ARBORICULTURE & ENVIRONMENT

Assessment of 23 trees within the Avenue of Honour, Bacchus Marsh

Health and condition review

Prepared For: Moorabool Shire Council
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1. Introduction

An audit of the trees that comprise the Bacchus Marsh Avenue of Honour (The Avenue) was completed in early 2019. The results identified 23 trees within The Avenue, that have been flagged for removal from a visual, ground based assessment.

Considering the high value and historic context of the trees, a more detailed assessment, including tomographic testing where required, has been sought to provide further management options which may allow retention of the trees.

C&R Ryder Consulting has been engaged to assess the trees recently identified as requiring removal. This report will provide:

- the findings of the assessment
- the risk associated with the trees
- management options to allow retention of the trees in the landscape.

2. Methodology

Josh Smyth and Cameron Ryder inspected the trees on Tuesday, 8 October 2019, Wednesday, 9 October 2019, Thursday, 14 November 2019 and Thursday, 5 December 2019. The following data was collected for the trees:

- Unique ID
- Image of tree
- Botanic and common name
- Tree dimensions (Height x Width)
- Diameter at breast height (DBH)
- Health
- Structure
- Defects
- Useful life expectancy (ULE)
- Recommended works
- Priority
- Risk Assessment
- Comments

The trees were assessed from ground level, heights were measured with a laser range finder, canopy widths were estimated and trunks measured with a diameter tape. An axe and probe were used to assess cavities and decay where appropriate.

An ARBOTOM was used to assess decay using sonic tomography where trees had been identified for removal due to decay.

For all tree assessment descriptors, see Appendix 1.

The risk assessment method adopted for tree assessment was Quantified Tree Risk Assessment (Ellison2005 and updates, current version 5). For risk factor descriptors, see Appendix 2.

3. Site Map

Figure 1: Aerial image of all trees (Nearmap 1 October 2019).

4. Tree Details

Table 1: Tree assessment summary.

ID	*Botanical Name*	Common Name	Origin	Height	Width	DBH	Age	Health	Structure	ULE (years)
N03	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	24	9	124	Over mature	Fair	Fair	10-20
N11	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	23	13	122	Over mature	Fair	Fair	10-20
N27	*Ulmus ×hollandica* 'Hollandica'	Dutch Elm	Exotic	18	9	84	Over mature	Fair	Poor	5-10
S32	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	22	9	105	Over mature	Poor	Poor	5-10
N33	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	27	9	144	Over mature	Fair	Very Poor	1-5
N35	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	29	9	141	Over mature	Fair	Poor	5-10
N47	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	32	9	169	Over mature	Poor	Fair	10-20
S58	*Ulmus glabra*	Wych Elm	Exotic	18	9	89	Mature	Fair	Poor	10-20
N101	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	24	9	108	Over mature	Poor	Fair	5-10
N105	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	24	9	123	Over mature	Poor	Fair	10-20
S106	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	30	9	166	Over mature	Poor	Fair	10-20
S108	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	33	9	178	Over mature	Poor	Poor	5-10
S110	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	30	9	165	Over mature	Poor	Fair	10-20
N111	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	29	9	149	Over mature	Fair	Fair	10-20
S116	*Ulmus ×hollandica* 'Hollandica'	Dutch Elm	Exotic	26	9	126	Over mature	Poor	Poor	5-10
S144	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	32	10	131	Over mature	Fair	Fair	10-20
S152	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	24	12	127	Over mature	Fair	Poor	10-20
S156	*Ulmus procera*	English Elm	Exotic	24	18	108	Mature	Fair	Fair	10-20
S160	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	35	18	158	Over mature	Good	Poor	5-10
N161	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	37	18	169	Over mature	Poor	Fair	10-20
N169	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	34	14	158	Over mature	Poor	Poor	5-10
N173	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	30	16	167	Mature	Fair	Poor	5-10
S174	*Ulmus ×hollandica* 'Vegeta'	Huntingdon Elm	Exotic	32	16	145	Mature	Fair	Fair	10-20

5. Discussion

5.1 The Site

Located on the east of the township, the Bacchus Marsh Avenue of Honour is a culturally significant row of elms. Initially planted in 1918 to commemorate local volunteers who served in the first World War, the trees line both sides of the Bacchus Marsh Road for approximately 2.9km and form an important and attractive feature of the township (Figure 2).

Figure 2: The Avenue is a significant and valuable landmark in the community.

The Avenue is listed on the Victoria Heritage Register (VHR H2238) and is covered by a local Heritage Overlay (HO47).

5.2 The Trees

23 trees were assessed in total.

The Avenue of Honour, established over several periods between the 1880's and the 1960's, was originally planted with a combination of Dutch Elm cultivars, the most common of which included in this assessment, is Huntingdon Elm *Ulmus* ×*hollandica* 'Vegeta'.

Cultivated for thousands of years, the elms represent a challenge to taxonomically classify, but characteristics of the trees in the Avenue are consistent with Huntingdon Elm although several sources list the trees originally planted as Canadian Elm Ulmus ×hollandica 'Canadian Giant' (known as *Ulmus montana* 'Canadian Giant' when available in the early 20th century) (Maiden 1908, Moorabool Shire Council 2004).

Huntingdon Elm is widely accepted as a cloned cultivar of Dutch Elm *Ulmus* ×*hollandica*, grown from seed produced in Huntingdon, England. Dutch Elm is, itself, generally accepted as a hybrid of Wych Elm *Ulmus glabra* and Smooth-leaved Elm *Ulmus minor*, although its exact origin is uncertain (More & White 2003, Spencer 1997).

5.3 Condition & Recommended works

The trees assessed were only those within The Avenue flagged for removal. Generally, they were over-mature specimens in the process of senescence and had characteristics of poor health, poor structure or both.

Full individual tree details, including recommended works, are provided in Appendix 4.

4 trees (ID N33, N35, S108 & S116. Figure 3, Figure 4, Figure 5 & Figure 6 respectively) are recommended for removal. They each have extensive decay in the trunk or root buttress or extensive decay in main stems. There are no mitigation options to maintain the tree at an acceptable level of risk in accordance with accepted industry standards (AS4373-2007).

The trees recommended for removal could be heavily reduced (or lopped) to significantly reduce likelihood of failures but has the additional outcome of exacerbating tree decline and is not a long-term management strategy; it should only be considered as a stopgap measure to stagger removals if desired.

Figure 3: Tree N33

Figure 4: Tree N35

Figure 5: Tree S108

Figure 6: Tree S116

15 trees (ID N03, N11, N27, S32, N47, S58, N101, N105, S106, S110, N111, S152, S156, N161 & N169) are recommended for pruning to reduce likelihood of failures; this may include deadwood removal, weight reduction of, or removal of, specific branches, and/or canopy reduction.

8 trees (ID N47, N105, S106, N111, S156, N161, N173 & S174) were identified as having cables previously installed. These require regular condition and tension inspections, if not already being completed.

2 trees (ID N11 & N161) are recommended for further aerial inspection. These can be performed by the contractor in the course of the other work specified for the trees.

Considering the age of the trees, the attrition rate is remarkably low, this may be somewhat explained by the evidence of ongoing management. Established management protocols should be continued and, where timeframe appropriate, these recommendations should be incorporated into the current maintenance regime.

5.4 Veteran Tree Management

Veteran tree management is the process of slowly ‘growing a tree down’, managing it to maintain risk and retain the tree. These works are prescribed to mature specimens that are beginning to senesce and decline.

The likelihood of failure can be reduced by reducing/removing longer branches, heavily decayed deadwood and by reducing the overall canopy size. This mimics the process where trees naturally shed branches but allows for retention of veteran trees in the landscape. Figure 7 demonstrates the ‘mortality spiral’ occurring over many decades, with veteran trees expected to be managed in a form like that of a declining tree (minus large deadwood).

Large decayed deadwood sections should be removed as should any long-extended branches where there is significant decay. Hollows should be preserved as much as possible. The resultant epicormic growth can be managed with selective pruning so that it does not become large and likely to fail.

In this manner, the canopy of the tree is made smaller and the force exerted on branches through strong winds and storms is reduced. This subsequently reduces the likelihood of branch failure and allows for tree retention.

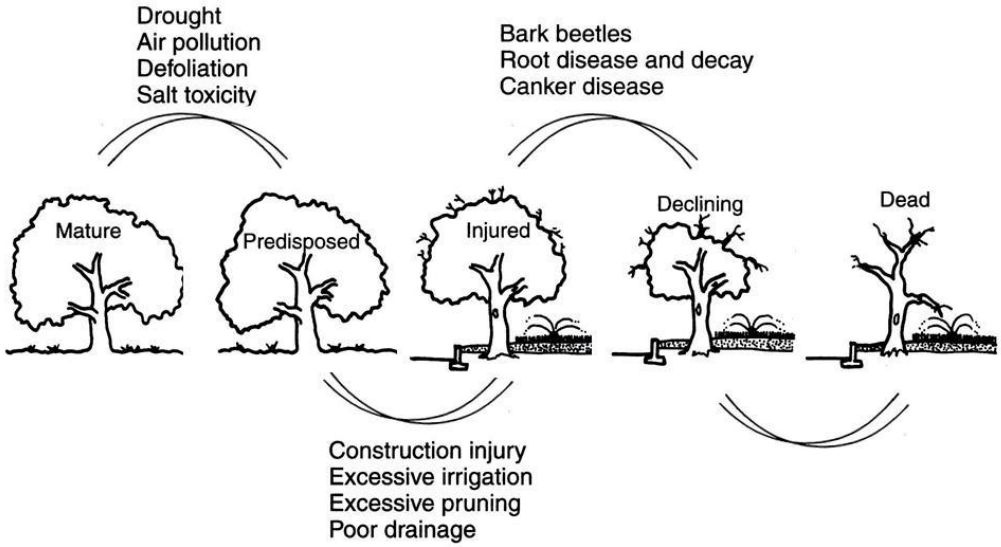


Figure 7: The 'mortality spiral' describing tree decline from vigorous to dead due to specific biological, cultural or environmental factors (image from Harris, Clark and Matheny 1999).

5.5 Arbotom® Sonic Tomography

Sonic tomography was performed using an ARBORTOM® sonic tomogram.

The Arbotom® is an impulse tomography unit that enables an inside view of the condition of trees and wood. Hidden decay, invisible cavities and cracks become visible with Arbotom® using sound impulses (www.rinntech.de).

The Arbotom measures the time taken for sound impulses to travel through a stem between the sensors placed around its circumference at the same height. Sound impulses travel more quickly through sound wood than decayed, split or defective wood.

Sensors are placed around the subject tree's stem at the location of concern (Figure 8). Testing is done by tapping lightly on the bolt of each sensor until the coefficient of variation for each sensor drops below 5%. After recording the velocity of sound impulses travelling from each sensor to every other sensor, the software generates a line graph and 2-D cross-sectional colour image that represents the findings.

The software provides an indication of the degree of damaged/decayed wood and calculates the maximum likely strength loss of the stem from a specific direction of loading. These have been included in Appendix 3.

Figure 8: Arbotom® sensors around the subject tree.

5.6 Risk Assessment

A risk assessment was conducted for the trees flagged. The Risk Assessment Method that has been adopted is Quantified Tree Risk Assessment (Ellison 2005 and updates, currently version 5) and has the following elements:

- Probability of failure (PF)
- Size of part likely to fail (FS)
- Target occupancy (TO)

The Quantified Tree Risk Assessment (QTRA) methodology is probabilistic and the lower the value the higher the risk. A result of 1/1 indicates that an event is certain to occur and 1/10,000,000,000 indicates that it is very unlikely. The three factors are used to arrive at a Risk of Harm (ROH).

An accepted threshold of risk is generally in the order of 1/10,000 but tolerance of risk needs to be weighed against tree value and given the historical context of this avenue may justify retention of trees with risk higher than this if the risk is as low as reasonably practicable.

The target occupancy of the Bacchus Marsh Road (C802) has generally been used as the basis for the risk assessment, only disregarded where a higher risk could be obtained from considering an alternative target. The road was estimated at a Target range of 2 which covers between 4200 and 430 cars per day at 60km/hr. If more accurate traffic figures are available, they may be used to further refine this value.

The results of the Arbotom® testing have been used to inform probability of failure, but are one of several factors involved in risk and should be viewed in the context of the tree and situation. Full risk assessment descriptors are included as Appendix 2.

4 trees (ID N33, N35, S108 & S116) were found to be at an unacceptable risk and require works to mitigate the risk (Table 2). The recommended works involve removal or heavy reduction and are specified in Appendix 4.

17 trees (ID N03, N11, N27, S32, N47, S58, N101, N105, S110, N111, S152, S156, S160, N161, N169, N173 & S174) were found to be at a tolerable risk as long as the risk is maintained as low as reasonably practicable (ALARP). Works including removal of deadwood, weight and canopy reductions have been recommended to keep the risk ALARP.

2 trees (ID S106 & S144) were found to be at a broadly acceptable level of risk if maintained ALARP. Minor works have been specified where appropriate to maintain the risk ALARP.

All individual works are included in Appendix 4.

Table 2: QTRA Advisory Risk Thresholds

ROH Description	Threshold	Action	Number of Trees Recorded
Unacceptable -Risks will not ordinarily be tolerated	1/1000	-Control the risk	0
Unacceptable if imposed on others or Tolerable by agreement	1/10,000	-Control the risk (unless there is stakeholder agreement to tolerate it) -Review the risk	4
Tolerable when imposed on others provided As Low As Reasonably Practicable (ALARP)	1/1,000,000	-Assess cost and benefit of risk control -Control risk where cost/benefit analysis dictates value -Review the risk	17
Broadly acceptable, Risk already ALARP	>1/1,000,000	-No action currently required -Review the risk	2
Total			23

5.7 Pruning and Removal

All pruning and removal works should be completed by qualified arborists with a minimum of Certificate III in arboriculture (or equivalent). All pruning completed is to be in accordance with AS4373-2007 *Pruning of Amenity Trees*.

6. Conclusion

C&R Ryder Consulting was engaged to assess 23 trees within the Avenue of Honour, Bacchus Marsh. Further investigative techniques, including sonic tomograph, were utilised to provide additional management and risk mitigation options.

The trees include several species of elm, including Huntingdon Elm *Ulmus ×hollandica* 'Vegeta', Dutch Elm *Ulmus ×hollandica* 'Hollandica', English Elm *Ulmus procera* and Wych Elm *Ulmus glabra*.

The assessed trees generally have fair to poor health and fair structure. The health of the trees is unsurprising given the age of the avenue. Planted over several periods, the eldest plantings are senescing, and continued decline over time is likely.

Ongoing management and pruning have resulted in fair structure for the majority of those assessed, although several were noted with poor or very poor structure. Generally, this is where decay has become significant and problematic.

The trees have variable useful life expectancy (ULE), most having 10-20 years, although several had further reduced ULE based on individual condition.

Risk Assessment

The trees were assessed for risk. The Risk Assessment Method adopted is Quantified Tree Risk Assessment (Ellison 2005 and updates, currently version 5). Where appropriate, an ARBOTOM sonic tomography unit was employed to assess decay within the trunk and root buttress to determine in further detail the risk associated with the trees.

- 4 trees (ID N33, N35, S108 & S116) were found to be at an unacceptable risk and require works to mitigate the risk.
- 17 trees (ID N03, N11, N27, S32, N47, S58, N101, N105, S110, N111, S152, S156, S160, N161, N169, N173 & S174) were found to be at a tolerable risk as long as the risk is maintained as low as reasonably practicable (ALARP).
- 2 trees (ID S106 & S144) were found to be at a broadly acceptable level of risk if maintained ALARP.

Works Summary

Works have been specified to mitigate or further inform the risks deemed unacceptable.

- 4 trees (ID N33, N35, S108 & S116) are recommended for removal
- 15 trees (ID N03, N11, N27, S32, N47, S58, N101, N105, S106, S110, N111, S152, S156, N161 & N169) are recommended for pruning
- 2 trees (ID N11 & N161) are recommended for further aerial inspection

Works have been specified to manage the risks deemed tolerable and generally acceptable in a manner as low as reasonably practicable.

All works are included in Appendix 4.

Where timeframe appropriate, the specified works should be integrated into the existing management schedule.

All pruning and removal works are to be completed by suitably qualified arborists with a minimum of Certificate III in arboriculture (or equivalent). All pruning completed (unless specifically noted) is to be in accordance with AS4373-2007 *Pruning of Amenity Trees*.

7. References

AS 4373, 2007, *Australian Standard, Pruning of Amenity Trees*, 2nd Edition Standards Australia.

Ellison, M.J., 2005, 'Quantified tree risk assessment used in the management of amenity trees', *Journal of Arboriculture* 31(2) 2005, International Society of Arboriculture, Champaign, Illinois, USA.

Maiden, J. H., 1908, 'Some Practical Notes on Forestry suitable for New South Wales – Trees other than Conifers and Palms: Urticaceae (Elms and Figs)', *Agricultural Gazette of New South Wales*, Vol. 19, Part 10, 1908, p. 784.

Moorabool Sire Council, 2004, *Bacchus Marsh Avenue of Honour Strategic Management Plan,* Moorabool Shire Council, Bacchus Marsh.

More, D & White, J. 2013. *Illustrated Trees of Britain and Northern Europe.* Domino Books Pty Ltd, London.

Spencer R. 1997, *Horticultural flora of south eastern Australia*; Vol. 2, Flowering Plants Dicotyledons, Part 1*,* University of New South Wales Press, Sydney, NSW.

Appendix 1. Tree Assessment Descriptors

1.1 Image of tree

Digital image captured on the day of assessments.

1.2 Botanic Name/Common Name

The tree identified to genus and species level as well as the generally accepted common name for the tree.

1.3 Tree Dimensions

The height and width of the tree as estimated by the arborist in whole metres.

1.4 Diameter at Breast Height

The trunk diameter of the tree measured with a diameter tape at 1.4m above ground level.

1.5 Diameter at Base

The trunk diameter of the tree measured with a diameter tape above the root flare.

1.6 Tree Age

Juvenile	**The tree is young and likely to have been planted in the last couple of years**
Semi-mature	The tree has established in the landscape; however, has not reached a mature size. Its age is likely to be less than 10-20% of the life expectancy for the tree
Mature	The tree has established and reached a more or less mature size for the landscape in which it is located. It is still actively growing. Its age is likely to be 20-70% of the life expectancy for the tree
Over mature	The tree is starting to decline due to age. The presence of decay and deadwood are key indicators at this stage.

1.7 Health

Very Good	The tree is demonstrating exceptional growth for the species, has a full, dense canopy and there is no sign of any pest or disease**.**
Good	The tree is demonstrating good growth for the species in its location with respect to its location and broader context. The canopy is full and complete and there are no signs of pest of disease.
Fair	The tree may have shown a reduction in optimal growth and/or there may be some twiggy deadwood within the canopy. There may be the presence of some pests or diseases that are not causing a significant decline in the tree
Poor	The tree is in decline with little growth. There may be sections of the canopy missing and pests or diseases may be prevalent
Very Poor	The tree is in significant decline, with large sections of the canopy dead. This tree is very unlikely to recover.
Dead	The tree is dead

1.8 Structure

Good	The tree's structure is typical of the species with no significant hazards such as included bark, trunk decay, splits or tears. In general there will be a single trunk with scaffold and/or subordinate branches that display good attachments

Fair	There may be minor defects in the canopy, but the overall tree is still relatively free of significant issues. The tree may need minor pruning to fix minor defects. The canopy will by mostly symmetrical and typical of the species.
Poor	The tree will have 1 or more significant defect that may be able to be remedied with pruning. This tree is likely to have an atypical canopy and may contain defects such as included bark or codominant stems.
Very Poor	The tree has substantial defects associated with its primary trunk and scaffold structure that cannot be remedied with pruning or other measures. It is likely that this tree will require removal in the short term.
Hazardous	The tree has major defects and is likely to fail. It should be removed as soon as possible.

1.9 Useful Life Expectancy

20+	The tree is a healthy specimen in good condition. It is expected to provide a degree of safety and contribution to the landscape for at least another 20 years with an appropriate level of management.
10-20 years	The tree is a reasonably healthy specimen in good or fair condition. It is expected to provide a degree of safety and contribution to the landscape for 10-20 years with an appropriate level of management.
5-10 years	The tree is in fair condition or a short lived species. It is likely to provide contribution to the landscape for 5-10 years with an appropriate level of management at which point removal may need to be considered.
1-5 years	The tree is a poor specimen in decline and is likely to require removal within 1-5 years.
0 years	The tree is either dead or has substantial defects requiring its removal in the short term.

Appendix 2. QTRA Descriptors

2.1 Target

Target Range	Property (repair or replacement cost)	Human (not in vehicles)		Vehicle Traffic (number per day)	Ranges of Value (probability of occupation or fraction of £1 500 000)
1	£1 500 000 – >£150 000	**Occupation:** **Pedestrians & cyclists:**	Constant – 2.5 hours/day 720/hour – 73/hour	26 000 – 2 700 @ 110kph (68mph) 28 000 – 2 900 @ 100kph (62mph) 31 000 – 3 200 @ 90kph (56mph) 32 000 – 3 300 @ 80kph (50mph) 36 000 – 3 700 @ 70kph (43mph) 42 000 – 4 300 @ 60kph (37mph) 47 000 – 4 800 @ 50kph (32mph)	1/1 – >1/10
2	£150 000 – >£15 000	**Occupation:** **Pedestrians & cyclists:**	2.4 hours/day – 15 min/day 72/hour – 8/hour	2 600 – 270 @ 110kph (68mph) 2 800 – 290 @ 100kph (62mph) 3 100 – 320 @ 90kph (56mph) 3 200 – 330 @ 80kph (50mph) 3 600 – 370 @ 70kph (43mph) 4 200 – 430 @ 60kph (37mph) 4 700 – 480 @ 50kph (32mph)	1/10 – >1/100
3	£15 000 – >£1 500	**Occupation:** **Pedestrians & cyclists:**	14 min/day – 2 min/day 7/hour – 2/hour	260 – 27 @ 110kph (68mph) 280 – 29 @ 100kph (62mph) 310 – 32 @ 90kph (56mph) 320 – 33 @ 80kph (50mph) 360 – 37 @ 70kph (43mph) 420 – 43 @ 43kph (37mph) 470 – 48 @ 50kph (32mph)	1/100 – >1/1 000
4	£1 500 – >£150	**Occupation:** **Pedestrians & cyclists:**	1 min/day – 2 min/week 1/hour – 3/day	26 – 4 @ 110kph (68mph) 28 – 4 @ 100kph (62mph) 31 – 4 @ 90kph (56mph) 32 – 4 @ 80kph (50mph) 36 – 5 @ 70kph (43mph) 42 – 5 @ 60kph (37mph) 47 – 6 @ 50kph (32mph)	1/1 000 – >1/10 000
5	£150 – >£15	**Occupation:** **Pedestrians & cyclists:**	1 min/week – 1 min/month 2/day – 2/week	3 – 1 @ 110kph (68mph) 3 – 1 @ 100kph (62mph) 3 – 1 @ 90kph (56mph) 3 – 1 @ 80kph (50mph) 4 – 1 @ 70kph (43mph) 4 – 1 @ 60kph (37mph) 5 – 1 @ 50kph (32mph)	1/10 000 – >1/100 000
6	£15 – £1	**Occupation:** **Pedestrians & cyclists:**	<1 min/month – 0.5 min/year 1/week – 6/year	None	1/100 000 – 1/1 000 000

Vehicle, pedestrian and property Targets are categorised by their frequency of use or their monetary value. The probability of a vehicle or pedestrian occupying a Target area in Target Range 4 is between the upper and lower limits of >1/1 000 and 1/10 000 (column 5). Using the VOSL £1 500 000, the property repair or replacement value for Target Range 4 is £1 500 - >£150.

2.2 Size of Failure

Size Range	Size of tree or branch	Impact Potential
1	> 450mm (>18") dia.	1/1 - >1/2
2	260mm (10½") dia. - 450mm (18") dia.	1/2 - >1/8.6
3	110mm (4½") dia. - 250mm (10") dia.	1/8.6 - >1/82
4	25mm (1") dia. - 100mm (4") dia.	1/82 - 1/2 500

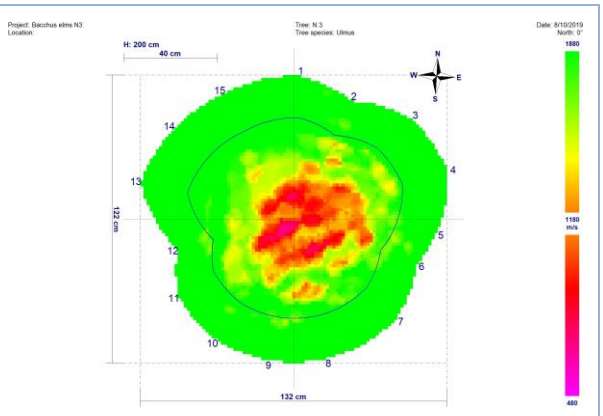
* Range 1 is based on a diameter of 600mm.

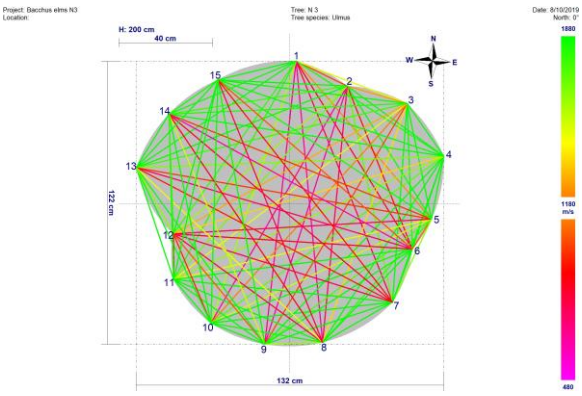
2.3 Probability of Failure

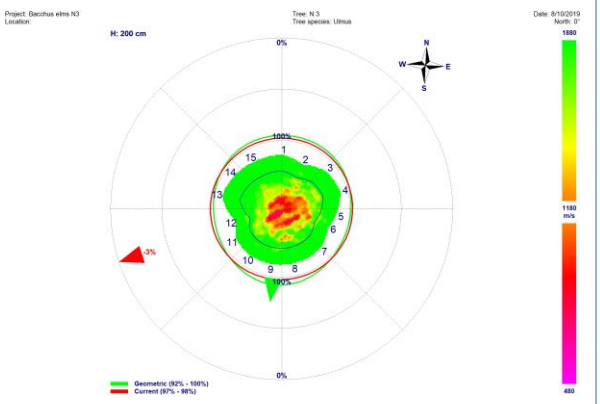
Probability of Failure Range	Probability
1	1/1 - >1/10
2	1/10 - >1/100
3	1/100 - >1/1 000
4	1/1 000 - >1/10 000
5	1/10 000 – >1/100 000
6	1/100 000 – >1/1 000 000
7	1/1 000 000 – 1/10 000 000

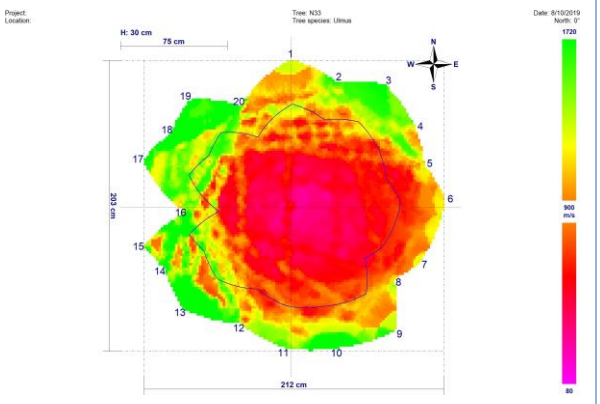
The probability that the tree or branch will fail within the coming year.

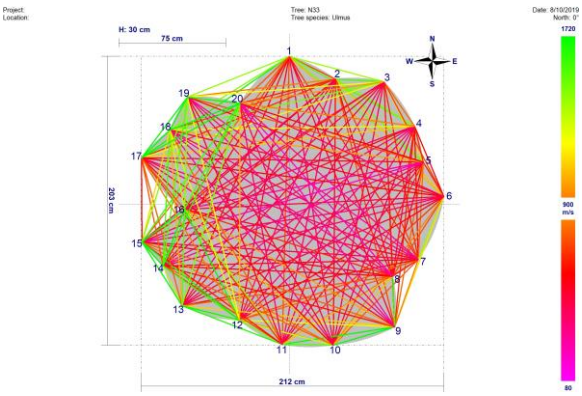
Appendix 3. Sonic Tomograms

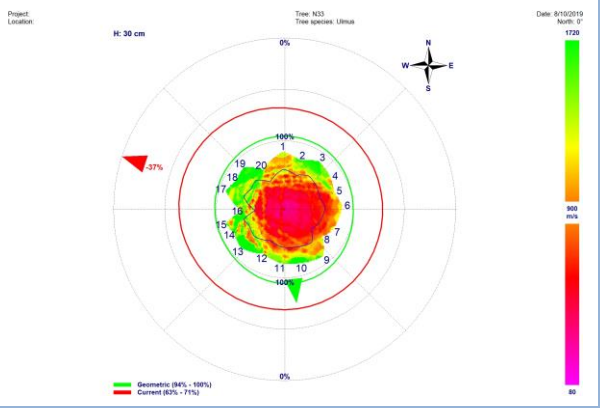




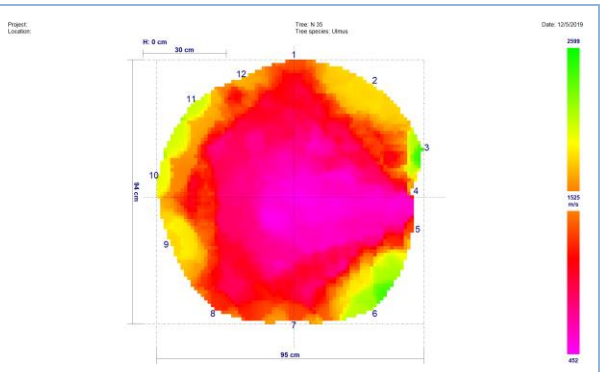


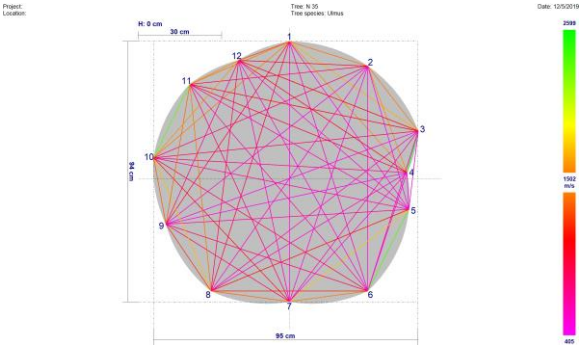


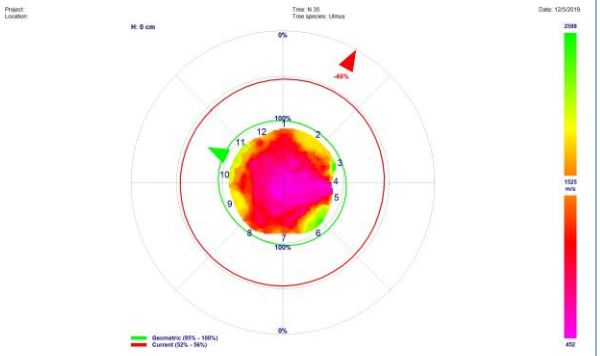




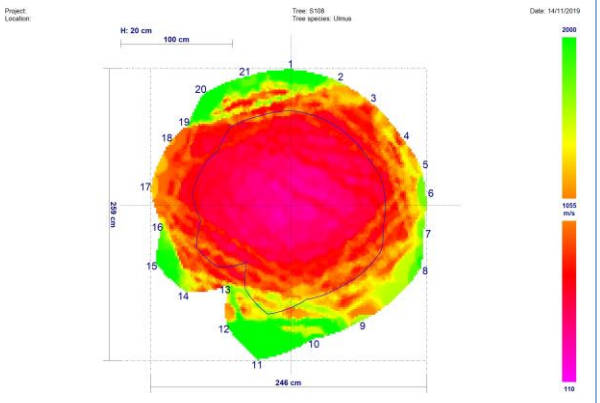

N35

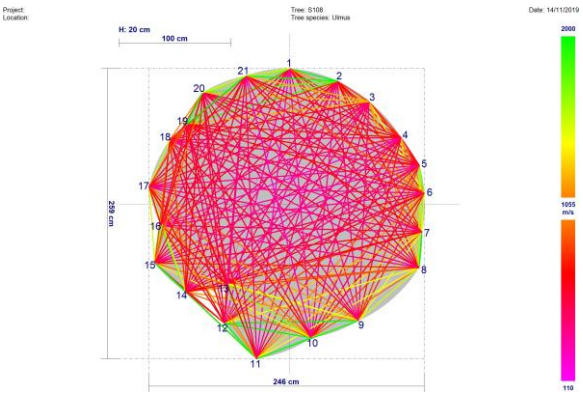


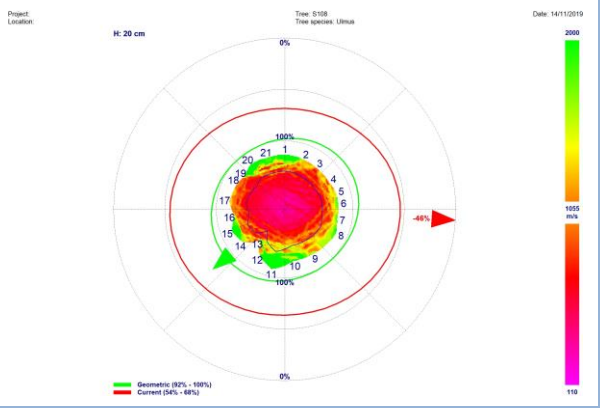


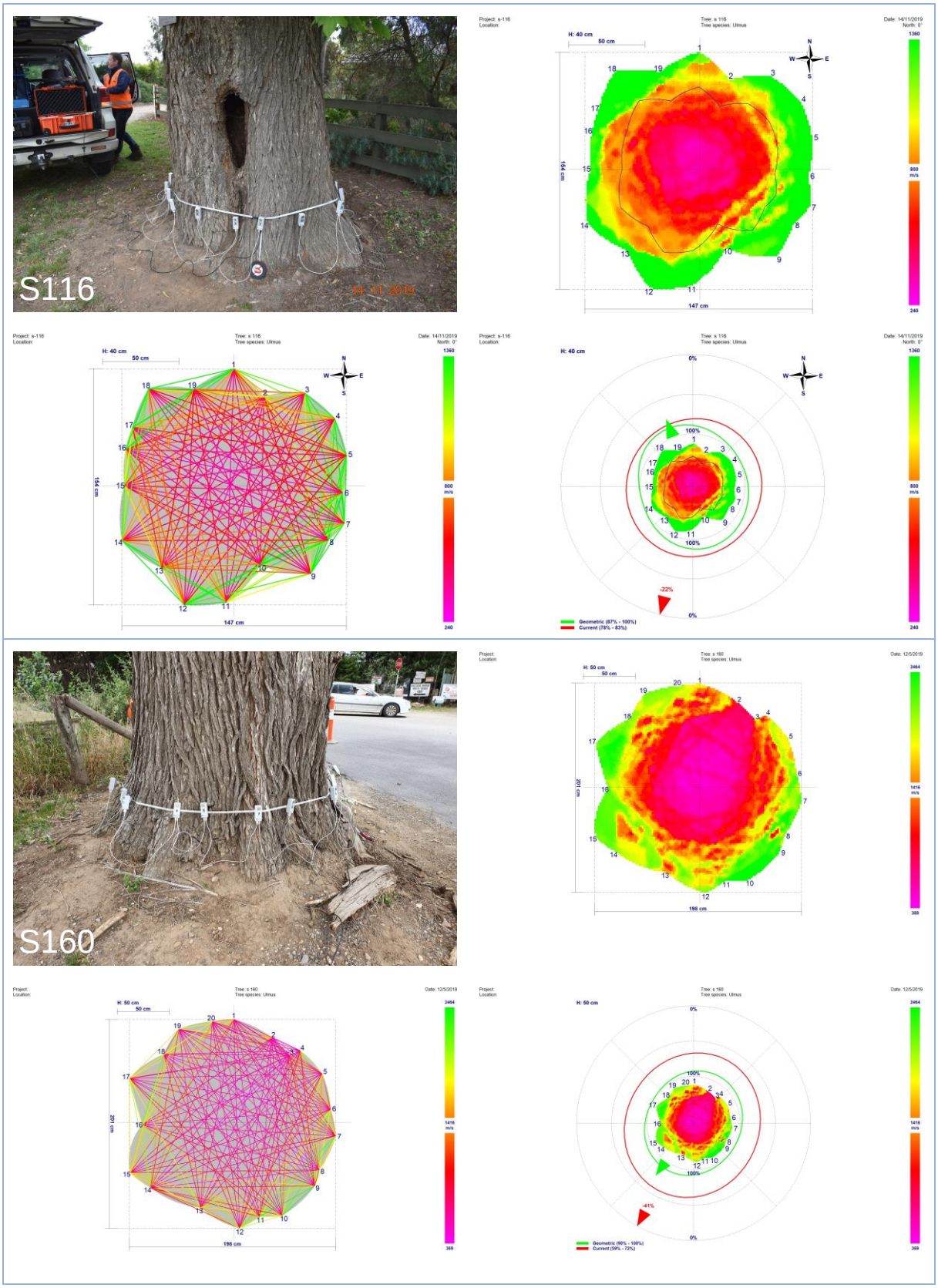


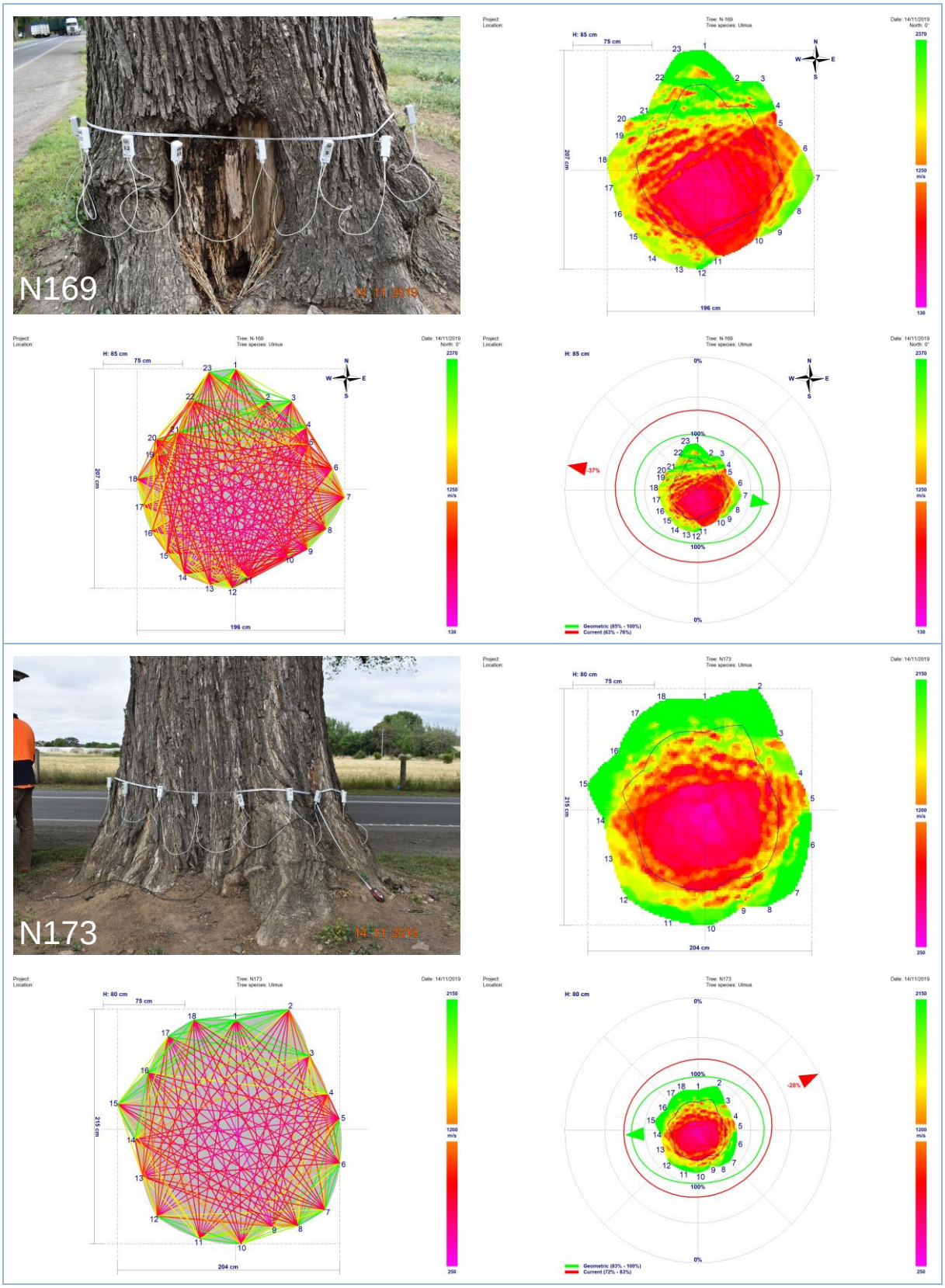

S108








S116
14 11 2019
H: 40 cm
50 cm
154 cm
147 cm
800 m/s
240
1360
100%
-22%
Geometric (87% - 100%)
Current (78% - 83%)
S160
H: 50 cm
207 cm
198 cm
1416 m/s
369
2464
-41%
Geometric (90% - 100%)
Current (59% - 72%)


N169
14.11.2019
H: 85 cm
75 cm
287 cm
196 cm
N
W
E
S
2370
1250
m/s
130
Geometric (85% - 100%)
Current (62% - 76%)
-37%
N173
H: 80 cm
75 cm
216 cm
204 cm
2150
1200
m/s
250
Geometric (83% - 100%)
Current (72% - 83%)
-28%

Appendix 4. Photographic Tree Reports

Tree ID: **N03**

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 24 **Health:** Fair

Width (m): 9 **Structure:** Fair

DBH (cm): 124 **ULE:** 10-20

Probability of Faillure: 4. Low 1/1,000-1/10,000

Size of Part: 101-250mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 500000

Recommended Works: **Priority** Low-2 years

Remove large lateral branch to the north over private property.

Comments:

Mechanical damage at base, no decay obvious, ARBOTOM revealed minor decay between ribs, trunk still sound. Decay at 3m in old failure stub. Decay visible at previous branch unions.

Inspection Date: 8/10/2019

Easting: 275026.758 **Northing:** 5826928.322

Tree ID: **N11**

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 23 **Health:** Fair

Width (m): 13 **Structure:** Fair

DBH (cm): 122 **ULE:** 10-20

Probability of Faillure: 4. Low 1/1,000-1/10,000

Size of Part: 101-250mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 500000

Recommended Works: **Priority** Low-2 years

Inspect problematic union, reduce if heavily decayed. Weight reduction above decayed union on central stem and roadside branches.

Comments:

Suspected lightning damage. Mechanical damage on roadside stem. Moderate decay in upper branch union (~22m) on central stem.

Inspection Date: 8/10/2019

Easting: 275104.894 **Northing:** 5826910.358

Tree ID: N27

Botanical Name: *Ulmus ×hollandica 'Hollandica'*

Common Name: Dutch Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 18 **Health:** Fair

Width (m): 9 **Structure:** Poor

DBH (cm): 84 **ULE:** 5-10

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: Greater than 450mm

Target Rating: Human Occupancy, 1min/day to 2

Risk of Harm: 1/ 400000

Recommended Works: **Priority** Moderate-12 months

Canopy reduction of 4-8m throughout. Reinspect in 2 years.

Comments:

Significant decay in main stem at failed union. Considerable decay through trunk. Minor deadwood in upper canopy. Failure unlikely towards roadway.

Inspection Date: 8/10/2019

Easting: 275263.921 **Northing:** 5826875.833

Tree ID: S32

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 22 **Health:** Poor

Width (m): 9 **Structure:** Poor

DBH (cm): 105 **ULE:** 5-10

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: 101-250mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 50000

Recommended Works: **Priority** Moderate-12 months

Reduce extended branches over private property to the south. Remove deadwood. Reduce branches with dieback.

Comments:

Moderate dieback and considerable reduction in health. Deadwood in upper canopy. Decay cavity in trunk at base. Significant decline.

Inspection Date: 8/10/2019

Easting: 275300.279 **Northing:** 5826850.882

Tree ID: **N33**

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic

Age Class: Over mature

Height (m): 27

Health: Fair

Width (m): 9

Structure: Very Poor

DBH (cm): 144

ULE: 1-5

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: Greater than 450mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 4000

Recommended Works: **Priority** High-6 months

Remove tree

Comments:

ARBOTOM indicates major internal trunk decay near base. Codominant stems above 5m, mild inclusion.

Inspection Date: 8/10/2019

Easting: 275321.922 **Northing:** 5826861.618

Tree ID: **N35**

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic

Age Class: Over mature

Height (m): 29

Health: Fair

Width (m): 9

Structure: Poor

DBH (cm): 141

ULE: 1-5

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: Greater than 450mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 4000

Recommended Works: **Priority** High-6 months

Remove tree

Comments:

Decay at major split, 4m, aerial ARBOTOM indicates considerable decay in central stem.

Inspection Date: 8/10/2019

Easting: 275340.506 **Northing:** 5826858.762

Tree ID: N47

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m):	32	**Health:**	Poor
Width (m):	9	**Structure:**	Fair
DBH (cm):	169	**ULE:**	10-20

Probability of Faillure: 4. Low 1/1,000-1/10,000

Size of Part: Greater than 450mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 40000

Recommended Works: **Priority** Low-2 years

Remove deadwood in upper canopy. Inspect cable tensions and conditions.

Comments:

Upper canopy decline, moderate deadwood. Basal decay pocket. Codominant stems on roadside, mild inclusion, considerable reaction wood.

Inspection Date: 8/10/2019

Easting: 275459.043 **Northing:** 5826831.815

Tree ID: S58

Botanical Name: *Ulmus glabra*

Common Name: Wych Elm

Origin: Exotic **Age Class:** Mature

Height (m):	18	**Health:**	Fair
Width (m):	9	**Structure:**	Poor
DBH (cm):	89	**ULE:**	10-20

Probability of Faillure: 4. Low 1/1,000-1/10,000

Size of Part: Greater than 450mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 40000

Recommended Works: **Priority** Low-2 years

Reduce considerable weight on stem towards roadway. Remove lower moderate deadwood.

Comments:

Codominant union at 2m with vascular necrosis but minimal decay.

Inspection Date: 8/10/2019

Easting: 275538.794 **Northing:** 5826759.858

Tree ID: N101

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 24 **Health:** Poor

Width (m): 9 **Structure:** Fair

DBH (cm): 108 **ULE:** 5-10

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: 101-250mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 50000

Recommended Works: **Priority** Low-2 years

Remove deadwood. Continue existing veteran tree management, slowly reducing canopy weight and height to limit branch and stem failure potential.

Comments:

Deadwood in upper canopy. Moderate wound on trunk. Minor decay hollows throughout. Loss of soil from erosion of bank.

Inspection Date: 8/10/2019

Easting: 275886.076 **Northing:** 5826486.900

Tree ID: N105

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 24 **Health:** Poor

Width (m): 9 **Structure:** Fair

DBH (cm): 123 **ULE:** 5-10

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: 101-250mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 50000

Recommended Works: **Priority** Low-2 years

Remove deadwood. Inspect cable tension and condition. Continue existing veteran tree management, slowly reducing canopy weight and height to limit branch and stem failure

Comments:

Deadwood in upper canopy. Moderate necrosis of large middle stem.

Inspection Date: 8/10/2019

Easting: 275914.666 **Northing:** 5826461.575

Tree ID: S106

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 30 **Health:** Poor

Width (m): 9 **Structure:** Fair

DBH (cm): 166 **ULE:** 10-20

Probability of Faillure: 4. Low 1/1,000-1/10,000

Size of Part: 26-100mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 5000000

Recommended Works: **Priority** Low-2 years

Remove deadwood. Remove lower lateral branch to the west. Reducing canopy on south to manage as veteran. Inspect cable tension and condition.

Comments:

Moderate deadwood. Moderate decline. Minor decay cavities. Moderate decay on top of lowest lateral branch to the west.

Inspection Date: 8/10/2019

Easting: 275905.074 **Northing:** 5826448.753

Tree ID: S108

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 33 **Health:** Poor

Width (m): 9 **Structure:** Poor

DBH (cm): 178 **ULE:** 1-5

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: Greater than 450mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 4000

Recommended Works: **Priority** High-6 months

Remove tree

Comments:

Moderate deadwood in upper canopy. Moderate decline. Minor decay cavities at previous branch unions. ARBOTOM indicates extensive decay of root buttress.

Inspection Date: 14/11/2019

Easting: 275922.819 **Northing:** 5826433.784

Tree ID: S110

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 30 **Health:** Poor

Width (m): 9 **Structure:** Fair

DBH (cm): 165 **ULE:** 10-20

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: 26-100mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 500000

Recommended Works: **Priority** Low-2 years

Remove deadwood. Remove lateral branch to south with top vascular dieback. Continue existing veteran tree management.

Comments:

Moderate deadwood in upper canopy. Minor decay cavities at previous branch unions. Fungal fruiting body noted on previous large pruning wound. Vascular dieback of lateral branch to south.

Inspection Date: 8/10/2019

Easting: 275936.462 **Northing:** 5826418.696

Tree ID: N111

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 29 **Health:** Fair

Width (m): 9 **Structure:** Fair

DBH (cm): 149 **ULE:** 10-20

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: 26-100mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 500000

Recommended Works: **Priority** Low-2 years

Remove deadwood. Inspect cable tension and condition. Continue existing veteran tree management.

Comments:

Minor decine, minor deadwood in upper canopy. Codominant stems, minimal inclusion. Minor patches of vascular necrosis on trunk.

Inspection Date: 8/10/2019

Easting: 275960.295 **Northing:** 5826417.958

Tree ID: S116

Botanical Name: *Ulmus ×hollandica 'Hollandica'*

Common Name: Dutch Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 26 **Health:** Poor

Width (m): 9 **Structure:** Poor

DBH (cm): 126 **ULE:** 1-5

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: Greater than 450mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 4000

Recommended Works: **Priority** High-6 months

Remove tree

Comments:

Moderate decine, minor deadwood in upper canopy, considerable epicormic growth. Cavity in trunk, ARBOTOM indicates extensive internal decay. Hanging branch lodged in canopy.

Inspection Date: 14/11/2019

Easting: 275977.856 **Northing:** 5826376.251

Tree ID: S144

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 32 **Health:** Fair

Width (m): 10 **Structure:** Fair

DBH (cm): 131 **ULE:** 10-20

Probability of Faillure: 4. Low 1/1,000-1/10,000

Size of Part: 26-100mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 5000000

Recommended Works: **Priority** None

No works

Comments:

Minimal deadwood in canopy. Minor decay in old branch unions and stubs although main trunk appears sound. Several upper canopy unions codominant with minor inclusion but unlikely to fail.

Inspection Date: 9/10/2019

Easting: 276172.341 **Northing:** 5826176.124

Tree ID: S152

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 24 **Health:** Fair

Width (m): 12 **Structure:** Poor

DBH (cm): 127 **ULE:** 10-20

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: 101-250mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 50000

Recommended Works: **Priority** Moderate-12 months

Remove upper stem with large wound. Remove deadwood.

Comments:

Minor root damage from mowing. Moderate cavity at 3m not affecting structural integrity. Several previous failures, one large.

Inspection Date: 9/10/2019

Easting: 276230.392 **Northing:** 5826118.410

Tree ID: S156

Botanical Name: *Ulmus procera*

Common Name: English Elm

Origin: Exotic **Age Class:** Mature

Height (m): 24 **Health:** Fair

Width (m): 18 **Structure:** Fair

DBH (cm): 108 **ULE:** 10-20

Probability of Faillure: 4. Low 1/1,000-1/10,000

Size of Part: 101-250mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 500000

Recommended Works: **Priority** Moderate-12 months

Remove decayed branches over abbatoir. Reduce low branch over road by ~10%. Inspect cable tension and condition.

Comments:

No major decay evident, minor decay in upper branches.

Inspection Date: 9/10/2019

Easting: 276255.468 **Northing:** 5826091.933

Tree ID: S160

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Mature

Height (m): 35 **Health:** Good

Width (m): 18 **Structure:** Fair

DBH (cm): 158 **ULE:** 10-20

Probability of Faillure: 4. Low 1/1,000-1/10,000

Size of Part: Greater than 450mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 40000

Recommended Works: **Priority** None

No works

Comments:

Cavity and decay in main trunk; ARBORTOM indicates good residual wall thickness. Trunk has been consistently damaged by vehicles. Codominant from 4m, although union apears sound.

Inspection Date: 9/10/2019

Easting: 276290.708 **Northing:** 5826059.526

Tree ID: N161

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 37 **Health:** Poor

Width (m): 18 **Structure:** Fair

DBH (cm): 169 **ULE:** 10-20

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: 251-450mm

Target Rating: Human Occupancy, 1min/day to 2

Risk of Harm: 1/ 1000000

Recommended Works: **Priority** Moderate-12 months

Inspect large cavity at 15m. Inspect cable tension and condition. Remove deadwood, continue existing veteran tree management. Reinspect in 2 years.

Comments:

Small cavity at base, percussive test sounds hollow. Multi-stemmed above 4m, main union appears sound. Several cavities at previous branch stubs, large cavity at 15m.

Inspection Date: 9/10/2019

Easting: 276317.723 **Northing:** 5826062.478

Tree ID: N169

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Over mature

Height (m): 34 **Health:** Poor

Width (m): 14 **Structure:** Poor

DBH (cm): 158 **ULE:** 5-10

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: Greater than 450mm

Target Rating: Human Occupancy, 14min/day to

Risk of Harm: 1/ 40000

Recommended Works: **Priority** Moderate-12 months

Remove defective branch over roadway in upper canopy. Remove deadwood. Reduce height of canopy to manage as veteran. Reinspect in 2 years.

Comments:

Decline, deadwood in upper canopy and seasonal growth is poor. ARBOTOM confirms significant decay in large cavity at the base. Several small cavities at previous branch stubs.

Inspection Date: 14/11/2019

Easting: 276368.905 **Northing:** 5826005.576

Tree ID: N173

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic **Age Class:** Mature

Height (m): 30 **Health:** Fair

Width (m): 16 **Structure:** Poor

DBH (cm): 167 **ULE:** 5-10

Probability of Faillure: 4. Low 1/1,000-1/10,000

Size of Part: Greater than 450mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 40000

Recommended Works: **Priority** Moderate-12 months

Inspect cable tension and condition. Reinspect in 2 years.

Comments:

Minimal deadwood. Large decay cavity in lower trunk. Multi-stemmed above 5m, main union appears sound. ARBOTOM indicates moderate decay in main stem but considerable reaction wood is present.

Inspection Date: 14/11/2019

Easting: 276397.229 **Northing:** 5825978.086

Tree ID: S174

Botanical Name: *Ulmus ×hollandica 'Vegeta'*

Common Name: Huntingdon Elm

Origin: Exotic

Age Class: Mature

Height (m): 32

Health: Fair

Width (m): 16

Structure: Fair

DBH (cm): 145

ULE: 10-20

Probability of Faillure: 3. Moderate 1/100-1/1,000

Size of Part: 101-250mm

Target Rating: Vehicles, 4200 at 60kph

Risk of Harm: 1/ 50000

Recommended Works: **Priority** Moderate-12 months

Inspect cable for tension and condition. Continue existing veteran tree management.

Comments:

Lower trunk appears burnt, potentially vehicle accident. Minor decay evident in trunk from previous wound. Minor decay at previous branch removal wounds. Multi-stemmed above 6-8m.

Inspection Date: 9/10/2019

Easting: 276387.467 **Northing:** 5825968.077