Islington Borough Council i-Tree Eco Inventory Report Public Trees

Treeco2nomics

i-Tree Eco

Executive Summary

In this report, the trees managed by Islington Borough Council have been assessed based on the benefits that they provide to society. These trees, which form part of Islington's natural capital, are generally recognised and appreciated for their amenity, presence and stature in the cityscape. However, society is often unaware of the many other benefits (or ecosystem services) that trees provide to those living in our towns and cities.

The trees in and around our urban areas (together with woodlands, shrubs, hedges, open grass, green space and wetland) are collectively known as the 'urban forest'. This urban forest improves our air, protects watercourses, saves energy, and improves economic sustainability[1]. There are also many health and well-being benefits associated with being in close proximity to trees and there is a growing research base to support this[2].

Islington's publicly managed trees are a crucial part of the town's urban forest. Many of the benefits that Islington's urban forest provides are offered through its public trees.

Economic valuation of the benefits provided by our natural capital[3] (including the urban forest) can help to mitigate for development impacts, 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. Yet, as the benefits provided by such natural capital are often poorly understood, they are often undervalued in the decision making process.

In order to produce values for some of the benefits provided by Islington's publicly managed trees, a state of the art, peer reviewed software system called i-Tree Eco[4] (referred to as 'Eco' throughout the report) was used.

This is a partial analysis as not all trees or ecosystem services were quantified or valued. Therefore the figures presented in this report should be regarded as a conservative estimate.

Highlights Include:

- **The trees managed by Islington Borough Council remove 8.1 tonnes of air-borne pollutants each year and store just over 18,000 tonnes of carbon.**

- **These trees divert over 15,700 cubic meters of storm water runoff away from the local sewer systems each year. This is worth an estimated £23,800 each year in avoided stormwater treatment costs.**

- **The total replacement cost of all public trees in Islington currently stands at £57,113,000**

- **The amenity value as assessed by the Capital Asset value for Amenity Trees (CAVAT) of the council managed trees is calculated to be worth £1.15 billion.**

Table 1 (below) contains the headline figures.

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1 Doick et al (2016)

2 http://depts.washington.edu/hhwb/

3 Natural capital can be defined as the world's stocks of natural assets which include geology, soil, air, water, trees and all living things

4 i-Tree Eco is i-Tree is a suite of open source, peer-reviewed and continuously improved software tools developed by the USDA Forest Service and collaborators to help urban foresters and planners assess and manage urban tree populations and the benefits they can provide. i-Tree Eco is one of the tools in the i-Tree suite. It is designed to use complete or sample plot inventories from a study area along with other local environmental data to: Characterise the structure of the tree population, Quantify some of the environmental functions it performs in relation to air quality improvement, carbon dioxide reduction, and stormwater control, Assess the value of the annual benefits derived from these functions as well as the estimated worth of each tree as it exists in the landscape.
I-Tree Eco is adaptable to multiple scales from a single tree to area-wide assessments.
For more information see www.itreetools.org

Islington Public Tree Inventory - Headline Figures		
Total Number of Trees Measured	39,805	
Most Common Species	Acer pseudoplatanus, Platanus x acerifolia, Fraxinus excelsior	
Amenity Value (CAVAT)	£1,158,932,066.00	
Replacement Cost	£57,112,999.00	
Species Recorded	282	
Amounts and Values		
Pollution Removal	8.1 tonnes	£574,613.00
Carbon Storage	18,166 tonnes	£4,463,091.00
Carbon Sequestration	431 tonnes	£105,812.00
Avoided Runoff	15,721m³	£23,838.00
Total Annual Benefits	**£704,263.00**	

Table 1: Headline figures

Total Number of Trees Measured: Not all records supplied were used in the analysis. For further details see the methodology section below.
Leaf Area: The area of ground covered by leaves when viewed from above (not to be confused with Leaf Area Index (LAI) which is the total surface area of leaves). This is not the total canopy cover for Islington as only the council inventoried trees are included in the analysis and some tree canopy dimensions were conservatively estimated.
Capital Asset Value for Amenity Trees (CAVAT): A valuation method developed in the UK to express a tree's relative contribution to public amenity and its prominence in the urban landscape.
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 Landscape Appraisers (CTLA) Methodology guidance from the Royal Institute of Chartered Surveyors
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 CO_2e and the DECC figures of £67 per metric ton for 2019.
Pollution removal: This value is calculated based on the UK social damage costs for 'Transport Inner London' and the US externality prices where UK figures are not available; £0.984 per Kg (carbon monoxide - USEC), £36.52 per kg (ozone - USEC), £98.91 per Kg (nitrogen dioxide - UKSDC), £1.956 per Kg (sulphur dioxide - UKSDC), £273.19 per Kg (particulate matter less than 2.5 microns - UKSDC).
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 £1.516 per cubic metre and includes the cost of the avoided energy and associated greenhouse gas emissions in treating the water.

Data processed using i-Tree Eco Version 6.0.13.

Methodology

Islington's tree inventory (which included 44,641 records) was exported from the EzyTreev database, reformatted and uploaded into Eco. Amongst the data collected were tree species and diameter at breast height (dbh).

The minimum data required by Eco is tree species and the dbh. However, the more data that is available for each tree, the more accurate the i-Tree outputs will be.

The data provided within the inventory did not include trees managed by housing associations or other highways institutions or private trees and was limited to the inventory provided by the local authority.

The Eco software also requires data to be input in a format with values over 0 for all the structural data of each tree. Several estimates had to be inputted based on the information available within the provided tree inventory.

Of the original 44,641 records, 39,805 were suitable for import. Reasons for removal included no dbh no species or 'dead' recorded, or trees recorded as a group of 'Mixed spp.' for example. Some records were also disregarded by request of the client for this survey.

The inventory data is processed within Eco using the in-built local pollution and climate data to provide the following results (listed in Table 2 below). Please refer also to Appendix IV for further details on methodology.

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) i-Tree eco also calculates Oxygen production but this service is not valued.
Structural and Functional values	Replacement Cost in £. Carbon storage value in £. Carbon sequestration value in £. Pollution removal value in £. Avoided runoff in £

Table 2: Study Outputs.

The top ten species for each category were used for charts and tables within this report and some charts have been divided by each strata. However, the figures related to all other species are available within the i-Tree program. For a more detailed description of the model calculations see Appendix IV.

Tree Characteristics

Tree Species

Islington's council tree inventory has a relatively high diversity of species (282). The most common tree species, with 8.2% of the 39,805 trees in the Islington tree inventory are Sycamore (Acer pseudoplatanus). The second, third and fourth most common trees are respectively: London plane (Platanus x acerifolia - 6.2%), Ash (Fraxinus excelsior - 6.2%) and Cherry (Prunus spp - 5.8%). Appendix II contains a full list of species included in the inventory.

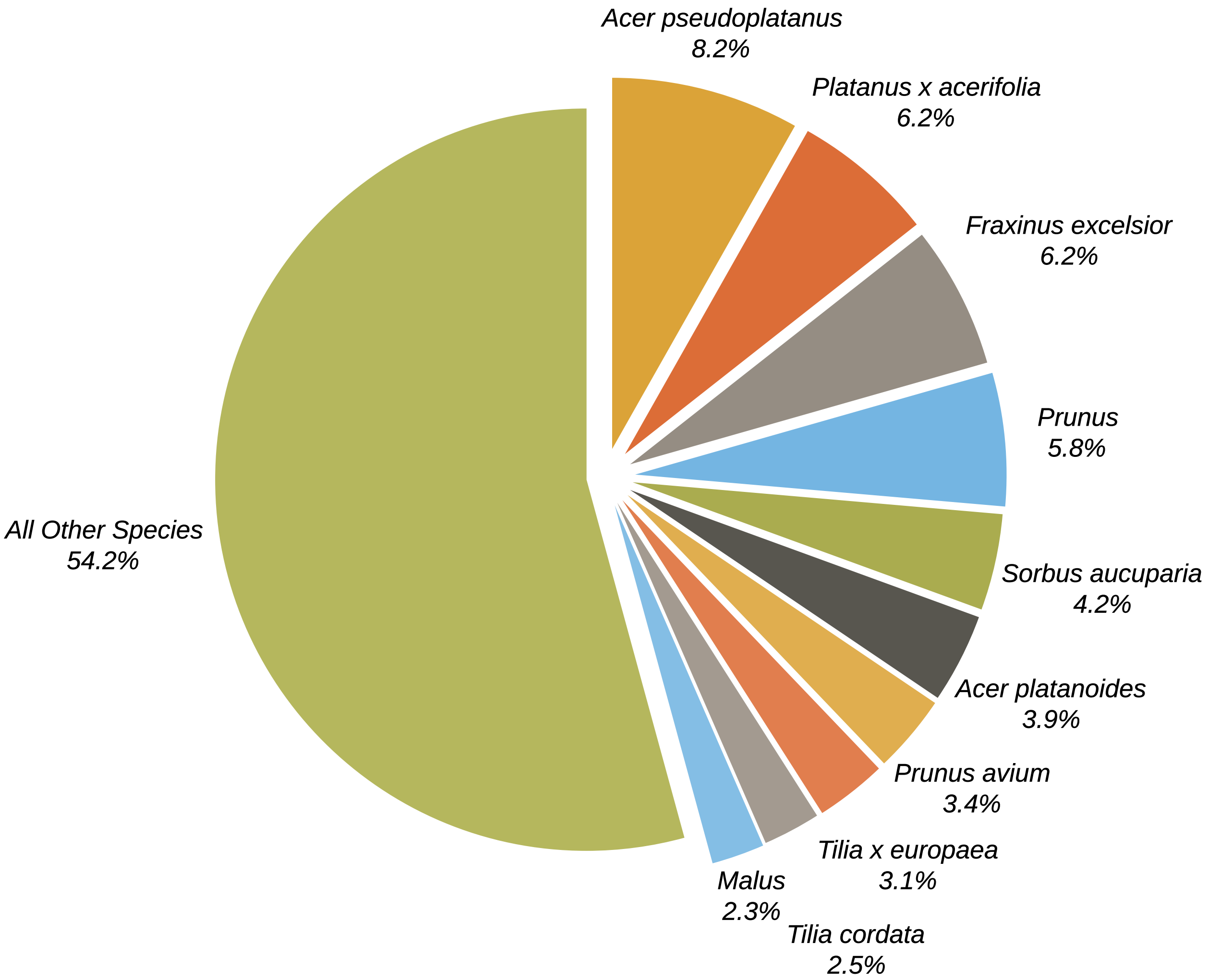

Figure 1: Percentage Population of Tree Species

Tree Diversity

Tree diversity is an important aspect of the tree population to take into account. Tree diversity increases overall resilience in the face of various environmental stress-inducing factors. Diversity includes both the individual diversity within a tree species (i.e. genetic diversity) and between different tree species in terms of different genera or families (e.g. Acer (maple family); Ligustrum (olive family)).

Tree species which originate from more distant regions to each other may be more genetically dissimilar, their presence may therefore increase resilience to environmental perturbations. A more diverse tree-scape is better able to deal with possible changes in climate or potential pest and disease impacts. This is because with more diverse tree populations the likelihood that they all will be vulnerable to a particular threat is lower and therefore a smaller proportion will be detrimentally affected. The tree population within Islington's tree inventory represents a very rich community of trees given the area, with 282 species identified. However, some of the inventory records provided are at the genus level only, indicating that species richness may actually be greater than the 282 species provided.

Tree species from 6 continents are represented in Islington's tree inventory. Most of the species are native to Europe and Asia (see Figure 2 below). However, further work would be required to assess the condition, size and populations of these trees and to provide recommendations on the best species to choose for any future plantings.

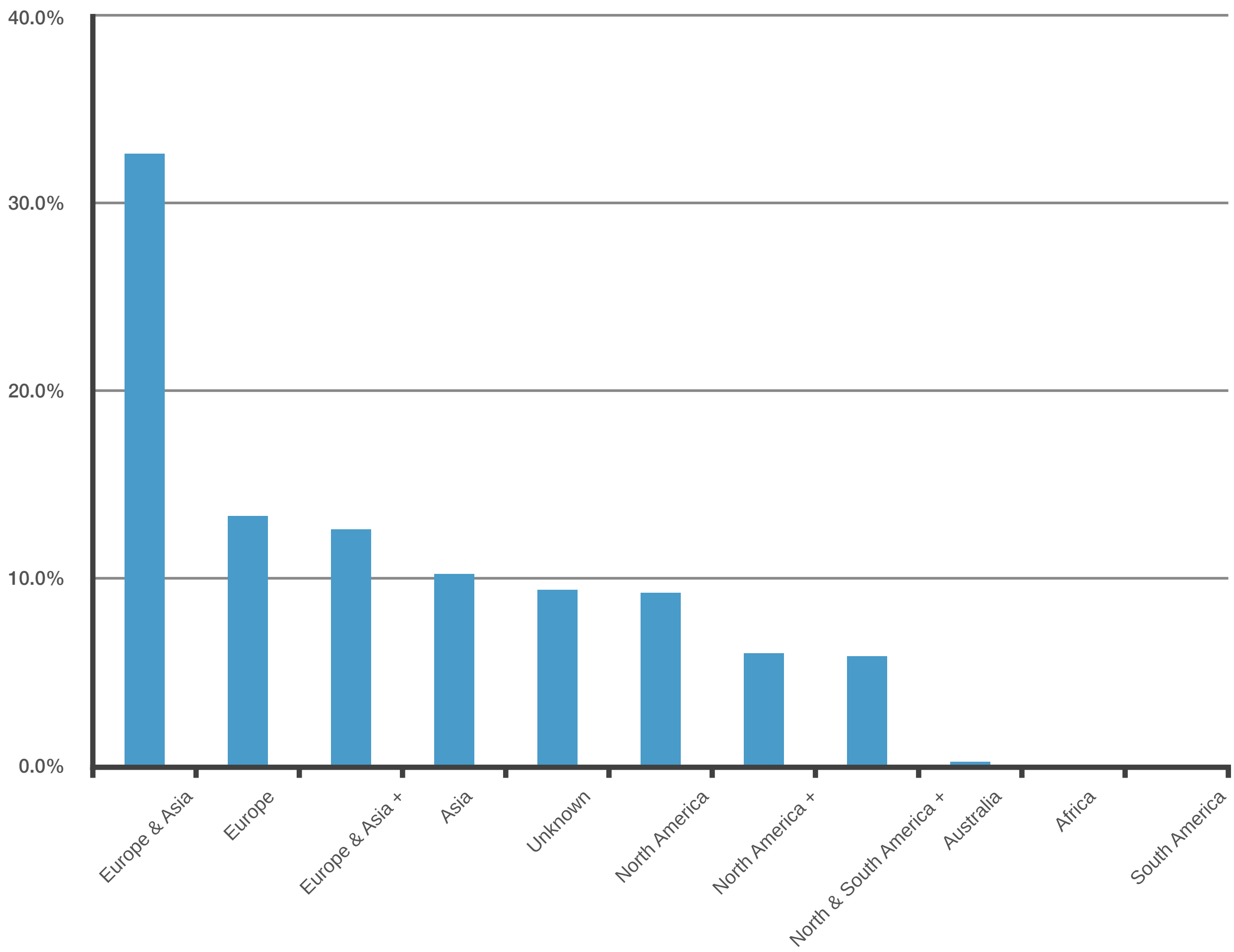

Figure 2: Origin of Tree Species

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 to consider 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.

In this inventory, trees were sized by their stem diameter at breast height (dbh) at 1.3m. Figure 3 (below) shows the percentage of tree population for the ten most common trees by dbh class.

The chart below represents a fairly typical size class contribution for an urban area, displaying a negative correlation (with percentage composition declining as size increases). There is, however, some variation between species. If new plantings are made up of smaller stature species there will be a definite lack of larger trees in the future. To maintain or increase canopy cover and tree benefits at or above current levels then more trees capable of attaining a larger size will need to be planted and cared for in areas where their presence can be guaranteed to ensure that there is no shortfall in the future.

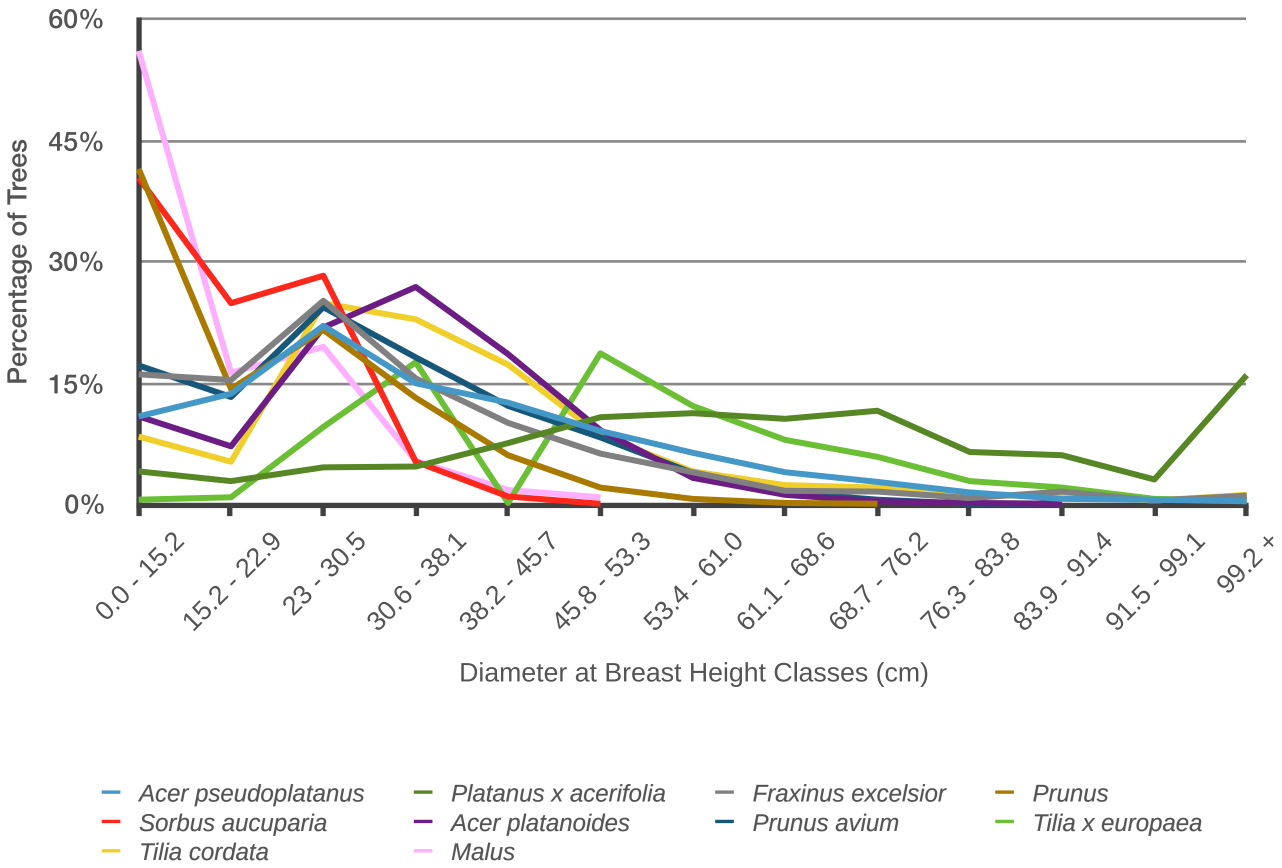

Figure 3: Percentage of Tree Population by DBH Class

Leaf Area and Population

Leaf area is an important metric because the total photosynthetic area of a trees canopy is directly related to the amount of benefit provided. The larger the canopy and its surface area, the greater the amount of air pollution or rainfall which can be held in the canopy of the tree.

Within Islington's tree inventory, total leaf area is estimated at 8,672,000 m². If all the layers of leaves within the tree canopies were spread out, they would cover an area over 6 times the size of Hyde Park.

The three most dominant species in terms of leaf area are Platanus x acerifolia (which has 23.9% of the total leaf area for all trees), Acer pseudoplatanus (11.6%) and Fraxinus excelsior (6.4%).

Figure 4 (below) shows the top ten dominant trees' contributions to total leaf area. In total these ten species, representing 43% of the tree population, contribute almost 66% of the total leaf area. The remaining 57% of the tree population (not represented in Figure 4) provide the remaining 34% of leaf area.

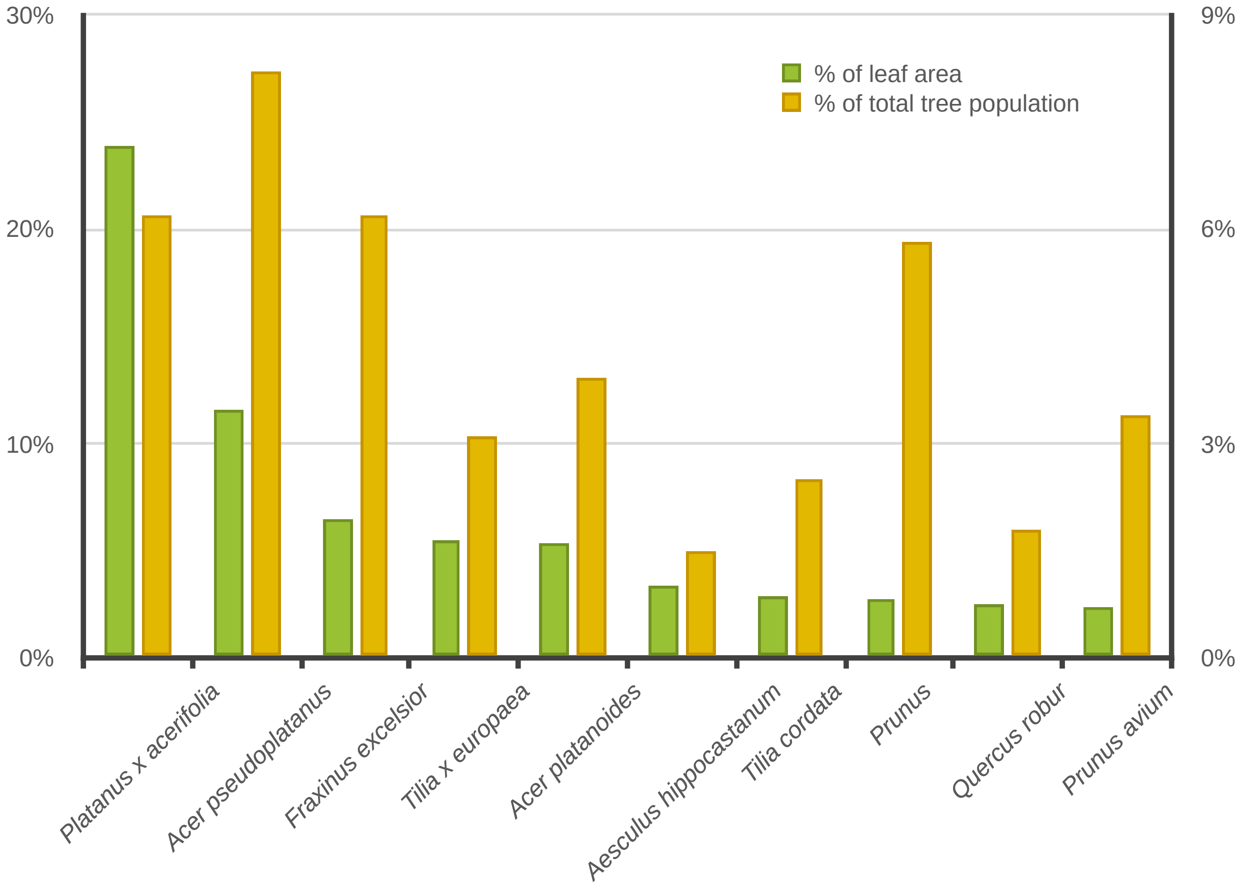

Figure 4: Percentage Leaf Area and Population of the Ten Most Dominant Trees

Leaf Area by Strata

Figure 5 (below) shows the leaf area in Islington by strata. It is the highest in housing strata covering (3,037,900m²).

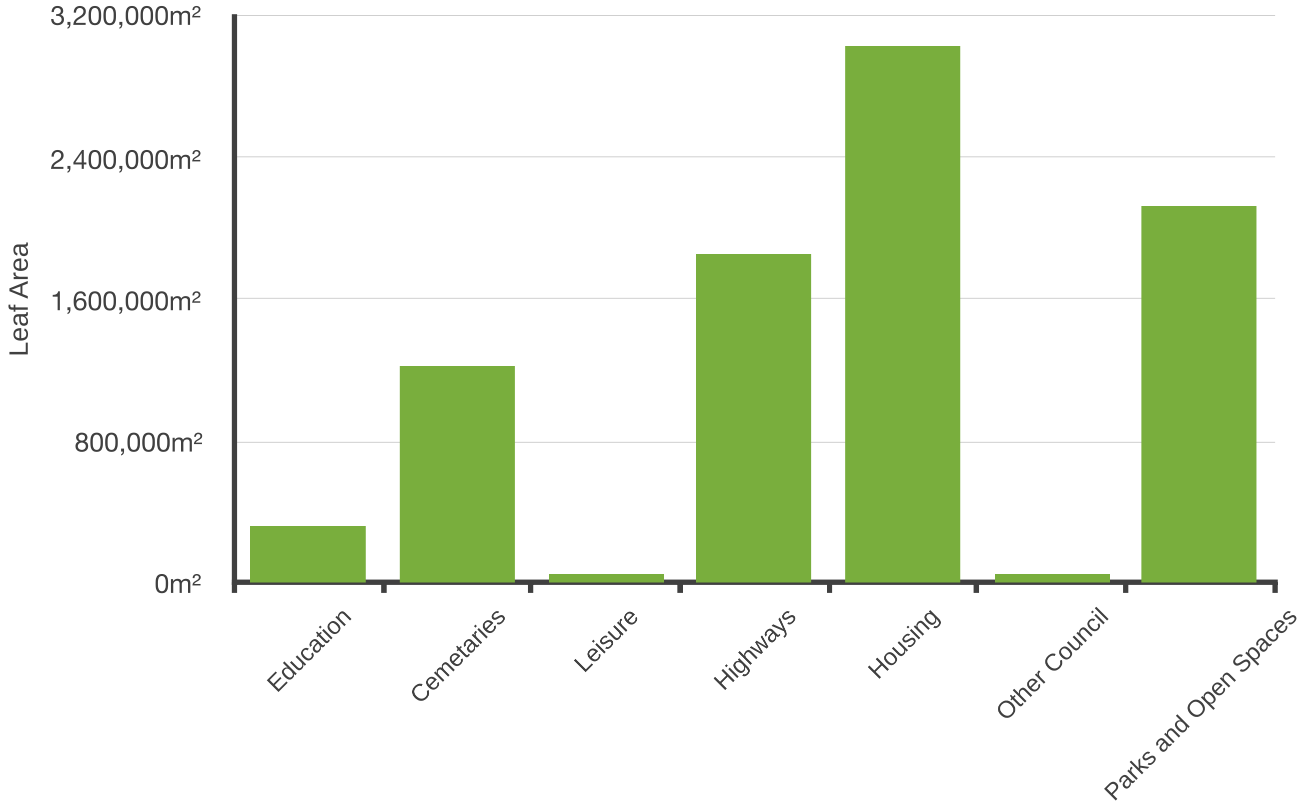

Figure 5: Leaf Area by Strata

Results - Ecosystem Services Resource

Air Pollution Removal

Poor air quality is a common problem in many urban areas, in particular along the road network. 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 severe health problems in humans to damage to buildings.

Urban trees can help to improve air quality by reducing air temperature and directly removing pollutants[5]. Trees intercept and absorb airborne pollutants on to the leaf surface[6]. In addition, by removing pollution from the atmosphere, trees reduce the risks of respiratory disease and asthma, thereby contributing to reduced health care costs[7].

Trees also emit volatile organic compounds (VOCs) that can contribute to low-level ozone formation which is detrimental to human health. 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. Eco accounts for both reduction of ozone and production of VOCs within its algorithms and as shown in Figure 6 Eco estimated that the inventoried trees in Islington remove more ozone than they produce.

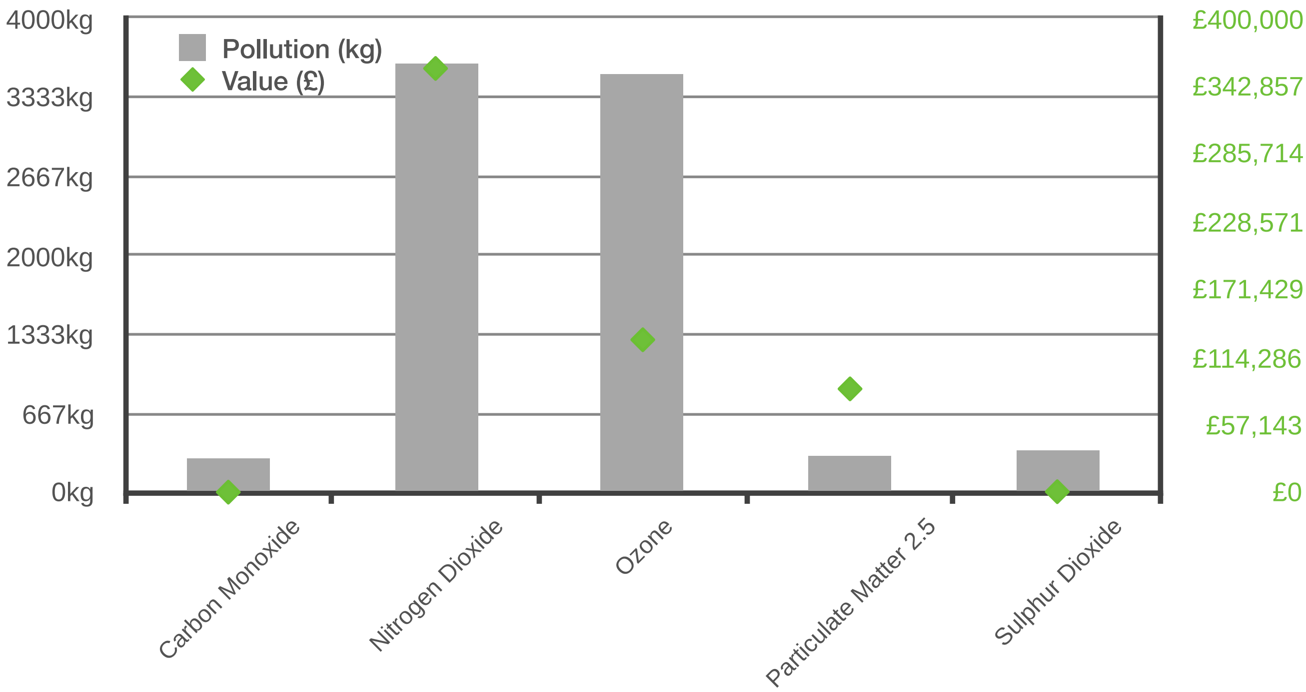

Figure 6: Value of the Pollutants Removed and Quantity Per-Annum within Islington

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.

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5 Tiwary et al., 2009

6 Nowak et al., 2000

7 Peachey et al., 2009. Lovasi et al., 2008

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.

Figure 7 (below) shows the breakdown for the top ten pollution removing tree species in Islington's tree inventory. As different species can capture different sizes of particulate matter,[8] it is recommended that a broad range of species should be considered for planting in any air quality strategy.

It is interesting to note that despite being the 6th most common species, '*Sorbus aucuparia*' isn't in the top ten species for air pollution removal. This is likely due to its generally smaller size and leaf area. This illustrates how large trees provide more benefits than smaller specimens. To highlight this, *Aesculus hippocastanum*, a particularly large-leaved species, is not in the top ten by percentage composition (it is 18th, with 1.5%) but it is 6th for pollution removal.

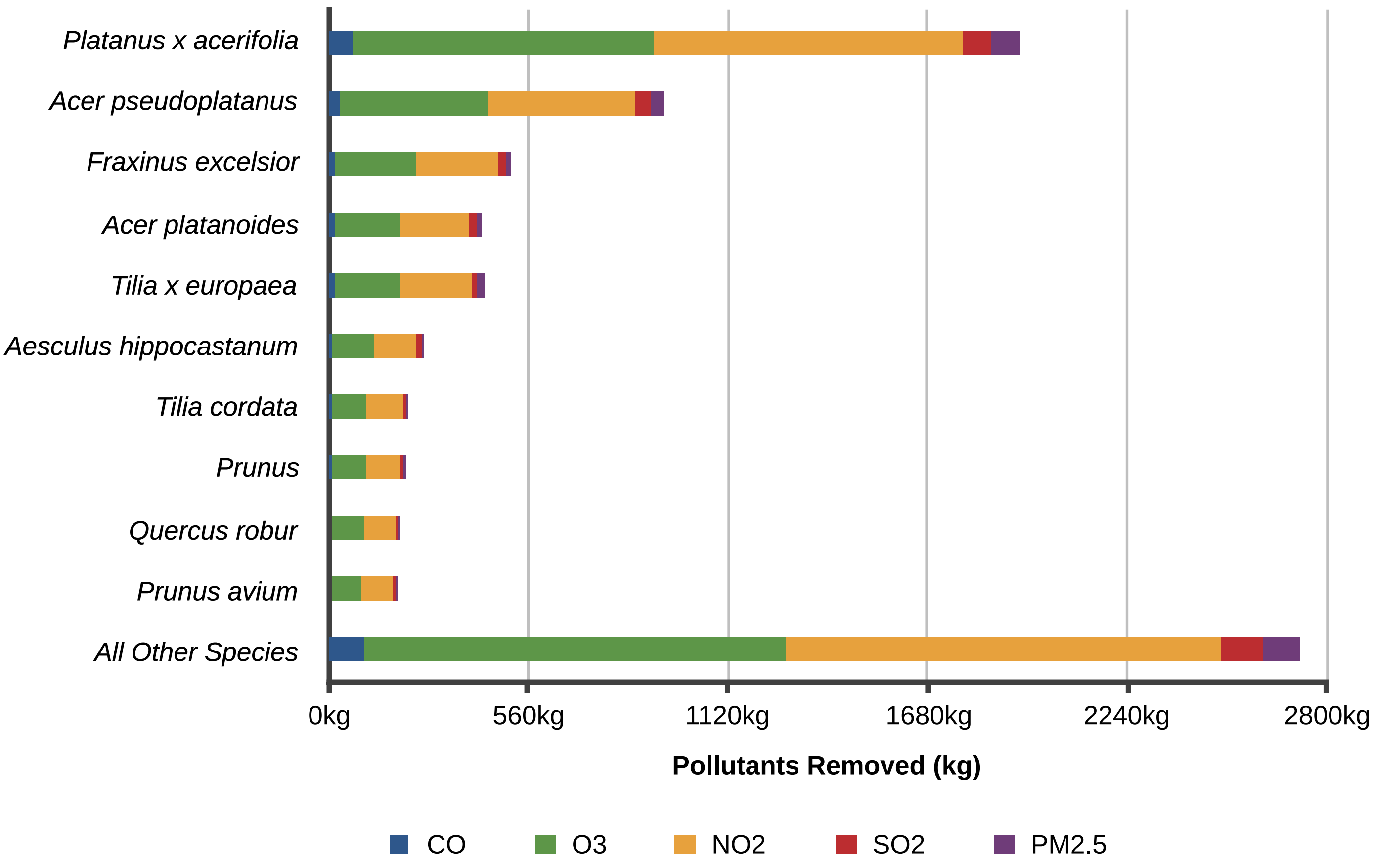

Figure 7: Pollution Removal by Tree Species

[8] Freer-Smith et al. 2005

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 to several tonnes of carbon for decades or even centuries[9].

Overall the trees in the Islington tree inventory store an estimated 18,166 tonnes of carbon with a value of £4.46 million.

Figure 8 (below) illustrates the carbon storage of the top ten tree species.

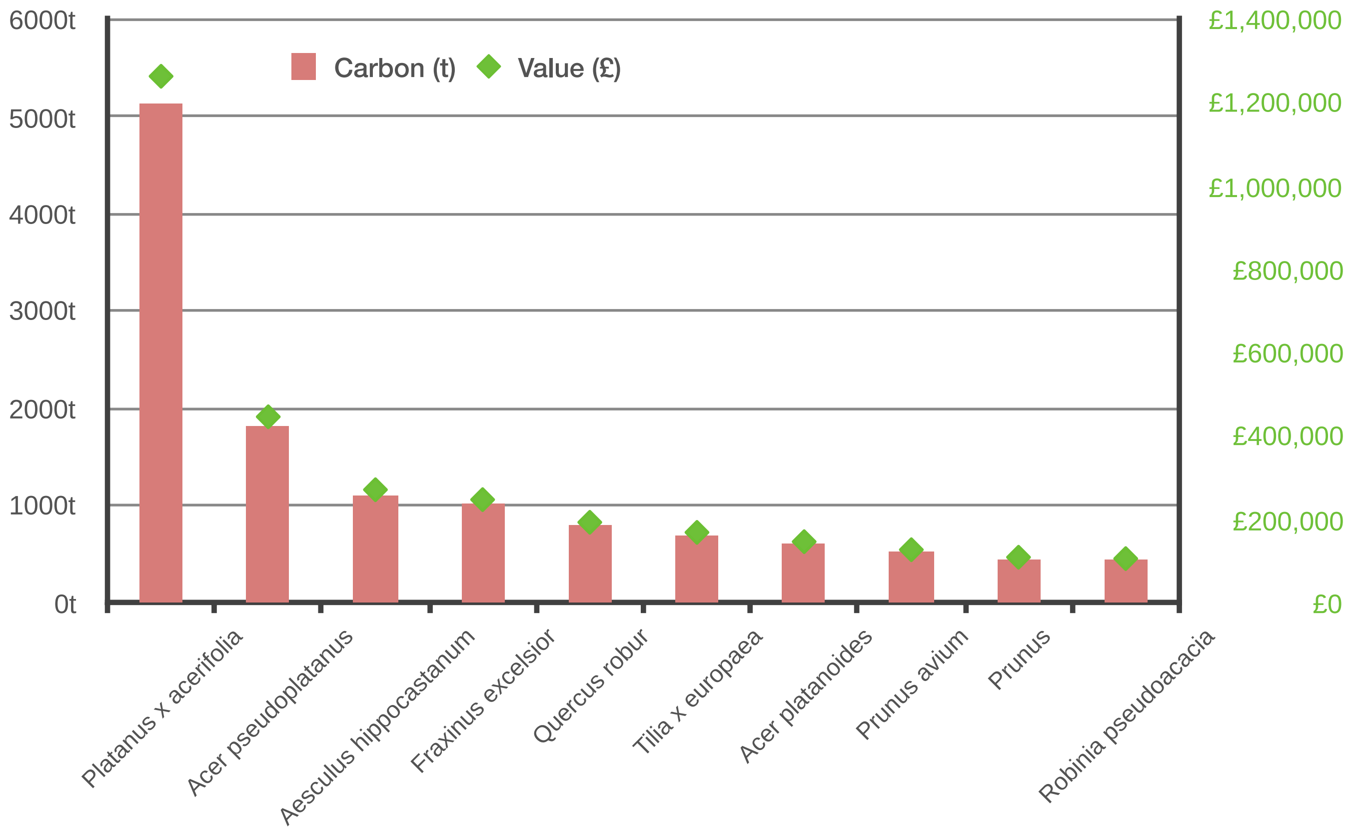

Figure 8: Carbon Storage (tonnes) for Top Ten Tree Species in Islington

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.

[9] Kuhns 2008, Mcpherson 2007

Carbon Storage by Strata

There are 18,166 tonnes of Carbon stored in the trees in Islington. The highest quantity is stored in housing strata (6,093 tonnes) which is 33.5% of the total storage in Islington (see figure 9 below). This is due to a higher number of trees in housing strata compared to the other strata.

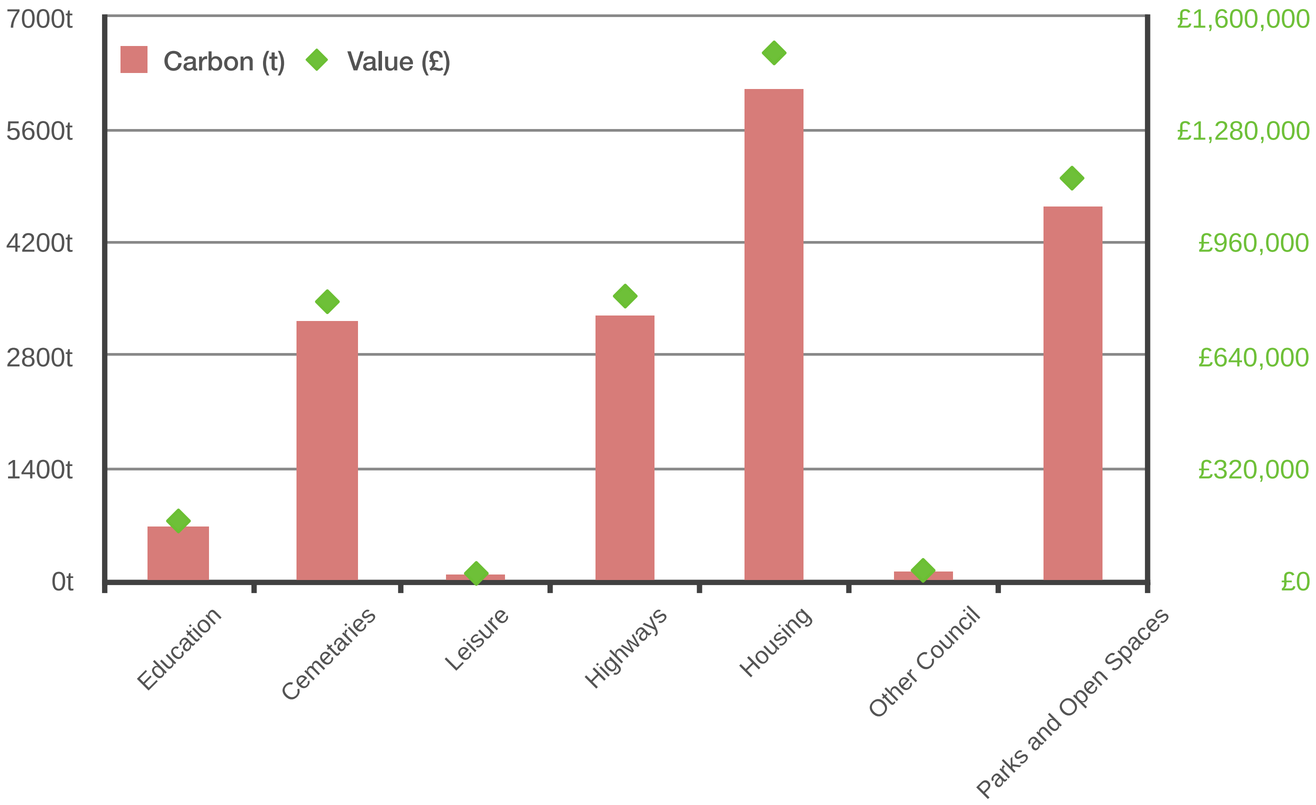

Figure 9: Carbon Stored by Strata

Carbon Sequestration

Carbon sequestration is calculated from the predicted growth of the trees based on field measurements of the tree, climate data and genera specific growth rates within Eco. This provides a measure of tree growth (converted volume). This volume is then converted into tonnes of carbon based on species specific conversion factors, it is then converted to CO_2 equivalent before then being multiplied by the unit cost for carbon. The current (2019) UK social cost for carbon is £67 / tonne.

Islington's inventory trees sequester an estimated 431 tonnes of carbon per year, with a value of £105,812. 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)
Platanus x acerifolia	78.69	£19,334
Acer pseudoplatanus	44.88	£11,026
Fraxinus excelsior	24.40	£5,994
Aesculus hippocastanum	17.88	£4,392
Acer platanoides	17.68	£4,344
Prunus	17.07	£4,194
Prunus avium	16.88	£4,149
Quercus robur	16.31	£4,008
Tilia x europaea	15.98	£3,925
Robinia pseudoacacia	10.91	£2,680
All Other Species	170.00	£41,767
Total	430.68	£105,811

Table 3: Top Ten Carbon Sequestration by Species

Of the tree species inventoried, the *Platanus x acerifolia* store and sequester the most carbon, adding approximately 79 tonnes in the study year to the current *Platanus x acerifolia* carbon storage of 5,144 tonnes.

For comparison, the average newly registered car in the UK produces 34.3g carbon per km[10]. Carbon sequestration in Islington's tree inventory therefore corresponds to around 12,553,936 'new' vehicle km per year, equivalent to 63 people driving a car over 30 years[11].

10 http://naei.beis.gov.uk/data/emission-factors
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/454981/veh0150.csv/preview

11 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/729521/national-travel-survey-2017.pdf

Carbon Sequestration by Strata

Trees remove four million tonnes of Carbon from the UK atmosphere each year[12].
Housing strata has the largest carbon sequestration value at 149.85 tonnes/yr (table 4 below). This value is expected due to the housing strata having the largest population of larger trees within Islington's inventory.

Strata	Gross Carbon Sequestration (tonne/yr)	Value (£)
Education	17.17	£4,218
Cemetaries	66.88	£16,431
Leisure	2.62	£645
Highways	92.95	£22,838
Housing	149.85	£36,819
Other Council	2.92	£718
Parks and Open Spaces	98.27	£24,143
Total	430.66	£105,812

Table 4: Carbon Sequestration in Each Strata

[12] Forestry Commission England (2010)

Avoided 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, waterways, lakes and oceans. During precipitation events, a portion of the precipitation is intercepted by vegetation (trees and shrubs) while the remainder reaches the ground. Precipitation that reaches the ground and does not infiltrate into the soil becomes surface runoff[13].

In urban areas, the large extent of impervious surfaces increases the amount of runoff. However, trees are very effective at reducing surface runoff[14]. The trees' canopy intercepts precipitation, while the root system promotes infiltration and storage of water in the soil.

Annual avoided surface runoff in Eco is calculated based on rainfall interception by vegetation, specifically the difference between annual runoff with and without vegetation. The trees within Islington's tree inventory reduce runoff by an estimated 15,720 m^3 a year with an associated value of £23,838.

Figure 10 (below) shows the volumes and values for the ten most important species for reducing runoff.

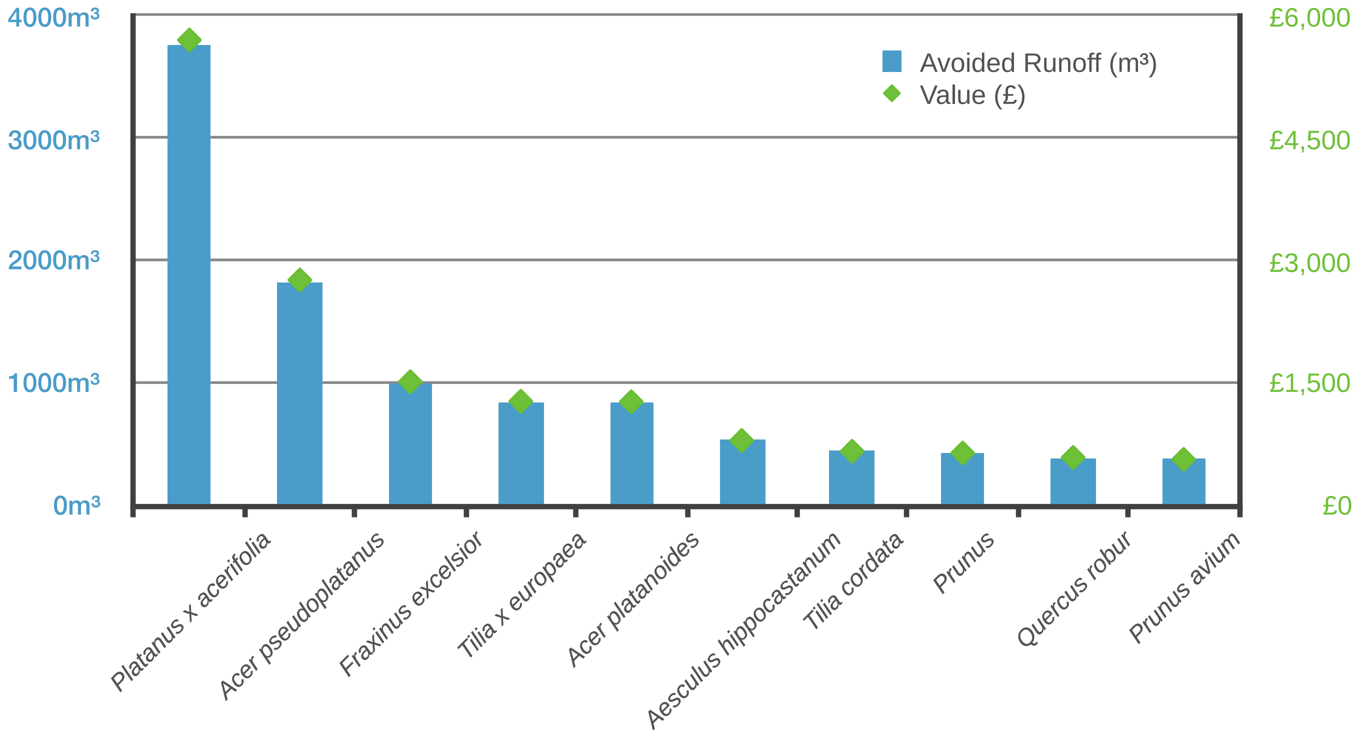

Figure 10: Avoided Runoff by Top Ten Species

The trees in Islington's tree inventory play an important role in reducing runoff: The *Platanus x acerifolia* intercepts the largest proportion of the precipitation for a species, and is, by a considerable margin, the most important species in this category. This is due to the trees' population, canopy size and leaf morphology.

15,720³ is equivalent to over 6 Olympic swimming pools of stormwater being averted every single year.

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13 Hirabayashi 2012

14 Trees in Hard Landscapes (TDAG) 2014

Avoided Runoff by Strata

Figure 11 shows that housing strata has the highest avoided runoff value, preventing 5,505m³ of stormwater each year from entering sewerage systems which has an associated saving of £8,348; this is 35% of the total runoff value for the Islington Inventory.

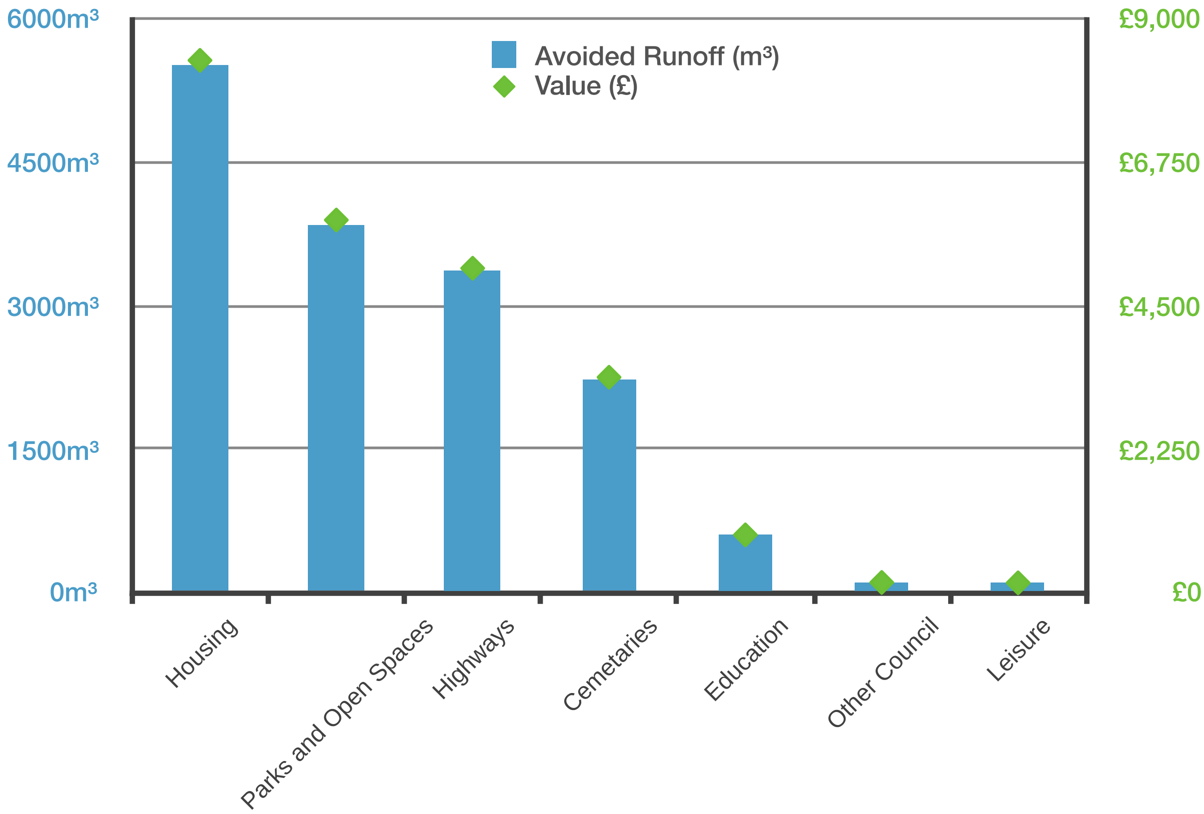

Figure 11: Avoided Runoff for each Strata

Potential Pests and Diseases

Various insects and diseases can affect trees, reducing both their health and value, and therefore the sustainability of our urban forests. As most pests generally tend to have a specific range of tree hosts, the potential damage that can be caused by each will differ.

In this instance Plane Wilt and Ash Dieback have been selected to illustrate how the results from this survey can be used to estimate the potential pest impacts on the trees in Islington's tree inventory.

These pathogens have the potential to reduce the performance of or kill a number of trees that are present in Islington's tree inventory. Figure 12 (below) illustrates the impact of these pathogens, the potential percentage of population that could become infected and those which are resistant.

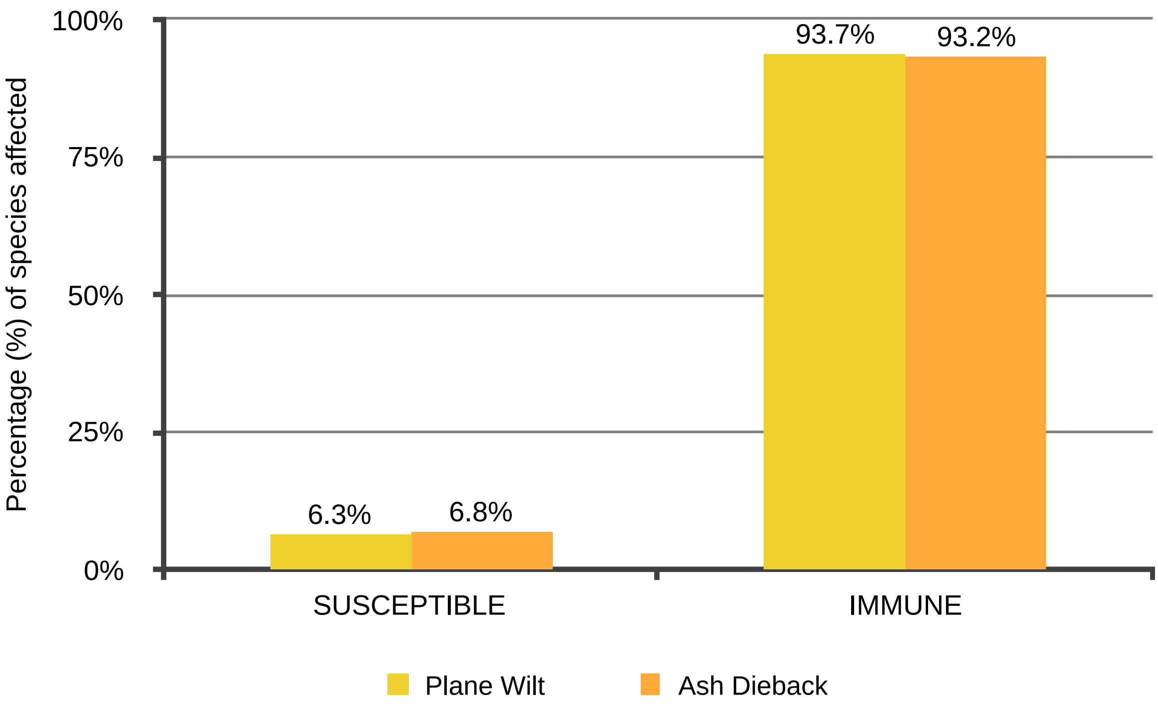

Figure 12: Potential Pest Impacts on Species

Plane wilt, also known as canker stain disease, is a serious disorder of plane trees, which are important amenity trees in the parks and avenues of many European cities. The disease is caused by the fungus *Ceratocystis platani*, which is present in the USA and Europe.[15]
The fungus causes the foliage to wilt and then dieback, causing limbs and stems to break. This fungus could affect around 6.3% (or 2,499) of the trees in Islington.

[15] https://www.forestry.gov.uk/PDF/FCPH-PW.pdf/$FILE/FCPH-PW.pdf

Ash dieback *(Hymenoscyphus fraxineus)* is harmless in its native range in Asia, associating with native ash species including *Fraxinus mandshurica*. However, European ash *(Fraxinus excelsior and Fraxinus angustifolia)* has shown to be highly susceptible to the pathogenicity of *H fraxineus. F excelsior* is the 2nd most common species in Islington's tree inventory, accounting for 6.8% of the population (or 2,697 trees). Ash trees can be large in stature and provide a significant amount of ecosystem services to Islington and so their replacement should they perish would be costly (Figure 13).

For the purpose of this study all species of Ash including, *Fraxinus Excelsior, Fraxinus Excelsior 'Pendula', Fraxinus Augustifolia 'Raywood', Fraxinus Ornus, Fraxinus americana, 'Autumn Purple', Fraxinus Oxycarpa* and *Fraxinus Pennsylvanica 'Summit'* have been included. According to the Defra Management Plan for Chalara (Ash Dieback) many species of Ash can be infected but the intensity and appearance of symptoms varies. Common Ash (*Fraxinus Excelsior)* is the most severely affected[1]. This information should be considered when reviewing the impacts of Ash Dieback on Islington's trees.

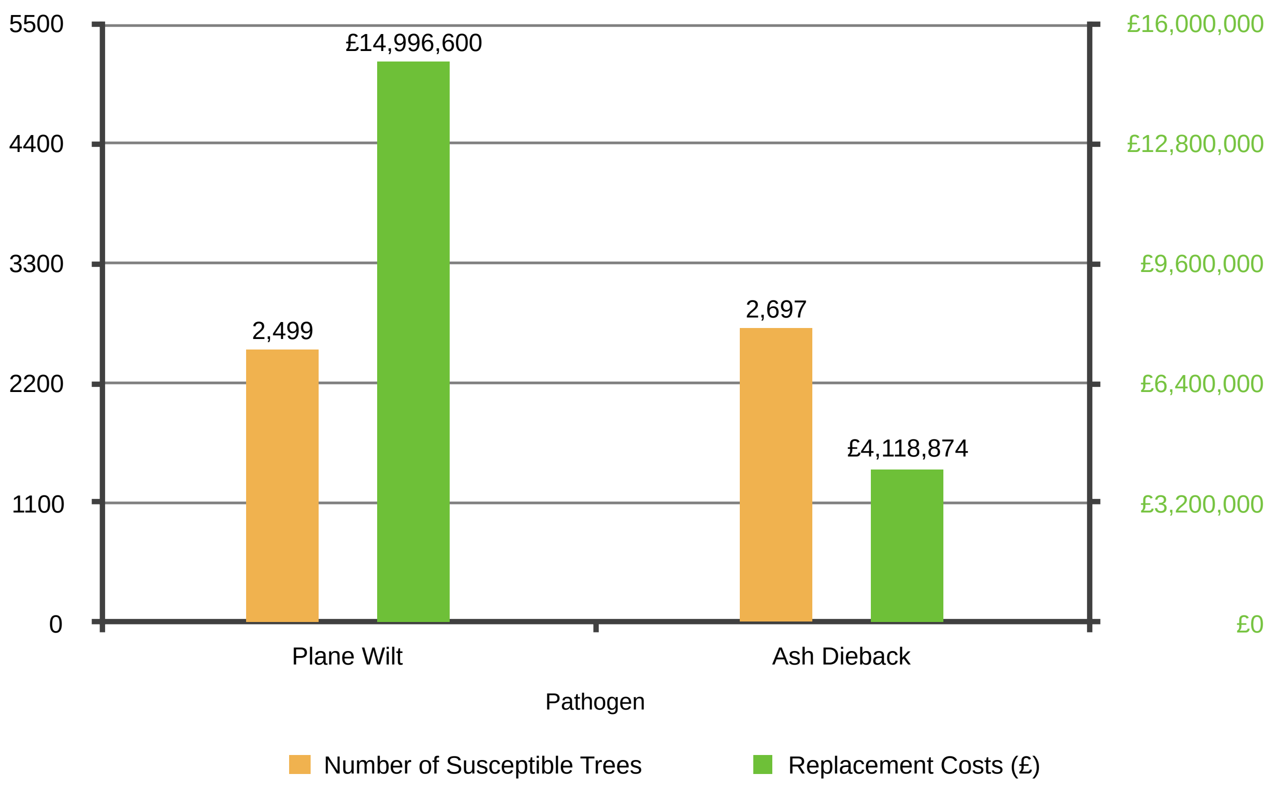

Figure 13: Potential Pest Impacts on Replacement Cost

[1] Defra, 2013

Replacement Cost

In addition to estimating the environmental benefits provided by trees Eco 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[16].

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 14, below.

The total value of all trees in the study area as estimated by Eco currently stands at £57.1 million. London plane *(Platanus x acerifolia)* is the most valuable species of tree, on account of both its size and population, followed by sycamore (*Acer pseudoplatanus)* and ash (*Fraxinus excelsior)*. These three species (or genera) account for £24 million (42%) of the total replacement cost of the trees in Islington's tree inventory, with the London Plane alone accounting for 26% of the total structural value.

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

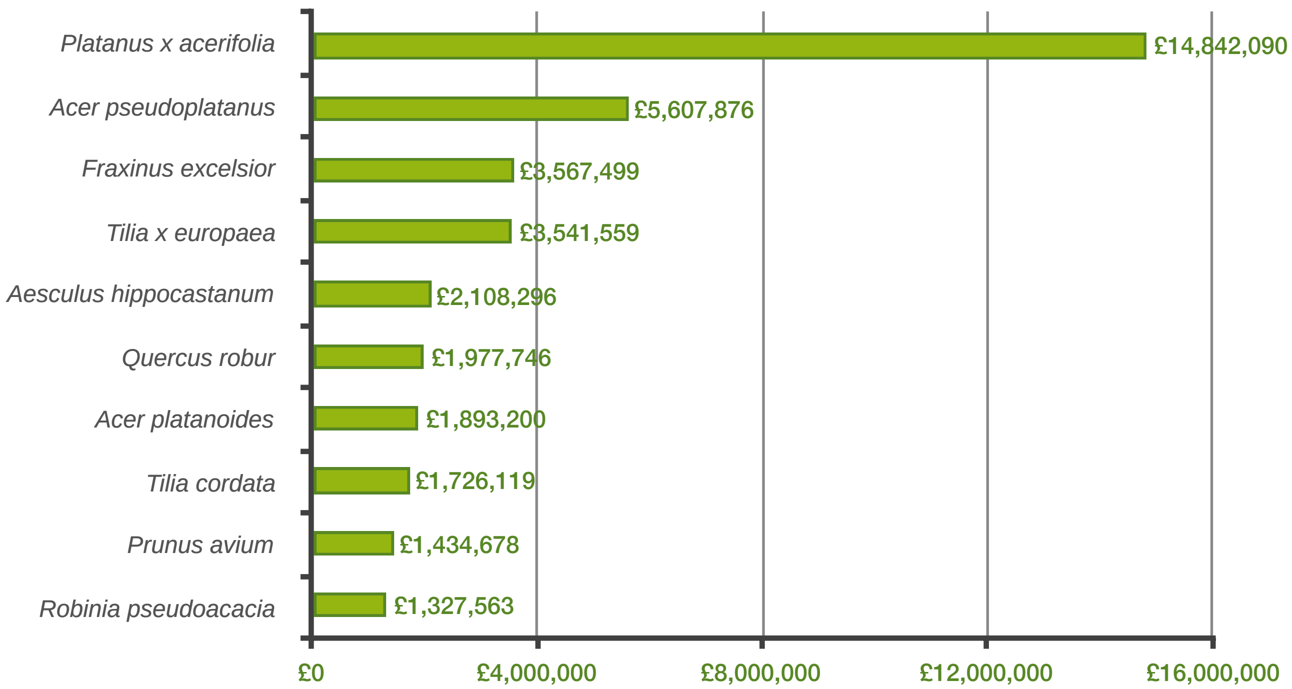

Figure 14: Replacement Cost for Top Ten Trees in Islington

16 Hollis, 2007

Replacement Cost by Strata

Housing strata has the highest Replacement Cost value at £19.4 million (Figure 15) which is 34% of the total replacement cost in Islington (£57,113,000).

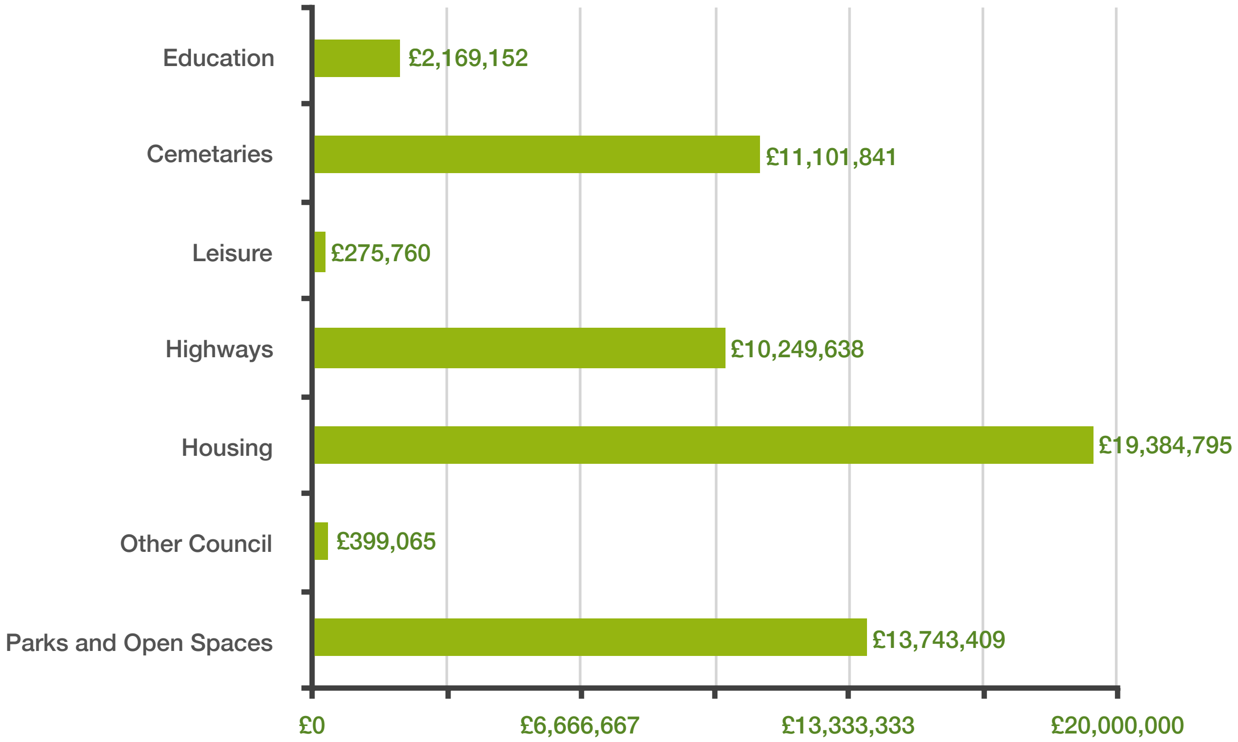

Figure 15: Replacement Cost in each Strata

CAVAT - The amenity value of trees

Capital Asset Valuation for Amenity Trees (CAVAT) is a method developed in the UK to provide a value for the public amenity that trees provide. The CTLA valuation method does not take into account the health or amenity value of trees, and is a management tool rather than a benefit valuation.

Particular differences to the CTLA valuation include the Community Tree Index (CTI) value, which adjusts the CAVAT assessment to take account of the greater benefits of trees in areas of higher population density, using official population figures. CAVAT allows the value of Islington's trees to include a social dimension by valuing the visual accessibility and prominence within the overall urban forest.

For the urban forest of Islington, the estimated total public amenity asset value is over £1.15 billion.

The particular nature of local street trees, local factors and choices could not be taken into account as part of this study. The value should reflect the reality that street trees have to be managed for safety. They are frequently crown lifted and reduced (to a greater or lesser extent) and are generally growing in conditions of greater stress than their open grown counterparts. As a result, they may have a significantly reduced functionality under the CAVAT system.

This study also included assumptions of condition based on the Safe Useful Life Expectancy (SULE), as this was not included in the Islington tree inventory information.

The London plane (*Platanus x acerifolia*) of Islington holds the highest CAVAT value (Table 5, below), although the Sycamore (*Acer pseudoplatanus*) is the most numerous tree, representing 8.2% of the total tree population.

Species	CAVAT Value	Percent of Total Population	Replacement Cost
Platanus x acerifolia	£336,269,810.00	6.24%	£14,842,089.00
Acer pseudoplatanus	£102,644,556.00	8.22%	£5,607,875.00
Aesculus hippocastanum	£68,825,378.00	1.49%	£2,108,296.00
Tilia x europaea	£63,839,796.00	3.06%	£3,541,559.00
Fraxinus excelsior	£68,633,945.00	6.16%	£3,567,498.00
Quercus robur	£39,990,630.00	1.82%	£1,977,746.00
Thuja plicata	£24,782,090.00	1.45%	£983,913.00
Acer platanoides	£30,597,641.00	3.86%	£1,893,199.00
Tilia cordata	£31,215,019.00	2.48%	£1,726,119.00
Prunus avium	£23,533,570.00	3.41%	£1,434,677.00
All Other Species	£368,599,630.00	61.81%	£19,430,022.00
Total	**£1,158,932,065.00**	**100%**	**£57,112,993.00**

Table 5: The ten species with the highest CAVAT valuation

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 about how trees are managed to provide long term benefits to communities and this is one of the key outcomes 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*), more commonly known as Ash Dieback.
- Data can be used to produce educational information about Islington's trees (e.g. informational tree tags).
- Using the data for cost benefit analysis to inform decision making.
- 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 Islington's tree management plan.
- Inform species selection. Size does matter! Identify trees that can grow on to full maturity and reach their optimal canopy size (given any site specific restrictions) 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 Islington's inventory trees to build resilience to future change.

Conclusions

The tree population within Islington's tree inventory generally has a good species and age diversity. It is acknowledged that there are a number of constraints on urban planting, however that can hinder planting of larger-growing species. Additional larger-growing species provide some resilience from possible future influences such as climate change and pest and disease outbreaks. The role of Islington's trees in complementing people's health is clear, through air pollution removal especially. Islington's trees provide a valuable benefit of over £704,513 in ecosystem services each year.

However, it is recommended that records for all council managed trees (all trees not on private land) are obtained so that Islington Borough Council can better understand the full value of its tree stock.

In terms of structural diversity, the London plane (*Platanus x acerifolia*) has the largest proportion of trees in the larger size classes within the top ten populated species but other tree species such as *Tilia x europaea* and *Acer pseudoplatanus* are also well represented. Larger-growing trees are important because they provide greater canopy cover and therefore ecosystem service provision. They also tend to have higher amenity value than their smaller counterparts.

Islington has a rich species diversity, with 282 species within the tree inventory. However, there is a slight reliance on *Platanus x acerifolia* to provide ecosystem services, including 28.2% of all carbon stored, 18.3% of annual carbon sequestration, and 24% of annual avoided runoff. Like many urban areas, Islington would benefit from having a greater proportion of larger trees, of a more diverse range of species, in order to build resilience into its tree population and reduce reliance on a small number of species.

The values presented in this study represent only a portion of the total value of the trees within Islington because only a proportion of the total benefits have been evaluated. Trees confer many other benefits, such as contributions to our health and well-being, reducing urban temperatures, providing amenity value and habitats for wildlife. 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. Targets to increase canopy cover, protect large and veteran trees, plant large trees where possible, diversify the urban forest and plant climate adaptable species should also be investigated through the production of an 'Urban Forest Masterplan'.

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. New tree planting can contribute to the growth of canopy cover. However, 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 Islington's tree inventory in a variety of ways and there are great uncertainties about how this may manifest. Some species may be less able to survive under new climatic conditions. New conditions may also allow different pests and diseases to become prevalent. Further studies into this area would be useful in informing any long-term tree strategies or urban forest masterplans, such as species choice for example.

The challenge now is to ensure that policy makers and practitioners take full account of Islington's 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 the Islington's inventory 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:

- Amount of carbon emitted in Islington Inventory in 7 days
- Annual carbon (C) emissions from 14,200 family cars
- Annual C emissions from 5,830 single-family houses

Nitrogen dioxide removal is equivalent to:

- Annual nitrogen dioxide emissions from 571 family cars
- Annual nitrogen dioxide emissions from 257 single-family houses

Sulphur dioxide removal is equivalent to:

- Annual sulphur dioxide emissions from 4,100 family cars
- Annual sulphur dioxide emissions from 11 single-family houses

Carbon sequestration is equivalent to:

- Annual carbon (C) emissions from 300 family cars
- Annual C emissions from 100 single-family houses

Oxygen Production is equivalent to:

- Annual Oxygen intake from 3,744 people

Municipal carbon emissions are based on 2010 U.S. per capita carbon emissions (Carbon Dioxide Information Analysis Center 2010). Per capita emissions were multiplied by city population to estimate total city carbon emissions.

Light duty vehicle emission rates (g/mi) for CO, NOx, VOCs, PM, SO2 for 2010 (Bureau of Transportation Statistics 2010; Heirigs et al 2004), PM2.5 for 2011-2015 (California Air Resources Board 2013), and CO_2 for 2011 (U.S. Environmental Protection Agency 2010) were multiplied by average miles driven per vehicle in 2011 (Federal Highway Administration 2013) to determine average emissions per vehicle.

Household emissions are based on average electricity kWh usage, natural gas Btu usage, fuel oil Btu usage, kerosene Btu usage, LPG Btu usage, and wood Btu usage per household in 2009 (Energy Information Administration 2013; Energy Information Administration 2014)

- CO_2, SO2, and NOx power plant emission per KWh are from Leonardo Academy 2011. CO emission per kWh assumes 1/3 of one percent of C emissions is CO based on Energy Information Administration 1994. PM emission per kWh from Layton 2004.
- CO_2, NOx, SO2, and CO emission per Btu for natural gas, propane and butane (average used to represent LPG), Fuel #4 and #6 (average used to represent fuel oil and kerosene) from Leonardo Academy 2011.
- CO_2 emissions per Btu of wood from Energy Information Administration 2014.
- CO, NOx and SOx emission per Btu based on total emissions and wood burning (tons) from (British Columbia Ministry 2005; Georgia Forestry Commission 2009).

Oxygen production figures are based on the total oxygen produced by the trees within the inventory divided by the average intake of oxygen for each person per year - https://ntrs.nasa.gov/search.jsp?R=20060005209

Appendix II. Species Dominance Ranking List

Species	Percent Population	Percent Leaf Area	Dominance Value
Platanus x acerifolia	6.20	23.90	30.20
Acer pseudoplatanus	8.20	11.60	19.80
Fraxinus excelsior	6.20	6.40	12.50
Acer platanoides	3.90	5.30	9.20
Prunus	5.80	2.70	8.50
Tilia x europaea	3.10	5.40	8.40
Prunus avium	3.40	2.40	5.80
Sorbus aucuparia	4.20	1.40	5.50
Tilia cordata	2.50	2.80	5.30
Aesculus hippocastanum	1.50	3.40	4.80
Quercus robur	1.80	2.50	4.30
Acer campestre	2.30	1.30	3.60
Robinia pseudoacacia	1.80	1.80	3.60
Malus	2.30	0.60	2.90
Sorbus aria	1.60	1.20	2.80
Tilia	1.10	1.50	2.60
Betula pendula	1.80	0.60	2.40
Thuja plicata	1.50	1.00	2.40
Acer platanoides 'Columnare'	1.00	1.20	2.30
Sambucus nigra	1.80	0.20	2.00
Crataegus monogyna	1.70	0.30	2.00
Acer saccharinum	0.70	1.20	1.90
Malus tschonoskii	1.30	0.50	1.90
Pyrus calleryana 'Chanticleer'	1.40	0.40	1.80
Sorbus intermedia	1.00	0.70	1.70
Chamaecyparis lawsoniana	1.10	0.60	1.70
Ailanthus altissima	0.80	0.90	1.70
Alnus cordata	0.80	0.70	1.50
Prunus cerasifera	0.80	0.50	1.30

Species	Percent Population	Percent Leaf Area	Dominance Value
Betula utilis	1.00	0.20	1.20
Prunus padus	0.70	0.50	1.20
Fraxinus angustifolia 'Raywood'	0.60	0.60	1.20
Populus nigra 'Italica'	0.50	0.70	1.20
Taxus baccata	0.60	0.60	1.10
Carpinus betulus	0.70	0.40	1.10
Prunus subhirtella	0.90	0.20	1.00
Liquidambar styraciflua	0.80	0.20	1.00
Corylus colurna	0.60	0.40	1.00
Ilex aquifolium	0.80	0.20	0.90
Tilia platyphyllos	0.30	0.50	0.90
Prunus Kanzan	0.50	0.30	0.80
Fagus sylvatica	0.30	0.50	0.80
Betula	0.60	0.20	0.70
Acer platanoides 'Crimson King'	0.30	0.40	0.70
Amelanchier	0.60	<0.10	0.70
Betula pubescens	0.40	0.20	0.70
Betula ermanii	0.50	0.10	0.70
Juglans regia	0.20	0.40	0.60
Fraxinus ornus	0.40	0.20	0.60
Acer	0.30	0.30	0.60
Quercus cerris	0.30	0.30	0.60
Cupressocyparis leylandii	0.40	0.20	0.60
Salix caprea	0.40	0.20	0.60
Salix alba	0.30	0.30	0.50
Sorbus	0.40	0.10	0.50
Quercus/live ilex	0.20	0.30	0.50
Populus	0.20	0.30	0.50
Ulmus	0.30	0.30	0.50
Crataegus	0.40	0.10	0.50
Fraxinus	0.20	0.20	0.40

Species	Percent Population	Percent Leaf Area	Dominance Value
Cotoneaster	0.30	0.10	0.40
Pyrus	0.30	0.10	0.40
Prunus sargentii	0.30	0.10	0.40
Laurus nobilis	0.30	0.10	0.40
Pinus sylvestris	0.20	0.20	0.40
Tilia tomentosa	0.20	0.20	0.40
Pterocarya fraxinifolia	0.10	0.30	0.40
Ligustrum lucidum	0.30	0.10	0.40
Prunus laurocerasus	0.30	0.10	0.40
Sorbus x thuringiaca	0.20	0.20	0.40
Acer cappadocicum	0.10	0.20	0.40
Pyrus calleryana	0.30	0.10	0.40
Crataegus prunifolia	0.30	<0.10	0.40
Alnus glutinosa	0.20	0.10	0.40
Cedrus deodara	0.10	0.20	0.30
Populus canescens	0.10	0.20	0.30
Aesculus x carnea	0.10	0.20	0.30
Acer negundo	0.20	0.20	0.30
Ginkgo biloba	0.30	0.10	0.30
Chamaecyparis	0.20	0.10	0.30
Betula albo-sinensis	0.30	<0.10	0.30
Ilex altaclarensis	0.20	0.10	0.30
Corylus avellana	0.20	0.10	0.30
Salix x sepulcralis Simonkai	0.10	0.20	0.30
Prunus lusitanica	0.20	0.10	0.30
Populus nigra	0.10	0.20	0.30
Ficus carica	0.20	0.10	0.30
Carpinus betulus 'Fastigiata'	0.20	0.10	0.30
Liriodendron tulipifera	0.20	0.10	0.30
Prunus serrula	0.20	0.10	0.30
Castanea sativa	0.10	0.10	0.30
Eucalyptus gunnii	0.10	0.10	0.30

Species	Percent Population	Percent Leaf Area	Dominance Value
Pinus nigra	0.10	0.10	0.20
Sequoia sempervirens	0.10	0.20	0.20
Pyrus communis	0.20	0.10	0.20
Acer rubrum	0.10	0.10	0.20
Ulmus parvifolia	0.10	0.10	0.20
Salix	0.10	0.10	0.20
Prunus cerasifera var. nigra	0.10	0.10	0.20
Laburnum anagyroides	0.10	0.10	0.20
Prunus maackii	0.20	<0.10	0.20
Platanus orientalis	<0.10	0.20	0.20
Catalpa bignonioides	0.10	0.10	0.20
Prunus domestica	0.20	<0.10	0.20
Tilia mongolica	0.20	<0.10	0.20
Ostrya carpinifolia	0.10	0.10	0.20
Fagus sylvatica 'Purpurea'	0.10	0.10	0.20
Olea europaea	0.10	<0.10	0.20
Araucaria araucana	0.10	0.10	0.20
Quercus rubra	0.10	0.10	0.20
Ulmus procera	0.10	0.10	0.20
Buddleja davidii	0.10	<0.10	0.20
Gleditsia triacanthos	0.10	<0.10	0.10
Eriobotrya japonica	0.10	<0.10	0.10
Pinus	0.10	0.10	0.10
Magnolia	0.10	<0.10	0.10
Cupressus	0.10	<0.10	0.10
Gleditsia triacanthos 'Sunburst'	0.10	<0.10	0.10
Metasequoia glyptostroboides	0.10	0.10	0.10
Ilex	0.10	<0.10	0.10
Populus tremula	0.10	0.10	0.10
Tilia cordata 'Greenspire'	0.10	<0.10	0.10
Betula papyrifera	0.10	<0.10	0.10

Species	Percent Population	Percent Leaf Area	Dominance Value
Quercus	0.10	<0.10	0.10
Rhus	0.10	<0.10	0.10
Lagerstroemia indica	0.10	<0.10	0.10
Ulmus glabra	0.10	<0.10	0.10
Populus alba	<0.10	0.10	0.10
Taxus baccata 'fastigiata'	0.10	<0.10	0.10
Fraxinus excelsior 'Pendula'	<0.10	0.10	0.10
Koelreuteria paniculata	0.10	<0.10	0.10
Salix babylonica	0.10	<0.10	0.10
Aesculus	<0.10	0.10	0.10
Acer rubrum 'Red Sunset'	0.10	<0.10	0.10
Tilia euchlora	<0.10	<0.10	0.10
Prunus spinosa	0.10	<0.10	0.10
Sorbus torminalis	0.10	<0.10	0.10
Salix fragilis	<0.10	<0.10	0.10
Cupressus macrocarpa	<0.10	<0.10	0.10
Crataegus x lavallei	0.10	<0.10	0.10
Sorbus commixta	0.10	<0.10	0.10
Cercis siliquastrum	0.10	<0.10	0.10
Sequoiadendron giganteum	<0.10	<0.10	0.10
Syringa vulgaris	0.10	<0.10	0.10
Acer saccharum	<0.10	<0.10	0.10
Pyrus salicifolia	0.10	<0.10	0.10
Morus nigra	<0.10	<0.10	0.10
Alnus incana	<0.10	<0.10	0.10
Picea abies	<0.10	<0.10	0.10
Pinus wallichiana	<0.10	<0.10	0.10
Nothofagus antarctica	<0.10	<0.10	0.10
Populus nigra betulifolia	<0.10	<0.10	0.10
Eucalyptus	<0.10	<0.10	0.10
Quercus robur 'Fastigiata'	0.10	<0.10	0.10
Cedrus atlantica	<0.10	<0.10	0.10

Species	Percent Population	Percent Leaf Area	Dominance Value
Abies	<0.10	<0.10	0.10
Aesculus indica	<0.10	<0.10	0.10
Betula nigra	0.10	<0.10	0.10
Cedrus atlantica glauca	<0.10	<0.10	0.10
Parrotia persica	0.10	<0.10	0.10
Pyracantha	<0.10	<0.10	0.10
Ligustrum vulgare	<0.10	<0.10	0.10
Paulownia tomentosa	<0.10	<0.10	0.10
Crataegus crus-galli	<0.10	<0.10	0.10
Liriodendron tulipifera Fastigiatum	<0.10	<0.10	0.10
Morus alba	<0.10	<0.10	<0.10
Prunus dulcis	<0.10	<0.10	<0.10
Ligustrum japonicum	<0.10	<0.10	<0.10
Platanus occidentalis	<0.10	<0.10	<0.10
Zelkova serrata	<0.10	<0.10	<0.10
Magnolia kobus	<0.10	<0.10	<0.10
Prunus serrulata	<0.10	<0.10	<0.10
Juglans nigra	<0.10	<0.10	<0.10
Betula lenta	<0.10	<0.10	<0.10
Cytisus	<0.10	<0.10	<0.10
Sophora japonica	<0.10	<0.10	<0.10
Quercus palustris	<0.10	<0.10	<0.10
Cryptomeria japonica	<0.10	<0.10	<0.10
Malus baccata	<0.10	<0.10	<0.10
Cedrus libani	<0.10	<0.10	<0.10
Acer davidii	<0.10	<0.10	<0.10
Nothofagus obliqua	<0.10	<0.10	<0.10
Pittosporum tenuifolium	<0.10	<0.10	<0.10
Chitalpa tashkentensis	<0.10	<0.10	<0.10
Magnolia grandiflora	<0.10	<0.10	<0.10
Quercus coccinea	<0.10	<0.10	<0.10

Species	Percent Population	Percent Leaf Area	Dominance Value
Acer capillipes	<0.10	<0.10	<0.10
Acer x freemanii	<0.10	<0.10	<0.10
Acer palmatum	<0.10	<0.10	<0.10
Laburnum	<0.10	<0.10	<0.10
Cotoneaster watereri	<0.10	<0.10	<0.10
Cotoneaster franchetii	<0.10	<0.10	<0.10
Malus sylvestris	<0.10	<0.10	<0.10
Ulmus 'New Horizon'	<0.10	<0.10	<0.10
Buxus sempervirens	<0.10	<0.10	<0.10
Acer pensylvanicum	<0.10	<0.10	<0.10
Ceanothus	<0.10	<0.10	<0.10
Populus euramericana x nigra	<0.10	<0.10	<0.10
Taxodium distichum	<0.10	<0.10	<0.10
Acacia dealbata	<0.10	<0.10	<0.10
Photinia serrulata	<0.10	<0.10	<0.10
Malus floribunda	<0.10	<0.10	<0.10
Tilia petiolaris	<0.10	<0.10	<0.10
Acer griseum	<0.10	<0.10	<0.10
Quercus hispanica	<0.10	<0.10	<0.10
Acer monspessulanum	<0.10	<0.10	<0.10
Picea omorika	<0.10	<0.10	<0.10
Acer rubrum 'Armstrong'	<0.10	<0.10	<0.10
Picea glauca	<0.10	<0.10	<0.10
Celtis occidentalis	<0.10	<0.10	<0.10
Malus x purpurea v eleyi	<0.10	<0.10	<0.10
Acer ginnala	<0.10	<0.10	<0.10
Abies koreana	<0.10	<0.10	<0.10
Chamaecyparis nootkatensis	<0.10	<0.10	<0.10
Cornus alba	<0.10	<0.10	<0.10
Alnus	<0.10	<0.10	<0.10
Tamarix tetragyna	<0.10	<0.10	<0.10

Species	Percent Population	Percent Leaf Area	Dominance Value
Fraxinus pennsylvanica 'Summit'	<0.10	<0.10	<0.10
Quercus frainetto	<0.10	<0.10	<0.10
Quercus petraea	<0.10	<0.10	<0.10
Viburnum lantana	<0.10	<0.10	<0.10
Aesculus parviflora	<0.10	<0.10	<0.10
Fraxinus americana 'Autumn Purple'	<0.10	<0.10	<0.10
Arbutus unedo	<0.10	<0.10	<0.10
Laburnum x watereri	<0.10	<0.10	<0.10
Thuja	<0.10	<0.10	<0.10
Sorbus hupehensis	<0.10	<0.10	<0.10
Salix alba 'Tristis'	<0.10	<0.10	<0.10
Koelreuteria paniculata Fastigiata	<0.10	<0.10	<0.10
Thuja occidentalis	<0.10	<0.10	<0.10
Amelanchier asiatica	<0.10	<0.10	<0.10
Fraxinus oxycarpa	<0.10	<0.10	<0.10
Aesculus x carnea 'Briottii'	<0.10	<0.10	<0.10
Cercidiphyllum japonicum	<0.10	<0.10	<0.10
Larix decidua	<0.10	<0.10	<0.10
Garrya elliptica	<0.10	<0.10	<0.10
Robinia	<0.10	<0.10	<0.10
Zelkova carpinifolia	<0.10	<0.10	<0.10
Cornus mas	<0.10	<0.10	<0.10
Magnolia denudata	<0.10	<0.10	<0.10
Acer platanoides 'Fairview'	<0.10	<0.10	<0.10
Platycladus orientalis	<0.10	<0.10	<0.10
Davidia involucrata	<0.10	<0.10	<0.10
Salix cinerea	<0.10	<0.10	<0.10
Juniperus virginiana	<0.10	<0.10	<0.10
Larix kaempferi	<0.10	<0.10	<0.10
Acer campestre 'Queen Elizabeth'	<0.10	<0.10	<0.10

Species	Percent Population	Percent Leaf Area	Dominance Value
Acer pseudoplatanus 'Spaethii'	<0.10	<0.10	<0.10
Cornus controversa	<0.10	<0.10	<0.10
Tilia americana	<0.10	<0.10	<0.10
Cotinus	<0.10	<0.10	<0.10
Mespilus germanica	<0.10	<0.10	<0.10
Acer rubrum 'October glory'	<0.10	<0.10	<0.10
Cupressus sempervirens	<0.10	<0.10	<0.10
Prunus fruticosa	<0.10	<0.10	<0.10
Pinus coulteri	<0.10	<0.10	<0.10
Salix viminalis	<0.10	<0.10	<0.10
Populus lasiocarpa	<0.10	<0.10	<0.10
Platanus	<0.10	<0.10	<0.10
Calocedrus decurrens	<0.10	<0.10	<0.10
Sorbus latifolia	<0.10	<0.10	<0.10
Pinus mugo	<0.10	<0.10	<0.10
Magnolia x soulangiana	<0.10	<0.10	<0.10
Acer japonicum	<0.10	<0.10	<0.10
Cornus kousa	<0.10	<0.10	<0.10
Prunus persica	<0.10	<0.10	<0.10
Cercis canadensis	<0.10	<0.10	<0.10
Populus trichocarpa	<0.10	<0.10	<0.10
Juniperus communis	<0.10	<0.10	<0.10
Sorbus sargentiana	<0.10	<0.10	<0.10
Malus toringoides	<0.10	<0.10	<0.10
Viburnum plicatum	<0.10	<0.10	<0.10
Viburnum	<0.10	<0.10	<0.10
Quercus castaneifolia	<0.10	<0.10	<0.10
Cupressus funebris	<0.10	<0.10	<0.10
Phellodendron amurense	<0.10	<0.10	<0.10
Ulmus minor	<0.10	<0.10	<0.10
Cotinus coggygria	<0.10	<0.10	<0.10

Species	Percent Population	Percent Leaf Area	Dominance Value
Elaeagnus	<0.10	<0.10	<0.10
Ziziphus	<0.10	<0.10	<0.10
Eucalyptus pauciflora pauci.	<0.10	<0.10	<0.10
Eucalyptus coccifera	<0.10	<0.10	<0.10

Appendix III. Tree Values by Species

Species	Trees	Carbon Storage (Tonnes)	Gross Carbon Seq (Tonnes/ Yr)	Avoided Runoff (m³/Yr)	Pollution Removal (Tonne/ Yr)	Replacement Cost (£)
Platanus x acerifolia	2482	5144.18	78.69	3759.60	1.94	£ 14842089.51
Acer pseudoplatanus	3272	1816.23	44.88	1822.99	0.94	£ 5607875.91
Fraxinus excelsior	2450	1006.35	24.40	1001.76	0.52	£ 3567498.75
Acer platanoides	1537	595.40	17.68	840.00	0.43	£ 1893199.69
Tilia x europaea	1217	686.09	15.98	843.98	0.43	£ 3541559.27
Aesculus hippocastanum	594	1103.17	17.88	527.50	0.27	£ 2108296.30
Tilia cordata	987	346.10	9.06	440.56	0.23	£ 1726119.33
Prunus	2296	443.24	17.07	426.18	0.22	£ 1058466.09
Quercus robur	725	784.73	16.31	390.58	0.20	£ 1977746.38
Prunus avium	1358	516.80	16.88	374.76	0.19	£ 1434677.93
Robinia pseudoacacia	706	429.90	10.91	280.14	0.14	£ 1327562.82
Tilia	455	179.34	4.49	235.01	0.12	£ 926520.59
Sorbus aucuparia	1655	175.71	8.13	217.70	0.11	£ 495015.82
Acer campestre	909	126.03	4.97	211.27	0.11	£ 336692.79
Acer saccharinum	290	220.17	4.42	191.28	0.10	£ 771359.06
Acer platanoides 'Columnare'	409	132.17	4.31	192.96	0.10	£ 388611.38
Sorbus aria	652	202.57	6.95	182.61	0.09	£ 655012.06
Thuja plicata	578	95.72	2.07	151.76	0.08	£ 983913.97
Ailanthus altissima	311	230.78	5.49	141.53	0.07	£ 656029.42
Alnus cordata	315	143.87	4.18	112.12	0.06	£ 451057.64
Sorbus intermedia	407	117.30	4.10	108.25	0.06	£ 377670.75
Populus nigra 'Italica'	185	175.54	3.80	109.82	0.06	£ 675102.33
Betula pendula	722	114.94	5.04	97.96	0.05	£ 300937.75
Malus	920	77.15	3.76	96.92	0.05	£ 244567.44
Chamaecyparis lawsoniana	422	114.16	2.57	99.41	0.05	£ 494778.10
Fraxinus angustifolia 'Raywood'	229	87.37	2.53	101.31	0.05	£ 320008.61
Taxus baccata	229	58.17	1.39	87.54	0.05	£ 337539.54
Malus tschonoskii	527	70.37	3.42	84.72	0.04	£ 211509.40

Species	Trees	Carbon Storage (Tonnes)	Gross Carbon Seq (Tonnes/ Yr)	Avoided Runoff (m^3/Yr)	Pollution Removal (Tonne/ Yr)	Replacement Cost (£)
Prunus cerasifera	308	87.08	3.16	77.01	0.04	£ 169952.91
Prunus padus	292	74.38	3.03	76.66	0.04	£ 202447.92
Tilia platyphyllos	139	69.94	1.65	85.62	0.04	£ 363478.66
Fagus sylvatica	112	78.98	1.60	74.84	0.04	£ 207359.50
Crataegus monogyna	669	80.32	3.49	51.21	0.03	£ 224803.11
Pyrus calleryana 'Chanticleer'	575	78.55	3.44	61.29	0.03	£ 234614.66
Prunus Kanzan	207	50.68	2.00	49.95	0.03	£ 121231.89
Corylus colurna	245	46.55	1.84	57.28	0.03	£ 140543.95
Carpinus betulus	270	47.66	1.78	61.23	0.03	£ 153398.36
Acer platanoides 'Crimson King'	128	45.61	1.41	62.72	0.03	£ 137751.76
Juglans regia	88	38.91	1.13	61.80	0.03	£ 121731.74
Sambucus nigra	719	59.02	2.97	38.04	0.02	£ 173267.05
Quercus cerris	104	95.56	2.20	47.95	0.02	£ 247349.30
Quercus/live ilex	90	100.68	2.00	45.04	0.02	£ 254494.09
Salix alba	113	77.98	1.75	40.67	0.02	£ 236278.15
Populus	86	84.71	1.67	46.33	0.02	£ 281856.36
Pterocarya fraxinifolia	51	90.89	1.52	42.41	0.02	£ 237185.49
Betula pubescens	174	33.45	1.44	38.72	0.02	£ 87478.92
Betula utilis	408	28.98	1.30	35.36	0.02	£ 74315.73
Aesculus x carnea	42	64.53	1.25	36.40	0.02	£ 195008.43
Populus canescens	53	50.87	1.11	32.20	0.02	£ 196641.82
Acer	115	31.81	1.06	45.78	0.02	£ 93266.30
Ulmus	102	42.32	0.94	40.00	0.02	£ 54728.79
Fraxinus ornus	149	25.20	0.85	32.63	0.02	£ 89040.31
Cedrus deodara	55	52.76	0.83	31.76	0.02	£ 347515.14
Acer cappadocicum	59	30.76	0.82	34.51	0.02	£ 95306.46
Fraxinus	99	23.74	0.77	29.93	0.02	£ 84488.39
Ilex aquifolium	301	38.18	1.63	28.65	0.01	£ 109603.14
Salix x sepulcralis Simonkai	51	56.92	1.20	25.19	0.01	£ 179302.21

Species	Trees	Carbon Storage (Tonnes)	Gross Carbon Seq (Tonnes/ Yr)	Avoided Runoff (m³/Yr)	Pollution Removal (Tonne/ Yr)	Replacement Cost (£)	
Salix caprea	157	25.81	1.02	24.79	0.01	£	75587.80
Prunus subhirtella	343	18.61	1.01	24.86	0.01	£	44467.29
Sorbus x thuringiaca	87	28.67	0.98	26.25	0.01	£	94083.51
Betula	234	18.37	0.96	24.91	0.01	£	39492.67
Pyrus	119	23.99	0.92	17.65	0.01	£	77765.61
Alnus glutinosa	86	23.37	0.78	22.16	0.01	£	71743.60
Populus nigra	51	41.75	0.77	23.67	0.01	£	141658.17
Pyrus calleryana	102	18.83	0.74	16.61	0.01	£	63249.55
Sorbus	160	16.21	0.74	19.81	0.01	£	47654.83
Betula ermanii	218	12.55	0.74	19.35	0.01	£	30577.31
Acer negundo	66	24.06	0.73	26.86	0.01	£	73848.13
Eucalyptus gunnii	44	31.45	0.72	22.38	0.01	£	64179.90
Liquidambar styraciflua	338	16.95	0.72	26.81	0.01	£	42106.64
Cupressocyparis leylandii	161	22.82	0.66	24.60	0.01	£	102101.38
Laurus nobilis	118	14.99	0.63	16.99	0.01	£	41111.42
Prunus laurocerasus	118	11.98	0.62	15.24	0.01	£	26719.83
Catalpa bignonioides	49	26.32	0.61	10.70	0.01	£	73253.87
Castanea sativa	49	31.41	0.59	22.05	0.01	£	89303.18
Pinus sylvestris	93	24.19	0.59	25.95	0.01	£	141517.88
Sequoia sempervirens	29	37.91	0.55	25.75	0.01	£	176990.34
Tilia tomentosa	85	19.79	0.54	29.10	0.01	£	102311.09
Prunus sargentii	130	11.17	0.53	12.90	0.01	£	26653.01
Pinus nigra	54	27.27	0.52	16.57	0.01	£	231324.88
Prunus cerasifera var. nigra	52	15.56	0.52	12.62	0.01	£	38132.00
Pyrus communis	68	13.54	0.52	10.03	0.01	£	44965.90
Ulmus parvifolia	32	21.75	0.51	22.54	0.01	£	32206.65
Fagus sylvatica 'Purpurea'	20	29.19	0.50	18.38	0.01	£	77522.92
Salix	55	17.55	0.50	11.86	0.01	£	54756.37
Cotoneaster	136	9.69	0.50	13.25	0.01	£	18993.92
Platanus orientalis	12	47.03	0.46	25.76	0.01	£	126183.58

Species	Trees	Carbon Storage (Tonnes)	Gross Carbon Seq (Tonnes/ Yr)	Avoided Runoff (m^3/Yr)	Pollution Removal (Tonne/ Yr)	Replacement Cost (£)
Prunus serrula	76	9.70	0.46	11.64	0.01	£ 22672.49
Prunus lusitanica	85	9.50	0.46	11.63	0.01	£ 22196.29
Carpinus betulus 'Fastigiata'	66	10.57	0.45	16.42	0.01	£ 33444.65
Quercus rubra	34	16.54	0.44	11.42	0.01	£ 48529.42
Ligustrum lucidum	124	7.54	0.42	13.14	0.01	£ 12388.08
Ficus carica	75	10.82	0.41	12.99	0.01	£ 30342.47
Acer rubrum	50	10.18	0.41	16.44	0.01	£ 30318.46
Populus tremula	21	18.70	0.37	11.14	0.01	£ 68137.12
Ginkgo biloba	101	9.76	0.37	9.76	0.01	£ 27613.03
Ostrya carpinifolia	40	9.63	0.34	10.87	0.01	£ 31630.37
Laburnum anagyroides	58	8.01	0.32	10.12	0.01	£ 17205.35
Chamaecyparis	92	10.28	0.31	11.30	0.01	£ 44231.85
Liriodendron tulipifera	63	11.62	0.30	17.55	0.01	£ 38421.33
Araucaria araucana	27	9.66	0.22	14.89	0.01	£ 56501.66
Crataegus	157	12.29	0.63	8.93	<0.01	£ 33251.03
Ilex altaclarensis	96	12.90	0.51	8.83	<0.01	£ 37899.00
Amelanchier	258	4.01	0.36	7.41	<0.01	£ 16698.18
Populus alba	18	15.50	0.35	9.64	<0.01	£ 62197.11
Gleditsia triacanthos	42	9.24	0.34	5.66	<0.01	£ 26194.80
Salix fragilis	15	15.55	0.33	7.22	<0.01	£ 48987.77
Crataegus prunifolia	129	5.28	0.33	5.28	<0.01	£ 15432.87
Fraxinus excelsior 'Pendula'	18	13.08	0.29	9.48	<0.01	£ 50878.99
Quercus	29	9.01	0.28	6.43	<0.01	£ 24970.10
Gleditsia triacanthos 'Sunburst'	41	7.66	0.27	4.42	<0.01	£ 20432.09
Populus nigra betulifolia	7	16.56	0.26	7.62	<0.01	£ 54847.73
Aesculus	14	11.12	0.26	9.54	<0.01	£ 28649.08
Corylus avellana	97	8.75	0.26	7.91	<0.01	£ 23636.41
Prunus domestica	60	3.74	0.22	5.44	<0.01	£ 6958.56
Betula albo-sinensis	104	2.84	0.22	5.74	<0.01	£ 7528.86
Cupressus macrocarpa	19	11.13	0.21	5.40	<0.01	£ 53519.49

Species	Trees	Carbon Storage (Tonnes)	Gross Carbon Seq (Tonnes/ Yr)	Avoided Runoff (m³/Yr)	Pollution Removal (Tonne/ Yr)	Replacement Cost (£)
Acer saccharum	12	7.28	0.21	7.06	<0.01	£ 20081.76
Pinus	32	9.05	0.20	8.28	<0.01	£ 56343.50
Salix babylonica	26	5.05	0.20	4.97	<0.01	£ 15620.21
Ilex	41	4.62	0.20	3.53	<0.01	£ 11819.51
Morus nigra	18	7.88	0.19	4.55	<0.01	£ 21056.58
Ulmus procera	40	4.42	0.19	9.02	<0.01	£ 6854.77
Sorbus torminalis	21	4.71	0.18	5.05	<0.01	£ 15301.57
Aesculus indica	9	7.17	0.17	6.16	<0.01	£ 19361.70
Eucalyptus	13	7.03	0.17	5.02	<0.01	£ 14411.97
Eriobotrya japonica	43	3.16	0.17	4.43	<0.01	£ 6190.33
Platanus occidentalis	4	9.82	0.16	5.93	<0.01	£ 28059.61
Cedrus atlantica	11	12.70	0.15	5.70	<0.01	£ 65528.72
Sequoiadendron giganteum	15	11.26	0.15	6.46	<0.01	£ 44770.09
Taxus baccata 'fastigiata'	23	8.41	0.15	7.53	<0.01	£ 50605.29
Magnolia	39	3.20	0.15	5.39	<0.01	£ 9611.59
Betula papyrifera	37	2.70	0.15	3.44	<0.01	£ 7119.40
Pinus wallichiana	11	7.47	0.14	6.12	<0.01	£ 47176.81
Paulownia tomentosa	16	4.55	0.14	2.11	<0.01	£ 13199.97
Koelreuteria paniculata	30	3.75	0.14	4.61	<0.01	£ 11141.54
Tilia cordata 'Greenspire'	31	3.44	0.14	7.17	<0.01	£ 16967.21
Cedrus atlantica glauca	13	9.03	0.13	4.28	<0.01	£ 46386.83
Metasequoia glyptostroboides	31	4.69	0.13	8.11	<0.01	£ 23080.97
Tilia euchlora	17	4.14	0.13	6.87	<0.01	£ 21254.88
Alnus incana	19	3.52	0.13	4.06	<0.01	£ 10484.17
Ulmus glabra	27	3.45	0.13	6.12	<0.01	£ 5259.19
Pyrus salicifolia	24	2.72	0.13	2.27	<0.01	£ 7778.43
Olea europaea	55	2.46	0.13	4.32	<0.01	£ 7144.75
Prunus maackii	71	1.54	0.13	3.23	<0.01	£ 4444.60
Nothofagus antarctica	15	3.21	0.12	4.51	<0.01	£ 6525.15
Cupressus	46	3.12	0.12	2.45	<0.01	£ 12741.62

Species	Trees	Carbon Storage (Tonnes)	Gross Carbon Seq (Tonnes/ Yr)	Avoided Runoff (m³/Yr)	Pollution Removal (Tonne/ Yr)	Replacement Cost (£)	
Crataegus x lavallei	27	2.72	0.12	2.11	<0.01	£	8211.22
Buddleja davidii	54	1.61	0.12	3.41	<0.01	£	3781.16
Quercus palustris	10	3.79	0.11	2.22	<0.01	£	10777.82
Sophora japonica	10	3.08	0.10	2.43	<0.01	£	8917.51
Zelkova serrata	11	3.00	0.10	3.15	<0.01	£	8399.10
Crataegus crus-galli	18	2.40	0.10	1.27	<0.01	£	7155.11
Prunus serrulata	11	2.07	0.10	2.49	<0.01	£	4925.20
Quercus hispanica	4	4.02	0.09	1.90	<0.01	£	10373.72
Picea abies	15	3.73	0.09	5.20	<0.01	£	10662.06
Cercis siliquastrum	26	2.91	0.09	2.26	<0.01	£	8830.43
Quercus robur 'Fastigiata'	20	2.40	0.09	2.20	<0.01	£	6638.23
Prunus dulcis	14	2.10	0.09	2.10	<0.01	£	3905.58
Pyracantha	17	1.87	0.09	2.31	<0.01	£	4912.83
Prunus spinosa	28	1.77	0.09	2.44	<0.01	£	5401.87
Morus alba	13	2.14	0.08	2.60	<0.01	£	6302.51
Quercus coccinea	8	2.00	0.08	1.95	<0.01	£	5889.11
Tilia mongolica	60	1.49	0.08	3.91	<0.01	£	8350.56
Syringa vulgaris	29	1.40	0.08	0.92	<0.01	£	3040.51
Salix alba 'Tristis'	2	3.70	0.07	1.29	<0.01	£	11022.73
Quercus frainetto	3	2.75	0.07	1.40	<0.01	£	7607.65
Abies	13	2.28	0.07	4.76	<0.01	£	9072.13
Nothofagus obliqua	7	1.85	0.07	2.97	<0.01	£	4170.15
Malus sylvestris	8	1.79	0.07	1.49	<0.01	£	6049.43
Cytisus	11	1.62	0.07	2.22	<0.01	£	4469.97
Quercus petraea	2	7.04	0.06	1.79	<0.01	£	15093.31
Cedrus libani	9	3.38	0.06	2.26	<0.01	£	21096.25
Acer monspessulanum	3	2.56	0.06	2.24	<0.01	£	7915.53
Juglans nigra	9	1.44	0.06	3.26	<0.01	£	4503.14
Acer davidii	8	1.37	0.06	2.62	<0.01	£	3446.48
Pittosporum tenuifolium	10	1.36	0.06	1.71	<0.01	£	3834.20

Species	Trees	Carbon Storage (Tonnes)	Gross Carbon Seq (Tonnes/ Yr)	Avoided Runoff (m³/Yr)	Pollution Removal (Tonne/ Yr)	Replacement Cost (£)	
Rhus	41	0.67	0.06	0.74	<0.01	£	2239.93
Populus euramericana x nigra	3	9.12	0.05	2.97	<0.01	£	26148.72
Taxodium distichum	4	3.30	0.05	2.43	<0.01	£	16470.92
Tilia petiolaris	3	2.22	0.05	2.54	<0.01	£	11526.92
Aesculus parviflora	2	2.08	0.05	1.70	<0.01	£	5450.82
Acacia dealbata	6	1.77	0.05	1.59	<0.01	£	5438.25
Malus floribunda	7	1.10	0.05	1.09	<0.01	£	3735.19
Ligustrum japonicum	15	0.98	0.05	1.61	<0.01	£	2031.31
Parrotia persica	20	0.82	0.05	1.26	<0.01	£	1919.62
Ligustrum vulgare	19	0.69	0.05	1.36	<0.01	£	1233.92
Acer rubrum 'Red Sunset'	31	0.49	0.05	1.62	<0.01	£	1841.39
Lagerstroemia indica	40	0.40	0.05	1.12	<0.01	£	2050.72
Acer ginnala	2	2.08	0.04	2.12	<0.01	£	6484.66
Chamaecyparis nootkatensis	3	1.97	0.04	1.51	<0.01	£	9040.56
Cryptomeria japonica	9	1.62	0.04	2.53	<0.01	£	7263.19
Picea glauca	4	1.37	0.04	1.41	<0.01	£	4909.26
Laburnum	9	1.10	0.04	1.22	<0.01	£	2350.93
Acer pensylvanicum	6	0.92	0.04	1.87	<0.01	£	2372.79
Acer capillipes	8	0.88	0.04	1.77	<0.01	£	2155.89
Cotoneaster franchetii	9	0.87	0.04	1.16	<0.01	£	1666.53
Betula nigra	22	0.46	0.04	1.01	<0.01	£	1744.17
Celtis occidentalis	4	0.76	0.03	1.35	<0.01	£	2067.24
Alnus	4	0.75	0.03	1.06	<0.01	£	2284.51
Acer griseum	6	0.73	0.03	1.35	<0.01	£	2139.70
Cotoneaster watereri	10	0.47	0.03	0.79	<0.01	£	951.45
Acer palmatum	10	0.44	0.03	0.82	<0.01	£	1340.82
Fraxinus pennsylvanica 'Summit'	4	0.76	0.02	1.01	<0.01	£	2907.78
Fraxinus oxycarpa	2	0.69	0.02	0.93	<0.01	£	2549.30
Robinia	2	0.62	0.02	0.72	<0.01	£	1972.39

Species	Trees	Carbon Storage (Tonnes)	Gross Carbon Seq (Tonnes/ Yr)	Avoided Runoff (m³/Yr)	Pollution Removal (Tonne/ Yr)	Replacement Cost (£)
Zelkova carpinifolia	2	0.59	0.02	0.56	<0.01	£ 1718.03
Fraxinus americana 'Autumn Purple'	4	0.49	0.02	0.85	<0.01	£ 1502.16
Salix cinerea	2	0.41	0.02	0.46	<0.01	£ 1274.96
Malus x purpurea v eleyi	6	0.37	0.02	0.55	<0.01	£ 1024.56
Sorbus hupehensis	4	0.33	0.02	0.50	<0.01	£ 981.64
Laburnum x watereri	4	0.32	0.02	0.59	<0.01	£ 676.25
Malus baccata	13	0.29	0.02	0.71	<0.01	£ 1130.20
Magnolia kobus	15	0.27	0.02	0.98	<0.01	£ 889.77
Buxus sempervirens	10	0.25	0.02	0.38	<0.01	£ 568.99
Magnolia grandiflora	12	0.23	0.02	0.71	<0.01	£ 697.50
Chitalpa tashkentensis	12	0.22	0.02	0.74	<0.01	£ 660.50
Ceanothus	10	0.19	0.02	0.27	<0.01	£ 562.72
Sorbus commixta	30	0.14	0.02	0.71	<0.01	£ 1743.75
Pinus coulteri	1	0.41	0.01	0.44	<0.01	£ 2397.45
Populus lasiocarpa	1	0.33	0.01	0.38	<0.01	£ 1391.08
Calocedrus decurrens	1	0.30	0.01	0.32	<0.01	£ 1657.05
Thuja	4	0.27	0.01	0.53	<0.01	£ 2410.68
Garrya elliptica	3	0.21	0.01	0.42	<0.01	£ 338.96
Arbutus unedo	5	0.19	0.01	0.33	<0.01	£ 467.77
Tilia americana	1	0.19	0.01	0.46	<0.01	£ 975.66
Aesculus x carnea 'Briottii'	3	0.18	0.01	0.52	<0.01	£ 486.99
Photinia serrulata	9	0.18	0.01	0.39	<0.01	£ 506.69
Abies koreana	6	0.17	0.01	0.34	<0.01	£ 299.73
Juniperus virginiana	2	0.17	0.01	0.44	<0.01	£ 599.06
Larix decidua	3	0.15	0.01	0.42	<0.01	£ 390.85
Larix kaempferi	2	0.15	0.01	0.43	<0.01	£ 478.36
Sorbus latifolia	1	0.15	0.01	0.21	<0.01	£ 432.70
Acer x freemanii	11	0.14	0.01	0.50	<0.01	£ 639.37
Picea omorika	7	0.14	0.01	0.29	<0.01	£ 319.37

Species	Trees	Carbon Storage (Tonnes)	Gross Carbon Seq (Tonnes/ Yr)	Avoided Runoff (m³/Yr)	Pollution Removal (Tonne/ Yr)	Replacement Cost (£)	
Acer campestre 'Queen Elizabeth'	2	0.12	0.01	0.25	<0.01	£	167.59
Tamarix tetragyna	6	0.12	0.01	0.24	<0.01	£	323.39
Ulmus 'New Horizon'	10	0.12	0.01	0.45	<0.01	£	208.75
Platanus	1	0.11	0.01	0.32	<0.01	£	267.70
Amelanchier asiatica	4	0.09	0.01	0.14	<0.01	£	260.87
Cotinus	2	0.09	0.01	0.05	<0.01	£	100.34
Viburnum lantana	6	0.09	0.01	0.20	<0.01	£	348.75
Cornus alba	6	0.08	0.01	0.27	<0.01	£	235.52
Liriodendron tulipifera Fastigiatum	19	0.08	0.01	0.77	<0.01	£	974.09
Betula lenta	16	0.07	0.01	0.41	<0.01	£	930.00
Cornus mas	3	0.07	0.01	0.17	<0.01	£	133.81
Acer rubrum 'Armstrong'	7	0.05	0.01	0.25	<0.01	£	406.87
Koelreuteria paniculata Fastigiata	4	0.05	0.01	0.21	<0.01	£	205.07
Thuja occidentalis	4	0.11	<0.01	0.16	<0.01	£	481.72
Pinus mugo	1	0.10	<0.01	0.16	<0.01	£	492.38
Prunus persica	1	0.10	<0.01	0.12	<0.01	£	114.72
Cornus kousa	1	0.08	<0.01	0.12	<0.01	£	80.50
Magnolia x soulangiana	1	0.08	<0.01	0.14	<0.01	£	121.96
Acer japonicum	1	0.06	<0.01	0.13	<0.01	£	86.49
Platycladus orientalis	3	0.05	<0.01	0.09	<0.01	£	196.23
Populus trichocarpa	1	0.05	<0.01	0.05	<0.01	£	109.46
Acer platanoides 'Fairview'	3	0.04	<0.01	0.15	<0.01	£	174.37
Acer pseudoplatanus 'Spaethii'	2	0.04	<0.01	0.11	<0.01	£	116.25
Cupressus sempervirens	2	0.04	<0.01	0.05	<0.01	£	110.61
Magnolia denudata	3	0.04	<0.01	0.16	<0.01	£	174.37
Viburnum plicatum	1	0.04	<0.01	0.04	<0.01	£	66.22
Cercis canadensis	1	0.03	<0.01	0.06	<0.01	£	51.27
Eucalyptus pauciflora pauci.	1	0.03	<0.01	0.01	<0.01	£	38.36

Species	Trees	Carbon Storage (Tonnes)	Gross Carbon Seq (Tonnes/Yr)	Avoided Runoff (m³/Yr)	Pollution Removal (Tonne/Yr)	Replacement Cost (£)	
Cercidiphyllum japonicum	4	0.02	<0.01	0.08	<0.01	£	205.07
Cornus controversa	2	0.02	<0.01	0.08	<0.01	£	76.72
Cupressus funebris	1	0.02	<0.01	0.03	<0.01	£	43.70
Juniperus communis	1	0.02	<0.01	0.05	<0.01	£	38.36
Sorbus sargentiana	1	0.02	<0.01	0.05	<0.01	£	58.12
Viburnum	1	0.02	<0.01	0.03	<0.01	£	58.12
Acer rubrum 'October glory'	2	0.01	<0.01	0.05	<0.01	£	116.25
Cotinus coggygria	1	0.01	<0.01	0.02	<0.01	£	38.36
Davidia involucrata	3	0.01	<0.01	0.07	<0.01	£	153.80
Eucalyptus coccifera	1	0.01	<0.01	0.01	<0.01	£	38.36
Malus toringoides	1	0.01	<0.01	0.04	<0.01	£	58.12
Mespilus germanica	2	0.01	<0.01	0.05	<0.01	£	76.73
Prunus fruticosa	2	0.01	<0.01	0.05	<0.01	£	98.68
Quercus castaneifolia	1	0.01	<0.01	0.03	<0.01	£	58.12
Salix viminalis	2	0.01	<0.01	0.04	<0.01	£	116.25
Elaeagnus	1	<0.01	<0.01	0.01	<0.01	£	38.36
Phellodendron amurense	1	<0.01	<0.01	0.02	<0.01	£	51.27
Ulmus minor	1	<0.01	<0.01	0.02	<0.01	£	19.18
Ziziphus	1	<0.01	<0.01	0.01	<0.01	£	51.27
Total	39,805	18165.61	430.67	15720.84	8.09		£57112999.00

Appendix IV. Notes on Methodology

Data Formatting

Tables 6 and 7, below show the list of edits which were made for this project, to enable the tree inventory to be processed.

In total 44,641 records were provided.

Reason for Removal	Details	Number of records removed
No Species	There is no data in this field (a minimum requirement for iTree)	1,158
No DBH	There is no data in this field (a minimum requirement for iTree)	388
Condition = “Dead” / “Felled”	The tree has been classified as “dead” or “Felled”	215
Records disregarded for this survey	Records not required to be processed by Islington	3,075
	NUMBER OF RECORDS REMOVED	**4,836**

Table 6: Inventory Records removed for use in i-Tree

SULE Rating	Condition Rating	iTree Equivalent
Less than 20 years	Poor	62%
21-40 years	Fair	82%
41-60 years	Fair	82%
61-80 years	Good	92%
80+ years	Good	92%

Table 7: Condition ratings used in i-Tree

i-Tree Methodology

i-Tree Eco is designed to use standardised field data and local hourly air pollution and meteorological data to quantify forest structure and its numerous effects, including:

- Forest structure (e.g., species composition, tree health, leaf area, etc.).
- Amount of pollution removed hourly by trees, and its associated percent air quality improvement throughout a year. Pollution removal is calculated for ozone, sulphur dioxide, nitrogen dioxide, carbon monoxide and particulate matter (<2.5 microns).
- Total carbon stored and net carbon annually sequestered by trees.
- Effects of trees on building energy use and consequent effects on carbon dioxide emissions from power plants.
- Structural value of the forest, as well as the value for air pollution removal and carbon storage and sequestration.
- Potential impact of infestations by pests, such as Asian Longhorned beetle, emerald ash borer, gypsy moth, and Dutch elm disease.

To calculate current carbon storage, biomass for each tree was calculated using equations from the literature and measured tree data. Open-grown, maintained trees tend to have less biomass than predicted by forest-derived biomass equations[17]. To adjust for this difference, biomass results for open-grown urban trees were multiplied by 0.8. No adjustment was made for trees found in natural stand conditions. Tree dry-weight biomass was converted to stored carbon by multiplying by 0.5.

To estimate the gross amount of carbon sequestered annually, average diameter growth from the appropriate genera and diameter class and tree condition was added to the existing tree diameter (year x) to estimate tree diameter and carbon storage in year x+1.

The amount of oxygen produced is estimated from carbon sequestration based on atomic weights: net O2 release (kg/yr) = net C sequestration (kg/yr) × 32/12. To estimate the net carbon sequestration rate, the amount of carbon sequestered as a result of tree growth is reduced by the amount lost resulting from tree mortality. Thus, net carbon sequestration and net annual oxygen production of trees account for decomposition[18].

Recent updates (2011) to air quality modelling are based on improved leaf area index simulations, weather and pollution processing and interpolation, and updated pollutant monetary values.

Air pollution removal estimates are derived from calculated hourly tree-canopy resistances for ozone, and sulphur and nitrogen dioxides based on a hybrid of big-leaf and multi-layer canopy deposition models[19]. As the removal of carbon monoxide and particulate matter by vegetation is not directly related to transpiration, removal rates (deposition velocities) for these pollutants were based on average measured values from the literature[20] [21] that were adjusted depending on leaf phenology and leaf area. Particulate removal incorporated a 50 percent resuspension rate of particles back to the atmosphere[22].Annual avoided surface

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17 Nowak 1994

18 Nowak, David J., Hoehn, R., and Crane, D. 2007.

19 Baldocchi 1987, 1988

20 Bidwell and Fraser 1972

21 Lovett 1994

22 Zinke 1967

runoff is calculated based on rainfall interception by vegetation, specifically the difference between annual runoff with and without vegetation. Although tree leaves, branches and bark may intercept precipitation and thus mitigate surface runoff, only the precipitation intercepted by leaves is accounted for in this analysis. The value of avoided runoff is based on estimated or user-defined local values. As the local values include the cost of treating the water as part of a combined sewage system the lower, national average externality value for the United States is utilised and converted to local currency with user-defined exchange rates.

Replacement Costs were based on valuation procedures of the Council of Tree and Landscape Appraisers, which uses tree species, diameter, condition and location information[23] [24].

For a full review of the model see UFORE (2010) and Nowak and Crane (2000).
For UK implementation see Rogers et al (2014).
Full citation details are located in the bibliography section

CAVAT

An amended CAVAT method was chosen to assess the trees in this study, in conjunction with the CAVAT steering group (as done with previous i-Tree Eco studies in the UK).
In calculating CAVAT the following data sets are required:

- The current Unit Value,
- Diameter at Breast Height (DBH),
- The CTI (Community Tree Index) rating, reflecting local population density
- An assessment of accessibility,
- An assessment of overall functionality, (that is the health and completeness of the crown of the tree);
- An assessment of Safe Life Expectancy.

The current Unit Value is determined by the CAVAT steering group and is currently set at £15.88 (LTOA 2012).

DBH is taken directly from the field measurements.

The CTI rating is determined from the approved list (LTOA 2012) and is calculated on a borough by borough basis. The CTI for Islington is 1.25, thereby increasing the basic CAVAT value.

Accessibility, i.e. the ability of the public to benefit from the amenity value of trees, was generally judged to be 100% for trees in Parks, street trees and other open areas, and was generally reduced for residential areas and transportation networks to 60% (increased to 100% if the tree was on the street), to 80% on institutional land uses and to 40% on Agricultural plots. For this study, park trees and street trees only were included, with 100% accessibility therefore assumed.

The condition assessment was based upon the Safe Useful Life Expectancy (SULE). This therefore may not be fully accurate, especially for each individual tree.

Safe Useful Life Expectancy assessment was taken directly from the spreadsheet provided and adjusted to a percentage within the spreadsheet.

For full details of the method refer to Doick, *et al* (2018)[25]

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[23] Hollis, 2007

[24] Rogers et al (2012)

[25] Doick, *et al* (2018)

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