Internal Decay Assessment of Common Lime (O)

1-9 Old Park Hill
Bristol
BS2 8BB

For University of Bristol

October 2023

Ref: 23642Dv01

Record Sheet

Report title	Internal Decay Assessment of Common Lime (O)
Location	1-9 Old Park Hill Bristol BS2 8BB
Client	University of Bristol
Report reference	23642D
Version	V01
Date of issue	19th October 2023
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Contents

1.0 Introduction and scope of survey

1.1 I was instructed by Kevin Stuckey to carry out an internal decay assessment of a common lime in the grounds of 1-9 Old Park Hill.

1.2 The investigation was carried out on 11th October 2023.

1.3 A detailed visual tree assessment was not undertaken but any obvious defects or features were noted.

1.4 The survey was carried out using a combination of a PiCUS sonic tomograph and an IML Resi-PD400 digital wood inspection drill, more commonly referred to as a Resistograph.

1.5 Comments and recommendations are limited to the findings of the PiCUS and Resistograph surveys only and are valid for a period of twelve months from the date of this report.

2.0 PiCUS Sonic Tomography - explanatory notes

2.1 The PiCUS tomograph measures the time taken for sonic stress waves to pass through the wood of a tree between sensors that are placed at a predetermined level around the tree stem.

2.2 The relative velocities of these waves help determine the wood density of a cross-section of the tree (sonic waves generally travel faster through sound wood than through decayed wood). These velocities are then calculated and interpreted by the PiCUS software to produce a colour tomogram of internal decay patterns.

2.3 The different colours on the tomogram indicate changes in relative sound velocities through the cross-section which help identify varying levels of wood density:

Dark brown represents the highest velocity and therefore dense or sound wood.
Pink and blue are the lowest relative velocities and may indicate decayed wood, cracks, included bark and/or cavities.
Green identifies velocities between these two thresholds. This may be wood that has a reduced density but is not yet decayed, such as wood with active/early fungal infection.

2.4 The interior red line indicates the t/R ratio. This is based on Mattheck and Breloer's (1994) method for calculating the safety margin of hollow/decayed stems. It is the ratio between the thickness of sound residual wall remaining (t) and the radius of the cross-section (R). For a central cavity, Mattheck affirms that this ratio should be no less than 0.3 (or 30% of the radius). If the ratio is less than this, then remedial work should be undertaken to reduce the lever-arm of the affected stem.

2.5 It should be noted that this calculation is provided as a baseline safety factor only. Research has shown that trees can remain safely standing with t/R ratios significantly

less than 0.3. When assessing risk of stem failure, the t/R ratio is therefore utilised in conjunction with other factors including the type of decay or defect as well as tree species, age, stem geometry, height/stem diameter ratio (HDR), aspect, location and vitality.

2.6 The red numbers around the tomogram indicate the measuring points (MPs). The graph axis shows the dimension of the cross-section in centimetres. North is indicated by a blue arrow on the tomogram.

2.7 The height on the tree stem at which the tomograph is taken is measured from ground level on the upper slope aspect of the stem and is recorded in the survey notes. The sensors are placed horizontally around the stem from this point.

2.8 The tomogram represents a cross-section of the tree at the measurement level only. The extent of decay may differ above or below the point of measurement.

3.0 Resi-PD400 Resistograph - explanatory notes

3.1 The PD400 measures the drilling resistance of wood and comprises a portable micro-drill with a 400mm x 1.5mm needle and a 3mm drill tip. The drilling needle is driven into the wood under constant drive and the energy required along the drilling depth is measured and electronically recorded.

3.2 The PD400 measures both the drill resistance (shaft friction) and force required to push the needle into the wood. The captured data is evaluated and processed to deliver a measuring curve, which is presented as a digital line graph. The drill resistance curve is shown in green and the feed force in blue.

3.3 Interpretation of these measurement profiles not only helps to determine variations in wood density and condition but also the ratio of sound wood to decayed wood.

3.4 The resistograph measures wood quality at specific drilling points only. Decay levels may differ above or below the points of measurement.

3.5 The estimated t/R ratio is provided with the results. The depth of bark has been excluded from the calculation.

4.0 Inspection notes

Tag no.	O	Tree species	Common lime Tilia x europaea			
Height (m)	15m	Stem diameter at 1.5m	78cm	Age class	Mature	
Crown spread in four cardinal directions (m)			North	South	East	West
			5.5m	6.0m	3.5m	5.5m
Physiological condition		Good				

Growing on top of 10m high retaining wall overhanging Park Row. 27m N of buildings.
Extensive basal epicormics.
Bark anomaly/dysfunction from 0.6m-1.2m above ground level (agl) on N aspect.
Stem lesion on S aspect with bark fissure from 1m-2.5m agl.
Virtually occluded cavity at approx. 1.2m agl on S aspect with significant exudation. Probed to 30cm radial depth.
Partially occluded pruning wound/cavity at 2.2m agl on SW aspect.
Scaffold stem at 2.5m agl on E aspect truncated at approx. 2m from union.
Lapsed pollard at 3.5m agl to 3x primary stems and 1x sub-dominant stem (plus 1x truncated) – acute forks with bark inclusion.
Reduced at 10m agl with approx. 5m regrowth.

Pl. 1 – Common lime

5.0 Tomograph and Resistograph findings

PiCUS tomograph findings

5.1 One tomograph was taken at 120cm agl to assess the extent of decay.

5.2 The tomogram is presented in section 7.0 and the findings are summarised below.

Measurement level	Percentage of cross-section identified as:		
	Cavity or decay (pink/blue shading)	Incipient decay / early wood degradation (green shading)	Sound wood (brown shading)
120cm	0%	0%	100%

Resistograph findings

5.3 Three resistograph readings were taken at 120cm agl at corresponding locations to the PiCUS MPs. A further four readings were taken at 20cm and 160cm agl.

5.4 The results are presented in section 8.0 and are summarised in the table below. When calculating the t/R ratio the depth of bark has been excluded. Figures are rounded to the nearest 5mm.

Drill no.	Cardinal pt. PiCUS MP	Height (cm) agl	Stem Radius (cm) R	Radial depth of sound wood including bark (cm)	Radial depth of sound wood excluding bark (cm) t	t/R ratio
R1	East 3	120	40.0	33.0	31.5	0.79
R2	North 6	120	40.0	>40.0	>39.0	>0.98
R3	West 9	120	40.0	>40.0	>39.0	>0.98
R4	East Below 3	20	44.0	34.0	32.0	0.73
R5	North Below 6	20	44.0	>40.0	>39.0	>0.89
R6	East Above 3	160	39.0	>40.0	>38.5	>0.99
R7	North Above 6	160	39.0	>40.0	>38.5	>0.99

6.0 Discussion and management recommendations

6.1 The tomograph indicates no decay or reduction in wood density at measurement level with 100% of the cross-section identified as sound wood. The most likely reason for this is that the cavity/decay is too small in diameter to register a sufficient sonic delay to trigger a change of colour on the tomograph image. Furthermore, the defect is virtually occluded and surrounded by strong reaction wood. This type of wood has significantly better acoustic properties and modulus of elasticity than primary growth. Analysis of the sound paths confirm consistent transmission speeds throughout the cross-section, which therefore hide the defect.

6.2 Three resistograph readings taken at 120cm agl confirm that the cavity/decay is very small. Reading R1 taken on the east aspect identifies a small pocket of decay from 31.5cm to 36cm. Readings R2 and R3 taken on the north and west aspects indicate sound wood to maximum drill depth.

6.3 R4 taken at 20cm agl on the east aspect also identifies a small pocket of decay at a depth of 32cm. R5 taken on the north aspect confirms sound wood to maximum drill depth.

6.4 Two readings R5 and R6 taken at 160cm agl identify sound wood to maximum drill depth.

6.5 It was not possible to take resistograph readings on the south aspect due to the proximity of the retaining wall.

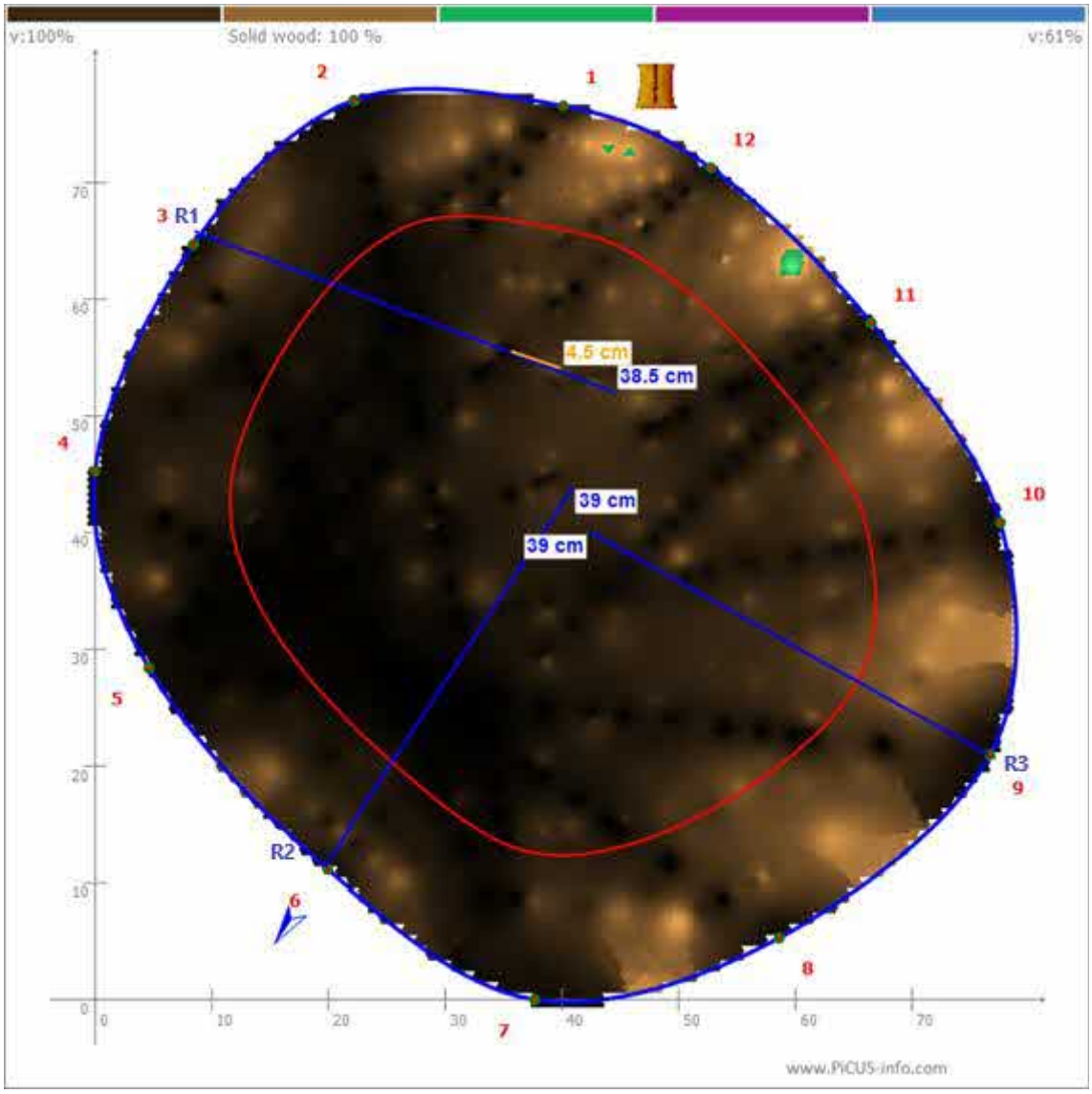
6.6 The small cavity is presumably a result of historical branch removal, which has now virtually occluded and is surrounded by strong wound wood. The ratio of remaining sound wood is within accepted safety margins and the tree has a modified crown structure and therefore a high basic safety factor.

6.7 In my opinion, based on the survey findings, the tree may be retained but should be visually inspected annually to monitor any change to its condition. Given its location on top of a large retaining wall, it should continue to be managed at a reduced scale by cyclical crown pruning.

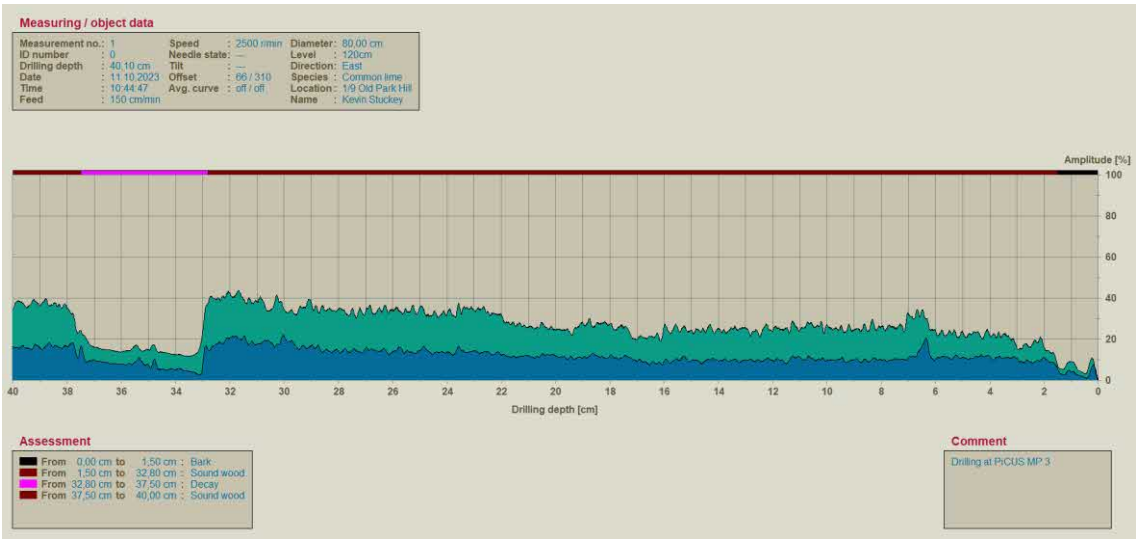
7.0 PiCUS Tomograph results

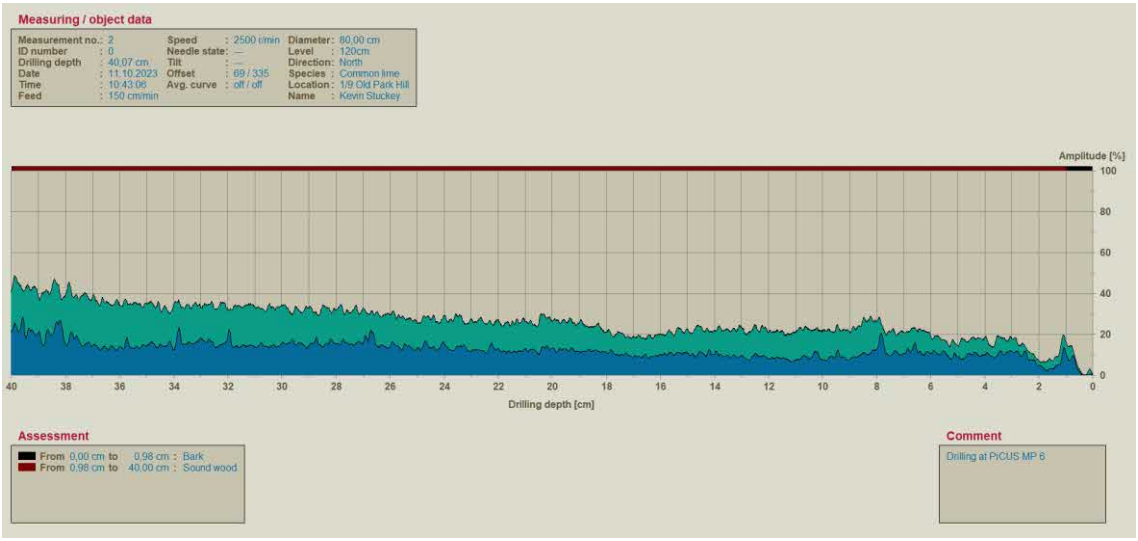
Tomogram taken at 120m agl.
Stem diameter at measurement level is 80cm.

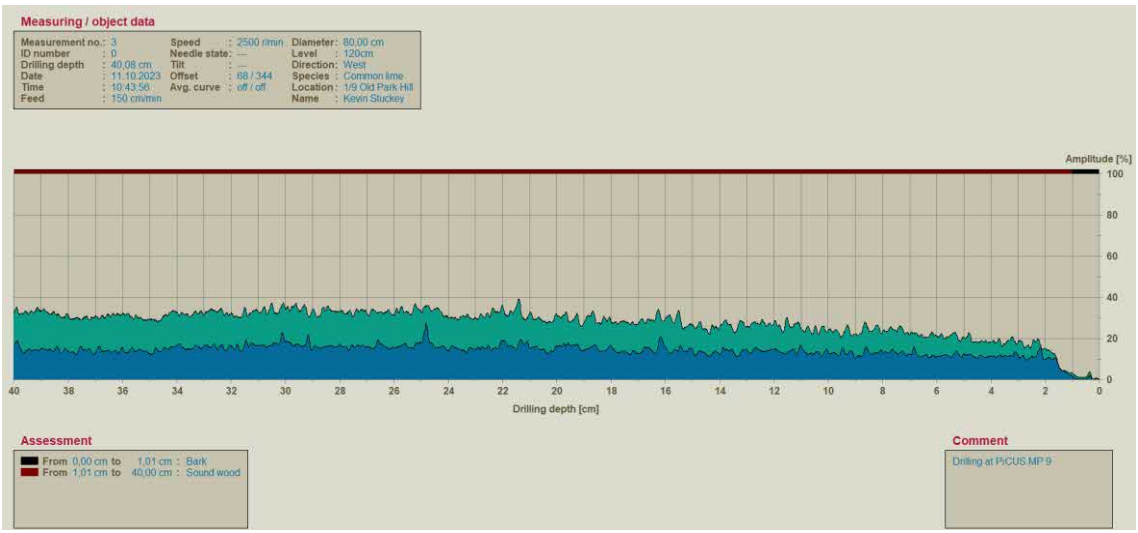
The direction and radial depth of sound wood (excluding bark) identified by the resistograph readings (R1, R2, R3) is shown in centimetres and indicated by the blue lines.
The extent of decay identified at R1 is shown by the orange line.

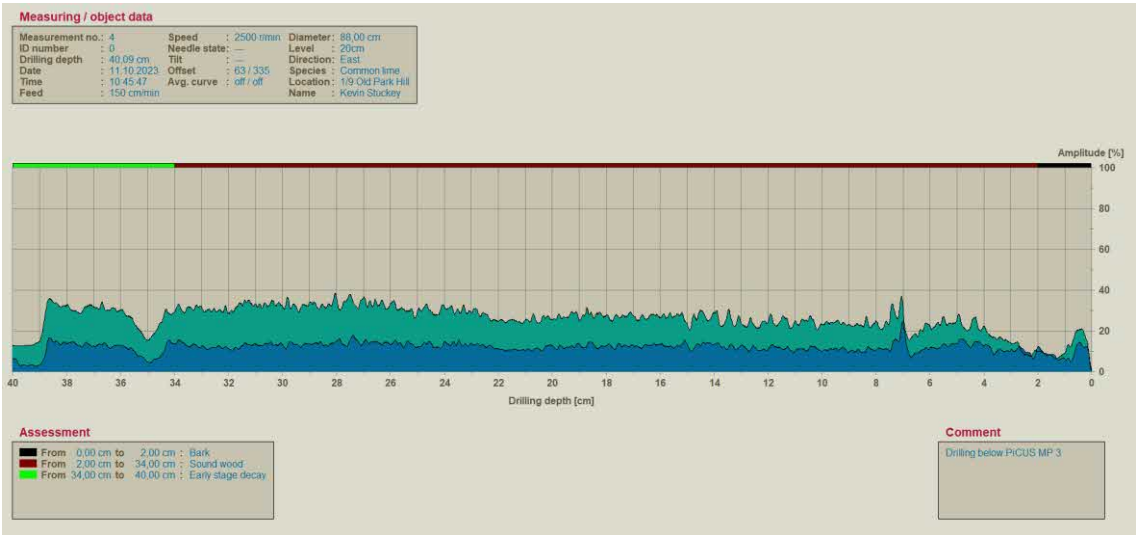


8.0 Resi-PD400 Resistograph results





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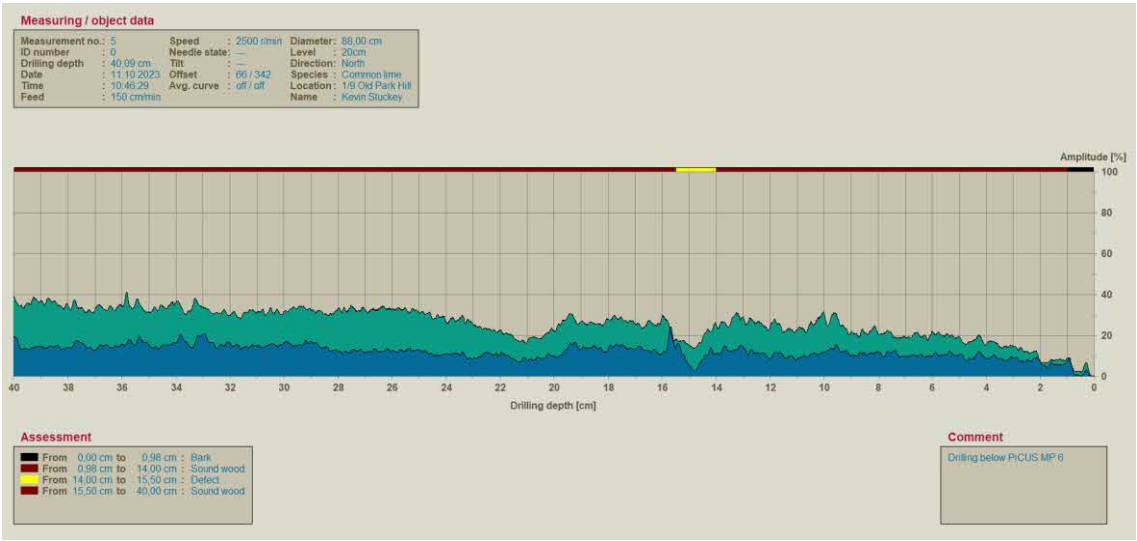
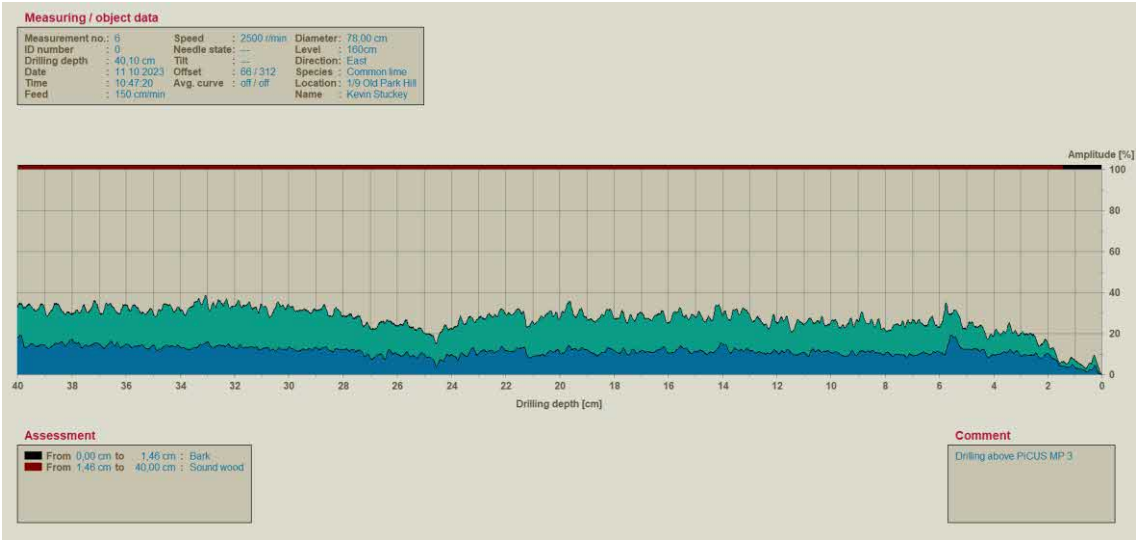
Measurement no.: 4
ID number : 0
Drilling depth : 40,09 cm
Date : 11.10.2023
Time : 10:45:47
Feed : 150 cm/min
Speed : 2500 r/min
Needle state: ---
Tilt : ---
Offset : 63 / 335
Avg. curve : off / off
Diameter: 88,00 cm
Level : 20cm
Direction: East
Species : Common lime
Location: 1/9 Old Park Hill
Name : Kevin Stuckey
Amplitude [%]
Drilling depth [cm]
Assessment
From 0,00 cm to 2,00 cm : Bark
From 2,00 cm to 34,00 cm : Sound wood
From 34,00 cm to 40,00 cm : Early stage decay
Comment
Drilling below PiCUS MP 3


Measuring / object data
Measurement no.: 5
ID number : 0
Drilling depth : 40,09 cm
Date : 11.10.2023
Time : 10:46:29
Feed : 150 cm/min
Speed : 2500 r/min
Needle state: ---
Tilt : ---
Offset : 66 / 342
Avg. curve : off / off
Diameter: 88,00 cm
Level : 20cm
Direction: North
Species : Common lime
Location: 1/9 Old Park Hill
Name : Kevin Stuckey
Amplitude [%]
Drilling depth [cm]
Assessment
From 0,00 cm to 0,98 cm : Bark
From 0,98 cm to 14,00 cm : Sound wood
From 14,00 cm to 15,50 cm : Defect
From 15,50 cm to 40,00 cm : Sound wood
Comment
Drilling below PiCUS MP 6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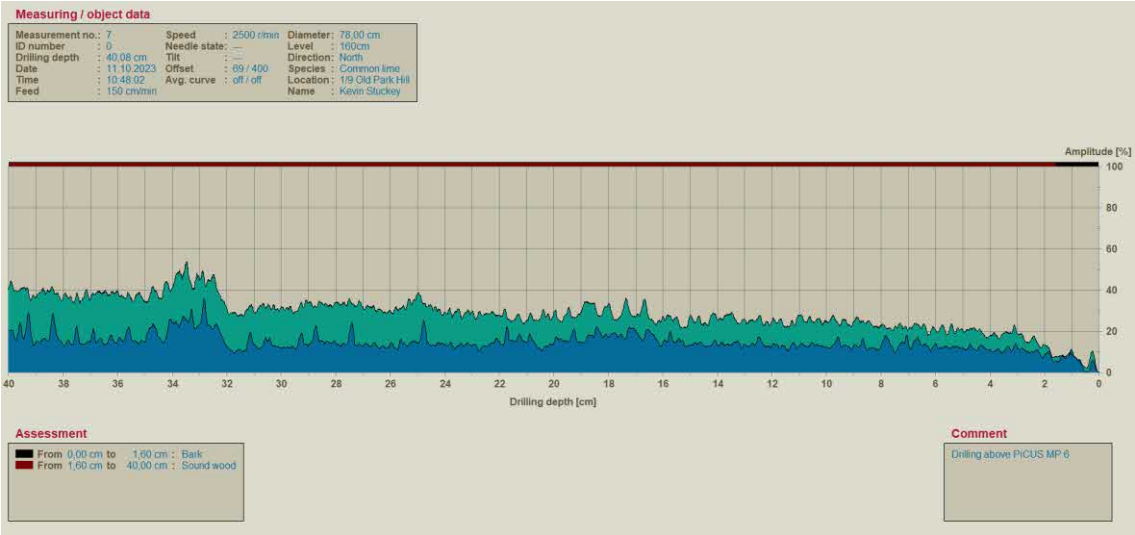
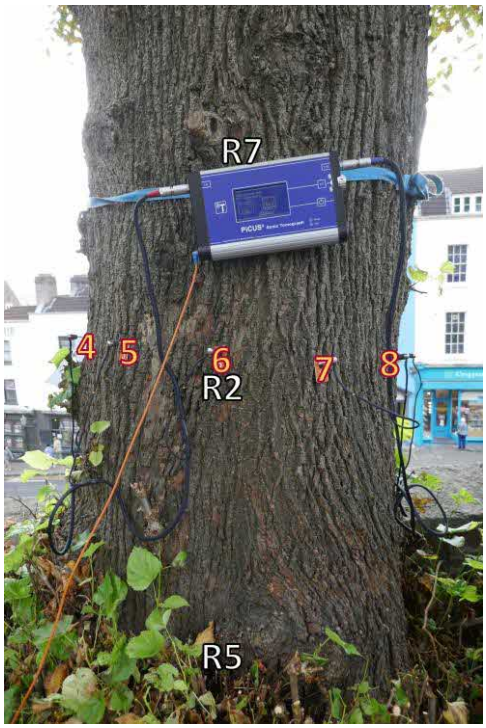
Measurement no.: 6
ID number : 0
Drilling depth : 40,10 cm
Date : 11.10.2023
Time : 10:47:20
Feed : 150 cm/min
Speed : 2500 r/min
Needle state: ---
Tilt : ---
Offset : 66 / 312
Avg. curve : off / off
Diameter: 78,00 cm
Level : 160cm
Direction: East
Species : Common lime
Location: 1/9 Old Park Hill
Name : Kevin Stuckey
Amplitude [%]
Drilling depth [cm]
Assessment
From 0,00 cm to 1,46 cm : Bark
From 1,46 cm to 40,00 cm : Sound wood
Comment
Drilling above PiCUS MP 3


Measuring / object data
Measurement no.: 7
ID number : 0
Drilling depth : 40,08 cm
Date : 11.10.2023
Time : 10:48:02
Feed : 150 cm/min
Speed : 2500 r/min
Needle state: —
Tilt : —
Offset : 69 / 400
Avg. curve : off / off
Diameter: 78,00 cm
Level : 160cm
Direction: North
Species : Common lime
Location : 1/9 Old Park Hill
Name : Kevin Stuckey
Amplitude [%]
100
80
60
40
20
0
40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
Drilling depth [cm]
Assessment
From 0,00 cm to 1,60 cm : Bark
From 1,60 cm to 40,00 cm : Sound wood
Comment
Drilling above PiCUS MP 6

9.0 Photographs

PiCUS MPs at 120cm agl shown in red. Resistograph drill points R1 to R7.

Pl. 2



Pl. 3

Pl. 4

Pl. 5

Bibliography

British Standards Institution, (2010). BS 3998:2010 Tree Work - Recommendations. London

Boddy, L., (2021). Fungi and trees. Their complex relationships. Arboricultural Association.

Fay, N, Dowson, D & Helliwell, R (2005). Tree Surveys: A Guide to Good Practice. The Arboricultural Association

Health and Safety Executive, (2001). Reducing risks protecting people. HSEs decision making process. HSE book. Sudbury

Health and Safety Executive, (2007) Management of the risk from falling trees. HSE Sector Information Minute, SIM01/2007/056

Humphries, D. & Wright, C. (2021). Fungi on trees. A photographic reference. Arboricultural Association

Lonsdale, D. (1999). Principles of tree hazard assessment and management. HMSO, London

Mattheck, C. (2007). Updated Field Guide for Visual Tree Assessment. Karlsruhe GmbH

Mattheck, C. Bethge, K. and Weber, K., (2015). The Body Language of Trees: Encyclopaedia of Visual Tree Assessment. Karlsruhe GmbH

National Tree Safety Group, (2011). Common Sense Risk Management of Trees. FC

Schwarze F.W.M.R, Engels J & Mattheck C (2004). Fungal Strategies of Wood Decay in Trees. Springer, Heidelberg

Strouts, R.G. & Winter, T.G. (1994). Diagnosis of ill-health in trees. HMSO, London

Weber, K. & Mattheck, C. (2003). Manual of wood decay in trees. Arboricultural Association