Water Resources Management Plan 2019

Annex 2: Demand Forecast

December 2019

Version 1

from Southern Water

Contents

1. Executive summary

Our demand forecast for Water Resources Management Plan 2019 covers the period up to 2069-70 and follows guidance issued by the Environment Agency and recommendations from UK Water Industry Research.

Under normal year conditions, total demand for water in our supply area between 2020-21 and 2069-70 is forecast to grow by 11%. This is much lower than the 37% forecast growth in population over the same period. This is due to a reduction in per capita consumption by over 16litres/person/day (14% reduction), which partly offsets the increase in demand due to population increase. This reduction results from more water efficient behaviour in the home as well as replacement of older devices such as water closets, washing machines and dishwashers by more water efficient models.

As part of our commitment to reduce demand, we have committed to reducing per capita consumption at the company level to 100litres/person/day by 2039-40 and reduce leakage by 15% over AMP7 and by 50% by 2049-50. These are covered in detail in Annex 6.

Following guidance, we have adopted the plan-based forecast for population and properties up to 2044-45. The forecast is primarily based on housing projections by Local Authorities in our supply area. We have extended the forecast to 2069-70 by using the annual growth rate at the end of 2044-45. Accordingly, population is forecast to grow to over 3.5 million people by 2069-70. Total connections to our water supply system are forecast to increase by 47% to over 1.6 million. The combined effect of population and properties growth results in an overall 8% drop in average household occupancy from 2.43 to 2.23 over the planning period. This is in line with expected demographic trends.

The base year for our demand forecast is 2017-18. Summer weather is the main influence on household demand, which is the largest component of our total demand. The summer of 2017 was warmer but wetter than the long term average. The summer of 2016 was warmer and drier than the long term average but not sufficiently to warrant classification as a dry year. By comparison the summer of 2015 reflected the long term average for terms of both temperature and rainfall. We have therefore normalised 2017-18 domestic demand using per capita consumption figures reported for 2015-16 given that there has been no material shift in our domestic meter penetration since 2015-16.

In keeping with the guidance we originally developed our base-year demand for the Normal Year Average Annual Demand scenario using normalised household consumption, non-household consumption as reported in 2017-18, and the 3-year average of reported figures for leakage and other components of demand (i.e. operational use and water taken unbilled). We subsequently replaced the 3-year average leakage figure with the estimated shadow leakage figure for 2017-18. The shadow leakage figure was much higher than the 3-year average and it was primarily offset against unmeasured domestic consumption such that the total DI remained unchanged. Other demand scenarios (i.e. Dry Year Annual Average, Dry Year Critical Period and Dry Year Minimum Deployable Output) use scaling factors based on historical data dating back to 1997-98.

We operate in a water stressed region and therefore in keeping with Best Practice we have used micro-component analysis to forecast domestic demand. The analysis takes into account current and future water use in houses associated with different domestic activities. Using the results of customer surveys and metering data we have subdivided our domestic customers into three main groups.

- Customer group 1: detached houses with consumption generally greater than 325litres/property/day
- Customer group 2: semi-detached and terraced houses with consumption in the 250-325litres/property/day range
- Customer group 3: flats and bungalows with consumption lower than 250litres/property/day

We have forecast demand separately for each customer group using ownership, frequency-of-use and volume-per-use data for devices such as water closets, washing machines, dishwashers, and for activities such as personal washing and garden watering. We have used data from customer surveys as well as published figures for the various inputs.

Total household demand is forecast to increase to 352.2Ml/d by 2069-70, an increase of 16% over the planning period. The increase is due to the projected increase the population we serve. The per capita consumption is forecast to drop from 120.3litres/person/day at the start of the planning period to 102.7litres/person/day by 2069-70. This represents a decrease of 15%, even after accounting for potential impacts of climate change on demand. The decrease is driven by replacement of older devices by new, more water-efficient devices as well as behavioural change.

For non-household demand, we have subdivided non-household properties into ten sectors and forecast demand for each sector. Total non-household demand is forecast to increase by 10% to 127.7Ml/d by 2069-70.

All other components of demand are kept constant at the 2017-18 base-year values.

Total demand at the company level for each of the planning scenarios is given in Table 1.

Table 1 Demand forecast under different planning scenarios

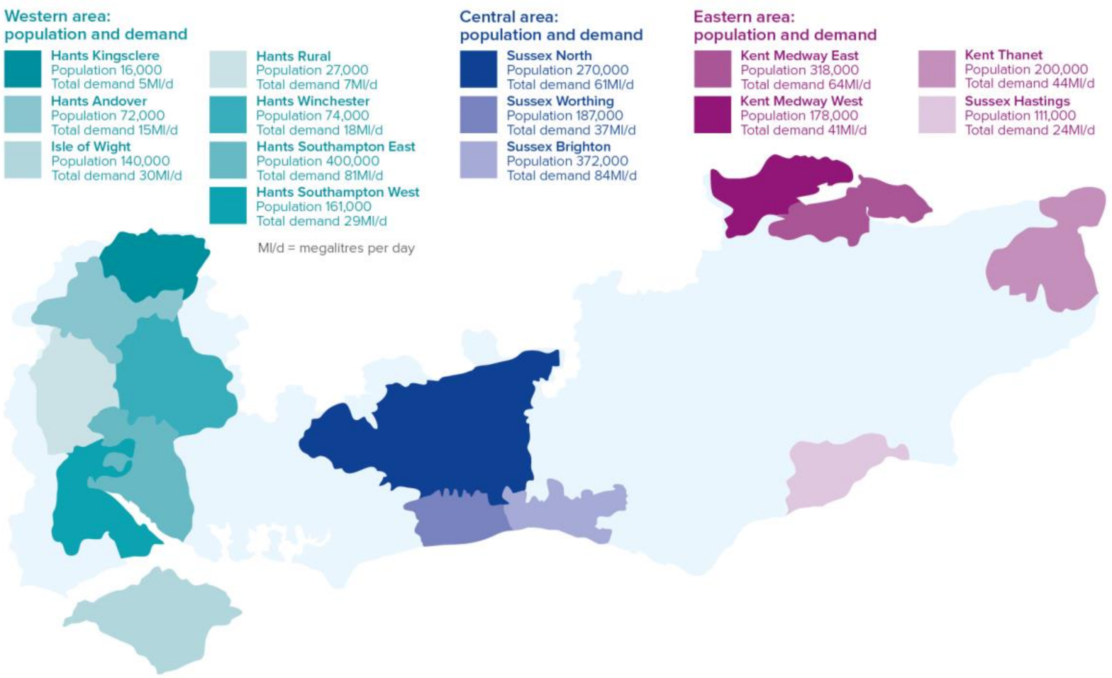
Planning scenario	2019-20 demand (Ml/d)	2069-70 demand (Ml/d)	Net change (Ml/d)	Net change (%)
Normal year annual average	535.1	594.9	59.8	11%
Dry year annual average	571.0	636.0	65.0	11%
Dry year critical period	643.9	720.0	76.1	12%
Dry year minimum deployable output	561.0	624.1	63.2	11%

We have taken account of the impacts of the sources of uncertainty on our demand forecast including population growth, behaviour change, non-household growth and climate change. We developed 81 demand projections for each of the four planning scenarios for use in headroom analysis. The demand forecast scenarios feed into the supply-demand balance modelling work (Annex 5).

2. Our current demand

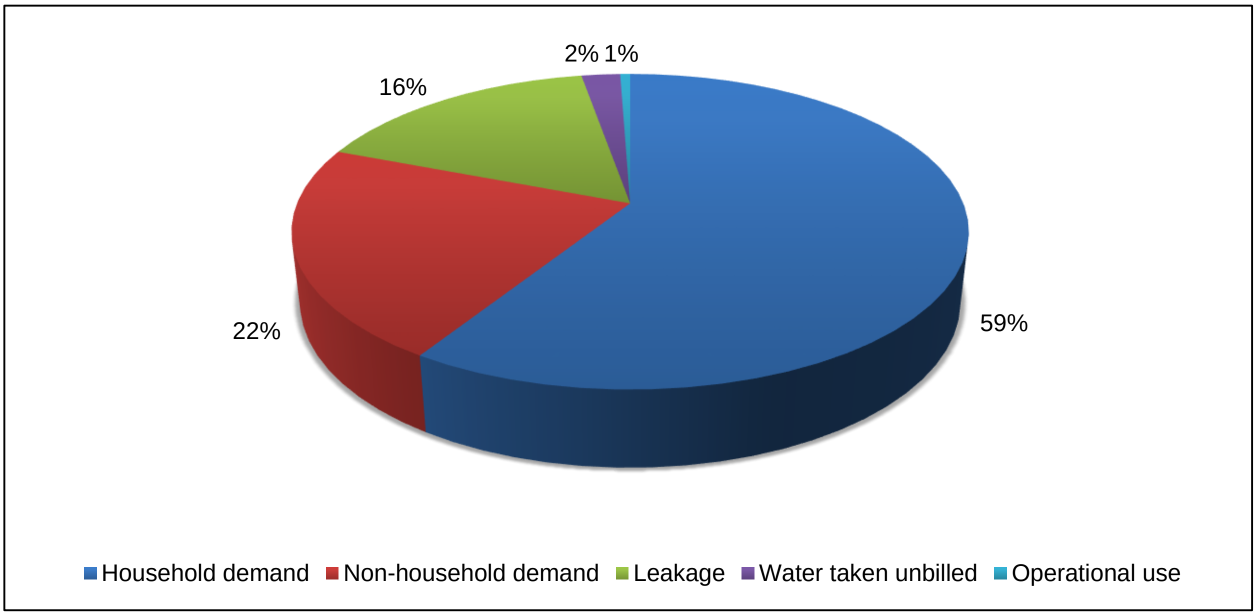
Our supply area covers a total of about 4,450 square kilometres and extends from east Kent, through parts of Sussex, to Hampshire and the Isle of Wight in the west, and serves just over 2.5 million customers. It's divided into three main areas and fourteen water resource zones (WRZs) as shown in Figure 1.

Figure 1 Our three main supply areas and fourteen WRZs with total population and water supplied in 2017-18



In 2017-18, we put a total of 541.0Ml/d into our water distribution system (Distribution input or DI); the breakdown into various demand components is shown in Figure 2.

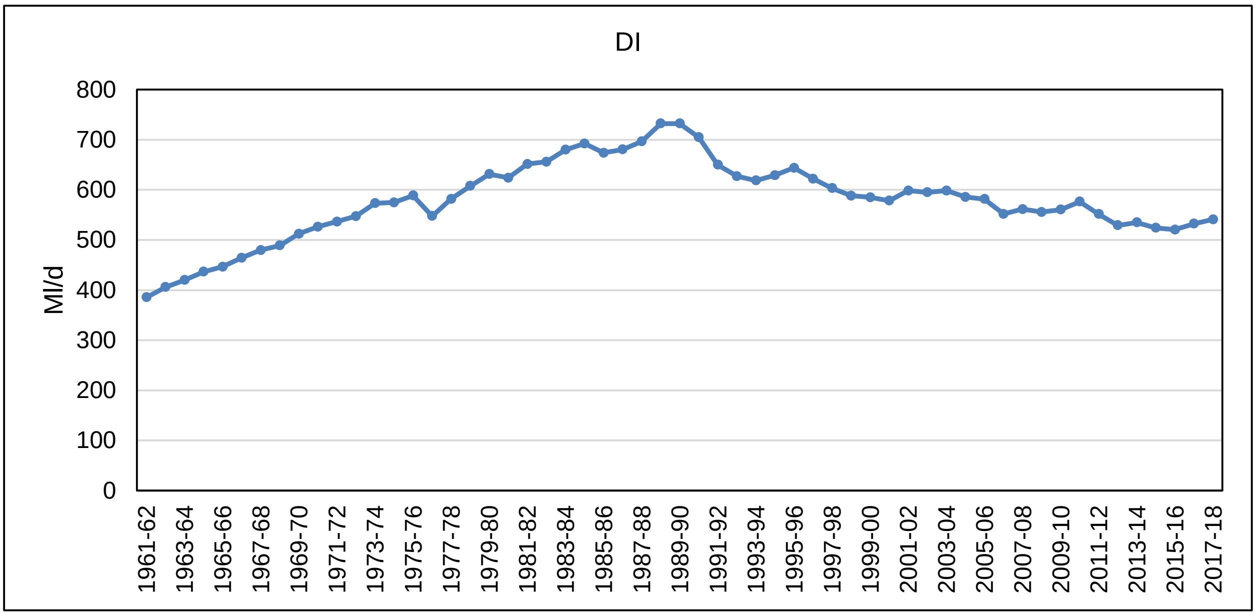
Figure 2 Breakdown of 2017-18 DI



Our DI has declined since privatisation of the water industry in 1989-90 (Figure 3), despite the increase in population over this time. This reduction has been a result of decline in both household and non-household consumption as well as leakage. Decrease in household demand has been driven by:

- Increased customer awareness
- Changes in lifestyle
- Development of more efficient devices such as washing machines and dishwashers
- On-going water efficiency campaigns run by the company
- Increased domestic metering

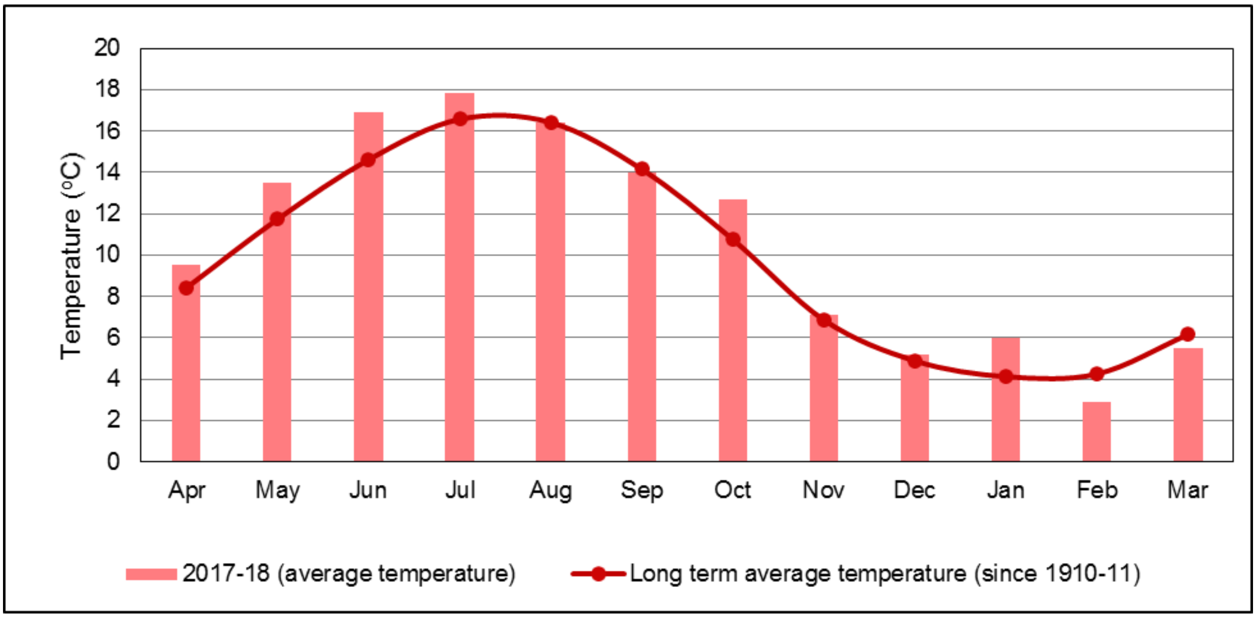
Figure 3 Distribution input since 1961-62



3. Planning scenarios

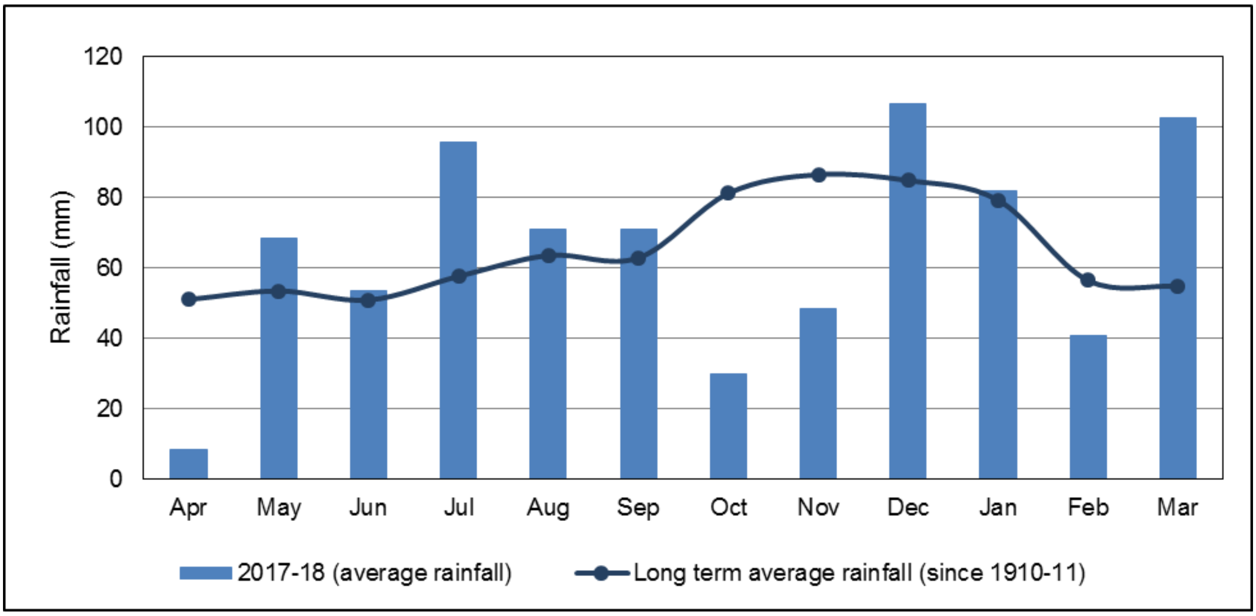
Demand is primarily driven by temperature and rainfall and varies throughout the year in response to changing weather conditions. The base year for our demand forecast is 2017-18. Met office data for south east and central south England shows that for the most part, the summer was warmer than average, with average temperatures during April-July higher than the long term average (Figure 4). October and January were warmer than average but February was much colder than average.

Figure 4 Comparison of average monthly temperatures during 2017-18 with the long-term average



Rainfall in April was very low but was higher than the long term average during the remainder of the summer (Figure 5). Rainfall during the October, November and February was much lower than average but December and March were wet. Rainfall during March was nearly twice as much as the long term average.

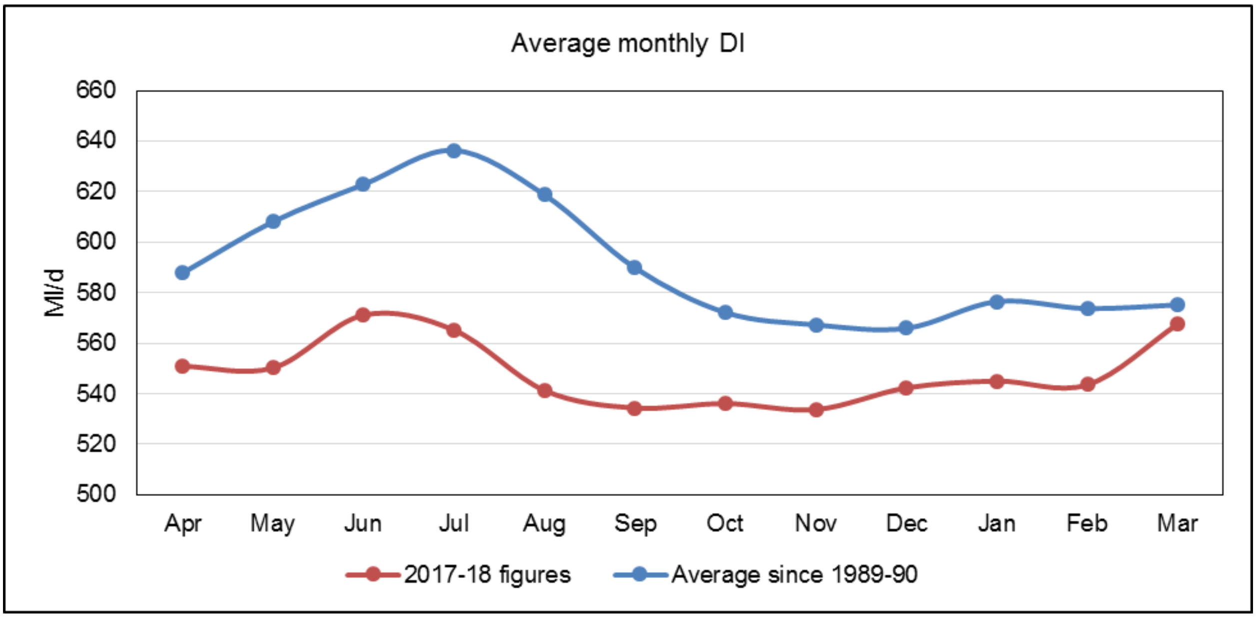
Figure 5 Comparison of average monthly rainfall during 2017-18 with the long-term average



Southern Water

As temperature and rainfall vary throughout the year, so does demand. Typically, demand is higher during spring/summer compared to autumn/winter. A key driver for higher demand during spring/summer is increase in discretionary use such as garden water. A hot, dry summer leads to a pronounced ***summer peak*** in demand whereas a wet summer results in a lower contrast between summer and winter demand profiles. Figure 6 shows a comparison of the average monthly DI for 2017-18 with the average monthly DI since 1989-90. The two profiles are broadly similar except that the summer peak is not as pronounced and July did not record the highest DI in 2017-18, most probably due to high rainfall (Figure 5). The spike in March 2018 was due to sharp increase in leakage as a result of freeze-thaw due to much lower temperatures experienced in February (Figure 4).

Figure 6 Monthly demand profiles



Peak demand for planning purposes is based the average demand over a 7-day rolling period; the highest value over a year defines the ***average day peak week*** or ***critical period*** demand.

3.1 Scenario definitions

The guideline issued by the Environment Agency (EA) (Environment Agency and Natural Resources Wales, 2017) requires demand forecasts to be produced for two planning scenarios, namely, dry year annual average (DYAA) and critical period (DYCP). We have additionally developed forecasts for normal year annual average (NYAA) and dry year minimum deployable output (DYMDO) scenarios. These scenarios are defined below.

- ***NYAA demand:*** This is the demand for water expected under ***normal*** conditions. If the base year is not a normal year, then the demand during the year needs to be normalised to account for factors such as meter penetration, weather and any demand restrictions that may have been imposed during the year
- ***DYAA demand:*** This is the annual average demand in a year with low rainfall, but without any demand restrictions in place. This demand is used with the average deployable output (ADO) supply scenario. Our aim is to introduce hosepipe bans no more than once in ten years on average
- ***DYCP demand:*** This is the peak demand over a 7-day rolling period. This demand is used with the peak deployable output (PDO) supply scenario
- ***DYMDO demand:*** This the demand during the autumn period in a dry year when groundwater levels and river flows are generally at their lowest and sources are operating

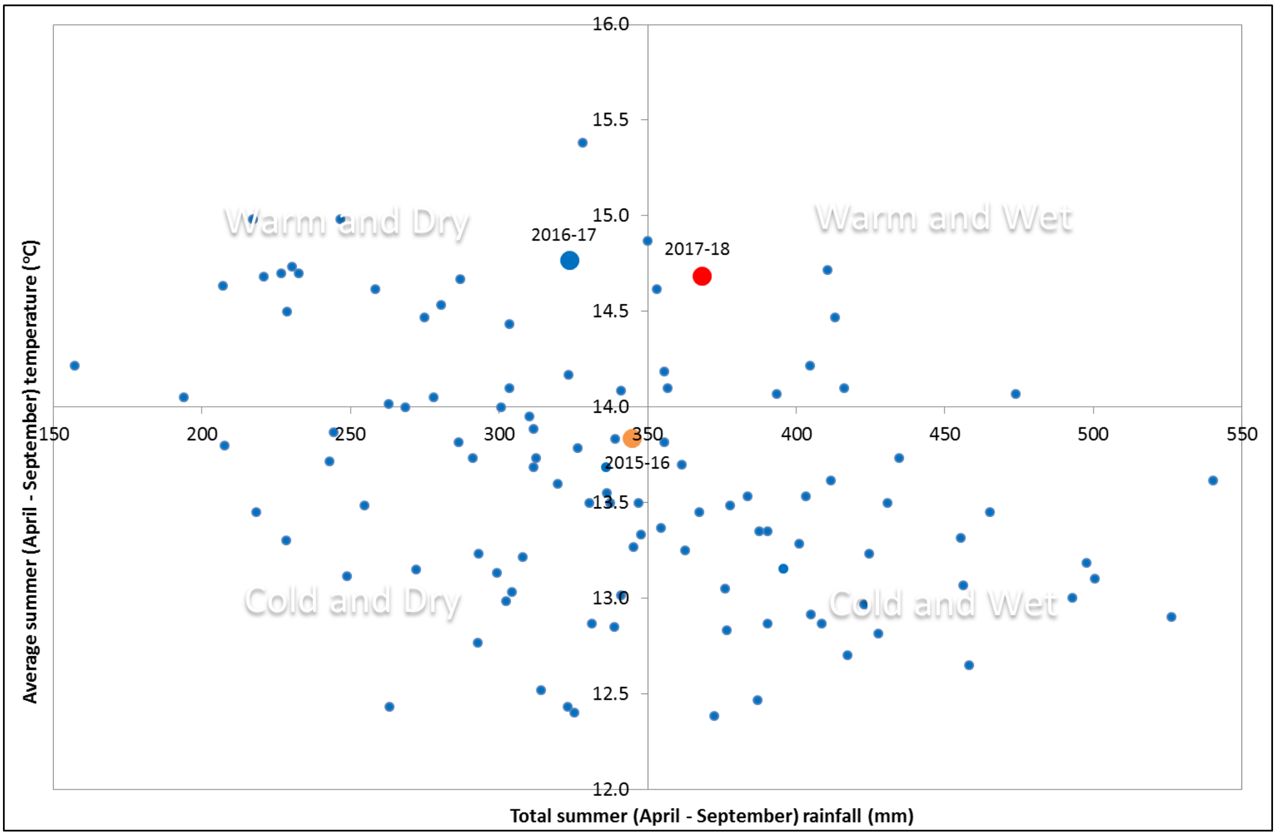
close to their minimum deployable outputs (MDO). Whilst demand in this period is generally not as high as in the summer, it is important to investigate this scenario because the available supplies are generally vulnerable

3.2 Base year demand

In addition to the summer weather, demand in our supply area over the past few years has also been influenced by our Universal Metering Programme (UMP). The programme aimed to meter over 90% of our domestic customers by 2014-15. The UMP formally ended in 2015-16 with a total meter penetration of 87%.

As discussed above, 2017-18 was not a normal year in terms of summer rainfall and temperature. This is further illustrated in Figure 7 which shows the summer of 2017 (i.e. the summer of 2017-18) to be slightly drier but wetter than average. As it was wetter at the same time, it cannot be classified as a ***dry year***.

Figure 7 Average summer temperature and total summer rainfall since 1910



By contrast, the summer of 2015 (i.e. 2015-16) was much closer to the average conditions (Figure 7). Total rainfall during the summer of 2015 was 344.7mm against the long term average of 339.7mm and the average summer temperature was 13.8°C against the long term average of 13.7°C. By comparison, the summer of 2017 recorded a total rainfall of 368.3mm and an average temperature of 14.7°C.

The slightly warmer and wetter summer did not lead to a significant difference in per capita consumption (PCC) figures between 2015-16 (129.8litres/person/day) and 2017-18 (128.9litres/person/day). We have nevertheless adjusted 2017-18 demand to reflect a ***normal*** year. We have done this by applying 2015-16 PCC figures to 2017-18 population figures to calculate domestic demand that would have been expected had 2017-18 experienced average summer conditions. Non-household demand is kept the same as reported in 2017-18[1]. This is because non-household demand is reflective of the overall economic climate as well and not just the summer weather.

Following EA guidance (Environment Agency and Natural Resources Wales, 2017) total leakage for the base-year is the average of the reported figures for the last three years. We have applied the same principle to the other unbilled components of demand (water taken unbilled and operation use) and taken a three-year average. There was an increase in voids properties on our billing system during 2017-18 which increased the 'water taken unbilled – illegally' component of our annual water balance. We currently have a plan in place to reduce the number of voids and the 'water taken unbilled – illegally' figure was accordingly adjusted to estimate the base-year figure. The resulting base-year demand for the NYAA scenario is 3.3Ml/d lower than the outturn 2017-18 figure (Table 2).

Table 2 Base-year demand

Component	Outturn figure (Ml/d)	Normalised figure (Ml/d)
Household demand	319.1	319.9
Non-household demand	118.2	118.0[1]
Total leakage	88.7	86.8
Water taken unbilled	11.9	9.2
Operational use	3.1	2.9
Total DI	**541.0**	**536.7**

[1]The outturn figures changed slightly after the revised demand forecast had been developed; but did not result in material change. The outturn figure was slightly higher

Following the publication of UKWIR (2017) we have carried out a reassessment of our 2017-18 leakage figure using the new recommended methodology. The resulting leakage figure is significantly higher than the figure derived from our current method. Changing leakage impacts all components of the DI in annual water balance calculations used for annual reporting as it impacts the original gap between the DI and sum of its components and the subsequent adjustments done using the Maximum Likelihood Estimation (MLE) method. Table 3 shows the comparison in water balance outputs (post MLE) for 2017-18 using the two leakage estimation methods.

Table 3 Comparison of annual water balance using leakage figures based on current and new reporting method

Component	Water balance output (Ml/d) – current leakage methodology	Water balance output (Ml/d) – new leakage methodology
Household demand	319.1	312.5
Non-household demand	118.2	116.4
Total leakage	88.7	102.6
Water taken unbilled	11.9	11.1
Operational use	3.1	2.9
Total DI	**541.0**	**545.6**

The higher leakage figure reduces the pre MLE gap between DI and the sum of it individual components and results in a lower degree of adjustments through the MLE process. As a result, the post MLE DI and leakage figures are higher when using the new leakage methodology but all other outputs are lower (Table 3). This is acknowledged in UKWIR (2017) where it states on page 1:

[1] The outturn figures changed slightly after the revised demand forecast had been finalised. However, it did not lead to any material change. The actual reported non-household consumption figure was 0.2Ml/d higher than the figure used to rebase DI.

‘***Applying this methodology is likely to change reported leakage and comparisons of historic data may no longer be valid.***’

Our calculation of demand factors (Section 3.3) is based on disaggregation of DI since 1997-98 into its various components and it is not feasible to reliably reconstruct the long-term data based on a single data point; especially when leakage and domestic demand can be influenced by a number of factors such as weather, meter penetration and company policy on supply-pipe repairs. We have therefore retained the rebased total DI in Table 2 as it complies with EA guidance but have adjusted other components to reflect higher leakage.

Over 87% of our household customers are metered which means there is high degree of confidence in our measured consumption figure. Unmeasured consumption, on the other hand, is an estimate. Following our metering programme, we do not have an Individual Household Monitor (IHM) as all properties that could be feasibility metered have been metered. We use a selection of DMAs as Small Area Monitors (SAMs) to calculate unmeasured consumption. The DMAs used for this purpose are single-flow DMAs i.e. with no imports/exports, have a relatively high degree of unmeasured domestic properties and are representative of customer base as a whole. Unmeasured domestic consumption is calculated as:

unmeasured consumption = total flow into the DMA – (total measured consumption + leakage)

As can be seen from the equation above, any increase in leakage will lead to a lowering in unmeasured consumption as total flow into the DMA and measured consumption remain unchanged. Accordingly, in our rebased demand for the base year, we have primarily offset the increase in leakage against unmeasured domestic consumption (Table 4).

Table 4 Rebased base-year demand using current and new leakage methods

Component	Normalised figure - current leakage method (Ml/d)	Normalised figure - new leakage method (Ml/d)
Household demand	319.9	305.3
Non-household demand	118.0[1]	116.4
Total leakage	86.8	102.6
Water taken unbilled	9.2	9.5
Operational use	2.9	2.9
Total DI	**536.7**	**536.7**

3.3 Demand factors

As we have not experienced a dry year since the completion of UMP, we do not have actual data for the various planning scenarios. We have therefore used the same method as we used for WRMP14 in order to determine factors to convert NYAA figures into DYAA, DYCP and DYMDO figures using data from 1997-98 onward. The method is as follows:

1. Calculate annual average, peak 7-day and MDO values for each year.
2. Remove non-household demand and leakage figures to calculate household demand for each year.
3. Apply corrections to household demand to account for any restrictions such as Temporary Use Bans (TUBs) that may have been place in the year.
4. For each year, recalculate household demand using the meter penetration level in the base year. For this purpose, it is assumed that metering lowers average demand by 15% and peak demand by 20%.

5. Add base-year non-household demand and total leakage to the recalculated household demand to calculate ***rebased*** DI for average, peak and MDO conditions.
6. DYAA factor is calculated by taking the 90th percentile of the rebased annual average data from1997-98 to 2017-18 and dividing it by the NYAA DI figure; DYCP factor is calculated by dividing the 90th percentile of the rebased peak DI with the NYAA DI figure and DYMDO factor is calculated by dividing the rebased MDO DI data with the NYAA DI figure.
7. When rebuilding base-year DI for DYAA, DYCP and DYMDO scenarios, the uplift factors are only applied to the household demand and all other components (leakage, non-household demand etc.) are retained from the NYAA scenario.

The method described above is used to calculated demand factors at the WRZ level. The calculated demand factors, aggregated at the area level, are show in Table 5 and the corresponding DI figures are shown in Table 6.

Table 5 Calculated demand factors

Area	DYAA factor	DYCP factor	DYMDO factor
Western	1.16	1.41	1.13
Central	1.09	1.30	1.07
Eastern	1.09	1.32	1.05
Southern Water	1.11	1.34	1.08

Table 6 Base-year DI for each scenario

Area	NYAA (Ml/d)	DYAA (Ml/d)	DYCP (Ml/d)	DYMDO (Ml/d)
Western	185.1	202.4	229.5	199.2
Central	179.4	189.3	212.3	186.7
Eastern	172.3	181.8	205.2	177.4
Southern Water	536.7	573.4	646.9	563.3

Our method for determining peak demand factors in each WRZ looks at the 7-day rolling average over the entire year and selects the 7-day period with the highest demand without considering the time of the year. The 1997-98 to 2017-18 dataset used for determining demand factors shows that peak demand typically occurs in the summer months which suggests that it is primarily driven by domestic demand resulting from higher use during the summer months. The Isle of Wight WRZ typically shows a higher peak factor than other WRZs for the summer months, which could be indicative of higher demand due to tourism during the summer period. However, more recently, peak demand in some WRZs (Sussex Brighton and Kent Medway) has occurred during winter months suggesting that it could be driven by leakage rather than consumption in these WRZs.

4. Population, property and occupancy forecasts

Growth is one of the key drivers for demand. Together with our neighbouring water companies (Affinity Water, Portsmouth Water, South East Water and SES Water), we commissioned a study in 2016 to provide forecasts for:

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

The study was completed at the start of 2017 (Experian, 2017). Forecasts up to the year 2044-45 were developed in line with the guidance issued by the EA (Environment Agency and Natural Resources Wales, 2017) and UK Water Industry Research (UKWIR, 2016a).

Accordingly, the following four sets of forecasts were produced with outputs provided at Census 2011 output area (OA) and 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 forecasts

The guidance (Environment Agency and Natural Resources Wales, 2017) requires water companies in England to base their growth forecasts on local plans published by the local council or unitary authority. In this regard, the guidance states the following:

- If a local council has a published adopted plan that is not being revised, then the water company must take account of the planned property forecast. Water companies need to ensure that their planned property forecast and resulting supply does not constrain the planned growth by local councils
- If a local council has published a draft plan but it has not yet been adopted water companies must take account and use this as the base of their forecast
- If a local council has not started or published a draft plan the water company should use alternative methods such as household projections from Department of Communities and Local Government or derive their own analysis using methodologies outlined in UKWIR (2016)

In keeping with the guidance, we have adopted the plan-based forecast as our baseline growth forecast.

4.1 Methodology

To meet the requirement set out in the guidance, Experian contacted each local authority in our supply area on our behalf, requesting their latest information on the number of dwellings they were planning for in their plan. Experian specifically asked local authorities to identify the most relevant figures 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. Of the 45 local authorities contacted in our supply area, 41 responded.

Experian also collected information for each local authority from their website. This information was used to fill gaps due to non-response and also to validate the responses received. The responses received for each local authority, the current status of the local authority plan and the source of information used for the plan-based figures for each area are given in Experian (2017).

Most local authority plans do not extend beyond 10-20 years and therefore had to be extended to the 25-year period covered by this plan. 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 (2016a) guidance.

For population forecasts, Experian did not use plan-based projections as local authorities had used different methods and assumptions to forecast population. Experian based their method on their research which shows that while over- or undersupply of housing does not impact population growth in the short term, it is likely to be a factor in the long term. Using trend-based population projections for plan-based household projections can lead to unrealistic occupancy forecasts, which was recognised in the UKWIR guidance (2016a). Experian therefore used a two-step approach. In the first step, occupancy rates from the trend-based forecast were applied to the plan-based household forecasts. In the second step, a weighted average between trend and the plan-based population forecast was taken for each local authority. The weights applied were as follows:

- Plan 0.75
- Trend 0.25

This approach recognises that over the long-term population will be influenced by the supply of new homes. Where plan- and trend-based numbers 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 numbers are comparable. Where the plan-based figure is lower than the trend-based figure, 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-based figure 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).

The annual dwelling targets are incorporated into the forecasts using the following steps in accordance with UKWIR (2016a) guidance:

- Produce a cumulative dwelling forecast for the local plan period
- Extrapolate the plan based cumulative dwelling forecast to 2044-45
- Apply dwelling forecast to the base year from the trend-based forecasts (2015) to produce total residential property forecasts
- Apply trend-based vacancy rates to the plan-based property forecasts to derive vacant property forecasts
- Subtract vacant properties from total properties to produce total households
- Calculate household population by applying trend-based occupancy rates
- Calculate the mid-point between trend and plan-based household population for each local authority
- Assume communal population remains at trend-based levels
- Sum communal and household population to derive total population

WRZ boundaries do not necessarily match with local authority boundaries. In order to calculate population figures for a WRZ, the overall occupancy of the local authority area was calculated. This figure was then applied to the number of address points falling within the WRZ boundary to calculate the population for the WRZ. This was done for each year of the forecast.

4.2 Accounting for uncertainty

The UKWIR (2016a) 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. Theses tables provide confidence intervals for different sized areas (regions, counties and local authorities) and suggests that water companies can apply the confidence interval for a given WRZ 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 Office for National Statistics (ONS) has struggled to project population in the past (mainly due to issues with under/over estimating migration levels in the previous population estimates).

The UKWIR (2016a) 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 (2016a) guidance recommends companies to assess uncertainty for just population or just households, according to whether they intend to calculate household water consumption using PCC or per household consumption (PHC) rates.

Experian (2017) 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. The percentage difference between the forecasts for 2015 and the mid-year estimates for Southern Water at the company level was +0.2%; however these errors are likely 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.

To capture future uncertainty, Experian (2017) 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. They 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 were used to estimate the error distribution.

To generate projections, Experian (2017) 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 WRZ level. 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 (2016a) guidance.

Experian (2017) is attached as Appendix A.

4.3 Results

4.3.1 Growth in total customer base

The four projections by Experian (2017) for population and properties are shown in Figure 8 and Figure 9 respectively. It should be noted that Southern Water billing system shows the number of connections or accounts rather than properties. This is because multiple properties can have a single connection, or a single property may have more than one water connection. The property figures provided by Experian have therefore been translated into connections. In forecasting growth, we have not considered any switching from non public works supply (i.e. homes or businesses currently using private wells for their potable water needs) to us for their water supplies. According to Drinking Water Inspectorate (DWI, 2019) about 1% of the population in England and Wales rely on a private water supply with most of such supplies in remote, rural parts. Any change in our customer base due to such switching is therefore likely to be negligible with no material impact on our growth and demand forecasts.

Plan-based figures predict higher growth during remainder of AMP6 and therefore a higher populations and connections figures for the start of AMP7. Plan-based forecast shows the population at the start of AMP7 to be ca. 30,000 and total connections to be ca. 23,000 higher than the other projections at the start of AMP7.

Figure 8 Forecasts for total population

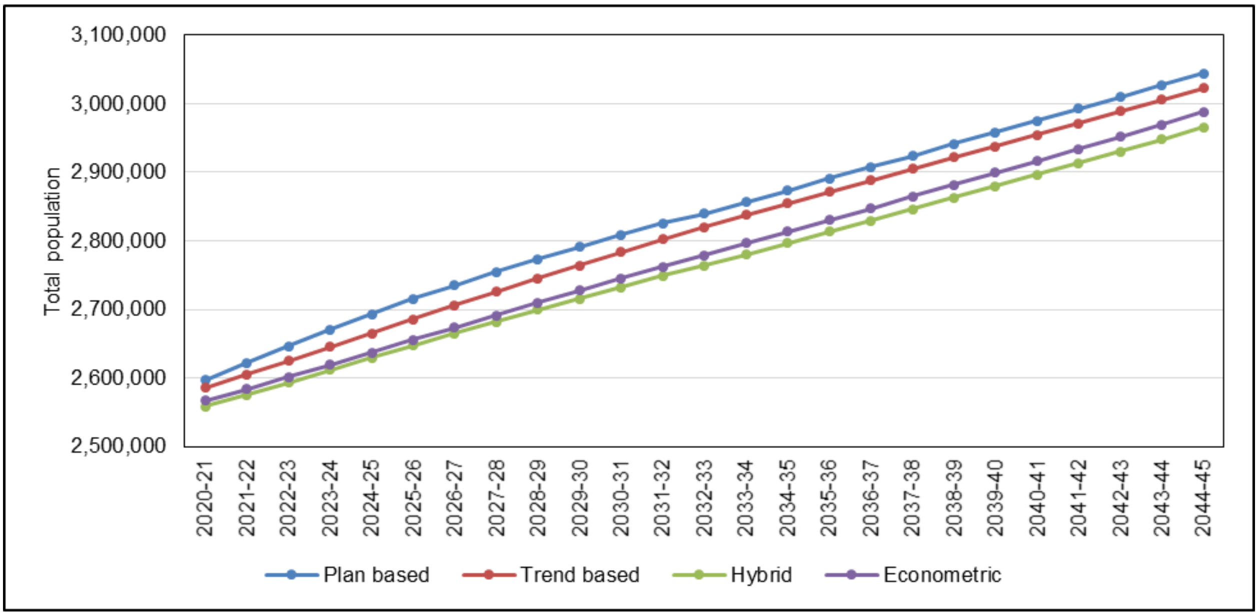
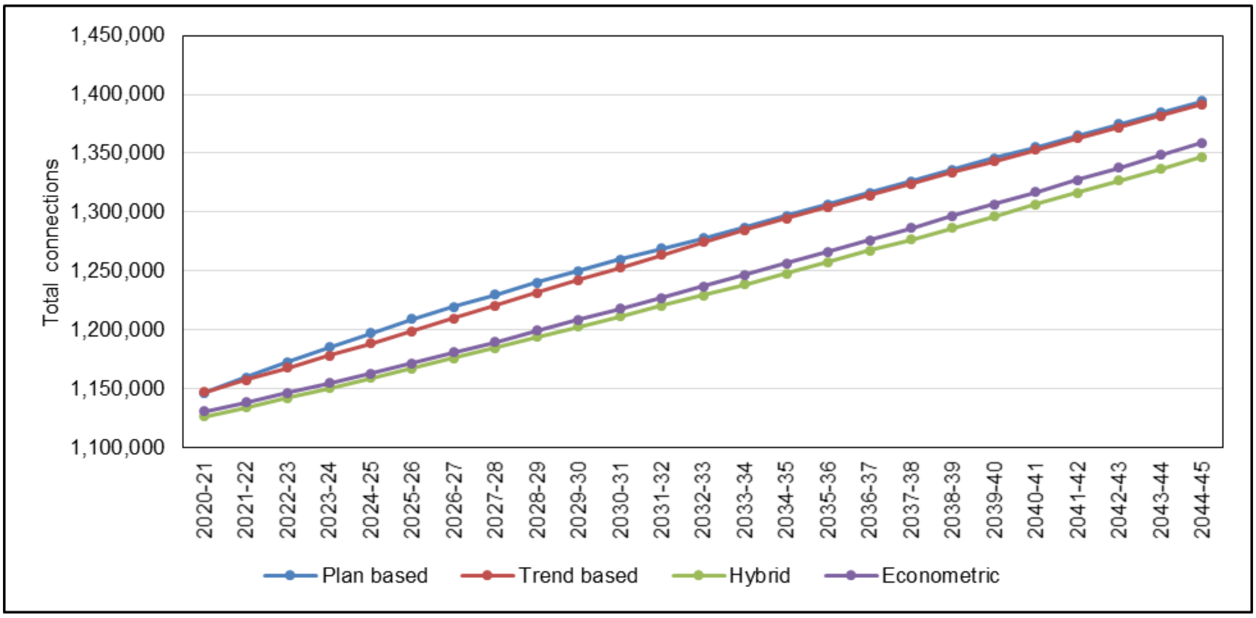


Figure 9 Forecasts for total connections



In terms of net growth over the planning period from 2020-21 to 2044-45, all four forecasts are very similar. For total population, plan-based and trend-based forecasts predict a 17% net increase in whereas hybrid and econometric forecasts predict a 16% increase. For total connections, plan-based forecast predicts a 22% increase, trend-based forecast a 21% increase whereas the other forecasts predict a 20% increase.

Growth rates vary by area. For the plan-based projection, the Eastern area shows the highest growth in total population (24%) followed by the Western area (16%). The Central area shows the lowest increase (12%). Total population numbers by area are shown in Figure 10.

The projected growth in total connections is much higher than total population and the differences between the three areas are much more pronounced. The Eastern area shows 29% increase over the planning period, followed by Western area at 20% and the Central area at 16%. The actual numbers by area are shown in Figure 11.

Figure 10 Total population forecast by area (Plan-based scenario)

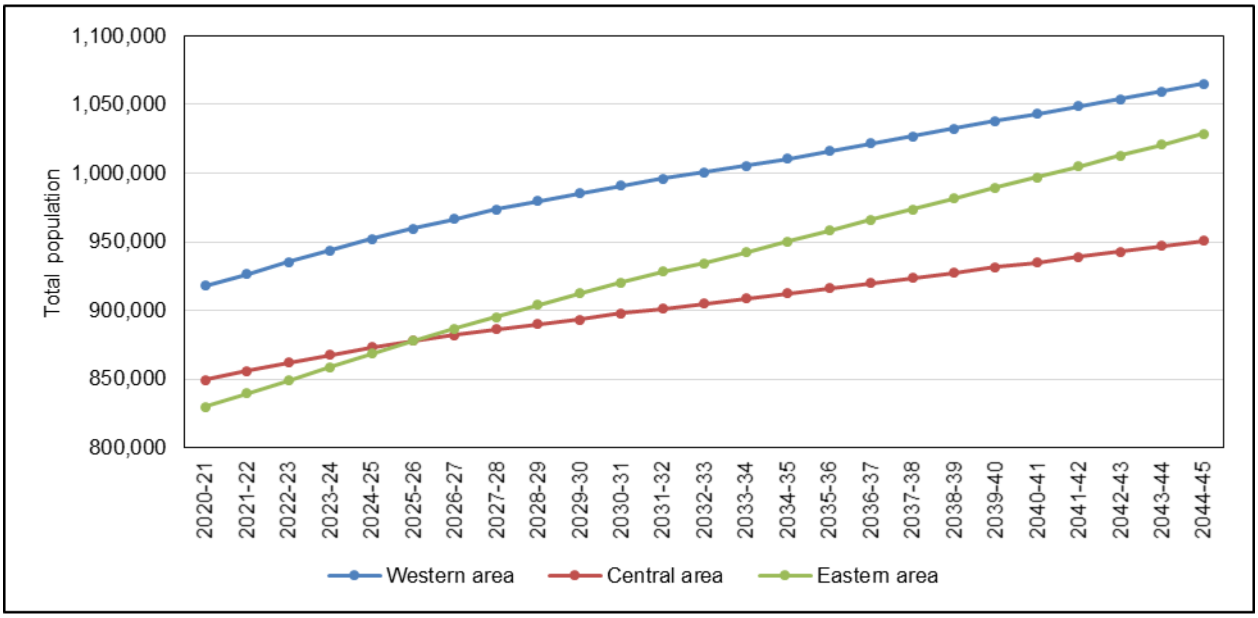


Figure 11 Total connections forecast (Plan-based scenario)

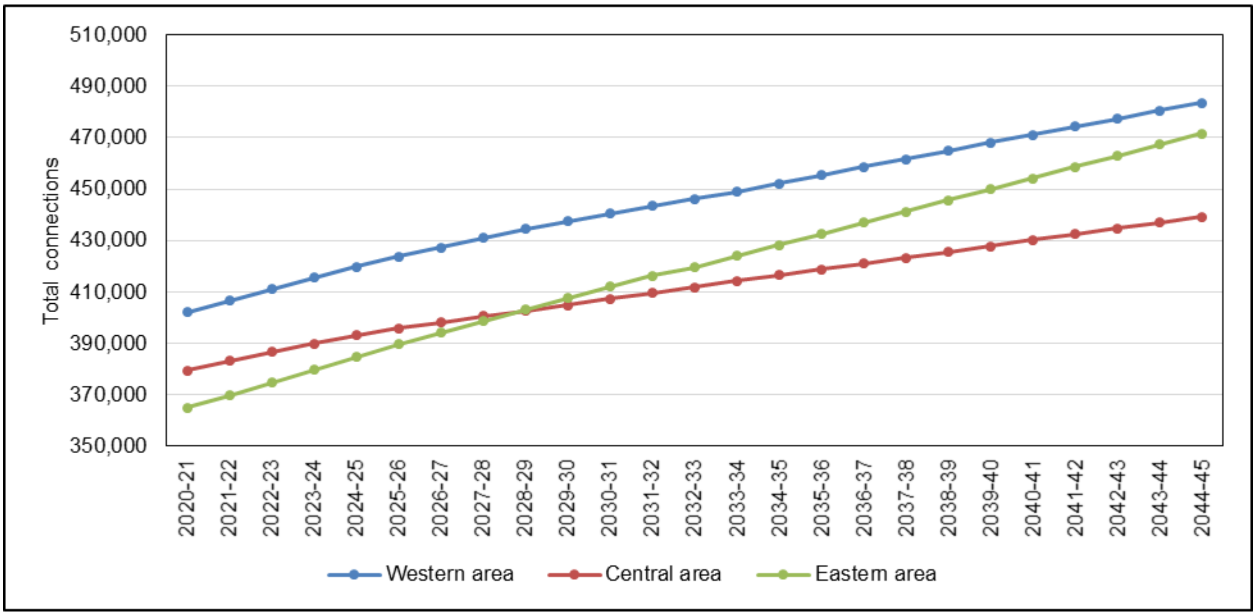


Figure 8 to Figure 11 show the original forecast by Experian up to 2044-45. As our plan covers the period up to 2069-70, we have extrapolated the forecast using the annual growth rate towards the end of the Experian forecast. The growth figures for total population and total growth are shown Figure 12 and Figure 13 respectively. Total population growth across the company is 37% with the Eastern area showing the highest growth (52%) and the Central area showing the lowest (25%);

total population in the Western area is forecast to grow by 34%. Total connections growth across the company is 46% with the highest growth in the Eastern area (65%) followed by Western (42%) and Central (33%) areas.

Figure 12 Total population forecast up to 2069-70

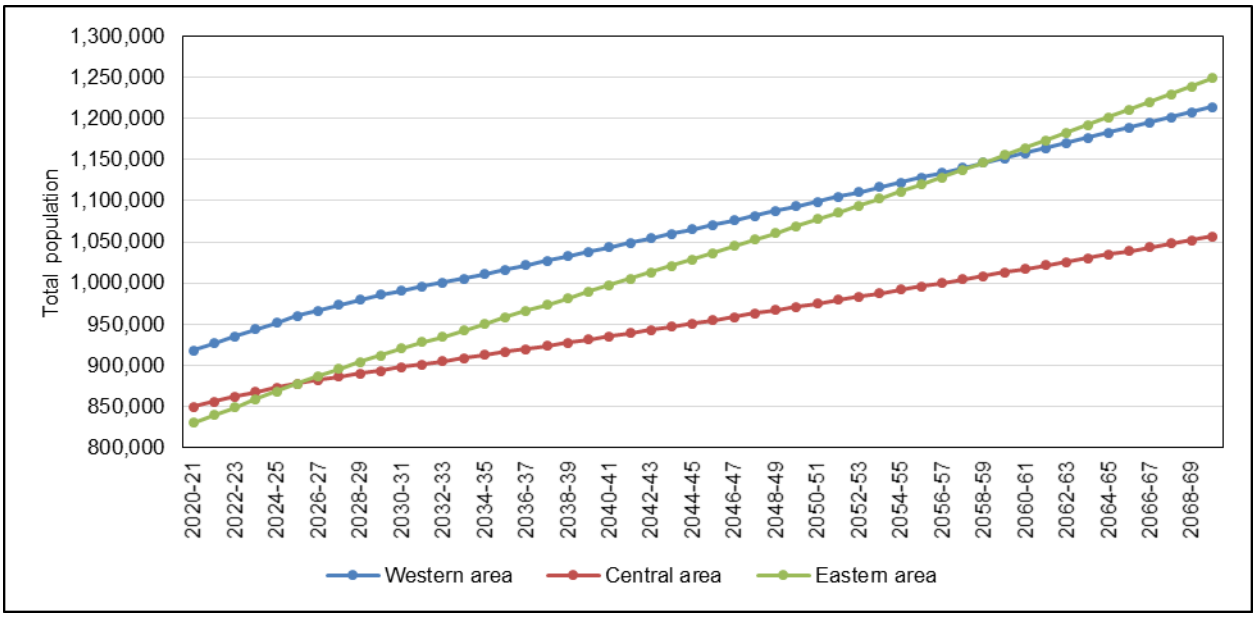
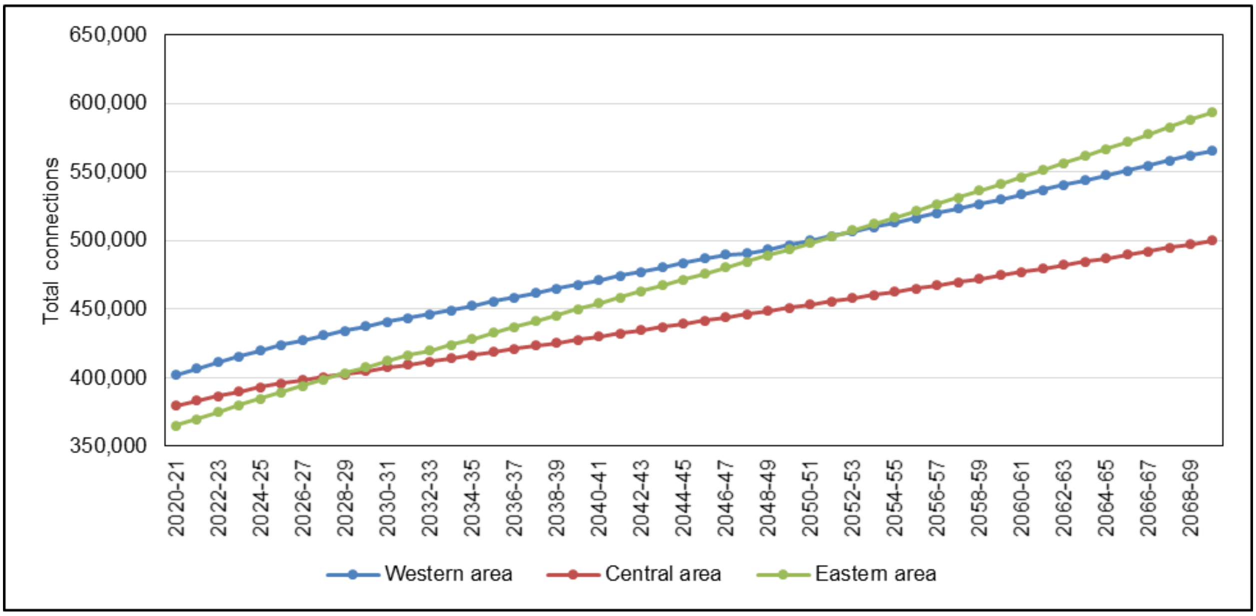


Figure 13 Total connections forecast up to 2069-70



4.3.2 Growth in household customer base

Our customer base has historically been reported in terms of household and non-household customers and this continues to be the case for all Ofwat and EA tables used for reporting company performance. Our non-household population numbers include both communal and non-communal populations. Household population accounts for over 98% of the total population we serve and is a key driver for demand in our area. As discussed in Section 6, non-household demand forecast is based on growth in different sectors rather than population, which implicitly takes account of any population driven growth in any particular sector. Further splitting non-household customers into communal and non-communal segments therefore has no material impact on the demand forecast. Our classification of household/non-household customers is based on Ofwat definition used for market separation in April, 2017. This is not led to any significant change is distribution of household/non-household consumption as part of total DI. Similarly, as mentioned above in Section 4.3.1, we have not included any switching from in non-connected properties in our future growth forecasts as any such switching is likely to be a very small fraction of our total customer base. In the Experian (2017) forecast, the trend in household population growth differs from total population growth. Household population is forecast to grow by 17% overall. The Eastern area still shows the highest growth (24%) but the growth is more than twice as high as the Central area (11%) and significantly higher than the Western area (16%). Household population forecast figures by area are shown in Figure 14.

The picture is very similar for household connections. Overall, household connections are forecast to grow by 23%. The Eastern area has the highest projected growth (31%), followed by the Western area (22%) and the Central area (17%) (Figure 15).

Figure 14 Household population forecast (Plan-based scenario)

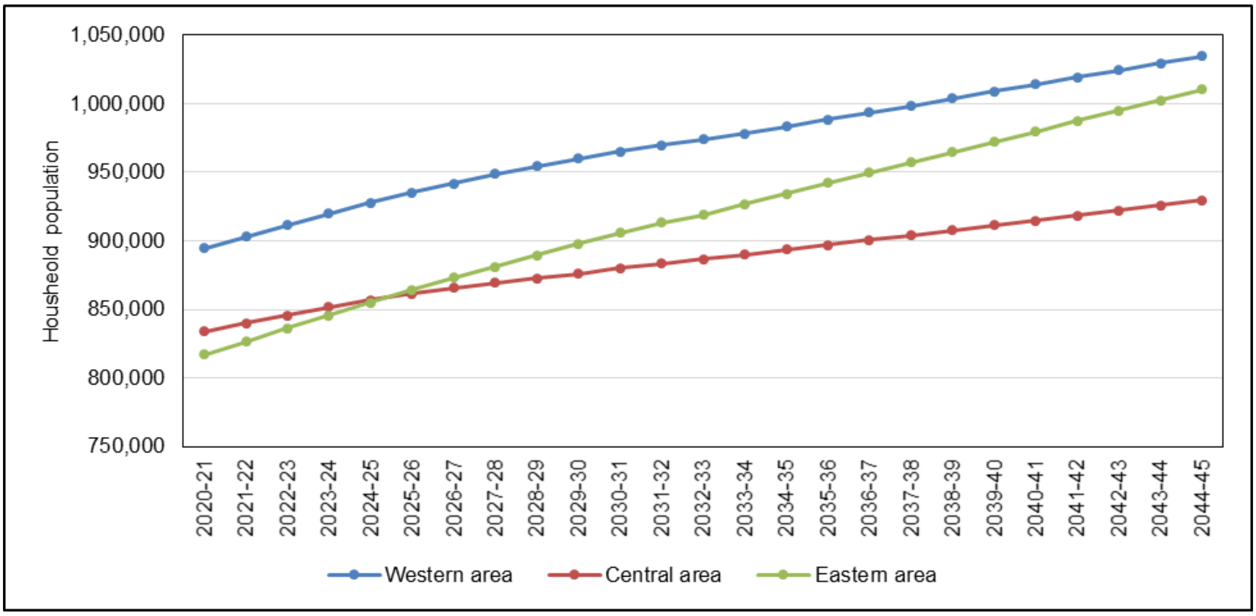
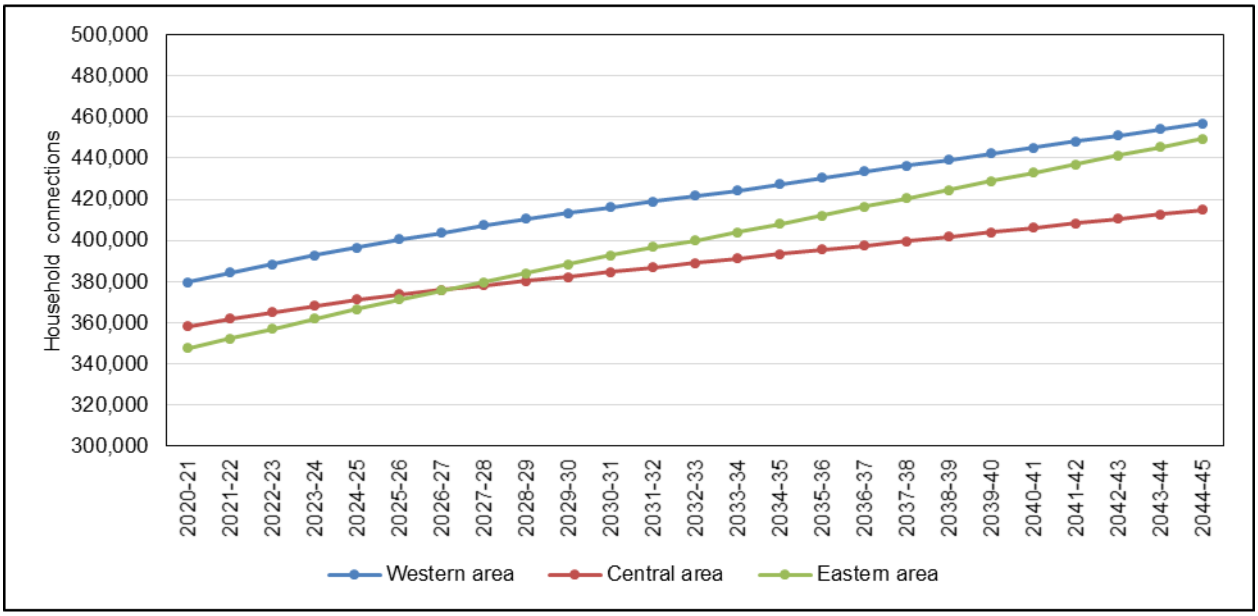
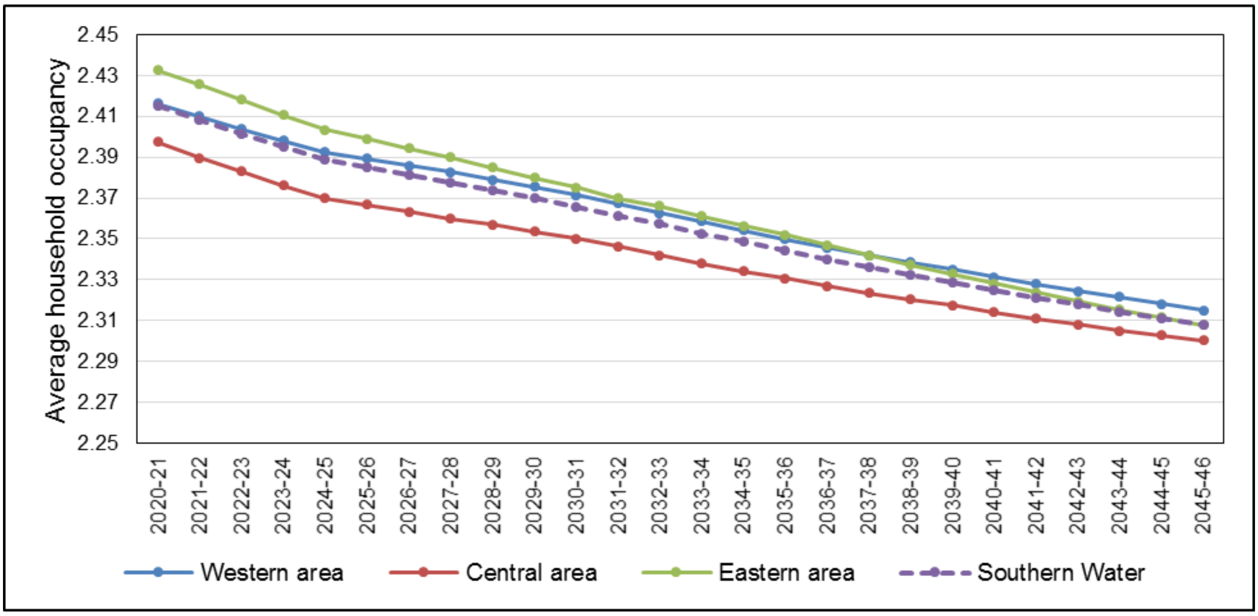


Figure 15 Household connections forecast (Plan-based scenario)



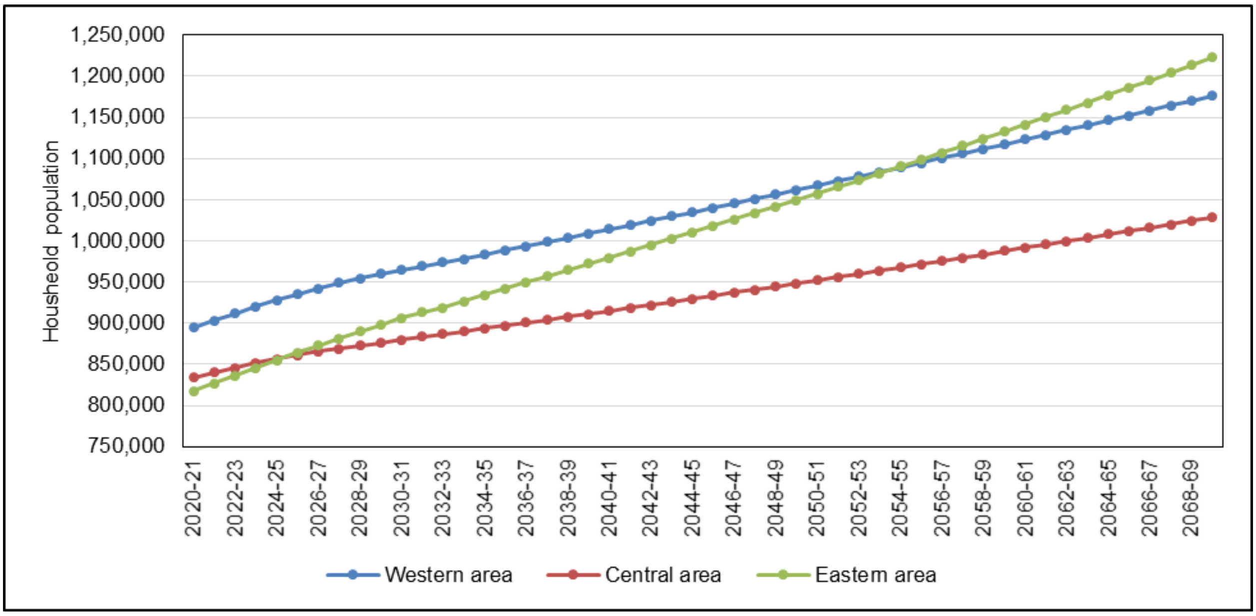
The higher growth in household population compared to household connections leads to a drop in average household occupancy over the planning period. The forecast for the three areas as well as the company as a whole are shown in Figure 16. In percentage terms, the Eastern area shows the highest drop at -9%, followed by the Western area at -8% and the Central area at -7%.

Figure 16 Household occupancy forecast (Plan-based scenario)



The extrapolated forecasts up to 2069-70 for household population, connections and occupancy are shown in Figure 17 to Figure 19.

Figure 17 Household population forecast up to 2069-70



Southern Water

Figure 18 Household connections forecast up to 2069-70

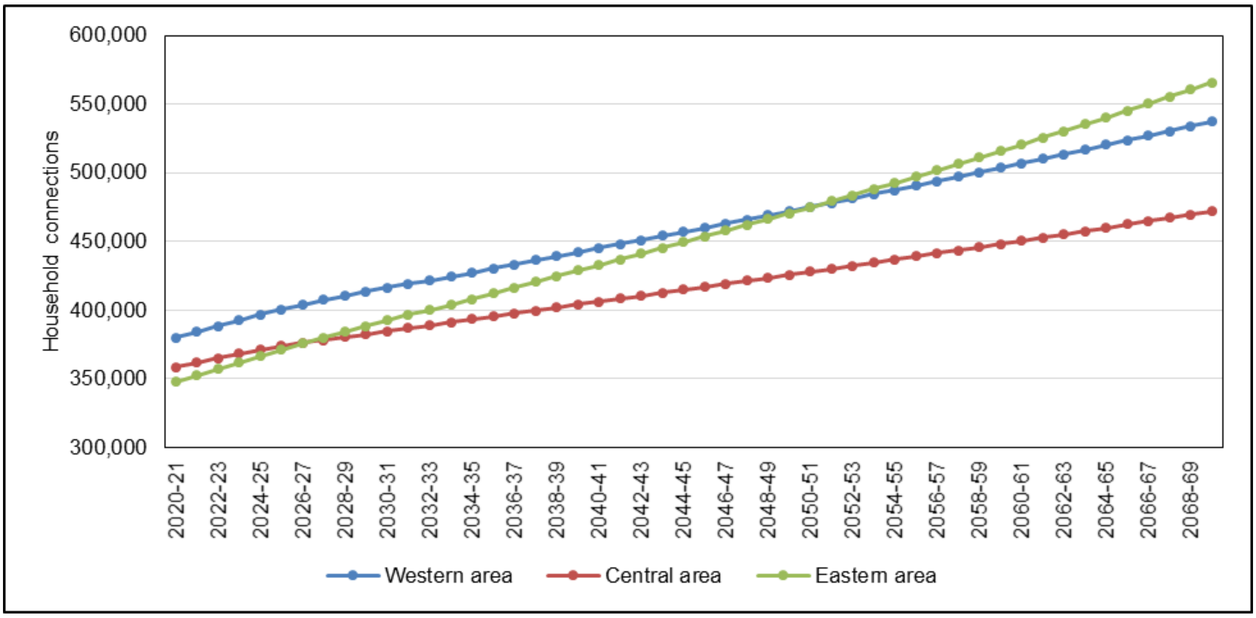
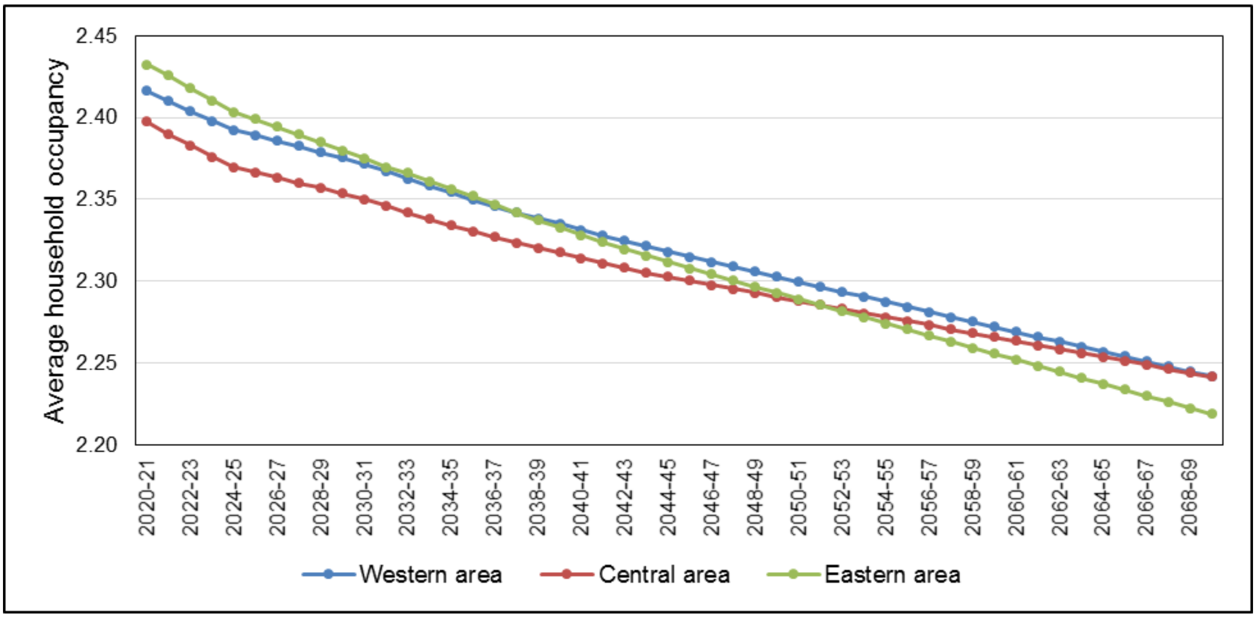


Figure 19 Household occupancy forecast up to 2069-70



4.3.3 Growth at the district level

We have also used the data provided by Experian to construct household connections the district level up to 2044-45. The results are shown in

Table 7. In cases where an area is supplied by more than one water company, we have forecast the number of connections that would fall in our supply area. As the table shows, significant growth is forecast for Medway and Thanet which is driving the high growth in our Eastern area.

Table 7 Household connections forecast at the district level; (B) indicates borough

District	2019-20	2024-25	2029-30	2034-35	2039-40	2044-45
Adur District	28,068	29,921	31,477	33,037	34,573	36,128
Arun District	32,818	36,206	38,265	39,679	41,117	42,569
Basingstoke and Deane District (B)	11,579	12,473	13,092	13,666	14,228	14,798
Canterbury District (B)	2,635	2,812	3,006	3,183	3,378	3,570
Chichester District	12,487	13,344	14,251	15,056	15,840	16,629
City of Southampton (B)	101,690	106,917	110,824	113,790	117,808	121,705
Crawley District (B)	39,356	40,812	41,285	42,405	43,293	44,183
Dartford District (B)	393	422	445	447	446	445
Dover District	25,173	27,230	28,150	28,690	29,201	29,734
Eastleigh District (B)	55,901	60,398	64,468	67,232	69,960	72,680
Fareham District (B)	16,923	17,894	18,647	19,358	20,020	20,676
Gravesham District (B)	42,338	44,167	45,930	47,547	49,150	50,744
Hastings District (B)	42,853	44,105	45,082	46,060	47,064	48,059
Horsham District	59,614	64,306	66,564	68,629	70,679	72,739
Isle of Wight	67,415	70,121	72,815	75,516	78,216	80,921
Lewes District	11,111	11,777	12,262	12,940	13,603	14,257
Maidstone District (B)	1,862	2,016	2,184	2,330	2,504	2,674
Medway (B)	111,523	121,088	130,726	140,316	149,965	159,616
Mid Sussex District	96	101	104	110	112	116
New Forest District	35,431	37,096	38,643	40,113	41,610	43,083
Rother District	8,656	9,191	9,512	9,772	10,045	10,320
Swale District (B)	43,655	46,915	50,122	52,806	56,081	59,363
Test Valley District	49,517	52,379	55,260	58,141	61,031	63,912
Thanet District	63,942	69,849	75,707	80,406	85,498	90,580
The City of Brighton and Hove (B)	122,176	126,241	129,773	133,279	136,824	140,338
Tonbridge and Malling District (B)	369	388	408	428	441	458
Wiltshire	79	82	85	90	96	101
Winchester District (B)	36,267	40,214	41,502	42,216	42,973	43,737
Worthing District (B)	49,397	50,272	50,885	51,480	52,064	52,661

5. Household demand forecast

UKWIR (2015) recommends choosing a forecasting method commensurate with the supply-demand situation in each WRZ. Simpler methods can be used where the supply-demand balance is in surplus and more complex techniques applied where the supply-demand balance is in deficit.

We supply water in a part of the country that has been classified as ***water stressed*** by the EA (Environment Agency, 2013). In order to prevent any adverse environmental impact as a result of our abstractions, we have agreed to implement sustainability reductions in the Western area and similar reductions could potentially be implemented in the Central area in the future. This means that we will be able to take less water from the environment in these areas in future, which could exacerbate the supply-demand situation, particularly during droughts.

In view of the water stressed nature of our supply area and the need to further reduce abstractions from existing sources, demand management has been a core component of our water resources strategy since AMP5. The UMP and the accompanying water efficiency campaign have led to significant reduction in domestic demand. As a result, the total household consumption in 2017-18 (319Ml/d) was lower than it was at the end of AMP4 in 2009-10 (322Ml/d), before the UMP started. This has been achieved despite over 11% increase in household population during this time. Over the same period, the average PCC in our supply area reduced from 145litres/person/day to 129litres/person/day (over 11% reduction). This is among the lowest in the industry. A study by Southampton University (Ornaghi and Tonin, 2015) estimated that customers who switched to metering reduced their consumption by 16.5% on average.

Having installed as many meters as we feasibly could in AMP5, we have continued to promote water efficiency in AMP6. Some of the specific measures we are undertaking in AMP6 are as follows:

- 28,000 home visits to provide our customers with advice on saving water and installing water-saving device such as low-flow shower heads and tap inserts where possible
- Offering discounted water butts in order to promote their use by our customers for garden watering and other outdoor activities instead of mains water
- Visiting 234 schools to fit water saving devices and educate pupils – our future customers – to value water as a scarce source
- We have offered help and advice to 120 small businesses on saving water
- We are incentivising communities to reduce their consumption and working with Local Authorities to promote water efficiency in the social housing sector. We have offered up to £50,000 for community projects to selected villages around the rive Itchen in Hampshire if they can reduce their consumption by 25% and are working with Brighton and Hove City Council to visit 1,000 social housing homes in order to help some of our most vulnerable customers save on their water bills
- We are also working with developers building 15,000 homes in Ebbsfleet (Kent) and 1,500 homes at Fawley (Hampshire) to build more sustainable homes

In our baseline demand forecast, we have assumed that we will at least maintain our current levels of water efficiency activities leading to a continuous decline in PCC, driven by behaviour change as well as changes in technology. As part of our ‘Target 100’ initiative we aim to reduce PCC at the company level to 100litres/person/day by 2040. This is reflected in our final planning demand forecast.

In keeping with UKWIR (2015) recommendation, we have used micro-component analysis (MCA) for our domestic demand forecast, as we did for WRMP14. MCA breaks down domestic consumption into typical domestic activities (i.e. toilet flushing, bathing etc.) and consumption is estimated separately for each activity, or micro-component, using ownership, frequency-of-use and volume-per-use (OFV) data. MCA is better aligned with our 'Target 100' initiative as it provides insights into volumetric distribution of total PCC among various uses – both discretionary and non-discretionary – and can inform better targeting of water efficiency messaging and advice.

Future changes in PCC are estimated based on likely changes in technology, behaviour and climate and their effect on individual micro-components. MCA therefore offers a better alternative to quantifying the impacts of various influences on PCC than some of the simpler methods. However, as noted in UKWIR (2015), MCA is data intensive and requires periodic updates to OFV estimates.

In addition to better understanding consumption patterns, we also need to collect consumption data more frequently in order to influence behaviour in a timely manner (e.g. during periods of peak demand).

We plan to start installing smart metering solutions in AMP7 which can provide near real-time data on domestic consumption and will also be carrying out periodic customer surveys to update our OFV estimates.

We have broken down total domestic demand into the following micro-components:

- Toilet flushing
- Personal washing
- Clothes washing
- Dishwashing
- Miscellaneous indoor use
- Garden watering
- Miscellaneous outdoor use

5.1 Customer segmentation

Water companies have traditionally classified their customers based on metering status i.e. unmeasured and measured. Following the implementation of UMP, this broad classification is no longer fit for purpose in our case as the vast majority (87%) of our customers is now measured. Similarly, further breakdown of the measured customers into Optants, Change-of-Occupier metering and Selectives is not feasible as all properties that could be cost-effectively metered have had a meter installed as part of the UMP. We have therefore looked at alternative options to segment our customers that better reflects their consumption patterns.

We conducted a customer survey at the start of 2016, once the UMP had been completed. The survey covered both unmeasured and measured customers. One of the key aims of the survey was to link household characteristics with actual consumption for measured customers. For this purpose, we specifically asked the measured respondents if they were willing for their details to be passed on to us so that we can link their responses to our billing data. The survey was conducted over the phone and covered 9,885 customers of which 6,203 were measured customers. Out of these, 5,451 customers (88%) agreed to their details being shared along with their responses.

For this plan, our supply area has been subdivided into 14 WRZs compared to the 10 WRZs that existed previously. We therefore conducted another survey in early 2017 to update the results for the newly created WRZs. This provided us with another 1,491 measured customers whose consumption could be linked to their household characteristics. The sampling strategy for both 2016 and 2017 surveys used the 'Mosaic' geodemographic segmentation developed by Experian to get responses from a representative sample.

When actual consumption figures for 2016-17 were appended to Mosaic grouping, there was no clear relationship between Mosaic group, occupancy and consumption (Table 8). We have updated Table 8 using 2017-18 data as well and the results are similar.

Table 8 Occupancy and consumption by Mosaic group for 2016-17 and 2017-18

Mosaic group	Average occupancy	Per household consumption (litres/property/day)	
		2016-17	2017-18
Domestic Success	3.34	381.2	375.4
Country Living	2.46	369.1	396.1
Prestige Positions	2.72	354.8	359.0
Family Basics	3.31	346.5	336.6
Aspiring Homemakers	3.22	332.0	338.7
City Prosperity	2.78	320.5	332.4
Suburban Stability	2.54	314.0	294.9
Rural Reality	2.43	273.2	273.8
Transient Renters	2.72	269.9	270.0
Urban Cohesion	2.17	263.9	285.9
Modest Traditions	2.17	241.1	238.3
Rental Hubs	2.08	237.1	244.0
Municipal Challenge	1.98	211.7	245.2
Senior Security	1.66	206.4	199.8
Vintage Value	1.38	156.3	156.7

Grouping by property type provided a much clearer relationship between property type, occupancy and consumption with both occupancy and average consumption highest for detached properties and lowest for flats. This is confirmed by data from 2015-16 to 2017-18 (Table 9).

Table 9 Occupancy and consumption by property type

Property type	Average occupancy	Per household consumption (litres/property/day)		
		2015-16	2016-17	2017-18
Detached house	2.80	391.2	362.7	365.4
Semi-detached house	2.76	319.2	312.7	310.3
Terraced house	2.72	299.5	293.5	288.0
Bungalow	1.95	244.6	237.2	260.8
Flat	1.68	191.1	182.2	180.8

Consequently, we decided to segment our domestic customers by property type creating three main groups as follows:

- Customer group 1: detached houses with consumption greater than 325litres/property/day
- Customer group 2: semi-detached and terraced houses with consumption between 250litres/property/day and 325litres/property/day
- Customer group 3: flats and bungalows with consumption up to 250litres/property/day

To verify the segmentation scheme, we have additionally looked at consumption data for 2014-15 and the results are consistent (Table 10).

Table 10 Consumption (litres/property/day) by customer group at the company level

Customer group	2014-15	2015-16	2017-18	2017-18
1	364.3	391.2	362.7	365.4
2	306.7	310.0	303.7	299.9
3	229.1	217.0	206.8	218.2
All	**301.7**	**307.2**	**294.1**	**295.7**

Area level figures for the data in Table 10 are given in Appendix B.

There is no corresponding consumption data for unmeasured customers but we have retained this segmentation for unmeasured customers for the sake of consistency. It is considered that the consumption will be higher for unmeasured customers compared to measured customers in each category. However, unmeasured consumption is also likely to be heavily influenced by property type as seen in the case of measured customers and we therefore consider the segmentation to be valid for unmeasured customers as well.

In projecting future growth, we have assumed that all future growth will be in the measured category as all new houses are meant to have a meter. Future growth is apportioned between the various customer groups using their base-year distribution. We have assumed the unmeasured property numbers to remain constant over time as all properties where it was feasible and cost-effective to have a meter installed were metered as part of our UMP. It is still possible that some of our current unmeasured customers will opt for a meter but the number is likely to be very small and will diminish over time with no material impact on our overall demand forecast – especially at the WRZ level.

The number of void household properties on our billing system has increased over the last two years to over 3% of total households. We have put a plan in place to bring this total down to its previous level (ca. 2.6% of total households) by the end of AMP7. The household properties profile used for the demand forecast reduces the number of void properties in line with our voids reduction plan and then keeps the number of voids constant at 2.6% of total household properties from AMP8 onward.

New builds are typically considered to have a lower occupancy and lower PCC (as they are likely to have newer, more water efficient fittings and devices). For our WRMP14 forecast, we had assumed all new builds to be built in accordance with Part G of the Code for Sustainable Homes with an average PCC of 125litres/person/day. This was based on WRc (2013) which suggested that homes built to a design standard of 105litres/person/day are more likely to exceed their design standard than homes built to a design standard of 125litres/person/day. Our reported PCC for measured customers in 2016-17 was 125litres/person/day and in in 2017-18 it was 122litres/person/day. As this level of PCC is consistent with the likely PCC of new builds, we have not considered new builds as a separate category as there is no evidence to suggest that their average consumption will be significantly lower than our existing measured customers.

5.2 Data

The MCA method requires information on household characteristics, as well as OFV data for the micro-components. For both unmeasured and measured customers, we have mainly used company specific data for our forecast, but have supplemented it with publicly available data where appropriate.

5.2.1 Household characteristics

As mentioned above, we conducted two customer surveys, in 2016 (9,885 respondents) and 2017 (5,570 respondents), to gather data on household characteristics. Both surveys were conducted over the phone. The 2016 survey covered our entire supply area, whereas the 2017 survey covered the newly created WRZs in Western and Eastern areas. The data was primarily used to develop customer segmentation as described above. Table 11 to Table 13 show the base-year figures for the three areas using data from our billing system.

Table 11 Base-year household population by customer group

Area	Customer group 1	Customer group 2	Customer group 3	Overall
Western	292,997	457,386	117,356	867,739
Central	160,276	460,905	192,515	813,697
Eastern	203,363	472,025	119,009	794,397
Southern Water	**656,636**	**1,378,263**	**425,503**	**2,460,402**

The three areas are similar in that Customer group 2 is the largest segment in terms of both population and connections. However, while Western and Eastern areas have Customer group 1 as the second largest group, the Central area has Customer group 3 as the second largest group (Table 11 and Table 12).

Table 12 Base-year household connections by customer group

Area	Customer group 1	Customer group 2	Customer group 3	Overall
Western	109,192	176,719	68,865	354,776
Central	60,228	166,763	107,597	334,588
Eastern	74,410	178,511	69,728	322,649
Southern Water	**243,830**	**521,992**	**246,190**	**1,012,012**

Table 13 Base-year household occupancy by customer segment

Area	Customer group 1	Customer group 2	Customer group 3	Overall
Western	2.68	2.59	1.70	2.45
Central	2.66	2.76	1.79	2.43
Eastern	2.73	2.64	1.71	2.46
Southern Water	**2.69**	**2.66**	**1.74**	**2.45**

The other aspect in which Central area is different is that Customer group 2 has the highest occupancy; the other areas have Customer group 1 with the highest occupancy. Customer group 3 has the lowest occupancy in all cases (Table 13). The occupancy estimates from the surveys are slightly higher than our company level figures.

5.2.2 Ownership

Ownership data for the micro-components is based on a customer survey we carried out in 2012 (4,500 respondents) and the 2017 survey mentioned above. The same template was used for both surveys to ensure that the results were directly comparable. The ownership figures from the surveys are considered to be robust as the respondents are likely to know about the presence of a device (for example, washing machine), an activity in their household (for example, garden watering) even if they do not themselves use the device or engage in the activity.

5.2.3 Frequency

The surveys carried out in 2012 and 2017 did ask the respondents about the frequency of use of water using devices and activities; however, we recognise that the person responding to the question may not necessarily know the answer if they are not the ones using a device or carrying out the activity. Secondly, in self-reporting surveys, there is a tendency for respondents to sometimes give answers they believe they ought to be giving, which may not necessarily reflect reality. The frequency data from the survey is therefore not considered to be as robust as ownership data. We have therefore applied frequency values in view of the general range given from multiple datasets covered in WRc (2012).

5.2.4 Volume

The volume associated with devices such as water closets (WCs), washing machines and dishwashers depends on their age. Older devices use more water on average than their present-day equivalents. We therefore asked the respondents about the age of their device as they were more likely know that compared to the volume. We then used published data such as WRc (2012) as well as the information on major retailers' websites to link the ages of various devices to their volume per use.

Activities such as showering and garden watering are a function of both the flow rate of the device being used as well as duration of the activity. We have primarily relied on published data (Critchley and Phipps 2007; WRc 2012) to estimate volumes associated with these such activities.

5.3 Results

5.3.1 Toilet flushing

The analysis assumes that:

- All households have at least one WC
- All WCs in the household are of the same type
- Frequency of toilet flushing is unrelated to number of WCs in the household
- Frequency of toilet flushing per head declines with an increase in occupancy
- When a WC is replaced, it is replaced by the latest available model

We have considered three generations of WCs in terms of average volume used per flush (Table 14). Cistern devices typically last for a long time, as evidenced by a substantial number of Generation 1 units (ca. 20% overall) still in use (Table 15). Replacement rates assigned to the three generations in Table 14 take this into account.

Table 14 Volumes associated with different generations of WCs and their replacement rates

Generation	Age (years)	Average volume per flush (litres)	Replacement rate (per annum)
1	Over 25	12	15%
2	10 – 25	9	5.0%
3	Less than 10	6	0.0%

As can be seen from Table 15, by 2069-70 WCs are forecast to be almost exclusively dual-flush systems. Detailed ownership figures by area and metering status are given in Appendix C.

Frequency of use of most micro-components, including toilet flushing, is seen to be related with occupancy (WRc 2012). Frequency of use tends to decline with increase in occupancy; however, it is not a linear relationship as other factors (for example, age of occupants) can also influence frequency. We have assigned frequency values keeping this view. The figures we have used are shown in Table 16 and within the range suggested in WRc (2012). Detailed breakdown by area and metering status is given in Appendix C.

Table 15 Ownership of WCs at the company level

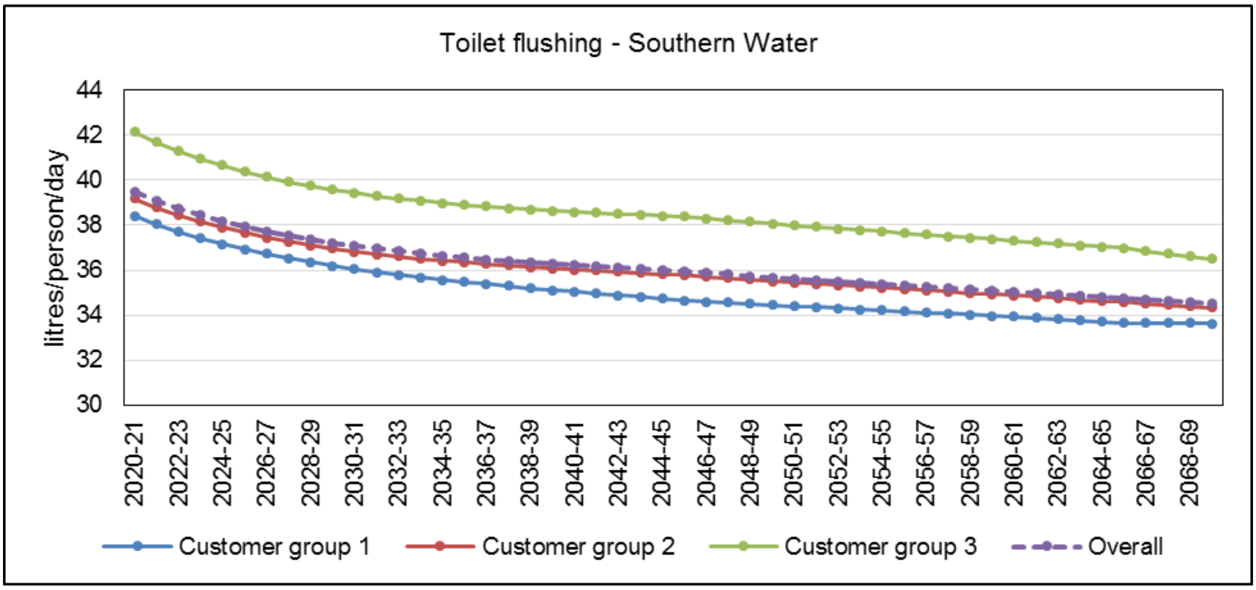
Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	16%	34%	51%	0%	2%	98%
2	21%	25%	54%	0%	1%	99%
3	19%	26%	54%	0%	1%	99%
All	**20%**	**32%**	**48%**	**0%**	**2%**	**98%**

Table 16 Average frequency of toilet flushing

Area	2017-18 (flushes/person/day)			2069-70 (flushes/person/day)		
	Customer group 1	Customer group 2	Customer group 3	Customer group 1	Customer group 2	Customer group 3
Western	4.8	4.9	5.1	5.1	5.0	5.1
Central	5.2	5.3	5.6	5.6	5.5	5.5
Eastern	5.0	5.1	5.4	5.4	5.2	5.4
Southern Water	**5.0**	**5.1**	**5.4**	**5.4**	**5.2**	**5.3**

The volume associated with toilet flushing is forecast to decline over the forecasting period (Figure 20). This is mainly driven by replacement of older cisterns by the newer cisterns and moderated slightly by the increase in frequency due to decrease in occupancy. Detailed forecast by area and metering status is given in Appendix C.

Figure 20 Forecast consumption for toilet flushing at the company level



5.3.2 Personal washing

We have considered the following three modes of personal washing.

- Bath
- Normal shower
- Power shower

The term ***power shower*** is used for showers that have an internal pump to enhance flow rate and not for electrical showers. The ownership in this case does not apply to mere presence of a device, but actual use. So if a property has a bath and a shower but the bath is not used, then the ownership of bath for the property is considered to be zero. Table 17 shows ownership figures for the three personal washing modes. Detailed breakdown by area and metering status is given in Appendix D.

Table 17 Ownership of personal washing modes

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	55%	50%	50%	42%	26%	74%
2	53%	64%	36%	40%	38%	62%
3	46%	67%	33%	34%	43%	57%
All	**52%**	**62%**	**38%**	**39%**	**36%**	**64%**

We have assumed that showers will continue to become more popular compared to baths, consistent with the trend seen in the recent past. The rate of switching is assumed to be 15% over the course of the planning period; however a minimum threshold of 20% is applied to ownership of baths in recognition that there will always be a proportion of customers who will take baths either regularly or intermittently.

In terms of power shower ownership, it is assumed that 50% of all new showers will be power showers but the maximum ownership of power showers is capped at 75% of total showers. The assumptions are the same for unmeasured and measured customers.

From the customer surveys, the frequency of baths is seen to be much lower than for showers and so although the frequency values have been modified, the frequency of bath is kept lower in accordance with the survey results (Table 18). Frequency of all modes of personal washing is assumed to be inversely related to occupancy and for equivalent occupancy, unmeasured households are assumed to have a higher frequency compared to measured households based on WRc (2012). While the model allows the frequency of personal washing to increase over time, the maximum number of showers and baths per person per week are capped at 7 and 4 respectively to prevent these from becoming unreasonably high over the planning period. The frequency values used for individual customer groups in unmeasured and measured categories are consistent with WRc (2012). Frequency of personal washing at area level and by metering status is given in Appendix D.

Table 18 Average frequency of personal washing at the company level

Customer group	2017-18 (times/person/day)		2069-70 (times/person/day)	
	Bath	Shower	Bath	Shower
1	0.10	0.73	0.11	0.76
2	0.09	0.70	0.09	0.72
3	0.08	0.68	0.08	0.68
All	**0.09**	**0.69**	**0.09**	**0.69**

The volume per bath is set at 75 litres, which is the volume of a standard bath in the UK. Volume consumed in shower is a function of both flow rate and duration. The flow rates for normal and power showers are set at 6 litres/minute and 12 litres/minute respectively based on the flow rates typically quoted in literature (e.g. Critchley and Phipps, 2007). The duration of normal showers for the base-year is initially set at 8 minutes for unmeasured households based on a Unilever study (BBC, 2011); for measured households it is set at 7 minutes. Over the planning period, the duration is reduced to

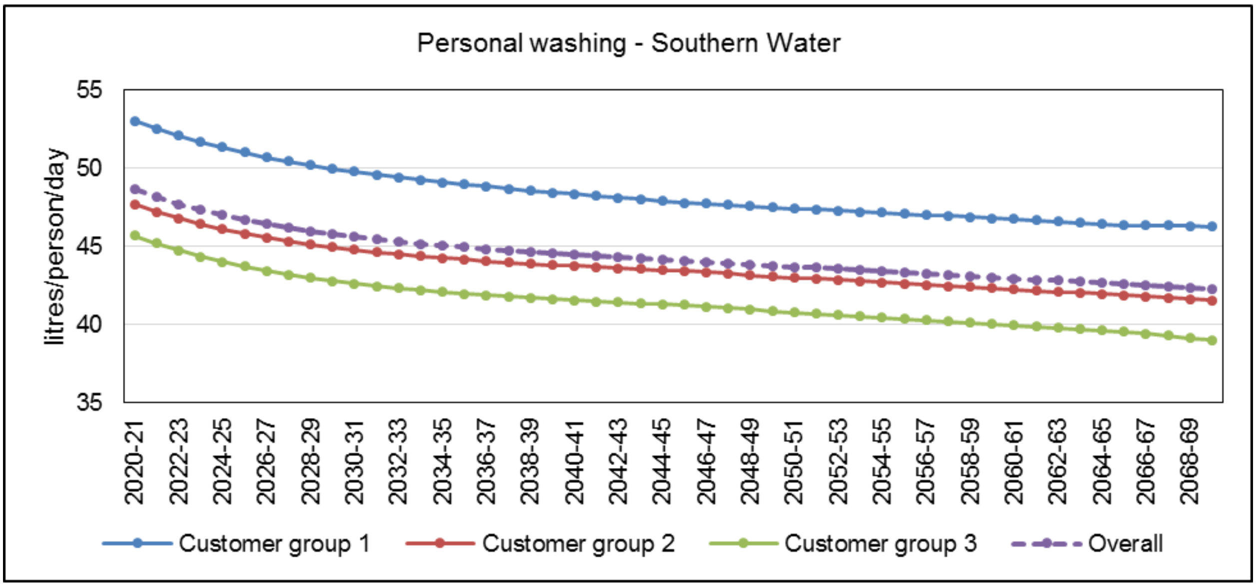
7 minutes for unmeasured households and to 4.5 minutes for measured households by 2069-70. For power showers, the duration for unmeasured customers reduces from 8 minutes at the start of the planning period to 7 minutes by 2069-70. For measured customers the duration of power showers changes from 6.5 minutes to 5 minutes by 2069-70. These figures are the same for all customer groups and reduction in duration in all cases in linear over the planning period.

The volume consumed per normal shower therefore reduces from 64 litres to 56 litres for unmeasured households and from 56 litres to 36 litres for measured households. In the case of power showers, the reduction is from 96 litres to 84 litres for unmeasured customers and from 78 litres to 60 litres for measured customers.

The assumed change in behaviour towards shorter showers and consequently lower consumption per shower is used as a proxy for baseline water efficiency. Shower durations are also used for uncertainty analysis as discussed later in this report.

As a result, the volume associated with personal washing declines overall despite the shift from baths to showers (and hence more frequent personal washing events) and the increase in ownership of power showers (Figure 21). Forecast by area and by metering is given in Appendix D.

Figure 21 Personal washing forecast at the company level



5.3.3 Clothes washing

Clothes washing considers the use of washing machines and washing clothes by hand as customer surveys indicate that some washing is done by hand as well. Ownership of washing machines is very high and a considerable number of households do some washing by hand (Table 19). Breakdown of ownership by area and metering status is given in Appendix E.

We have considered four generations of washing machines in terms of age and linked them to the volume used per full cycle using published data and information available on major retailers' websites (Table 20). Distribution by area and metering status is given in Appendix E.

Volume used in hand washing of clothes is set at 30 litres/wash.

Given the already high ownership of figures (Table 21), overall ownership of washing machines is assumed to remain unchanged over time. It is assumed that when a washing machine is replaced, it is replaced by the latest available model. Ownership figures by area and metering status are given in Appendix E.

Table 19 Ownership of clothes washing by hand and by washing machines

Customer group	Clothes washing by hand	Washing machine
1	29%	98%
2	29%	97%
3	26%	93%
All	**28%**	**96%**

Table 20 Volume assigned to washing machine generations

Generation	Age (years)	Volume per full cycle (litres)	Replacement rate (per annum)
1	Over 10	100	20%
2	6 -10	85	10%
3	3-5	55	8%
4	Less than 3	50	0%

Table 21 Ownership of washing machines by generation at the company level

Customer group	2017-18 ownership				2069-70 ownership			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	10%	20%	39%	30%	0%	0%	0%	100%
2	11%	21%	35%	33%	0%	0%	0%	100%
3	10%	20%	37%	33%	0%	0%	0%	100%
All	**11%**	**21%**	**36%**	**32%**	**0%**	**0%**	**0%**	**100%**

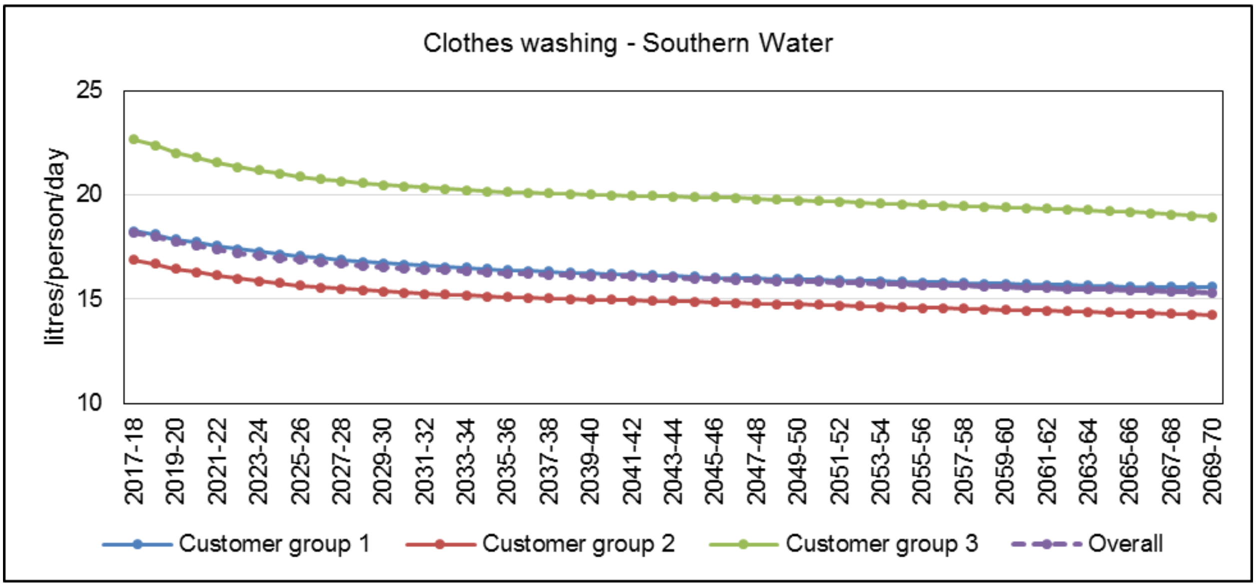
Unlike toilet flushing and personal washing, frequency of washing machine use is assumed to increase with occupancy. Table 22 shows the values for each customer group by area. These are within the ranges given in WRc (2012). Frequency values for washing of clothes by hand are around 1 wash per household per week on average. Over time frequency is assumed to decline with decrease in occupancy.

Table 22 Frequency of washing machine use

Area	2017-18 (uses/household/week)			2069-70 (uses/household/week)		
	Customer group 1	Customer group 2	Customer group 3	Customer group 1	Customer group 2	Customer group 3
Western	4.39	4.09	3.40	3.86	4.13	3.87
Central	5.70	5.51	4.97	5.37	5.35	5.20
Eastern	5.48	4.96	4.41	4.96	5.08	4.58
Southern Water	**5.11**	**4.80**	**4.39**	**4.71**	**4.79**	**4.49**

The volume associated with clothes washing is forecast to reduce over time (Figure 22). This is largely due to the replacement of older washing machines with newer, more water efficient washing machines. To a lesser extent, it is related to a reduction in frequency. Forecast by area and by metering status is shown in Appendix E.

Figure 22 Volume associated with clothes washing at the company level



5.3.4 Dishwashing

Dishwashing is modelled in a similar way as clothes washing. It considers dishwashing by hand and well as by dishwashers. All households are assumed to do some dishwashing by hand, irrespective of whether or not they own a dishwasher. The ownership of dishwashers is assumed to increase by 50% over the planning period. Maximum ownership is capped at 75% in view of the fact that not all properties have space for a dishwasher. The ownership figures are given in Table 23; figures by area and by metering status are given in Appendix F.

Table 23 Ownership of dishwashers

Customer group	2017-18	2069-70
1	75%	75%
2	50%	73%
3	30%	47%
All	**51%**	**67%**

As in the case of washing machines, four generations of dishwashers are considered. The volume is linked to the age of the dishwashers as shown in Table 24.

Table 24 Volume assigned to generations of dishwashers

Generation	Age (years)	Volume per full cycle (litres)	Replacement rate (per annum)
1	Over 10	55	12%
2	6 -10	40	6%
3	3-5	15	3%
4	Less than 3	11	0%

For dishwashing by hand, measured households are assumed to use 10 litres per wash whereas unmeasured households are assumed to use 12.5 litres per wash.

The ownership of various generations of dishwashers at the company level is shown in Table 25; distribution by area and by metering status is given in Appendix F.

Table 25 Distribution of dishwashers by age

Customer group	2017-18 ownership				2069-70 ownership			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	11%	23%	35%	31%	0%	1%	5%	95%
2	8%	24%	33%	36%	0%	0%	3%	97%
3	13%	21%	29%	37%	0%	0%	3%	97%
All	**10%**	**23%**	**33%**	**34%**	**0%**	**0%**	**3%**	**96%**

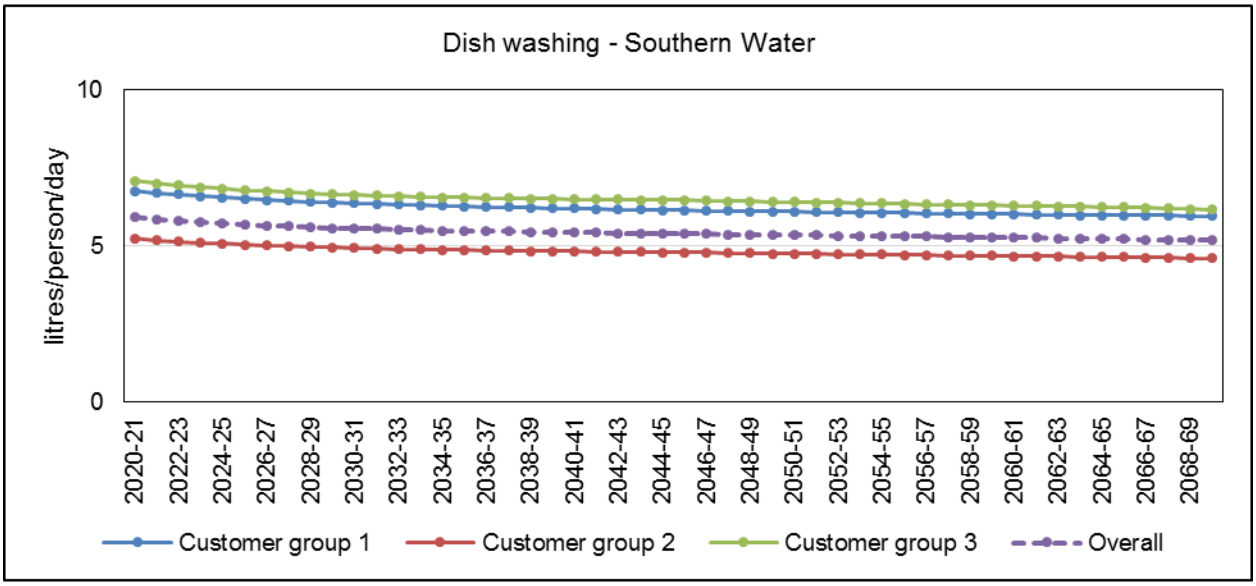
Frequency of dishwasher use is also linked to occupancy and higher occupancy is assumed to result in higher frequency of use. For households that own a dishwasher, 20% of the dishwashing is assumed to be done by hand. The values are shown in Table 26.

The volume associated with dishwashing is forecast to decline but only marginally (Figure 23). The decrease primarily comes from the replacement of older dishwashers with newer ones. Forecast by area and metering status are given in Appendix F.

Table 26 Frequency of dishwashing

Area	2017-18 (uses/household/week)			2069-70 (uses/household/week)		
	Customer group 1	Customer group 2	Customer group 3	Customer group 1	Customer group 2	Customer group 3
Western	5.25	4.82	4.54	4.88	5.20	4.77
Central	6.01	5.48	4.94	5.40	5.97	5.41
Eastern	5.66	5.45	5.02	5.41	5.53	5.32
Southern Water	**5.59**	**5.23**	**4.86**	**5.22**	**5.52**	**5.15**

Figure 23 Forecast of volume associated with dish washing at the company level

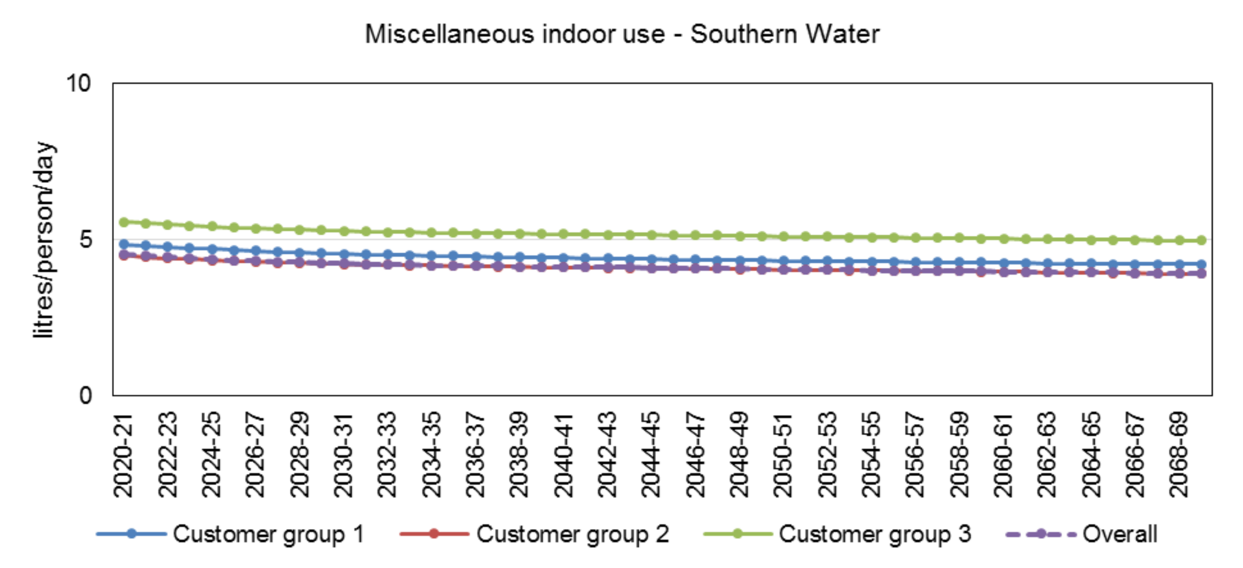


5.3.5 Miscellaneous indoor use

Miscellaneous indoor use includes activities such as drinking, cooking, kitchen sink use (excluding dishwashing) and bath sink use (washing hands, brushing teeth etc.). It is assumed that measured households would generally be more conscious about their water use but it is difficult to assign an appropriate volume. Therefore, this micro-component, together with miscellaneous outdoor use is primarily used to reconcile domestic PCC with normalised household demand.

The company level forecast is shown in Figure 24. Forecasts by area and metering status are given in Appendix G.

Figure 24 Miscellaneous indoor use forecast at the company level



5.3.6 Garden watering

We have considered four modes of garden watering, namely hosepipes, sprinklers, watering cans and 'other'. We have not included water butts as they do not use mains water. The ownership figures are shown in Table 27. Ownership by area and metering status is given in Appendix H.

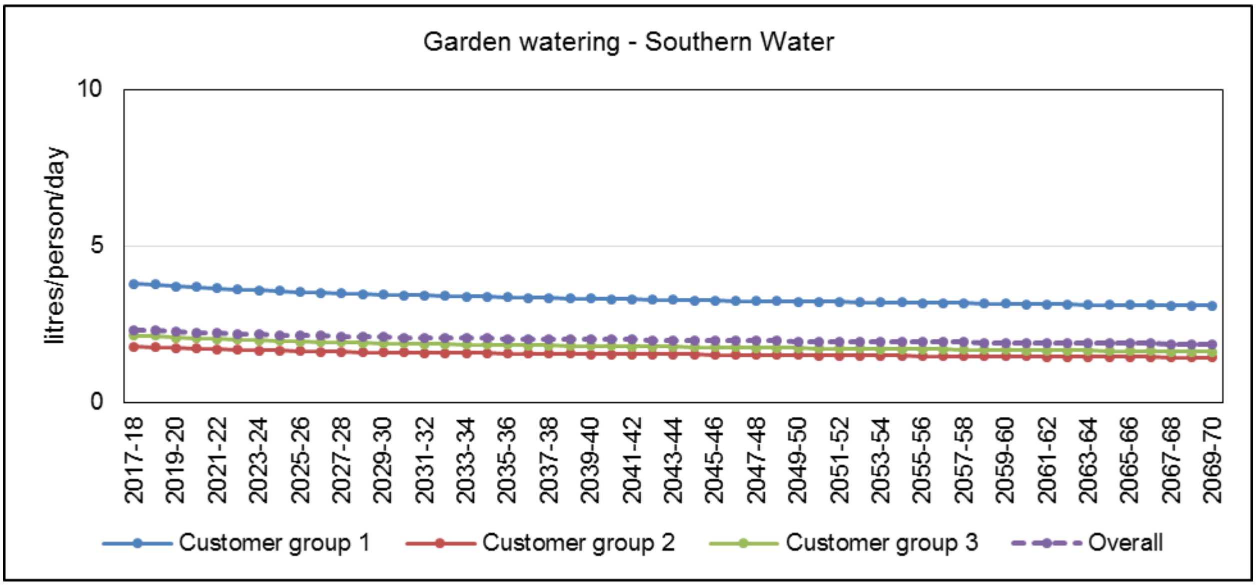
Table 27 Ownership of garden watering devices at the company level

Southern Water	Base-year ownership (%)				Final year ownership (%)			
	Hose Pipe	Sprinklers	Watering Can	Other	Hose Pipe	Sprinklers	Watering Can	Other
1	27%	5%	32%	0%	27%	5%	32%	0%
2	24%	2%	33%	0%	23%	2%	33%	0%
3	18%	1%	37%	0%	17%	1%	37%	0%
All	**23%**	**2%**	**34%**	**0%**	**23%**	**2%**	**34%**	**0%**

The volumes associated with hosepipes and sprinklers are a function of flow rate and duration. For hosepipes, the flow rate is set at 12 litres/minute and for sprinklers it is set a 6 litres/minute. Duration of hosepipe use ranges from 20 minutes to 28.4 minutes for measured households whereas for unmeasured households it can be up to 139 minutes; the duration of sprinkler use is around 45 minutes for both unmeasured and measured households. These figures are primarily from the customer surveys. The volume of watering cans is set at 5 litres based on published figures where it is set at 10 litres for 'other'.

The forecast at the company level is shown in Figure 25. Forecasts by area and metering status is given in Appendix H.

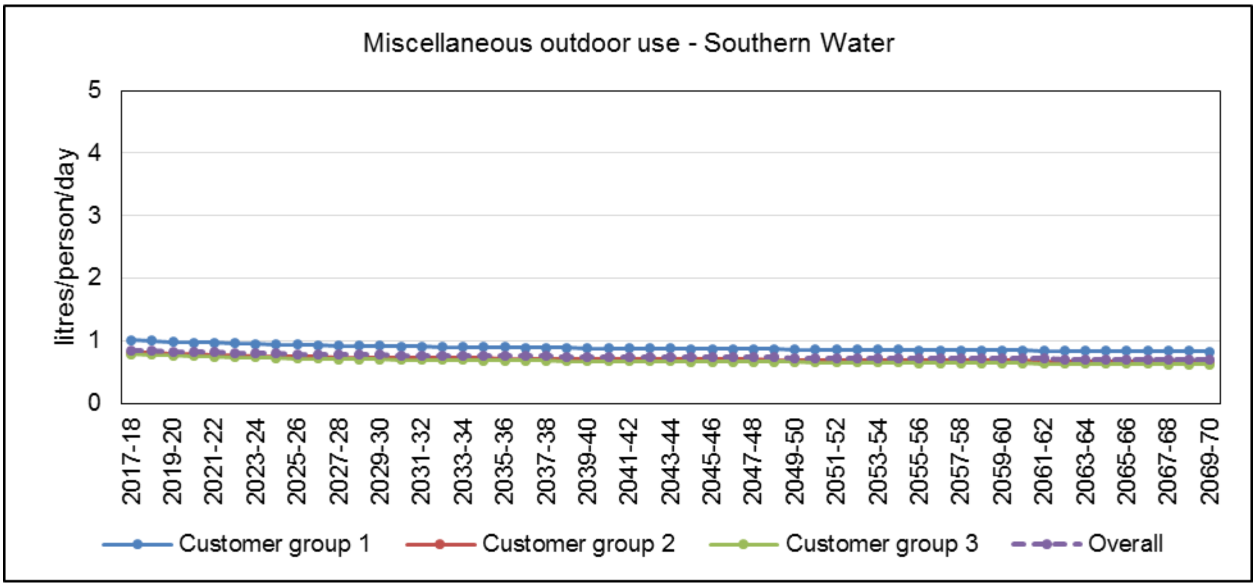
Figure 25 Garden watering forecast at the company level



5.3.7 Miscellaneous outdoor use

This includes activities such as car washing, washing outdoor surfaces etc. As in the case of miscellaneous indoor use, it is difficult to assign a volume to this micro-component and is primarily used as a balancing factor to reconcile base year demand. The forecast at the company level is shown in Figure 26. Forecasts by area and metering status is given in Appendix I.

Figure 26 Forecast for miscellaneous outdoor use



5.4 Climate change impact

Climate change is likely to lead to a warmer climate with an increased frequency of extreme events (storms, floods, droughts etc.). The component of domestic demand that is most likely to be impacted by such a shift in climate is external use (garden watering, filling up paddling pools etc.) but it may also result in higher frequency of personal washing and clothes washing. However, it is difficult to quantify the magnitude of any such changes in terms of OFV. Moreover, there is also the possibility of changes in behaviour in response to climate change (for example, allowing the garden to be ‘brown’ for parts of the year) so climate change may not necessarily lead to an increase in consumption. There is therefore considerable uncertainty as to how climate change will manifest itself over various timescales and the behavioural response it will invoke.

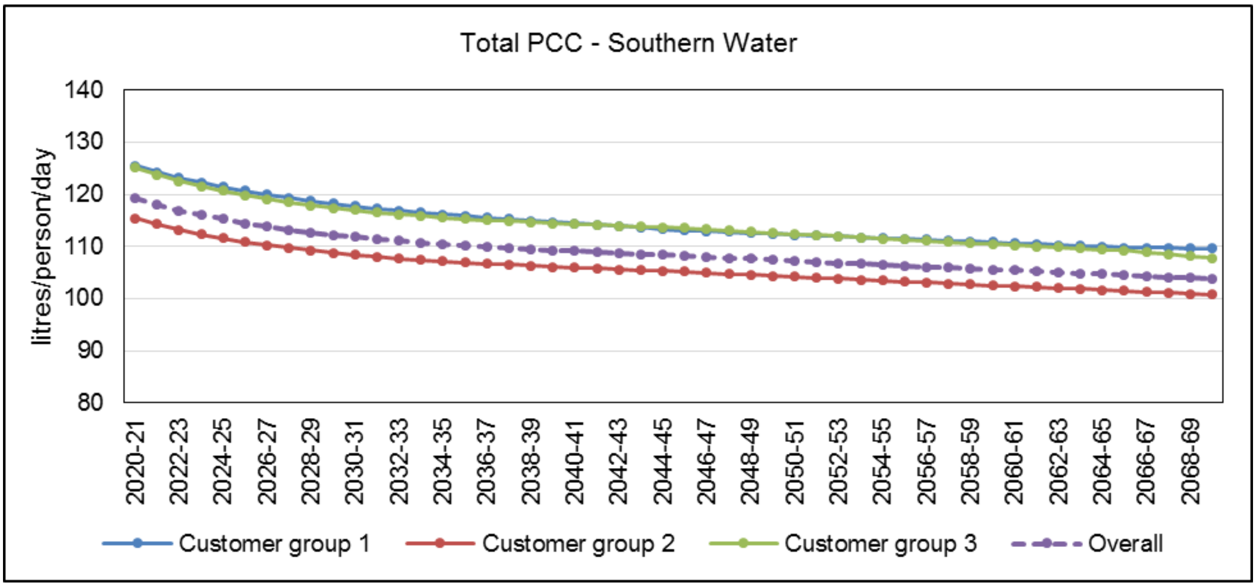
UKWIR (2013) assessed climate change impact on demand. For household demand, two sets of estimates have been provided for south east England; one using data from the Thames Region and the other using data from the Severn Trent Region.

For average annual conditions, climate change impacts from the Thames Region, as percentage change from base-year, vary from 0.18 to 1.33 with a 50th percentile value of 0.63. For the Severn Trent Region, the corresponding range is from 0.37 to 1.57 with a 50th percentile value of 0.84. In our demand forecast, we have used one of recommended approaches in UKWIR (2013) by taking the average of 50th percentile values from the two regions (P50 scenario). This leads to a 0.76% increase in household demand by 2045-46. We have capped the increase at this level for the remainder of the planning period. This adds 2.6Ml/d to household demand by 2069-70. No adjustment has been applied to non-household demand forecast as UKWIR (2013) did not find any correlation between climate change and non-household demand. In the absence of any reliable data on qualitative and quantitative climate change impacts on individual micro-components, we have applied climate change impacts to overall PCC rather than individual micro-components.

5.5 Total PCC

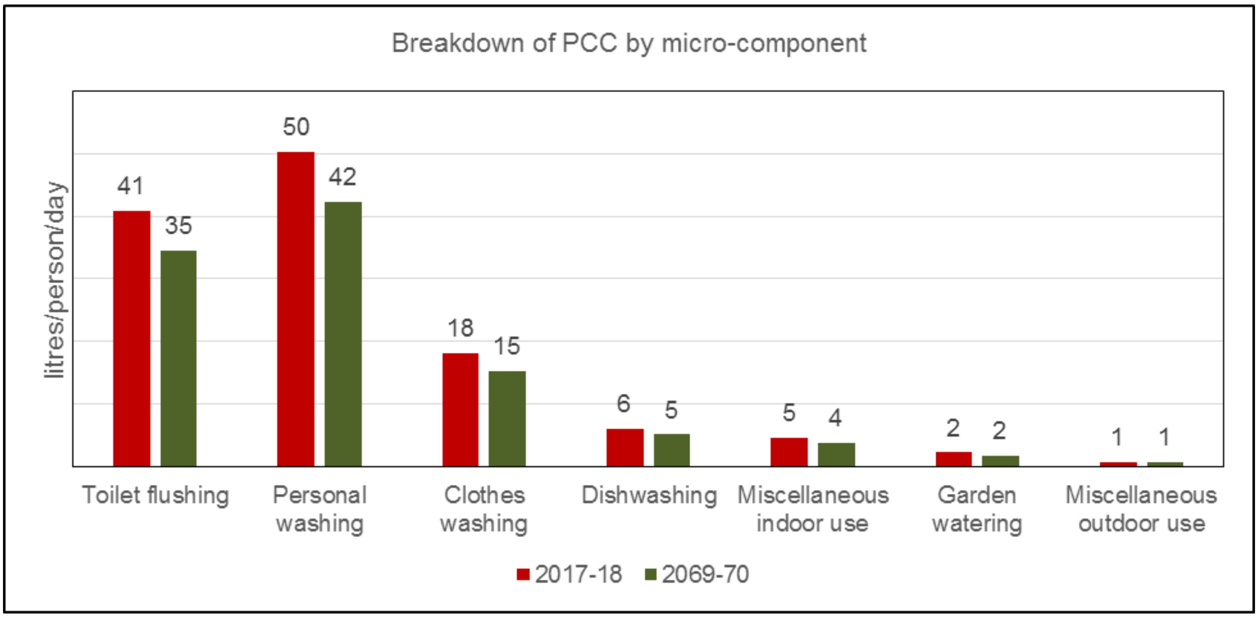
The total PCC forecast is given in Figure 27. This includes climate change impacts as discussed later in this report. Forecasts by area and metering status are given in Appendix J. Following on from the trends seen for individual micro-components, PCC is forecast to decrease over the planning period. This is due to replacement of older devices by newer, more water efficient versions as well as a shift towards more water efficient behaviour modelled through reductions in shower durations. Figure 28 shows the change in consumption associated with each micro-component from the base-year to the final planning year.

Figure 27 Total PCC forecast at the company level



In calculating PCC for the DYAA, DYCP and DYMDO scenarios, we have multiplied the NYAA demand (in Ml/d) with the respective demand factor (Table 5) and then divided it by the household population to calculate PCC for each scenario. In terms of assigning the change in PCC from NYAA to other scenarios, UKWIR (2013) suggests that it could primarily be due to outdoor use. While garden water is the most obvious activity that would see an increase during warm, dry weather, increase in other usages cannot be ruled out. More people tend to take part in physical activities during warm and dry weather, which can result in them drinking more water, taking extra showers, washing clothes more frequently etc. In the absence of any reliable estimates as to how consumption associated with various micro-components changes, both qualitatively and quantitatively, during dry and peak demand periods, we have opted to distribute the change in PCC for the DYAA, DYCP and DYMDO scenarios among all micro-components using their distribution in the NYAA PCC.

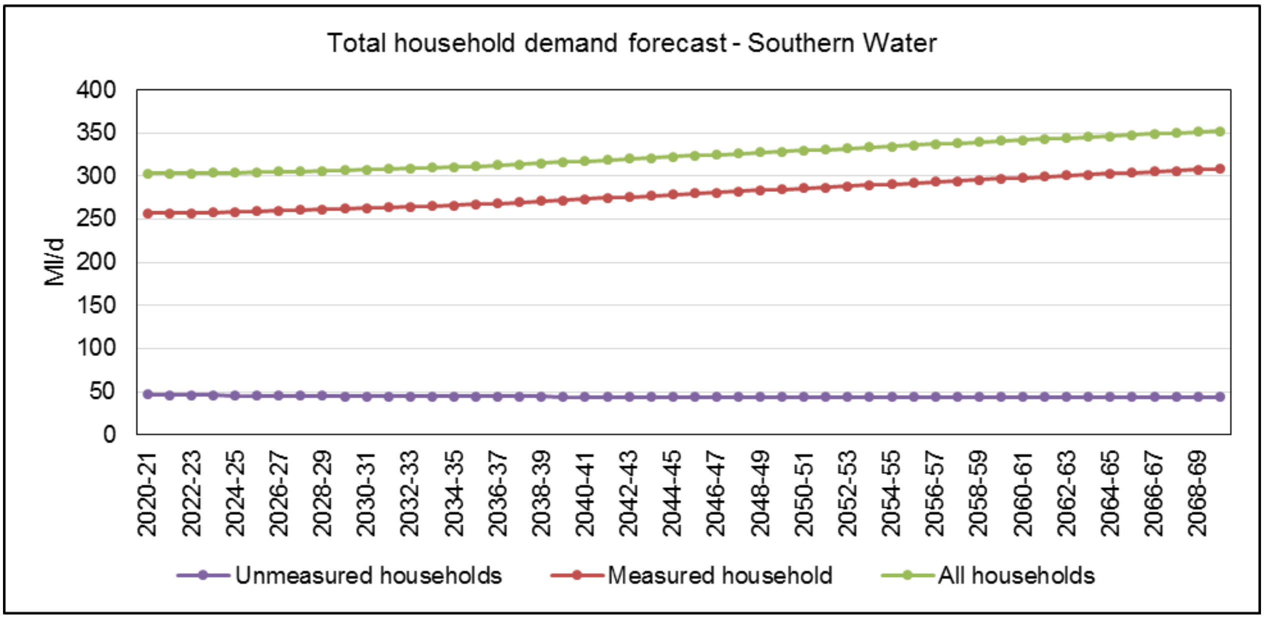
Figure 28 PCC breakdown by micro-component for the base year and final planning year



5.5.1 Total household demand forecast

Total household demand forecast, including climate change impacts is shown in Figure 29. Total household demand grows by 6% against a 37% increase in population and 46% increase in properties. This is because the forecast drop in PCC offsets some of the increase due to growth in our customer base. The increase in domestic demand is driven by growth in measured consumption (8%); unmeasured household consumption shows a decrease (6%) as all growth is assigned to measured households. Detailed breakdown by area is given in Appendix K.

Figure 29 Total household demand forecast at the company level



5.6 Water efficiency ('Target 100')

Taking account of our customers and stakeholders' views, we have also set ourselves higher leakage and PCC reduction targets than originally set out in the draft WRMP. We aim to reduce leakage by 15% over AMP7 across the company instead of in selected WRZs. Our baseline demand forecast suggests that with technological advances and by maintaining promotion of water efficient behaviour at our current levels, the PCC in our supply area will be reduced to 109litres/person/day by 2039-40 under the NYAA scenario (Figure 27). We now plan to reduce PCC to 100litres/person/day by 2040 as part of our 'Target 100' policy with the following four key strands.

1. Installation of smart metering technology: We are currently undertaking trials of devices that can read meters and send the reading to the customers using their Wifi. The aim is to provide customers with near real-time information on their consumption so that they can see the consumption associated with various water-using activities and take measures to conserve water where they can. If the trial proves successful, we plan to roll out 100,000 devices over AMP7.
2. Home visits: We currently undertake home visits to promote water efficiency. The programme has a high uptake rate and can result in up to 10% further savings on top of the savings achieved through metering. We plan to continue with this programme and combine it with leak detection so that while we offer help and advice on water efficiency, we can also help detect any plumbing losses or supply-pipe leaks.
3. Proactive customer contact: We are looking to develop tools and systems that allow us to identify any significant increase in consumption so that we can proactively engage with our customers at an early stage to determine if the increase is due to change in circumstances or may be a leak. This will allow us to specifically target customers or geographical areas for water efficiency messages during periods of high demand.
4. Incentivising water efficiency behaviour: Our customer and stakeholder engagement has shown little appetite for seasonal tariffs as a way of managing demand. As an alternative, we are looking to reward customers for conserving water. Given the sustainability reductions that we have implemented in the Western area, the first scheme will be rolled out in Hampshire in partnership with the Eastleigh Borough Council. The scheme will offer rewards to residents for recycling waste and reducing water consumption on a monthly basis. The scheme was will be introduced in the Central area towards the end of AMP7 and in the Eastern area during AMP8.

In modelling PCC reductions as a result of 'Target 100', we have made assumptions regarding customer behaviour over the planning period. The assumptions apply to both unmeasured and measured customers unless stated otherwise.

1. Rate of increase in power shower ownership will be lower by 50%.
2. Shower duration will reduce by 2 minutes for unmeasured customers and by up to 3 minutes for measured customers.
3. Frequency of showers will be lower by 15% compared to the baseline scenario.
4. Rate of increase in hosepipe ownership will be lower by 50% compared to the baseline scenario.
5. Rate on increase in garden watering frequency (using mains water) will be lower by 50% compared to the baseline scenario.
6. Rate of change in frequency of water machine use will be lower by 25% (i.e. increased use of washing machines on full load).
7. Rate of change in frequency of dishwasher use will be lower by 25% (i.e. increased use of dishwashers on full load.

It should be noted that these assumptions are used as proxies for simulating PCC reduction. These do not necessarily reflect actual reductions in each of the micro-components but rather the total reduction in PCC that will be required to reach 'Target 100'**.**

As a result of 'Target 100', our domestic demand by 2039-40 will be lower by 29Ml/d under the NYAA scenario compared to the baseline demand.

6. Non-household demand forecast

6.1 Customer segmentation

We have retained the customer segmentation that we used for WRMP14. For WRMP14 we mapped Standard Industrial Classification (SIC) codes to classification of non-household sectors developed by Cambridge Econometrics (CE). We have since revised our internal codes. Consequently, we have remapped our internal codes to CE's sectors for this plan. The base-year distribution of non-household demand by sectors and by area is shown in Table 28.

Table 28 Non-household sectors and base-year demand (in Ml/d) by area

	Sector	Western area	Central area	Eastern area	Southern Water
1	Agriculture etc.	1.7	1.2	1.4	4.3
2	Mining & quarrying	0.0	0.2	0.1	0.3
3	Manufacturing	3.9	4.4	5.2	13.4
4	Electricity, gas & water	3.4	2.2	2.3	7.9
5	Construction	0.0	0.0	0.0	0.0
6	Distribution, hotels & catering	3.6	7.0	1.6	12.2
7	Transport & communications	0.8	0.3	0.4	1.6
8	Financial & business services	16.0	10.2	9.8	36.0
9	Government & other services	13.0	10.9	9.0	32.8
10	Unknown	2.5	2.7	2.6	7.8
	Total	44.8	39.1	32.5	116.4

6.2 Model

In order to forecast non-household demand for WRMP14, CE developed a tool that allows linking of non-household demand to four parameters that are considered to be key influences on demand, namely, water efficiency, economic output, price of water and weather. The length of available data were insufficient to allow a full econometric analysis and derivation of robust coefficients to link demand to the four parameters. Forecasts were therefore based on water efficiency trends and elasticity of output. The three modelled scenarios were as follows:

- Baseline scenario (water efficiency 2% p.a. consistent with trend observed over the years; output elasticity 0.6; no link to water price or weather)
- Higher water efficiency (water efficiency 3% p.a.; elasticity of output 0.6; no link to water price or weather)
- Weaker water efficiency (water efficiency 1% p.a.; elasticity of output 0.6; no link to water demand or weather)

For the draft plan we adopted the ***weaker water efficiency*** scenario based on the assumption that most of the water efficiency savings have been achieved over the past 15-20 years and therefore the potential for water savings going forward will not be as great as it has been in the past. This resulted in a 15% increase in non-household demand by 2044-45 which was then kept constant till 2069-70.

Since the opening of the non-household sector to market competition on 1 April 2017, a number of retailers have entered the market. We hosted two conferences with the retailers in 2017 and 2018 and have reviewed the services being offered by the retailers. All retailers are offering water savings as part of their offering to incentivise customers. The market has been operating for just over a year and we have not seen any reductions in demand as yet but we anticipate that over time, we will begin to the see the impact of water efficiency measures on demand in the non-household sector as well. However, it is as yet difficult to estimate what the potential decrease in demand may be, either in different regions or different sectors. In developing their plan for south east England, the Water Resources in the South East (WRSE) group have assumed a 5% increase in non-household demand by 2080 (Water Resources in the South East, 2018). For the final plan we have assumed 10% growth by 2069-70 which midway between the 15% growth forecast in our draft plan and the 5% growth in Water Resources in the South East (2018).

6.3 Results

Non-household demand forecast, by sector, at the company level is shown in Figure 30 and total non-household demand forecast is shown in Figure 31. The breakdown by supply area is given in Appendix L.

Figure 30 Non-household demand forecast by sector at the company level

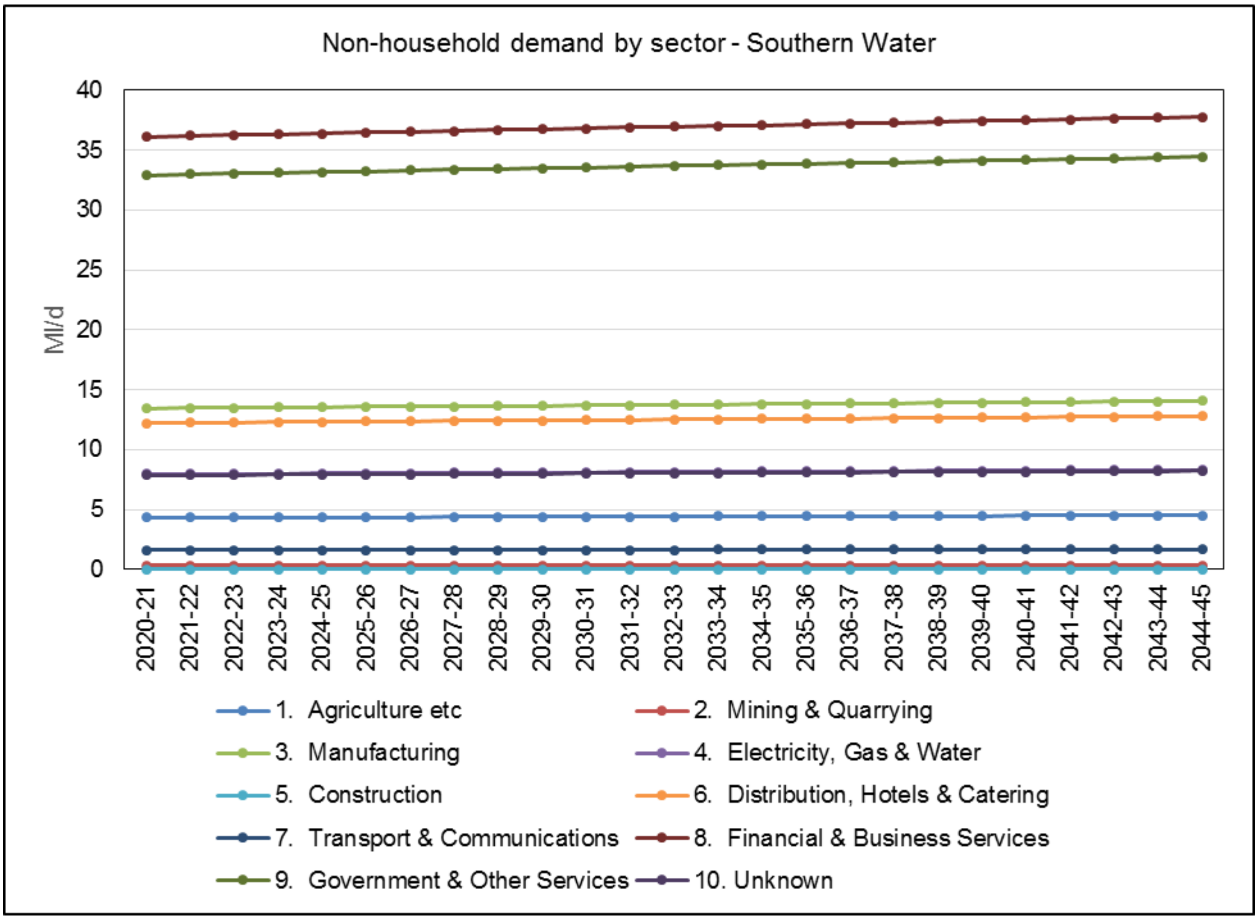
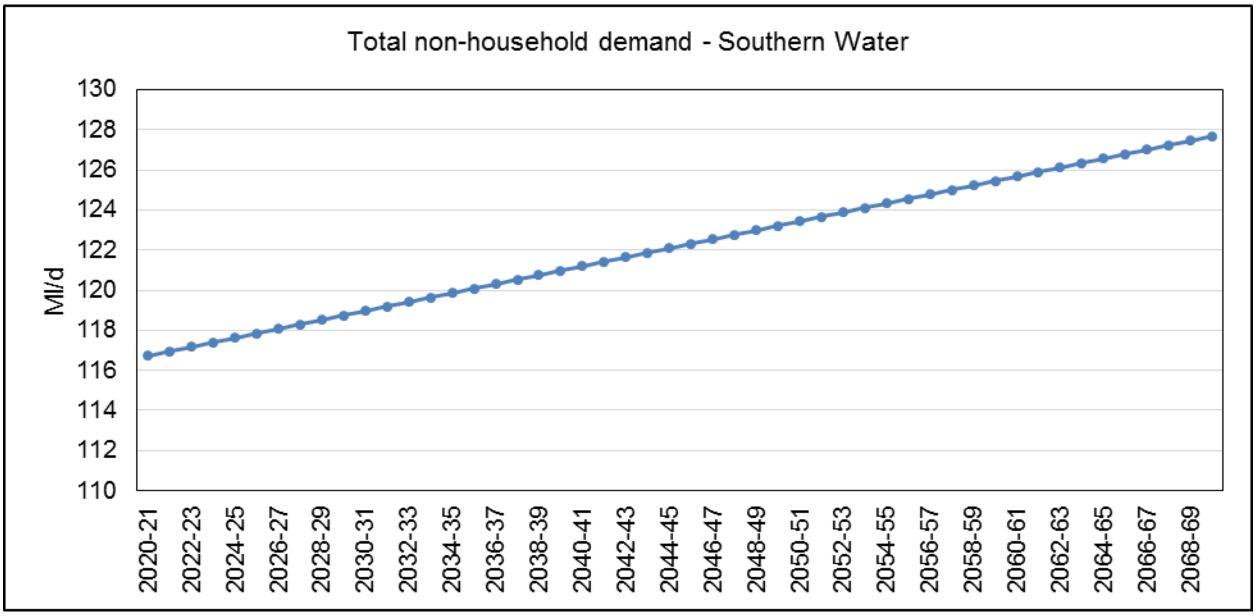


Figure 31 Total non-household demand at the company level



7. Other components of demand

7.1 Leakage

Leakage is an estimate of the amount of water that we lose from our infrastructure before it reaches our customer taps.

Leakage, defined in this plan, comprises of two components:

- Distribution losses; which are losses from trunk mains, distribution mains, service reservoirs and communications pipes
- Underground supply pipe losses which are losses occurring between the point of delivery at the property boundary and the point of consumption

Distribution losses are the responsibility of the company. Supply pipe losses are the responsibility of the customers, but we provided a free supply pipe repair service for many years prior to the start of UMP in order to contain this component of leakage. We have recently reinstated this policy.

A low level of leakage is desirable because it defers the need for investment in new resources which would otherwise be required to meet increases in demand over time. However, it is not necessarily economic to reduce leakage to very low levels, because to do so could involve large incremental costs for relatively small savings in demand. In such circumstances, it may be preferable to develop other options which can achieve the same water savings but at far lower costs. Thus, a balance must be found between reducing leakage to levels that can offset investments in new resources, and the cost of a given level of leakage reduction. The concept of the Economic Level of Leakage (ELL) is used for this purpose. The ELL is the level of leakage where the marginal cost of active leakage control equals the marginal cost of the leaking water. Active leakage control refers to those management policies and processes used to locate and repair unreported leaks from the water company supply system and from customer supply pipes. When external impacts (i.e. environmental and social) of leakage control activities are additionally considered then ELL becomes Sustainable Economic Level of Leakage (SELL). The SELL approach ensures that leakage targets are set at a level that is optimal for customers and society as a whole.

Since the mid-1990s we have progressively driven down leakage through a pro-active monitoring campaign coupled with a find and fix programme of work. A cornerstone of this approach has been to monitor the amount of water through our system and in particular the amount of water that flows in the system during the night, typically when household consumption is at its lowest level. The approach we use today has been developed over years of monitoring and developing the methodology.

Just as we developed our own methodology so have many of the other water companies. Recognising that this leads to inconsistencies the water companies have been working together, co-ordinated by Water UK, to improve the consistency of reporting of definitions of key measures of performance, so that performance can be compared between companies more easily. This work is supported by Ofwat, the Environment Agency, Natural Resources Wales and the Consumer Council for Water.

The result of this work has shown that we will need to make changes to our current reporting to align with the new, more consistent, reporting definitions, and for some of these changes it will take some time and this applies to leakage.

For the draft plan we used our historic approach to calculate leakage and used the previous three years' average as the base year leakage figure in accordance with EA guidance. As discussed in Section 3.2, we originally calculated the base-year leakage figure to calculate the total DI for the base-year. We then replaced the leakage figure with the leakage figure for 2017-18 based on the new method. Although the leakage increased significantly, it did not impact the base-year DI as the increase was offset by a decrease in unmeasured household consumption (Table 4).

Our outturn leakage for 2017-18, based on the existing method was 88.7Ml/d; our target for AMP6 is 87.1Ml/d based on five-year average over the AMP. Our average leakage in the first three years of this AMP is on target. In order to meet our AMP6 target, we have undertaken a number of initiatives in AMP6 to better detect and repair leaks. These include:

- Identifying areas for additional metering on trunk mains to improve network visibility
- Subdivided DMAs into smaller areas
- Implementing flow modulated pressure management and demand led pressure management
- Installing new and superior data loggers with GPRS
- Periodic determination of trunk main and reservoir losses

All of these measures primarily help reduce distribution losses. Supply-pipe losses account for over 15% of our total leakage. We have therefore re-introduced a free supply-pipe repairs policy with the aim of incentivising our customers to report any leaks on their supply-pipe.

For the draft plan, our leakage profile over AMP6 was in line with our annual targets in view of our current leakage management strategy. From 2020-21 onward, leakage was kept constant in order to assess options for leakage reduction together with other demand management options to determine the optimal leakage levels.

For the baseline forecast in the final plan, we have kept leakage constant over the planning period at the base-year value as it is difficult to redefine AMP6 leakage profile with limited data points. However we plan to reduce leakage by 15% over AMP7 and by 50% by 2050. We plan to achieve this using the following three primary levers:

- Active Leakage Control (ALC) (traditional 'find and fix')
- Water mains renewal
- Smart Networks technology

The traditional ALC methodology will primarily be used for maintaining current levels of leakage but is not considered to deliver further reductions in leakage due to resource constraint i.e. sufficient numbers of suitably qualified leakage personnel in the south-east England. This resource shortage will be further exacerbated as most water companies will also attempting to increase ALC resources to achieve leakage reductions over AMP7. We therefore plan to employ a range of emerging smart technologies (combined with greater use of Big Data analytics) to significantly increase ALC efficiency.

We are also proposing to undertake a mains renewals programme in AMP7 in order to reduce leakage further. In order to maximise leakage benefits from the programme we have developed a complete DMA replacement policy which will see the replacement of all water mains, communication pipes and customer supply pipes in selected DMAs. This will lead to the creation of 45 'no leak' zones and ensures that future maintenance needs in these areas are negligible providing customers with an improved level of service. Mains renewal also has long term resilience benefits by delivering infrastructure in a sustainable way and not passing the burden of 'lumpy' large scale asset replacement to future generations.

Our leakage strategy for AMP7 also delivers significant additional benefits such as:

- Reduction in interruptions to supply
- Reduction in the number of mains bursts
- Reduction in discolouration complaints
- Improving total Iron & Manganese (TIM) compliance
- Replacement of lead communication pipes
- Reduction in operational expenditure due to reduced reactive effort

7.2 Operational use and water taken unbilled

For Distribution System Operational Use (DSOU) and water taken unbilled (legally and illegally) we have retained the base-year figures given in Table 4 throughout the planning period.

8. Total demand

Total baseline DI forecast by component for the NYAA scenario is shown in Figure 32. Total increase in DI over the planning period is 11% as a result of increase in household and non-household demand as described in Section 5.5.1 and Section 6.3 respectively. The figures for each area are given in Appendix M.

Figure 32 Demand forecast by component at the company level for the NYAA scenario

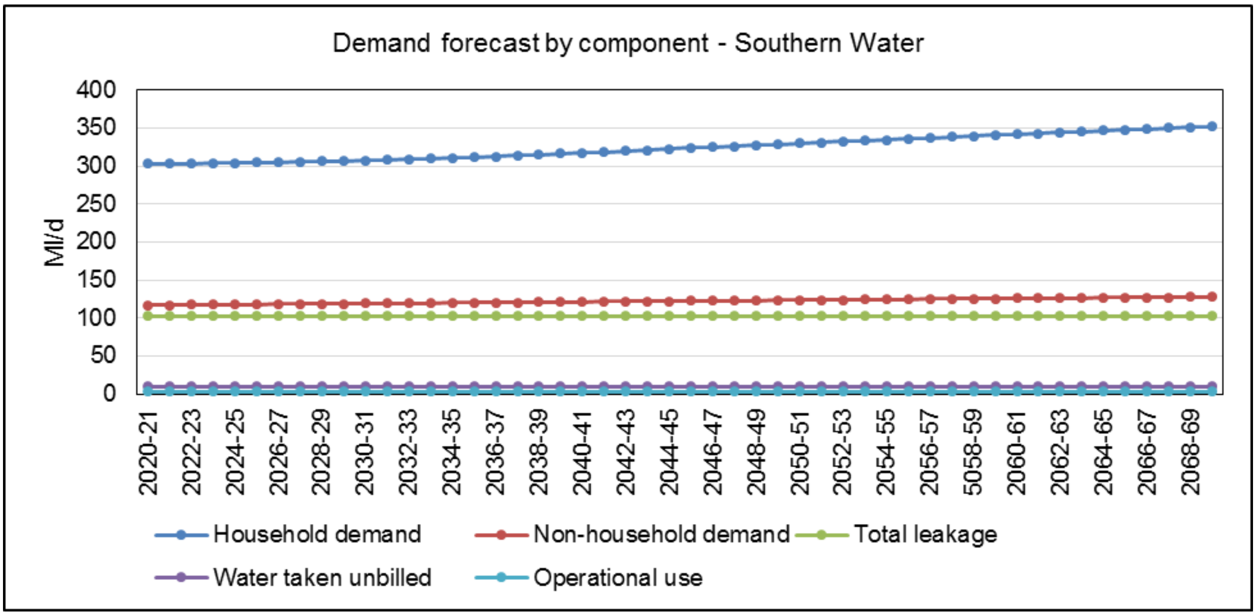
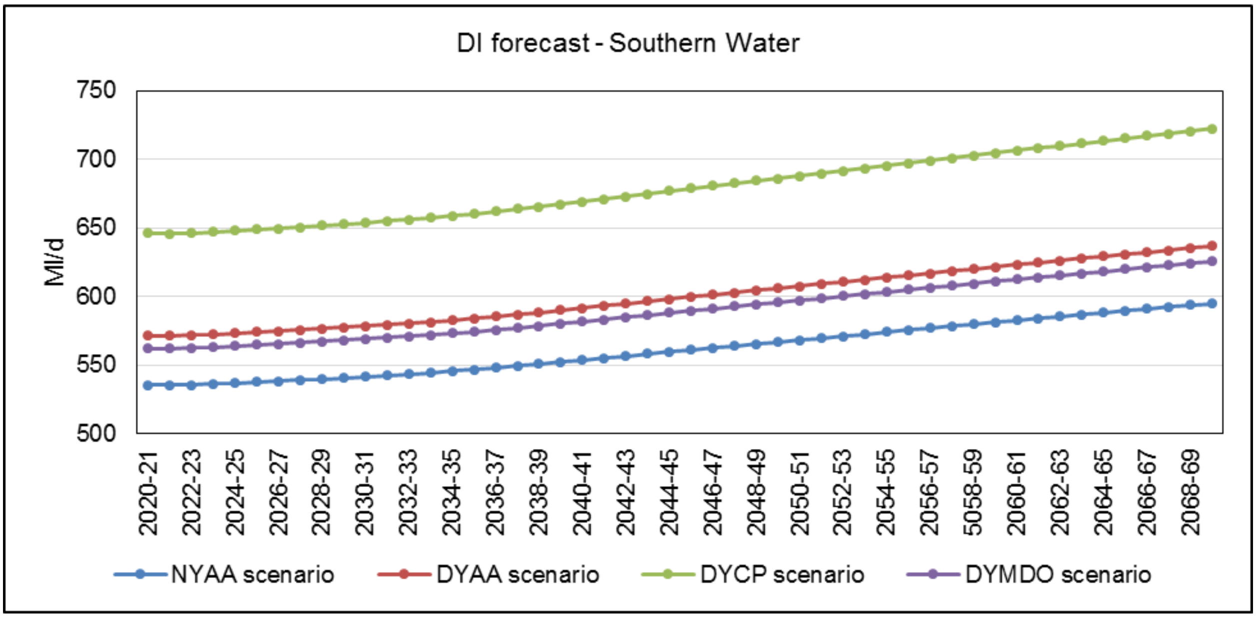


Figure 33 shows the total demand for all scenarios with area-wise breakdown in Appendix N.

Figure 33 Total DI forecast at the company level under each planning scenario



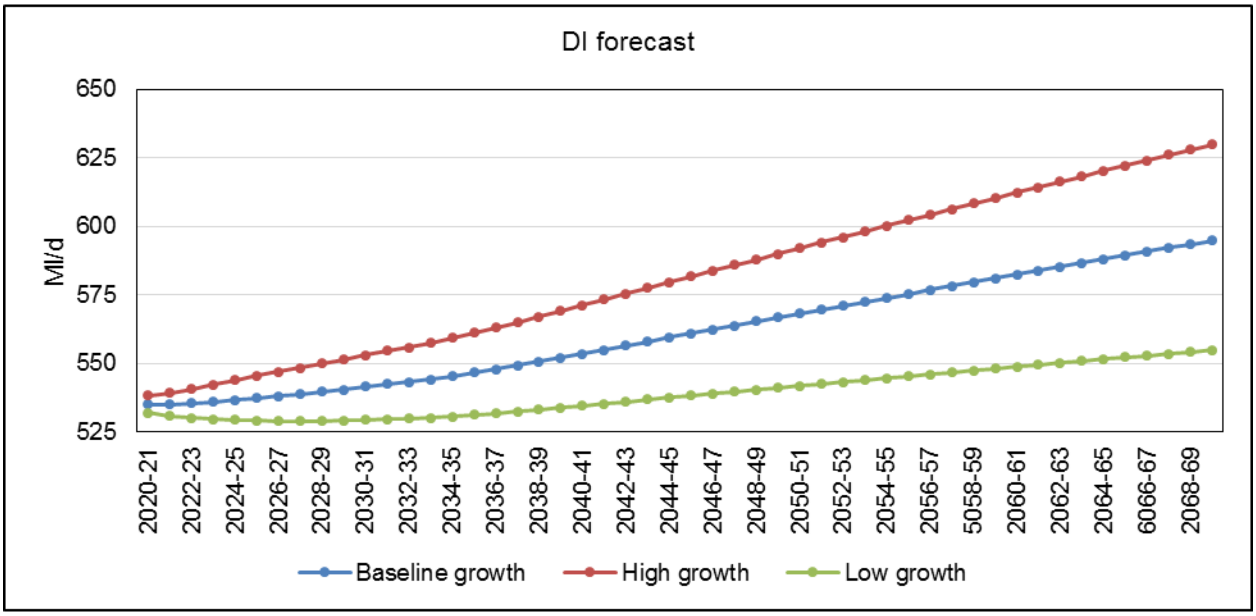
9. Uncertainty analysis

As can be gauged from the preceding sections, a number of uncertainties are associated with various inputs in the demand forecast. While it would not be feasible to test sensitivity of demand forecast to every uncertainty, a few key sources of uncertainty have been tested for their impact on the modelled forecast.

9.1 Population forecast

We have adopted the plan-based scenario as our baseline population forecast. In order to test the impact of population change on domestic demand, we have developed two scenarios; a low growth scenario and a high growth scenario using the methods outlined in UKWIR (2016). The ***low growth*** scenario is based on the lower confidence interval methodology and the ***high growth*** scenario is based on the upper confidence interval methodology. Consequently, under the low growth scenario, the population increases by 13% up to 2069-70 whereas for the high growth scenario, the increase is 63%. For the low growth scenario under NYAA conditions, the increase in demand over the planning period is 4% compared to 7% increase for the baseline scenario. For the high growth scenario, demand increases by 17%. The impact of population growth on NYAA demand is shown in Figure 34.

Figure 34 Impact of population growth scenarios on DI forecast (NYAA scenario)



9.2 Customer behaviour

Customers' water use behaviour is perhaps the most important influence on demand but at the same time it is the most difficult to assess and forecast in quantitative terms as it is dictated by a number of factors. This is highlighted by two recent UKWIR projects (UKWIR, 2014 and UKWIR, 2016b) that have looked at the impacts of customer behaviour on demand.

UKWIR (2014) developed five behavioural typologies in terms of engagement with water-efficient behaviours. The typologies were based on a customer survey specifically designed for the work. The work suggested that the behavioural differences could be reflected in actual consumption by these typologies. UKWIR (2016b) sought to validate the findings of the 2014 study by using consumption data. However, the results could not be validated as the 'most engaged' customers did not have the lowest consumption as they behavioural typologies suggested.

In view of the results from the two UKWIR studies, we did not try to segment customers into ***behavioural*** groups. However, we do recognise the impact that any change in attitudes to water use can have on our demand forecast. We have therefore modelled two water efficiency scenarios using shower times and garden watering as proxies for behaviour change.

The ***high efficiency scenario*** assumes that for unmeasured customers, average shower times will reduce by 2 minutes for both normal and power showers; for measured customers, the duration reduces by 3 minutes in the case of normal showers and by 2.5 minutes in the case of power showers. The lower threshold for a shower event, using either a normal or power shower, is set at 4 minutes. The rate of increase in ownership of power showers also decreases by 30% whereas the frequency of showering reduced by 15% over the planning period.

Under this scenario, the ownership of hosepipes is reduced by nearly one-half and frequency of hosepipe use is also reduced by half over the planning period. The frequency of washing machine and dishwasher use is also assumed to reduce by 25% over the planning period.

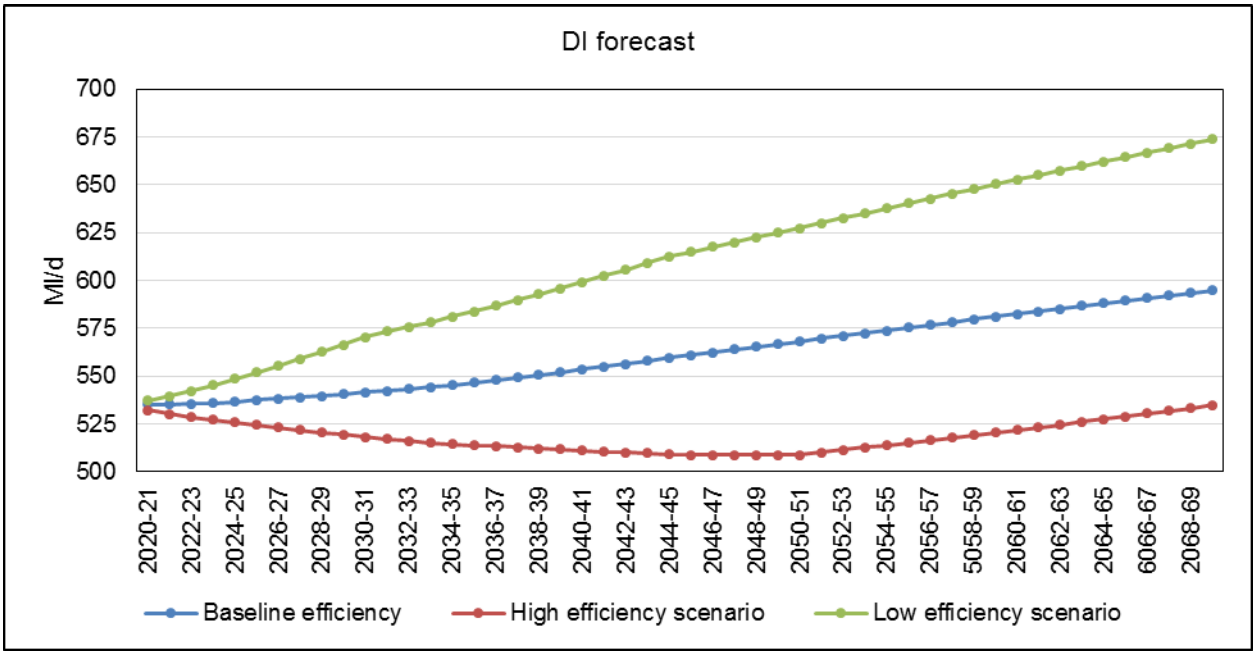
As a result, total NYAA demand at the end of the planning period is almost the same as in the base year (Figure 35).

The ***low efficiency scenario*** assumes that average shower times will increase by 0.50 minute in all cases; the ownership of power showers increases by 50% and there is a 15% increase in the frequency of power showers.

Under this scenario, the ownership of hosepipes as well as frequency of hosepipe use increases by 50% over the planning period.

This low efficiency scenario results in a 25% increase in NYAA demand (Figure 35).

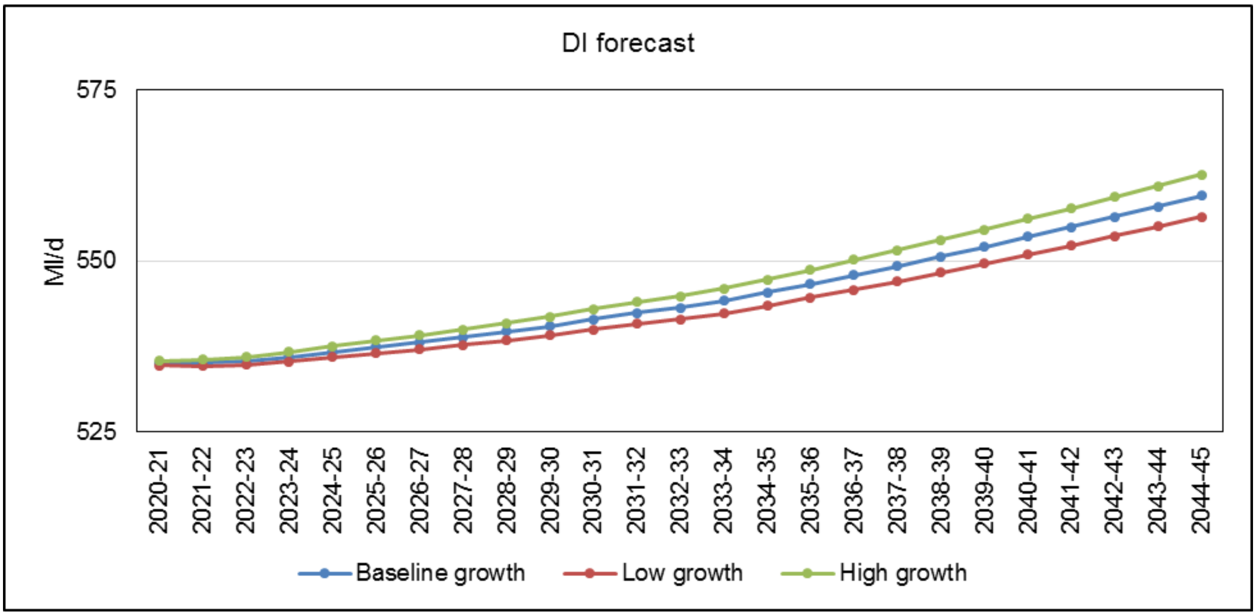
Figure 35 Impact of water efficiency scenarios on DI forecast (NYAA scenario)



9.3 Non-household demand

As we have not been able to include any water efficiency impacts on non-household demand due to lack of data, we have developed two additional non-household scenarios. In the ***low growth*** scenario, the rate of growth in non-household demand is taken to be half of the baseline growth rate. Conversely, in the ***high growth*** scenario, the rate of growth in non-household demand is set at double the baseline growth rate. The results are shown in Figure 36 which show a ±1% change in total demand in 2069-70 compared to the baseline scenario.

Figure 36 Impact of non-household demand scenarios on DI forecast (NYAA scenario)

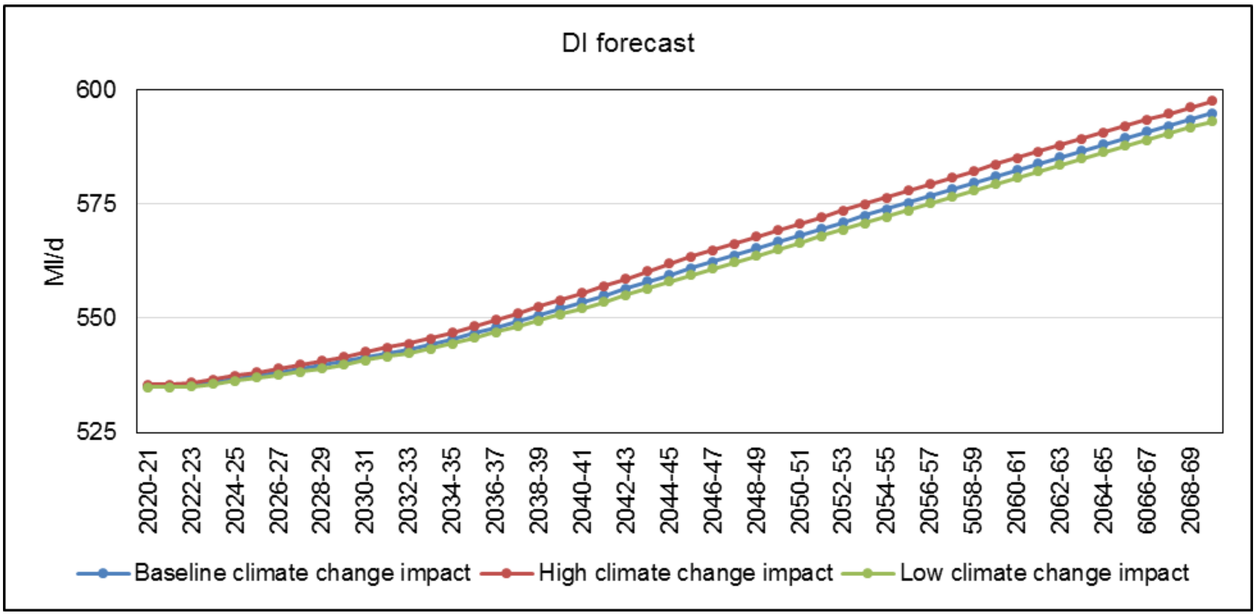


9.4 Climate change

We have included climate scenarios in our uncertainty analysis. For the baseline scenario we used the P50 scenario for south east England from UKWIR (2012). For sensitivity analysis we have used the P10 (low climate change impact) and P90 (high climate change impact) scenarios.

As shown in Figure 37, climate change impact scenarios do not lead to a significant change from the baseline scenario; the change is within ±1%

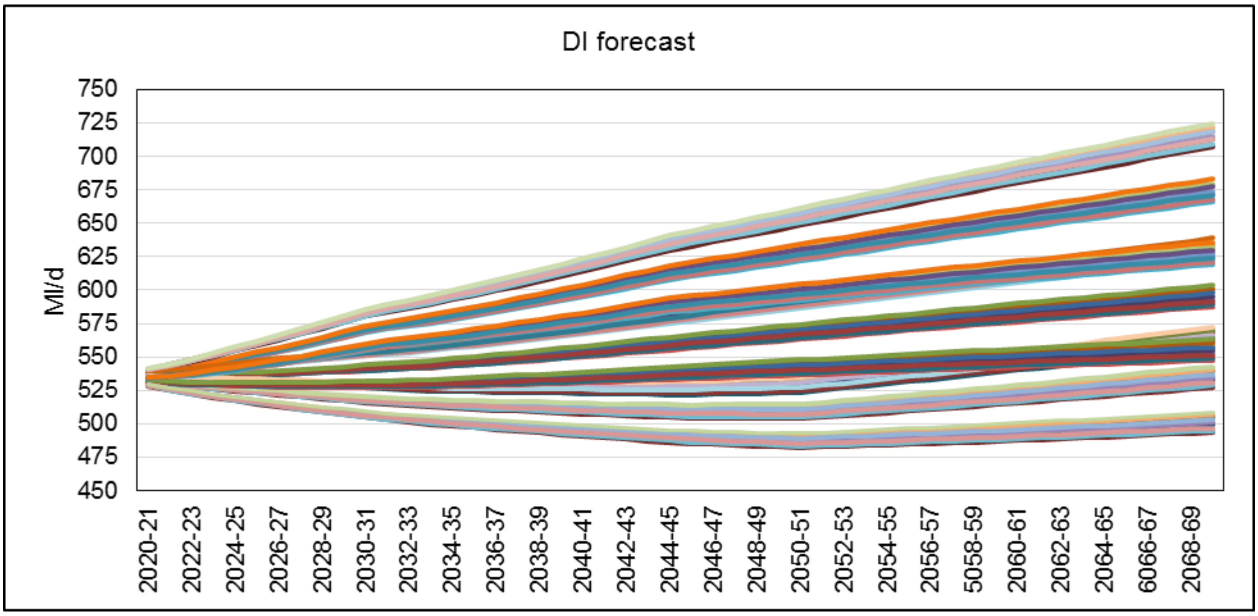
Figure 37 Impact of climate change impact scenarios on DI forecast (NYAA scenario)



9.5 Combined scenarios

We have thus far described the impacts of uncertainty associated with population growth, behaviour change, non-household growth and climate change separately. In reality, several combination of scenarios are possible. To capture that full range of demand associated with the uncertainty scenarios, we have generated DI for each of the 81 possible combinations of scenarios described above for each of the planning scenarios. The forecasts are shown in Figure 38 and the definitions for the scenarios are given in Appendix O. These scenarios have been used to inform headroom analysis.

Figure 38 DI forecasts for the 81 scenario under NYAA conditions



The maximum and minimum DI values at the end of planning season for each of the scenarios is shown in Table 29.

Table 29 Maximum and minimum DI figures from the 81 scenarios runs at 2069-70 for each planning scenario

Planning scenario	Minimum demand in 2069-70 (Ml/d)	Maximum demand in 2069-70
Normal year annual average	493.69	724.75
Dry year annual average	524.08	779.72
Dry year critical period	586.20	892.26
Dry year minimum deployable output	515.32	763.89

10. Comparison with Water Resources Management Plan 2014

A comparison of the baseline 2017-18 demand for various planning scenarios from the current forecast with the 2014 Water Resources Management Plan is shown in Table 30. As shown in Table 31, the increase in NYAA demand is primarily due to increase in leakage and non-household demand.

Table 30 Comparison of the baseline demand forecast figures for 2017-18 from the 2014 plan and the current plan

Planning scenario	2014 Demand forecast (Ml/d)	Current demand forecast (Ml/d)
NYAA	527.4	536.5
DYAA	557.0	573.1
DYCP	702.3	647.8
DYMDO	539.5	563.6

Table 31 Comparison of demand components for 2017-18 from the 2014 demand forecast and the current forecast

Planning scenario	2014 demand forecast (Ml/d)	Current demand forecast (Ml/d)
Household demand	328.3	305.3
Non-household demand	101.3	116.4
Leakage	88.0	102.6
Water taken unbilled	9.2	12.4
Total DI	**526.9**	**536.7**

11. References

- BBC, 2011, 'People's showering habits revealed in survey [online]', Available at: http://www.bbc.co.uk/news/science-environment-15836433 [Accessed, 2017].
- Critchley, R. and Phipps, D., 2007, 'Water and Energy Efficient Showers: Project Report', Report prepared for United Utilities.
- DWI, 2019, 'Private water supply [online], Available at http://www.dwi.gov.uk/private-water-supply/ [Accessed, 2019]
- Environment Agency, 2013. 'Water stressed areas – final classification'. Cat code: LIT 3230
- Environment Agency and Natural Resources Wales, 2016, 'Final Water Resources Planning Guideline', Bristol.
- Environment Agency and Natural Resources Wales, 2017, 'Water Resources Planning Guideline': Interim Update, Bristol.
- Experian, 2017, 'Population, Household, Property and Occupancy Forecasts for WRMP19'. Unpublished report for Southern Water.
- Ornaghi, C. and Tonin, M. 2015. 'The effects of metering on water consumption – policy note. University of Southampton'. Project supported by ESRC grant ES/K01210X/1.
- UKWIR, 2013, 'Impact of climate change on water demand', Report no. 13/CL/04/12.
- UKWIR, 2014, 'Understanding customer behaviour for water demand forecasting', Report no. 14/WR/01/14.
- UKWIR, 2015, 'WRMP19 methods; household consumption forecasting – guidance manual', Report no. 15/WR/02/9.
- UKWIR, 2016a, 'Population, household property and occupancy forecasting', Report no. 15/WR/02/8.
- UKWIR, 2016b, 'Integration of behavioural change into demand forecasting and water efficiency practices', Report no. 16/WR/01/15.
- UKWIR, 2017, 'Consistency of reporting performance measures, Reporting guidance – Leakage', Report no. 17/RG/04/.
- WRc, 2012, 'Compendium of micro-component statistics' Report no. 9193.02.
- WRc, 2013. 'Water Consumption of Homes Built to Part G and Code for Sustainable Homes Standard'. Report no. P9324.02
- Water Resources in the South East, 2018, 'From source to tap: the south east strategy for water', http://www.wrse.org.uk/wp-content/uploads/2018/04/WRSE_File_726_From_Source_To_Tap.pdf.

Water Resources Management Plan 2019

Annex 2: Demand Forecast
Appendix A: Growth forecast

December 2019

Version 1

from Southern Water

Population, Household, Property and Occupancy Forecasts for WRMP19

January 2017

Contents

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 had the lowest response rate, 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: Southern Water local authority plan response, local plan status and data source

Local Authority	Local authority response	Local Plan Status	Data source	Published/ adopted date
Adur	Yes	Submitted	Housing Implementation Strategy / e-mail response from local authority	Mar-16
Arun	Yes	Submitted	As yet unpublished housing trjectory - subject to change through examination.	Nov-16
Ashford	Yes	Published	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
Basingstoke and Deane	Yes	Adopted	Updated Housing Land Supply Statement	May-16
Brighton and Hove	Yes	Adopted	Appendix 3 City Plan Part One Housing Trajectory	Mar-16
Canterbury	Yes	Submitted	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
Chichester	Yes	Adopted	Chichester Local Plan Key Policies 2014-2029	Jul-15
Christchurch	No (supplied Jan 2017)	Adopted	Local Plan 2014	Apr-14
Crawley	No	Emerging	The Crawley Borough Local Plan 2015 – 2030, HOUSING IMPLEMENTATION STRATEGY	Nov-14
Dartford	Yes	Adopted	AMR 2016 and 5 Year Housing Land Supply	Sep-16
Dover	Yes	Adopted	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
East Hampshire	Yes	Adopted	Adopted Housing and Employment Allocations (April 2016)	May-14
Eastbourne	Yes	Adopted	Eastbourne Core Strategy Local Plan	Feb-13
Eastleigh	Yes	Emerging	Data supplied by local authority	Oct-16
Fareham	Yes	Adopted	Annual Monitoring Report 2015/16	Aug-11
Gosport	Yes	Adopted	Gosport AMR Housing Trajectory 2016 (updated October 2016)	Oct-15
Gravesham	Yes	Adopted	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
Hastings	Yes	Adopted	Local Plan	Feb-14
Havant	No (supplied Jan 2017)	Adopted	Annual Monitoring Report 2015/16	Mar-11
Horsham	Yes	Adopted	Housing Authority Monitoring Report Mid Yearly Update May 2016	Nov-15
Isle of Wight	Yes	Adopted	Island Plan Core Strategy and 2014 SHMA	Mar-12
Lewes	Yes	Adopted	Annual Monitoring Report 2016	May-16
Maidstone	Yes	Submitted	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
Medway	Yes	Emerging	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
Mid Sussex	Yes	Submitted	Housing Implemention Plan August 2016	Aug-16
Mole Valley	Yes	Adopted	Annual Monitoring Report 2014/15	May-15
New Forest	Yes	Adopted (Under review)	Local Plan Review Initial Proposals Consultation Document	Jul-16
Portsmouth	Yes	Adopted	Strategic Housing Land Availbality Assessment December 2015	Jan-12
Rother	Yes	Adopted	Adopted Core Strategy - Sep 2014	Sep-14
Sevenoaks	Yes	Emerging	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
Shepway	Yes	Adopted	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
South Downs National Park	No	Draft	SOUTH DOWNS LOCAL PLAN: PREFERRED OPTIONS	Sep-15
Southampton	Yes	Adopted	Authority Monitoring Report, 2016	Mar-15
Swale	Yes	Submitted	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
Tandridge	Yes	Emerging	Housing Supply Statement 2016 and Tandridge Strategic Housing Market Assessment (2015)	Jun-16
Test Valley	Yes	Adopted	Test Valley Borough Revised Local Plan DPD 2011-2029	Jan-16
Thanet	Yes	Emerging	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
Tonbridge and Malling	Yes	Emerging	Kent and Medway Growth and Infrastructure Framework Refresh June 2016 - New dwelling completions	Jun-16
Tunbridge Wells	Yes	Adopted	Core Strategy 2006-2026	Jun-10
Waverley	Yes	Submitted	Local Plan Appendix A	Dec-16
Wealden	No	Adopted	AMR 2013-14	Feb-13
West Berkshire	Yes	Adopted	Five Year Housing Land Supply at September 2016	Jul-12
Wiltshire	Yes	Adopted	Housing Land Supply Statement, April 2016	Jan-15
Winchester	Yes	Adopted	Annual Monitoring Report Dec 2015	Mar-13
Worthing	No	Adopted	Annual Monitoring Report 2014 - 2015	Apr-11

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

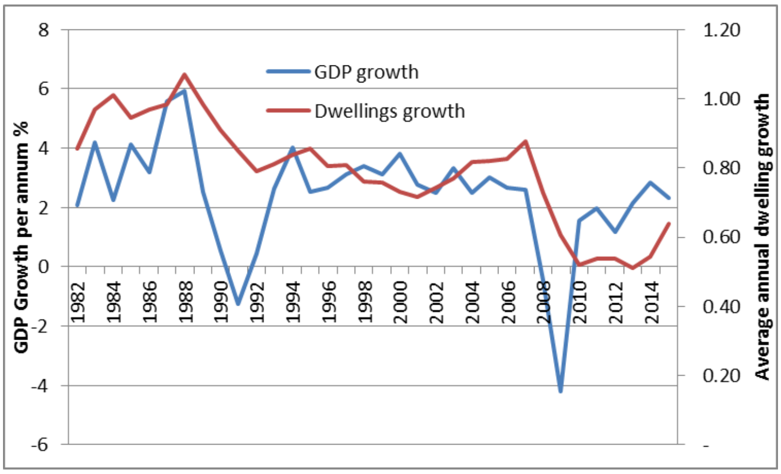
Output area level plan-based forecasts are produced by controlling the trend based OA forecasts for each variable to the plan-based local authority targets derived in the previous section. Note that no attempt is made to allocate plan-based growth to specific output areas or collections of output areas.

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 (NPF) 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

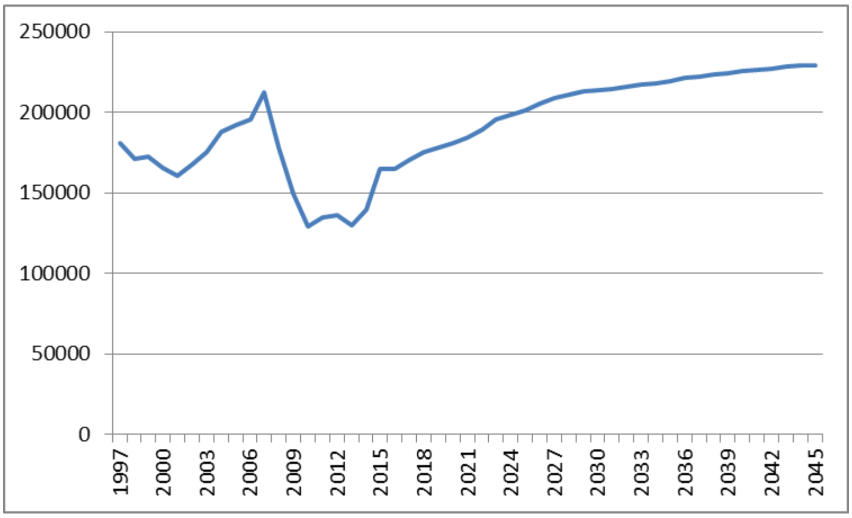
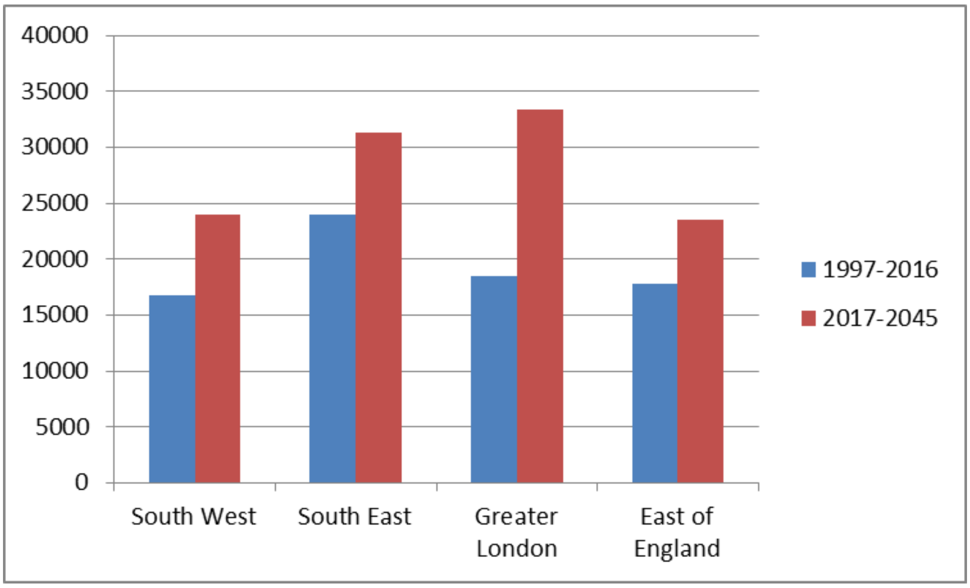


Figure 4.3 summarises the regional econometric forecasts for the areas covered by this research (South East, Greater London, East of England and the South West) in terms of average annual dwelling completions over the forecast period. A key point to note is that the forecasts for all regions are markedly 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.

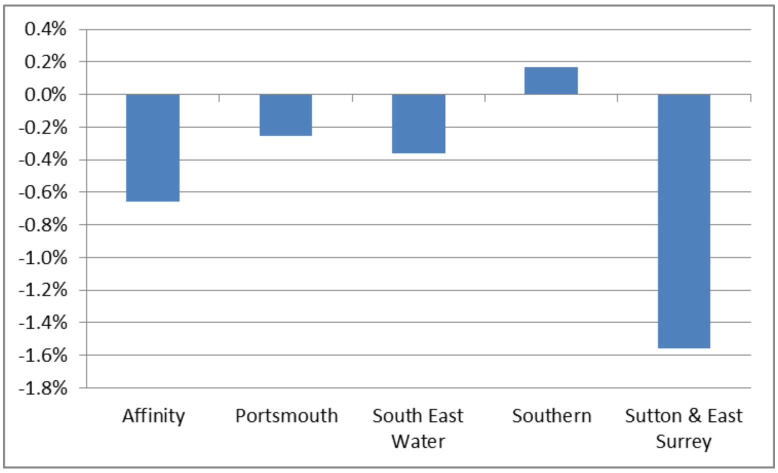
6. Uncertainty estimates

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 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)



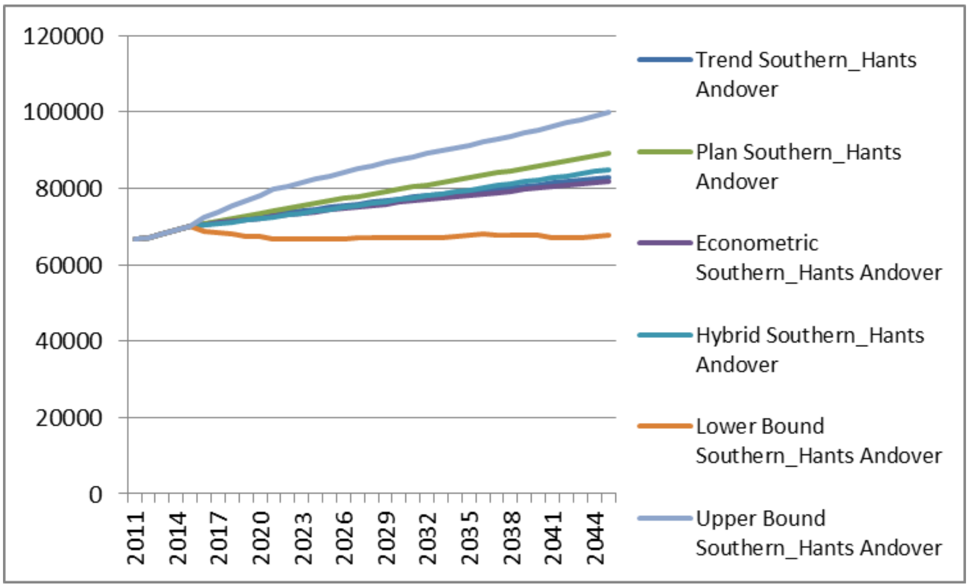
To capture future uncertainty, we derived an error distribution around the household and population projections from the 2012-based population projections and the 2015 mid-year estimate actuals for every local authority in England. We calculated the ratio between actual and projected growth in population 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 a Southern Water 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 population forecast sits above the other forecasts and is closer to the upper confidence bound. When economic factors are considered the forecast is more likely to be lower and closer to trend.

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

Figure 6.2: Forecast population range for Southern Hants Andover



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.

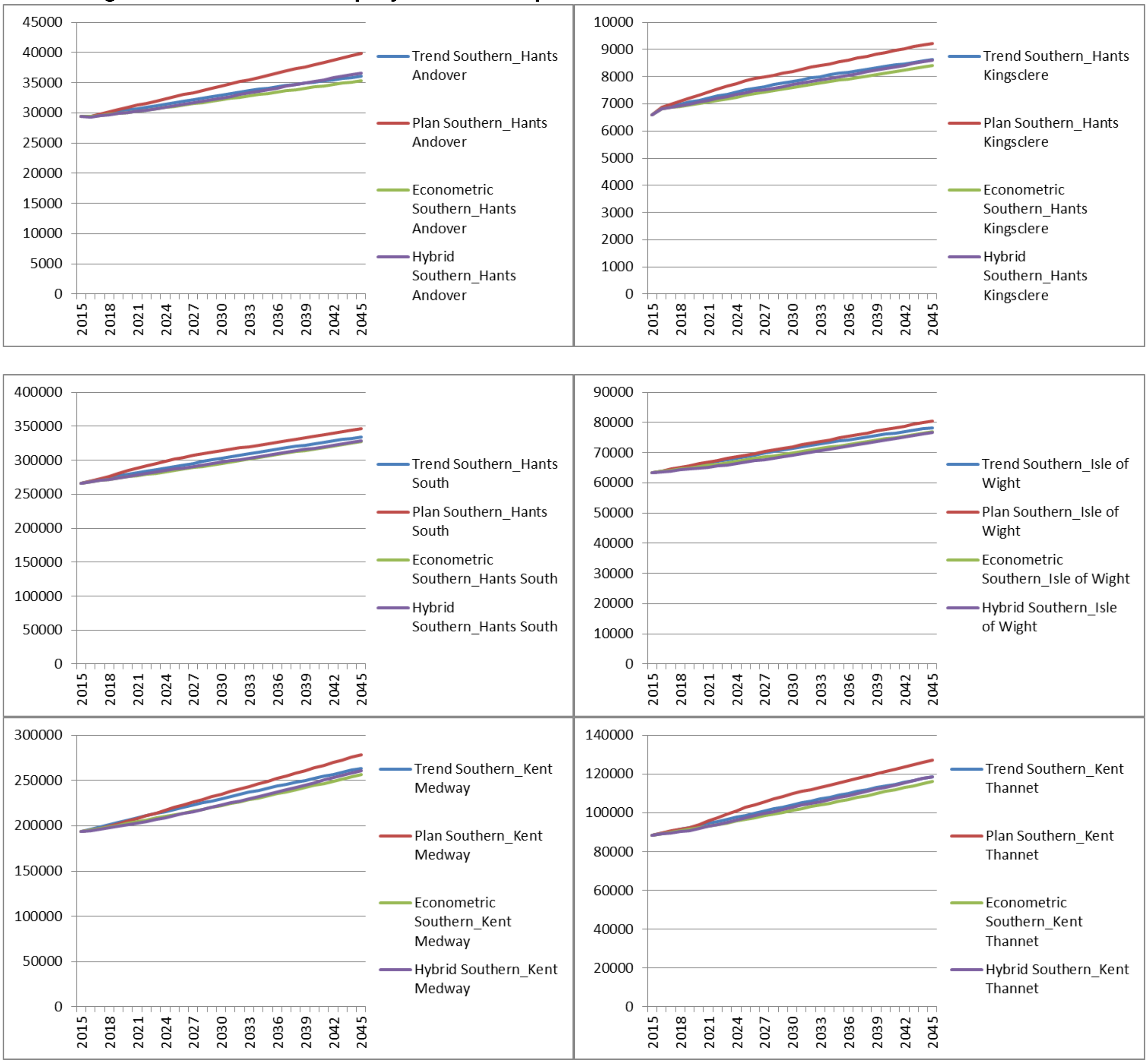
8. WRZ level results

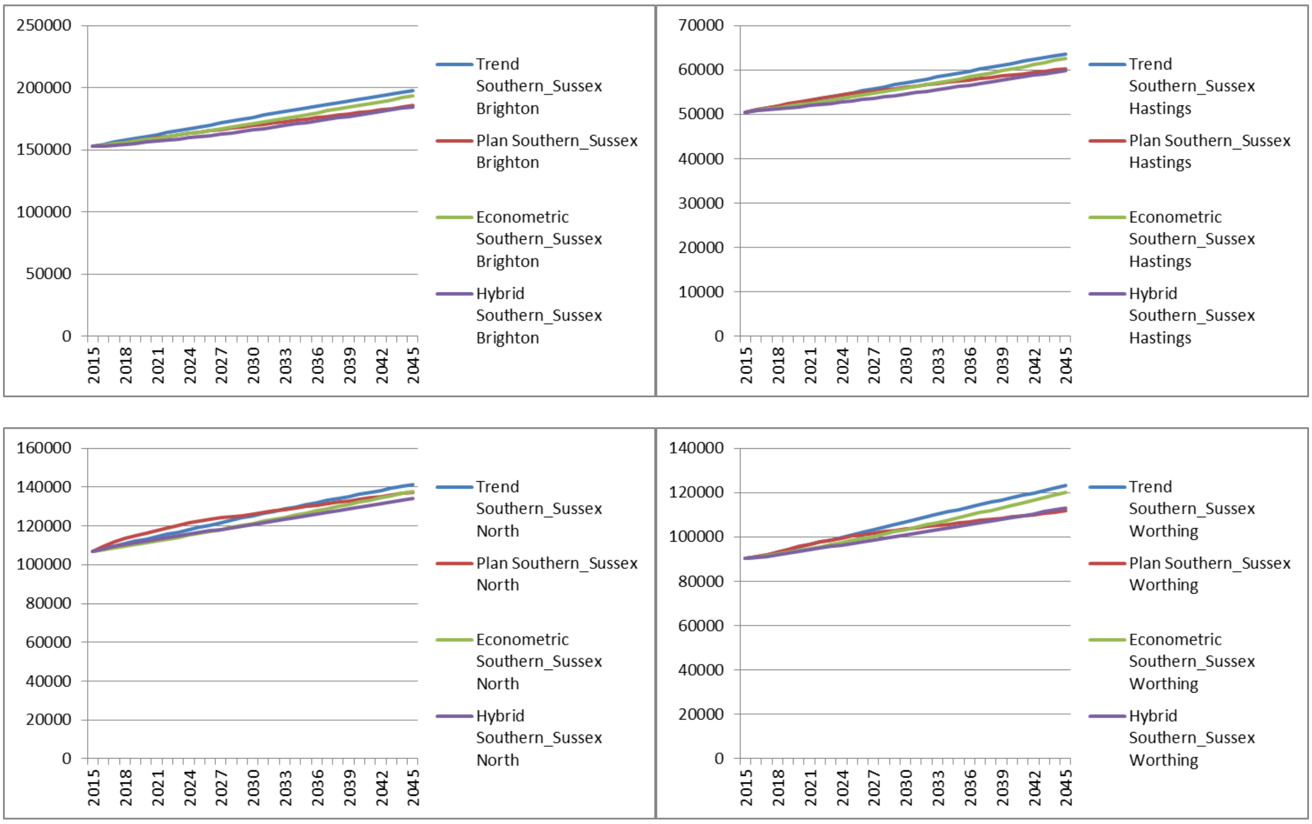
This section provides a summary of the household, household population and occupancy projections for each of the forecasts for each Southern Water WRZ.

8.1.1 WRZ household forecasts

At company level, the plan-based household forecasts are marginally stronger than the trend-based forecasts. The econometric forecasts and hybrid household forecasts are weaker (due to the economic uncertainty associated with housing delivery). At WRZ level Hants Andover, Hants Kingsclere, Hants South Isle of Wight, Kent Medway and Kent Thannet all have plan-based forecasts that are higher than the other variants. The remaining WRZ areas have plan-based forecasts that fall below trend. Across all WRZ areas, the hybrid forecasts tend to lie between the lower-end of the forecast range.

Fig 8.1: WRZ household projections comparison

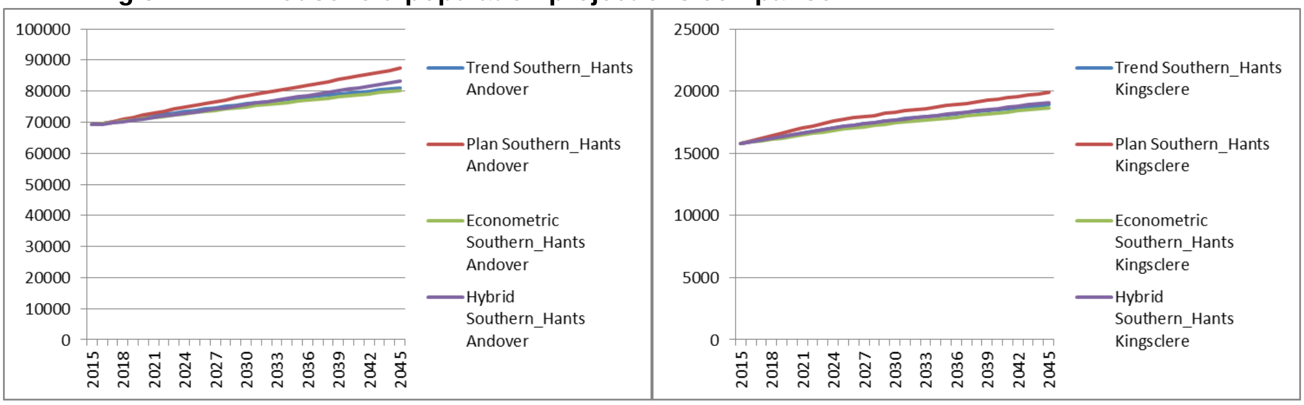


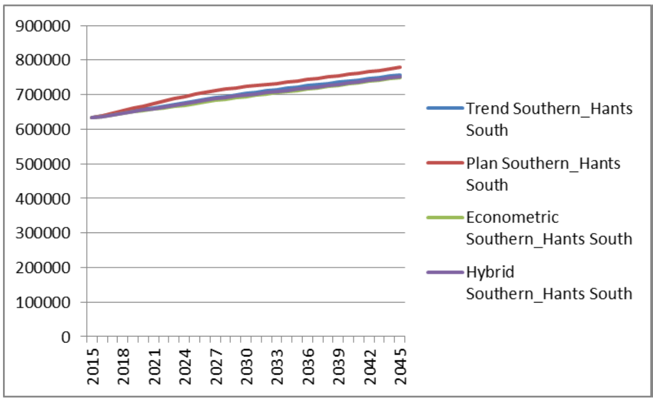


8.1.2 WRZ household population forecasts

At company level, the plan-based household population forecasts are stronger than trend, reflecting the strong growth promulgated in local authority plans. The econometric forecast is the weakest household population forecast. The hybrid forecast lies between the trend and econometric forecast. The lowest forecast (econometric) is 2% lower than the strongest forecast (plan) in 2045. The forecast range is therefore relatively low. At WRZ level the variance between forecasts is more pronounced.

Fig 8.2: WRZ household population projections comparison

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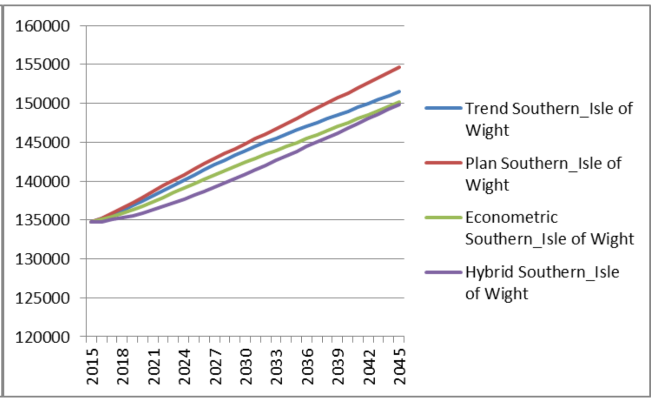
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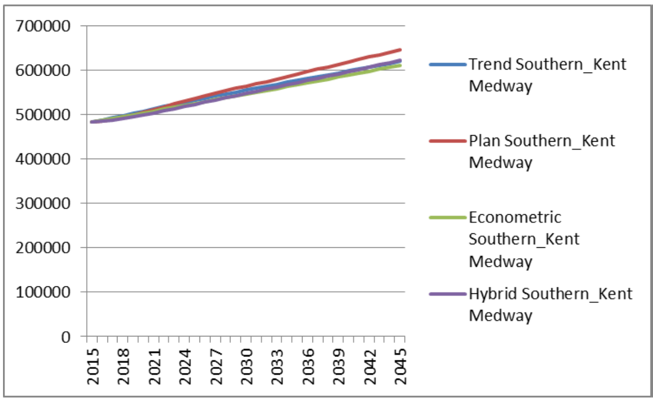
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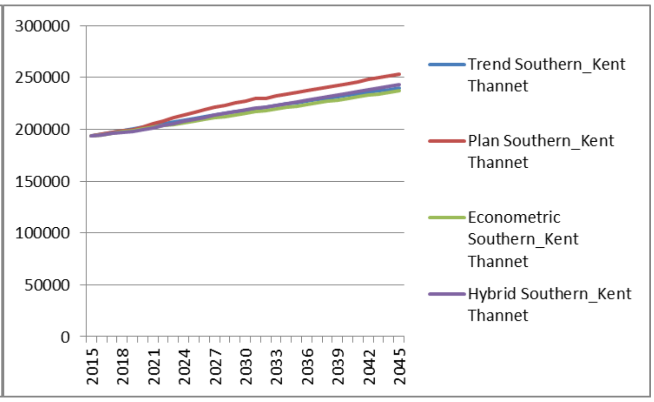
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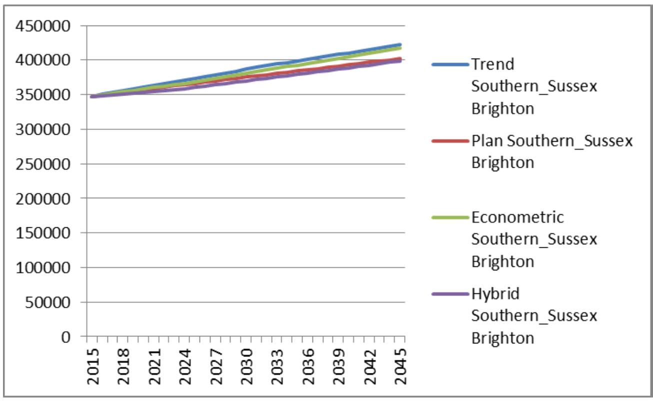
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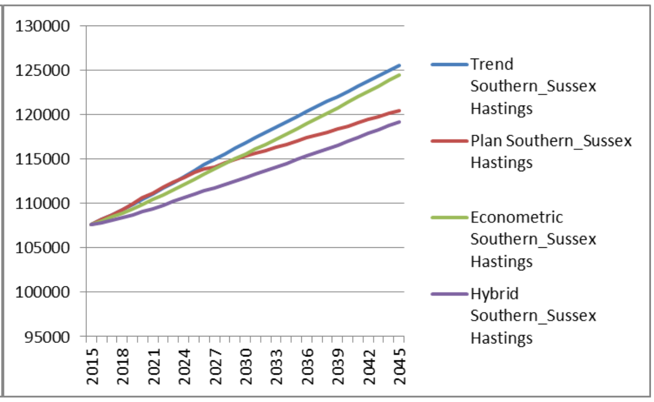
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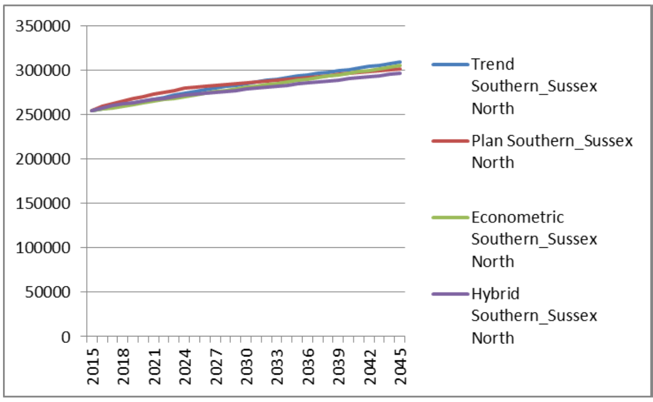
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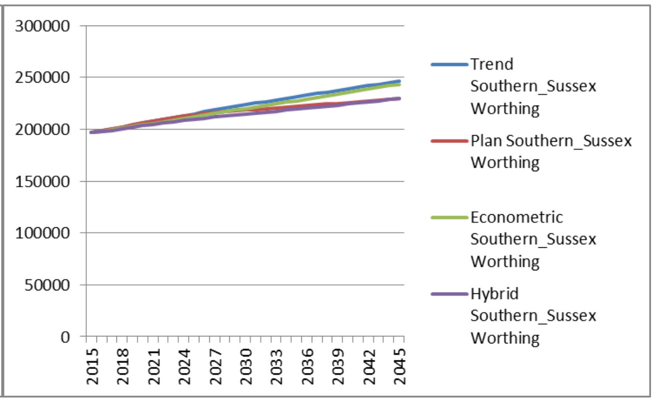
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9. Comparison with previous forecasts

9.1.1 Comparison with outturn

For WRMP14, Southern Water used the Experian most-likely forecasts for population and the Experian plan-based forecasts for households in their resources plan. The most-likely population forecast was essentially trend-based but used a different trend depending on the local authority. This was because only ONS interim short-term projections were available at the time and they did not include updated assumptions based on the Census 2011. As a result, Experian looked at alternative population trends and identified the most appropriate forecast for each local authority area.

At company level, the difference between the most–likely household population forecast and outturn between 2011 and 2015 was very small. The household population growth forecast was 3.3 per cent, compared with an outturn of 3.5%. However the picture was more mixed at WRZ level, with some areas growing more quickly, such as Hants Andover, Hants South and Kent Medway and some areas growing more slowly than forecast. Hants Kingsclere and Isle of Wight grew significantly more slowly than forecast.

Figure 9.1: Southern Water WRMP14 household population forecasts compared with outturn, 2011 to 2015

AREA	% population growth, 2011 to 2015		% household growth, 2011 to 2015	
	Most-likely forecast	Outturn	Plan-based forecast	Outturn
Southern_Hants Andover	4.2	5.3	5.9	6.6
Southern_Hants Kingsclere	3.1	1.4	1.2	4.3
Southern_Hants South	3.0	3.5	3.5	2.9
Southern_Isle of Wight	2.9	0.7	3.1	3.7
Southern_Kent Medway	3.7	4.6	3.0	3.0
Southern_Kent Thannet	2.3	3.1	2.8	4.4
Southern_Sussex Brighton	3.6	4.2	1.3	1.2
Southern_Sussex Hastings	2.8	2.1	2.8	3.1
Southern_Sussex North	4.5	3.3	3.7	3.4
Southern_Sussex Worthing	2.5	2.8	2.5	2.8
Company	3.3	3.5	2.9	3.0

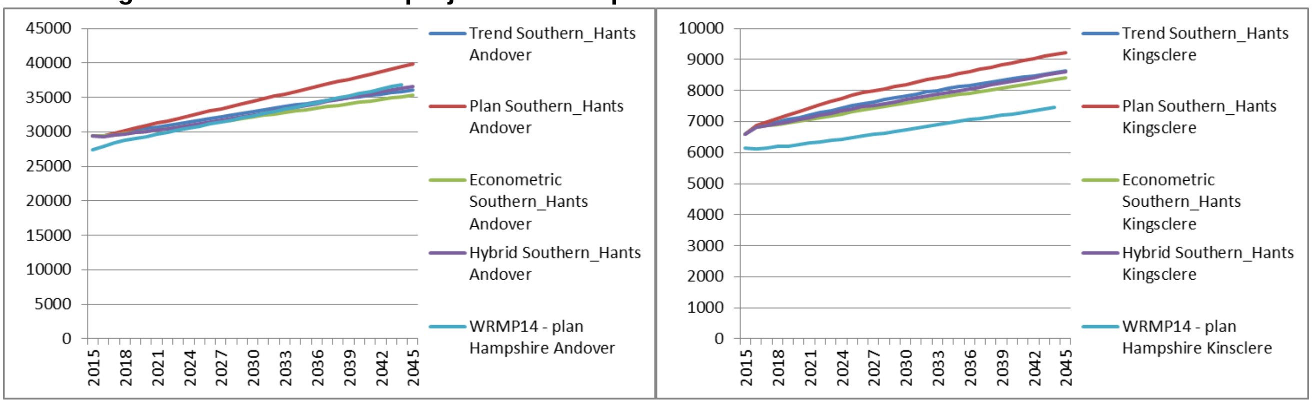
Turning to the plan-based household forecasts, once again, at company level the forecasts were very close to outturn (2.9% forecast compared with 3% outturn). However, at WRZ level, the picture is mixed and interestingly in some WRZ areas there appears to be a disconnection between the population forecasts and household growth. For example, population growth in the Isle of Wight and Hants Kingsclere was weaker than forecast, but the growth in households was stronger than forecast. In other WRZ areas the link between household growth and population growth was much clearer with household and population growth moving in the same direction relative to the forecasts. For example, Hants Andover, where population growth and household growth were both around 1% stronger than forecast.

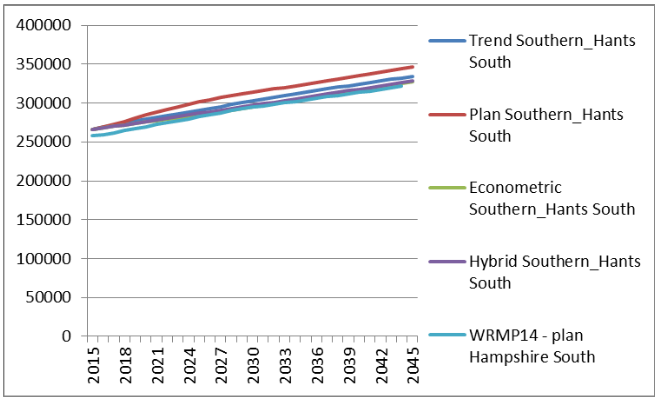
It is difficult to attribute the differences between the forecast growth and actual growth to specific demographic or economic (or indeed ‘policy’) factors for local areas. The analysis serves to demonstrate that at the company level, the forecasts have been accurate, albeit for a relatively short period of time. They also demonstrate that the local authority plans have been a relatively good indication of likely growth when considered across a large area. However at local level, the difference between local authority plans and realised growth in some areas is greater. We would therefore recommend that the forecasts for smaller areas are treated with the most caution and consideration should be given as to the impact a divergence from forecast on water resources in a given area.

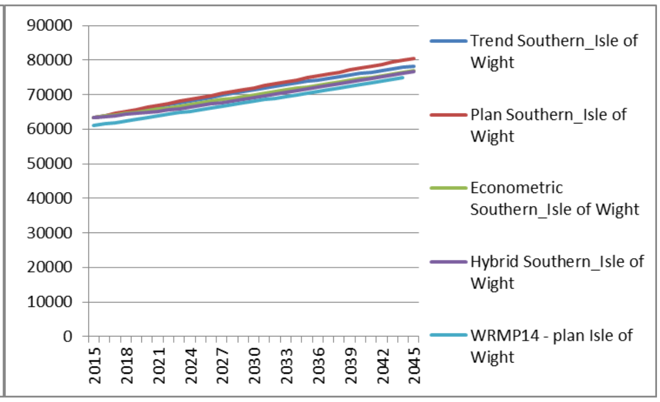
9.1.2 Comparison with household forecasts for WRMP19

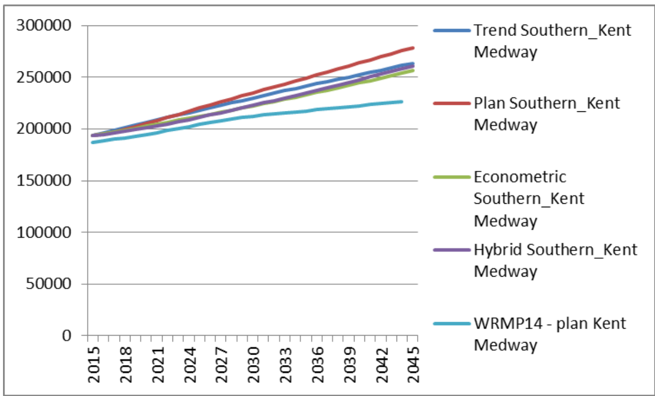
At company level, the household forecasts for WRMP19 are stronger than those used for WRMP14. The household forecasts for WRMP19 range from 4% to 9% higher than the plan-based forecast for WRMP14 in 2040. The closest forecasts to WRMP14 are the hybrid WRMP19 forecasts. The WRMP19 forecasts for each WRZ area are plotted against the WRMP14 plan-based forecast for each area in figure 9.2 below. Note that there are differences in levels in 2011 in some WRZ areas due to the boundary data and postcode population data used to allocate OA areas to WRZ boundaries. The comparison data for WRMP14 was provided by Southern Water so may also include differences due to the Address Point methodology used by Southern. At company level the discrepancy is small but is greater in some (particularly smaller) WRZ areas.

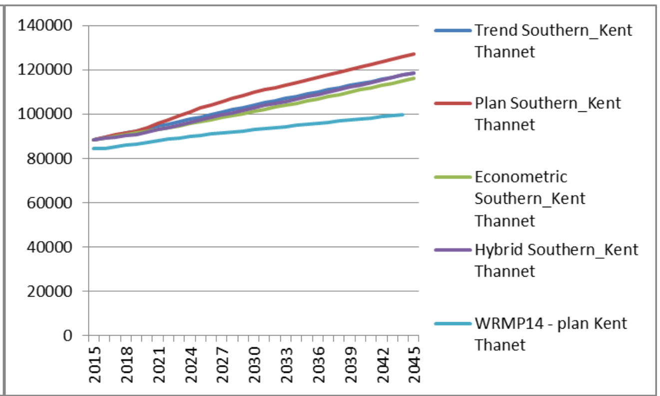
Fig 9.2: WRZ household projections comparison

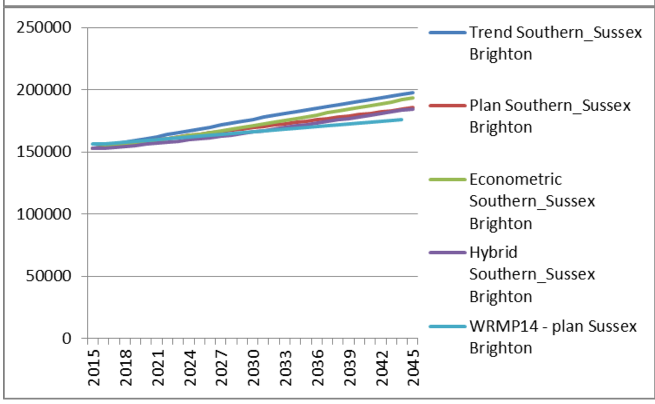


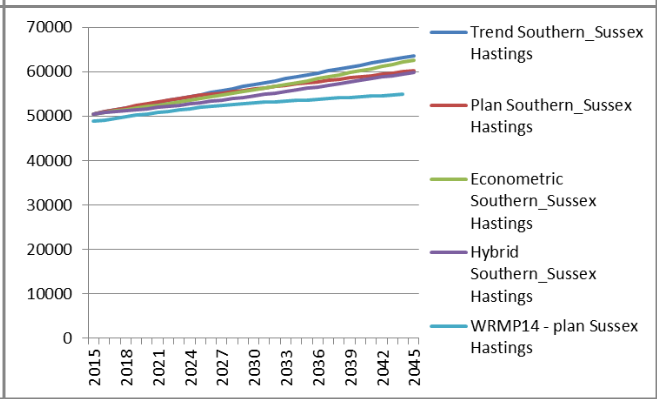


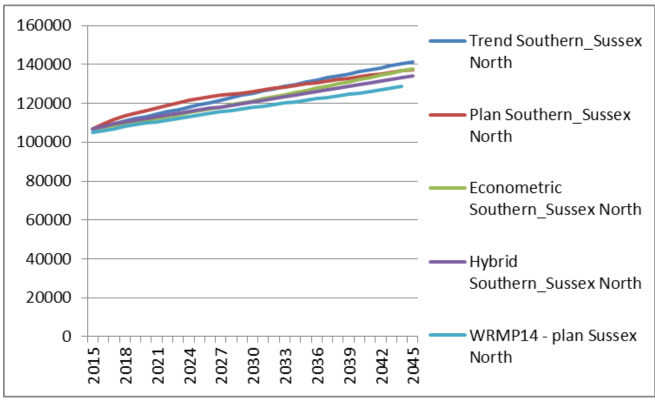


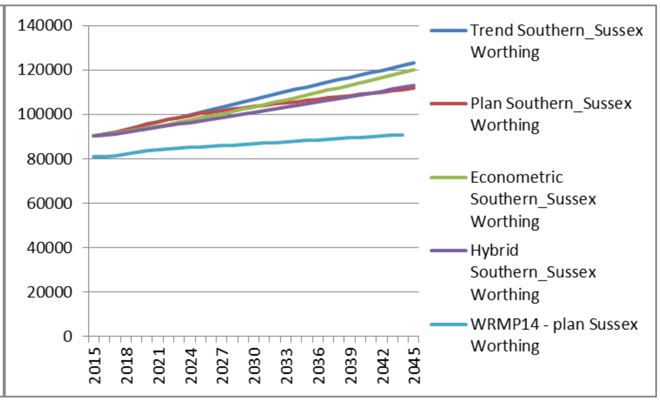










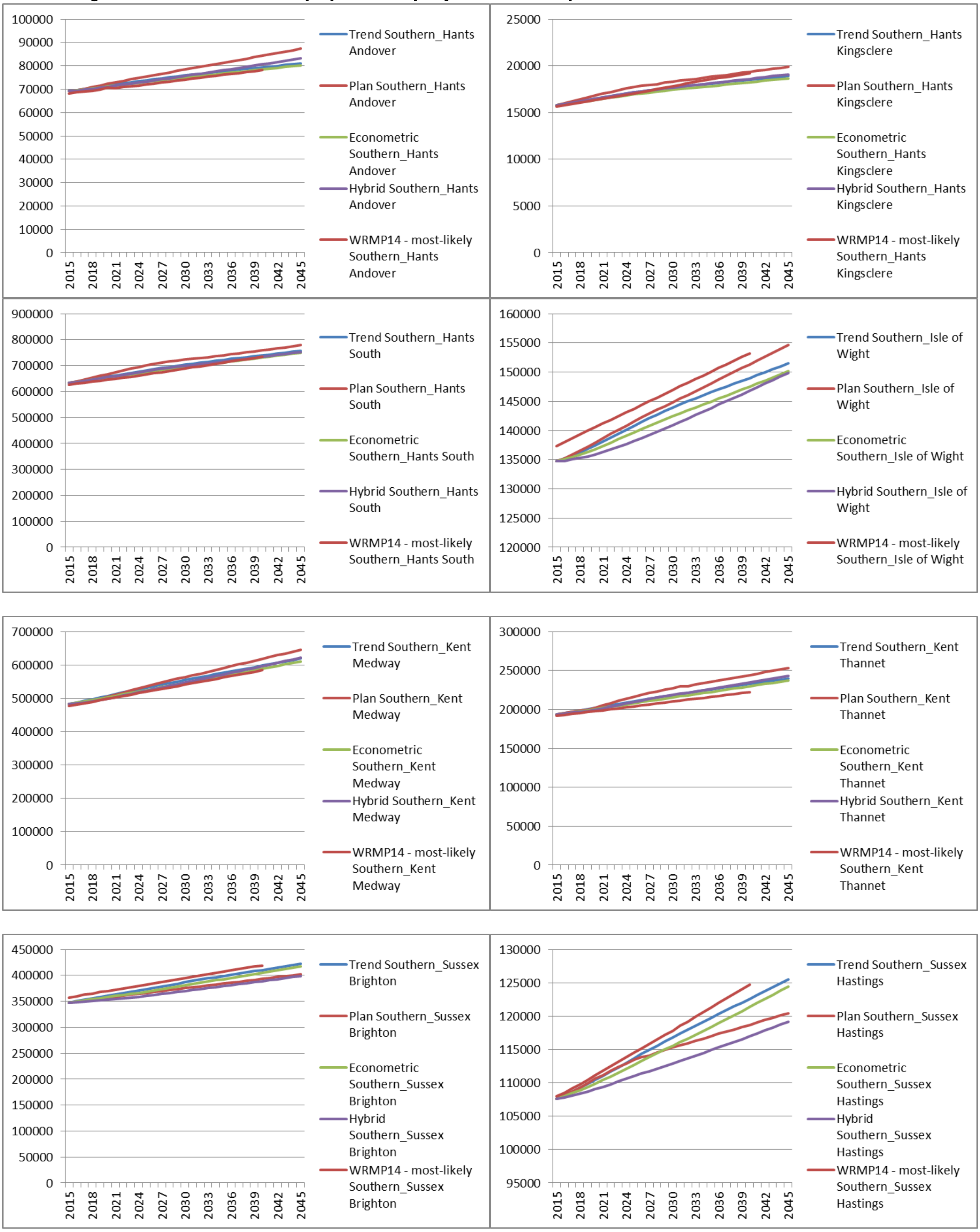


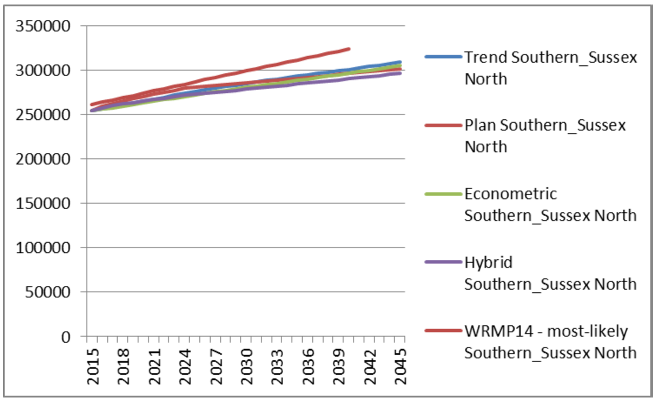
9.1.3 Comparison with household population forecasts for WRMP19

At company level the WRMP19 forecasts are very similar to the most-likely forecasts used for WRMP14. The difference between the WRMP19 forecasts and the most-likely forecast ranges from -0.8% to 1.3% in 2040. The Hybrid forecasts are the closest to WRMP19, with a -0.1% difference in 2040. At WRZ level, the trends in many areas are similar to WRMP14 with some divergence evident in Sussex Hastings and Sussex North.

The forecasts at WRZ level are summarised in figure 9.3 below.

Fig 9.3: WRZ household population projections comparison

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250000
200000
150000
100000
50000
0
2015
2018
2021
2024
2027
2030
2033
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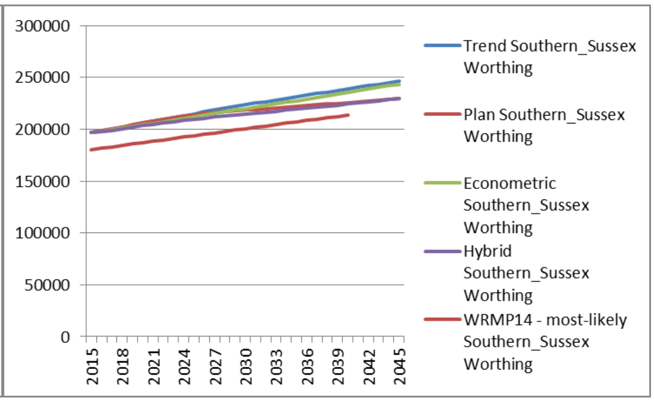
2045
Trend Southern_Sussex North
Plan Southern_Sussex North
Econometric Southern_Sussex North
Hybrid Southern_Sussex North
WRMP14 - most-likely Southern_Sussex North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2015
2018
2021
2024
2027
2030
2033
2036
2039
2042
2045
Trend Southern_Sussex Worthing
Plan Southern_Sussex Worthing
Econometric Southern_Sussex Worthing
Hybrid Southern_Sussex Worthing
WRMP14 - most-likely Southern_Sussex Worthing

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Annex 2: Demand Forecast Appendix B: Consumption figures for customer groups at the area level

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Southern Water

A breakdown of average consumption per property for each of the three customer groups in the three supply areas is given herein. The figures are based on metered consumption over the past 4 years.

Table 1 Western area consumption figures (litres/property/day)

Customer group	2014-15	2015-16	2016-17	2017-18
1	360.0	357.2	351.7	353.7
2	295.6	307.3	288.7	292.6
3	218.5	208.8	198.0	209.7
All Groups	**295.6**	**299.2**	**285.1**	**290.3**

Table 2 Central area consumption figures (litres/property/day)

Customer group	2014-15	2015-16	2016-17	2017-18
1	351.8	519.0	344.4	362.3
2	307.5	316.8	298.1	304.4
3	227.2	214.6	205.5	229.8
All Groups	**306.5**	**318.5**	**291.9**	**301.3**

Table 3 Eastern area (litres/property/day)

Customer group	2014-15	2015-16	2016-17	2017-18
1	377.2	386.3	388.7	386.8
2	320.4	312.8	319.7	305.2
3	225.5	219.0	215.8	218.2
All Groups	**311.5**	**308.1**	**311.1**	**302.6**

Table 4 Southern Water (litres/property/day)

Customer group	2014-15	2015-16	2016-17	2017-18
1	364.3	391.2	362.7	365.4
2	306.7	310.0	303.7	299.9
3	229.1	217.0	206.8	218.2
All Groups	**301.7**	**307.2**	**294.1**	**295.7**

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Annex 2: Demand Forecast Appendix C: Toilet flushing inputs and outputs by supply area and metering status

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WATER for LIFE

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Ownership

The ownership figures for the generations of WCs used for demand forecasting are given herein for each customer group in each supply area for unmeasured and measured customers. The term 'generation' indicates the age of the WC which is then linked to the average volume per flush as follows:

Generation 1: over 25 years old; 12litres/flush
Generation 2: 10 to 25 years old; 9litres/flush
Generation 3: less than 10 years old; 6litres/flush

Unmeasured households

Table 1 Ownership of WCs by generation – Western area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	14%	39%	47%	0%	3%	97%
2	24%	22%	54%	0%	2%	98%
3	21%	27%	52%	0%	2%	98%
All	**20%**	**30%**	**50%**	**0%**	**2%**	**98%**

Table 2 Ownership of WCs by generation – Central area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	14%	39%	47%	0%	3%	97%
2	24%	22%	54%	0%	2%	98%
3	21%	27%	52%	0%	2%	98%
All	**20%**	**30%**	**50%**	**0%**	**2%**	**98%**

Table 3 Ownership of WCs by generation – Eastern area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	19%	37%	44%	0%	3%	97%
2	24%	22%	54%	0%	2%	98%
3	21%	27%	52%	0%	2%	98%
All	**20%**	**30%**	**50%**	**0%**	**2%**	**98%**

Table 4 Ownership of WCs by generation – Southern Water

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	16%	36%	48%	0%	3%	97%
2	24%	22%	54%	0%	2%	98%
3	21%	27%	52%	0%	2%	98%
All	**20%**	**30%**	**50%**	**0%**	**2%**	**98%**

Measured households

Table 5 Ownership of WCs by generation – Western area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	18%	32%	50%	0%	1%	99%
2	20%	26%	54%	0%	1%	99%
3	19%	26%	55%	0%	1%	99%
All	**20%**	**32%**	**48%**	**0%**	**1%**	**99%**

Table 6 Ownership of WCs by generation – Central area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	16%	28%	56%	0%	1%	99%
2	20%	26%	54%	0%	1%	99%
3	19%	26%	55%	0%	1%	99%
All	**20%**	**32%**	**48%**	**0%**	**1%**	**99%**

Table 7 Ownership of WCs by generation – Eastern area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	12%	40%	48%	0%	2%	98%
2	20%	26%	54%	0%	1%	99%
3	19%	26%	55%	0%	1%	99%
All	**20%**	**32%**	**48%**	**0%**	**1%**	**99%**

Table 8 Ownership of WCs by generation – Southern Water

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	16%	34%	51%	0%	1%	99%
2	20%	26%	54%	0%	1%	99%
3	19%	26%	55%	0%	1%	99%
All	**20%**	**32%**	**48%**	**0%**	**1%**	**99%**

All households

Table 9 Ownership of WCs by generation – Western area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	17%	33%	50%	0%	2%	98%
2	21%	25%	54%	0%	1%	99%
3	19%	26%	54%	0%	1%	99%
All	**20%**	**32%**	**48%**	**0%**	**2%**	**98%**

Table 10 Ownership of WCs by generation – Central area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	16%	28%	56%	0%	1%	99%
2	20%	26%	54%	0%	1%	99%
3	19%	26%	55%	0%	1%	99%
All	**20%**	**32%**	**48%**	**0%**	**1%**	**99%**

Table 11 Ownership of WCs by generation – Eastern area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	13%	40%	48%	0%	2%	98%
2	21%	25%	54%	0%	1%	99%
3	19%	26%	54%	0%	1%	99%
All	**20%**	**32%**	**48%**	**0%**	**2%**	**98%**

Table 12 Ownership of WCs by generation – Southern Water

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Generation 1	Generation 2	Generation 3	Generation 1	Generation 2	Generation 3
1	16%	34%	51%	0%	2%	98%
2	21%	25%	54%	0%	1%	99%
3	19%	26%	54%	0%	1%	99%
All	**20%**	**32%**	**48%**	**0%**	**2%**	**98%**

Frequency of WC use

Table 13 Frequency of WC use by customer group – unmeasured households

Area	Frequency (times/person/day) 2017-18				Frequency (times/person/day) 2069-70			
	1	2	3	Overall	1	2	3	Overall
Western	5.0	4.9	4.9	4.9	5.0	5.0	4.9	5.0
Central	5.4	5.5	5.8	5.6	5.4	5.6	5.8	5.6
Eastern	5.4	5.5	5.8	5.5	5.5	5.6	5.8	5.6
Southern Water	**5.2**	**5.4**	**5.7**	**5.4**	**5.2**	**5.4**	**5.7**	**5.5**

Table 14 Frequency of WC use by customer group – measured households

Area	Frequency (times/person/day) 2017-18				Frequency (times/person/day) 2069-70			
	1	2	3	Overall	1	2	3	Overall
Western	4.8	4.9	5.1	4.9	5.0	5.1	5.3	5.1
Central	5.2	5.3	5.5	5.3	5.5	5.5	5.7	5.5
Eastern	4.9	5.1	5.3	5.1	5.2	5.3	5.4	5.3
Southern Water	**4.9**	**5.0**	**5.3**	**5.1**	**5.2**	**5.3**	**5.5**	**5.3**

Table 15 Frequency of WC use by customer group – all households

Area	Frequency (times/person/day) 2017-18				Frequency (times/person/day) 2069-70			
	1	2	3	Overall	1	2	3	Overall
Western	4.8	4.9	5.1	5.1	5.0	5.1	5.2	5.2
Central	5.2	5.3	5.6	5.6	5.5	5.5	5.7	5.7
Eastern	5.0	5.1	5.4	5.4	5.2	5.4	5.5	5.5
Southern Water	**5.0**	**5.1**	**5.4**	**5.4**	**5.2**	**5.3**	**5.5**	**5.5**

Volumetric forecast for toilet flushing

Unmeasured households

Figure 1 Toilet flushing volume forecast – Western area

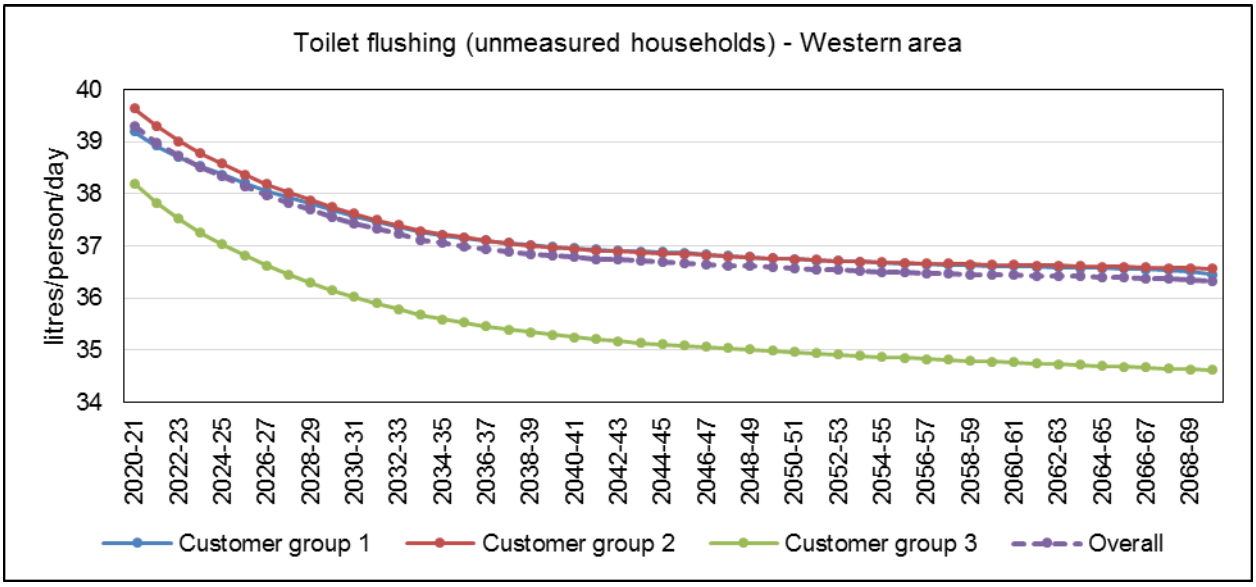


Figure 2 Toilet flushing volume forecast – Central area

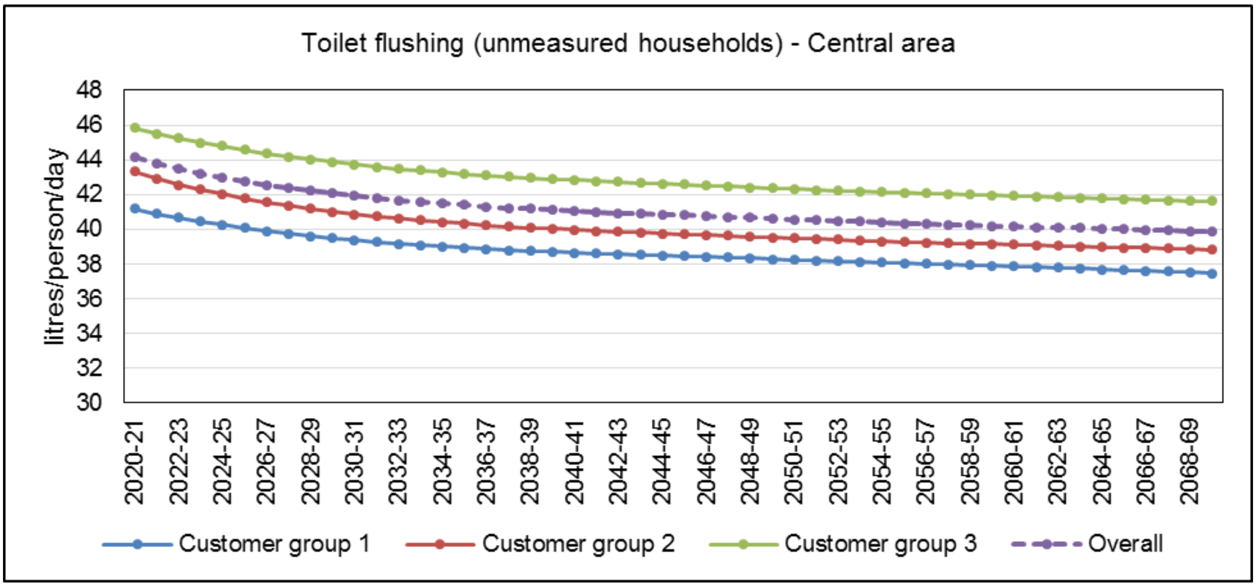


Figure 3 Toilet flushing volume forecast – Eastern area

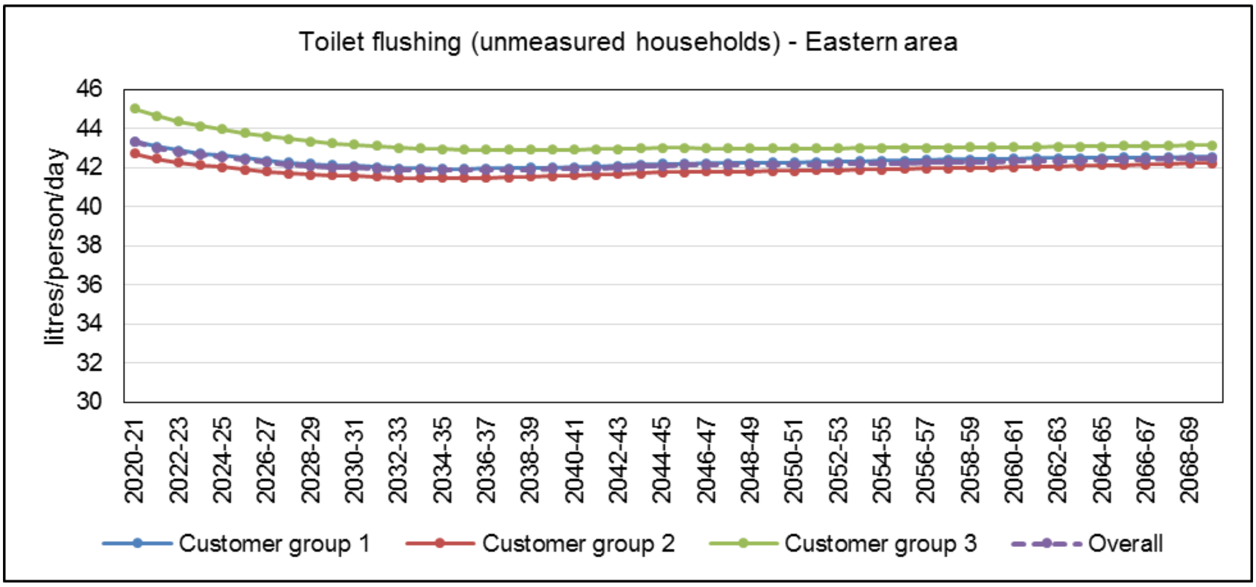
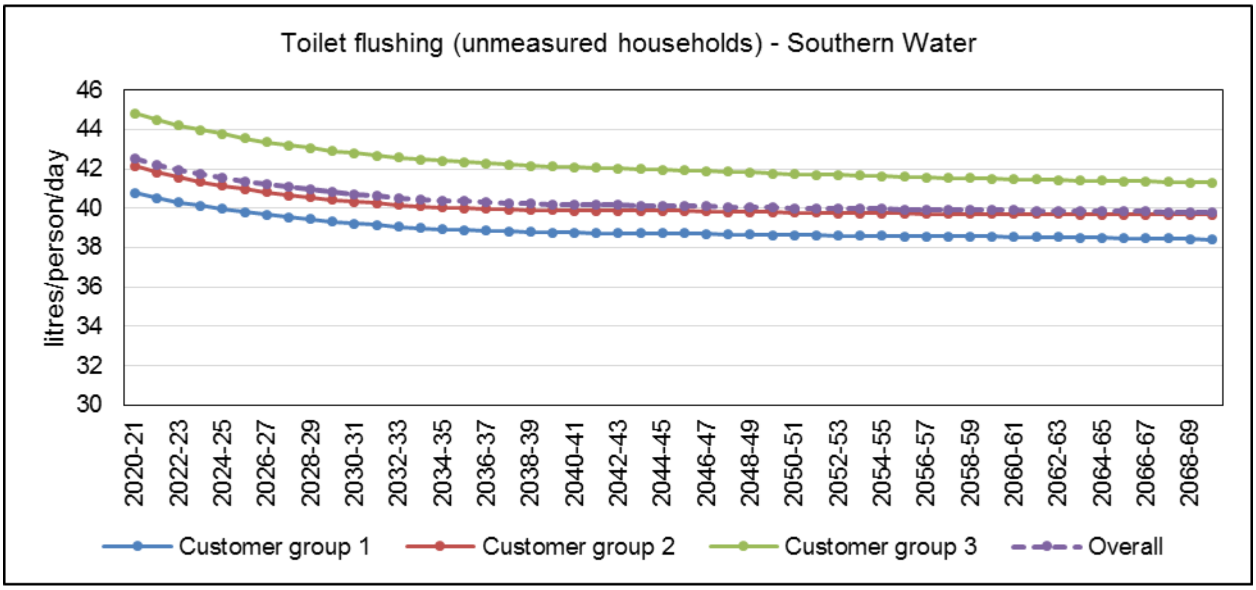


Figure 4 Toilet flushing volume forecast – Southern Water



Measured households

Figure 5 Toilet flushing volume forecast – Western area

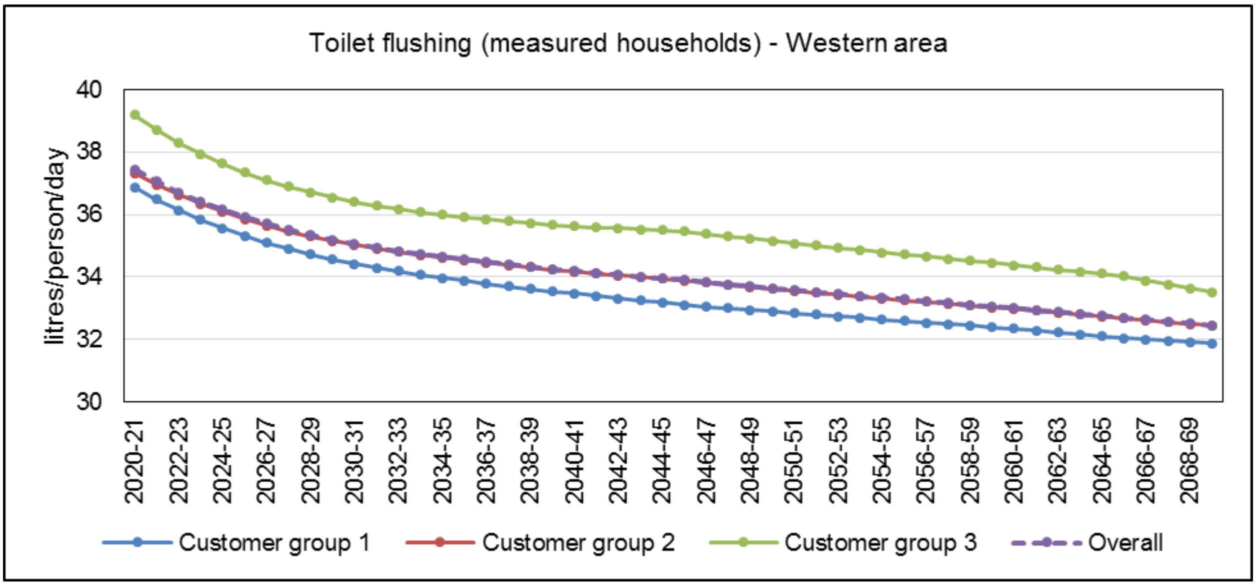


Figure 6 Toilet flushing volume forecast – Central area

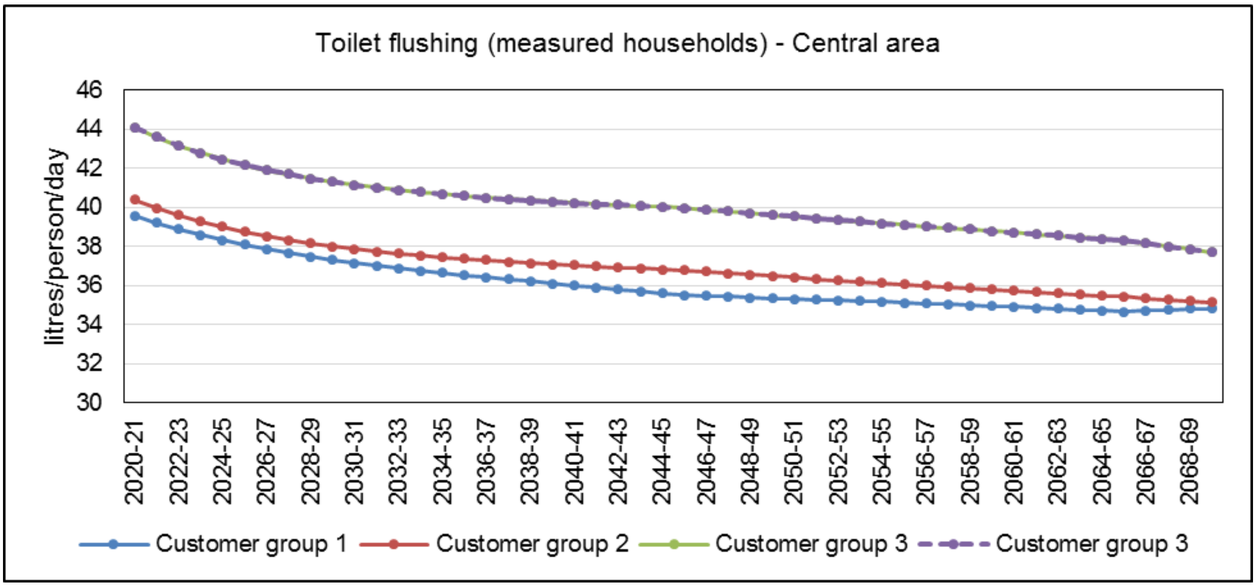


Figure 7 Toilet flushing volume forecast – Eastern area

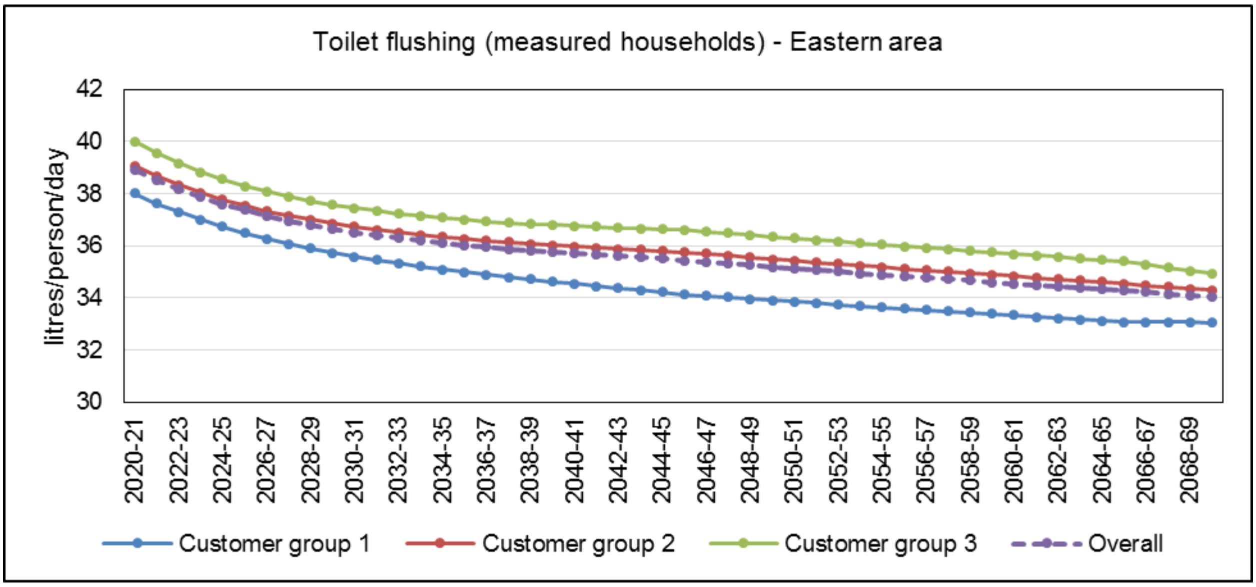
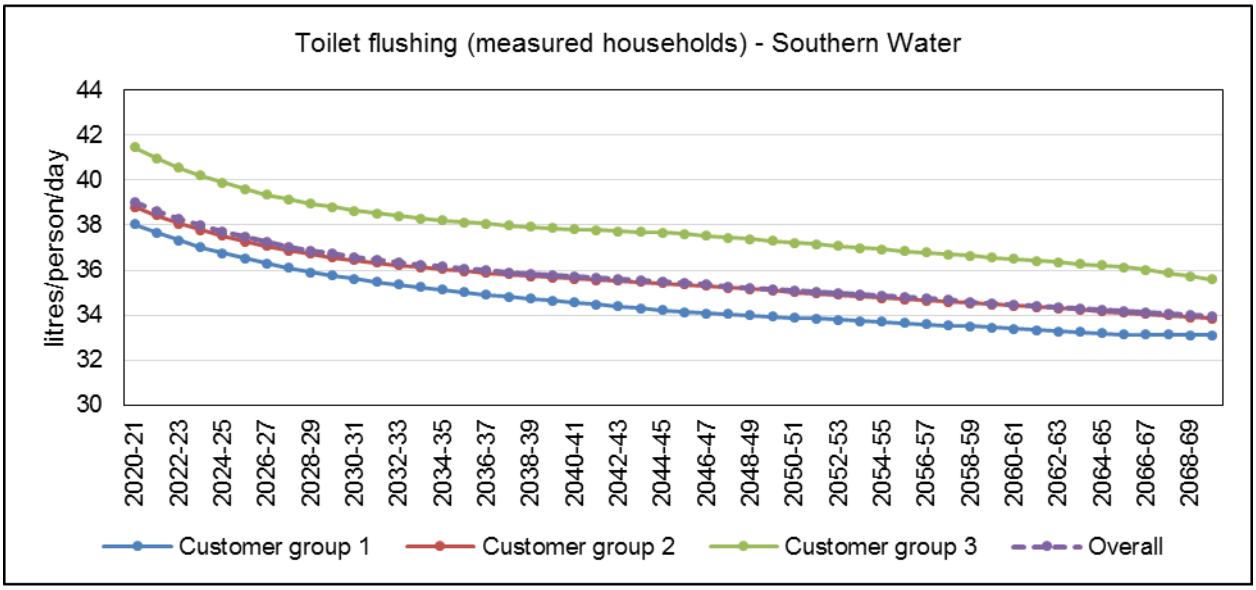


Figure 8 Toilet flushing volume forecast – Southern Water



All households

Figure 9 Toilet flushing volume forecast – Western area

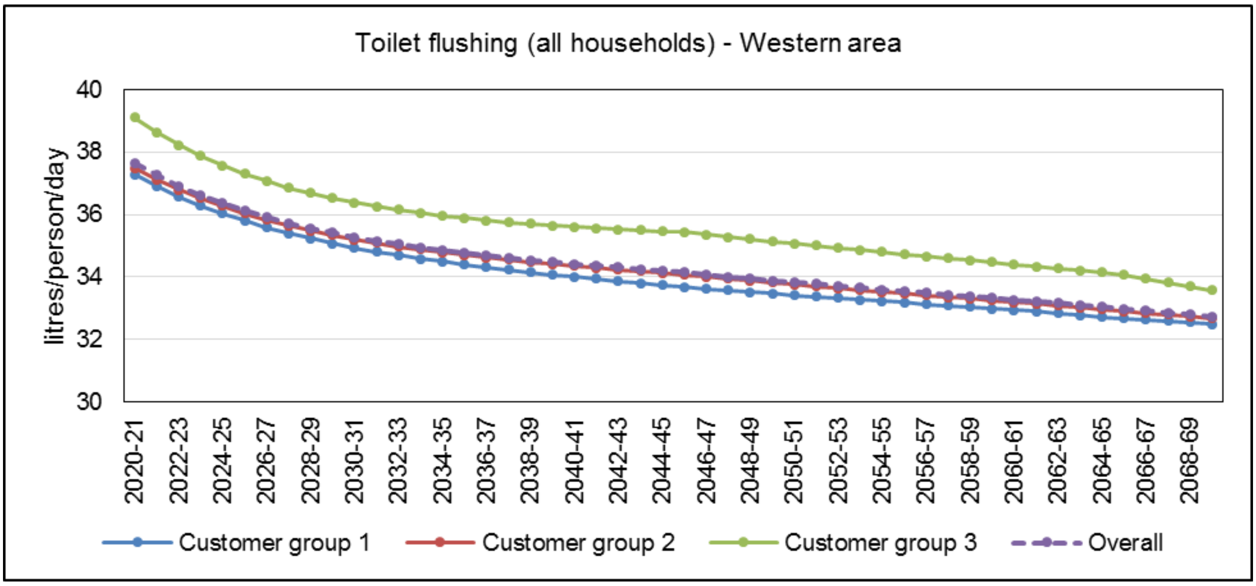


Figure 10 Toilet flushing volume forecast – Central area

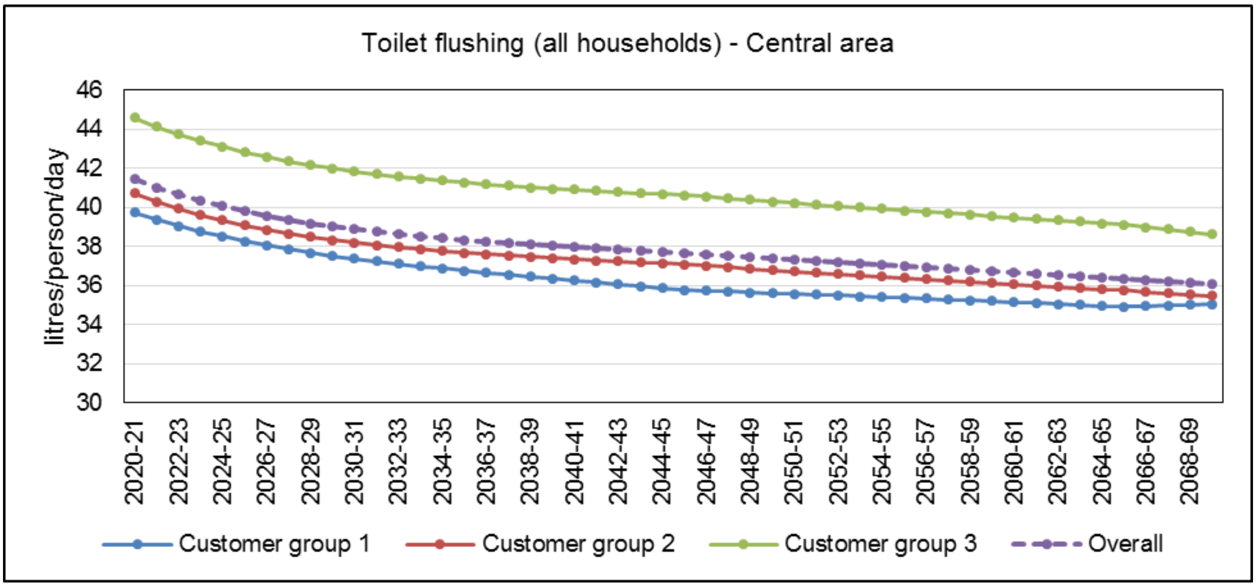


Figure 11 Toilet flushing volume forecast – Eastern area

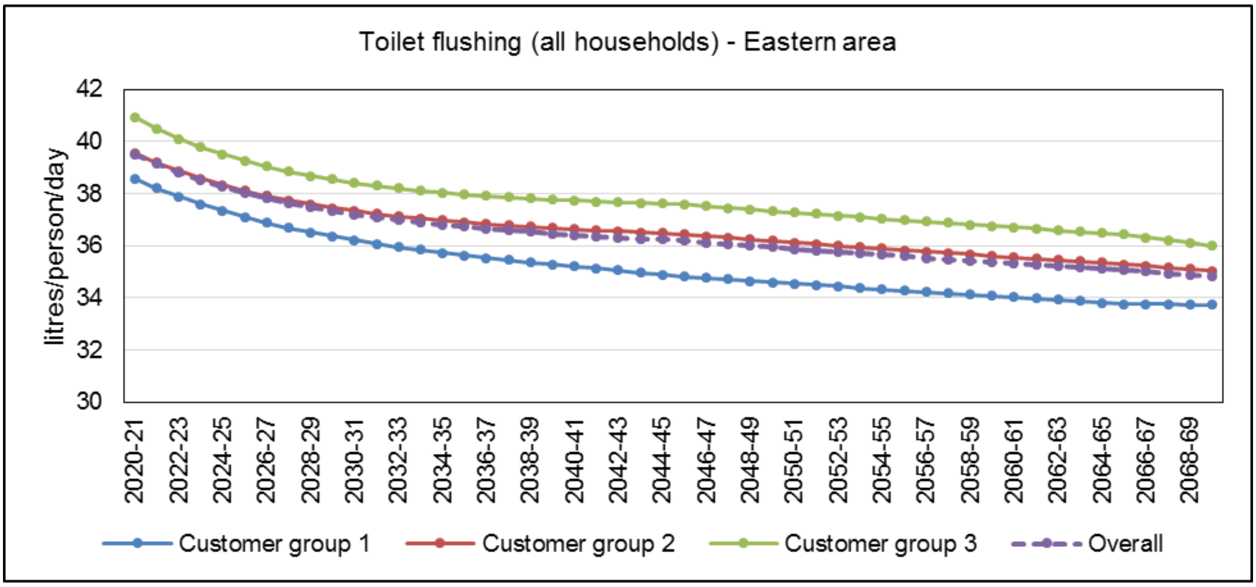
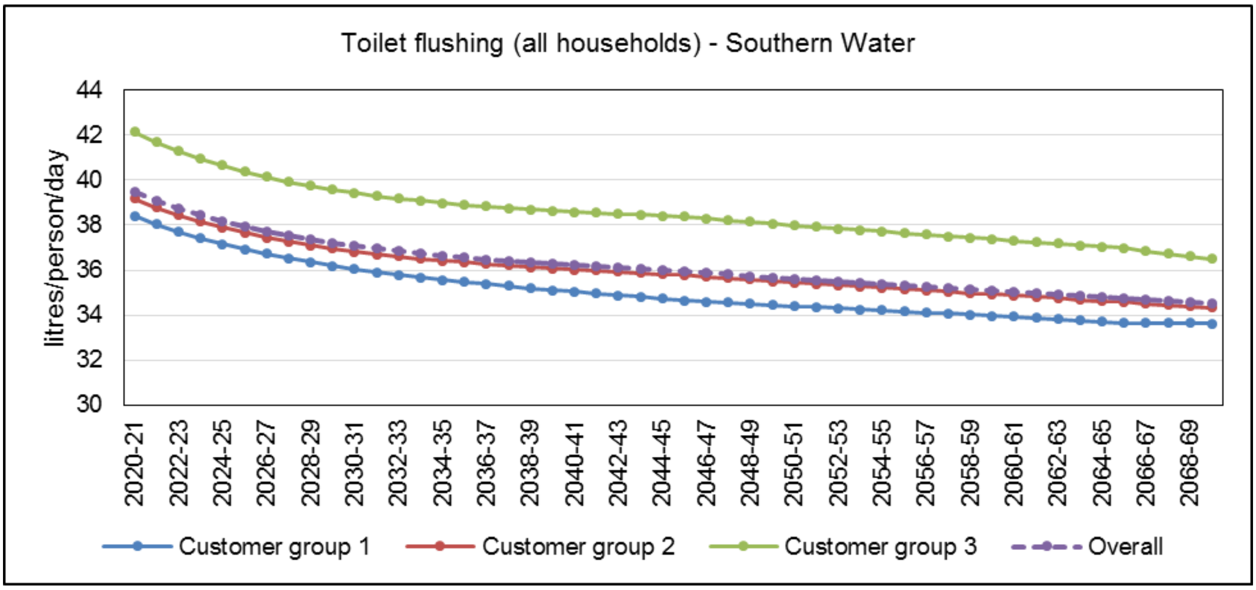


Figure 12 Toilet flushing volume forecast – Southern Water



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Annex 2: Demand Forecast Appendix D: Personal washing inputs and outputs by supply area and metering status

December 2019

Version 1

from Southern Water

Ownership

The tables below show the ownership figures for the three main personal washing modes considered in the demand forecast (baths, normal showers and power showers). The term 'ownership' in this case refers to actual use and not mere presence or absence of a device. For example, in cases where a property has a bath but is not being used, the ownership of bath is assumed to be zero.

Unmeasured households

Table 1 Ownership of personal washing modes – Western area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	56%	56%	44%	42%	25%	75%
2	58%	61%	39%	44%	34%	66%
3	52%	68%	32%	40%	45%	55%
All	**56%**	**61%**	**39%**	**42%**	**33%**	**67%**

Table 2 Ownership of personal washing modes – Central area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	48%	53%	47%	36%	25%	75%
2	52%	71%	29%	39%	49%	51%
3	63%	73%	27%	48%	52%	48%
All	**57%**	**70%**	**30%**	**43%**	**48%**	**52%**

Table 3 Ownership of personal washing modes – Eastern area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	55%	57%	43%	41%	28%	72%
2	57%	68%	32%	43%	44%	56%
3	45%	73%	27%	34%	52%	48%
All	**53%**	**67%**	**33%**	**40%**	**43%**	**57%**

Table 4 Ownership of personal washing modes – Southern Water

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	54%	56%	44%	41%	26%	74%
2	55%	67%	33%	42%	43%	57%
3	57%	72%	28%	43%	51%	49%
All	**56%**	**67%**	**33%**	**42%**	**43%**	**57%**

Measured households

Table 5 Ownership of personal washing modes – Western area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	59%	50%	50%	45%	25%	75%
2	56%	60%	40%	42%	32%	68%
3	41%	64%	36%	31%	37%	63%
All	**54%**	**58%**	**42%**	**41%**	**31%**	**69%**

Table 6 Ownership of personal washing modes – Central area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	46%	47%	53%	35%	25%	75%
2	46%	69%	31%	34%	45%	55%
3	47%	70%	30%	35%	49%	51%
All	**46%**	**65%**	**35%**	**35%**	**43%**	**57%**

Table 7 Ownership of personal washing modes – Eastern area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	58%	52%	48%	45%	27%	73%
2	55%	64%	36%	42%	37%	63%
3	42%	64%	36%	32%	38%	62%
All	**53%**	**61%**	**39%**	**41%**	**34%**	**66%**

Table 8 Ownership of personal washing modes – Southern Water

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	55%	50%	50%	42%	26%	74%
2	52%	64%	36%	40%	37%	63%
3	44%	66%	34%	33%	42%	58%
All	**51%**	**61%**	**39%**	**39%**	**36%**	**64%**

All households

Table 9 Ownership of personal washing modes – Western area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	59%	51%	49%	44%	25%	75%
2	56%	60%	40%	42%	32%	68%
3	42%	64%	36%	31%	38%	62%
All	**54%**	**59%**	**41%**	**41%**	**32%**	**68%**

Table 10 Ownership of personal washing modes – Central area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	46%	47%	53%	35%	25%	75%
2	46%	69%	31%	35%	46%	54%
3	51%	71%	29%	38%	50%	50%
All	**48%**	**65%**	**35%**	**36%**	**43%**	**57%**

Table 11 Ownership of personal washing modes – Eastern area

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	58%	52%	48%	44%	27%	73%
2	55%	64%	36%	42%	37%	63%
3	42%	65%	35%	32%	39%	61%
All	**53%**	**62%**	**38%**	**41%**	**35%**	**65%**

Table 12 Ownership of personal washing modes – Southern Water

Customer group	2017-18 ownership (%)			2069-70 ownership (%)		
	Bath	Normal shower	Power shower	Bath	Normal shower	Power shower
1	55%	50%	50%	42%	26%	74%
2	53%	64%	36%	40%	38%	62%
3	46%	67%	33%	34%	43%	57%
All	**52%**	**62%**	**38%**	**39%**	**36%**	**64%**

Frequency of personal washing

Unmeasured households

Table 13 Frequency of personal washing by customer group – Western area

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.07	0.07	0.71	0.72
2	0.07	0.07	0.68	0.68
3	0.07	0.07	0.63	0.63
All	**0.07**	**0.07**	**0.69**	**0.69**

Table 14 Frequency of personal washing by customer group – Central area

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.07	0.07	0.87	0.87
2	0.06	0.06	0.86	0.86
3	0.07	0.07	0.87	0.87
All	**0.06**	**0.06**	**0.86**	**0.87**

Table 15 Frequency of personal washing by customer group – Easterna area

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.07	0.07	0.83	0.84
2	0.07	0.07	0.79	0.80
3	0.04	0.04	0.79	0.80
All	**0.06**	**0.07**	**0.80**	**0.81**

Table 16 Frequency of personal washing by customer group – Southern Water

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.07	0.07	0.78	0.79
2	0.06	0.07	0.78	0.79
3	0.06	0.06	0.82	0.83
All	**0.06**	**0.06**	**0.79**	**0.80**

Measured households

Table 17 Frequency of personal washing by customer group – Western area

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.14	0.14	0.71	0.73
2	0.09	0.09	0.68	0.70
3	0.08	0.09	0.62	0.64
All	**0.10**	**0.10**	**0.68**	**0.70**

Table 18 Frequency of personal washing by customer group – Central area

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.10	0.11	0.75	0.77
2	0.09	0.10	0.71	0.73
3	0.09	0.09	0.67	0.69
All	**0.09**	**0.10**	**0.71**	**0.73**

Table 19 Frequency of personal washing by customer group – Easterna area

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.08	0.09	0.73	0.76
2	0.09	0.09	0.70	0.72
3	0.09	0.09	0.62	0.64
All	**0.09**	**0.09**	**0.70**	**0.72**

Table 20 Frequency of personal washing by customer group – Southern Water

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.11	0.11	0.73	0.75
2	0.09	0.09	0.69	0.72
3	0.09	0.09	0.64	0.66
All	**0.09**	**0.10**	**0.69**	**0.72**

All households

Table 21 Frequency of personal washing by customer group – Western area

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.12	0.13	0.71	0.73
2	0.09	0.09	0.68	0.70
3	0.08	0.09	0.62	0.64
All	**0.10**	**0.10**	**0.68**	**0.70**

Table 22 Frequency of personal washing by customer group – Central area

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.10	0.10	0.76	0.78
2	0.09	0.09	0.73	0.74
3	0.08	0.08	0.73	0.73
All	**0.09**	**0.09**	**0.73**	**0.75**

Table 23 Frequency of personal washing by customer group – Easterna area

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.08	0.09	0.75	0.77
2	0.09	0.09	0.71	0.73
3	0.08	0.08	0.66	0.66
All	**0.08**	**0.09**	**0.71**	**0.73**

Table 24 Frequency of personal washing by customer group – Southern Water

Customer group	Frequency (times/person/day)			
	Bath (2017-18)	Bath (2069-70)	Shower (2017-18)	Shower (2069-70)
1	0.10	0.11	0.73	0.76
2	0.09	0.09	0.70	0.72
3	0.08	0.08	0.68	0.68
All	**0.09**	**0.09**	**0.71**	**0.72**

Volumetric forecast for personal washing

Unmeasured households

Figure 1 Personal washing volume forecast – Western area

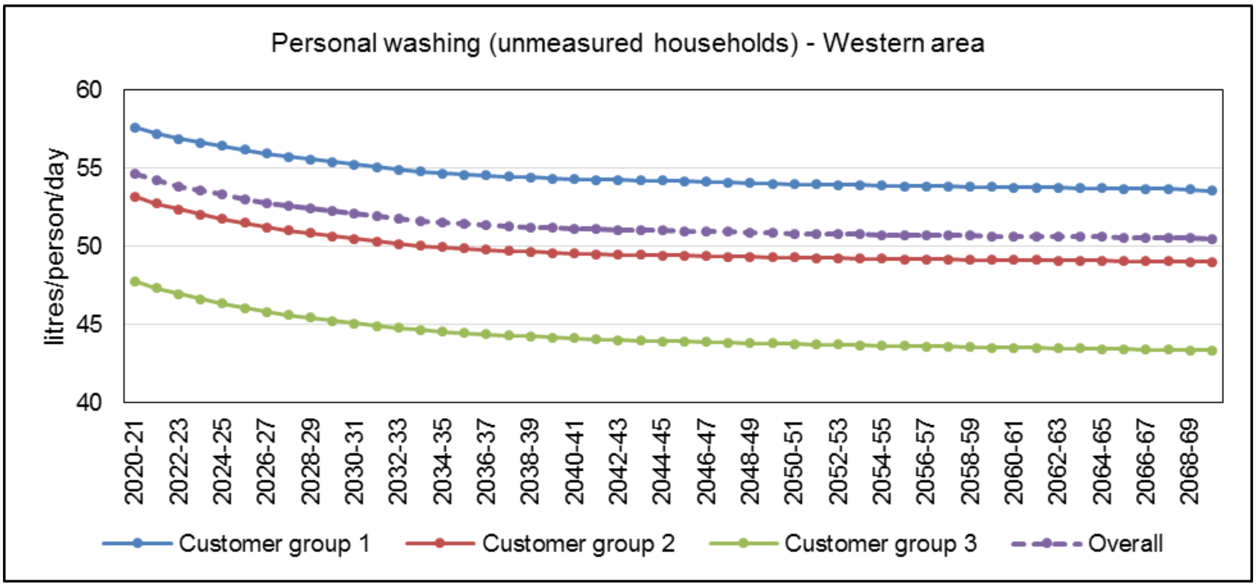


Figure 2 Personal washing volume forecast – Central area

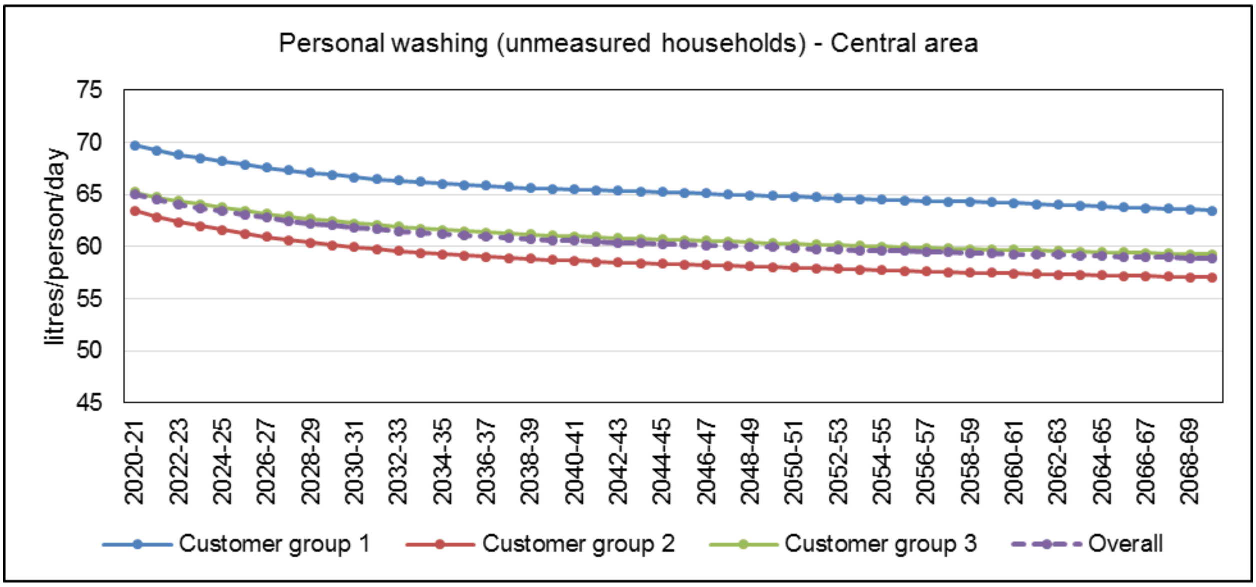


Figure 3 Personal washing volume forecast – Eastern area

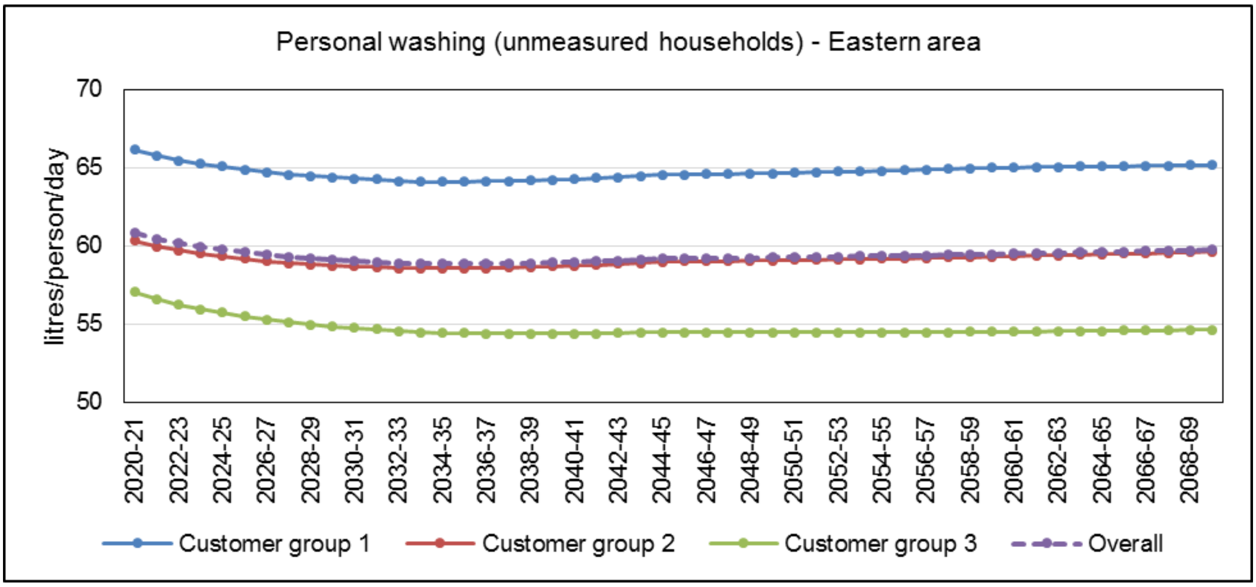
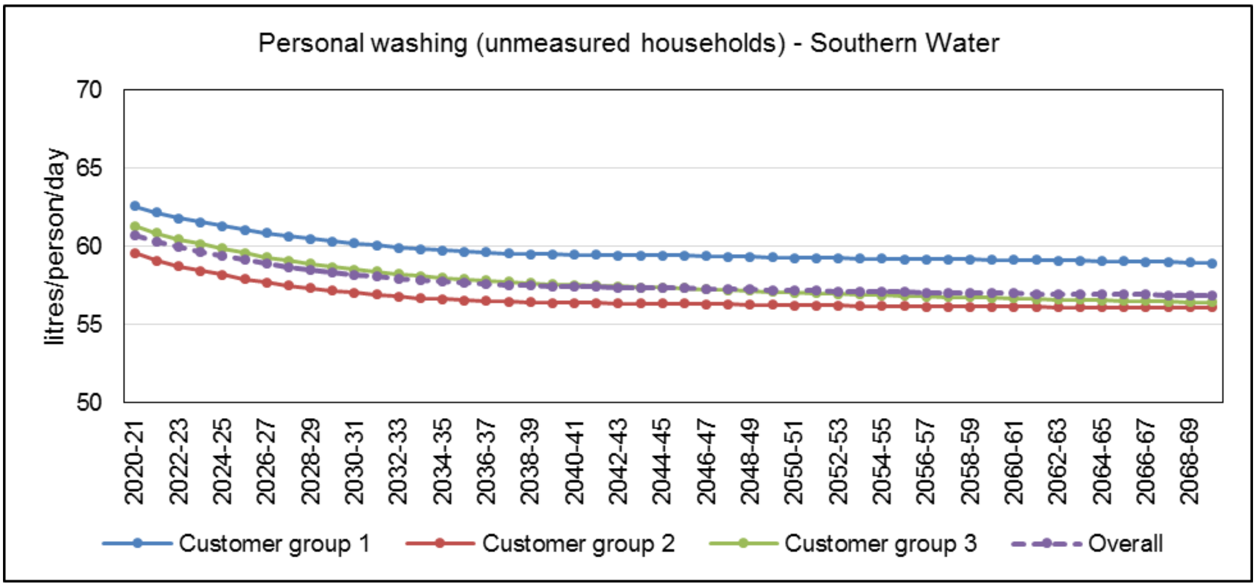


Figure 4 Personal washing volume forecast – Southern Water



Measured households

Figure 5 Personal washing volume forecast – Western area

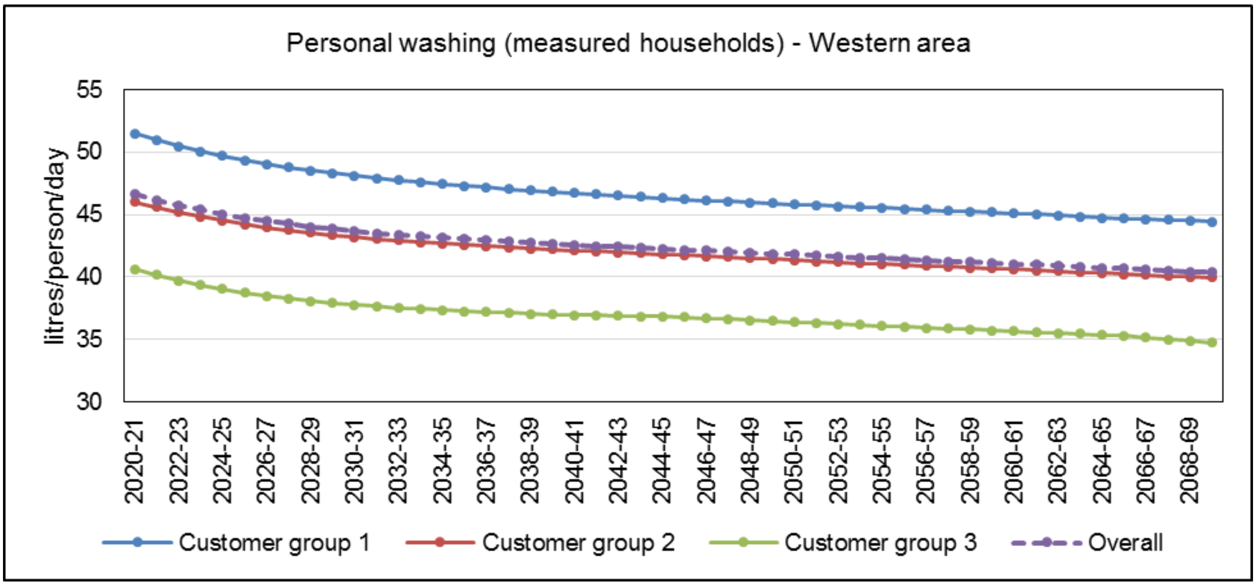


Figure 6 Personal washing volume forecast – Central area

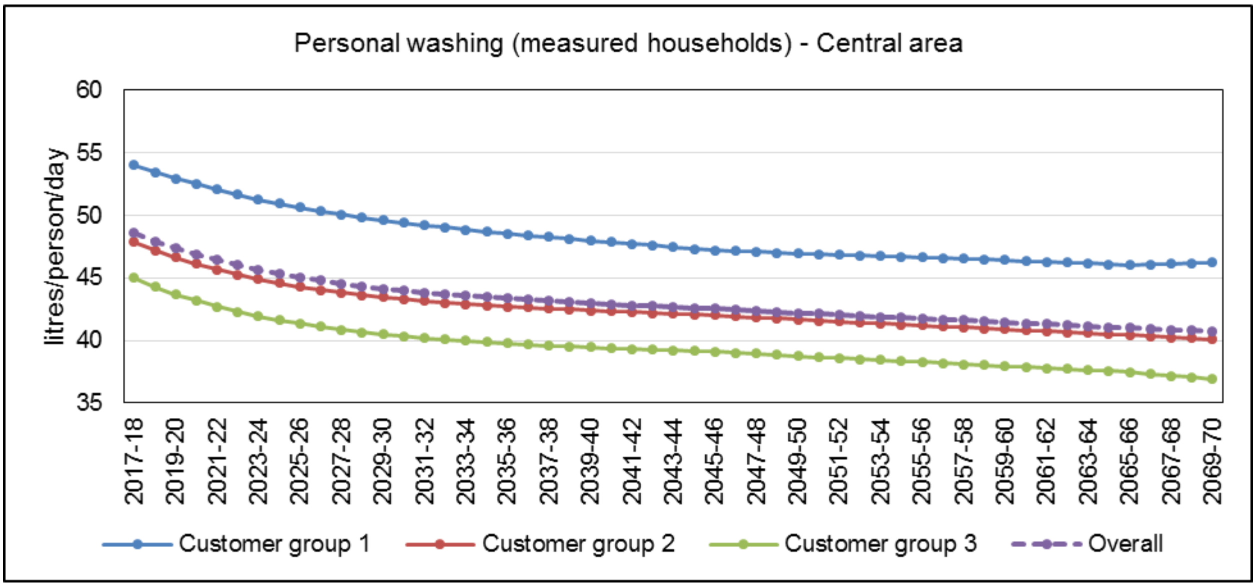


Figure 7 Personal washing volume forecast – Eastern area

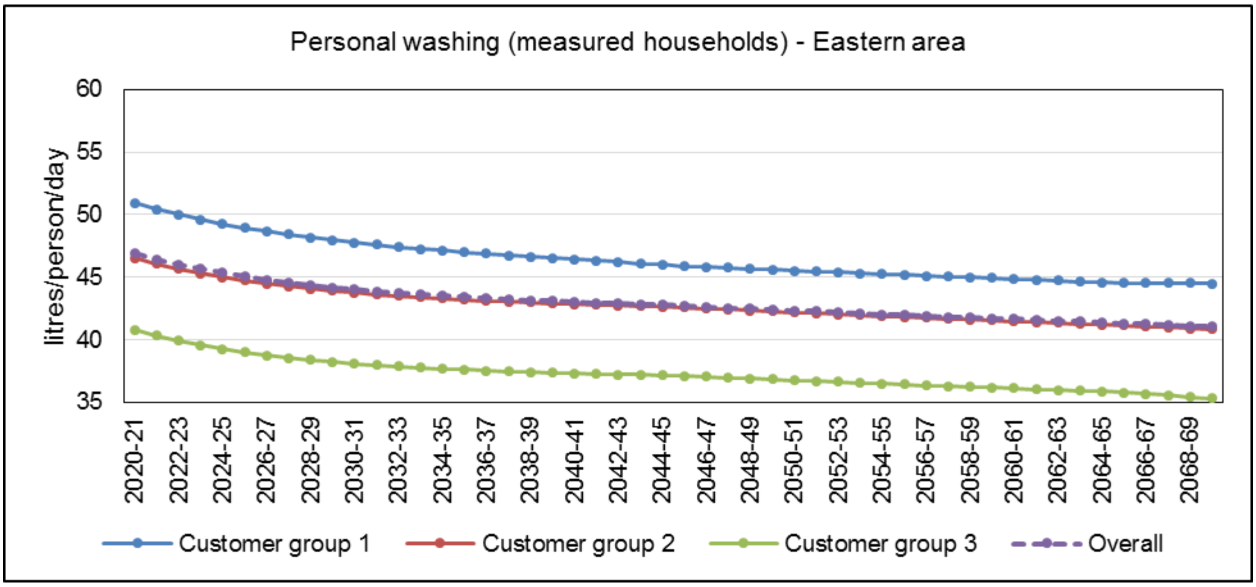
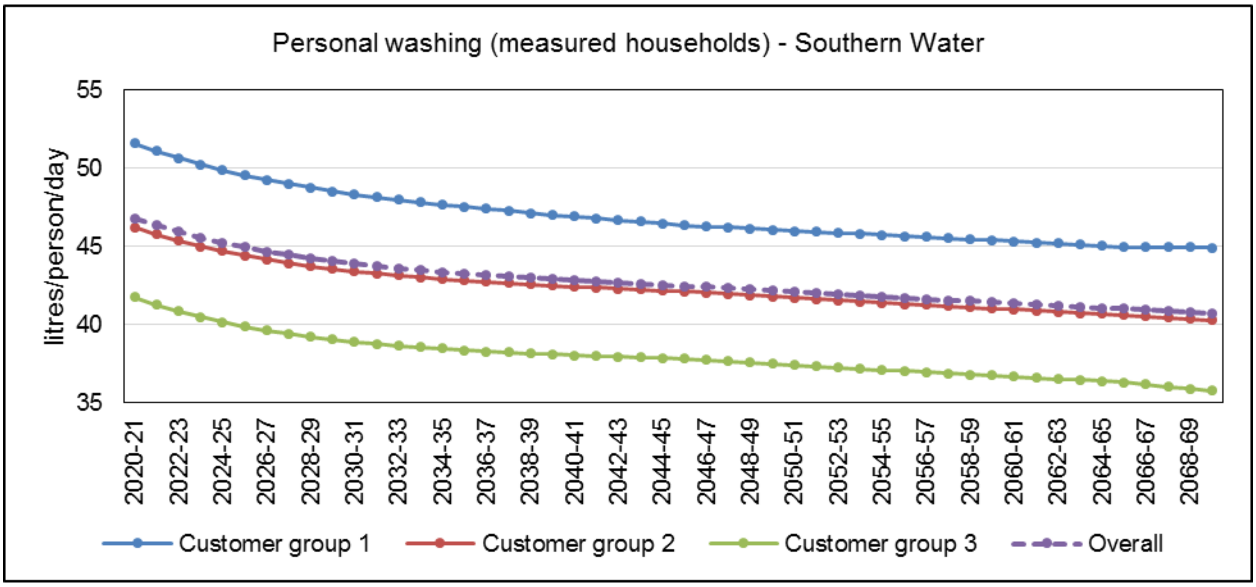


Figure 8 Personal washing volume forecast – Southern Water



All households

Figure 9 Personal washing volume forecast – Western area

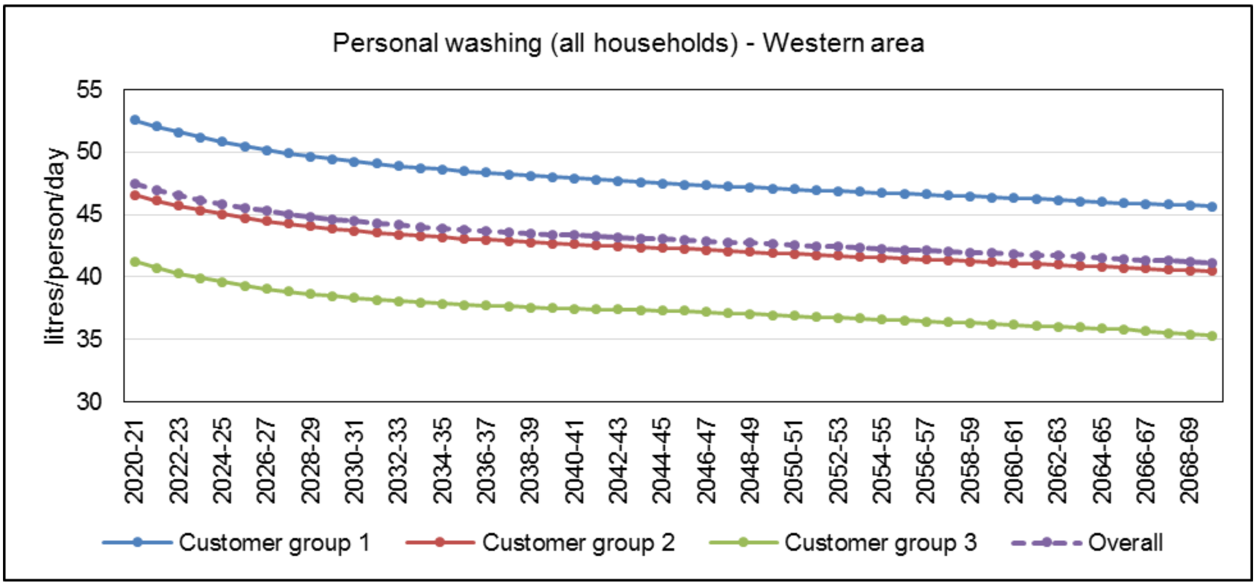


Figure 10 Personal washing volume forecast – Central area

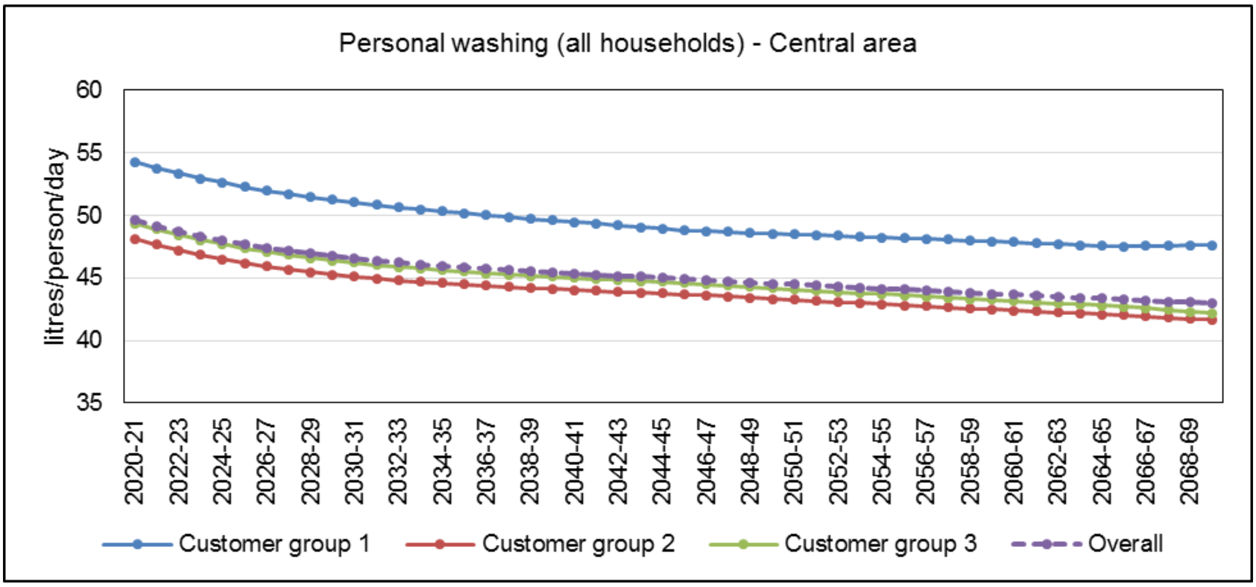


Figure 11 Personal washing volume forecast – Eastern area

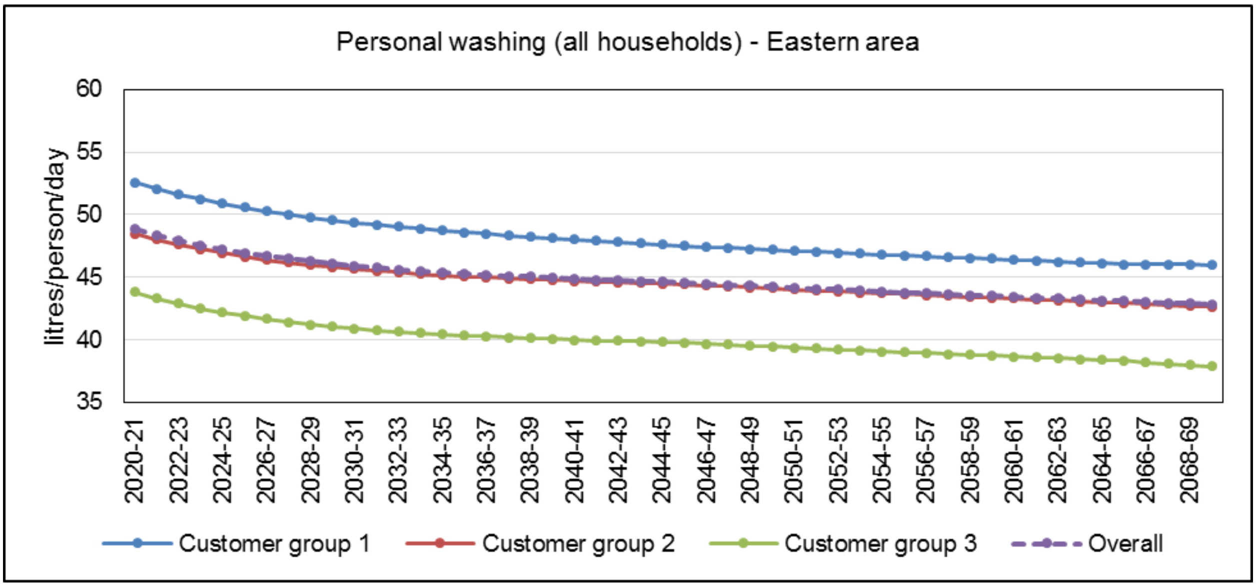
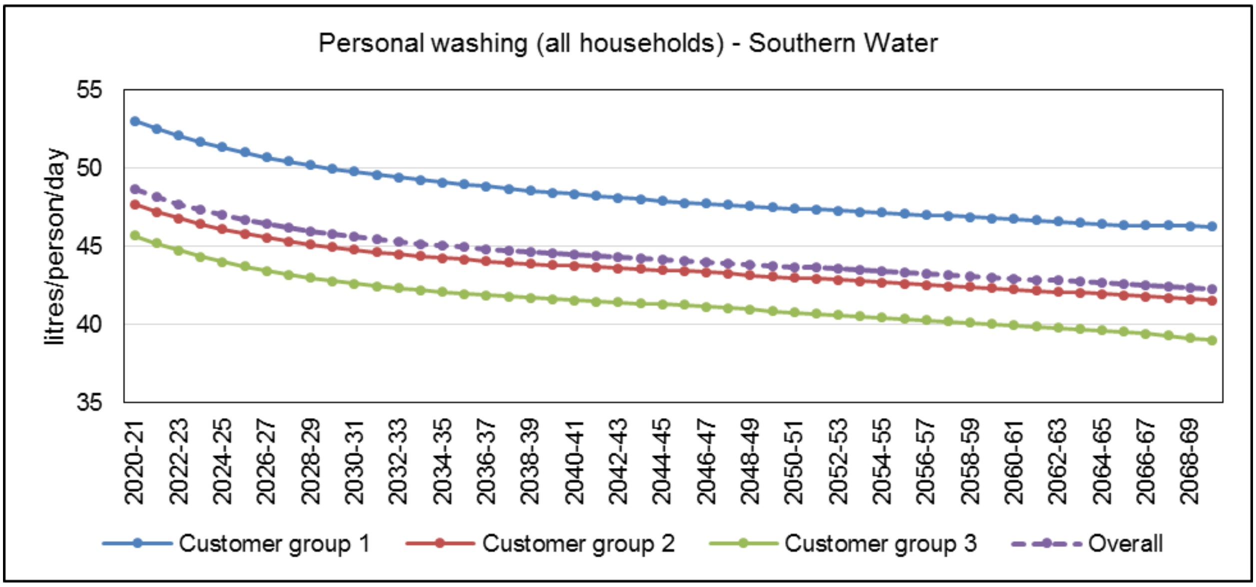


Figure 12 Personal washing volume forecast – Southern Water



Water Resources Management Plan 2019

Annex 2: Demand Forecast Appendix E: Clothes washing inputs and outputs by supply area and metering status

December 2019

Version 1

from Southern Water

Ownership

The tables below show the ownership of clothes washing modes by supply area for each customer group. The ownership is assumed to remain unchanged over time.

Unmeasured households

Table 1 Ownership of clothes washing modes – Western area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	32%	32%	97%	96%
Customer group 2	28%	28%	95%	95%
Customer group 3	26%	26%	90%	90%
All	**28%**	**28%**	**94%**	**94%**

Table 2 Ownership of clothes washing modes – Central area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	31%	31%	96%	96%
Customer group 2	31%	31%	93%	93%
Customer group 3	26%	26%	88%	87%
All	**28%**	**28%**	**91%**	**90%**

Table 3 Ownership of clothes washing modes – Eastern area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	28%	28%	97%	97%
Customer group 2	26%	26%	97%	96%
Customer group 3	26%	26%	94%	94%
All	**27%**	**27%**	**96%**	**96%**

Table 4 Ownership of clothes washing modes – Southern Water

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	32%	32%	97%	96%
Customer group 2	28%	28%	95%	95%
Customer group 3	26%	26%	90%	90%
All	**28%**	**28%**	**94%**	**94%**

Measured households

Table 5 Ownership of clothes washing modes – Western area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	40%	40%	99%	99%
Customer group 2	36%	36%	99%	99%
Customer group 3	32%	32%	95%	95%
All	**36%**	**36%**	**98%**	**98%**

Table 6 Ownership of clothes washing modes – Central area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	32%	32%	96%	96%
Customer group 2	29%	29%	93%	93%
Customer group 3	20%	20%	91%	91%
All	**27%**	**27%**	**93%**	**93%**

Table 7 Ownership of clothes washing modes – Eastern area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	26%	26%	99%	99%
Customer group 2	25%	25%	99%	99%
Customer group 3	29%	29%	96%	96%
All	**26%**	**26%**	**98%**	**98%**

Table 8 Ownership of clothes washing modes – Southern Water

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	33%	33%	98%	98%
Customer group 2	31%	30%	97%	97%
Customer group 3	26%	26%	94%	94%
All	**30%**	**30%**	**97%**	**97%**

All households

Table 9 Ownership of clothes washing modes – Western area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	40%	40%	99%	99%
Customer group 2	36%	36%	98%	98%
Customer group 3	31%	31%	95%	95%
All	**36%**	**36%**	**98%**	**98%**

Table 10 Ownership of clothes washing modes – Central area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	32%	32%	96%	96%
Customer group 2	29%	29%	93%	93%
Customer group 3	21%	21%	90%	91%
All	**27%**	**27%**	**93%**	**93%**

Table 11 Ownership of clothes washing modes – Eastern area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	26%	26%	99%	99%
Customer group 2	26%	25%	98%	98%
Customer group 3	28%	29%	95%	96%
All	**26%**	**26%**	**98%**	**98%**

Table 12 Ownership of clothes washing modes – Southern Water

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Washing machine	Washing machine
Customer group 1	33%	33%	98%	98%
Customer group 2	30%	30%	97%	97%
Customer group 3	26%	26%	93%	94%
All	**30%**	**30%**	**96%**	**96%**

Washing machine ownership by generation

The tables below show ownership of washing machines by generation. The term ‘generation’ indicates the age of the washing machine which is then linked to the average volume per use as follows:

Generation 1: over 10 years old; 100litres/use
Generation 2: 6 to 10 years old; 85litres/use
Generation 3: 3 to 5 years old; 55litres/use
Generation 4: less than 3 years old; 50litres/use

Unmeasured households

Table 13 Ownership of washing machine by generation – Western area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	12%	23%	32%	33%	0%	0%	0%	99%
2	3%	22%	43%	31%	0%	0%	1%	99%
3	6%	27%	40%	26%	0%	0%	1%	99%
All	**7%**	**23%**	**39%**	**31%**	**0%**	**0%**	**1%**	**99%**

Table 14 Ownership of washing machine by generation – Central area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	5%	16%	36%	43%	0%	0%	1%	99%
2	12%	19%	42%	27%	0%	0%	1%	99%
3	2%	17%	39%	42%	0%	0%	0%	99%
All	**5%**	**18%**	**40%**	**37%**	**0%**	**0%**	**1%**	**99%**

Table 15 Ownership of washing machine by generation – Eastern area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	8%	19%	31%	42%	0%	0%	0%	100%
2	6%	16%	39%	39%	0%	0%	1%	99%
3	9%	22%	27%	42%	0%	0%	0%	100%
All	**7%**	**18%**	**34%**	**41%**	**0%**	**0%**	**0%**	**99%**

Table 16 Ownership of washing machine by generation – Southern Water

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	9%	20%	33%	38%	0%	0%	0%	99%
2	7%	19%	41%	33%	0%	0%	1%	99%
3	4%	20%	36%	40%	0%	0%	0%	99%
All	**6%**	**19%**	**37%**	**37%**	**0%**	**0%**	**1%**	**99%**

Measured households

Table 17 Ownership of washing machine by generation – Western area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	11%	20%	35%	34%	0%	0%	0%	100%
2	1%	5%	9%	86%	0%	0%	0%	100%
3	2%	7%	10%	81%	0%	0%	0%	100%
All	**2%**	**6%**	**10%**	**83%**	**0%**	**0%**	**0%**	**100%**

Table 18 Ownership of washing machine by generation – Central area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	10%	20%	48%	22%	0%	0%	1%	99%
2	17%	23%	35%	25%	0%	0%	0%	100%
3	9%	17%	40%	34%	0%	0%	0%	100%
All	**13%**	**21%**	**39%**	**27%**	**0%**	**0%**	**0%**	**100%**

Table 19 Ownership of washing machine by generation – Eastern area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	9%	20%	36%	34%	0%	0%	0%	100%
2	9%	19%	34%	39%	0%	0%	0%	100%
3	12%	20%	39%	29%	0%	0%	0%	100%
All	**10%**	**20%**	**35%**	**36%**	**0%**	**0%**	**0%**	**100%**

Table 20 Ownership of washing machine by generation – Southern Water

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	10%	20%	39%	30%	0%	0%	0%	100%
2	12%	21%	34%	32%	0%	0%	0%	100%
3	12%	20%	37%	31%	0%	0%	0%	100%
All	**11%**	**21%**	**36%**	**32%**	**0%**	**0%**	**0%**	**100%**

All households

Table 21 Ownership of washing machine by generation – Western area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	12%	21%	36%	31%	0%	0%	0%	100%
2	10%	22%	36%	33%	0%	0%	0%	100%
3	15%	24%	32%	29%	0%	0%	0%	100%
All	**11%**	**22%**	**35%**	**32%**	**0%**	**0%**	**0%**	**100%**

Table 22 Ownership of washing machine by generation – Central area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	9%	20%	49%	22%	0%	0%	1%	99%
2	17%	23%	36%	25%	0%	0%	0%	100%
3	7%	17%	40%	36%	0%	0%	0%	100%
All	**12%**	**20%**	**39%**	**28%**	**0%**	**0%**	**0%**	**100%**

Table 23 Ownership of washing machine by generation – Eastern area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	9%	20%	36%	35%	0%	0%	0%	100%
2	9%	19%	34%	39%	0%	0%	0%	100%
3	11%	21%	37%	31%	0%	0%	0%	100%
All	**9%**	**19%**	**35%**	**36%**	**0%**	**0%**	**0%**	**100%**

Table 24 Ownership of washing machine by generation – Southern Water

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	10%	20%	39%	30%	0%	0%	0%	100%
2	11%	21%	35%	33%	0%	0%	0%	100%
3	10%	20%	37%	33%	0%	0%	0%	100%
All	**11%**	**21%**	**36%**	**32%**	**0%**	**0%**	**0%**	**100%**

Frequency of clothes washing (hand wash)

Table 25 Frequency of clothes washing by hand – unmeasured households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 3	All	Customer group 1	Customer group 2	Customer group 3	All
Western area	0.53	0.51	0.85	0.55	0.54	0.52	0.86	0.56
Central area	0.64	0.64	0.84	0.73	0.65	0.65	0.86	0.74
Eastern area	0.58	0.55	0.86	0.62	0.60	0.56	0.89	0.64
Southern Water	**0.57**	**0.57**	**0.85**	**0.64**	**0.58**	**0.58**	**0.87**	**0.66**

Table 26 Frequency of clothes washing by hand – measured households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 3	All	Customer group 1	Customer group 2	Customer group 3	All
Western area	0.73	0.59	0.78	0.65	0.80	0.63	0.86	0.70
Central area	0.62	0.55	0.57	0.57	0.68	0.60	0.62	0.62
Eastern area	0.47	0.42	0.73	0.47	0.51	0.46	0.82	0.52
Southern Water	**0.61**	**0.52**	**0.68**	**0.57**	**0.66**	**0.56**	**0.76**	**0.62**

Table 27 Frequency of clothes washing by hand – all households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 3	All	Customer group 1	Customer group 2	Customer group 3	All
Western area	0.70	0.58	0.79	0.64	0.76	0.63	0.86	0.69
Central area	0.62	0.56	0.65	0.59	0.68	0.60	0.68	0.64
Eastern area	0.48	0.44	0.76	0.49	0.52	0.47	0.83	0.53
Southern Water	**0.60**	**0.53**	**0.71**	**0.58**	**0.65**	**0.57**	**0.77**	**0.55**

Frequency of clothes washing (washing machine)

Table 28 Frequency of washing machine use – unmeasured households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 3	All	Customer group 1	Customer group 2	Customer group 3	All
Western area	5.12	5.02	4.45	4.96	5.07	4.97	4.37	4.91
Central area	6.25	6.13	6.26	6.21	6.19	6.07	6.15	6.13
Eastern area	6.13	5.85	5.62	5.84	6.03	5.76	5.48	5.73
Southern Water	**5.69**	**5.73**	**5.88**	**5.78**	**5.63**	**5.66**	**5.77**	**5.69**

Table 29 Frequency of washing machine use – measured households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 3	All	Customer group 1	Customer group 2	Customer group 3	All
Western area	4.86	4.56	4.03	4.54	4.57	4.31	3.68	4.26
Central area	5.64	5.43	4.50	5.21	5.29	5.12	4.16	4.88
Eastern area	5.40	4.82	4.15	4.82	5.02	4.47	3.75	4.46
Southern Water	**5.26**	**4.91**	**4.26**	**4.84**	**4.92**	**4.59**	**3.88**	**4.51**

Table 30 Frequency of washing machine use – all households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 3	All	Customer group 1	Customer group 2	Customer group 3	All
Western area	4.39	4.09	3.40	3.86	4.13	3.87	3.11	3.62
Central area	5.70	5.51	4.97	5.37	5.35	5.20	4.57	5.03
Eastern area	5.48	4.96	4.41	4.96	5.08	4.58	3.95	4.57
Southern Water	**5.11**	**4.80**	**4.39**	**4.71**	**4.79**	**4.49**	**3.98**	**4.38**

Volumetric forecast for clothes washing

Unmeasured households

Figure 1 Clothes washing volume forecast – Western area

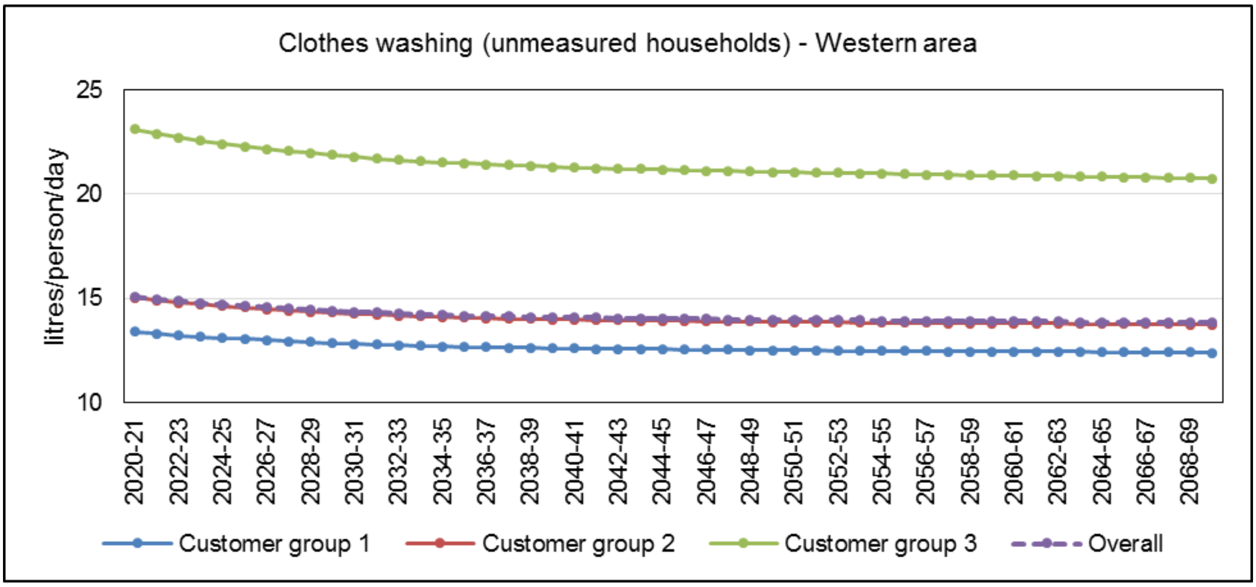


Figure 2 Clothes washing volume forecast – Central area

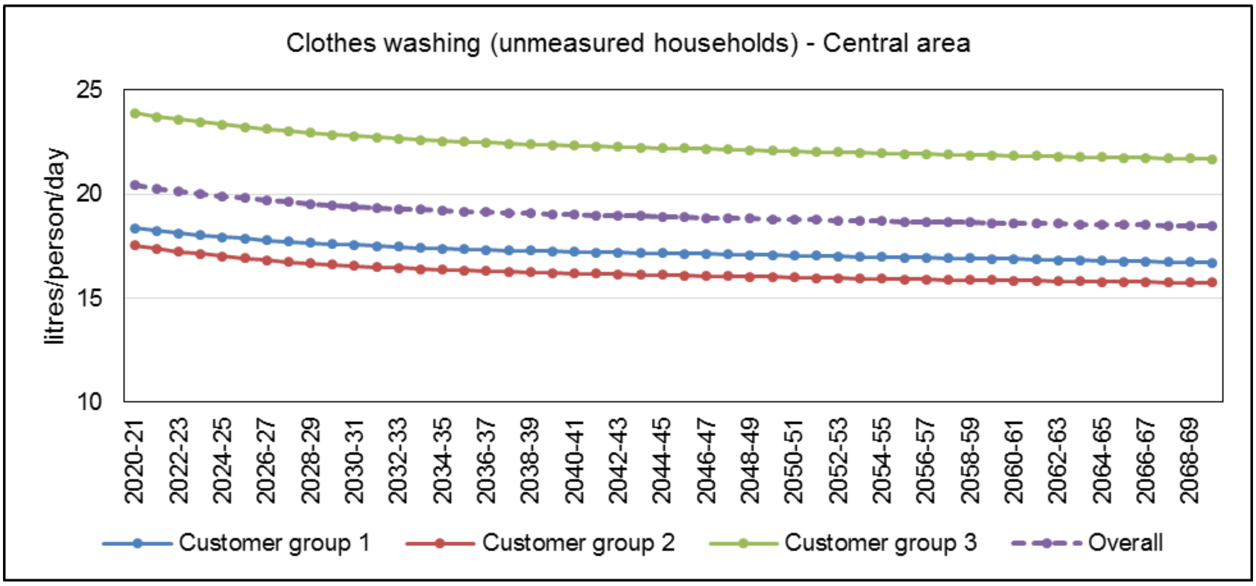


Figure 3 Clothes washing volume forecast – Eastern area

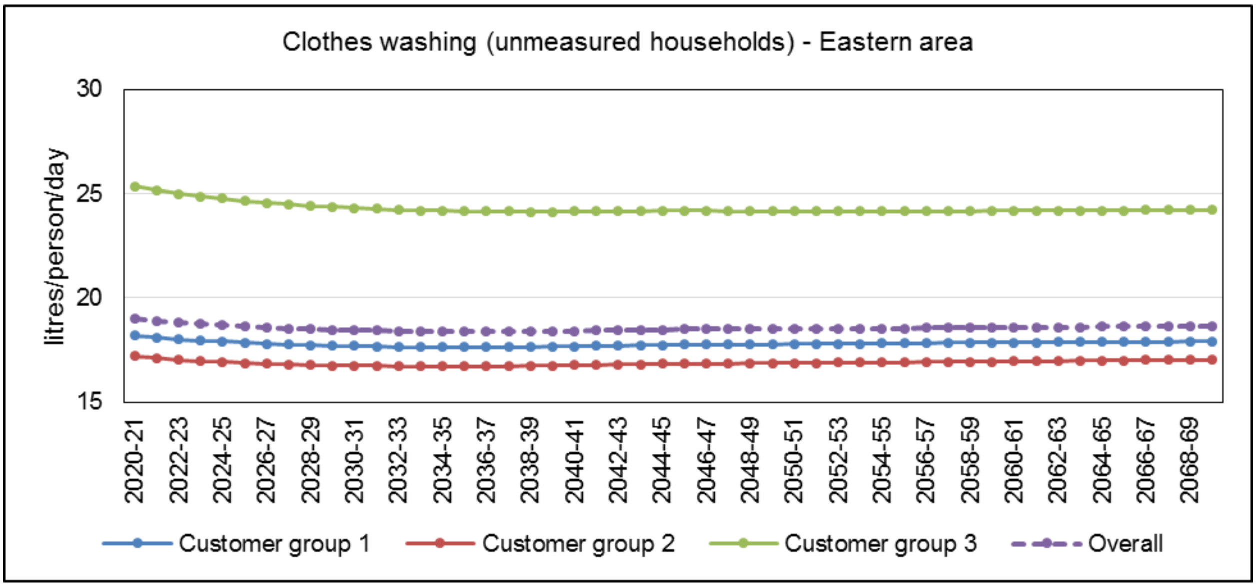
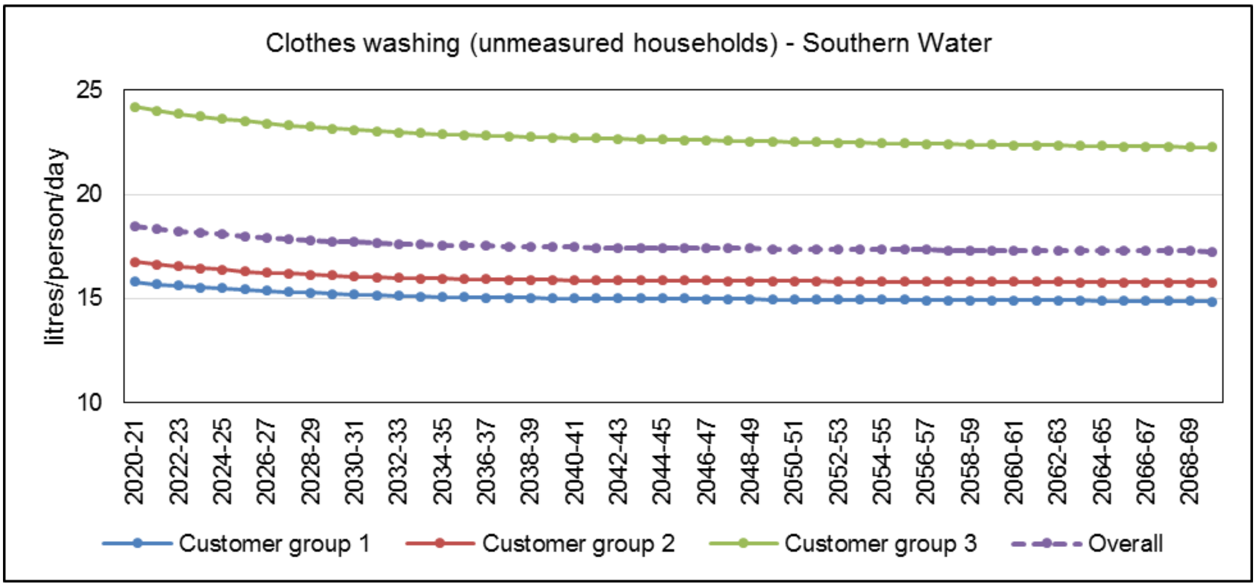


Figure 4 Clothes washing volume forecast – Southern Water



Measured households

Figure 5 Clothes washing volume forecast – Western area

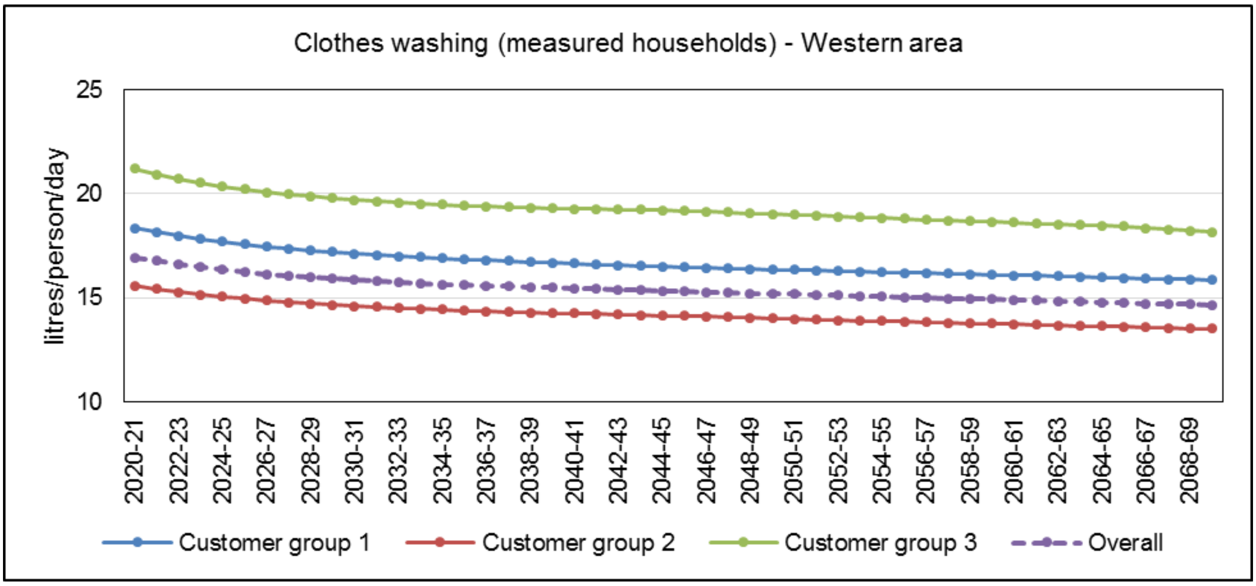


Figure 6 Clothes washing volume forecast – Central area

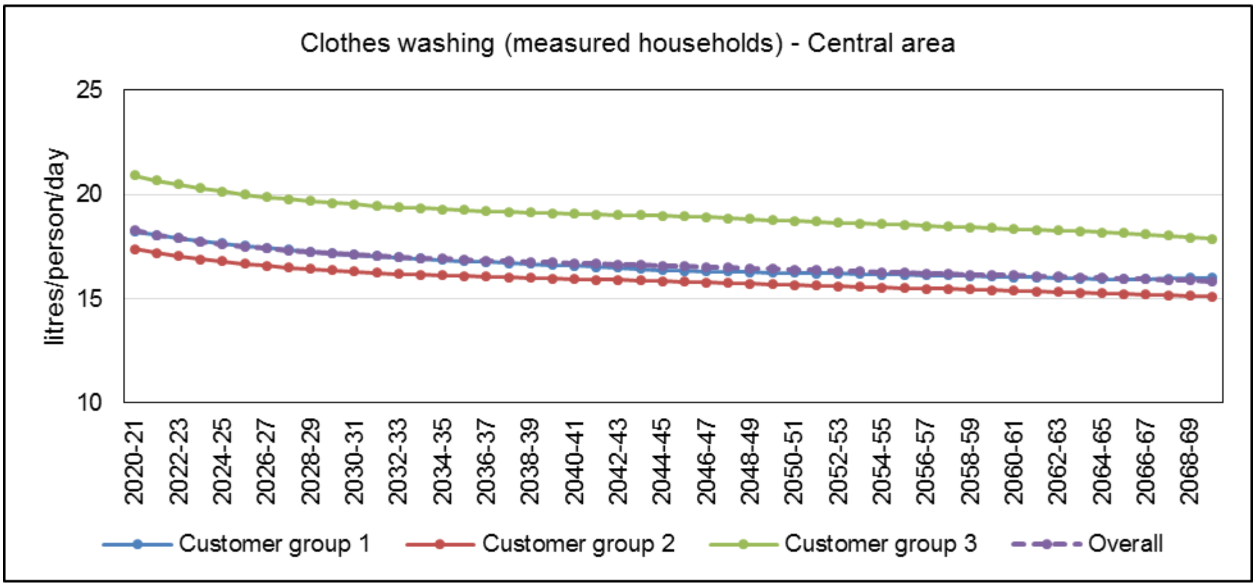


Figure 7 Clothes washing volume forecast – Eastern area

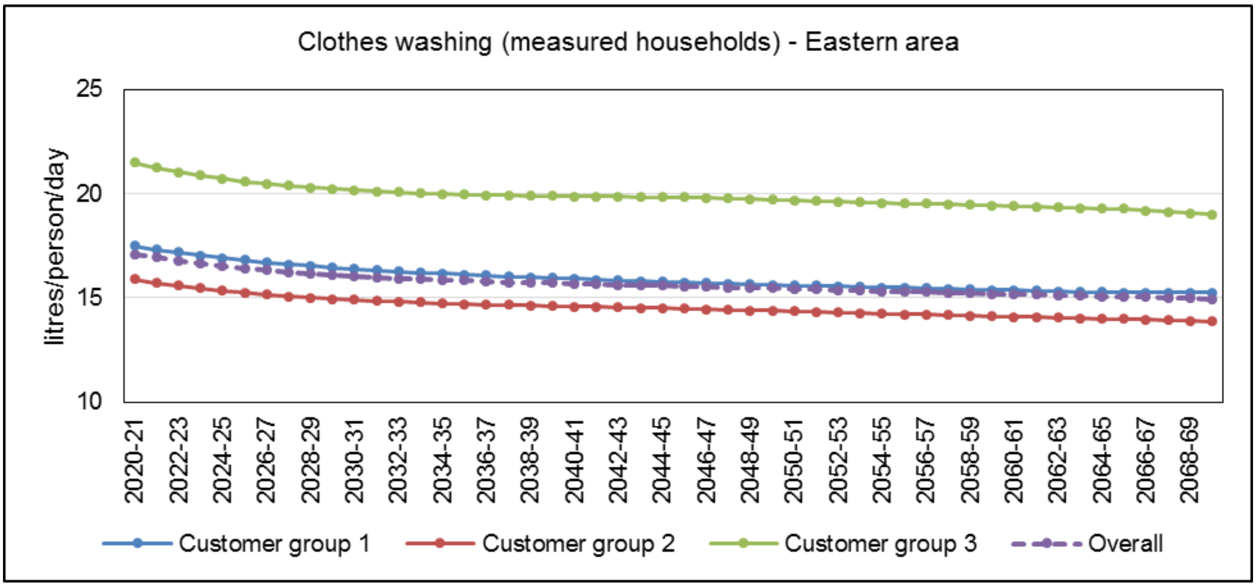
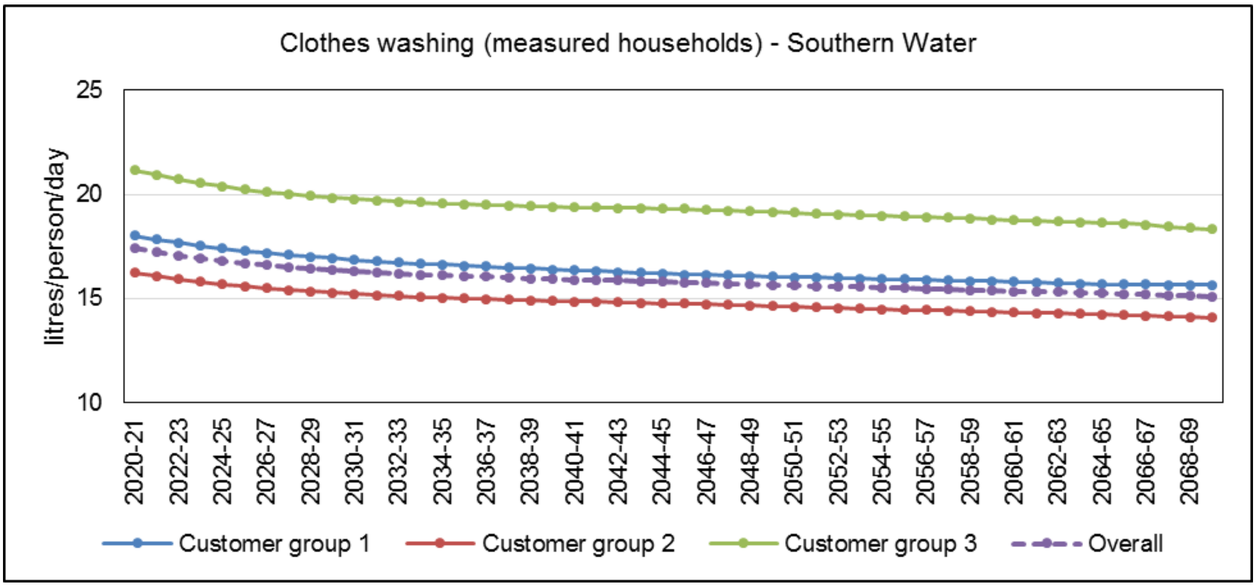


Figure 8 Clothes washing volume forecast – Southern Water



All households

Figure 9 Clothes washing volume forecast – Western area

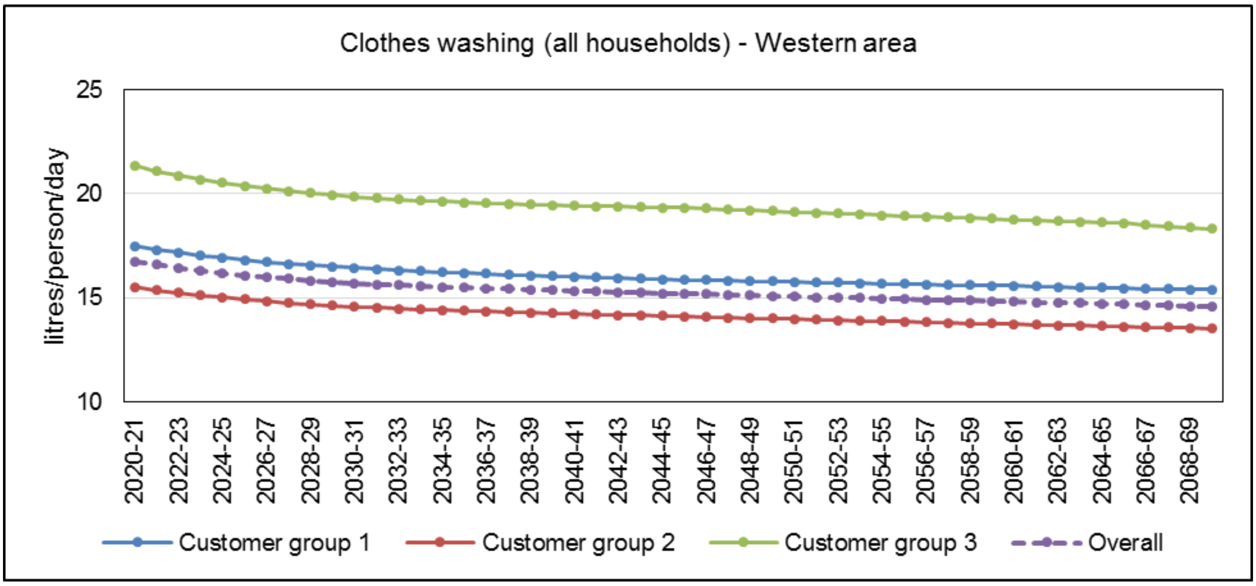


Figure 10 Clothes washing volume forecast – Central area

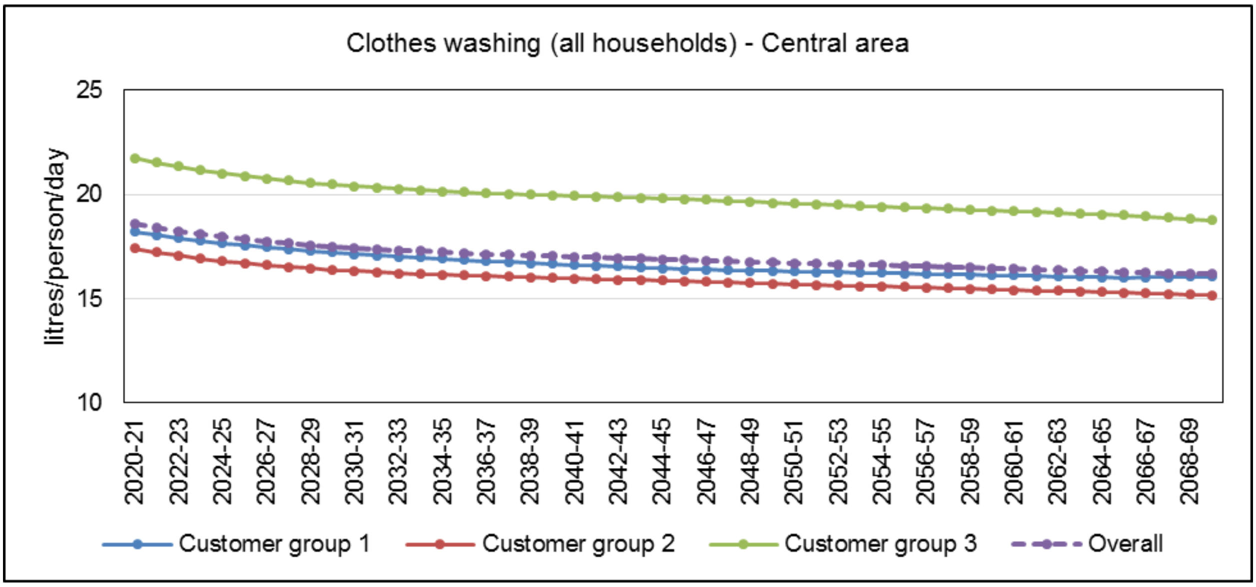


Figure 11 Clothes washing volume forecast – Eastern area

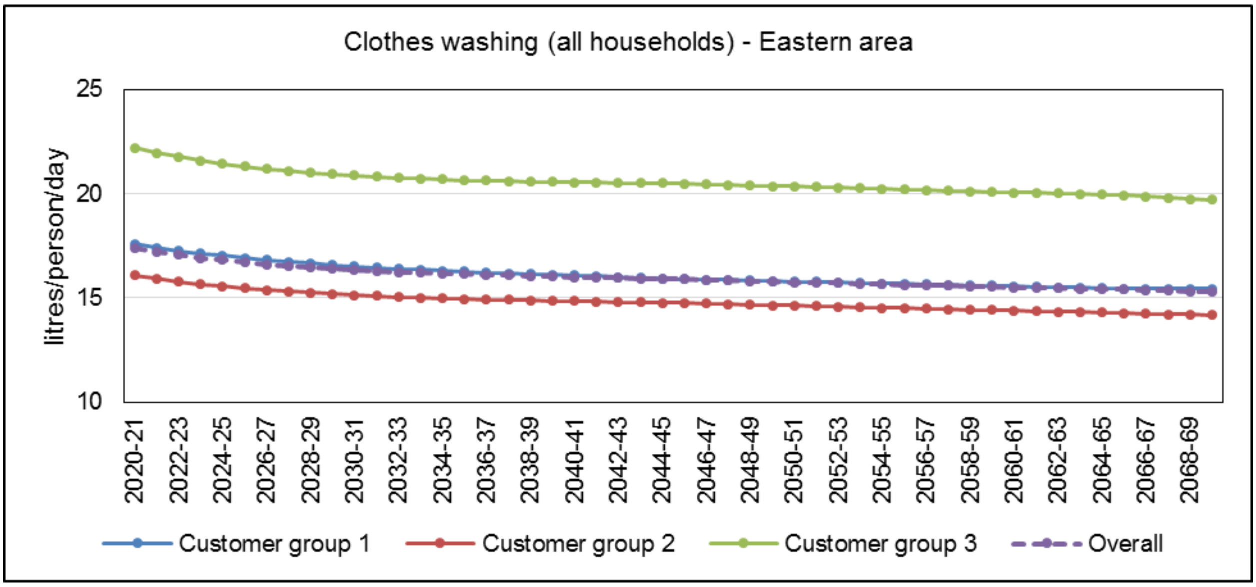
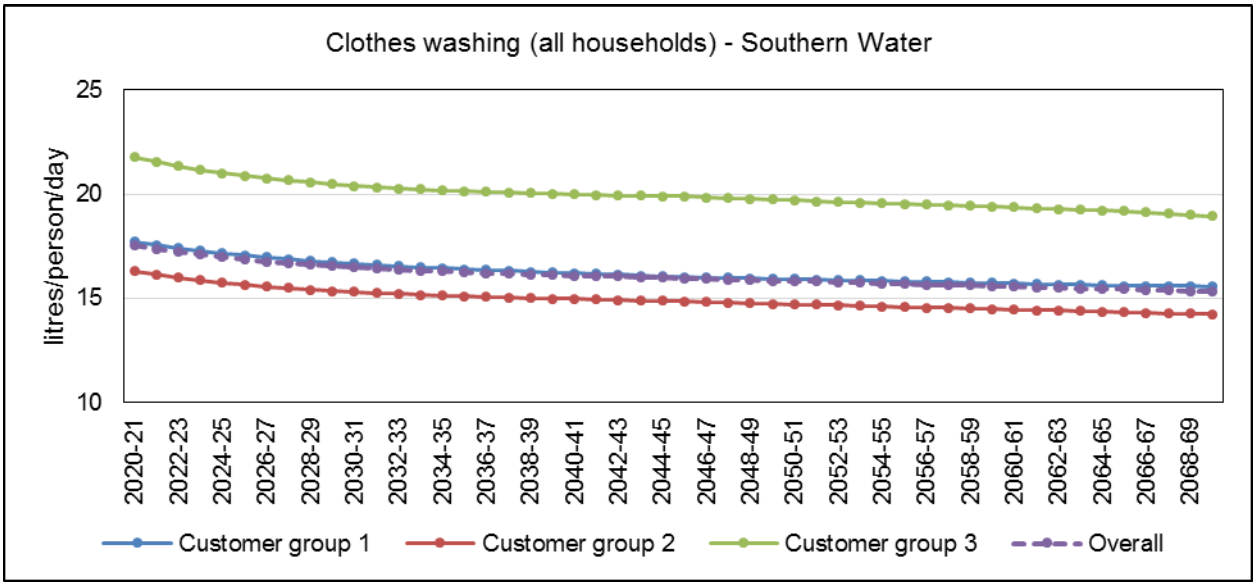


Figure 12 Clothes washing volume forecast – Southern Water



Water Resources Management Plan 2019

Annex 2: Demand Forecast Appendix F: Dish washing inputs and outputs by supply area and metering status

December 2019

Version 1

from Southern Water

Ownership

The tables below show the ownership of dish washing modes by supply area for each customer group. The ownership is assumed to remain unchanged over time.

Unmeasured households

Table 1 Ownership of dish washing modes – Western area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Dishwasher	Dishwasher
1	100%	100%	77%	75%
2	100%	100%	47%	70%
3	100%	100%	23%	38%
All	**100%**	**100%**	**45%**	**59%**

Table 2 Ownership of dish washing modes – Central area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Dishwasher	Dishwasher
1	100%	100%	70%	75%
2	100%	100%	45%	71%
3	100%	100%	23%	37%
All	**100%**	**100%**	**36%**	**53%**

Table 3 Ownership of dish washing modes – Eastern area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Dishwasher	Dishwasher
1	100%	100%	68%	75%
2	100%	100%	41%	66%
3	100%	100%	25%	40%
All	**100%**	**100%**	**41%**	**61%**

Table 4 Ownership of dish washing modes – Southern Water

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Dishwasher	Dishwasher
1	100%	100%	77%	75%
2	100%	100%	47%	70%
3	100%	100%	23%	38%
All	**100%**	**100%**	**45%**	**59%**

Measured households

Table 5 Ownership of dish washing modes – Western area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Dishwasher	Dishwasher
1	100%	100%	75%	74%
2	100%	100%	57%	73%
3	100%	100%	45%	64%
All	**100%**	**100%**	**59%**	**72%**

Table 6 Ownership of dish washing modes – Central area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Dishwasher	Dishwasher
1	100%	100%	75%	75%
2	100%	100%	44%	72%
3	100%	100%	23%	37%
All	**100%**	**100%**	**44%**	**63%**

Table 7 Ownership of dish washing modes – Eastern area

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Dishwasher	Dishwasher
1	100%	100%	76%	75%
2	100%	100%	48%	73%
3	100%	100%	29%	48%
All	**100%**	**100%**	**50%**	**69%**

Table 8 Ownership of dish washing modes – Southern Water

Customer group	2017-18	2069-70	2017-18	2069-70
	Hand wash	Hand wash	Dishwasher	Dishwasher
1	100%	100%	75%	75%
2	100%	100%	50%	73%
3	100%	100%	31%	49%
All	**100%**	**100%**	**52%**	**68%**

All households

Table 9 Ownership of dish washing modes – Western area

Customer group	2017-18 Hand wash	2069-70 Hand wash	2017-18 Dishwasher	2069-70 Dishwasher
1	100%	100%	76%	74%
2	100%	100%	57%	73%
3	100%	100%	43%	63%
All	**100%**	**100%**	**59%**	**71%**

Table 10 Ownership of dish washing modes – Central area

Customer group	2017-18 Hand wash	2069-70 Hand wash	2017-18 Dishwasher	2069-70 Dishwasher
1	100%	100%	75%	75%
2	100%	100%	44%	72%
3	100%	100%	23%	37%
All	**100%**	**100%**	**43%**	**62%**

Table F11 Ownership of dish washing modes – Eastern area

Customer group	2017-18 Hand wash	2069-70 Hand wash	2017-18 Dishwasher	2069-70 Dishwasher
1	100%	100%	75%	75%
2	100%	100%	47%	73%
3	100%	100%	28%	47%
All	**100%**	**100%**	**49%**	**68%**

Table 12 Ownership of dish washing modes – Southern Water

Customer group	2017-18 Hand wash	2069-70 Hand wash	2017-18 Dishwasher	2069-70 Dishwasher
1	100%	100%	75%	75%
2	100%	100%	50%	73%
3	100%	100%	30%	47%
All	**100%**	**100%**	**51%**	**67%**

Dishwasher ownership by generation

The tables below show ownership of dishwashers by generation. The term 'generation' indicates the age of the dishwasher which is then linked to the average volume per use as follows:

Generation 1: over 10 years old; 55litres/use
Generation 2: 6 to 10 years old; 40litres/use
Generation 3: 3 to 5 years old; 15 litres/use
Generation 4: less than 3 years old; 11litres/use

Unmeasured households

Table 13 Ownership of dishwasher by generation – Western area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	9%	32%	39%	19%	0%	1%	9%	89%
2	9%	26%	40%	26%	0%	1%	7%	92%
3	9%	26%	34%	31%	0%	1%	4%	95%
All	**9%**	**29%**	**39%**	**23%**	**0%**	**1%**	**7%**	**92%**

Table 14 Ownership of dishwasher by generation – Central area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	5%	20%	36%	38%	0%	1%	7%	92%
2	8%	17%	34%	40%	0%	0%	4%	95%
3	9%	16%	32%	43%	0%	0%	4%	96%
All	**8%**	**17%**	**34%**	**41%**	**0%**	**0%**	**4%**	**95%**

Table 15 Ownership of dishwasher by generation – Eastern area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	8%	20%	36%	37%	0%	1%	7%	93%
2	6%	23%	34%	37%	0%	1%	4%	95%
3	15%	19%	33%	32%	0%	0%	4%	95%
All	**8%**	**22%**	**34%**	**36%**	**0%**	**1%**	**4%**	**95%**

Table 16 Ownership of dishwasher by generation – Southern Water

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	8%	26%	38%	28%	0%	1%	8%	91%
2	8%	22%	36%	34%	0%	1%	5%	94%
3	10%	18%	33%	39%	0%	0%	4%	95%
All	**8%**	**23%**	**36%**	**33%**	**0%**	**1%**	**5%**	**94%**

Measured households

Table 17 Ownership of dishwasher by generation – Western area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	14%	27%	33%	26%	0%	1%	5%	95%
2	11%	24%	33%	32%	0%	0%	4%	96%
3	21%	29%	23%	27%	0%	1%	2%	97%
All	**13%**	**26%**	**32%**	**29%**	**0%**	**1%**	**4%**	**96%**

Table 18 Ownership of dishwasher by generation – Central area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	6%	20%	32%	42%	0%	1%	5%	95%
2	4%	23%	32%	41%	0%	0%	3%	97%
3	3%	18%	24%	55%	0%	0%	2%	98%
All	**4%**	**21%**	**31%**	**44%**	**0%**	**0%**	**3%**	**97%**

Table 19 Ownership of dishwasher by generation – Eastern area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	13%	20%	38%	29%	0%	0%	4%	95%
2	10%	24%	30%	36%	0%	0%	2%	97%
3	15%	13%	40%	32%	0%	0%	3%	97%
All	**12%**	**21%**	**34%**	**33%**	**0%**	**0%**	**3%**	**97%**

Table 20 Ownership of dishwasher by generation – Southern Water

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	12%	23%	34%	31%	0%	1%	4%	95%
2	8%	24%	32%	36%	0%	0%	3%	97%
3	14%	21%	28%	37%	0%	0%	2%	97%
All	**10%**	**23%**	**32%**	**34%**	**0%**	**0%**	**3%**	**97%**

All households

Table 21 Ownership of dishwasher by generation – Western area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	13%	28%	34%	25%	0%	1%	5%	94%
2	10%	24%	34%	32%	0%	1%	4%	96%
3	20%	29%	24%	27%	0%	1%	2%	97%
All	**13%**	**26%**	**33%**	**29%**	**0%**	**1%**	**4%**	**96%**

Table 22 Ownership of dishwasher by generation – Central area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	6%	20%	32%	42%	0%	1%	5%	95%
2	4%	22%	33%	41%	0%	0%	3%	97%
3	5%	18%	26%	52%	0%	0%	2%	97%
All	**5%**	**21%**	**31%**	**43%**	**0%**	**0%**	**3%**	**97%**

Table 23 Ownership of dishwasher by generation – Eastern area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	13%	20%	38%	30%	0%	0%	4%	95%
2	9%	24%	31%	36%	0%	0%	2%	97%
3	15%	14%	39%	32%	0%	0%	3%	97%
All	**11%**	**21%**	**34%**	**33%**	**0%**	**0%**	**3%**	**97%**

Table 24 Ownership of dishwasher by generation – Southern Water

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Generation 1	Generation 2	Generation 3	Generation 4	Generation 1	Generation 2	Generation 3	Generation 4
1	11%	23%	35%	31%	0%	1%	5%	95%
2	8%	24%	33%	36%	0%	0%	3%	97%
3	13%	21%	29%	37%	0%	0%	3%	97%
All	**10%**	**23%**	**33%**	**34%**	**0%**	**0%**	**3%**	**96%**

Frequency of dish washing (by hand in households which also own a dishwasher)

Table 25 Frequency of dish washing by hand – unmeasured households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 3	All	Customer group 1	Customer group 2	Customer group 3	All
Western area	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Central area	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Eastern area	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Southern Water	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**

Table 26 Frequency of dish washing by hand – measured households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 1	Customer group 2	Customer group 1	Customer group 2	Customer group 1	Customer group 2
Western area	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Central area	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Eastern area	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Southern Water	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**

Table 27 Frequency of dish washing by hand – all households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 1	Customer group 2	Customer group 1	2	3	All
Western area	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Central area	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Eastern area	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Southern Water	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**

Frequency of dish washing (dishwasher)

Table 28 Frequency of washing machine use – unmeasured households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 1	Customer group 2	Customer group 1	Customer group 2	Customer group 1	Customer group 2
Western area	5.26	4.90	4.82	5.02	5.22	4.85	4.76	4.97
Central area	6.38	6.47	6.62	6.54	6.33	6.41	6.54	6.47
Eastern area	6.39	6.28	6.23	6.29	6.31	6.20	6.12	6.20
Southern Water	**5.87**	**5.99**	**6.31**	**6.08**	**5.81**	**5.93**	**6.22**	**6.01**

Table 29 Frequency of washing machine use – measured households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 1	Customer group 2	Customer group 1	Customer group 2	Customer group 1	Customer group 2
Western area	5.25	4.82	4.51	4.86	5.20	4.77	4.46	4.82
Central area	5.97	5.36	4.33	5.19	5.94	5.32	4.29	5.16
Eastern area	5.57	5.32	4.76	5.27	5.48	5.24	4.67	5.18
Southern Water	**5.56**	**5.14**	**4.51**	**5.10**	**5.49**	**5.09**	**4.47**	**5.05**

Table 30 Frequency of washing machine use – all households

Area	2017-18 frequency (uses/household/week)				2069-70 frequency (uses/household/week)			
	Customer group 1	Customer group 2	Customer group 1	Customer group 2	Customer group 1	Customer group 2	Customer group 1	Customer group 2
Western area	5.25	4.82	4.54	4.88	5.20	4.77	4.48	4.83
Central area	6.01	5.48	4.94	5.40	5.97	5.41	4.75	5.31
Eastern area	5.66	5.45	5.02	5.41	5.53	5.32	4.83	5.27
Southern Water	**5.59**	**5.23**	**4.86**	**5.22**	**5.52**	**5.15**	**4.71**	**5.13**

Volumetric forecast for dish washing

Unmeasured households

Figure 1 Dish washing volume forecast – Western area

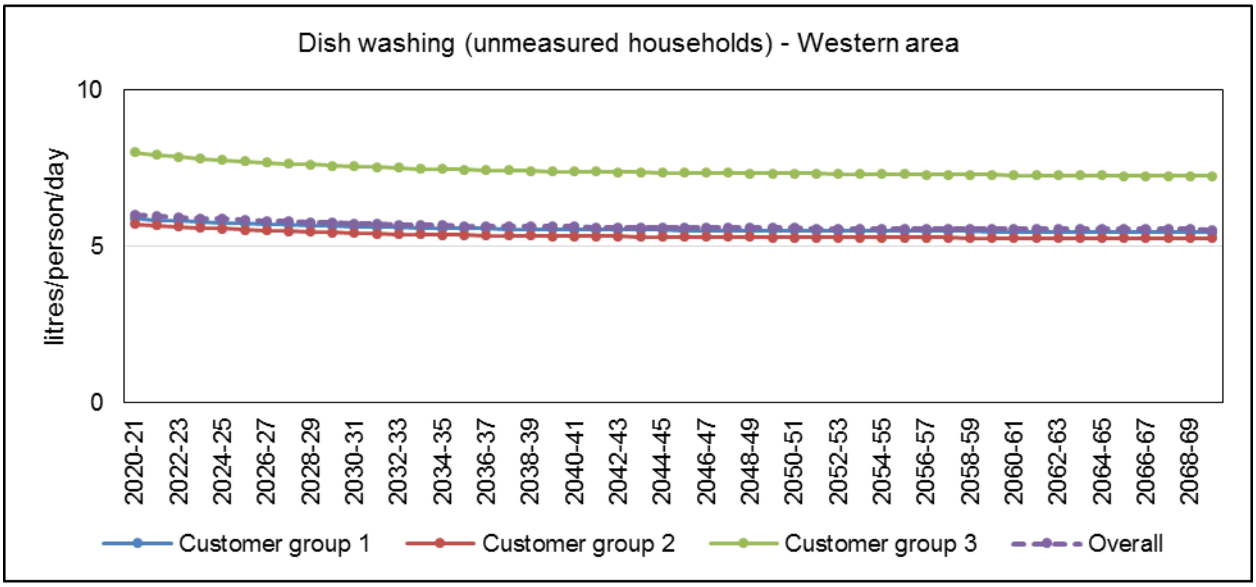


Figure 2 Dish washing volume forecast – Central area

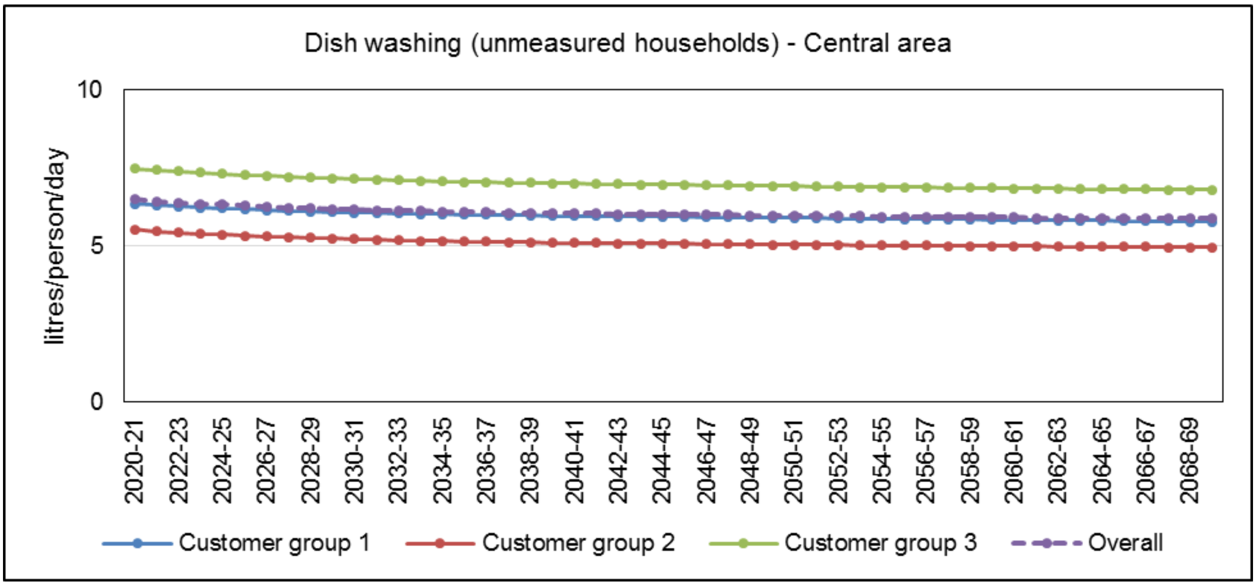


Figure 3 Dish washing volume forecast – Eastern area

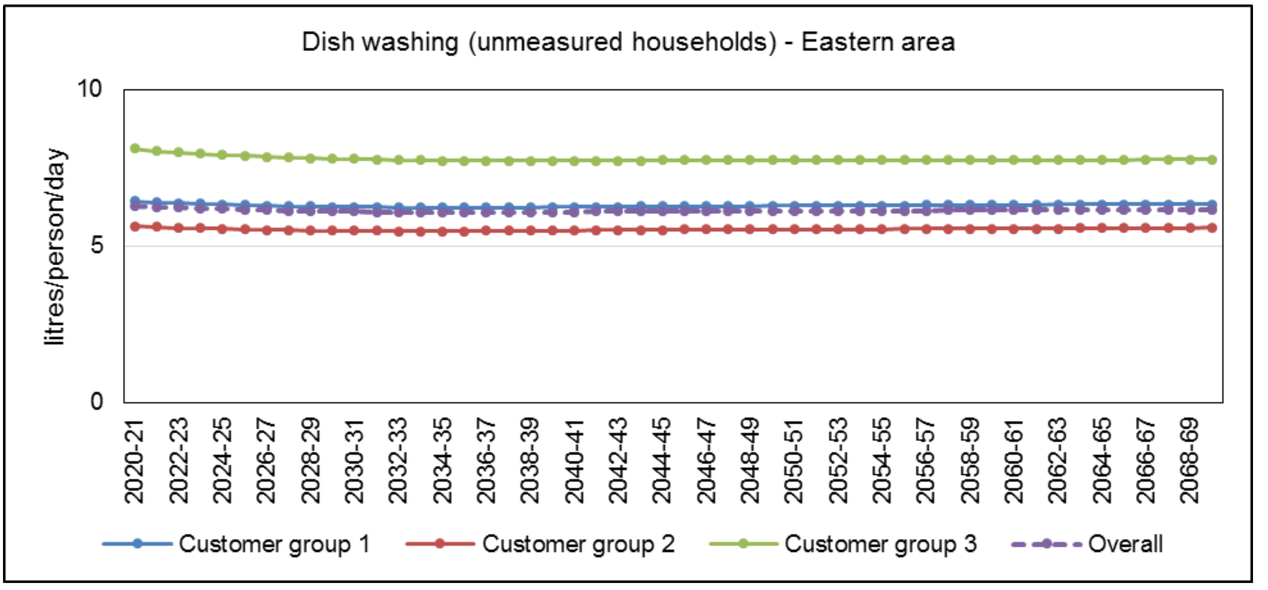
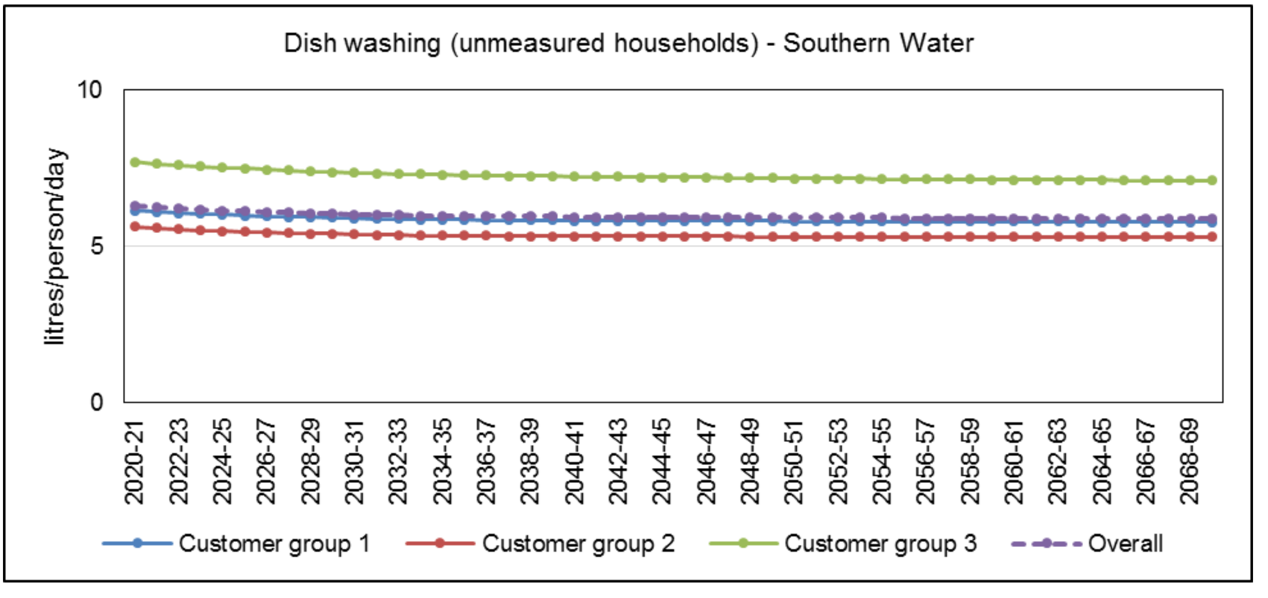


Figure 4 Dish washing volume forecast – Southern Water



Measured households

Figure 5 Dish washing volume forecast – Western area

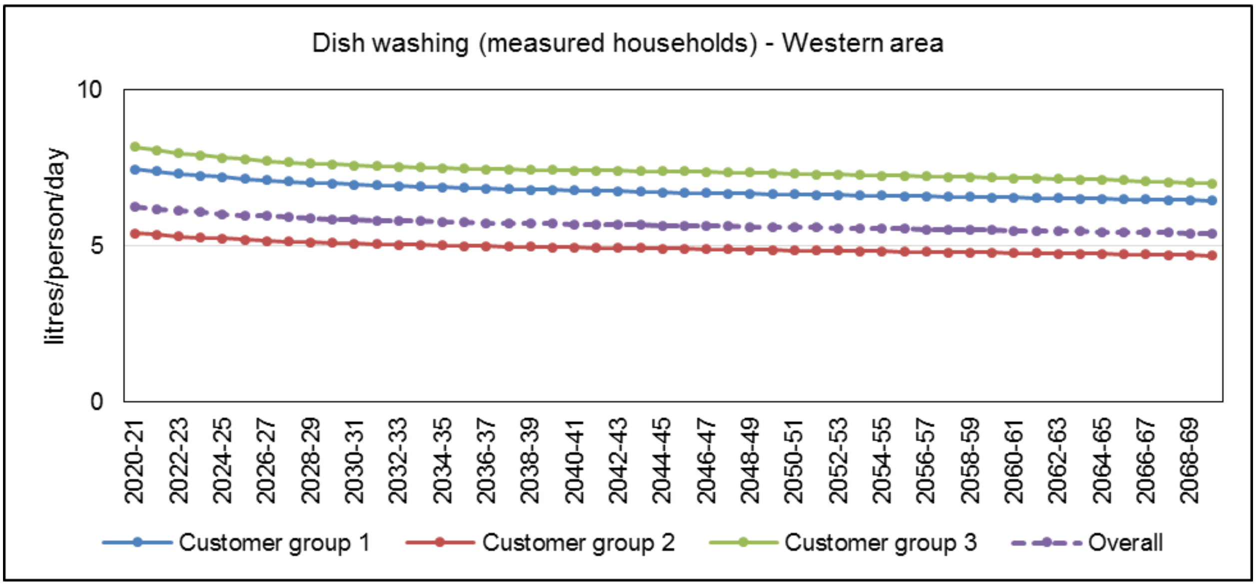


Figure 6 Dish washing volume forecast – Central area

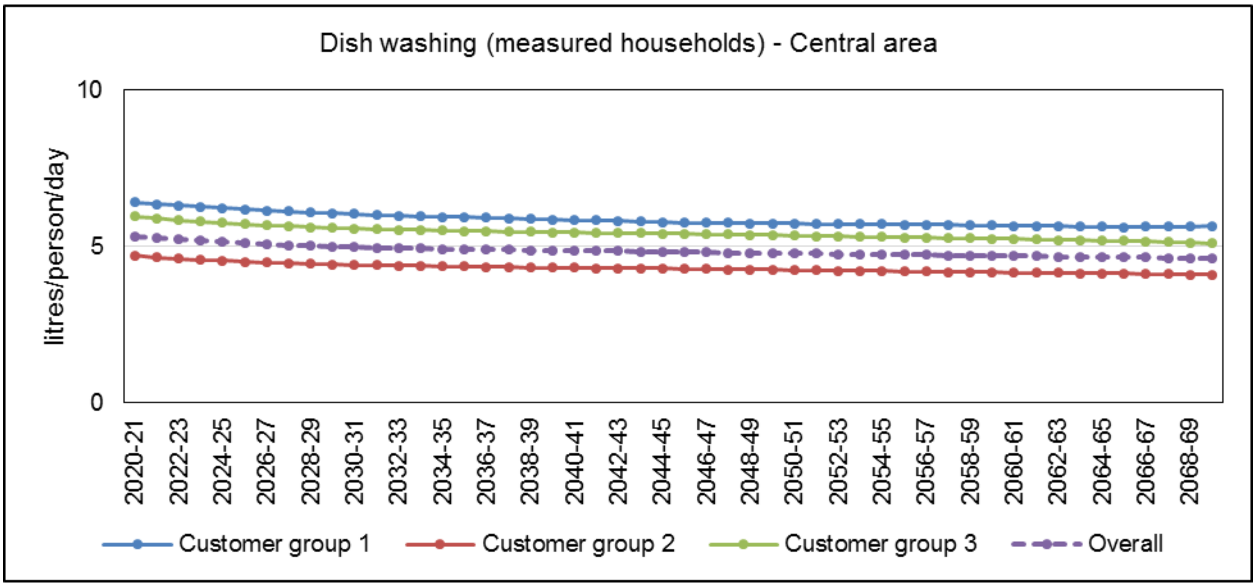


Figure 7 Dish washing volume forecast – Eastern area

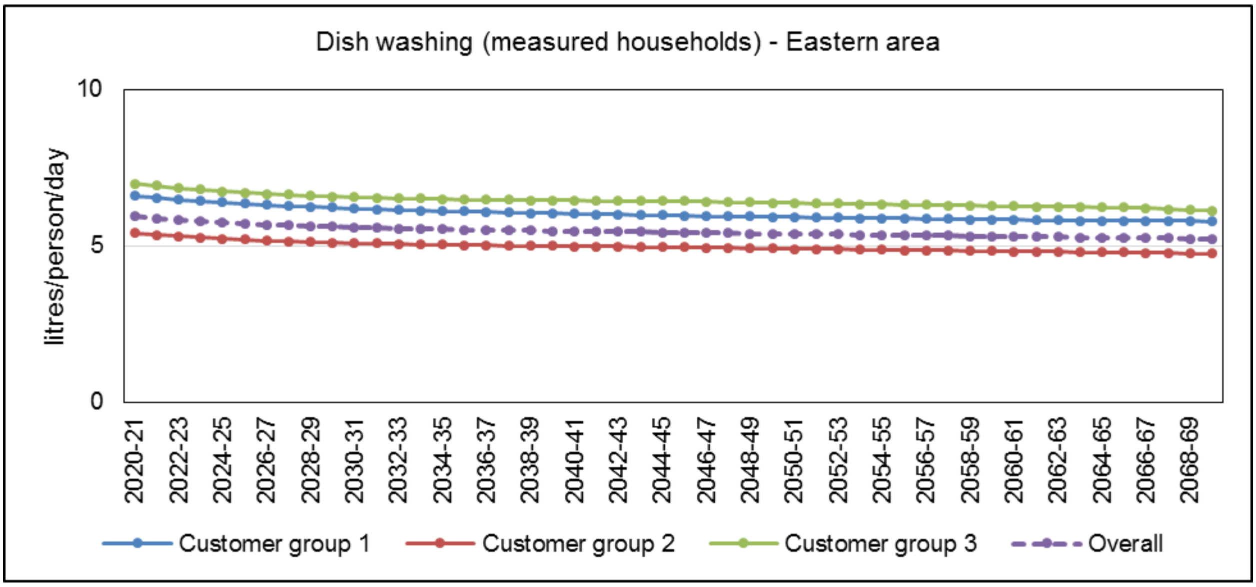
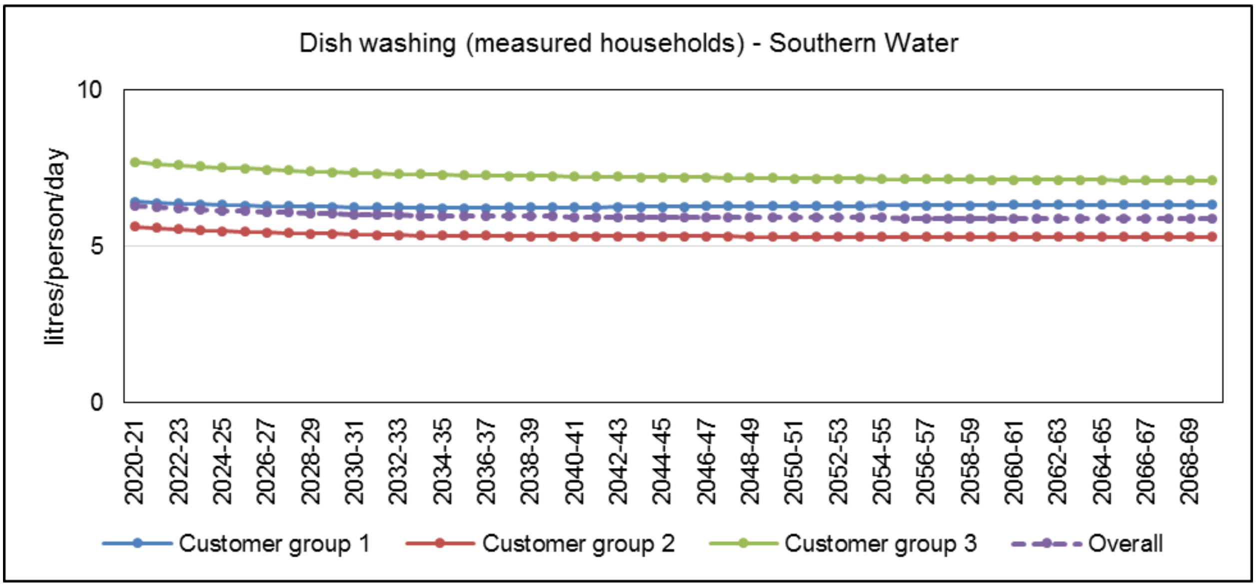


Figure 8 Dish washing volume forecast – Southern Water



All households

Figure 9 Dish washing volume forecast – Western area

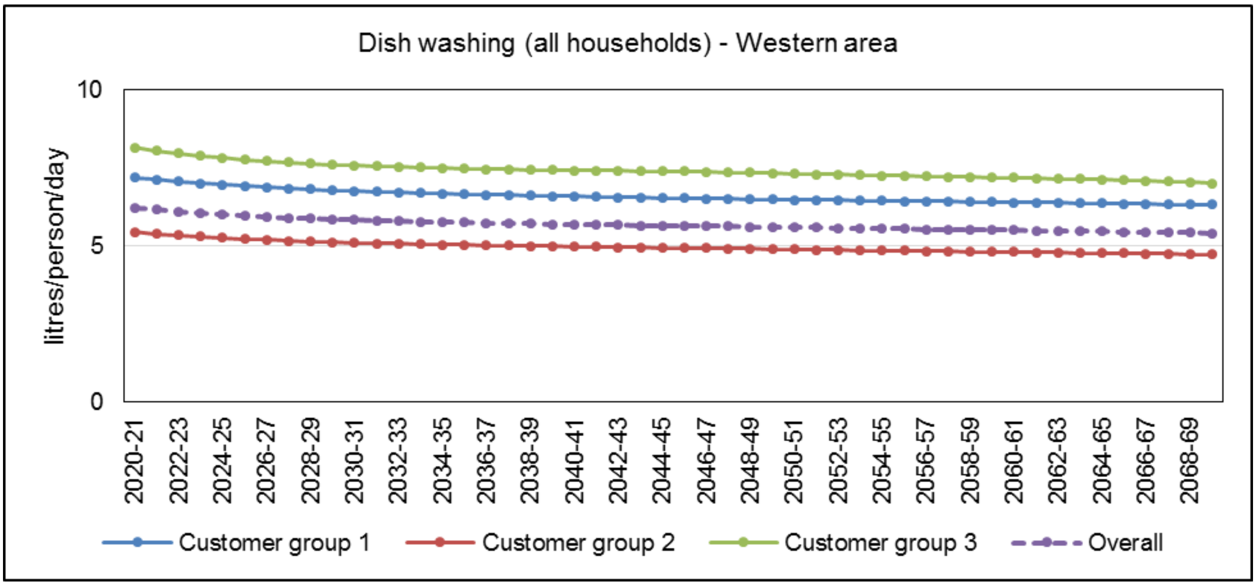


Figure 10 Dish washing volume forecast – Central area

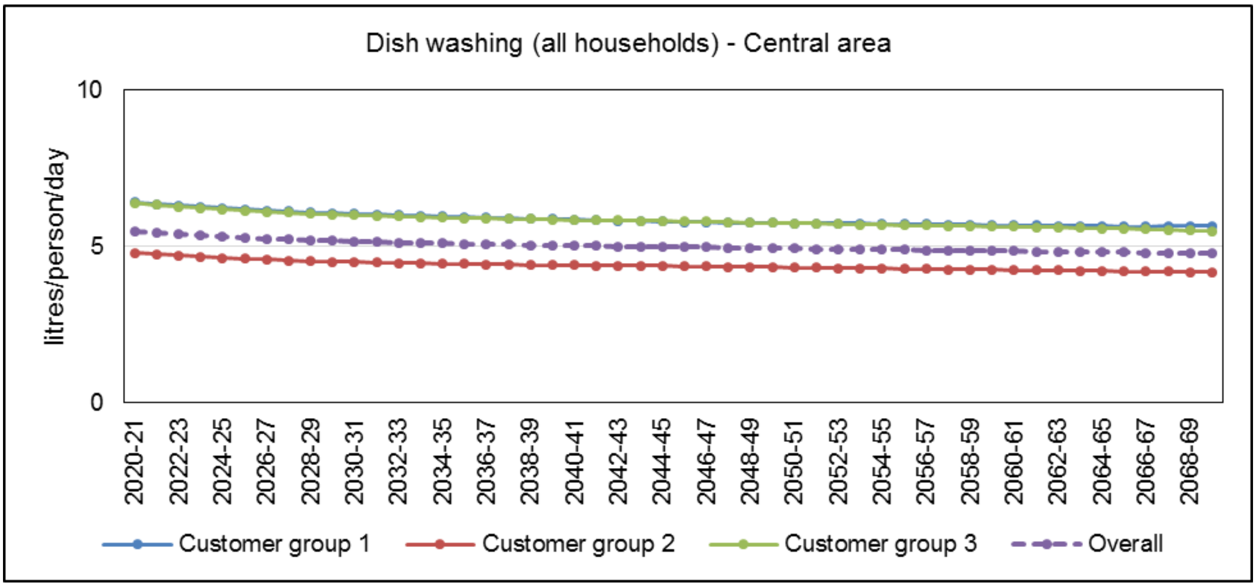


Figure 11 Dish washing volume forecast – Eastern area

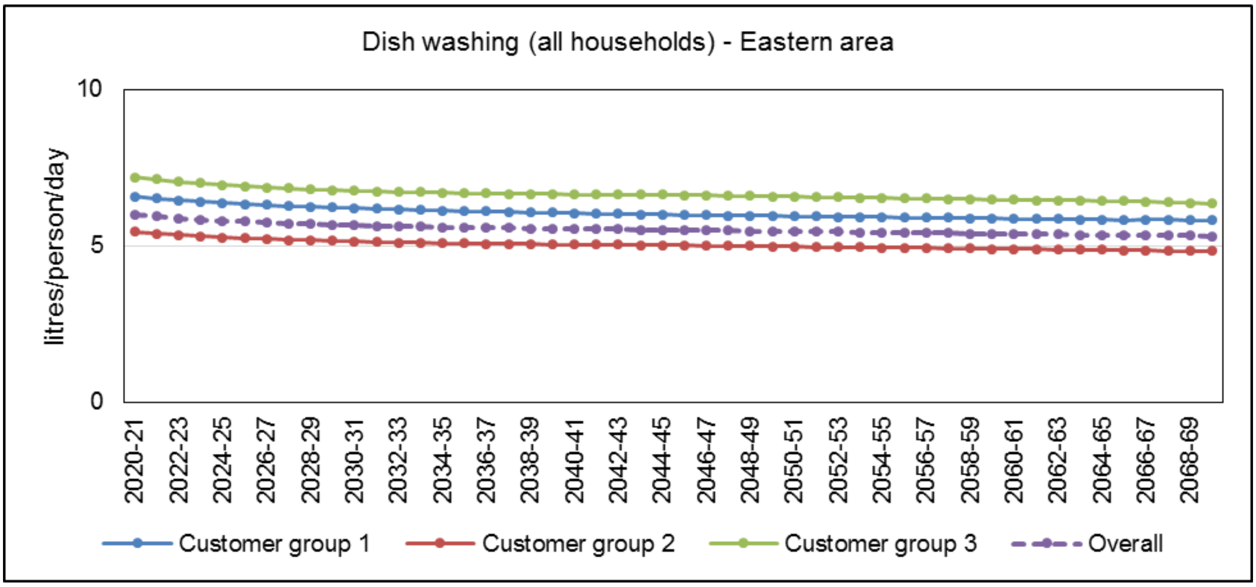
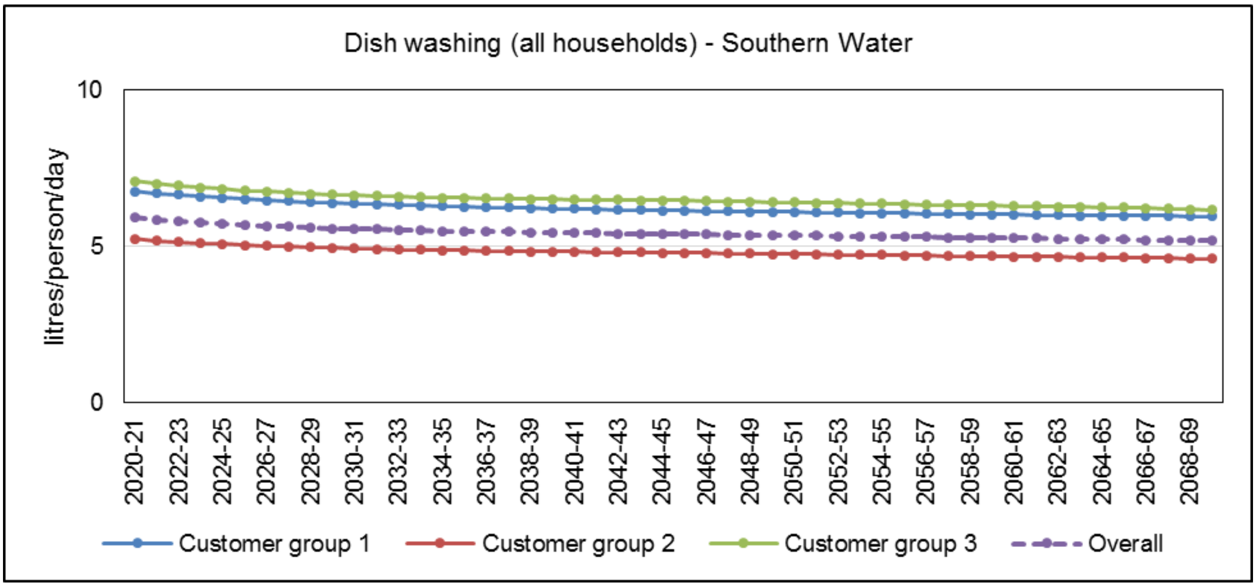


Figure 12 Dish washing volume forecast – Southern Water



Water Resources Management Plan 2019

Annex 2: Demand Forecast Appendix G: Miscellaneous indoor use forecast by area and metering status

December 2019

Version 1

from Southern Water

Unmeasured households

Figure 1 Miscellaneous indoor use volume forecast – Western area

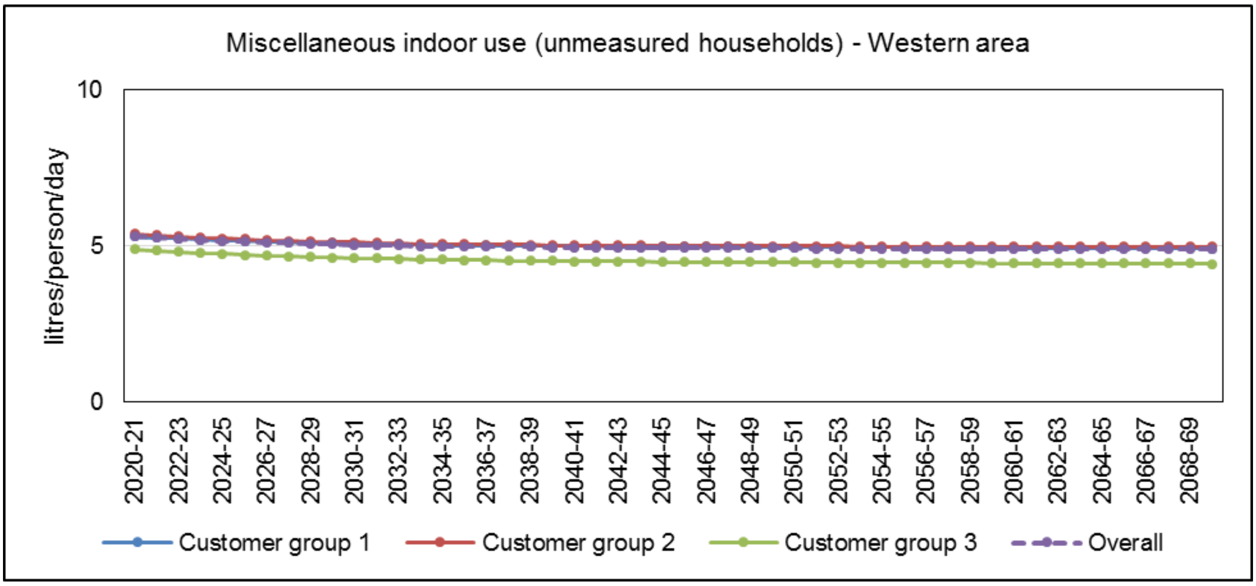


Figure 2 Miscellaneous indoor use volume forecast – Central area

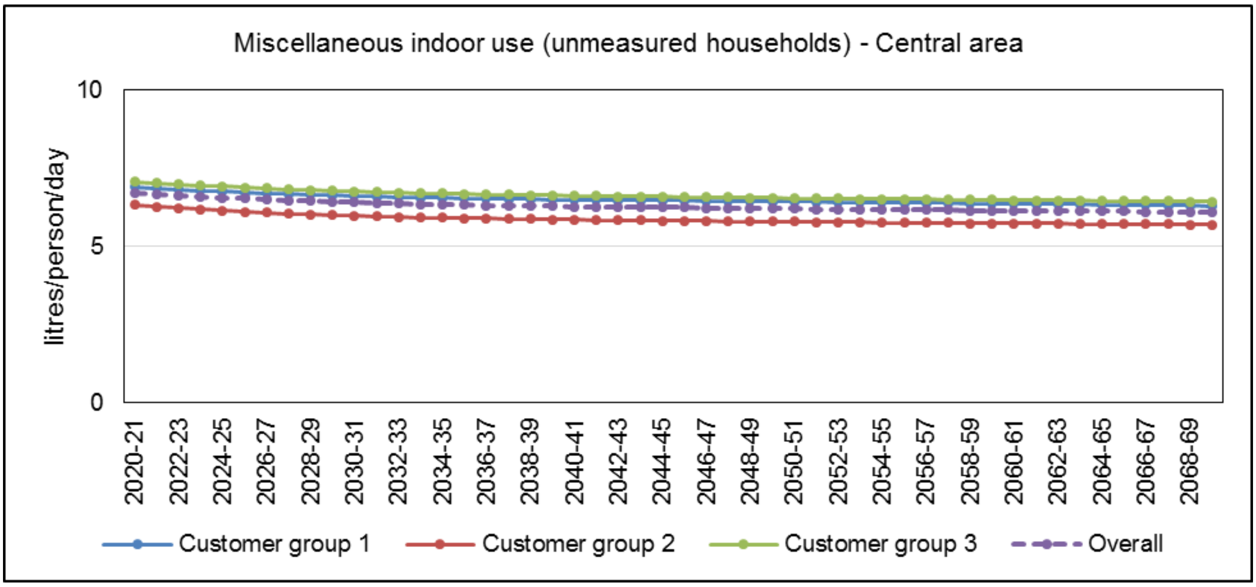


Figure 3 Miscellaneous indoor use volume forecast – Eastern area

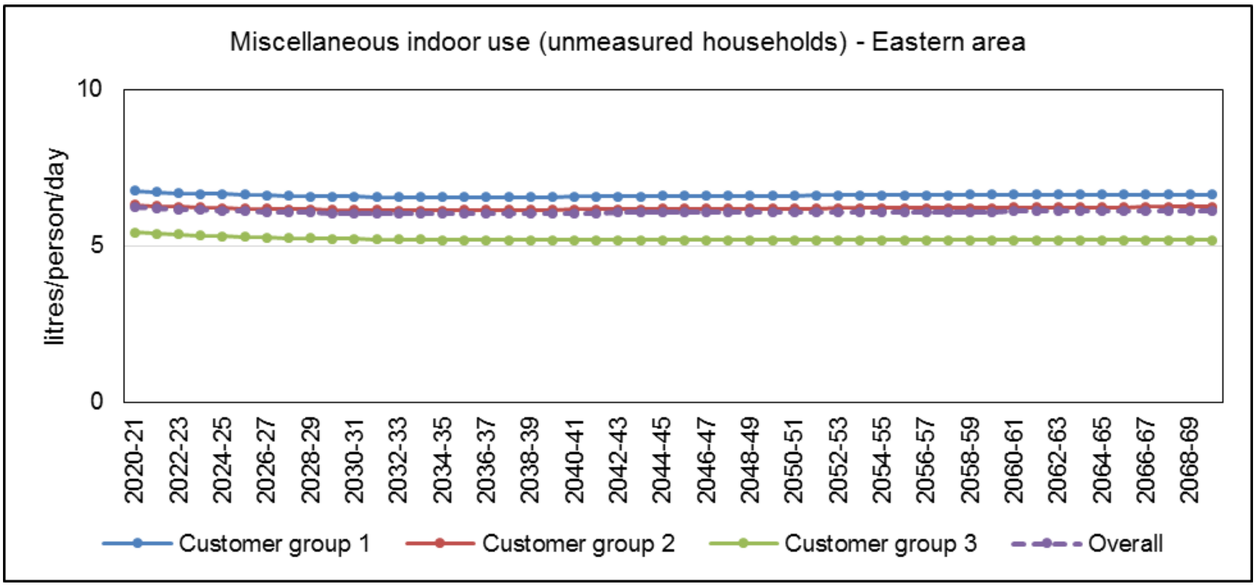
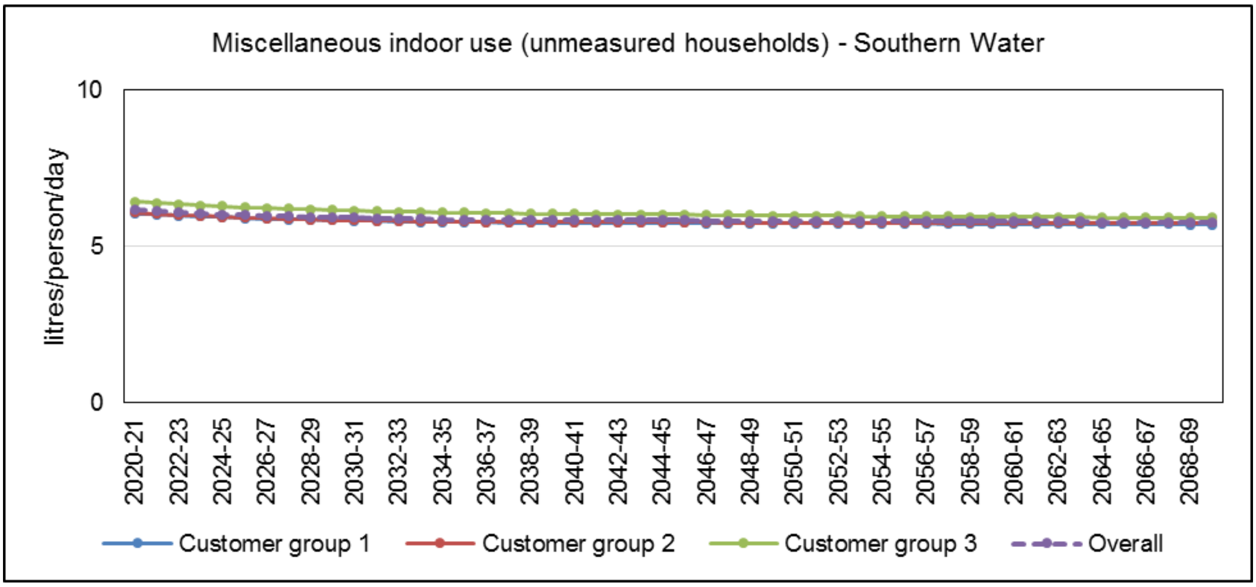


Figure 4 Miscellaneous indoor use volume forecast – Southern Water



Measured households

Figure 5 Miscellaneous indoor use volume forecast – Western area

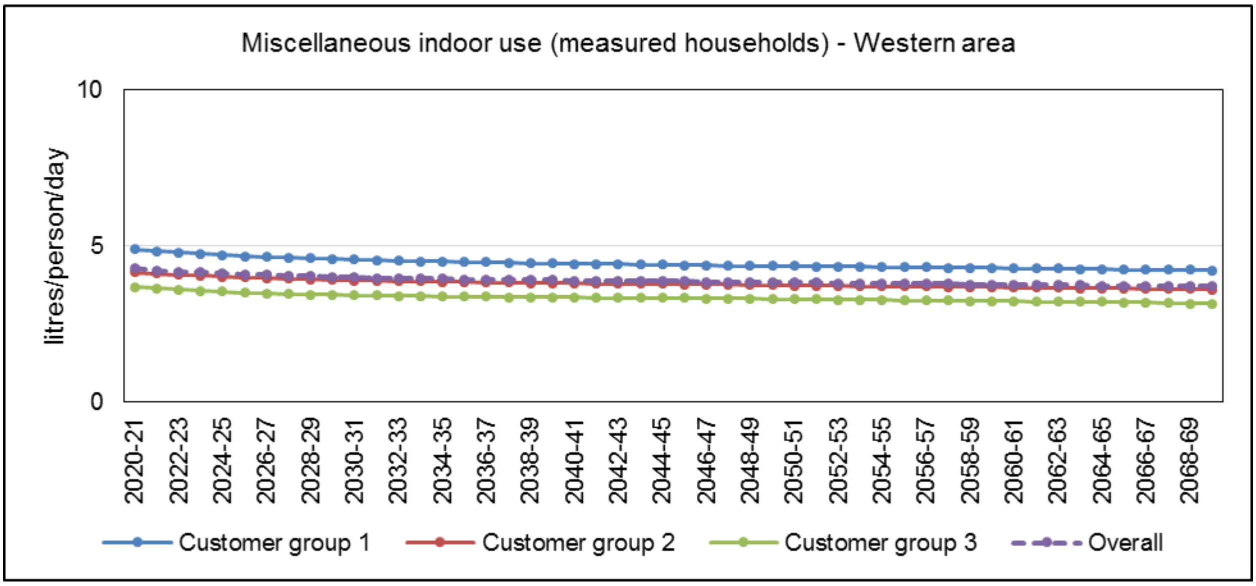


Figure 6 Miscellaneous indoor use volume forecast – Central area

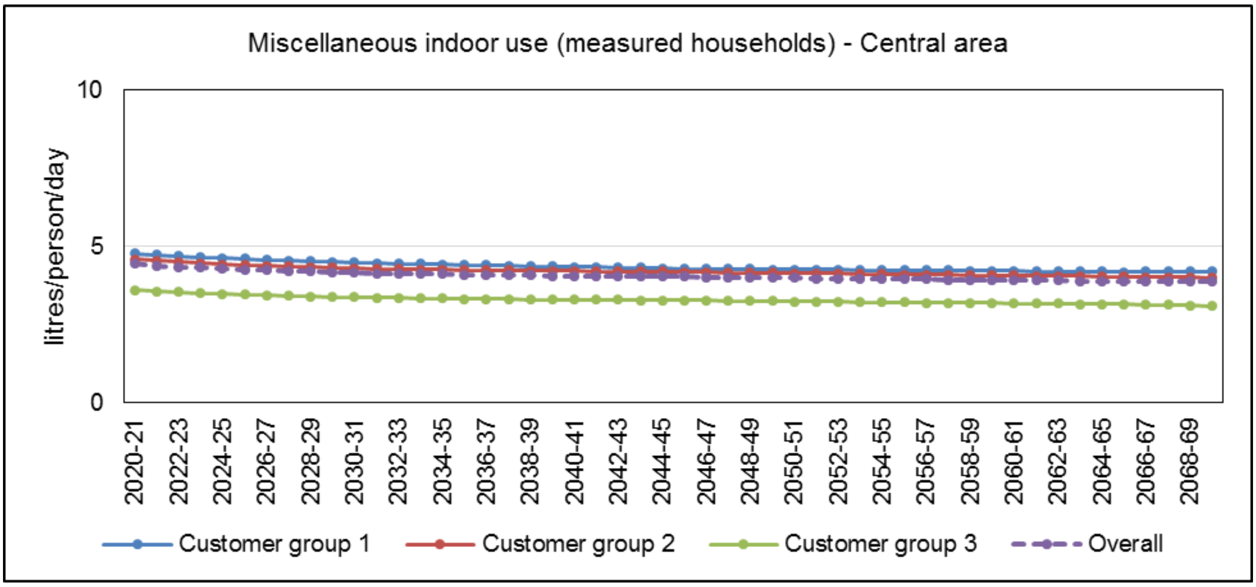


Figure 7 Miscellaneous indoor use volume forecast – Eastern area

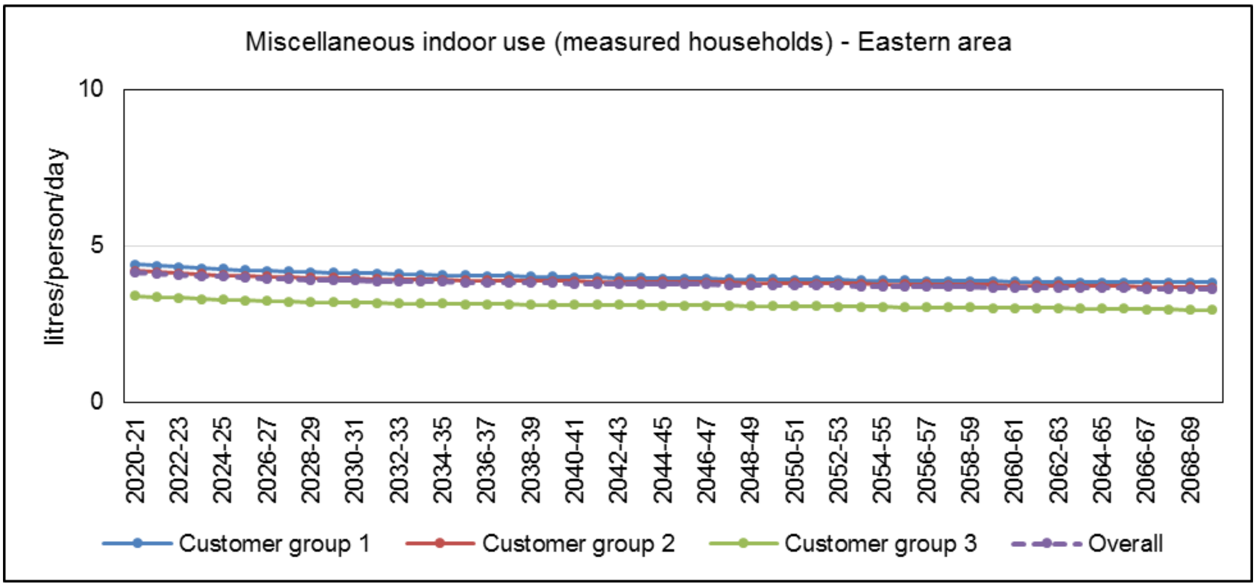
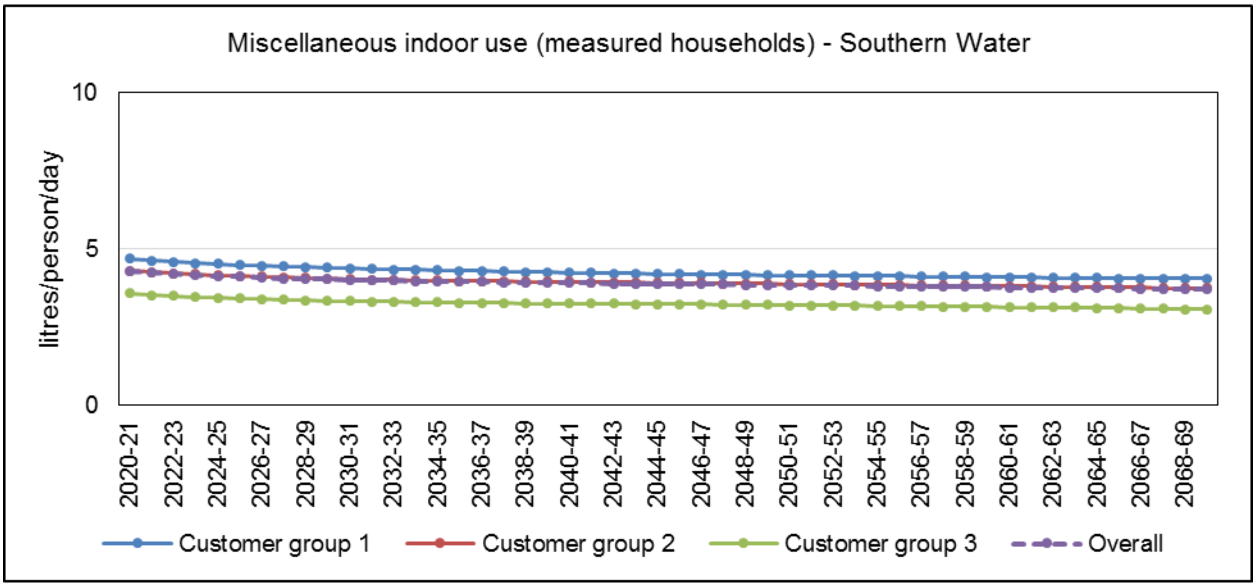


Figure 8 Miscellaneous indoor use volume forecast – Southern Water



All households

Figure 9 Miscellaneous indoor use volume forecast – Western area

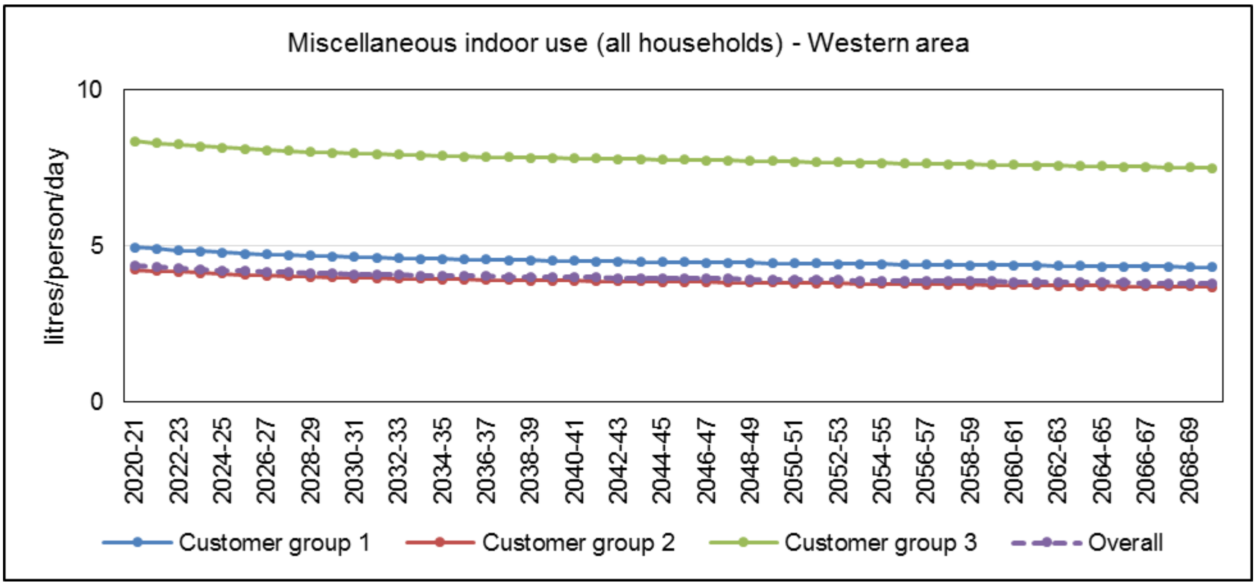


Figure 10 Miscellaneous indoor use volume forecast – Central area

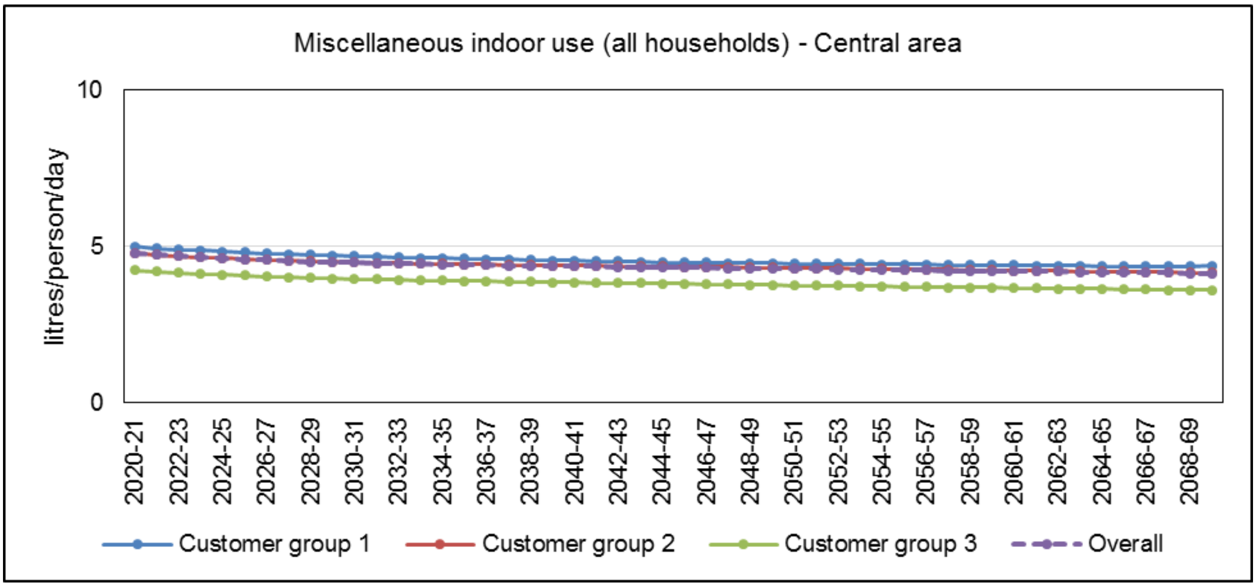


Figure 11 Miscellaneous indoor use volume forecast – Eastern area

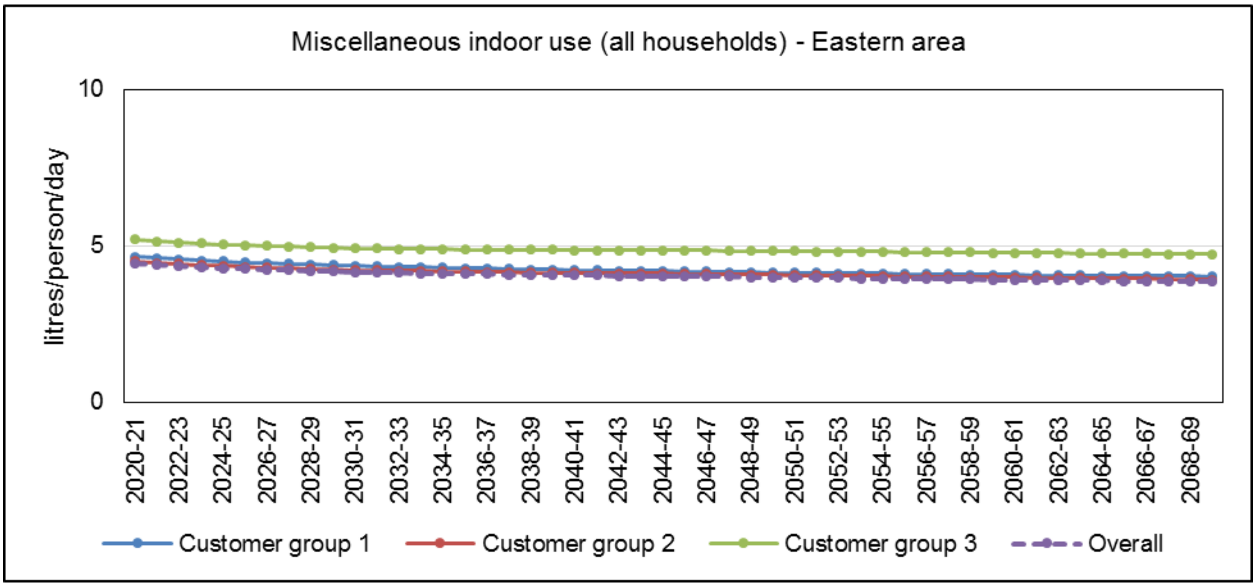
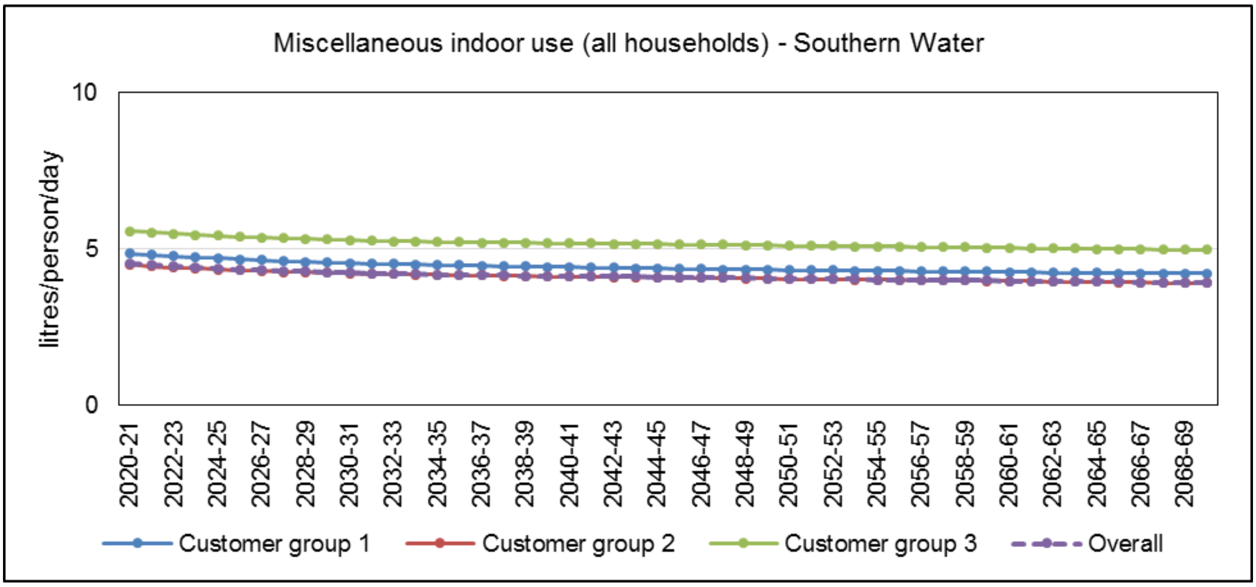


Figure 12 Miscellaneous indoor use volume forecast – Southern Water



Southern Water

Water Resources Management Plan 2019

Annex 2: Demand Forecast Appendix H: Garden watering inputs and outputs by supply area and metering status

December 2019

Version 1

from Southern Water

Ownership

The tables below show the ownership of garden watering modes by supply area for each customer group. The ownership is assumed to remain unchanged over time.

Unmeasured households

Table 1 Ownership of garden watering modes – Western area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	28%	8%	34%	0%	28%	8%	34%	0%
2	29%	5%	27%	0%	29%	5%	27%	0%
3	24%	7%	24%	0%	24%	7%	24%	0%
All	**28%**	**6%**	**29%**	**0%**	**28%**	**6%**	**29%**	**0%**

Table 2 Ownership of garden watering modes – Central area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	27%	0%	36%	0%	27%	0%	36%	0%
2	35%	3%	42%	0%	35%	3%	42%	0%
3	37%	0%	37%	0%	38%	0%	37%	0%
All	**35%**	**1%**	**39%**	**0%**	**35%**	**1%**	**39%**	**0%**

Table 3 Ownership of garden watering modes – Eastern area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	28%	8%	20%	0%	28%	8%	20%	0%
2	22%	5%	26%	0%	22%	5%	26%	0%
3	25%	1%	18%	0%	25%	1%	18%	0%
All	**24%**	**4%**	**23%**	**0%**	**24%**	**4%**	**23%**	**0%**

Table 4 Ownership of garden watering modes – Southern Water

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	28%	6%	30%	0%	28%	6%	30%	0%
2	28%	4%	32%	0%	28%	4%	32%	0%
3	33%	1%	31%	0%	33%	1%	31%	0%
All	**29%**	**3%**	**31%**	**0%**	**29%**	**3%**	**31%**	**0%**

Measured households

Table 5 Ownership of garden watering modes – Western area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	26%	7%	33%	0%	26%	7%	33%	0%
2	25%	2%	28%	0%	25%	2%	28%	0%
3	15%	1%	29%	0%	15%	1%	29%	0%
All	**23%**	**3%**	**30%**	**0%**	**23%**	**3%**	**30%**	**0%**

Table 6 Ownership of garden watering modes – Central area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	27%	4%	34%	0%	27%	4%	34%	0%
2	24%	0%	40%	0%	24%	0%	41%	0%
3	14%	1%	52%	0%	14%	1%	52%	0%
All	**22%**	**1%**	**42%**	**0%**	**22%**	**1%**	**42%**	**0%**

Table 7 Ownership of garden watering modes – Eastern area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	27%	4%	29%	0%	28%	4%	29%	0%
2	21%	2%	34%	0%	21%	3%	34%	0%
3	14%	2%	30%	0%	14%	2%	29%	0%
All	**21%**	**3%**	**32%**	**0%**	**21%**	**3%**	**32%**	**0%**

Table 8 Ownership of garden watering modes – Southern Water

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	27%	5%	32%	0%	27%	5%	32%	0%
2	23%	2%	34%	0%	23%	2%	34%	0%
3	14%	1%	39%	0%	14%	1%	38%	0%
All	**22%**	**2%**	**34%**	**0%**	**22%**	**2%**	**34%**	**0%**

All households

Table 9 Ownership of garden watering modes – Western area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	26%	7%	33%	0%	26%	7%	33%	0%
2	25%	2%	28%	0%	25%	2%	28%	0%
3	16%	1%	29%	0%	15%	1%	29%	0%
All	**24%**	**3%**	**30%**	**0%**	**24%**	**3%**	**30%**	**0%**

Table 10 Ownership of garden watering modes – Central area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	27%	3%	34%	0%	27%	3%	34%	0%
2	25%	0%	41%	0%	25%	0%	41%	0%
3	20%	0%	48%	0%	19%	0%	49%	0%
All	**24%**	**1%**	**42%**	**0%**	**23%**	**1%**	**42%**	**0%**

Table 11 Ownership of garden watering modes – Eastern area

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	27%	5%	28%	0%	28%	4%	28%	0%
2	21%	3%	33%	0%	21%	3%	33%	0%
3	16%	2%	28%	0%	16%	2%	28%	0%
All	**21%**	**3%**	**31%**	**0%**	**21%**	**3%**	**31%**	**0%**

Table 12 Ownership of garden watering modes – Southern Water

Customer group	2017-18 ownership (%)				2069-70 ownership (%)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	27%	5%	32%	0%	27%	5%	32%	0%
2	24%	2%	33%	0%	23%	2%	33%	0%
3	18%	1%	37%	0%	17%	1%	37%	0%
All	**23%**	**2%**	**34%**	**0%**	**23%**	**2%**	**34%**	**0%**

Frequency of garden watering

Unmeasured households

Table 13 Frequency of garden watering – Western area

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
3	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
All	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**

Table 14 Frequency of garden watering – Central area

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
2	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
3	0.10	0.11	0.10	0.11	0.10	0.11	0.10	0.11
All	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**

Table 15 Frequency of garden watering – Eastern area

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
2	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
3	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
All	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**

Table 16 Frequency of garden watering – Southern Water

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
2	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
3	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
All	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**

Measured households

Table 17 Frequency of garden watering – Western area

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
3	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
All	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**

Table 18 Frequency of garden watering – Central area

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
3	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
All	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**

Table 19 Frequency of garden watering – Eastern area

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
2	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
3	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02
All	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**

Table 20 Frequency of garden watering – Southern Water

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.08	0.07	0.08	0.07	0.08	0.07	0.08	0.07
2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
3	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
All	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**

All households

Table 21 Frequency of garden watering – Western area

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
3	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
All	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**

Table 22 Frequency of garden watering – Central area

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
2	0.07	0.06	0.07	0.06	0.07	0.06	0.07	0.06
3	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
All	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**

Table 23 Frequency of garden watering – Eastern area

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.07	0.06	0.07	0.06	0.07	0.06	0.07	0.06
2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
3	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
All	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**

Table 24 Frequency of garden watering – Southern Water

Customer group	2017-18 frequency (times/household/day)				2069-70 frequency (times/household/day)			
	Hosepipe	Sprinklers	Watering can	Other	Hose Pipe	Sprinklers	Watering can	Other
1	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
3	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04
All	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**

Volumetric forecast for garden watering

Unmeasured households

Figure 1 Garden watering volume forecast – Western area

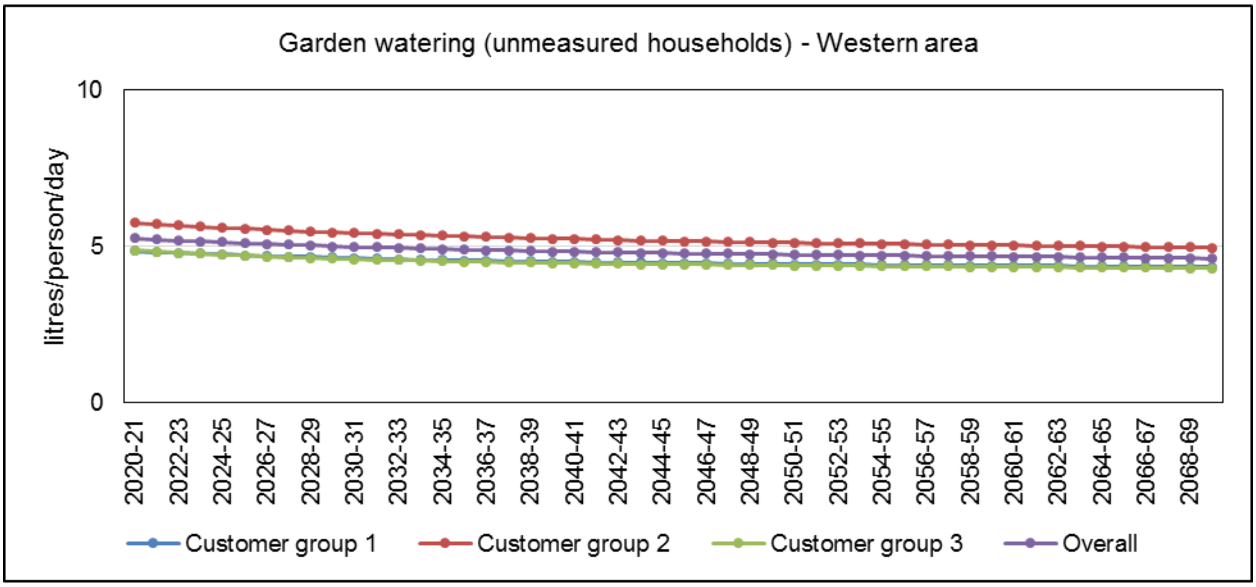


Figure 2 Garden watering volume forecast – Central area

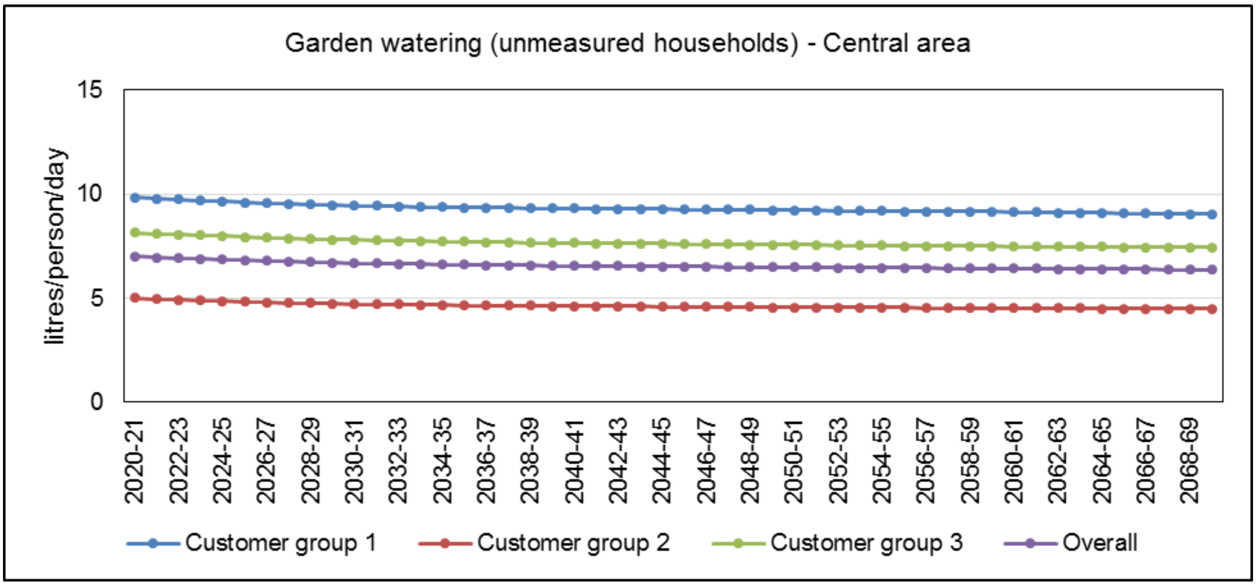


Figure 3 Garden watering volume forecast – Eastern area

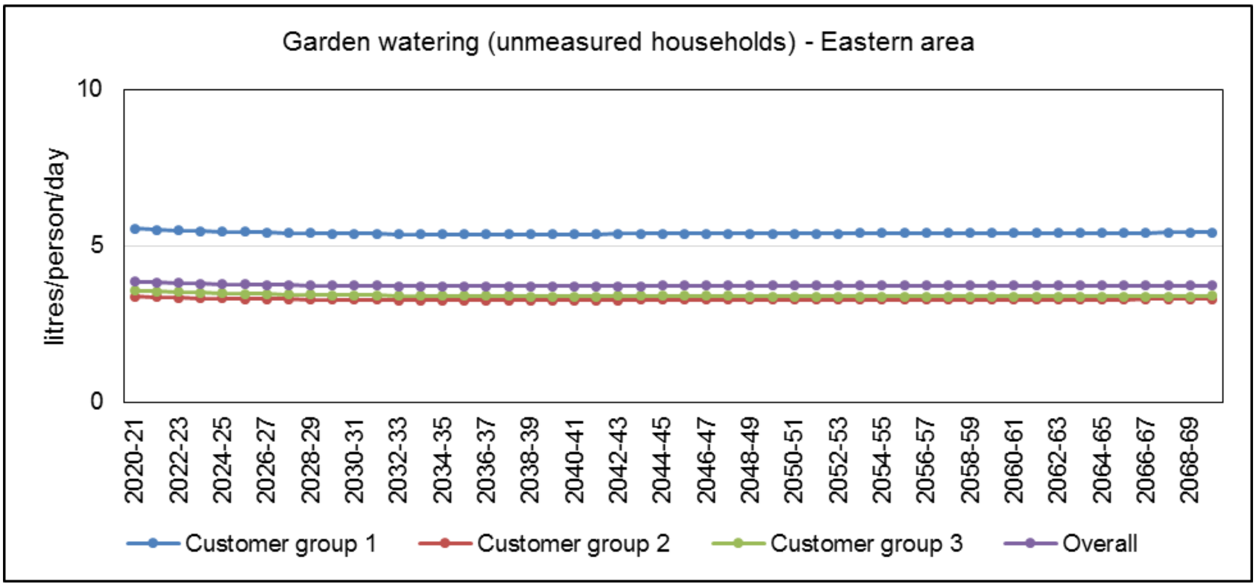
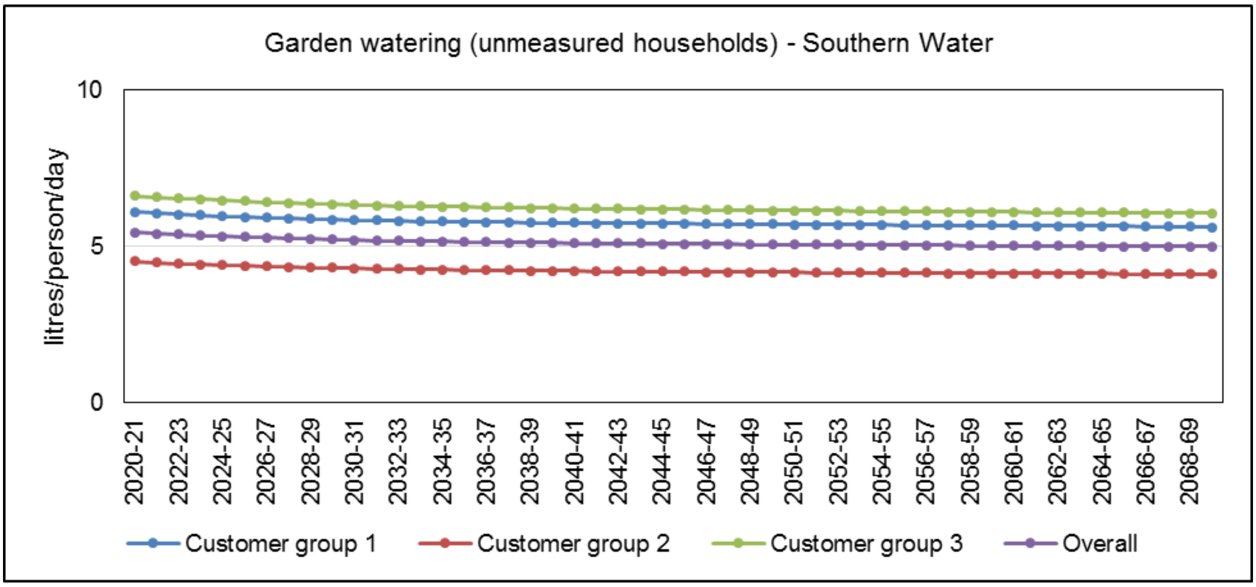


Figure 4 Garden watering volume forecast – Southern Water



Measured households

Figure 5 Garden watering volume forecast – Western area

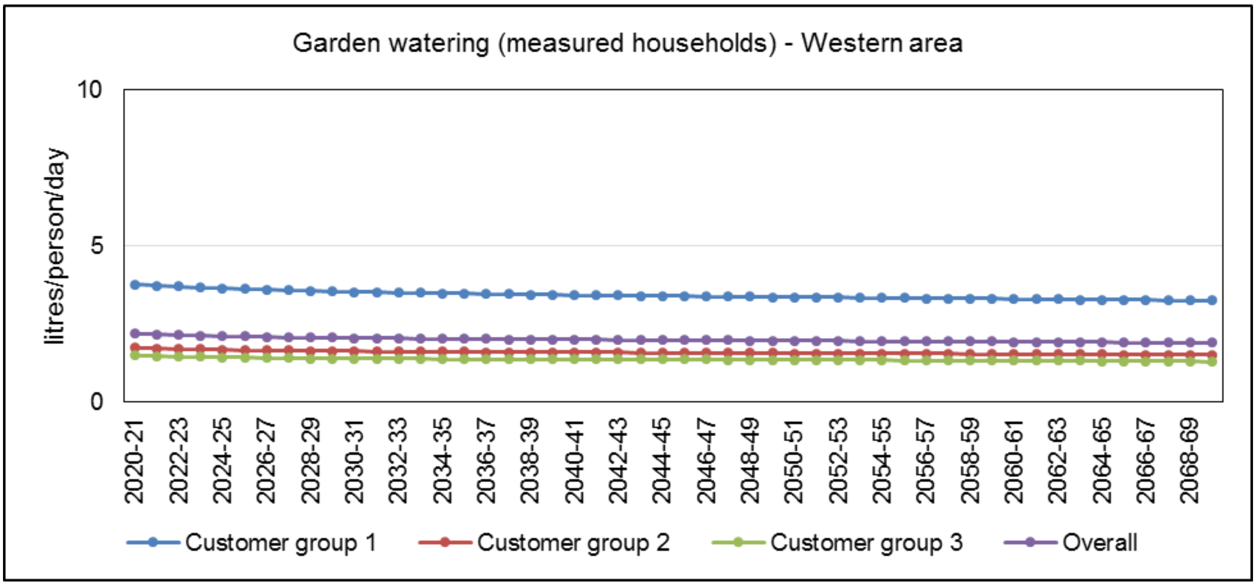


Figure 6 Garden watering volume forecast – Central area

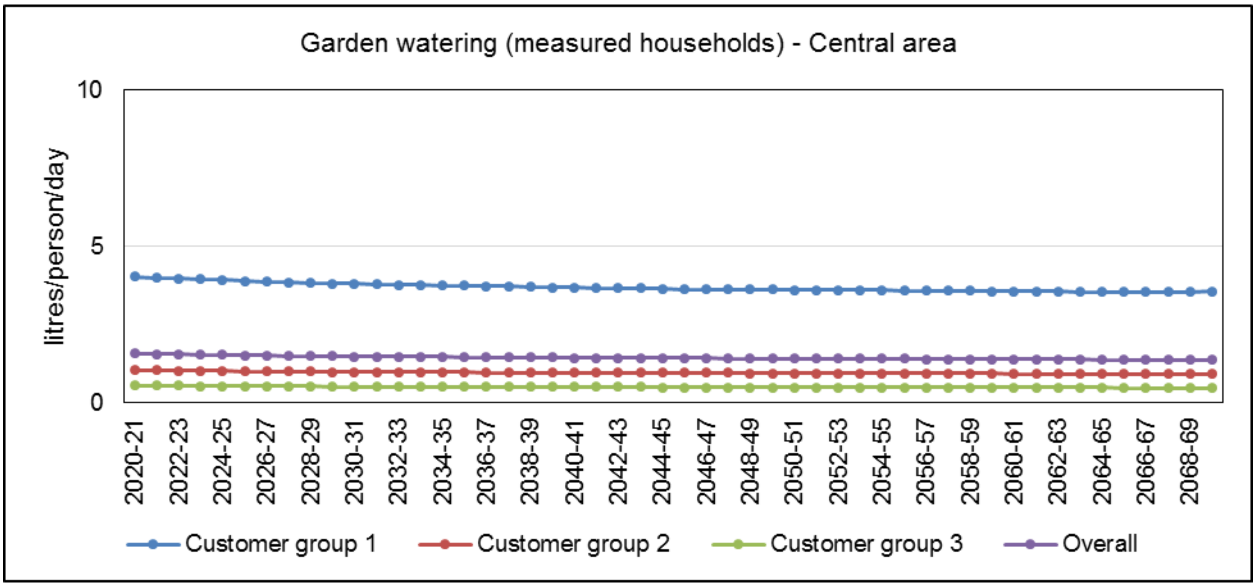


Figure 7 Garden watering volume forecast – Eastern area

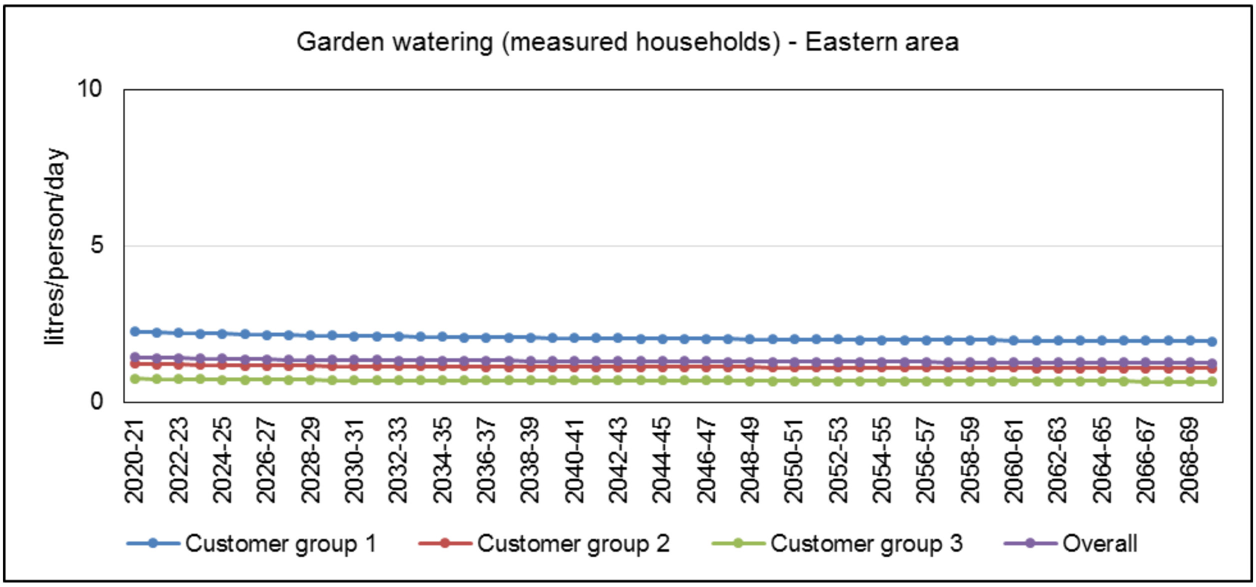
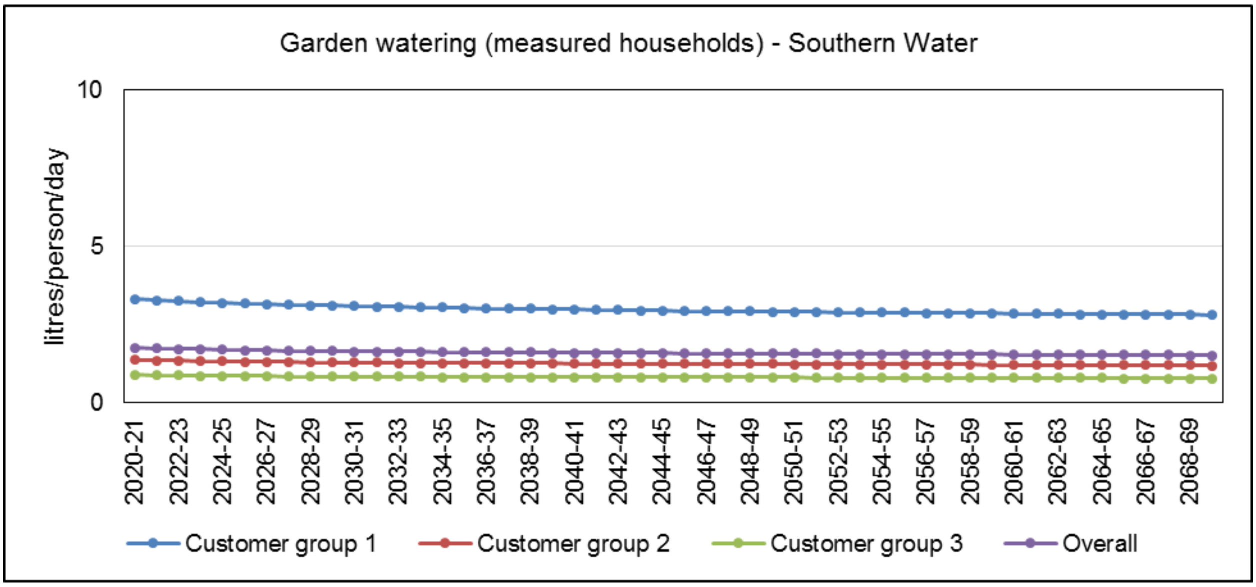


Figure 8 Garden watering volume forecast – Southern Water



All households

Figure 9 Garden watering volume forecast – Western area

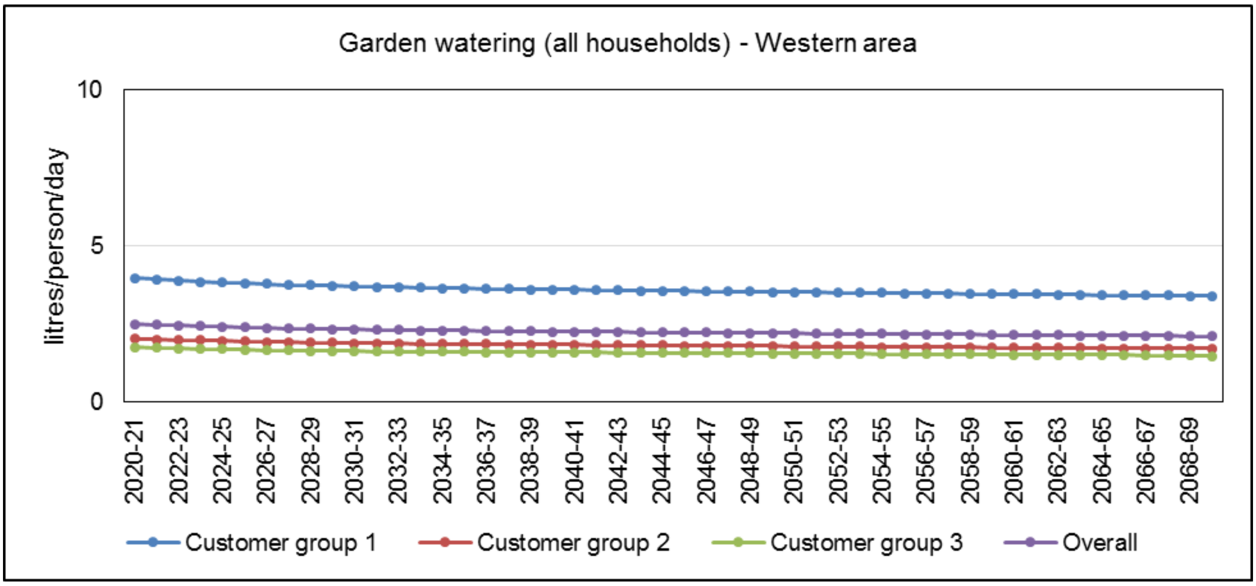


Figure 10 Garden watering volume forecast – Central area

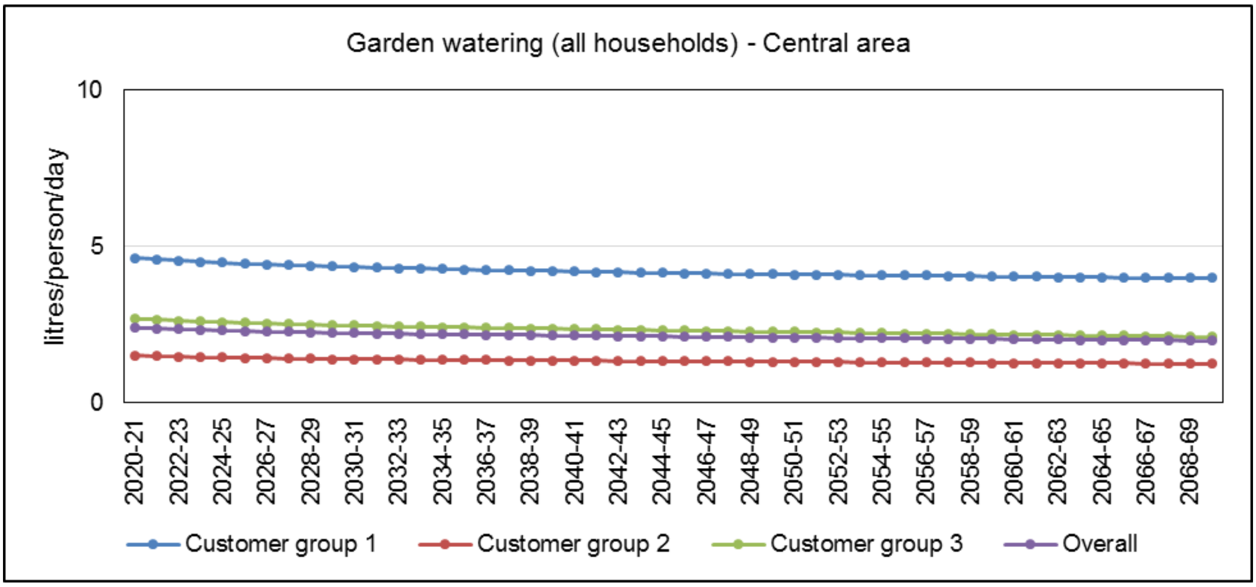


Figure 11 Garden watering volume forecast – Eastern area

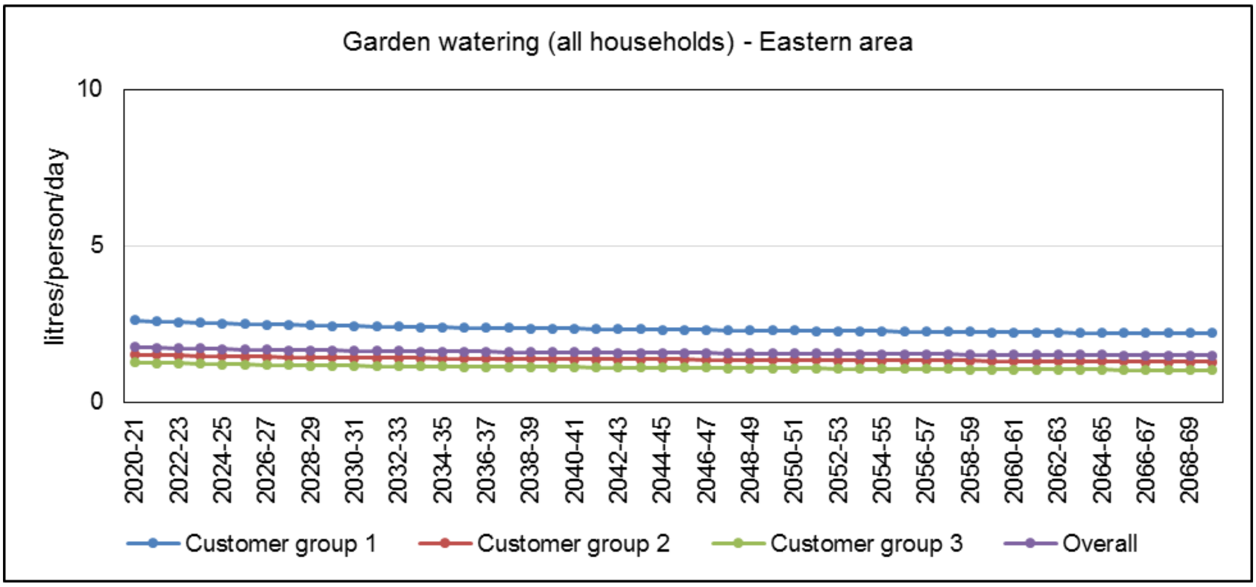
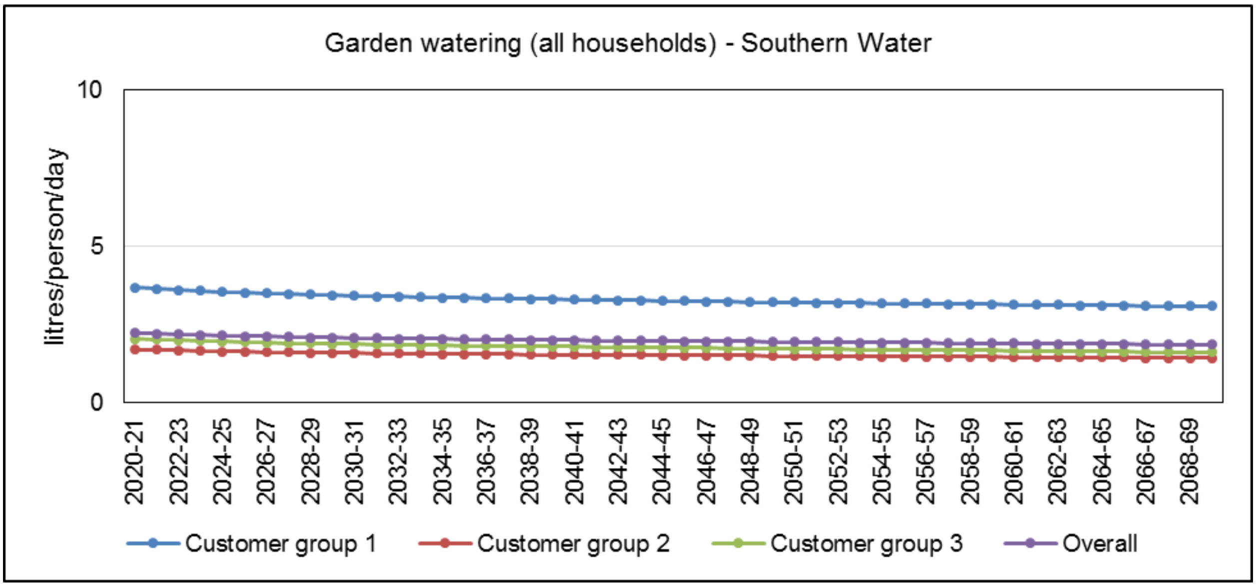


Figure 12 Garden watering volume forecast – Southern Water



Water Resources Management Plan 2019
Annex 2: Demand Forecast Appendix I: Miscellaneous outdoor use forecast by area and metering status

December 2019

Version 1

from Southern Water

Unmeasured households

Figure 1 Miscellaneous outdoor use volume forecast – Western area

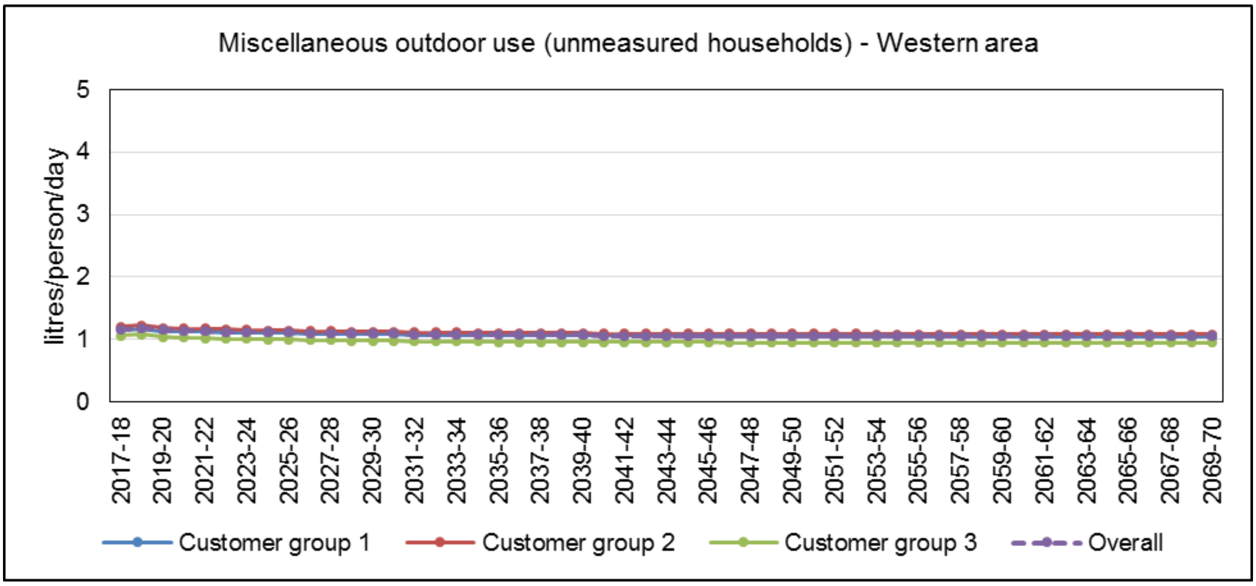


Figure 2 Miscellaneous outdoor use volume forecast – Central area

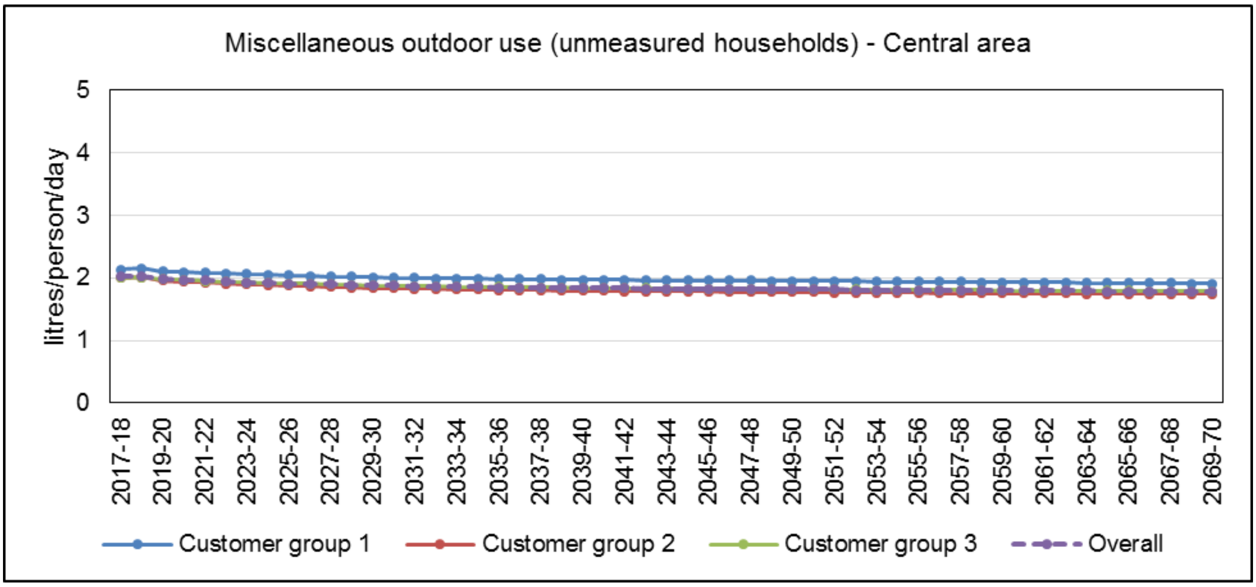


Figure 3 Miscellaneous outdoor use volume forecast – Eastern area

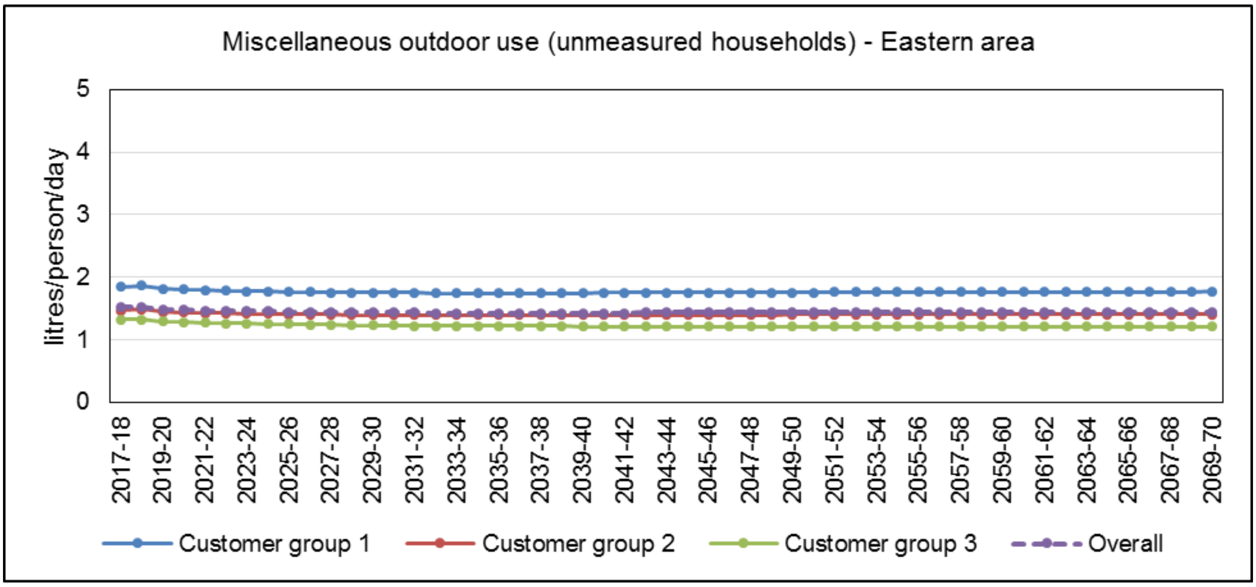
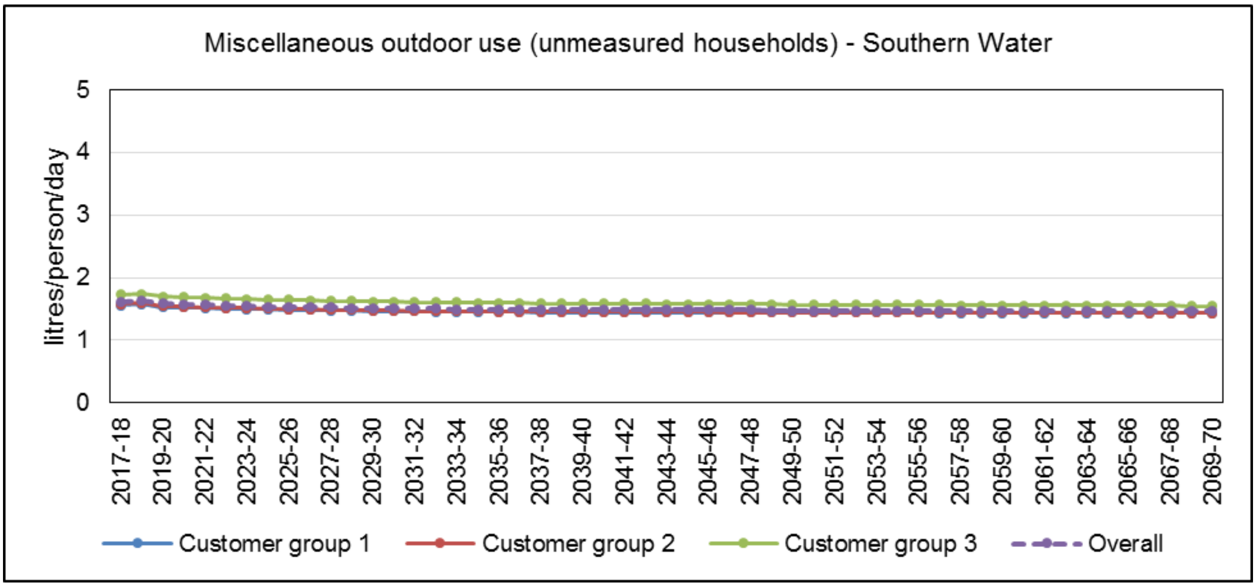


Figure 4 Miscellaneous outdoor use volume forecast – Southern Water



Measured households

Figure 5 Miscellaneous outdoor use volume forecast – Western area

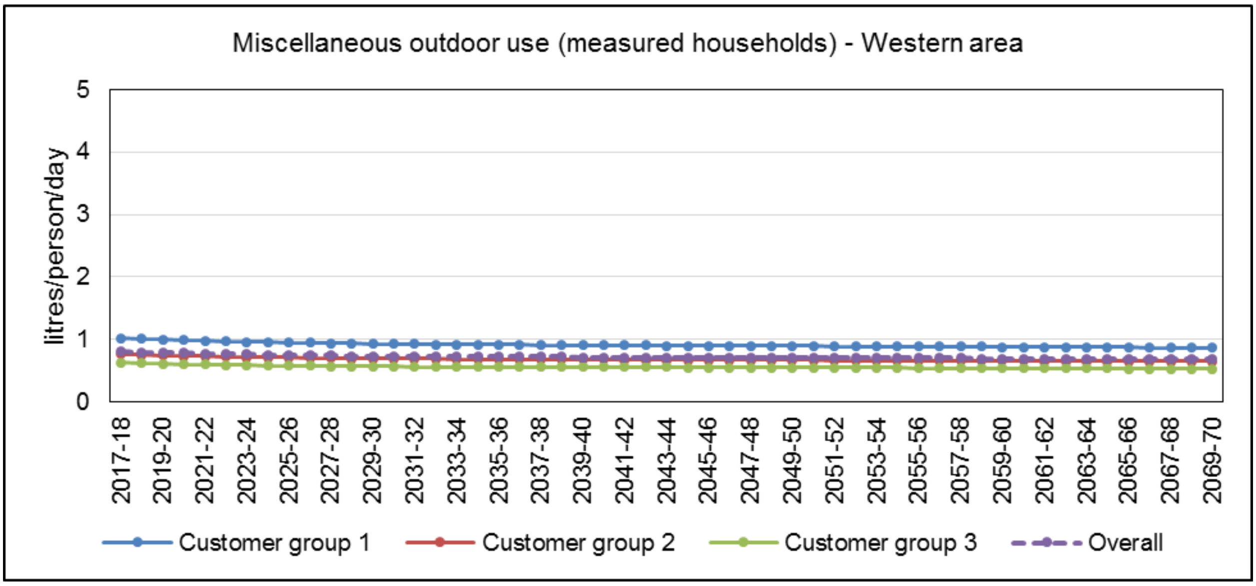


Figure 6 Miscellaneous outdoor use volume forecast – Central area

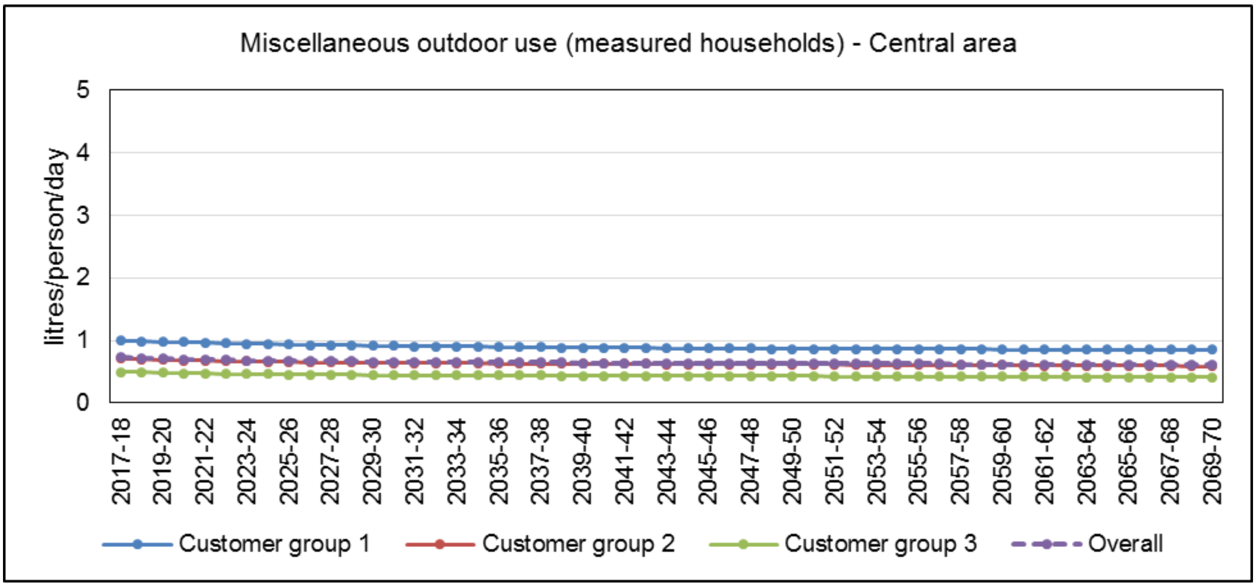


Figure 7 Miscellaneous outdoor use volume forecast – Eastern area

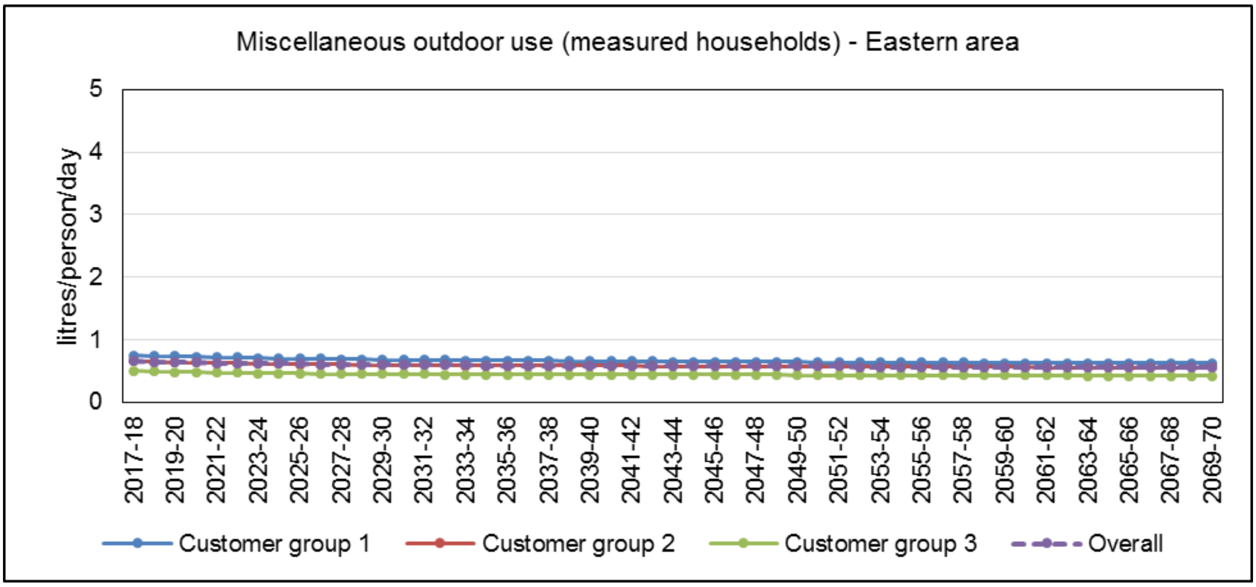
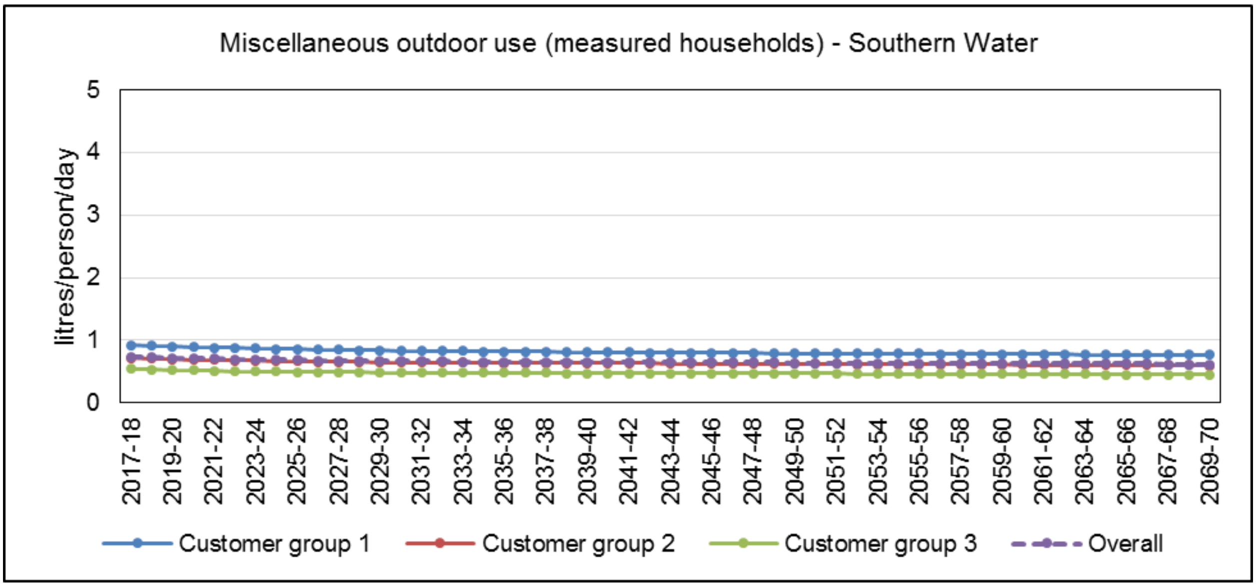


Figure 8 Miscellaneous outdoor use volume forecast – Southern Water



All households

Figure 9 Miscellaneous outdoor use volume forecast – Western area

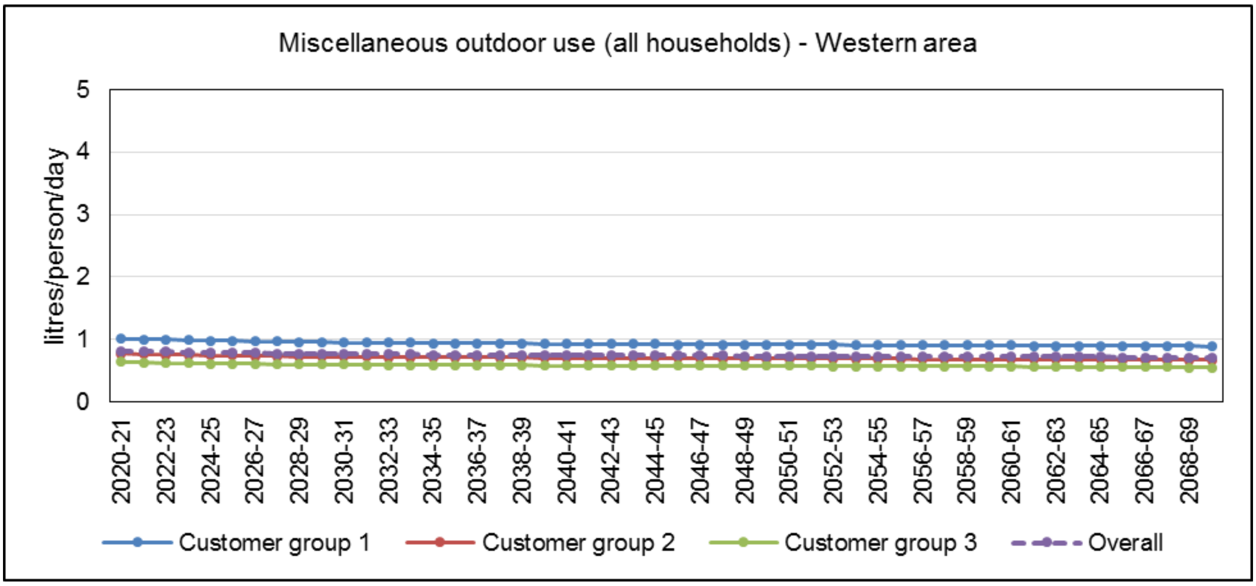


Figure 10 Miscellaneous outdoor use volume forecast – Central area

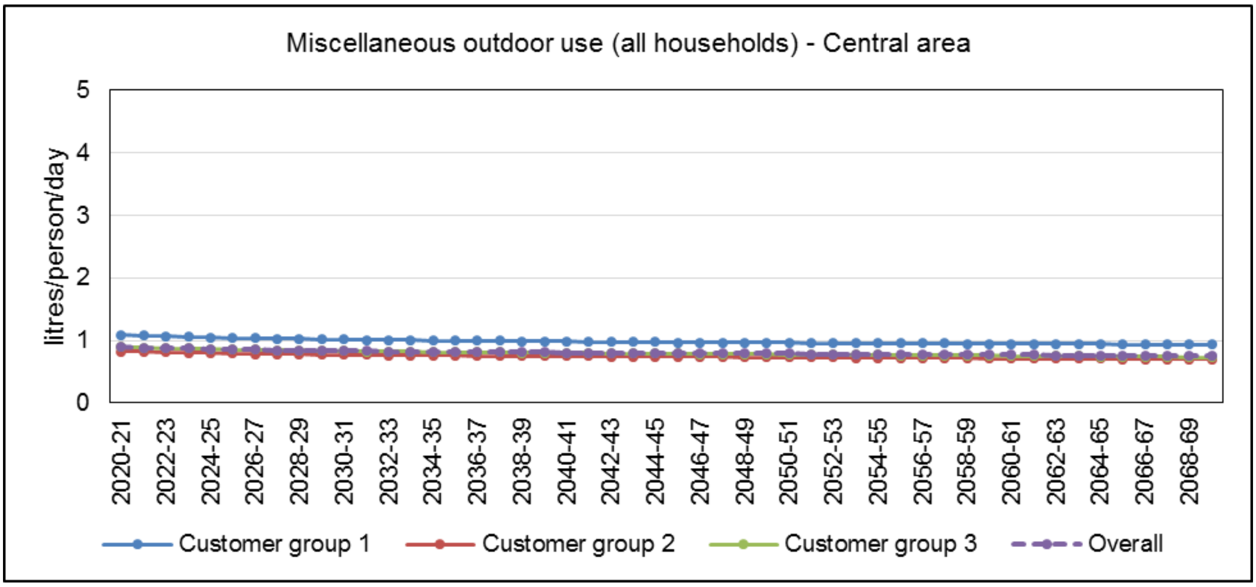


Figure 11 Miscellaneous outdoor use volume forecast – Eastern area

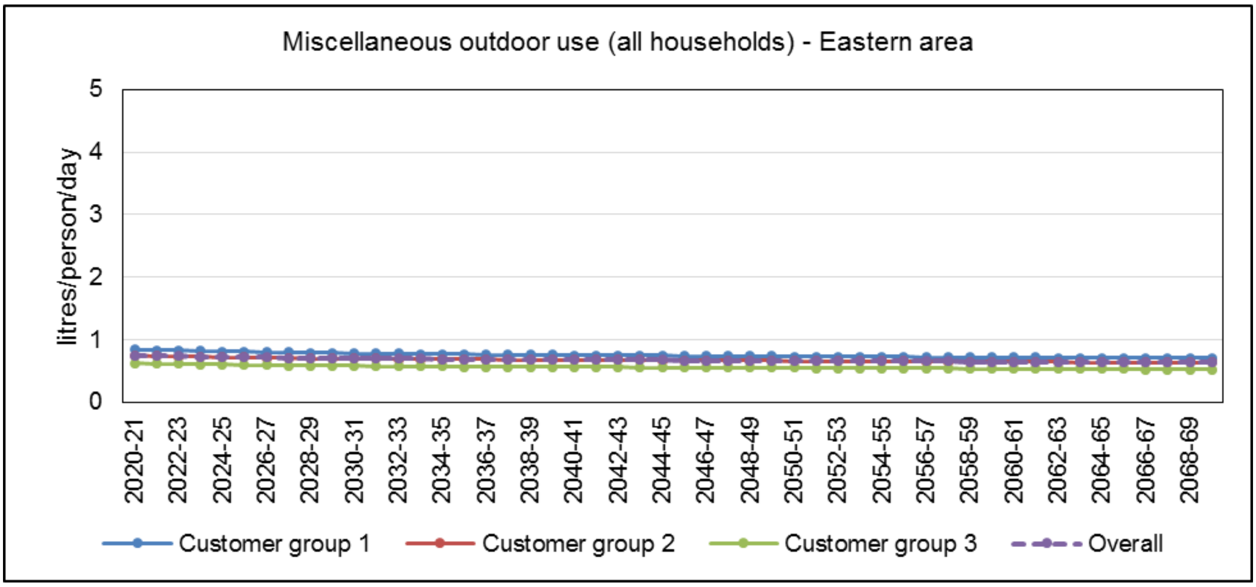
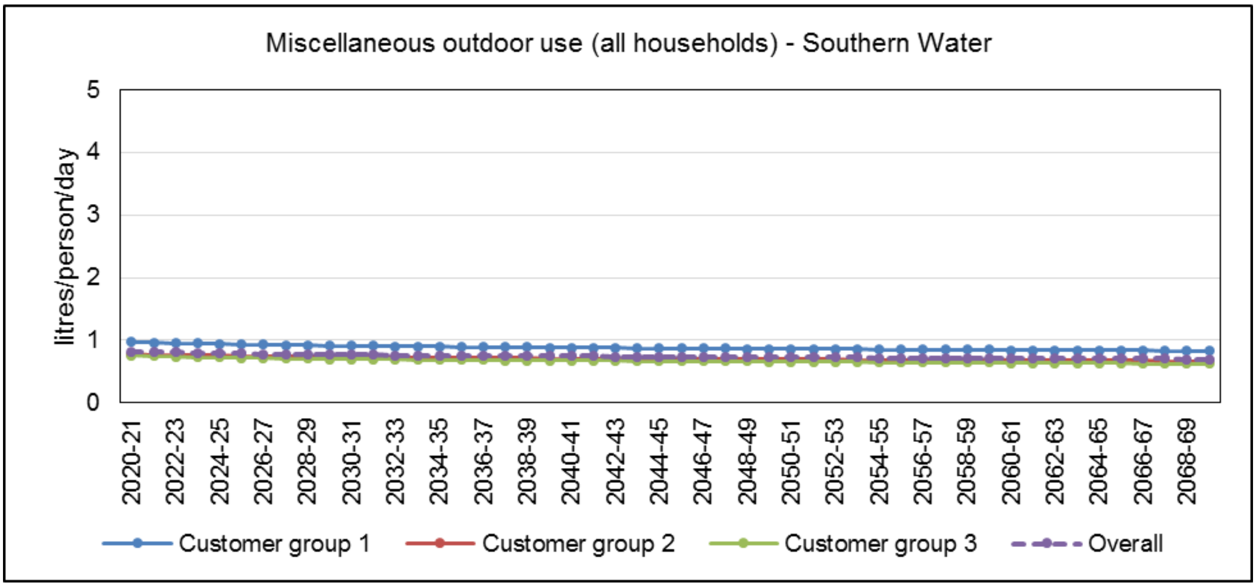


Figure 12 Miscellaneous outdoor use volume forecast – Southern Water



Water Resources Management Plan 2019

Annex 2: Demand Forecast Appendix J: Total PCC forecast by area and metering status

December 2019

Version 1

from Southern Water

Unmeasured households

Figure 1 Total PCC forecast – Western area

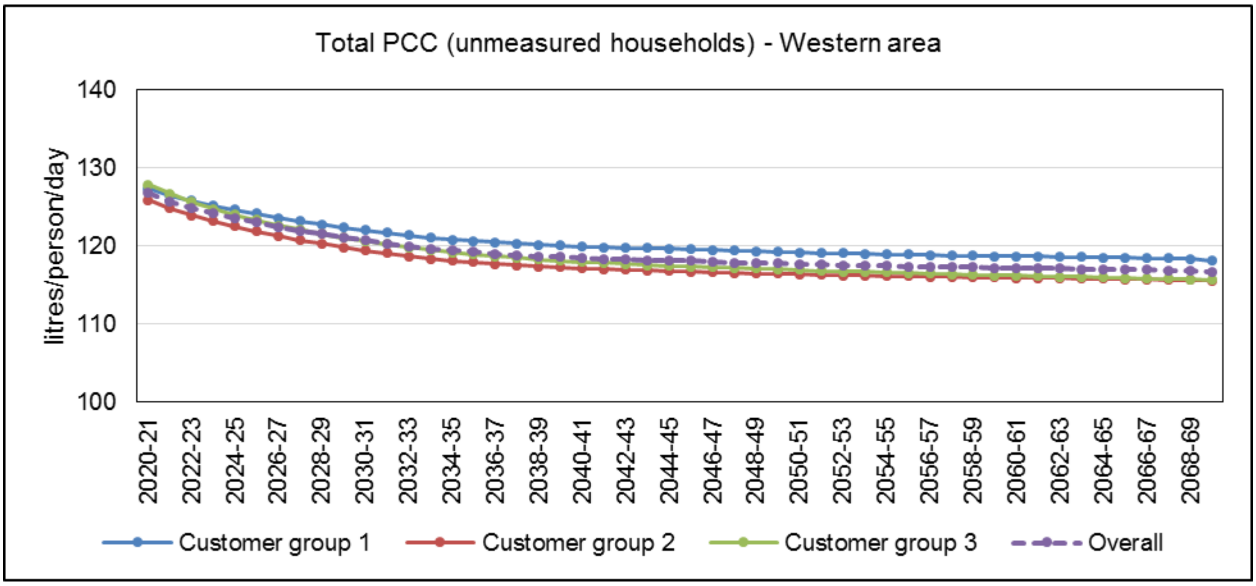


Figure 2 Total PCC forecast – Central area

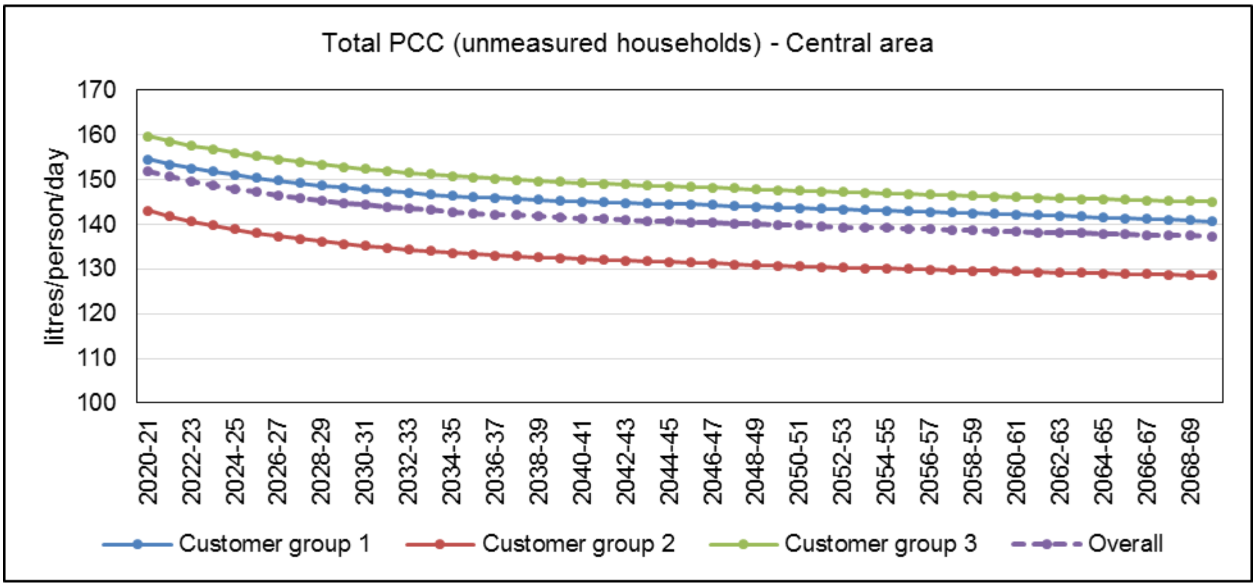


Figure 3 Total PCC forecast – Eastern area

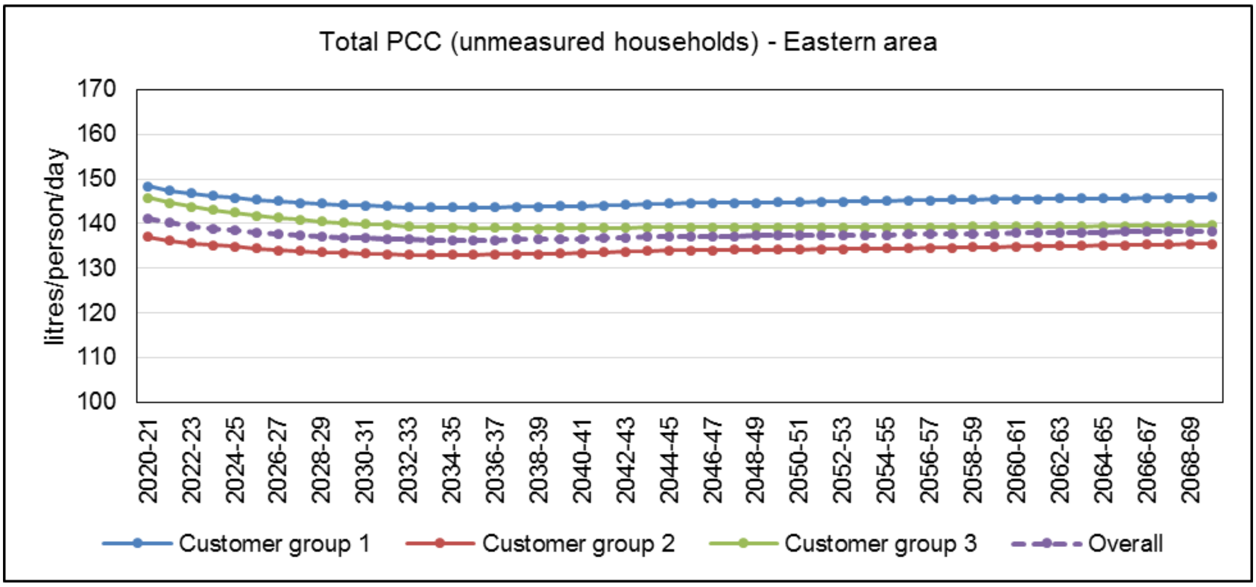
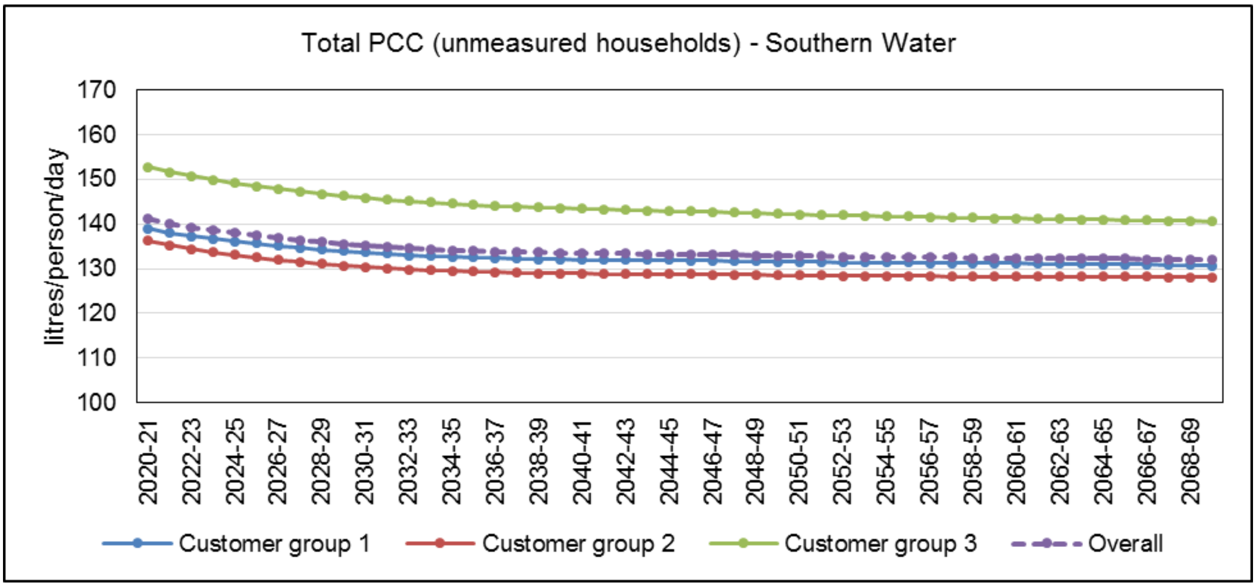


Figure 4 Total PCC forecast – Southern Water



Measured households

Figure 5 Total PCC forecast – Western area

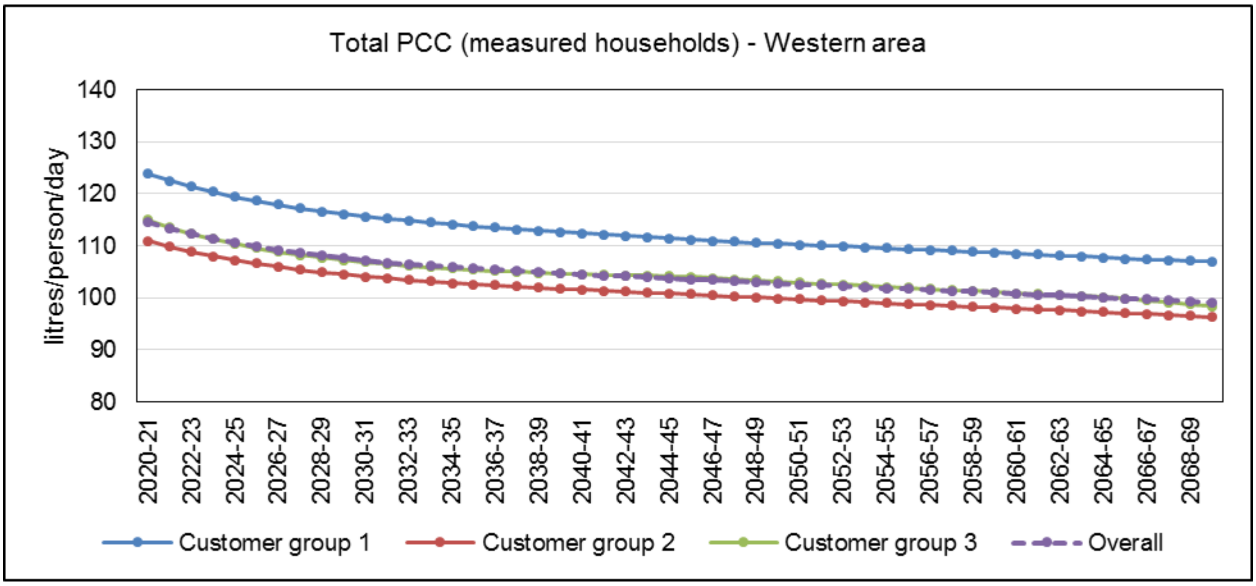


Figure 6 Total PCC forecast – Central area

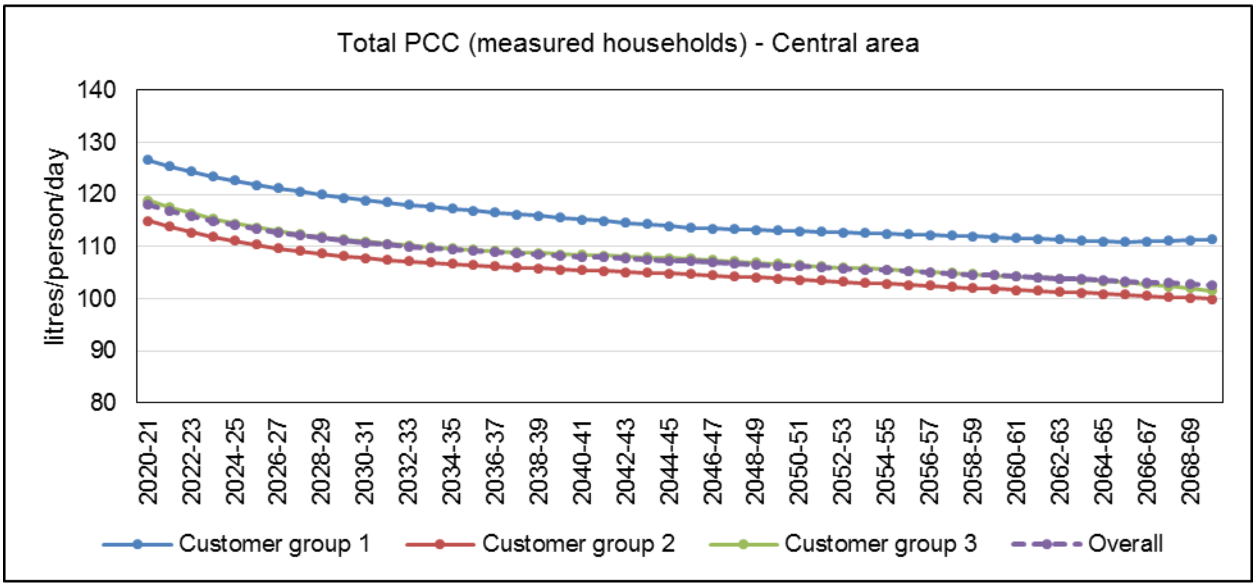


Figure 7 Total PCC forecast – Eastern area

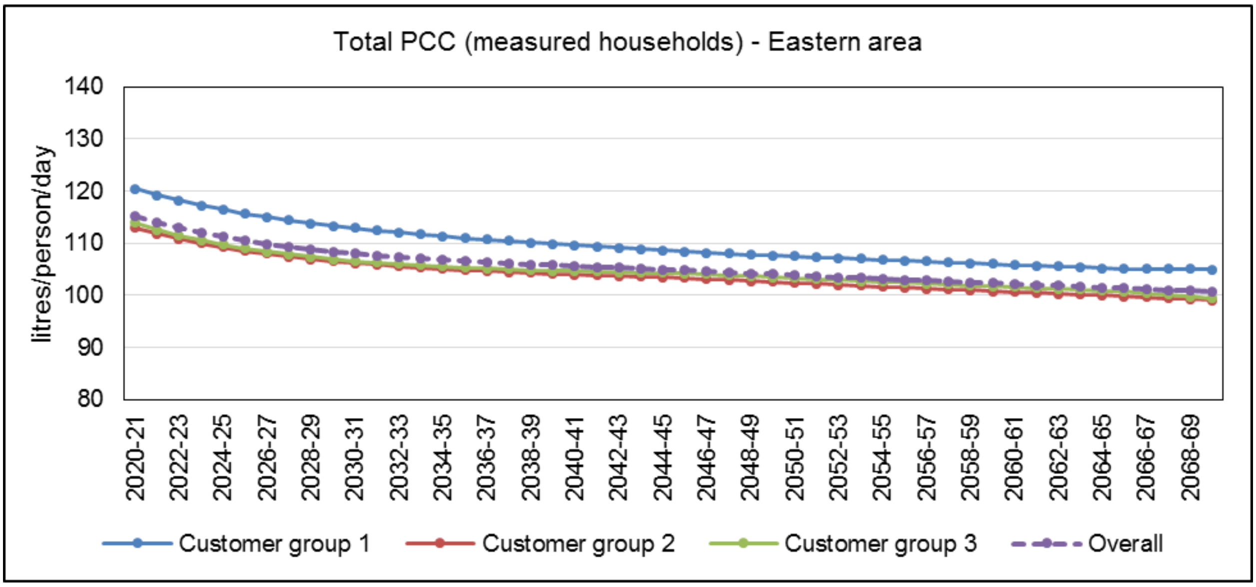
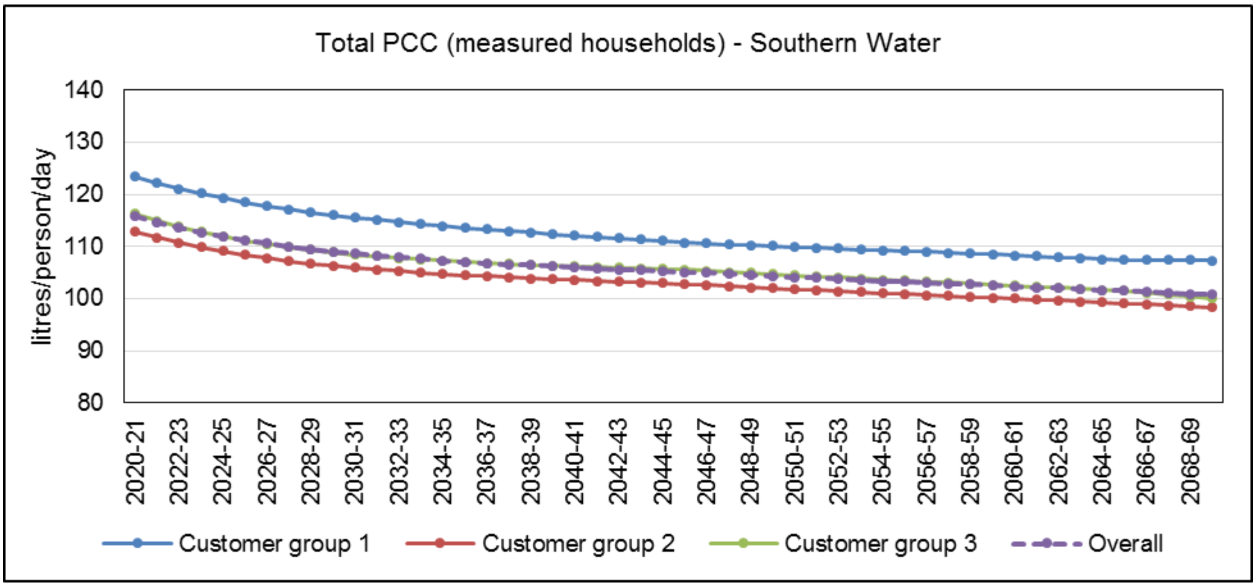


Figure 8 Total PCC forecast – Southern Water



All households

Figure 9 Total PCC forecast – Western area

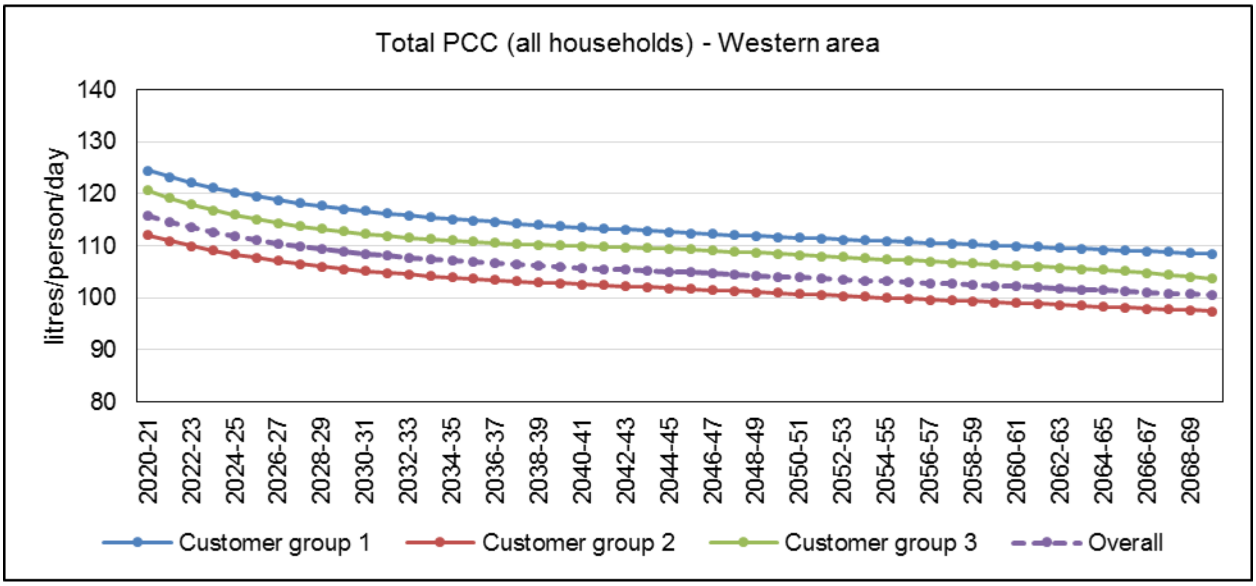


Figure 10 Total PCC forecast – Central area

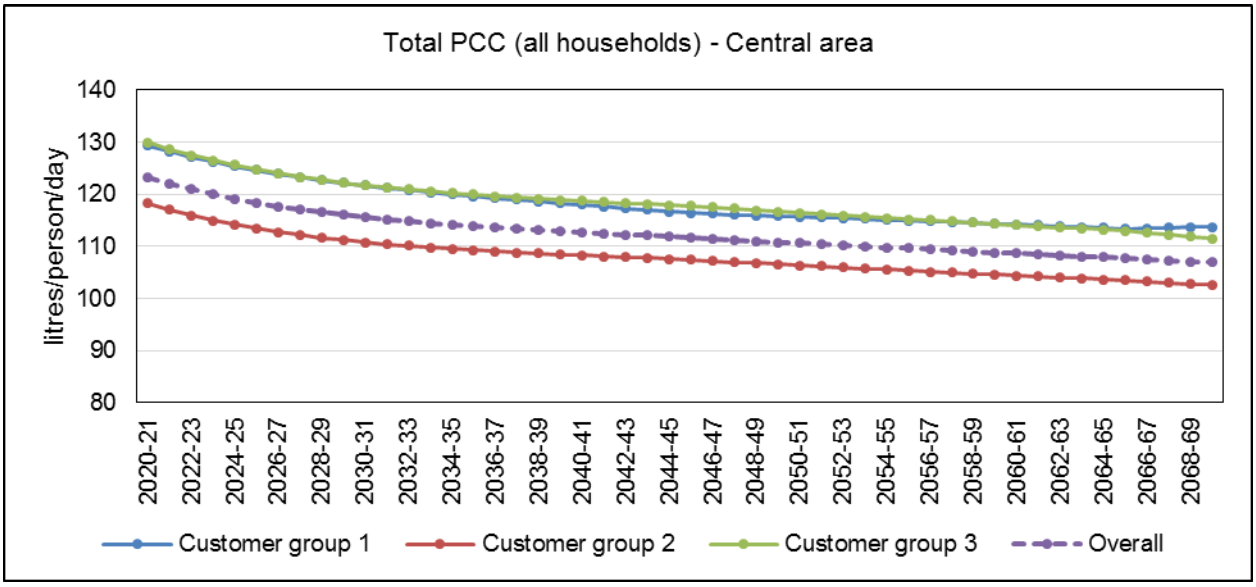


Figure 11 Total PCC forecast – Eastern area

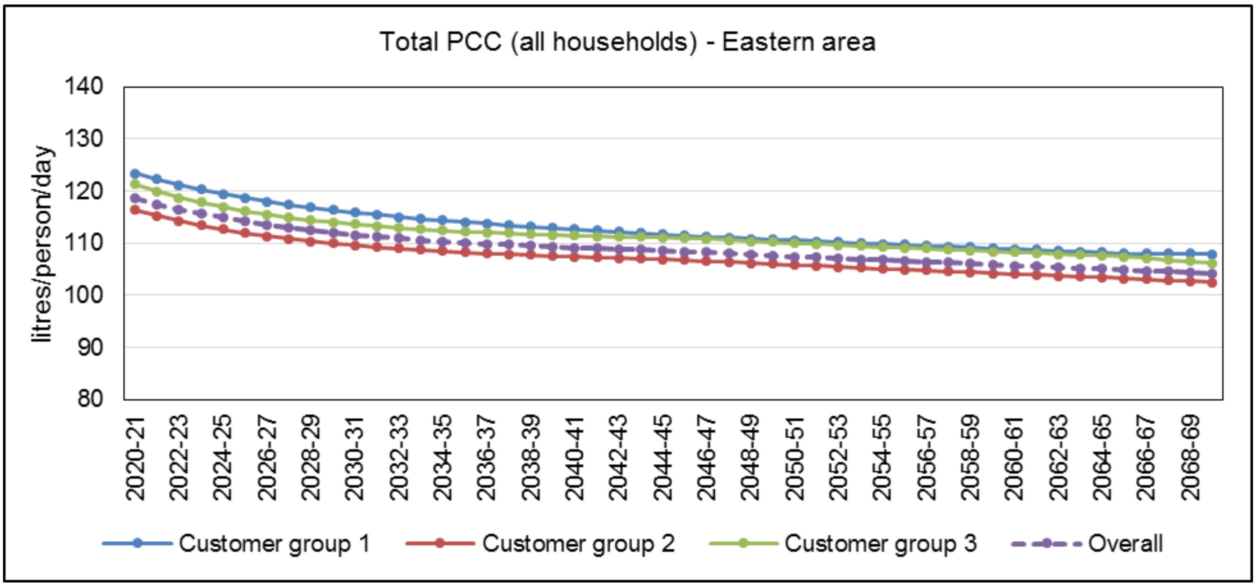
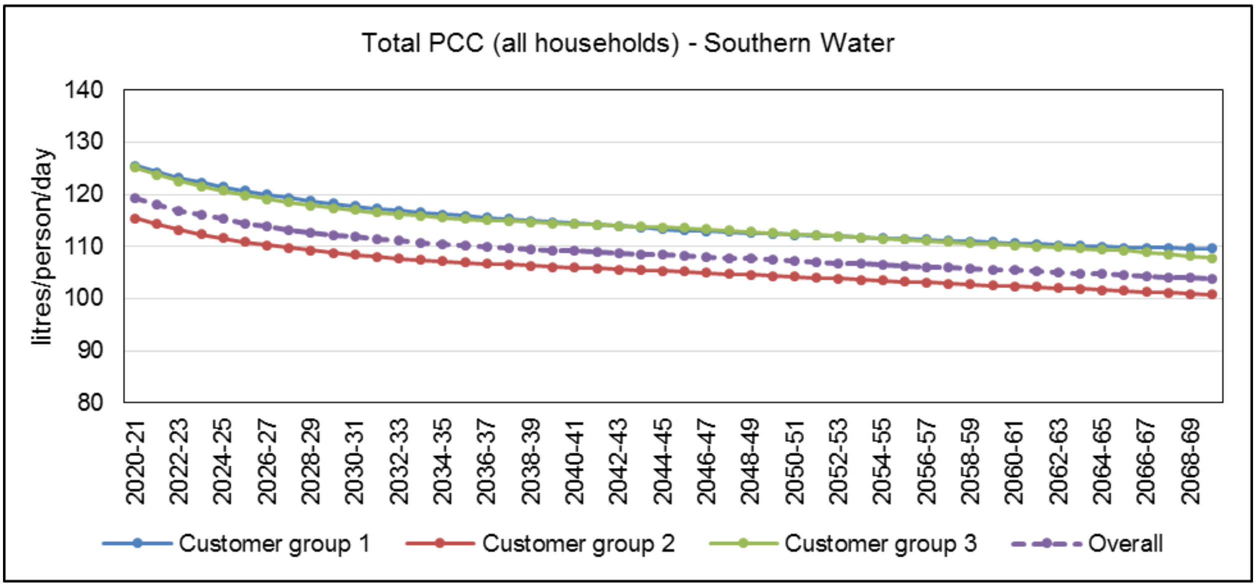


Figure 12 Total PCC forecast – Southern Water



Water Resources Management Plan 2019

Annex 2: Demand Forecast Appendix K: Total household demand forecast by area and metering status

December 2019

Version 1

Figure 1 Total household demand forecast – Western area

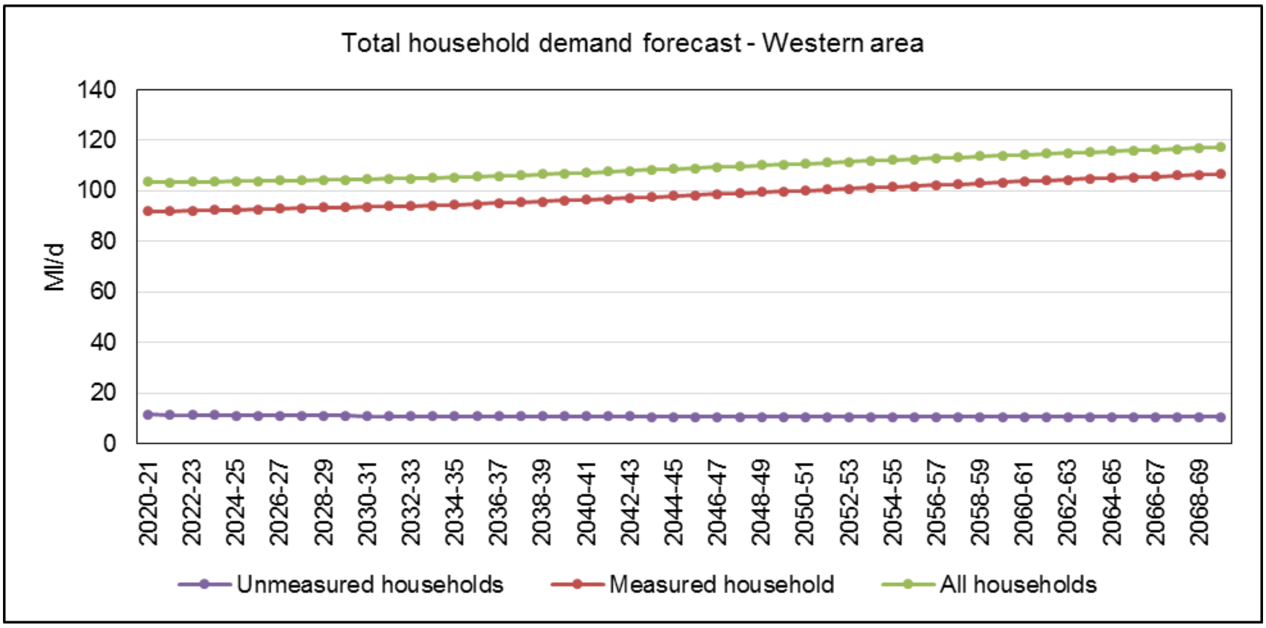


Figure 2 Total household demand forecast – Central area

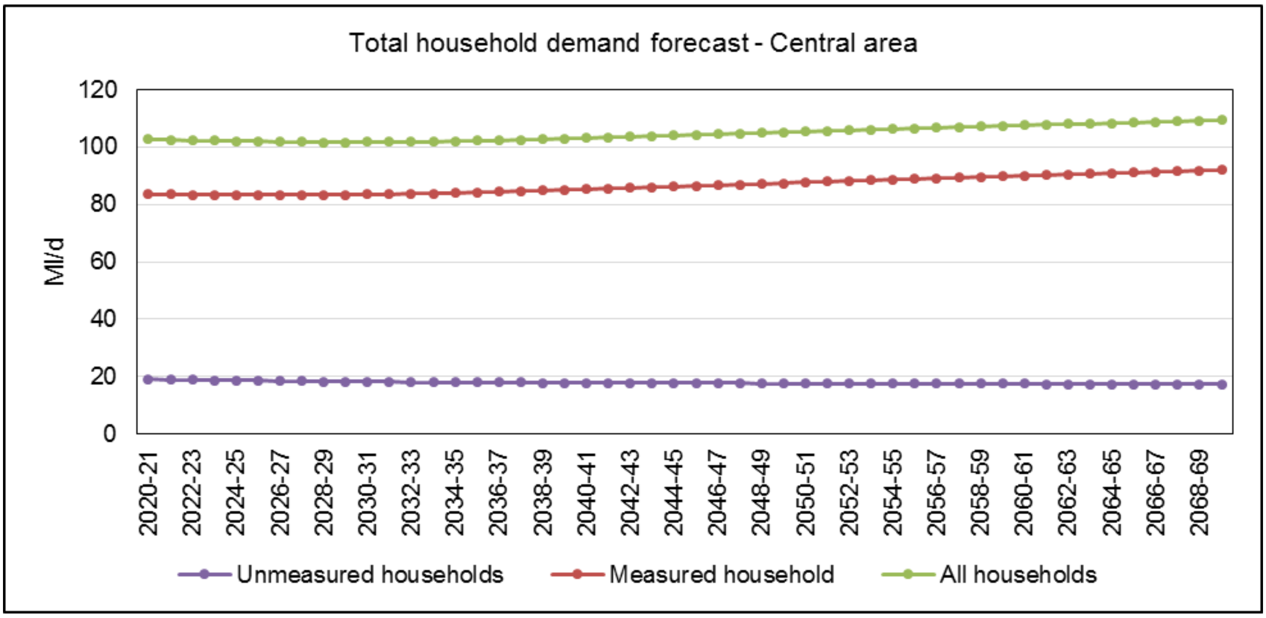


Figure 3 Total household demand forecast – Eastern area

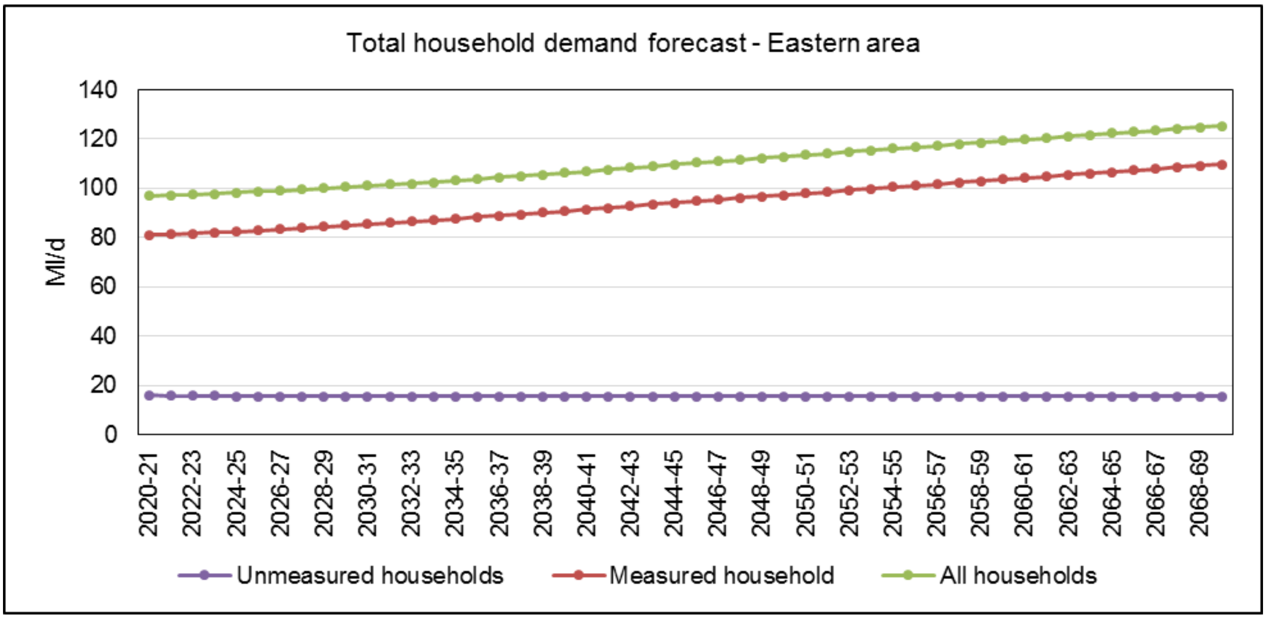
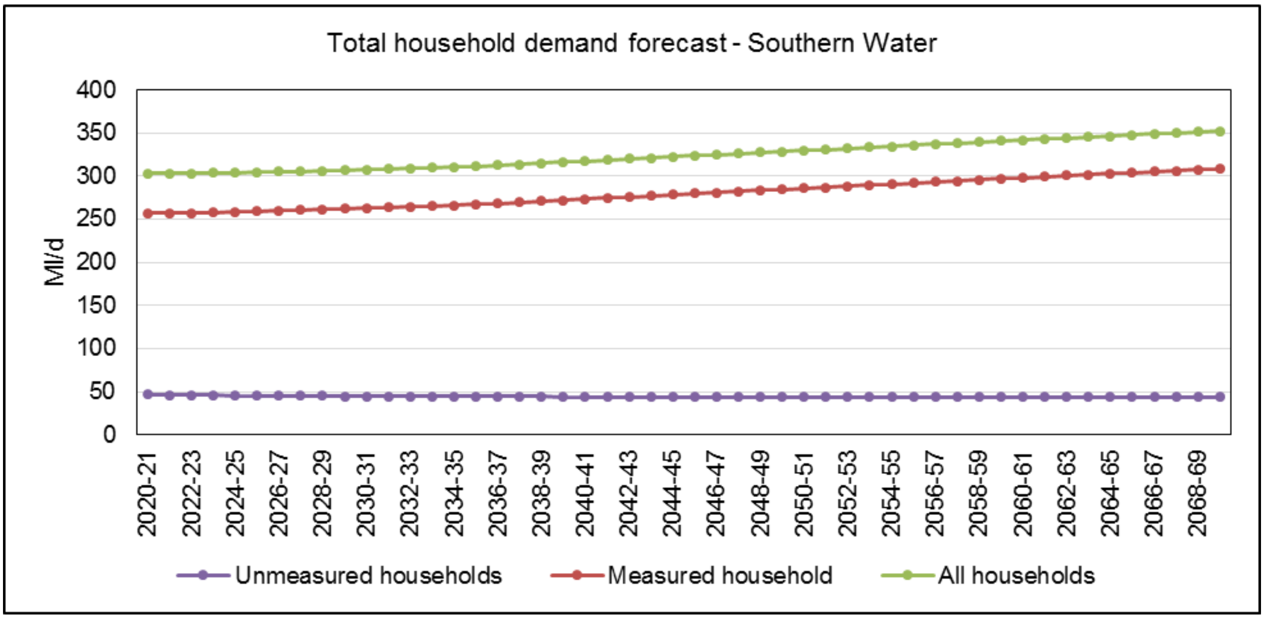


Figure 4 Total household demand forecast – Southern Water



Measured households

Figure 5 Total household demand forecast – Western area

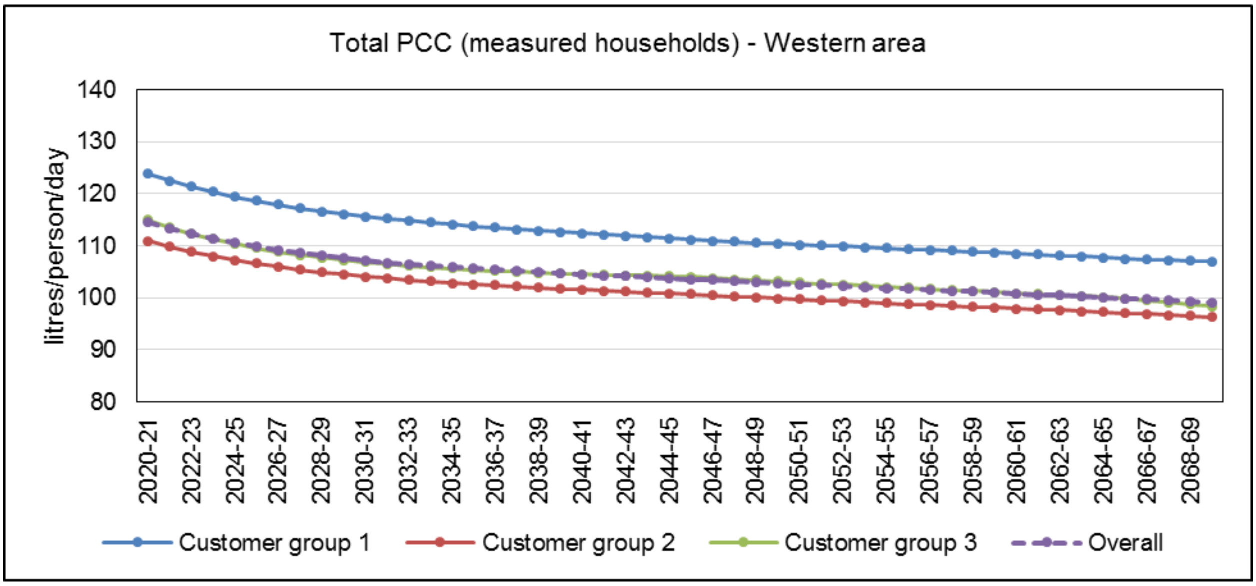


Figure 6 Total household demand forecast – Central area

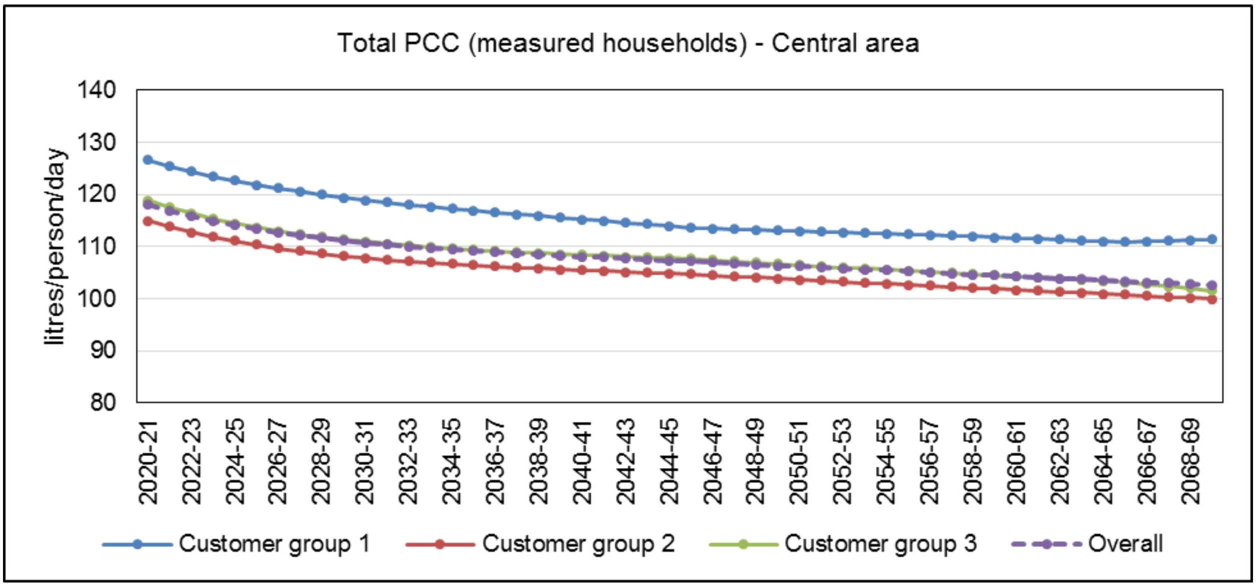


Figure 7 Total household demand forecast – Eastern area

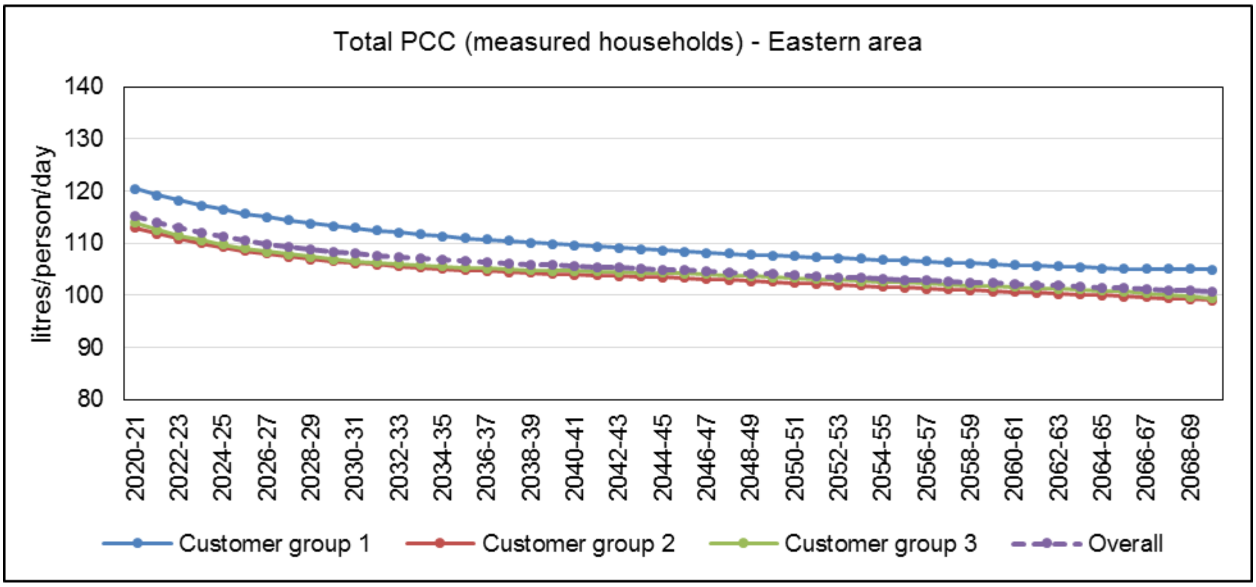
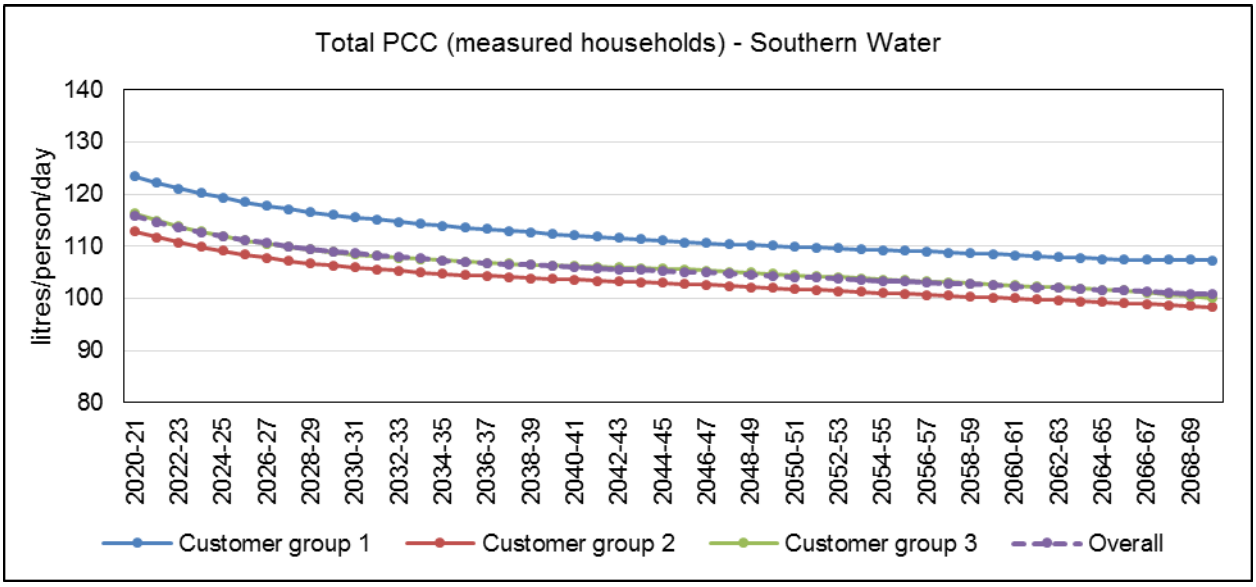


Figure 8 Total household demand forecast – Southern Water



All households

Figure 9 Total household demand forecast – Western area

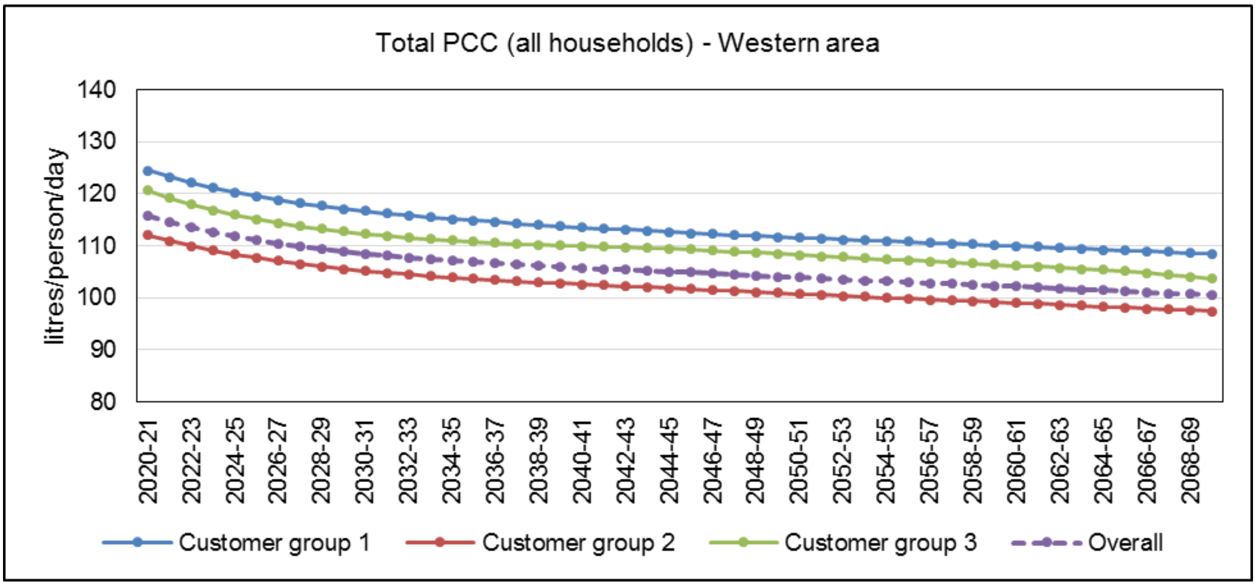


Figure 10 Total household demand forecast – Central area

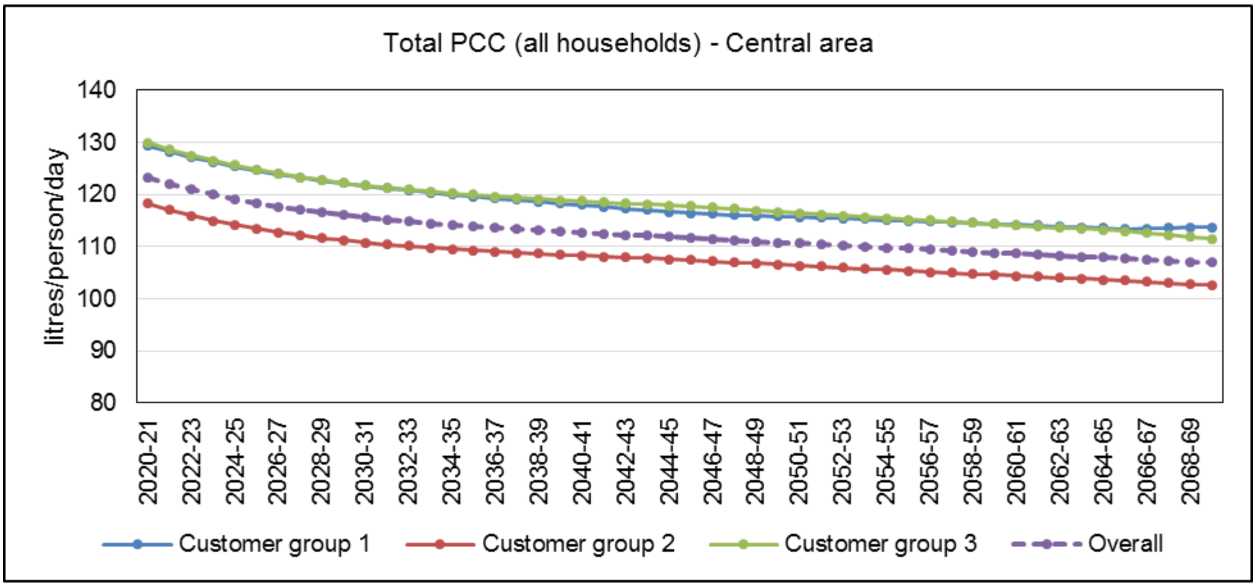


Figure 11 Total household demand forecast – Eastern area

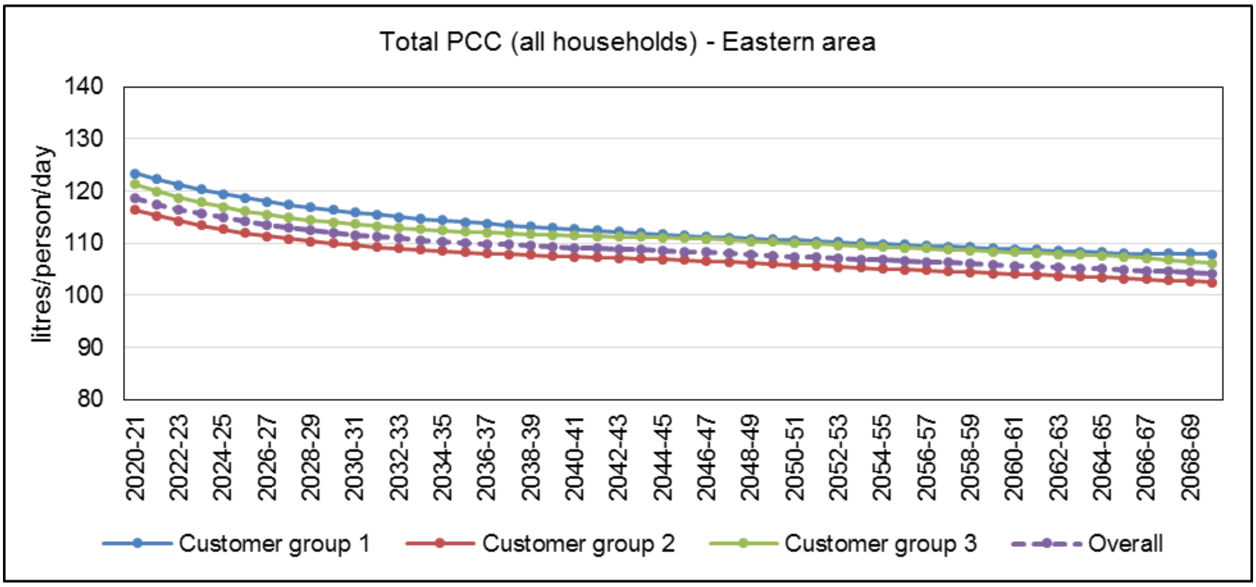
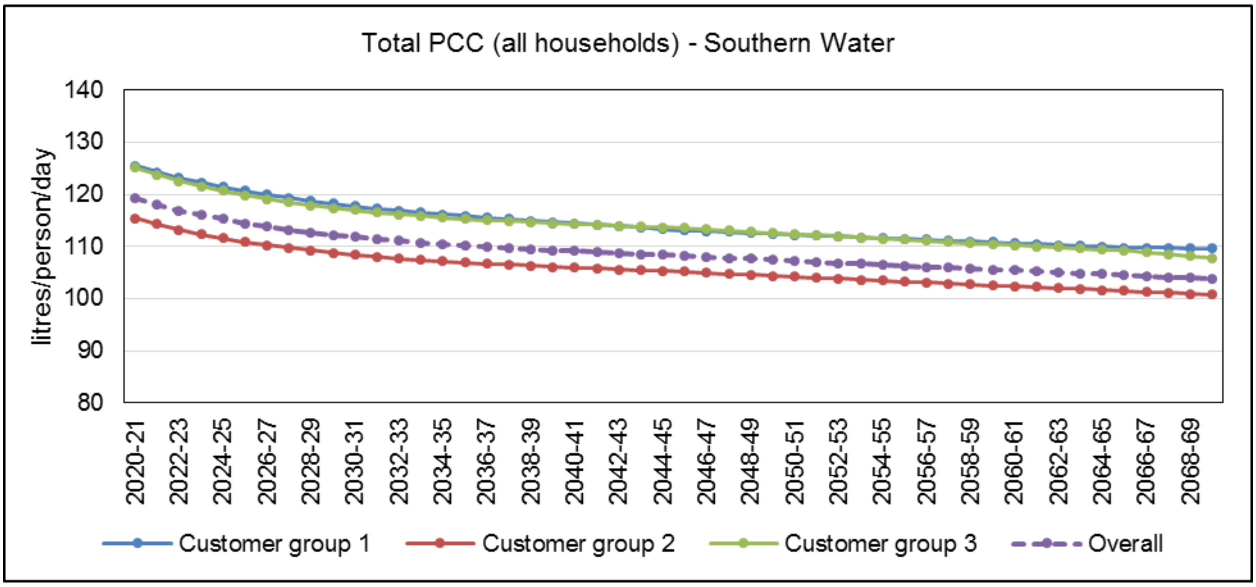


Figure 12 Total household demand forecast – Southern Water



Water Resources Management Plan 2019
Annex 2: Demand Forecast Appendix L: Total non-household demand forecast by area and sector

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Figure 1 Total non-household demand forecast – Western area

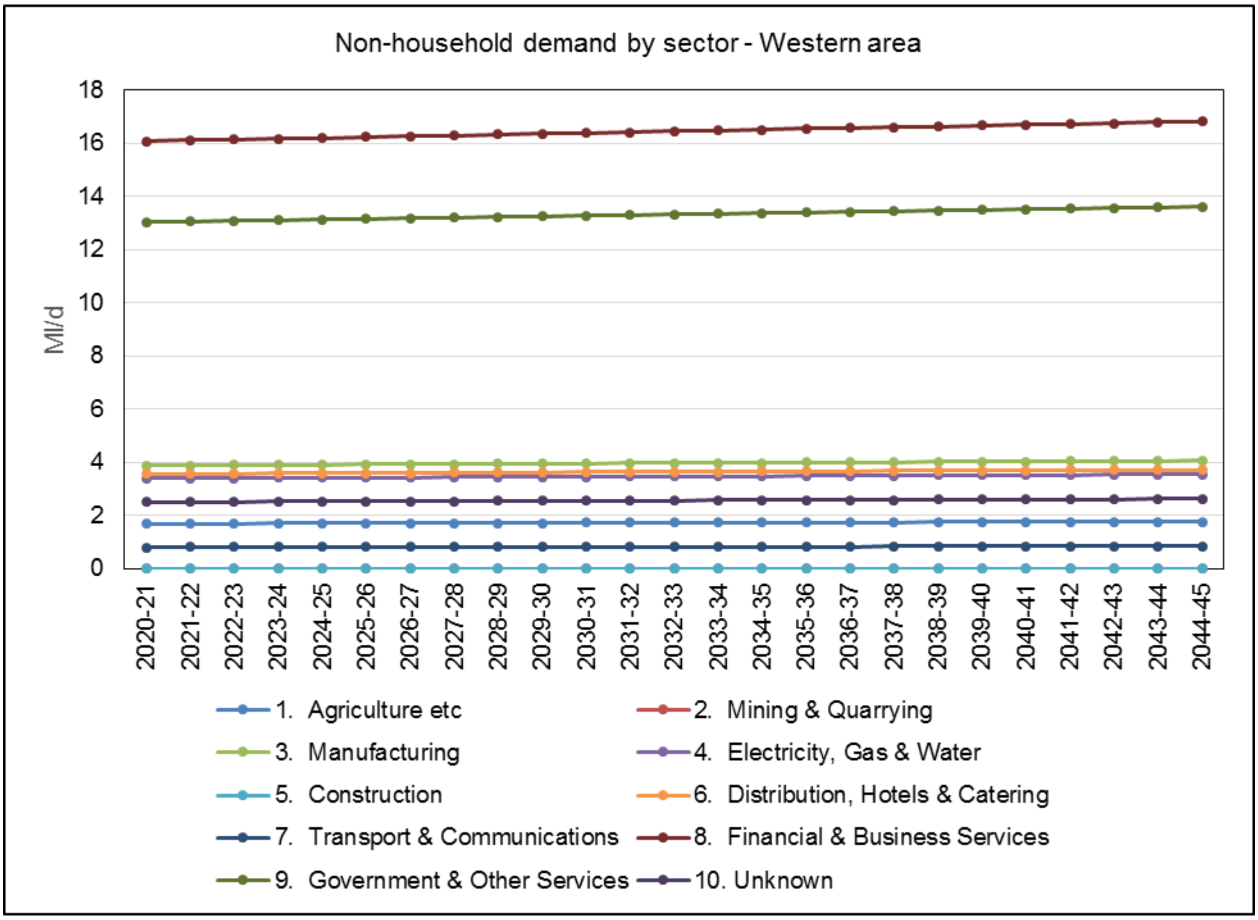


Figure 2 Total non-household demand forecast – Central area

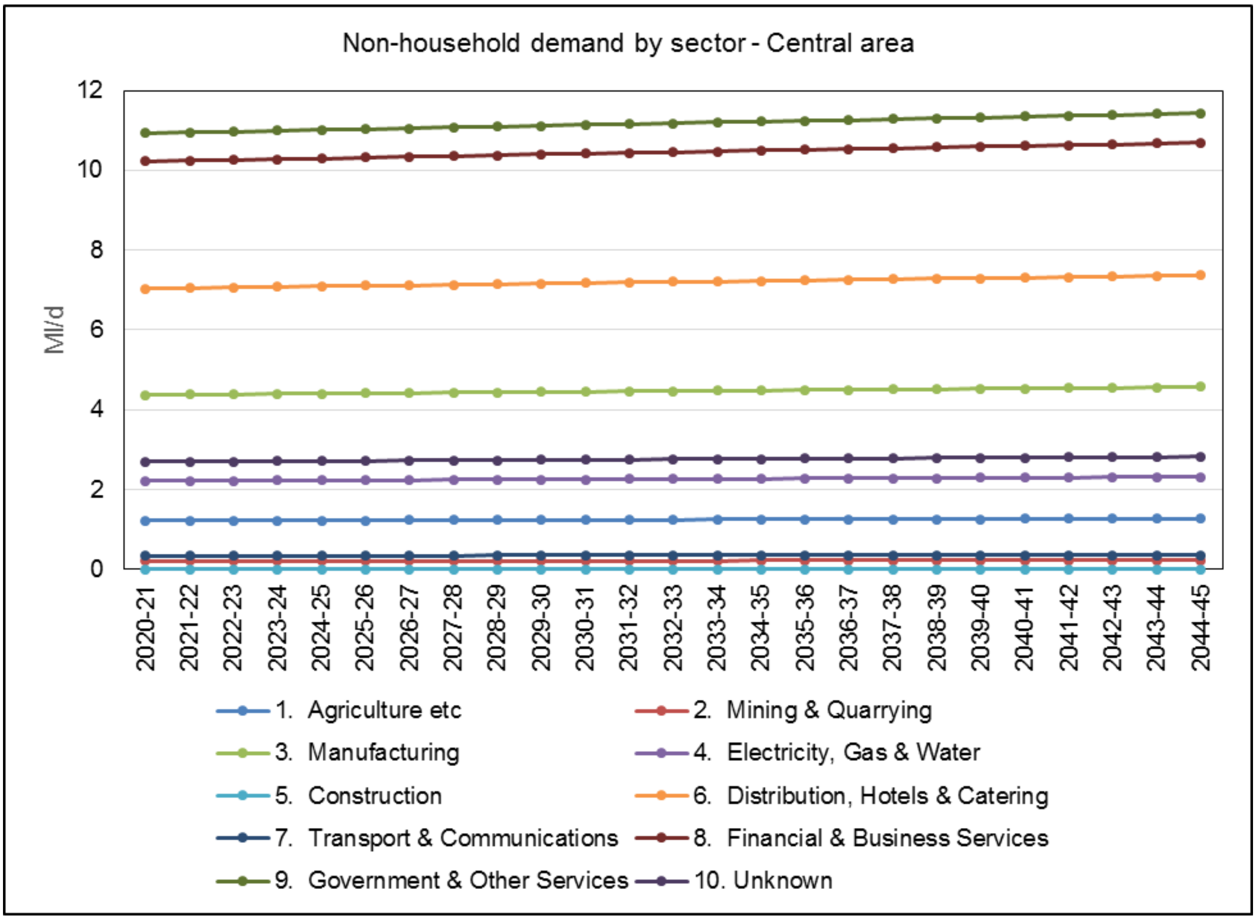


Figure 3 Total non-household demand forecast – Eastern area

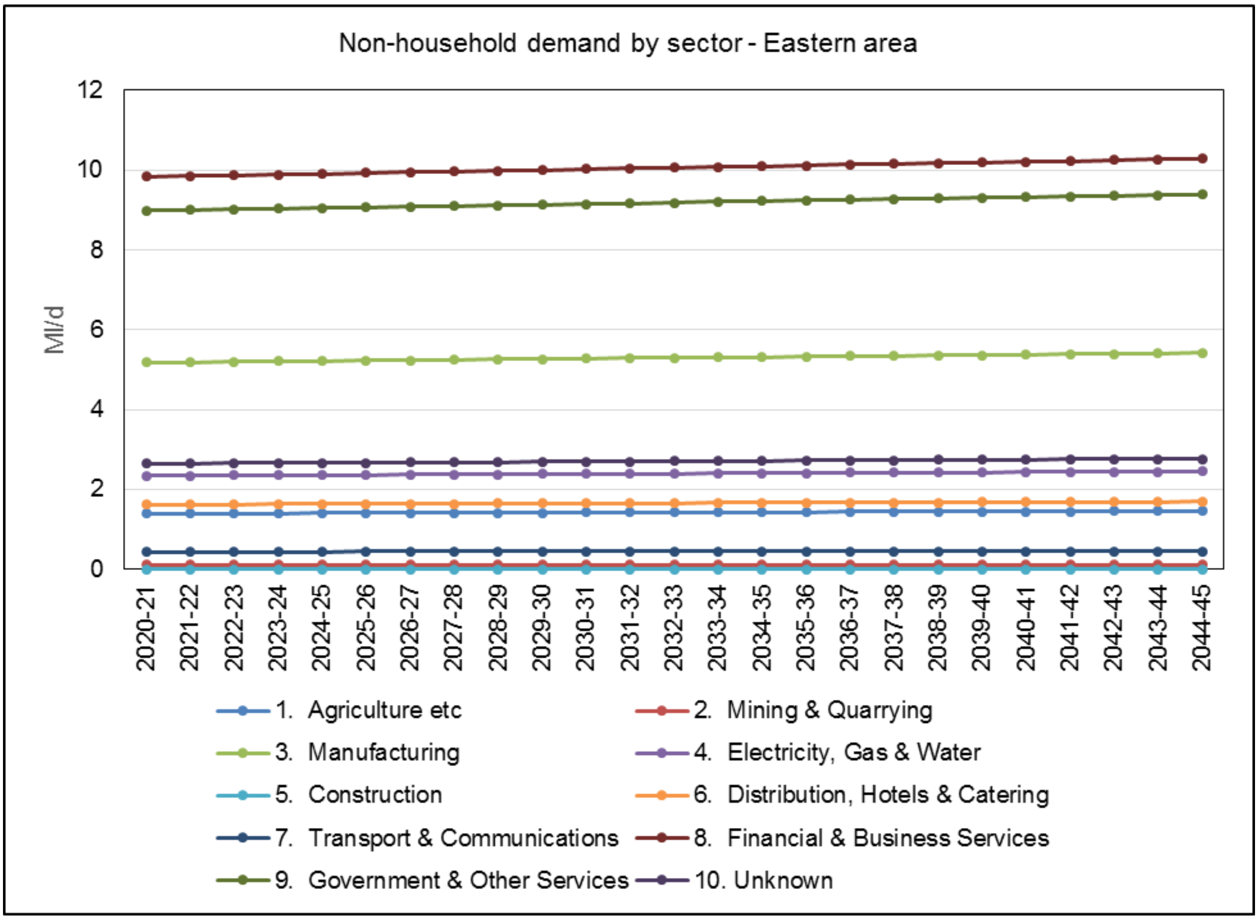
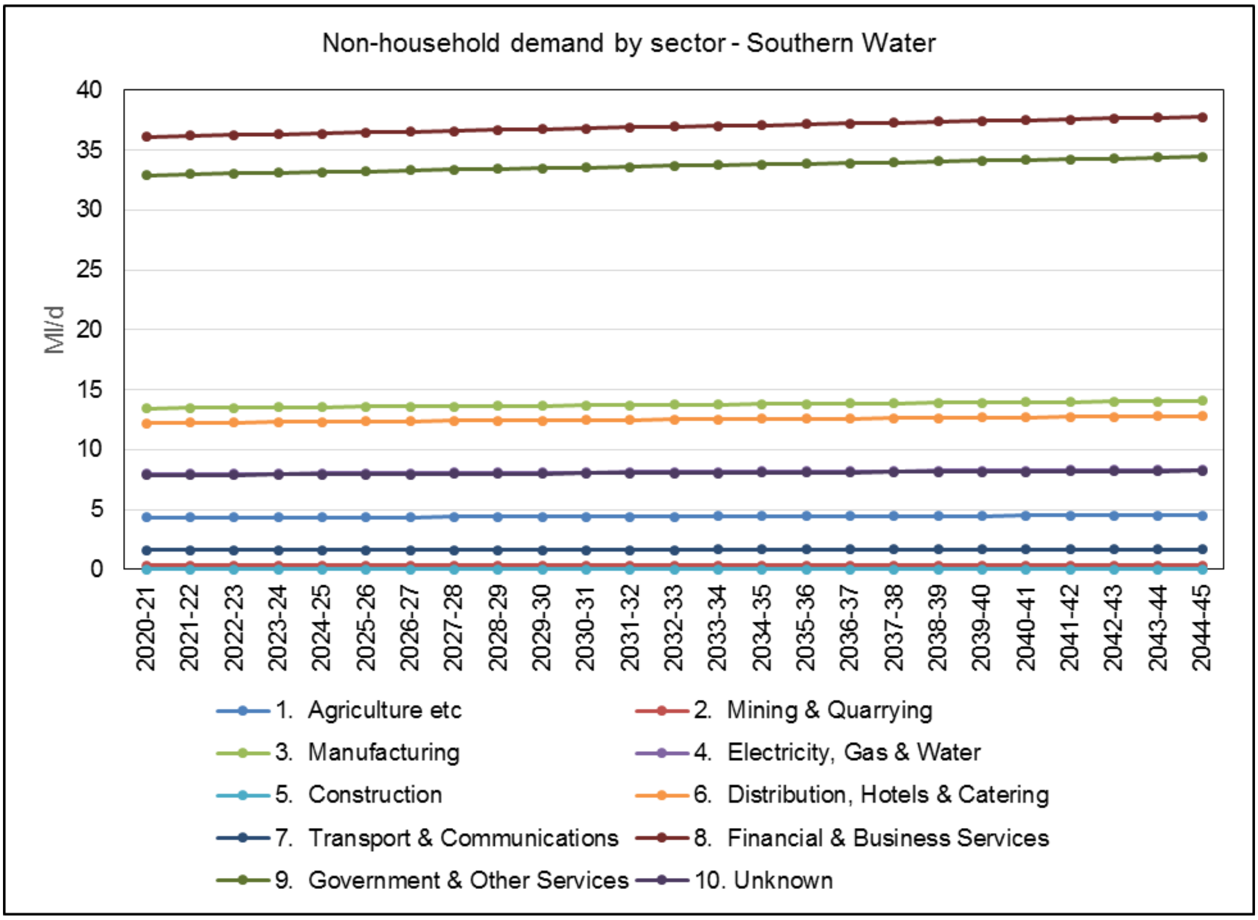


Figure 4 Total non-household demand forecast – Southern Water



Measured non-households

Figure 5 Total non-household demand forecast – Western area

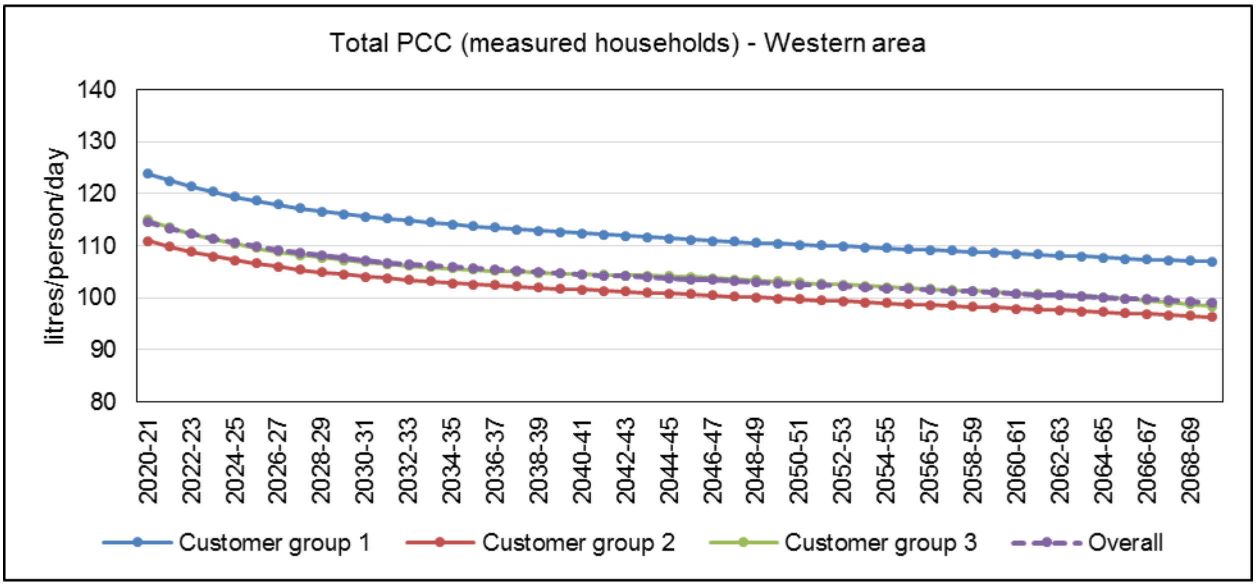


Figure 6 Total non-household demand forecast – Central area

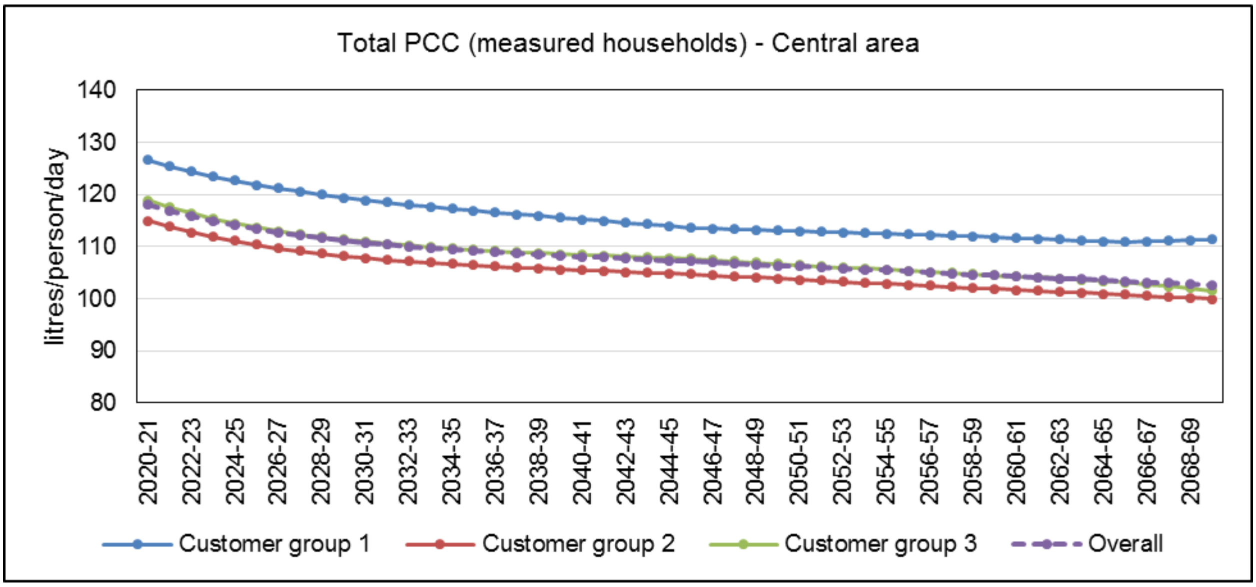


Figure 7 Total non-household demand forecast – Eastern area

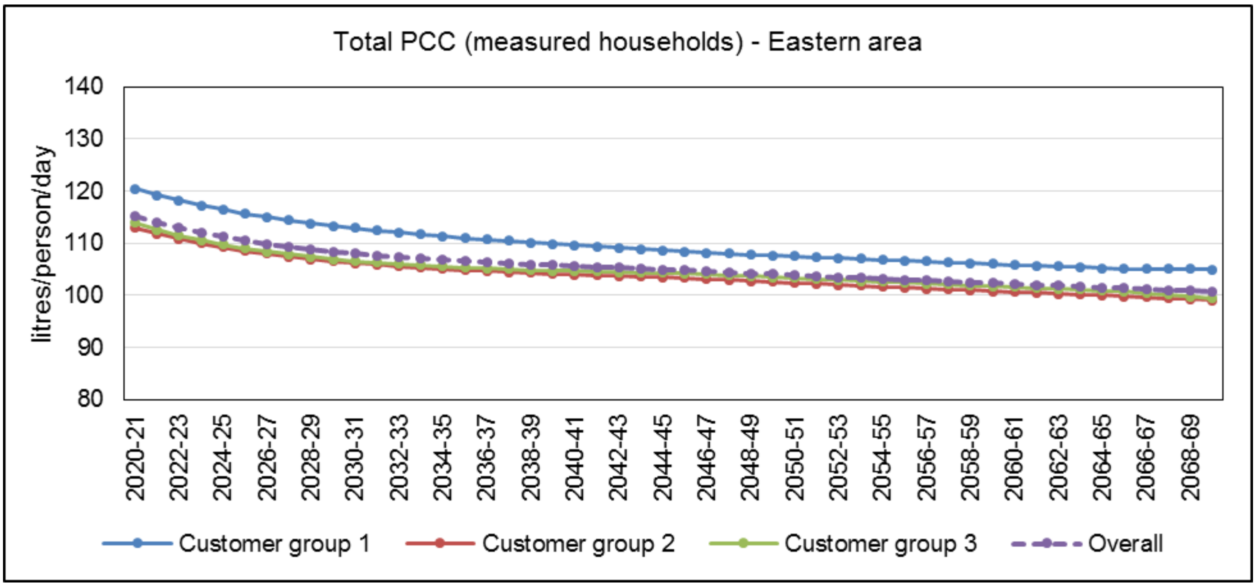
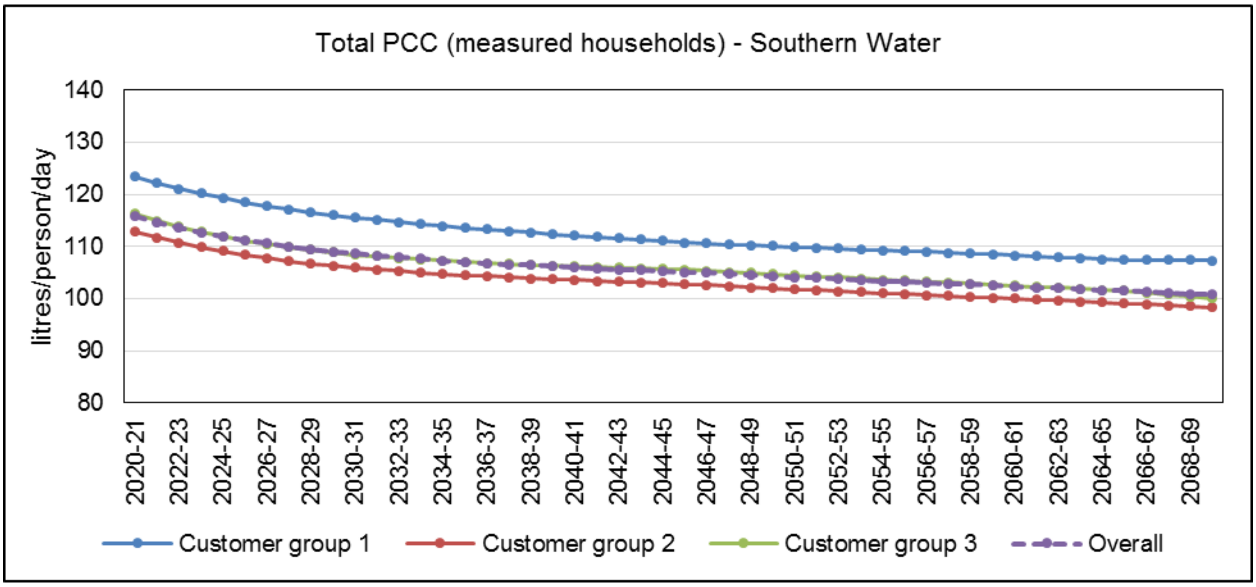


Figure 8 Total non-household demand forecast – Southern Water



All non-households

Figure 9 Total non-household demand forecast – Western area

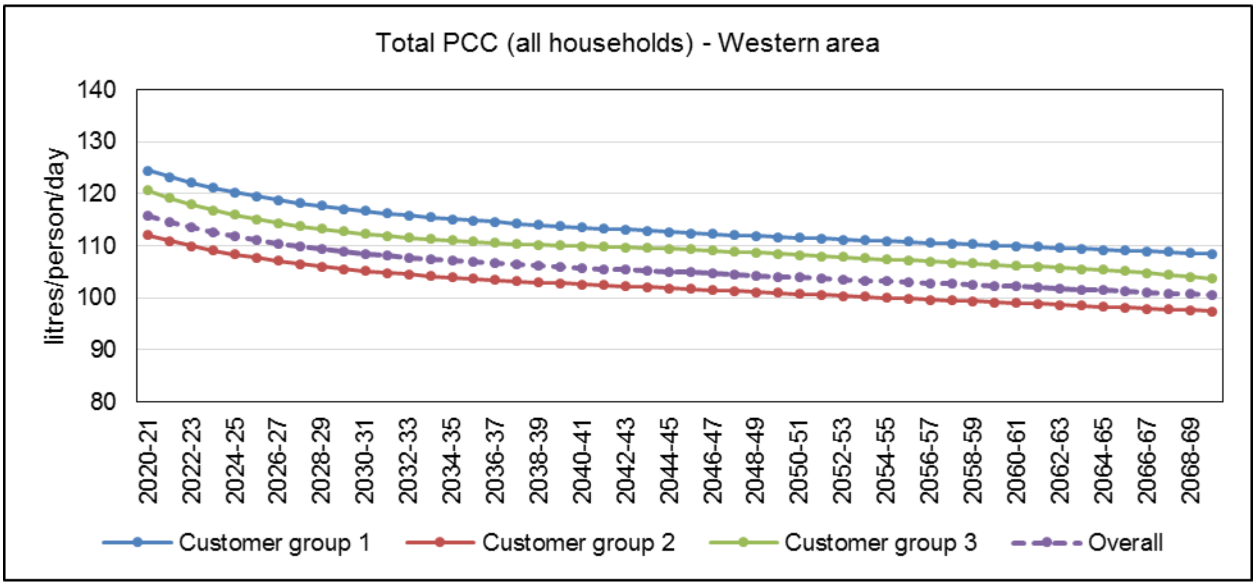


Figure 10 Total non-household demand forecast – Central area

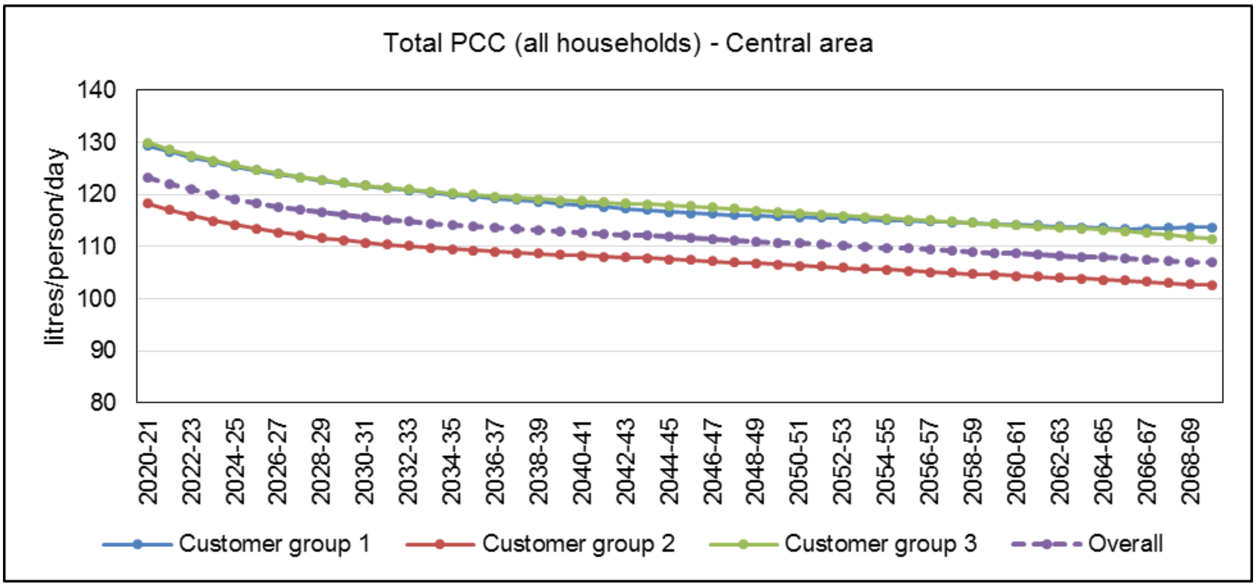


Figure 11 Total non-household demand forecast – Eastern area

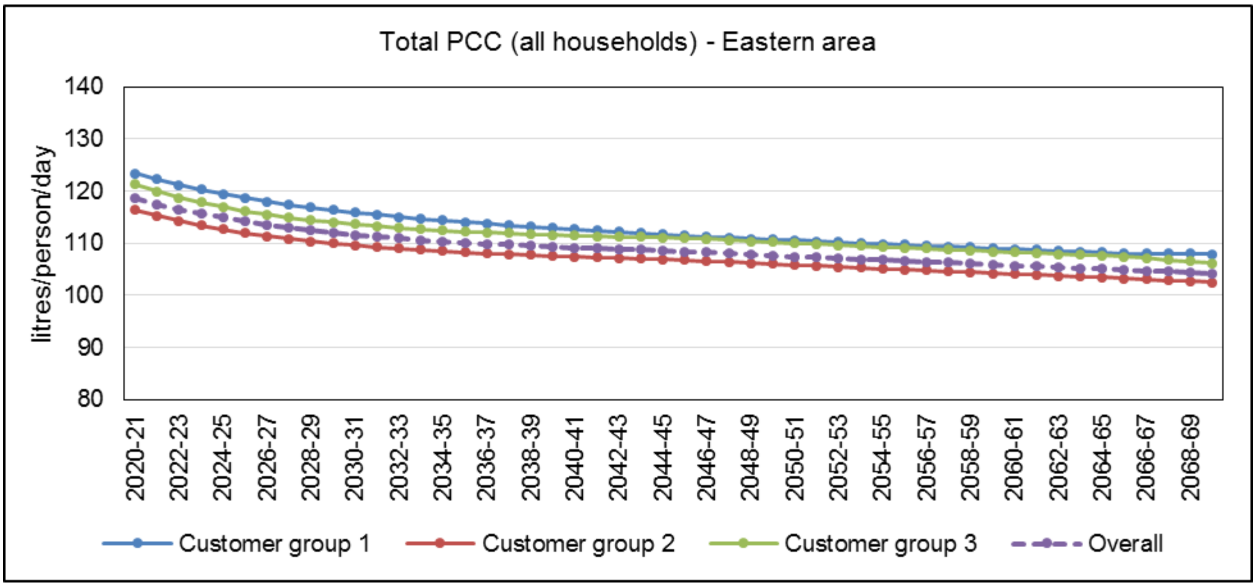
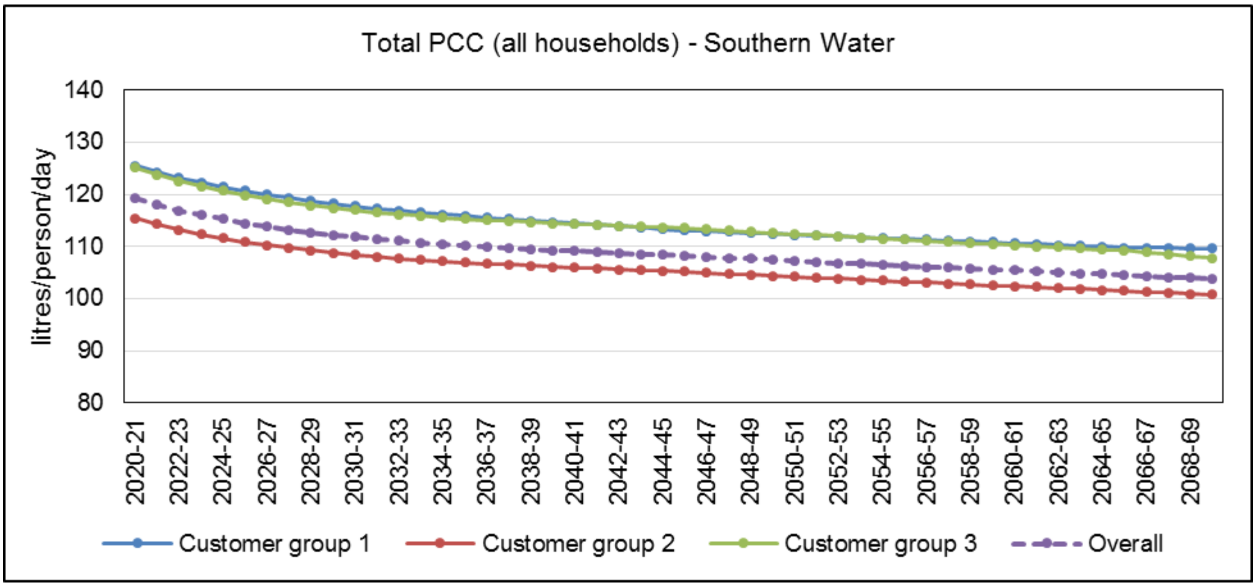


Figure 12 Total non-household demand forecast – Southern Water



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Annex 2: Demand Forecast Appendix M: Total demand forecast by area and component

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Figure 1 Total demand forecast – Western area

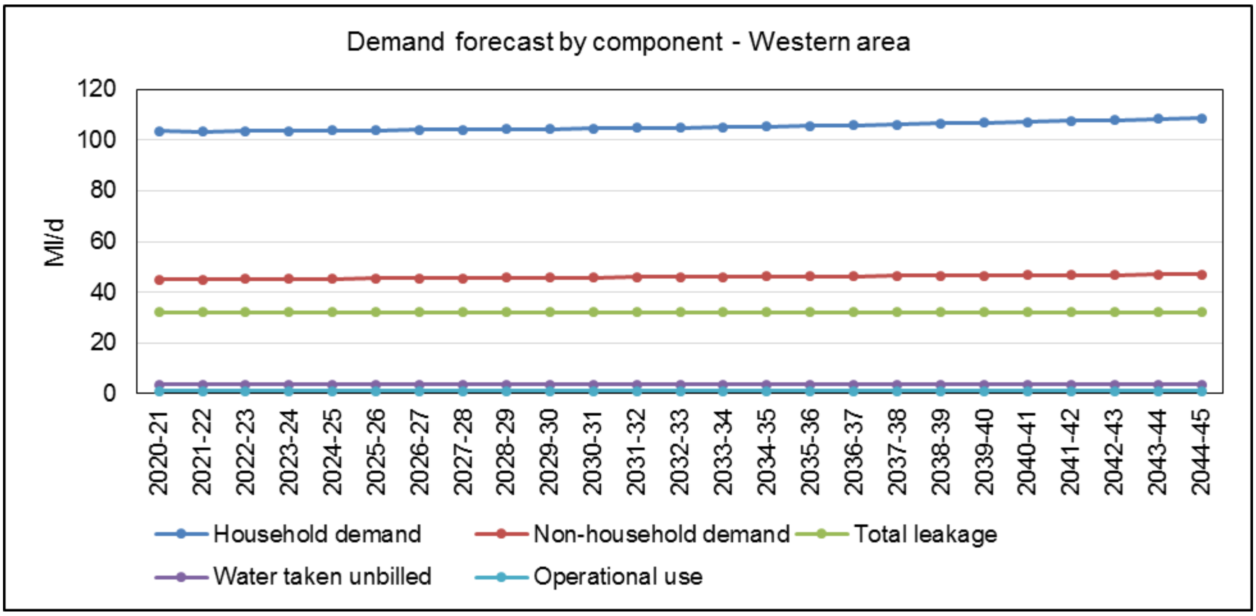


Figure 2 Total demand forecast – Central area

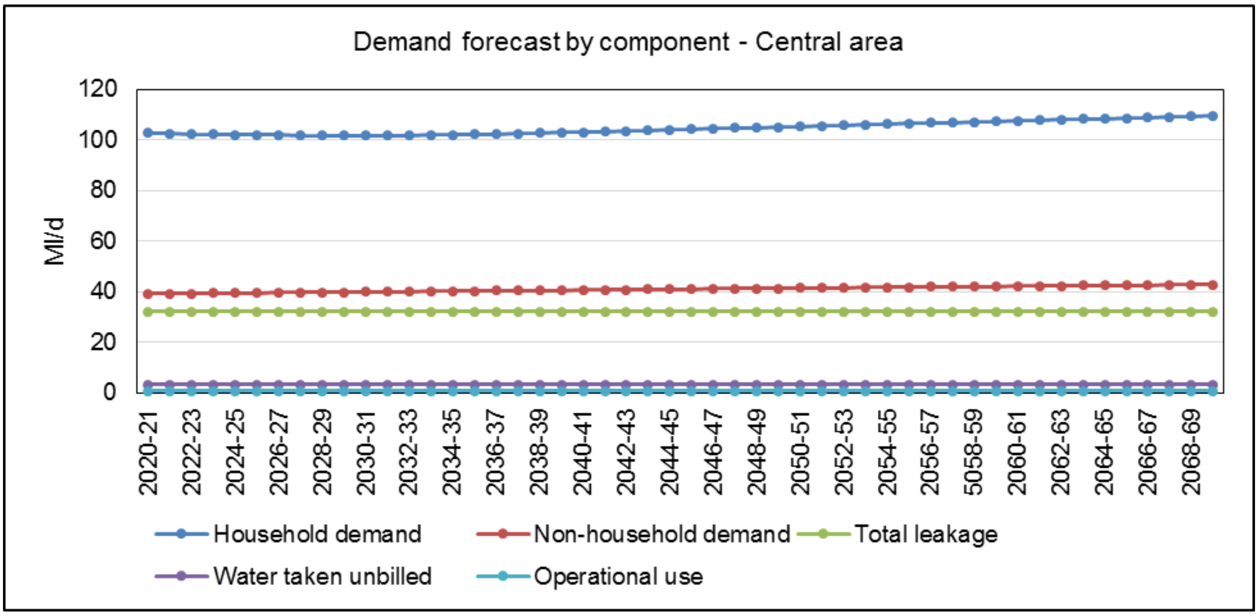


Figure 3 Total demand forecast – Eastern area

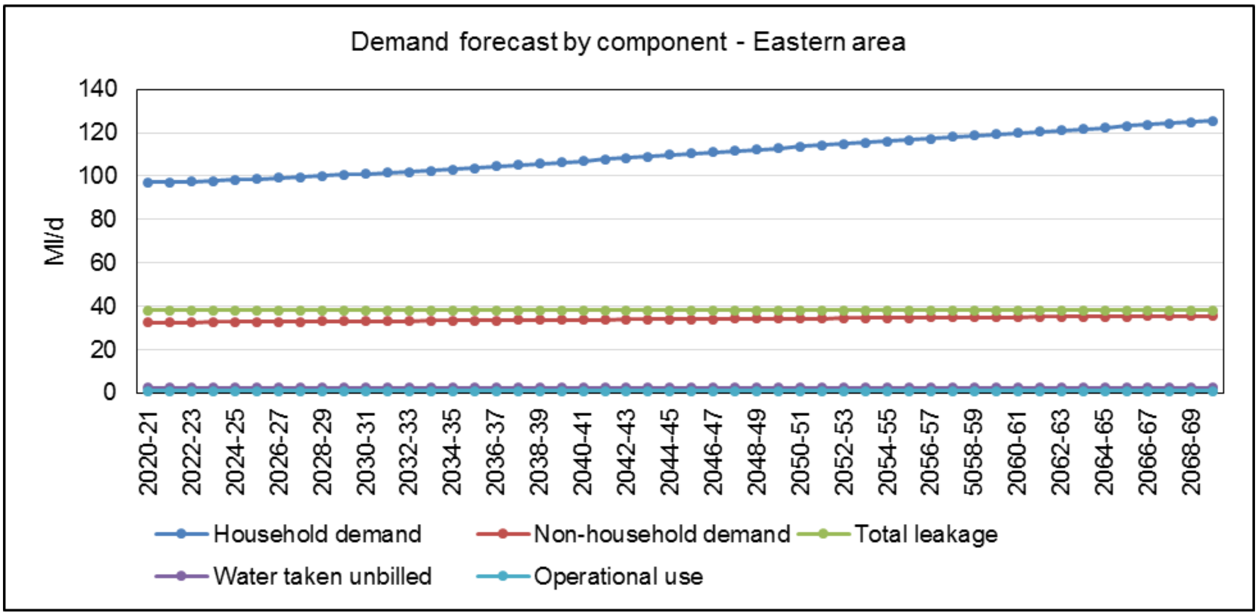
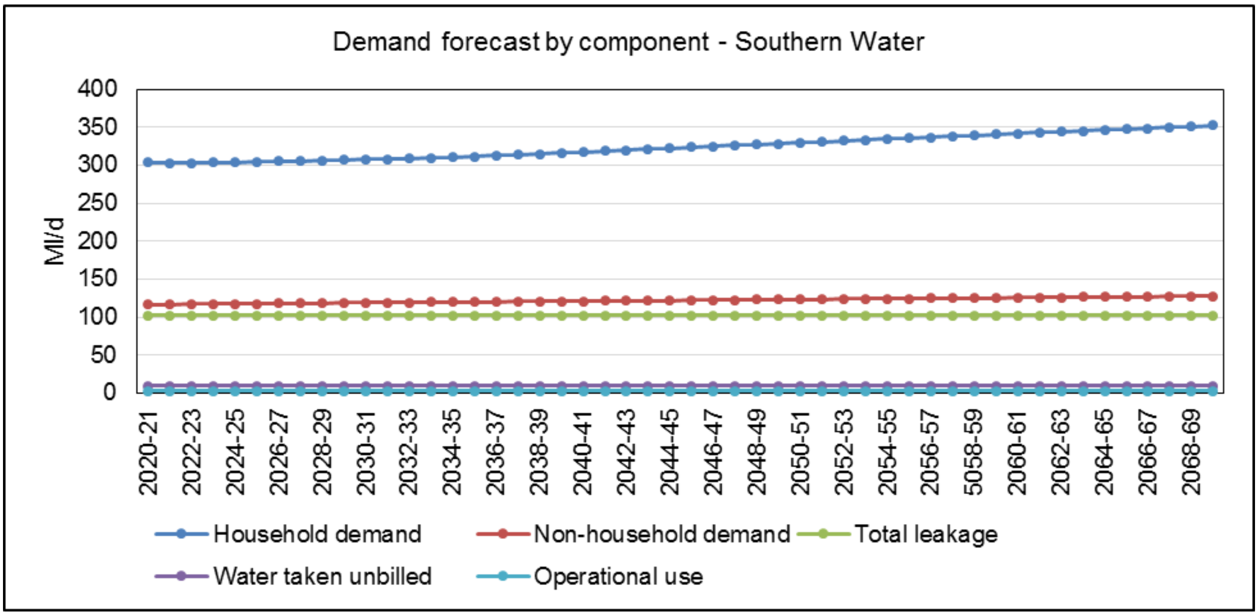


Figure 4 Total demand forecast – Southern Water



Measured s

Figure 5 Total demand forecast – Western area

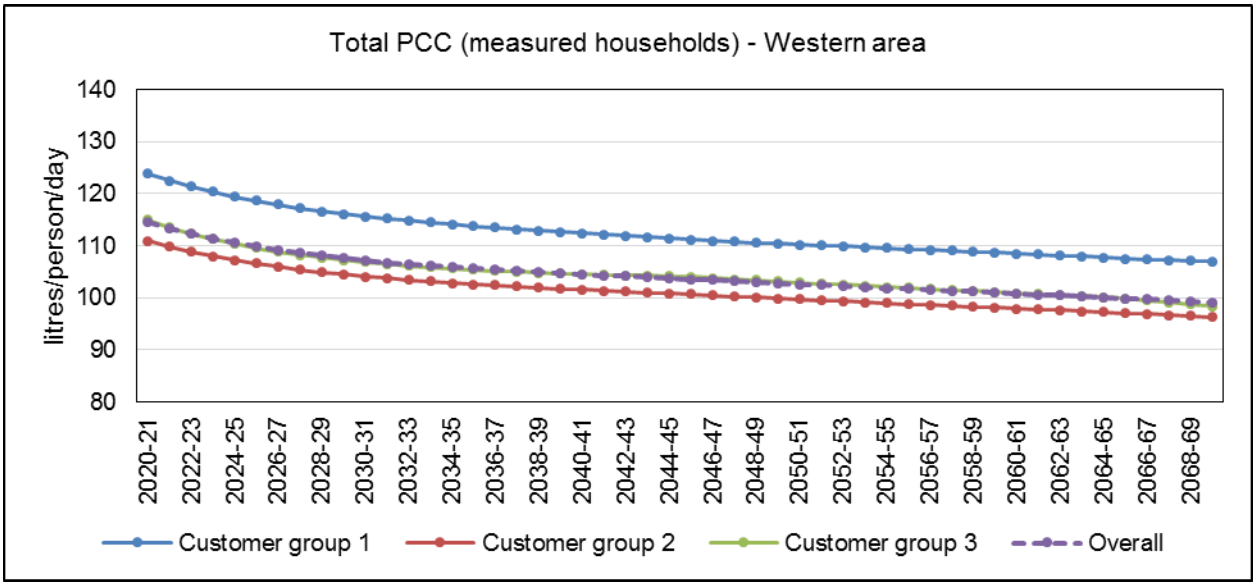


Figure 6 Total demand forecast – Central area

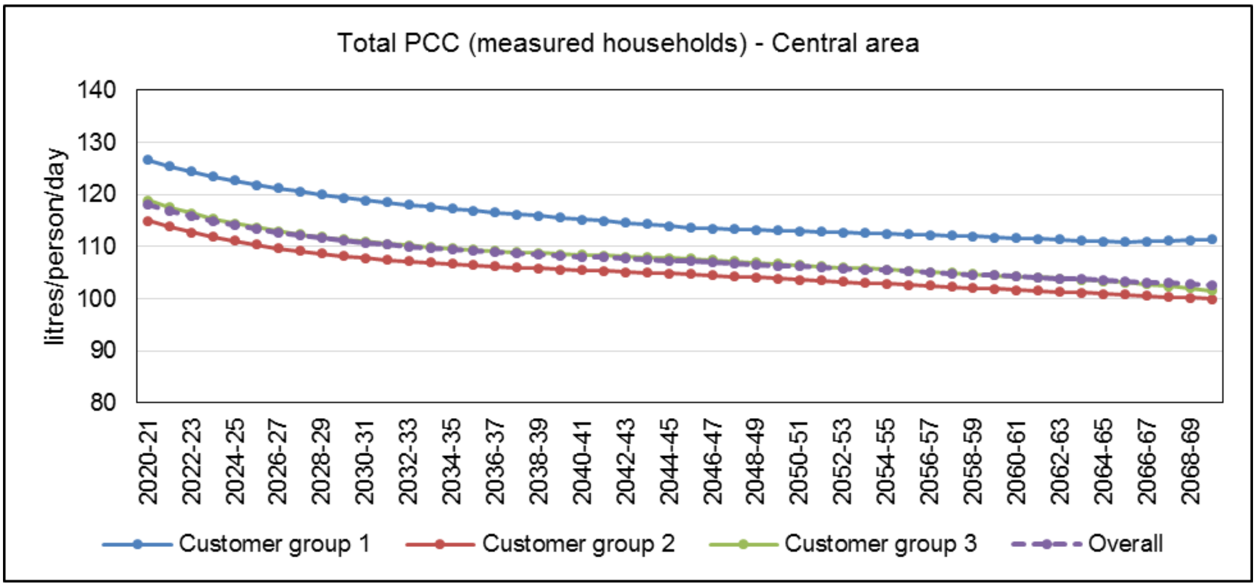


Figure 7 Total demand forecast – Eastern area

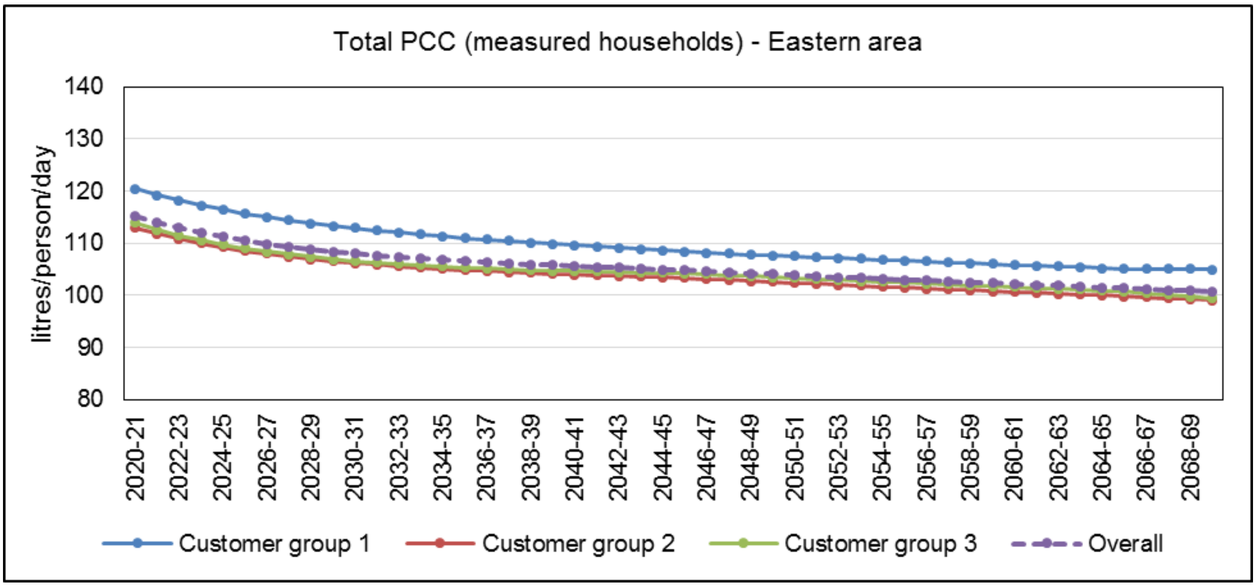
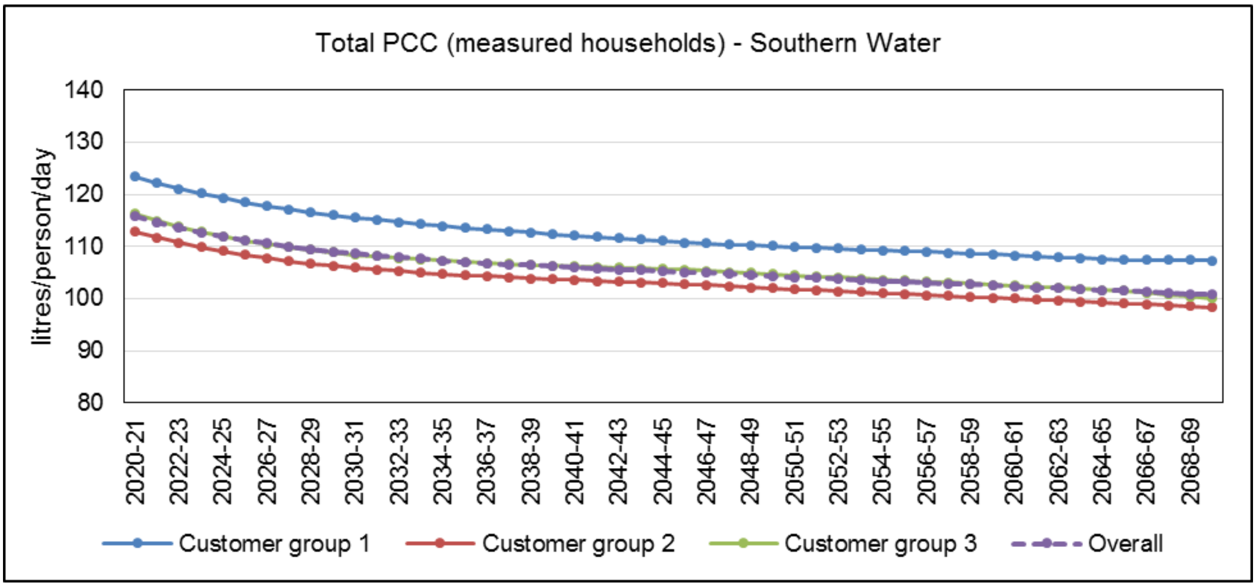


Figure 8 Total demand forecast – Southern Water



All s

Figure 9 Total demand forecast – Western area

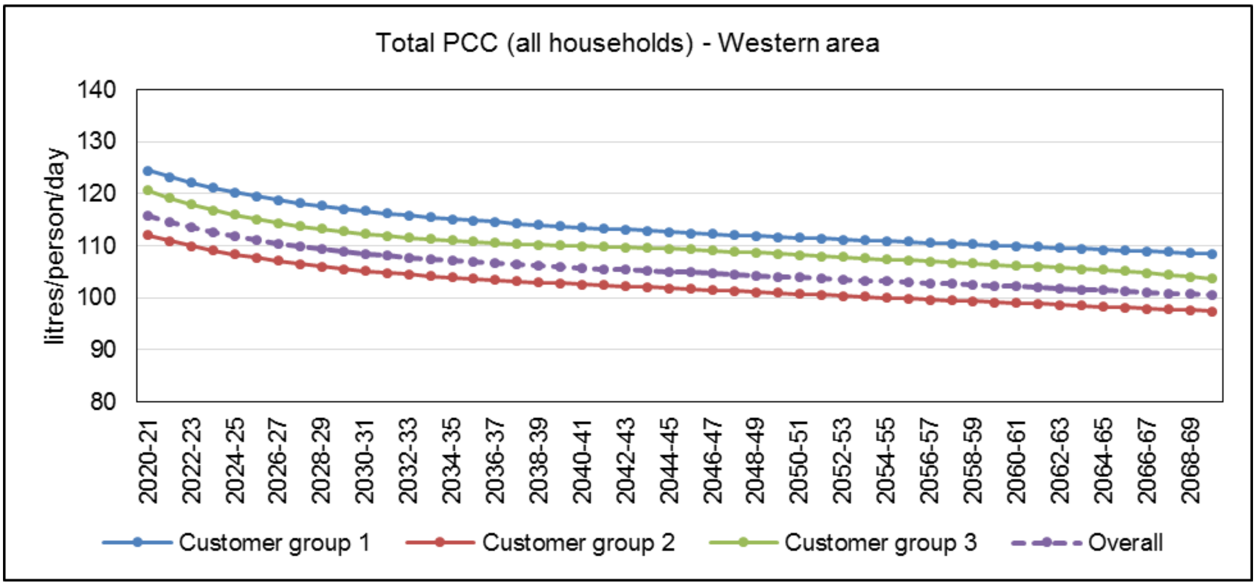


Figure 10 Total demand forecast – Central area

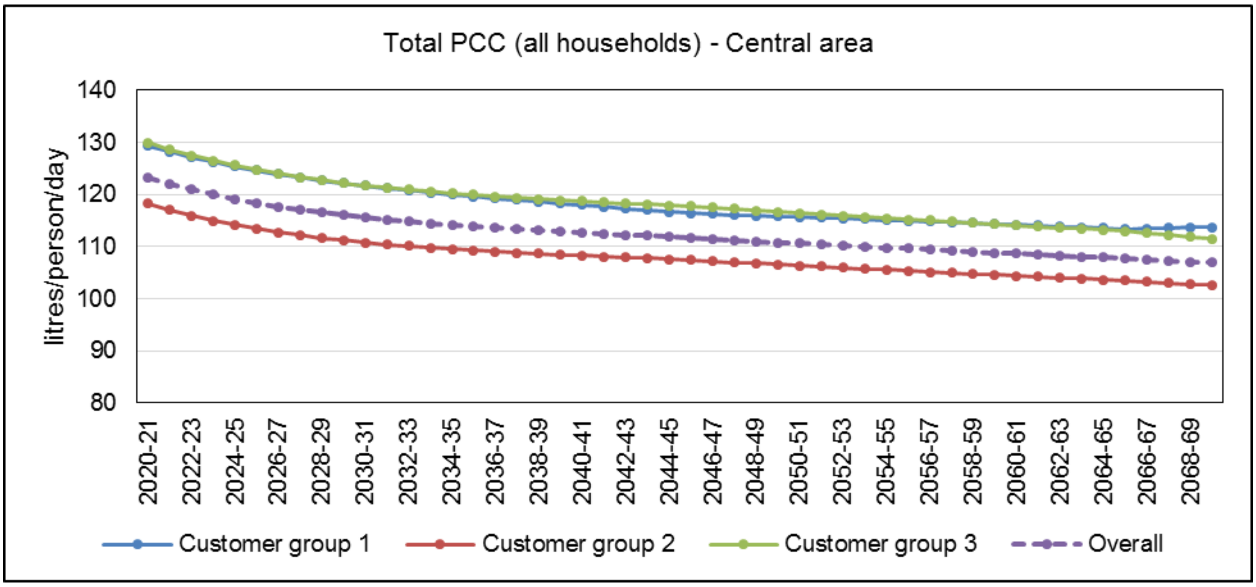


Figure 11 Total demand forecast – Eastern area

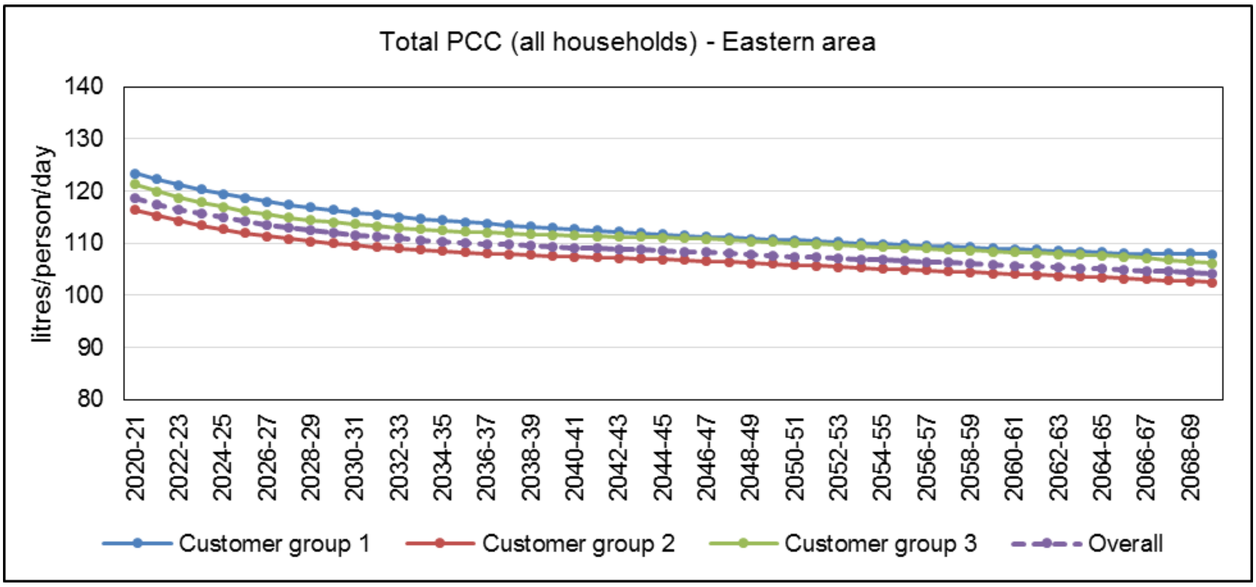
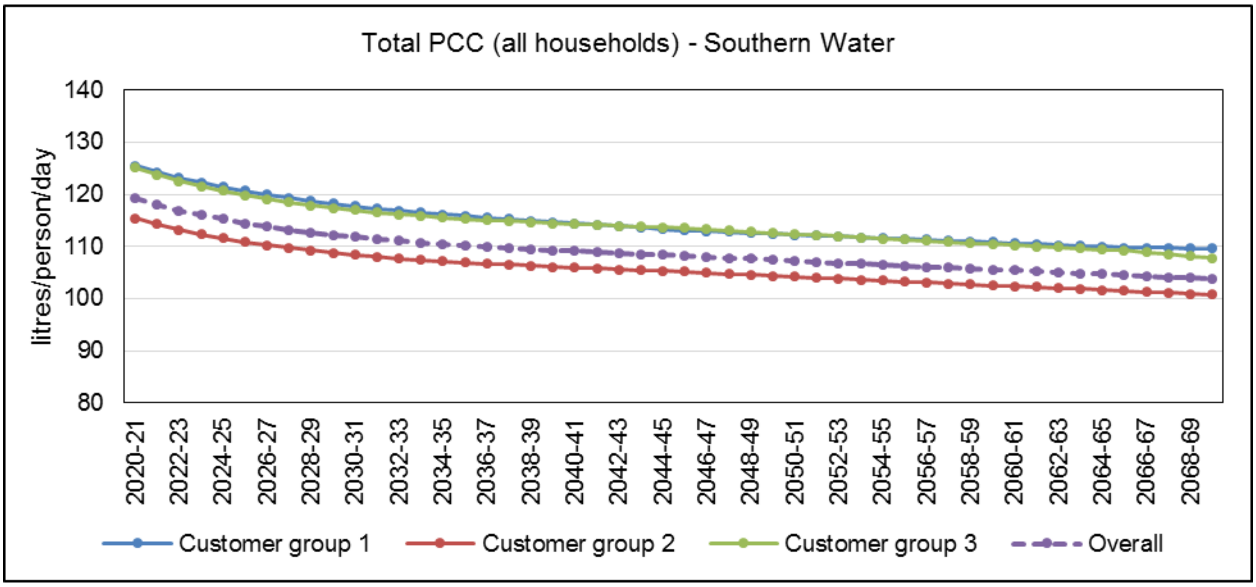


Figure 12 Total demand forecast – Southern Water



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Annex 2: Demand Forecast Appendix N: Total distribution input forecast by area and scenarios

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Total distribution input (DI) forecast by area and scenario

Figure 1 Total DI forecast – Western area

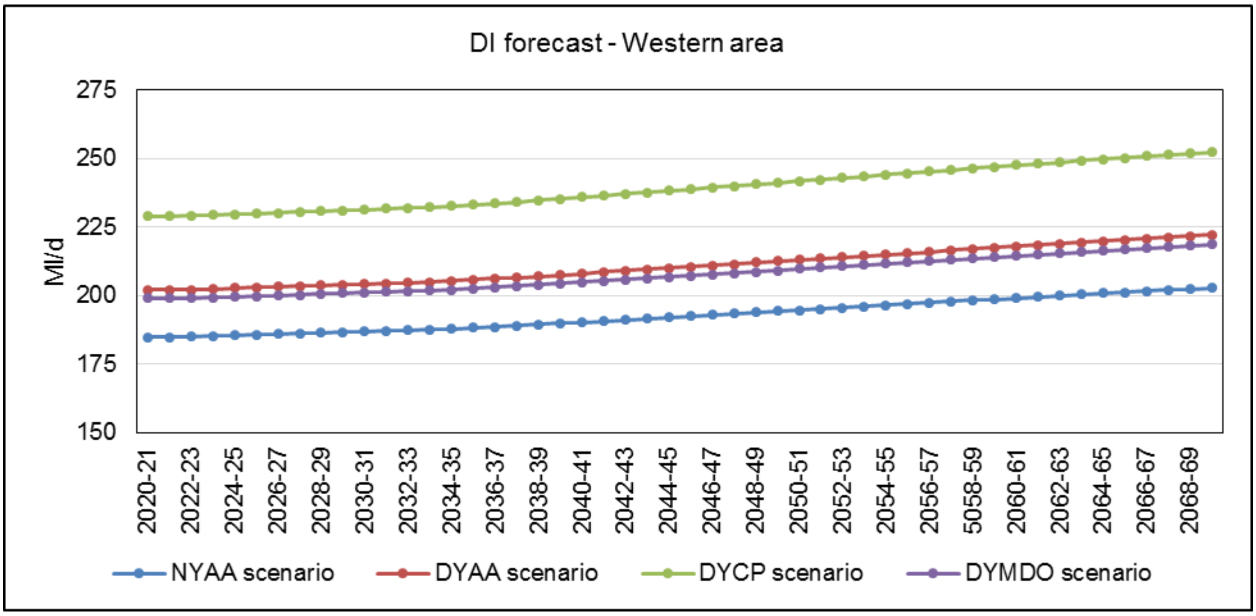


Figure 2 Total DI forecast – Central area

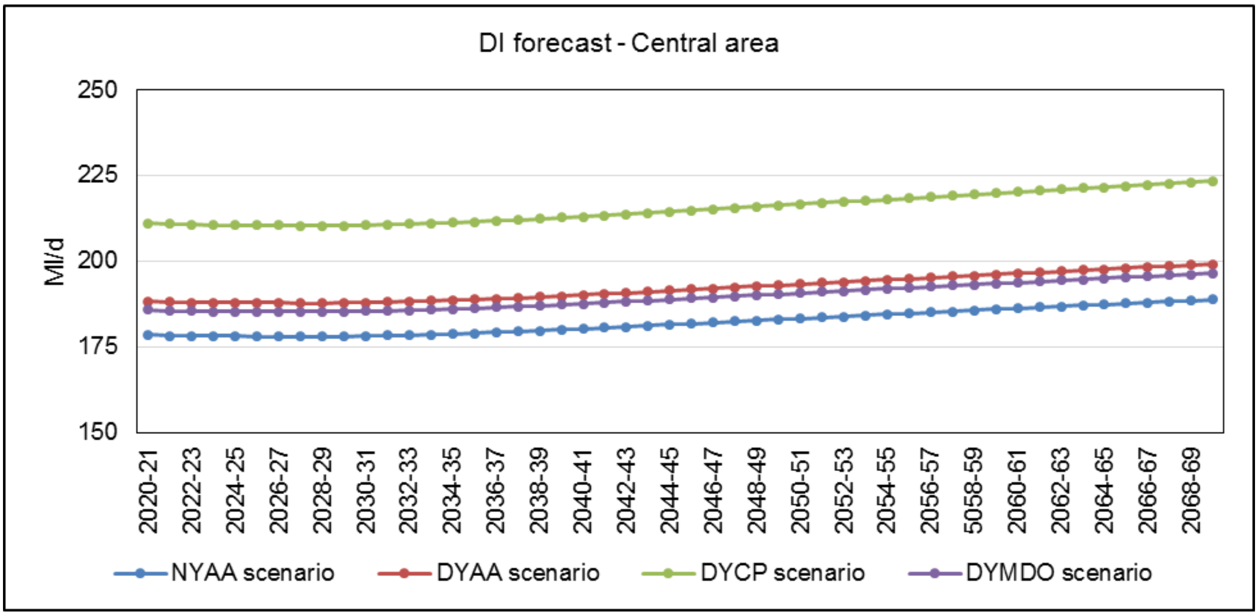


Figure 3 Total DI forecast – Eastern area

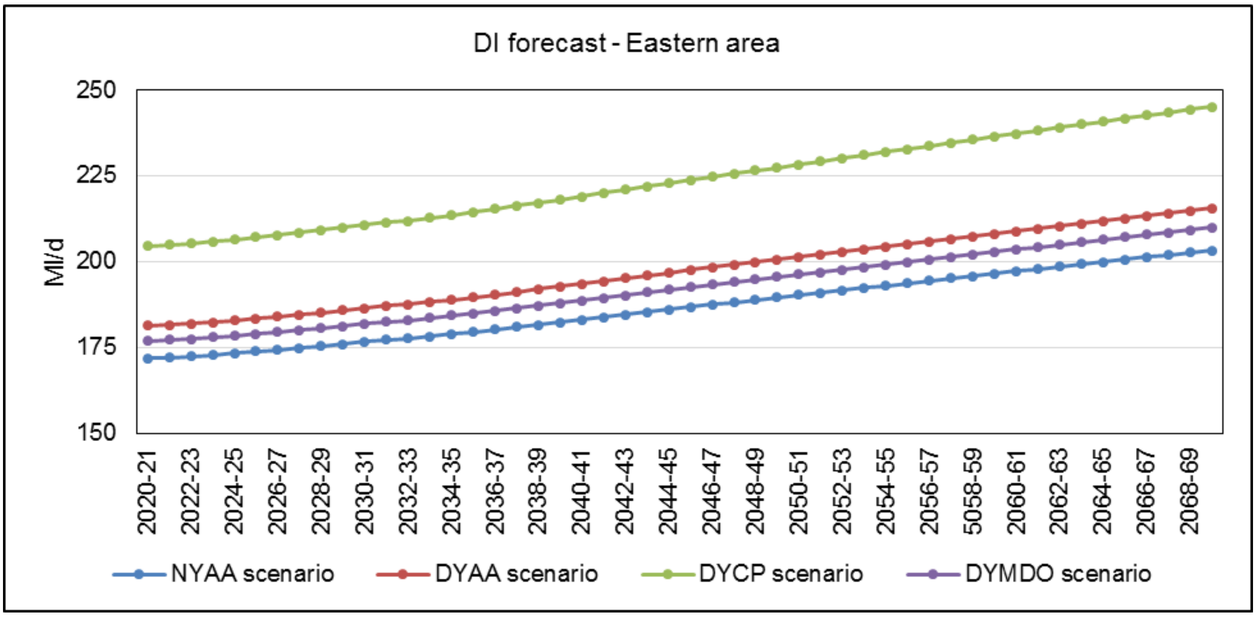
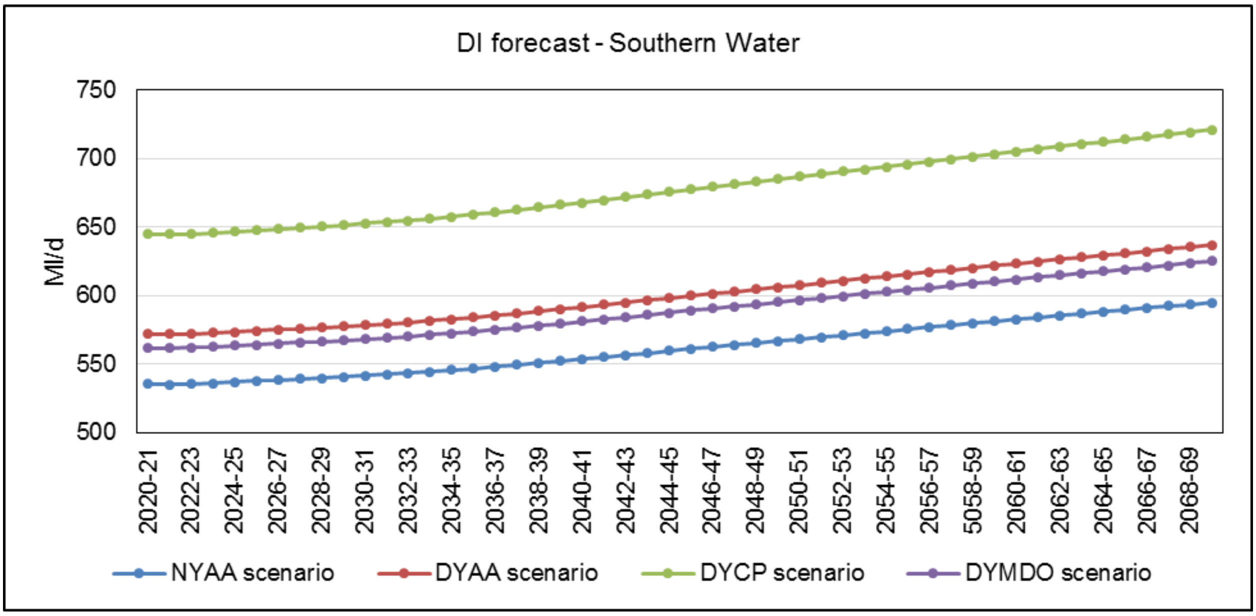


Figure 4 Total DI forecast – Southern Water



Southern Water

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Annex 2: Demand Forecast Appendix O: Scenarios for headroom analysis

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The table below shows the combinations of population, climate change, water efficiency and non-household demand scenarios used to create the 81 demand scenarios used in the headroom analysis.

Table 1 Scenarios used in headroom analysis

Scenarios	Population scenario	Climate change scenario	Water efficiency scenario	Non-household demand scenario
1	Baseline	Low	Baseline	Baseline
2	Baseline	Low	Baseline	Low
3	Baseline	Low	Baseline	High
4	Baseline	Low	Low	Baseline
5	Baseline	Low	Low	Low
6	Baseline	Low	Low	High
7	Baseline	Low	High	Baseline
8	Baseline	Low	High	Low
9	Baseline	Low	High	High
10	Baseline	Medium	Baseline	Baseline
11	Baseline	Medium	Baseline	Low
12	Baseline	Medium	Baseline	High
13	Baseline	Medium	Low	Baseline
14	Baseline	Medium	Low	Low
15	Baseline	Medium	Low	High
16	Baseline	Medium	High	Baseline
17	Baseline	Medium	High	Low
18	Baseline	Medium	High	High
19	Baseline	High	Baseline	Baseline
20	Baseline	High	Baseline	Low
21	Baseline	High	Baseline	High
22	Baseline	High	Low	Baseline
23	Baseline	High	Low	Low
24	Baseline	High	Low	High
25	Baseline	High	High	Baseline
26	Baseline	High	High	Low
27	Baseline	High	High	High
28	High	Low	Baseline	Baseline
29	High	Low	Baseline	Low
30	High	Low	Baseline	High
31	High	Low	Low	Baseline
32	High	Low	Low	Low
33	High	Low	Low	High

Scenarios	Population scenario	Climate change scenario	Water efficiency scenario	Non-household demand scenario
34	High	Low	High	Baseline
35	High	Low	High	Low
36	High	Low	High	High
37	High	Medium	Baseline	Baseline
38	High	Medium	Baseline	Low
39	High	Medium	Baseline	High
40	High	Medium	Low	Baseline
41	High	Medium	Low	Low
42	High	Medium	Low	High
43	High	Medium	High	Baseline
44	High	Medium	High	Low
45	High	Medium	High	High
46	High	High	Baseline	Baseline
47	High	High	Baseline	Low
48	High	High	Baseline	High
49	High	High	Low	Baseline
50	High	High	Low	Low
51	High	High	Low	High
52	High	High	High	Baseline
53	High	High	High	Low
54	High	High	High	High
55	Low	Low	Baseline	Baseline
56	Low	Low	Baseline	Low
57	Low	Low	Baseline	High
58	Low	Low	Low	Baseline
59	Low	Low	Low	Low
60	Low	Low	Low	High
61	Low	Low	High	Baseline
62	Low	Low	High	Low
63	Low	Low	High	High
64	Low	Medium	Baseline	Baseline
65	Low	Medium	Baseline	Low
66	Low	Medium	Baseline	High
67	Low	Medium	Low	Baseline
68	Low	Medium	Low	Low
69	Low	Medium	Low	High

Scenarios	Population scenario	Climate change scenario	Water efficiency scenario	Non-household demand scenario
70	Low	Medium	High	Baseline
71	Low	Medium	High	Low
72	Low	Medium	High	High
73	Low	High	Baseline	Baseline
74	Low	High	Baseline	Low
75	Low	High	Baseline	High
76	Low	High	Low	Baseline
77	Low	High	Low	Low
78	Low	High	Low	High
79	Low	High	High	Baseline
80	Low	High	High	Low
81	Low	High	High	High