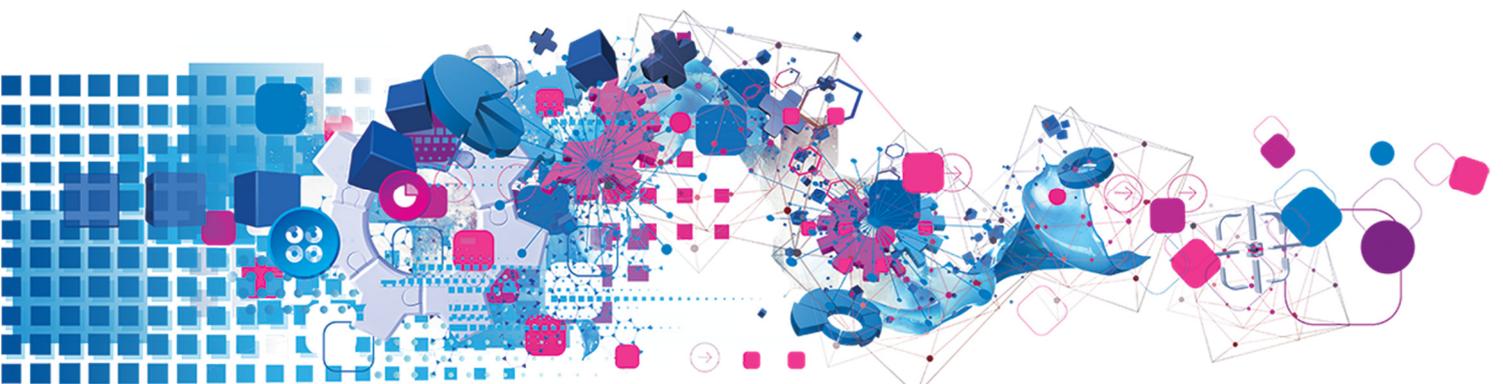




# Population, Household, Property and Occupancy Forecasts for WRMP19

January 2017

---



# Contents

1. Introduction.....	3
2. Trend-based forecasts .....	4
2.1.1 Data sources .....	4
2.1.2 District and household level estimates and forecasts.....	4
2.1.3 Output area level estimates and forecasts.....	5
3. Plan-based forecasts .....	6
3.1.1 Overview .....	6
3.1.2 Collecting relevant local authority plan data .....	6
3.1.3 Producing local authority plan-based forecasts .....	7
3.1.4 Deriving plan-based population forecasts.....	8
3.1.5 Steps to produce the local authority plan-based forecast.....	8
3.1.6 Output area plan-based forecasts.....	9
4. Econometric forecasts.....	10
4.1.1 National and regional dwelling completion forecasts.....	11
4.1.2 Econometric forecast – local authority approach.....	12
4.1.3 Output area econometric-based forecasts.....	12
5. Hybrid forecasts .....	13
5.1.1 The hybrid forecast – Experian approach.....	14
5.1.2 Output area hybrid forecasts.....	14
6. Uncertainty estimates.....	15
7. WRZ level estimates and forecasts.....	17
8. WRZ level results .....	18
8.1.1 WRZ household forecasts.....	18
8.1.2 WRZ total population forecasts .....	18
9. Comparison with previous forecasts .....	20
9.1.1 Comparison with outturn .....	20
9.1.2 Comparison with household forecasts for WRMP19 .....	20

# 1. Introduction

The aim of the project is to develop population, household, property and occupancy forecasts for use within company Water Resources Management Plans (WRMPs) and Business Plans for Price Review 2019 (PR19) for a group of water companies.

The group of companies for the project is as follows:

- Affinity Water
- Portsmouth Water
- South East Water
- Southern Water
- Sutton & East Surrey Water

The outputs from the study include annual population, household, property and occupancy forecasts for each year in the period 2015/16-2044/45. Forecasts are required for:

- Total Population
- Household population
- Communal population
- Households
- Household Occupancy
- Residential properties

These forecasts are required to be produced in line with the methodologies outlined below:

- UK Water Industry Research (UKWIR) and Environment Agency's new guidance on population, household, property and occupancy forecasting for WRMP (UKWIR Report Ref No. 15/WR/02/8 – Feb 2016); and
- Water Resources Planning Guideline from the EA and Natural Resources Wales (Final Water Resources Planning Guideline, May 2016).

Accordingly, four sets of forecasts have been produced with outputs provided at Census 2011 output area and water resource zone (WRZ) level:

- Trend-based (i.e. based on official statistics)
- Plan-based (i.e. based on Local Plans)
- Econometric forecasts (i.e. taking account of economic factors)
- Hybrid

Estimates of forecast uncertainty have also been produced.

This document sets out the approach and data sources used to produce each forecast and the uncertainty estimates.

Headline analysis of the outputs is included for each water company alongside a comparison of the forecasts with companies' previous forecasts and commentary provided as to the drivers for the changes observed including an analysis of the impact of the economic environment.

## 2. Trend-based forecasts

Trend-based projections have been produced using a range of official statistics and Experian proprietary data, as detailed in section 2.1.1 below. Trend-based forecasts are subsequently used as input to produce the plan and econometric forecasts. The UKWIR report recommends producing trend-based projections since they are relatively easy to produce, widely used and importantly, are required to produce plan-based and other forecasts. They also serve as a useful comparison against plan-based forecasts.

The basic approach is to produce local authority district level projections, which are then used to control small area (output area) estimates and projections. The final step is to aggregate a set of output area estimates to WRZ level using a postcode best-fit methodology. The trend-based approach used is consistent with UKWIR guidance.

### 2.1.1 Data sources

- ONS 2014-based sub-national population projections
- ONS 2011-2015 local authority mid-year population estimates
- ONS 2011-2015 lower super output area mid-year population estimates
- DCLG 2014-based household projections
- DCLG 2011-2015 local authority dwelling stock statistics
- DCLG 2011-2015 local authority council tax statistics
- Experian output area population and household estimates and projections, 2016
- Experian postcode level population counts, 2015.
- Census 2011 household space estimates (occupied and vacant household spaces)
- WRZ GIS shape files (supplied 2016).

### 2.1.2 District and household level estimates and forecasts

The starting point for the WRZ level projections is to create a set of district level targets, which are used as control totals for the subsequent output area estimates. These are produced as follows:

1. Estimates of total population are derived from ONS mid-year population estimates 2011-2015. The population is projected forward by applying the population growth rates from the 2014-based SNPP for each district to the ONS 2015 total population level.
2. Household population and communal population is derived from the DCLG 2014-based household projections, and controlled to the total population projections produced in the previous step.
3. Estimates of the number of properties are derived from DCLG dwelling stock statistics, with the base year in 2011 aligned to the Census 2011. Estimates of the number of vacant properties are derived from DCLG council tax statistics 2011-2015. Estimates of the number of vacant dwellings are subtracted from the estimates of properties to derive households.
4. Households are projected by applying the projections of average household size from the DCLG 2014-based household projection to the household population derived in step 2 above.
5. Vacant property estimates are projected forward and added to the household projections to derive total properties. A curve was fitted to the historic council tax vacancy rates (2010 – 2015), as it is anticipated that in most areas, the proportion of vacant properties will decrease over time as a result in changes to council tax rules.
6. The SNPP and DCLG 2014-based projections extend to 2039. A simple extrapolation was applied to extend the projection to 2045.
7. Household occupancy is derived as the total household population divided by total households.

### 2.1.3 Output area level estimates and forecasts

The next task is to drill down below the district level targets to a more refined geographic area. Experian has used 2011 Census Output Areas (COA - e.g. E00155230) for the analysis of small spatial areas which can then be aggregated WRZ areas.

The various stages taken to construct the OA population and household projections are set out below:

1. Age forwards Census 2011 OA total population using a cohort survival approach (e.g. the number of 20\_24 year olds this year is based on 4/5 times the number of 20\_24 year olds in the previous year (i.e. 1/5 move up to the next age group) plus 1/5 times the number of 16\_19 year olds the previous year (i.e. 1/5 move up to the 20\_24 year olds from the 16-19 age group).
2. Births are estimated by applying district level fertility rates to its constituent OA level population of females aged 15\_44. Death and migration rates at OA level are also estimated by applying district level rates.
3. OA total population estimates between 2011 and 2014 are calibrated to the ONS lower super output area mid-year population estimates.
4. Source OA level counts of communal population from Census 2011. The counts are controlled to district level targets post 2011.
5. Calculate household population by subtracting communal population from total population.
6. Estimates of the number of households in each OA are taken from Census 2011 and pushed forward by combining the growth in OA household population with changes to average household size in its encompassing district.
7. Calibrate the OA population and property estimates and projections to align with district level projections.
8. Check occupancy (household population over total households) for each output area, alter if required.
9. Calibrate all OA variables to district level projections.

## 3. Plan-based forecasts

### 3.1.1 Overview

Plan-based forecasts taken account of the dwelling targets contained within local authority Local Plans. The WRMP Guidance states that companies supplying customers wholly or mainly in England you will need to base their forecast population and property figures on local plans published by the local council or unitary authority. However it also acknowledges that local authorities are at different stages of producing their plans and that the plans may therefore be subject to change.

In this respect the WRMP guidance states that if your local council has:

- a **published adopted plan** that is **not** being revised, you must take account of the planned property forecast. You will need to ensure **your planned property forecast and resulting supply does not constrain the planned growth by local councils**. If you adjust the planned property forecast and select a higher number you will need to justify why you have selected a higher forecast and provide evidence.
- published a draft plan but it has not yet been adopted you must take account and use this as the base of your forecast. You should discuss with your local council whether it expects to make changes to the forecast for the adopted plan
- not started or published a draft plan you should use alternative methods such as household projections from Department of Communities and Local Government or derive your own analysis using methodologies outlined in UKWIR (2016) Population, household property and occupancy forecasting.

The WRMP guidance states that all companies should:

- Clearly describe the assumptions and supporting information used to develop population, property and occupancy forecasts. You should demonstrate you have incorporated local council information (particularly in relation to their published adopted local plans) in England.

### 3.1.2 Collecting relevant local authority plan data

To meet the requirement set out in the WRMP guidance, Experian contacted each local authority on behalf of the water companies, asking for their latest information on the number of dwellings they were planning for in their local plan. Experian specifically asked local authorities to identify the most relevant figures for water companies to use i.e. to take account of the status of the local authority plan in the area and anticipated changes to draft plans. Experian also asked the local authority to cite the source of the information. The data collection exercise was run over an eight week period and was conducted via e-mail and telephone. Figure 3.1 below shows the response rate for each company.

**Figure 3.1: Response rate by company (% of contacted local authorities that supplied information)**

Water Company	Number of districts	Responded	Response rate (%)
Affinity Water	52	40	76.9
Portsmouth Water	9	8	88.9
South East Water	35	34	97.1
Southern Water	45	41	91.1
Sutton and East Surrey Water	15	12	80.0

Affinity Water and Sutton and East Surrey Water had the lowest response rates, which is mainly due to the poor response rate from London boroughs. In London, dwellings targets continue to be set at regional level,

so it is some ways easier to obtain the relevant information from the London Plan. However, Experian found that some London boroughs are in the process of updating their local plans and setting targets that exceed the London Plan targets but these plans were at the early stages of development and therefore subject to change.

Experian also collected information for each local authority from their websites. This information was used to fill gaps due to non-response and also to validate the responses received. Figure 3.2 summarises the responses received for each local authority in the company area. It also shows the current status of the local authority plan and the source of information used for the plan-based figures for each area. The 'Published/ adopted date' refers to the date of the submitted plan and/ or the date of the data source used. We recommend that this table will help demonstrate how local authority plan data has been incorporated into your forecasts for WRMP19.

**Figure 3.2: Sutton & East Surrey local authority plan response, local plan status and data source**

Status	Local authority response	Local Plan Status	Data source	Published/ adopted date
Bromley	Yes	Draft	Proposed submission draft local plan and five year housing land supply paper November 2016	Nov-16
Crawley	No	Emerging	The Crawley Borough Local Plan 2015 – 2030, HOUSING IMPLEMENTATION STRATEGY	Nov-14
Croydon	Yes	Published	Updated Croydon Housing Trajectory for the Croydon Local Plan Proposed Submission	Sep-16
Elmbridge	Yes	Adopted	Annual Monitoring Report 2016	Jul-11
Epsom and Ewell	No	Adopted	Figures from dated plan no longer representative. Trend used.	Jul-07
Guildford	Yes	Published	Land Availability Assessment (LAA) 2016	May-16
Horsham	Yes	Adopted	Housing Authority Monitoring Report Mid Yearly Update May 2016	Nov-15
Merton	No	Adopted	London Plan	Jul-11
Mid Sussex	Yes	Submitted	Housing Implementation Plan August 2016	Aug-16
Mole Valley	Yes	Adopted	Annual Monitoring Report 2014/15	May-15
Reigate and Banstead	Yes	Adopted	Core Strategy	Jul-14
Sevenoaks	Yes	Emerging	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
Sutton	Yes	Draft	Council Housing Monitoring Returns & the Draft Sutton Local Plan	Sep-16
Tandridge	Yes	Emerging	Housing Supply Statement 2016 and Tandridge Strategic Housing Market Assessment (2015)	Jun-16
Wealden	No	Adopted	AMR 2013-14	Feb-13

### 3.1.3 Producing local authority plan-based forecasts

The annual dwelling allocations from the local plans were extracted from the information provided by each local authority. The information was compared against the following:

1. Trend-based dwellings forecasts (see previous chapter)
2. Recent completions (DCLG, housing statistics 2011-2016)
3. Information collected from local authority websites

In cases where the local authority did not respond to our survey, we used information collected from their website which was assessed against trend based forecasts. Where the local authority was developing a new plan we used the housing targets that were proposed for the new plan.

Most local authority local plans extend to 10-20 years into the future and therefore need to be extended to cover the entire WRMP period. After testing, Experian extrapolated the dwelling targets outlined in the local plan rather than using data from the trend-based forecasts. This is in accordance with UKWIR guidance.

### 3.1.4 Deriving plan-based population forecasts

The UKWIR report recommends using either plan-based population projections consistent with local authority plans (if the local authority has produced these as part of their plan), trend-based projections or modified trend-based projections. Experian did not attempt to collect plan-based projections from local authorities as we found that these were not produced on a consistent basis and where available were produced using different assumptions.

Experian chose to develop a modified trend-based forecast for the plan-based forecasts. The UKWIR report suggest that care is taken when modifying the trend-based figures based on plans since neither building more houses than is forecast under trend nor the under supply of properties will necessarily impact population levels, since people will either not necessarily fill vacant properties or will share leading to an increase in average household size. However, our research has shown, that over the long-term it is reasonable to expect and assume that consistent over or under-supply of housing relative to demand (indicated by house prices) will impact on population growth. Furthermore, using trend-based population figures for plan can lead to unrealistic occupancy forecasts which the UKWIR report recognises and recommends water companies to rectify accordingly.

In acknowledging these issues Experian has used a two-step compromise approach. The first step is to apply occupancy rates from the trend-based forecast to the plan-based household forecasts. The second step is to take a weighted average between trend and the plan-based population forecast for each local authority. The weights applied are as follows:

- Plan 0.75
- Trend 0.25

This approach has the benefit of recognising that over the long-term population will be influenced greatly by the supply of new homes. Where trend and plan are similar (which is true in most cases where the local plan is adopted and up to date) then the plan and trend based population are comparable. Where the plan is lower than trend the approach recognises that population growth will not necessarily slow at the same rate but will be lower than trend in the long-term. Where the plan is higher than trend, the approach recognises that additional homes may attract more people but these may either not all be filled and/ or will enable occupancy rates to fall (assuming that the under supply of homes has dampened the decline in occupancy rates over time).

### 3.1.5 Steps to produce the local authority plan-based forecast

The annual dwelling targets are incorporated into the forecasts using the following steps in accordance with UKWIR guidance:

1. Produce a cumulative dwelling forecast for the local plan period.
2. Extrapolate the plan based cumulative dwelling forecast to 2045.
3. Apply dwelling forecast to the base year from the trend-based forecasts (2015) to produce total residential property forecasts.
4. Apply trend-based vacancy rates to the plan-based property forecasts to derive vacant property forecasts.
5. Subtract vacant properties from total properties to produce total households.
6. Calculate household population by applying trend-based occupancy rates.
7. Calculate the mid-point between trend and plan-based household population for each local authority.

8. Assume communal population remains at trend-based levels
9. Sum communal and household population to derive total population.

### **3.1.6 Output area plan-based forecasts**

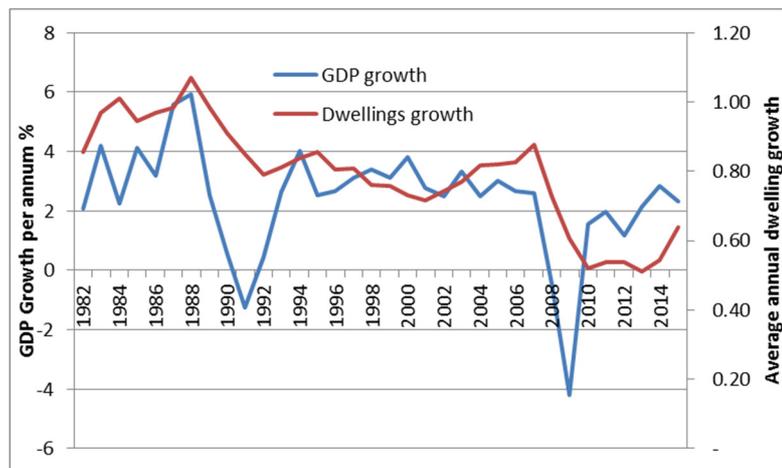
Output area level plan-based forecasts are produced by controlling the trend based OA forecasts for each variable to the plan-based local authority targets derived in the previous section. Note that no attempt is made to allocate plan-based growth to specific output areas or collections of output areas.

## 4. Econometric forecasts

Econometric forecasts take into account economic factors in determining demographic growth. An econometric model is an analytical forecasting tool which operates by simplifying the real world into a set of variables, equations and identities. It produces forecasts to describe likely future outcomes based on the past interactions between variables under a set of pre-determined macroeconomic assumptions. As recognised by the UKWIR guidance, econometric methods are most applicable to larger geographic areas. The UKWIR guidance also acknowledges that additional house building can encourage additional inward migration from other areas, so particular care is needed in estimating the population change that may be associated with economic and housing development.

For this reason, Experian has identified a link between economic growth and the rate of house building and produced forecasts for the number of new dwellings completed per annum at UK and regional level. The trend-based local authority dwelling forecasts are then controlled to the regional targets. A two-stage approach is then used to derive population forecasts. The first step involves applying trend-based occupancy rates to the econometric household forecast. The second step involves taking the mid-point between the trend and the econometric forecast. Similar to the plan-based forecast, the rationale for this approach is that limiting the supply of housing over the long-term will potentially limit population growth in a local area. At the same time, additional supply of housing can attract inward migration. Both these factors are recognised in this approach.

**Figure 4.1: The relationship between UK economic growth and dwellings growth, 1982 - 2015**



The housing completions forecast model takes into account the following factors:

- Private investment in housing
- Government investment in housing
- Construction of buildings Gross Value Added
- House prices
  - Residential income
  - Employment

Experian produces UK, regional and local house price forecasts as part of our standard economic forecasting service. The forecasts are widely used by a number of clients in a range of industry sectors.

House prices are a key determinant of housing completions in the model, which are themselves derived from forecasts of residential income and employment.

The short-term UK dwelling completion forecast is adjusted in line with Experian's construction forecasts, which are produced using a Delphi process, whereby the average is taken of forecasts supplied by an expert forecasting panel. The regional forecasts are adjusted to align with the UK total.

#### 4.1.1 National and regional dwelling completion forecasts

The forecast predicts an upward trend in dwelling completions at national level over the forecast period. Housing completions in 2015 showed significant upturn compared with the post-recession slump witnessed between 2010 and 2014, however available data for the first three quarters of 2016, suggests that completions in 2016 will be similar to 2015 levels. We therefore anticipate steady rates of growth from 2017 onwards, supported by government policy. In the Autumn Statement 2016, the government announced that the National Productivity Investment Fund (NPIF) will spend an additional £1.4bn to provide 40,000 affordable homes by 2021 and invest £1.7bn to support construction of new homes on public sector land in England by 2021. It is assumed that this support will bolster activity in the sector and the number of annual dwelling completions will reach the most recent peak of over 200,000 dwellings recorded in 1997 in 2030. The average annual completion rate is forecast at 209,000 dwellings per annum between 2017 and 2045, compared with an average of 165,000 delivered between 1997 and 2016 (192,500 between 1978 and 2015).

**Figure 4.2: Dwelling completions per annum, GB 1997 to 2045**

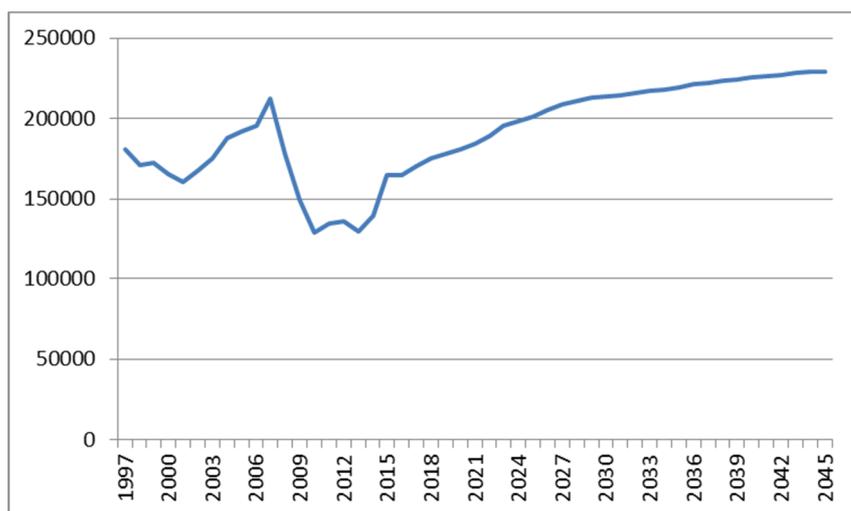
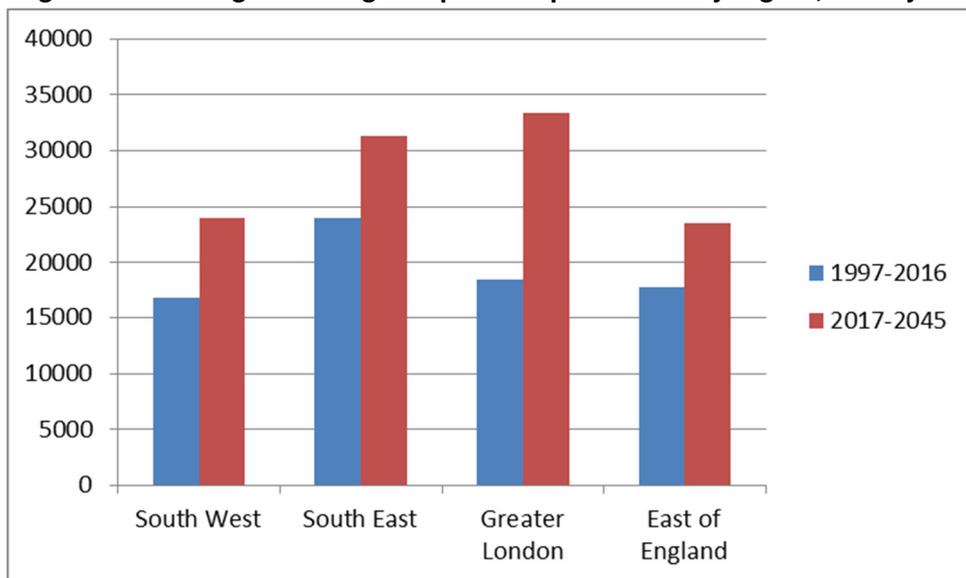


Figure 4.3 summarises the regional econometric forecasts for the areas covered by this research (South East, Greater London, East of England and the South West) in terms of average annual dwelling completions over the forecast period. A key point to note is that the forecasts for all regions are markedly higher than achieved in recent times. However these figures are still lower than the housing requirements projected by government trend based projections and the figures planned by local authorities in the regions (with the exception of London). In London, only 15 of the 33 London boroughs are covered by this study. For the London boroughs included in this study, the econometric forecast is closer to the plan-based forecasts. These issues are explored further in the next chapter of this report.

**Figure 4.3: Average dwelling completions per annum by region, history and forecasts**



### 4.1.2 Econometric forecast – local authority approach

The econometric-based forecasts have been produced using the following steps:

1. Trend-based local authority property targets are summed to regions and controlled to the econometric dwelling completion forecast for each region.
2. Trend-based vacancy rates are applied to the local authority property levels to derive vacant properties.
3. Vacant properties are deducted from the total property count to derive household levels.
4. Trend-based average household size is applied to the number of households to derive a first cut econometric total population.
5. The mid-point between trend and the first cut population is taken as the final total population forecast.
6. Assume communal population remains at trend-based levels.
7. Deduct communal population from total population to derive household population at local authority level.

### 4.1.3 Output area econometric-based forecasts

Output area level econometric-based forecasts are produced by controlling the trend based OA forecasts for each variable to the econometric-based local authority targets derived previously.

## 5. Hybrid forecasts

According to the UKWIR guidance, a “hybrid approach” could involve calculating a weighted-average of the forecasts (not necessarily using the same weight for each forecast), or could involve using different forecast trends for different periods in the future. It acknowledges that there is no established method for a hybrid approach.

Experian has produced three alternative forecasts for this study:

The **trend-based forecast** represents growth if recent trends (5 to 6 years) in terms of demographic change (births, deaths and migration) and long-term household formation patterns continue into the future. Since the trend-based forecasts use the most recent data, they themselves are influenced by both economic and policy factors. For example, recent positive economic growth in an area may have attracted new migrants, which in turn influence the decision to plan for more houses. Accordingly an assumption about higher migration will be carried into the trend-based projection, boosting long-term population growth and housing requirements.

The **plan-based forecasts** show the expected growth if local authorities are able to deliver the dwelling targets set out in their plans. These plans will themselves have been informed by trend-based projections, but the timing of when the plans were produced will, together with many other factors, affect the scale of planned growth. Furthermore, the targets set out in local plans are statements of intent and whilst the local authority has a responsibility to find enough sites to accommodate planned growth in the short-term, ultimately developers will decide whether it is profitable to develop on those sites at a given time. However, the WRMP guidance states that water company growth figures must not constrain planned growth, where an adopted plan is in place.

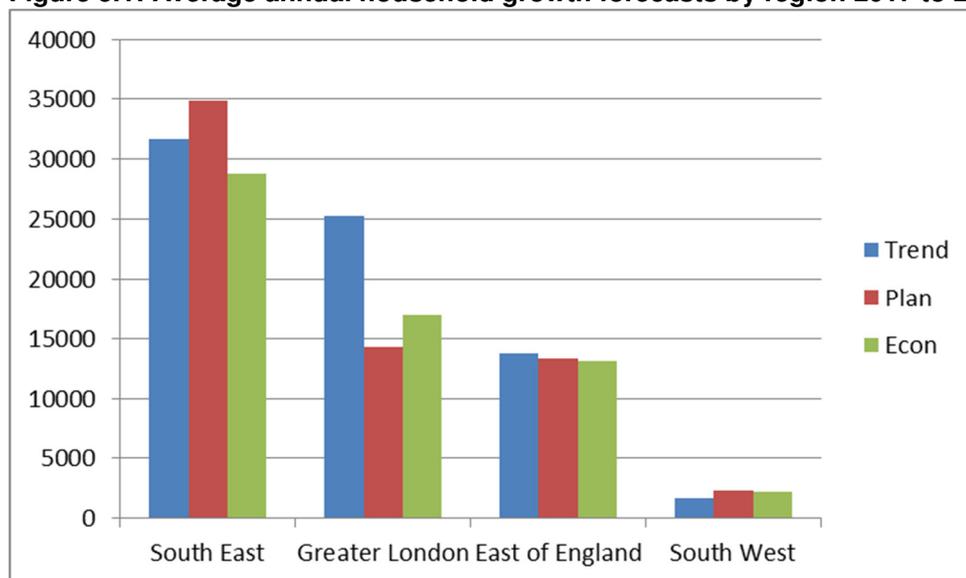
The **econometric forecast** is designed to determine what growth we would expect once economic factors are taken into account. The forecasts consider long-term trends which are potentially limited by market conditions. In reality, previous plans and policies have distorted the housing market which is also inherently captured in the econometric forecasts.

Figure 5.1 below shows the total average annual households growth for the districts covered by the study in each region under the trend, plan and econometric forecast. For the South East, the plan based forecast is 10% above trend. There a number of districts in the South East with planned housing provision in excess of the most recent trend-based forecasts and in excess of recent delivery targets. Under the econometric forecast, the forecast average annual growth is 8% below trend.

For Greater London, the trend based forecast is significantly higher than both the plan and econometric-based forecast. This reflects the strong population growth projected by ONS for London, with significant population growth resulting from inward international migration. The plan based figures for London are broadly consistent with the London Plan, however Experian found that some local authorities are now updating their local plans, and have proposed increased provision above the current allocation in the London Plan. Where available, these updated plan-based figures were incorporated into our estimates. For example, Enfield is currently consulting on housing targets that are twice the London Plan allocation (but is still lower than the trend-based forecast for the borough).

The targets for East of England are broadly comparable at regional level for the districts covered by this study. The plan-based forecast is 3% below trend and the econometric forecast is 5% below trend.

**Figure 5.1: Average annual household growth forecasts by region 2017 to 2045**



We have seen that each of these forecasts is interdependent since it is not possible to completely isolate the causal effects from one another. Given these factors, the hybrid forecast is designed to take account of the variance associated with the trend, plan and econometric forecasts and present a plausible outcome factoring in the information available.

### 5.1.1 The hybrid forecast – Experian approach

The hybrid approach takes the mid-point between the econometric and plan-based household forecast for each district. The district level forecasts are then summed to regional targets and controlled to the regional econometric-based household forecasts. The rationale here is that rates of housing development will be greatest in local authority areas with the most accommodating planning system but limited at the broader level according to economic conditions.

The hybrid population forecast is then derived by applying the forecast occupancy rate from the econometric forecast to the hybrid household forecast. This approach acknowledges that economic factors will influence household occupancy and in the long-run limit the capacity for population growth in local areas.

### 5.1.2 Output area hybrid forecasts

Output area level hybrid forecasts are produced by controlling the trend based OA forecasts for each variable to the hybrid local authority targets derived previously.

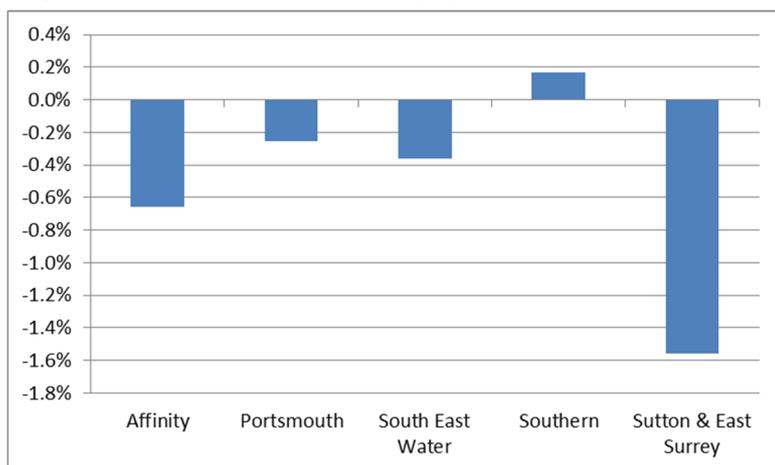
## 6. Uncertainty estimates

The UKWIR guidance provides look-up tables to calculate population uncertainty based on analysis of the error between previous official trend-based population projections and the Census 2011 results. The table provides confidence intervals for different sized areas (regions, counties and local authorities) and suggests that water companies can apply the confidence interval for a given water resource zone based on its population size. The confidence intervals have been generated across all local authority areas and assume that the projection bias is symmetrical. It acknowledges that uncertainty may be much wider in parts of the country where ONS has struggled to project population in the past (mainly due to issues with under/ over estimating migration levels in the previous population estimates). This was a particular problem in large urban areas and London boroughs.

The UKWIR guidance states that uncertainty is present in all forecasts of population, households and occupancy since there are links and interactions between them. Care is therefore required to ensure that uncertainty effects are not duplicated. UKWIR guidance recommends companies to assess uncertainty for just population or just households, according to whether they intend to calculate household water consumption using per capita consumptions or per household consumptions rates.

Experian has used a comparison between the trend based population forecasts produced for WRMP14 for each local authority area and the mid-year estimates to estimate likely future uncertainty in the future. Figure 6.1 shows that the percentage differences between the trend-based forecasts for 2015 and the mid-year estimates (here aggregated to water company level) were relatively small, ranging between -1.6 and +0.2%, however we would expect these errors to increase as we move further away from the base year. A stochastic process was developed to produce a range of errors around the trend-based forecasts into the future.

**Figure 6.1: WRMP14 trend total population forecasts for 2015 compared with mid-year population estimate by company area (percentage difference, 2015)**



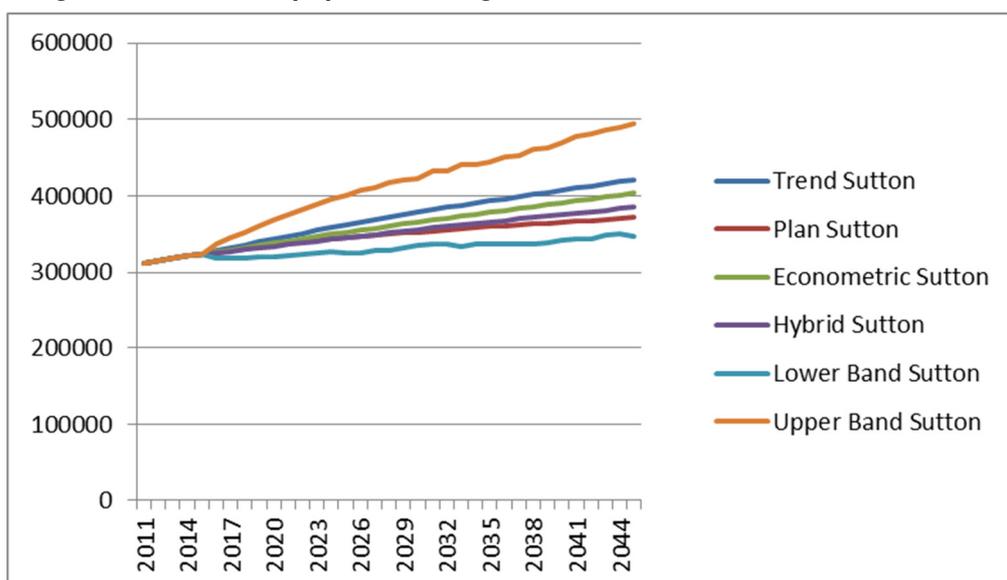
To capture future uncertainty, we derived an error distribution around the household and population projections from the 2012-based population projections and the 2015 mid-year estimate actuals for every local authority in England. We calculated the ratio between actual and projected growth in population for each year. This provided a large number of observations (number of districts multiplied by number of years). After removing outliers, the distribution was observed to be approximately normal. The mean and standard deviation of these errors was used to estimate the error distribution.

To generate projections, we conducted a large number of runs for each local authority modifying the growth rate for each projected year by applying a randomly drawn error from the distribution. These runs were then aggregated to Water Resource Zone level by applying appropriate shares. From these aggregated projections, upper (95%) and lower (5%) confidence bounds were estimated from the quantiles. These were then compared with the comparable confidence intervals presented in the UKWIR guidance.

An example of the uncertainty results for Sutton WRZ is shown in figure 6.2 below, alongside the trend, plan, econometric and hybrid forecast. The upper and lower bounds represent the 90% confidence interval for the trend-based forecasts. We can therefore be 90% confident that the actual population in a particular year will be between the upper and lower forecast values. In all cases the range of alternative forecasts sits within the 90% confidence interval. The alternative forecasts themselves represent the uncertainty associated with the forecasts. In this example, the plan-based forecasts sit nearer to the lower bound forecast.

The same confidence intervals have been applied to the household forecasts.

**Figure 6.2: Forecast population range for Sutton WRZ**



## 7. WRZ level estimates and forecasts

The final stage is to aggregate the output area data to Water Resource Zone (WRZ). The methodology is consistent with guidance and ONS postcode best fit approach to producing small area estimates.

Three inputs are fed into the calculations:

- Client supplied WRZ GIS boundaries
- Census 2011 Output Area (COA) boundaries
- Current year population for each OA and postcode

The programme first identifies the output areas that are either located entirely within each boundary of a given WRZ or that cut across the WRZ boundary (intersect). For each of these OAs, the process calculates the proportion of each OA population that is inside each WRZ as a proportion of the total OA population using Experian postcode level estimates for 2015. These rates are kept fixed in the forecast. The proportions are then applied to the population and property variables of these OAs to give the population falling inside the given WRZs. The adjusted OA targets are then summed to form the total for each WRZ boundary. The ratios applied have been supplied in the OA level dataset for each company.

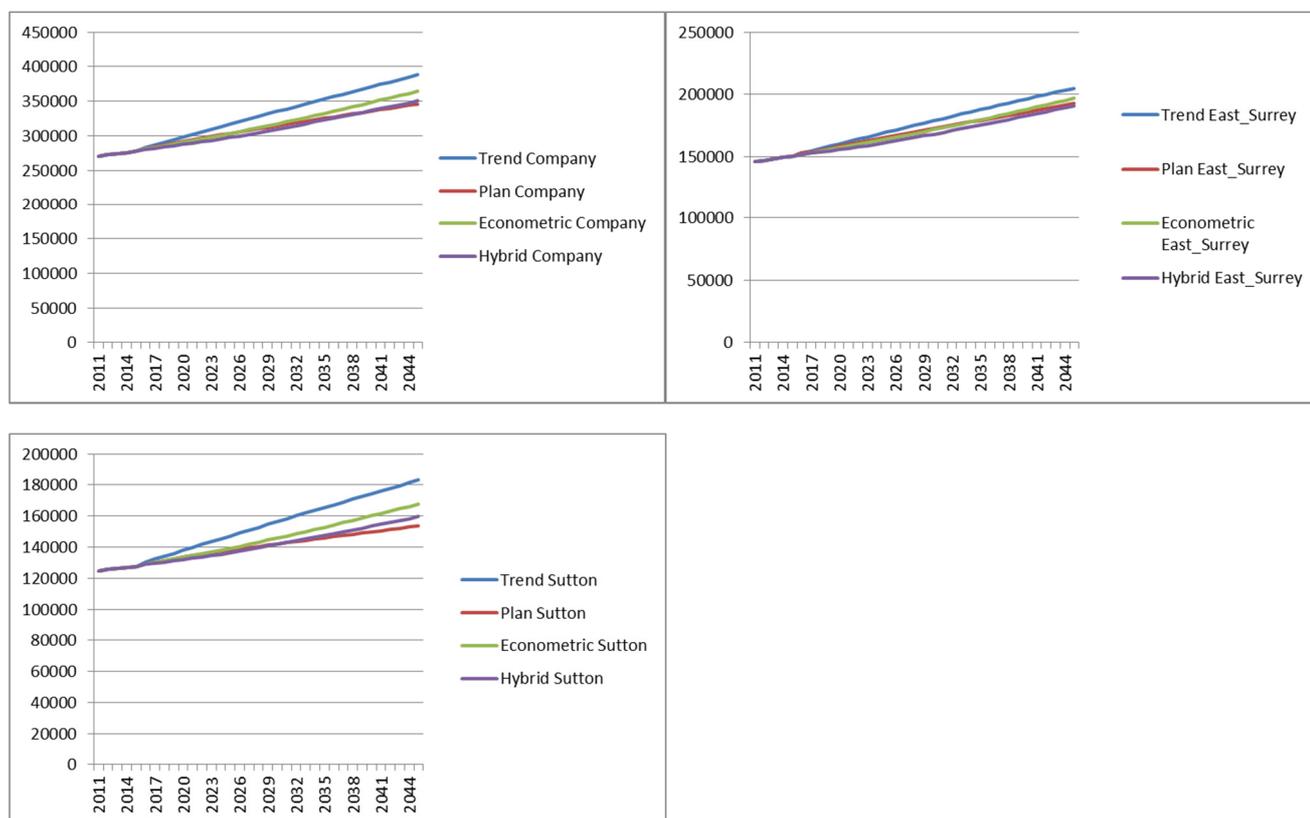
## 8. WRZ level results

This section provides a summary of the household, household population and occupancy projections for each of the forecasts for each Affinity Water WRZ.

### 8.1.1 WRZ household forecasts

At company level, the trend-based household forecasts are stronger than the econometric, hybrid and plan-based forecasts. The plan and hybrid forecasts follow a similar trajectory. By 2045, the trend-based forecast is 12 per cent higher than plan. The trend-based household forecast for East Surrey WRZ is also the strongest, but the range between the forecasts is narrower than at company level. The trend-based forecast is 6 per cent higher than plan by 2045. The variance for Sutton WRZ is greater, with the trend-based forecast some 20 per cent higher than plan in 2045. The econometric forecast suggests that growth may be stronger than plan in Sutton WRZ and is forecast to be 9% higher than plan in 2045.

**Fig 8.1: WRZ household projections comparison**

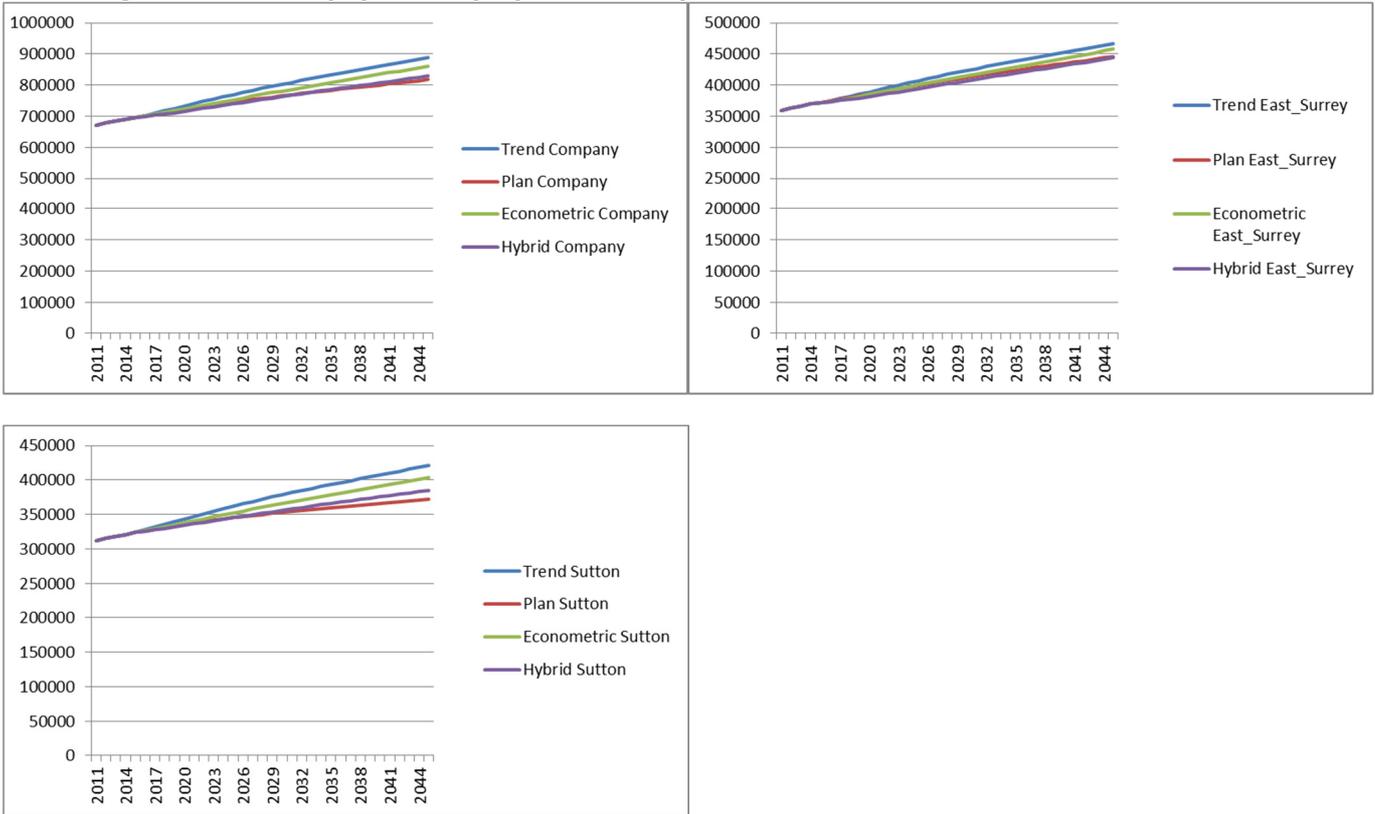


### 8.1.2 WRZ total population forecasts

At company level, the trend-based total population forecasts are stronger than plan. The plan and hybrid forecast follow a similar path and represent the bottom range of the population forecasts. The econometric forecast sits in the middle of the range. The lowest forecast (plan) is 8 per cent lower than the strongest forecast (trend) in 2045. The econometric forecast is 3 per cent lower than trend by the end of the forecast period. As with the household forecasts, the forecast range for East Surrey WRZ is narrower than for Sutton

WRZ – 4.8 per cent between high (trend) and low (hybrid) compared with 11.7 per cent between high (trend) and low (plan) for Sutton.

**Fig 8.2: WRZ total population projections comparison**



# 9. Comparison with previous forecasts

## 9.1.1 Comparison with outturn

Sutton and East Surrey Water provided the forecasts they used for WRMP14 for comparison with the latest forecasts and outturn. The forecasts used by Sutton and East Surrey water appear to be similar to the Experian most-likely WRMP14 forecasts.

At company level, actual total population growth was marginally stronger than forecast at 3.5 per cent between 2011 and 2015 compared with the forecast of 3.1 per cent. The property forecast of 2.2 per cent was close to the outturn of 2.1 per cent over the period 2011 to 2015. The analysis suggests that the WRMP14 population and property forecasts were a sound basis for the resources plan and that by factoring in economic factors and trends as well as local plan information provided an accurate view of likely growth. Indeed had the company used pure, plan-based forecasts, total population growth would have been underestimated (forecast at 1%) and using ONS trend-based forecasts would have overestimated growth (forecast at 5%). The analysis lends weight to the fact that using a blended forecast can improve forecast accuracy, particularly over the short-term.

## 9.1.2 Comparison with household forecasts for WRMP19

At company level, the property and population forecasts used for WRMP14, exhibit a similar growth profile to the econometric forecasts from WRMP19. The econometric forecast does not factor in local authority plans directly. The hybrid forecast factors in the plan and economic factors influencing the forecasts and suggests a slightly weaker growth profile, with average population growth of 0.6 per cent per annum between 2016 and 2045, compared with 0.7 per cent for the econometric forecast. Similarly, for properties, the hybrid forecast suggests growth of 0.7 per cent per annum compared with 0.9 per cent for the econometric forecast. The WRMP14 property forecast suggested annual average growth of 0.8 per cent between 2016 and 2040.

**Fig 9.2: Property and total population forecasts for WRMP19 compared with WRMP14**

