on development sites*⁵. An encroachment represents the percentage of the surface area that will be disturbed by construction activities. Table 7 sets out these results.

Distances from construction footprint were estimated.

Table 7 – TPZ & SRZ encroachments.

Tree #	TPZ / SRZ (m)	Distance from construction footprint (m)	% TPZ area lost	% SRZ area lost
1	7.2/2.9	~8.2	0	0
2	8.7/3.0	~8.7	0	0
3	6.0/2.6	~4.4	~8%	0
4	4.2/2.3	~4.0	<1%	0
5	4.8/2.4	~3.5	~8%	0
6	4.1/2.3	0 (within)	100	100
7	6.5/2.8	0 (within)	100	100
8	4.0/2.5	0 (within)	100	100
9	4.0/2.5	0 (within)	100	100
10	3.0/2.3	~1.0	~29%	~23%
11	6.0/2.7	0 (within)	100	100
12	2.2/1.9	0 (within)	100	100
13	3.6/2.2	0 (within)	100	100
14	6.0/2.7	0 (within)	100	100
15	2.5/2.0	0 (within)	100	100
16	3.2/2.1	0 (within)	100	100
17	2.4/1.8	~2.0	~4%	0
18	2.1/1.7	~3.5	0	0
19	4.2/2.3	5+	0	0
20	4.8/2.5	5+	0	0
21	2.6/2.0	0 (within)	100	100
22	2.6/2.1	0 (within)	100	100
23	2.5/2.0	0 (within)	100	100
24	3.1/2.3	0 (within)	100	100
25	2.0/1.5	0 (within)	100	100
26	2.4/1.8	0 (within)	100	100
27	3.7/2.3	0 (within)	100	100
28	2.7/1.8	0 (within)	100	100
29	3.6/2.2	0 (within)	100	100
30	2.0/1.6	0 (within)	100	100
31	2.0/1.7	0 (within)	100	100
32	2.2/1.8	0 (within)	100	100
33	2.0/1.7	0 (within)	100	100
34	2.0/1.7	0 (within)	100	100
35	2.9/1.9	0 (within)	100	100

36	2.4/2.1	0 (within)	100	100
37	5.0/2.4	0 (within)	100	100
38	2.0/1.5	0 (within)	100	100
39	2.5/2.0	0 (within)	100	100
40	2.0/1.8	0 (within)	100	100
41	2.0/1.6	0 (within)	100	100
42	2.0/1.8	0 (within)	100	100
43	3.1/2.2	0 (within)	100	100
44	2.0/1.6	0 (within)	100	100
45	7.3/3.1	0 (within)	100	100
46	2.3/1.8	0 (within)	100	100
47	2.8/2.0	0 (within)	100	100
48	3.6/2.3	0 (within)	100	100
49	4.8/2.1	~3.0	~13%	0

5.3 THE TREES

During a site visit, observations were made regarding the health and structural condition of the trees, and their suitability to the site.



Figure 7 – Tree 1 – a mature specimen of Bangalay (*Eucalyptus botryoides*) – as viewed from the southeast.



Figure 8 – Trees 2-5 are all mature specimens of *Eucalyptus* varieties. These trees stand within the area of indigenous remnant vegetation listed as 240L in the *Section 170 Register*.



Figure 9 – Tree 2, as viewed from the north, is probably the most significant tree that stands to be impacted by the works. NOTE: Tree 2 contained a nesting Tawny Frogmouth (red arrow) at time of inspection.

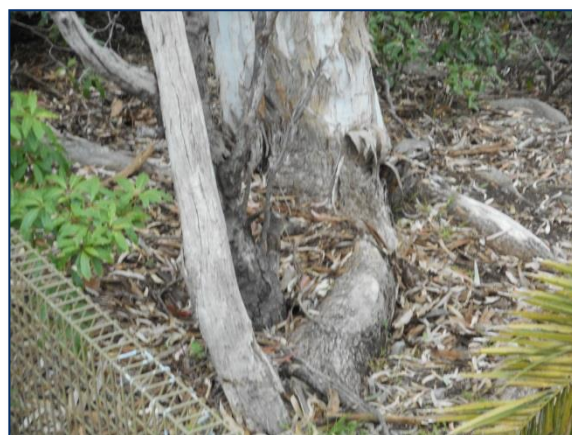


Figure 10 – Tree 2 exhibits several large surface roots.



Figure 11 – Tree 5 due to structural concerns is recommended for removal. Trees 4 stands far enough away from the construction footprint that only minor TPZ encroachments are likely. Building demolition methods will need to be tree-sensitive.



Figure 12 – Trees 6-8 stand within the construction footprint, and will require removal.



Figure 13 – Tree 9 has structural concerns and is recommended for removal. Trees 11 stand within the construction footprint. Tree 10 stands just outside the footprint, these trees are intended to be retained. .



Figure 14 – Tree 14 exhibits severe structural defects and should be removed regardless of the development. Trees 12-13 stand within the construction footprint and are intended to be retained.



Figure 15 – Tree 14 is exhibiting very poor structure, and only fair health and vigour. Recommended for removal.



Figure 16 – The co-dominant structure of Tree 14, which has most of its canopy positioned above the adjacent structure, probably due to phototropic growth towards the north. Recommended for removal.



Figure 17 – Trees 15 & 16 stand within the construction footprint and should be removed.



Figure 18 – Trees 17-20 are within the construction footprint and are to be removed. (Trees 18 & 19 not pictured).



Figure 19 – Trees 28 & 29 – the two largest specimens of Willow-leaved Hakea (*Hakea salicifolia*) – are within the construction footprint and will require removal.



Figure 20 – Trees 37-41 – a Cheese Tree (*Glochidion ferdinandi*), 3x Broad-leaved Paperbarks (*Melaleuca quinquenervia*), and a Woollybutt (*Eucalyptus longifolia*) – are within the construction footprint and will require removal.

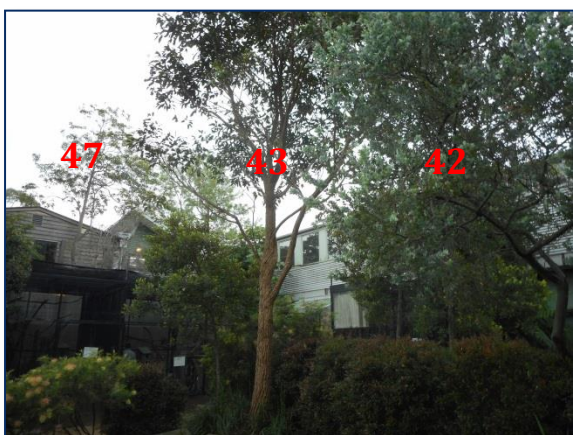


Figure 21 – Trees 42, 43 & 47 – a Queensland Silver Wattle (*Acacia podalyriifolia*), Swamp Mahogany (*Eucalyptus robusta*), and a Native Frangipani (*Hymenosporum flavum*) – are within the construction footprint and will require removal.

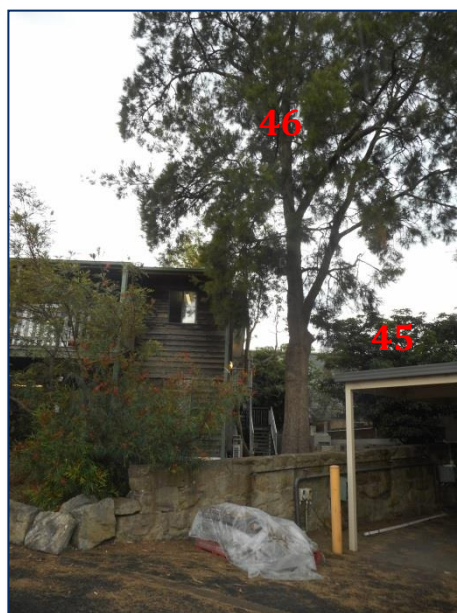


Figure 22 – Trees 45 & 46 – a Sweet Pittosporum (*Pittosporum undulatum*), and a River She Oak (*Casuarina cunninghamiana*) – are within the construction footprint and will require removal.

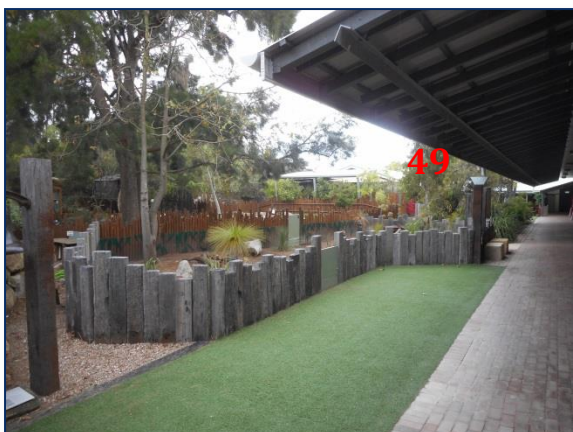
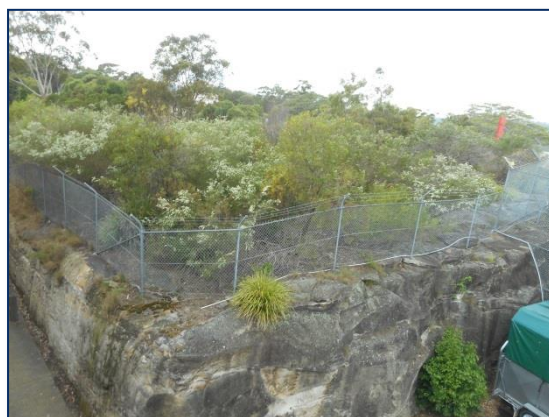
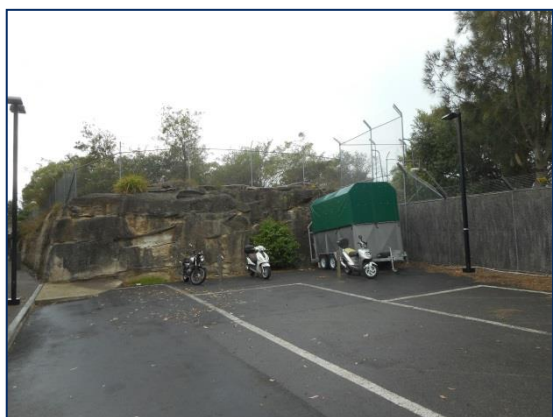


Figure 23 – Tree 49 – a heavily pruned Willow-leaved Hakea (*Hakea salicifolia*) has low significance, but may be suitable for retention if adequate Tree Protection measures are implemented. The other trees within the animal enclosures should remain unaffected.



Figure 24 – In the northwest corner of the site stand 4x mature specimens of Maiden's Gum (*Eucalyptus maidenii*). While they stand far enough from the construction footprint that they should not be impacted, it is however likely that they will require some pruning to the branches positioned over the driveway, to accommodate the movement of machinery to and from the site.



Figures 25 & 26 – The area to the northeast of the site is an area of indigenous remnant vegetation listed as 105L in the *Section 170 Register*. It is fenced, and sits atop a sandstone outcrop that is elevated above the level of the rest of the site. As such, it is very unlikely to be impacted by construction activities, and no controls are considered necessary. Figure 25 shows 105L as viewed from the coach parking area. Figure 26 shows 105L from the top level of the multi-storey car park.

6 DISCUSSION

6.1 THE SITE

The site is within the Taronga Zoo complex, adjacent to the staff car park and entrance, off Whiting Beach Road, Mosman (see Section 4).

The Taronga Conservation Society Australia has developed its own *Tree Protection Guidelines*¹⁰, which provides specifications and protections for trees on development sites which are to be retained. However, the Tree Protection measures outlined in this report are taken from *AS4970-2009 Protection of trees on development sites*⁵.

There are 49 trees within the site boundaries (shown in Figure 2), or close enough to be impacted by construction activities. There are other small trees and shrubs within the site, but for the purpose of this report, only trees protected by Clause 5.9 of the *Mosman Local Environment Plan 2012*⁸ have been included (i.e. trees that are '5m or more in height' or which "have a circumference of 450mm or more measured 300mm above ground level"). While Clause 5.9 also applies to trees (taller than 2m) which form curtilage to a heritage item – which these trees do – the proposed demolition of actual heritage items (78B and 15M⁹) would render the curtilage less significant, and so trees less than 5m tall have not been included.

As shown in Figure 7, the site is adjacent to two areas of remnant indigenous vegetation; one to the northeast (105L⁹), and another to the southwest (240L⁹). These two areas are listed in the *Taronga Zoo Landscape Management Plan*¹¹ as "*Angophora costata* Association", despite not actually containing any specimens of Sydney Red Gum (*Angophora costata*).

The area listed as 105L is atop a sandstone outcrop that is elevated above the level of the rest of the site, and as such should be relatively easy to exclude from construction impacts.

The area listed as 240L, however, is downslope from the construction footprint, and will require specific Tree Protection measures to be implemented prior to, and during, site establishment.

6.2 THE PROPOSED DEVELOPMENT

As shown in Section 4.1, the development proposed for the site involves the construction of a mixed use building which is to be a new research and education facility. The proposal involves a 3-level building comprising of open offices, classrooms and lecture rooms, laboratories and research facilities.

As shown in Figures 4 & 5, for purposes of structural soundness and public safety, Trees 5, 9, and 14 will require removal. Additionally, the extent of necessary demolition will likely require the removal of 21-48, and possibly of Trees 6-8, 14-18, 21-48.

Trees 1-4, 19-20 & 49 are eligible for retention. If so desired, Tree Protection measures should be implemented to ensure they survive the construction period.

Trees 5-16 stand in or in the vicinity of the area listed as 240L in the *Section 170 Register*, however none are of species known to be associated with Sydney Red Gum (*Angophora costata*) communities.

¹⁰ TCSA Capital Works & Infrastructure Division. 2012. *Tree Protection Guidelines (Edition 7)*.

¹¹ Britton, G. & Wallace, B. 2006. *Taronga Zoo: Landscape Management Plan*.

6.3 HERITAGE CONSIDERATIONS

As shown in Section 4.2, Taronga Zoo itself is listed as a Heritage Item (#I34) under the *Mosman Local Environment Plan 2012*⁸. However, the *Mosman Local Environment Plan 2012*⁸ qualifies this listing to the “Rainforest Aviary”, “Elephant House”, bus shelter and office, floral clock and lower entrance gates. Further, none of the trees on the subject site are identified as local heritage items under the *Mosman Local Environment Plan 2012*⁸.

Urbis’ *Taronga Institute of Science & Learning: Request for Secretary’s Environmental Assessment Requirements*⁹ report lists Heritage Items (from the *Section 170 Register* prepared for the site), which are relevant to the development (due to their proximity). These include the following (as shown in Figure 7):

- 78B – Old amenity block (proposed for demolition)
- 15M – ZPB Archives and Records (proposed for demolition)
- 105L – Remnant indigenous vegetation (to be retained)
- 123L – Australian Section Landscape (to be retained)
- 240L – Remnant indigenous vegetation (to be retained)
- 77B – Koala House (to be retained)
- 120B – Alligator enclosure (to be retained)

Usually for Heritage sites, the trees are considered as part of the curtilage. Curtilage is the area or land (including the items within) around a building or structure, which combine to form part of its outward appearance. However, the proposed demolition of two heritage items, as well as the extent of hard landscaping proposed for demolition, means the curtilage of this site is to be altered beyond recognition. It is noted that the trees proposed to be removed/affected by the proposal are some distance from those items listed in *Mosman Local Environment Plan 2012*⁸ and therefore there will be no impact to these items and their associated curtilage. As such, the curtilage values of the trees within the site are minimal, and have not been given much weight in this report.

This is not true however for the larger trees around the perimeter of the site proposed for development, as these trees can be seen from greater distances, and form part of the broader landscape. Views to and from the site are subject to preservation measures.

However as Items 105L and 240L are proposed to be retained (other than the required removal of some trees within 240L), the impacts of the proposal including during the demolition and construction stage should be mitigated, such as implementation of appropriate soil and erosion control protection measures and stormwater management. Also as remnant indigenous plant populations, their ecological worth is increased.

6.4 THE TREES

Tree 1 is a mature specimen of Bangalay (*Eucalyptus botryoides*), with an approximate height of 12m. It is exhibiting good health and vigour, but only fair structure. It has a co-dominant structure, and exhibits some bark cracking. It has been assessed as having a long ELE, and high significance, and as such has been determined to have a high Retention Value (Priority for Retention). It likely stands far enough from the construction footprint to remain viable, and is to be retained.

Tree 2 is a mature specimen of Maiden's Gum (*Eucalyptus maidenii*), with an approximate height of 14m. It is exhibiting only fair health and vigour, and fair structure. It has a co-dominant structure, and some crossing branches within its canopy. It has been assessed as having a medium ELE, and high significance, and as such has been determined to have a high Retention Value (Priority for Retention). It likely stands far enough from the construction footprint to remain viable, and is to be retained.

Tree 3 is a mature specimen of Sydney Blue Gum (*Eucalyptus saligna*), with an approximate height of 14m. It is exhibiting only fair health and vigour, and fair structure. It has a co-dominant structure, and some crossing branches within its canopy. It has been assessed as having a long ELE, and high significance, and as such has been determined to have a high Retention Value (Priority for Retention). It likely stands far enough from the construction footprint to remain viable, and is to be retained.

Tree 4 is a mature specimen of Grey Gum (*Eucalyptus punctata*), with an approximate height of 8m. It is exhibiting only fair health and vigour, and poor structure. It has a suppressed form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It stands close enough to the construction footprint to be impacted by the works – primarily the demolition works – but is likely to remain viable if effective Tree Protection measures are implemented. Tree 4 is to be retained.

Tree 5 is a mature specimen of Grey Gum (*Eucalyptus punctata*), with an approximate height of 10m. It is exhibiting only fair health and vigour, and poor structure. It has a suppressed form, with a northward lean, and the majority of its canopy positioned over the adjacent structure. It also has a considerable bark lesion at ground level. It has been assessed as having a 'remove' ELE, and low significance, and due to its hazardous form has been determined to have a very low Retention Value (Priority for Removal). Tree 5 is recommended for removal.

Tree 6 is a mature specimen of *Radermachera sp.* which is a genus in the *Bignoniaceae* family, native to Southeast Asia. It has an approximate height of 9m. It is exhibiting good health and vigour, and good structure. It has been assessed as having a long ELE, but low significance, and as such has been determined to have a medium Retention Value (Consider for Retention). It is likely to require removal to accommodate the demolition works. Tree 6 is to be removed.

Tree 7 is a mature specimen of Swamp Mahogany (*Eucalyptus robusta*), with an approximate height of 15m. It is exhibiting only fair health and vigour, and fair structure. It has a suppressed form. It has been assessed as having a medium ELE, but low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It is likely to require removal to accommodate the demolition works, Tree 7 is to be removed.

Tree 8 is a mature specimen of Swamp Mahogany (*Eucalyptus robusta*), with an approximate height of 14m. It is exhibiting only fair health and vigour, and fair structure. It has a co-dominant form. It has been assessed as having a medium ELE, but low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It is likely to require removal to accommodate the demolition works. Tree 8 is to be removed.

Tree 9 is a mature specimen of Swamp Mahogany (*Eucalyptus robusta*), with an approximate height of 11m. It is exhibiting only poor health and vigour, and poor structure. It has a suppressed form, with a twisted leading branch. It has been assessed as having a 'remove' ELE, and low significance, and due to its hazardous form has been determined to have a very low Retention Value (Priority for Removal). Tree 9 is to be removed.

Tree 10 is a semi-mature specimen of Swamp Mahogany (*Eucalyptus robusta*), with an approximate height of 10m. It is exhibiting poor health and vigour, and poor structure. It has a suppressed form. It has been assessed as having a medium ELE, but low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It is likely to require removal to accommodate the demolition works, but if not will require some non-destructive root investigation to demonstrate that it will remain viable (in the event that it is desired for retention). Tree 10 is to be retained.

Tree 11 is a mature specimen of Swamp Mahogany (*Eucalyptus robusta*), with an approximate height of 14m. It is exhibiting only poor health and vigour, and fair structure. It has some over-extended branch structures within its canopy. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It is likely to require removal to accommodate the demolition works, but if not will require some non-destructive root investigation to demonstrate that it will remain viable (in the event that it is desired for retention). Tree 11 is to be retained.

Tree 12 is a semi-mature specimen of Swamp Mahogany (*Eucalyptus robusta*), with an approximate height of 10m. It is exhibiting fair health and vigour, and fair structure. It has a suppressed form. It has been assessed as having a medium ELE, but low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It is likely to require removal to accommodate the demolition works, but if not will require some non-destructive root investigation to demonstrate that it will remain viable (in the event that it is desired for retention). Tree 12 is to be retained.

Tree 13 is a mature specimen of Coast Myall (*Acacia binervia*), with an approximate height of 10m. It is exhibiting only fair health and vigour, but poor structure. It has a co-dominant, suppressed form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It is likely to require removal to accommodate the demolition works, but if not will require some non-destructive root investigation to demonstrate that it will remain viable (in the event that it is desired for retention). Tree 13 is to be retained.

Tree 14 is a mature specimen of Swamp Mahogany (*Eucalyptus robusta*), with an approximate height of 11m. It is exhibiting only fair health and vigour, and poor structure. It has extensive decay throughout its lower stem. It has a co-dominant form, with the majority of its canopy positioned over the adjacent structure. It has been assessed as having a 'remove' ELE, and low significance, and due to its hazardous form has been determined to have a very low Retention Value (Priority for Removal). Tree 14 is to be removed.

Tree 15 is a semi-mature specimen of Snow-In-Summer (*Melaleuca linariifolia*), with an approximate height of 6m. It is exhibiting only fair health and vigour, but poor structure. It has a co-dominant, suppressed form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It is required to be removed to accommodate the demolition works, Tree 15 is to be removed.

Tree 16 is a semi-mature specimen of Snow-In-Summer (*Melaleuca linariifolia*), with an approximate height of 5m. It is exhibiting only fair health and vigour, but poor structure. It has a suppressed form. It has been assessed as having a medium ELE, but low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It is required to be removed to accommodate the demolition works, Tree 16 is to be removed.

Tree 17 is a semi-mature specimen of Coast Banksia (*Banksia integrifolia*), with an approximate height of 10m. It is exhibiting good health and vigour, but only fair structure. It has been assessed as having a medium ELE, but low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It stands within the construction footprint and is required to be removed to accommodate the demolition works. Tree 17 is to be removed.

Tree 18 is a semi-mature specimen of Coast Banksia (*Banksia integrifolia*), with an approximate height of 8m. It is exhibiting fair health and vigour, and fair structure. It has a suppressed form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It stands within the construction footprint, and is required to be removed to accommodate the demolition works. Tree 18 is to be removed.

Tree 19 is a mature specimen of Mexican Fan Palm (*Washingtonia sp.*), with an approximate height of 6m. It is exhibiting good health and vigour, and good structure. It has been assessed as having a long ELE, but low significance, and as such has been determined to have a medium Retention Value (Consider for Retention). It stands within the construction footprint, and is required to be removed to accommodate the demolition works. Tree 19 is to be removed.

Tree 20 is a mature specimen of Bangalay (*Eucalyptus botryoides*), with an approximate height of 19m. It is exhibiting good health and vigour, but only fair structure. It exhibits crossing branches, and previous failures within its canopy. It has been assessed as having a medium ELE, but low significance, and as such has been determined to have a medium Retention Value (Consider for Retention). It likely stands far enough from the construction footprint to remain viable. Tree 20 is to be retained.

Tree 21 is a semi-mature specimen of Swamp Mahogany (*Eucalyptus robusta*), with an approximate height of 9m. It is exhibiting fair health and vigour, and fair structure. It has a co-dominant form. It has been assessed as having a medium ELE, but low significance, and as such has been determined to have a medium Retention Value (Consider for Retention). It will require removal to accommodate the demolition works. Tree 21 is to be removed.

Tree 22 is a semi-mature specimen of Broad-leaved Paperbark (*Melaleuca quinquenervia*), with an approximate height of 9m. It is exhibiting good health and vigour, and fair structure. It has a co-dominant form. It has been assessed as having a long ELE, but low significance, and as such has been determined to have a medium Retention Value (Consider for Retention). It will require removal to accommodate the demolition works. Tree 22 is to be removed.

Tree 23 is a semi-mature specimen of Broad-leaved Paperbark (*Melaleuca quinquenervia*), with an approximate height of 11m. It is exhibiting good health and vigour, and poor structure. It has a co-dominant form, with associated inclusion. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 23 is to be removed.

Tree 24 is a semi-mature specimen of Broad-leaved Paperbark (*Melaleuca quinquenervia*), with an approximate height of 10m. It is exhibiting good health and vigour, and poor structure. It has an overly-slender form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 24 is to be removed.

Tree 25 is a semi-mature specimen of Broad-leaved Paperbark (*Melaleuca quinquenervia*), with an approximate height of 9m. It is exhibiting good health and vigour, and poor structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 25 is to be removed.

Tree 26 is a semi-mature specimen of Broad-leaved Paperbark (*Melaleuca quinquenervia*), with an approximate height of 12m. It is exhibiting fair health and vigour, and poor structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 26 is to be removed.

Tree 27 is a semi-mature specimen of Tuckeroo (*Cupaniopsis anarcardioides*), with an approximate height of 6m. It is exhibiting good health and vigour, and poor structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 27 is to be removed.

Tree 28 is a semi-mature specimen of Willow-leaved Hakea (*Hakea salicifolia*), with an approximate height of 6m. It is exhibiting fair health and vigour, and poor structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 28 is to be removed.

Tree 29 is a semi-mature specimen of Willow-leaved Hakea (*Hakea salicifolia*), with an approximate height of 7m. It is exhibiting fair health and vigour, and poor structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 29 is to be removed.

Tree 30 is a semi-mature specimen of Brush Cherry (*Syzygium australe*), with an approximate height of 6m. It is exhibiting good health and vigour, and fair structure. It has a co-dominant form. It has been assessed as having a medium ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 30 is to be removed.

Tree 31 is a semi-mature specimen of Willow-leaved Hakea (*Hakea salicifolia*), with an approximate height of 6m. It is exhibiting fair health and vigour, and fair structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 31 is to be removed.

Tree 32 is a semi-mature specimen of Willow-leaved Hakea (*Hakea salicifolia*), with an approximate height of 6m. It is exhibiting fair health and vigour, and poor structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 32 is to be removed.

Tree 33 is a semi-mature specimen of Willow-leaved Hakea (*Hakea salicifolia*), with an approximate height of 6m. It is exhibiting fair health and vigour, and poor structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 33 is to be removed.

Tree 34 is a semi-mature specimen of Willow-leaved Hakea (*Hakea salicifolia*), with an approximate height of 6m. It is exhibiting fair health and vigour, and fair structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 34 is to be removed.

Tree 35 is a semi-mature specimen of Willow-leaved Hakea (*Hakea salicifolia*), with an approximate height of 6m. It is exhibiting fair health and vigour, and fair structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 35 is to be removed.

Tree 36 is a semi-mature specimen of Willow-leaved Hakea (*Hakea salicifolia*), with an approximate height of 7m. It is exhibiting good health and vigour, and fair structure. It has a co-dominant form. It has been assessed as having a medium ELE, but low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 36 is to be removed.

Tree 37 is a mature specimen of Cheese Tree (*Glochidion ferdinandi*), with an approximate height of 12m. It is exhibiting fair health and vigour, and fair structure. It has a co-dominant form. It has been assessed as having a medium ELE, and medium significance, and as such has been determined to have a medium Retention Value (Consider for Retention). It will require removal to accommodate the demolition works. Tree 37 is to be removed.

Tree 38 is a semi-mature specimen of Broad-leaved Paperbark (*Melaleuca quinquenervia*), with an approximate height of 5m. It is exhibiting good health and vigour, and fair structure. It has a suppressed form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 38 is to be removed.

Tree 39 is a semi-mature specimen of Broad-leaved Paperbark (*Melaleuca quinquenervia*), with an approximate height of 13m. It is exhibiting good health and vigour, but poor structure. It has a co-dominant form. It has been assessed as having a medium ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 39 is to be removed.

Tree 40 is a semi-mature specimen of Broad-leaved Paperbark (*Melaleuca quinquenervia*), with an approximate height of 9m. It is exhibiting fair health and vigour, and fair structure. It has been assessed as having a medium ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 40 is to be removed.

Tree 41 is a semi-mature specimen of Woollybutt (*Eucalyptus longifolia*), with an approximate height of 11m. It is exhibiting fair health and vigour, and fair structure. It has been assessed as having a long ELE, but only low significance, and as such has been determined to have a medium Retention Value (Consider for Retention). It will require removal to accommodate the demolition works. Tree 41 is to be removed.

Tree 42 is a semi-mature specimen of Queensland Silver Wattle (*Acacia podalyriifolia*), with an approximate height of 5m. It is exhibiting fair health and vigour, and fair structure. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 42 is to be removed.

Tree 43 is a semi-mature specimen of Swamp Mahogany (*Eucalyptus robusta*), with an approximate height of 9m. It is exhibiting good health and vigour, but poor structure. It has a co-dominant form, with an associated defect. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 43 is to be removed.

Tree 44 is a semi-mature specimen of Willow-leaved Hakea (*Hakea salicifolia*), with an approximate height of 5m. It is exhibiting fair health and vigour, and fair structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 44 is to be removed.

Tree 45 is a semi-mature specimen of Sweet Pittosporum (*Pittosporum undulatum*), with an approximate height of 5m. It is exhibiting good health and vigour, but only fair structure. It has a co-dominant form. It has been assessed as having a medium ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 45 is to be removed.

Tree 46 is a mature specimen of River She Oak (*Casuarina cunninghamiana*), with an approximate height of 20m. It is exhibiting good health and vigour, but poor structure. It has a co-dominant form. It has been assessed as having a long ELE, and medium significance, and as such has been determined to have a high Retention Value (Priority for Retention). It will require removal to accommodate the demolition works. Tree 46 is to be removed.

Tree 47 is a mature specimen of Native Frangipani (*Hymenosporum flavum*), with an approximate height of 12m. It is exhibiting good health and vigour, but only fair structure. It has been assessed as having a medium ELE, and medium significance, and as such has been determined to have a medium Retention Value (Consider for Retention). It will require removal to accommodate the demolition works. Tree 47 is to be removed.

Tree 48 is a semi-mature specimen of Silky Oak (*Melaleuca quinquenervia*), with an approximate height of 13m. It is exhibiting good health and vigour, but poor structure. It has a co-dominant form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It will require removal to accommodate the demolition works. Tree 48 is to be removed.

Tree 49 is a semi-mature specimen of Willow-leaved Hakea (*Hakea salicifolia*), with an approximate height of 5m. It is exhibiting good health and vigour, but only fair structure. It has a lopped form. It has been assessed as having a short ELE, and low significance, and as such has been determined to have a low Retention Value (Consider for Removal). It stands close enough to the construction footprint to be impacted by the works – primarily the demolition works – but is likely to remain viable if effective Tree Protection measures are implemented. Tree 49 is to be retained.

6.4 WORKING WITHIN TPZS & SRZS

The Australian Standard *AS4970-2009 Protection of trees on development sites*⁵ has recommendations for minimising impacts on trees when working within TPZs and SRZs.

Firstly, it lists the following activities as excluded from being carried out within TPZs⁵:

- Machine excavation including trenching
- Excavation for silt fencing
- Cultivation
- Storage
- Preparation of chemicals, including preparation of cement products
- Parking of vehicles and plant
- Refuelling
- Dumping of waste
- Wash down and cleaning of equipment
- Placement of fill
- Lighting of fires
- Soil level changes
- Temporary or permanent installation of utilities and signs
- Physical damage to the tree

For minor encroachment (<10% of the TPZ area, and outside the SRZ) “*detailed root investigations should not be required*” so long as the area lost can be “*compensated elsewhere and contiguous with the TPZ*”, which in this case may be achievable for Trees 3, 4, & 17.

For trees with a major encroachment (>10% of the TPZ area, or inside the SRZ), the area lost should also be “*compensated elsewhere and contiguous with the TPZ*”. However, the project arborist must also “*demonstrate that the tree(s) would remain viable*”. In most cases, this will require an inspection of the root system, after it is exposed by non-destructive means. The project arborist then makes assessments of the location and distribution of roots, the potential loss of root mass and various tree and site factors. This has relevance for Trees 10-13, & 49.

6.5 NON-DESTRUCTIVE EXCAVATION TO INVESTIGATE ROOT SYSTEMS

*AS4970-2009 Protection of trees on development sites*⁵ states that the “location and distribution of the roots [are] to be determined through non-destructive investigation methods (pneumatic, hydraulic, hand digging or ground penetrating radar).”

Investigation is advised for trees that are to be retained with a TPZ encroachment >10%, or any SRZ encroachment. As shown in Table 7, this is applicable for Trees 10-13, & 49.

The level of investigation would be limited to excavating a trench approximately 500mm deep, along the boundary in the areas where it intersects with the TPZs of those Trees 10-13, & 49 that are to be retained.

Any root investigation should be supervised by a suitably qualified consulting arborist (AQF Level 5 minimum).

6.6 SITE ESTABLISHMENT

6.6.1 WASTEWATER & EROSION CONTROL

Aside from the demolition works, the most concerning aspect of the development is in regards to the slope at the site, and the sensitivity of the areas downslope from the construction footprint.

Effective wastewater and erosion controls must be installed prior to the beginning of the demolition works.

This is particularly important for the area of remnant indigenous vegetation (listed as 240L in the *Section 170 Register*), which is downslope of the construction footprint. Altered nutrient levels and toxic runoff has the potential to do great damage to Australian indigenous plant communities, which are generally very sensitive to soil conditions.

6.6.2 PRUNING

As shown in Figure 24, there are 4 large Maiden's Gum (*Eucalyptus maidenii*) adjacent the site entrance (but outside the construction footprint) which may require some clearance pruning to allow machinery to be brought onto site without damaging these trees. The trees are already pruned to allow delivery truck access, however it is likely that larger machinery will be brought onto site during construction.

Once the dimensions of any machinery and plant to be used onsite are known, a pruning specification can be developed.

Any pruning specifications should be written by a suitably qualified consulting arborist (minimum AQF Level 5), and any pruning should be conducted by suitably qualified arborists (minimum AQF Level 3).

Alternatively, pruning may be conducted without a pruning specification, if it is supervised by a suitably qualified consulting arborist (minimum AQF Level 5), and conducted by suitably qualified arborists (minimum AQF Level 3).

Any pruning works should be conducted before the installation of Tree Protection measures, in accordance with the Australian Standard *AS4373-2007 Pruning of amenity trees*¹².

¹² Standards Australia. 2007. *AS4373-2007 Pruning of amenity trees*.

6.6.3 TREE REMOVALS

Any trees identified for removal should be removed before the installation of Tree Protection measures.

6.7 REPLACEMENT PLANTINGS

The plantings that will make up the soft landscaping elements of the new development represent an opportunity to enhance the ecology of the site, by using plant species that are associated with Sydney Red Gum (*Angophora costata*) communities. Not only will any such species be readily adapted to the remnant soil types, and will likely function as sources of food and habitat for native fauna.

The *Taronga Zoo: Landscape Management Plan*¹¹ provides examples of trees, shrubs, grasses and groundcovers that are associated with Sydney Red Gum (*Angophora costata*) communities.

Some example trees include:

- Sydney Red Gum (*Angophora costata*)
- Red Bloodwood (*Corymbia gummifera*)
- Sydney Peppermint (*Eucalyptus piperita*)

Some example shrubs include:

- Sweet Wattle (*Acacia suaveolens*)
- Mock Olive (*Notelaea longifolia*)
- Tree Broom Heath (*Monotoca elliptica*)

Some example grasses/groundcovers include:

- Spiny-headed Mat-rush (*Lomandra longifolia*)
- Blue Flax-lily (*Dianella caerulea*)
- Brown's Common Lovegrass (*Eragrostis brownii*)

7 CONCLUSIONS

Based on ground-based visual inspections alone, the following conclusions have been made for the 49 trees at the site:

- These trees are not situated within proximity to the heritage items listed under the *Mosman Local Environment Plan 2012*⁸, such as the “Rainforest Aviary”, “Elephant House”, bus shelter and office, floral clock and lower entrance gates.
- The site is adjacent to two areas of remnant indigenous vegetation; one to the northeast (105L), and another to the southwest (240L). These two areas are listed in the *Taronga Zoo Landscape Management Plan* as “*Angophora costata* Association”, despite not actually containing any specimens of Sydney Red Gum (*Angophora costata*).
- The area listed as 105L is atop a sandstone outcrop that is elevated above the level of the rest of the site, and as such should be relatively easy to exclude from construction impacts.
- The area listed as 240L, however, is downslope from the construction footprint, and will require specific Tree Protection measures to be implemented prior to, and during, site establishment.
- The extent of the necessary demolition will likely require the removal of Trees 5-9, 14-18, and 21-48.
- Trees 1-4, 10-13, 19-20 & 49 are eligible for retention (of which Trees 1-4 stand within the area listed as 240L).
- Taronga Zoo itself is listed as a Heritage Item (#134) under the *Mosman Local Environment Plan 2012*.
- As Items 105L and 240L are proposed to be retained (other than the required removal of some trees within), the impacts of the proposal including during the demolition and construction stage should be mitigated, through the implementation of appropriate soil and erosion control protection measures, as well as stormwater management measures.
- Altered nutrient levels and toxic runoff (from erosion or stormwater) has the potential to do great damage to Australian indigenous plant communities, which are generally very sensitive to soil conditions. This is particularly important for the area of remnant indigenous vegetation (listed as 240L in the *Section 170 Register*), which is downslope of the construction footprint.
- Trees 5, 9 & 14 are hazardous and should be removed regardless of the development.
- TPZ incursions for Trees 3-5 & 17 are allowable.
- TPZ incursions for Trees 10-13, 19-20 & 49 will require the project arborist to demonstrate that the trees will remain viable i.e. via non-destructive excavation.
- Any root investigation should be supervised by a suitably qualified consulting arborist (AQF Level 5 minimum).
- The 4 large Maiden’s Gum (*Eucalyptus maidenii*) adjacent the site entrance may require some clearance pruning to allow machinery to be brought onto site without damaging these trees.
- Once the dimensions of any machinery and plant to be used onsite are known, a pruning specification can be developed.
- Any pruning works should be conducted before the installation of Tree Protection measures, in accordance with the Australian Standard *AS4373-2007 Pruning of amenity trees*.
- Any trees identified as undesirable for retention should be removed before the installation of Tree Protection measures.



8 RECOMMENDATIONS

The following are the recommendations for the 49 trees at the site.

Table 8 – Recommendations.

Tree #	Species	Recommendation
1	<i>Eucalyptus botryoides</i>	Retain Install Tree Protection measures
2	<i>Eucalyptus maidenii</i>	Retain Install Tree Protection measures
3	<i>Eucalyptus saligna</i>	Retain Install Tree Protection measures
4	<i>Eucalyptus punctata</i>	Retain Install Tree Protection measures
5	<i>Eucalyptus punctata</i>	Remove (hazardous) Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
6	<i>Radermachera</i> sp.	Remove Replace where appropriate with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
7	<i>Eucalyptus robusta</i>	Remove Replace where appropriate with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
8	<i>Eucalyptus robusta</i>	Remove Replace where appropriate with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
9	<i>Eucalyptus robusta</i>	Remove (hazardous) Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
10	<i>Eucalyptus robusta</i>	Retain Undertake non-destructive excavation to determine extent of root system that will be compromised
11	<i>Eucalyptus robusta</i>	Retain Undertake non-destructive excavation to determine extent of root system that will be compromised
12	<i>Eucalyptus robusta</i>	Retain Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
13	<i>Acacia binervia</i>	Retain Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
14	<i>Eucalyptus robusta</i>	Remove (hazardous) Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
15	<i>Melaleuca linariifolia</i>	Remove Replace where appropriate with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
16	<i>Melaleuca linariifolia</i>	Remove Replace where appropriate with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
17	<i>Banksia integrifolia</i>	Remove Replace where appropriate with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities

18	<i>Banksia integrifolia</i>	Remove Replace where appropriate with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
19	<i>Washingtonia</i> <i>sp.</i>	Retain Install Tree Protection measures
20	<i>Eucalyptus botryoides</i>	Retain Install Tree Protection measures
21	<i>Eucalyptus robusta</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
22	<i>Melaleuca quinquenervia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
23	<i>Melaleuca quinquenervia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
24	<i>Melaleuca quinquenervia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
25	<i>Melaleuca quinquenervia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
26	<i>Melaleuca quinquenervia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
27	<i>Cupaniopsis anacardioides</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
28	<i>Hakea</i> <i>salicifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
29	<i>Hakea</i> <i>salicifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
30	<i>Syzygium australe</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
31	<i>Hakea</i> <i>salicifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
32	<i>Hakea</i> <i>salicifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
33	<i>Hakea</i> <i>salicifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
34	<i>Hakea</i> <i>salicifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
35	<i>Hakea</i> <i>salicifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
36	<i>Hakea</i> <i>salicifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
37	<i>Glochidion ferdinandi</i>	Remove Replace with species associated with Sydney Red Gum

		(<i>Angophora costata</i>) communities
38	<i>Melaleuca quinquenervia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
39	<i>Melaleuca quinquenervia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
40	<i>Melaleuca quinquenervia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
41	<i>Eucalyptus longifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
42	<i>Acacia podalyriifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
43	<i>Eucalyptus robusta</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
44	<i>Hakea salicifolia</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
45	<i>Pittosporum undulatum</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
46	<i>Casuarina cunninghamiana</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
47	<i>Hymenosporum flavum</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
48	<i>Grevillea robusta</i>	Remove Replace with species associated with Sydney Red Gum (<i>Angophora costata</i>) communities
49	<i>Hakea salicifolia</i>	Retain Install Tree Protection measures

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The information contained within this report is to be used solely for the purposes that were specified at the time of engagement.

All attempts have been made to ensure the legitimacy of any information which has been gathered in the process of compiling this report, however Sydney Arbor Trees Pty. Ltd. cannot be held liable for inaccurate or misleading information which has been provided by others.

Any tree inspections or assessments which have been carried out for the purposes of this report are valid only at the time of inspection and are based on what could reasonably be seen or diagnosed from a visual inspection carried out from ground level.

All inspections, unless otherwise stated, are based upon Visual Tree Assessment (VTA) techniques, industry best practice and applied knowledge. No internal diagnostic testing or below ground investigation has been carried out, unless otherwise stated.

Trees are a dynamic living organism and as such they have a finite lifespan the end of which cannot always be predicted or understood, even apparently healthy trees can die suddenly or fall without warning. As such there is no warranty or guarantee provided, or implied, regarding the future risks associated with any tree.