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Methods of estimating population and household projections

Science report: SC030238

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Steve Killeen

Head of Science

Executive Summary

In September 2005, the Environment Agency commissioned Experian Business Strategies to review the different methods for estimating and projecting households and population. This was done with a view to developing an established approach that can be used by the Environment Agency and potentially adopted by the water industry.

Four methods were used to estimate current household and population counts and to project household and population counts in the future. This report provides information on official data sources and outlines various methods for apportioning administrative data to create smaller geographic areas. We comment on the accuracy and integrity of different forecast methodologies, under different circumstances and different needs.

We start by asking why small area population and household statistics are needed. There are a variety of uses and users of population and household data within the water industry, with these data covering a range of different geographical reporting levels. As things stand, local authority district geographies are the lowest level of official population data, but are too big to be used to estimate the base year population even at the water company level. As such, data need to be 'tailored' to meet the precise business planning and regulatory reporting requirements imposed on water companies, and this tailoring requires sub-district estimation techniques. Output Areas are a good choice as a geographic level for estimation.

In section three, Sources and methods: estimates, we consider the sources and methods for estimating small area population and household counts and outline how local authority district-level estimates are produced. Mid-year estimates of population should be taken as the benchmark local authority district-level population count, because they are constructed using the current best practice in population estimation. Alternative methods for estimating base year household counts by local authority district are available but all were found to have potential drawbacks.

We present evidence from our own investigation into which method is most accurate. When combined with our experience and knowledge, this evidence allows conclusions and rules of thumb to be drawn. In order to produce small area household and/or population estimates (where population is not split into many age and gender categories), we conclude that the choice is between the apportionment and ratio methods. As both methods have their advantages and disadvantages, an ideal strategy would be to use both methods in parallel and then average the results. This would help minimise the number of small areas that end up with large outlier estimates.

In section four, Sources and methods: projections, we have outlined how local authority district-level household and population projections are produced. We examine the merits of using trend-based projections versus the merits of adopting a policy-driven approach. Trend-based projections should be produced as a minimum requirement. Ideally, policy-driven projections that capture new build allocations should additionally be derived in order to compare and contrast against trend.

There is no universally accepted 'gold standard' for producing small area estimates of populations and households. The process of producing estimates and projections is as

important as the results themselves. We cannot produce a set of standard recommendations for every circumstance, as the estimation and projection process will need to be adapted to accommodate individual requirements.

Consequently, in section five, Conclusions and recommendations, we outline a set of evidence-based rules of thumb that should be followed wherever possible. The results of an investigation into the accuracy of different approaches to forecasting communal population, for example, suggests that keeping communal population fixed at the level shown in Census 2001 is at least as accurate as any forecast approach. Our analysis of the performance of the trend-based and policy-driven approaches suggests that, on average, incorporating a policy-driven approach will improve the accuracy of household and household population projections. We always recommend calibrating small area estimates to local authority district targets. This will improve the accuracy of the small area statistics, as the population estimates for larger areas are usually more accurate than for smaller areas.

All information in this report is correct as at the beginning of 2006. It is inevitable that certain issues, especially those concerning policy, will change and that, as a consequence, this report may become out of date. There may be a need for a revised version to reflect any changes in Government policy and the availability of data.

Contents

1. Background

1.1 Introduction

The Environment Agency has various uses for population and household data, not least as an input for forecasting water demand. Statistics from sources such as the Office for National Statistics (ONS) provide information for administrative boundaries, including wards and local authority districts. But the data at this level do not match the geographical areas needed for business planning, such as Environment Agency regions, water company supply areas or water resource zones.

Various methods for apportioning administrative data to create smaller refined geographic areas are available. Such methods can utilise demographics data at postcode and 2001 Census Output Area (OA) level and can be combined with administrative data to fit most spatial requirements. Yet, different estimation methods produce different results and there are issues about how to produce forecasts when OA- or postcode-level data are not available.

To address these shortcomings, in September 2005 the Environment Agency commissioned Experian Business Strategies to review the different methods for estimating and projecting future population and occupancy. This was with a view to developing an established approach that could be used by the Environment Agency and potentially adopted by the water industry.

This report will assist the Environment Agency and their partners to:

- identify sources of data for estimating and projecting future populations and household counts;
- describe different methods for apportioning administrative data to other client-defined geographical areas;
- comment on the accuracy and integrity of different forecast methodologies, under different circumstances and different needs.

The project will benefit water resources staff and those involved with land-use planning who need to evaluate the integrity of demographic growth forecasts. It may also help water quality or waste staff in their own forward planning. The intended audience includes the Environment Agency and water company staff.

1.2 Structure of this report

This report sets out the findings of the study and takes the following shape.

- Why are small area population and household statistics needed (Section 2)?
- Sources and methods: estimates (Section 3).
- Sources and methods: projections (Section 4).
- Recommendations (Section 5).

- Estimates and projections: a user checklist (Section 6).

2 Why are (small area) population and household estimates needed?

2.1 Introduction

There are clearly a variety of uses and users of population and household statistics within different organisations. Population estimates are often used to allocate national and regional funding to local authorities and to calculate rates of employment, crime or mortality, in order to demonstrate the effectiveness of funding at national, regional and, increasingly, the local level. Within private organisations such as retailers and banks, an understanding of the local population base and its demographic profile is important for estimating the size of the potential market for their products or services.

Estimates and projections of the number of households have recently come to the forefront of national debate. Sharp increases in house prices and the subsequent impact on affordability has led the government to increase the priority of housing needs within the policy arena. This has led to the development of sustainable community plans and the publication of the Barker review, which set out a range of policy recommendations to improve the functioning of the housing market. The targeted new build programmes set out in regional policy statements will affect the population base in an area and impact on the provision of public sector services such as education and health. They will also affect demand for water and waste facilities.

Furthermore, in the pursuit of service provision at the local level, there is an ever increasing demand for statistics based on non-standard geographies that do not fit administrative boundaries. The user of these statistics is required either to produce their own ‘tailored’ estimates in-house, shop around for alternative data sources or use specialist data providers to meet their needs. All of these options have cost and time implications for the user.

Throughout this report, the term ‘small area’ is used to define any geographical area smaller than a Local/Unitary Authority District or London Borough.

2.2 Needs within the water industry

There are a variety of uses and users of population and household data within the water industry. These data cover a range of geographical building blocks, from national level aggregates down to small area counts for micro-management of current and future resources. The very nature of water resource management means that the boundaries of water companies and their constituent planning and management zones cut across administrative boundaries. This means that the data are typically ‘tailored’ to meet the precise business planning and regulatory reporting requirements imposed on water companies.

Even within organisations such as the Environment Agency, different approaches are required to satisfy different needs. For instance, water resources staff involved with

spatial planning need to evaluate the integrity of demographic growth forecasts, whereas staff involved with water quality and waste management have their own forward planning requirements.

The differing needs of water companies and regulators for estimates of population and households are summarised in Table 1.

Table 1 The needs of water companies and regulators for estimates of population and households

Geographic Scale	Water Company	Environment Agency	OfWat
National/ Regional	n/a	Estimate national water balance and long-term water demand projections for next 25–30 years.	National water balance and long term water demand projections.
Company	Business planning – annual, five-year horizon. Performance management – annual, tariff policy.	Analysis of intra- and inter-regional resource development. On-going, with 20–25 year planning horizon. Assessment of options and impacts of sewage treatment infrastructure.	Monitor company performance, including investment plans, operating spend and tariffs. Annual, five-year planning horizon.
Water Resource Zone	Water resource planning, every five years, 25–30 year horizon. June returns, annual, five-year horizon. Leakage control.	Review population and household projections supplied by water companies to ensure consistency of national and regional water resource planning. Granting abstraction licences.	Monitor investment plans, including new water resources, leakage control plans, customer metering. Annual, five-year planning horizon.
Sub Water Resource Zone	Capture development hot-spots. Investment in water and sewage treatment work and sewerage infrastructure, 25–30 year horizon.	Localised environmental impacts of abstractions and sewage treatment effluents.	Assess the utilisation of existing water resources and the supporting infrastructure.

2.3 What levels of geographic scale exist?

What is the most suitable spatial level to meet the needs of the Environment Agency and the water companies? To some extent that will depend on a range of criteria, including purpose of use, resources available to construct the dataset, associated costs and the level of accuracy placed on the estimates.

Local authority-level estimates of population are typically used by demographers in estimating population counts for standard and non-standard geographies. This is because the data is freely available from the ONS, can be downloaded from the ONS web-site and is relatively timely in its release (2004 mid-year estimates (MYE) were released in Autumn 2005). However, without any data tailoring, will aggregations of local authority district data be robust enough to act as a 'proxy' for a water company area?

An analysis of the population of the Essex & Suffolk Water region in 2001 clearly highlights that this is not the case. An estimate of population at the company level based on all the local authorities and unitary authorities (LAUAs) that form part of the zone overestimates the true population in 2001 by 77 per cent. Meanwhile, the estimates of base year population count for Essex based on LAUAs that fit wholly within the Essex resource zone underestimate population by 31 per cent (over 456,000 people). The discrepancies are even larger for the Suffolk water resource zone, where only two LAUAs fit fully within the zone and six other LAUAs straddle across the water resource boundary.

Table 2 Estimate of population in the Essex & Suffolk Water region in 2001

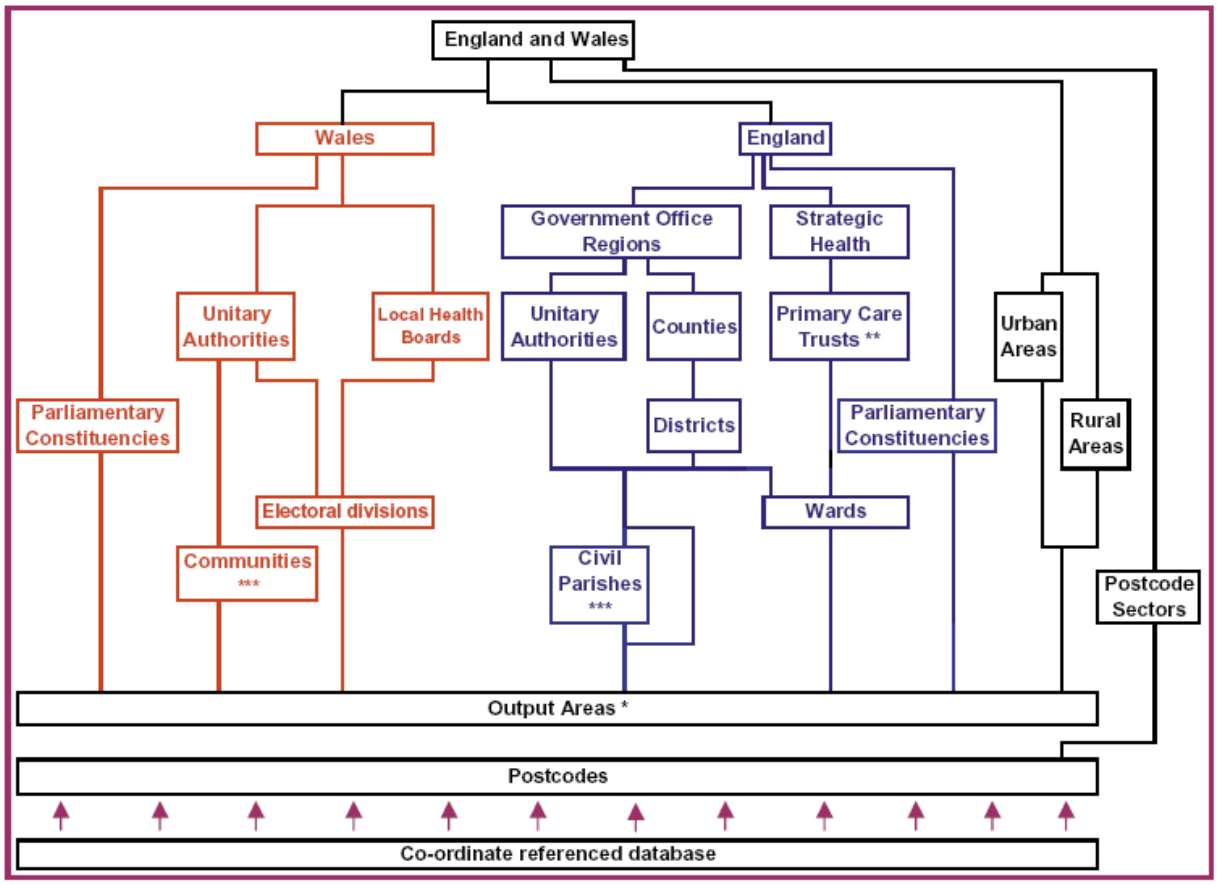
	Essex		Suffolk		E&S	
	2001	% Diff	2001	% Diff	2001	% Diff
All LA/UA	2,249,850	52	855,688	209	3,105,538	77
Whole LA/UA	1,020,469	-31	203,325	-27	1,223,794	-30
Actual*	1,476,000		277,000		1,753,000	

*Actual numbers sourced from Household Water Demand: Essex & Suffolk Water, Experian Business Strategies 2006.

Clearly, using LAUA administrative boundary data to establish a base year population count does not accurately capture the true population.

So what are the alternative geographical building blocks that can be used to estimate the base year population?

The diagram below has been taken from the ONS web-site and shows how spatial geographies nest together.



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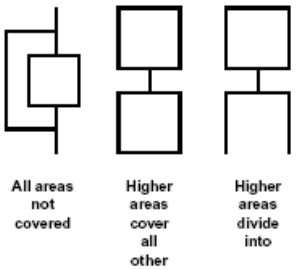


* Output Areas may build on a best fit basis to some areas.

** Wards may sometimes be split between Primary Care Trusts.

*** Civil Parishes or Communities falling below the threshold populations for the release of Census Area Statistics will be amalgamated with a contiguous area to form an Output Area.

Figure 1 Spatial geographies

There are many areas that are, on average, smaller than district and unitary authority areas, including wards, parishes, census OAs and postcodes. Sub-regional housing market areas are an additional geographical area and are likely to become relevant in the summer of 2006 with the publication of Planning Policy Statement 3 (PPS3). This policy aims to define the areas within which people search for a home as the basis for planning new housing, rather than local administrative boundaries.

There are advantages and disadvantages attached to each area building block and these are summarised in Table 3.

Table 3 Census output geography

Area	Advantages	Disadvantages
LAUA district (300+ in England and Wales)	Many of the smaller output geographies nest within LAUA boundaries, or can be made to nest using best-fit lookups. Compiled by cohort survival method, they are deemed the most appropriate approach to produce best estimates given data inputs. Most timely data. Annual migration estimates available too.	Too coarse to be used on their own to estimate population at company level or below – see Essex & Suffolk Water example.
Ward (14,000)	Smaller than LAUA. Users can get a closer fit with company reporting requirements. Nest within LAUAs.	Regularly reviewed to maintain a broad count between the number of electors each councillor represents, and so can change. Still too coarse to use individually to meet company requirements. No time series data available, although the ONS has recently released experimental ward based estimates for 2002 and 2003.
Postal Sectors – for example SW1 1 (9,500+)	Can link to company billing data and planned new build information if a postcode has been allocated to a planning submission.	Need to use a best fit lookup to nest into LAUA boundaries. New postcodes are added and existing postcodes renamed, so difficult to compile consistent time series data. No time series data.
Parishes (11,000)	Parishes are confined within local authority boundaries but are not contiguous with electoral wards.	Parishes cover less than half of the population in England and Wales. There are areas that are not parished – mainly the main urban areas.
Post codes (1.4 million)	Can link to company billing data and planned new build information if a postcode has been allocated to a planning submission. Can link to address point data for analysis within a GIS (Geographical Information Systems) framework.	Data processing issues. Need to use a best fit lookup to nest into LAUA boundaries. New postcodes are added and existing postcodes renamed, so difficult to compile consistent time series data. No time series data.
Output Areas (230,000)	Most refined spatial building block reported from Census 2001. Nest within higher level geographies, so can be calibrated to higher targets as needed. Fixed geography.	Data processing issues. Need to use a best fit lookup to nest into some higher geographies. No time series data.

The latest nationally available ward estimates produced by the ONS are based on 2002 data. These relate to Census Area Statistics (CAS) wards that were in existence when Census data were released in 2003. These statistics are still an experimental series and, as such, are subject to further development and change. Importantly, as the data extend out to 2002, there remains a gap between the data input and the requirement by water companies to establish a base year estimate of population.

Following on from the release of ward-level estimates, the ONS Small Area Population Estimates (SAPE) team has now released both lower layer and middle layer Super Output Area (SOA)-level population estimates for England and Wales. As with the ward estimates, these figures are classified as experimental ONS statistics.

2.4 Total population, residents of households or households?

The estimated resident population of an area includes all people who usually live there, whatever their nationality. Members of HM and US Armed Forces in England and Wales are included on a residential basis wherever possible. HM Forces stationed outside England and Wales are not included. Students are taken to be resident at their term-time address.

The communal population, including those living in medical and care establishments, defence establishments, prison service establishments and education establishments (including halls of residence), are removed from the total population counts. This is done for two reasons[1]: (i) to derive an estimate of residents in households, which can be linked with estimates of per capita water consumption to estimate water demand and form an input into the reporting needs of water companies; and (ii) to facilitate the estimation and projections of households and population.

The census definition of a household is one person living alone, or a group of people (not necessarily related) living at the same address with common housekeeping – that is, sharing either a living room or sitting room or at least one meal a day. A household space is the accommodation occupied by a household (or, if unoccupied, available for a household).

A dwelling can either consist of one household space (an unshared dwelling) or two or more households (a shared dwelling).

Total dwellings can be linked to total households by accounting for: (i) multi-occupied households; (ii) vacant household spaces; and (iii) holiday or second homes.

Changes in the number of dwellings due to new build or demolitions will influence the population counts of areas, change the housing density and potentially put pressure on the local water system. Information on these changes can be either real-time (a new housing development has been completed and its utility service switched-on) or forward looking by up to 20 years and beyond, where land has been allocated to a new housing

[1] See section 3.2.5 for options for residents in communal establishments.

development as part of a local or regional structure plan or the sustainable communities remit of the Department for Communities and Local Government (DCLG).

In this report, the term household is used to refer to occupied household spaces and, as such, are properties (normally occupied) receiving water for domestic purposes.

Estimates of the number of households are used to cross-reference company billing data and also to monitor new build, demolitions and changes to the housing stock that will influence levels of metering within the company area.

Combining data for households and the number of residents in households produces occupancy rates, which are a key driver of water demand.

2.5 Summary

1. There are a variety of uses and users of population and household data within the water industry. These data can cover a range of different geographical reporting levels and span forecast horizons as far out as 30 years.
2. Boundaries of water companies and their constituent planning and management zones cut across administrative boundaries.
3. As they stand, LAUA geographies are too big to be used to estimate the base year population even at the water company level.
4. Ward level estimates are more refined than LAUAs, but estimates from the ONS are still experimental and are not as timely as LAUA releases.
5. As such, data need to be ‘tailored’ to meet the precise business planning and regulatory reporting requirements imposed on water companies and require sub-district estimation techniques.

3 Sources and methods: estimates

3.1 Introduction

In this section, we consider the sources and methods for estimating small area population and household counts.

We start with a discussion of the local authority district level population and household datasets that are available from the ONS. A clear understanding of how these datasets are constructed is critical, as they often act as a calibration target for subsequent sub-district area analysis. This, in turn, is a fundamental requirement for aligning population and household estimates with company level, supply zone and planning zone areas.

We then move on to present the results of an investigation into the use of ratio, additive and apportionment methods for estimating households and population for OAs and wards in both Nottingham unitary authority (UA) and UK-wide.

3.2 Local Authority and Unitary Authority-level population estimates

3.2.1 Source

The ONS prepares annual MYE of population for LAUA areas in England and Wales.

Mid-2004 population estimates at LAUA level by five-year age groups and gender are available for no charge from the ONS. The mid-year point relates to the estimated resident population as of 30 June each year. The 2004 MYE of population were released in the autumn of 2005.

Historical population data at the LAUA-level is available from 1981 on an annual basis for boundaries that were in place on 1 April 2001. The ONS estimates population changes that are due to boundary changes and backcast the data accordingly.

Historical and current year MYE of population are available on-line for free on the ONS web-site, under the theme ‘Population and Migration’, at http://www.statistics.gov.uk.

Mid-2004 estimates can be found from the following page, under 'current datasets': http://www.statistics.gov.uk/statbase/product.asp?vlnk=601

It is ONS policy to publish population estimates rounded to at least the nearest hundred persons.

3.2.2 Method

MYE of population are calculated by ageing forwards the 2001 Census data each year. This is done by adding in changes for births, deaths and migration and taking account of other notable changes, such as prison populations, armed forces and their dependants, and boarding school pupils. This is often referred to as a cohort-survival model.

Population 2002 = Population 2001 + (births - deaths) + (in-migration - out-migration) + other changes

These calculations are carried out at the LAUA-level, using local-level data on births and deaths, combined with estimates of migration and other changes. Local estimates of births and deaths are considered the most accurate element of this calculation, as the collection of this data is a statutory requirement for all LAUA areas in England and Wales. Data is collected by single-year age groups and gender, and reported back to the ONS for overall collation.

Local-level estimates of internal migration (that is migration within England only) are based on an analysis of data from various sources, including General Practitioner (GP) patient records and the National Health Centre Register (NHCR). The 2001 Census is used as a supplementary source, to assist in, for example, the distribution of the NHCR data between the former health authority areas and LAUA areas.

International migration includes migration between England and (i) the rest of the UK, (ii) the rest of the World and (iii) visitor switchers and asylum seekers. Migration between England and the UK is calculated in the same manner as internal migration.

Migration between England and the rest of the world (excluding the Republic of Ireland) is based on information from the International Passenger Survey (IPS). The IPS is a sample survey of passengers travelling through airports, seaports and the channel tunnel. It captures information on the number of people intending to stay in the UK or leave the UK for a year or more, at a national and former health authority level.

Migration between the Republic of Ireland and the UK is captured by an analysis of the Quarterly Household Survey in Ireland, as migrants to and from the UK are not covered by the IPS. The Quarterly survey is, in essence, the Irish Labour Force Survey and has a greater level of uncertainty than internal migration estimates between England and the UK.

The Home Office provides records of asylum seekers, their dependants and visitor switchers, with applications for asylum providing the basis for estimated inflows of asylum seekers. Additional information on asylum seekers is available from: publications.rds@homeoffice.gsi.gov.uk

Further information on MYE of population and their methodology is described in the guide *Making a population estimate in England and Wales* (National Statistics Methodological Series No.34), which is available at http://www.statistics.gov.uk/downloads/theme_population/Making_PopulationEstimate.pdf

3.2.3 Analysis and commentary

An analysis of changes to ONS population estimates for the UA of Brighton & Hove for 2001 shows that, even at such a coarse level of geography and using the most sophisticated methods adopted by the ONS, estimating current year population is not without difficulty.

Prior to the release of results from the 2001 Census, ONS MYE of population used Census 1991 population data (adjusted for timings issues between the census date in April and the June mid-year point) to derive the 1991 MYE. The 1991 Census was the starting point for rolling forward subsequent annual estimates. However, the 2001 Census provided evidence that the 1991 Census population estimate was too high, due to an overestimate of the impact of under-enumeration.[2] This meant that population estimates made between 1991 and 2001 were overestimates, with the error being compounded year-on-year. Moreover, research by the ONS provided evidence that the net migration estimates, which are the most difficult component of population change to measure accurately, were also over-stated between 1991 and 2001.

The effect of these changes led to the 2001 MYE of population for Brighton & Hove being revised down by 5 per cent – from 262,300 to 249,000 – on release of the census-adjusted MYE for 2001.

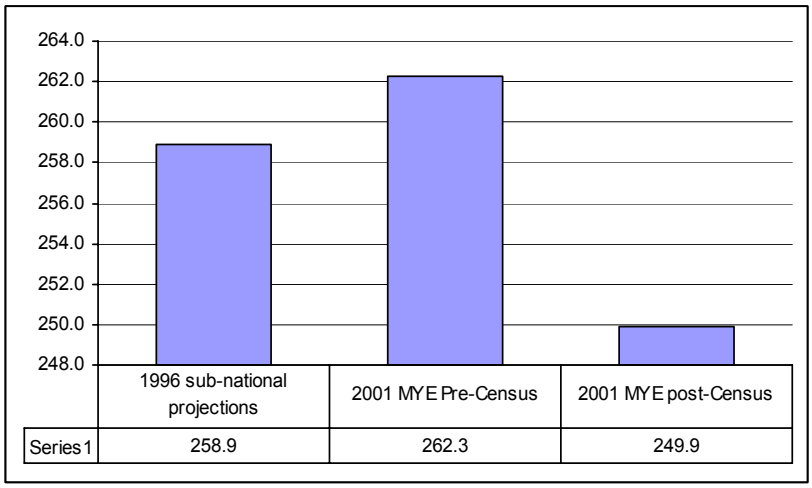


Figure 2 Brighton and Hove Population estimates

There have been well-documented changes to the initial One Number Census (ONC) population counts, as a result of follow-up longitudinal studies (September 2003), the Manchester matching exercise (in November 2003) and local authority population studies (October 2004). Even now, corrections are being made to ONS MYE. In December 2005, the ONS published a correction to the mid-2004 population estimates, affecting the London Borough of Harrow and 'higher' geographical levels.[3]

[2] Further information on the 1991 adjustment (published on 13 February 2003) is at the following link: http://www.statistics.gov.uk/downloads/theme_population/Meth_PopES_82_2000.pdf

[3] Methodology regarding the revisions can be found at: http://www.statistics.gov.uk/about/data/methodology/specific/population/PEMethodology/ and: http://www.statistics.gov.uk/about/data/methodology/specific/population/PEMethodology/PEArchive.asp

But revisions to data should not be treated as errors. In most instances, the initial estimate was based on the best information available at the time of computation. If more accurate data subsequently becomes available, it would be foolish not to incorporate it into the estimation process and revisions should therefore be viewed as refinements. If the changes to the estimates are significant – as in the case of Manchester, Derby, Southwark and several others across the UK – where possible, and if time constraints permit, companies and individuals making population estimates should make best use of the refined data and not rely solely on first releases.

3.2.4 Summary

Table 4 ONS mid-year estimates (MYE) of population

Advantages	Disadvantages
Updated annually Timely – 2004 MYE estimate released in Autumn 2005 Consistent geography No data charge Official estimates Detailed age breakdown Other administrative data can nest within the LA/UA boundaries Rolled-forward from adjusted Census 2001 Use of calibrating sub-LAUA level data Method continuously improved and refined	Revisions LAUA boundaries are too large to meet the spatial reporting needs of water companies Migration is the biggest source of error

3.2.5 LAUA household estimates

There are several other sources that can be used for estimating household counts by area, beyond simple Census 2001 counts. Anglia University and the DCLG produce projections of household representative rates (see glossary), by age, gender, and local authority district/London borough, for 2003–26. Household estimates are derived by combining projections of household representative rates with the population in private households, by age and gender.

The 2003-based household projections are the latest official view of trends in household formation. These can be sourced from the DCLG website (http://www.communities.gov.uk/index.asp?id=1002882&PressNoticeID=2097).

As at April 2006, the 1996-based household projections remained the latest official view of trends in household formation. This is because there has been a significant delay in the release of the new household representative rate projections. One solution that has

been used in the interim to estimate current year counts of households at the LAUA-level is detailed below.

1. Source the latest ONS MYE of population, by age and gender.
2. Subtract LAUA level communal population from the MYE to establish household population.
3. Apply the 1996-based household representative rates, by age and gender, to the latest ONS MYE of population, by age and gender.
4. Calibrate the counts to actual LAUA household counts in 2001 (available from Census 2001).

This solution requires a choice to be made: keep communal population beyond 2001 fixed at the level shown in Census 2001, or grow it in line with trends in total population? The results of an investigation into the accuracy of different approaches to forecasting communal population suggests that keeping communal population fixed at the level shown in Census 2001 is at least as accurate as any forecast approach, and is easier and less time consuming. Nevertheless, local adjustments should be made to communal population counts if significant changes have occurred, such as the closure of a hospital or armed forces base.

Alternative methods of estimating base year household counts by LAUA are detailed below.

1. Pushing forward household[4] counts from Census 2001 by adding in housing starts, removing demolitions and adjusting for conversions of houses into flats. Data on housing starts and completions are available at LAUA-level from the DCLG on an annual basis from 1999–2000 onwards.[5] Issues of timeliness and incomplete local authority-reported data suggest that this approach is better used to cross-check LAUA household projections, rather than used to derive the original household estimate.

The relationship between housing starts and population change for the period 2001 to 2004, using all English LAUAs where full four-quarter housing completion data is available, is shown in Figure 3. London borough outliers were removed to get a better relationship, but the R^2 value is still only moderate. Using population and dwelling-change median values, the LAUAs in Figure 3 were split into four quadrants to identify whether certain LAUAs could be grouped by region. The four quadrants created were:

i. LAUAs with HIGH dwelling change and HIGH population change;
ii. LAUAs with HIGH dwelling change and LOW population change;
iii. LAUAs with LOW dwelling change and HIGH population change;
iv. LAUAs with LOW dwelling change and LOW population change.

Each region studied has LAUAs that fall in each quadrant. The East Midlands and East of England have the highest proportion of LAUAs in quadrant 1, which has strong

[4] Strictly speaking this should read household spaces, the term households is used instead of household spaces.
[5] Table 253 House building: permanent dwellings started and completed, by tenure and district, 2004–05. For more details contact HOUSEBUILDING.STATISTICS@communities.gsi.gov.uk

housing completions and population growth. The North West and North East have the highest proportion in quadrant 4 (low housing completions and low population growth).

Around 15 per cent of LAUAs fall into quadrant 2, where there is relatively strong housing completions but weak population growth. Areas such as Slough, Reading and Woking in the South East have experienced a fall in population in the period, despite strong housing completions. In the South West, areas such as the Cotswolds and North Devon have experienced strong population growth with relatively low housing completions.

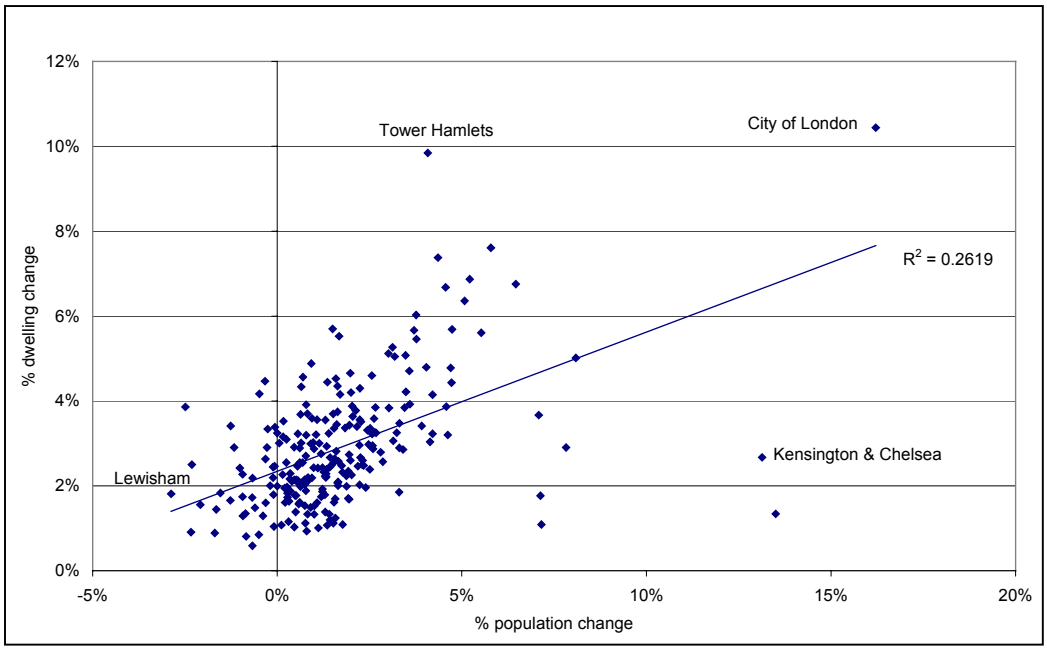


Figure 3a Change in population and dwelling completions by English LADs 2001 to 2004

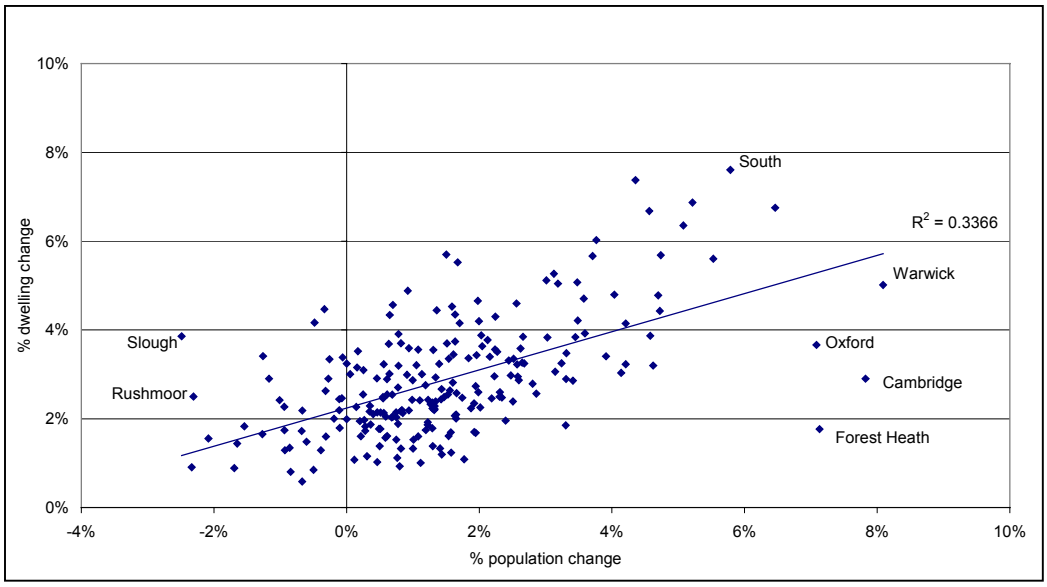


Figure 3b Change in population and dwelling completions by English LADs (excluding London) 2001 to 2004

2. The population of England increased by 823,000 in the five-year period to 2003. Using housing stock data at a national level and applying average household sizes in each year to push forward the 1999 population increases the population by 1,224,000 persons, a 50 per cent overestimate of the actual population change. However, the use of housing stock data does prove to be a reasonable method in the short term and there is scope for improvement, as the housing stock data produced by DCLG does not include estimates for missing returns. Only 312 out of 354 LAUAs submitted full four-quarter data in 2004–05.

Table 5 Mid-year population for England (000s)

	1999	2000	2001	2002	2003
Actual[1]	49,033	49,233	49,450	49,647	49,856
Estimate[2]		49,312	49,602	49,920	50,257
Error		0.2%	0.3%	0.6%	0.8%

Sources: 1 ONS; 2 Derived from DCLG (Table 111 Conversions and demolitions).

There is a need for detailed regional demolition and flat conversion data, in order to estimate population more accurately using this housing stock method. The data are unpublished by DCLG at a regional level.

3. Using changes in Post Office Address File (PAF) counts between 2001 and 2005, assuming that each additional household count on the PAF system is one extra household. This approach has merits: PAF counts are updated on a monthly basis and are easy to obtain from the Post Office[6]. However, the approach is relatively time consuming, and requires applying occupancy rates to the new household counts to derive population and then scaling back to ensure consistency with LAUA-level MYE of population.

3.2.6 Summary

1. MYE of population from the ONS should be taken as the benchmark LAUA-level population count, because it is constructed using current best practice in population estimation.
2. The ONS LAUA-level population estimates should be treated as the minimum data source for calibrating any sub-district population estimates.
3. There are concerns regarding data revisions and the accuracy of migration data in the estimation procedure.
4. Alternate methods of estimating base year household counts by LAUA are available, but all have potential drawbacks. These alternate approaches are better used to cross check LAUA household projections, rather than to derive the original household estimate.

6 www.royalmail.com/portal/rmg/jump2?catId=18000179&mediaId=18000180

3.3 Sub-district analysis

This section defines the different methods available to estimate small area populations and households, by describing each method and listing the data sources that can be used in estimation procedure.

3.3.1 Methods available

There are four main methods available for estimating small area populations, plus several hybrid methods.

- Apportionment – shares out current local authority population/households.
- Ratio change – applies a rate of change to the previous census.
- Additive change – adds an estimate of change to the previous census.
- Cohort survival – ages forwards the structure of the previous year population.

Detailed formulae for each estimation method can be found in Appendix A.

3.3.1.1 Apportionment

The apportionment methodology allocates the population of a large reference area such as an LAUA to a smaller area using a set of mutually exclusive smaller areas, such as wards or the electoral register.

For example, the population of each ward is calculated as the total LAUA population multiplied by the ward electorate divided by the LAUA electorate.

Apportionment assumes the relationship between the indicator population and the true population is the same for each small area within the LAUA. This method only requires data for the current time period and hence is easy to use for years where there have been boundary changes.

3.3.1.2 Ratio change

The ratio change method uses an indicator of current and past population to update an earlier population estimate for a small area.

For example, the population of each small area (such as a ward) is estimated as its population at the time of the Census multiplied by the indicator of current population (ward electorate now) divided by the indicator of past population (ward electorate in the Census year).

The ratio change method assumes the relationship between the indicator of population and the actual population has remained unchanged since the base year.

3.3.1.3 Additive change

A proxy indicator (such as electorate, number of dwellings or PAF counts) is added to a base year population estimate. For example, the population of a ward is calculated as its population in the census year, plus changes in the electorate between the time of the census and the current year.

If a population indicator is being used, the change is typically added directly to the base year population count. If dwelling change or PAF counts are being used, an occupancy rate adjustment is needed to move from dwelling counts back to population. The change may be assumed to be zero (no change from the previous census), or can be derived from average occupancy figures obtained from sources such as the DCLG (particularly as average household size has been declining almost continuously for the past 30 years), estimated from local housing surveys or studies, or varied according to the type of new dwelling built. This is often known as the 'dwelling led' method of population.

3.3.1.4 Cohort survival

The cohort survival method is used by the ONS and the General Register Office for Scotland (GROS) to age forward the census population and includes estimates of births, deaths and the migration of residents of each age group.

The current population of age group 'a' is estimated as those aged 'a' in the previous year, less those who would have been aged 'a' but have died plus immigrants of age 'a' minus emigrants of age 'a'.

This method requires separate estimates of births, deaths and migrants over the estimation period. Data on migration is rarely available for small areas. Hence, a typical approach is to age forward the census population, add births, apply a higher level (such as LAUA) age-specific mortality rate to estimate deaths and calibrate to LAUA total population counts in order to adjust for migration and ensure consistency with estimates produced by the ONS.

3.3.2 Data requirements

There are a variety of data sources that can be used as inputs to meet the data requirements of each of the four methods discussed above. The minimum data requirements for each method are summarised in Table 6, while commentary on sources of data for each method are detailed in Table 7.

Table 6 Minimum data requirement by method

Method	Reference area (such as LAUA)	Indicator of current population	Base population from an earlier year	Indicator of change in population
Apportionment	yes	yes	no	no
Ratio change	no	yes	yes	no
Additive change	no	no	yes	yes
Cohort survival	no	no	yes	yes

Source: LARIA/Estimating with Confidence, p37

As discussed in section 3.2.6, the LAUA population is taken as the reference area or the area calibrator and is used to control the small area population estimates.

Table 7 Sources of data by method

Requirement	Source	Comment
A. Indicator of current population	1. Electoral Register	Adult population only. Opt-out clause gives bias to results.
	2. Postal Address File (PAF) available from Royal Mail	Counts dwellings, which could be empty. It distinguishes between residential and business addresses. PAF (household) counts consistently higher than 2001 Census figures for occupied households.
	3. Address point data from Ordnance Survey	Link PAF to a grid reference for GIS analysis. Considered accurate in standard residential areas, but less so in areas with multi-occupation and flats (such as inner cities). Difficult to allocate new housing to a correct location before OS (Ordnance Survey) data has been updated.
	4. Council Tax register	Lists dwellings. Occupancy rate adjustment needed to translate from dwellings to population. Note: underestimates dwellings in an area with multi-occupied properties and flats billed as one property.
B. Base year population	1. 2001 Census	Full coverage in the One Number Census. Issues with undercounts, and often will need aligning with MYE.
	2. Local Census	Often prohibitively expensive.
C. Indicator of change	1. All sources discussed in A above	Boundary changes for electoral geography and re-naming of postcodes.
	2. Housing completions	Require data on completions, demolitions and conversions, plus an adjustment for second homes and vacancies. Private completions data available from NHBC, public completions data available from local councils and housing associations.

3.3.3 Which method is most accurate?

To establish which method should be chosen on the grounds of accuracy alone, Experian has carried out a range of tests using data from the 1991 and 2001 Censuses of Population, PAF data and ONS ward level estimates for OAs and wards in Nottingham UA and OAs throughout Great Britain. The estimates were also split, in some cases, into rural and urban areas. The ratio, additive and apportionment methods for estimating households, and the ratio and apportionment methods for estimating populations were evaluated.

3.3.3.1 Small timescales between the base variable and the year to be estimated

Ratio/additive methods appear best if: (i) they are over smaller timescales – preferably year-on-year; (ii) the tracking variable has consistent definition over the two years (or start and end points) being considered. For example, in the comparison of 2001-based 2002 ward-level population estimates with the Government MYE, 98 per cent of the estimates produced by the ratio method were within 5 per cent of the MYE. In contrast, only 46 per cent of estimates produced by the apportionment method were within 5 per cent of the MYE.

The ratio method, apart from a very small number of outliers, produces estimates that are very close to the MYE. This is not surprising, as the prediction is from one year to the next and the MYE themselves are calculated from an adapted ratio method. This is the main reason for the high similarity between the two figures.

Figure 4 shows the average absolute error by decile for population estimates over the 2001 to 2002 period for wards in England and Wales for the ratio change and apportionment methods. The first decile represents the wards with the lowest 10 per cent of the population, while the tenth decile represents the wards with the highest 10 per cent of the population. At the ward level, the ratio method performs better than the apportionment method for every decile. With both methods, the absolute error increases in line with the ward population.

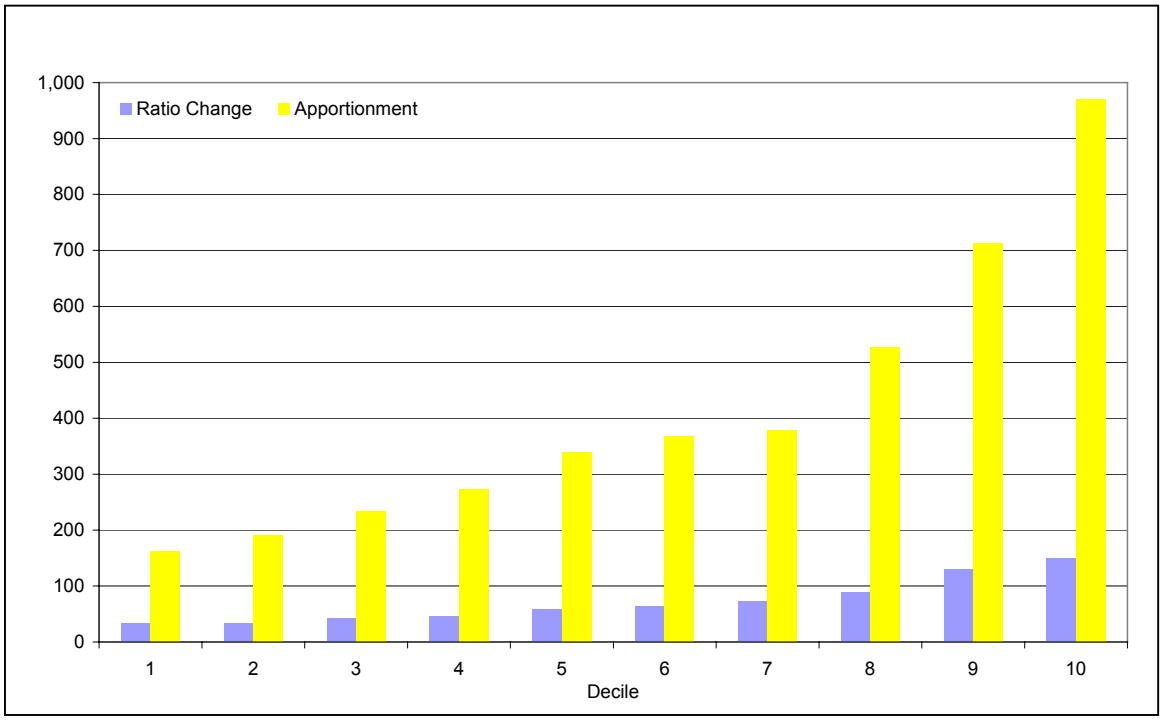


Figure 4 Average absolute error in ward-level population estimates, 2001–02

The additive and apportionment methods underestimate population counts more in rural areas than in urban areas, whilst the ratio change method overestimates population change more in rural areas than urban areas.

3.3.3.2 Large timescales between the base variable and the year to be estimated

The apportionment method appears better than the ratio/additive method when: (i) any change figures have start and end dates that are separated by a long period of time; (ii) the base count to be used does not correspond exactly in definition with the 'outcome count' to be estimated.

Ratio/additive (and especially ratio) methods work poorly, and produce outliers for small areas, when there is a large difference between the proxy measure and the base measure. Apportionment is less likely to produce very large errors, although it is likely to make many smaller errors.

At the output area level, the apportionment method is more accurate for areas with small counts than the ratio/additive method. In the exercise comparing 1991-based household estimates with 2001 Census figures for Nottingham UA, the ratio and additive methodologies considerably underestimated the 2001 Census figure. The ratio method seemed slightly better, with a smaller mean percentage change from the census than the additive method, and it also had a slightly smaller standard deviation. The apportionment method seemed to be the most accurate. The ratio method estimates were within 10 per cent of census figures for 473 of Nottingham's OAs (50.9 per cent), while the additive method estimates were within 10 per cent of census figures for 475 OAs (51.1 per cent). The apportionment estimates were far more accurate, with 759 OAs (81.7 per cent) within 10 per cent of the census figures.

Figure 5 shows the average absolute error by decile for household estimates over the 1993 to 2001 period for OAs in Nottingham and Rutland LAUAs, produced by the ratio change, additive change and apportionment methods. The first decile represents the OAs with the lowest 10 per cent of households, while the tenth decile represents the OAs with the highest 10 per cent of households. The largest absolute errors are at these extremes (the first and last decile). Noticeably, at the OA level, the apportionment method performs better than the ratio/additive change methods at every decile.

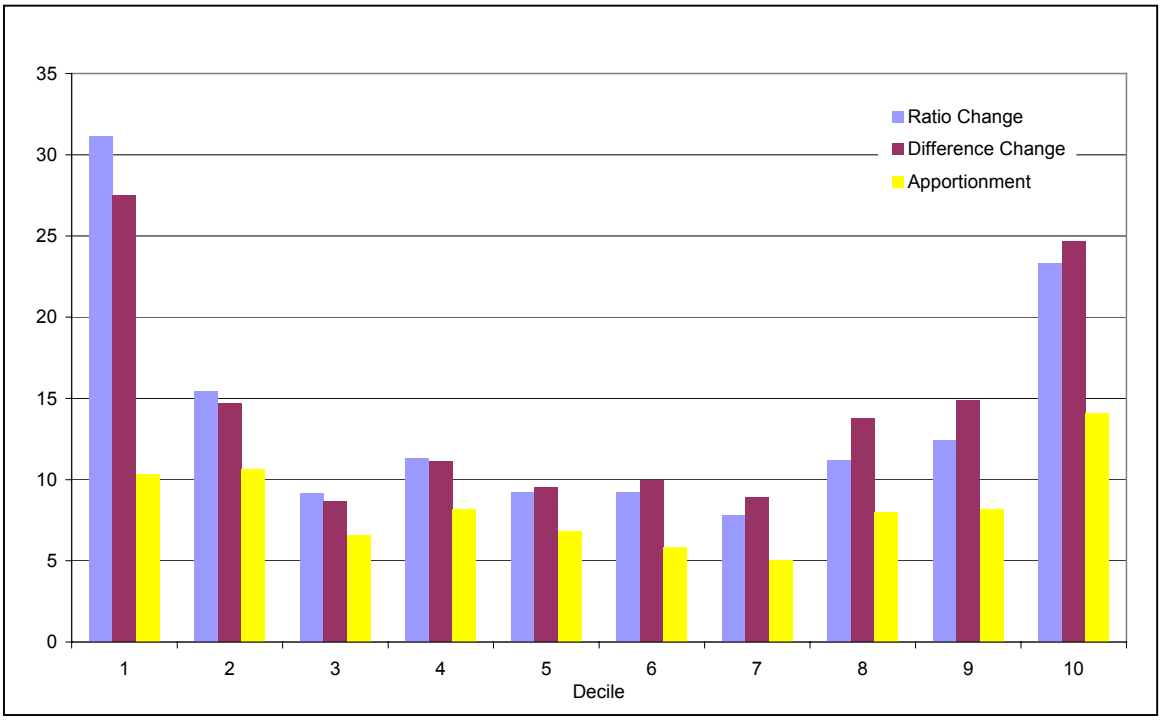


Figure 5 Average absolute error in OA-level household estimates for 1993–2001

A further investigation was undertaken by Experian to estimate households and populations for the OAs in Nottingham UA using the cohort survival method. From studying the results of this methodology, the following points can be drawn.

The results of the cohort survival method were heavily influenced by the migration rates for each OA, based on the 2001 Census. As the calculated rates were based solely on the population movements for one year, anomalous counts within the data are subsequently repeated throughout the progression of the projection and can lead to over- or under-exaggerated results.

Although the OA level allows detailed analysis of spatial and temporal changes in household figures, migration and birth rates drawn from census data can be misleading, unrealistic and often missing altogether. A number of OAs used in this project had either male or female birth rates calculated at zero, while some had both. This meant that the only increase in population had to be through a positive migration rate and if this was also zero or negative then future projections would ultimately continue to fall year-on-year.

3.3.3.3 Estimation rules of thumb

There is no universally accepted 'gold standard' for small area estimates of households and population and, as such, it is difficult to state definitively which methods are better than others. The results of our analysis show that the accuracy of the method is highly dependent upon a variety of factors including the input data, the geographic level of analysis and the time span.

The results of the above investigations, combined with our experience and knowledge of producing small area household and population estimates, suggest the following conclusions and rules of thumb.

1. The results of any household and/or population estimation method are highly dependent upon three main factors:
    i. the quality of the input data that is available
    ii. the geographic level that estimation is undertaken for
    iii. and the estimation method used
2. Given the above, it is very important to audit each set of possible input data in order to assess and understand its strengths and weaknesses before using it in any study. Typical questions posed in the audit should include the following.
    i. How timely is the dataset?
    ii. Is a time series available?
    iii. Do small areas nest into higher level geographies?
    iv. Will there be boundary changes in the future?
    v. Are there data processing issues?
3. It is important to choose the correct geographic level for estimation, as:
    i. estimation generally becomes more difficult (and potentially inaccurate) as the geographic level becomes smaller, but
    ii. estimation at too large a geographic level can lead to significant inaccuracies if the areas do not approximate well to the true areas for which estimates are required.
4. Unless they are too small in relation to the final area(s) that estimation is required for, we suggest that OAs are a good choice as a geographic level for estimation. Key reasons for this are detailed below.
    i. OAs are designed to remain geographically stable over much longer periods of time than other small areas, such as wards. This can help considerably when trying to compare both inputs and outputs for a method over time.
    ii. Large volumes of potentially useful data (such as 2001 Census data) are available for OAs.
    iii. OAs are small enough to allow them to act as good building blocks for other areas (they can produce good best-fit approximations for larger areas that they do not fit into exactly).
5. For England and Wales, given available input data, the cohort survival method is considered best practice at LAUA and higher geographic levels.
6. For small areas (below LAUA level), the cohort survival method is not recommended. This is because robust small area migration data are not available except from the 2001 Census (and even the accuracy of 2001 Census OA-to-OA level migration data has been questioned due to the effect of Small Count Adjustment Method (SCAM) ‘rounding’ on this dataset).

7. The ‘additive change’ method is also not recommended for small areas. This is because, in order to be totally accurate, it would need to assume that the ‘indicator (or tracking) variable’ is measuring exactly the same thing as the ‘base variable’ (in which case, annual small area estimates would be readily available by simply accumulating the ‘indicator variable’). In reality, the ‘indicator variable’ will be a ‘proxy measure’ for the base variable.

8. This means that, realistically, in order to produce small area household and/or population estimates (where population is not split into many age/gender categories), the choice is between the apportionment and ratio methods.

9. As both methods have their advantages and disadvantages, an ideal method would be to use both methods in parallel and to then average the results. The rationale behind this is that although both methods can produce outliers (poor estimates), they will rarely produce outliers for the same small areas. Averaging the results minimises the number of small areas that end up with large outlier estimates.

10. If only one method can be used then the following points should be borne in mind.

    a. Apportionment method

        i. This is the simplest method to apply – it is therefore probably the best method to use initially, if small area household/population estimates have not been made before.

        ii. It also has the lowest data requirements – in particular, the ‘indicator variable’ is only required for the year being estimated.

        iii. It can also be the best method to use if there is a large gap (of several years) between the latest base variable (2001 Census small area data) and the year to be estimated.

        iv. Our OA-level analysis suggests that the apportionment method is generally more accurate for small areas (populations less than 500).

    b. Ratio method

        i. Whilst this method is slightly more difficult to apply than the apportionment method, it can potentially offer better results (evidence of this is provided by the fact that, after evaluation of several methods, the ONS have currently chosen the ratio method as their preferred method for their own SAPE).

        ii. This method requires a consistently defined ‘indicator variable’ for both the ‘base year’ and the ‘estimation year’, which correlates strongly with the ‘base variable’.

        iii. Care needs to be taken for small areas where the ‘base year’ values for the ‘indicator variable’ and ‘base variable’ differ greatly. In these cases it may be necessary to ‘cap’ (or limit) the ratios that are applied to upper and lower levels.

        iv. The ratio method tends to work best where there is a small gap (less than several years) between the latest base variable and the year to be estimated. For the ratio method to currently be ideally applied (if 2001 Census data is used as the ‘base variable’), the method should

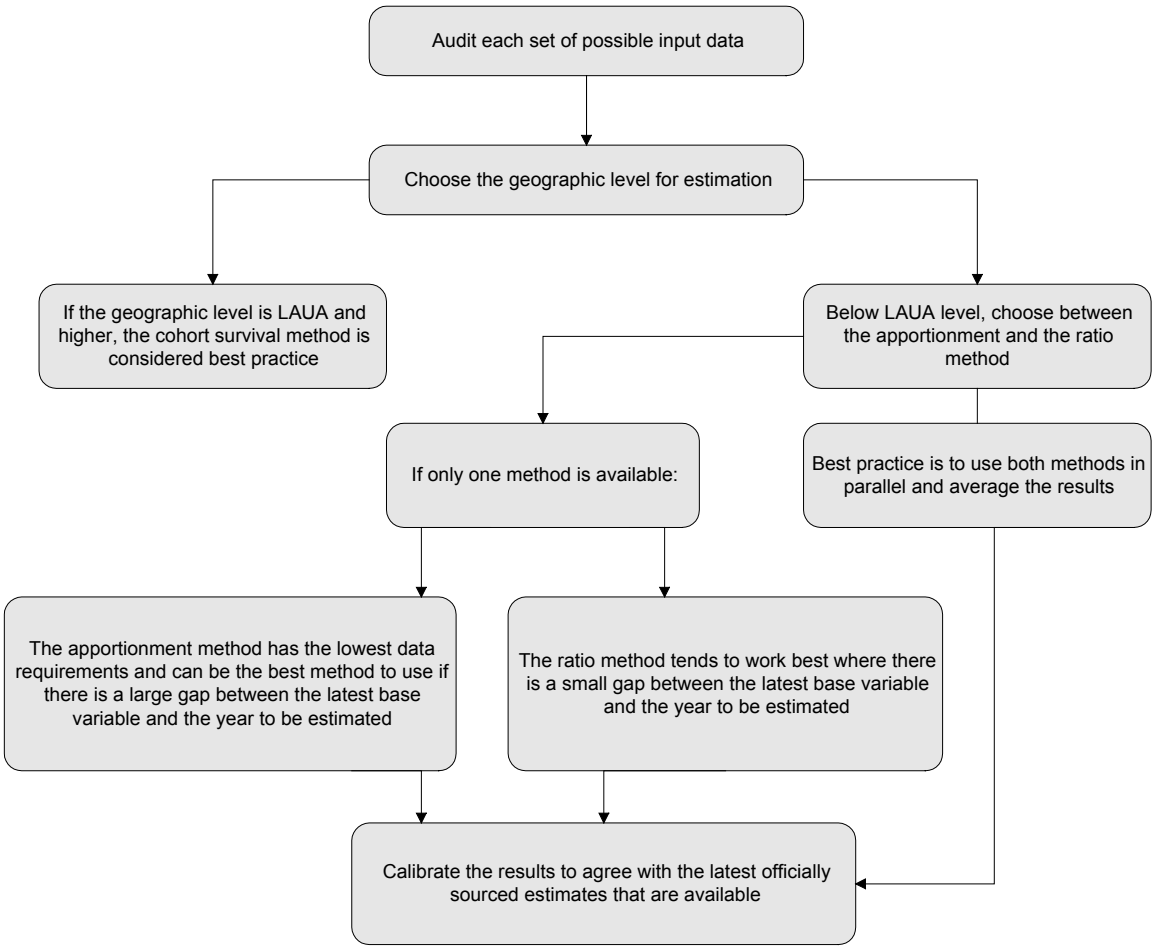
be run one year at a time, given the current gap from the 2001 Census. The calibrated results for one year then become the starting point for the next year.

v. Our ward-level analysis suggests the ratio change method is generally more accurate for larger areas (populations of between 500 and 30,000+)

11. It is strongly recommended that the results are calibrated to agree with the latest available officially-sourced estimates.

12. A two stage process is needed if small area population estimates disaggregated by age and/or gender categories are required. Firstly, the results of an apportionment and/or ratio model for total population (or a large subset of the population, for example adults) should be produced. Secondly, a fixed or 'aged forward' age and/or gender distribution should be applied to the total population figure to calculate detailed age and/or gender bands.

The decision making process in producing household and population estimates.



To a great extent, our findings are in-line with those outlined in the report *Making local population statistics: a guide for practitioners: estimating with confidence*. Summary findings from that report are detailed below.

- Desk-top methods for updating estimates provide more reliable data than simply using the latest census figures without any adjustments at all.
- There is no one method that is better than all others in every case.
- There is not much to choose between the accuracy of different desk-top methods.
- When there is no clear reason to prefer one desk-top method over another, taking an average of two outperforms the use of single methods. It does so by reducing the likelihood of large errors.
- About the same amount of accuracy is attributable to the type of area to be estimated, the general method used, and the particular approach (including the data used) to the method used.

3.3.4 Calibrating small area counts to larger area targets

Having produced small area estimates of population and households, evidence suggests that it is appropriate to calibrate/control/scale these estimates with those for a larger area such as the LAUA. This should be done for the following reasons.

- Population estimates for LAUAs are more widely scrutinised than small area estimates.
- LAUA-level population estimates are derived using best available data on births, deaths and migration, and utilise the cohort-survival approach, which is deemed the most appropriate method for LAUA-area estimation.
- Calibrating to LAUA estimates will make the small area estimate consistent with estimates that already command confidence.
- Population estimates of larger areas are usually more accurate than smaller areas.

Evidence of purposes of controlling and its impact on accuracy are reported by King (1990), Small area 'regional' controlling, BURISA Newsletter issue 95.

In general, calibrating will improve the accuracy of small area statistics if the estimates are all inaccurate by similar amounts. If this is not the case, the calibrating process will introduce errors to these estimates. In such cases, the method used to create the estimates will need refining or, alternatively, evidence will need to be provided to argue that the small area estimates are of greater accuracy before the calibrating process establishes data consistency.

The actual method of calibrating is the same as the apportionment method described in section 3.3.1.1 above.

3.3.5 Disclosure protection measures

The measures detailed below are applied to all 2001 Census output for England and Wales, in order to prevent the inadvertent disclosure of information about identifiable individuals, and are relevant to small area estimation.

The SCAM approach is utilised by the ONS to add or subtract a random adjustment to small cell counts within published 2001 Census tables, in order to preserve confidentiality within Census results.

The effect of this technique is that counts of the same variable for the same area may be different in different published census tables.

The theory behind SCAM, however, means that the size of the errors (from actual) should significantly decrease as the geographic level increases. The differences between the different accumulated levels would tend to support this claim, as reported in Table 8.

Table 8 SCAM size of errors (from actual) by geographic level

Size of errors	(8850 Wards) OA to ward		(376 LADs) OA to LAUA		(376 LADs) ward to LAUA	
	Counts	Percent	Counts	Percent	Counts	Percent
+ or - 10%	8850	100	376	100	376	100
+ or - 5%	8844	99.9	376	100	376	100
+ or - 2%	8660	97.9	376	100	376	100
+ or - 1%	7368	83.3	376	100	376	100
+ or - .5%	4887	55.2	375	99.7	375	99.7
+ or - 0.1%	1085	12.3	252	67.0	374	99.5
Total	8850	100	376	100	376	100

Small area census counts for variables including population and households should therefore be calibrated to larger geographies (such as LAUA) before being used in small area estimation methods, in order to minimise the affect of SCAM.

Two pairs of thresholds are applied to Census data.

1. For the release of standard tables, an area must contain at least 1,000 residents and 400 resident households.
2. For the release of Census Area Statistics (CAS), an area must contain at least 100 residents and 40 resident households.

All thresholds apply to populations on Census day, April 2001.

Where civil parishes (England) or communities (Wales) or wards fall below either of the thresholds for CAS but contain more than 50 people and 20 households, profiles with summary statistics are released. The equivalent thresholds for the 1991 Census were 50 people and 16 households, and the increase in the threshold to 20 households reflected the change in average household size between 1991 and 2001. Where civil parishes or communities had less than 50 people and less than 20 households, counts of the total numbers of residents, males, females and resident households were released after small cell adjustment.

In addition, where parishes, communities or wards fell below these thresholds, they were amalgamated with contiguous areas, in consultation with the local authorities concerned. This produced areas with sufficient population for the release of Standard Tables or CAS.

3.3.6 Summary

- In choosing an estimation methodology, select the method that best fits the purpose of need.
- In practice, the choice of method will depend on the desired level of accuracy, the data availability, the cost and resources needed to establish the estimate, the required output geography and the appropriateness of the assumptions used by each method.
- Evidence from our own analysis and earlier work suggests an average of more than one method may be used to avoid extreme errors likely to be incurred for small areas

by using imperfect data. Accuracy can be enhanced by utilising a multitude of data sources to cross-check first-cut estimates, particularly in areas with large communal populations and high numbers of students and members of the armed forces.

- The results of any household and/or population estimation method are highly dependent upon the quality of the available input data, the geographic level that estimation is undertaken for and the estimation method used.

- In order to produce small area household and/or population estimates (where population is not split into many age/gender categories), the choice is between the apportionment and ratio methods.

- As both methods have their advantages and disadvantages, an ideal method is to use both methods in parallel and then to average the results. This minimises the number of small areas that end up with large outlier estimates.

- For water companies, an estimate of total population in each small area (wards, OAs, postal sectors) is a more important requirement than the age structure within each area.

- Water companies need to report outputs at non-standard geographies. This suggests producing outputs at a very refined building block such as census OAs and then aggregating to the required geography. Whilst the errors will probably be large for individual areas, they will be reduced when aggregated to larger areas, especially if the estimation procedure calibrates the small area estimates to published LAUA estimates.

Table 9 Method summary

Method	Advantage	Disadvantage
Apportionment (share out LAUA population using a small area data source)	Requires data only for current year, hence easy to use in areas where boundary changes have occurred. Simple, cheap and quick to produce a desk-top estimate.	Assumes the small area source (PAF, electoral role, council tax) is equally represented in every small area. May overestimate populations in areas with high concentration of retirement age population, as older age groups account for a higher proportion of the electoral role.
Ratio change (uses an indicator of current and past population to update an earlier population estimate for a small area)	Works better in areas where there has been little change between small areas since the census.	Assumes the relationship between the small area and the indicator variable is the same as in the previous census. May prove inaccurate for small areas subject to new, post-census build activity.
Additive change (change in the population indicator is assumed to estimate the change in population directly)	Simple, easy to use and quick. Better for one or two year out estimation.	May underestimate population in areas with relatively high number of children.
Cohort survival (age forward previous year population accounting for births, deaths and migration)	Used by ONS and GROS for LAUA estimation, which suggests that it is the most robust method for large area estimation.	Data hungry and time consuming to derive. Issues of how to estimate migration for small areas.

4 Sources and methods: projections

4.1 LAUA level projections

4.1.1 Population

- The ONS produce LAUA-level population projections for England and Wales.
- These projections are available by gender and single-year age groups.
- The latest long-term (25-year) sub-national projections are the 2003-based projections, which were published in November 2004.
- The projections use recent demographics data to inform assumptions about future demographic behaviour.
- The projections use a standard cohort survival (or component model), as discussed in section 3.3.1.4, and use the 2003-based MYE as the starting point for the projections.
- The population projections incorporate purely trend-based projections of migration flows – as such, they are neither a forecast of what analysts expect to happen nor statements of policy.

4.1.2 Households

- Household projections for LAUAs in England are calculated in four stages.

    1. Derive household population by subtracting the communal population (nursing homes, hospitals and prisons) from total population by age and gender. The communal population is drawn from Census 2001.
    2. Apply Government Actuary's Department (GAD)-based projections of martial status rates (married, single, widow, divorced), by gender and age, to the household population.
    3. Apply DCLG-prepared trend-based projections of household representative rates for type of household, age, gender, marital status, co-habiting and non-cohabiting to this population.
    4. Calibrate to pre-determined national level targets.

- Household projections for Wales are prepared at a broader county level.
- The latest official projections of households and household representative rates are the 2003-based projections, which are available from the DCLG.
- A method previously used to update household projections involves applying the 1996 trend-based projections of household representative rates (by age and gender)

to ONS LAUA-level population projections by age and gender (suitably adjusted for communal population), and controlled to census household counts in Census 2001.

- There are two main uses of the household projections at LAUA level. One is to prepare a set of trend based household projections based on trends in household representative rates and trend based population that can form the basis of discussion on future housing demand. The second use is to prepare a set of targets for controlling small area household estimates and projections.

- The key point to note is that the household projections are purely trend-based and are not consistent with local area housing statements. Moreover, if houses aren't built, then the headship rates can't continue to increase and household size can't continue to decline.

4.1.3 Policy-driven population and households

- To account for planned future developments such as the DCLG's Sustainable Communities Plan and the current housing allocations promulgated in Regional Planning Guidance (RPG) and Regional Spatial Strategies (RSS), 'policy-driven' household and population projections can be prepared.

- The first stage is to prepare a set of LAUA-level trend-based household projections for the area under investigation (as discussed above). These are then aligned with LAUA-level housing growth figures from RSS documents.

- Table 10 compares trend-based household projections with those documented in the draft East of England Plan (RSS 14). An upper scenario is also presented, as the government has stated that the East of England housing supply should be increased from 23,900 dwellings per year for 2001–21 to 24,800 per year, which would bring the total RSS dwelling provision figure to 496,000 by 2021.

Table 10 Distribution of dwelling provision 2001–21

	ONS	RSS14	RSS14 upper
Essex, Southend and Thurrock	141,990	123,400	128,050
Basildon	10,510	10,700	11,100
Braintree	20,280	7,700	7,990
Brentwood	2,940	2,900	3,010
Castle Point	5,750	4,000	4,150
Chelmsford	10,570	14,000	14,530
Colchester	13,950	17,100	17,740
Epping Forest	7,350	11,000	11,410
Harlow	3,170	8,000	8,300
Maldon	8,210	2,400	2,490
Rochford	6,630	4,600	4,770
Tendring	18,750	8,500	8,820
Uttlesford	5,630	8,000	8,300
Southend-on-Sea	11,320	6,000	6,230
Thurrock	16,930	18,500	19,200

- A Proposed Changes draft to RSS14 is due in September 2006 and may include additional housing in response to the Barker Report. The total amount of housing could then be more than the RSS14 upper estimates detailed in Table 10. Any additional housing would probably be located within an existing town or as an extension of one. The Government's response to the Barker review is a commitment to increase the rate of house building from today's figures of150,000 per year to 200,000 per year by 2016[7].

- Aligning trend based household growth with policy statements has the effect of reallocating the hot-spots of household growth to areas where land has been set-aside for new build over the period to 2021.

- There is an associated issue of completion rates during the plan period. The RSS14 annual average is 23,900 completions per year, whereas completions for 2001–10 are expected to average around 20,000 per year. DCLG is therefore intervening to raise the average rate to about 27,000 completions per year for 2011–21. This raises the issue of how to treat policy-driven 'step changes' in work on projections.

- Applying projections of average household size from the trend-based projections to the 'policy-driven' household projections results in policy-driven projections of population. The age and gender profile of the population may be assumed to be the same as the trend-based projection or may vary in line with the type of new dwelling built (for example, 400 one-bedroom flats will not include children, whilst 200 planned new key worker properties will not include the elderly).

- An assessment of the impact of growth areas in the South East, the East of England and the South Midlands on population growth to 2021 has been carried out. These were based on the housing projections in the draft South East Plan, the draft East of England Plan and the Milton Keynes and South Midlands Regional Strategy Consultation Draft. All of these are draft strategies; higher housing figures could be imposed by the Government.

- As Figure 6 shows, the biggest difference between where the trend-based projection exceeds the policy-driven projection occurs for Essex, followed by Buckinghamshire (which includes Milton Keynes)[8]. The policy adjustments make least difference to Kent (which includes Medway), despite the fact that it contains both Ashford and part of the Thames Gateway.

[7] DCLG website.
[8] Areas shown are Experian virtual counties, not current administrative units (for example, Milton Keynes is included in Buckinghamshire).

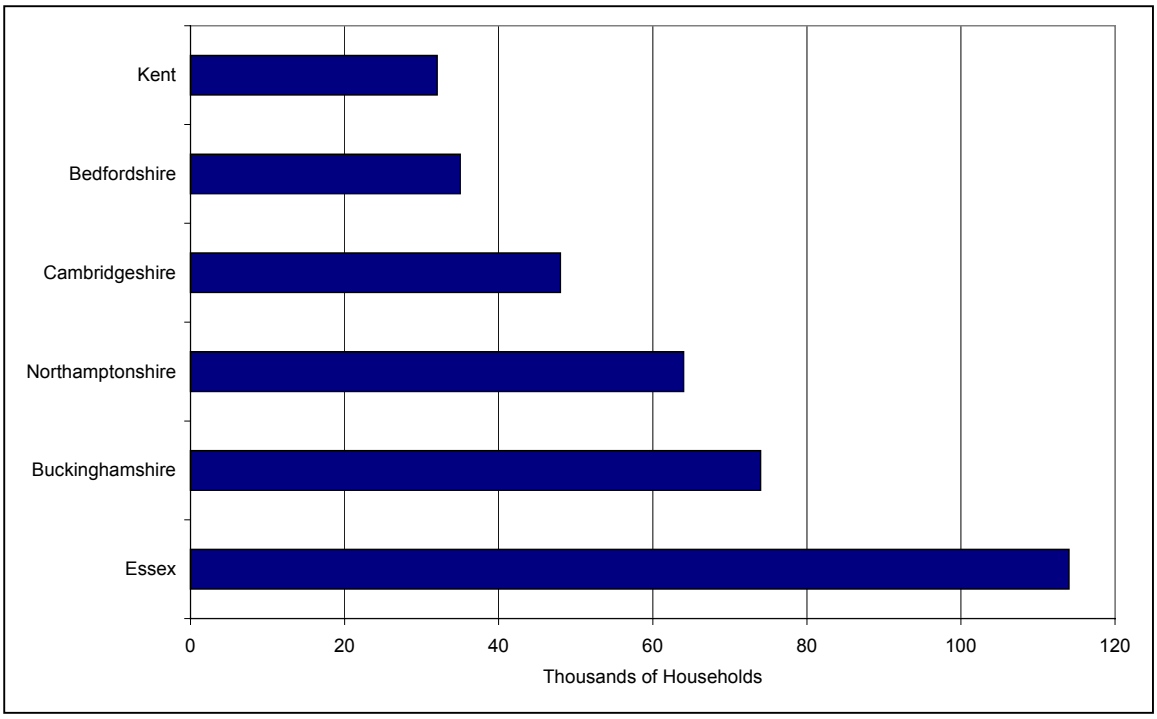


Figure 6 Trend-based minus policy-driven household projections

- RSSs include sub-regional policies that identify development 'hot spots' more precisely than county-level policies. For example, where growth is centred on a particular town it may spill over the boundary into the adjoining local authority district. The sub-regional policies quantify this growth and should assist exercises to predict small area populations (for example, to show growth locations more precisely where a district is divided by water resource zones).

- The difference between the policy-driven and trend-based projections is not solely a function of the level of housing targets in the sub-region. It is also a function of the strength of recent migration flows, as strong migration in recent years will be manifested in strong trend-based population projections.

- Policy-driven household and population projections are available from regional government bodies. For example, London borough level household and population projections have been prepared by the Greater London Authority for the *Draft alterations to the London plan* and were published in October 2005.

4.1.4 Summary

- Trend-based projections may understate LAUA-level household and population growth in areas of significant planned new house-build activity.

- Trend-based projections may over-state household and population growth in areas where recent new build development has led to strong migratory flows, as strong migration in recent years will lead to strong trend-based population projections.

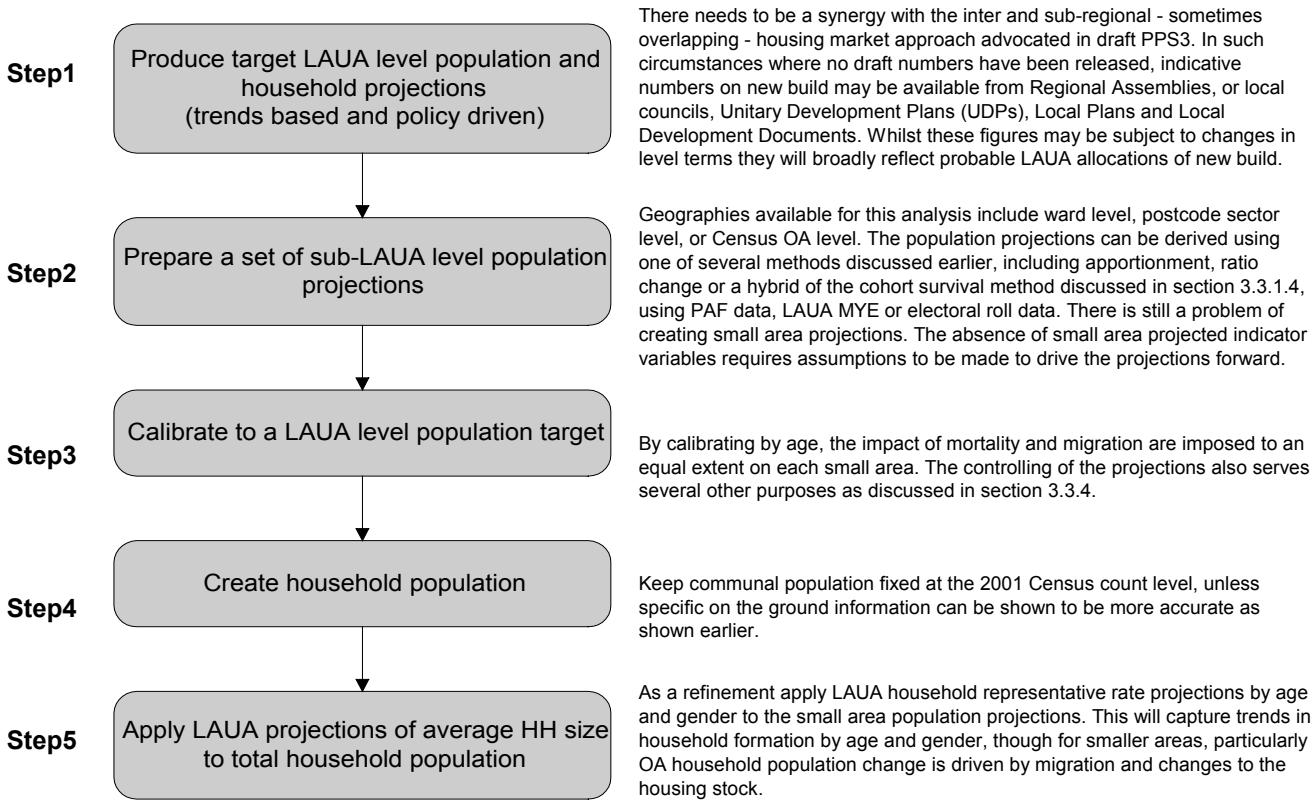
4.2 Small area projections – a framework for water companies

There is no universally accepted method for producing small area projections of populations and households. As seen in the section on producing population and household estimates, the chosen way will be determined by a range of user needs, local circumstances, data availability, time and cost.

For water companies, there is a need for population projections that, on the one hand, capture likely housing development hot-spots at a spatially refined level and, on the other hand, provide a view of population over 25–30 year horizon to meet water resource planning requirements. PPS3 will require much more flexibility, with a five-year 'developable' housing land supply identified at all times and the ability to 'draw down' allocations if demand is not being met (as measured by 'affordability').

The remainder of this section provides a framework for meeting the needs of water companies.

4.2.1 A trends-based and policy-driven baseline projection



At this stage, you will have a set of small area household and population projections, controlled to a set of trend-based and policy-driven targets.

4.2.2 A refined ‘new build’ projection

It may be desirable to further refine the projections at this stage. New build housing allocations promulgated by regional agencies are somewhat aspirational, as they are tied in to statements of policy rather than statements of fact. However, this could be changing. As part of the new planning regime, RSSs will set local authority targets and there will be much stricter requirements for Local Planning Authorities to monitor housing delivery and 'draw down' allocations to meet demand – including preparing annual monitoring reports.

Incorporating RSSs is recommended as they allow the identification of instances where environmental infrastructure capacity (water resource, waste water treatment, waste treatment) will need to be enhanced and when additional capacity will be needed. There is a need to capture that benchmark to engage Government offices and Regional Assemblies where natural resource planning regimes and the development planning regimes are misaligned.

It is possible to add additional local flavour to the household projections by accounting for possible new developments that are at various stages in the planning pipeline. This requires taking a view on the likelihood of a development actually going ahead and predicting its start and completion dates using source data from planning departments in local councils or using specialist providers such as ABI Data Services or Emap Glenigan.

Emap Glenigan is a leading provider of business information to the construction industry. It collects and researches planning applications for all types of development projects, including residential and commercial properties. Project start date and indicative completion date are usually provided. Approximately 40 people collect planning application data from local authority planning departments once a week. The data is updated at the end of every day.

The likelihood of a development being completed will depend upon which planning stage the development has reached. The nearer a build is to starting on site, the more likely it will actually commence. The likelihood of each planning stage eventually being completed varies according to circumstances. A good stock monitoring system may inform the new build probabilities by tracking each planning applicant through to the build stage.

The planning application often provides an indication of the type of dwelling to be built, which can be used to predict likely average household size rather than applying the LAUA average rate.

It is reasonable to include only big development sites, such as those with more than 10 to 15 dwellings, when making a projection. However, in rural areas in particular, smaller thresholds should be used: several sites with less than 10 houses can add up to a significant increase in population. Many local authorities rely to a large extent on small 'windfall' developments below the 10-unit threshold.

Each planning application is provided with an OS grid reference (Eastings and Northings), accompanied by a postcode sector or full postcode. This provides a means of

allocating each development to a GIS, as highlighted below for the areas in and around East Anglia.

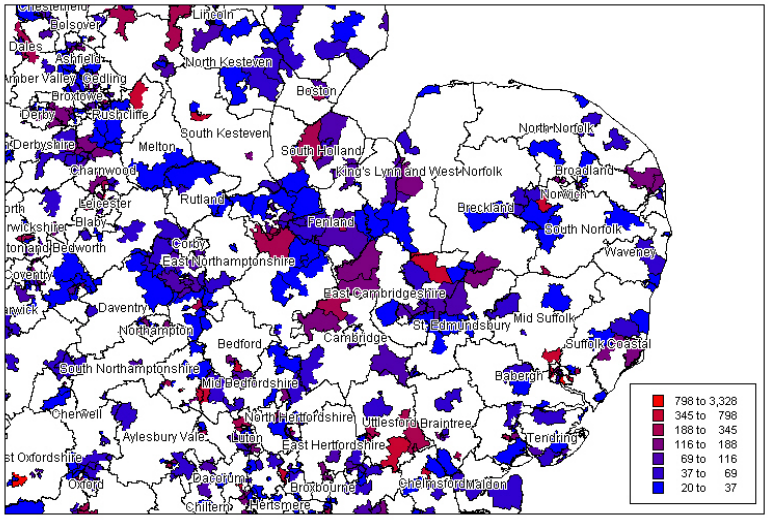


Figure 7 Emap Glenigans data for East Anglia

Monitoring property pipeline data and using the information to inform population and household projections is extremely time-consuming in terms of data collection, evaluation and estimation. Nevertheless, such a system will provide a useful indicator of potential new build activity by size of development and location. It can be particularly informative in rural areas, where even a small development can place pressure on the existing water supply system.

Environment Agency policy at RSS level usually requires infrastructure capacity to be available when a development is ready for occupation. For example, it could take three to four years to proceed from planning approval to first completions for housing sites. The vast majority of Emap Glenigan data has a development build time of up to four years and is a short term reallocation measure. Only a small minority of the larger projects have a completion date beyond 2010. Clearly, for these projects, the infrastructure capacity needs to be considered over a much longer time-frame. This method should be used alongside the policy-driven method so that the infrastructure timings of each can be compared.

4.2.3 Method – example

To provide evidence for the merits of aligning population and household projections with long-term RSSs and short-to-medium term property pipeline information, we have carried out an evaluation of the Essex water resource zone. Note: the results are for illustrative purposes only and are subject to change.

The population and household estimates and projections for the Essex water resource zone area for a trend based and policy aligned projection were prepared using a number of steps.

- Communal population from Census 2001 is subtracted from total resident population in 2001 to derive private household population.

- A hybrid cohort method is utilised to push forward postal sector level projections of private household population.

- LAUA-level household representative rates are applied to the resident in household population to derive the household projections.

- All projections are calibrated to district-level targets using a postal sector-to-district lookup.

- Property pipeline data from Emap Glenigan is incorporated into the projections at postal sector-level and probability assumptions of the build being completed are applied to the data.

- Average postal sector-level occupancy rates are applied to translate the amended household projections back into private household population.

- Communal population is added to the private household population to derive total population, with an assumption of fixed communal population at 2001 levels applied over the full projection period.

- Population and household projections are calibrated to district-level targets (trend-based and policy-driven) using a postal sector-to-district lookup.

- Finally, postal sectors are aggregated to the pre-determined definition of the water resource zone area.

4.2.4 Analysis and commentary

The maps presented below show the absolute change in households between 2001 and 2021 by postal sector geography, under a trend-based projection and trend based adjusted for planned new build. The LAUA administrative boundaries are those in black and the water resource zone boundary is in yellow.

The blue circle highlights one area where planned new build activity captured in property pipeline data overwrites the trend-based projection and re-allocates household growth.

Incorporating the property pipeline information increases household growth within the water resource area by an additional 4 per cent (5000 households) compared to that suggested by trend-based projection. New developments are now being allocated to particular locations within each LAUA and, in this instance, moving them within the water resource zone area.

Due to the effects of the LAUA-level calibrations, adding in planned new build activity into a population and household projection may reduce household growth within a water resource zone area that cuts across an LAUA boundary.

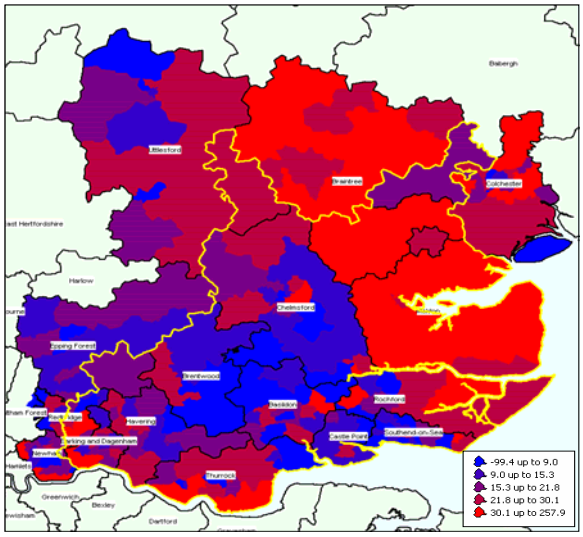


Figure 8(i) Trend-based projection

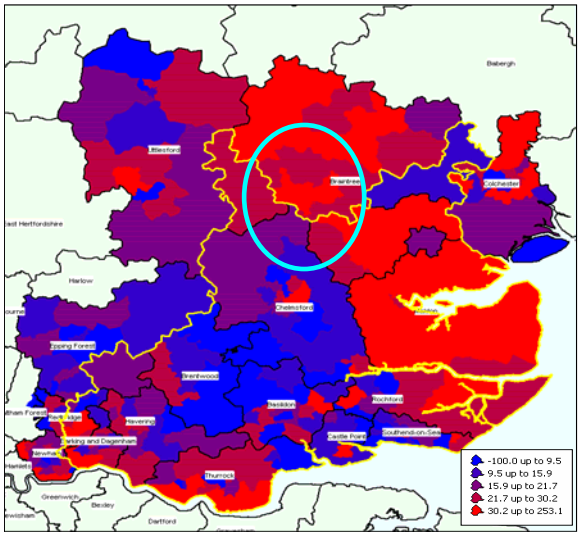
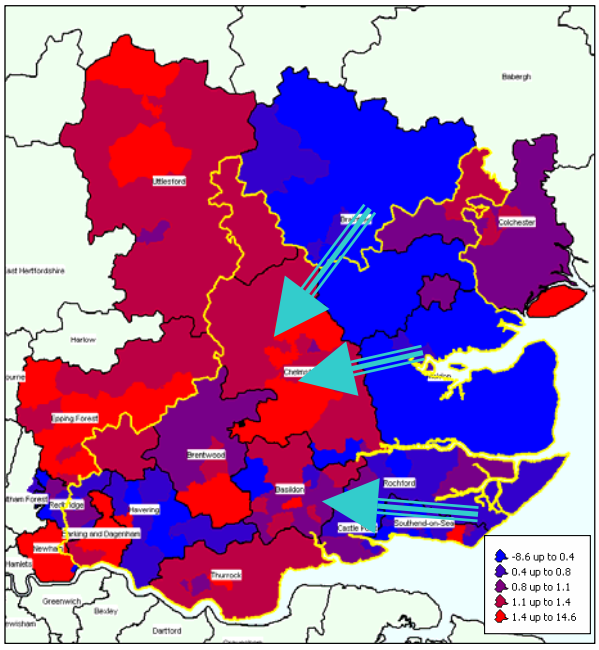


Figure 8(ii) Trend-based adjusted for planned new build

A more significant impact on housing growth in the Essex water resource zone results from the calibration to housing allocations, as set out in RPG 14. This reduces projected household growth in the resource zone, compared with the trend-based projections, by 13,000 households (10 per cent) over the period 2001–21.

Moreover, the policy-driven projections shift household growth from east to west in those areas surrounding the Essex water resource zone, as shown clearly in the map below.

This location shift is a primary purpose of the RSS and is set out in more detail in sub-regional policy. It will be an important link between development plan delivery and the infrastructure work that will be required by water companies and others.



	Change 2001–21	
	Households	Population
[1] Trend	124,000	300,080
[2] RPG 14	111,000	268,620
[3] Trend (plus new build)	129,000	312,180
[4] RPG 14 (plus new build)	111,000	268,620

Figure 8(iii) Policy-driven projection relative to trend

RPG 14 household projections adjusted for planning pipeline information [4] are 10 per cent lower than trend projections [1] and 14 per cent lower than trend projections adjusted for property pipeline information [3].

Assuming an average occupancy rate of 2.42, the trend-based projections [1] overestimate population growth by 12 per cent (31,000) compared with the RGP 14 growth [2].

Assuming a per capita consumption of 150 litres per day, the population overestimate of 31,000 would translate to over 4.7 million litres of water per day by 2021.

4.2.5 Testing the validity of using RPGs

A comparison of both the projections calculated from old (typically mid-1990s) RPG housing plans and 1991 household and household population projections with the current estimates was undertaken to determine the likely accuracy of using RPGs to help inform household population and household projections. We have assessed the relative performance of trend-based versus policy-driven projections in the past to comment on the validity of using a policy-driven projection now and in the future.

The trend-based projections are based on the ONS population and DCLG household projections. A time period of 1991 to 2001 was chosen; typically the RPG allocations in the mid-1990s were annual allocations from 1991 to 2011. The South West, North West, Yorkshire and Humber, and East Midland regions are shown in this example. The mid-1990s RPGs were not found to be available electronically for any of the regions and the physical documents tend to be out of print and difficult to source. All data have been aggregated to county level where appropriate, in order to match the geographic scale in the RPGs.

Figure 9a shows the annual average error rates for the household projections using a trend-based and policy-driven approach. Across all areas, the policy-driven approach has smaller average absolute errors (942 households per annum) compared to the trend-based projection (1,145 households). This is still the case after removing Greater Manchester from the analysis, where both the policy-driven and trend-based approaches considerably overestimate household growth. In fact, in the majority of cases both the policy-driven and trend-based approaches overestimate household growth across the four regions. In the policy-driven approach, the overestimation occurs for counties not achieving their anticipated RPG housing allocation. In contrast, Lancashire, Merseyside and Cornwall, which all have negative RPG errors, exceeded their RPG housing allocation in the period.

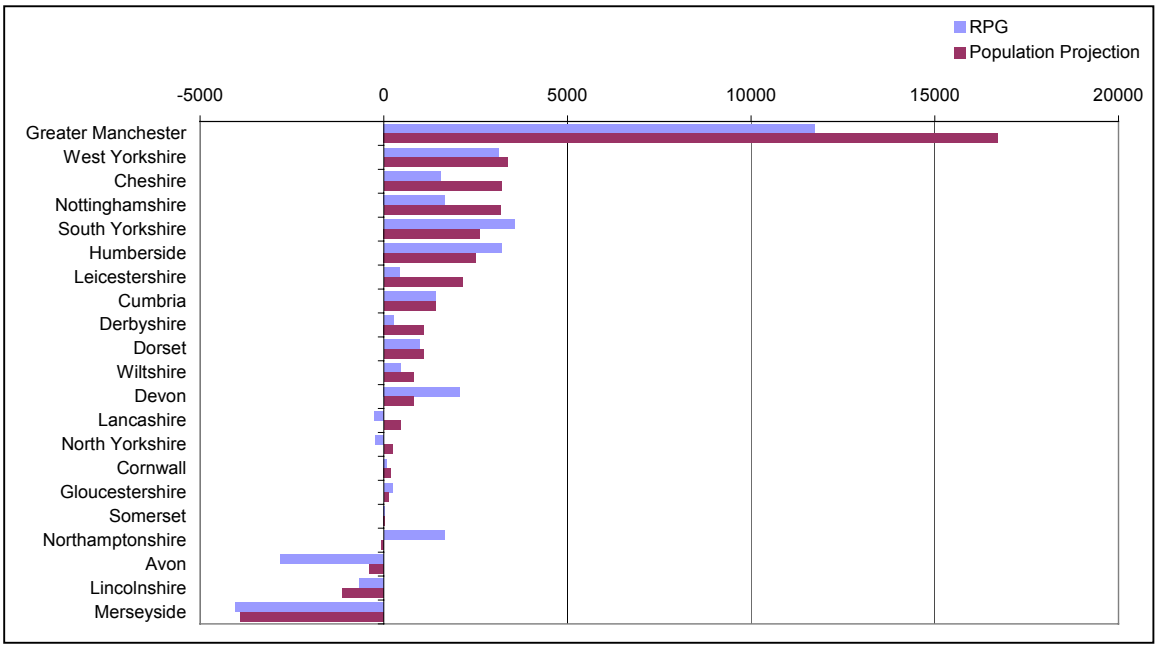


Figure 9a Annual change in household numbers 1991–2001
Note: RPG/household projections minus the current household estimates.

Figure 9b shows the annual average error rates for the household population projections using the same approach and demonstrates that the policy-driven approach once again produces better results. Across all areas, the policy-driven approach has smaller average absolute errors (1,164 persons per annum) compared to the trend-based projection (1,641 persons). As with households, in the majority of cases both the policy-driven and trend-based approach overestimate household population growth.

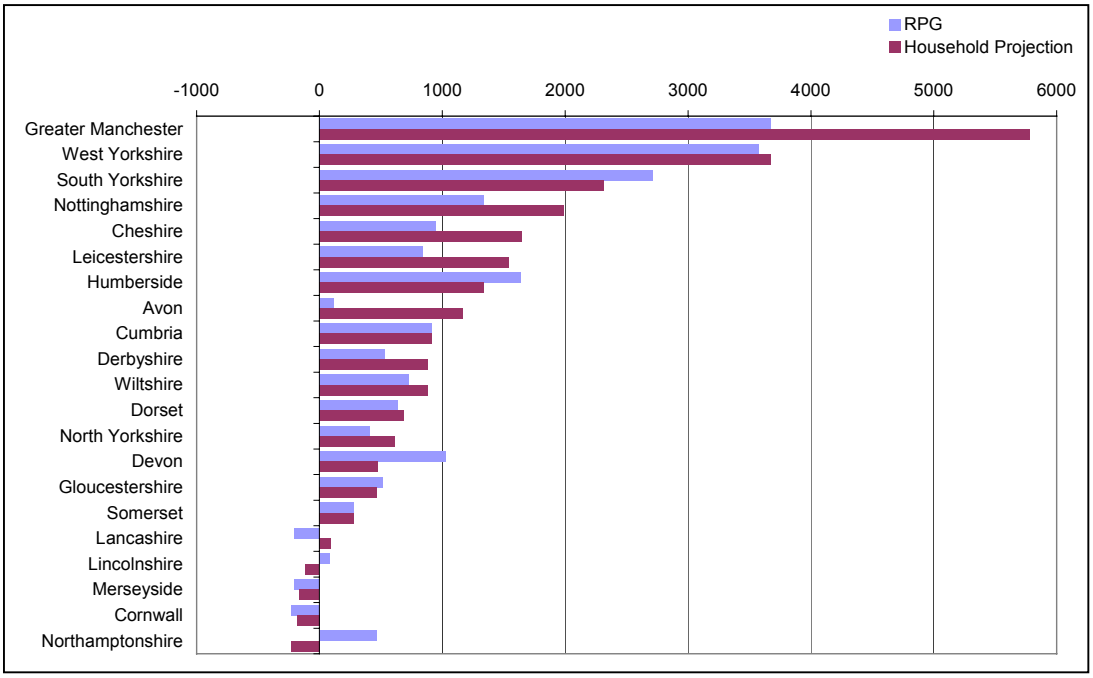


Figure 9b Annual change in population 1991–2001
Note: RPG/population projections minus the current population estimates.

A choice has to be made whether to base higher level (LAUA) household and household population projections on trend-based projections and/or policy-driven projections. The

new RSSs will make policy-driven projections easier to produce. Furthermore, our analysis of the performance of the trend-based and policy-driven approaches suggests that, on average, incorporating a policy-driven approach will improve the accuracy of household and household population projections. However, the policy-driven approach was not found to be more accurate in all circumstances.

5 Conclusions and recommendations

- There is no universally accepted ‘gold standard’ for producing small area estimates of populations and households. The process of producing estimates and projections is as important as the results themselves.
- The starting point of any estimate and projection should be establishing a robust set of LAUA-level population and household targets.
- Trend-based LAUA-level projections should be produced as a minimum requirement. Ideally ‘policy-driven’ projections capturing new build allocations, as set out in RSSs, Unitary Development Plans (UDPs), local plans or local development documents, should be derived in order to compare and contrast against trend. This may help pinpoint potential outliers in new build activity and subsequently provide more solid information to inform water demand planning. This will particularly be the case if the difference between the high and low estimate cannot be covered off in the headroom calculation. Our analysis of the performance of the trend-based and policy-driven approaches suggests that, on average, incorporating a policy-driven approach will improve the accuracy of household and household population projections.
- Beware of statistical bias in the local authority-level data provided by local planning authorities. This data may not agree with the most recent information available from the ONS and RPG/RSS. The same warning applies to housing allocations, which are statements of policy and intent; policy can change.
- Do not rely on a single source of data for a sub-area analysis. A multitude of information from sources such as Census 2001, PAF, billing data and OS address points should be used to establish and then cross-check small area estimates. Where different data produce different estimates, an average of the estimates should be used, as this is likely to avoid extreme errors from the use of imperfect data.
- The method chosen to produce small area estimates should be able to deal with alternative boundaries, in order to create geographies that precisely match the needs of water companies.
- The results of an investigation into the accuracy of different approaches to forecasting communal population suggest that keeping communal population fixed at the level shown in Census 2001 is at least as accurate as any forecast approach. It is also easier and less time consuming.
- Small area projections can be refined by incorporating property pipeline information, which will add additional local flavour to the projections. The raw data itself will also provide a useful indicator of potential new build activity by size of development and location. The latter is of particular use in rural areas, where even a small development can place pressure on the existing water supply network.
- In general, calibrating estimates to LAUA targets will improve the accuracy of small area statistics, as the population estimates for larger areas are usually more accurate than for smaller areas.

6 Estimates and projections: a user checklist

There is no universally accepted method for producing small area estimates and projections of populations and households. In producing these estimates and projections, the method should be determined by user needs, local circumstances, data availability, time and cost.

However, the following steps should always be undertaken when producing small area household and population estimates and projections. Each of the five steps has been referenced to the relevant section in the main report.

Produce target LAUA level population and household projections (trends based and policy driven)

STEP 1

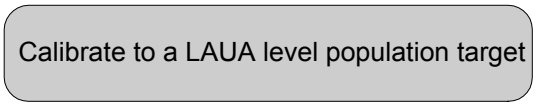
- Population estimates and projections are available from the ONS at LAUA level.
- Household estimates are derived by combining projections of household representative rates with the population in private households, by age and gender.
- Aligning population and household projections with long-term RSSs, UDPs, local plans and local development documents will produce policy-driven estimates and projections.
- There needs to be a synergy with the inter and sub-regional - sometimes overlapping - housing market approach advocated in draft PPS3. In such circumstances where no draft numbers have been released, indicative numbers on new build may be available from Regional Assemblies, local councils, UDPs, local plans and local development documents. Whilst these figures may be subject to change, in level terms they will broadly reflect probable LAUA allocations of new build. See sections 3.3.3 and 4.2.1 for more information.

Prepare a set of sub-LAUA level population projections

STEP 2

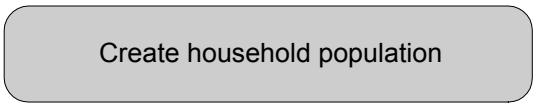
- Audit input data sources and choose the geographic level required for the estimation.
- Choose method(s) for estimating total population and households based on the size of the area and the time frame for estimation.
- Geographies available for this analysis include ward level, postcode sector level and census OA level.
- The population projections can be derived using one of several methods, including apportionment, ratio change or a hybrid of the cohort survival method discussed in section 3.3.1.4.

- There is still the problem of creating small area projections. The absence of small area projected indicator variables requires assumptions to be made in order to drive the projections forward.



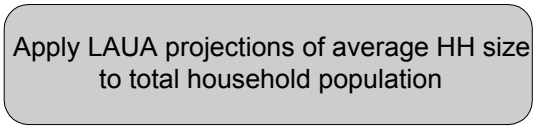
STEP 3

- Having produced small area estimates of population, evidence suggests that it is appropriate to calibrate these estimates with those for a larger area such as a LAUA.
- Calibrating the small area results to agree with the latest available officially-sourced estimates is discussed in section 3.3.4. By calibrating by age, the impact of mortality and migration are imposed to an equal extent on each small area.
- Calibrating to LAUA estimates will make the small area estimate consistent with those estimates that already command confidence. Population estimates for larger areas are usually more accurate than for smaller areas.



STEP 4

- Subtract communal population from total resident population to derive private household population (see section 3.2.5).
- Keep communal population fixed at the 2001 Census count level, unless specific on-the-ground information can be shown to be more accurate. Local adjustments should be made to communal population counts if significant changes have occurred, such as the closure of a hospital or armed forces base.



STEP 5

- As a refinement apply LAUA household representative rate projections by age and gender to the small area population projections. This will capture trends in household formation by age and gender, though for smaller areas, particularly output area household population change is driven by migration and changes to the housing stock.

At this stage, you will have a set of small area household and population projections, controlled to a set of trend-based and policy-driven targets.

Appendix A : Estimation method formulae

In defining the methodologies the following notation is used.
Ps0 = Population of each small area at base date (such as a ward in 2001).
Pst = Population of each small area at time period t (such as ward population in 2004).
P.t = Population of LAUA (the calibrating target figure – sum of small areas) at time t.
Ps,a-1,t-1 = Population of each small area by age group minus one year at base date minus one year.
Is0 = Indicator for each small area at base date.
Ist = Indicator for each small area at time t.
I.t = Indicator for LAUA at time t.
Ds,a-1,(t-1 to t) = Deaths for each small area by age group during the year.
M(in)s,a-1,(t-1 to t) = Migration into a small area, by age group during the year.
M(out)s,a-1,(t-1 to t) = Migration out of a small area, by age group during the year.

1. Apportionment

Pst = P.t * Ist / I.t

In this example, the population of each ward is calculated as the total LAUA population (P.t) multiplied by the ward electorate (Ist) divided by the LAUA electorate (I.t).

2. Ratio change

Pst = Ps0 * Ist / Is0

In this example, the population of each small area (such as ward) is estimated as its population at the time of the census (Ps0) multiplied by the indicator of current population (such as the ward electorate now) divided by the indicator of past population (such as the ward electorate in the census year).

3. Additive change

Pst = Ps0 + (Ist – Is0)

A proxy indicator (such as the electorate, the number of dwellings or PAF counts) is added to a base year population estimate. For example, population of a ward is calculated as its population in the Census year, plus changes in the electorate between the time of the Census and the current year.

4. Cohort survival

Psat = Ps,a-1,t-1 - Ds,a-1,(t-1 to t) + M(in)s,a-1,(t-1 to t) - M(out)s,a-1,(t-1 to t)

The current population of age group ‘a’ is estimated as those aged ‘a’ in the previous year, minus those who would have been aged ‘a’ but have died, plus immigrants of age ‘a’ minus emigrants of age ‘a’.

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Barker Report
http://www.hm-treasury.gov.uk/consultations_and_legislation/barker/consult_barker_index.cfm#report

Anglia University and the DCLG
http://www.anglia.ac.uk/ruskin/en/home/faculties/fst/research/phrg/hps.html

Government Actuary's Department
http://www.gad.gov.uk/Population_Projections/Population_projections_background.htm

Glossary of terms

Additive change method
A proxy indicator (such as the electorate, the number of dwellings or PAF counts) is added to a base year population estimate. For example, population of a ward is calculated as its population in the census year, plus changes in the electorate between the time of the census and the current year.

Apportionment change method
The apportionment method allocates the population for a large reference area, such as an LAUA, to a smaller area using a set of mutually exclusive smaller areas, such as wards or the electoral register.

Best fit
The process for assigning areas to geographies in other hierarchies.

Census Area Statistics (CAS)
More detailed than key statistics, these tables show some cross analysis of census topics down to the smallest geographic level (Output Areas).

Census key statistics
Summary tables covering the main census topics and displaying information as percentages and counts.

Census standard tables
The most detailed statistics for local areas; presented as 129 tables for wards and higher areas. Includes topics such as ethnicity that are not available in the CAS.

Cohort survival method
Mid-year estimates of population are calculated by ageing forwards the 2001 Census data each year. This is done by adding in changes for births, deaths and migration and taking account of other notable changes, such as changes in prison populations, the armed forces and their dependents, and boarding school pupils.

Communal establishment
Detailed below is the census definition of communal establishment.
"A communal establishment is defined as ‘an establishment providing managed residential accommodation’. ‘Managed’ means full-time or part-time supervision of the accommodation."
Examples of communal establishments are prisons, large hospitals, hotels, guest houses and sheltered accommodation.

Dwelling
A household’s accommodation (a household space) is defined as being in a shared dwelling if it has accommodation type ‘part of a converted or shared house’, not all the rooms (including bathroom and toilet, if any) are behind a door that only that household can use and there is at least one other such household space at the same address with which it can be combined to form the shared dwelling. If any of these conditions is not met, the household space forms an unshared dwelling. Therefore a dwelling can consist

of one household space (an unshared dwelling) or two or more household spaces (a shared dwelling).

Econometric forecast
Forecasts derived on the basis of the past statistical relationship between demand and its determinants.

GOR
Government Office Region – of which there are nine within England.

Households
Throughout this report Experian uses the census definition of households.
'A household is defined as one person living alone, or a group of people (not necessarily related) living at the same address with common housekeeping – that is, sharing either a living room or sitting room or at least one meal a day.'
This definition differs slightly from the Environment Agency definitions of households/non households.
'Households – Properties (normally occupied) receiving water for domestic purposes which are not factories, offices or commercial premises.'
'Non-Households – Properties receiving water for domestic purposes but which are not occupied as domestic premises; i.e. factories, offices and commercial premises, cattle troughs. They also include properties containing multiple households which receive a single bill (e.g. block of flats).'

Household Reference Person
The concept of Household Reference Person (HRP) was new to the 2001 Census output. It replaces Head of Household, which was used in 1991. For a person living alone, it follows that this person is the HRP. If the household contains only one family (with or without ungrouped individuals), the HRP is the same as the Family Reference Person (FRP). If there is more than one family in the household, the HRP is chosen from among the FRPs using the same criteria as for choosing the FRP (economic activity, then age, then order on the form). If there is no family, the HRP is chosen from the individuals using the same criteria. In 1991, the Head of Household was taken as the first person on the form unless that person was aged under 16 or was not usually resident in the household.

Household representative rates
Household representative rates refer to the projection of people within a population group that can be regarded as household representatives.

Household resident
Detailed below is the census definition of a household resident.
'A household resident is any person who usually lives at the address, or who has no other usual address. For people with more than one address (e.g. Armed Forces personnel, people who work away from home) the usual address is where the person spends the majority of his/her time, unless they have a spouse or partner at another address. In the latter instance, the usual address is where the person's family resides. Students and schoolchildren studying away from the family home are treated as resident at their term-time address.'

Household space
A household space is the accommodation occupied by an individual household or, if unoccupied, available for an individual household.

Local Authority
The most local level of Government in any part of the UK, includes: non-metropolitan districts, metropolitan districts, unitary authorities and London boroughs in England; unitary authorities in Wales; council areas in Scotland; and district council areas in Northern Ireland.

Output Area
Output Areas are subdivisions of 2003 wards and each represent approximately 125 households.

Population
Detailed below is the census definition of population base.
'The 2001 Census has been conducted on a resident basis. This means the statistics relate to where people usually live, as opposed to where they are on Census night. Students and schoolchildren studying away from the family home are counted as resident at their term-time address. As in 1981 and 1991, residents absent from home on Census night were required to be included on the Census form at their usual/resident address. Wholly absent households were legally required to complete a Census form on their return. No information is provided on people present, but not usually resident.'

Ratio change method
The ratio change method uses indicators of current and past population to update an earlier population estimate for a small area.

Small Count Adjustment Method (SCAM)
SCAM is the approach utilised by the ONS to add or subtract a random adjustment to small cell counts within published 2001 Census tables.

Time series
A run of data that shows how the value of a variable changes over time. Normally, time-series data are updated on a regular periodic basis.

Visitor switchers
Visitor switchers are persons who enter the UK as short-term visitors but are subsequently granted an extension of stay for a year or longer (for example as a student or on the basis of marriage). Data from the Home Office cover non-EEA (European Economic Area) citizens only.

List of abbreviations

CAS	Census Area Statistics
DCLG	Department for Communities and Local Government
GAD	Government Actuary's Department
GIS	Geographical Information Systems
GP	General Practitioner
GROS	General Register Office for Scotland
IPS	International Passenger Survey
LAUA	Local Authorities and Unitary Authorities [includes London boroughs]
MYE	Mid-Year Estimate
NHCR	National Health Centre Register
ONC	One Number Census
ONS	Office for National Statistics
OS	Ordnance Survey
PAF	Postcode Address File
PPS3	Planning Policy Statement 3
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
SAPE	Small Area Population Estimates
SCAM	Small Count Adjustment Method
SOA	Super Output Area
UDPs	Unitary Development Plans

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