Treework Environmental Practice

# Veteran Tree Report
# The Green
# Leigh
# TN11 8QL

**On behalf of**

**Leigh Parish Council**

**240517-1.0-LPC-IVTR-MS**


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**June 2024**

**Executive Summary**

I was instructed by Louise Kleinschmidt, Clerk of Leigh Parish Council, on 12 March 2024, to carry out a detailed assessment of the structural condition of and risk posed by an historic veteran oak tree on the Green and to provide a report setting out management recommendations. I inspected the tree on 4th May 2024.

The subject tree is a veteran English oak (*Quercus robur*) pollard with an approximately 2.5 m high bole, overall height of 14m and girth of 590cm. It has developed into three discrete, separate stems to the north (itself significantly hollow), north-west and the east, supported by a decayed, open cavity, shell of a trunk, the trunk itself consisting of at least two separate functional units divided by largely dysfunctional tissue and open cavity at ground level on the trees northern side, albeit with vigorous callous growth around the margins of the units, considered to be providing structural strengthening.

Veteran trees such as this, offer rare micro-habitats primarily associated with the presence of decay and dead wood. Dead wood and decay within standing live trees offer the richest saproxylic biodiversity and the rarest resource within any tree population. The National Planning Policy Framework recognises that such trees, because of this rare habitat are considered to be irreplaceable and can only be removed in 'wholly exceptional' circumstances.

The tree does not appear to be protected by a Tree Preservation Order but is situated within a Conservation Area, administered by Sevenoaks District Council.

It is understood that the tree has the following history of interventions:

- Significant historic crown reduction/end weight works (date unknown) at an approximate height of 11m, which the tree appeared to respond favourably, with vigorous extension growth.
- Historic static, metal rod and bolt cable bracing has been installed (approximately 6m in height).
- Recent, dynamic (flexible), cable bracing (Cobra) has also been installed (approximately 4-5m and 4-8m height). Thought installed in December 2022.
- Metal fencing to the canopy drip line has been relatively recently installed.
- Mulch applied on the soft ground, to the crown's drip line, although some grass is now growing through it.

A minor, residential road (approximately 24 vehicles per hour) runs directly to the south of the tree. A nearby private property is potentially within falling distance of the tree.

This assessment has applied a TreeCalc wind load analysis and QTRA assessment.

The TreeCalc model indicates that the Basic Safety Factor of the tree has been reduced by decay, as one would expect for a veteran tree at this life stage and habitat value. The model generates a Basic Safety Factor for the stem that is marginally below the nominal minimum Basic Safety Factor and as a result the model specifies a relatively minor crown reductions to increase the Basic Safety Factor to acceptable levels. The Quantified tree Risk Assessment calculation suggests a risk of harm (in the next 12 months) within the 'tolerable' region, but again, where one would normally apply some intervention.

The following interventions are recommended:

- **A crown reduction back to the previously pruned points**
- **The older, static bracing system to remain in situ.**
- **For the more recent dynamic (Cobra) bracing system, either:**
    - **The original installer provides a rationale of the positioning of the system and carries out a check, or.**
    - **An independent specialist carries out a review and reinstalls if necessary (we work with a third-party specialist, who we can recommend)**
- **Annual monitoring of the tree (to meet your duty of care)**
- **Reapplying woodchip mulch.**
- **Installing a board or other appropriate material to prevent entry via the cavity at ground level.**

Note that the recommendation of a cyclical crown reduction is considered sufficient to increase the Basic Safety Factor to acceptable levels irrespective of the bracing system.

## Contents

# 1 Background

## 1.1 Scope

**1.1.1** I was instructed by Louise Kleinschmidt, Clerk of Leigh Parish Council, on 12 March 2024, to carry out a detailed assessment of the structural condition of and risk posed by an historic veteran oak tree on the Green and to provide a report setting out management options. The instruction was in response to a query in relation to the recently installed cable bracing system and concerns due to its proximity to the road and nearby properties.

**1.1.2** I inspected the tree on 4th May 2024. Weather conditions were dry and mainly bright. I carried out a visual assessment from ground level and took measurements using a tape measure. All elements of the survey were recorded during site visits made by Matt Searle (Principal Arboricultural Consultant, Treework Environmental Practice).

**1.1.3** It is recognised that this tree is veteran, with significant cultural as well as habitat value. Veteran trees offer the richest saproxylic biodiversity and the rarest resource within any tree population. This habitat value is recognised in the National Planning Policy Framework, recognising that such trees, considered to be irreplaceable habitat can only be removed in 'wholly exceptional' circumstances. When considering the management of such trees, conservation aims as well as health and safety considerations are essential.

# 2 The Tree: Form and Dimensions

## 2.1 Form

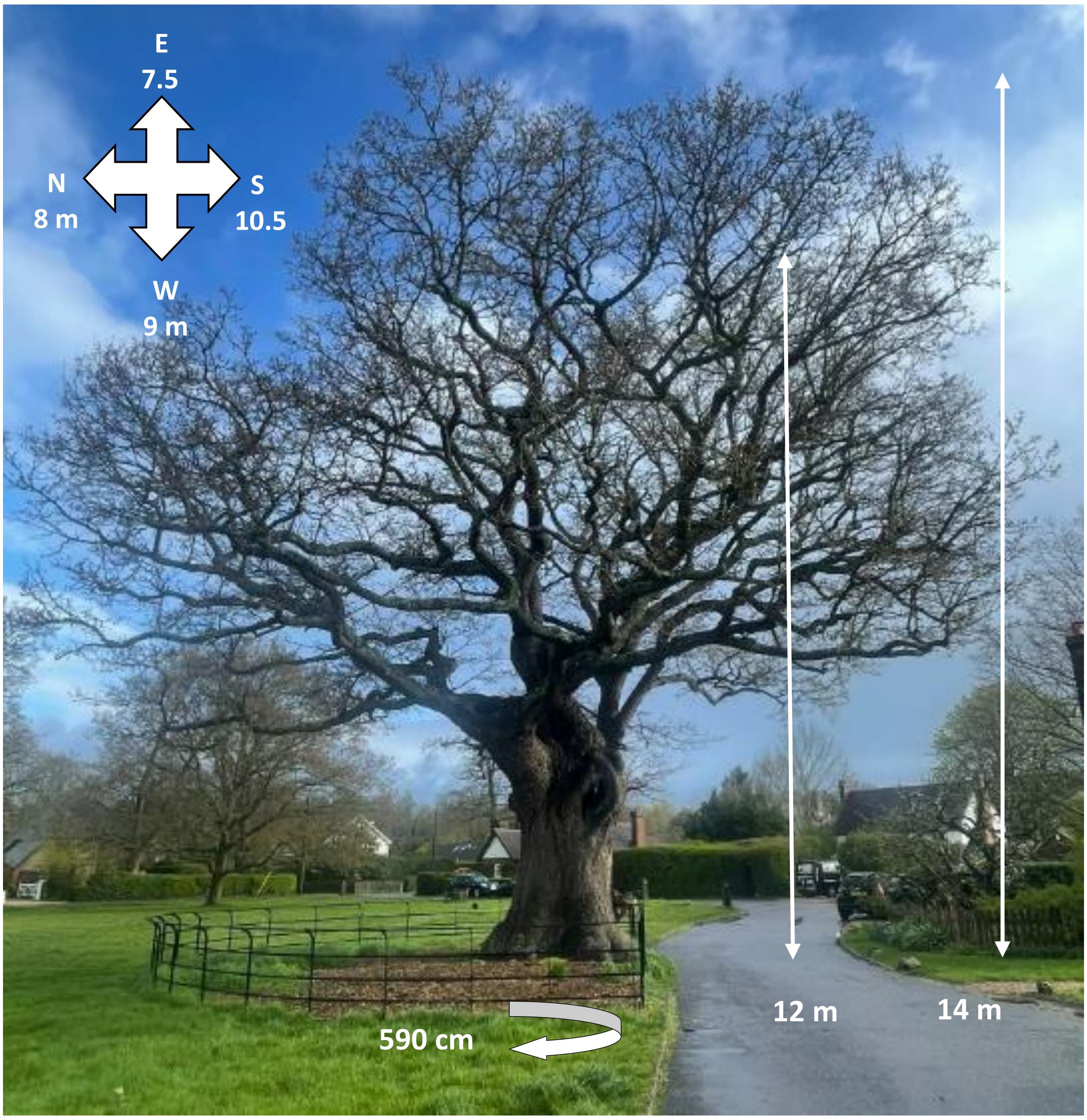
**2.1.1** An historic English oak (*Quercus robur*) pollard with an approximately 2.5 m high bole, overall height of 14m and girth of 590cm. The bole has historically developed into three discrete, separate stems to the north (itself significantly hollow), north- west and the east, supported by a decayed, open cavity, shell of a trunk, the trunk consisting of at least two separate functional units divided by largely dysfunctional tissue and open cavity at ground level on the trees northern side.

**2.1.2** For the purpose of the Stability Analysis, using TreeCalc, I will use the diameter of the entire trunk, rather than the two distinct sections.

**Images 1, 2 and 3**. Looking northeast, west and southwest.

## 2.2 Dimensions

**Image 4**: Dimensions




# 3 The Tree: Cable Bracing

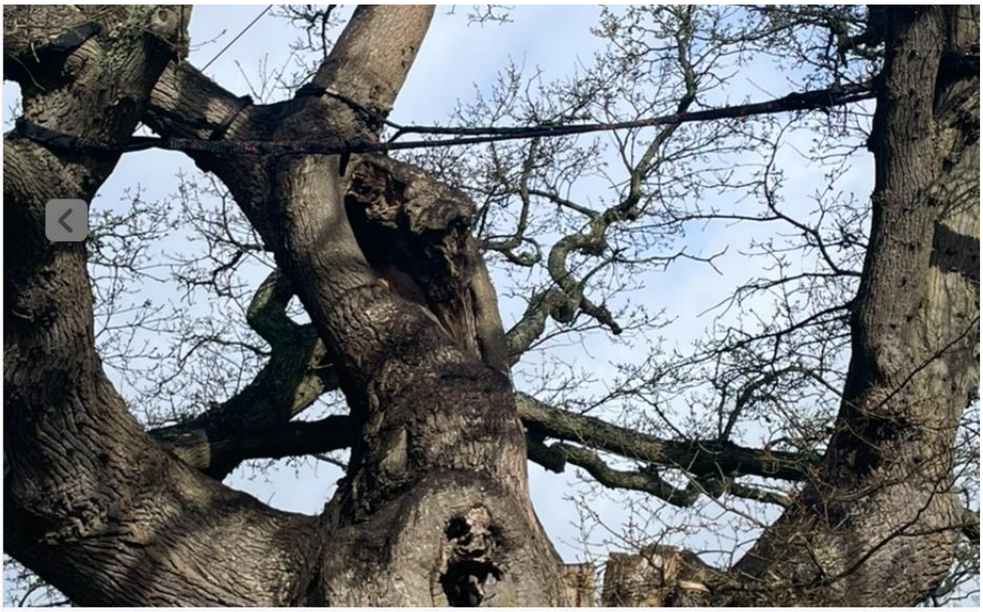
## 3.1 Background

**3.1.1** Historic static, rigid, metal rod and bolt cable bracing has been installed at an approximate height of 6m. The installation date is unknown.

**3.1.2** Recent, dynamic, flexible, cable bracing (Cobra) has also been installed, at heights of between 4-5m and 4-8m. It is understood, it was installed in December 2022.

**3.1.3** The positioning of both bracing systems are shown in images 5, 6 and 7 below.


**Images 5, 6** (Dynamic system) and 7 (Static system).



## 3.2 Purpose

**3.2.1** Bracing provides a method of linking branches together with the aims of reducing the probability of tree or branch failure. The overall objective is to attempt to stop a branch failing and the tree falling apart and /or to minimise damage to property or people in case of failure. It is often combined with light pruning [1].

## 3.3 The (older) Static System

**3.3.1** It is unclear what purpose the static system is offering. Given the time since it has been installed, to attempt to remove it is likely to result in damage. Removal could also alter the force distribution in the tree or (unintentionally) alleviate strain at specific points (e.g. forks), with a high level of unpredictability. As a result, It is recommended to leave this system in situ.

## 3.4 The dynamic (Cobra) System

**3.4.1** Such systems consist of materials with high elasticity, installed with allowance for future growth, with slight slack in the rope. Their principal purpose is to eliminate the stress peaks during strong winds by damping energy as the rope elongates. Veteran trees such as this often have 'stiffer' branches with less movement than younger trees, potentially resulting in such flexible systems being less effective.

**3.4.2** 'Cable bracing, propping and related techniques' states that 'dynamic systems should be installed only in the upper part of the crown; in the top half taken from the location of the defect'. It does also state that 'in more complicated cases, there is always the possibility to use a combination of cabling system at several levels'. Veteran trees fall within the category of 'more complicated cases' having complex morphology. However, this system has been installed much lower in the crown. It is not obviously apparent why it has been installed in this location.

**3.4.3** 'Cable bracing, propping and related techniques' also states that 'it is possible to use more than one cabling system in a tree or a combination of dynamic and static systems if needed'.

1 Cable bracing, propping and related techniques, Ancient Tree Forum.

**3.4.4** Every cabling system must be checked regularly. The manufacturers define the interval between checks. Is recommended to provide the owner with a schedule in relation to each check and for any additional work carried out. I have seen no such schedule.

**3.4.5** I would recommend that either the original installer of the system (understood to be Bartletts) reinspects the system and provides a rationale for the positioning of the system for review and/or an experienced, independent cabling installer reviews the current Cobra system and either signs it off or reinstalls the system.

**3.4.6** Note that the recommendation of a repeated crown reduction is considered sufficient to increase the Basic Safety Factor to acceptable levels irrespective of the bracing system (see below).

# 4 The Tree: Ancient or Veteran?

## 4.1 The Value of Ancient and Veteran Trees

**4.1.1** Ancient and veteran trees are valuable primarily for the continuity of rare micro-habitats primarily associated with the presence of decay and dead wood. Dead wood and decay within standing live trees offer the richest saproxylic biodiversity and the rarest resource within any tree population. This habitat value is recognised in the National Planning Policy Framework, recognising that such trees, considered to be irreplaceable habitat can only be removed in 'wholly exceptional' circumstances.

**4.1.2** Such trees are defined by their longevity. This longevity is a product of the genetic attributes of the individual tree, the environmental conditions within which the tree is growing and an element of chance.

**4.1.3** For a tree to undergo extended life stages it will have experienced either a retarded rate of growth due to stress or resource limitations, or it will have survived collapse, storm damage or pruning operations that have rejuvenated the crown structure through the initiation and development of dormant or adventitious buds. These latter processes illustrate an important distinction between the ageing of animals and trees. Trees have the ability to generate new growth from undifferentiated meristematic tissue so that whilst a tree's origins might be considered old in chronological terms, the age of individual parts may vary considerably in a developmental and functional sense (del Tredici, 1999 and Thomas, 2001). For example, at initiation, epicormic growth has the physiological characteristics of a juvenile shoot (Raumbault, 2006 and Halle, 2007). This means that in the ancient phase the tree can be viewed as being comprised of relatively distinct, discrete, independent functional units with crown parts occupying a range of developmental stages (Lonsdale, 2013).

**4.1.4** Size can limit longevity. Whether this is due to the problem of transporting water over long distances (Čermák, 2008), the availability of resources for laying down annual increments across an increasing crown structure, the restricted width of those annual increments or the increased hydraulic resistance due to the increased number of vessel endings along a branch with great age (Rust and Roloff, 2002), longevity in trees does not generally favour a large crown.

**4.1.5** The processes that occur as a tree passes into the ancient phase of development create habitat features that in any other context could be viewed as damage and as undesirable. The dieback, dead wood, decay and hollowing, split and broken branches and loose bark are all rare and valuable attributes that support unique ecosystems and populations of rare species that rely on these micro-environments.

## 4.2 Ancient and Veteran Tree Features

**4.2.1** A tree is defined as an ancient tree when it has passed into the ancient phase of development, characterised by the features outlined in Box 2, but primarily determined by a reconfiguration or reorganisation of the crown (dieback at the periphery) and decay within the bole and principal crown limbs.

**4.2.2** The conceptual distinction between an ancient and a veteran tree is outlined in Box 1. The reality is that it is often not possible to reliably distinguish between an ancient and a veteran tree in the field during a survey. More importantly the habitat value offered by both is significant and may be indistinguishable.

**Box 1. Ancient or Veteran?**

Ageing in trees is not a simple concept and is not analogous with ageing in animals. Trees progress through developmental stages, but it is common for a tree to have parts that are different ages in both a chronological and a physiological sense.

Trees of different species pass through developmental stages at different rates. A birch, for example, will reach maturity and enter the ancient phase much sooner (in terms of years) than an oak. Trees of the same species with different genetic attributes and growing under different environmental conditions may also pass though stages of development at very different rates.

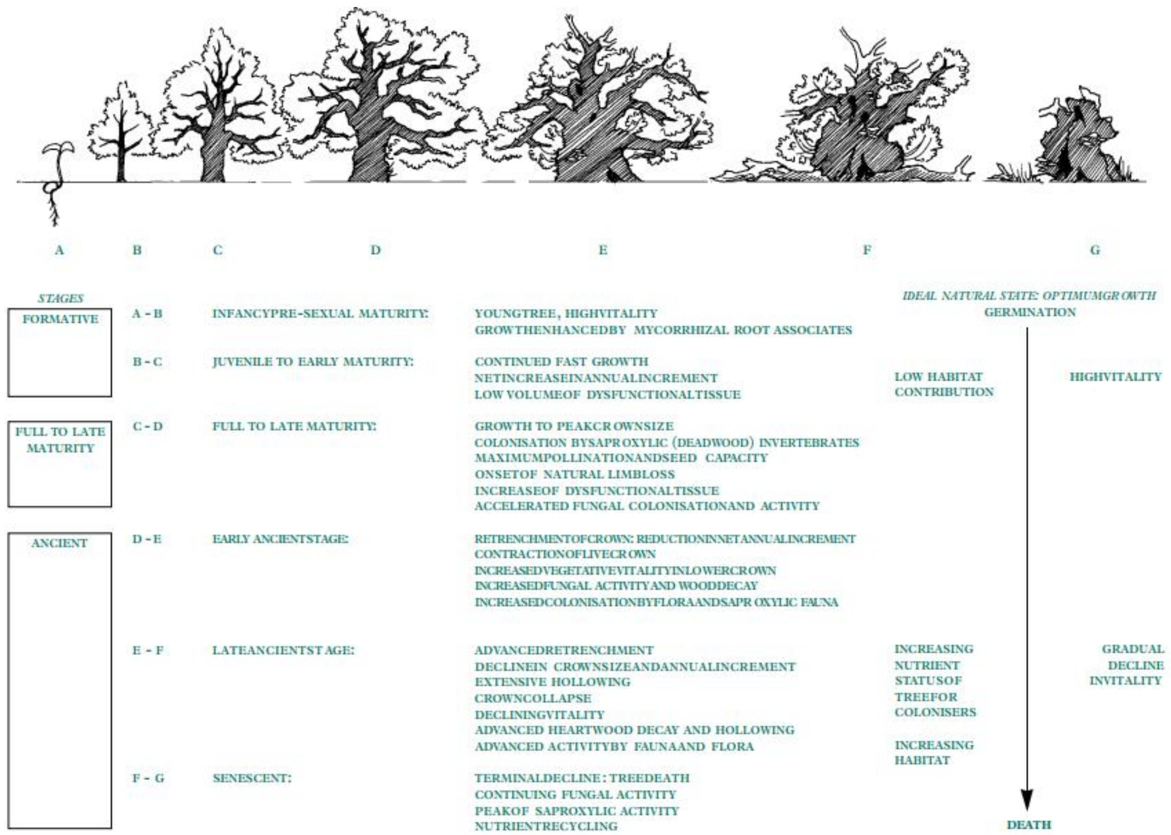
Consequently, an ancient tree can be considered to have reached the ancient phase of development by passing through the stages at a rate typical for a tree of a particular species, with certain genetic attributes and under particular growing conditions. This cannot be defined in simple chronological terms. Given that we cannot, generally, be sure of the history of development of any individual tree, an ancient tree is identified by the features associated with the re-organisation of the crown at the latter phases of development. These features are described in Box 2.

Consequently, a veteran tree is one that exhibits the morphological features that one would observe in a tree at the ancient phase of development, but at an earlier age than might be expected, due to the tree having been exposed to some shock, stress, environmental change or management practice.

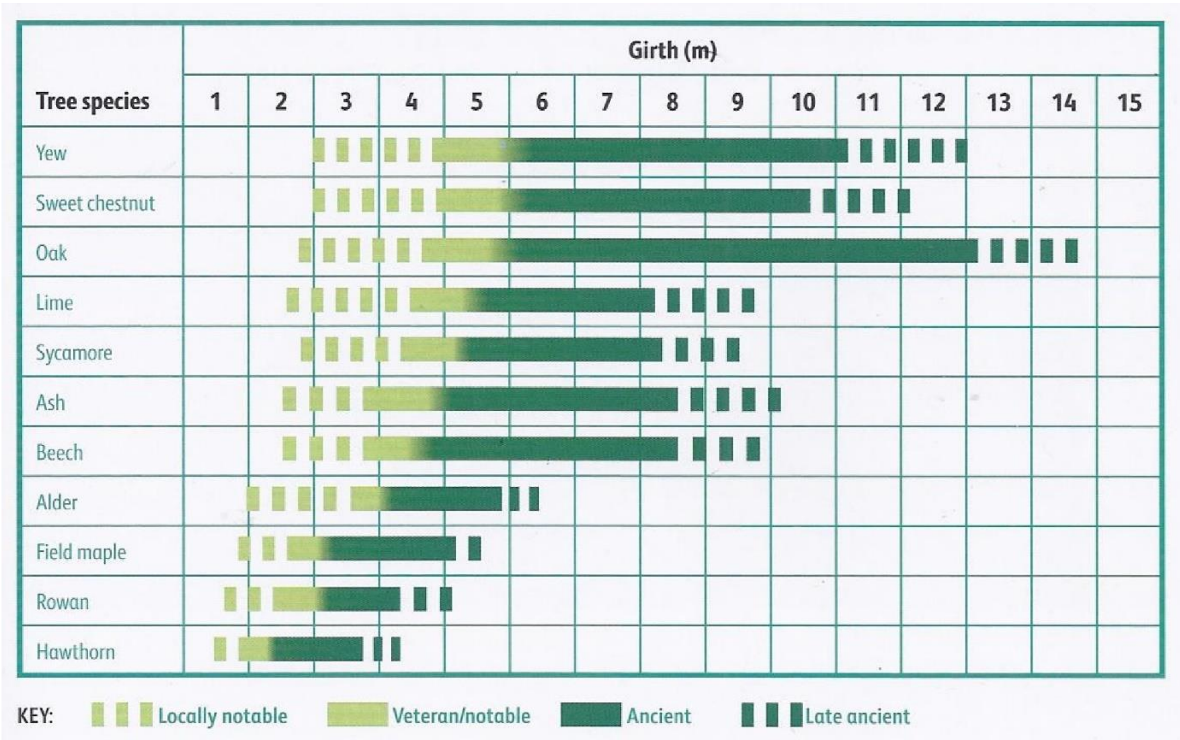
One important criterion for a tree to be considered to be a veteran is that it must demonstrate resilience and longevity. A damaged tree that has only declined since the incident that forced it out of the mature phase is unlikely to qualify as a veteran tree.

Lonsdale (2013) Chapters 1 and 2 discuss the distinction between an ancient and veteran tree. Del Tredici (1999) describes the concepts behind the ageing process in trees. Life stages are discussed in Read (2000).

## Life Stages of a Tree. Figure 13 in Read (2000)




## Girth in relation to age and developmental classification of trees (Lonsdale, 2013)



**Box 2. Key Veteran Features**

**Dead wood**
Dead wood is often colonised by decay fungi. Fallen and attached dead wood may support different suites of colonising species. Extensive, large diameter dead wood whether standing or fallen is of great habitat value.
**Hollowing**
Decay processes are natural and inevitable during the ageing process of a tree. Hollowing in the trunk or major limbs often has limited impact on stability where stem diameters are large. Decaying wood is recycled by being broken down with nutrients returned directly to the soil or captured by adventitious roots within the hollow stem.
**Rot holes.**
These can develop through limb loss and bark wounds, are expanded by microorganisms and invertebrates, and can become occupied by birds and bats.
**Rot sites.**
Wood may be colonised by decay fungi eventually leading to the creation of rot holes (see above). Such sites can then become valuable for saproxylic species.
**Fungal fruiting bodies**
Fruiting bodies of fungi known to cause wood decay are significant as evidence of fungal processes.

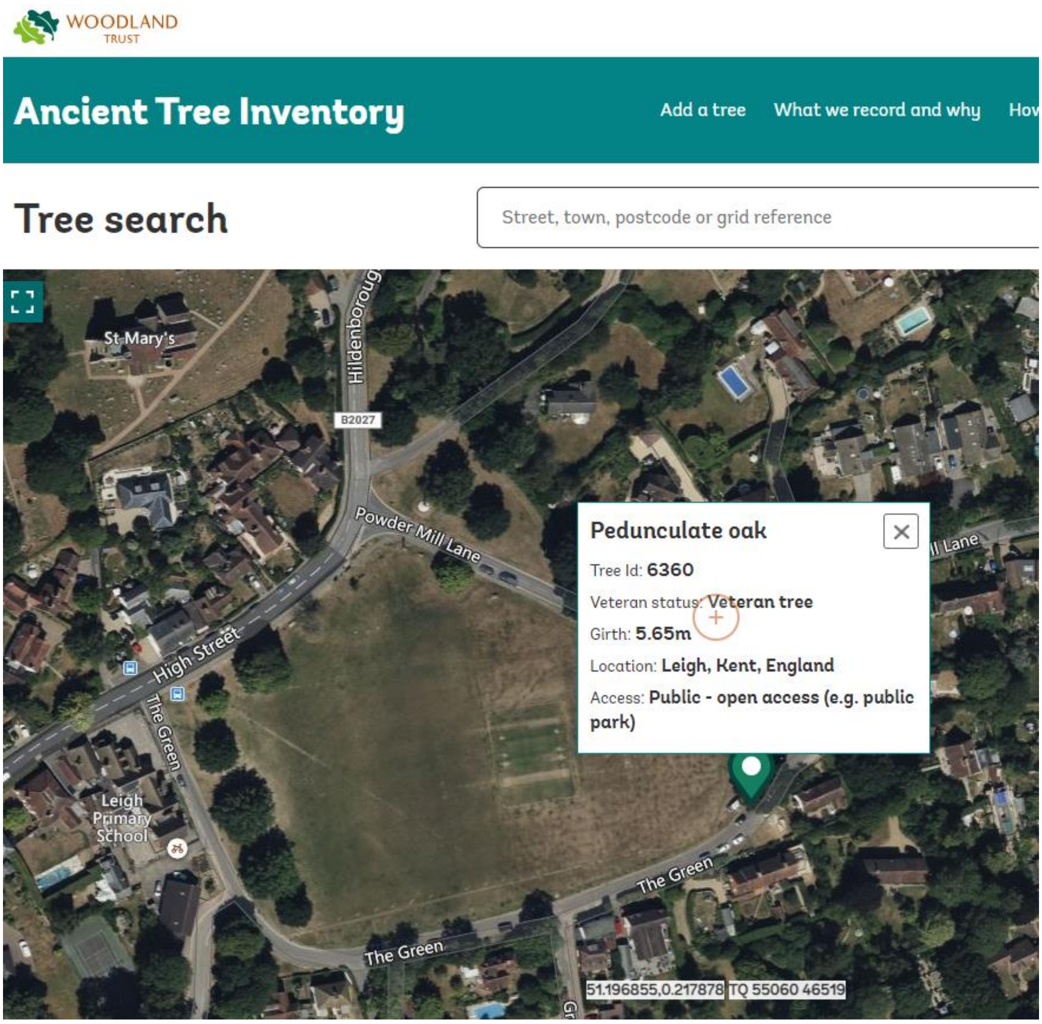
**Secondary Veteran Features**

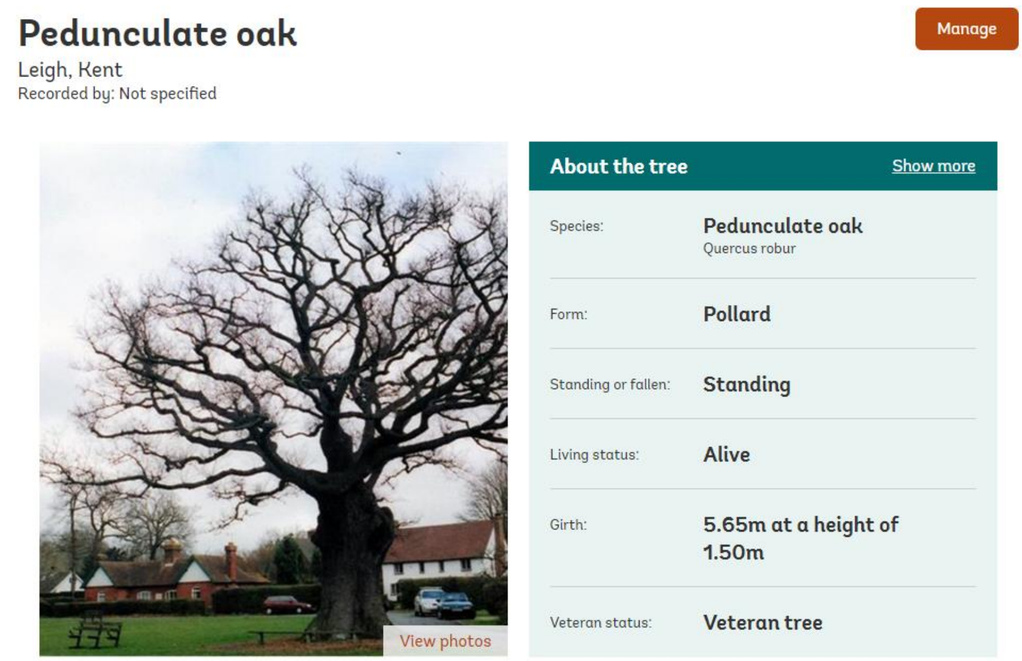
**Split limbs**
The process of gradual limb loss may be initiated in a small proportion of upward curving limbs where internal stresses result in longitudinal splits (along the grain).
**Tears**
Exposed woody tissue wounds usually elongated in shape, principally torn along (not across) the grain. Tears are associated with the recent shedding of live limb parts and result when attached fibres on the underside resist separation from the parent stem.
**Scars**
An aged tear with exposed tissue surrounded with a roll of wound wood.
**Live stubs**
Stubs are naturally fractured, truncated ends of live stems or branches. A stub is a result of a natural fracture and may follow the process described under splitting.
**Loose and dead bark**
Areas of dead, loose and flaking bark consistent with the tree developing individual functional units.
**Crown dieback**
Trees entering the ancient phase of development exhibit dieback of the crown and a concurrent retrenchment to a lower but still vigorous internal crown of epicormic shoots.

**4.2.3** This tree is certainly veteran. As to whether it could be described as both ancient and veteran, past crown reduction work has made it less clear whether the tree has naturally begun to reconfigure and reorganisation its crown. Peripheral die back of the crown, can be a part of this process but also a stress response. There is little crown epicormic growth, which can help the tree develop a secondary, lower crown. At 590 cm, its trunk girth (measured at 1.5m height) is of a size that, for an oak, it could be assessed as ancient.

**4.2.4** This tree has been recorded as 'veteran' on The Woodland Trust's National Ancient and Veteran Tree Inventory (tree id 6360).

**Image 8 & 9:** ATI extract (Woodland Trust)



### 4.3 Statutory Protection :Tree Preservation Orders (TPO's) and Conservation Areas

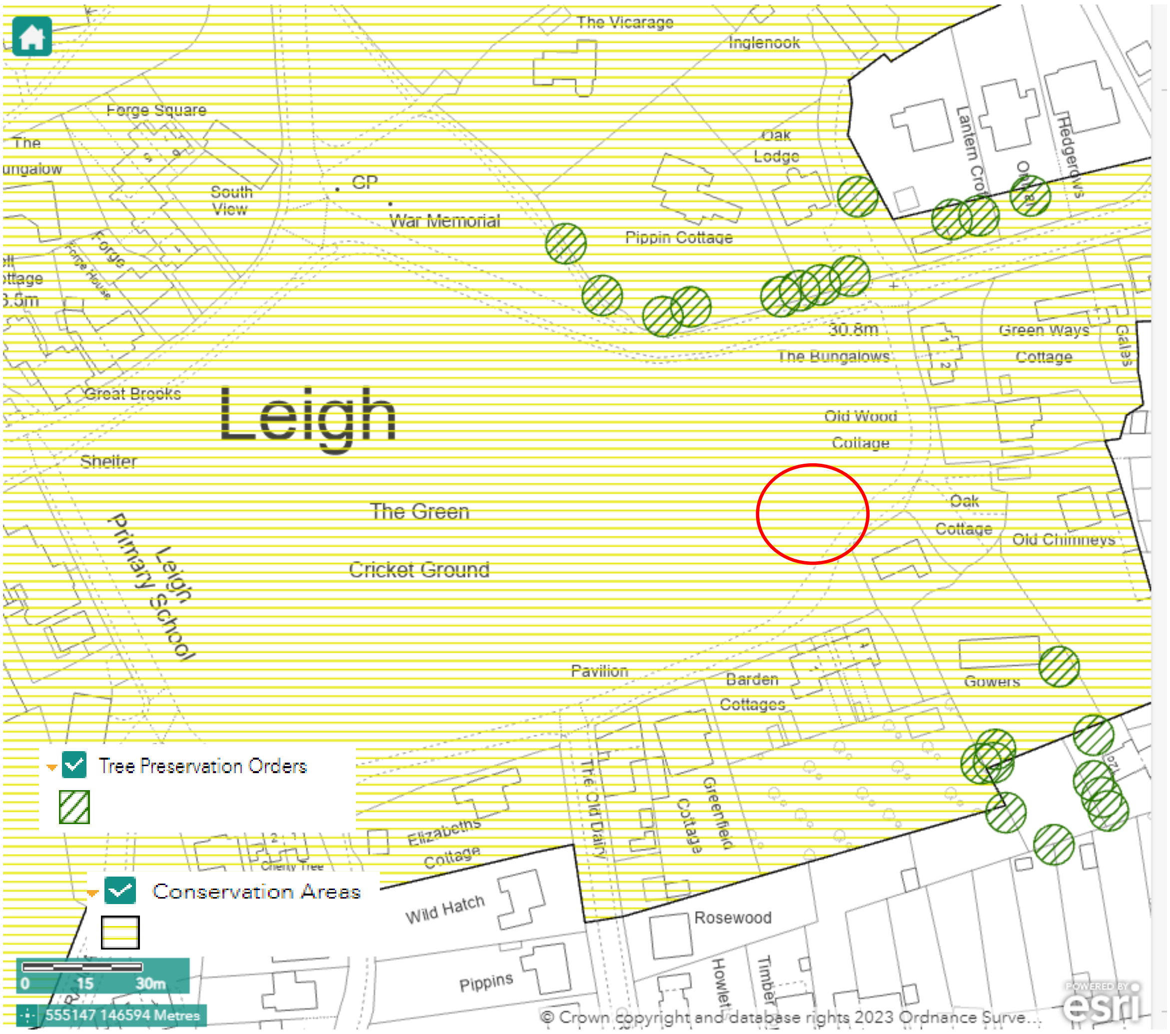



**Image 10**: Extract of Sevenoaks District Planning Map (16 May 2024)

**4.3.1** Reference to Sevenoaks's on line portal indicates that thew tree is not protected by a Tree Preservation Order but is within a designated Conservation Area. As such any work to the tree will require a prior tree work notification to Sevenoaks District Council.

## 5 Tree Risk Management Context

### 5.1 Duty Of Care

**5.1.1** The Health and Safety Executive's general criteria for managing risks informs that risks that could be described as 'Tolerable' within a Tolerability of Risk framework (TOR) should be reduced to a level that is as low as reasonably practicable (ALARP) through the balancing of the costs of possible risk reduction measures with the benefits in terms of reduced risk levels.

**5.1.2** Leigh PC apply a range of measures to manage the risks posed by its trees, including inspections by competent people. The frequency and method for which is unknown.

**5.1.3** For this tree, Leigh PC have commissioned Treework Environmental Practice to assess the tree, have clearly engaged a contractor to apply bracing to the tree, have previously carried out a crown reduction to the tree and have fenced the area immediately beneath its crown on The Green to discourage occupancy beneath it.

# 6 Physical Context

**6.1.1** The tree is located on a relatively level area of grass, approximately 0.5m to the north of the road.

**6.1.2** The road is understood to have a 30-mph speed limit. A count of passing cars at 11am on Thursday 4th April 2024, recorded 4 cars passing the tree within ten minutes (equating to approximately 24 cars per hour). Traffic generally appeared to be serving residents. It is likely that traffic is heavier during ‘rush hours’ and when cricket and other activities are present on the green. Traffic is free flowing. Cars are not parked beneath the tree.

**6.1.3** The tree is fenced. A park bench is situated well outside of the canopy/the trees falling distance. It has been reported that children have climbed into the hollow tree through an open cavity at ground level (see image 11 below), although this seems unlikely at only 37cm in height.

**Image 11:** Cavity to the north.

**6.1.4** Historic damage/pruning of the buttress roots adjacent to the road on the trees southern aspect are evident.

**Image 12:** Historic root pruning

**6.1.5** The tree stands alone, without shelter from neighbouring trees or vegetation.

**6.1.6** Annual wind statistics for the Tonbridge area, from Willyweather.co.uk, based on a five year average, show that the dominant wind direction is west-southwest, while winds appear to also occur from southern directions (see Figures 13 and 14 below).


**Image 13**: Google aerial image with prevailing wind direction.

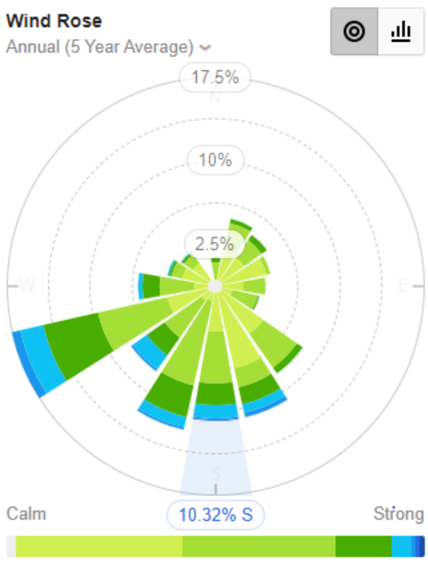



**Image 14**: Wind rose for Tonbridge area from willyweather.co.uk

**6.1.7** While the greatest concentration of high winds are shown to be from the southwest, it is important to note that only 0.66% are reported as being 'strong' from this direction. Also important to note is that this wind information is presented for the general Tonbridge area and not specific to the location of this tree.

**6.1.8** According to Figure 6 of BS 6399-2:1997 (see Appendix A), this area of the UK is within a zone that is expected to be subjected to storms with mean wind speeds of 21 m/s (47 mph, low end of Beaufort Scale 9 – Strong Gale) and a return period of 50 years (i.e. with a probability of 2% that a storm will occur that exceeds these mean wind speeds).

**6.1.9** The crown that is supported on the western stems is slightly smaller than the crown on the eastern stem and so the upper half of the eastern crown, is a little more exposed, although not significantly (see image 15).

**Image 15**: Eastern canopy

# 7 Condition

**7.1** Thought to be an historic pollard with a bole approximately 2.5m high and a total height of approximately 14m. The bole has historically developed into three discrete, separate stems to the north (itself significantly hollow), north- west and the east, supported by a decayed, open cavity, shell of a trunk, the trunk consisting of two, almost separate functional units, albeit with vigorous callous growth around the margins of the cavity, that is considered to be providing structural strengthening.

**7.2** There were no observable indications of deteriorating root stability, such as the fruiting bodies of decay fungi or displaced soil. Historic root pruning and damage occurred, probably during the installation and/or resurfacing of the surfaced road to the south (see image 12 above).

**7.3** Usual indicators of declining root function in the above-ground parts of the tree, include dieback or decline in the crown or parts of the crown or dead areas of bark on the buttresses or stem.

**7.4** Despite the historic root damage, generally, the base and buttresses appear to have vigorous growth, including reaction wood and normal incremental stem growth (see image 16 below).

**7.5** Each of the two sections of stem appear to be structurally sound with no significant current indications of structural instability.

**7.6** Some upper crown die back was observed (see image 17 below), although not particularly unusual for a tree of this life stage. Such die back can be related to root decline/death. It should be monitored.

**7.7** It is worth noting that the tree responded favourably to the last crown reduction, thought to be 10-15 years ago, indicating recent good vigour and functionality from its roots through to the outermost parts of its crown.

**Image 16**: Functional wood

**Image 17**: Tip die- back

# 8 Interventions

**8.1** I have seen no documentation regarding tree work interventions. I met Louise Kleinschmidt, Clerk of the Parish on 4 April 2024, who relayed the following information:

- Significant historic crown reduction/end weight works (date unknown) at an approximate height of 11m, which the tree appeared to respond favourably, with vigorous extension growth.
- Historic static, metal rod and bolt cable bracing has been installed (approximately 6m in height).
- Recent, dynamic (flexible), cable bracing (Cobra) has also been installed (approximately 4-5m and 4-8m in height). Thought to be installed in December 2022.
- Metal fencing to the canopy drip line has been relatively recently installed.
- Mulch applied on the soft ground, to the crown's drip line, although some grass is now growing through it.

# 9 Stability Analysis

**9.1** The tree, as is normal for veteran oaks of this life stage and morphology, has a trunk that is significantly hollow. The trunk has also divided into two more-or-less discreet sections.

**9.2** To provide an evidence framework for better understanding the structural stability of the tree and its component parts, 'TreeCalc'[2], which applies the principles of Tree Statics, has been used to produce an illustrative model (presented in Image 18 below).

**9.3** TreeCalc is an online software that has been developed based on the Statics Integrated Assessment (SIA) which is a theoretical, desk-based exercise using basic tree dimensions and properties (including wood properties), together with appropriate parameters to describe the conditions related to the location of a tree and wind speeds that it might be expected to be subjected (See Appendix A) in order to provide a broad assessment of a theoretical Basic Safety Factor (BSF) for stem fracture and the minimal residual wall required for a particular tree.

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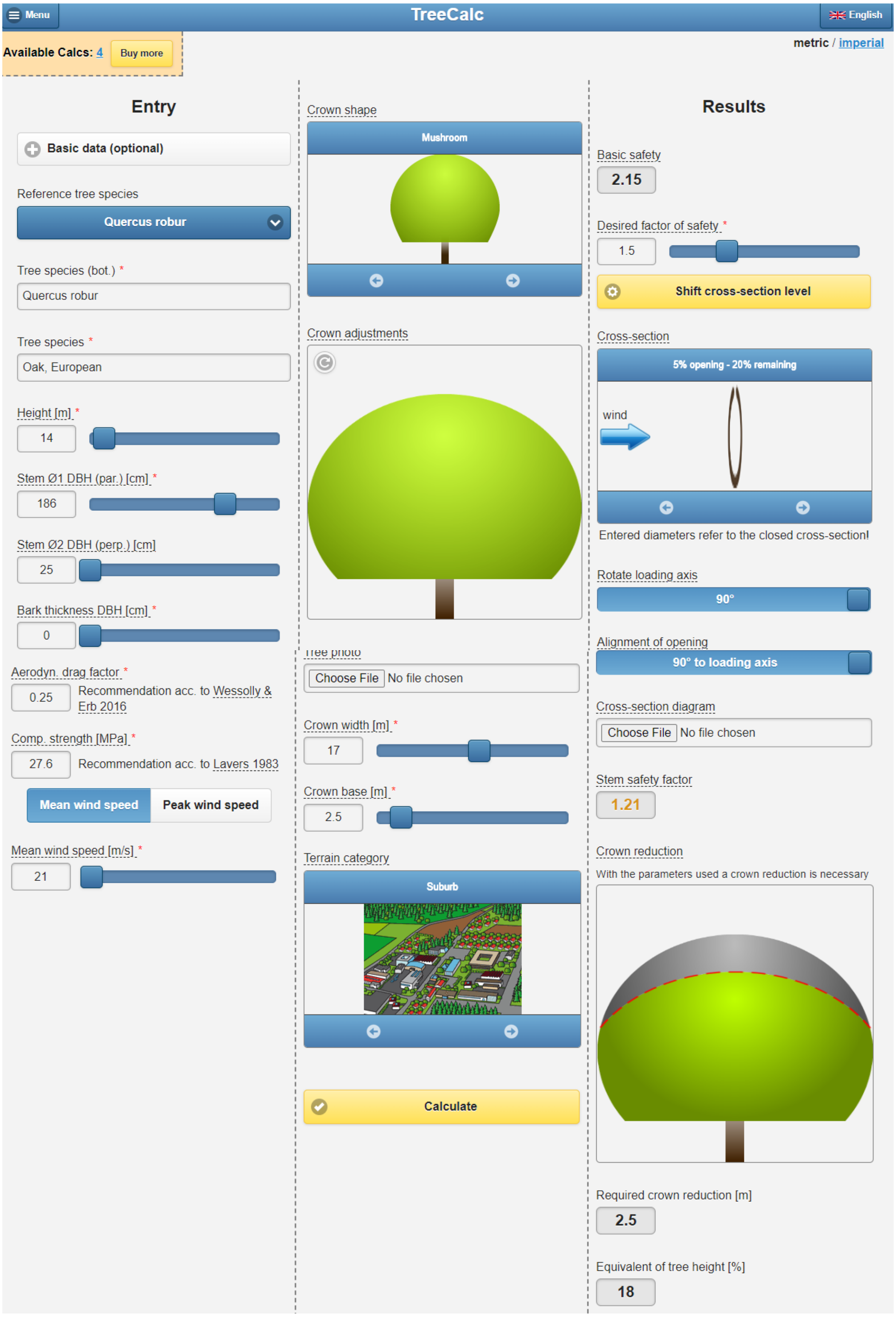
2 A static load test applies the basic engineering principle of statics to the assessment of a tree as a mechanical structure required to support a particular load. Results are achieved by making individual estimates of the loads that the tree might be expected to be subjected to, and the material properties of the wood of the species being assessed, in addition to the geometrical properties of the stem supporting the crown structure. The method was developed by L. Wessolly and G. Sinn at the University of Stuttgart in the 1980s (Wessolly, 1995, 1996, 1998, Wessolly and Sinn 1989, Brudi and van Wassenaer, 2001)

**Image 18**: TreeCalc Model



**9.4** The Basic Safety Factor calculation is based on the theoretical load bearing capacity of a solid elliptical stem with material properties consistent with the reference wood properties for that species, exposed to the design wind load. Adjustments are then made to reflect any hollowing in the stem (trunk), and these generate a Stem Safety Factor.

**9.5** To provide a degree of confidence that the subject tree poses a low risk of failure a Stem Safety Factor of greater than 1.5 is generally required.

**9.6** There are several important caveats that need to be considered and are why, the models are illustrative only to inform, rather than direct, management decisions. These caveats include:

- This veteran tree has a complex morphology which is not the normal morphology for which TreeCalc has been developed.
- For the purpose of the modelling, a single functional unit, albeit a significantly hollow stem with an opening has been applied. It is accepted that this tree could effectively be two separate functional units (two separate trees, if you will).
- TreeCalc calculations are based on compression failure and not consider torsion or longitudinal flattening or cracks.
- TreeCalc does not provide a Safety Factor for the tree's roots.
- TreeCalc does not factor in the dead weight of an asymmetrical crown.
- The Basic Safety Factor and the Stem Safety Factor generated by TreeCalc do not factor in the additional wound wood development and the potential different material properties of this wood.
- The effect of the bracing systems is not accounted for in the model.

**9.7** The local terrain has implications for the speed of both the wind and gusts. TreeCalc applies four terrain categories; Sea, Countryside, Suburb and City. The landscape of the Green is best matched to the 'Suburb' category. The 'suburb' category has therefore been modelled.

**9.8** The model is based on the wind zone that the general area (Tonbridge) is in, which is expected to be subjected to storms with mean wind speeds of 21 m/s (47 mph, low end of Beaufort Scale 9 – Strong Gale) (see Physical Context, above and Appendix A)

**9.9** Wind direction is modelled for east/west, because this is the direction in which the stem is thinnest and so is considered likely to be weakest. The largest lateral crown extent has been modelled, based on an average crown diameter for the whole tree.

**9.10** The models show that for the stem as a whole, the tree would be expected to have a Basic Safety Factor of 87.63, if the stem were theoretically solid.

**9.11** When 20% remaining stem cross-section with a 5% opening is modelled, the Stem Safety Factor reduces to below the desired 1.5, 1.21 with a minor crown reduction is generated, to return the Safety Factor to 1.5.

**Table 1**: TreeCalc illustrative model results for wind speed zone of 21 metres per second.

| Terrain Category | Basic Safety Factor | Stem Cross-Section | Stem Safety Factor | Required Crown Reduction to Achieve 1.5 Stem Safety Factor |
|---|---|---|---|---|
| Suburban | 2.15 | 5% Opening<br><br>20% remaining | 1.21<br><br>(desired outcome 1.5+) | 2.5 m<br><br>(equivalent tree height 18m) |

## 10 Risk Assessment

**10.1** Using TreeCalc, the stability analysis suggests an intervention in the form of a crown reduction to return to what is considered to be an acceptable safety factor.

**10.2** The above takes no account of the risk of harm, other than to the tree itself and potential loss of significant habitat value this veteran tree provides. That is, if it were to fail, what might the non-tree related consequences be.

**10.3** Quantified Tree Risk Assessment (QTRA) (Ellison, 2005) is generally accepted within the arboricultural industry as an appropriate risk assessment tool to assist either in reaching decisions regarding the future management of a tree identified to have significant faults, or to identify the appropriate interval between, or intensity of, tree inspection regimes.

**10.4** QTRA is not intended to be predictive but instead estimates the probability of the risk of harm to members of the public, property or vehicles (over the period of one year). This is estimated in terms of the likelihood of the event that a tree or tree part fails and that this event coincides with the occupation of the “target” zone (the area likely to be impacted were a tree to fail), by a pedestrian, vehicle or property.

**10.5** Risk of harm within the methodology is estimated as the product of the likelihood that the target area is occupied, the size of the part most likely to fail (expressed as a fraction of the maximum size of part) and the likelihood that the tree or tree part will fail. Within the methodology these factors are referred to as the Target Value, the Impact Potential (Size of Part) and the Probability of Failure. The resultant value for risk of harm is called the Risk Index.

**10.6** For all metrics (e.g. vehicle occupancy of the road, property and vehicle costs), generic, published industry standard levels of use and values have informed this assessment.

**10.7** An assessment of the stem and crown structure of each tree is undertaken to identify the size of the part within each tree considered as posing the highest risk of failure.

**10.8** An estimate of the likelihood of failure of the part most likely to fail is then made. In the case of the three trees subject of this report, the most significant risk being assessed is a large limb (+450mm diameter) onto a passing vehicle (possibly just touching a third party property.

**10.9** The risk of harm estimated using QTRA is the key system output and should be interpreted with reference to the Tolerability of Risk framework (HSE, 2001). Briefly, this recommends that risks identified as higher than 1/10,000 should be considered as unacceptable, with appropriate management introduced to reduce risks to within a region that can be considered to be tolerable (between 1/10,000 and 1/1,000,000). Risks lower than 1/1,000,000 should be considered to be broadly acceptable and resources should not be allocated to reduce these further. Based on this framework, the Risk Index values should be read as follows:

- 1/1 – 1/10,000 – Manage immediately
- 1/10,000 – 1/1,000,000 – Apply scheduled management (may include regular re-inspection)
- 1/1,000,000 – Does not currently require risk management.

**10.10** The QTRA calculation here suggests a 1:40,000 risk of harm (in the next 12 months) and an action 'to apply scheduled management (may include regular re-inspection'.

# 11 Recommendations

## 11.1 Tree Risk

**11.1.1** In the light of the above information the following recommendations (and an estimate of cost) is presented (in table 2) for managing the risk of structural collapse of the southern section.

**Table 2:** Tree Risk Management Recommendations

| Management Action | Positive Considerations | Negative Considerations | Effectiveness Over Time | Approximate Cost | Action date |
|---|---|---|---|---|---|
| **Crown height reduction** | Easy to implement, relatively inexpensive. | Would need to be applied cyclically, removes photosynthetic area which can reduce the tree's ability to add strengthening wood to the stem. | Every 3 – 5 years | £1,500-£2,000 | **Within 1 year** |

| Management Action | Positive Considerations | Negative Considerations | Effectiveness Over Time | Approximate Cost | Action date |
|---|---|---|---|---|---|
| **Bracing system**<br><br>**Option 1:**<br><br>**A review by the original installers or;**<br><br>**Option 2:**<br><br>**An Independent review and potential reinstall.** | Long-term solution, would prevent loss of the tree through structural failure. | Relatively high cost. | Long-term / Permanent | £1,500 | **Within 1 year** |
| **Annual monitoring** | Audits PC's Duty of Care | Does not directly address the stability of the tree, would need to be updated annually, may recommend other management actions | Every year | £1,250 with report) | **Annually** |

### 11.2 Management to support Health and Longevity

**11.2.1** Management to support the health and long-term viability of the tree are also recommended (in table 3 below). By supporting the tree's vitality, it will have greater resources to adding strengthening incremental growth of to the trunk and callous growth.

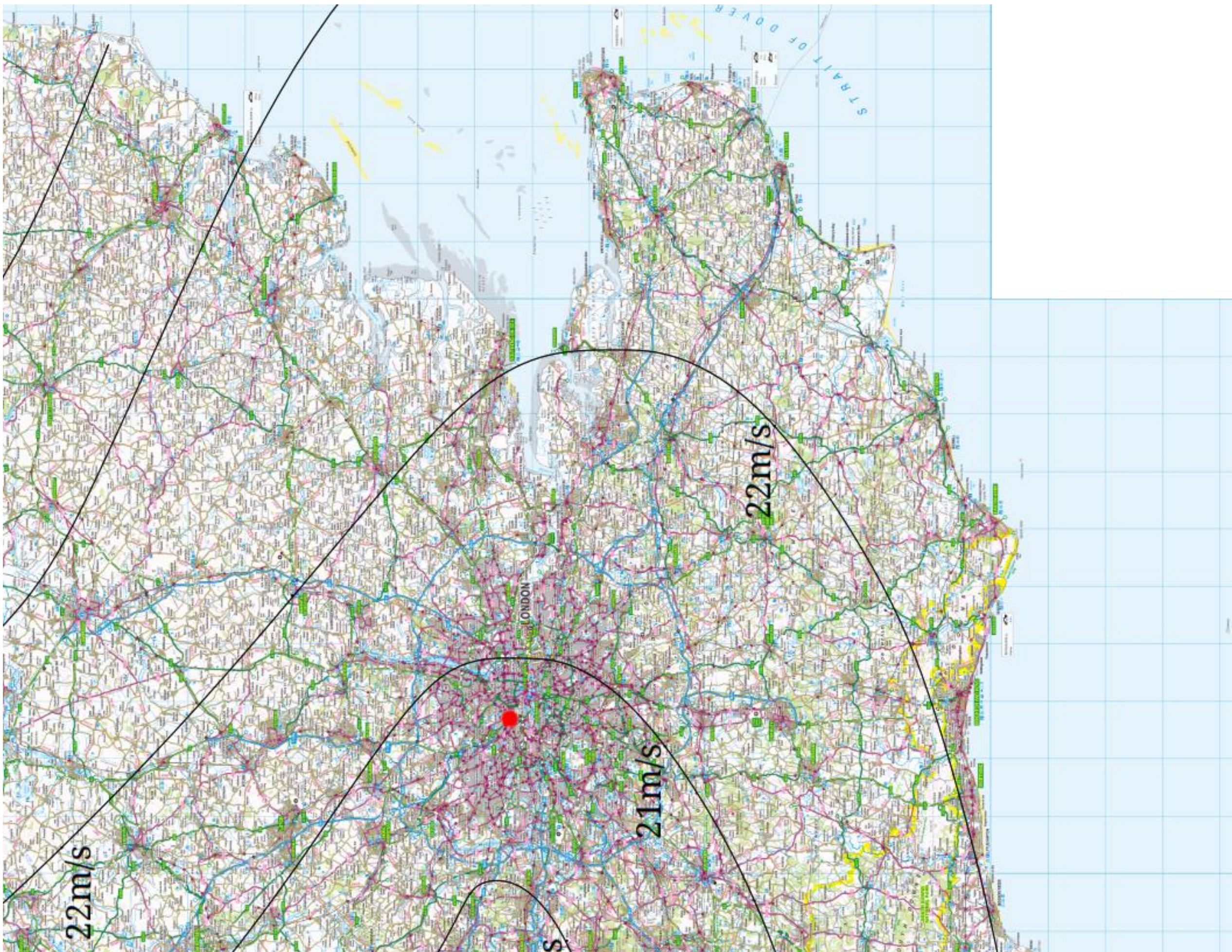
**Table 3**: Health and Longevity Management Recommendations

| Management Action | Positive Considerations | Negative Considerations | Effectiveness Over Time | Approximate Cost | Action date |
|---|---|---|---|---|---|
| **Maintain a healthy root environment by regularly re-applying woodchip mulch, ideally to a depth of 100 mm of a similar species, over soft ground at least to the trees drip line.** | Easy to implement, relatively inexpensive. | None. | Every 1-2 years | Unknown | **Within 1 year, then annually** |

| Management Action | Positive Considerations | Negative Considerations | Effectiveness Over Time | Approximate Cost | Action date |
|---|---|---|---|---|---|
| **Carefully install a board or other appropriate material to prevent entry into the tree via the cavity at ground level (see image 11).** | Medium to Long-term solution, would prevent potential damage (including fire) inside the tree. Low cost | Ensure fixings are non-invasive, otherwise a risk of tree damage. | Medium to Long-term | unknown | **Within 1 year.** |

# Appendix A

## Wind Zone Map (Based on Figure 6, BS 6399-2:1997)


22m/s
21m/s
20m/s
22m/s
21m/s
20m/s
LONDON

# Appendix B

## Limitations

**General**

1. The results, conclusions and recommendations presented within this report are based on the conditions found at the time of inspection. Tree growth is continual and subject to dynamic, natural processes. The effects of any debilitating factors may be progressive. Consequently, the observations made, and the data collected and analysed are interpreted to present an assessment of the tree in relation to its current condition and situation.

2. The recommendations presented within this report are valid for a period of one year only. Whilst recommendations regarding an appropriate re-inspection interval or in relation to a programme for subsequent detailed assessments may be offered over periods greater than one year, the significance of any changes in the factors relating to the tree or site over such periods cannot be predicted and continual monitoring and reassessment of a tree with identified problems is essential.

3. Any significant alteration to the site that may affect the tree or trees being assessed including level changes, hydrological changes, extreme climatic events or other site works, or any deterioration in vitality or observed fungal fruiting bodies will necessitate a re-assessment of the subject tree or trees.

4. The assessment of the tree has been made primarily in the light of the information collected during the assessment. Whilst consideration of the vitality of the tree, the site conditions and an understanding of decay processes will inform the recommendations contained within this report, no further tests, measurements, analysis, research or data searches have been performed in relation to the tree or the site.

5. No documented information has been provided regarding the history of root disturbance or severance or changes in local ground conditions (soil levels, drainage patterns etc.) or the location of underground services.

6. All measurements, compass bearings, proportions and assessments of age *etc* are estimates recorded through the use of appropriate instruments and presented at an appropriate degree of resolution.

7. The tree inspection is limited to the season in which the inspection takes place. When in the dormant period and trees are not in leaf, no assessment of foliar condition is possible

for deciduous trees; however, twig, bud character and general crown condition are taken into consideration.

8. Fungal fruiting bodies that may indicate wood decay processes are not necessarily present at the time of the survey due to seasonal or other factors. Observations and comments regarding wood decay fungi may be accordingly restricted.

9. Where parts of the tree are obscured, for instance by ivy or debris, it is possible that structural faults may not have been observed by the surveyor. In these cases, where appropriate, works may be recommended to remove the obstruction prior to a subsequent inspection.

10. No account has been taken of the effects of leaves, fruit, exudation or insect activity associated with trees that may affect people or property, nor of toxicity or allergic properties, nor of root or other tree-related nuisance.

**Tree Statics**

1. Treework Environmental Practice has invested heavily in acquiring the expertise and experience to enable the company to offer the assessment of trees using the principles of tree statics and the static load test. However, Treework Environmental Practice do not accept liability for any errors or omissions in the basis of the model on which the analysis presented in this report is based.

2. Treework Environmental Practice offers advice regarding the risk of failure posed by trees within the context of the tree statics model. Treework Environmental Practice will endeavour to advise on situations and interpret data collected in order to determine where there is a degree of doubt regarding the validity or applicability of the model.

3. The action of the wind across a surface and upon a tree crown is a complex and dynamic one. It is assumed that the estimates for the loading that a tree might be subjected to are reasonable and conservative (*i.e.* an over-estimate of the likely wind loads is assumed). It is possible that in particular circumstances wind loads can be underestimated.

4. Wind loads greater than those used as a threshold within the model can occur both regionally and locally. No liability can be accepted for the failure of a tree subjected to loads greater than those chosen as an appropriate test threshold within the analysis.

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