Level 3 - Individual Tree Assessment

On Behalf of:	Kirbymoorside Town Council
Site Address:	Gilamoor entrance to Manor Vale Woodland
Reason for Assessment:	To assess a mature Oak with suspected decay close to ground level.
Tree Location:	Located on a bank to the east of the public footpath approximately 12m from the entrance gate I have highlighted the position of the tree in yellow on the Google Earth image opposite.
Growing Area:	Based on the relative age of the surrounding trees, this tree is assumed to have developed as an individual, though is becoming included within the woodland.
Altitude:	103m
Exposure:	The tree is sheltered from winds from the north and east. It is relatively exposed to the prevailing winds from the south and west.
Assessor:	Ian Barnes – details in Appendix A.
Date of Assessment:	30/06/2018.
Assessment Method:	Level 3 - None invasive - details in Appendix B

Location Plan:

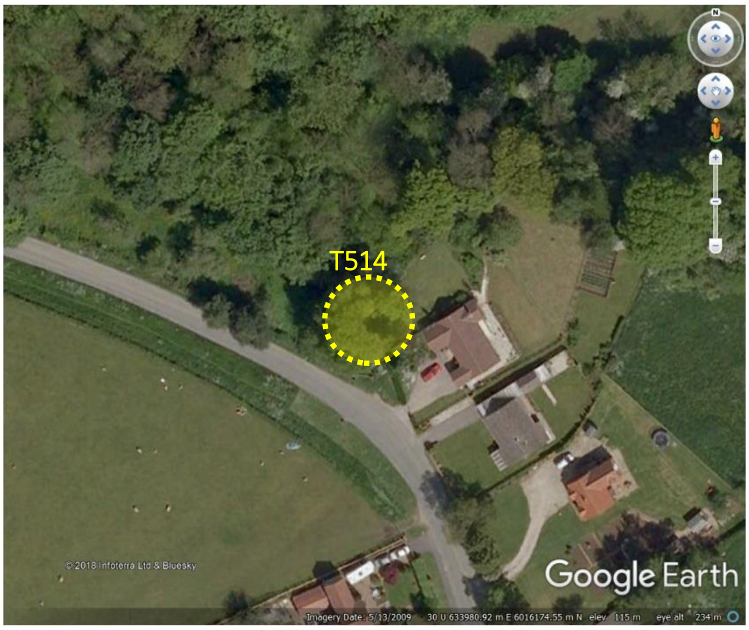


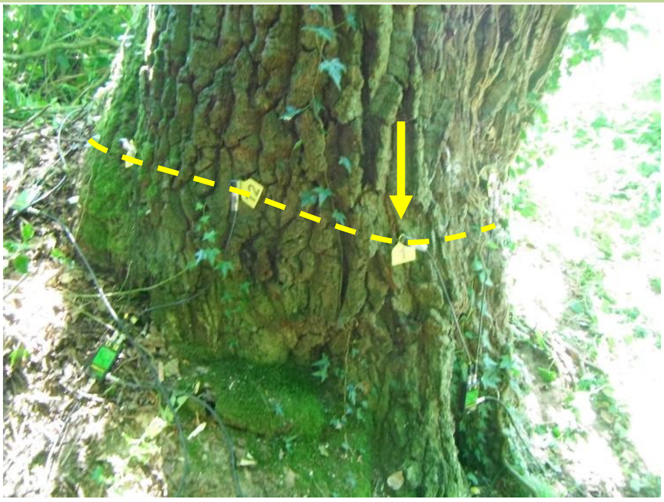
Image downloaded and used courtesy of ©Google and ©third-party suppliers notated on the image above.

Tree No.	Species	Age	Height (m)	Underside of Canopy (m)	Diameter @ 1.5m (mm)	Canopy Radius (m) North	South	East	West	Vitality	Safe Life Expectancy (Years)	Risk Assessment
T514	Oak	OM	23	3	1270	9	10	8	11	Poor	20+	Low

Observations / Comments

- Initial visual assessment of the main stem shows there to be an area of loose bark on the northern and southern stem, this was assumed to be the principal area of suspected decay based upon sounding with a nylon mallet and assessing the resonance of the wood.
- The northern section has partial attached and degraded remnants of fruiting bodies, these were unidentifiable but assumed to be either Ganoderma or Inonothus species, both of which are commonly found as heart rot on Oak.
- I assessed the stem at 15cm above ground level (measured on the eastern buttress) using a Fakopp Arborsonic 3D Tomograph, as this was considered to be the hollowest area of the main stem.
- I undertook the sonic tomograph assessment of the main stem using 12 measurement points as indicated by the Yellow dashed line on photograph 1 & 2 below; the Yellow arrow shows the position of sensor 1 (northern sensor) on photograph 1 below; and the second arrow shows the position of sensor 7 (southern sensor) on photograph 2 below.

Photograph 1 - SOT at 290mm looking east



Photograph 2 - SOT at 290mm looking west

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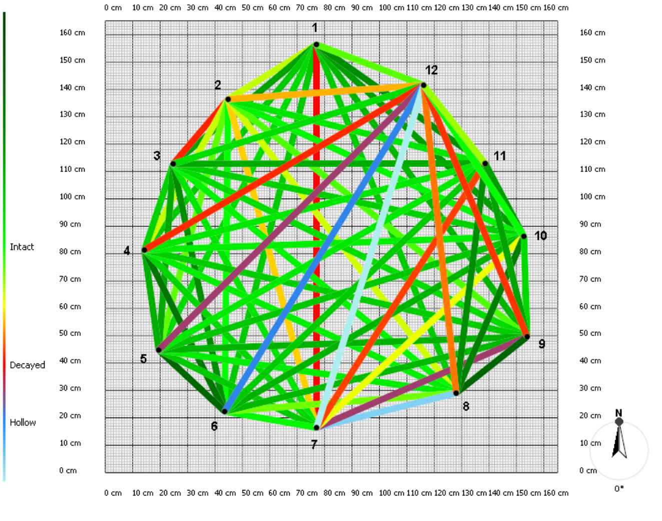
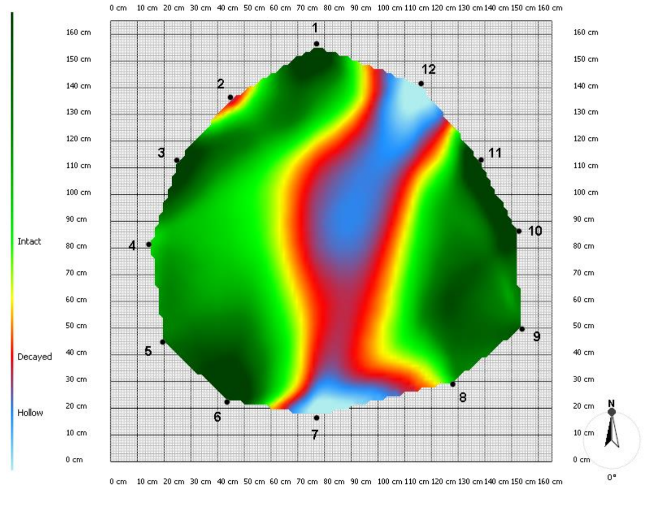
Sonic Graph

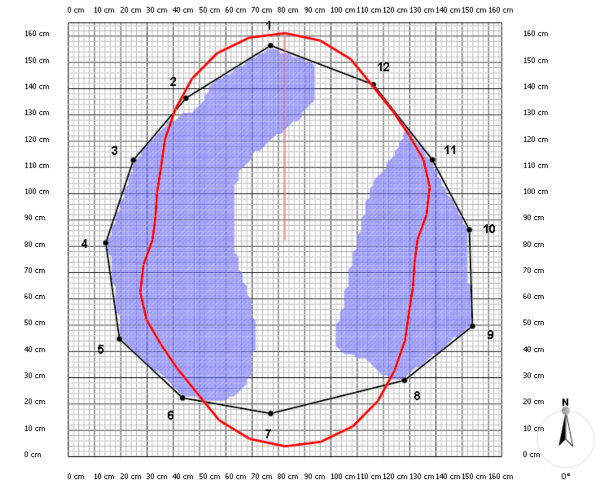


Sonic Tomogram (SOT)

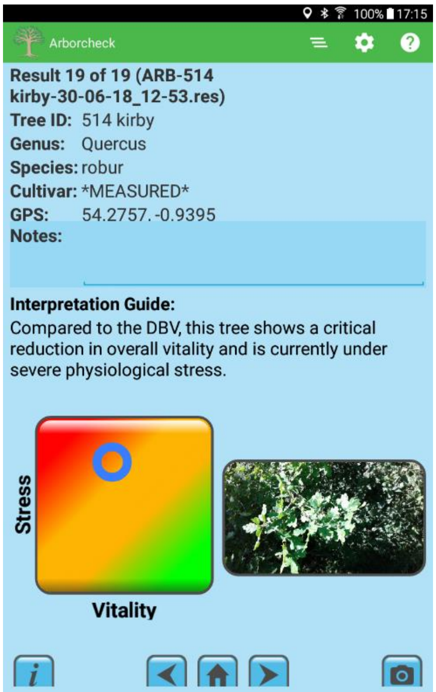


Photograph 3 – looking NE

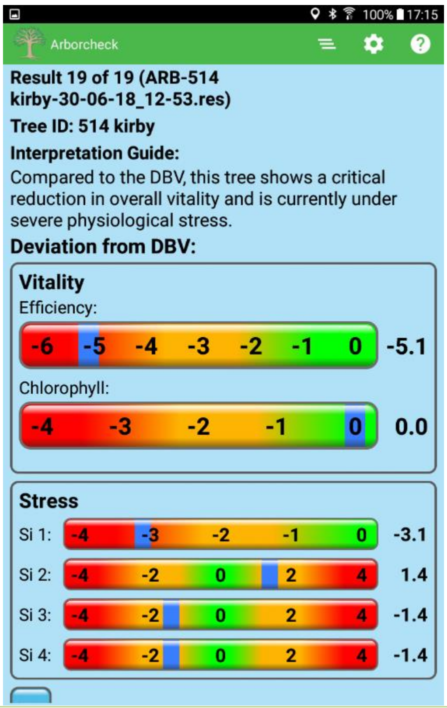
Biomechanics Layer Map



Vitality Assessment



Vitality Assessment



Findings

- The sonic graph confirms the central portion of the stem has restricted sound transmission. Based upon the red lines being predominately from east to west the decay is assumed to be central north to south. This image does show a high proportion of green lines on the outer most shell of the stem, particularly north to south, indicating only a reasonably thick shell wall is retained.

- The SOT (Sonic Tomogram) shown above, indicates that the stem has undergone significant decay from roughly northeast to south indicated by the blue area. The eastern and western buttress still has reasonably uniform high sound transfer abilities shown in green.

- Based upon this assessment the decayed element is within the typical safe limits of decay in trees of this size.

- The software detected a 40cm deep crack between sensor 7 & 8 which may well be exacerbating the extent of decay displayed in the southern portion of the stem. Such a crack may enable increased stem colonisation by the decay fungi and ideally this should be assessed periodically.

- An assessment of the trees vitality was undertaken, this is based upon a non-destructive measurements of leaf chlorophyll fluorescence & chlorophyll content using Arborcheck, which uses techniques that are used widely by scientists all over the world as a means of detecting physiological damage caused by biotic or abiotic stress factors. By assessing the Efficiency of photosynthesis (the ability of the photosynthetic systems within the leaf to convert light energy from the sun to the complex carbohydrates required for sustained tree growth) and Chlorophyll Content, this is limited by the amount of carbohydrate available for growth which reduces nutrient uptake resulting in leaf chlorosis and necrosis. This assessment shows the tree to be less than ideal and compared to the baseline data, this tree shows a critical reduction in overall vitality and is currently under severe physiological stress.

- A visual assessment of the remaining tree shows that Ivy is beginning to develop on the main stem and within the lower canopy and may obscure defects, ideally this should be controlled or removed.

- The canopy does contain several dead branches and ideally this needs to be kept within safe limits.

- The tree has been harshly lopped historically and excessively thinned. Some of this work has involved the removal of large limbs both close to the main stem and within the main canopy network. This work has been undertaken to a poor standard and left poorly made final cuts which are now sites of dysfunction and possibly decay.

- The response of the tree to the harsh work has been to continue to develop and to try to outgrow the problem which has created the current canopy which contains a range of elongated limbs with limited secondary branching, suggesting the tree will struggle to dampen wind loads and may be predisposed to branch failure and the tree will require formative pruning to manage this issue.

Conclusion

- The bearing strength of the trees stem at the level of assessment is currently sufficient to offer support, based upon calculations which compare the greenwood strength of the retained wood and the estimated load based upon the tree canopied surface area, wind resistance and the mechanical advantage offered by the height of the tree. The assumed supportive element of the stem at the assessment height is shown as blue shading on the Biomechanics Layer Map above.

- The tree canopy being approximately 257m^2 as shown above in photograph 3.

- Comparison of the bearing capacity with the expected loading resulting from the canopy areas suggests that the tree has enough basic safety, as such the tree is assumed to offer a low risk of stem failure assuming a wind speed of up to 33m/s (118.8 km/h or 73.8 mph or Beaufort Force 12) which are likely to be experienced on site annually based upon published data.

- The thickened area of blue in the south west area of the stem is around sensor 4, 5 & 6 suggests there has been a response by the tree to mechanical loading and adaptive wood has been produced. Based upon this information the tree has reduced strength against winds from the north and south, indicated by the red lines outside the stem on the Biomechanics Layer Map. However, significant winds from these directions are not expected and this is not considered as issue.

- Further decay is expected and has a potential to overcome the remaining stem, in the assessed section of the stem in the medium to long term and if retained the tree will require periodic re-appraisal to enable comparison with this base line information.

- The tree is currently within safe limits at the level of assessment but is expected to suffer further decay and become predisposed to stem or buttress failure in the medium to long term. However, trees are a self-adapting structure and providing sufficient time and energy availability, trees can compensate for even significant decay.

- The vitality of the trees is compromised and although such stress could be in response to the current environmental factors because of the recent extreme weather conditions, however comparing several aerial photographs on Bing & Google Earth show the trees foliage to be yellowing for some time. In addition, the canopy does contain significant deadwood some of which is up to 200mm in diameter which suggests decline may have occurred for some time.

Recommendations

- If retention of the tree is required, then I suggest that the canopy needs to be cleared of immediately defective material, ideally deadwood greater than 100mm should be removed.
- The Ivy growing on the trees stem and within the canopy should be treated to prevent regrowth and ideally removed in the current growing season.
- To counter the moderate risk of branch failure the elongated branches within the canopy should be reduced, by a process known as retrenchment in the current growing season. This pruning method gradually reduces the canopy volume, reducing the mechanical and wind loading on the canopy, though maintains the canopies characteristic shape. I have indicated the likely level of reduction in red on the photograph below. This will have the additional benefit of limiting wind loading and reduce the potential for torsional movement in the main stem.
- If the tree is retained, improvement to local growing conditions is likely to be beneficial to the trees health, consider localised rootzone improvement, through mulching of the available rooting zone as soon as possible. In addition to this decompaction of the public footpath could be considered and this would help greatly the development of the western buttress – Please contact me for further information if required.
- Ongoing tree assessment will be required periodically and ideally the buttress should be assessed by sonic tomography in the summer of 2020.

APPENDIX B – EXPLANATORY NOTES

This assessment has been prepared from a visual assessment taken from ground level without any detailed investigation. Observations are based upon the body language of the trees and any visual indicators present at the time of inspection. This survey should be regarded as a preliminary overview; ongoing inspections will be required as specified individually. In most situations the health, condition and safety of trees should be checked on a cyclic basis, alternating between early and late seasons to ensure a full picture of tree health is established. Inspections should only be carried out by a suitably qualified arborist.

Similarly, numerous potential defects may not be detectable dependent upon timing of inspection, in particular, wood decay fungi, which may only occasionally produce external fructifications annually (rather than perennially), or may not provide external symptoms until an advanced state is achieved.

Reasonable risk management generally aims to provide a tree that can be regarded stable in a normal / foreseeable, regularly experienced storm events i.e. force 10 storms. The level of risk offered by the tree will be significantly greater as the wind speed that the tree is exposed to increases beyond this level. Additionally, the threat from aerial parts i.e. Tight unions may remain even following works, although failures of such parts are likely to be limited to small diameter branches and to periods of extreme weather.

As an arborist, I am a tree specialist and use my knowledge, education, training and experience to examine trees, recommend measures to enhance their beauty and health, and attempt to reduce the risk of living near trees. As a client, you may choose to accept or disregard these recommendations, or seek additional advice.

As an arborist I cannot detect every condition that could possibly lead to a tree or limb failure. Trees are living organisms that may fail in many ways, some of which we do not fully understand.

Conditions are often hidden within the tree and below the ground. As arborists, we cannot guarantee that a tree will be healthy or safe under all circumstances, or for a specified period of time. Sometimes trees may appear "healthy," but may be structurally unsound. Likewise, remedial treatment, like any medicine, cannot be guaranteed.

Treatment, pruning and removal of trees may involve considerations beyond the arboricultural perspective, such as property boundaries and ownership, disputes between neighbours, planning issues, sight lines, landlord-tenant matters etc. Arborists cannot take such issues into account unless complete and accurate information is given to them. Likewise, as an arborist I cannot accept any responsibility for the authorization r non-authorization of any recommended treatment or remedial measure.

Furthermore, certain trees are borderline cases as to whether they should remain or be removed. If conditions change a tree may need further monitoring in the future to determine its health and structure. Trees can be managed, but they cannot be controlled, and to live near a tree is to accept some degree of risk.

Mathematical abbreviations: > = Greater than, < = Less than.

Measurements / estimates: All dimensions are estimates unless otherwise indicated. Measurements taken with a tape or clinometer are indicated with a '#'. Less reliable estimated dimensions are indicated with a '?'.

Tree number: Numbered Tag attached to each stem usually on the inside face of the stem at roughly 2.5 metres. Were the number is followed by a C this demotes that the tag refers to a compartment or group.

Name: Tree species are detailed by their common name.

Age: I record the age as an estimate of the tree likely span for guidance only i.e.:

Y	**Young**	- Recently established/planted tree.
EM	**Early Mature -**	An established tree in the first third of its likely expected life span
SM	**Semi Mature -**	Fully established and growing with high vigour
M	**Mature -**	The middle one third of its likely expected life span
EOM	**Early Over Mature -**	Clear reduction in vitality, typically small deadwood early canopy retrenchment.
OM	**Over Mature -**	The later one third of its likely expected life span with sign of canopy retrenchment.
V	**Veteran -**	An aged example of the species, typically with defects & high conservation value
S	**Senescent -**	Beyond its expected Life span possible of historical interest or in a state of decline.

Height: I estimate height to the nearest metre to the mean height.

Height to underside: I estimate height to the nearest half metre to the mean underside of the canopy.

Diameter: These figures relate to a measurement of the stem at 1.5m above ground level recorded in millimetres, measured with a rounded down diameter tape. Figures prefixed with MS denote trees or shrubs with multiple stems.

Canopy (N S E W): I estimate the distance of the canopy radius to the nearest metre to provide a mean distance of separation between the stem and the outer canopy.

Vitality: Is a personal assessment of the tree's growth rate in the current season, in comparison to other trees within the locality, region and an indicator of the tree likely response to site change.

D - Dead	A dead or very low vitality tree
P - Poor	A tree of low vitality
L - Low	A tree in noticeable poor state
F - Fair	A tree of lower vitality
G - Good	A tree of high vitality
E -Excellent	A tree of very high vitality

Safe Life: Is a personal assessment of the trees likely expected remaining safe life span in years, assuming the site management continues as it is at present or the tree is protected from significant environmental change. Trees can reverse even serious decline and the expected safe life can be significantly improved following changes / improvements to site management and following remedial works.

40+ Good vitality a tree a tree with high potential.
20+ Normal vitality a tree in good health.
10+ Early reduction in vitality / reducing foliage cover.
<10 Marked decline / reduced foliage cover.
<5 Serious decline or very low vitality tree.
<1 A dead / almost dead tree

Comments / Observations: General comments referring to tree health, structure and condition.

Management Options: Comments detailing remedial works required improving immediate safety or improve the management of the tree.

Priority: Guidance for the time scale in which works should be completed, from the date of the report.

Tree Risk Assessment: The International Society of Arboriculture (ISA) Tree Risk Assessment Qualification (TRAQ) takes a qualitative rather than quantitative approach to risk assessment. It uses matrices to compare the likelihood of failure of a tree or tree part, the likelihood that it will impact the target and the potential consequences of failure. Unless stated otherwise the risk assessment assumes the risk offered over the next year.

Matrix 1. Likelihood of failure

Likelihood of failure	Likelihood of Impacting 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

Matrix 2. Risk Rating matrix

Likelihood of failure & impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate.	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Glossary of Terms.

Sonic Tomography (SOT): Sonic tomographs detect defects (e.g., hollows or wood rot) in a non-invasive way by generating a two-dimensional map of the sound velocity transmitted across a tree's section, mirroring the integrity of the inspected wood. It works on the principle that sound waves passing through decay move more slowly than sound waves traversing solid wood. The system sends sound waves from a number of points around a tree trunk to the same number of receiving points, the relative speed of the sound can be calculated, and a two-dimensional image is generated. Using the differences in the transit times between sensors, the analysis software constructs a two-dimensional picture, which show zones of differing sound transmission properties within the stem. The software uses pre-set colours, for example, areas with high "sonic speed" in green whereas low sonic values are shown in magenta. Other colours of yellow & red represent various levels of rotting zones based on sonic speed measurements in the respective areas. Sonic Tomography gives valuable density information about the trees. The density strongly correlates with the soundness of the wood. This is very useful to access the stability of the tree. In some situations, the sonic investigation is interfered with by the internal structure of the wood.

CHLOROPHYLL FLUORESCENCE By measuring the capacity of a plant to carry out photochemistry this can provide a measure of health and identify impacts from a range of issues including stresses caused by environmental conditions. It is used as a means of detecting physiological damage caused by biotic or abiotic stress factors.

Safety Factor. Safety factor is the ratio of the wood strength from the species database as shown at "Strength" and this computed maximal stress, multiplied by a correction factor of 70%. The formula is: (SF=0.7 $Strength$ / $MaxStress$). The rationale behind this approach is that given all the parameters above the software tries to estimate the stress in the wood and if this exceeds the maximum limit the material can resist, then the trunk would break. This is based upon several key elements including:

- Expected wind speed will not breach 33m/s or 72 mph.
- Drag factor is the drag coefficient of the crown, taken from the tree species database.
- Strength is the yield strength of the trunk wood, also taken from the species database.
- Wind force is the calculated force acting on the crown centre at the given wind speed and crown size.
- Tree weight above layer is the estimated total weight of tree that is above the selected layer.
- The torque resulting from the wind and gravity forces.
- Max stress is the maximal stress resulting from the torque and mass of the tree, taking into consideration the tomogram. The Layer Details section shows the details for the selected layer. Decayed area is the percentage of the decayed region on the selected layer compared to the total layer area.

Safety Factor	below 50%	50% - 100%	100% - 150%	above 150%
Risk Rating	Extreme Risk	High Risk	Moderate Risk	Low Risk

RETRENCHMENT PRUNING

Retrenchment pruning is a term coined by Paul Muir of Treework Environmental Practice, to describe the technique that has been developed in the field of environmental arboriculture to imitate the natural process of ageing. Crown retrenchment is used to describe the way in which peripheral dieback occurs as the tree redirects energy and growth to the formation of a consolidated lower region of the crown. Crown retrenchment pruning is used to extend tree viability, both in terms of vitality and stability, whilst retaining habitat features associated with ageing.

Retrenchment pruning is a technique that can be used to reduce the potential for a fully mature, late-mature or ancient tree to collapse or 'fall apart' under its own weight due to excessive end-loading on long or weakly attached limbs. It is also applicable in trees where incipient decline appears to result from excessive transportation distances from the root system to the crown periphery. While this technique may have a general value, it is especially useful for managing formerly pollarded trees (lapsed pollards) and mature trees showing signs of dieback. Retrenchment pruning gives best results for suitable tree species and growth conditions.

The practice of retrenchment pruning follows a detailed inspection, which assesses the viability of the tree in terms of current vitality, the probability of tree loss as a result of expected decline in vitality or from structural collapse. This assessment informs decisions as to whether retrenchment pruning is appropriate. If the tree is prone to imminent mechanical failure that threatens its viability then gradual retrenchment treatment would not be appropriate. In such cases an alternative method is suggested involving significant reduction to selected failure-prone limbs (see Read 2000, pp 42-43).

This methodology is now adopted and detailed within **British Standard BS3998:2010 Tree Work – Recommendations**. Section **3.22** details Retrenchment as a '*form of crown reduction (**3.13**), intended to encourage development of the lower crown, which emulates the natural process whereby the crown of an ageing tree retains its overall biomechanical integrity by becoming smaller through the progressive shedding of small branches*'.

Retrenchment pruning is a phased form of crown reduction, which is intended to emulate the natural process whereby the crown of a declining tree retains its overall biomechanical integrity by becoming smaller through the progressive shedding of small branches and the development of the lower crown (retrenchment). This natural loss of branches of poor vitality improves the ratio between dynamic (biologically active) and static (inactive) mass, thus helping the tree as a whole to retain good physiological function. This natural process is not, however, always sufficient to prevent trees from falling apart or from posing unacceptable risks to fixed targets (e.g. roads, pavements etc.).

Retrenchment pruning should be chosen as the main option for managing lapsed pollards that would otherwise tend to break up and that, because of an inadequate lower crown, might not have enough leaf area to survive if reduced to the ultimately intended height and spread in a single operation. It may also be used for managing coppiced trees that have remained uncut for so long that they are unlikely to survive re-coppicing.

> *NOTE 1 - Pollarding is a traditional form of sustainable tree management that originally provided a product (fodder, timber pole or firewood) as part of a silvopastoral system of land management (typified by wood -pasture). It is also a system for managing trees in formal situations, either so as to control their size or for cultural reasons.*

The second and any subsequent pruning treatments should take place only when newly developed branches suitable for retention have become strongly established. After the final phase of progressive reduction, a cyclic pruning of new growth should continue, so as to avoid the excessive loading of extensively decayed branches. If there is a need to encourage the production of a dense lower crown, the development of shoots from dormant and/or epicormic buds should be stimulated by retaining stubs when branches are pruned. The length of the stubs should be about three to five times their basal diameter. Since epicormic branches tend to be weakly attached, any such branches that subsequently develop should if necessary be pruned (subject to inspection) in order to help prevent biomechanical failure.

NOTE 2 - A long stub is likely to bear a number of dormant buds or (in some species) potential sites for adventitious bud formation. Also, adventitious shoots sometimes form near natural fractures in which bark has been torn, leaving jagged edges. This is a natural survival mechanism after storm damage. In order to encourage the formation of such shoots for the purpose of crown retrenchment, pruning may be undertaken by means of partial cutting followed by controlled fracture. Also, the bark may be scored, with the intention of stimulating such growth.

NOTE 3 - The technique of "coronet cutting" produces a stub-end that consists of an irregular series of acute axial V-cuts, rather than a flat surface. This technique is mainly suited to the creation of natural-looking fractures on trees that have been reduced to tall stumps ("monoliths"). Since there are particular hazards associated with this type of pruning, it requires specialist training. To specify the details and timing of retrenchment pruning, an individual tree management plan may be drawn up and later modified as appropriate over the duration of the programme. If possible, the details of the work and of the condition of the tree should be recorded throughout the duration of any such plan, to improve knowledge for future application. The plan should be based on the following decisions:

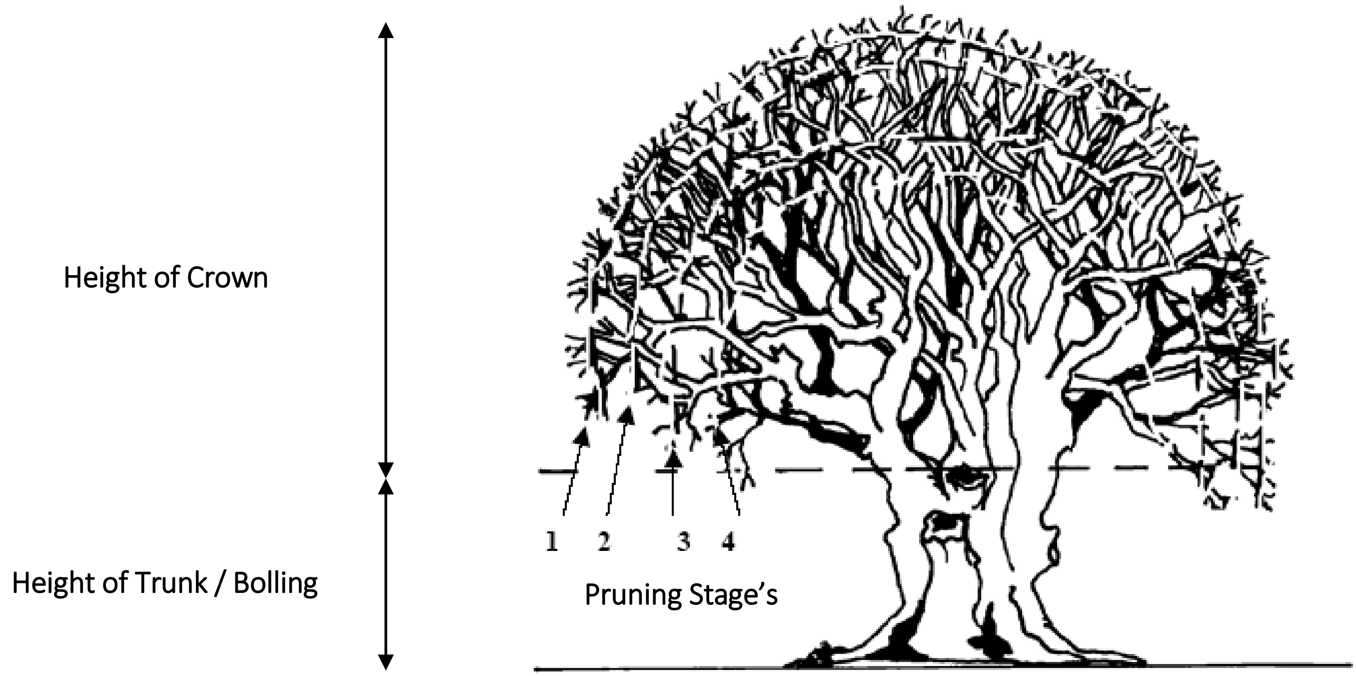
a) the objectives of retrenchment pruning for the tree concerned (with respect to its structural integrity, desired crown shape and size, vitality etc.);

b) the suitability of pruning as a means of improving or safeguarding the biomechanical integrity of the tree, taking account of its predicted tolerance to pruning, by virtue of its species, age and the current vitality and expected response to the pruning;

c) the number of phases of work, the predicted details and timing of each phase and overall duration of the programme;

d) the time for starting the work (assessment of priority for different trees).

Example for Retrenchment Pruning



Ratio of trunk/boll to crown height	Total number of years to carry out reduction	Number of stages to carry out phased reduction	Period between stages (years)
4:1	36	6	6
3:1	25	5	5
2:1	20	5	4
1:1	16	4	4
Example for tree with trunk/crown ratio 1:3			
Stage 1:	Intervention stage	Typically involves 10% reduction targeted to end-growth (degree will depend on current vitality)	
Stage 2, 3 & 4	Intermediate stages	Six years apart preceded by re-inspection & moderated in response to vitality indications	