

Appendix F: Land-use modelling

F.1 Background

F.1.1 Land type

In terms of UK land use in respect to the residential sector, land type can be discussed in terms of built land, greenfield, green belt, and brownfield.

- **Built land** refers to residential dwellings including gardens and drives but neglecting roads and amenities.
- **Greenfield** is land neither built on nor previously built on.
- **Green belt** also refers to land that is neither built on nor previously built on and has been designated as green belt to restrict the sprawl of built up areas on to previously undeveloped land and to preserve the character of historic towns. In 1997, approximately 2 million hectares of land was designated as green belt in England, Scotland and Northern Ireland whilst none was designated in Wales.
- **Brownfield**, also known as **previously developed land (PDL)**, is land which was previously built on and is capable of being rebuilt. In Scotland, the equivalent terms used as are vacant and derelict land. Brownfield is classified by the National Land Use Database (for England only) into the following five categories:
 - Land Type A: Previously developed land now vacant
 - Land Type B: Vacant buildings
 - Land Type C: Derelict land and buildings. This represents land or buildings so damaged by previous development through contamination, sub surface structures *etc.* that it is unavailable for beneficial use without treatment.
 - Land Type D: Land or buildings currently in use and allocated in the local plan and/or having planning permission
 - Land Type E: Land or buildings currently in use with redevelopment potential

For the purpose of the modelling in this study, PDL is used for any previously developed land and greenfield for non-previously developed land.

Building and demolition of domestic residences cause changes to the ratio of the different land types. The Government has set a target of 60% of new build to be built on PDL. This policy has encouraged the use of PDL sites for rebuilding, thus reducing the amount of greenfield required for new build. There has been a significant shift in this over the last decade. In the mid 1990s, around 50% of all new dwellings in England were built on PDL sites, rising to 60% in 2001 and 65% in 2003 (ODPM 2006). In London the proportion is significantly higher than the government's target of 60%, at 91%. The West Midlands (67%) and South East (65%) were both significantly higher than the average.

PDL exists in relative abundance with 64,100 hectares of PDL accounted for in 2004 (NLUD 2004), an area almost twice the size of the Isle of Wight (380 km²). This land exists countrywide, with notable peaks in the North West and South East, each with an area of over 10,000 hectares (100 km²).

F.1.2 Density

It is not only the extent but the type of house building and demolition which has an effect on land use changes within the residential sector, but the density of development is also key. It is important to note there are different measures of density to characterise areas of different size. Residential density (persons per hectare, pph) is used for areas up to the borough and local authority level whereas population and town

density (person per square kilometre) is used for metropolitan areas and above. Residential density, living density, workplace density, dwelling density, room density, bed density and plot ratio are all density measures used at the neighbourhood and development site scale. As the area of investigation increases the tendency is for density to decrease. For instance, Greater London wards average is 66 pph, the Greater London Borough average is 61 pph, Greater London is 46 pph, whereas for England the average is 38 pph. It can therefore be misleading to compare density figures of different scales (Burdett *et al* 2004). Density can also be expressed in terms of the number of dwellings per hectare.

When discussing and using density measure for any area scale it is important to understand the differentiation between gross and net residential density. According to TCPA, net residential densities are defined as referring 'only to the land covered by the residential development, with any gardens and other spaces that are physically included in it, and usually half the width of any adjacent roads.' Gross residential density, on the other hand, is defined to also 'include certain nearby non-residential development, in order to reflect the amount of services and amenities such as schools and parks that are needed to support the housing element.' In addition, there is a third density measurement, town density, that is occasionally calculated, which is used to indicate the overall gross residential density of an entire urban settlement or discrete urban area, with no part omitted (TCPA 2003).

Different dwelling types (categorised by detached, semi-detached, terraced, flat *etc.*) have different land footprints, typical values from as low as 20 dwellings per hectare for outer urban detached houses to 100 dwellings per hectare for pre-1919 terraces to 328 dwellings per hectare for high density flats such as those in Kings Wharf, London (Hardy & Kells 2005; GLA 2003). The older suburbs of many English towns are comprised of semi-detached and terraced houses with gardens at around 35-40 dwellings per hectare (Burdett *et al* 2004). In the London boroughs of Islington and Camden, a number of public housing schemes, from the 1970s onwards, demonstrated that the Martin's Centre (Cambridge) theoretical calculations could be realised in practice with typical outcomes in density terms of between 310 to 390 persons per hectare without loss of privacy, amenity or compromising housing mix and choice (Burdett *et al* 2004).

In recent years, average urban densities for new build have been around 25 dwellings per hectare for the regions and 40 to 78 dwellings per hectare for outer London boroughs and inner London boroughs respectively (GLA 2003). However, between 2001 and 2004, the influence of Planning Policy Guidance 3 and the Density Direction requirement has helped to achieve a 56% increase in net annual average new development densities, from 25 to 40 dwellings per hectare (ODPM 2005).

Household size (the number of people in a household) has implications for the dwelling density that can be achieved and varies with geographic location. For example, the inner London boroughs are projected to see an increase in young single people wanting to live by themselves compared to families that will continue to move to the outer London boroughs.

The modelling for this study is based on the number of dwellings per hectare, rather than persons per hectare, since the aim was to identify the amount of land required by the projected forecast in household formation to 2050.

F.2 Model calculations

The calculation of greenfield take for the three scenarios (A, B and C) was made using the following data:

- the extent of PDL in English regions in 2004 (NLUD 2004)
- the annual build and demolition rates under each scenario
- the mean density of demolished houses
- the mean density of new build

And the following assumptions were made:

- A mean demolition density of 40 dwellings per hectare under all three scenarios. Given the lack of data on density or dwelling types currently being demolished, demolition is not targeted at specific housing types in any of the scenarios
- All new build (replacement and additional dwellings) occurs on all available previously developed land (PDL) in the first instance. This assumes that all the land can be used and that none is required for non-residential purposes. Once this is used up, building occurs on greenfield sites. No distinction is made between greenbelt and greenfield land.
- The pool of available PDL is assumed to be that which exists in 2004 and that freed up by residential demolition in the ensuing years. No account has been taken of additional PDL arising from non-residential sites after 2004.
- The land-use calculation only takes account of the land required for the house and garden and does not include any additional land for infrastructure eg roads, schools, parks etc. In this analysis, 'dwelling density' refers to the land occupied by the house and garden only.

Given the limitations in data availability, the calculations for PDL and greenfield take were performed on the basis of figures for England. In Wales, demolition and new build rates are running around 3-5% of that for England, approximately reflecting the relative populations. Data for the extent of PDL in both Wales and Northern Ireland were unavailable. In Scotland, the situation is different – population change is predicted to be negative with further migration to England and therefore no consequent pressure on greenfield or PDL.

The calculation was performed in the following way:

$$G = \text{PDL} - n_{\text{new}} * \text{dens}_{\text{new}} + n_{\text{dem}} * \text{dens}_{\text{dem}}$$

where, PDL is the available previously developed land in 2004 (ha) and where, from 2004 to the time horizon being calculated:

G is the required greenfield take (ha);

n_{new} is the number of new build;

n_{dem} is the number of demolished dwellings;

dens_{new} is the density of new build (dwellings/ha);

dens_{dem} is the density of demolished dwellings (dwellings/ha), assumed to be 40 dwellings per hectare.

Two values for dens_{new} were assumed:

- 25 dwellings per hectare, equivalent to historic figures for new urban development densities (and lower than the assumed demolition rate)
- 40 dwellings per hectare, equivalent to recent figures for new development densities (and equal to the assumed demolition rate)

A further step was performed with the required greenfield take, G, assumed to be zero and the consequent density of new build under each scenario was calculated.

References

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