

Valuing Greenness
Green spaces, house prices and Londoners' priorities

June 2003



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Contents

List of maps.....	ii
List of tables.....	ii
Foreword	iii
Introduction	v
Key findings	vi
1. Benefits of green spaces.....	1
1.1 Undermining the benefits of green spaces	2
2. The approach	3
2.1 Main housing attributes	3
2.2 Comparing the indicators across London	6
3. Model results.....	18
3.1 Limitations of the hedonic pricing model	23
4. Conclusion.....	24
4.1 Segmented preferences within the population	24
4.2 Future studies.....	24
Appendix 1. Definitions.....	26
1.1 Urban green spaces	26
1.2 Green spaces used in the model	26
1.3 Sites of importance for nature conservation	27
1.4 London’s open space hierarchy	30
1.5 Health quality indicator – years of life lost	30
1.6 Dwelling density	30
Appendix 2. Semi-log model	31
Appendix 3. Acronyms.....	32
Appendix 4. References.....	33

List of maps

Map 1: London boroughs 6
Map 2: Strategic green spaces in London 7
Map 3: Average ward house sale process..... 8
Map 4: Travel time to central London by public transport..... 9
Map 5: Income support 10
Map 6: Dwelling density 11
Map 7: Education 12
Map 8: Crime 13
Map 9: Overcrowded households 14
Map 10: Air quality..... 15
Map 11: Health facilities..... 16
Map 12: Health quality..... 17

List of tables

Table 1: Indicators used in this study to explain house prices..... 4
Table 2: Descriptive statistics 18
Table 3: Borough statistics 20
Table 4: Scatter plot matrix for four significant indicators..... 22

Foreword

The environment and quality of life is a topic of great interest in London, while house prices are a source of endless interest and speculation. This report brings these two topics together.

It starts by asking how we might value the importance of open green space when nobody pays anything directly for access to them. If we cannot value such spaces – for example, parks and woodland – then there is a risk they will be underprovided and existing space will be lost.

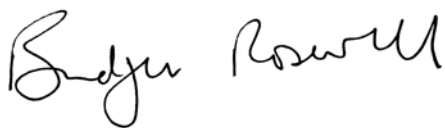
This report takes house prices as an indicator of how attractive different parts of London are and then asks to what extent house prices are affected by the amount of open green space in the local area. We can then at least partially value open green space by seeing what difference it makes to the level of house prices.

Of course to do this properly we also need to consider what else might make house prices vary. So as well as valuing greenness this report also helps us to think about the role of travel times, deprivation levels, health, schools and other environmental factors in determining the variation of house prices across London.

Open green space is indeed important but it also turns out that the rate of income support and travel times play a distinct role.

We hope this research will contribute not only to the debate about the importance of the environment to Londoners, but also to the debates on housing and on commuting.

We welcome any comments that you may have on this report and any suggestions for taking this work forward. If you are particularly interested in housing issues, you may wish to read our recent report *Market Failure and the Housing Market in London*, a study of how market forces might be operating in the London housing market. All GLA Economics reports can be found on our website at www.london.go.uk/mayor/economic_unit/index.jsp



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Valuing Greenness:

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Introduction

You buy a house for value with considerable care
For environmental externalities: views and quality of air;
But as you get older; these characteristics matter less,
Compared with access to a doctor and a twilight home of rest.

Patricia Hilary Willis (1936-): House Hunting

Green spaces play a vital role in the lives of Londoners. They encourage healthy living, environmental sustainability and community development. They also provide a source of education, preserve our heritage and culture, and promote recreation and tourism. Wildlife habitats and nature conservation are further important aspects of London's green spaces. The importance of green spaces has become a central theme for policy makers. Green spaces not only provide a pleasant and natural environment but also contribute to improving quality of life in London's urban areas. They assist sustainable use of housing, jobs and infrastructure. It is estimated that each year in England more than 33 million people make over 2.5 billion visits to urban green spaces (DTLR, 2002).

The Annual London Survey 2001, an opinion poll of 1,400 Londoners commissioned by the Mayor's consultation team (MORI, 2002), showed that:

- 72 per cent of Londoners agree that London is a city that is good for parks, open spaces and community recreation facilities and activities
- 69 per cent agreed that London is a city that is easy to get around
- 40 per cent agreed that London is a green city
- 51 per cent said that affordable housing/property prices should be one of two things that should be improved to make London a better place to live, followed by safety with 50 per cent, and transportation with 33 per cent
- 36 per cent said that housing prices were one of two of the worst aspects of living in London.

Valuing Greenness: Green spaces, house prices and Londoners' priorities attempts to estimate the importance of the more natural and larger green spaces for London's urban environment – spaces considered to be strategically important in the draft London Plan or the Mayor's Biodiversity Strategy. The report examines how the availability of open green space interacts with socio-economic, environmental and accessibility indicators across the different parts of London. In other words, the benefits of green spaces are measured in terms of people's preferences for where to live in London. As the value of green spaces is reflected by house prices, the main concern is with the amenity value of open space. It is important to note that this report examines the overall provision of strategic green spaces in London and does not address specific issues such as quality and public accessibility of green spaces.

The next section summarises the key findings. Chapter 1 examines the benefits of green spaces in London, and potential threats to them. Chapter 2 describes the approach and the spatial patterns of the variables used in the analysis. Chapter 3 covers the statistical analysis and interpretation of the results along with the limitations. Chapter 4 presents a brief conclusion with some guidance for further study of the value of London's green spaces.

The technical econometric analysis of the results and tests for significance are provided in an accompanying working paper, *Valuing Greenness: Is there a segmented preference for housing attributes in London?* (GLA, 2003).

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Key findings

These key findings are based on a correlative study and any direct causation and effects should not be assumed. The findings are discussed in detail in Chapter 2.

- Housing prices show weak correlations with the other variables in the model. Housing prices are not determined by a single specific parameter, but by a wide set of indicators. This is perhaps due to the variation in living spaces that exists between wards and within communities in London. However, a large proportion of the variation in house prices (66 per cent) is accounted for by examining the indicators together.
- The amount of green space in wards is the fifth most significant indicator in explaining the variation in average house prices. The first four indicators are level of income support, travel time to central London, average air quality and dwelling density.
- A 1 per cent increase in green space in a typical ward can be associated with a 0.3 to 0.5 per cent increase in average house price.
- Homebuyers tend to have one of two preferences; one biased towards close proximity to central London with its high density of dwellings and higher house prices, and the other towards the open spaces of the Green Belt.
- Wards with a large amount of green space have better educational performance. The spatial patterns shown by educational performance and green spaces suggest that a high percentage of students aged 10 who score less than level 4 are in wards with lower percentages of green space.
- A plausible correlation exists between green spaces and deprivation indicators (income support and overcrowding), as there is some indication that wards with a lower number of green spaces have more income support claimants and overcrowded households.
- Air quality, as expected, is higher in wards with more green spaces and our analysis suggests a negative correlation between NO₂ levels and open green spaces in wards.
- Air quality levels are negatively correlated with house prices, which may indicate that Londoners value proximity to central London and areas with good travel links more highly than open green spaces.

1. Benefits of green spaces

Green spaces are classic public goods. One person's use of a green space does not deprive others from using it or restrict others from enjoying it. Everyone can enjoy green spaces without paying a marginal price, like one pays for using public transport. Since there is no direct price information available, measuring travel costs (and time) for visiting green spaces is one way to estimate the demand or the marginal value for green spaces.

The direct benefits of green spaces are mainly recreational and educational. The recreational value of green space in terms of leisure, sport, culture and tourism is believed to be immense for London. Parks are used for exercise and sporting activity. Parks and green spaces are increasingly used as an outdoor classroom for school subjects ranging from nature study to citizenship (DTLR, 2002a). In recent years, over 1,500 species of flowering plant and 300 types of bird have been seen in the capital (GLA, 2002a). Green spaces reduce surface water run-off, moderate air temperature and offset harmful emissions. They increase sustainability of urban areas by absorbing noise, reducing heavy metals levels in soil and improving the visual appearance of cities.

The indirect benefits of green spaces, though harder to quantify, are believed to be substantial. Green spaces provide health benefits by enabling people to exercise and relax. Clinical evidence suggests that green spaces reduce stress and prevent obesity (Tibbats, 2002). They play an essential part in the physical, emotional and psychological development of children. They also give identity to urban landscape and are part of the heritage and culture of local people and communities. Green spaces are a congregation point for local festivals, civic celebrations, fairs and other forms of social interaction.

Green spaces have induced effects, which can be quantified to some extent. In the UK, local authorities manage and maintain 27,000 parks and green space, at an annual revenue cost of at least £630 million (Rural Development Commission, 1997). The Lantra report, *The Land Based Sector Work Force Development Plan 2001-02*, identified approximately 50,000 employees within the Greater London region working in the land-based industries, employed by 12,000 businesses (Lantra, 2001).

Property values have been correlated with proximity to green spaces. In London the best urban parks and green spaces are often surrounded by expensive and sought-after properties. A study of two neighbourhoods in Ontario, Canada, found an increase in property values of around \$8 per foot closer to green space (Crompton, 1999). Using 1,800 house purchase transactions in the London region, proximity to the Green Belt increased house values by £276 (or 4.9 per cent) at 1968 prices (Wabe, 1970).

Parks and open spaces contribute substantially to London's marketing image and may have an important role in encouraging inward investment (GLA, 2002a). The presence of a Regional Park makes the Lee Valley a more desirable location for industry due to an attractive image. The net expenditure on total services ranging from park operations to sports and leisure management has increased from £10.1 million in 1999/2000 to nearly 10.9 million in 2000/01 (Lea Valley Park, 2001).

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Mile End Park in Tower Hamlets has used £2 million received from the Single Regeneration Budget (SRB) in schemes such as ranger training, work with drug users in the park and horticultural therapy (GLA, 2001). Green space is also believed to contribute significantly to the local economy by attracting new retail units and generating additional customers for local shops (Tibbats, 2002). The GLA scrutiny report (GLA, 2001) on green spaces in London suggested that deprivation levels are often high in areas lacking in green spaces.

1.1 Undermining the benefits of green spaces

London's green spaces face significant threats. Lack of facilities and dedicated staff, concerns about dog fouling, increased crime and anti-social behaviour, vandalism, graffiti, litter and disrepair discourage use and reduce the benefit of green spaces to the public.

Green spaces and parks have also suffered from low political support and tend to be neglected by local authorities as they are not statutory functions.

London faces a marked growth in population and jobs and related infrastructure over the coming decades. This creates strong development pressures on the use of land. There is a trade-off between protecting and enhancing London's green spaces whilst addressing the need for affordable housing. The draft London Plan focuses new growth on land that has already been developed, while protecting and enhancing open spaces (GLA, 2002b).

2. The approach

There are two main methods used to measure the benefits of green spaces.

1. Hedonic pricing method¹

The hedonic pricing method is based on the proposition that the value of a good or service is based on its attributes. The price of amenities for which markets do not exist – such as green spaces – can be inferred from observing and analysing the price of goods for which markets do exist – such as houses. For example, the purchase price of a house is determined by local socio-economic characteristics such as housing densities, accessibility to transport and health services, and local features such as green spaces and river views.

2. Willingness to pay approach

The willingness to pay approach asks individuals to state directly how much they would be prepared to pay to preserve public goods such as green spaces.

This report uses the hedonic pricing method due to the availability of data and because it is less complicated. Geographic information system (GIS) data is used to complement available statistical data. This model accounts for a number of factors, ranging from accessibility to central London to socio-economic and environmental conditions that affect house prices². This report also examines whether the indicators have a statistically significant impact on house prices, and uses the significance of green spaces to explain the variation in house prices.

2.1 Main housing attributes

The purchase price which a potential buyer is ready to pay for a house is based on a number of housing characteristics, ranging from structural characteristics (eg number of rooms, garage space and plot size) to local socio-economic and public sector characteristics (eg quality of schools, health services and the local unemployment rate). Other important criteria include local environmental quality, transport links and access to other services. This study has used the indicators in Table 1 to explain the variation in house prices.

¹ See Rosen (1974) and Freeman (1979) for more information on hedonic pricing methods.

² Home sale prices in 2001, £ mean price for dwellings (ONS, 2001).

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Table 1 Indicators used in this study to explain variation in house prices

Green spaces†	
1. Green spaces	<p>In this study, green spaces refer to total identifiable 'strategic green spaces' (km²) for each ward. The identifiable green spaces are the Green Belt, Metropolitan Open Land, Sites of Metropolitan Importance, Sites of Borough Importance and Sites of Local Importance. Strategic green spaces are described further in Appendix 1. This is divided by the total area of the ward and expressed as a percentage. Green spaces such as urban parks, private gardens and common green spaces around flats are excluded from this study, except in the Green Belt, as data are not available.</p> <p><i>Source: Connecting with London's Nature: The Mayor's Draft Biodiversity Strategy, 2002</i></p>
Housing	
2. Overcrowding*	<p>Percentage of households living at densities of 1.00 or more persons per room.</p> <p><i>Source: 1991 Census (estimated to 1998 ward boundaries)</i></p>
3. Dwelling density	<p>Total dwellings for each ward divided by the ward area, expressed as number of dwellings per km².</p> <p><i>Source: Valuation Office Agency, 2001</i></p>
Deprivation	
4. Income support (IS)*	<p>Income support claimants as a percentage of population over the age of 18 for each ward.</p> <p><i>Source: Department for Work and Pensions, 1998</i></p>
Education	
5. SATs 2 scores*	<p>Standard Achievement Targets 2 scores. Pupils scoring at less than Level 4 as a proportion of total pupils aged 10. Data are for 1998 and refer to school addresses in the absence of pupil addresses. This means that, in the absence of some heroic form of modelling to attribute pupil addresses to schools, we can only attribute school performance to the ward in which a school is located. Values for schools have therefore been attributed to the wards in which the schools are located (and aggregated across schools where there is more than a single school in a ward). Where there is no school in a ward, the ward has been attributed the average value for all schools in the borough. This is clearly very crude, given the size and complexity of school catchment areas even at primary-school level. It does, nevertheless, reflect something of the areas in which the schools operate (London Index of Deprivation, 2002).</p> <p><i>Source: Department for Education and Skills, 1998</i></p>
Crime	
6. Domestic burglaries*	<p>Domestic burglaries as a per cent of adult population (18 years+). The dataset was originally compiled with grid references and the number of offences. The grid references and their values were plotted and attributed to wards. The most common reported crime is domestic burglaries.</p> <p><i>Source: MPS, (1999/2000).</i></p>

Travel accessibility	
7. Travel times†	Travel time zones to central London have been averaged for each ward. Central London is defined as roughly the same as zone 1 of the underground map. Transport for London divides London into 1,019 travel zones. The following modelling periods have been used: morning (07:00-09:59), interpeak (10:00-15:59) and evening peak (16:00-18:59). <i>Source: Transport for London, 2001</i>
Health accessibility	
8. Health†	Postcode level data for hospitals, NHS trust sites, dentists and GPs are summed and then mapped to obtain a ward level health indicator. <i>Source: London Health Observatory, 2002</i>
Environment	
9. NO ₂ average*	Levels of nitrogen dioxide in parts per billion (ppb). The data are derived from mapping of NO ₂ concentrations in London. There are a large number of air quality monitoring sites around London, which give valuable information on pollution at specific sites. The continuous surface map is modelled with the use of data on emissions of air pollutants together with weather data and geographical information to calculate the likely pollution concentrations. <i>Source: South East Institute of Public Health, 1999</i>
Dummy variable	
10. High affluent	Wards with average house prices greater than £500,000 located within Underground zone 1. This indicator is included to avoid the data being skewed because of large deviation from higher average house prices.

Notes:

† The headline indicator for each domain in the London Index of Deprivation (London Index) is used, as this allows a convenient and useful interpretation of the index. The headline indicator is the one with the greatest conceptual link to the domain and the one with the highest intra-domain correlations. Its use to represent a domain avoids the inclusion of noise from low-scoring indicators included in the multivariate assemblies used by IMD2000. The transformation used in the London Index is readily understandable and transparent, and avoids the impact of negative scores. No weighting is used for domains. (GLAd, 2002)

* Computed by using Mapinfo GIS system.

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

2.2 Comparing the indicators across London

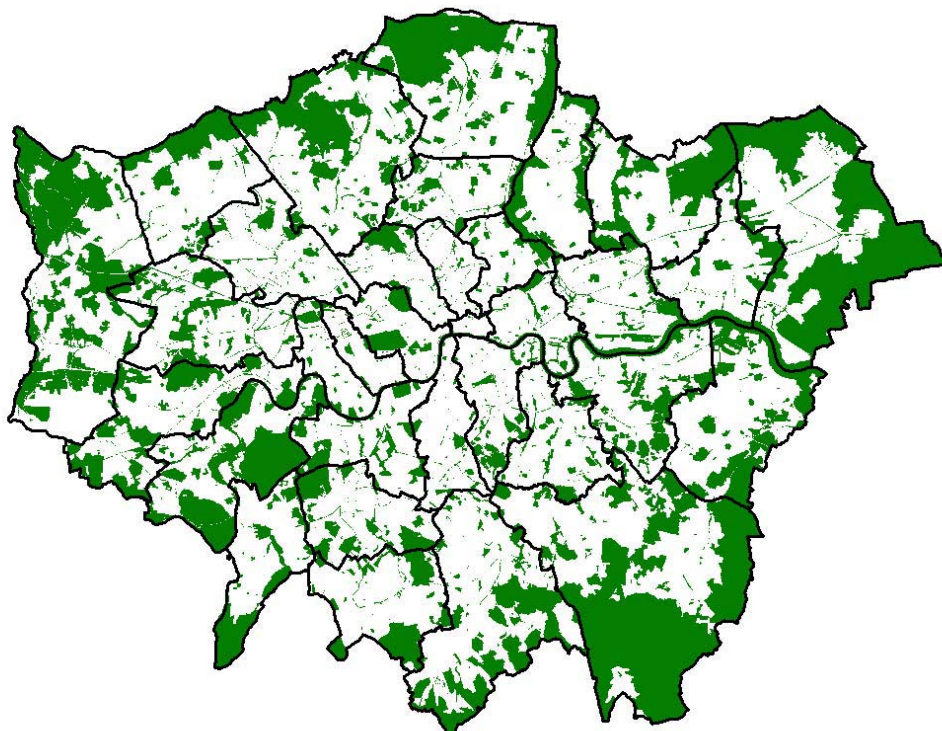
This section examines the indicators on the basis of their spatial pattern – how they compare for each ward. Indicators are discussed with respect to green spaces and other relevant variables in the analysis. The maps provide a useful comparison across the London boroughs.

Map 1 London boroughs



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Map 2 Strategic green spaces in London



Source: GLA Biodiversity Strategy 2001

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Two-thirds of London's land area is occupied by green spaces and water (GLA, 2002a). Map 2 shows the five main categories of green spaces used for this analysis, as described in Table 1. These categories are described in detail in Appendix 1. In total, over 1,300 Sites of Importance for Nature Conservation have been identified, covering nearly 19 per cent of London.

Other strategically important open space is not included in the study as London-wide data were not available. Green spaces not used in this study include some of the open space hierarchy described in the draft London Plan for which data are not available (GLA, 2002b). (For example, a study in Merton found that a third of these sites were not included within a Site of Importance for Nature Conservation). Areas omitted include, for example, parks, sports pitches and school grounds. A sample of aerial photographs of Greater London, analysed by the London Ecology Unit in 1992, suggested that parks comprise 8 per cent (12,500ha) of London's total land area. Sports pitches cover approximately 3 per cent (4,700 ha), grounds of schools and other institutions cover 1.5 per cent (2,400 ha) and common green spaces around flats cover a further 1.1 per cent (1,700 ha). Nevertheless, the green spaces indicator used here is a reasonable measure of London's more strategically important green spaces.

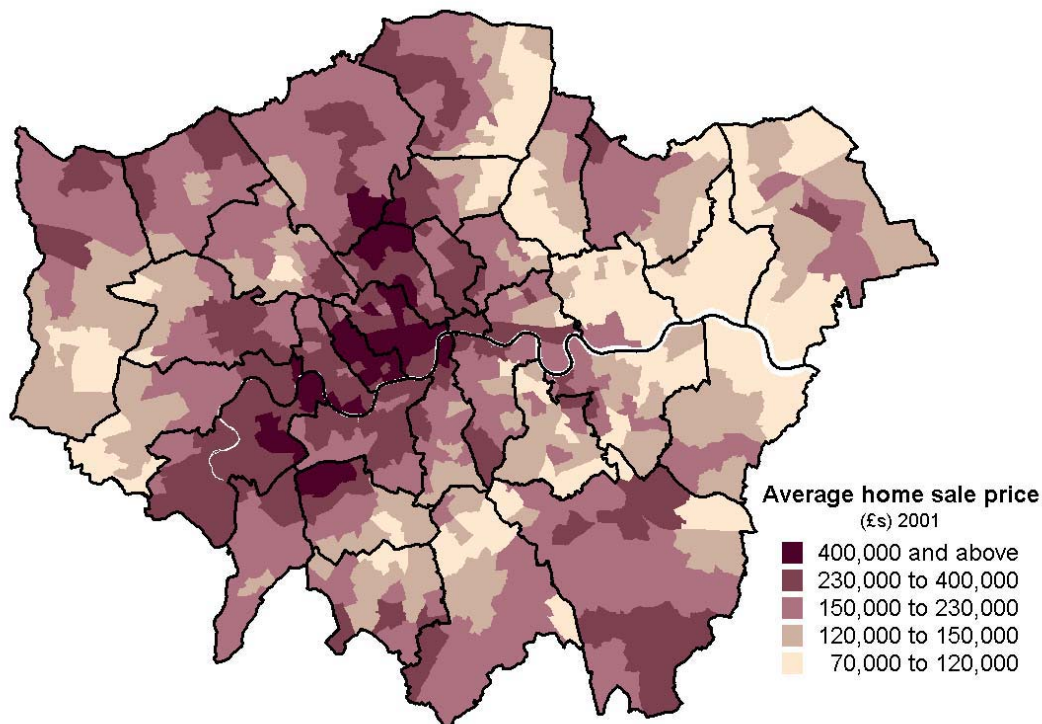
Quality and public accessibility are important factors in determining the perceived value of green spaces. For example, the Royal Parks are well managed, well maintained and easily accessible compared to private green spaces located in the Green Belt.

Between 1997 and 2000, 492 acres of Green Belt land in London, 1,380 acres in East Anglia and 2,768 acres in the South East were turned over to housing. The figures suggest that 44,000 houses have been built in the Green Belt during this period and, on average, 8 per cent of all land developed for housing was in the Green Belt in these regions (The Times, 2002).

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Map 3. Average ward home sale prices
(£s) 2001



Source: ONS (2001)

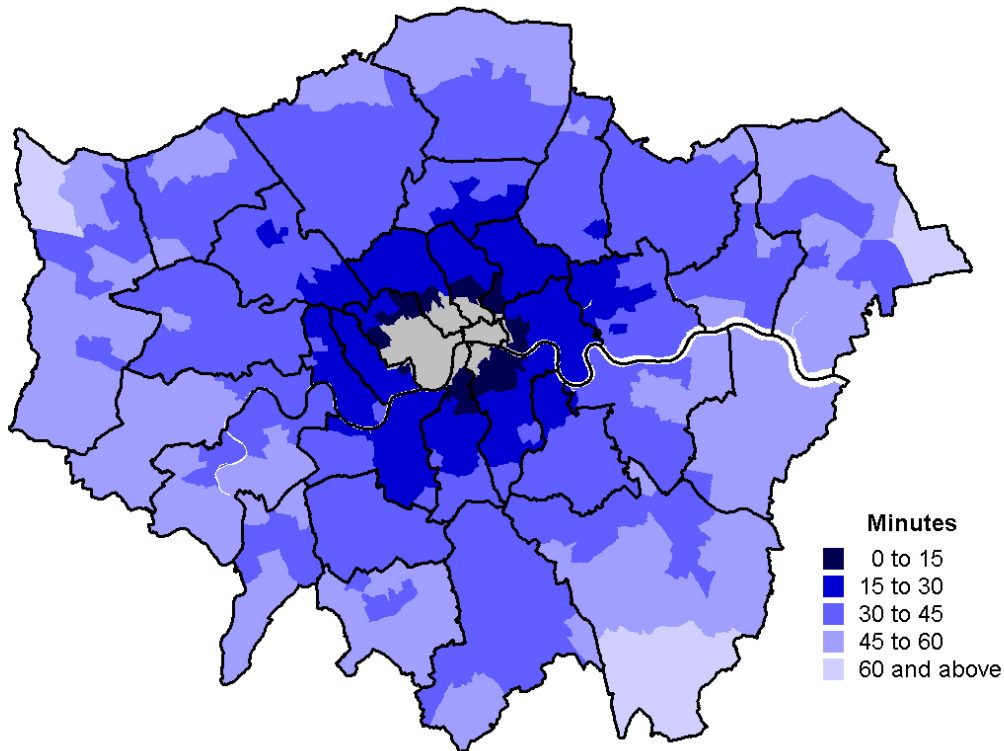
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Average house prices are particularly high in the west end and central London. Areas in Richmond upon Thames and Merton have significantly high house prices, mainly due to open green spaces and rich amenity value of the location. Richmond Park and the Royal Botanical gardens are situated in Richmond upon Thames, along with the Thames River. Relatively high prices in Bromley in the Green Belt show that people want to live close to London and enjoy the environmental benefits and less stressful lifestyle of the south east. This also implies that people prefer areas of low density dwelling with larger plots of land, gardens and more privacy.

Newham, Greenwich and Lewisham, which are predominantly associated with high levels of deprivation, have low house prices. Barking and Dagenham have low house prices due to a high level of industrial activity and poor quality of housing. Map 3 also shows low prices around Heathrow, in Hillingdon, which can be associated with high noise and low air quality levels.

The high affluent dummy variable accounts for the high house prices in some of the wards in Westminster and Kensington and Chelsea. This variable explains the variation in house prices in these wards due in large part to 'status' and appeal of the area.

Map 4 Travel time to central London by public transport



Note: the grey area denotes central London

Source: TfL 2001

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Accessibility to central London is one of the main considerations for homebuyers in London and significantly affects house prices. Map 4 shows major travel hubs like Stratford and good travel links from Croydon, Barnet and Brent. Over three-quarters of people who work in central London travel to work by public transport, compared to only 13 per cent for the UK as a whole. People who work in central London spend, on average, more than twice as long travelling to work as the rest of the UK. London is far more dependent on good public transport than any other part of the UK because of its size (GLA, 2001a).

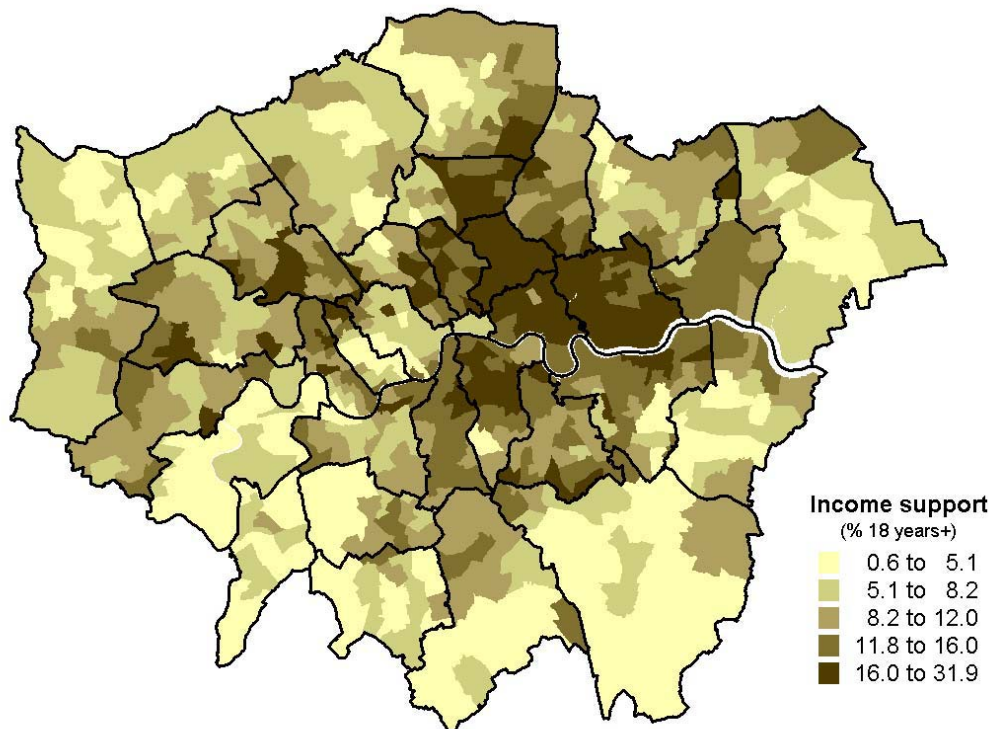
Areas with high travel times to central London can be contrasted with areas with low travel times. Many areas near central London are busy urban centres with high density and noise pollution. Within central London, convenient locations have higher house prices, such as parts of Kensington and Chelsea and Westminster.

However, the effects of green spaces should not be completely ignored. Although travel times may be high near the Green Belt, house prices are high as well in some parts. Many people may choose to live in relaxed environments away from central London, and housing prices reflect this. It should also be noted that travel time to central London is not the only important transport criteria, as there are a number of other employment hubs in London, for example in Croydon, the Isle of Dogs and Heathrow.

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Map 5 Income support



Source: DWP

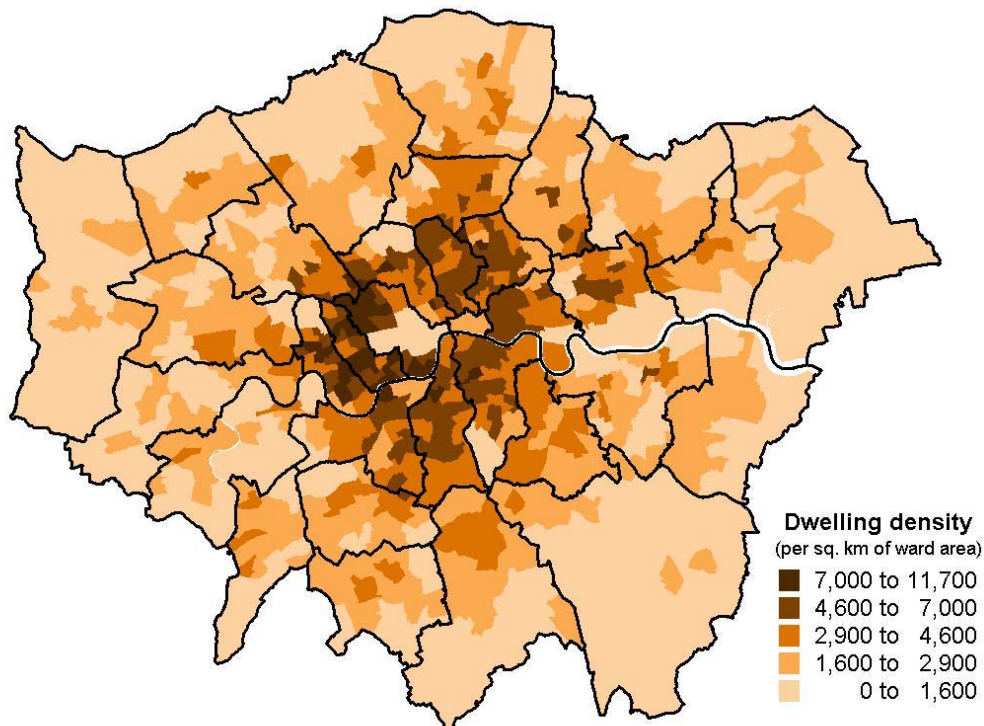
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Map 5 shows the number of income support claimants is high in inner east and north London and in inner southern boroughs such as Lewisham. It also shows house prices are low in the high-income support regions³. The presence of council flats in central London correlates with high-income support in this region. Social housing has traditionally been in denser and older parts of London (eg near the docks). Income support is quite low in the outer band of London characterised by the Green Belt. This may imply that the region attracts people with high incomes who prefer to live close to open spaces.

A report by WS Atkins (2000) and a statement by London Wildlife Trust stress that public open space for recreational and amenity purposes is unequally distributed within and between London boroughs owing to historical and geographical reasons. Whilst outer London has more green spaces than inner London, there are still significant differences between the areas, which are reflected in social problems and inequalities (GLA, 2001b). The causation may not be as direct as stated and deprived areas have also emerged in areas lacking in green spaces.

The spatial distribution in Map 5 may indicate that green spaces can help in the regeneration and development of local communities by attracting business and increasing demand for houses. While this may ease social conditions in deprived regions, it can also drive poorer people to other regions.

³ The negative correlation between house prices and income is also reflected by the correlation coefficients. See *Working Paper 3: Valuing Greenness: Is there a segmented preference for housing attributes in London?* (GLA, 2003)

Map 6 Dwelling density

Source: GLA, Valuation Office Agency (2001)

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Areas of high dwelling density often have higher house prices. This is especially true in central London where there is a concentration of multi-storied buildings and high demand for houses due to the proximity to employment centres. Social housing contributes to high dwelling density, but is not included in the measure of house prices used in this model. Social housing is not normally associated with high house prices, but in central London it exists side-by-side with many high-income areas. Middle-income earners may find these properties unaffordable, and may have to look for property outside these areas, as they do not qualify for social housing. Low dwelling density is apparent in the central area due to the presence of office buildings. Densities become lower again moving outwards from central London.

There is low dwelling density in the Green Belt because of strict planning policy against the construction of houses. This is mainly to reinforce the structural benefit of the Green Belt in preventing urban sprawl and maintaining amenity value. Moreover, it is also due to preferences for houses instead of flats, and for open spaces along with other factors such as private gardens and bigger plot size.

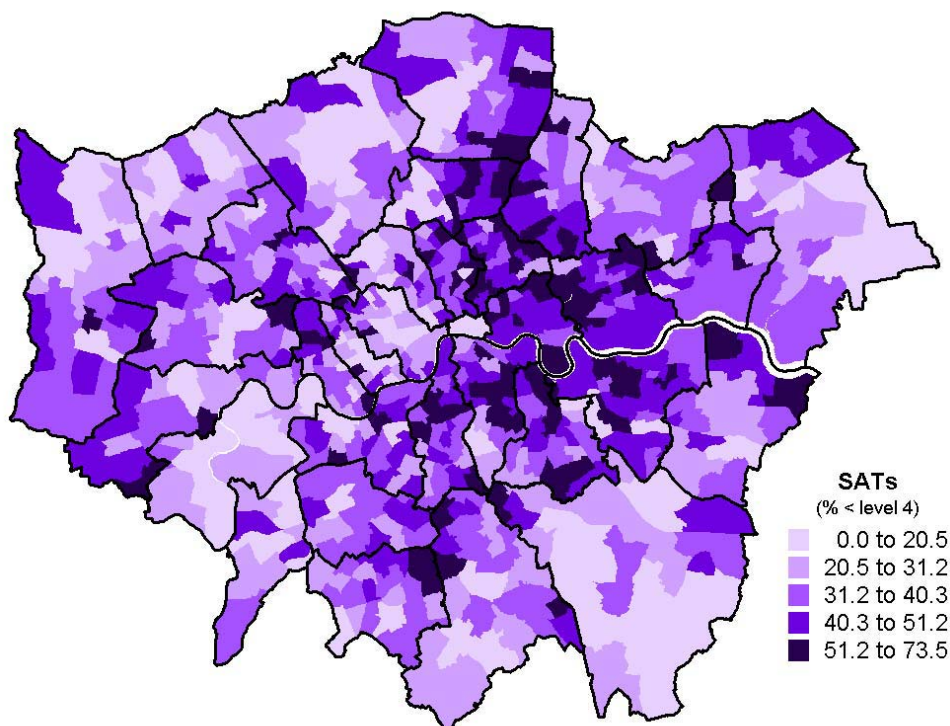
It is worth pointing out that dwelling density is an inverse indicator of green spaces. It can be taken as proxy for those green spaces not included in the green space indicator (see Appendix 1.6).

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Map 7 Education

Proportion of SAT2 pupils failing to reach level 4



Source: DfES

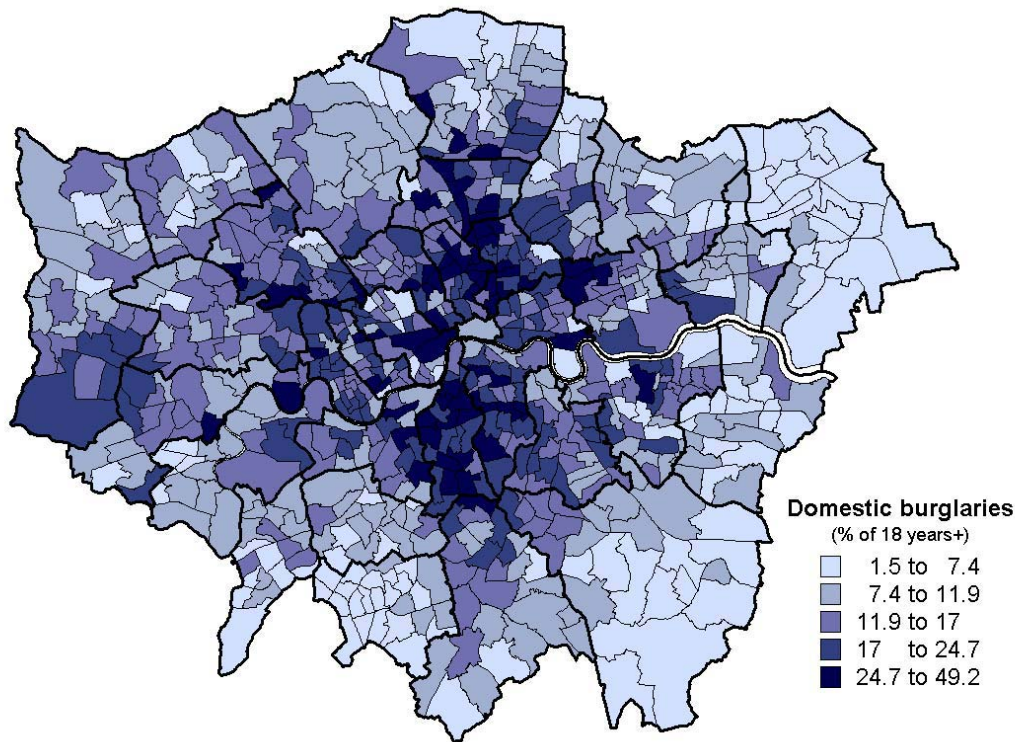
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Map 7 shows low performance in primary school Standard Achievement Targets (SATs). The highest numbers of underperforming schools are in Newham, Tower Hamlets, Lewisham and Greenwich, which also have the lowest average house prices. Students performed relatively well in the north-west and south-east regions of London where income support is low and the number of green spaces is high. This does not indicate a direct link between green spaces and education performance, as it can be attributed to the fact that people with middle to high incomes who can afford to live in these regions can also afford to choose better schools and to provide better support to their local schools.

The scatter plot matrix and correlation coefficients in *Working Paper 3: Valuing Greenness: Is there a segmented preference for housing attributes in London?* (GLA, 2003) shows that house prices are lower in areas where education performance is poor. Low educational performance in the boroughs mentioned above can be attributed to high levels of deprivation.

Green spaces are important for the healthy development of children in their early years (Tibbats, 2002). Parks and green spaces provide opportunities for children to play, to interact with nature and learn valuable lessons about social interaction with friends (Tibbats, 2002). Parks and green spaces serve as a vital resource. They support curriculum activities and provide a fully interactive and continually changing outdoor classroom. Children living in an urban environment can spend most of their leisure time indoors playing computer games or watching television. If opportunities for play are restricted by no or inconvenient access to green spaces, children will be deprived of an essential part of their physical, emotional and psychological development.

Map 8 Crime



Source: MPS (1998)

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The crime rate is lowest in the Green Belt region. Map 8 reinforces the inner-outer London dichotomy, but with significant peaks in outer west boroughs such as Hounslow and Hillingdon. In 2001, the incidence of crime was considerably lower in areas of the south east and London than in more urban areas for all offences where data were obtained (The Countryside Agency, 2002).

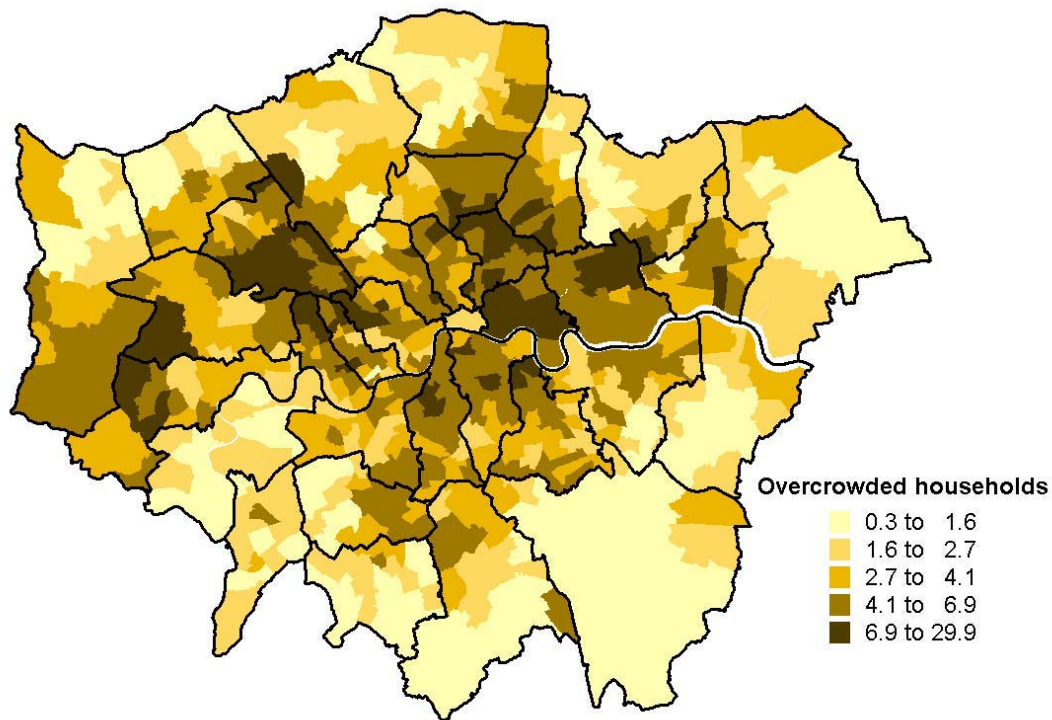
The British Crime Survey shows a low rate of reporting for burglaries in lower income areas (GLAd, 2002).

Fear of crime is a common factor that deters people from using parks and green spaces. Safety and other psychological issues, including feelings of fear and vulnerability, are based on real experiences and perceived concerns. This applies to people's own personal fears, and especially to fears for their children (DTLRa, 2002).

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Map 9 Overcrowded households



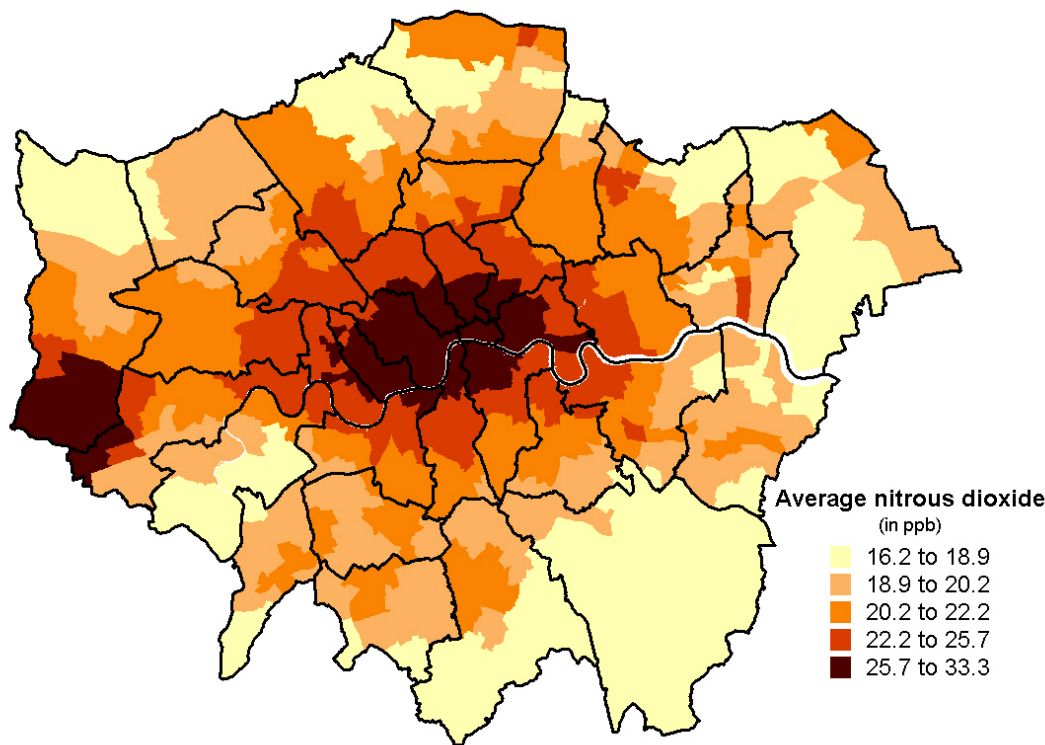
Source: 1991 Census

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The number of overcrowded households is high in some wards of Ealing, Tower Hamlets, Hackney and Newham. There are fewer overcrowded households in the Green Belt region and boroughs such as Richmond upon Thames, Greenwich and Wandsworth. Overcrowding is a measure of people per room, and this may indicate it is cheaper to buy larger houses outside central London.

Map 9 also reflects quality of housing. For example, much poor quality high density housing was built in the East End during the 18th and 19th centuries to house workers for industries and the docks, and some of this housing still remains. Large housing estates were built in Barking and Dagenham between the first and second world wars to re-house people from the East End.

Map 10 Air quality



Source: GLA, TfL (2002)

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Air quality is significantly higher in areas with a high proportion of green spaces. The annual mean NO₂ (nitrogen dioxide) objective is set at a level of 21 parts per billion (ppb). Map 10 shows that most of Greater London fails to achieve this objective (GLA, 2002c). Central London has high NO₂ concentrations due to high economic activity and transport density. Heathrow is clearly identifiable on Map 10. High concentration levels in Barking and Dagenham can be attributed to energy-intensive industrial activity. The area around the Blackwall tunnel and trunk roads A102, A20 and A2 near the Greenwich peninsula also has high levels of NO₂ concentration.

The significance of travel time is clear in Map 10, as central London, the main travel hubs, interchanges and congested routes have high NO₂ concentrations. Some of these regions also have high house prices – especially central London despite increased levels concentration⁴.

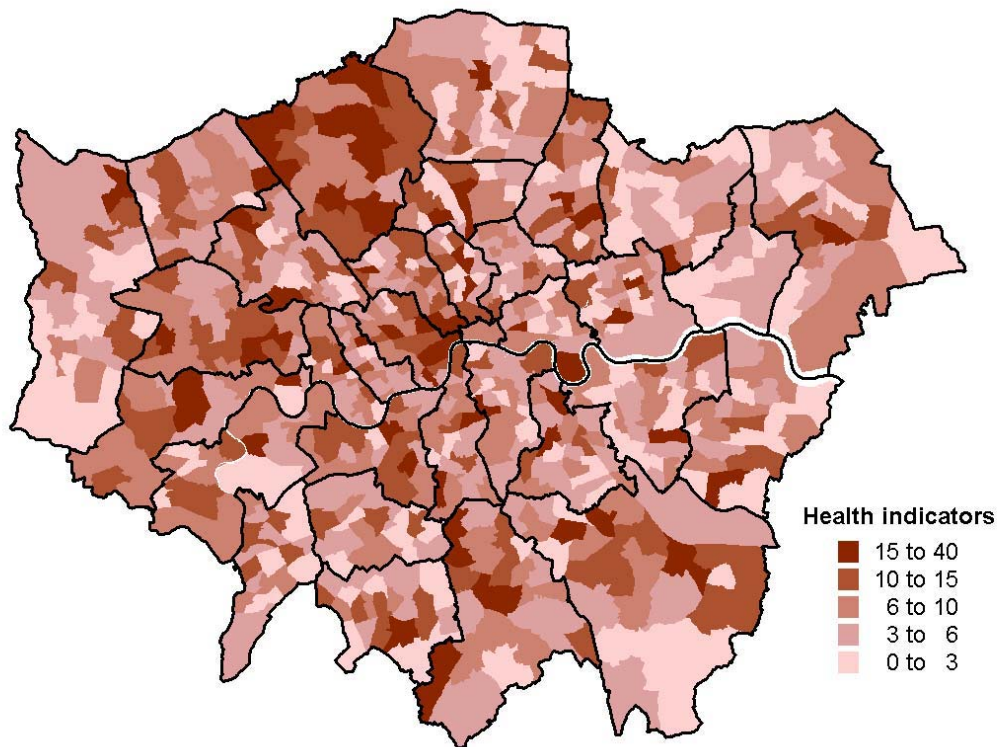
Generally cities are hotter and more susceptible to smog compared to rural areas. This reinforces the importance of green spaces in cities to provide shade, improve the local climate and absorb harmful pollution.

⁴ Air quality is determined by concentration maps as given in *Cleaning London's Air: The Mayor's Air Quality Strategy* (GLA, 2002c). The impact on health from concentration levels is substantially more than emission levels.

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

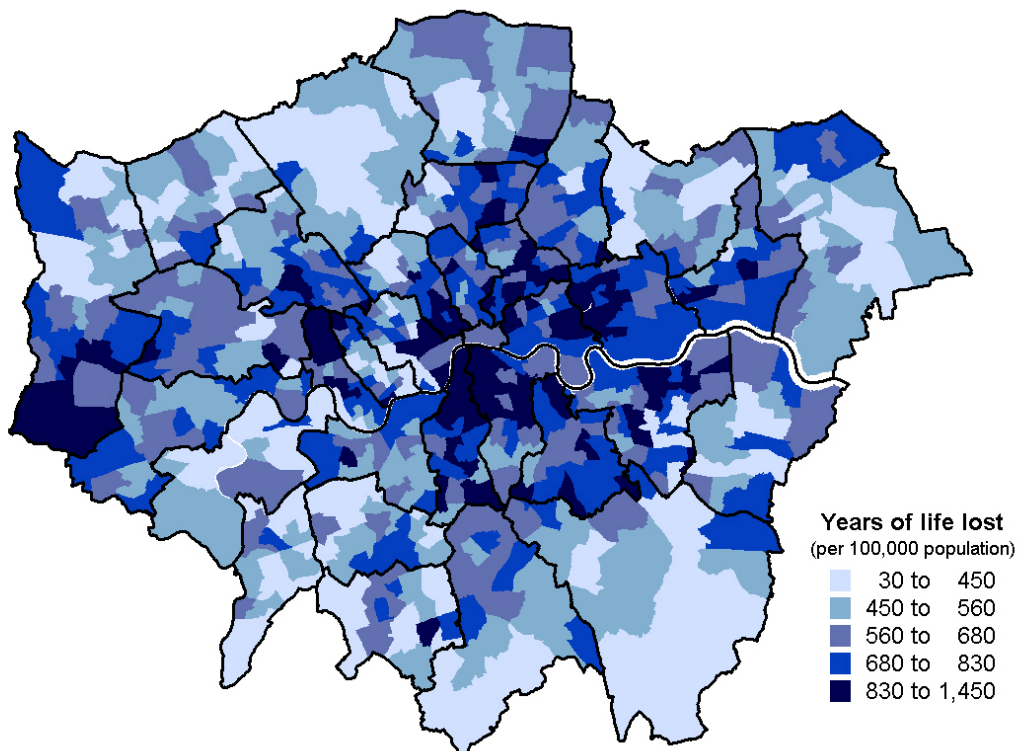
Map 11 Health facilities



Source: London Health Observatory (2002)

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Map 11 shows the sum of NHS trust sites, general dental practices, GPs and care trusts in each ward. Overall hospital waiting times for London residents are higher than the national average. There are fewer GPs per head of population in London than the England average and fewer Londoners are registered with a General Dental Service (GLA, 2001a).

Map 12 Health quality⁵

Source: ONS, HoLP

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Disparities in health between deprived and affluent parts of London are extreme and Map 12 suggests a clear inner-outer dichotomy with some exceptions, especially in Hillingdon. The chance of dying before reaching the age of 65 is almost twice as high in the most deprived areas of London as in the least deprived areas. Over the last ten years, reported cases of tuberculosis have doubled in some London boroughs. Rates of notification ranged from 2.6 per 100,000 in Havering to 105 per 100,000 in Newham. Key factors related to health are education, housing, social support, job, income and environmental quality. In a recent survey, 15 per cent of people in Kingston upon Thames and Richmond upon Thames reported fair, poor or bad health, compared with over 30 per cent in east London and the City (GLA, 2001a).

Green spaces are believed to make a positive contribution to health. They reduce stress, accelerate recovery and increase happiness. The rural population in the south east is healthier than its urban counterparts in terms of low birth weight and mortality (The Countryside Agency, 2002).

⁵ Not included in the regression analysis. Definition provided in Appendix 1.5.

3. Model results

The hedonic pricing model takes the indicators in Chapter 1 and uses a simple semi-log equation to reflect the variation in house prices (see Appendix 2). Data were collected for 760 London wards (1998 boundaries)⁶. Using the data and spatial patterns of the indicators, the hedonic pricing model produces the results in Table 2.

Table 2 Descriptive statistics

	Minimum	Maximum	Mean	Standard deviation	Skewness
Home sale price (£s) 2001	79,121	1,208,150	199,000	115,000	2.94
Area (km ²)	0.24	30.51	2.06	2.26	5.18
Dwellings (no)	230	10,227	4,027.88	1,252.66	0.62
Dwelling density (no./km ²)	53.49	11,686.56	3,142.58	2,054.26	1.28
Income support 18 yrs+ (IS) %	0.62	31.81	10.90	5.71	0.59
Education below threshold (SAT) %	0	73.44	35.53	13.72	0.01
Overcrowding	0.34	29.82	4.15	2.80	2.12
Domestic burglaries 18 yrs+ %	1.58	49.14	14.04	7.58	1.18
Travel time (mins)	2.09	78.10	34.86	12.44	-0.43
Green space (km ²)	0	29.98	0.71	1.81	7.93
Per cent green (%)	0	98.25	19.57	20.57	1.27
Health (no.)	0	40	6.66	5.04	1.43
NO ₂ average (ppb)	16.24	33.23	21.78	3.15	1.11

Table 2 shows the descriptive statistics at ward level for the variables. The ward with lowest average house price (£79,121) is River in Barking and Dagenham. Belgrave in Westminster had the highest average house price in wards. It is interesting to see the range of dwelling density from 53 dwellings per km² in the ward of Darwin in Bromley to almost 12,700 in the ward of Church Kensington and Chelsea. It takes a little over half-an-hour on average in London to reach the central area by public transport. Darwin in the borough of Bromley came out with the highest travel time (78 minutes) to central London. The average proportion of open green spaces in wards is around 20 per cent.

⁶ Wards in the City of London were grouped as one.

Most of the indicators have a positive skew⁷ and their logarithms would have ensured better approximated normal distributions. This has not been done to ensure transparency and avoid other measurement errors such as multicollinearity⁸.

Ranked explanatory power of each variable, according to the regression results of the hedonic pricing model:

1. Income support
2. Travel time
3. NO₂ average
4. Dwelling density
5. Per cent green
6. Standard Achievement Targets (SATs)
7. Domestic burglaries
8. Overcrowded households
9. High affluent dummy variable
10. Health facilities indicator.

The results suggest that an absolute change in each indicator can explain a relative change in house prices. The top nine indicators are significant in explaining the variation in house prices.

The significance of the main indicators is explained below. Due to the inherent simple nature of the model (see 3.1) the results, while indicative, may result in a downward bias in the regression coefficients.

A 1 per cent fall in the proportion of income support claimants is associated with house prices that are 3.1 to 4.2 per cent higher than average. Income support claimants, as seen from Map 5, are located predominantly in areas with a high proportion of council flats, such as Newham, Tower Hamlets and Hackney. The presence of council flats may depress house prices and affect other residential property prices in these areas.

On average, a one-minute reduction in travel time to central London is associated with a 1 to 1.5 per cent increase in average house price.

On average, dwelling density indicates the level of demand for houses in any region, which is reflected by house prices. Historically, Hackney has high-density housing which is relatively cheap due to its poor quality. Analysis shows a unit increase in dwellings per square kilometre of ward area relates to a 0.05 per cent increase in average house prices.

On average, a 1 per cent increase in the amount of green space in a ward can be associated with a 0.3 to 0.5 per cent increase in average house price.

Education performance of schools has some relationship to housing preferences. A 1 per cent decrease in the number of students scoring less than Level 4 as a proportion of total students (aged 10) can on average be associated with a 0.4 to 0.7 per cent increase in house prices.

⁷ Skewness is a measure of distribution which indicates how much a distribution differs significantly from a normal symmetric distribution.

⁸ Explained in 3.1.

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Table 3 shows the indicators for each borough ranked by descending average house prices.

Table 3 Borough statistics

BOROUGH	Average house price (£)	Area (km²)	Dwelling density (no/km)	Income support (%)	Education SAT (%)	Over-crowding (%)	Crime (%)	Travel time (mins)	Green spaces (km²)	Per cent green (%)	NO₂ average (ppb)	Health indicator (no)
Kensington and Chelsea	580,309	12.08	7348.11	7.91	26.98	4.97	17.38	20.96	1.33	10.99	26.73	126
Westminster	411,127	21.44	6287.15	8.64	30.24	5.29	15.08	9.98	5.21	24.30	28.35	228
Camden	342,121	21.72	4769.74	13.47	30.66	4.80	17.99	17.52	4.47	20.58	25.91	216
City of London	313,073	2.90	1651.79	5.17	7.92	2.67	11.79	2.09	0.10	3.29	31.85	7
Hammersmith and Fulham	304,115	16.33	5971.42	11.36	35.13	4.71	17.87	26.72	2.40	14.72	25.19	168
Richmond upon Thames	300,115	57.18	1915.11	4.50	19.03	1.56	10.27	45.05	30.98	54.19	19.55	129
Islington	264,664	14.81	5628.34	16.78	41.86	4.75	23.42	17.51	0.82	5.51	25.76	147
Wandsworth	253,815	34.19	4116.39	9.48	36.79	3.86	15.81	28.30	8.12	23.73	22.23	197
Barnet	220,649	86.49	1796.00	7.56	28.78	3.31	10.92	38.64	30.57	35.35	20.53	258
Lambeth	209,773	26.73	4723.58	13.91	42.26	4.99	25.25	23.91	2.24	8.39	23.57	158
Southwark	208,963	28.76	4540.70	15.81	44.34	5.39	19.79	18.32	5.57	19.35	25.10	135
Tower Hamlets	208,367	19.70	4544.86	19.38	47.97	11.12	17.31	18.59	2.87	14.55	26.08	117
Merton	204,522	37.50	2501.88	6.76	33.94	3.05	8.74	37.58	10.80	28.81	20.06	97
Kingston upon Thames	202,057	37.15	2025.25	4.91	25.53	1.89	8.08	44.92	11.61	31.26	19.72	104
Ealing	195,834	55.37	2405.76	10.34	34.31	5.51	13.11	39.34	14.02	25.33	21.58	229
Haringey	193,511	29.49	3529.45	15.92	40.46	5.07	18.44	30.76	6.19	21.00	21.39	172

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

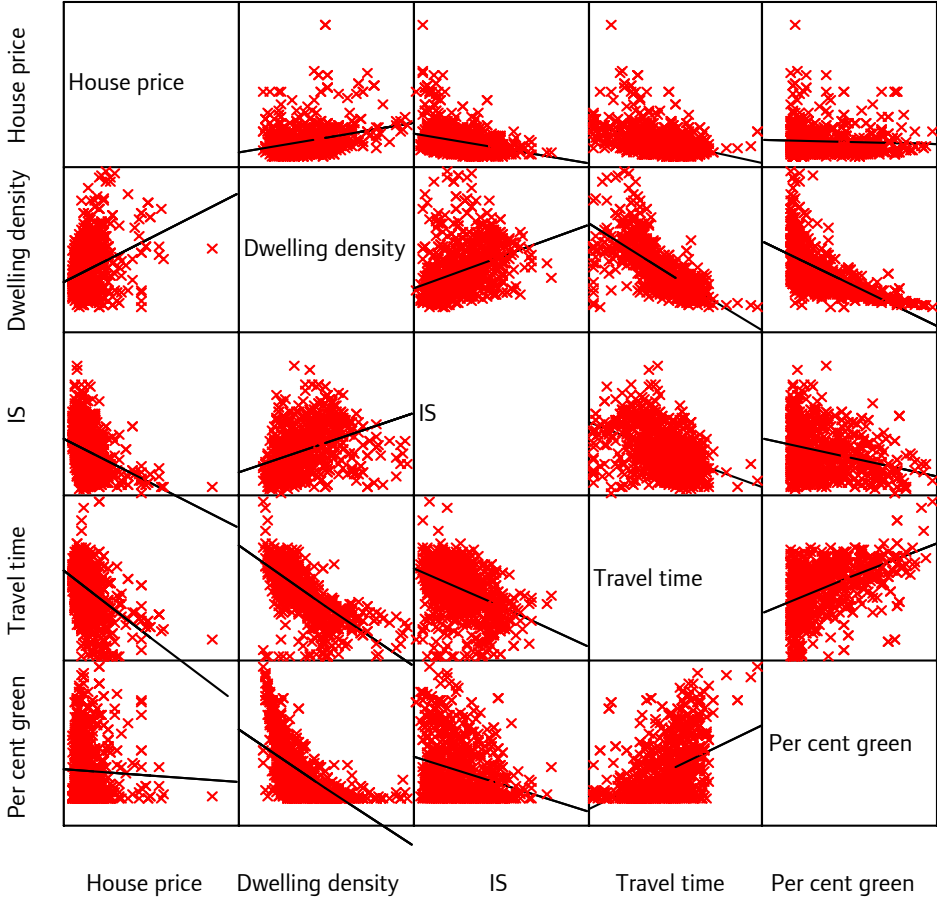
Hounslow	188,345	55.81	1917.76	9.83	35.69	4.51	14.70	46.48	21.16	37.91	21.83	174
Harrow	183,825	50.32	1928.37	7.09	27.75	3.20	11.02	40.32	14.29	28.40	19.31	150
Bromley	181,633	149.68	1441.56	6.00	26.31	1.31	9.04	48.12	85.19	56.91	18.16	192
Hackney	179,896	19.01	5008.99	20.45	46.19	7.38	24.37	22.36	3.36	17.70	24.41	123
Brent	176,188	43.09	2977.61	13.67	35.40	6.73	19.07	31.77	5.22	12.11	21.80	222
Hillingdon	157,871	115.36	1342.88	7.22	31.15	3.26	12.45	48.83	51.58	44.71	20.92	152
Redbridge	154,309	56.25	2073.82	8.71	30.41	2.74	10.32	37.27	22.16	39.39	20.25	90
Enfield	154,170	81.88	2025.68	9.89	34.34	3.04	12.47	42.40	35.80	43.72	19.91	166
Sutton	152,841	43.72	2123.88	5.99	33.05	1.74	5.92	48.50	12.53	28.65	19.75	140
Greenwich	147,419	47.20	2377.99	12.59	45.47	3.26	12.97	42.63	12.57	26.63	20.50	161
Croydon	144,664	86.21	2135.62	8.38	35.36	2.86	12.33	40.86	27.65	32.07	19.04	234
Havering	136,130	111.98	1261.17	6.86	28.76	1.70	4.41	48.02	63.94	57.10	18.54	146
Lewisham	134,782	35.00	3253.33	13.02	40.42	4.02	15.43	33.65	5.23	14.95	20.99	149
Bexley	125,900	60.46	1774.16	6.29	34.22	1.57	7.30	49.61	19.14	31.66	19.31	118
Waltham Forest	123,958	38.71	2781.93	12.39	42.29	4.39	12.54	35.92	11.50	29.71	20.41	155
Newham	115,229	36.10	3618.27	19.01	49.13	7.86	14.63	29.65	7.17	19.87	22.11	141
Barking and Dagenham	93,748	36.02	2223.96	13.97	38.25	4.15	11.10	40.23	6.87	19.07	19.92	58

Apparent differences between different parts of London can be observed. It is worth noting that boroughs such as Richmond upon Thames, Barnet and Merton have high average house prices, low dwelling density and good travel links to central London. This may imply that tenure mix is a key variable for London, where a high proportion of the population of London live in socially rented accommodation. Links between dwelling density and house prices may also imply that people work in central London or close proximity to central London for a short part of their working life and then move to more open areas in London or elsewhere.

Valuing Greenness:

Green spaces, house prices and Londoners’ priorities

Table 4 Scatter plot matrix for four significant indicators



Note: IS = income support

Table 4 shows a linear regression fit between the four significant indicators of house prices. The slope of the line estimates the effect of a marginal change in one variable on another.

Housing prices share a small relationship with other variables in the model. This may be due to the variation that exists between wards and within communities in Greater London. The diversity of populations and living spaces show that housing prices are not determined by a single specific parameter, but by a wide set of indicators.

A large amount of correlation exists between the variables, which helps explain the disparity between central London and wards closer to the Green Belt. Specifically, dwelling density shows a positive correlation with housing prices, a negative correlation with travel times, and a negative relationship with percentage of green space. Housing prices in Central London have become inflated by high demand; resulting in higher prices in areas that are more crowded. Moreover, these areas have fewer green spaces and the shortest travel times.

The model also reveals a plausible correlation between areas with characteristically a higher percentage of green spaces and lower levels of deprivation, as expressed through a negative correlation between percentage of green spaces and income support. In addition, a positive

correlation between dwelling density and income support shows that more crowded areas of London also have high levels of poverty despite higher housing prices.

3.1 Limitations of the hedonic pricing model

a. Use of ward level data

The data, though indicative, is at ward level, which restricts analysis within statutory boundaries. Services, access to transport and green spaces are not restricted within ward boundaries. Where a large open space is included within one ward and borders another, the first ward is allocated all the space and the second allocated none. Where a facility has a catchment (eg a school, as in Table 1, or a hospital) parts of the catchment often lie in other wards. Postcode level data would show more specific local area characteristics because of more detailed geographical boundaries.

b. The model suffers from two main data problems:

- Measurement error: There will be errors in the observed values of the dependent and explanatory variables. The statistical model also depends on the choice of and weights attached to significant indicators. Inclusion of some other key indicators such as noise, ethnic mix, river views, income and specific characteristics of houses (eg number of rooms, detached, terraced garages), would add to the robustness of the model.
- Multicollinearity: Multicollinearity is a serious problem in hedonic models and arises when the effects of several variables are closely linked. If multicollinearity exists, it becomes hard to determine which correlated variables are truly influential. An example of multicollinearity occurs within the NO₂ variable when levels of one pollutant may be closely correlated with the levels of another. For example, suspended PM₁₀ is closely related to NO₂. Only NO₂ concentrations are used to take account of this problem and there is no significant residual problem with multicollinearity⁹.

c. Non-linear relationship

Some indicators, such as per cent green and overcrowding, are not linearly related to house prices. Other pairs of indicators, as seen from Table 4, also appear to have a curvilinear relationship. Taking squares for these indicators can remove the bias but then it becomes difficult to interpret the data. Moreover, given the large number of degrees of freedom, this does not cause significant problems with the heterogeneity of the variances.

d. Market failure

The property market suffers from market failure because of government intervention in the form of rent ceiling, taxes, subsidised housing and planning controls.

e. Limited scope

Hedonic pricing models do not estimate option, existence or bequest values of green spaces. For example, the non-use values of biodiversity are not measured.

⁹ Discussed in *Working Paper 3: Valuing Greenness: Is there a segmented preference for housing attributes in London?* (GLA, 2003).

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

4. Conclusion

The Mayor's Biodiversity Strategy recognises the importance of green spaces and gives priority to promoting the use of green spaces by improving access to habitat and enhancing the natural green space network (GLA, 2002a). This report highlights the importance of green spaces for living in an urban environment. It appears that residents of London attach a marginal value to open green space as is reflected in the price premium they are prepared to pay to secure a dwelling with this advantage. It is interesting that the multiple regression analysis was required to reveal this value, as a simple correlation between house price and the amount of green space suggests that prices are somewhat lower where there is a good complement of open space. Clearly the inclusion of the other socio-economic, physical environment and travel time indicators of house prices has enabled this more informative estimate.

The Mayor's draft London Plan highlights the benefits of green spaces (GLA, 2002b). It recognises their contribution to the quality of life of Londoners and reinforces London as a world city. The draft London Plan sets out policies for the protection and promotion of open green spaces in London. The Mayor will also work with boroughs, the Countryside Agency and other agencies to create new open spaces and enhance existing areas, particularly in areas that do not have open green spaces. This report suggests London's residents would benefit from more work in this area.

4.1 Segmented preferences within the population

In showing the importance of green spaces, this report has explained the inner-outer dichotomy for London with some outliers. Preferences for housing with close proximity to central London and low travel times overshadow the desire for a greener environment for some people. Other people value a greener environment despite longer commuting times to central London. The analysis reveals some wards with high house prices, have shorter travel times to central London, high dwelling density and few green spaces. On the other hand, there are also wards with high house prices, longer travel times, low dwelling density and more green spaces. GLA Economics has also published a technical working paper which analyses this dichotomy (GLA, 2003).

4.2 Future studies

This report is indicative, but not comprehensive in its valuation of green spaces. This is mainly because green spaces have a number of attributes, with each one requiring a different methodology to measure it. For example, measuring biodiversity values is different from measuring active sports values. Survey-based techniques can value green space as a whole, or as an aggregate of individual attributes. Net migration of people to rural areas will provide a good picture of the value of green spaces as an indicator of quality of life. This report has not taken into account the relevance of green spaces to visitors (especially tourists) which should be quantified as well.

This report has looked primarily at London as a place to live, rather than a place to work. Further work is needed to understand the benefits of green spaces to businesses and commuters.

The analysis of property values does not include sections of the population that do not own their own homes. It can be argued that higher costs of housing are often reflected in high

private rents. Up to date and accessible information about private rents in London is limited. According to the GLA's London Household Survey 2002¹⁰, 14.7 per cent of London's households rent in the private sector. Tenure mix is a key variable for London as well, where a high proportion of the population lives in council rented accommodation.

This report is a snapshot in time and it is difficult to understand the relationships between the variables and implications resulting from changes to them. Due to the unavailability of ward level data, a time series analysis – which would assist policy and planning decisions – has not been undertaken. A time series analysis could show any channels of influence between the various variables.

¹⁰ From the Mayor's *Private Sector Rents Bulletin*, Issue 1, Winter 2002/03, http://www.london.gov.uk/mayor/housing/rents_bull/index.jsp

Appendix 1. Definitions

1.1 Urban green spaces

There are a number of definitions of green spaces. The Urban Green Spaces Taskforce, set up in January 2001, agreed a working description of urban green spaces (DLR, 2001):

- Urban open space is a mixture of private and public, formal and informal landscape and townscape within designated urban boundaries. It can include streets, boulevards, plazas, pedestrian areas, footpaths, cycle ways, squares, parks and green space.
- Urban green spaces are increasingly understood to mean the green areas within the overarching term of open space. These include:
 - public parks and gardens
 - play spaces – playgrounds, play areas, adventure playgrounds and play centres
 - natural green spaces – urban wildlife, ecology and woodland areas
 - amenity green spaces – residential squares and public spaces around buildings
 - functional green spaces – publicly accessible cemeteries, allotments, community gardens, sports
 - fields, publicly accessible school grounds, churchyards and urban farms
 - green corridors, including river banks, canals and waterfronts
 - greening of urban vacant and derelict land
 - private green spaces which benefit the public.

The main focus for the Taskforce is urban parks and play areas. However, the concerns and issues of the taskforce are relevant to the whole range of green spaces.

1.2 Green spaces used in the model

Green Belt

This designation is set out in government planning guidance¹¹ and includes the purposes and uses detailed below. The draft London Plan recognises the role of Green Belt and its protection. In practice this has led to the designation of land surrounding the outer built edge of London as Green Belt.

Including land in Green Belts

Land is included in Green Belts for five purposes :

- to check the unrestricted sprawl of large built-up areas
- to prevent neighbouring towns from merging into one another
- to assist in safeguarding the countryside from encroachment
- to preserve the setting and special character of historic towns
- to assist in urban regeneration, by encouraging the recycling of derelict and other urban land.

¹¹ PPG2 Green Belts (1995)

The use of land in Green Belts

Once Green Belts have been defined, the use of land in them has a positive role to play in fulfilling the following objectives:

- to provide opportunities for access to the open countryside for the urban population
- to provide opportunities for outdoor sport and outdoor recreation near urban areas
- to retain attractive landscapes, and enhance landscapes, near to where people live
- to improve damaged and derelict land around towns
- to secure nature conservation interest
- to retain land in agricultural, forestry and related uses.

Metropolitan Open Land

Metropolitan Open Land is unique to London and is a designation that is applied to strategic open spaces within the urban environment. The draft London Plan sets out the functions and criteria of Metropolitan Open Land as follows:

Functions

- protecting open space to provide a clear break in the urban fabric and contribute to the green character of London
- protecting open space to serve the needs of Londoners outside their local area
- protecting open space that contains a feature or landscape of national or regional importance.

Criteria

- Metropolitan Open Land should fulfill one or more of the following criteria:
- contribute to the physical structure of London by being clearly distinguishable from the built up area;
- include open air facilities, especially for leisure, recreation, sport, arts and cultural activities and tourism, which serve the whole or significant parts of London;
- contain features or landscapes of historic, recreational, nature conservation or habitat interest, of value at the metropolitan or national level;
- form part of a Green Chain and meets one of the above criteria.

1.3 Sites of importance for nature conservation

The following definitions are from *Connecting with London's nature: The Mayor's Biodiversity Strategy* (GLA, 2002a).

A1.2 The different kinds of wildlife sites¹² and areas

A1.2.1 There are three kinds of site, which are chosen on the basis of their importance to a particular defined geographic area. This use of search areas is an attempt, not only to protect the best sites in London, but also to provide each part of London with a nearby site, so that people are able to have access to enjoy nature.

¹² Sites of Importance for Nature Conservation are described in Appendix 1 of the Mayor's Biodiversity Strategy (GLA, 2002a).

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Sites of metropolitan importance

A1.2.2 Sites of Metropolitan Importance for Nature Conservation are those sites which contain the best examples of London's habitats, sites which contain particularly rare species, rare assemblages of species or important populations of species, or sites which are of particular significance within otherwise heavily built-up areas of London.

A1.2.3 They are of the highest priority for protection. The identification and protection of Metropolitan Sites is necessary, not only to support a significant proportion of London's wildlife, but also to provide opportunities for people to have contact with the natural environment.

A1.2.3.1 The best examples of London's habitats include the main variants of each major habitat type, for example hornbeam woodland, wet heathland, or chalk downland. Habitats typical of urban areas are also included, eg various types of abandoned land colonised by nature ('wasteland' or 'unofficial countryside'). Those habitats which are particularly rare in London may have all or most of their examples selected as Metropolitan Sites.

A1.2.3.2 Sites of Metropolitan Importance include not only the best examples of each habitat type, but also areas which are outstanding because of their assemblage of habitats, for example the Crane corridor, which contains the River Crane, reservoirs, pasture, woodland and heathland.

A1.2.3.3 Rare species include those that are nationally scarce or rare (including Red Data Book species) and species which are rare in London.

A1.2.3.4 A small number of sites is selected which are of particular significance within heavily built up areas of London. Although these are of lesser intrinsic quality than those sites selected as the best examples of habitats on a London wide basis they are outstanding oases and provide the opportunity for enjoyment of nature in extensive built environments. Examples include St James's Park, Nunhead Cemetery, Camley Street Natural Park and Sydenham Hill Woods. In some cases (eg inner London parks) this is the primary reason for their selection. For sites of higher intrinsic interest it may only be a contributory factor. Only those sites that provide a significant contribution to the ecology of an area are identified.

A1.2.4 The list of sites was updated regularly by the London Ecology Committee and is now available, and details of the site boundaries, from the Greater London Authority and the London Biodiversity Records Centre.

A1.2.5 Should one of these sites be lost or damaged, something would be lost which exists in a very few other places in London. Management of these sites should as a first priority seek to maintain and enhance their interest, but use by the public for education and passive recreation should be encouraged unless these are inconsistent with nature conservation.

Sites of borough importance

A1.2.6 These are sites which are important on a borough perspective in the same way as the Metropolitan sites are important to the whole of London. Although sites of similar quality may be found elsewhere in London, damage to these sites would mean a significant loss to the borough. As with Metropolitan sites, while protection is important, management of borough sites should usually allow and encourage their enjoyment by people and their use for education.

A1.2.7 Since 1988 borough sites have been divided, on the basis of their quality, into two grades, but it must be stressed that they are all important on a borough-wide view.

A1.2.8 In defining Sites of Borough Importance, the search is not confined rigidly to borough boundaries; these are used for convenience of defining areas substantially smaller than the whole of Greater London, and the needs of neighbouring boroughs should be taken into account. In the same way as for Sites of Metropolitan Importance, parts of some boroughs are more heavily built-up and some borough sites are chosen there as oases providing the opportunity for enjoyment of nature in extensive built environments. The borough is an appropriate search area in relation to Planning Policy

Guidance on nature conservation (1994) which, in paragraphs 15 and 25, states that local plans should identify, and include policies for, areas of local nature conservation importance.

A1.2.10 Since essentially a comparison within a given borough is made when choosing Sites of Borough Importance, there is considerable variation in quality between those for different boroughs; for example, those designated in Barnet will frequently be of higher intrinsic quality than those in Hammersmith and Fulham, a borough comparatively deficient in wildlife habitat. Only those sites that provide a significant contribution to the ecology of an area are identified.

Sites of local importance

A1.2.11 A Site of Local Importance is one, which is, or may be, of particular value to people nearby (such as residents or schools). These sites may already be used for nature study or be run by management committees mainly composed of local people. Where a Site of Metropolitan or Borough Importance may be so enjoyed it acts as a Local site, but further sites are given this designation in recognition of their role. This local importance means that these sites also deserve protection in planning.

A1.2.12 Local sites are particularly important in areas otherwise deficient in nearby wildlife sites. Only those sites that provide a significant contribution to the ecology of an area are identified.

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Appendix 1 of *Connecting with London's nature: The Mayor's Biodiversity Strategy* (GLA, 2002a) identifies further categories of land that is important for biodiversity, but for which data were not available to this study.

1.4 London's open space hierarchy

Table 3D.1 of the draft London Plan gives an open space hierarchy that has been employed to give planning protection to public open spaces in London for many years (GLA, 2002b). Whilst many of these sites will be included within Green Belt, Metropolitan Open Land or the Sites of Importance for Nature Conservation, studies suggest that about a quarter will not be so included. Unfortunately there was no comprehensive source of data on these sites for use in this study.

1.5 Health quality indicator – years of life lost

These are rates that are age-standardised up to age 75. The rate of years of life lost is calculated by dividing the number of years of life lost under 75 for circulatory diseases, cancer, accidents, suicides and undetermined injury between 1996 and 1998, by the sum of the population (under 75) of each Health Authority in 1996, 1997, and 1998. The calculation is expressed per 100,000 population. A three-year period was used to add robustness to the data¹³.

1.6 Dwelling density

The density of dwellings in London is negatively correlated with other land uses, including commercial and institutional uses. Prominent among these other uses are the lesser green spaces for which there was no data available for this study, particularly private residential gardens which amount to approximately 20 per cent of London's land area. This category also includes allotments, cemeteries, school grounds and sports pitches. It is not possible to separate out dwelling density from these competing land uses. To this extent, dwelling density is an inverse indicator of the green spaces not included within the strategic green space indicator.

¹³ Taken from the London Index of Deprivation 2002, Source: Health of Londoners project.

Appendix 2. Semi-log model

The association of variables with house prices as explained by the semi-log model. For example:

$$\ln HP = \alpha_0 + \alpha_{PG} Pcntgreen + e_i$$

$$\alpha_{PG} = \frac{\text{Relative change in house prices}}{\text{Absolute change in per cent green}}$$

The slope coefficient measures the constant relative change in house prices for a given absolute change in the explanatory variables. A relative change multiplied by 100 becomes a percentage change.

Valuing Greenness:

Green spaces, house prices and Londoners' priorities

Appendix 3. Acronyms

CPRE	Council for the Protection of Rural England
DfES	Department for Education and Skills
DTLR	Department for Transport, Local Government and the Regions (now Department for Transport)
DWP	Department for Work and Pensions
GLA	Greater London Authority
GIS	Geographical Information System
HoLP	Health of Londoners Project
LFEPA	London Fire and Emergency Planning Authority
MPS	Metropolitan Police Service
NO ₂	Nitrous dioxide
NOX	Nitrous oxides
ONS	Office of National Statistics
PM ₁₀	Particulate Matters
ppb	parts per billion
SATs	Standard Achievement Targets
SEIPH	South East Institute for Public Health
SO ₂	Sulphur dioxide
TfL	Transport for London

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Valuing Greenness:

Green spaces, house prices and Londoners' priorities

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Vietnamese

Tiếng Việt

Nếu bạn muốn bản sao của tài liệu này bằng
ngôn ngữ của bạn, hãy gọi điện theo số hoặc
liên lạc với địa chỉ dưới đây.

Greek

Αν θα θέλατε ένα αντίγραφο του
παρόντος εγγράφου στη γλώσσα
σας, παρακαλώ να τηλεφωνήσετε
στον αριθμό ή να επικοινωνήσετε
στην παρακάτω διεύθυνση.

Turkish

Bize telefon ederek ya da yukarıdaki
adrese başvurarak bu belgenin
Türkçe'sini isteyebilirsiniz.

Punjabi

ਜੇ ਤੁਹਾਨੂੰ ਇਸ ਦਸਤਾਵੇਜ਼ ਦੀ ਕਾਪੀ ਤੁਹਾਡੀ ਆਪਣੀ ਭਾਸ਼ਾ
ਵਿਚ ਚਾਹੀਦੀ ਹੈ, ਤਾਂ ਹੇਠ ਲਿਖੇ ਨੰਬਰ 'ਤੇ ਫੋਨ ਕਰੋ ਜਾਂ ਹੇਠ
ਲਿਖੇ ਪਤੇ 'ਤੇ ਰਾਬਤਾ ਕਰੋ:

Hindi

यदि आप इस दस्तावेज़ की प्रति अपनी भाषा में चाहते हैं,
तो कृपया निम्नलिखित नम्बर पर फोन करें अथवा दिये
गये पता पर सम्पर्क करें।

Bengali

আপনি যদি আপনার ভাষায় এই দলিলের প্রতিলিপি
(কপি) চান, তা হলে নীচের ফোন নম্বরে
বা ঠিকানায় অনুগ্রহ করে যোগাযোগ করুন।

Urdu

اگر آپ اس دستاویز کی نقل اپنی زبان میں چاہتے
ہیں، تو براہ کرم نیچے دیئے گئے نمبر پر فون کریں
یا دیئے گئے پتہ پر رابطہ قائم کریں۔

Arabic

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Gujarati

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જોઈતી હોય તો, કૃપા કરી આપેલ નંબર ઉપર
ફોન કરો અથવા નીચેના સરનામે સંપર્ક સાધો.

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