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SURVEYS, INSPECTIONS, REPORTS

OAK TREE
3 THE WOODLANDS
Off CHESTER ROAD
GRESFORD
WREXHAM
LL12 8NU

ADVANCED TREE INSPECTION UTILISING THE PICUS SONIC, PICUS TREETRONIC AND IML P-400 RESISTOGRAPH DECAY DETECTION EQUIPMENT

Report by:

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Client	**Mrs Pilsbury**
Planning Authority	**Wrexham County Borough Council**
Grid Reference	**SJ35335498**
Dates of Surveys	**30 August 2024**
Reference	**092024/ATI/P**

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Registered Consultant

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PRO3755

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1.0 SUMMARY

The subject tree was identified as Common Oak (*Quercus robur*), located in the rear garden of 3 The Woodlands, Off Chester Road, Gresford, Wrexham, LL12 8NU [OS Grid Ref SJ35335498].

An Advanced Inspection of was carried out, utilising specialist decay detection equipment. Sonic tests were carried out at 20cm height and 150cm height. An electrical resistance test was carried out at 20cm height and 150cm height. Resistograph microdrill tests were carried out at 20cm height and 150cm height.

The sonic tomographs (SoT) indicate sound wood (brown colours) in the East and West of the trunk cross-section. The light brown colours indicate a slight reduction in velocity of the sonic waves, where a fungus has inoculated the wood and is just beginning to affect the structure of the wood cells. A significant decay cavity (blue colours) is indicated North-Southeast across the centre of the trunk, with associated advanced decay (violet colours) and early-stage decay (green colours) at the periphery of the cavity.

The electrical impedence tomograph (EIT) indicates a typical EIT Type 3 ring-like distribution at the West (MP5-9) of the trunk, with higher conductivity (blue colours) on the outside (sapwood), an inner ring of high resistance (red colours) and high conductivity (blue colours) in the centre. The disruption of the inner red ring in the North, Southwest and Southeast sections of the trunk indicates decay is likely to be developing in these sections of the trunk.

The combination of low velocity SoT (blue) and high conductivity EIT (blue) to the inside of the South of the trunk (MP8-9) [indicating an area of active fungal decay], means that there is still some woody material in this area – because air (e.g. a decay cavity) has very high electric resistance (red). The cracks/bark inclusions have likely hindered the transmission of the sound waves, resulting in a larger decay cavity indicated on the SoT tomograph than is actually present in the wood. The fungus has likely begun to affect the wood in these areas to some degree, but it is not yet completely degraded to form a cavity.

Using the TreeSA method of assessing the compressive strength and wind load parameters, the Q74Exp software was used to calculate the safety factor for the trunk and required load bearing capacity. The drillings confirm that a decay cavity is developing across the centre (North-Southeast) of the trunk, but at this time, there is a sufficiently thick residual wall of sound wood around the trunk for it to remain stable.

The conclusion is that the fungal decay is not significantly affecting the structural stability of the trunk of the Oak tree at this time.

The **Tree Risk Rating** for the next 2 years for the Oak is determined as **Low** with regards to the people using the gardens of the properties.

The most appropriate and proportionate action would be to consider crown reducing tree volume by up to 15% to include a height reduction of circa 1.5m and a radial reduction of circa 1m, to leave a well-balanced natural crown shape, with crown dimensions of circa 8.5m high x 10m spread. Any large deadwood (>35mm diam.) overhanging the neighbouring garden should be removed for safety reasons.

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2.0 INTRODUCTION

2.1 Brief

Stephen Cutmore BSc (Hons), MICFor, MArborA, VETcert Consulting Level, was instructed by Mrs Pilsbury, to carry out an advanced inspection of a Common Oak (*Quercus robur*), located in the rear garden of 3 The Woodlands, Off Chester Road, Gresford, Wrexham, LL12 8NU [OS Grid Ref SJ35335498].

The definition of the assignment was to:

1. Carry out an Advanced Tree Inspection of the Oak tree, utilising hi-tech decay detection tools.

2. Assess the condition of the tree.

3. Provide a report with management options.

2.2 Purpose of this report

The purpose of this report is to advise you of the results of the parts 1 and 2 of the assignment. These results are set forth in the *Conclusions* section, following. This report describes the field conditions as found and interpreted.

2.3 Scope of report

Date of consultation.

The field examinations were made on 30 August 2024, and observations and conclusions are as of that date.

Limit of scope.

This is solely an *Arboricultural Report* and cannot comment on topics outside this discipline. If additional advice is required, it is strongly recommended that other professionals are consulted e.g. Structural Engineers or Surveyors.

Unless stated otherwise:

1) Information contained in this report covers only those trees that were examined and reflects the condition of those trees at the time of the inspection.

2) The inspection is limited to visual examination of the subject trees from ground level and an advanced inspection, utilising decay detection equipment, to assess the internal condition of the trunks.

3) There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the subject trees may not arise in the future.

4) This report has been prepared for the sole use and benefit of the client. Any liability of Stephen Cutmore Arboricultural & Ecological Services shall not be extended to any third party.

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2.0 INTRODUCTION (continued)

2.4 Relevant background information

Jon Brewin, Arboricultural Officer, Wrexham County Borough Council, previously made a site visit to look at the tree and observed areas of decay on the trunk. The recommendation was to carry out an advanced inspection of the tree.

2.5 Tree identification and location

The subject tree was identified as Common Oak (*Quercus robur*), located in the rear garden of 3 The Woodlands, Off Chester Road, Gresford, Wrexham, LL12 8NU [OS Grid Ref SJ35335498].

2.6 Qualification

Stephen Cutmore is a Chartered Arboriculturist (Institute of Chartered Foresters), with over thirty five years' experience in the arboricultural and forestry industry as a contractor and over twenty five years' experience as an arboricultural consultant. Full details of my qualifications and experience entitling me to give expert opinion evidence are in Appendix 7.

2.7 Copyright

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3.0 DATA COLLECTION

3.1 Site visit

A site visit was made on 30 August 2024. The weather was dry and sunny. There were no limiting factors to the inspection.

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3.0 DATA COLLECTION (continued)

3.2 Methodology

An advanced inspection of the Oak was carried out, utilising specialist decay detection equipment.

Picus Sonic Tomograph

The Oak tree was tested with the Picus Sonic Tomograph (non-invasive technique) to assess the internal condition of the trunk. The Picus Sonic Tomograph works on the basis that solid wood is a better sound transmitter than decayed wood. Sonic sensors were strategically spaced around the circumference of the trees, to detect stress-waves induced by manual impact and propagated through the wood. Electronic callipers were used to accurately plot the positions of the sensors. Picus Expert (Q74Exp) software was used to generate a two-dimensional colour sonic tomograph (SoT) of the cross-section, detailing areas of solid wood, decay and cavities within the tree. On the tomograph, brown colours indicate solid, healthy wood. The colours green, violet and blue indicate increasing degrades of decay. Two tests were carried out at 20cm and 150cm above ground level. The SoT tomographs are included as *Figures 4-6* and also as *Appendix 2.*

Picus Treetronic

The Oak tree was further assessed at the same test positions (20cm and 150cm above ground level), with the Picus Treetronic, which uses electric current/voltage to examine the tree. The resulting measurements are displayed in a two dimensional map showing the apparent electrical impedance of the wood, called an Electrical Impedance Tomogram (EIT). The red cables are attached to the nails of the SoT MPs and the black cables are attached to additional nails which are inserted between the SoT MPs and an electric current is transmitted through the trunk. If the SoT tomograph shows 12MPs, the EIT tomograph therefore shows 24MPs (red & black cables).

The electric impedance - or resistance - of the wood (i.e. the ability of the wood to transmit an electric current) is influenced most of all by the water content, cell structure and chemical elements which change if decay is present in the tree. The Treetronic can detect such changes by measuring how the heterogeneous wood “bends” the electrical field.

By analysing both the Sonic (SoT) and Electrical Impedance (EIT) tomograms together, detailed information about the position, extent and - in some cases - the kind of decay can be determined. The EIT is also able to clearly identify areas of entrapped bark, resin etc. that could be mistaken for decay, so it is often possible to distinguish between cracks, cavities and ‘wet’ diseased wood.

EIT can detect very early stages of decay and also get information about areas above or below the measuring point, so helps identify root decay problems. On the EIT tomograph, blue colours indicate areas of low resistance (high water content), red colours indicate high resistance (low water content). Two EIT tests were carried out at 20cm and 150cm height. The EIT tomographs are included as *Figures 7 & 8* and as *Appendix 3.*

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3.0 DATA COLLECTION (continued)

3.2 Methodology

Picus Treetronic

Unlike SoT, which is a relative measurement and thus independent of tree species, EIT is to some extent species dependent, with tree species having their own EIT 'fingerprint'. Most European tree species are Type 1 (e.g. Beech, Birch, Lime, Pine, Poplar and many more). Type 1 trees show **higher conductivity** (low resistance – blue colours) **on the outside** and **high resistance** (low conductivity – red colours) towards the **inside** of the tree.

Coast Redwoods are Type 2 showing **high resistance** on the **outside** and **high conductivity** on the **inside**.

Common Oak (*Quercus robur*) and Sessile Oak (*Quercus petraea*) are Type 3 showing a ring-like distribution, with **higher conductivity** on the **outside** (sapwood), an **inner ring** of **high resistance** and **high conductivity** in the **centre** (due to high concentration of certain ions). The studies into EIT Types were mostly conducted on European Oaks, so there is no scientific proof which EIT Type other Oak species are. In these cases, the SoT and EIT tomographs have to be interpreted by looking for typical traits.

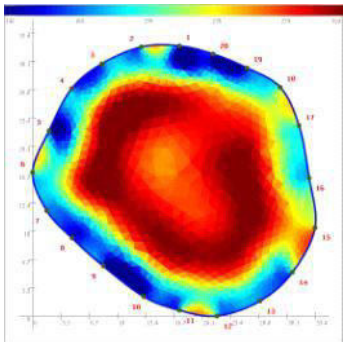


Figure 1: Healthy EIT Type 1.

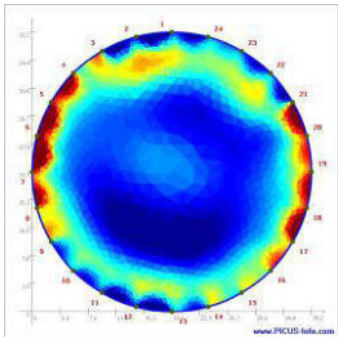


Figure 2: Healthy EIT Type 2.

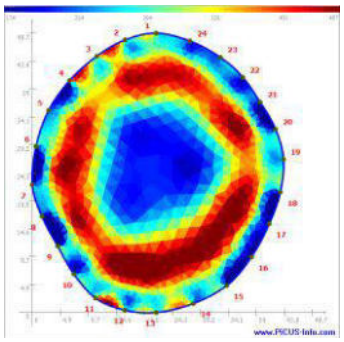


Figure 3: Healthy EIT Type 3.

IML PD-400 Resistograph

Following the Picus Tomograph assessments, a further assessment of the Oak was made utilising the IML PD-400 Resistograph. The PD-400 Resistograph is a precision tool, used to accurately assess the internal condition of trees. The device has a narrow 2mm diameter drilling needle with a maximum drilling length of 400mm. As the drilling needle is drilled into the wood at a constant velocity, the resistance of the wood against the tip of the drill-bit is digitally recorded. High resistance indicates solid, healthy wood. Low resistance indicates defects in the form of decayed wood, cavities, cracks, etc.

Five drill tests were made around the trunk of the Oak at 20cm height, at the Picus test height. Five drill tests were made around the trunk of the Oak at 150cm height, at the Picus test height. The Resistograph readings are included as *Figures 9-18* and as Appendix *4*.

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3.0 DATA COLLECTION (continued)

3.3 Observations

The mature Oak has a height of 10m and the crown spread of 12m. The tree has a diameter at breast height (1.5m height) of 88cm. The tree has previously been pollarded and in the recent past has had some crown reduction work carried out.

The crown appears to be in a fair condition, with good foliar density, colour and size. Some decline in condition was observed in the form of twig dieback and small deadwood. Some larger dead branches and dead stubs were observed in the crown. The tree is showing good vitality in the form of epicormic shoot and adventitious shoot development and woundwood development around pruning wounds, in response to previous cutting. An old rip-out wound was observed at approx. 2m height on the North side of the trunk, with the bark ripped down to the base. Another old rip-out wound was observed at approx. 2.2m height on the Southeast side of the trunk, with the bark ripped down to the base. The tree has responded with good woundwood development at the margins of the wounds. Brown cubical rot was observed in the exposed wood in the wounds, but no fungal fruiting bodies were observed on the trunk or on the grass around the base.

3.4 Results

Picus Sonic Tomograph

Test #1 at 20cm above ground level.

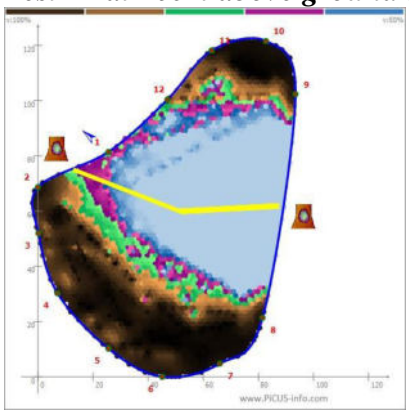


Figure 4: SoT of Oak at 20cm height.

The sonic tomograph (SoT) in *Fig.4* indicates sound wood (brown colours) in the East and West of the trunk cross-section. The light brown colours indicate a slight reduction in velocity of the sonic waves, where a fungus has inoculated the wood and is just beginning to affect the structure of the wood cells.

A significant decay cavity (blue colours) is indicated North-Southeast across the centre of the trunk, with associated advanced decay (violet colours) and early-stage decay (green colours) at the periphery of the cavity.

The super-imposed yellow lines indicates possible cracks or bark inclusions in the wood detected by the Q74Exp software. Cracks/bark inclusions can hinder the transmission of the soundwaves across the trunk, so can cause anomalies in the SoT, with more decay indicated than is actually present in the wood.

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3.0 DATA COLLECTION (continued)

3.4 Results

Picus Sonic Tomograph

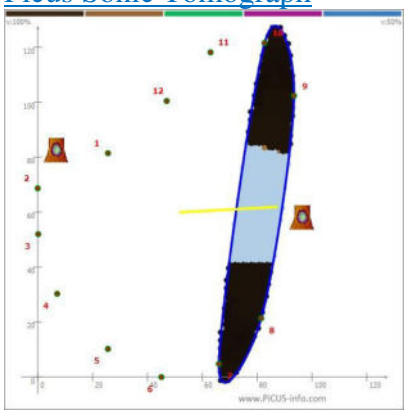


Figure 5: Section of tomograph at 20cm just using MPs 7-10.

By selecting just the readings from MPs 7-10, the tomograph indicates approx. 50% more wood at the periphery of the Southeast section of the trunk is sound/healthy, than was indicated on the original SoT. The possible cracks in the wood have likely hindered the transmission of the soundwaves, indicating more decay in the SoT tomograph, than is actually present. To clarify this, further tests were carried out utilising the Picus Treetronic and IML PD-400 Resistograph microdrill.

Test #2 at 150cm above ground level.

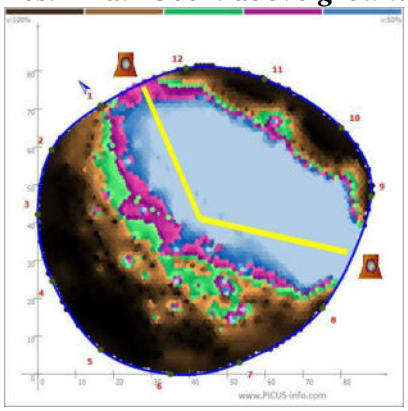


Figure 6: SoT of Oak at 150cm height.

The sonic tomograph (SoT) in *Fig.6* indicates sound wood (brown colours) in the East and West of the trunk cross-section. The light brown colours indicate a slight reduction in velocity of the sonic waves, where a fungus has inoculated the wood and is just beginning to affect the structure of the wood cells.

A significant decay cavity (blue colours) is indicated North-Southeast across the centre of the trunk, with associated advanced decay (violet colours) and early-stage decay (green colours) at the periphery of the cavity.

The super-imposed yellow lines indicates possible cracks or bark inclusions in the wood detected by the Q74Exp software. Cracks/bark inclusions can hinder the transmission of the soundwaves across the trunk, so can cause anomalies in the SoT, with more decay indicated than is actually present in the wood.

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3.0 DATA COLLECTION (continued)

3.4 Results

Picus Treetronic

Test #1 at 20cm above ground level.

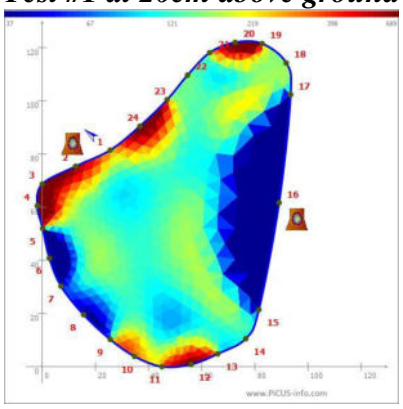


Figure 7: EIT of Oak at 20cm height.

When a trunk is healthy the sapwood is relatively wet (high conductivity = blue colour) compared to the drier heartwood (high resistance = red colour). The electrical impedance tomograph (EIT) in *Fig.7* indicates a typical EIT Type 3 ring-like distribution at the West (MP5-9) of the trunk, with higher conductivity (blue colours) on the outside (sapwood), an inner ring of high resistance (red/yellow colours) and high conductivity (blue colours) in the centre.

However, when the heartwood starts to become infected with fungal decay, the colour scale can be inverted. For example, the sapwood has still the same properties in absolute values but compared to the heartwood it is relatively dry (dry - usually high resistance = red). The increasing resistance (red colour) of the sapwood at the periphery of the North section of the trunk (MP23-4) of the trunk and the disruption of the inner red ring in the North, Southwest and Southeast sections of the trunk indicates decay is likely to be developing in these sections of the trunk.

Test #2 at 150cm above ground level.

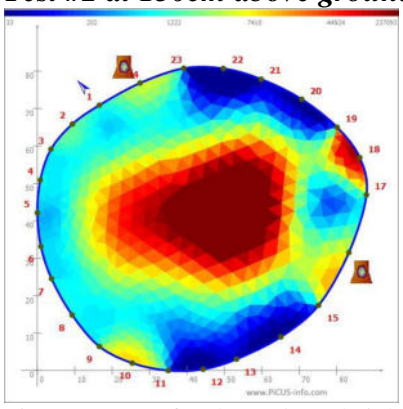


Figure 8: EIT of Oak at 150cm height.

The electrical impedance tomograph (EIT) in *Fig.*8 shows high resistance (red colour) at the centre, which indicates a decay cavity is likely to be developing in this section of the trunk.

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3.0 DATA COLLECTION (continued)

3.4 Results

IML PD-400 Resistograph

Lower test position

Test#1 MP1 at 20cm height

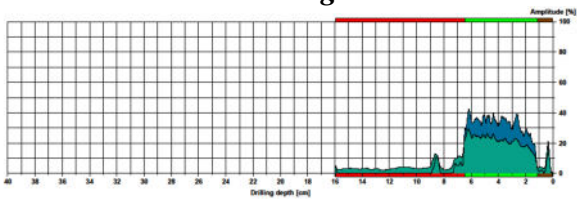


Figure 9: Oak Test #1 at MP1 towards South.

The drilling shows the needle passes through the bark then encounters high resistance in sound wood to 6.49cm depth. Resistance drops sharply as the needle encounters advanced decay/cavity. The needle automatically retracted to avoid needle breakage.

Test#2 MP5-6 at 20cm height

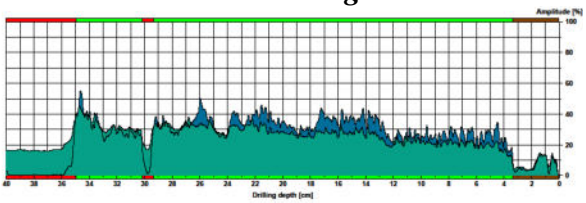


Figure 10: Oak Test #2 at MP5-6 towards East.

The drilling shows the needle passes through the bark then encounters high resistance in sound wood to 29.36cm depth. Resistance drops briefly in a small decay pocket to 30.16cm, then increases in sound wood to 34.94cm depth. Resistance drops as the needle encounters advanced decay/cavity to the end of the drilling depth.

Test#3 MP7-8 at 20cm height

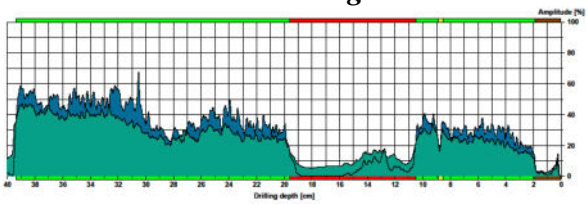


Figure 11: Oak Test #3 at MP7-8 towards North.

The drilling shows the needle passes through the bark then encounters high resistance in sound wood to 10.5cm depth, (with a crack in the wood indicated at 8.56cm). Resistance drops as the needle encounters advanced decay/cavity to 19.6cm. Resistance increases in sound wood to 39.34cm. Resistance drops as the needle encounters advanced decay/cavity.

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3.0 DATA COLLECTION (continued)

3.4 Results

IML PD-400 Resistograph

Lower test position

Test#4 MP8-9 at 20cm height

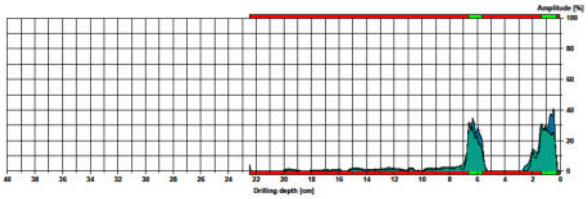


Figure 12: Oak Test #4 at MP8-9 towards North.

The drilling shows the needle passes through the bark then encounters high resistance in sound wood to 1.37cm depth. Resistance decreases in early-stage decay and drops further in advanced decay/cavity to 5.67cm. Resistance increases in sound wood to 6.64cm. Resistance drops as the needle encounters advanced decay/cavity. The needle automatically retracted to avoid needle breakage.

Test#5 MP12 at 20cm height

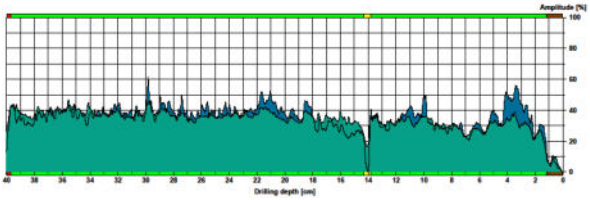


Figure 13: Oak Test #5 at MP12 towards Southwest.

The drilling shows the needle passes through the bark then encounters high resistance in sound wood to 13.82cm depth. Resistance drops sharply and briefly, as the needle passes through a crack in the wood to 14.31cm. Resistance increases in sound wood to 39.71cm, then resistance drops as the needle encounters advanced decay/cavity.

Higher test position

Test#1 MP1 at 150cm height (Measurement#6)

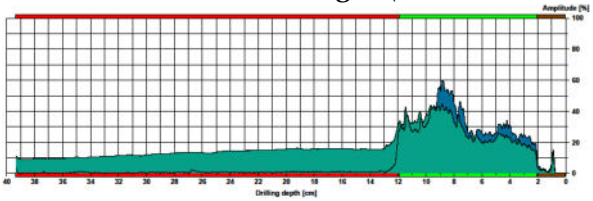


Figure 14: Oak Test #1 at MP1 towards South.

The drilling shows the needle passes through the bark then encounters high resistance in sound wood to 11.29cm depth. Resistance drops sharply as the needle encounters advanced decay/cavity to 39.34cm. The needle automatically retracted to avoid needle breakage.

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3.0 DATA COLLECTION (continued)

3.4 Results

IML PD-400 Resistograph

Higher test position

Test#2 MP5-6 at 150cm height (Measurement#7)

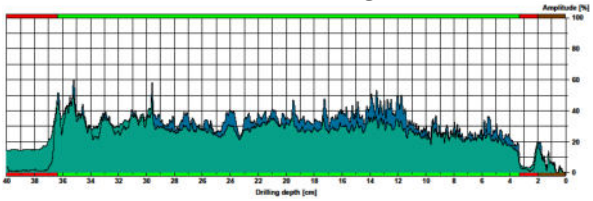


Figure 15: Oak Test #2 at MP5-6 towards East.

The drilling shows the needle passes through the bark then encounters low resistance in decay in the sapwood (or a possible delamination of the bark) to 3.29cm depth. Resistance increases in sound wood to 36.39cm. Resistance drops sharply as the needle encounters advanced decay/cavity to the end of the drilling depth.

Test#3 MP8 at 150cm height (Measurement#8)

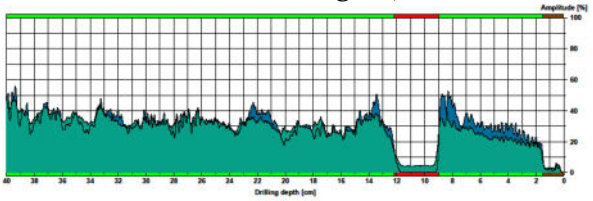


Figure 16: Oak Test #3 at MP8 towards North.

The drilling shows the needle passes through the bark then encounters high resistance in sound wood to 8.96cm depth. Resistance drops sharply as the needle encounters advanced decay/cavity to 12.19cm. Resistance increases in sound wood to the end of the drilling depth.

Test#4 MP8-9 at 150cm height (Measurement#9)

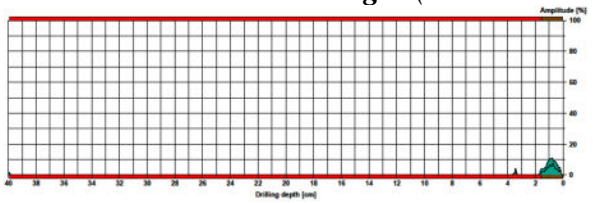


Figure 17: Oak Test #4 at MP8-9 towards Northwest.

The drilling shows the needle passes through the bark then encounters low resistance in advanced decay/cavity for the entire 40cm drilling depth.

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3.0 DATA COLLECTION (continued)

3.4 Results

IML PD-400 Resistograph

Higher test position

Test#5 MP10-11 at 150cm height (Measurement#10)

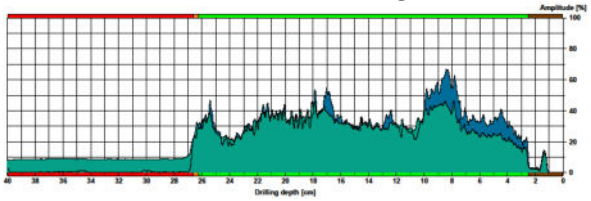


Figure 18: Oak Test #5 at MP10-11 towards West.

The drilling shows the needle passes through the bark then encounters high resistance in sound wood to 26.27cm depth. Resistance decreases in early-stage decay to 26.64cm, then drops sharply as the needle encounters advanced decay/cavity to the end of the drilling depth.

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4.0 APPRAISAL

4.1 Analysis of Picus SoT and EIT tomographs

By analysing both the SoT and EIT tomographs, a better understanding of the condition of the wood can be obtained.

Test #1 at 20cm

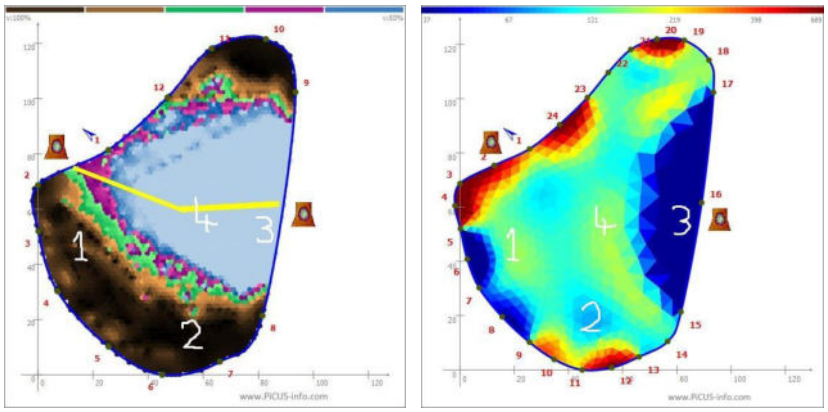


Figure 19: Analysis of SoT and EIT of Oak at 20cm height.

The tomographs show a combination of high velocity SoT (brown) and high resistance EIT (red/yellow) indicating healthy wood to the inside of the West of the trunk (MP3-5) [labelled 1].

The combination of high velocity SoT (brown) and high conductivity EIT (blue) to the inside of the Southwest of the trunk (MP5-7) indicates very early-stage active decay [labelled 2]. When a fungus inoculates the wood and begins to start attacking the cells, it releases enzymes to digest the wood, which increases the moisture content, hence the increase in conductivity.

Electric resistance tomography can help to overcome some of the limitations of sonic tomography, such as acoustic shadows caused by cracks. The combination of low velocity SoT (blue) and high conductivity EIT (blue) to the inside of the South of the trunk (MP8-9) [indicating an area of active fungal decay] [labelled 3], means that there is still some woody material in this area – because air (e.g. a decay cavity) has very high electric resistance (red). The cracks/bark inclusions have likely hindered the transmission of the sound waves, resulting in a larger decay cavity indicated on the SoT tomograph than is actually present in the wood. The fungus has likely begun to affect the wood in these areas to some degree, but it is not yet completely degraded to form a cavity.

The combination of low velocity SoT (blue) and high resistance EIT (yellow) at the centre of the trunk indicates an area of inactive decay/cavity [labelled 4].

To clarify this, drill tests were carried out utilising the IML PD-400 Resistograph microdrill.

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4.0 APPRAISAL (continued)

4.1 Analysis of Picus SoT and EIT tomographs

By analysing both the SoT and EIT tomographs, a better understanding of the condition of the wood can be obtained.

Test #2 at 150cm

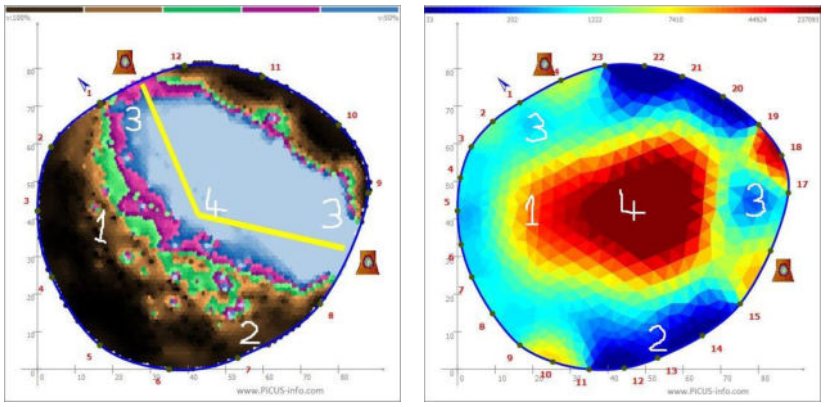


Figure 20: Analysis of SoT and EIT of Oak at 150cm height.

The tomographs show a combination of high velocity SoT (brown) and high resistance EIT (red/yellow) indicating healthy wood to the West of the centre of the trunk [labelled 1].

The combination of high velocity SoT (brown) and high conductivity EIT (blue) to the inside of the South of the trunk (MP6-8) indicates very early-stage active decay [labelled 2]. When a fungus inoculates the wood and begins to start attacking the cells, it releases enzymes to digest the wood, which increases the moisture content, hence the increase in conductivity.

Electric resistance tomography can help to overcome some of the limitations of sonic tomography, such as acoustic shadows caused by cracks. The combination of low velocity SoT (blue/violet/green) and high conductivity EIT (blue) to the North and Southeast of the centre of the trunk [indicating an area of active fungal decay] [labelled 3], means that there is still some woody material in this area – because air (e.g. a decay cavity) has very high electric resistance (red). The cracks/bark inclusions have likely hindered the transmission of the sound waves, resulting in a larger decay cavity indicated on the SoT tomograph than is actually present in the wood. The fungus has likely begun to affect the wood in these areas to some degree, but it is not yet completely degraded to form a cavity.

The combination of low velocity SoT (blue/violet/green) and high resistance EIT (yellow/red) at the centre of the trunk indicates an area of inactive decay/cavity [labelled 4].

To clarify this, drill tests were carried out utilising the IML PD-400 Resistograph microdrill.

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4.0 APPRAISAL (continued)

4.2 Analysis of IML PD-400 Resistograph drillings

Test #1 at 20cm height

The drillings for test #1, #2, #3, #4 and #5 at 20cm indicate sound wood to 6.49cm, 34.94cm, 10.5cm (and 19.6cm), 1.37cm and 39.7cm respectively, before encountering advanced decay/cavity. Superimposed red line on *Figure 21* indicates likely extent of cavity.

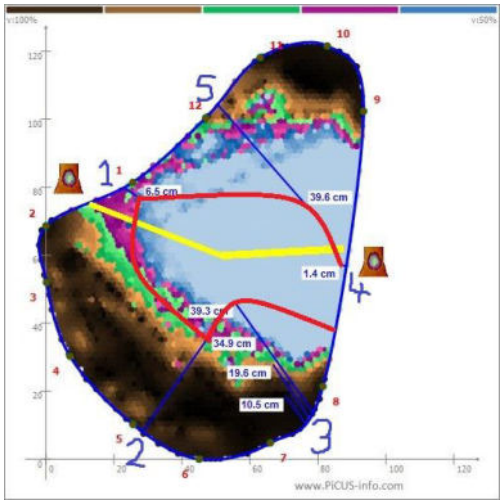


Figure 21: Analysis of drillings at 20cm height.

The drillings confirm that a decay cavity is developing across the centre (North-Southeast) of the trunk, but the cracks in the wood are causing an anomaly in the SoT, with more decay indicated than is actually present in the trunk cross-section.

Using the TreeSA method of assessing the compressive strength and wind load parameters, the Q74Exp software was used to calculate the safety factor for the trunk and required load bearing capacity. The minimum thickness of residual wall required around the periphery of the trunk is indicated by the super-imposed green line on *Figure 22*. The drillings confirm that at this time, there is a sufficiently thick residual wall of sound wood around the trunk for it to remain stable.

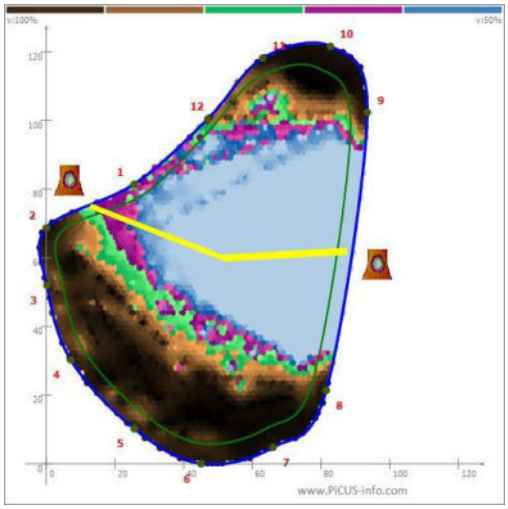


Figure 22: TreeSA minimum thickness at 20cm height.

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4.0 APPRAISAL (continued)

4.2 Analysis of IML PD-400 Resistograph drillings

Test #2 at 150cm height

The drillings for test #1, #2, #3, #4 and #5 at 150cm indicate sound wood to 11.29cm, 36.39cm, 8.96cm, 0cm and 26.27cm respectively, before encountering advanced decay/cavity. Superimposed red line on *Figure 23* indicates likely extent of cavity.

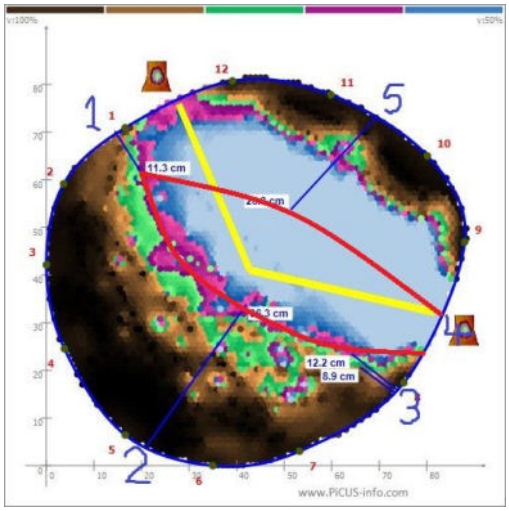


Figure 23: Analysis of drillings at 150cm height.

The drillings confirm that a decay cavity is developing across the centre (North-Southeast) of the trunk, but the cracks in the wood are causing an anomaly in the SoT, with more decay indicated than is actually present in the trunk cross-section.

Using the TreeSA method of assessing the compressive strength and wind load parameters, the Q74Exp software was used to calculate the safety factor for the trunk and required load bearing capacity. The minimum thickness of residual wall required around the periphery of the trunk is indicated by the super-imposed green line on *Figure 24*. The drillings confirm that at this time, there is a sufficiently thick residual wall of sound wood around the trunk for it to remain stable.

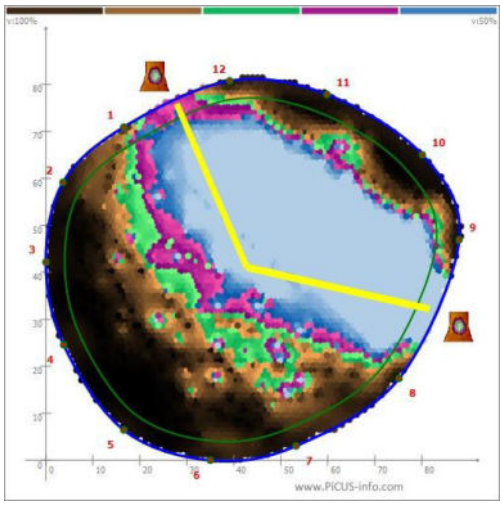


Figure 24: TreeSA minimum thickness at 150cm height.

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4.0 APPRAISAL (continued)

4.3 Tree Risk Assessment

By using a process of rating the likelihood of tree failure and the consequences of the event (International Society of Arboriculture Tree Risk Assessment methodology), a risk level was determined for the next **2 years** for the Oak. The main target identified is the people using the gardens of the properties. There are **five** steps in determining the Tree Risk Rating, which is obtained by following **all** the steps in the process in sequence.

Step 1: Likelihood of Failure

The likelihood of failure in the next year can be categorised using the following guidelines:

Improbable – the tree or tree part is not likely to fail during normal weather conditions and may not fail in many severe weather conditions within the specified time period.

Possible – failure may be expected in extreme weather conditions, but it is unlikely during normal weather conditions within the specified time period.

Probable – failure may be expected under normal weather conditions within the specified time period.

Imminent – failure has started or is most likely to occur in the near future, even if there is no significant wind or increased load.

The Oak was assessed as having a **Possible** Likelihood of Failure.

Step 2: Likelihood of Impacting a Target

To estimate this likelihood, the occupancy rate of any targets within the target zone and any factors that could affect the failed tree as it falls towards the target are determined. The likelihood of impacting a target can be categorised using the following guidelines:

Very Low – the chance of a failed tree or tree part impacting the specified target is remote. This is the case for a rarely used site that is fully exposed to the assessed tree, or an occasionally used area that has some protection against being struck by the tree failure due to the presence of other trees between the tree being assessed and the targets.

Low – there is a slight chance that the failed tree or tree part will impact the target. This is the case for an occasionally used area that is fully exposed to the assessed tree, a frequently used area that is partially exposed to the assessed tree, or a constant target that is well protected from the assessed tree.

Medium – the failed tree or tree part could impact the target, but is not expected to do so. This is the case for a frequently used area that is fully exposed on one side to the assessed tree, or a constantly occupied area that is partially protected from the assessed tree.

High – the failed tree or tree part is likely to impact the target. This is the case when a fixed static target is fully exposed to the assessed tree or near a high-use road or walkway with an adjacent street tree.

The Oak was assessed as having a **Low** Likelihood of Impacting the people using the gardens of the properties.

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4.0 APPRAISAL (continued)

4.3 Tree Risk Assessment

Step 3: Categorising Likelihood of a Tree Failure Impacting a Target

After determining the likelihood of failure and the likelihood of impacting a target, the combined likelihood of a failure impacting a target can be categorised using the following table.

Table 2: Likelihood of failure and likelihood of impacting a target

Likelihood of Failure	**Likelihood of Impacting a Target**			
	Very Low	**Low**	**Medium**	**High**
Imminent	Unlikely	Somewhat likely	Likely	Very Likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

The Oak was assessed as having an **Unlikely** value of failure impacting the people using the gardens of the properties.

Step 4: Categorising Consequences of Failure

Consequences are estimated based on the value of the target and the harm that may be done to it. Consequences of failure may be categorised using the following guidelines:

Negligent – consequences are those that involve no personal injury, low-value property damage or disruptions that can be replaced or repaired.

Minor – consequences are those involving minor personal injury, low to moderate-value property damage, or small disruption of activities.

Significant – consequences are those that involve substantial personal injury, moderate to high-value property damage or considerable disruption of activities.

Severe – consequences are those that could involve serious personal injury or death, high-value property damage, or major disruption of important activities.

The Consequences of Failure for the Oak was assessed as **Severe**.

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4.0 APPRAISAL (continued)

4.3 Tree Risk Assessment

Step 5: Tree Risk Rating

Having determined the combined likelihood of a tree failure impacting the target and categorising the severity of the associated consequences, the tree risk rating can be determined using the following table.

Table 3: Tree Risk Rating

Likelihood of Failure and Impact	**Consequences**			
	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

The **Tree Risk Rating** for the next 2 years for the Oak is determined as **Low** with regards to the people using the gardens of the properties.

5.0 CONCLUSIONS

Test #1 at 20cm height

The sonic tomograph (SoT) indicates sound wood (brown colours) in the East and West of the trunk cross-section. The light brown colours indicate a slight reduction in velocity of the sonic waves, where a fungus has inoculated the wood and is just beginning to affect the structure of the wood cells. A significant decay cavity (blue colours) is indicated North-Southeast across the centre of the trunk, with associated advanced decay (violet colours) and early-stage decay (green colours) at the periphery of the cavity.

The electrical impedance tomograph (EIT) indicates a typical EIT Type 3 ring-like distribution at the West (MP5-9) of the trunk, with higher conductivity (blue colours) on the outside (sapwood), an inner ring of high resistance (red/yellow colours) and high conductivity (blue colours) in the centre. The increasing resistance (red colour) of the sapwood at the periphery of the North section of the trunk (MP23-4) of the trunk and the disruption of the inner red ring in the North, Southwest and Southeast sections of the trunk indicates decay is likely to be developing in these sections of the trunk.

The combination of low velocity SoT (blue) and high conductivity EIT (blue) to the inside of the South of the trunk (MP8-9) [indicating an area of active fungal decay], means that there is still some woody material in this area – because air (e.g. a decay cavity) has very high electric resistance (red). The cracks/bark inclusions have likely hindered the transmission of the sound waves, resulting in a larger decay cavity indicated on the SoT tomograph than is actually present in the wood. The fungus has likely begun to affect the wood in these areas to some degree, but it is not yet completely degraded to form a cavity.

The drillings confirm that a decay cavity is developing across the centre (North-South) of the trunk.

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5.0 CONCLUSIONS (continued)

Test #2 at 150cm height
The sonic tomograph (SoT) indicates sound wood (brown colours) in the East and West of the trunk cross-section. The light brown colours indicate a slight reduction in velocity of the sonic waves, where a fungus has inoculated the wood and is just beginning to affect the structure of the wood cells. A significant decay cavity (blue colours) is indicated North-Southeast across the centre of the trunk, with associated advanced decay (violet colours) and early-stage decay (green colours) at the periphery of the cavity.

The electrical impedance tomograph (EIT) shows high resistance (red colour) at the centre, which indicates a decay cavity is likely to be developing in this section of the trunk.

The combination of low velocity SoT (blue/violet/green) and high conductivity EIT (blue) to the North and Southeast of the centre of the trunk [indicating an area of active fungal decay] [labelled 3], means that there is still some woody material in this area – because air (e.g. a decay cavity) has very high electric resistance (red). The cracks/bark inclusions have likely hindered the transmission of the sound waves, resulting in a larger decay cavity indicated on the SoT tomograph than is actually present in the wood. The fungus has likely begun to affect the wood in these areas to some degree, but it is not yet completely degraded to form a cavity.

Overall conclusions of the Oak
The tree has previously been pollarded and in the recent past has had some crown reduction work carried out, which has reduced the weight and sail area of the crown. Using the TreeSA method of assessing the compressive strength and wind load parameters, the Q74Exp software was used to calculate the safety factor for the trunk and required load bearing capacity. The drillings confirm that a decay cavity is developing across the centre (North-Southeast) of the trunk, but at this time, there is a sufficiently thick residual wall of sound wood around the trunk for it to remain stable.

Brown rot decay in the heartwood of the trunk and branches degrades the cellulose and hemicellulose components of the wood, leaving the lignin relatively untouched. The decay process of this fungus on Oaks is typically very slow and only in very advanced stages, the trunk can fail in a sudden brittle failure, due to the loss of tensile strength of the degraded wood.

Trees respond to fungal decay by depositing chemicals (e.g. suberin, phenols) in the wood, which have anti-fungal properties. These strong defensive barriers help resist the radial spread of the fungus. The extent and intensity of the fungal decay will likely increase in time, but it may take a long period (possibly decades) before the decay spreads across the trunk cross-section.

The conclusion is that the fungal decay is not significantly affecting the structural stability of the trunk of the Oak tree at this time.

The **Tree Risk Rating** for the next 2 years for the Oak is determined as **Low** with regards to the people using the gardens of the properties.

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6.0 RECOMMENDATIONS

6.1 Priorities of work

The management recommendations have been allocated a priority rating, according to the safety risk posed and the urgency of the required work. This simple 'traffic light' code enables a programme of works to be easily compiled, which focuses on the most important works required.

High – urgent safety work requires action within 3 months.
Medium – non urgent but essential safety work requires action within 6 months.
Low – non essential but desirable work requires action as resources allow.

6.2 Recommendations

To minimise the risk of the trunk or branches failing, it would be sensible to consider some remedial pruning works, to reduce the height and size of the crown. This work would reduce the weight and wind loading and lower the centre of gravity, which would help reduce the risk to people and to the tree itself, whilst retaining a pleasing aesthetic natural crown shape and retaining valuable, irreplaceable wildlife habitat.

As the tree is showing good vitality in the form of epicormic shoot and adventitious shoot development and woundwood development around pruning wounds, in response to the previous cutting, it is likely that it will respond well to further cutting.

The most appropriate and proportionate action would be to consider crown reducing tree volume by up to 15% to include a height reduction of circa 1.5m and a radial reduction of circa 1m, to leave a well-balanced natural crown shape, with crown dimensions of circa 8.5m high x 10m spread. Any large deadwood (>35mm diam.) overhanging the neighbouring garden should be removed for safety reasons.

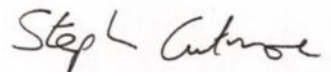
This work has a **Medium** priority –non urgent but essential safety work requires action within 6 months.

6.3 Additional information

The tree work should be carried out by a suitably qualified and experienced arborist, and the work should conform to B.S.3998 'Recommendations for Tree Work', (2010).

As the tree is subject to legal protection (Tree Preservation Order), written permission **must** be obtained from the Local Planning Authority (LPA), before carrying out any tree work. Failure to obtain the required permission could result in prosecution of both the tree owner and the contractor carrying out the work. Certain works (e.g. removing dead branches, felling dead or decayed trees) are classed as exempt, but it is advised that the LPA are given 5 days' notice before carrying out such works.

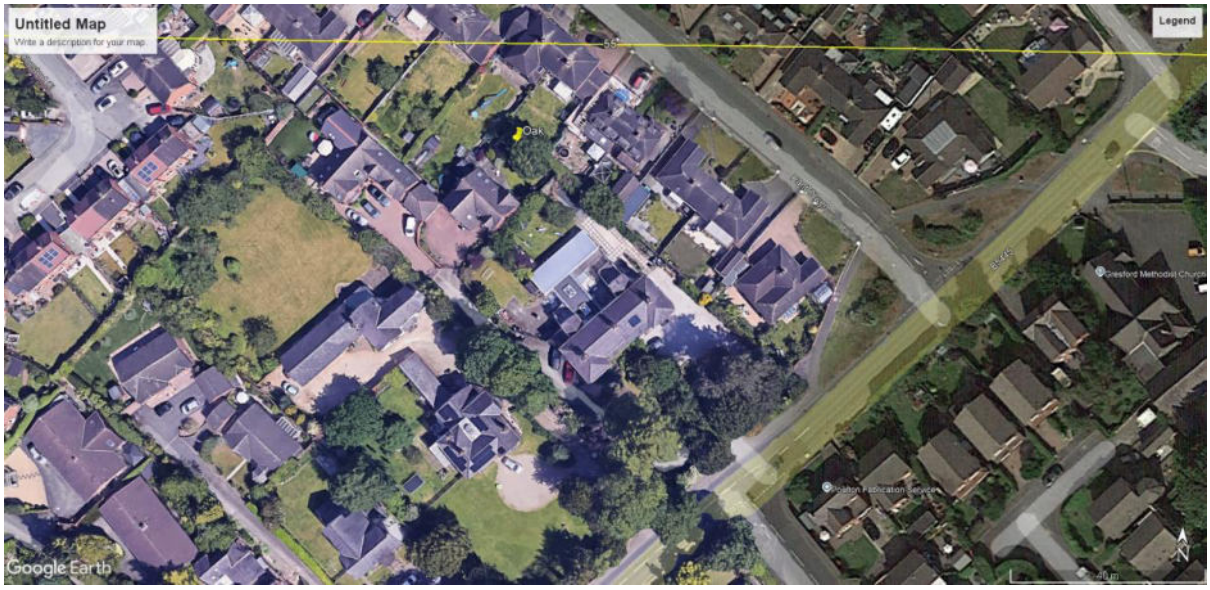
Report written and compiled by



Stephen Cutmore BSc (Hons), MICFor, MArborA, VETcert Consulting Level
Chartered Arboriculturist

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APPENDIX 1 – Site plan



Tree location plan.

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APPENDIX 2 – Picus Sonic Tomograph

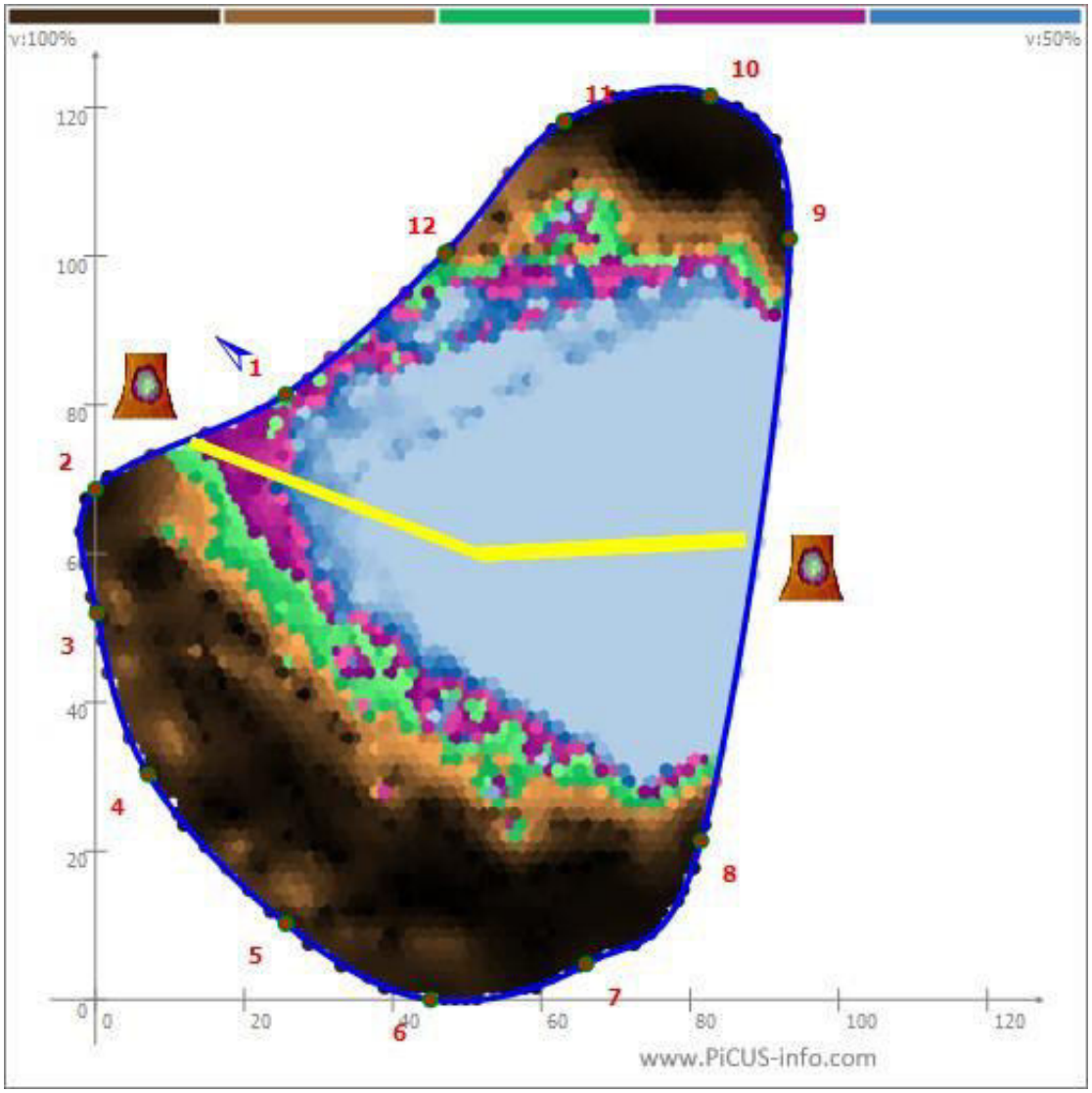


Plate 1: SoT of Oak at 20cm height.

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APPENDIX 2 – Picus Sonic Tomograph

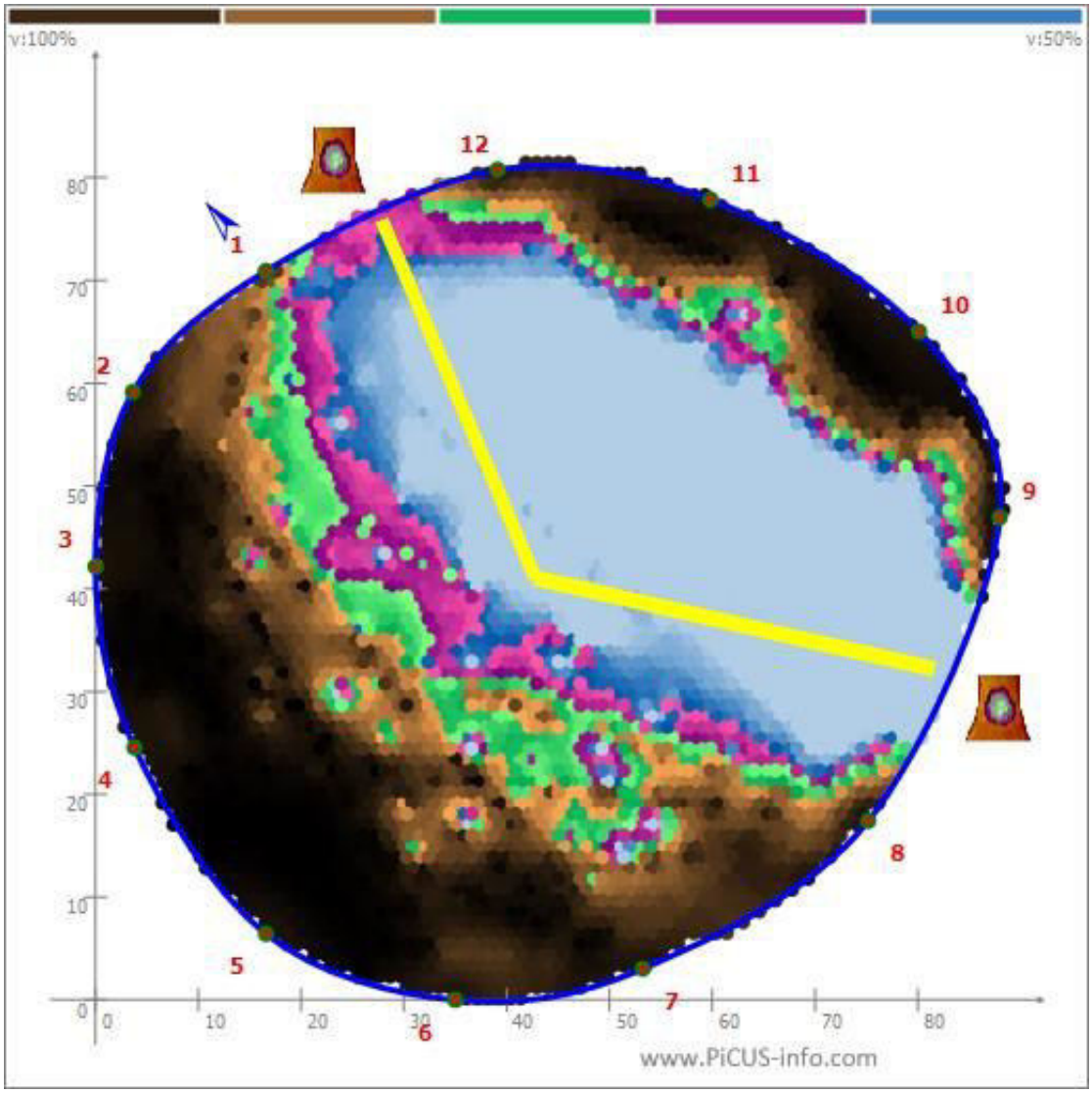


Plate 2: SoT of Oak at 150cm height.

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APPENDIX 3 – Picus Treetronic Tomograph

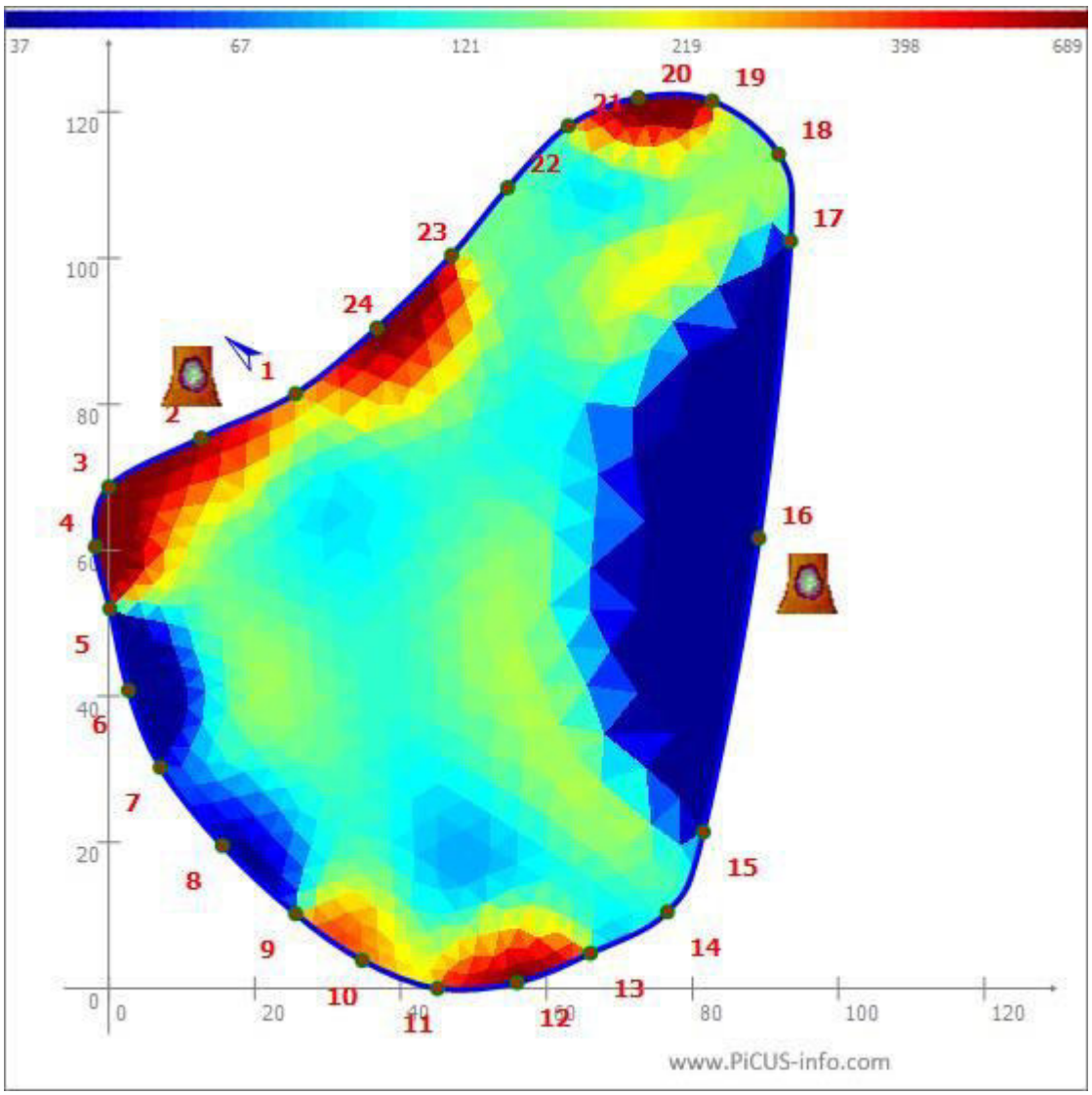


Plate 3: EIT of Oak at 20cm height.

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APPENDIX 3 – Picus Treetronic Tomograph

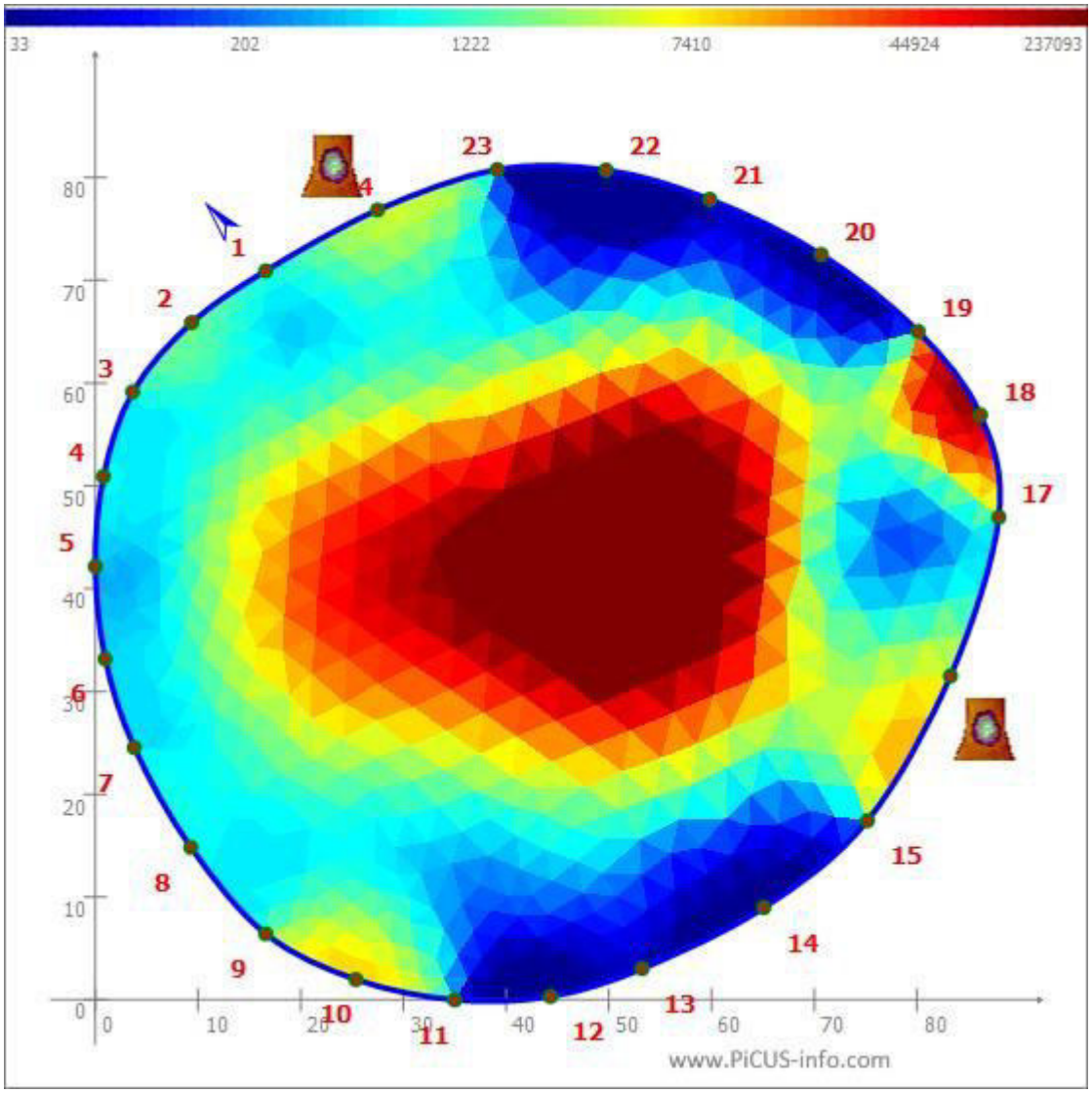


Plate 4: EIT of Oak at 150cm height.

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APPENDIX 4 – IML PD-400 RESISTOGRAPH DRILLINGS

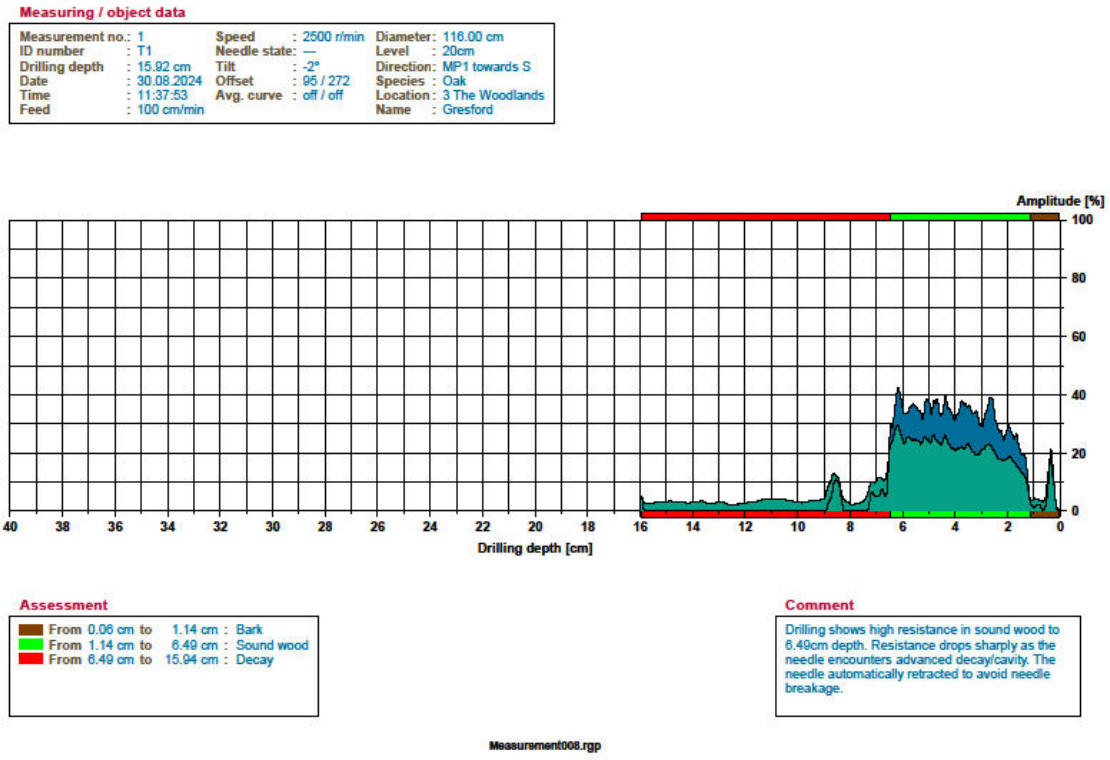


Plate 5: Oak Test #1 at MP1 at 20cm height.

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APPENDIX 4 – IML PD-400 RESISTOGRAPH DRILLINGS

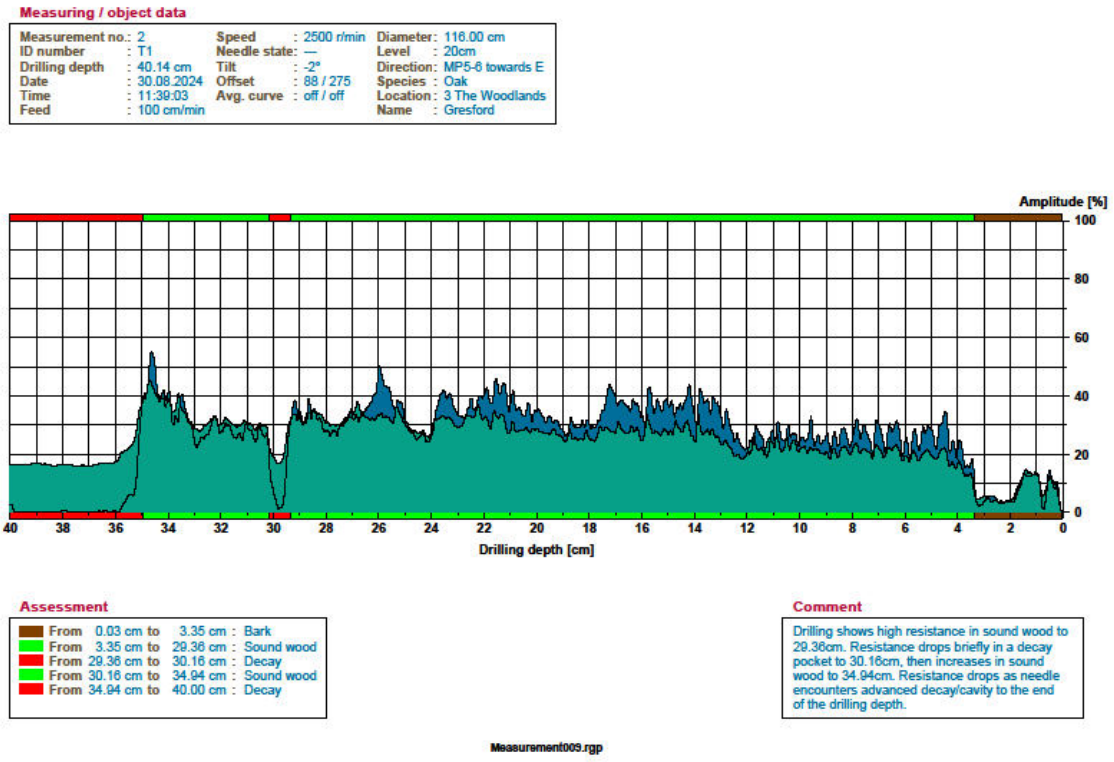


Plate 6: Oak Test #2 at MP5-6 at 20cm height.

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APPENDIX 4 – IML PD-400 RESISTOGRAPH DRILLINGS

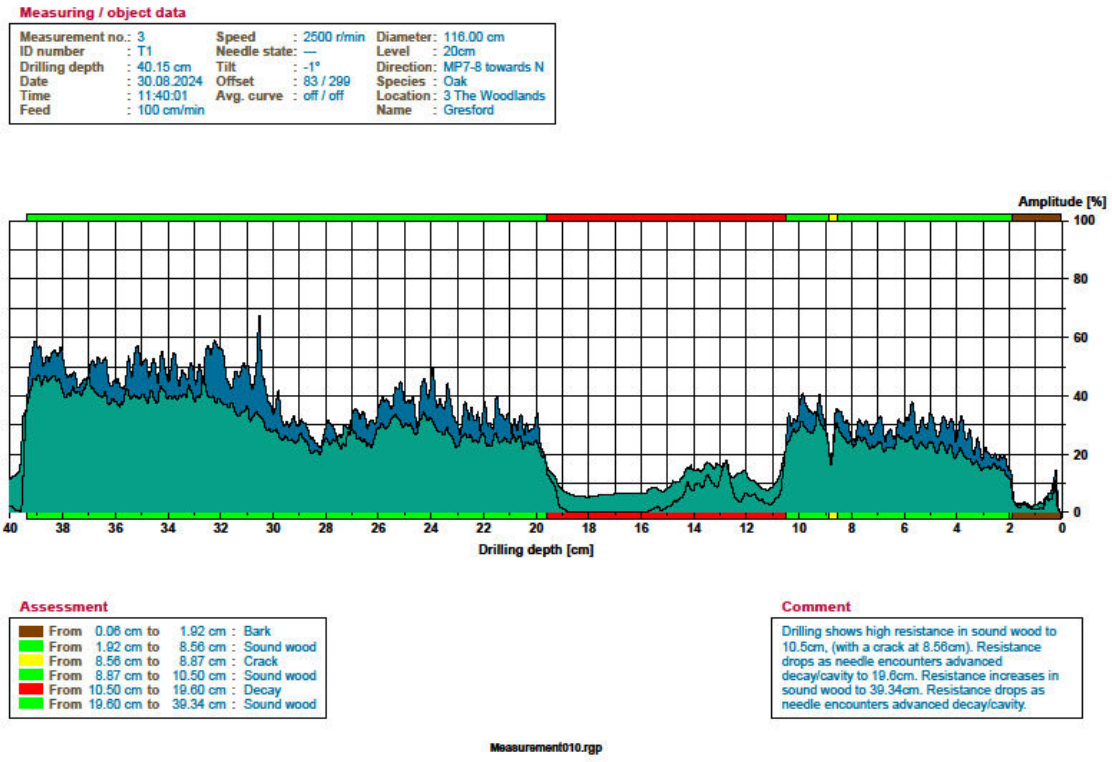


Plate 7: Oak Test #3 at MP7-8 at 20cm height.

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APPENDIX 4 – IML PD-400 RESISTOGRAPH DRILLINGS

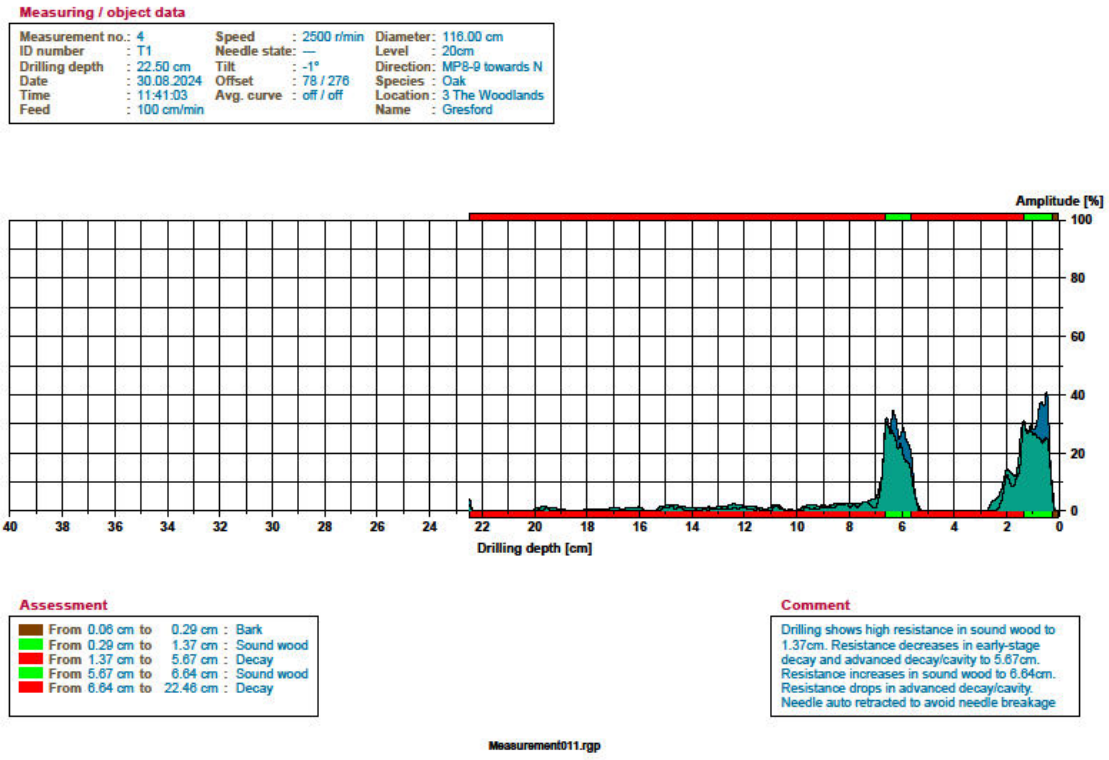


Plate 8: Oak Test #4 at MP8-9 at 20cm height.

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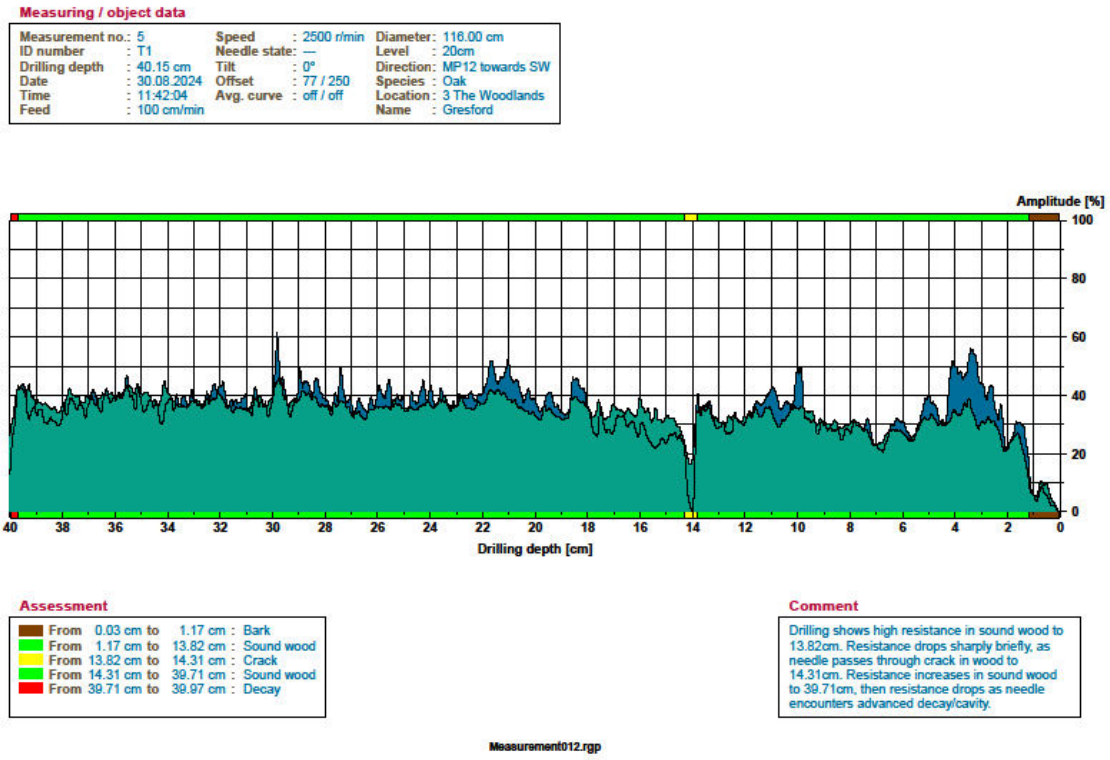


Plate 9: Oak Test #5 at MP12 at 20cm height.

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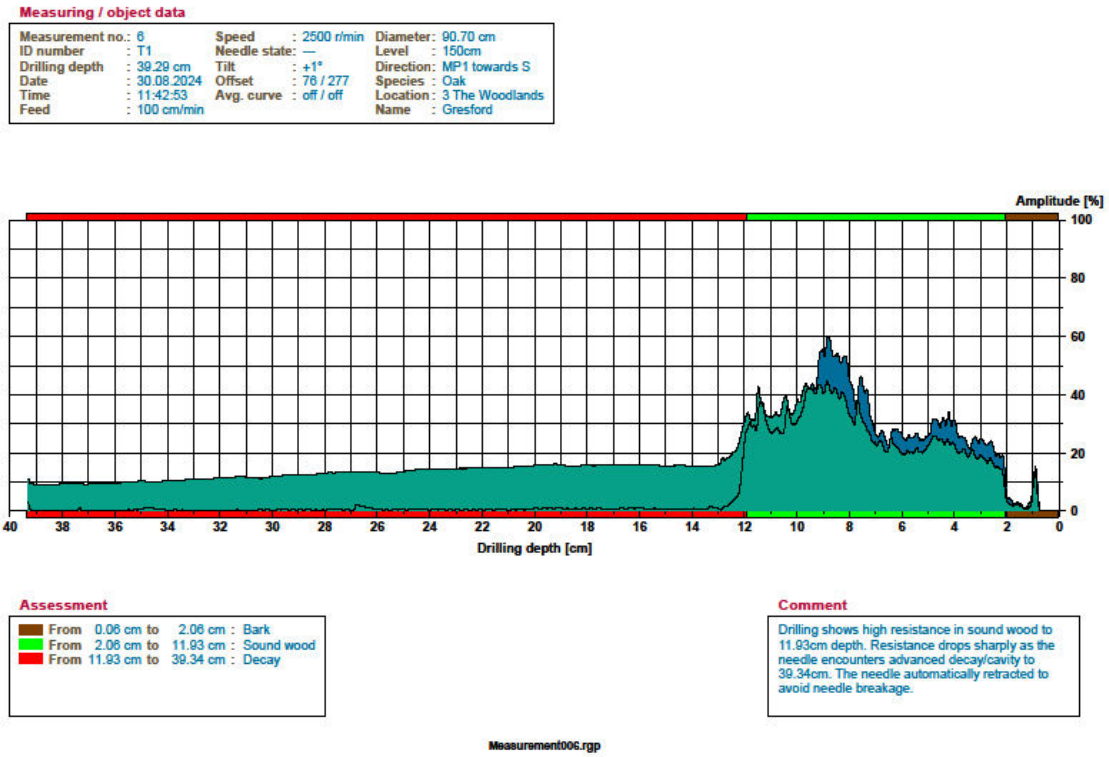


Plate 10: Oak Test #1 at MP1 at 150cm height (Measurement#6).

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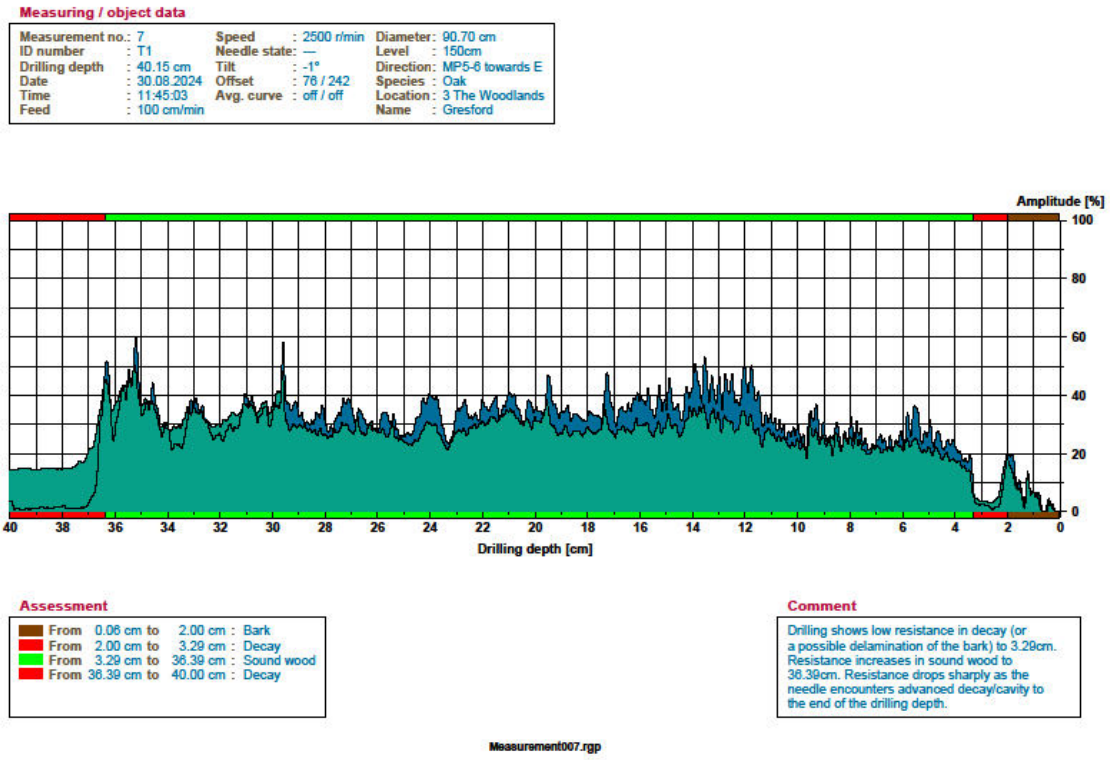


Plate 11: Oak Test #2 at MP5-6 at 150cm height (Measurement#7).

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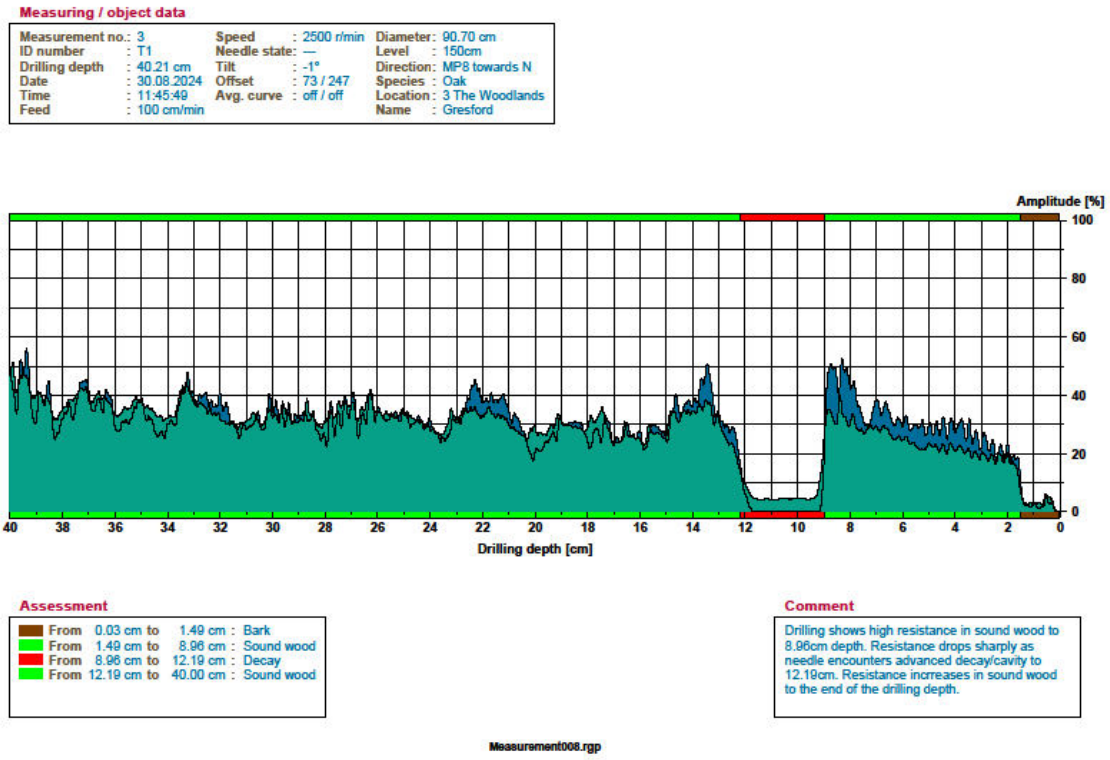


Plate 12: Oak Test #3 at MP8 at 150cm height (Measurement#8).

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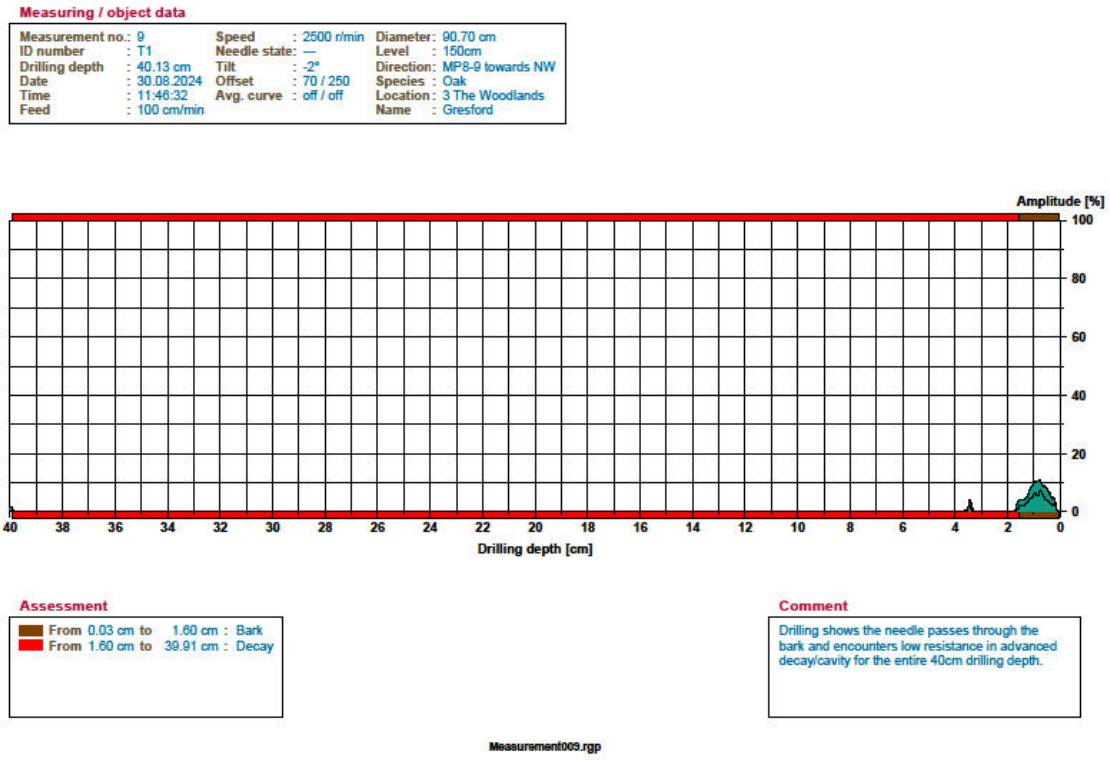


Plate 13: Oak Test #3 at MP8-9 at 150cm height (Measurement#9).

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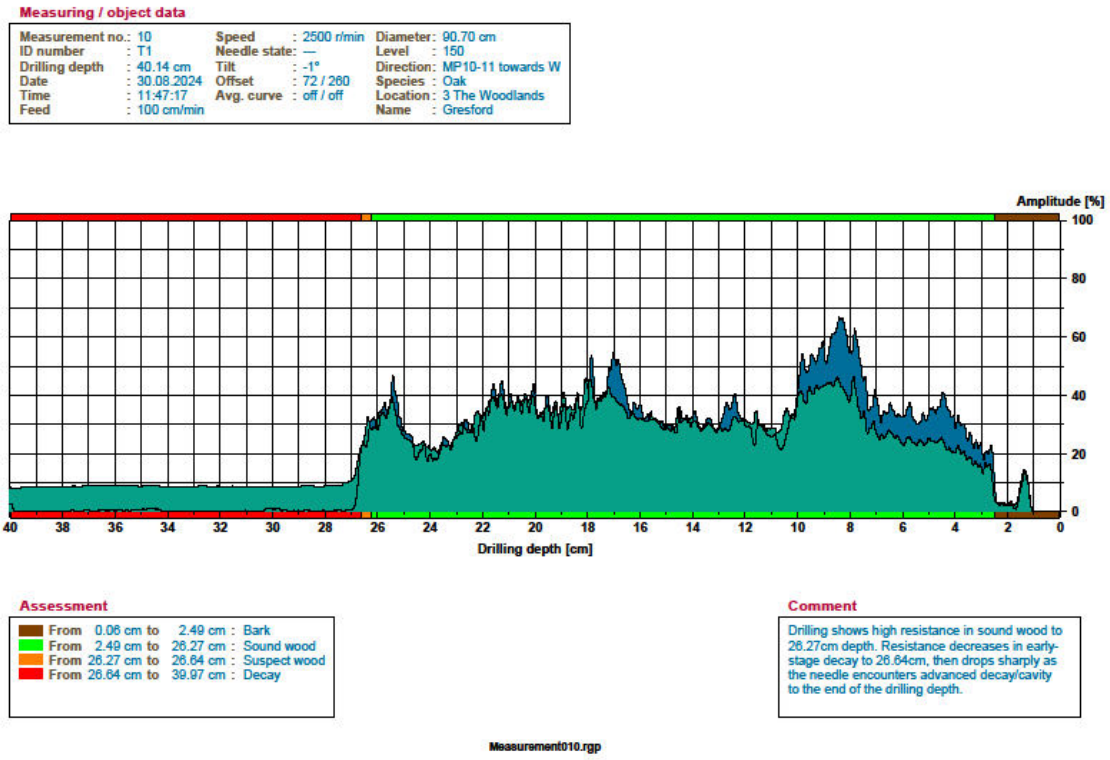


Plate 14: Oak Test #5 at MP10-11 at 150cm height (Measurement#10).

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APPENDIX 5 – Photographs



Photo 1: Basal cavity on North side of the trunk.



Photo 2: Rip-out wound and tear wound on North side of trunk.



Photo 3: Exposed wood in wound on Southeast side of trunk

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APPENDIX 5 – Photographs



Photo 4: Rip-out wound and woundwood development at margins of wound on Southeast side of trunk.



Photo 5: Crown appears in fair condition, with good vitality.



Photo 6: Suggested crown reduction work.

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APPENDIX 6 – Bibliography

The following publications were referred to in preparing this report.

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APPENDIX 7 – Consultant Profile



Stephen Cutmore

BSc (Hons) Arboriculture & Urban Forestry

Chartered Arboriculturist

Member of the Institute of Chartered Foresters (Professional 772508)

Institute of Chartered Foresters Registered Consultant

Member of the Arboricultural Association (Professional 3755)

Stephen Cutmore has over thirty five years' experience in the arboricultural and forestry industry as a contractor and during this period over twenty five years' experience as an arboricultural consultant.

He has specialist knowledge in advanced inspections of hazard trees, utilising hi-tech specialist equipment (Picus Sonic Tomograph, Picus Treetronic, IML Resistograph PD400 microdrill, IML Fractometer, Picus Wind Motion Sensors, Fakopp DynaTree/DynaRoot).

Stephen has attended three Masterclasses for the Picus, one Masterclass for the Treetronic and one Masterclass for the Resistograph, run by the UK distributors, Sorbus International.

He is also Tree Risk Assessment Qualified [TRAQ] (International Society of Arboriculture).

Stephen has attended the AA 'Getting to Grips With Subsidence' and follow-up 'Subsidence Investigation workshop' training courses.

Stephen is a Certified Veteran Tree Specialist (VETcert Consulting Level).

Stephen also has over fifteen years' experience as an ecological consultant. Stephen has held a Bat Licence since 2007 and a GCN Licence since 2011 [current bat licence with NRW (NRW[S091618/1]) and GCN licence with NRW (NRW[S092048/1]]. He is a member of Clwyd Bat Group and a member of the Bat Conservation Trust (102994).

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Veteran tree specialist
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