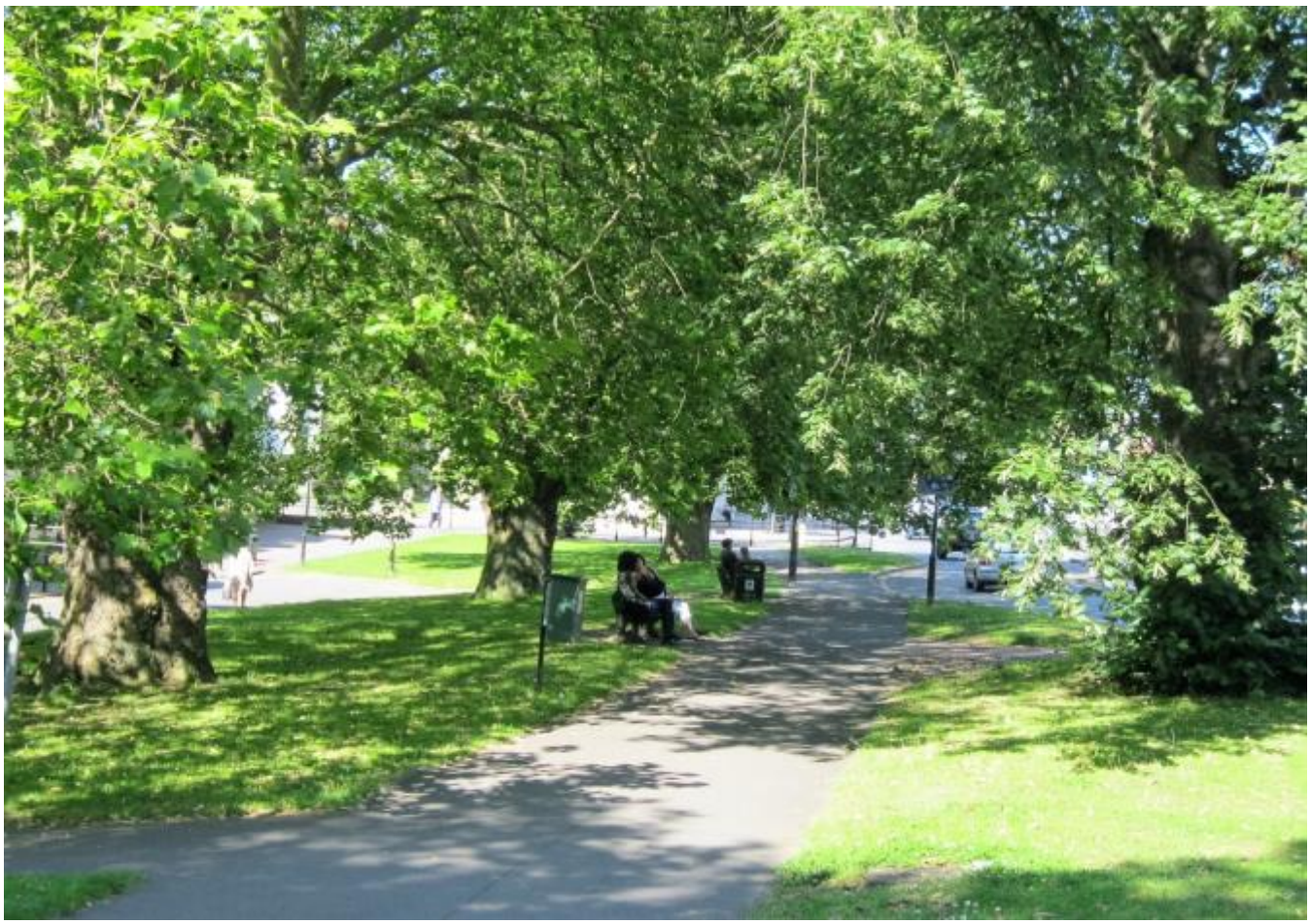
CAVAT

(Capital Asset Value for Amenity Trees)

Quick 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 Quick 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.

Contents:

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, 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 Full Method, described in detail separately, is recommended for use in decisions concerning individual trees or groups, when precision is required and sufficient time is available for a full assessment. The Guide to the Full method is available separately.

The Quick Method, described here, 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. In effect, it is designed to enable the value of the public tree stock to be indexed. Rises or falls in the CAVAT value will be seen to reflect changes in the quality and character of the stock over time, and function as a reflection of performance, an aide to management, and a rationale for investment. The tree manager is thereby empowered to act as an asset manager, drawing on evidence to justify investment in the tree stock.

The data required is limited to the minimum necessary to express the value of the tree stock as a whole, and to provide information to assist with management decisions. Data will generally be collected in conjunction with regular surveys of the tree stock, but may be extrapolated from smaller samples. The database software will need to be adapted to include the necessary fields, and to produce useful analysis of the information collected.

The suggested approach to use of the CAVAT Quick Method as a strategic tool is summarised in Note 4. CAVAT may also be used to calculate the structural value of the asset as part of an i-Tree assessment; in this situation the Full method should then be used, subject to the assessors' level of competence.

The Quick Method

Introduction

CAVAT enables a body to manage their trees as a public asset:

- to set a benchmark against which to measure changes in the value of tree stock,
- to allow analysis and assessment of the nature and condition of the stock, and
- to reassess and set management priorities, including the need for altered management regimes or new planting,
- to assess and communicate the success of policy and practice, and also the challenges.

The overall asset value is intended to act as a benchmark; the data will enable projections of the value and character changes over time, in response to different inputs/ influences.

Data collection will generally be carried out as part of the annual survey of the tree stock, although a sample approach could be used. (*See note 5*). 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. DBH measurement is required, converted into one of a series of 16 value bands. The band limits have been designed to ensure that the assessed values will respond quickly to changes in girth in the earlier stages of establishment and to support assessment and analysis of the changing asset. The assessment of Functionality is retained, in a simplified form. Life expectancy is retained an optional assessment; it may also be estimated as an arithmetical adjustment to the total stock value for reporting purposes. *(See note 6).*

Taken together this effectively minimizes any additional survey time.

The Variables

The Quick Method potentially involves four steps, and sets of key variables:

1. Basic value/unit value x size;
2. CTI value/CTI factor;
3. Functional value/functional status;
4. Quick value/ life expectancy.

Only three datasets need to be collected as part of the survey, the CTI factor having been set for the area as a whole*. (See note 7).* This may be reduced to two, if the statistical adjustment approach is used for life expectancy.

Step by Step

Step 1: Basic Value

On survey each tree is recorded in one of 16 bands according to its DBH (*see table A*), which gives its basic value. The table of up to date values is available separately. For the purposes of the Quick method the exact size is not needed; if it is being recorded precisely as part of the survey it should normally be possible for the database to calculate automatically the CAVAT banding. The derivation of the UVF is given in note 2.

Step 2: Community Tree Index (CTI) Value

The basic value of the tree population will be adjusted according to the population density of the urban areas of the Local Authority, using Community Tree Index (CTI) factor (*see Note 7 & Table C*). This gives the CTI value.

Step 3: Functional Value

Functionality is the main assessment in the CAVAT Quick 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. The Quick approach, although simplified to five value bands, remains 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. This can be retained at 100%, or reduced to 75%, 50%, 25% or zero, according to the assessed functional status. Detailed advice is given in note 8.

Step 4: CAVAT Quick Value

Finally, the assessor will normally also make an expert judgement as to potential life expectancy in its situation, using the Life Expectancy Adjustment bands. (*See note 6 & 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.

The CAVAT Quick Method follows the general approach of the Full Method, but is simplified for management of the population as a whole, by exclusion of the less critical factors and those which balance out over the population as a whole, by taking a broader view of functionality. The assessment for life expectancy is retained- but as an option. The alternative is to make a statistical adjustment of the overall stock value.

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 reflects the planting costs of a representative, standard tree in an urban area, divided by its cross sectional trunk area at breast height. 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 prices 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 7).*

The unit area cost is upgraded each year in line with inflation, (using the retail prices index) 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: CAVAT as an aide to Strategic Management

One of the main intentions of CAVAT is to enable management of the public tree stock as if it were a strategic asset- *asset value management*. The CAVAT Quick Method allows that asset value to be expressed and projected for a variety of management objectives. It may be used as an index, which will rise, or fall, with changes in the extent and character of the stock over time.

As the value of the stock of urban trees changes with time, the index will allow those changes to be expressed in a simple numerical form, and for the results to be subject to a variety of analyses. In turn this will allow the tree manager to analyse existing practices and procedures, test and adjust strategies, and to form appropriate local management policies, as part of an overall strategy. It will be possible to begin to view the value of the system against the cost of management and annual investment levels, for example in new planting. The results of potential management options may be projected in terms of their impacts on potential CAVAT stock value; in turn that will be an aid to justifying investment in planting, aftercare and management. Using simple, standard management analysis techniques, such as a strengths and weaknesses analysis (SWOT) it will then be possible to generate medium term action plans,

say for a six-year period, as well as longer term strategic plans. It will also allow the manager to communicate the basis of policy making and the results of management to interested parties, and not least the public, in a clear and consistent way. In turn this will support the allocation of funding.

Note 5: Data collection for the Quick Method

To implement Asset Value Management data handling will need to be integrated with existing database software. Three data fields are needed in respect of each tree:

1) The value band, derived from trunk diameter;
2) the functional status; and
3) the asset value.

The value band may be available through existing DBH data, or may be calculated as part of the annual survey. Functionality is a concept specifically developed as part of CAVAT; it needs to be assessed by inspection; it is unlikely to be realistically judged from existing records (although this has not been tested). The assessment will generally therefore be done as part of the general survey or resurvey of the stock and so would add minimal cost.

For purpose of analysis the software needs to be able to calculate at least:

- Numbers of trees in each value band, total and as divided by percentage function.
- functional value of trees in each category, in total and as divided by % functions;
- the adjustment for SLE;
- all either for stock as a whole, or for specified areas (e.g. parish/ward/street, etc.,).

Note 6: 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.

Statistical adjustment

As an alternative to individual assessment an adjustment may be made statistically to the asset value of the stock as a whole, based on the average life expectancy for different species. The

overall stock value would be reduced to avoid overstating the asset value. The degree of adjustment would depend on the age and life expectancy profile of the stock.

Suggested approach:

1. The stock is divided into 3 bands, and the numbers in each band calculated:

    I. Long life expectancy in their location greater than 160 years;
    II. Moderate life expectancy, of 160 – 80 years; and
    III. Short life expectancy, of less than 80 years.

2. With an even age distribution, (e.g. there were as many 5 as 100 year old oaks etc.,) the following adjustments would be made:

    I. For every long-lived tree the functional value would be reduced by 10%.
    II. For every moderate life expectancy tree the functional value would be reduced by 20%.
    III. For every short life expectancy tree the functional value would be reduced by 40%.

If the age and life expectancy profile were known to be significantly distorted an appropriate adjustment should be made. .Assuming an even distribution between short, medium and long-lived species the depreciation of overall asset value to account for the effects of life expectancy would be 23.3%.

Note 7: Community Tree Index (CTI)

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

Note 8: 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 Quick method the estimate is made to the nearest 25%.

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) Functional 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%, 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.

Tables

Table A: Value Bands

Band No.	Trunk Diam. (cm)
1	<5.9
2	6-8.9
3	9-11.9
4	12-14.9
5	15-19.9
6	20-24.9
7	25-29.9
8	30-39.9
9	40-49.9
10	50-59.9
11	60-69.9
12	70-84.9
13	85-99.9
14	100-114.9
15	115-129.9
16	<130

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

Table C: 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

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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; his main focus is to develop a framework to guide development of a new, community based trees and Green Infrastructure strategy for the district. He has previously worked in both public and private sectors. He is 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 City & Guilds training, on day release at Capel Manor College. He then 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 council's tree team, where he also self- tutored for the RFS 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 widespread 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.