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# The benefits of large species trees in urban landscapes: a costing, design and management guide

*Tom Armour, Mark Job and Rory Canavan of Arup*

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Armour, T, Job, M, Canavan, R

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# Acknowledgements

The guide was written by a research team from Ove Arup & Partners Ltd (Arup) under contract to CIRIA.

## Authors

**Tom Armour BA (Hons) Dip LA CMLI MIEnv Sc**
Tom is a chartered landscape architect with 25 years experience. He founded and heads the landscape architecture business at Arup working with multi-disciplinary teams on a wide range of major development projects in the UK and internationally. Tom believes in a rigorous approach to landscape design and promoting practical and economic sustainable design on projects. He also believes that landscape design should address 21st century issues: making cities more liveable, designing in resilience to climate change and promoting biodiversity and design for health and well-being. He has produced design guidance for a wide variety of projects including Crossrail in London, Cambridgeshire Guided Busway and an award winning 100-year strategy for the Thames Estuary.

**Mark Job BA (Hons) Dip LA CMLI**
Mark is a senior landscape architect at Arup with extensive experience of designing to integrate green infrastructure within urban environments. Mark has a particular interest in tackling problems associated with climate change and urbanisation, such as surface water flooding, air quality and urban microclimate. Mark has helped to author several design guides, including a guide for creating open space on previously developed land and an award winning 100-year strategy for raising flood defences along the Thames Estuary.

**Rory Canavan BSc (Hons) MSc N Dip CEnv MIEEM MSB**
Rory has over 13 years experience and leads the ecology and environmental assessment team at Arup's Leeds office. His experience has covered a wide variety of projects with particular experience of landscape scale and regional biodiversity issues. Rory's main area of expertise is in landscape ecology such as the ecological permeability of landscapes and the relationship between species movement, landscape patterns and processes. Rory's wider background also encompasses elements of landscape design within amenity/urban landscapes.

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# Executive summary

The UK's urban trees are special and have played an important role in combating the effects of growing urbanisation for many years. It is impossible to imagine towns and cities without them, yet they are in decline, and this guide is intended to inspire a call to action to reverse this trend.

This guide focuses on the benefits of large species trees (ie trees that can attain heights of over 15 m). While all trees are beneficial to an urban environment, larger species are particularly significant as the most important single elements of urban green infrastructure (GI). Large species trees convey the greatest financial, social and environmental benefits, and make a fundamental contribution to the well-being of almost 80 per cent of the UK population who live and work in urban conurbations. In the context of a changing climate, the importance of protecting and planting new large species trees in urban areas has never been more critical, and is a notion that is emphasised by numerous UK Government reports and initiatives.

## The benefits of large species trees

The overall aim of this guide is to highlight the vital importance of large species trees, including the retention and improvement of existing trees and carrying out new plantings in streets, squares and parks for new and existing developments. This guide demonstrates, with reference to a growing body of research from around the world, that the financial benefits of large species trees far outweigh the whole life costs associated with planting and maintaining them. Research in the US indicates that this cost–benefit ratio is most favourable in relation to large species trees rather than smaller more ornamental species. The benefits of trees are described with reference to the UK National Ecosystem Assessment (UNEP, 2011), which is the first analysis of the UK's natural environment in terms of the benefits it provides to society and continuing economic prosperity.

The growing body of research referenced in this guide provides a convincing argument for the inclusion of large species trees. The figures illustrate that on average the annual net benefit of planting large species trees is 44 per cent greater than for a medium species trees and 92 per cent greater than for a small species trees. , The research also demonstrates that it takes less than five years from planting for the net benefits of large species trees to outweigh net costs.

In summary, the financial benefits of retaining and planting large species trees are:

- increased property prices and land values, faster property sales, which encourages inward investment and growth due to the visual enhancement of urban areas by large species trees, benefiting developers

- reduced energy costs for property owners and businesses through microclimate regulation
- improved chances of gaining planning permission – a direct financial benefit to developers
- improved tourist and recreational facilities in urban areas.

Due to their size and stature, large species trees are particularly effective in urban areas in regulating the microclimate, attenuating and filtering water, attenuating noise and improving air quality and sequestering carbon. Mature trees also provide a significant habitat resource, enriching biodiversity in urban areas and promoting access to nature. The wide range of social and environmental benefits that large species trees bring to the urban environment can be summarised as follows:

- improved physical health
- improved mental health and well-being
- improved hospital recovery rates
- improved workplace productivity
- improved childhood development and well-being
- enhanced social cohesion
- reduced flood damage
- cleaner water

Different groups benefit from the retention and planting of large species trees in different ways, for example:

- urban societies benefit from improved health and well-being, improved air quality, reduced carbon levels, reduced levels of crime, improved water attenuation and filtration and the creation of ecologically rich environments
- developers benefit from increased property prices, land value, saleability and an improved prospect of gaining planning permission
- property owners benefit from reduced heating and cooling costs
- businesses benefit from improved workplace productivity and reduced levels of worker sickness
- retailers benefit from increased attractiveness of shopping environments, encouraging greater numbers of visitors and inferring a premium on product prices
- the urban population and those who visit urban areas in the UK benefit from improved microclimate, visual amenity and resilience to climate change.

## Guide to planting and retaining large species trees

The guide also provides technical assistance for the planning, design, planting and management of large species trees, drawing upon and signposting a range of existing publications and supporting technical advice. The guidance helps to dispel some common myths about the constraints that may restrict the inclusion of urban trees alongside practical information about addressing typical issues. Using this technical guidance, it is evident that through careful planning, design and placement, large species trees can be suitable for planting in a variety of urban situations. The advice is targeted at a range of professionals in the public and private sectors, including developers, local authorities, planners, landscape architects, consultants and contractors. The guide includes specific advice on overcoming:

- subsidence
- structural damage
- location of utilities and underground structures
- limited access
- overshading.

## Guide to the management and maintenance of trees

Understanding the constraints of urban environments and planting the right tree in the right place is an important mechanism to foster greater appreciation and planting of large species trees. However, equally as important is management of these valuable assets. Large species trees require ongoing maintenance to ensure healthy growth and development. In urban areas this is particularly important in ensuring that trees do not detract from the quality of public spaces through obstruction of access, creating dense screens (associated with anti-social behaviour) and appearing uncared for. This guide highlights that the requirement for maintenance should not be viewed as a liability, rather a profitable management of a valuable asset. This is demonstrated in the supporting case studies, which show that the annual benefits of trees far outweigh annual expenditure on maintenance. Specific guidance is given on how to manage urban trees as an asset through enforcement of tree strategies. The guide also offers advice on:

- the cost savings attributable to planting and maintaining trees properly, and avoiding damage to surfaces and infrastructure
- minimising the risk of damage from structural failure
- minimising security risks by maintaining clear sightlines
- identifying financial gains from leaf litter and other by-products of trees.



## Addressing the decline of large species trees – a call for action

Part A and Part B of the guide are intended to inspire action to reverse the decline of large species trees in the towns and cities of the UK. As urban conurbations have expanded so too has competition for space from transport routes, utilities and development plots. Also, many of the UK's finest urban trees are a living legacy from the Victorian era, and a substantial number are now nearing the end of their lives. The more recent proliferation of smaller ornamental varieties replacing mature stock has been the response to a misunderstanding of the problems with trees and the fear of issues like structural damage and subsidence. This guide provides the evidence to prove that urban landscapes can accommodate large trees with careful planning, and that the benefits they bring are worth saving.

The important outcomes from this research have shown that it makes sound financial sense to plant large species trees. Climate change will have a huge financial effect on towns and cities, and this research clearly illustrates the wider economic benefits that large species trees can play in combating these effects. This will help to change people's perception of the true role and status of these trees. It is vital that large species trees are seen as part of an integral urban ecosystem, rather than being considered merely as ornamentation within towns and cities.

# Contents

## Case studies



## Figures

## Tables

# Glossary

**Allée**

A walkway lined with trees or tall shrubs.

**Amsterdam tree soil**

A speciality load bearing sand and soil tree planting medium for trees in urban situations.

**Anti-heave layer**

A non rooting layer made up of clean open graded mineral aggregate below the surface finish (for example, porous resin bound gravel) of a tree pit.

**Arboriculturist**

A specialist, who through relevant education, training and experience, has gained recognised qualifications and expertise relating to the growing, maintaining and removing of trees that are grown for any reason other than as a timber crop.

**Article 40 Agreement**

An agreement under the Planning (Northern Ireland) Order 1991 that allows a local planning authority to enter into a legally-binding agreement with any person in association with the granting of planning permission. It is applicable in Northern Ireland only. See Section 75 Agreement for Scotland and Section 106 Agreement for England and Wales.

**Asset management**

Asset management is the management of (primarily) physical assets, their selection, maintenance, inspection and renewal. A common objective is to minimise the whole life cost of assets, but there may be other critical factors such as risk or business continuity to be considered objectively in decision making.

**Biochar**

Biochar is a solid material obtained from the carbonisation of biomass. Biochar may be added to soils with the intention to improve soil functions and reduce emissions from biomass that would otherwise naturally degrade to greenhouse gases. Biochar has carbon seqestrian value.

**Break out zones**

Excavated trenches filled with a suitable well-aerated, growth medium that allow tree roots to pass through areas of poor quality or compacted ground to areas of open landscape.

**Carbon sequestration**

The process of removal and storage of atmospheric carbon in carbon sinks.

**Carbon sink**

A natural (for example trees, oceans and soils) or man-made reservoir (for example biochar) that can absorb and hold atmospheric carbon.

**Clear stem**

A tree trunk with no branches normally associated with a specified height, for example a 5 m clear stem tree would have all branches removed to a height of 5 m above ground level.

**Community Infrastructure Levy**

A charge that local authorities in England and Wales would be able to levy on most types of new development in their areas. The proceeds of the levy will be spent on local and sub-regional infrastructure to support the development of the area.

**Conservation area**

An area of special architectural interest, the character or appearance of which it is desirable to preserve or visually improve.

**Cost–benefit ratio (CBR)**

The ratio of the benefit arising from a project relative to the cost of the project, normally expressed in monetary terms. CBR is an indicator, used in the formal discipline of CBA that attempts to summarise the overall value for money of a project or proposal. A CBR is the ratio of the costs of a project or proposal, expressed in monetary terms, relative to its benefits, also expressed in monetary terms.

**Ecosystem services**

The processes by which the environment produces resources used by humans such as clean air, water, food and materials.

**Engineered modular cell system**

An underground matrix, normally plastic used in urban tree pits that when filled with an uncompacted growth medium provides a load bearing root zone.

**Fastigiate**

Having upright usually clustered branches.

**Financial benefit**

Financial benefit is what can be gained through the presence of single large species trees or groups of trees (for example a 10 per cent increase in property value or a five per cent reduction in heating costs). In the context of this guide, many of the financial benefits described directly relate to developers as part of the target audience.

**Green infrastructure (GI)**

Refers to the environmental resources within and between towns and villages. It is a network of natural assets and spaces including, but not limited to, formal parks, gardens, historic landscapes, woodlands, green corridors, waterways, street trees and the countryside. GI is part of the life-support system of an area; providing functions and environmental services to a community, such as employment, tourism, culture, recreation, physical health and mental well-being, social interaction, contact with nature, drainage and flood management, climate change adaptation and pollution mitigation.

**Greenway**

A strip of undeveloped land normally within an urban area, set aside for recreational use or environmental protection.

**High moisture (water) demand tree**

A tree, such as poplar, willow and oak, which extract a lot of water from the ground.

**Kyoto Protocol**

An international agreement that sets binding targets for 37 industrialised countries and the European Community for reducing greenhouse gas (GHG) emissions.

**Large species tree**

A tree that can attain a height of 15 m or over when mature.

**Lollipop landscape**

A landscape containing small, normally ornamental, trees with a spherical crown.

**Medium species tree**

A tree that can attain a height of 8 m to 15 m when mature.

**Public realm**

Publicly accessible space in urban areas, including streets, open spaces, parks and watercourses.

**Red Data Book**

The International Union for the Conservation of Nature and Natural Resources (IUCN) Red List of threatened species.

**Root protection area**

Layout design tool indicating the area surrounding a tree that contains sufficient rooting volume to ensure the survival of the tree, shown in plan form in $m^2$ (as defined in BS 5837:2005).

**Section 75 Agreement**

An agreement under the Town and Country Planning (Scotland) Act 1997 that allows a planning authority to enter into a legally-binding agreement with any person in association with the granting of planning permission. It is applicable in Scotland only. See Article 40 Agreement for Northern Ireland and Section 106 Agreement for England and Wales.

**Section 106 Agreement**

An agreement under the Town and Country Planning Act 1990 that allows a local authority to enter into a legally-binding agreement with any person in association with the granting of planning permission. It is applicable in England and Wales only. See Article 40 Agreement for Northern Ireland and Section 75 Agreement for Scotland.

**Small species tree**

A tree that can attain a height of 5 m to 8 m when mature.

**Structural soil**

A growing medium that can be compacted to meet engineering requirements for paved surfaces, yet possess qualities that allow roots to grow freely.

**Sustainable (urban) drainage system (SuDS)**

Surface water drainage methods that take account of water quantity, water quality and amenity issues.

**Tree Protection Order (TPO)**

An order made by a local planning authority (LPA) to prohibit the cutting down, uprooting, topping, lopping, wilful damage, or wilful destruction of trees without the LPA's consent.

**Tree root desiccation zone**

The zone in which desiccation of soil is caused by tree roots not by atmospheric conditions.

**Tree strategy**

A document that outlines how trees will be managed and maintained in the long-term.

**Urban heat island effect**

The effect describing the increased temperature experienced in urban areas when compared to the surrounding countryside that arises because of the concentration of buildings, concrete and asphalt, and the associated increase in human and industrial activity.

**Urban forest**

A term describing a large collection of trees growing throughout an urban area.

**Urban tree**

A tree within an urban area such as a residential or commercial street within a town or city.

**Well-being**

A positive physical, social and mental state, and not just the absence of pain, discomfort and incapacity. It requires that basic needs are met, that individuals have a sense of purpose, and that they feel able to achieve important personal goals and participate in society. It is improved by conditions that include supportive personal relationships, strong and inclusive communities, good health, financial and personal security, rewarding employment, and a healthy and attractive environment. The Government's role is to enable people to have a fair access now and in the future to the social, financial and environmental resources needed to achieve well-being. An understanding of the effect of policies on the way people experience their lives is important for designing and prioritising them (Defra, 2009).

**The Water Framework Directive (Directive 2000/60/EC)**

The Water Framework Directive establishes a legal framework to protect and restore clean water across Europe, and ensure its long-term, sustainable use. In the UK, much of the implementation work will be undertaken by competent authorities (Environment Agency in England and Wales, Scottish Environment Protection Agency in Scotland and Northern Ireland Environment Agency in Northern Ireland). It came into force on 22 December 2000, and was transposed into UK law in 2003. Member States must aim to reach good chemical and ecological status in inland and coastal waters by 2015.

**Watershed**

A specific area of land that drains water into a river system or other body of water.

# Abbreviations and acronyms

| | |
|---|---|
| ADHD | Attention deficit hyperactivity disorder |
| ADD | Attention deficit disorder |
| BS | British Standard(s) |
| CAVAT | Capital asset value for amenity trees |
| CBA | Cost–benefit analysis |
| CBR | Cost–benefit ratio |
| DAS | Design and Access Statements |
| DRC | Depreciated replacement cost |
| FSC | Forestry Stewardship Council |
| GHG | Greenhouse gas |
| GI | Green infrastructure |
| LPA | Local planning authority |
| MA | Millennium Ecosystem Assessment |
| NEA | UK National Ecosystem Assessment |
| RPA | Root protection area |
| SSSI | Site of Special Scientific Interest |
| SuDS | Sustainable (urban) drainage system |
| TPO | Tree Protection Order |
| VOCs | Volatile organic compounds |
| WHO | World Health Organisation |

# Structure of the guide

The guide is divided into two main parts:

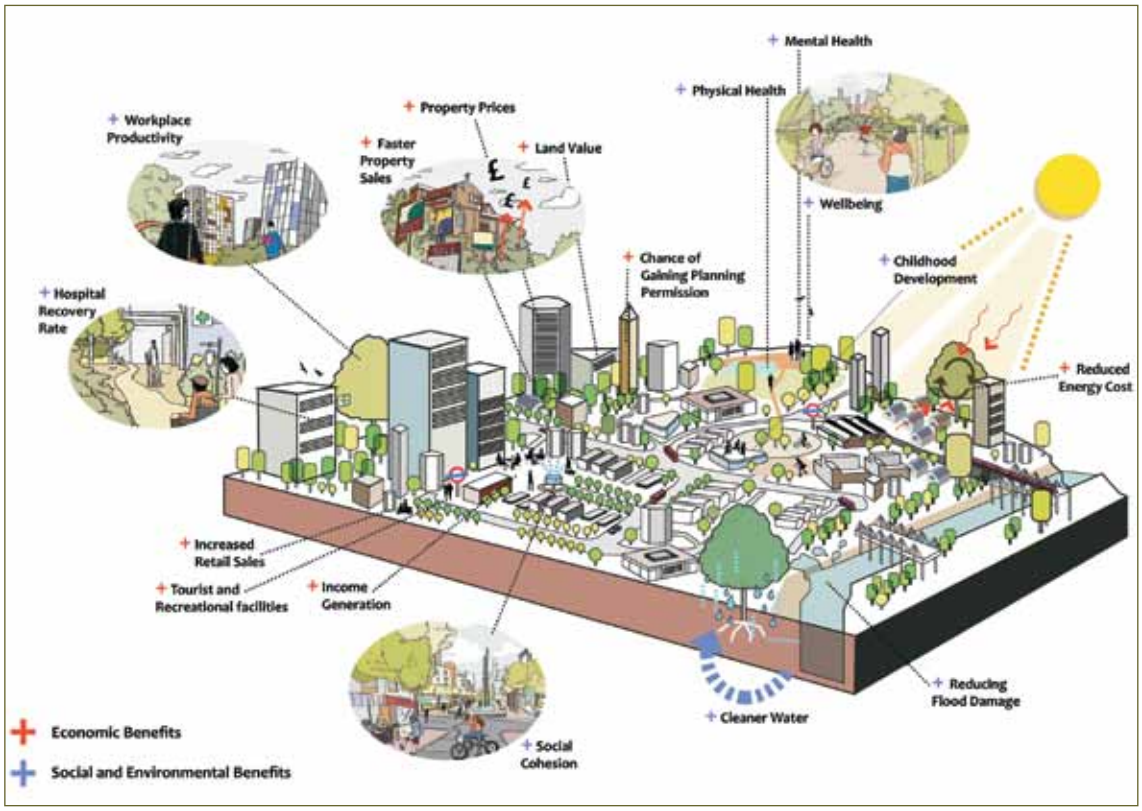
**Part A: covers the financial, social and environmental benefits of large species trees in the urban environment.**

*Large species trees along Malet Street, Central London*



**Part B: provides technical guidance for the planning, design, implementation of the works and management of large species trees.**

*Planting trees at the Queen Elizabeth Olympic Park, London*




*Ecosystem services*

# Part A

# The benefits of large species trees

# 1 Introduction

A stark analysis of the current situation in respect to the decline of large species trees in urban areas is given in guidance by Britt and Johnston (2008). There are large regional inconsistencies in the quality and extent of current urban tree stock in the UK, plus it marked inconsistencies within different areas and land uses within the same town or city.

They also illustrate the strategic inconsistencies within local authority tree strategies and the lack of effectiveness within current legislation to ensure that urban tree stock is adequately protected, managed and maintained.

It is important to recognise that trees are valued differently by different groups of people and in different situations. Within this guide, the various values have been specifically ordered with respect to those that may provide the greatest benefit in an urban environment. In particular, this guide recognises the significant value of multi-functional benefits, whereby environmental benefits contribute to social enrichment that also may be interpreted as a financial value.

Sections 1.1 to 1.2.2 of this guide illustrate that there are significant financial, social and environmental benefits to be gained from the inclusion and protection of large species trees. Reference is given to several studies that have been undertaken around the world. This further develops work undertaken by the Forestry Commission (2010).



*Figure 1.1 Recently planted large species trees incorporated into the recent commercial development at Chiswick Park, London*

## 1.1 Ecosystem services

The benefits of trees described in this guide are linked to the concept of ecosystem services, classified by the Millennium Ecosystem Assessment (MA) (Hassan *et al*, 2005).

Figure 1.2 describes the interrelationships between the ecosystem services of large species trees, the effects of these services and the resultant benefits. The ecosystem services approach links the effects large species trees have, through to societal benefits, as shown in Table 1.1.

This guide has been structured to clearly highlight the financial, social and environmental benefits of large species trees. Figure 1.2 indicates how the financial, social and environmental benefits of large species trees in urban landscapes are interlinked.

definition

***Supporting services***

The services that are necessary for the production of all other ecosystem services including soil formation, photosynthesis, primary production, nutrient cycling and water cycling.

***Provisioning services***

The products obtained from ecosystems, including food, fibre, fuel, genetic resources, biochemicals, natural medicines, pharmaceuticals, ornamental resources and fresh water.

***Regulating services***

The benefits obtained from the regulation of ecosystem processes, including air quality regulation, climate regulation, water regulation, erosion regulation, water purification, disease regulation, pest regulation, pollination and natural hazard regulation.

***Cultural services***

The non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences, taking account of landscape values.

Source: Millennium Ecosystem Assessment (MA) (Hassan *et al*, 2005)

*Table 1.1* ***Typical interrelationship between the ecosystem services provided by large species trees, their effects and benefits***

| Ecosystem service | Impact/effect | Societal benefits |
|---|---|---|
| Microclimate regulation> | Regulating temperatures> | Improved physical health |



## 1.2 The financial value of large species trees

This section describes two main case studies undertaken in the US that have formally derived a cost–benefit ratio (CBR) for large species trees. These case studies demonstrate the positive financial effects that large species trees can contribute to the urban landscape.

The principles of value transfer may be an appropriate system to convert the CBRs from international case studies to another similar urban environment. Further guidance on the methodology behind value transfer is available from Defra (2009).

The evidence from the US demonstrates the value of trees above that of their costs. It also finds that large species trees in particular have a significantly better CBR than medium or smaller species trees. It would be useful if a similar level of research could be undertaken in the UK. This would give valuable evidence to demonstrate the positive financial benefits of large species trees to developers, local authorities and designers.

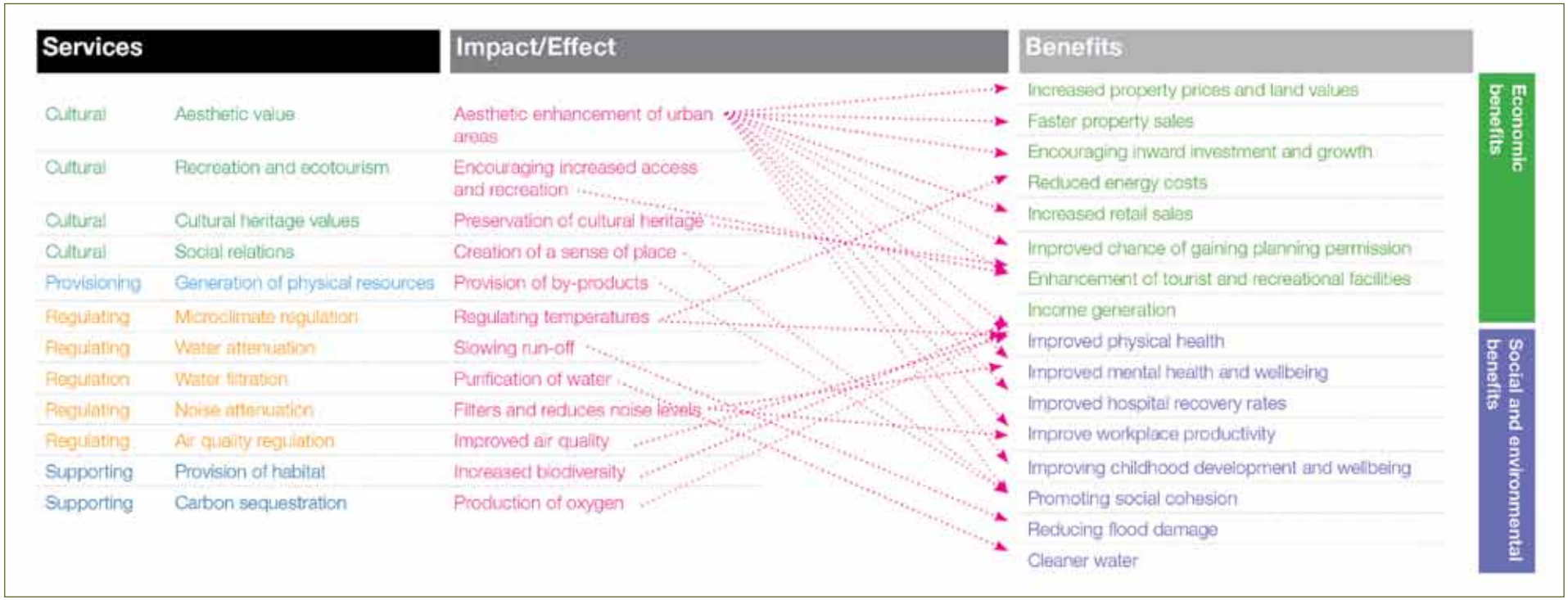



*Figure 1.2 Ecosystem services matrix*

**Case study 1.1**

## Cost–benefit analysis (CBA), San Joaquin Valley, California

San Joaquin Valley has seen a rapid urban expansion over the last 50 years and this has been associated with a steady increase in urban temperatures of 0.4°C per decade. The area has hot dry summers, leading to high cooling costs, with urban stormwater runoff a major source of pollution entering watercourses and water bodies. Tree planting programmes were recognised to be an important way of combating rising temperatures, reducing energy consumption and minimising water pollution. An extensive study was undertaken to investigate the financial benefits of tree planting in the region and established estimated annual costs and benefits.

The study (McPherson *et al*, 1999) indicated that large trees provide bigger cost savings and greater benefits than small and medium trees over a 40 year lifespan. The research demonstrated that it took only five years for combined benefits to outweigh total costs, based on implementation of the works and further maintenance costs, against benefits arising from improved air quality, water attenuation, carbon sequestration and water filtration in addition to increased property values.

The average annual net benefits of different tree species over a 40 year period were identified as:

- $1–$8 for a small tree (crape myrtle, less than 9 m high)
- $26–$37 for a medium tree (Chinese pistache, 9 m to 15 m high)
- $48–$63 for a large tree (London plane, over 15 m high).

The average annual costs of the same tree species were found to increase with mature tree size:

- $4–$9 for a small tree
- $7–$15 for a medium tree
- $11–$21 for a large tree.

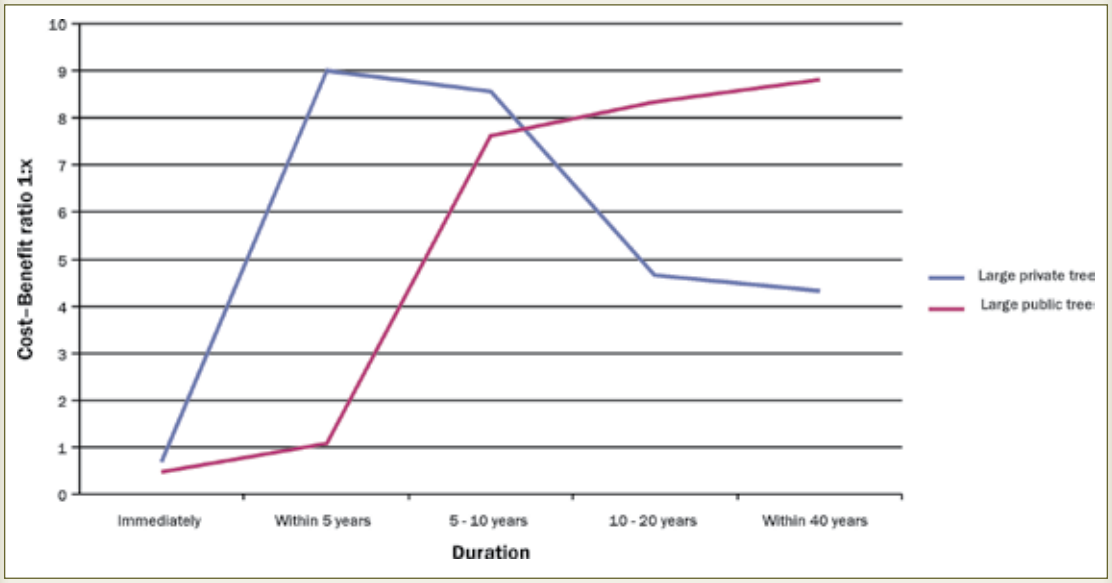



***Figure 1.3 Cost–benefit ratios of large trees in San Joaquin Valley, California***

These figures give a clear indication that annual benefits outweigh annual costs. One of the principle factors that influences this ratio is whether the trees in question are privately owned or in the public domain. Costs associated with publicly owned trees include infrastructure repair, litter clean-up, litigation, inspection and administration, much of which only become apparent as the tree matures. Table 1.2 provides more detail on the annual benefits and costs of large trees at different stages of their establishment.

*Table 1.2* *Cost–benefit ratios of large trees in San Joaquin Valley, California*

| | Large private tree | Large public tree |
|---|---|---|
| Cost–benefit ratio realised immediately on planting | | |
| *Benefits* | | |
| Air quality, energy, $CO_2$ | $5 | $2 |
| Other benefits | $40 | $43 |
| Net benefits | $45 | $45 |
| Tree and planting costs | $60 | $50 |
| Maintenance and inspection costs | $5 | $42 |
| Net costs | $65 | $92 |
| Cost–benefit ratio | 1:0.69 | 1:0.48 |
| Cost–benefit ratio realised within five years of planting | | |
| *Benefits* | | |
| Air quality, energy, $CO_2$ | $5 | $2 |
| Other benefits | $40 | $43 |
| Net benefits | $45 | $45 |
| Net maintenance and inspection costs | $5 | $42 |
| Cost–benefit ratio | 1:9 | 1:1.07 |
| Cost–benefit ratio realised within five to 10 years of planting | | |
| *Benefits* | | |
| Air quality, energy, $CO_2$ | $15 | $14 |
| Other benefits | $45 | $47 |
| Net benefits | $60 | $61 |
| Net maintenance and inspection costs | $7 | $8 |
| Cost–benefit ratio | 1:8.57 | 1:7.62 |
| Cost -benefit ratio realised within 10 to 20 years of planting | | |
| *Benefits* | | |
| Air quality, energy, $CO_2$ | $42 | $50 |
| Other benefits | $28 | $25 |
| Net benefits | $70 | $75 |
| Net maintenance and inspection costs | $15 | $9 |
| Cost–benefit ratio | 1:4.66 | 1:8.33 |
| Cost–benefit ratio realised within 40 years of planting | | |
| *Benefits* | | |
| Air quality, energy, $CO_2$ | $68 | $80 |
| Other benefits | $10 | $8 |
| Net benefits | $78 | $88 |
| Net maintenance and inspection costs | $18 | $10 |
| Cost–benefit ratio | 1:4.33 | 1:8.8 |

**Case study 1.2**

**Cost–benefit analysis (CBA), Modesto, California**

McPherson (2003) undertook a study in Modesto, California, demonstrating that for the city's 90 000 street and urban park trees $1.89 was returned annually for every $1 invested in management and maintenance. The annualised costs and benefits for a single tree over a 40 year period are summarised as follows:

- **energy savings:** saves $30 in summertime air conditioning by shading the building and cooling the air, equating to about nine per cent of total annual air conditioning costs
- **air quality benefits:** absorbs 10 lbs (4.5 kg) of air pollutants, including 4 lbs of ozone and 3 lbs (1.4 kg) of particulates. The value of the pollutant uptake by the tree is $45 using the local market price of emission reduction credits
- **stormwater runoff reductions:** intercepts 760 gallons (2877 litres) of rainfall in its crown, reducing the runoff of polluted stormwater and flooding, valued at $6 annually per tree, based on local expenditures for water quality management and flood control
- **atmospheric carbon dioxide reductions:** removes 330 lbs (150 kg) of $CO_2$ from the atmosphere through direct sequestration in the tree's wood and reduced power plant emissions due to cooling energy savings. The value of this benefit is $5 annually, per tree, assuming the California Energy Commission's price of $30/ton. This contribution to reducing atmospheric $CO_2$ equates to the $CO_2$ emissions from a typical car driven 500 miles (805 km)
- **increased property values and other benefits:** adds about one per cent to the sales price of a residential property, or about $25 each year over a 40 year period (assuming a median residential property sales price of $100,000).

The total value of these benefits amounts to $111 per tree, per year over 40 years.

The cost of implementing the works and maintenance costs included:

- planting
- pruning
- tree removal
- pest and disease control
- irrigation
- infrastructure repairs
- litter and storm cleanup
- litigation liability
- inspection and administration.

These costs together amounted to $58.50 per tree, per year over 40 years.

### 1.2.1 Interpreting the results for the UK

The important outcomes from this research have shown that it makes sound financial sense to plant large species trees. Climate change will have a huge financial effect on towns and cities, and this research illustrates the wider economic benefits that large species trees can play in combating these effects. This will help to change people's perception of the true role and status of these trees. It is important that large species trees are seen as part of an integral urban ecosystem, rather than being considered merely as ornamentation in towns and cities.

The significant outcomes of the cost benefit research with relevance to the UK are:

- the case studies provide major financial justification for planting large species trees. The figures illustrate that on average the annual net benefit of planting large species trees is 44 per cent greater than for a medium species trees and 92 per cent greater than for small species tree (McPherson *et al*, 1999)
- another convincing finding from this research is that it demonstrates that it takes only five years for the net benefits of planting large species trees to outweigh net costs
- this research is extremely valuable because it focuses attention on the wider benefits of large species trees (such as air quality improvements, carbon sequestration, energy savings and increased property prices – a benefit to developers) showing their full benefit as part of the urban ecosystem.

In the US valuation studies, they have incorporated savings on air conditioning costs, which is not a major consideration in the UK due to cooler summer climatic conditions. However, this should be set in the context of the predicted rise in UK summer temperatures by the UK Climate Impact Prediction worst case scenario. The shade cast by trees in the UK will become increasingly important to help avoid the widespread installation of air conditioning units (see Section 2.7.2).



*Figure 1.4 Recently planted small species trees close to a street with large species trees, London*

### 1.2.2 Valuation as a planning and design tool

These valuations provide an important tool for planners, developers and designers to justify investment in large species trees. It is vital to be able to predict the added value to a development from large species trees so as to justify the expenditure on retaining or planting new large species trees.

Extra expenditure may include a range of costs from taking professional advice to specifying works such as foundation or infrastructure improvements to long-term management costs to accommodate large species trees. Quantifying the value that large species trees bring to a development allows developers and designers to assess costs against benefits effectively in their decision making process. These tree values can also be used in marketing a new development by demonstrating an increased appreciation in property resale values to initial purchasers resulting from a maturing urban landscape (Trees and Design Action Group, 2008).

Some further preliminary work on identifying the financial benefits of trees is documented by the Woodland Trust (2011). This guide identifies the annual costs of different management regimes while also highlighting the different benefits attributable to trees.