



CAVAT

(Capital Asset Value for Amenity Trees)

Full Method: Users' Guide



Group of lime and London Plane, Epping: values from £160K- £265K

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This guide has essential information for all users of the CAVAT Full method. It is freely provided. However please be aware that CAVAT is an expert tool; all potential users are advised to ensure that they are properly trained.

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General Introduction

CAVAT (Capital Asset Value for Amenity Trees) provides a basis for managing trees in the UK as public assets rather than liabilities. It is designed not only to be a strategic tool and aid to decision-making in relation to the tree stock as a whole, but also to be applicable to individual cases, where the value of a single tree needs to be expressed in monetary terms.

It is intended particularly for councils and other Public Authorities and primarily for publicly owned trees. However, it may be used by other public bodies, including the courts, and by private institutions and individuals. It complements other tools of arboricultural analysis, such as single tree hazard assessment systems. So far as possible it draws upon objective evidence and published data, but it also relies on expert arboricultural knowledge and in some cases assessments that are specific to CAVAT. It should therefore only be used by arboriculturists who have received relevant training, and who have the relevant skills and experience.

The Town and Country Planning Act 1990 (sections 198 & 199) establishes that trees have value as a public amenity and that local planning authorities have a duty to act to protect trees in the public interest. The legislation itself does not specify how their amenity is to be assessed, leaving it open for the value of trees to be expressed in the most appropriate way for the intended purpose, and not necessarily in monetary terms. Because CAVAT is specifically designed as an asset management tool for trees that are publicly owned, or of public importance, it expresses value in monetary terms, and in a way that is directly related to the quantum of public benefits that each particular tree provides. Applied to the tree stock as a whole it enables it to be managed as if it were a financial asset of the community. Applied to single trees it both values the subject tree and allows a comparison to be made with the value of other public trees. CAVAT complements other forms of assessment of trees' amenity.

CAVAT takes the replacement value approach, extrapolating from known planting costs and adjusting for a short series of relevant factors. Spreadsheets are freely available to assist practitioners. The assessment has been refined to allow the final value to reflect realistically the contribution of the tree to public welfare through tangible and intangible benefits. (*See note 1*).

The Two Methods

CAVAT is based upon an expert inspection and assessment of individual trees. It may be integrated with a wider survey of the tree stock of a particular area, or used for specific cases. There are two versions of the CAVAT method, called the Full and Quick methods accordingly. Both share a common structure. The basic value is calculated from the measurement of stem diameter, giving a cross-sectional area which is multiplied by the current Unit Value Factor. (*See notes 2 & 3*). The location, size and life expectancy are then taken into account, but with variations. Essentially the Quick Method has been simplified to meet the desirability for speed in the assessment of large numbers of trees, and for clarity of results.

The Quick Method is intended specifically as a strategic tool for management of the stock as a whole, as if it were a financial asset of the community. The Guide to the Quick Method is published separately.



The Full Method is recommended for use in cases concerning individual trees or groups, when precision is required and sufficient time is available for a full assessment. It has proved useful in a variety of situations, including for calculation of compensation where trees have been destroyed or damaged, or for the quantum of new planting in planning cases. It is also useful as an aide to management decisions, for example cost benefit analysis of different potential pruning regimes of street trees. In relation to cases involving subsidence, according to the JMP (Joint Mitigation Protocol) the levels of evidence to be submitted in cases involving public trees will be set by reference to a full CAVAT valuation to be undertaken by the Local Authority. CAVAT may also be used to calculate the structural value of the asset, as part of a i-Tree assessment; the Full method should then be used, subject to the assessors' level of competence.

The Full Method

General Introduction

The Full Method is used in situations when a more detailed and precise assessment of the value of trees as individuals is required. For example, it would be used when reviewing the management options available for an individual tree or a group or avenue.

The Full Method involves a site inspection, and may in occasional cases involve further investigation, including internal decay detection or a climbing inspection. A full record of the inspection must be retained with appropriate evidence, including photographs.

Purposes

CAVAT is widely used now to establish a replacement value to enable realistic replacement and/ or compensation to be achieved in relation to:

- development control/ management functions,
- management decisions, including for trees subject to TPOs, or in conservation areas,
- assist in legal proceedings, (for example to advise a court as to the value of a tree, either publicly or privately owned, in proceedings following it having been illegally removed or damaged, or in planning enquiries or appeals) and
- management of the tree stock, to allow agreement as to adequate funding of replacement planting.



General Instructions

Although the method is designed to be robust, prospective users need to be aware of certain key principles and the need for training to ensure consistency and accuracy of results.

Steps 1 and 2 in both methods rely on measurement, government data, and the conversion formula, updated annually to take account of inflation, but also the assessment of accessibility which is specific to CAVAT. Step 3, Functionality, relies on expert assessment, also specific to CAVAT. For example, when the health of the tree is assessed the key judgement is not whether it has flaws to the arboricultural expert, but to what extent those flaws detract from its current performance as a public amenity. Where there is no loss of performance no penalty is imposed. Any potential shortening of life expectancy, say as a result of structural weakness, would be considered separately at Step 5.

Steps 4 and 5 apply only to the Full Method. At Step 4 the adjustments for amenity rely on observation, but also plant knowledge; at Step 5 the assessor requires a good understanding of tree health, and the ability to estimate reliably the safe life expectancy of the tree.

Assessors must also be aware that CAVAT does not discount the value of trees generally to account for indirect problems that they may cause, such as the potential to cause structural damage, nor additional costs of management to resolve any such problems. This is because it is designed to give a cost/benefit analysis, and to allow for these costs within the method would lead to a form of double accounting. However, the Full Method does discount value as part of Step 4, Adjusted Value, when it is found that there is an intrinsic problem, that is to say direct harm is being caused by the tree without it being resolved by management.

The Variables

The Full Method involves five steps, and sets of key variables:

1. Basic value/unit value x size;
2. CTI value/location, in terms of population and use, and accessibility;
3. Functional value/functional status;
4. Adjusted value/amenity factors, both positive and negative; and
5. Full value/life expectancy.



Step by Step

Step 1: Basic Value

The basic value is calculated using trunk area as key measure of size. The trunk area is calculated by using the measured trunk diameter, converted to give the cross sectional stem area. (*See notes 2 and 3*). The current unit value factor allows the basic value to be calculated

A spreadsheet, updated annually in May, is available separately to make the calculations.

Step 2: Community Tree Index (CTI) Value

There are two operations in Step 2. Firstly, the basic value is adjusted to take account of the population density using the Community Tree Index (CTI) factor (*see note 4, and Table A*). Then the modified basic value is discounted by up to 60%, according to how accessible the tree is in the particular location.

Operation 1.

The CTI index gives the basic adjustment for the Local Authority. The effective CTI value factor is that given in the final column of the table. In some instances, however, the area may not be typical of the Local Authority's overall area. In that case the ward figure, also available from the ONS website, may be used, with the CTI index factor values as shown in Table A.

Operation 2.

The second operation is to consider the relative accessibility to the public of the tree in its particular location. Most publicly owned trees will be not be discounted in value for a lack of accessibility; however the operation allows CAVAT to be applied to trees on private land, for example to TPO trees, or to trees in more remote public areas. Where a tree does not retain 100% of its value it may be discounted by up to 60%.

Taken together, these 2 operations give the CTI value.

Step 3: Functional Value

Functionality is the main assessment in the CAVAT Full method. The tree's value is modified to reflect how well it is performing biologically, as against what would be expected of a well-grown and healthy tree of the same species and girth. This is an expert assessment, requiring a good knowledge of species characteristics and potential.

The surveyor must consider crown completeness and functional condition sequentially. These combine to give the overall functional value. Precision is required in the assessment, either maintaining the value at 100% or reducing it proportionately in increments of 10%. Detailed advice is given in note 5.



Step 4: Adjusted Value

The functional value is then adjusted to take into account the surveyor's assessment of the positive and negative impacts arising from species characteristics, as expressed in its location. These are combined into a single modification; up to +/- 40% is possible. (*See note 6*).

Step 5: CAVAT Full Value

Finally, the assessor makes an expert judgement as to its potential life expectancy in its situation, using the Life Expectancy Adjustment bands. (*See note 7 and table B*).



Notes

Note 1: CAVAT, Lifetime Benefit and the Trunk Formula Method

CAVAT follows the depreciated replacement cost (DRC) approach, also used in the Council of Tree and Landscape Appraisers (CTLA) "trunk formula method", an appraisal method widely used in the U.S.A. However the CAVAT methods are designed to express the value of trees as public assets; whereas the stated aim of the CTLA methods is to express the value of the tree as a private asset, whether of a private individual or a public authority.

CAVAT allows the value of a tree to be assessed by extrapolation from the cost of a newly planted standard tree, using the ratio between their respective trunk areas as the critical measurement. The CAVAT value allows for the contributions, positive and negative, of the tree's location, relative contribution to amenity social value and appropriateness, as well as functionality and life expectancy. Essentially, the basic value is modified by a consideration of the impact of those factors that determine the quantum of general amenity benefit. The factors which are essentially related to "wear and tear" on the tree, including a shortened life expectancy, are dealt with in terms of depreciation. On the other hand factors based on variation from an arithmetic mean, (for example the particular benefits that flow from the characteristics of the species in question) allow for a either a potential increase or decrease in value.

Its results are broadly comparable with what research in both the U.K. and the U.S.A. suggests are the tangible lifetime benefits of trees to the community as a whole. The tangible benefits link is reflected both in use of official population statistics to generate the CTI index rating, in the nature of the adjustment for Functionality and also in the scale of the adjustments throughout.

Note 2: Basic Value

The relevant measurement to calculate the basic value is DBH, from which is derived the cross sectional area of trunk at breast height, using the equation $A = \pi r^2$. The procedure is first to measure the trunk radius in centimetres, (generally by converting the circumference to a radius by a "rounded-down" tape, using the formula $r = c \div 2\pi$). The radius is then squared, and multiplied by π (pi, approx. 3.142). This is subsequently converted into the basic value by multiplying by the current UVF (unit value factor). When using the spreadsheet the basic value is calculated automatically, using the diameter and the UVF. The equation may be expressed:

$$V = n \times \text{radius}^2 \times \text{unit value factor.}$$

Users should ensure that they are using the up to date spreadsheet, with the current UVF. (See note 3).



Note 3: The Unit Value Factor (UVF)

The UVF represents the full cost of a newly planted tree in a given area, divided by its trunk area. It has two components; the nursery gate price, expressed in terms of the cost of each square centimetre of stem, (or unit area cost) and the planting cost (transport, planting, materials, immediate care and management costs, but *not* after-care). The calculation of the unit area cost is from the average cost of a basket of species rather than for each individual species, in order to eliminate differences based only on production factors or variations in demand. The initial specification used in this calculation was 12-14 cm. standard containerised trees, however prior research has subsequently demonstrated that size, as opposed to species or production methods, is not generally a critical factor in unit cost variation.

The current UVF represents the average cost per square centimetre of stem area of the ten most commonly planted species, containerised, at trade prices, and from equivalent and competitively priced nurseries including immediate planting costs. The best estimate of the planting cost factor has been found to be 150%, based on consultation with tree officers and within the wider landscape industry.

By applying the Community Tree Index factor, the national unit area value may then be modified to take account of the effects of location to the benefits received by the local population. (*See note 4*).

The unit area cost is upgraded each year in line with inflation, (using RPI/X) from an original survey in 2004/5. Again, this is to minimise fluctuations in the UVF unrelated to the tree stock's contribution to public amenity. The up to date figure is used in the current CAVAT calculations, available separately.

Note 4: Community Tree Index

To generate the CTI index factor in the Full Method the adjustment is made in two stages; first according to the population density of the wider location, and secondly according to the tree's relative accessibility in that location. Any special characteristics of the immediate location are accounted for in step 4, Adjusted Value.

Operation 1

The CTI index factor is a means to reflect in the tree stock's asset value the relative population density in the local area and thus the relative number of those potentially able to benefit from the local authority's trees. There are 7 CTI bands; their values are shown in Table A. They vary from 100%, for the majority of the country, up to a maximum of 250% in the most densely populated inner city areas, according to the published population density. The population data has been sourced from Office of National Statistics (ONS) information. The results as applied nationally to England can be found in the separate National Community Tree Index Table.

Once selected for a borough the CTI factor will generally not be varied, although some large metropolitan authorities, where population densities vary significantly across their area, may find that more accurate results will be obtained through having different CTI values for different wards, etc. This will depend upon an assessment of whether the local authority is relatively



homogenous in character overall, or whether there are significant variations from ward to ward. Ward statistics are available from the Office for National Statistics, via the ONS website, <https://www.ons.co.uk/Default.asp>.

Operation 2

Having applied the factor for the general character of the area, the assessor then judges the relative accessibility of the tree within that area, and whether it is fully available to contribute to the public good. The potential CTI value after operation 1 may either be retained, by a score of 100%, or further reduced by 80%, 60% or 40%.

The key considerations under operation 2 are whether the tree is:

1. Fully accessible to the public i.e. within a public highway, public park, or woodland. For these locations the accessibility score remains 100%.
2. Wholly or partially accessible from public areas i.e. in a local authority owned location such as a school, local authority building or housing estate. For these locations the accessibility score would be reduced to 80% of its original value.
3. In an area of more restricted accessibility, including;
 - a. A less accessible publicly owned area i.e. a courtyard of a building,
 - b. In private land, where views are partially or wholly restricted or sheltered housing unit or private land. For these locations the accessibility score may be reduced to 40% or 60% of its original value.

A tree that is fully accessible and visible, in a prominent and well-used setting within the general area will score 100%; a tree not publicly accessible or visible will score 40% of its original value. A degree of judgement will be necessary to assess these scores.

Note 5: Functionality

The basis of CAVAT is that the cross sectional area of a tree's trunk is linked to overall crown size, in a healthy tree where growth has not be interrupted or compromised. The Functionality adjustment is necessary to reflect variations in crown completeness and condition, as against the crown that would be expected as the natural result of the trunk size. The Functionality adjustment is made irrespective of the cause of the difference. The assessor carefully estimates the adjustment so that the assessed functional value represents as realistically as possible the actual capacity of the tree to provide public amenity. The completeness of the crown is considered first, then the functional condition. For the Full method the estimate is made to the nearest 10%.

The two considerations for the Functionality adjustment are:

- 1) Crown completeness.
The value is reduced proportionately if:
 - The crown has been reduced by pruning and the tree has not fully recovered; or
 - the crown has been reduced by natural causes, e.g. storm damage or disease, and the tree has not fully recovered; or
 - the crown has failed to develop normally, e.g. because of root restriction, shading or grafting, and is smaller than would be expected from the stem size



- the crown is thin.

This is irrespective of the nature of the causative factors and whether they harm the tree's appearance.

2) Condition.

If the tree is in functionally poor condition, including disfigurement by disease obvious to the public, the value is reduced proportionately. Such conditions would include:

- Leaf or shoot disease;
- root disease, clearly affecting vitality;
- canker, or severe trunk lesions;
- fire damage.

No reduction is made at this stage for a condition, e.g. structural weakness, which does not affect the current functional status of the tree, providing that no immediate action (other than monitoring) is proposed. The value should be reduced proportionately where the assessor finds an immediate need to reduce the crown for arboricultural reasons, e.g. structural weakness, (i.e. as soon as practicably possible, and in no more than 1 year). Pests such as Horse Chestnut Scale, diseases such as bacterial wetwood, or physical conditions such as uneven form or wounding are not taken into account, unless they are sufficiently severe to adversely affect Functionality, by triggering crown reduction or by grossly affecting appearance etc.

A dead or effectively dead tree, or one requiring urgent removal, scores 0% value retained, and thus has a value of £0. Alternatively where crown reduction is proposed immediately, with the effect for example of allowing the tree to be retained rather than felled, the value may be recorded as if the tree had been pruned.

Note 6: Amenity and Appropriateness

1. Amenity

The value may be increased to take account of species characteristics that increase benefit to the community. Special factor adjustment should be used sparingly; there may be up to a maximum of 4 special factors and a maximum adjustment of 40%; (generally 10% for each amenity factor, other than Veteran/Ancient Trees, for which 30%). For example:

Townscape and visual importance:

- integral part of a designed landscape, including avenues or designed park or garden;
- contribution to the setting of an important place or building;
- in a school, or by its entrance;
- in a particularly prominent location, e.g. a town centre, or at the entrance of a major public building, etc; or
- part of a wider grouping giving character to the area, e.g. long-maintained street pollards.

National or Local designations or connections:

- in a Conservation Area, where the presence of trees has contributed to the designation;
- a locally designated tree, e.g. Landmark or Favourite Trees;
- a commemorative or memorial tree; or
- a tree known to be planted by a notable person.



Species characteristics:

- rare or unusual species; or
- attractive visual characteristics, e.g. notably attractive form, showy flowers, variegated foliage, attractive bark, etc. (N.B. count as 10% each, up to 20%); or

Nature Conservation

- particular wildlife importance, e.g. a bat roost, heronry, etc;
- designated species in local BAP (Biodiversity Action Plan); or
- a Veteran/Ancient Tree. (N.B. counts as 30% by itself).

2. Appropriateness to the Location

Conversely, the value may be reduced to take account of species characteristics that reduce the overall benefit to the community, being seriously inappropriate for the location, causing a problem or hazard and not effectively controlled by management. As for amenity factors reduction would normally be by 10% each, and to a maximum of 40% if the species has inappropriate species characteristics for the location causing obstruction or inconvenience, for example:

- a weeping or low spreading habit in a narrow footpath;
- obstruction, e.g. vigorous spiny suckers across a footway;
- major surface roots damaging the footpath;
- large, squashy fruit in hard surfaced area;
- honeydew drip e.g. in a dedicated car park or playground;
- a pronounced lean, causing a potential obstruction;
- detracts visually from its context, for example, a visually intrusive species in an otherwise consistent avenue, or an exotic species in a setting of native trees.

Note 7: Life Expectancy Adjustment

Trees assessed to have a life expectancy greater than 80 years retain 100% of their adjusted value; those with a life expectancy less than 80 years lose part of their Adjusted Value. Those with less than 5 years lose 90%. A judgement that the subject tree may not safely be retained reduces its value to zero.

As generally in CAVAT, the banding approach is used, for robustness and to reflect some of the practical difficulties of estimating age accurately. The weighting given to the bands is derived from an exponential curve, calculated on the basis that at less than 80 years life expectancy value is initially lost only slowly, but that towards the end of a tree's life the decline in value becomes increasingly swift. (*See Table B*). Eighty years is chosen as representing in round figures the current length of human life expectancy in the UK. The principles to be followed in assessing life expectancy are those of general arboricultural best practice.



Tables

Table A: CTI Factors

Population Density / Ha	CTI Factor %	CTI Band
<20	100	1
20 – 39	125	2
40 – 59	150	3
60 – 79	175	4
80 – 99	200	5
100 – 119	225	6
<119	250	7

Table B: Life Expectancy Adjustment

Life Expectancy (Years)	% Value Retained
80+	100
40 – 80	95
20 – 40	80
10 - 20	55
5 – 10	30
<5	10



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Special mention must finally be made of Jim Smith, London Trees and Woodlands Framework Manager, for his invaluable support, advice and advocacy, and to Andy Tipping, for having sufficient faith in CAVAT to put it into practice in Barnet, for his consistent championing of the project, and amongst many contributions for advocating the inclusion of population density as an improvement to the method, and for suggesting the means to do so.

The Author

Since 1989 the author has been employed by Epping Forest District Council, in the Forward Planning and Development Management teams. He now works there part time, as Principal Officer- Green Infrastructure, Trees & Landscape Strategy. His main responsibility is to develop a Trees and GI Framework to guide development of a new, community based tree strategy for the district, linked to the councils emerging Infrastructure Plan. He has previously worked in both public and private sectors. He is now a professional member of the Institute of Chartered Foresters.

A qualified and registered teacher he entered arboriculture in 1979, as trainee apprentice tree climber for RP Denton & Co; a Colchester based firm. After a rocky start Paul Denton trusted him sufficiently to fund day release City & Guilds training at Capel Manor College. He became lead tree climber, with responsibility for all site works. At that time the firm was accepted onto the Arboricultural Association's list of approved contractors. As a result he holds City and Guilds practical qualifications, including the Certificate in Arboriculture in addition to his M.A. from the University of Cambridge, where he had studied English Literature, matriculating in 1970. On leaving RP Denton in 1984 he joined Slough BC, as charge-hand of the tree team, where he self-tutored for the Professional Diploma, passing the practical part at the second attempt. He then worked as assistant County Tree officer for Essex CC, where he supervised collection of data for an early, county wide computerized tree inventory



His interest in tree valuation began early, as a potential solution to the wholesale death and mutilation of publicly planted trees, when he became aware that published information was generally limited to a simple statement of the annual planting numbers and the pruning budget.