Arboricultural Impact Assessment report

Site address

20 Selwyn Street, Mayfield East NSW 2304

Lot 1 DP 581002

Prepared for property owners

JBC Family Nominees Pty Ltd

24 July 2024

CONTENTS

1. INTRODUCTION

1.1. This document discusses 23 trees of a building proposal. None of the trees are mature *Ficus sp.* trees.

1.2. The survey and plan used to visualise the TPZ and SRZ had been provided to me from Land Development Solutions, Broadmeadow 2292 and Shade Designs Newcastle Pty Ltd.

1.3. Legislative controls attributable to this proposal are considered as follows:

1.3.1. This document takes into consideration the State Environmental Planning Policy (Transport and Infrastructure) 2021, Chapter 5 *Three Ports Port Botany, Port Kemble and Port of Newcastle, Section 5.29 – Preservation of trees or vegetation*

1.3.2. *Newcastle Local Environment Plan 2012 (pub. 30-5-2014)*

1.3.3. *Land zoning SP1: Special Activities (pub. 26-8-2022)*

1.3.4. Tree assessment in relation to *Newcastle Development Control Plan, March 1, 2023,* and its accompaniment with the *Newcastle Urban Forest Technical Manual, February 2018, Part A Private Trees, Part 3.0, and Part 4.0.*

1.4. Guidelines of the *Australian Standard: AS 4970-2009 Protection of trees on development sites, is* implemented herein for discussing the impact proposed development has on trees and trees' impacts in close proximity to built assets for determining encroachment tolerances.

2. METHOD

2.1. Amongst other common arboricultural methods, Area Tree Vet uses symptom evaluation by means of Visual Tree Assessment (VTA) as developed by Claus Mattheck et al (1994)[1]. Tree assessment applies VTA.

2.2. Tree assessment follows principles of ISA (International Society of Arboriculture) for a level 2 – Basic assessment, defined as a *detailed visual inspection of a tree and its surrounding site and a synthesis of the information collected*. Tools used were diametre tape, a hand trowel to conduct minor excavation to expose the root collar, compass, digital camera, digital distance measurer, and writing material to document data taken.

2.3. To overcome my photography deficiencies, all photos were put thorough a shadow/highlight filter and sharpened. Additionally resized from a RAW to JPEG for a manageable and transferable format.

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[1] Lonsdale, D.; 1999, *Principles of Tree Hazard Assessment and Management*: Page 148, 5.1.3 Systems for quantifying hazard and risk; page 149, Figure 5.1 Tree assessment strategy; page 151, paragraph 1. Mattheck, C., Breloer, H.; Strouts, R, 1994, *The Body Language of Trees: A Handbook for Failure Analysis*: Page 196: The Visual Tree Assessment procedure.

3. EXECUTIVE SUMMARY

3.1. The dominant tree population is to the west of the subject site. These are trees 1 to 19. Not all trees are in the site, but they share boundaries and have interlocking root zones. Trees 20, 21 and 22 are outside the eastern boundary and are considered public asset trees.

3.2. The landform along the west boundary is an increasingly steep embankment. The embankment increases in height the farther south one progresses. The face of the embankment supports root growth. The embankment has a dense understory of dominantly Lantana thickets. The trunks of trees 9 and 11 could not be accessed because of the density of Lantana. This Lantana thins out between trees 11 to 19. From there the vegetation is heavy with dense thickets of Lantana dotted with trees. This area is not accessible by foot. The land beyond tree 19 is not part of the proposal.

3.3. All trees are in relatively good condition. Several have been pruned. This may have been for high vehicle clearance.

3.4. Most trees are River She Oak. These trees grow best with one another. They form groves of the same species by growing from root suckers. I this way they support one another and provide allelopathic benefits to reduce competition. Between the larger trees are smaller saplings which are yet to develop heartwood. These trees have sprouted from root suckers. Several of the trees have structural defects. These are trees numbered 5, 8, 12 and 14. In isolation, these trees would be of concern in high-frequency areas, but here they are supported by adjoining trees and therefore pose minimal risks even if they would fail.

3.5. The density of the tree population has reduced sunlight infiltration resulting in some internal canopy dieback. Branch suppression from adjoining trees has affected balanced branching. However, these are not issues, but rather growth optimisation in a group situation.

3.6. Most trees are outside the scope of works. Trees 16, 20, 21 and 22 may require removal, however, fencing could accommodate their retention.

3.7. Tree 4, a Broad-leaved paperbark is the largest tree fringing the site.

3.8. Trees 9 and 11 are in poor condition resulting from disease, large size dead branches and extensive dieback. These trees could be removed due to associated hazards and risks. However, the determining authority would need to quantify their removal because they are not affected by site works.

3.9. The trees form an aesthetically pleasing, dense green barrier.

3.10. No tree requires removal, and all trees are retainable.

4. TREE PROTECTION PLAN

4.1. It is suggested that the chain wire fence to the east and west of the site accommodate trees 16, 20, 21 and 22.

4.2. As much of the tree population resides at a high point in the landform and are at a distance from construction of buildings and the driveway, they do not require temporary fencing.

5. CONSTRUCTION ENCROACHMENT

AS 4970-2009 Protection of trees on development sites

5.1. The Australian Standard: *AS 4970-2009 Protection of trees on development sites,* discusses the impact proposed development has on trees and trees' impacts in close proximity to built assets.

5.1.1. **Tree protection zone (TPZ)** Considers an area around a tree to be set aside for its protection. The TPZ considers its growing environment above and below ground to determine the size of allowable encroachment prior to site works which can affect tree health and sustainability. The TPZ is a combination of the trees' root protection zone and crown protection zone. TPZ radius calculation is done by measuring the trees DBH. DBH is the measurement of trunk width calculated at 1.4 metres above the ground surface from the base of the tree using a diametre tape. TPZ is calculated thus: DBH x 12. Multi-trunked trees are calculated using a different formula: $\sqrt{(DBH_1)^2 + (DBH_2)^2}$ + and so forth.

5.1.2. **Structural root zone (SRZ)** The SRZ need only be calculated when major encroachment into a TPZ is proposed. The SRZ is the area around the base of the tree required for the tree's stability in the ground, it is considered critical to the tree's integrity. The woody root growth and soil cohesion in this area are necessary to hold the tree upright. This zone considers a trees structural stability only, not the root zone required for a tree's vigour and long-term viability, *which will usually be much larger*[2]. An indicative SRZ radius calculation is done by measuring the trees' diametre immediately above the root buttress (DRB).

5.2. Tree 1, 10, 17, 20 and 22 are the only tree to have no TPZ incursion. Minimal TPZ incursion would occur to all other trees except tree 4, 16 and 20. Tree 22 would not be affected at all by the proposal due to its displacement to the south-east of the proposed.

5.3. Tree 4, being the largest tree with subsequently the largest TPZ and SRZ would have incursion to both TPZ and SRZ. However, as it resides on top a slope in the landform the TPZ and SRZ are along the face of the embankment and may not be as far to the east because of the one-dimension of the site layout as seen on paper.

5.4. SRZ incursion would occur to most other trees. This results from fencing to the west of the site (east of the trees) along the flat of the landform. This fencing should be of chain wire to reduce impact to the trees.

5.5. Tree 16 and 21 may not be retainable because of the location of the proposed chain wire fencing. Fencing could accommodate retention of the trees by placement around them rather than through the SRZ of the tree.

5.6. Trees 18a, 18b and 19 would have minimal TPZ incursion from the placement of the shipping containers. Their branch spread would not be affected by height of the shipping containers.

All measurements in metres

*Denotes a multi-trunked tree: The trees' diametre is a calculated exaggeration due to it being multi-trunked (more than one trunk).

Tree #	DBH Diametre at breast height	TPZ Tree protection zone	DRB Diametre at root buttress	SRZ Structural root zone
1	0.46*	**5.5**	0.67	**2.8**
2	0.45	**5.4**	0.53	**2.5**
3	0.53	**6.4**	0.65	**2.8**
4	1.15	**13.8**	1.48	**3.9**
5	0.52	**6.2**	0.73	**2.9**
6	0.53*	**6.4**	0.69	**2.8**
7	0.48	**5.8**	0.63	**2.7**
8	0.56	**6.7**	0.78	**3.0**
9	0.65	**7.8**	0.75	**2.9**
10	0.39	**4.7**	0.50	**2.5**
11	0.65	**7.8**	0.75	**2.9**
12	0.37	**4.4**	0.48	**2.4**
13	0.45	**5.4**	0.68	**2.8**
14	0.44	**5.3**	0.64	**2.7**
15	0.48	**5.8**	0.76	**2.9**
16	0.28	**3.4**	0.40	**2.3**
17	0.25*	**3.0**	0.60	**2.7**
18a	0.42*	**5.0**	0.58	**2.6**
18b	0.56	**6.7**	0.65	**2.8**
19	0.41	**4.9**	0.52	**2.5**
20	0.40	**4.8**	0.68	**2.8**
21	0.42*	**5.0**	0.54	**2.6**
22	0.41	**4.9**	0.58	**2.6**

[2] AS 4970-2009 Protection of trees on development sites. Section 1.4.5 Structural root zone (SRZ)

6. SITE PLAN WITH TPZ AND SRZ

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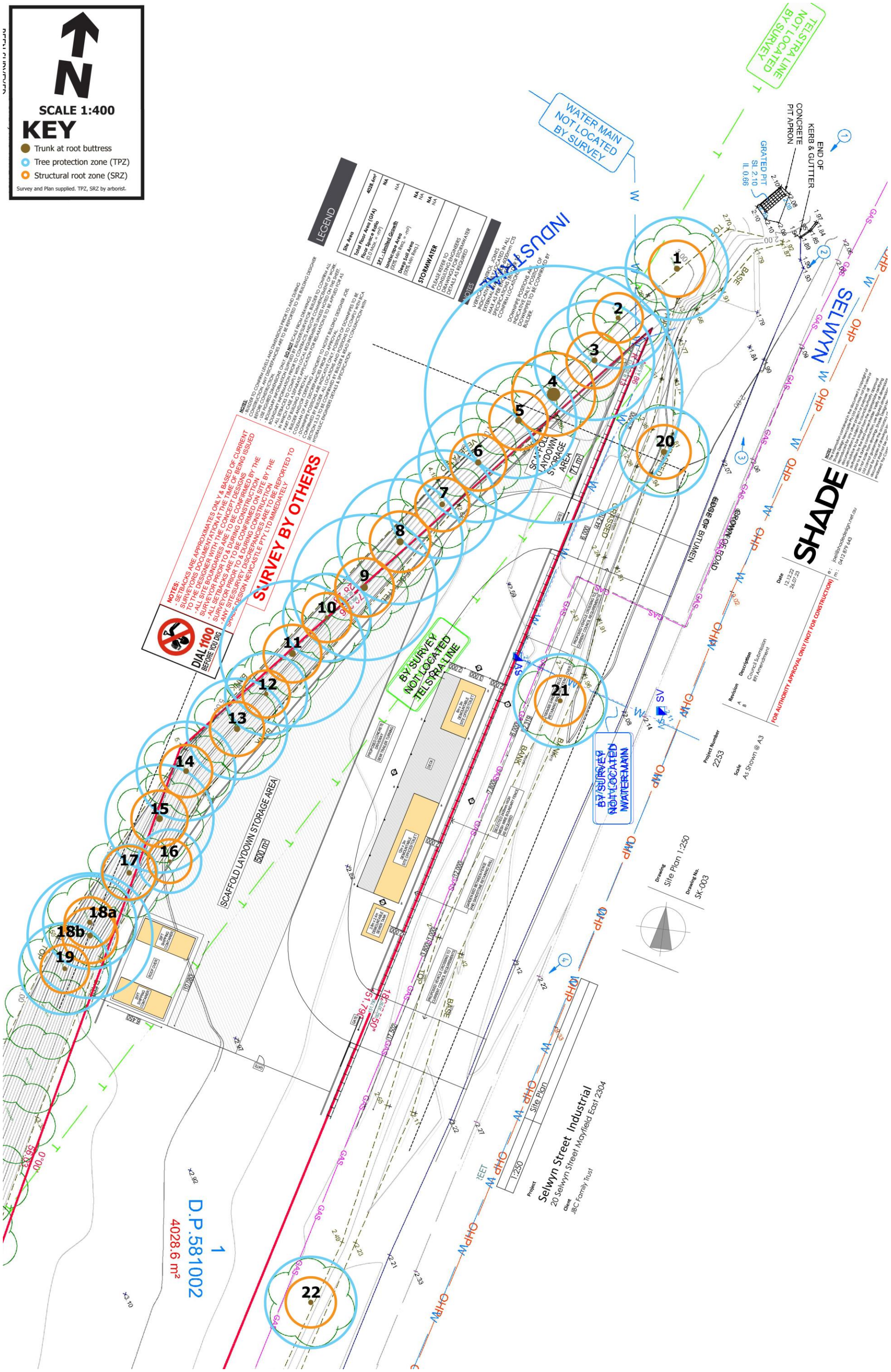


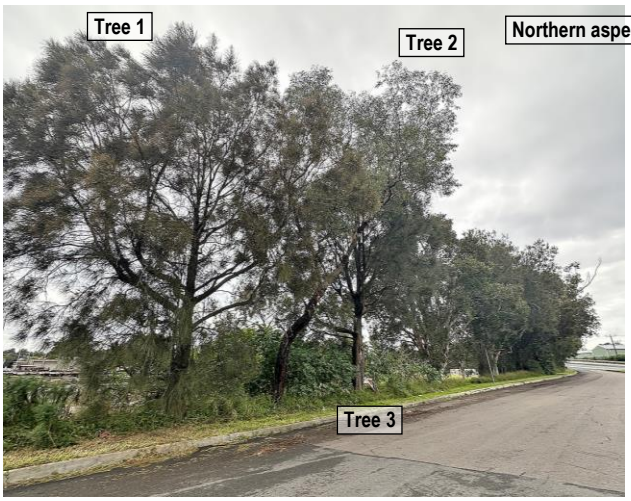
7. TREE SCHEDULE

#	Common / Botanical name	Age class	Height in metres	DBH in centimetres	CANOPY SPREAD in metres N	S	E	W	Average crown size in m²	Health & Vigour	Condition	Suitability	Sustainability in years	Landscape significance	Retention value
* Denotes a co-dominant or multi-trunked tree															
1	River She Oak *Casuarina cunninghamiana*	M	14	46*	6	4	3	5	60	Good / Normal	Good	Good	40+	4	Moderate
	Root crown suckers. Trunk fluted with fissures. Co-dominant, 45 and 10cm DBH. Branching over roadway. Medium volume dieback to inner canopy														
2	Narrow leaved ironbark *Eucalyptus crebra*	M	14	45	7	2	0	5	36	Fair / Normal	Average	Good	15 – 40	5	Low
	Moderately crooked trunk leaning north-west. Epicormic along tension side of lean. Impact injury along west side of trunk. Supressed														
3	River She Oak *Casuarina cunninghamiana*	M	14	53	6	5	3	5	64	Good / Normal	Fair	Good	15 – 40	3	High
	Basal flare. Trunk fluted with fissures, north. West side scaffold failure at 2m, failure damaged trunk. Pruning history														
4	Broad leaved paperbark *Melaleuca quinquenervia*	M	14	115	6	5	6	6	105	Good / Normal	Good	Good	40+	3	High
	Stout trunk. Basal flare. Trunk fluted with fissures. Low branching in to two leaders at 2m. One enveloping scaffold wraps around trunk to the east at 1m.														
5	River She Oak *Casuarina cunninghamiana*	M	16	52	6	5	4	5	89	Good / Normal	Good	Good	40+	3	High
	Basal flare. Trunk fluted with fissures. Rib formation at main branch junction at 3m.														
6	Broad leaved paperbark *Melaleuca quinquenervia*	M	12	53*	3	6	5	5	76	Good / Normal	Good	Good	40+	3	High
	Forks into two trunks at 1m, deep seam of included bark. Co-dominant, 38 and 37cm DBH. End weighted foliage distribution. Lengthy dead branches. Pruning history														
7	River She Oak *Casuarina cunninghamiana*	M	14	48	5	4	4	4	55	Fair / Low	Fair	Good	40+	3	High
	Basal flare. Trunk fluted with fissures. Branching from 1m. Poor foliage cover														
8	River She Oak *Casuarina cunninghamiana*	M	14	56	7	4	5	6	101	Good / Normal	Fair	Good	40+	3	High
	Basal flare. Lengthy and deep fissure, south-west to approximately 4m, discoloured. Included bark to lower scaffold branches. Pruning history														
9	Swamp mahogany *Eucalyptus robusta*	M	14	~65	5	5	2	5	52	Declining / Low	Poor	Good	5 - 15	5	Low
	Trunk not accessible. Divergent trunk over roadway. Bracket fungal fruiting bodies at 1.5m. All growth is epicormic. High volume dieback														
10	River She Oak *Casuarina cunninghamiana*	SM	14	39	3	5	1	5	39	Fair / Low	Fair	Good	40+	4	Moderate
	End weighted foliage distribution. Medium volume dieback														
11	Swamp mahogany *Eucalyptus robusta*	M	14	~65	5	3	6	5	72	Declining / Low	Poor	Good	15 – 40	4	Moderate
	Trunk not accessible. Low branching. East side scaffold failure. Transverse scaring with splits, exuding. High volume of large diametre dieback which is decaying														
12	River She Oak *Casuarina cunninghamiana*	SM	12	37	5	3	4	5	53	Fair / Low	Fair	Good	15 – 40	4	Moderate
	Basal flare. Trunk fluted with fissures. Acutely convergent framework. End weighted foliage distribution. High volume dieback														
13	River She Oak *Casuarina cunninghamiana*	M	16	45	6	2	3	6	61	Good / Normal	Good	Good	40+	3	High
	Basal flare. Trunk fluted with fissures. Well formed U-shaped leader junction at 2.5m.														
14	River She Oak *Casuarina cunninghamiana*	M	15	44	6	5	4	6	81	Fair / Normal	Fair	Good	40+	3	High
	North-east side of trunk has a lengthy, longitudinal trunk crack with thick margin rib formation. Acutely convergent leader junction at 4m. Low volume dieback														
15	River She Oak *Casuarina cunninghamiana*	M	15	48	6	4	6	4	76	Good / Normal	Good	Good	40+	3	High
	Basal flare. Trunk fluted with fissures. Decay present to lower north-east side of trunk. Branching at 2m. Divergent northern scaffold. Pruning history														
16	River She Oak *Casuarina cunninghamiana*	J	16	28	2	4	3	3	33	Good / Normal	Good	Good	40+	4	Moderate
	Basal flare. Upright. Isolated														
17	River She Oak *Casuarina cunninghamiana*	J	12	25*	2	4	3	3	33	Fair / Low	Fair	Good	40+	3	Low
	Multi-stemmed x 3 at ground level; 12, 12 and 18cm DBH, one trunk leans west to upright. Divergent branching. Broken branches north-west. Low volume dieback														

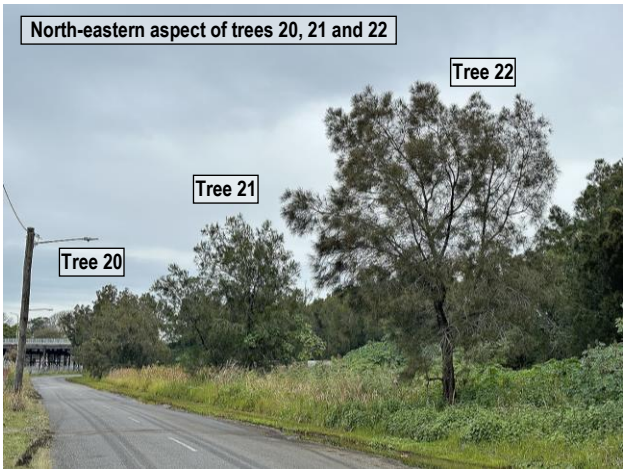
Tree schedule continued from previous page

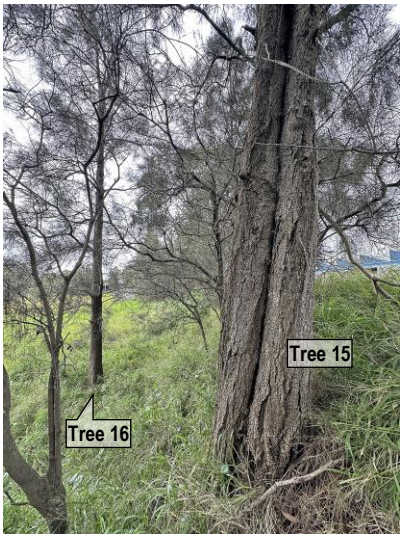
#	Common / Botanical name	Age class	Height in metres	DBH in centimetres	CANOPY SPREAD in metres N	S	E	W	Average crown size in m²	Health & Vigour	Condition	Suitability	Sustainability in years	Landscape significance	Retention value
* Denotes a co-dominant or multi-trunked tree															
18 a	Broad leaved paperbark *Melaleuca quinquenervia*	M	12	42*	5	2	3	4	38	Good / Normal	Good	Good	40+	4	Moderate
	Co-dominant, 33 and 26cm DBH. Trunk with slight leans south, stout. Low branching. Scaffold branches bow and sweep, highly divergent.														
18 b	Broad leaved paperbark *Melaleuca quinquenervia*	M	12	56	4	4	5	5	56	Good / Normal	Fair	Good	40+	3	High
	Branching at 2m.														
19	Broad leaved paperbark *Melaleuca quinquenervia*	M	13	41	5	4	4	5	66	Good / Normal	Good	Good	40+	3	High
	Upright. Branching at 2m. Extended west scaffold. Low volume dieback														
20	River She Oak *Casuarina cunninghamiana*	M	12	40	5	5	6	5	87	Good / Normal	Good	Good	40+	3	High
	Isolated. Slight lean east. Branching from 3m. Low volume dieback.														
21	River She Oak *Casuarina cunninghamiana*	M	14	42*	4	5	6	3	64	Good / Normal	Good	Good	40+	3	High
	Isolated. Divergent east scaffold														
22	River She Oak *Casuarina cunninghamiana*	M	14	42	5	4	7	4	75	Good / Normal	Good	Good	40+	3	High
	Isolated. Basal flare. Trunk fluted with fissures. Ivy along trunk. Branching from 1.5m. Extended east scaffold.														

8. Photos



Northern aspect of trees 1 to 11





9. DISCUSSION ON TREE CONDITIONS

9.1. **Tree 1** is a mature tree in good condition with normal vigour. It has a moderate crown size of 60m^2. It has adequate growth space with less restricted growth than the other trees. It has long term sustainability.

9.2. **Tree 2** has a crooked trunk that leans over the road. It is epicormic along the eastern side, opposing its lean. This suggests that reducing the length of the trunk by just one-third from overhanging the road may stimulate the epicormic growth to become endomorphic – the development of branches. Its health is fair because epicormic growth suggests an element of past trauma which is being overcome by new growth with normal vigour. The tree has a small average crown size of 36m^2. The poor branch distribution may become a risk to road users or pedestrians without formative pruning. Although site suitable, the tree has low sustainability and is of low retention value.

9.3. **Tree 3** had experienced a failure of its west scaffold branch, which remains on the ground alongside to its south. This has damaged the trunk and resulted in development of a small cavity which attributes to its average condition. The tree is relatively low in height with good basal flare indicating that it may recover from this failure without loss of stability. The tree has a moderate average crown size of 64m^2 and is of high retention value.

9.4. **Tree 4** is the largest and most prominent tree assessed. The one enveloping scaffold branch may eventually anastomise but would otherwise be end-weighted or removed to avoid buffeting damage to the trunk. It has a stout trunk with a low centre of gravity, no structural issues, and is in good health with normal vigour. This tree is long term sustainable, in good health qualifying for a high retention value and high landscape significance.

9.5. **Tree 5** has a rib formation at its main branching junction. This rib has formed because of included bark. The thickness of the rib suggests adaptive wood has reinforced this area to reduce failure potential of one or the other of its structural branches. This is a mature tree with a large average crown size of 89m^2. It is in overall good condition and has long term sustainability.

9.6. **Tree 6** has a low branch junction at 1m. The junction of its two leaders has a deep seam of included bark which has not formed adaptive wood as a response mechanism to weight loading. This is a concern for its structural integrity. Pruning of lengthy dead branches would allow better light penetration, which would stimulate lateral growth to offset its end weighted foliage This tree is otherwise in good health with normal vigour and a large average crown size of 76m^2. It has a high landscape significance and retention value.

9.7. **Tree 7** is a mature tree with good form. It appears in poor health, vigour and in fair condition because of its lack of foliage cover contributing to low photosynthesis. However, branching is balanced, and it has a moderate average crown size of 55m^2 contributing to its high retention value.

9.8. **Tree 8** is a broadly spreading tree despite its short height of 14m. There is a deep and discoloured seam which may have resulted from excessive movement of the trunk. Several areas of included bark at structural branch junctions are growth defects which are conducive to the species but offering it only fair in condition. However, it has a large average crown size of 101m2 suggesting good sustainability in this location and a high landscape significance.

9.9. **Tree 9** is in a declining health with low vigour. The dense thickets of lantana did not allow safe measurement of the root crown so this was approximated. It has a decomposing open wound to the north side of the trunk. At the base of the wound two aged fungal fruiting conks are present. It has a high volume of large diametre dieback attributable to its diseased condition. This tree is in poor condition and has succumbed to the decaying affects of the fungus. It is not long term sustainable but with a moderate average crown size of 52m2 it is of moderate landscape significance and retention value.

9.10. **Tree 10** is a semi-mature tree with a small average crown size of 39m^2. Foliage is concentrated to the ends of branches, and it has a medium volume of dieback. It is fair health but low in vigour. Removal of the diseased tree 9 and poor condition tree 10 may offer it long term sustainability by reducing competition and allowing better light infiltration.

9.11. **Tree 11** has dense thickets of lantana to approximately 2m in height which could not be safely penetrated. The root crown and diametre at breast height measurements were not able to be factually measured. Therefore, these measurements are approximating only. Transverse scaring which exudates suggest trauma and its fair condition. This tree is in declining health with low vigour due to the high volume of large diametre dead branches. The large average crown size of 72m^2 contributes to its moderate retention value but it is not long term sustainable.

9.12. **Tree 12** has a good structure, a sound base but an acutely convergent framework of a species predisposed of included bark may be indicative of future failure potential. Foliage concentrated to branch ends with a high volume of dieback presents as only fair health and low vigour. The tree has a moderate average crown size of 53m2 contributing to its moderate landscape significance and retention value.

9.13. **Tree 13** has good structure, health and vigour. The U-shaped leader junction is an unusually good form for a River She Oak. It is in good condition and has high landscape significance and retention value.

9.14. **Tree 14** has lengthy but compartmentalising trunk crack with thick margin rib formation. The rib formation is a good indication of the trees structural integrity and I have no concerns for its long-term sustainability despite an acutely convergent leader junction.

9.15. **Tree 15** has good structure with a sound, fissured base. However, surface decay is present to the lower north-east side of the trunk suggesting an element of pathogenic activity is occurring. Overall, the tree is in good condition and is long term sustainable.

9.16. **Tree 16** is a tall juvenile. It is displaced from the other trees residing on flat land to the east of tree 15 by approximately 4m. It is in good health, vigour and condition. It is not visually prominent but has long term sustainability.

9.17. **Tree 17** is potentially a 3-tree group which are clearly connected at the root level. One of the trees does lean to upright due to suppression. Their health is fair and vigour is low. Several broken branches to the north-west have affected structure which may have caused destabilisation. Its small average crown size of 33m2 contributes to low landscape significance and retention value.

9.18. **Tree 18a** is closely associated with **18b** which may be the same tree underground but have been assessed as individuals.

9.19. **Tree 18a** has highly contorted and divergent branching arising from a short stout trunk. It has a short height of 12m with good health and normal vigour. It is visually prominent with long term sustainability but its small average crown size of 38m^2 qualifies for moderate retention value.

9.20. **18b** is an upright tree with all the indications of good health, vigour form and condition. It is visually prominent with a moderate average crown size of 56m^2 and is of high retention value.

9.21. **Tree 19** is also an upright tree with good health, vigour form and condition. An extended west scaffold branch is beginning to impact height clearance of the road but could easily be addressed by pruning. This tree has a relatively large average crown size of 66m^2, is visually prominent with high sustainability and landscape significance.

9.22. **Tree 20, 21** and **22** are isolated trees to the eastern side of the site.

9.23. **Tree 20** is low branching with dense understory vegetation. It has good health and normal vigour in good condition. It has a large average crown size of 87m^2, is visually prominent with high sustainable and landscape significance.

9.24. **Tree 21** has good health and normal vigour in good condition. One divergent eastern scaffold does not detract from its good condition but could be end weight reduce to offer better balance. It has a large average crown size of 64m^2, is visually prominent with high sustainable and landscape significance.

9.25. **Tree 22** has good health and vigour and is in good condition. A vine entwining the lower trunk should be removed to prevent spread into branches which would affect health and potentially weigh the tree down potentially affecting structural integrity. It is visually prominent, has long term sustainability and high landscape significance with an average crown size of 75m^2.

10. AGE CLASS, HEALTH, VIGOUR AND CONDITION

10.1. The data section of this report uses the terms “Age”, “Structure” and “Health” which are described below. The reasoning for categorising three structure, health, vigour, and overall condition is to arrive at a hazard and risk rating and provide mitigation options to reduce probabilities of harm to humans and built assets.

10.2. **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*[3]. The age class for trees is commonly regarded as follows:

- **Juvenile:** A sapling which is yet to reach its first adult form. Heartwood is yet to fully develop, and a large portion of the tree consists of pithy wood. In my opinion a juvenile tree has a trunk diametre of less than approximately 29cm.
- **Semi-mature:** A tree which is approaching full genetic height and form. In my opinion a semi-mature tree has a trunk diametre of less than approximately 39cm.
- **Mature:** A tree which is fully grown and functioning as its genetic adult form has determined. In my opinion a mature tree has a trunk diametre of approximately 40cm or greater.
- **Over-mature or senescing:** Tree has existed in its adult form for such a length of time that that has begun to retrench its own crown. In some cases, its genetics and its biological condition has determined that branch abscission is vital to retaining its sustenance for the provision of reproduction. This is often seen by the loss of large branches or large, scaffold branch failures; lignotuber shoots along the ground surface, quantities of surrounding juveniles or seedling and/or profuse flowing and seeding in excess of overall crown condition. An over-mature or senescing tree can have a large quantity of structural defects.

10.3. **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. dormant, deciduous or semi-deciduous trees. Vigour can be categorised as **normal vigour, high vigour, low vigour, or dormant tree vigour.**

10.4. **Health:** As in human health, ill-health in a tree implies that the organism as a whole, is in some way malfunctioning. Ill-health in this report includes any deviation from the normal however much, or little of the tree is affected[4]. Healthy trees are better able to tolerate impacts, such as root injuries or toleration to construction encroachments than are non-vigorous trees. Healthy trees are generally vigorous and less likely under normal weather conditions to be hazardous in areas where humans interact with their surroundings.

- **Excellent:** Canopy density 100%. No dieback or deadwood. No history of failure. No pests. No decay.
- **Good:** Canopy density 90-100%. Little or no dieback or deadwood. No history of failure. Minor pests. Cavities at pruning wounds.
- **Fair:** Canopy density 60-90%. Small size twig dieback or deadwood. Small branch failures. Minor pests. Cavities at old pruning wounds.
- **Declining:** Canopy density 20-60%. Twig and branch dieback. History of scaffold branch failure. Significant pest infestation. One or more bracket fungal fruiting conks and/or small cavities.
- **Severe decline:** Canopy density less than 20%. Large and/or major scaffold branch failures. History of more than one scaffold branch failure. Severe pest infestation. Major cavities with bracket fungal fruiting conks[5].

10.5. **Structure:** Refers to the tree’s structural framework. VTA deploys a systematic process of indications beginning from its root crown where its ability to stabilise itself in the ground begins through to the positioning of branches. A trees’ structure is in a biological way determined by its species; however, its form can be manipulated by pruning activities and built assets that can affect its structure from developing in a natural way. In this way a trees structural integrity can become compromised; that is, the ability of a load-bearing part of a tree e.g.: tree trunk, branch, or root under normal conditions to sustain its resistance to loading forces. Overall tree structure is its form and will determine its sustainability in urban environments. Tree structure is rated excellent, good, average, fair or poor.

- **Excellent:** no deviation from natural form. Tree has excellent strength which is its ability to withstand stress and strain and is unlikely to fail in normal weather conditions.
- **Good:** some minor deviation from natural form, minor structural defects. Tree has good strength. Not likely to fail in normal weather conditions.
- **Average:** some deviation from natural form, minor structural defects. Defects likely to cause failures in normal weather conditions.
- **Fair:** great deviation from natural form, major structural. Defects will cause failures in any weather condition.
- **Poor:** tree is not a good representation of its natural form. Presents with significant quantities of structural defects posing a high risk of failure.

10.6. The overall **condition** of a tree is combination of its structure, health, and vigour. Structure, health, and vigour are giving ratings. Condition can be categorised as **good condition (G)**, **fair condition (F)**, **poor condition (P)** and **dead (D)**.

[3] British Standards 1991, p. 13; Harris et al. 2004, p. 262).

[4] Strouts, R.G., Winter, T.G., 2016, *Diagnosis of ill-health in trees*, Research for Amenity Trees No. 2, Arboricultural Association, The Malthouse, Stonehouse, United Kingdom.

[5] Clark, J., Matheny, N., 2009, *Tree Preservation during Development*, Treelogic Workshop, Melbourne, Australia, November 26 2009.

11. GLOSSARY[i]

11.1. **Acutely convergent:** A branch growing in a direction towards its point of attachment where the angle in the crotch is less than <90°.

11.2. **Basal flare:** Swelling at the root crown usually uniform around the base of the trunk involving tissue from the trunk and root crown.

11.3. **Condition:** A tree's crown form and growth habit, as modified by its environment (aspect, suppression by other trees, soils), the stability and viability of the root plate, trunk and structural branches (first and possibly second order branches), including structural defects such as wounds, cavities or hollows, crooked trunk or weak trunk/branch junctions and the effects of predation by pests and diseases. These may not be directly connected with vigour and it is possible for a tree to be of normal vigour but in poor condition.

11.4. **Dieback:** The death of some areas of the crown. Symptoms are leaf drop, bare twigs, dead branches and tree death, respectively. This can be caused by root damage, root disease, bacterial or fungal canker, sever 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 which may be temporary. Dieback can be categorised as Low, Medium or High-volume dieback.

11.5. **Epicormic shoots**: Juvenile shoots produced at branches or trunk from epicormic strands (arising from meristematic tissue) or sprouts produced from dormant or latent buds concealed beneath the bark. Production can be triggered by fire, pruning, wounding, or root damage but may also result from stress or decline.

11.6. **Fissure:** A seam between concave edges of fluted sections of a trunk, branch or root.

11.7. **Fluted (Fluting[ii])** A section of trunk, branch or root that is broadly convex or cable like and may be linear, helical or interconnected with sections usually separated by a fissure.

11.8. **Inclusion, included bark**:

11.8.1. The bark on the inner side of the branch union or is within a concave crotch that is unable to be lost from the tree and accumulates or is trapped by acutely divergent branches forming a compression fork.

11.8.2. Growth of bark at the interface of two or more branches on the inner side of a branch union or in the crotch where each branch forms a branch collar and the collars roll past one another without forming a graft where no one collar is able to subsume the other. Risk of failure is worsened in some taxa where branching is acutely divergent or acutely convergent and ascending or erect.

11.9. **Leader:** A structural branch asserting apical dominance.

11.10. **Photosynthesis:** In most green plants the process that converts light energy into chemical energy, with the uptake of carbon dioxide and production of water as a bi-product.

11.11. **Rib:** Adaptive wood that may form over a crack, included bark or enclosed bark and may be a sharp-edged rib as an elongated protuberance where a crack continues to develop or a round-edged rib where a broad convex swelling is formed over the crack by the addition of each new growth increment and the cracking is slowed or prevented from developing further (Mattheck & Breloer 1994, p. 57). Some rib-like growths may not be related to cracks or included bark having formed by older enlarged aerial roots, e.g. *Melaleuca quinquenervia.*

11.12. **Root crown:** Roots arising at the base of a trunk.

11.13. **Scaffold branch:** Considered a structural branch. Is the first order or other orders of branches elongated to form a permanent framework of branches supporting the crown, persisting beyond the tree's maturity.

11.14. **Sucker:** Epicormic shoot growing from a latent bud in older wood. Such shoots are vigorous and usually upright and arise below the graft union on the understock or at or below ground from the trunk or roots (Harris et al. 2004, p.18).

11.15. **Transverse stress:** A loading force at a right angle to a structure, e.g. such as causes a hazard beam.

11.16. **Transverse crack:** Caused by tensile stress stretching the fibres along their axes (Lonsdale 1999, p 50).

12. REFERENCES

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12.3. Mattheck, C., Breloer, H.; Strouts, R, 1994, *The Body Language of Trees: A Handbook for Failure Analysis,* Stationery Office Books.

12.4. Morton, A., 2003, The 7th National Street Tree Symposium, *Criteria for Assessment of Landscape Significance: Determining the retention value* of trees on development sites, 2006, Earthscape Horticultural Services, Sydney, Australia.

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13. ENDNOTES

[1] Lonsdale, D.; 1999, *Principles of Tree Hazard Assessment and Management*: Page 148, 5.1.3 Systems for quantifying hazard and risk; page 149, Figure 5.1 Tree assessment strategy; page 151, paragraph 1. Mattheck, C., Breloer, H.; Strouts, R, 1994, *The Body Language of Trees: A Handbook for Failure Analysis*: Page 196: The Visual Tree Assessment procedure.

[i] Largely adapted from Draper, B. D.; Richards, P., 2009, *Dictionary for Managing Trees in Urban Environments*, CSIRO Publishing, Collingwood, Victoria, Australia.

[iiiiii] Term by author.