Writtle Forest
Consultancy

Tree Condition Survey

A Tree Condition Assessment Report utilising Impulse tomography and Resistograph drilling

Christ Church
Christchurch Hill
Hampstead
London NW3 1AB

Ref No:

Client:	Oliver Kan Tree Services
Date instructed:	February 2018
Instructed by:	Mr Oliver Kan Oliver Kan Tree Services 228 Church Hill Rd, London, Barnet EN4 8PH
Visited by:	O.R. Booth & J. Percy-Lancaster
Documents referenced:	Dunster et al (2013). Tree Risk Assessment Manual. Champaign. Illinois: ISA Lonsdale (1999). 'Principles of Tree Hazard Assessment and Management'. DETR Mattheck & Weber (2003). 'Manual of Wood Decays in Trees'. Arboricultural Association. Mattheck, Bethge & Weber (2015). 'The Body Language of Trees - Encyclopaedia of Visual Tree Assessment'. KS Druck Lonsdale (1999). Principles of Tree Hazard Assessment and Management. Forestry Commission. London. Schwarze (2003). 'Diagnosis and Prognosis of the development of wood decay in Urban trees'. ENSPEC. Strouts & Winter (2000) 'Diagnosis of Ill Health in Trees'. TSO. London
Date of Visit:	21.03.18
Prepared by:	O.R. Booth & J. Percy-Lancaster
Date completed:	02.04.18

Contents

1. Introduction, Site Details & Overview of Tree

1.1 Instruction

Writtle Forest Consultancy have been instructed by Mr Oliver Khan to carry out non- invasive investigation, utilising impulse tomography as well as an aerial inspection to establish the condition of 1 number Horse Chestnut tree.

1.2 Tree Preservation Orders (TPO) and Conservation Areas (CA)

A tree protection status check was conducted by Writtle Forest Consultancy Ltd on 3rd April 2018 via the London Borough of Camden Council website and followed up with a telephone call. According to the London Borough of Camden Council interactive map the subject tree is located within the designated Hampstead Conservation Area. The Council Call Centre Representative confirmed that the tree was not currently subject to a TPO.

All trees of a stem diameter greater than 75mm, when measured at 1.5m above ground level will be protected by virtue of their location in the Conservation Area. As such the subject tree is protected. Under the Town and Country Planning (Tree Preservation) (England) Regulations 2012, a Section 211 Notice must be served upon the LPA, providing them with 6 weeks' notice of any intention to implement works to protected trees.

The purpose of this notice is to provide the LPA an opportunity to consider whether a TPO should be made in respect of the tree.

1.3 Description and General Aspects of the Site

The tree is located on a raised bank immediately adjacent to footpath Christchurch Passage and roadway Christchurch Hill.

1.4 Photograph of the tree and position within environment

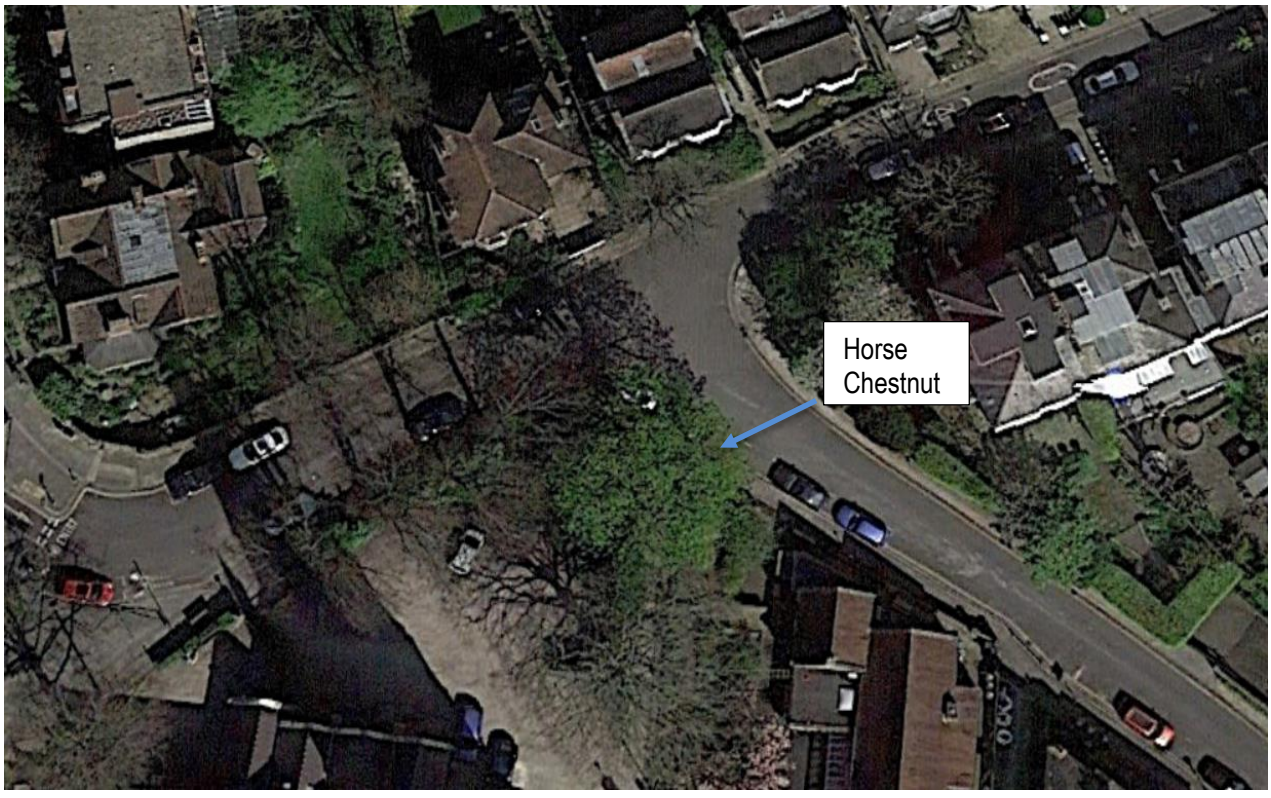


Photo 1: Overview of position of tree within the environment

2. Visual Tree Assessment

All dimensions and measurements are estimated unless otherwise indicated.

Tree no. and Species:	T1 Horse Chestnut
Surrounding environment:	The tree is located on a raised bank immediately adjacent to footpath Christchurch Passage and footpath adjacent to the road Christchurch Hill.
Targets:	Targets include pedestrians and children accessing the adjacent school, the school grounds, the roadway and junction.
Height:	20m
Stem diameter	(at 1.5m from g/l): 1550mm
Crown Spread:	North= 5.5 East= 6 South= 7 West= 7.5
Age Class:	Over Mature
Condition of root system:	No excavations were made within the root plate area.
Basal Condition:	The tree is growing on a slope, approx. 45 degree angle. The buttress root development is heavily fluted and growing over the pavement adjacent to the base of the tree to the north. There is a small fungal bracket attached to the stem at approx. 250mm from ground level to the east side of the stem believed to be *Rigidoporus ulmarius* (See Photos in Appendix 1).
Condition of stem:	There are 2 areas of target canker toward the north on the main stem, at approx. 2.2m, just below main union of stems, or possible historic pollard point. There is some visible decay at these areas. There are further target canker areas at the main union of the stems, however, the decay at these areas appears minimal, affecting primarily the surface area of the wood. Some decay was probed to the north west area of the pollard bole around an area of black staining generally associated with bleed canker. The cluster of stems at the probable historic pollard point are close growing with consequent development of included bark and partial fusion of limbs. There does not currently appear any significant defects at the pollard area relating to cracks or decay.
Condition of crown structure:	The crown of the tree has been historically heavily reduced- both laterally and vertically. Generally, the removal of side laterals has resulted in consequential wound tissue development. Typical to the species this has had varying degrees of success at halting the progress of decay. It would appear from all wounds inspected, resulting from vertical reduction of the main stems, that progressive decay of the wood is present. There is evidence in the stem to the north of historic storm damage which has grown strong wound tissue in response, although decayed exposed wood is still evident.
Condition of foliage and shoot growth:	Due to seasonality the foliage could not be observed however shoot extension and bud development appeared normal.

3. Structural condition of stems

3.1 Positioning of drill tests

Photo 2: Overview of tree

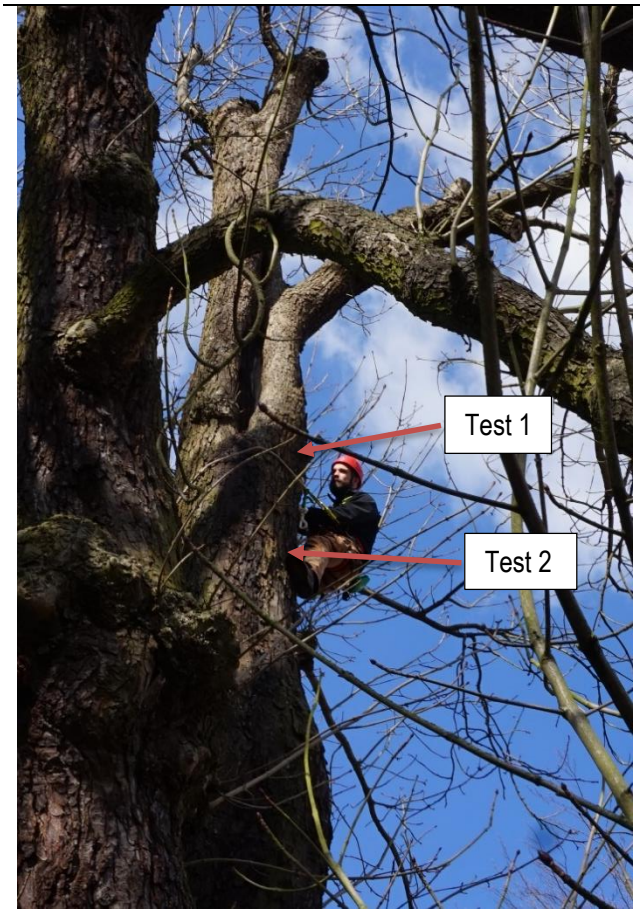


Photo 3: Limb to north. Tests carried out at approx. 7.5 and 6.5m.

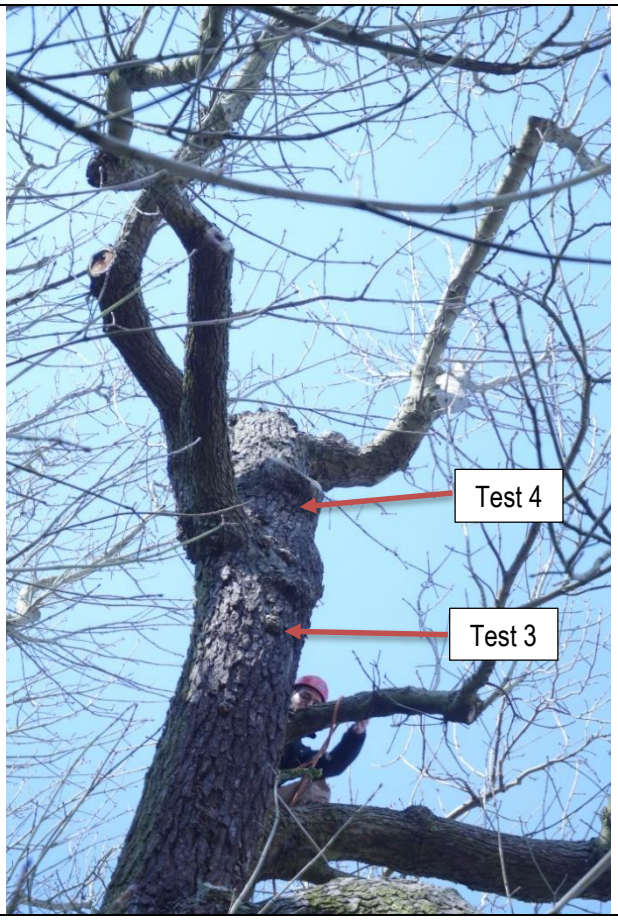
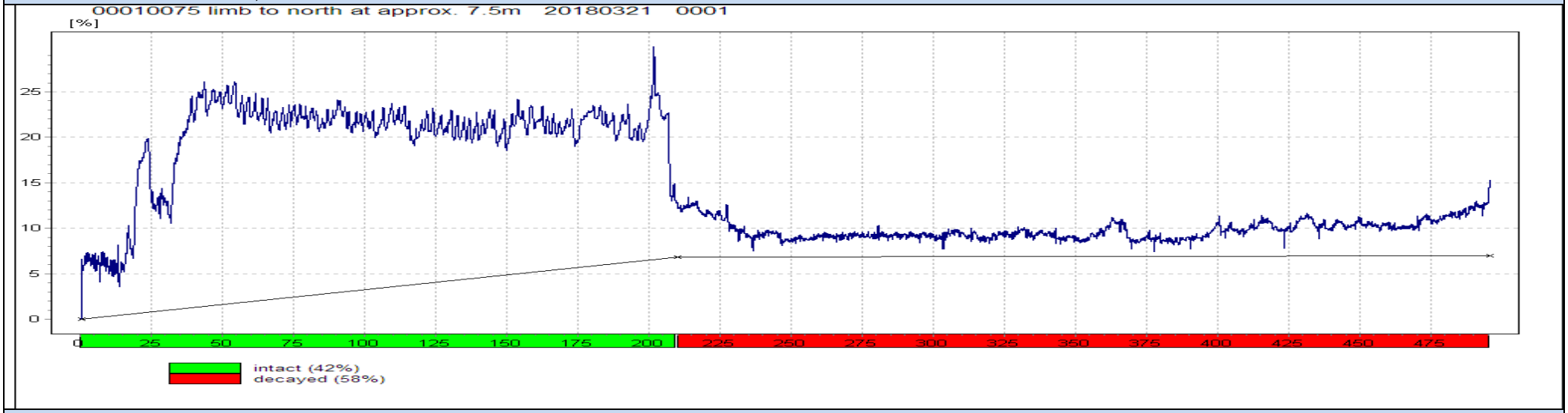
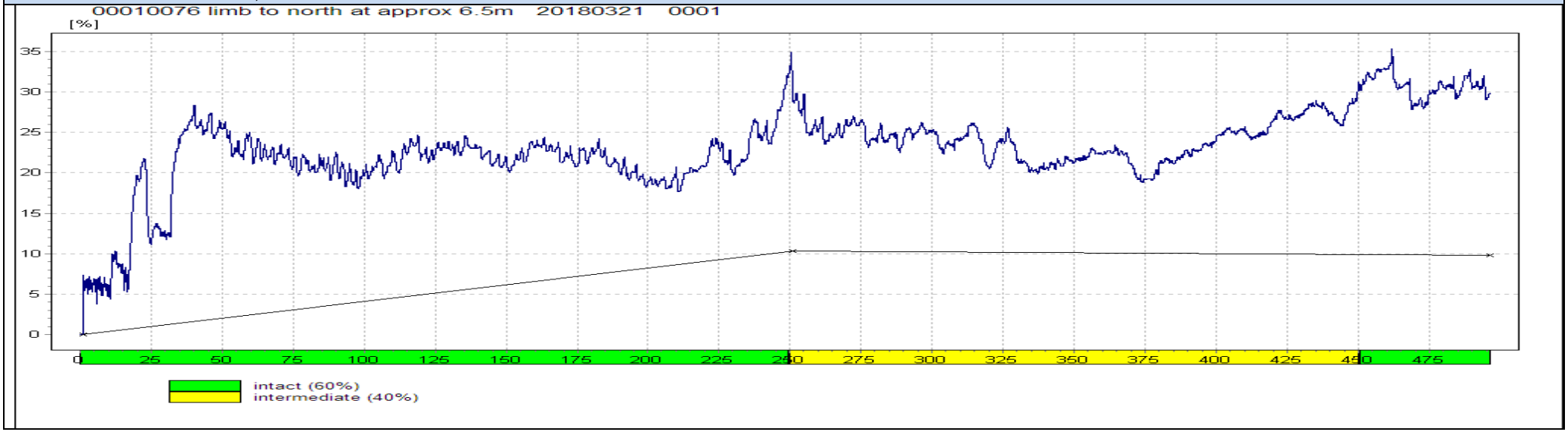


Photo 4: Limb to east. Tests carried out at approx. 8 and 7m.

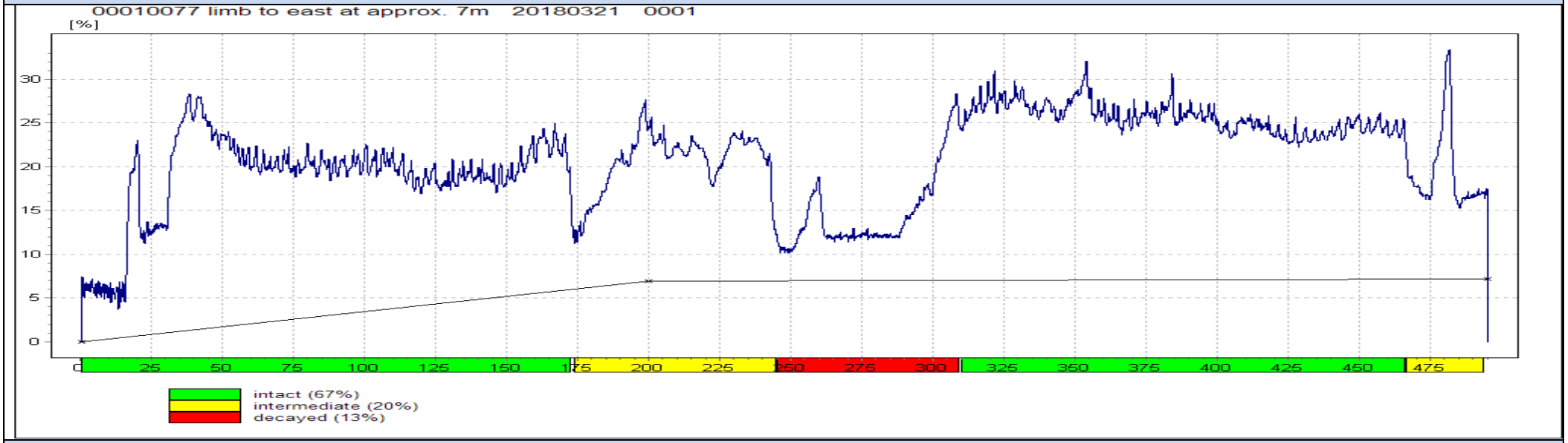
Drill Test & Position: Test 1, limb to north at 7.5m



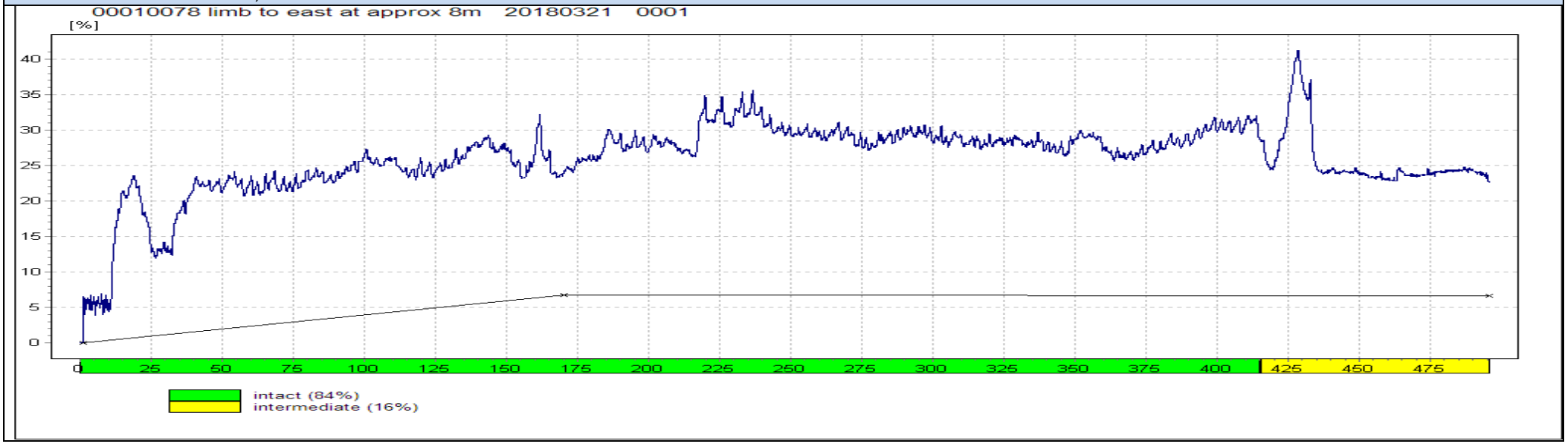
Drill Test & Position: Test 2, limb to north at 6.5m



Drill Test & Position: Test 3 limb to east at 7m



Drill Test & Position: Test 4, limb to east at 8m



4. Structural condition of main stem

The Stress-wave ('impulse') tomogram of the main stem identifies decayed or compromised wood as areas in purple/red; those areas with strong and intact wood structure are identified in green and partially damaged wood in yellow and orange.

4.1 Positioning of Tomograph test at 1.5m from ground level to south

Photo 5: Position of sensors viewed from the south at approx. 1.5 from ground level to the south.

Photo 6: Position of sensors viewed from the north at approx. 1.5 from ground level to the south.

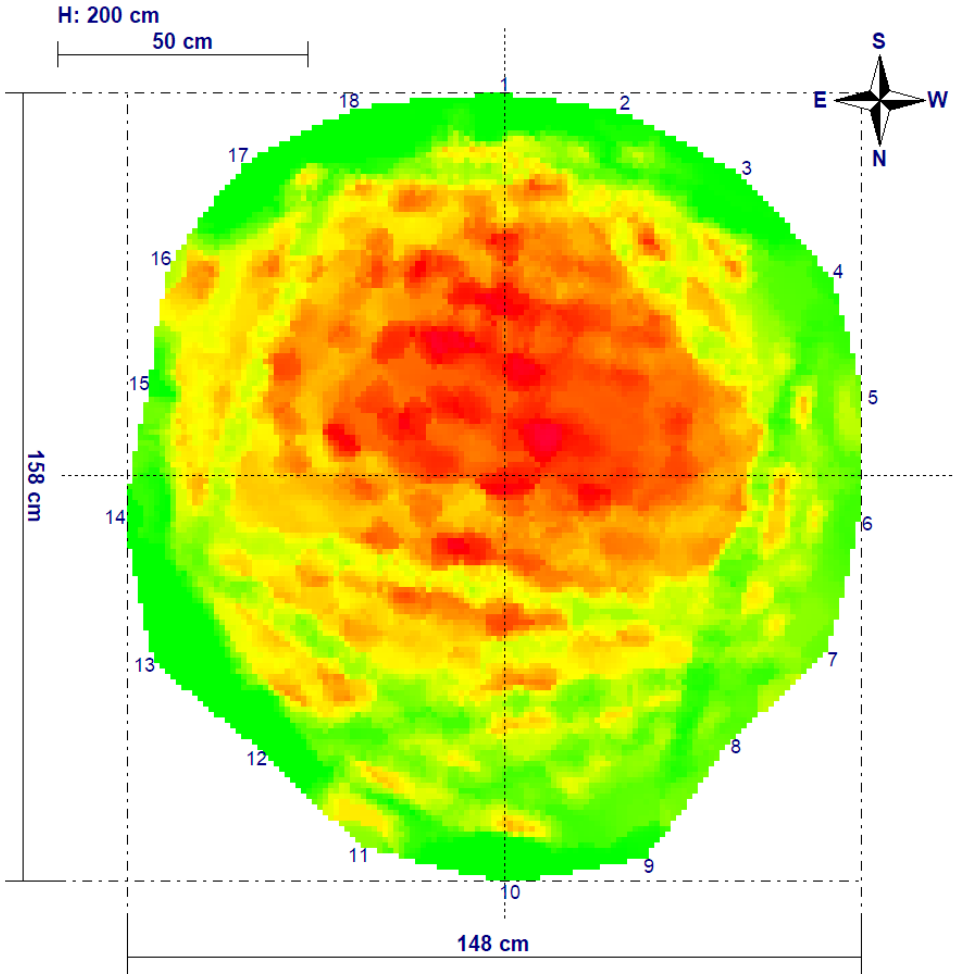
Photo 7: Position of sensors viewed from the east at approx. 1.5 from ground level to the south.

4.2 Impulse tomography test on base of main stem at 150cm above ground level to south

Project: christ church
Location: hampstead

Tree: horse chestnut
Tree species: Aesculus

Date: 21/03/2018
North: +180°

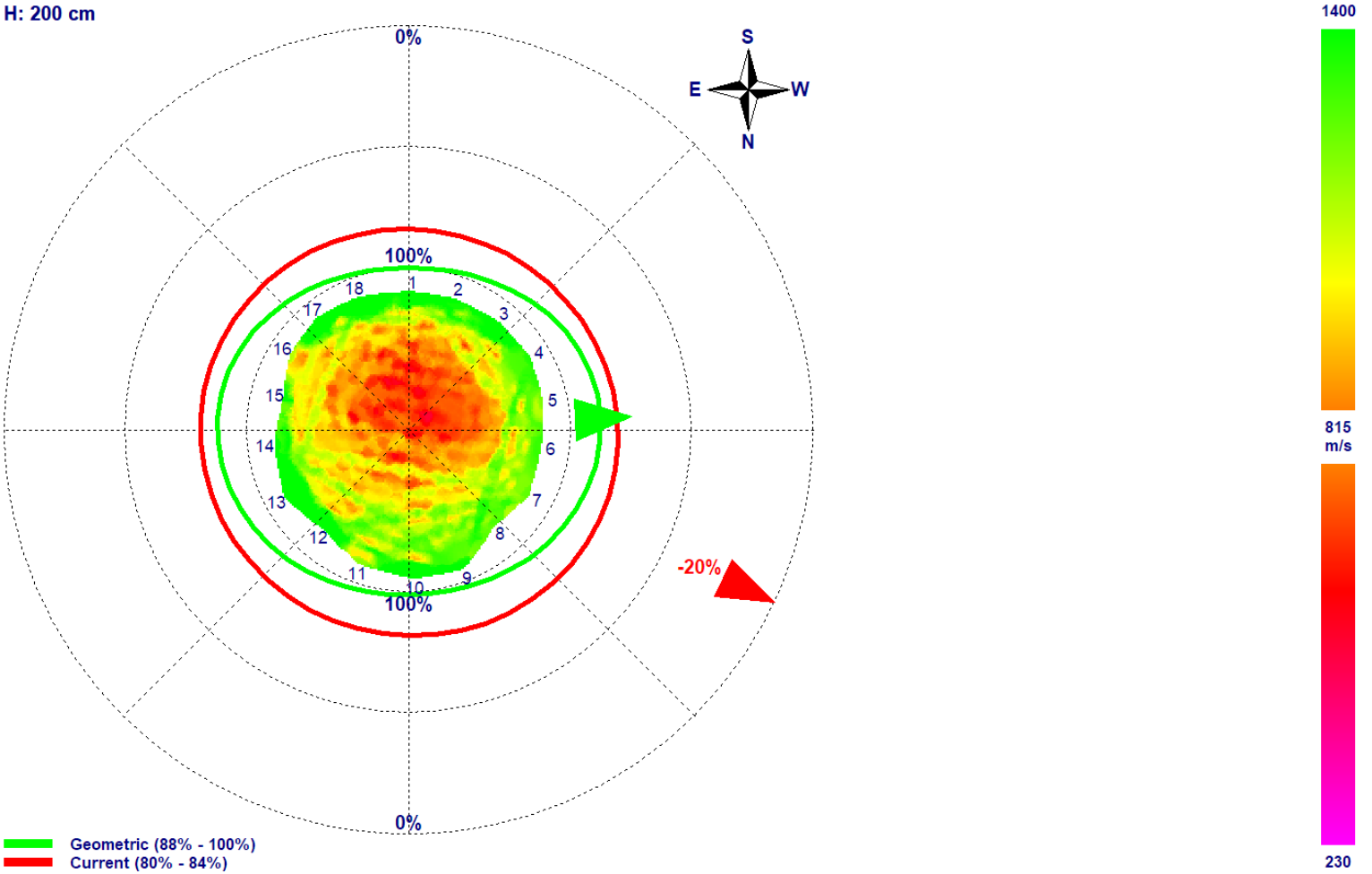


4.3 Calculated mechanical strength loss in location of tested cross-section at 150cm above ground level to south

Project: christ church
Location: hampstead

Tree: horse chestnut
Tree species: Aesculus

Date: 21/03/2018
North: +180°

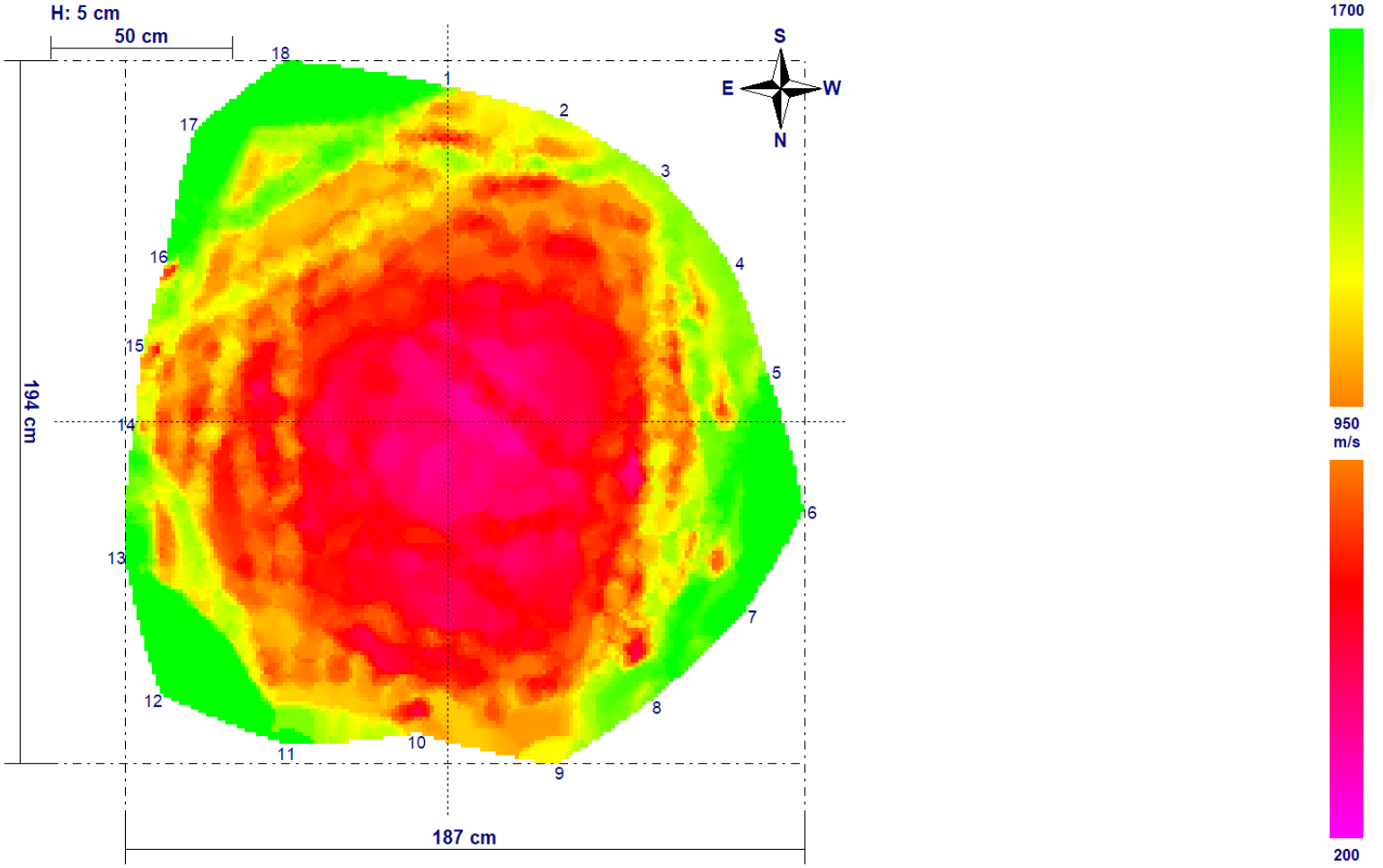


4.4 Impulse tomography test on base of main stem at 5cm above ground level to south

Project:
Location: Christ Church

Tree: Horse Chestnut
Tree species: Aesculus

Date: 21/03/2018
North: +180°

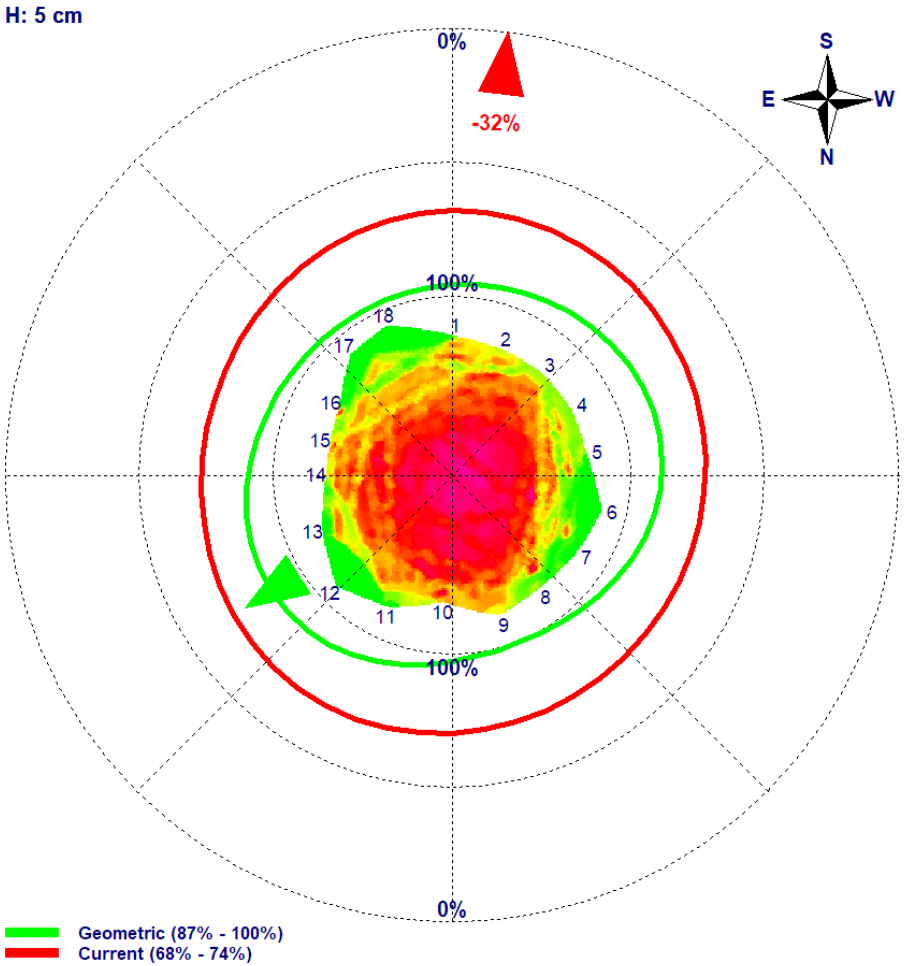


4.5 Calculated mechanical strength loss in location of tested cross-section at 5cm above ground level

Project:
Location: Christ Church

Tree: Horse Chestnut
Tree species: Aesculus

Date: 21/03/2018
North: +180°



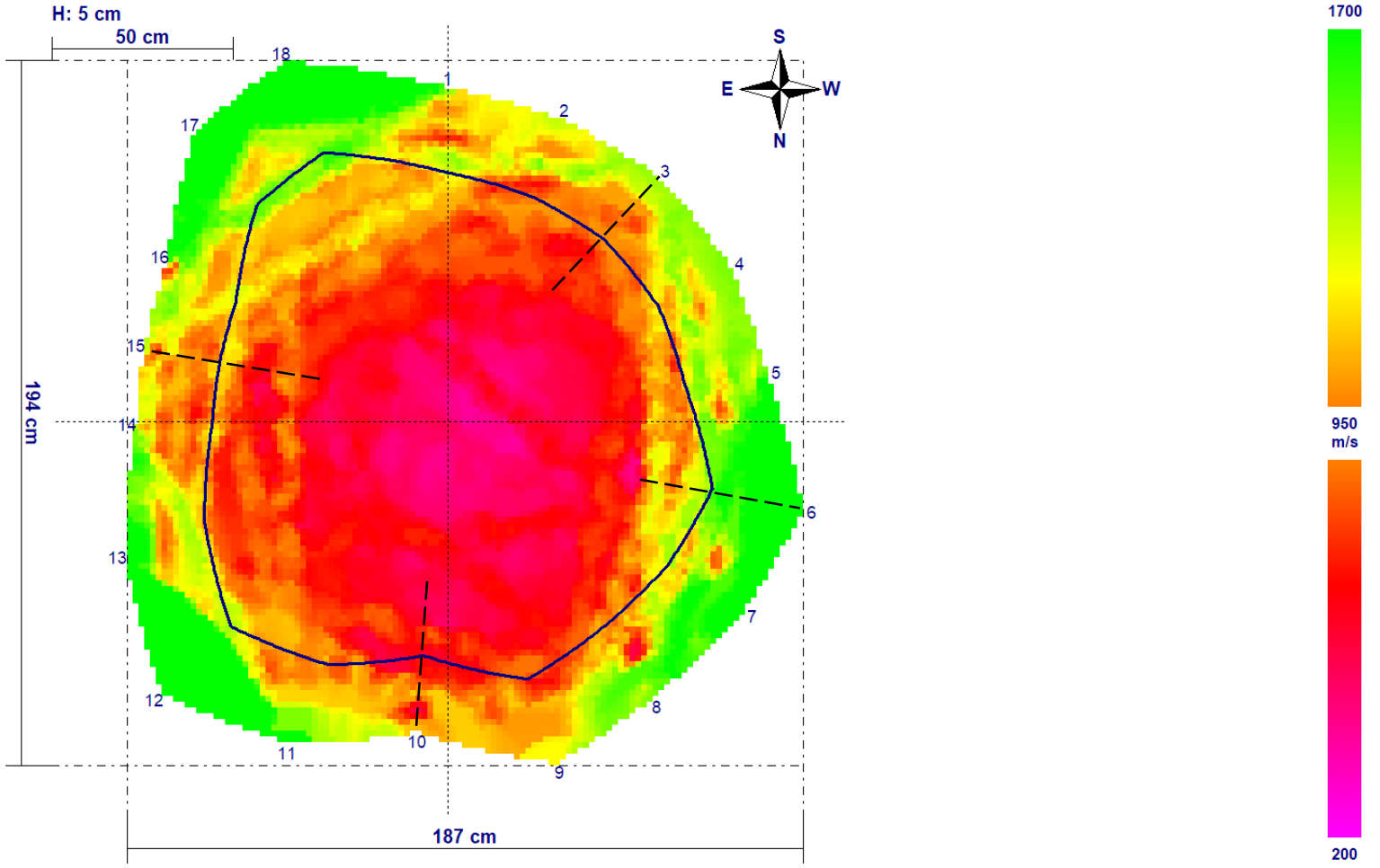
5. Resistograph Readings at Area of tomogram reading at 5cm from ground level to south

5.1 Showing drill positions in relation to Tomogram at 5cm from ground level to south

Project:
Location: Christ Church

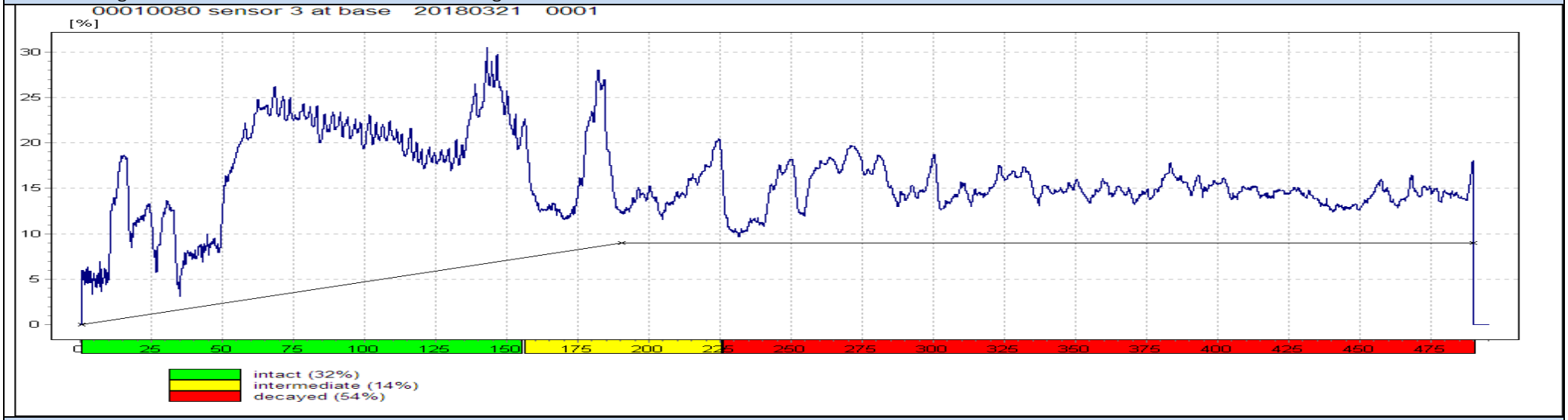
Tree: Horse Chestnut
Tree species: Aesculus

Date: 21/03/2018
North: +180°

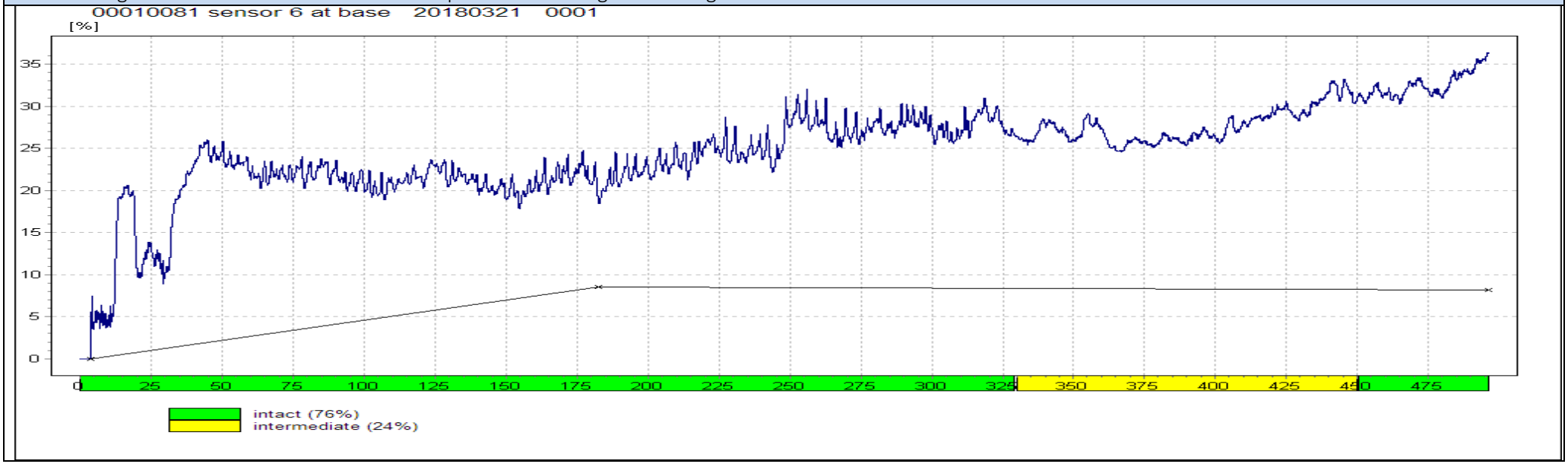


Note: Dark blue line represents a 1 to 4 ratio of the area of the tree. Within the dark blue line represents 75% of the structural wood of the tree. The black dotted lines represent the direction and depth of the drill readings.

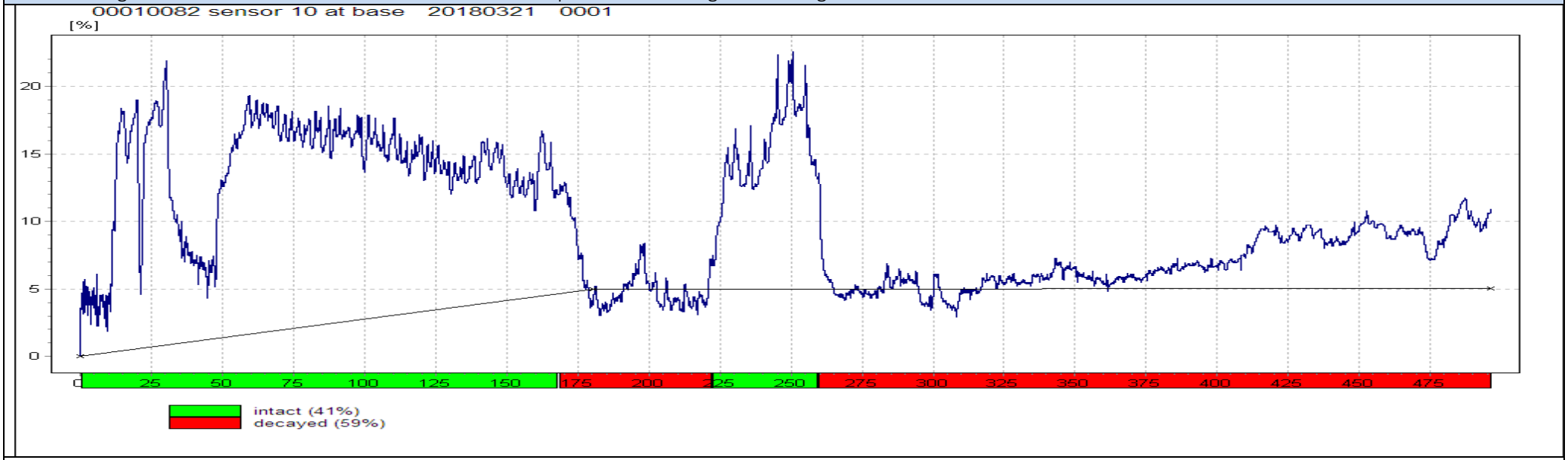
Drill Reading Position: Area of sensor 3 at 5cm above ground level



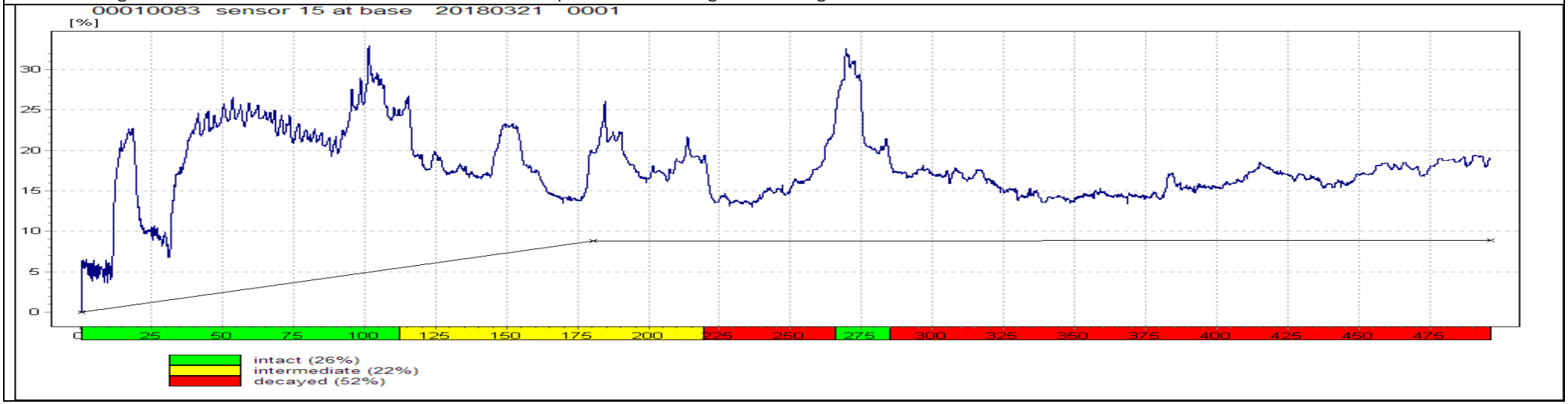
Drill Reading Position: Area of sensor 6 on same plane as of tomogram reading toward base of tree



Drill Reading Number & Position: Area of sensor 10 on same plane as of tomogram reading toward base of tree



Drill Reading Number & Position: Area of sensor 15 on same plane as of tomogram reading toward base of tree



6. Risk Assessment

6.1 Discussion of Risk

Risk has been assessed using the International Society of Arboriculture's (ISA) Tree Risk Assessment Methodology, referred to as TRAQ. This is a 'qualitative' system, which uses a matrix-based combination of ratings to reach a conclusion of associated risk.

Risk is the combination of the 'likelihood' of an event and the severity of the potential consequences. A hazard is a likely source of harm and this case relates to the tree or part of a tree that may fail.

The likelihood of failure considers all structural defects noted within the tree. The overall risk rating for the tree is derived from the tree part presenting the greatest risk. This is considered to be the main stem of the tree.

Likelihood of Failure and impact	Consequence of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Using the matrix above the Horse Chestnut tree has been currently attributed a high risk rating with respect to people and property.

7. Consideration of Findings

7.1 Consideration of structural integrity of main stems within crown

The tree has approximately 6 main vertical stems, issuing from the presumed historical pollard at 2.5m. All of these stems have been historically reduced in height and decay is suspected at these major reduction wounds. Two of the stems, that exhibited significant decay, were climbed, inspected and subsequently drilled. Decay was found at the wound of the main height reduction.

The limb to the north exhibited structural defects and decay due to historic storm damage. The drill reading at 7.5m showed 200mm of intact wood below the decay, which recovered significantly 1m further down the stem.

The limb to the east revealed in significant pockets of decay, although the whole limb exhibited a high degree of unusual movement with the climber in position. There were no visible signs of decay or structural condition at the base of the union of this stem at approx. 4m.

7.2 Consideration of structural integrity of main stem

The fruiting body was identified through morphology as *Rigidoporus ulmarius*. Lonsdale describes the decay caused as 'a friable brown rot with cubical cracking… ..usually confined to the central region of the buttress zone of the tree'.

There is decay and strength loss at both areas of the readings on the main stem. (Note: no readings were made to the very base of the tree, to the north, as it was not possible to apply the sensors to achieve a reading across a horizontal plane). The decay and consequent strength loss within the main stem is significant. (The tomogram reading to the base of the tree is substantiated by the drill readings).

It is considered prudent to reduce the risk posed by the possible failure of the tree as a consequence of the strength loss in the main stem.

8. Wind Loading

Vref	36	[m/s]	Wind speed	= 12 [Bft]
Zref	20	[m]	Reference height	
Z^	0.3		Terrain exponent	
Cw	0.3		Drag coefficient	
d	1.2	[kg/m³]	Air density	
gf	1		Gust factor (²)	
rf	1		Resonance factor	
	0	[%]	Porosity	
	☐		Topology correction	

Crown area	198	-53%	**93 [m²]**
Height of crown area center	11.9	-14%	**10.3 [m]**
Height of crown force center	12.8	-16%	**10.7 [m]**
Wind force on crown	33	-57%	**14 [kN]**
Stembase bending moment	427	-64%	**154 [kNm]**
Torsion moment	32	-82%	**-6 [kNm]**

Error variations referring ANSI/ANS-3.11/DIN 1319: "Sachverständige Anforderungen an Messgeräte und Messverfahren". Der Sachverständige DS 3/2007, 46-51.

Area	CA	HAC	HFC	WF	BM	TM	TH
Crown	198	11.9	12.8	33	427	32	20.0
Selected	93	10.3	10.7	14	154	-6	18.4
+1	93	10.3	10.7	14	154	-6	18.4
Auto	159	10.5	11.1	25	278	28	16.1
Auto	-20%	-12%	-13%	-25%	-35%	-10%	-20%

X Base point
X Top point
X Crown area center point
X Crown force center point
| Torsion center line

8.1. Interpretation

The horizontal light blue line represents the height reduction required to reduce wind loading by 35%. This is viewed with respect to the mechanical strength loss measured as 32%.

The horizontal red line represents the extent of a 5m crown reduction. This is considered as means of remediating the end loading of weight and top down decay within the main vertical stems.

The white shaded area of the crown shows the remaining crown following reduction works. This reduces the stem base bending moment by 64%. This adequately compensates for the mechanical strength loss measured at the area of the lowest tomogram.

The photo and calculations are representational from the perspective of the crown of the tree viewed from the north.

9. Recommendations

9.1. Conclusion

Given the current risk evaluated as a consequence of the discoverable decay and the position of the tree within the environment it is considered necessary to reduce the risk of failure of either significant parts of the tree or the tree as a whole.

The risk can be mitigated by felling the tree but given the prominent position and its cultural value this may not be deemed a satisfactory solution. The tree may be reduced to mitigate risk of failure at the main stem and of the failure of the main vertical stems at height. However, such reduction will reduce the overall biological functioning of the tree and may result in a rapid decline in the health of the tree.

The works to manage this tree will also carry a cost implication that may be viewed by the owner to outweigh the benefits of retaining the tree.

It should be noted that adjacent to the Horse Chestnut to the south is an over mature, veteran Beech tree which is of greater vitality and would offer longer term benefit to the area in terms of amenity. It is probable that the Horse Chestnut has offered some shelter and protection to the development of the Beech tree.

The options provided should be considered in light of the above conclusions and are not provided with any weighting other than this discussion.

9.2 Work schedule

The contractor should carry out all tree works to BS 3998 *Recommendations for Tree Work* (2010) and as modified by more recent research.

9.2.1 Option 1

Recommended works in relation to Structural condition	Time scale
Fell/remove the tree.	Within the next 3 months.

9.2.2 Option 2

Recommended works in relation to Structural condition	Time scale
Reduce tree by approx. 5m in height and approx. 2m in spread. This will involve cutting back into larger limbs and leaving relatively large wounds, removing decay at previous large reduction points. Installation of non- invasive cable bracing suitable to brace possible failure of vertical stems. (Installation only to reduce impact should failure occur).	Within the next 3 months.
Recommended works in relation to Biological Functioning	**Time scale**
Monitor for Horse Chestnut Leaf Miner Install Pheromone traps if presence is found to be currently significant Introduce Phosphite drench through injection to soils and beneath paving slabs if possible (to improve cell structure in relation to further fungal progression).	Within the next 3- 4 months Within the next 3- 4 months
Recommended works in relation to Monitoring & Further Inspection	**Time scale**
Carry out further Arbotom test to check progress of decay toward base of tree and around union of main pollard stems. (Resistograph readings may be required at the union as well). Carry out further drill readings to the base adjacent to the footpath area. Carry out ArboRadix tests to determine extent of intact stabilising root system.	Within next 24 months Within next 24 months Within next 24 months

Appendix 1: Photographs

Photo 8: Overview of tree viewed from north east

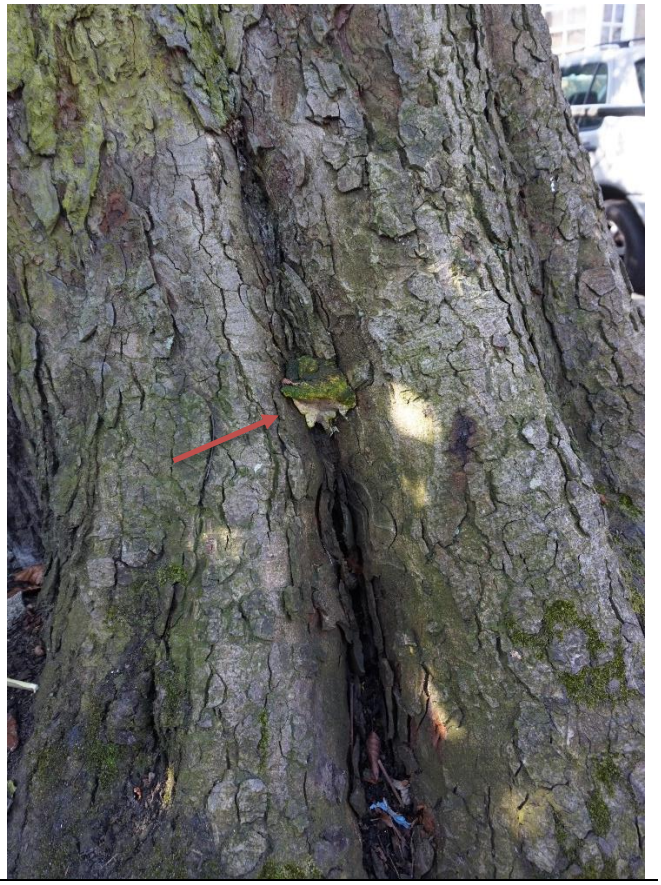


Photo 9: Fungal fruiting body to east of main stem

Photo 10: Main union of stems at approx.2.5m

Photo 11: Main target canker below main union at approx. 2.5m on stem to east

Photo 12: Further smaller target canker on main stem to north west at approx. 2.5m

Appendix 2: Limitations of Tree Condition Report

Limitations of the Tree Survey

The survey was based on visual observations and aids as detailed within the report.
A climbing inspection was not carried out.
No below ground inspections were carried out.
All observations were made from within the boundaries of the property, or from public land unless otherwise stated. Trees within neighbouring property are inspected as closely as is reasonably possible from within the boundaries of the property or from public land.
This report focuses on the physiological and structural condition of the tree as identified within this report.

Findings of the Survey and the Report

The recommendations in this tree report are valid for one year.
Independent data, where provided, has not been checked unless otherwise stated. This may affect the validity of the report and the client should satisfy themselves that any independent data provided is valid.
The tree/trees in question are evaluated using both visual tree assessment and stress wave tomography.
The information pertaining to the 'Arbotom'© Stress wave ('impulse') Tomography correlates to those details as provided by the manufacturers.

Displayed information and interpretation of the Impulse Tomography

Defects within the wood, not necessarily detrimental to structural integrity of the tree, may show up as areas of decay. Such areas as included bark, crack or stress fractures may appear on the read out as decayed areas. Such areas can only be verified by boring into the tree. This is only considered having discussed with the owner of the tree and maybe deemed necessary before felling the tree.

Timing of the Survey and the Report

Such considerations/ recommendations will become invalid if changes occur to the site as considered that affect the condition of the tree, the site as evaluated or the hazards as identified at the time of the survey.
If there are any such alterations, it is recommended that a new tree survey/report is undertaken.

Assessment of 'Targets' as considered

'Targets' are considered as those things, people and property that could be hit by the trees failing, whether such failure is partial or total.
These Targets are identified from an evaluation of the site at the time of the survey.
Changes to the site from the time of the survey may affect the targets as considered within the report and will require review or re-appraisal of the report.

Consideration of the Trees in Relation to Subsidence/ Heave

The report does not consider an assessment of the risk of Subsidence or Heave to any properties, built structures or drainage whether within the bounds of the site considered or adjacent to the site.
It is considered prudent to consider the effects of heave on any property if trees are removed.
Such considerations would be considered within a specific report.

Consideration of the Trees in relation to direct damage

The report does not consider direct damage related to tree root growth in relation to any structures whether within the bounds of the site considered or adjacent to the site.
Direct damage in this instance is considered to be where the roots of a tree have physical contact with a structure.

Trees in relation to other Properties

Works as recommended may affect third party property owners and /or third party trees. Considerations of these affects are not dealt with within this report.

This report/survey does not comment on possible effects of trees on neighbouring properties, including in relation to subsidence or heave, or with regard to possible hazards presented by trees surveyed.

Third party owners that maybe affected by recommended works and should be informed by the client, so that the relevant parties may seek their own advice as to possible effects of the recommendations given within this report.

Damage to, or possibility of damage to, any other structure that is not referred to within the report is not considered unless otherwise specified. This includes both neighbouring structures and any other structure on the property.

Trees subject to statutory controls

It has not been established whether or not any of the trees mentioned within the report are covered by any statutory controls. This can be done if requested.

If the trees are covered by a Tree Preservation Order or are located in a conservation area it will be necessary to consult the local authority before any pruning works, other than certain exemptions, can be carried out.

The works specified above are necessary for reasonable management and should be acceptable to the local authority. However, the local authority may take an alternative point of view and have the option to refuse consent.

Trees are subject to changes outside man's control

Trees are living organisms subject to changes outside man's control. Trees and environment alter with the seasons it is as well to inspect trees whilst in full leaf and when out of leaf.

If there are any harsh or unexpected weather conditions, or heavy storms it is also prudent to inspect trees.

Changes to ground water conditions will affect the root growth of a tree. Such changes are not always the result of man's influence and other factors may be involved.

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