Draft v7

i-Tree Eco Inventory Report

PREPARED FOR:

PREPARED BY:

James Watson -Treeconomics
Kenton Rogers -Treeconomics

February 2017

Executive Summary

The University of Exeter is a public research university based in Exeter, Devon. It was founded in 1955, although its predecessor institutions date back to 1900. There are four main campus' Streatham, St Lukes (both in Exeter), Truro and Penryn (both in Cornwall).

Trees are generally recognised by their stature and changing colours throughout the seasons but we are often unaware of the many benefits they provide us with each year. Trees in towns and cities (together with woodlands, shrubs, hedges, open grass and wetland) are collectively known as the urban forest.

The trees within the urban forest improve our air, protect our water, save energy, and improve economic sustainability. There are also many health benefits associated with being in close proximity to trees[1] and there is a growing research base to support this.

Economic valuation of the benefits provided by our natural capital can help to mitigate for development, inform land use changes and reduce any potential impact through planned intervention to avoid a net loss of natural capital. Such information can be used to help make better management decisions. In most landscapes the benefits provided by such 'natural capital' is often poorly understood. Consequently, these benefits (or ecosystem services) are often undervalued in decision making process.

In order to produce values for some of these benefits we use a state of the art, peer reviewed software system called iTree Eco (also referred to simply as 'Eco' throughout the report).

Highlights Include:

The trees in University of Exeter remove a total of 2 tonnes of pollutants each year and store 1,951 tonnes of CO2.

Existing trees in University of Exeter divert up to 4,217 cubic meters of storm water runoff away from the local sewer systems each year. This is worth £ 6,390.00 each year.

The total replacement cost of all trees in University of Exeter currently stands at £ 8,510,000.00

Table 1 (opposite) contains the headline figures.

[1] http://depts.washington.edu/hhwb/

University of Exeter - Headline Figures		
Total Number of Trees Measured	4928	
Tree Canopy Cover	29.54 hectares	
Most Common Species	Oak, Leyland Cypress, Ash	
Replacement Cost	£8,510,000.00	
Species Recorded	328	
Amounts and Values		
Pollution Removal (trees)	2 tons	£11,728.00
Carbon Storage (for trees in year of study (2009)	1951 tons	£125,000.00
Carbon Sequestration (trees)	43 tons	£2,752.00
Avoided Runoff (trees)	4217m³	£6,394.00
Total Annual Benefits	£20,874	

Table 1: Headline figures.

Carbon storage: the amount of carbon bound up in the above-ground and below-ground parts of woody vegetation.
Carbon sequestration: the annual removal of carbon dioxide from the air by plants
Carbon storage and carbon sequestration values are calculated based on DECC figures of £64 per metric ton for 2017
Replacement Cost: value based on the physical resource itself (e.g., the cost of having to replace a tree with a similar tree) using the Council of Tree and Landscapers Methodology guidance from the Royal Institute of Chartered Surveyors
Pollution removal value is calculated based on the UK social damage costs and the US externality prices where UK figures are not available; £984 per metric ton (carbon monoxide), £8639 per metric ton (ozone), £1,290 per metric ton (nitrogen dioxide), £470 per metric ton (sulphur dioxide), £299,940 per metric ton (particulate matter less than 2.5 microns).
Avoided Runoff: Based on the amount of water held in the tree canopy and re evaporated after the rainfall event. The value is based on an average volumetric charge of £1.516p per cubic metre.

Methodology

During 2009, the details of 5021 trees on University of Exeter campuses were recorded as part of its ongoing tree management program. Amongst the data collected were tree species, height, diameter at breast height (dbh), crown width and crown condition.

This data was made available for processing with i-Tree Eco. The data required reformatting before being imported into Eco.

For example, some of the numerical data such as dbh, tree height and crown width had to be converted into numbers with a maximum of 1 decimal place without any other punctuation marks or symbols. Tree condition had to be converted from a letter (e.g. F =Fair) to a numerical value based on canopy condition. The values used for this report are provided in table 2 below.

Original Entry Value	Original Value Meaning	New iTree value
G	Good	91-95%
F	Fair	71-90%
P	Poor	26-70%
D	Dead/Dying	0-25%

Table 2: Tree Condition Values

The minimum data required by Eco is tree species and the dbh. However, the more data that can be entered for each tree will result in a more accurate range of model calculations (Height and crown spread for example), but any trees without the minimum required data were removed from the records. For example, data for woodland blocks and tree groups was also provided but unfortunately due to formatting and missing data, these records could not be processed.

In total there were 4928 records (out of 5021) for individual trees with sufficient data to run through the model (98% of the original dataset for individual trees). For this report we used iTree Version 6.1.12.

The inventory data is processed within Eco using local pollution and climate data to provide the following results listed in table 3 (below).

Tree Structure and Composition	Species diversity. Dbh size classes. Leaf area. % leaf area by species.
Ecosystem Services	Air pollution removal by urban trees for CO, NO_2, SO_2, O_3 and PM 2.5. % of total air pollution removed by trees. Current Carbon storage. Carbon sequestered. Stormwater Attenuation (Avoided Runoff) iTree eco also calculates Oxygen production but these figures are reported herein.
Structural and Functional values	Replacement Cost in £. Carbon storage value in £. Carbon sequestration value in £. Pollution removal value in £. Avoided runoff in £

Table 3: Study Outputs.

The top ten species for each category were used within this report. However, all other figures are available within the iTree program.

For a more detailed description of the model calculations see Appendix IV.

Tree Characteristics

Tree Species

Nearly 10% of the 4928 trees in University of Exeter are Oak species (*Quercus spp*)[2]. The second, third and fourth most common trees are respectively, the Lawson Cypress (*Chamaecyparis lawsonia*), Ash (*Fraxinus excelsior*) and the Holly (*Ilex aquifolium*).

The large diversity of tree species (328) within University of Exeter creates the low percentages observed in the chart and a high percentage for 'all other species'.

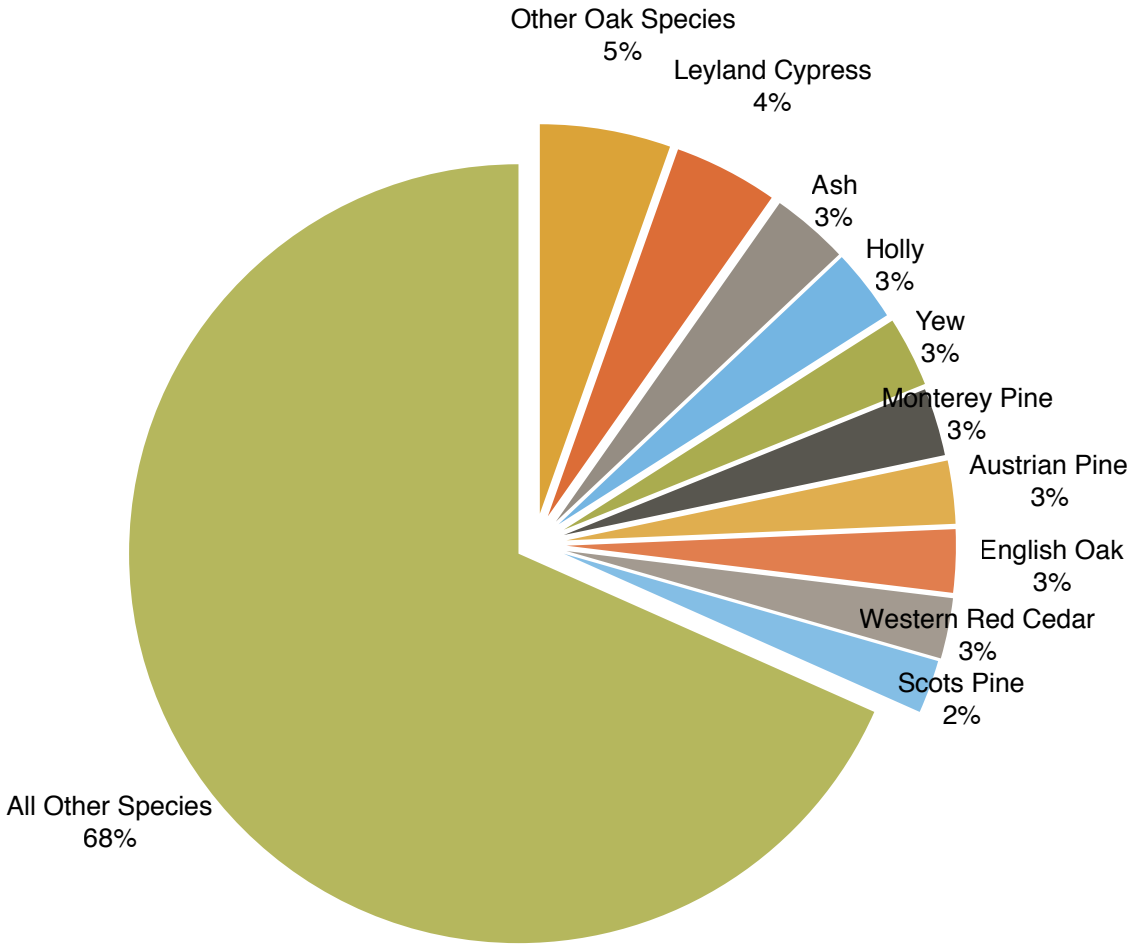

Figure 1: Percentage Population of Tree Species

[2] English Oak, Sessile Oak, Turkey Oak and Red Oak were recorded separately and all other oaks (eg: Holm oak, Hungarian oak, Luccombe Oak) were recorded together as often only the genus was listed in the original tree inventory dataset.

Tree Diversity

Tree diversity is an important aspect of the tree population to take into account, as diversity increases overall resilience in the face of various stress inducing factors [Including individual diversity within (i.e. genetic diversity of seedlings) and between species of trees in terms of different genera or families (i.e. *Acer* (maple family); *Ligustrum* (Olive family)].

A more diverse tree-scape is better able to deal with possible changes in climate or potential pest and disease impacts. The tree population within University of Exeter's grounds represents a very diverse community of trees given the area, with 328 species of tree identified.

Tree species from 6 continents are represented on the campus, and as one might expect, most of the species are native (see figure 2 below).

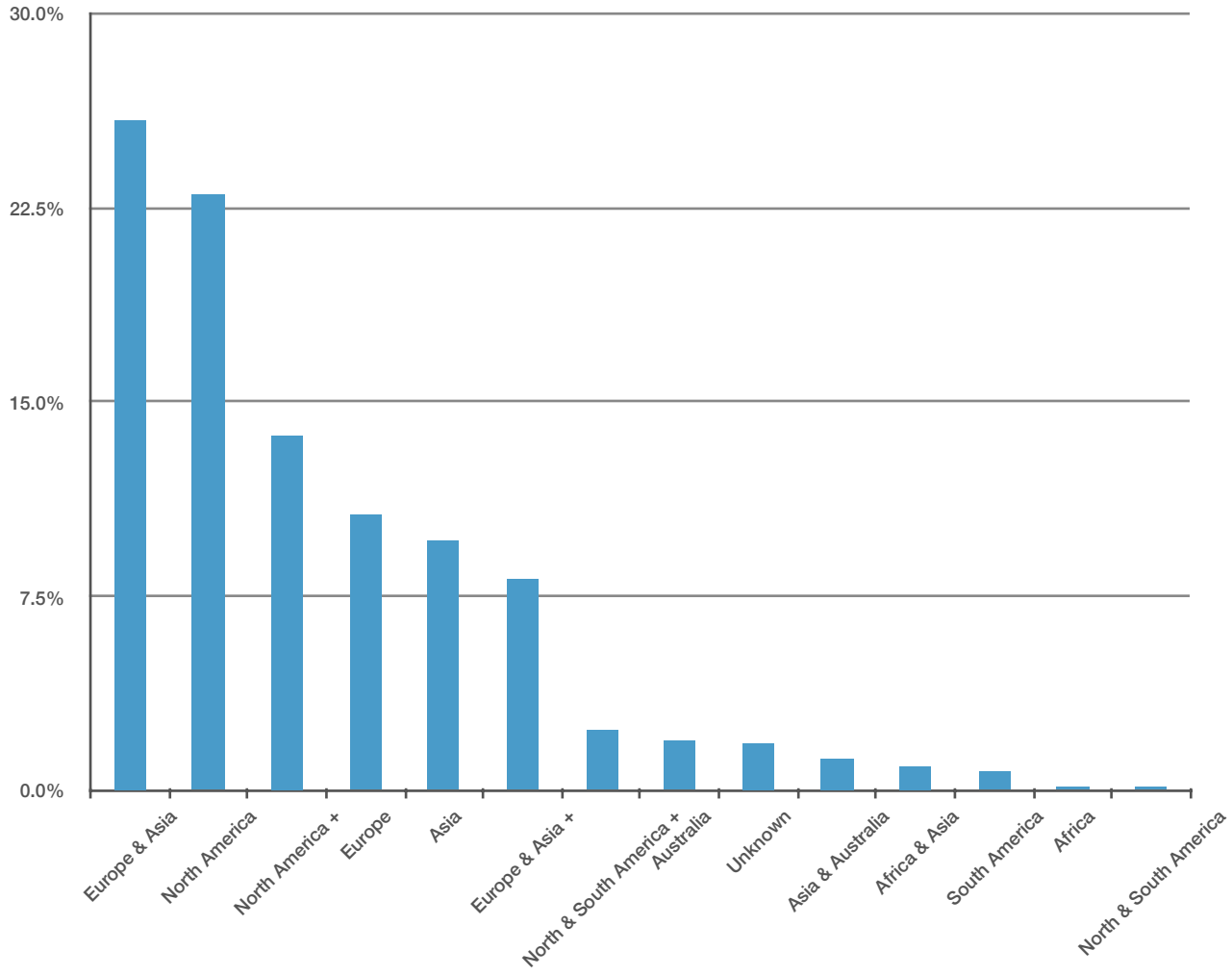

Figure 2: Origin of Tree Species

Note: The + sign indicates that the species is native to another continent other than the continents listed in the grouping. For example, Europe & Asia + would indicate that the species is native to Europe, Asia, and one other continent.

Size Distribution

Size class distribution is also an important aspect consideration in managing a sustainable and diverse tree population, as this will ensure that there are enough young trees to replace those older specimens that are eventually lost through old age or disease.

The size class distribution of trees within University of Exeter is one of the most balanced so far recorded by these types of studies. This structural diversity should increase the overall resilience of the tree stock within the grounds and illustrates good previous management practices.

In this survey trees were sized by their stem diameter at breast height (DBH) at 1.3m. Figure 3 (below) shows the percentage of tree population by DBH class.

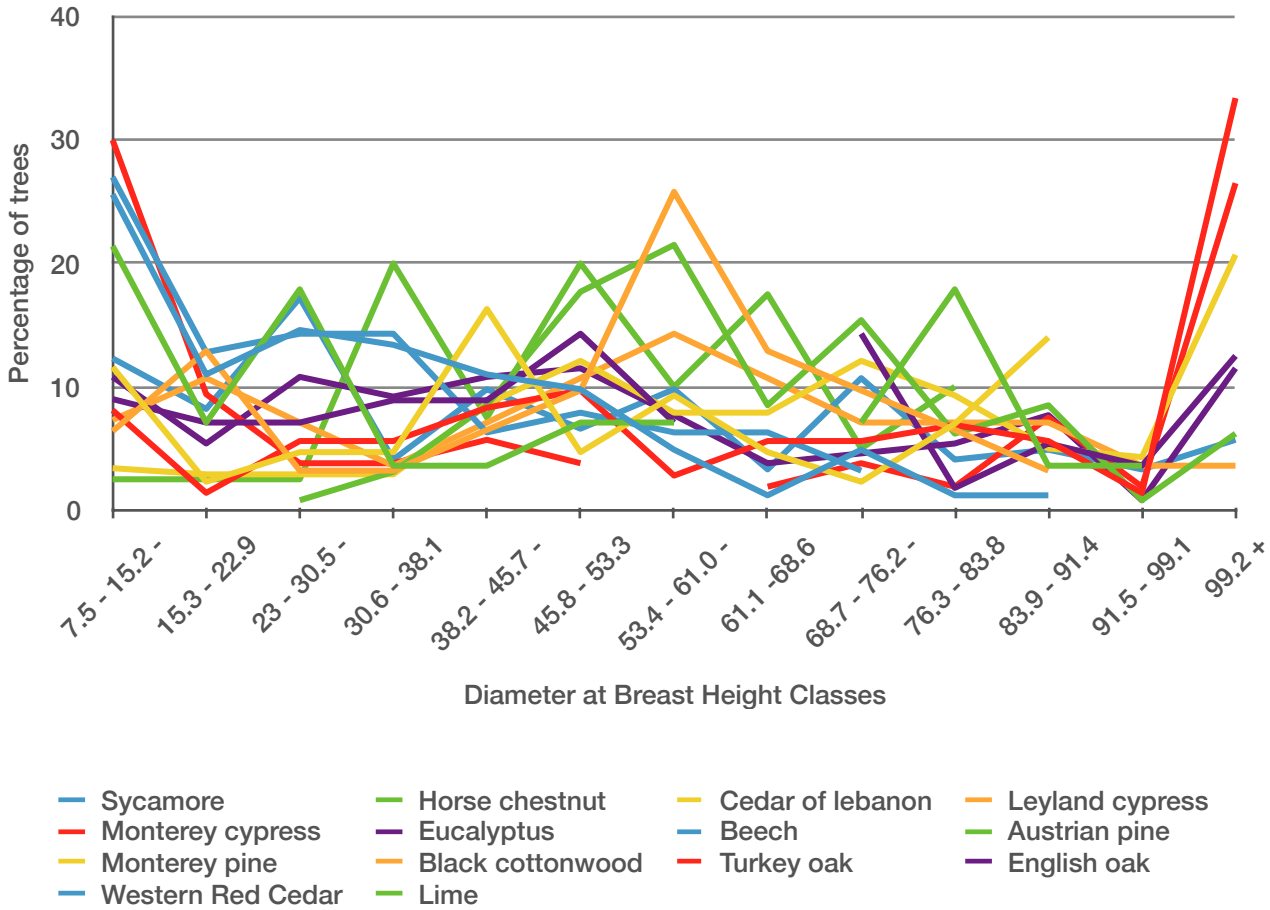

Figure 3: Percentage of tree population by DBH class

Leaf Area

Within University of Exeter campuses, total leaf area is estimated at 1,501,000 m^2. If all the layers of leaves within the tree canopies were spread out, they would cover an area greater than 168 football pitches.

The three most dominant species in terms of leaf area are the Monterey Pine (5.7%), Other Oak Species (5.7%) and the Austrian Pine (4.8%). Figure 4 (below) shows the most dominant trees' contributions to total leaf area. In total these 10 species, representing 27.9% of the trees, contribute 39% of the total leaf area. The remaining 72.1% of trees provide the other 61% of leaf area.

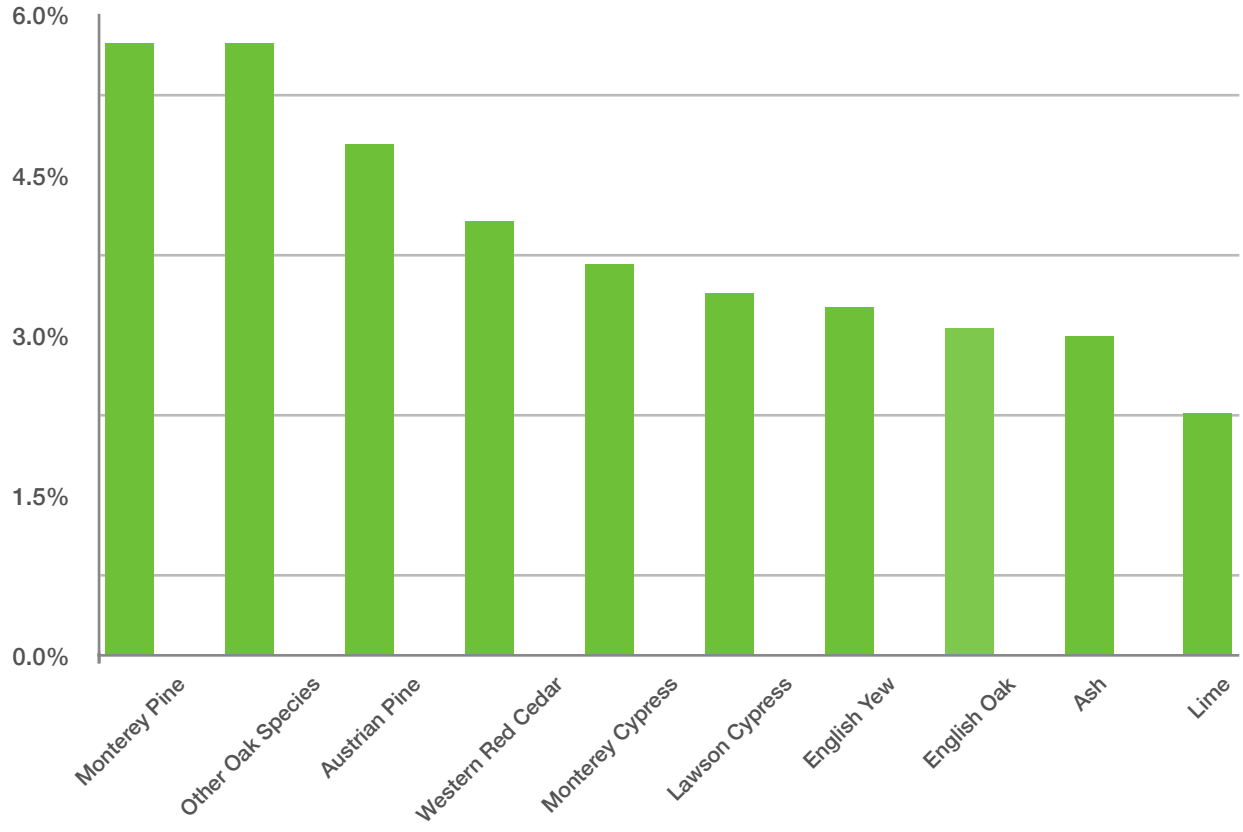

Figure 4: Percentage Leaf Area of the Ten Most Dominant Trees

Results - Ecosystem Services Resource

Air Pollution Removal

Poor air quality is a common problem in many urban areas and along road networks. Air pollution caused by human activity has become a problem since the beginning of the industrial revolution. With the increase in population and industrialisation, large quantities of pollutants have been produced and released into the urban environment. The problems caused by poor air quality are well known, ranging from human health impacts to damage to buildings.

Urban trees can help to improve air quality by reducing air temperature and by directly removing pollutants from the air[3]. They intercept and absorb airborne pollutants through leaf surfaces[4]. In addition, by removing pollution from the atmosphere, trees reduce the risks of respiratory disease and asthma, thereby contributing to reduced health care costs[5].

The situation is complicated by the fact that trees also emit volatile organic compounds (VOCs) that can contribute to low-level ozone formation; however integrated studies have revealed that an increase in tree cover leads to a general reduction in ozone through a reduction in the urban heat island effect [6].

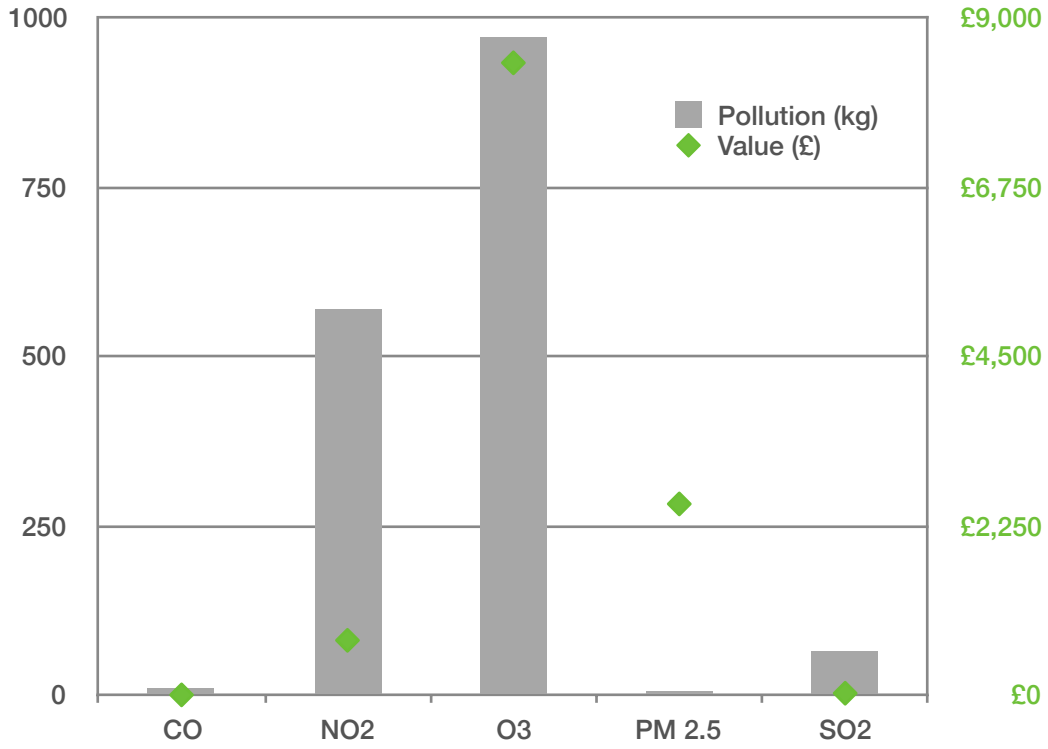

Figure 5: Value of the pollutants removed and quantity per-annum within University of Exeter. Valuation method's used are UK social damage cost (UKSDC) where they are available - where there are no UK figures, the US externality cost (USEC) is used as a substitution.

[3] Tiwary et al., 2009

[4] Nowak et al., 2000

[5] Peachey et al., 2009, Lovasi et al., 2008

[6] Nowak et al.,2006

Trees make a significant contribution to improving air quality by reducing air temperature (thereby lowering ozone levels), directly removing pollutants from the air, absorbing them through the leaf surfaces and by intercepting particulate matter (eg: smoke, pollen, ash and dusts). They also indirectly reduce energy consumption in buildings, leading to lower air pollutant emissions from power plants through providing shade, shelter or providing evaporative cooling.

As well as reducing ozone levels, it is well known that a number of tree species also produce the volatile organic compounds (VOCs) that lead to ozone production in the atmosphere. The i-Tree software accounts for both reduction and production of VOCs within its algorithms, and the overall effect of University of Exeter's trees is to reduce ozone through evaporative cooling[7].

Greater tree cover, pollution concentrations and leaf area are the main factors influencing pollution filtration and therefore increasing areas of tree planting have been shown to make further improvements to air quality. Furthermore, because filtering capacity is closely linked to leaf area it is generally the trees with larger canopy potential that provide the most benefits.

[7] Escobedo and Nowak (2009)

Carbon Storage and Sequestration

The main driving force behind climate change is the concentration of carbon dioxide (CO^2) in the atmosphere. Trees can help mitigate climate change by storing and sequestering atmospheric carbon as part of the carbon cycle. Since about 50% of wood by dry weight is comprised of carbon, tree stems and roots can store up carbon for decades or even centuries[8].

Over the lifetime of a tree, several tons of atmospheric carbon dioxide can be absorbed[9]. Overall the trees in University of Exeter store 1951 tonnes of carbon with a value of £124,000.

Figure 6 illustrates the carbon storage of the top ten trees along with the value of the carbon they contain.

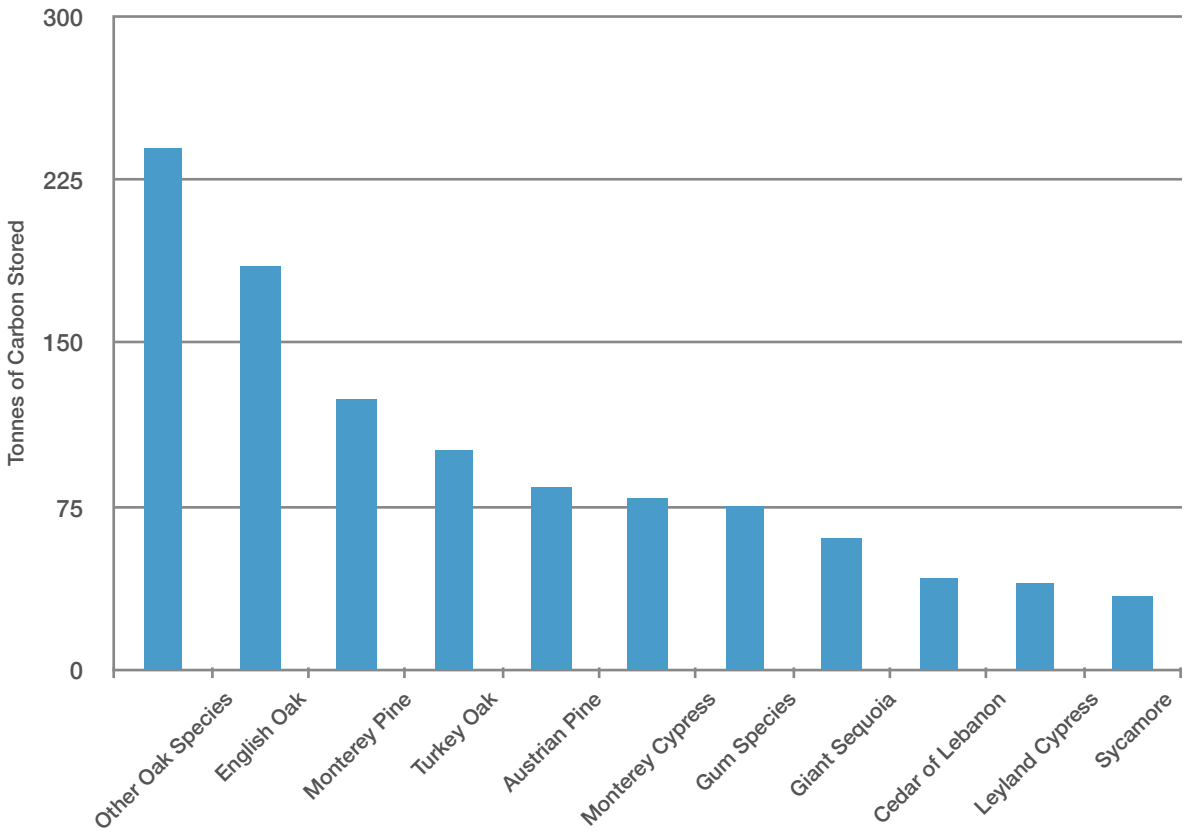

Figure 6: Carbon Storage (in tonnes) for top ten tree species in University of Exeter

Carbon storage by trees is another way that trees can influence global climate change. As trees grow they store more carbon by holding it in their tissue. As trees die and decompose they release this carbon back into the atmosphere. Therefore the carbon storage of trees and woodland is an indication of the amount of carbon that could be released if all the trees died.

Maintaining a healthy tree population will ensure that more carbon is stored than released. Utilising the timber in long term wood products or to help heat buildings or produce energy will also help to reduce carbon emissions from other sources, such as power plants.

[8] Kuhns 2008

[9] McPherson 2007

Carbon Sequestration

Carbon sequestration is calculated from the predicted growth of the trees based on field measurements and climate data. This provides a volume of tree growth. This volume is then converted into tonnes of carbon based on species specific conversion factors and then multiplied by the unit cost for carbon. The current UK social cost is £64 / tonne.

University of Exeter's trees annually sequester 43 tonnes of carbon per year, with a value of £2,752.00. Table 3 (below) shows the ten trees that sequester the most Carbon per year and the value of the benefit derived from the sequestration of this atmospheric carbon.

Species	Carbon Sequestration (tonnes/yr)	Carbon Sequestration (£/yr)
Other Oak Species	5.17	£330.00
English Oak	3.1	£198.19
Monterey Pine	2.01	£128.54
Austrian Pine	1.61	£102.87
Gum Species	1.25	£79.79
Turkey Oak	1.2	£76.57
Monterey Cypress	1.1	£69.98
Leyland Cypress	1.06	£67.64
Ash	1.03	£65.98
Sycamore	0.94	£60.32
All Other Species	24.51	£1572.85

Table 4: Top ten Carbon Sequestration by Species

Of the entire tree species inventoried, the Oak species store and sequester the most carbon, adding 4.32 tonnes every year to the current Oak carbon storage of 238.77 tonnes.

Stormwater Run-Off

Surface runoff can be a cause for concern in many areas as it can contribute to flooding and is a source of pollution in streams, wetlands, rivers, lakes, and oceans.

During precipitation events, a portion of the precipitation is intercepted by vegetation (trees and shrubs) while a further portion reaches the ground. Precipitation that reaches the ground and does not infiltrate into the soil becomes surface runoff[10].

In urban areas, the large extent of impervious surfaces increases the amount of runoff. However, trees are very effective at reducing surface runoff[11]. Trees also intercept precipitation, while their root systems promote infiltration and storage in the soil.

Annual avoided surface runoff is calculated based on rainfall interception by vegetation, specifically the difference between annual runoff with and without vegetation.

The trees within University of Exeter help to reduce runoff by an estimated 4,217 m^3 a year with an associated value of £6,390.00.

Figure 7 shows the volumes and values for the ten most important species for reducing runoff.

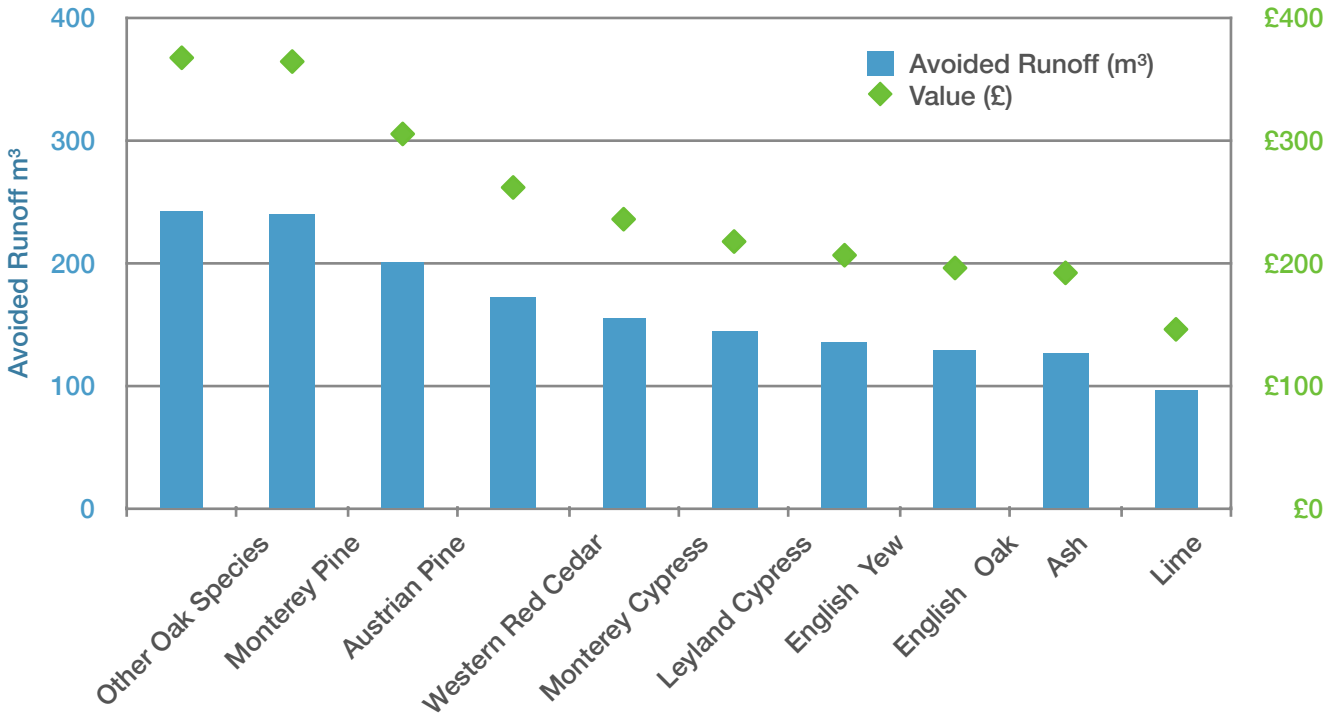

Figure 7: Avoided runoff by species

[10] Hirabayashi 2012

[11] Trees in Hard Landscapes 2014

It is clear that the trees in University of Exeter play an important role in reducing runoff: the Oaks intercept a large proportion of the precipitation, reducing runoff more than all the other species. This is due to its population and canopy size.

4217m^3 is equivalent to nearly 2 Olympic swimming pools of stormwater being averted every single year.

Replacement Cost

In addition to estimating the environmental benefits provided by trees the i-Tree Eco model also provides a structural valuation which in the UK is termed the 'Replacement Cost'. It must be stressed that the way in which this value is calculated means that it does not constitute a benefit provided by the trees. The valuation is a depreciated replacement cost, based on the Council of Tree and Landscape Appraisers (CTLA) formulae[12].

Replacement Cost is intended to provide a useful management tool, as it is able to value what it might cost to replace any or all of the trees (taking account of species suitability, depreciation and other economic considerations) should they become damaged or diseased for instance. The replacement costs for the ten most valuable tree species are shown in figure 8 below.

The total value of all trees in the study area currently stands at £8,510,000. Monterrey Pine is the most valuable species of tree, on account of both its size and population, followed by Oak (other species) and Austrian Pine. These three species of tree account for £2,273,000 million (27%) of the total replacement cost of the trees in University of Exeter.

A full list of trees with the associated replacement cost is given in Appendix III

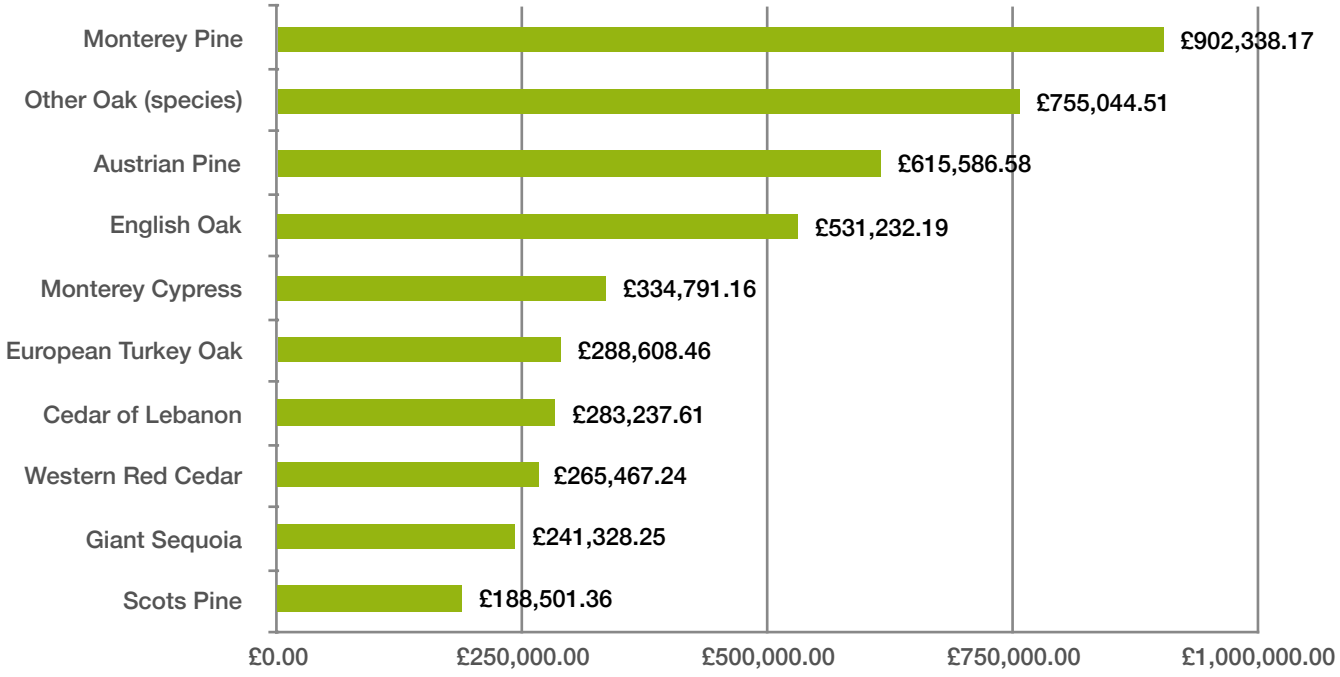

Figure 8: Replacement Cost for top ten trees in University of Exeter

[12] Hollis, 2007

Recommendations for using this study

The results and data from previous i-Tree studies have been used in a variety of ways to improve management of trees and inform decision making. With better information we can make better decisions and this is one of the biggest benefits of undertaking a project such as this.
For example:

- Data can be used to inform species selection for increased tree diversity thereby lessening the impacts from potential threats like *Hymenoscyphus fraxineus* (formerly *Chalara fraxinea*) *or* Ash Dieback.
- Data can be used to produce educational and public information about Exeter University's trees (e.g. Tree tags).
- Use the data for cost benefit analysis to inform decision making.
- Update existing tree groups and woodland inventory data to allow for processing with iTree Eco v6
- Undertake a gap analysis to help inform where to plant trees to optimise ecosystem services and maximise the benefits, to align to the objectives and priorities of University of Exeter's management plan.
- Size does matter! Identify trees that can grow on to full maturity and become the optimal canopy size and contribute the most benefits to the surrounding urban communities. Review together with an ancient tree management plan to include non-natives and heritage trees to broaden the potential for the university's trees to build resilience to future change.

Conclusions

The tree population within University of Exeter's campuses is generally healthy and has a good structural, species and age diversity. This will provide some resilience from possible future influences such as climate change and pest and disease outbreaks. The concept of trees as part of our public health infrastructure is a reality. University of Exeter's trees provide a valuable public benefit - at least £ 20,000.00 in environmental services each year.

Furthermore, the values presented in this study represent only a portion of the total value of the trees within University of Exeter's grounds because only a proportion of the total benefits have been evaluated and the woodland trees have not been measured. Trees confer many other benefits, such as contributions to our health and well being that cannot yet be quantified and valued. Therefore, the values presented in this report should be seen as conservative estimates.

The extent of these benefits needs to be recognised, and strategies and policies that will serve to conserve this important resource (through education for example) would be one way to address this.

As the amount of healthy leaf area equates directly to the provision of benefits, future management of the tree stock is important to ensure canopy cover levels continue to be maintained or increased. This may be achieved via new planting, but the most effective strategy for increasing average tree size and the extent of tree canopy is to preserve and adopt a management approach that enables the existing trees to develop a stable, healthy, age and species diverse, multi-layered population.

Climate change could affect the tree stock in University of Exeter in a variety of ways and there are great uncertainties about how this may manifest. Further research into this area would be useful in informing any long term tree and parkland strategies such as species choice for example.

The challenge now is to ensure that policy makers and practitioners take full account of university trees in decision making. Not only are trees a valuable functional component of our landscape they also make a significant contribution to peoples quality of life.

Appendix I. Relative Tree Effects

The trees in University of Exeter provide benefits that include carbon storage and sequestration and air pollutant removal. To estimate the relative value of these benefits, tree benefits were compared to estimates of average carbon emissions and average family car emissions. These figures should be treated as a guideline only as they are largely based on US values (see footnotes).

Carbon storage is equivalent to:

- Annual carbon (C) emissions from 1,520 family cars
- Annual C emissions from 624 single-family houses

Nitrogen dioxide removal is equivalent to:

- Annual nitrogen dioxide emissions from 90 family cars
- Annual nitrogen dioxide emissions from 41 single-family houses

Sulphur dioxide removal is equivalent to:

- Annual sulphur dioxide emissions from 798 family cars
- Annual sulphur dioxide emissions from 2 single-family houses

---

Average passenger automobile emissions per mile were based on dividing total 2002 pollutant emissions from light-duty gas vehicles (National Emission Trends http://www.epa.gov/ttn/chief/trends/index.html) divided by total miles driven in 2002 by passenger cars (National Transportation Statistics http://www.bts.gov/publications/national_transportation_statistics/2004/).

Average annual passenger automobile emissions per vehicle were based on dividing total 2002 pollutant emissions from light-duty gas vehicles by total number of passenger cars in 2002 (National Transportation Statistics http://www.bts.gov/publications/national_transportation_statistics/2004/).

Carbon dioxide emissions from automobile assumed six pounds of carbon per gallon of gasoline if energy costs of refinement and transportation are included (Graham, R.L., Wright, L.L., and Turhollow, A.F. 1992. The potential for short-rotation woody crops to reduce U.S. CO2 Emissions. Climatic Change 22:223-238).

Appendix II. Species Importance Ranking List

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Oak (Other Species)	*Quercus spp*	5.40	5.80	11.20
Monterey Pine	*Pinus radiata*	2.80	5.70	8.50
Leyland Cypress	*Cuprocyyparis leylandii*	4.30	3.40	7.70
Austrian Pine	*Pinus nigra*	2.60	4.80	7.40
Western Red Cedar	*Thuja plicata*	2.50	4.10	6.60
Ash	*Fraxinus excelsior*	3.20	3.00	6.20
Yew	*Taxus baccata*	2.90	3.20	6.20
English Oak	*Quercus robur*	2.60	3.10	5.70
Monterey Cypress	*Cupressus macrocarpa*	1.50	3.70	5.20
Scots Pine	*Pinus sylvestris*	2.20	2.20	4.40
Holly	*Ilex aquifolium*	3.00	1.00	4.00
Sycamore	*Acer pseudoplatanus*	1.70	2.20	3.80
Birch	*Betula pendula*	1.90	1.30	3.20
Lime	*Tilia cordata*	1.30	1.80	3.10
Beech	*Fagus sylvatica*	1.30	1.80	3.10
Big leaf lime	*Tilia platyphyllos*	0.80	2.30	3.10
Bay Laurel	*Laurus nobilis*	2.10	0.90	3.00
Gum Species	*Eucalyptus spp*	1.10	1.90	3.00
Birch Species	*Betula spp*	1.90	1.00	2.90
Cedar of lebanon	*Cedrus libani*	0.90	1.80	2.70
Coast redwood	*Sequoia sempervirens*	0.50	1.80	2.40
Field Maple	*Acer campestre*	1.20	0.90	2.20
Willow Species	*Salix spp*	1.10	1.10	2.20
Turkey Oak	*Quercus cerris*	1.10	0.90	2.00
Norway Maple	*Acer platanoides*	0.90	0.90	1.90
Giant Sequoia	*Sequoiadendron giganteum*	0.50	1.40	1.90
Elm spp	*Ulmus spp*	0.70	1.10	1.80
Leyland cypress	*Cupressus leylandii*	0.60	1.20	1.80

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Cypress Species	*Cupressus spp*	0.80	1.00	1.70
Plum Species	*Prunus spp*	1.30	0.40	1.60
Pine Species	*Pinus spp*	0.90	0.70	1.60
Douglas fir	*Pseudotsuga menziesii*	0.60	1.00	1.60
Portugal laurel	*Prunus lusitanica*	0.90	0.60	1.50
Alder	*Alnus glutinosa*	0.70	0.80	1.50
Western Balsam Poplar	*Populus trichocarpa*	0.60	0.90	1.50
Norway Spruce	*Picea abies*	0.50	1.00	1.50
Grey Poplar	*Populus canescens*	0.40	1.10	1.50
Lodgepole Pine	*Pinus contorta*	0.70	0.70	1.40
Japanese Maple	*Acer palmatum*	1.10	0.20	1.30
Whitebeam	*Sorbus aria*	1.00	0.40	1.30
Sweet cherry	*Prunus avium*	0.70	0.60	1.30
Walnut	*Juglans regia*	0.70	0.60	1.30
Ash Species	*Fraxinus spp*	0.60	0.60	1.30
Kwanzan Cherry	*Prunus serrulata*	1.00	0.20	1.20
Mountain Ash	*Sorbus acuparia*	1.00	0.20	1.20
Hawthorn	*Crataegus monogyna*	0.90	0.30	1.20
Horse Chestnut	*Aesculus hippocastanum*	0.60	0.60	1.20
Silver Lime	*Tilia tormentosa*	0.50	0.80	1.20
Giant Dracaena	*Cordyline australis*	0.90	0.20	1.10
Magnolia Species	*Magnolia spp*	0.70	0.40	1.10
Black Locust	*Robinia pseudoacacia*	0.60	0.50	1.10
Apple	*Malus spp*	0.70	0.30	1.00
Northern Red Oak	*Quercus Rubra*	0.50	0.50	1.00
European Larch	*Larix decidua*	0.30	0.60	1.00
Maple Species	*Acer spp*	0.60	0.30	0.90
Sawara Cypress	*Chamaecyparis pisifera*	0.60	0.30	0.90
Sweetgum	*Liquidambar styraciflua*	0.60	0.30	0.90

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Sycamore Species	*Acer psuedoplatanus spp*	0.40	0.50	0.90
Italian Alder	*Alnus cordata*	0.40	0.50	0.90
Windmill Palm	*Trachycarpus fortunei*	0.60	0.20	0.80
White Fir	*Abies concolor*	0.40	0.40	0.80
Sitka Spruce	*Picea sitchensis*	0.30	0.50	0.80
Basswood Species	*Tilia spp*	0.30	0.50	0.80
Deodar Cedar	*Cedrus deodara*	0.20	0.60	0.80
Hornbeam	*Carpinus spp*	0.40	0.40	0.70
Cherry Plum	*Prunus cerasifera*	0.40	0.30	0.70
Littleleaf Lime	*Tilia cordata*	0.20	0.50	0.70
Grand Fir	*Abies grandis*	0.20	0.50	0.70
Hazlenut	*Corylus avellana*	0.40	0.20	0.60
Strawberry Tree	*Arbutus unedo*	0.40	0.20	0.60
Itailian Stone Pine	*Pinus pinea*	0.30	0.30	0.60
Silver Fir	*Abies alba*	0.20	0.40	0.60
Larch Species	*Larix spp*	0.20	0.40	0.60
Cappadocian Maple	*Acer cappadocicum*	0.20	0.30	0.60
Japanese Red Cedar	*Cryptomeria japonica*	0.30	0.30	0.50
Crabapple	*Malus sylvestris*	0.30	0.10	0.50
Cherry Laurel	*Prunus laurocerasus*	0.30	0.20	0.50
Bishop Pine	*Pinus muricata*	0.20	0.30	0.50
Jeffery Pine	*Pinus jeffreyi*	0.20	0.30	0.50
Sweet Chestnut	*Castanea sativa*	0.20	0.20	0.50
Cottonwood Species	*Hibiscus spp*	0.30	0.10	0.40
Fir Species	*Abies spp*	0.30	0.10	0.40
Tulip tree	*Liriodendron tulipifera*	0.30	0.10	0.40
Incense Cedar	*Calocedrus decurrens*	0.30	0.10	0.40
Ginkgo	*Ginkgo biloba*	0.30	0.10	0.40
Holly Species	*Ilex spp*	0.30	0.10	0.40

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Lombardy Poplar	*Populus nigra*	0.30	0.10	0.40
Honey Locust	*Gleditsia triacanthos*	0.30	0.10	0.40
Myrtle Species	*Luma* spp	0.30	0.10	0.40
False Cypress Species	*Chamaecyparis spp*	0.30	0.10	0.40
Bald Cypress	*Taxodium distichum*	0.20	0.20	0.40
Southern Catalpa	*Catalpa bignonioides*	0.20	0.20	0.40
Kapuka	*Griselinia littoralis*	0.20	0.20	0.40
Caucacian Zelkova	*Zelkova carpinifolia*	0.20	0.20	0.40
Maritime Pine	*Pinus pinaster*	0.20	0.20	0.40
Goat Willow	*Salix caprea*	0.20	0.20	0.40
Red Horsechestnut	*Aesculus x carnea*	0.10	0.30	0.40
Juniper Species	*Juniperus spp*	0.30	0.00	0.30
Bird Cherry	*Prunus padus*	0.20	0.20	0.30
Silver Maple	*Acer saccharinum*	0.20	0.10	0.30
Celery Pine	*Phyllocladus* aspleniifolius	0.20	0.10	0.30
Indian Horsechestnut	*Aesculus indica*	0.20	0.20	0.30
Smooth-leaf Elm	*Ulmus minor*	0.20	0.10	0.30
Paper Birch	*Betula papyrifera*	0.20	0.10	0.30
Totara	*Podocarpus totara*	0.20	0.10	0.30
False Arborvitae	*Thujopsis dolabrata*	0.20	0.10	0.30
Laburnum	*Laburnum anagyroides*	0.20	0.00	0.30
Black Walnut	*Juglans nigra*	0.20	0.10	0.30
Pear	*Pyrus*	0.20	0.10	0.30
Southern Magnolia	*Magnolia grandiflora*	0.20	0.10	0.30
Blue Chinese Fir	*Cunninghamia lanceolata*	0.20	0.10	0.30
Cotoneaster Species	*Cotoneaster spp*	0.20	0.10	0.30
Copper Beech	*Fagus sylvatica*	0.10	0.20	0.30
Sessile Oak	*Quercus petraea*	0.10	0.20	0.30
Arizona Cypress	*Cupressus arizonica*	0.10	0.20	0.30

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Bhutan Pine	*Pinus wallichiana*	0.10	0.20	0.30
Chinese Wingnut	*Pterocarya stenoptera*	0.10	0.20	0.30
Silver Wattle	*Acacia dealbata*	0.10	0.10	0.30
Carolina Poplar	*Populus canadensis*	0.10	0.20	0.30
Roble	*Quercus lobata*	0.10	0.10	0.30
Hinoki Cypress	*Chamaecyparis obtusa*	0.20	0.10	0.20
Common Plum	*Prunus domestica*	0.20	0.00	0.20
Eastern Service Berry	*Amelanchier* canadensis	0.20	0.00	0.20
Sargent Cherry	*Prunus sargentii*	0.20	0.00	0.20
Paperbark Maple	*Acer griseum*	0.20	0.00	0.20
Nordmann Fir	*Abies nordmanniana*	0.10	0.10	0.20
Bristlecone Fir	*Abies bracteata*	0.10	0.20	0.20
Box Elder	*Acer negundo*	0.10	0.10	0.20
Coulter Pine	*Pinus coulteri*	0.10	0.10	0.20
Hornbeam Species	*Carpinus spp*	0.10	0.10	0.20
Grey Alder	*Alnus incana*	0.10	0.10	0.20
Dawn Redwood	*Metasequoia glyptostroboides*	0.10	0.10	0.20
Hawthorn Species	*Crataegus spp*	0.10	0.10	0.20
Japanese Larch	*Larix kaempferi*	0.10	0.10	0.20
Judus Tree	*Cercis siliquastrum*	0.10	0.10	0.20
Serbian Spruce	*Picea omorika*	0.10	0.10	0.20
Black Mulberry	*Morus nigra*	0.10	<0.10	0.20
Japanese Crabapple	*Malus floribunda*	0.10	0.10	0.20
Eucryphia	*Eucryphia*	0.10	0.10	0.20
Flowering Ash	*Fraxinus ornus*	0.10	<0.10	0.20
Tree of Heaven	*Ailanthus altissima*	0.10	0.10	0.20
Algerian Fir	*Abies numidica*	0.10	0.10	0.20
Chinese thuja	*Platycladus orientalis*	0.10	0.10	0.20
Snakebark Maple	*Acer davidii*	0.10	0.10	0.20

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Buckthorn	*Rhamnus*	0.10	<0.10	0.20
Morinda Spruce	*Picea smithiana*	0.10	0.10	0.20
Noble Fir	*Abies procera*	0.10	0.10	0.20
Crack Willow	*Salix fragilis*	0.10	0.10	0.20
Cheesewood Species	*Pittosporum spp*	0.10	0.10	0.20
Chilean Plum Yew	*Prumnopitys andina*	0.10	0.10	0.20
Caucasian Oak	*Quercus macranthera*	0.10	0.10	0.20
Devilwood Species	*Osmanthus americanus*	0.10	0.10	0.20
Tibetan Cherry	*Prunus serrula*	0.10	0.10	0.20
Jack Pine	*Pinus banksiana*	0.10	<0.10	0.20
Black Elderberry	*Sambucus nigra*	0.10	<0.10	0.20
California Torreya	*Torreya* californica	0.00	0.10	0.20
White Willow	*Salix alba*	0.00	0.10	0.20
Red Maple	*Acer rubrum*	0.10	0.10	0.10
Katsura Tree	*Cercidiphyllum*	0.10	0.10	0.10
Wych Elm	*Ulmus glabra*	0.10	<0.10	0.10
Empress Tree	*Paulownia tomentosa*	0.10	<0.10	0.10
Taiwania	*Taiwania cryptomerioides*	0.10	<0.10	0.10
Pacific Dogwood	*Cornus nuttallii*	0.10	<0.10	0.10
Chinese Juniper	*Juniperus chinensis*	0.10	<0.10	0.10
Japanese Zelkova	*Zelkova serrata*	0.10	0.10	0.10
Northern White cedar	*Thuja occidentalis*	0.10	<0.10	0.10
Swedish Whitebeam	*Sorbus intermedia*	0.10	<0.10	0.10
Spruce Species	*Picea spp*	0.10	0.10	0.10
Cornelian Cherry	*Cornus mas*	0.10	0.10	0.10
Japanese Pagoda Tree	*Styphnolobium japonicum*	0.10	0.10	0.10
Red Pine	*Pinus resinosa*	0.10	0.10	0.10
Chinese Plum Yew	*Cephalotaxus fortunei*	0.10	<0.10	0.10
Boxleaf Azara	*Azara microphylla*	0.10	<0.10	0.10

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Persian Ironwood	*Parrotia persica*	0.10	0.10	0.10
Fig	*Ficus carica*	0.10	0.10	0.10
Campbell's Magnolia	*Magnolia campbellii*	0.10	0.10	0.10
Oriental Spruce	*Picea orientalis*	0.10	0.10	0.10
Cowtail Pine	*Cephalotaxus harringtonia*	0.10	<0.10	0.10
Black Tupelo	*Nyssa sylvatica*	0.10	<0.10	0.10
Brewers Spruce	*Picea breweriana*	0.10	<0.10	0.10
Blue Spruce	*Picea pungens*	0.10	0.10	0.10
Devils Walking Stick	*Aralia spinosa*	0.10	<0.10	0.10
Callery Pear	*Pyrus calleryana*	0.10	<0.10	0.10
Willow leaf Podocarp	*Podocarpus salignus*	0.10	<0.10	0.10
Dove tree	*Davidia involucrata*	0.10	<0.10	0.10
Rhododendron Species	*Rhododendron*	0.10	<0.10	0.10
Tawhiwhi	*Pittosporum tenuifolium*	0.10	<0.10	0.10
Azara Species	*Azara spp*	0.10	<0.10	0.10
Kowhai	*Sophora microphylla*	0.10	<0.10	0.10
Himalayan Birch	*Betula utilis*	0.10	<0.10	0.10
Patula Pine	*Pinus patula*	0.10	<0.10	0.10
Goldenrain Tree	*Koelreuteria paniculata*	0.10	<0.10	0.10
Loquat tree	*Eriobotrya japonica*	0.10	<0.10	0.10
Patagonian Cypress	*Fitzroya cupressoides*	0.10	<0.10	0.10
Eastern White Pine	*Pinus strobus*	0.10	<0.10	0.10
Hungarian Oak	*Quercus frainetto*	0.10	<0.10	0.10
Chinese Cypress	*Glyptostrobus pensilis*	0.10	<0.10	0.10
Sumac Species	*Rhus spp*	0.10	<0.10	0.10
Monkey Puzzle	*Araucaria araucana*	0.10	<0.10	0.10
Red Beech	*Fuscospora fusca*	<0.10	0.10	0.10
Western Hemlock	*Tsuga heterophylla*	<0.10	0.10	0.10
Pacific Silver Fir	*Abies amabilis*	<0.10	0.10	0.10

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Silver Fir	*Abies alba*	<0.10	0.10	0.10
Turkish Hazelnut	*Corylus colurna*	<0.10	0.10	0.10
Downy Oak	*Quercus pubescens*	<0.10	0.10	0.10
Cider Gum	*Eucalyptus gunnii*	<0.10	0.10	0.10
Japanese White pine	*Pinus parviflora*	<0.10	0.10	0.10
Nothofagus	*Nothofagus dombeyi*	<0.10	0.10	0.10
Ailanthus Species	*Ailanthus spp*	<0.10	0.10	0.10
Japanese Corktree	*Phellodendron amurense*	<0.10	<0.10	0.10
Turkish Pine	*Pinus brutia*	<0.10	<0.10	0.10
American Basswood	*Tilia americana*	<0.10	0.10	0.10
RaulÍ	*Lophozonia alpina*	<0.10	<0.10	0.10
Beech Species	*Fagus spp*	<0.10	<0.10	0.10
Kentucky Coffeetree	*Gymnocladus dioicus*	<0.10	0.10	0.10
Grey-budded Snake-bark	*Acer rufinerve*	<0.10	<0.10	0.10
Hemlock Species	*Tsuga spp*	<0.10	<0.10	0.10
Japanese Walnut	*Juglans Ailantifolia*	<0.10	<0.10	0.10
Eastern White Pine	*Pinus strobus*	<0.10	0.10	0.10
American Hornbeam	*Carpinus caroliniana*	<0.10	<0.10	0.10
Western White Pine	*Pinus monticola*	<0.10	0.10	0.10
Corkscrew Willow	*Salix matsudana*	<0.10	<0.10	0.10
Scarlet Oak	*Quercus coccinea*	<0.10	<0.10	0.10
Ponderosa Pine	*Pinus ponderosa*	<0.10	<0.10	0.10
Five Finger Tree	*Pseudopanax arboreus*	<0.10	<0.10	0.10
Dogwood Species	*Cornus spp*	<0.10	<0.10	0.10
Pin Oak	*Quercus palustris*	<0.10	<0.10	0.10
Chinese Pine	*Pinus armandii*	<0.10	<0.10	0.10
Shirofugen cherry	*Prunus* Shirofugen	<0.10	<0.10	0.10
Viburnum Species	*Viburmum spp*	<0.10	<0.10	0.10
Eastern Hemlock	*Tsuga canadensis*	<0.10	<0.10	0.10

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Nirrhe	*Eucryphia glutinosa*	<0.10	<0.10	0.10
Fastigate Hornbeam	*Carpinus betulus*	<0.10	<0.10	0.10
Caucasian Wingnut	*Pterocarya fraxinifolia*	<0.10	<0.10	0.10
Hackberry Species	*Celtis spp*	<0.10	<0.10	<0.10
Large Leaved Kowhai	*Sophora tetraptera*	<0.10	<0.10	<0.10
Gowen Cypress	*Hesperocyparis goveniana*	<0.10	<0.10	<0.10
Prickly Ash	*Zanthoxylum americanum*	<0.10	<0.10	<0.10
Common Juniper	*Juniperus communis*	<0.10	<0.10	<0.10
Common Lilac	*Syringa vulgaris*	<0.10	<0.10	<0.10
Red Lantern Tree	*Crinodendron hookerianum*	<0.10	<0.10	<0.10
Bristlecone Pine	*Pinus longaeva*	<0.10	<0.10	<0.10
Deciduous Camellia	*Stewartia pseudocamellia*	<0.10	<0.10	<0.10
Japanese Yew	*Taxus cuspidata*	<0.10	<0.10	<0.10
Serviceberry Species	*Amelanchier spp*	<0.10	<0.10	<0.10
Painted Maple	*Acer pictum*	<0.10	<0.10	<0.10
Catalpa Species	*Catalpa spp*	<0.10	<0.10	<0.10
Italian Cypress	*Cupressus sempervirens*	<0.10	<0.10	<0.10
Tatar Maple	*Acer tataricum*	<0.10	<0.10	<0.10
Michelia	*Magnolia champaca*	<0.10	<0.10	<0.10
Persian Silk	*Albizia julibrissin*	<0.10	<0.10	<0.10
Chinese Spruce	*Picea asperata*	<0.10	<0.10	<0.10
Hardy Orange	*Citrus trifoliata*	<0.10	<0.10	<0.10
Chinese Tulip Tree	*Liriodendron chinense*	<0.10	<0.10	<0.10
Buckeye Species	*Aesculus glabra spp*	<0.10	<0.10	<0.10
Wild Service Tree	*Sorbus torminalis*	<0.10	<0.10	<0.10
Japanese Snowball	*Viburnum plicatum*	<0.10	<0.10	<0.10
Locust Species	*Gleditsia spp*	<0.10	<0.10	<0.10
Apple Species	*Malus spp*	<0.10	<0.10	<0.10
Pineapple Guava	*Acca sellowiana*	<0.10	<0.10	<0.10

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Eastern Redbud	*Cercis canadensis*	<0.10	<0.10	<0.10
Pitch Pine	*Pinus rigida*	<0.10	<0.10	<0.10
Flowering Dogwood	*Cornus florida*	<0.10	<0.10	<0.10
Japanese Fir	*Abies homolepis*	<0.10	<0.10	<0.10
White Ash	*Fraxinus americana*	<0.10	<0.10	<0.10
Narrow-leafed Ash	*Fraxinus angustifolia*	<0.10	<0.10	<0.10
Oriental Planetree	*Platanus orientalis*	<0.10	<0.10	<0.10
Antarctic Beech	*Lophozonia moorei*	<0.10	<0.10	<0.10
Bay Tree Species	*Laurus nobilis spp*	<0.10	<0.10	<0.10
Bhutan Cypress	*Cupressus cashmeriana*	<0.10	<0.10	<0.10
Tiger-tail Spruce	*Picea alcoquiana*	<0.10	<0.10	<0.10
Siberian Crabapple	*Malus baccata*	<0.10	<0.10	<0.10
Broom Teatree	*Leptospermum scoparium*	<0.10	<0.10	<0.10
Pacific Madrone	*Arbutus menziesii*	<0.10	<0.10	<0.10
Silverleaf Cotoneaster	*Cotoneaster pannosus*	<0.10	<0.10	<0.10
David's Pine	*Pinus spp*	<0.10	<0.10	<0.10
Yew Podocarpus	*Podocarpus* macrophyllus	<0.10	<0.10	<0.10
Northern Hackberry	*Celtis occidentalis*	<0.10	<0.10	<0.10
Himalayan Strawberry Tree	*Cornus capitata*	<0.10	<0.10	<0.10
Fraser Fir	*Abies fraseri*	<0.10	<0.10	<0.10
Smooth Hawthorn	*Crataegus laevigata*	<0.10	<0.10	<0.10
Syrian Privet	*Fontanesia phillyreoides*	<0.10	<0.10	<0.10
Dahurian Larch	*Larix gmelinii*	<0.10	<0.10	<0.10
Weinmannia Species	*Weinmannia spp*	<0.10	<0.10	<0.10
Atlantic White Cedar	*Chamaecyparis thyoides*	<0.10	<0.10	<0.10
Dichrostachys Species	*Dichrostachys spp*	<0.10	<0.10	<0.10
Tanoak	*Notholithocarpus densiflorus*	<0.10	<0.10	<0.10
Korean Fir	*Abies koreana*	<0.10	<0.10	<0.10
Common Box	*Buxus sempervirens*	<0.10	<0.10	<0.10

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Cedar-of-Goa	*Cupressus lusitanica*	<0.10	<0.10	<0.10
Mountain Ash Species	*Sorbus spp*	<0.10	<0.10	<0.10
Sawtooth Oak	*Quercus acutissima*	<0.10	<0.10	<0.10
Brazilian Pepper	*Schinus terebinthifolia*	<0.10	<0.10	<0.10
Apache Pine	*Pinus engelmannii*	<0.10	<0.10	<0.10
Hupeh Rowan	*Sorbus hupehensis*	<0.10	<0.10	<0.10
Euroschinus Species	*Euroschinus spp*	<0.10	<0.10	<0.10
Quince Species	*Cydonia spp*	<0.10	<0.10	<0.10
Striped Maple	*Acer pensylvanicum*	<0.10	<0.10	<0.10
Witchhazel Species	*Hamamelis spp*	<0.10	<0.10	<0.10
Silversword Species	*Argyroxiphium spp*	<0.10	<0.10	<0.10
Cladrastis Species	*Cladrastis spp*	<0.10	<0.10	<0.10
Plum Pine Species	*Podocarpus elatus spp*	<0.10	<0.10	<0.10
Lilac Species	*Syringa vulgaris spp*	<0.10	<0.10	<0.10
Sea Buckthorn	*Hippophae rhamnoides*	<0.10	<0.10	<0.10
Giant Dogwood	*Cornus controversa*	<0.10	<0.10	<0.10
Big Cone Douglas fir	*Pseudotsuga macrocarpa*	<0.10	<0.10	<0.10
Nothofagus Species	*Nothofagus spp*	<0.10	<0.10	<0.10
Eucryphia Species	*Eucryphia spp*	<0.10	<0.10	<0.10
Digger Pine	*Pinus sabiniana*	<0.10	<0.10	<0.10
Blackthorn	*Prunus spinosa*	<0.10	<0.10	<0.10
Prince Albert's Yew	*Phyllocladus asplenifolius*	<0.10	<0.10	<0.10
Sargent's Rowan	*Sorbus Sargentiana*	<0.10	<0.10	<0.10
Mediterranean Cypress	*Cupressus sempervirens*	<0.10	<0.10	<0.10
Lace-leaf Maple	*Acer palmatum*	<0.10	<0.10	<0.10
Crabapple	*Malus sylvestris*	<0.10	<0.10	<0.10
Golden Chain Tree Species	*Laburnum anagyroides spp*	<0.10	<0.10	<0.10
Shrubby Spurge Species	*Euphorbia cotinifolia spp*	<0.10	<0.10	<0.10

Japanese Torreya	*Torreya nucifera*	<0.10	<0.10	<0.10

Species Common Name	Species Scientific Name	Percent Population	Percent Leaf Area	Importance Value
Kerria Species	*Kerria spp*	<0.10	<0.10	<0.10
Higan cherry	*Prunus subhirtella*	<0.10	<0.10	<0.10
Golden Larch	*Pseudolarix amabilis*	<0.10	<0.10	<0.10
Wollemi Pine	*Wollemia nobilis*	<0.10	<0.10	<0.10
Norway Maple	*Acer platanoides*	<0.10	<0.10	<0.10
Notro	*Embothrium coccineum*	<0.10	<0.10	<0.10
Prumnopitys Species	*Prumnopitys spp*	<0.10	<0.10	<0.10
Willow-leaved Pear	Pyrus_salicifolia	<0.10	<0.10	<0.10
Macedonian Pine	Pinus peuce	<0.10	<0.10	<0.10
Rhamnus Species	Rhamnus spp	<0.10	<0.10	<0.10

Appendix III. Tree Values by Species

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m³/Yr**	**£**
Monterey Pine	140	124.27	2.01	240.5	902338.17
Oak Species	268	238.77	5.17	242.54	755044.51
Austrian Pine	130	83.28	1.61	201.57	615586.58
English Oak	130	184.9	3.1	129.46	531232.19
Monterey Cypress	72	78.65	1.1	155.7	334791.16
European Turkey Oak	53	101.58	1.2	39.46	288608.46
Western Red Cedar	122	29.47	0.54	172.77	283237.61
Cedar of Lebanon	43	41.64	0.57	76.24	265467.24
Giant Sequoia	27	60.77	0.55	57.45	241328.25
Scots Pine	108	23.95	0.66	91.65	188501.36
Lime	64	28.84	0.72	77.08	170697.27
Leyland Cypress	212	39.42	1.06	143.68	169607.66
Gum Species	56	74.93	1.25	79.5	165976.5
Coast Redwood	27	30.58	0.47	77.74	165711.34
Common Lime	40	22.52	0.55	96.45	149911.12
English Yew	145	19.47	0.55	136.32	143103.58
Ash	156	30.05	1.03	126.84	134437.45
Sycamore	82	33.81	0.94	91.21	127583.52
Maple Species	31	26.73	0.17	12.62	109615.35
Black Cottonwood	28	23.93	0.52	38.49	106040.69
Gray Poplar	20	19.65	0.46	46.44	98308.48
Beech	63	27.62	0.82	77.22	93810.4
Deodar Cedar	12	11.88	0.19	24.84	86334.81
Pine Species	44	10.11	0.2	28.5	72616.36
Leyland Cypress	31	13.49	0.3	48.95	70346.62
Hedge Maple	60	19.69	0.3	39.95	65561.95
Horse Chestnut	28	23.44	0.53	26.47	59621.04
Douglas Fir	28	8.51	0.19	42.94	58269.62

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m³/Yr**	**£**
Ash Species	31	14.27	0.24	26.42	56785.83
Willow Species	54	16.05	0.45	45.58	55518.63
Cypress Species	38	11.58	0.23	40.18	53254.32
White Birch	96	14.58	0.8	54.46	51443.43
Birch Species	94	13.38	0.7	43.8	46036.15
Lombardy Poplar	13	9.74	0.22	4.45	45461.95
Northern Red Oak	24	11.19	0.35	22.48	42354.51
Carolina Poplar	5	11.92	0.15	7.06	38795.66
Lodgepole Pine	36	5.66	0.17	30.3	37626.03
Silver Lime	23	5.73	0.2	32.23	36959.81
Alder	35	8.54	0.34	32.39	35918.88
Itailian Stone Pine	13	4.09	0.1	13.32	35144.12
Bishop Pine	8	4.37	0.09	12.71	34764.4
Holly	148	9.6	0.61	42.99	34522.8
Norway Maple	46	7.78	0.32	39.08	32861.55
Red Horsechestnut	6	10.17	0.18	11.38	32501.43
Sycamore Species	22	9.64	0.23	19.81	32017.87
Durmast Oak	6	12.25	0.2	8.49	31920.59
Littleleaf Lime	11	4.45	0.13	19.17	31276.69
Whitebeam	49	7.85	0.29	14.97	30063.57
Black Locust	29	7.69	0.29	20.37	29319.68
Plum Species	62	9.36	0.37	15.88	28346.69
Coulter Pine	5	3.91	0.06	5.01	28207.52
English Walnut	33	8.52	0.18	25.65	27260.51
Sweet Chestnut	11	9.35	0.16	9.95	26911.63
Basswood Species	16	5.32	0.12	21.24	26820.34
Silver Maple	10	6.07	0.12	5.35	26803.01
Bald Cypress	12	5.36	0.08	7.16	26707.26
Incense Cedar	15	4.2	0.1	4.21	26663.59
Magnolia Species	34	6.97	0.16	17.35	25455.84

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m³/Yr**	**£**
Grand Fir	10	4.99	0.1	19.79	25061.32
Sitka Spruce	16	4.84	0.15	21.62	24821.39
Sweet Cherry	35	6.46	0.32	25.2	23394.67
Copper Beech	6	10.51	0.14	8.8	22887.11
Black Walnut	8	6.02	0.14	5.24	22842.91
White Willow	2	6.2	0.1	4.88	22273.66
Norway Spruce	27	6.43	0.22	40.24	20997.82
White Fir	20	4.29	0.12	16.57	20963.13
Campbell's Magnolia	3	6.18	0.04	2.62	20077.24
Walnut	2	5.54	0.02	1.56	20041.22
Italian Alder	18	4.69	0.2	20.54	19124.02
Maritime Pine	8	2.5	0.06	8.09	18251.94
Southern Catalpa	11	4.24	0.14	7.49	16677.79
Cappadocian Maple	12	4.57	0.12	12.93	16470.61
Portugal Laurel	44	5.17	0.29	23.61	16276.74
Rhododendron Species	4	5.55	0.02	0.84	16009.49
Jeffery Pine	8	2.39	0.06	12.6	15986.9
European Silver Fir	9	3.2	0.07	16.8	15522.95
Cheesewood Species	5	5.27	0.05	2.32	15469.88
Laurel Bay	105	3.31	0.29	37.27	13857.68
California Torreya	2	2.35	0.04	6.15	13839.84
Elm	35	6.36	0.26	45.17	13327.57
Common Apple	35	3.41	0.19	12.4	13299.44
Caucacian Zelkova	8	3.3	0.12	8.21	13224.59
Bristlecone Fir	4	2.52	0.04	6.43	12911.44
Goat Willow	10	3.2	0.1	6.34	12900.27
Tulip Tree	13	3.12	0.07	6.1	12474.7
Cherry Plum	21	5.6	0.22	12.16	12391.06
Indian Horse Chestnut	8	4.34	0.09	6.54	12285.8
Lilac Species	1	3.24	0.05	0.12	12150.05

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m³/Yr**	**£**
Algerian Fir	3	2.46	0.04	4.87	11857.75
Japanese Red Cedar	14	2.05	0.07	10.68	11047.74
Cowtail Pine	5	3.31	0.06	0.83	11044.76
Bhutan Pine	6	1.48	0.03	6.33	10482.77
Hornbeam Species	4	2.64	0.07	5.83	10133.05
Grey Alder	6	2.03	0.07	4.07	9966.45
European Larch	16	3.59	0.11	26.6	9906.11
Hornbeam	18	2.37	0.13	15.9	9535.97
Sawara Cypress	29	2.17	0.07	14.31	8776.29
Oneseed Hawthorn	45	2.52	0.17	11.45	8765.88
Tree of Heaven	5	2.27	0.06	3.18	8521.66
Arizona Cypress	7	1.56	0.04	6.59	8469.72
Azara Species	3	5.48	0.02	1.55	8071.35
Strawberry Tree	18	1.57	0.09	8.39	8045.74
Giant Dracaena	44	0.31	<0.01	8.44	7845.75
Fir Species	14	2.26	0.04	5.87	7710.09
Cottonwood Species	15	1.91	0.07	5.98	7442.72
Kwanzan Cherry	50	2.15	0.17	9.33	7227.37
Common Pear	10	1.64	0.07	3.01	7109.32
Sweetgum	30	1.51	0.07	11.29	6966.62
Southern Magnolia	8	1.66	0.07	4.48	6856.39
Japanese Zelkova	3	1.79	0.06	3.39	6499.99
European Mountain Ash	47	2.06	0.12	8.97	6381.67
Larch Species	10	2.09	0.07	15.29	6333.49
Boxelder	5	1.46	0.06	5.19	6322.75
Caucasian Oak	3	1.72	0.06	4	5986.17
Red Pine	3	1.08	0.03	3.11	5922.95
Holly Species	13	1.61	0.08	5.43	5887.26
Windmill Palm	32	0.28	<0.01	6.66	5706.94
Japanese Maple	55	0.78	0.09	9.38	5705.73

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m³/Yr**	**£**
Chinese Wingnut	4	1.56	0.06	7.96	5639.03
Nordmann Fir	6	1.16	0.04	5.38	5420.52
Ginkgo	16	1.43	0.07	2.87	5318.16
Dawn Redwood	7	0.64	0.03	2.97	5076.25
Juniper Species	13	1.9	0.02	1.72	4900.94
Bhutan Cypress	1	1.7	0.04	0.66	4877.38
Lleuque	3	1.25	0.04	4.01	4806.47
Pere David's Maple	5	1.1	0.04	2.7	4669.87
Morinda Spruce	4	1.07	0.03	3.32	4620.03
Oriental Spruce	3	1.01	0.03	2.55	4553.81
Silver Wattle	7	1.28	0.06	5.38	4312.41
Honey Locust	14	1.08	0.07	3.4	4060.75
Eastern White Pine	1	0.51	0.01	2.41	3914.02
Cider Gum	1	1.55	0.03	3.37	3650.01
Roble	5	1.64	0.05	6.28	3598.79
European Crabapple	16	0.93	0.07	6.14	3578.15
Ailanthus Species	1	0.99	0.03	3.01	3474.05
Hawthorn Species	7	0.88	0.04	2.65	3466.36
Turkish Hazelnut	2	0.76	0.03	3	3205.78
Paper Birch	10	1.2	0.06	4.24	3060.97
Catalpa Species	1	0.71	0.02	1.04	3015.87
Eucryphia	6	0.75	0.03	2.48	2939.03
Red Beech	2	1.07	0.04	3.64	2859.14
Scarlet Oak	2	0.64	0.02	1.07	2789.67
Blue Spruce	3	0.59	0.02	2.13	2785.96
Red Maple	3	0.69	0.03	3.75	2785.32
Common Cherry Laurel	14	0.96	0.06	7.63	2768.46
Tibetan Cherry	5	0.75	0.04	2.21	2666.26
Turkish Pine	2	0.4	0.01	2.03	2657.25
Kapuka	12	0.95	0.06	6.56	2641.82

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m³/Yr**	**£**
Black Mulberry	7	0.59	0.03	1.8	2526.19
Hinoki Cypress	8	0.5	0.02	2.83	2444.43
Chinese Juniper	5	0.47	0.02	1.71	2432.87
Brewers Spruce	4	0.54	0.02	1.33	2406.42
Wild Service Tree	1	0.49	0.02	0.94	2399.29
Spruce Species	4	0.58	0.02	2.47	2344.32
Grey-Budded Snake-Bark	2	0.55	0.02	1.73	2328.13
European Bird Cherry	9	0.91	0.05	6.71	2297.52
Coihue	1	0.87	0.02	3.06	2201.9
Downy Oak	2	0.63	0.03	2.56	2159.92
Japanese Pagoda Tree	4	0.63	0.03	2.32	2131.64
Pin Oak	1	0.61	0.02	1.65	2070.97
Western White Pine	1	0.32	0.01	2.12	2070.97
American Basswood	1	0.32	0.01	2.87	2070.97
Mexican Weeping Pine	3	0.22	0.01	1.12	1968.74
Ponderosa Pine	2	0.3	0.01	1	1933.19
Pacific Silver Fir	2	0.43	0.01	3.13	1913.03
Fir	2	0.43	0.01	3	1913.03
Japanese White Pine	2	0.23	0.01	2.27	1899.99
Kentucky Coffeetree	1	0.5	0.02	2.63	1848.42
Pacific Madrone	1	0.39	0.01	0.52	1823.11
European Filbert	22	0.24	0.04	8.45	1798.09
Japanese Corktree	2	0.39	0.02	2.07	1779.26
Noble Fir	4	0.45	0.02	3.32	1777.41
Viburnum Species	2	0.38	0.02	0.59	1650.51
False Arborvitae	11	0.33	0.02	3.13	1636.77
Locust Species	1	0.37	0.01	0.92	1633.25
Fraser Fir	1	0.31	0.01	0.43	1608.17
Swedish Whitebeam	5	0.45	0.03	1.62	1577.36
White Ash	1	0.36	0.01	0.78	1560.44

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m³/Yr**	**£**
Judas Tree	6	0.4	0.03	3.22	1529.69
Sargent Cherry	8	0.35	0.03	1.13	1473.03
Japanese Fir	1	0.25	0.01	0.83	1460.48
False Cypress Species	13	0.66	0.02	4.01	1431.13
Gowen Cypress	1	0.26	0.01	1.22	1429.57
Blue Chinese Fir	9	0.31	0.02	3.23	1413.82
Caucasian Wingnut	1	0.37	0.01	1.33	1409.76
Japanese Flower Crabapple	6	0.32	0.02	2.57	1379.91
Luma Species	15	0.24	0.03	2.4	1379.77
Crack Willow	3	0.48	0.02	4.09	1334.42
Rauli	2	0.48	0.02	1.97	1319.4
Narrow-leafed Ash	1	0.22	0.01	0.77	1314.72
Katsura Tree	4	0.4	0.03	2.84	1311.83
Serbian Spruce	7	0.44	0.03	2.17	1239.58
European Black Elderberry	6	0.3	0.02	1.27	1234.69
Taiwania	5	0.23	0.01	1.75	1187.08
Totara	12	0.2	0.01	2.39	1083.76
Golden Chain Tree	12	0.41	0.03	1.94	1076.42
Phyllocladus Species	9	0.22	0.01	6.08	1052.94
Western Hemlock	2	0.23	0.01	3.15	1033.12
Jack Pine	6	0.22	0.01	1.27	1013.34
Paperbark Maple	8	0.23	0.02	0.96	962.77
Chinese Pine	1	0.13	<0.01	1.59	937.34
Flowering Ash	7	0.24	0.02	1.47	873.51
Smooth-leaf Elm	11	0.82	0.02	3.57	870.19
Eastern Service Berry	10	0.02	0.01	0.66	841.88
Corkscrew Willow	2	0.21	0.01	1.25	773
Fastigate Hornbeam	2	0.19	0.01	0.5	723.13
Oriental Arborvitae	6	0.15	0.01	2.26	663.82

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m³/Yr**	**£**
Larix Kaempferi	5	0.2	0.01	4.35	651.38
Tiger-tail Spruce	1	0.16	0.01	0.61	625.3
Empress Tree	5	0.14	0.01	1.8	605.19
Bay Tree Species	1	0.16	0.01	0.68	586.28
Pacific Dogwood	5	0.19	0.02	1.71	577.4
Mimosa	1	0.15	0.01	0.99	538.88
Common Plum	9	0.16	0.02	1.55	535.8
Buckeye Species	1	0.15	0.01	0.97	517.98
David's Pine	1	0.06	<0.01	0.47	501.29
Buckthorn	6	0.15	0.02	1.64	463.56
Cotoneaster Species	8	0.08	0.01	4.07	437.61
Siberian Crabapple	1	0.11	0.01	0.61	432.7
Beech Species	2	0.19	0.01	1.9	430.58
Devilwood Species	5	0.14	0.01	2.27	402.9
Callery Pear	5	0.1	0.01	0.25	392.91
Chinese Plum Yew	5	0.06	0.01	1.4	371.28
Boxleaf Azara	5	0.11	0.01	1.3	368.37
Devils Walking Stick	5	0.03	0.01	0.38	360.53
Black Tupelo	5	0.04	0.01	0.76	360.53
Nirrhe	2	0.09	0.01	0.5	359.4
Himalayan Birch	4	0.03	0.01	0.28	344.06
Persian Ironwood	3	0.11	0.01	2.94	328.19
Northern White Cedar	5	0.11	0.01	1.64	324.5
Kowhai	4	0.07	0.01	0.37	306.15
Dove Tree	4	0.01	0	0.99	292.72
Goldenrain Tree	3	0.09	0.01	1.02	277.18
Patagonian Cypress	3	0.07	<0.01	0.9	254.82
Cornelian Cherry	4	0.07	0.01	2.41	245.18
Monkey Puzzle Tree	3	0.01	<0.01	0.14	242.81
Hungarian Oak	3	0.03	<0.01	0.57	230.63

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m^3/Yr**	**£**
Tawhiwhi	3	0.06	0.01	1.57	224.92
Loquat Tree	3	0.04	<0.01	0.99	224.92
Sumac Species	3	0.05	0.01	0.35	224.29
Chinese Weeping Cypress	3	0.05	<0.01	0.36	219.44
Fig	3	0.05	0.01	2.91	203.42
Sweet Mountain Pine	3	0.02	<0.01	0.58	200.63
Hemlock Species	2	0.06	<0.01	1.58	199.53
Hardy Orange	2	0.05	0.01	0.13	199.26
Five Finger Tree	2	0.07	0.01	0.81	199.26
Wych Elm	5	0.13	0.01	1.87	193.62
American Hornbeam	2	0.04	0.01	1.29	189.6
Podocarpus	3	0.08	<0.01	1.85	189.54
Hackberry Species	1	0.07	0.01	1.23	182.64
Apache Pine	1	0.03	<0.01	0.22	178.73
Japanese Snowball	2	<0.01	<0.01	0.08	178.13
Mediterranean Cypress	2	0.04	<0.01	0.17	168.7
Tatar Maple	2	0.01	<0.01	0.16	165.94
Shirofugen Cherry	2	0.07	0.01	0.7	164.13
Syrian Privet	1	0.07	0.01	0.4	157.65
Broom Teatree	1	0.07	0.01	0.52	157.65
Michelia	1	0.08	0.01	1.01	157.65
Red Lantern Tree	2	0.01	<0.01	0.3	157.11
Chinese Tulip Tree	2	0.01	<0.01	0.13	157.11
Large Leaved Kowhai	2	0.02	<0.01	0.36	157.11
Deciduous Stewartia	2	0.05	0.01	0.27	156.48
Serviceberry Species	2	0.01	<0.01	0.21	153.75
Apple Species	2	<0.01	<0.01	0.05	153.75
Bristlecone Pine	2	0.01	<0.01	0.28	153.75
Pitch pine	2	<0.01	<0.01	0.02	153.75
Common Lilac	2	0.02	<0.01	0.3	153.75

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m³/Yr**	**£**
Japanese Yew	2	0.01	<0.01	0.22	153.75
Common Juniper	2	0.04	<0.01	0.3	149.1
Pineapple Guava	2	<0.01	<0.01	0.04	146.36
Italian Cypress	1	0.05	<0.01	0.07	136.67
Eastern Redbud	2	<0.01	<0.01	0.02	135.61
Prickly Ash Species	2	0.02	<0.01	0.33	135.61
Himalayan Strawberry Tree	1	0.07	<0.01	0.44	117.96
Antarctic Beech	1	0.08	<0.01	0.7	117.96
Higan Cherry	1	0.06	<0.01	0.03	116.17
Dogwood Species	2	0.01	<0.01	0.8	109.52
Tanoak	1	0.04	<0.01	0.34	102.74
Flowering Dogwood	2	<0.01	<0.01	0.02	101.48
Painted Maple	1	0.04	<0.01	1.05	100.54
Eastern Hemlock	2	0.01	<0.01	0.51	96.6
Striped Maple	1	0.02	<0.01	0.17	89.06
Norway Maple	1	<0.01	<0.01	0.01	89.06
Mountain Ash Species	1	0.01	<0.01	0.3	89.06
Smooth Hawthorn	1	0.03	<0.01	0.41	88.68
Sea Buckthorn	1	0.03	<0.01	0.12	88.68
Common Box	1	0.01	<0.01	0.33	78.56
Quince Species	1	0.01	<0.01	0.18	78.56
Cladrastis Species	1	0.01	<0.01	0.15	78.56
Dichrostachys Species	1	0.01	<0.01	0.36	78.56
Eucryphia Species	1	0.01	<0.01	0.1	78.56
Brazilian Pepper	1	0.02	<0.01	0.23	78.56
Japanese Torreya	1	0	<0.01	0.03	78.56
Chinese Spruce	1	0.04	<0.01	0.99	77.75
Lace-leaf Maple	1	0.01	<0.01	0.06	76.88
Crabapple	1	0.01	<0.01	0.04	76.88

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m^3/Yr**	**£**
Digger Pine	1	<0.01	<0.01	0.08	76.88
Oriental Planetree	1	0.02	<0.01	0.75	76.88
Blackthorn	1	0.01	<0.01	0.07	76.88
Willow-leaved Pear	1	<0.01	<0.01	0.01	76.88
Sawtooth Oak	1	0.01	<0.01	0.26	76.88
Sargent's Rowan	1	0.02	<0.01	0.07	76.88
Yew Podocarpus	1	0.01	<0.01	0.47	69.52
Silversword Species	1	<0.01	<0.01	0.15	67.81
Northern Hackberry	1	0.01	<0.01	0.46	67.81
Notro	1	<0.01	<0.01	0.01	67.81
Euroschinus Species	1	0.01	<0.01	0.18	67.81
Witchhazel Species	1	0.02	<0.01	0.17	67.81
Kerria Species	1	<0.01	<0.01	0.03	67.81
Prumnopitys Species	1	<0.01	<0.01	0.01	67.81
Shrubby Spurge Species	1	0.01	<0.01	0.04	67.81
Weinmannia Species	1	0.01	<0.01	0.39	67.81
Cedar-of-Goa	1	0.03	<0.01	0.33	66.36
Plum Pine Species	1	<0.01	<0.01	0.15	60.01
Golden Larch	1	<0.01	<0.01	0.02	60.01
Bigcone Douglas Fir	1	<0.01	<0.01	0.1	60.01
Wollemi Pine	1	<0.01	<0.01	0.01	60.01
Korean Fir	1	0.01	<0.01	0.33	58.78
Giant Dogwood	1	<0.01	<0.01	0.11	58.78
Silverleaf Cotoneaster	1	0.01	<0.01	0.48	58.78
Golden Chain Tree Species	1	0.01	<0.01	0.04	50.74
Nothofagus Species	1	0.01	<0.01	0.1	50.74
Dahurian Larch	1	0.02	<0.01	0.39	45.16
Hupeh Rowan	1	0.02	<0.01	0.21	34.69
Prince Albert's Yew	1	0.01	<0.01	0.07	30.6
Atlantic White Cedar	1	0.01	<0.01	0.37	22.89

	Trees	Carbon Storage	Gross Carbon Sequestration	Avoided Runoff	Replacement Cost
Species	**Number**	**Tonnes**	**Tonne/Yr**	**m^3/Yr**	**£**
Macedonian Pine	1	0.53	<0.01	<0.01	<0.01
Rhamnus Species	1	0.05	<0.01	<0.01	<0.01
Total	**4928**	**1951**	**43.12**	**4216.97**	**8508377**

Bibliography

Baldocchi, D (1988). A multi layer model for estimating sulfur dioxide deposition to a deciduous oak forest canopy. Atmospheric Environment 22, 869-884.

Baldocchi, D., Hicks, B., Camara, P (1987). A canopy stomatal resistance model for gaseous deposition to vegetated surfaces. Atmospheric Environment. 21, 91-100.

Bidwell, R., Fraser, D (1972). Carbon monoxide uptake and metabolism by leaves. Canadian Journal of Botany 50, 1435-1439.

Escobedo, F., Nowak, D (2009). Spatial heterogeneity and air pollution removal by an urban forest. Landscape and Urban Planning, 2009 Vol. 90 (3-4) pp. 102-110.

Hirabayashi, S. 2012. i-Tree Eco Precipitation Interception Model Descriptions, http://www.itreetools.org/eco/resources/iTree_Eco_Precipitation_Interception_Model_Descript ions_V1_2.pdf

Hollis, A. (2007) Depreciated replacement cost in amenity tree valuation. UKI-RPAC guidance note 1.

IGCB. Air quality damage costs per tonne, 2010 prices [Online]. Available at:http://www.defra.gov-.uk/environment/quality/air/air-quality/economic/damage/ [Accessed: May 20th 2011].

i-Tree. (2013) 'i-Tree software suite v5' [Online] Available at: http://www.itreetools.org/resources/manuals.php [Accessed: Dec 2016].

Kuhns, M (2008). Landscape trees and global warming. [Online] Available at: http://www.doughnut/articles/landscape%20trees%20and%20global%20warming%20-%2... 1/15/2008 [Accessed: Sep 2 2011].

Lovasi, G., Quinn, J., Neckerman, K., Perzanowski, M. & Rundle, A. (2008) Children living in areas with more street trees have lower prevalence of asthma. Journal of Epidemiology & Community Health, 62(7), pp. 647

Lovett, G (1994). Atmospheric deposition of nutrients and pollutants in North America: an ecological perspective. Ecological Applications 4, 629-650.

Mcpherson, G. (2007) Urban Tree Planting and Greenhouse Gas Reductions. Available at: https://pdfs.semanticscholar.org/3c16/93b7f0945cf4900d41c5a9d-d54d9409ae7ad.pdf

Nowak, D. (1994) Atmospheric carbon dioxide reduction by Chicago's urban forest. In, McPherson, E., Nowak, D., Rowntree, R., (Eds). Chicago's urban forest ecosystem: Results of the Chicago Urban Forest Climate Project. USDA Forest Service, Radnor, PA.

Nowak, D., Civerolo, K., Rao, S., Sistla, G,. Luley, C., Crane, D. (2000). A modeling study of the impact of urban trees on ozone. Atmospheric Environment 34, 1601-1613.

Nowak, D.J., D.E. Crane, and J.C. Stevens. 2006. Air pollution removal by urban trees and shrubs in the United States. Urban Forestry and Urban Greening. 4(2006):115-123.

Nowak, David J., Hoehn, R., and Crane, D. 2007. Oxygen production by urban trees in the United States. Arboriculture & Urban Forestry 33(3): 220-226.

Rogers, K,. Hansford, D., Sunderland, T., Brunt, A., Coish, N., (2012) Measuring the ecosystem services of Torbay's trees: The Torbay i-Tree Eco pilot project. Proceedings of the ICF - Urban Tree Research Conference. Birmingham, April 13-14.

Tiwary, A., Sinnet, D., Peachey, C., Chalabi, Z,. Vardoulakis, S., Fletcher, T., Leonardi, G., Grundy, C., Azapagic, A., T, Hutchings. (2009). An integrated tool to assess the role of new planting in PM_{10} capture and the human health benefits: A case study in London. Environmental Pollution 157, 2645-2653.

Trees Design Action Group (2014). Trees in Hard Landscapes - A guide for delivery. [Online] available at: www.tdag.org.uk/trees-in-hard-landscapes.html

UFORE (2010). Methods [Online] Available at: http://www.ufore.org/methods.html [Last Accessed 22 Feb 2011].

UK National Ecosystem Assessment (2011). [Online] Available at: http://uknea.unep-wcmc.org/ [Accessed 2 Feb 2015]

Zinke, P (1967). Forest interception studies in the United States. In Sopper, W., Lull, H., eds. Forest hydrology. Oxford, UK: Pergamon Press 137-161.