Veolia Water East
Water Resources Management Plan
October 2009

Main Report

Foreword

I am pleased to introduce our final Water Resources Management Plan which was prepared under our former name, Tendring Hundred Water Services which changed to Veolia Water East on 1 July 2009. This Plan is an important part or our long term planning to ensure we are able to provide secure supplies of safe drinking water to 2035 and beyond. The Plan involves detailed consideration of the amount of water we have compared with the consumption patterns of our customers. We consider how both of these are affected by the various challenges our local communities are facing in years to come.

This plan has been produced in response to the consultation on our draft Water Resources Management Plan, published in May 2008. The consultation was open to any person or organisation that wanted to make a comment on our plan until the end of the consultation period at the end of August 2008.

All comments received were directed to the Secretary of State for the Environment and in accordance with section 37B(4) of the Act we have produced a separate document entitled *Statement of Response to Representations Received,* which details:

- the consideration that we have given to the representations received;
- the changes that we have made to our draft Water Resources Management Plan as a result of our consideration of these representations and our reasons for doing so; and
- where we have made no change to our draft Water Resources Management Plan as a result of our consideration of any representation, the reason for this.

This document is our final Water Resources Management Plan, incorporating the changes that we have made to our draft plan following the consultation. The reader should refer to the *Statement of Response to Representations Received* to understand why we have made changes to our final plan.

We are fortunate that our customers have demonstrated a responsible attitude to water consumption for a number of years through actions to reduce consumption and many have chosen to pay for the water they use with metered charges; in fact almost 68% of our customers now have a water meter fitted. This means that we have one of the lowest levels of household consumption in the country at 118 litres per person per day. These levels of consumption have encouraged the Government to set targets for water consumption in new homes that match those of our customers. At the same time our experience has shown our water resources are robust at times of drought. In combination this means that supplies to our customers are secure and will remain so without the need for substantial investment in the next 5 years.

Nevertheless we cannot be complacent and it is important we take full account of changes on the horizon for example from potential housing growth such as the Haven Gateway. Our Plan therefore includes continued efforts to keep our leakage levels low and we will also meter remaining unmeasured customers to enable them to manage water efficiently.

We need to make sure our plans are flexible to cope with uncertainty and in case we face unexpected challenges in the longer term. We will do this by continuing to prepare plans for development of new resources at the least practical cost.

I hope our final Plan will help to explain the measures we are taking to ensure your water supply remains secure in the future.

Nevil Muncaster

Managing Director

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List of Abbreviations

ACORN	A classification of Residential Neighbourhoods
ADPW	Average day demand peak week
ALC	Active Leakage Control
AMP4	Asset Management Plan 2000-2005
AWS	Anglian Water Services
AZP	Average Zone Pressure
CACI	Demographic and Market Information Provider
CAMS	Catchment abstraction management strategies
CLG	Communities and Local Government Department
CP	Choice Preference
CSC	Consumer Services Council
CSH	Code for Sustainable Homes
DEFRA	Department for Environment, Food and Rural Affairs
DMP	Drought Management Plan
DO	Deployable Output
DP	Drought Permit
DWRMP	Draft Water Resources Management Plan 2008
EA	Environment Agency
ELL	Economic Level of Leakage
GCM	Global Circulation Models
GCCM	Global Climate Change Models
JR07	June Return 2007, Annual Report to Ofwat
LA	Local Authorities
l/h/d	Litres Per Head Per Day
Ml/d	Megalitres per day; Megalitres = one million litres (1000 cubic metres)
MLE	Maximum Likelihood Estimation
MNF	Minimum Night flow
NEP	National Environment Programme
Ofwat	The Water Services Regulation Authority
ONS	Office for National Statistics
OPEX	Operating Expenditure
PCC	Per Capita Consumption - Consumption Per Head of Population
PR04	Price Review of Water Charges 2004
RSS	Regional Spatial Strategies
SDS	Strategic Direction Statement
SEA	Strategic Environmental Assessment
SRO	Source Reliable Output
SSSI	Site of Special Scientific Interest
VWE	Veolia Water East
UK	United Kingdom
UKCIP	UK Climate Impacts Programme
UKWIR	United Kingdom Water Industry Research Limited
uPCC	Unmeasured Per capita Consumption
WAFU	Water Available For Use
WIA	Water Industry Act 1991
WRP	Water Resources Plan 2004
WRMP	Water Resources Management Plan 2009
WTW	Water Treatment Works

Public Notice

Site names used in this document have been encoded for security purposes

1 Overview of Company Plan and Stakeholder Consultation

1.1 Executive Summary

Veolia Water East (VWE) supplies 154,000 people with water in North East Essex. Eighty percent of the supply comes from groundwater, drawn from a supply of robust confined aquifer chalk boreholes. The balance of the supply is sourced from the River Colne and stored in a reservoir shared with Anglian Water. Currently, these water sources provide sufficient water to meet all the needs of the customers.

This document is the final Water Resources Management Plan (WRMP) and the purpose of the Plan is to show how the Company intend to maintain sufficient water supplies to meet the customers' needs from 2010 to 2035. It is a statutory document for public consultation and the document will become final later in 2009. In order to write this final WRMP, studies were undertaken to understand how the supply and demand of water will change over the next 25 years, taking into account any uncertainty. The results show future population growth and increased consumption. To balance this requirement, the Company will adapt to meet the needs of its customers whilst utilising existing supplies and protecting the environment.

The Company wants to reduce waste where possible. The main way of achieving this is to continue to monitor leakage and ensure it is maintained at a sustainable and cost efficient level so that VWE can maintain the position of having one of the lowest levels of leakage in the industry. Customers of VWE are currently the most efficient users of water in the industry and the Company will aim to maintain this position by finding new ways of supporting the customers in using water even more efficiently. The Company believes the best way of promoting water efficiency is to increase the penetration of household metering. VWE already has the highest household meter penetration rates in the industry and it is hoped to increase the percentage of households with a meter to over 90% by 2016.

This final WRMP forecasts a baseline situation with a surplus of supply over demand until beyond 2035, as shown in Figure 1.1. Company investment is not driven by a deficit in supply.

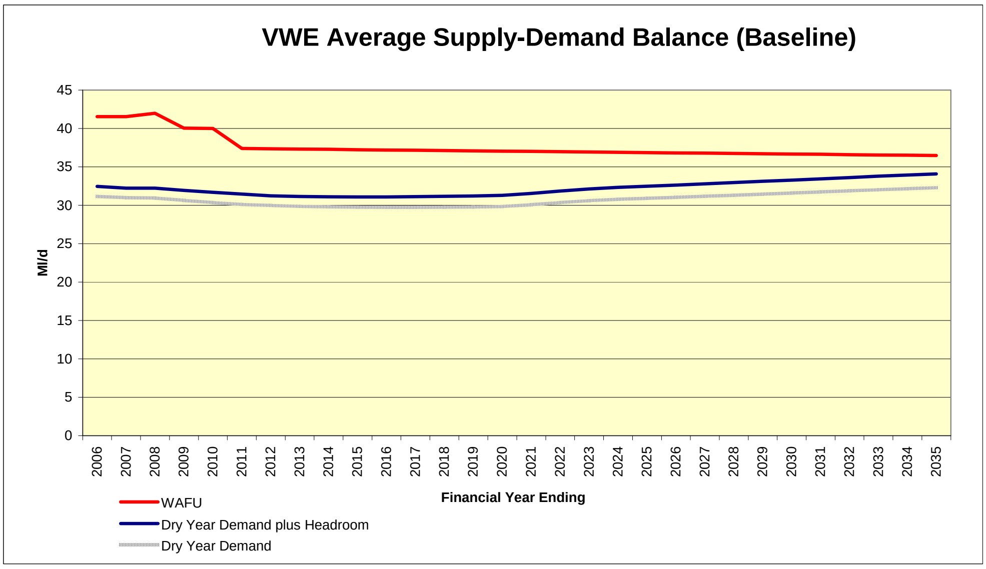


Figure 1.1 Average Supply-Demand Balance

1.2 Veolia Water East (VWE) – Operating Area

VWE supplies drinking water to approximately 154,000 people and some 4,000 businesses within an area of 352km^2 on the North East Essex coastline. During the holiday season the population supplied is increased substantially by the influx of visitors to the coastal resorts. The boundary of the supply area, which is known as the Tendring Peninsula, is 104 km long with 81km being coast or estuary and only 23 km being a land border with Anglian Water Services' (AWS) supply area shown in Figure 1.2. This makes the Company one of the smallest water only companies in the UK.

In 2007, 29.8Ml/d was put into supply. Typically 80% of this comes from groundwater, drawn from a supply of confined aquifer chalk boreholes in the River Stour/River Brett valleys in Suffolk. The boreholes have a long history of good bacteriological quality and have proved robust and reliable during the groundwater drought conditions of 1995 – 1998 and more recently in 2006/7. The balance of 20% of supply is sourced from the River Colne and stored in an open surface reservoir (VARD) which is owned and operated in equal partnership with AWS via a specialised committee. These sources provide sufficient water to meet the needs of VWE customers.

The Company has one of the lowest levels of leakage in the water industry combined with having one of the highest meter penetrations at 68%. Therefore, despite operating in the driest part of the driest region in the UK, through managing demand, a positive balance of supply over demand has been maintained. As a result the Company has never had to resort to formal restrictions in over 40 years and through several drought periods.

Figure 1.2 Map of Veolia Water East Operating Area

Key Company Statistics

Source type: Chalk/gravel groundwater and river water	***No. of River Abstractions:*** 1
Volume into supply: 29.8 mega litres/day	***No. of boreholes:*** 11
Average consumption measured: 118 litres/person/day	***No. of treatment works:*** 2
Average consumption unmeasured: 134 litres/person/day	***Length of water mains:*** 908 km
Percentage of domestic customers metered: 68%	***No. of treated storage sites and water towers :*** 8
Water Resource Zone : 1	***No. of Pumping Stations (includes treated and raw water :*** 18

1.3 How Water Resources Management Plans are Produced

It is now a statutory duty for water companies to prepare, consult, publish and maintain Water Resources Management Plans. The VWE Plan explains how the Company will ensure a secure and sustainable supply of high quality water for customers over the next 25 years, taking into account the far reaching changes we are likely to see across that period of time.

As part of the Plan, forecasts of demand for water from 2010 to 2035 are set out, based on the assumption that the current leakage reduction continues in conjunction with our Water Efficiency Strategy (see Appendix B). These demand forecasts are then compared against the forecasts of available water supply, based on current resources and future known changes in water resources. Along with demand and supply, the impact of climate change has to be considered. The forecast also has to build a safety reserve of additional water to deal with unexpected circumstances or extreme conditions. This additional water is called headroom and allows for uncertainty in our assessments.

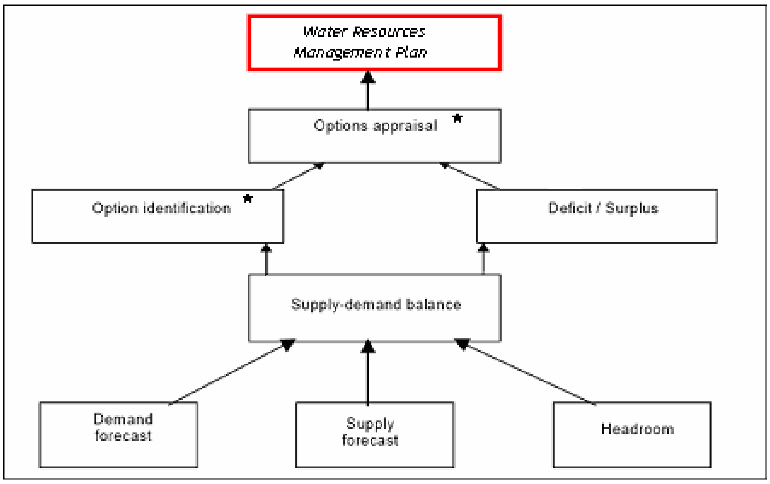
By comparing the company's supply and demand forecasts, a surplus or deficit of water for each year can be identified, this is known as the baseline-supply-demand balance. If a water deficit is shown then investment is required to ensure that security of supply can be maintained. The last stage is to set out the final supply-demand balance, which must show that the Plan meets the forecast demand for water over the 25 year period.

The draft WRMP was checked for consistency by Defra and the Environment Agency in March 2008, and published by VWE for public consultation in May 2008. The draft WRMP was consistent with the Company's Strategic Direction Statement and Drought Management

Plan, both of which are available on the Company website. As a result of this document being placed in the public domain, names of sites have been replaced with security codes.

This final WRMP follows the same structure as the draft WRMP. The Overview, Stakeholder Consultation and Summary sections formed the basis for the consultation process for the draft WRMP (Sections 1 and 2). These sections remain largely unchanged from the draft WRMP. A more detailed explanation of the plan is contained in the Main Report (Section 3 onwards). An essential part of the final WRMP is the supply-demand balance tables which accompany the Main Report and these are used by the Company's regulators; the Environment Agency and Ofwat. To assist understanding of some of the terminology, a glossary is located in Appendix A.

The plans take account of directions from the Secretary of State for the Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency regarding a range of issues including any sustainability reductions that are required in abstraction and the effect of risk and uncertainty including climate change. The information and results from the draft WRMP were also submitted within the Supply-Demand section in water companies' draft 5 yearly business plan submissions to Ofwat in August 2008. Figure 1.3 shows the process that water companies are required to follow in the production of their WRMP.



** VWE will not have a deficit and the Plan does not feature option identification and appraisal stages*

Figure 1.3 Components of the WRMP*

1.3.1 Previous Consultation

In 2007, two public consultations were carried out, one on the VWE Strategic Direction Statement (SDS) and the other on which water services VWE customers are willing to pay for. The results of these consultations showed that customers were most willing to pay for an improvement in the pass rate of water safety tests, a reduction in the number of complaints about the taste/aesthetics of the water and enhancements in service to allow water to be saved through efficiency measures. Any interpretation of the results should be carefully drawn, however if customers are willing to pay more for water efficiency measures, this does suggest strong customer support for demand management measures such as metering, water efficiency promotion and reducing demand from tariffs. This work has been used as a guide in preparing this Plan.

2 Summary of the Final Water Resources Management Plan

It is the Company's duty to provide safe and wholesome drinking water in sufficient quantities to meet the demand of customers. There is currently enough sufficient clean, wholesome water to satisfy the needs of customers served by VWE. It is important to evaluate and assess the Company's future water resource situation to ensure that the Company can continue to maintain the current level of service over the next 25 years. This final WRMP is based upon several work packages carried out, the key results have been summarised below.

In order to meet the challenge of maintaining the water supply for customers, it is important to balance supply and demand for water in the medium and long term. As a company, the "twin track" approach of fully utilising existing sources in parallel with active management of customers' demand will be followed.

2.1 Supply-Demand Balance

The relationship underlying the water resources plan may be expressed as a balanced equation such that:

Deployable Output (Supply) *+safety margin for asset availability (outage)*	**≥**	**Consumption (Demand)** *+ system use* *+ safety margin for uncertainty and risk (headroom)*

This relationship is forecast to be maintained throughout the planning period. However, if this were not the case then the Plan would identify the least cost combinations of investments that would be required in order to change the quantum of any element and restore balance. All volumes are expressed as millions of litres per day (Ml/d).

Although the WRMP has a planning horizon of 25 years, the work involved in developing this Plan has looked beyond that in order to assess the impacts of climate change (to 2050 and 2080).

2.2 Supply Side of the Balance

2.2.1 Deployable Output

The Deployable Output (DO) is the output of a commissioned source or group of sources or of a bulk supply. VWE Deployable Output is derived from groundwater sources and a shared reservoir with Anglian Water Services (AWS). The Company's latest assessment of drought outputs indicates that abstraction capacity in 2007 is of 42.69 Ml/d at average and 56.35 Ml/d at peak. This has been achieved by utilising the existing groundwater sources within the license constraints and using the shared reservoir, VARD, at a 40(VWE):60(AWS) share. This reflects an overall increase in Deployable Output since the 2004 WRMP. The base year DO values are 0.45Ml/d lower than the 2007 figures as the latter values include an improvement in the treatment losses at VHXI.

2.2.2 Outage

Outage is a volume of water that is deducted from the Deployable Output to allow for short term non availability of sources and plant. The outage in periods of average water demand was found to be 0.66 Ml/d (1.6% of Deployable Output), whilst at peak periods of water demand, the outage was 1.59 Ml/d (2.8% of Deployable Output in the base year). This is considered to be a representative value of current conditions and reflects the quality scheme improvements gained during the AMP4 period (2005-2010).

The data for plant failure was applied to a statistical model and the results were assigned an appropriate confidence level of 95%, as a result this ensures that the safety margin will only be exceeded for 5% of time or for only one in 20 years. Deducting outage from DO gives Water Available For Use (WAFU) and currently the base year WAFU is 41.53 Ml/d. This represents a very small increase since 2004. Outage is not considered a major problem for VWE as there is a significant amount of spare capacity in the groundwater sources and treatment works, combined with storage in the reservoir.

2.3 Demand Side of the Balance

2.3.1 Demand Forecast

The demand forecast is developed using predictions of consumption, system losses and headroom. Consumption estimates are based on population, households and non-household growth (commercial) and associated increased consumption which is calculated from the forecasts of use derived from micro-component studies. System losses are leakage from the pipe network and this includes losses from Company owned pipes and customers' pipes. Headroom is a calculated amount of water which takes into account uncertainties in deriving the individual components of the water balance.

The proposed Haven Gateway development is expected to be one of the fastest growing areas in the country and could potentially generate up to 23,000 new jobs and some 30,000 new homes, although less than two thirds of this is expected within the Company's supply area. This has been taken into account when forecasting household and population growth.

As a result of the studies carried out for this Plan, and taking into account the information received from Essex County Council regarding the Haven Gateway development, a revised figure, to that stated in the SDS, forecasts an increase of 13,379 new households and 26,928 more people on the Tendring Peninsula (within the Company area) over the course of the next 25 years.

VWE micro-component model of household demand shows that measured per capita consumption (PCC) will increase from 118.6 l/h/day in the base year to 131.8 l/h/day by 2035. For the unmeasured PCC this will rise from 134.6 l/h/day to 142.4 l/h/day by 2035. The Company has used these model figures to calculate measured and unmeasured PCC specific to the VWE customer base.

The impact of increasing population and water consumption can be seen on the dry year demand curves on Figures 2.1 and 2.2

2.3.2 Reducing Demand Through Metering and Tariffs

The Company is acutely aware of the need to promote the efficient use of water by its customers and to conserve water resources in order to manage the forecast increase in demand for water in the future. A policy of demand management to achieve this aim, through selective and subsidised optional metering, has been in place for more than 10 years.

Our current metering programme assumes customers will continue to voluntarily switch to metered charging (optants) progressively until 2030. For our new Plan we are proposing a new metering strategy with the aim of metering 90% of household customers by 2015. By accelerating metering we save water and therefore energy. By completing our metering programme by 2015 we can leave 1215 tonnes of water in the environment and save 345 tonnes of carbon dioxide emissions. The new metering target will be achieved either through a the Comparative Billing project, subject to receiving funding from Ofwat or by compulsory metering of remaining unmeasured households.

Metering Implementation Option A: Accelerated Optional Metering – Comparative Billing Project. As part of this work, meters are fitted in certain geographical areas to households without a meter. The current occupiers of the properties remain on the un-metered charges, however they are provided with comparative bills so that the benefit of the metered bills can be shown and if they choose to, customers can opt to become charged by their metered consumption permanently. When these properties are sold, the existing meters will become charging meters to the new occupants.

Metering Implementation Option B: Compulsory Metering. We operate in an area designated by the Environment Agency as under ‘medium water stress’ and therefore we have considered the cost-benefit of compulsory metering. Our assessment demonstrates that compulsory metering has a positive cost-benefit and saves £220,000 compared to our current progressive optional metering programme. This is because installing meters on a street by street basis and over a shorter period can be done more efficiently and therefore at lower cost. The lower costs would reflect in lower bills to customers. Metering on a street by street basis would also save around £600k compared to an accelerated but ad hoc optional metering programme to reach the same target of 90% of households by 2015.

Our stakeholders responded to the proposed metering programme presented in the draft WRMP. We have taken account of those comments to determine the preferred strategy in our final planning scenario.

2.3.3 Water Efficiency Strategy

The Company has not placed restrictions on water use for over 40 years and the aim is to maintain this level of service over the course of the next 25 years. The Company recognise that its customers are currently the most efficient users of water in England and Wales, using on average less water than those in all other water supply companies. New ways will be continue to be explored. The VWE water efficiency strategy is provided in Appendix B. This document details how we propose to support our customers in using water even more efficiently in conjunction with our accelerated metering programme so that this position can be maintained.

Just under 10% of the Company’s customers are non-households, to these 4,000 commercial businesses advice will be provided on water efficiency as well as offers of assistance to help them save water. As set out in our Water Efficiency Strategy, VWE will continue to work closely with local authorities and developers to ensure new houses are water efficient and how older homes could be retrofitted with water efficient devices.

2.3.4 Leakage

VWE has a highly developed and integrated network of some 900 km of mains, and records the one of lowest levels of leakage of 5.04 Ml/d in the industry. As a Company it is important to reduce the waste of water where possible. VWE will continue to monitor leakage and ensure it is maintained at a sustainable and cost efficient level. The leakage targets based on social, environmental and financial costs will be reassessed. This approach to leakage has been supported by customers of VWE.

2.4 Factors Impacting Supply and Demand

2.4.1 Climate Change

Climate change affects both the resources available for use and customer demand. Climate change impacts are being assessed by applying global climate change models (GCCM's) to derive future rainfall patterns and thus to forecast changes in regional water levels and river flows. From these forecasts estimates of potential reductions in operational output are made.

In the previous WRMP (2004) the risk of resource loss was included with the headroom analysis. However for this Plan, the impact of climate change on supply is included directly as a deduction from DO. This is an additional safety margin relating to the loss of resources arising from an increased frequency of extreme events. The climate change assessments indicate a reduction of 1.02 M//d at average and 1.11 Ml/d at peak in available resource between 2007 and 2035 pro-rata with uncertainty over these estimates included in the Headroom assessment of this Plan. These reductions associated with climate change are illustrated within the declining Water Available For Use (WAFU) in Figures 2.1 and 2.2.

Demand behaviour is also affected by climate change as longer drier summers for example are expected to increase personal hygiene use of water. A research project '*Climate Change and the Demand for* Water' was carried out by Defra for use in the Price Review of Water Charges (PR04) and the results remain valid for this Plan. This project forecasts an increase of between 1.83% in household consumption in 2020 in the Anglian Region and a 2.6% increase in industrial/commercial consumption associated with climate change in 2030. The impact of climate change on demand is also included in the Headroom assessment.

2.4.2 Headroom

Headroom can be considered as a safety margin in the WRMP to allow for future uncertainties in supply and demand. Headroom is a composite assessment of a series of uncertainties and risks as follows:

- Gradual pollution
- Accuracy of supply-side data

- Source climate change risk
- Demand forecast components
- Demand forecast variation
- Climate change demand

As VWE has a supply-demand surplus for the foreseeable future the simpler point scoring headroom methodology of the '*WR/13 A Practical Method for Converting Uncertainty into Headroom* UKWIR 1998' has been used. This has provided the following results:

RESULTS OF HEADROOM CALCULATION

Row		Present Day 06/07	11/12	16/17	21/22	26/27	31/32	Planning Horizon 36/37	
H1	DEPLOYABLE OUTPUT [Ml/d]	**42.24**	**38.00**	**37.81**	**37.62**	**38.93**	**38.74**	**38.63**	From WRPG
H2	TARGET HEADROOM [%]	**3.0**	**3.3**	**3.7**	**4.0**	**4.3**	**4.6**	**5.0**	Row H28 from Form 3A
H3	TARGET HEADROOM [Ml/d]	**1.3**	**1.3**	**1.4**	**1.5**	**1.7**	**1.8**	**1.9**	
H4	AVAILABLE HEADROOM [Ml/d]								From WRPG

[3] Target headroom [Ml/d] = (Row H1 * Row H2) /100

Now goto Form 1B and read step 2 of the step-by-step guide

2.5 Baseline Supply-Demand Forecast

Although the demand for water is set to increase by 2035, the overall outcome of this Plan indicates that there is a surplus of supply in both the average and peak demand forecasts until 2035. This is clearly illustrated in Figures 2.1 and 2.2 below for both average and peak conditions. Therefore there are no baseline planning problems and so no options need to be considered and appraised to address any deficits.

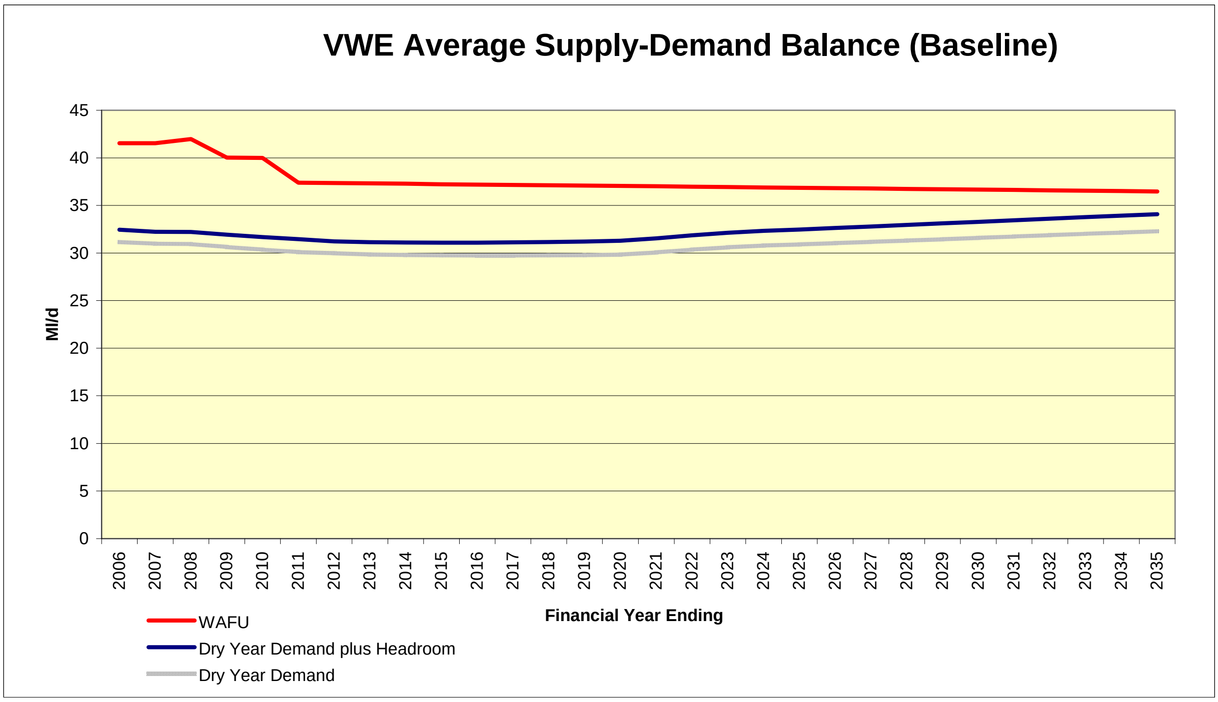


Figure 2.1 Baseline Average Supply-Demand Balance

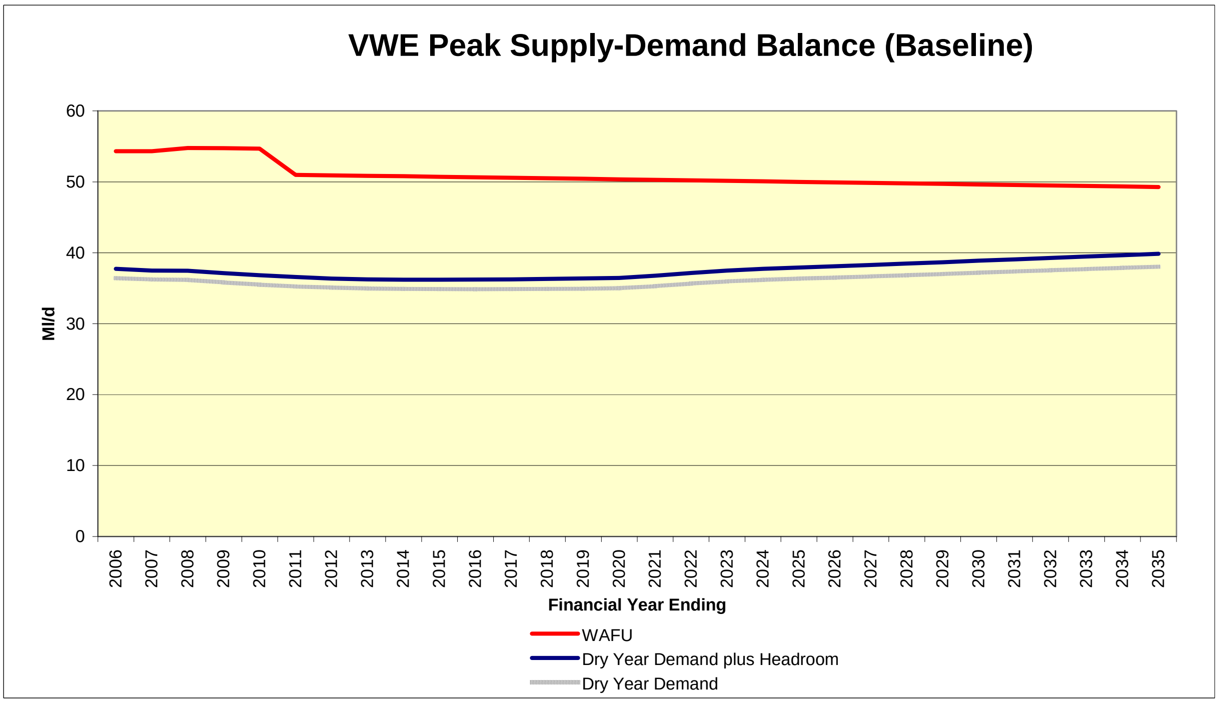


Figure 2.2 Peak Supply-Demand Balance

2.6 Carbon Footprint

As the Plan has determined that we have a stable supply-demand balance until 2035 energy consumption is closely aligned with growth in demand and thus the baseline forecast of distribution input within the final WRMP.

2.7 Final Water Resources Strategy

The updated supply and demand forecasts for this Plan show that there is no need for substantial expenditure on resource development before 2034/35. Nevertheless continued efforts are required in order to improve the Company's operational efficiency and retain flexibility to meet potential unplanned challenges. The final planning strategy for 2010 to 2035 is based on VWE policies for maintaining low levels of demand and optimising the use of the existing water resource base.

The Company's strategy for maintaining an adequate balance of supply over demand is summarised as follows:-

- Further acceleration of metering from 2010 onwards through encouraging further optants and an accelerated metering programme to achieve metering of greater than 90% domestic properties by 2015 having regard to impact of vulnerable groups to ensure water remains affordable.
- Maintain leakage below the economic level of leakage (ELL).
- Continued customer water efficiency from awareness of environmental/sustainability issues and gradual increases in water re-use, other conservation measures and improved appliance efficiency through our new Water Efficiency Strategy.
- Retention of the abstraction license for VGBE so that at the appropriate time seek to increase supply by re-use of the sands/gravel source based on reverse osmosis treatment for drought contingency or demand step change response.
- For longer term consideration continue to progress with the promotion of increased yield of the Ely-Ouse-Essex transfer in conjunction with Abberton raising by Essex and Suffolk Water.
- In conjunction with Anglian Water, benefit from an increase in deployable output within existing licence limits by 2025 following the construction of additional surface storage at VARD.

2.7.1 Future Investigations

In order that we ensure we are prepared to meet future uncertainties and challenges VWE will continue working on a range of issues. These include improving the understanding of customer consumption patterns and what is needed to support their continued efforts to prevent waste of water. VWE will continue to work with the Environment Agency to prepare for the challenges and further studies that the new River Basin Management Plans may require as part of the Water Framework Directive and as the Company moves closer towards the 2015 deadline for the completion of the first cycle. Finally in light of the proposal to accelerate metering VWE will consider industry best practice in alternative charging models to ensure water remains affordable for all.

3 General Information on Plan Content and Development

3.1 Company information

VWE supply drinking water to approximately 154,000 people and some 4,000 businesses within an area of 352km^2 in North East Essex. During the holiday season the population supplied is increased substantially by the influx of visitors to the coastal resorts. The boundary of the supply area, which is known as the Tendring Peninsula, is 104 km long with 81km being coast or estuary and only 23 km being a land border with Anglian Water Services' (AWS) supply area shown in Figure 3.1. This makes the Company one of the smallest water only companies in the UK.

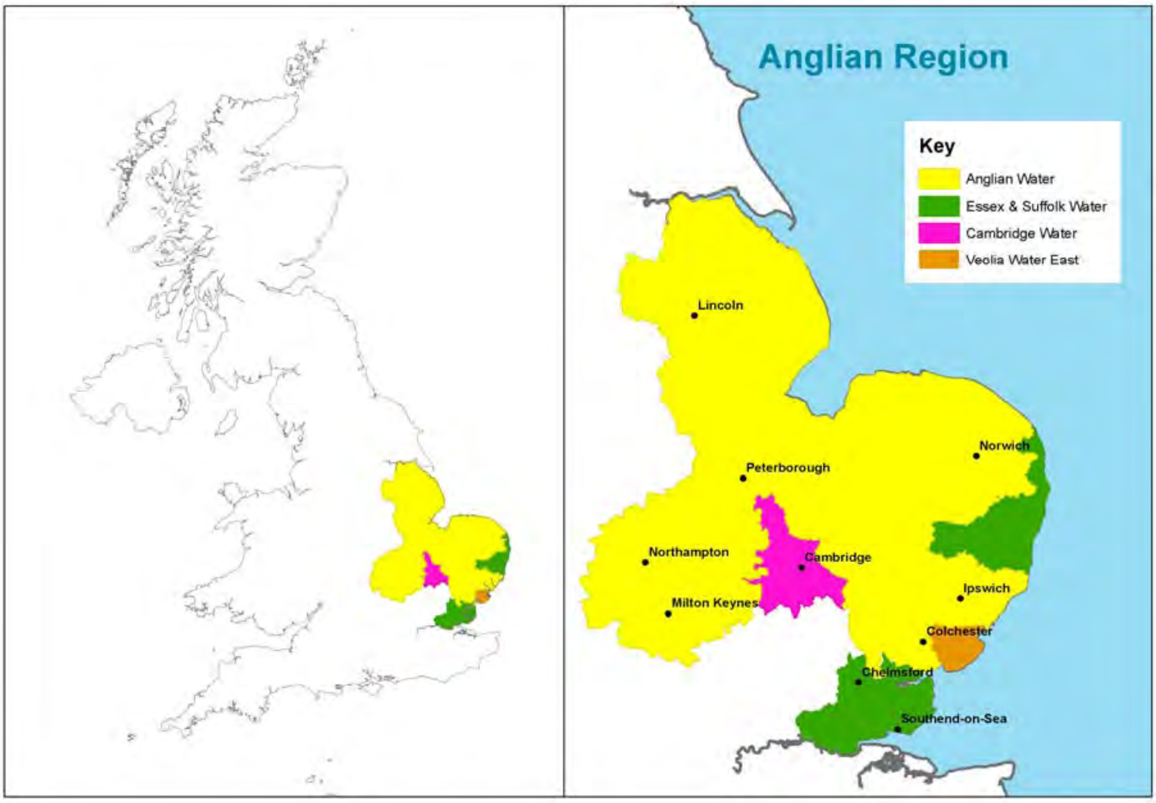


Figure 3.1 Location of Veolia Water East as Part of the UK Water Industry

In 2007 29.8Ml/d was put into supply. Typically 80% of this comes from groundwater, drawn from a supply of confined aquifer chalk boreholes in the River Stour/River Brett valleys in Suffolk. The boreholes have a long history of good bacteriological quality and have proved robust and reliable during the groundwater drought conditions in 1995 – 1998 and more recently in 2006/7. The balance of 20% of supply is sourced from the River Colne and stored in an open surface reservoir (VARD) which is owned and operated in equal partnership with AWS via a specialised committee. These sources provide sufficient water to meet the needs of VWE customers. Accordingly, this final WRMP indicates that VWE will be able to maintain a stable balance between supply and demand until 2035 without the need for substantial capital investment.

3.2 Planning Period

This WRMP looks at the water resource situation over a 25 year period from 2010 until 2035. The Plan uses 2005/06 as the base year as the most recent data for 2006/07 is from an atypical year in terms of climatic conditions which resulted in supply restrictions elsewhere in the country. In this final WRMP up to date (2007/08) population and property numbers have been incorporated. Ofwat, the financial regulators, use 2007/2008 as the base year for the business plan periodic review; however VWE does not expect to see large differences between the base year chosen and 2007/08.

3.3 Resource Zones

A resource zone is the largest possible zone in which all resources, including external transfers can be shared and hence the zone in which all customers experiences the same risk of supply failure from a resource shortfall. The Company's supply network is highly integrated and risk of supply failure is shared throughout the VWE area. As such the Company submission is based on a single water resource zone shown in Figure 3.2. This remains unchanged from the previous 2004 WRP.

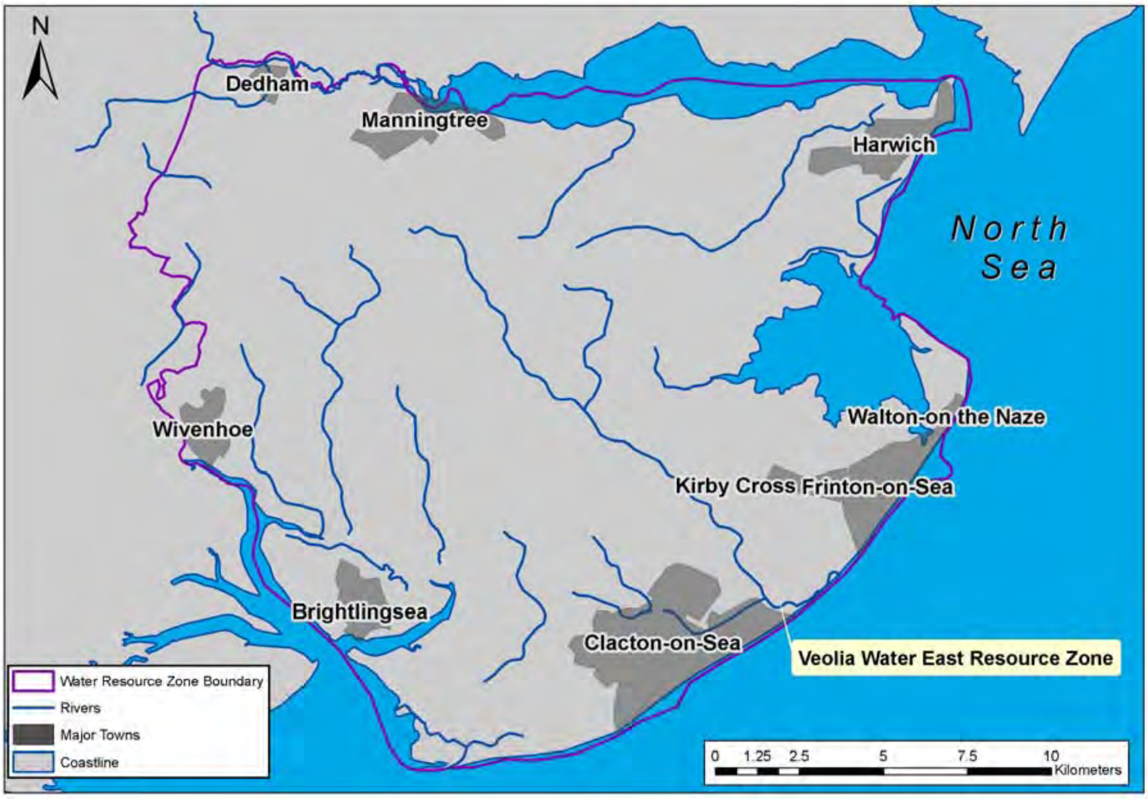


Figure 3.2 Veolia Water East Resource Zone

3.4 Recent Consultations with Customers

A key principle of the new planning regulations for WRMP is that companies consult key stakeholders and customers over their proposals.

VWE consults customers and stakeholders continually. This final WRMP builds upon the comments received during the consultation on the draft WRMP. In 2007 there were two consultations; the first was with the Consumer Council for Water, Natural England, Environment Agency, Defra, Drinking Water Inspectorate and Essex County Council for their views on the Company's Strategic Direction Statement. Some very useful comments were collected at a public consultation meeting as part of this work where it was revealed that the consultees were happy with the level of service currently provided by VWE. However they did want VWE to do more to make people think about water efficiency and that un-metered customers should be made aware that the transfer to metered use is free of charge. This consultation also showed that comprehensive metering is supported. However mixed responses were received regarding compulsory metering with concerns raised over the impact on low income households. VWE has taken these views into account in developing its new Water Efficiency Strategy.

Natural England were keen to see all water companies, including VWE, champion a more sustainable approach to land water management where this will help deliver their objectives for the natural environment.

Following on from the SDS work, VWE aims to achieve the objectives set out below. These objectives come from the Strategic Direction Statement of VWE and are those relating to the water resources' strategy:

- The Company will manage it's water resources available to meet customers demand and future growth
- The Company will provide clean and safe drinking water
- The Company will manage the water resources available to us, and minimise abstraction by reducing waste
- The Company will meter all customers, minimise losses and work with customers to reduce waste
- The Company will manage risk and invest in a responsible and sustainable manner ensuring the service is affordable

The second consultation was a cost-benefit analysis and 'willingness to pay' package of work which was carried out in the autumn of 2007 to assess VWE customer preferences regarding security of supply and the impact of company operations on the water quality and aesthetic appearance of the water supplied. The draft WRMP reflected the customer preferences expressed within the 'willingness to pay' consultation.

A total of 500 respondents expressed their views relating to 6 attributes which are shown in Figure 3.3. Different combinations of change were offered each time in a random manner. The different permutations of responses enabled a ranked order or value to be expressed for the different attributes. The results were validated by comparison with a Contingent

Valuation assessment for supply pipe ownership. The results were also assessed for segmentation in accordance with ACORN social groupings and market share simulations produced. It was decided to not ask for views on the attributes associated with Hosepipe Bans and River Water Levels as the Company's circumstances have ruled that these are not regarded as being key attributes.

For the draft WRMP, the results of the Choice Preference (CP) outcomes were compared to the proposals within this Plan and this has informed the choice of priority issues for which customer and stakeholder views are sought. The results of the CP survey work are shown on Figure 3.3.

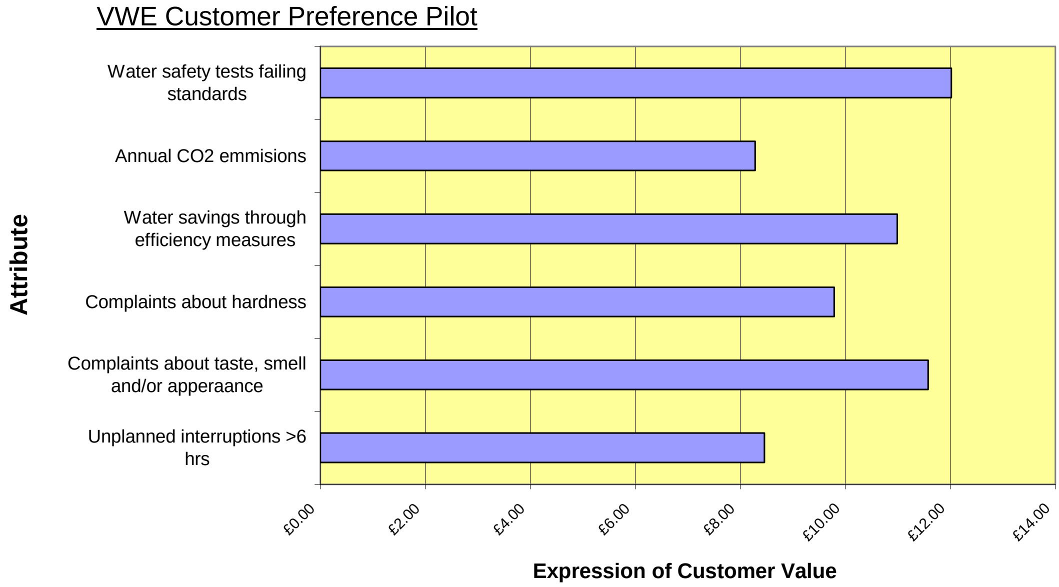


Figure 3.3 Results of Customer Preference Pilot Study

Any interpretation of results should be carefully drawn. Top level results from the customer choice preference survey indicate that customers would be willing to pay the most for an improvement in the number of Water Safety Tests failing standards. After that, customers would also be willing to see a reduction of water quality issues, such as taste, smell and/or appearance.

Conversely customers expressed a lower value for lessening the impact of unplanned restrictions and for reducing the number of complaints about water hardness. The attribute that customers are least willing to pay for is reductions in annual carbon dioxide emissions, which suggests that either they are in the most part satisfied with the current level of service, or that they feel that it is not worth paying any more for enhancements, or that the Company should pay for improvements.

The area that relates to this Plan particularly is the attribute relating to water efficiency measures. The survey results indicate that customers would be willing to pay a significant amount, after improvements to Water Quality issues, for enhancements in service to make water savings through water efficiency measures. It could be taken that this suggests strong customer support for demand management measures that such as metering, water efficiency promotion and reducing consumption from tariffs. This is consistent with the

Company's strategy of accelerating metering and enhanced water efficiency communications/education programme.

VWE took into account the views of VWE customers as expressed in this work during the formulation of the final WRMP. The consultation on the draft WRMP sought further views on the strategy proposals contained therein. Details of the responses and how they have been addressed are contained within the separate document *Draft Water Resources Management Plan Statement of Response to Representations Received* (January 2009). These responses have been taken into account in the production of this final WRMP.

3.5 Scenarios

It is important for water companies to understand how supply-demand balances change for different climatic and demand conditions so that they can maintain their levels of service. These considerations are made by assessing different planning periods.

As with the draft WRMP, the Company has chosen to base this final WRMP on a dry year annual average planning scenario. A dry year **critical period scenario is not presented** as this does not drive any investment over the Plan period. The normal year annual average scenario for this final version has been based on the 2005/6 year. This year was characterised as normal in the 2006 June Return and provides the most recent climatically normal year upon which the Plan can be based.

The 2006-07 year was characterised by a hosepipe ban across much of the south east. Although a hosepipe ban was not implemented by VWE, this coupled with the high level of publicity surrounding water resources in the south east, resulted in significant reductions in demand for water by VWE customers. This makes the 2006-07 year unsuitable as a base year for the WRMP. For the final WRMP the 2007-08 year will be available to update the base position for the demand forecast.

The **dry year annual average scenarios** are based on an analysis of the years 2002 to 2007 including the dry year of 2003 which exhibited a significantly lower consumption than experienced in 1995 as a result of the increased meter penetration.

More detailed information is available in Section 5; Water Demand.

3.6 Reconciliation of Data

In addition to consumption from unmeasured customers other unmeasured components of the water taken from the distribution system include:

- Unmeasured non-household use;
- Operational use by companies (DSOU);
- Water taken legally but not billed; and
- Water taken illegally.

This means that these components have to be estimated and added to the measured components and then reconciled with the distribution input (which is measured). The difference between measured distribution input and the combined components of demand is known as the 'Water Balance'. Leakage is unmeasured and it is important that it is neither under nor over estimated. An independent leakage figure is derived using measured minimum night flows and leakage is therefore known with a reasonable degree of certainty minimising the potential error margin of the remaining unmeasured components. VWE does not consider it necessary therefore to undertake a statistical Maximum Likelihood Estimation (MLE) to divide the unmeasured element between the unmeasured components.

VWE confidently estimates that water taken illegally, water taken legally but not billed, and distribution system operational use represent a very small proportion of overall unmeasured demand. As leakage estimates are supported by the night flows analysis, and confidence in this is high, the majority of the residual unmeasured demand is allocated to unmeasured households. VWE does not have a consumption monitor and this limits the level of confidence associated with this value. However, the number of unmeasured households, and hence unmeasured volume, is forecast to decline rapidly in line with our metering strategy (over 90% by 2015).

VWE uses a water balance to derive the base year (2005-06) components of demand. The proportions within the water balance are shown in Table 3.1. The water balance for 2005-06 amended with updated population for 2006/7 is shown in Table 3.2. The detailed components of the water balance and their values can clearly be seen.

Components of Demand 2005-06	Ml/d	Proportion of distribution input (%)
Measured household (inc uspl)	9.85	32.55
Measured non household	6.46	21.35
Operational use	0.02	0.07
Water taken legally unbilled	0.01	0.03
Water taken illegally	0.00	0.00
Leakage (excl uspl)	4.47	14.77
Unmeasured household (inc uspl)	9.44	31.20
Unmeasured non household	0.01	0.03
Sum:	30.26	100.00

Table 3.1 Components of Demand

THWS 2005-06		
Water Delivered - Volumes	units	
Billed measured household	Ml/d	9.85
Billed measured non-household	Ml/d	6.46
Billed measured	*Ml/d*	*16.31*
Billed unmeasured household	Ml/d	9.44
Billed unmeasured non-household	Ml/d	0.01
Billed unmeasured	*Ml/d*	*9.45*
Water delivered (potable) - includes unbilled	Ml/d	25.77
Water delivered (non-potable)	Ml/d	0.00
Water delivered (non-standard rates: potable)	Ml/d	0.00
Water delivered (non-standard rates: non-potable)	Ml/d	0.00
Distribution input	Ml/d	30.26
Bulk Supply Imports	Ml/d	0.00
Bulk Supply Exports	Ml/d	0.00
Water Treated at Own Works to Own Customers	Ml/d	30.26
Water Delivered - Components		
Per capita consumption (measured household - excluding supply pipe leak)	l/h/d	118.45
Meter under-registration (measured households)	Ml/d	0.30
Meter under-registration (measured non-households)	Ml/d	0.29
Billed measured household	Ml/d	9.85
Billed measured non-household	Ml/d	6.46
Total measured	***Ml/d***	***16.31***
Distribution system operational use	Ml/d	0.02
Water taken legally unbilled	Ml/d	0.01
Water taken illegally unbilled	Ml/d	0.00
Estimated water delivered per unmeasured non-household	l/pr/d	128.24
Per capita consumption (unmeasured household-excluding supply pipe leak)	l/h/d	134.65
Billed unmeasured non-household	Ml/d	0.01
Billed unmeasured household	Ml/d	9.44
Total unmeasured	***Ml/d***	***9.48***
Underground supply pipe leakage (other metered households)	l/pr/d	20.00
Underground supply pipe leakage (unmeasured households)	l/pr/d	20.00
Underground supply pipe leakage (excluding metered households)	l/pr/d	1.20
Underground supply pipe leakage (void properties)	l/pr/d	18.00
Distribution losses	Ml/d	4.47
Total leakage	***Ml/d***	***5.05***
Billing:		
Households billed unmeasured water	000s	23.90
Households billed measured water (external meter)	000s	40.81
Households billed measured water (not external meter)	000s	1.29
Total billed households	*000s*	*66.00*
Total household properties (water supply area)	*000s*	*67.10*
Households: unmeasured sprinkler/hosepipe charge	000s	
Non-households billed unmeasured water	000s	0.08
Non-households billed measured water	000s	4.00
Total Non-households billed	*000s*	*4.08*
Total Non-household properties (water supply area)	*000s*	*4.29*
Non-households: unmeasured sprinkler/hosepipe charge	000s	
Void Properties	000s	1.32
Population:		
Population - households billed unmeasured water	000s	66.56
Population - households billed measured water	000s	82.53
Population - non-households billed unmeasured water	000s	0.00
Population - non-households billed measured water	000s	4.47
Population - total	*000s*	*153.56*

Table 3.2 Water Balance 2005/06 Amended with Updated Population

3.7 Sensitivity Testing

This final WRMP is considered to be robust. Many uncertainties are dealt with in Headroom, Section 7. However, the expansion of the Haven Gateway and Harwich is expected to lead to a demographic change in the region and this could drive a change in water using behaviour. This is the most significant risk to this Plan. As a result, a scenario of much higher PCC growth was modelled and the results are plotted in Figure 3.4. This shows that a significant increase in dry year annual average measured PCC to 150l/h/d by 2035 would create a supply-demand imbalance in 2027. This scenario also assumes a lower level of water efficiency in new homes (meeting Code for Sustainable Homes level 1/2) than in the actual forecast (a third of new homes built to CSH level 3/4). The peak position remains in surplus at the end of the planning period. Therefore, from this work, it can be demonstrated that the Company's WRMP is robust in the short to medium term. If a rising trend on demand and PCC is noticed in the future, this will trigger a review of the Plan.

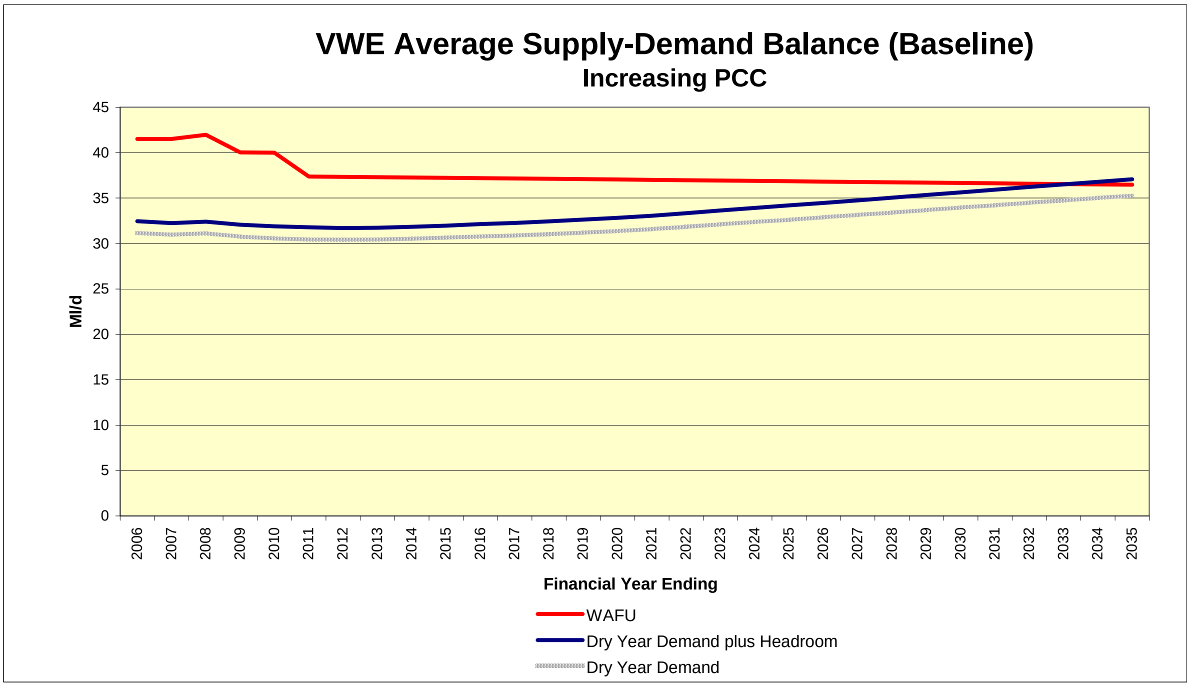


Figure 3.4. Average Supply-Demand Balance (PCC Sensitivity)

3.8 Company Policies

The decisions that are made in this Plan are based both on company policy and on an assessment of customer's expectations.

Despite operating in the driest region in the UK, VWE has progressively developed sources and managed demand to maintain a positive balance of supply over demand without resorting to formal restrictions for over 40 years through several major drought periods. Therefore, in line with customer expectations the Company does not plan to impose formal restrictions on water use over the course of the next 25 years. This will be achieved through the efficient management of water by VWE and its customers. In order to meet this commitment to customers whilst at the same time ensuring that a sustainable environment is maintained, the Company will:

- Manage the water resources available, and minimise abstraction by reducing waste.
- Develop and implement integrated long-term plans (rolling 25 year) for water supply, water quality, water resources and asset maintenance and replacement.
- Work closely with environmental partners in the region.
- Monitor leakage and ensure it is maintained at a sustainable and cost efficient level as well as reassess leakage targets based on social, environmental and financial costs.
- Work with local authorities and developers to ensure that new houses are water efficient and older homes can be retrofitted with water efficient devices.
- Maintain position of customers having one of the lowest PCC in England by finding new ways of supporting customers in using water even more efficiently.
- Implement our new Water Efficiency Strategy to promote water efficiency through a range of activities, including the introduction of specialised training and roles for staff.
- Encourage water saving technologies, such as grey water and rain water reuse and such initiatives when appropriate or when customers ask us.
- The Company also wishes to implement a focussed approach to achieve comprehensive metering whilst ensuring water remains affordable to all.
- Intend to deliver a plan for additional storage at VARD so that existing supplies can be augmented by 2025.

3.8.1 Level of Service

Companies are required to express their levels of service in terms of how frequently they will need to impose restrictions on the use of water. VWE will be continuing with the same level of service for water supply restrictions as set out in the Company's 2004 WRP. This is set out below.

Water Restriction	Hosepipe ban	Drought Order/permit	Rotacuts/standpipes
Level of Service	No restrictions	No restrictions	No restrictions

The Company has never had to resort to formal restrictions in over 40 years, through several drought periods including 1995/96, and more recently in 2006/07 when many water companies in South East England imposed hosepipe bans. Thus the preferred Levels of Service are supported by historical *actual* Levels of Service.

Recent modelling work undertaken by Anglian Water Services (AWS, who jointly operate the VARD reservoir with VWE) demonstrates that actual Levels of Service have been in line with planned Levels of Service. AWS reviewed the yield of reservoirs operated by the Company. The yield of the VARD was reviewed by modelling the impact on reservoir storage of current unrestricted demand (25.7 Ml/d) and climate data from 1920 to 2006. At no point during this period did the yield of the reservoir drop below the Base Water Level storage. Under this modelling scenario, the minimum storage occurred in September 1976, when storage dropped to 0.8 million cubic metres (capacity 2.14 Ml/d).

It can therefore be concluded that storage in the VARD resource would have been sufficient to ensure that *actual* levels of service were in line with planned levels of service and that no demand restrictions would have been required under the historic climatic conditions experienced since 1920.

Since 1995/96 when the highest peak in demand of 50.9 Ml/d occurred, peak demands have reduced to less than 42 Ml/d. This reduction in peak demands has occurred over a period coincident with investment in demand management measures such as the greater uptake of domestic water meters.

As noted in Section 3.4, recent consultation with stakeholders for their views of the VWE' Strategic Direction Statement confirmed that the consultees were happy with the level of service currently provided by VWE. The plan presented in this document will ensure that the chosen level of service (no formal restrictions on water use) will continue in line with customers' expectations.

3.8.2 Leakage

The Company has achieved a leakage level well below the Economic Level of Leakage (ELL) and main policy of VWE is to remain below ELL and prevent any increases in the levels of leakage, subject to being properly funded and fairly compared on operational expenditure efficiency.

The existing level of leakage is close to the minimum achievable level using Active Leakage Control (ALC). Currently VWE is operating with an ELL at 5.8 Ml/d but recent performance has been within the present target of 5.05 Ml/d.

Within the timeframe of these plans a slow gradual improvement is expected to be seen as a result of increased metering (reducing supply pipe losses) and improvements in technology as they become available.

3.8.3 Metering

A number of strategies have been implemented over the past decade to manage demand so that supply restrictions and additional new water resources are not required in the future. The most effective of these schemes has been the promotion of water meters. The Company sees metering as the fairest method of charging and as a result 68% (2007) of household and 98% (2007) of businesses are now metered. This is the highest ratio in the UK water industry.

VWE has also compulsorily metered swimming pools, garden sprinklers and hosepipe users. The Company believes that the existence of volume related charging accounts for most of the consumption reduction achievable by metering.

Figure 3.5 shows the trend of water supplied to customers and the percentage of households that are metered. The effect of population growth is shown as well as metering.

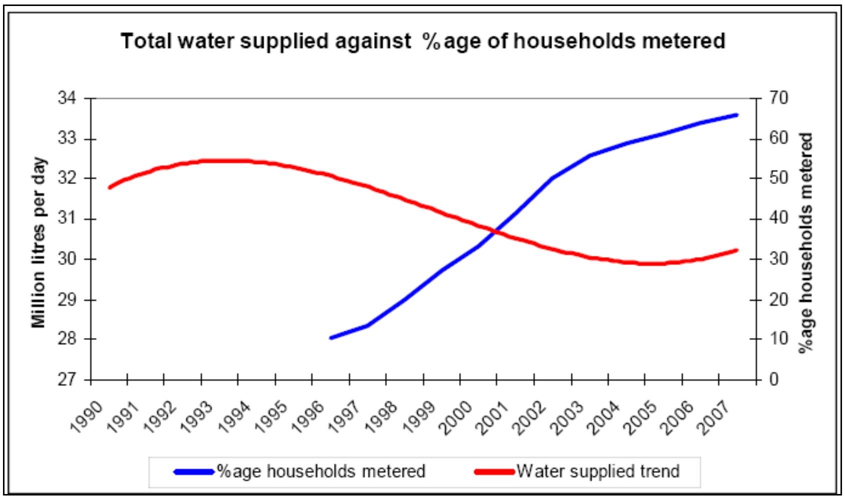


Figure 3.5 Total Water Supplied Against Percentage of Metered Households

VWE metered customers, on average, use 15% less water than unmetered customers. This is good for both the environment and the customers as they are able to manage consumption to suit their requirements and their budget.

The current metering penetration is 68% and is increasing 0.66% annum. The Company aim to see this figure move to at least 90% by 2015 and are happy to assist customers in making the decision to switch to a meter or not. This has the support of key stakeholders; Environment Agency, Consumer Council for Water, Defra, and customers of VWE who have acknowledged this as a sensible approach. An alternative approach is to compulsorily meter customers on a street by street basis. This method is lower cost than the optional metering programme in our current strategy outlined in our 2004 Water Resources Plan. Despite support for metering there remain concerns over regarding compulsory metering. In this Plan the Company is proposing to accelerate growth in metered customers via a comparative billing programme, rather than through compulsory metering.

The Company will work with vulnerable customers and support groups to minimise any adverse impacts of metering.

3.9 Cost-Benefit of Compulsory Metering

Our current metering programme assumes customers will continue to voluntarily switch to metered charging (optants) progressively until 2030. For our new Plan we are proposing a revised metering strategy with the aim of metering 90% of household customers by 2015. By accelerating metering we save water and therefore energy. By completing our metering programme by 2015 we can leave 1215 tonnes of water in the environment and save 345 tonnes of carbon dioxide emissions compared to our 2004 Plan. These calculations are shown in Figures 3.6 below. Customers participating in the preference study (section 3.4) ranked support for further water efficiency measures third highest but ranked further reductions in carbon dioxide emissions 5th out of the 6 attributes.

	2008 dWRMP rate of installation	AMP4 rate of installation	Change in meters installed pa	Cum rate of volume saved Ml/d in the year	Total Cum volume saved Ml to date	Cum TCO2 tonnes
2011	2.400	1.000	1.400	-0.11	39	11.0
2012	2.400	1.000	1.400	-0.22	118	33.6
2013	2.400	1.000	1.400	-0.33	238	67.6
2014	2.400	1.000	1.400	-0.44	397	112.9
2015	2.400	1.000	1.400	-0.55	596	169.5
2016	0.000	1.000	-1.000	-0.47	767	218.3
2017	0.000	1.000	-1.000	-0.39	911	259.2
2018	0.000	1.000	-1.000	-0.32	1027	292.3
2019	0.000	1.000	-1.000	-0.24	1116	317.5
2020	0.000	1.000	-1.000	-0.17	1177	334.8
2021	0.000	1.000	-1.000	-0.09	1210	344.2
2022	0.000	1.000	-1.000	-0.02	1215	345.8
2023	0.000	0.000	0.000	0.00	1215	345.8
2024	0.000	0.000	0.000	0.00	1215	345.8
2025	0.000	0.000	0.000	0.00	1215	345.8
2026	0.000	0.000	0.000	0.00	1215	345.8
2027	0.000	0.000	0.000	0.00	1215	345.8
2028	0.000	0.000	0.000	0.00	1215	345.8
2029	0.000	0.000	0.000	0.00	1215	345.8
2030	0.000	0.000	0.000	0.00	1215	345.8
Total	12.000	12.000				

Figure 3.6 Carbon Savings from Compulsory Metering

The new metering target will be achieved either through continuation in 2010 of the Comparative Billing project, subject to receiving funding from Ofwat or by compulsory metering of remaining unmeasured households.

Metering Implementation Option A: Accelerated Optional Metering – Comparative Billing Project. As part of this work, meters are fitted in certain geographical areas to households without a meter. The current occupiers of the properties remain on the un-metered charges, however they are provided with comparative bills so that the benefit of the metered bills can be shown and if they choose to, customers can opt to become charged by their metered consumption permanently. When these properties are sold, the existing meters would become charging meters to the new occupants.

Metering Implementation Option B: Compulsory Metering. We operate in an area designated by the Environment Agency as under ‘medium water stress’ and therefore we have considered the cost-benefit of compulsory metering. Installing meters on a street by street basis and over a shorter period can be done more efficiently and therefore at lower cost compared to our 2004 Plan. The lower costs would reflect in lower bills to customers than previously forecast.

Estimates for the unit cost of ad hoc optant metering and compulsory metering are £236 and £177 respectively, a reduction of 25% through scale and geographical economies. The unit costs assume 25% of meters are installed in existing meter boxes. Considering the net present value of our existing ad hoc metering strategy with one of compulsory metering demonstrates a reduced cost of £220k, Figure 3.7. Clearly there is uncertainty in the unit cost estimates however the positive cost benefit is achieved for unit costs that exceeding 19% lower than for ad hoc installations.

	Optant Metering programme as AMP4			Compulsory Metering programme as DWRMP 2008		
	No. installed pa	Unit cost /£	Total cost of installation	No. installed pa	Unit cost /£	Total cost of installation
2006	985					
2007	908					
2008	874					
2009	840					
2010	809	0	0	0	0	0
2011	1000	£235.53	£235,528	2400	£176.65	£423,950
2012	1000	£235.53	£235,528	2400	£176.65	£423,950
2013	1000	£235.53	£235,528	2400	£176.65	£423,950
2014	1000	£235.53	£235,528	2400	£176.65	£423,950
2015	1000	£235.53	£235,528	2400	£176.65	£423,950
2016	1000	£235.53	£235,528	0	£176.65	£0
2017	1000	£235.53	£235,528	0	£176.65	£0
2018	1000	£235.53	£235,528	0	£176.65	£0
2019	1000	£235.53	£235,528	0	£176.65	£0
2020	1000	£235.53	£235,528	0	£176.65	£0
2021	1000	£235.53	£235,528	0	£176.65	£0
2022	1000	£235.53	£235,528	0	£176.65	£0
2023	0	£235.53	£0	0	£176.65	£0
2024	0	£235.53	£0	0	£176.65	£0
2025	0	£235.53	£0	0	£176.65	£0
2026	0	£235.53	£0	0	£176.65	£0
2027	0	£235.53	£0	0	£176.65	£0
2028	0	£235.53	£0	0	£176.65	£0
2029	0	£235.53	£0	0	£176.65	£0
Total cost			£2,826,330			£2,119,748
NPV @ 5.50%			£2,029,898			£1,810,385
Saving of compulsory programme over optant programme						**£219,513**

Figure 3.7 Cost Benefit of Compulsory Metering Compared with 2004 Water Resources Plan

Metering on a compulsory street by street basis would also save around £600k compared to an accelerated but ad hoc optional metering programme to reach the same target of 90% of households by 2015.

Our assessment demonstrates that compulsory metering has a positive cost-benefit and saves £220,000 compared to our current progressive ad hoc optional metering programme. We consequently propose to go ahead with universal metering given both the cost and water efficiency benefits.

We expect to achieve our target of getting 90% of consumers charged by a meter without doing so on a compulsory basis. However, if we find that uptake is not as great as we expect then we would seek to charge by meter on a compulsory basis at a future date. This would follow a period of comparative billing for customers. We are nonetheless mindful of the concerns that remain over the impact that a compulsory metering programme would have on vulnerable and low income customers when these new meters are put into charge. Accordingly the views of stakeholders have been sought during the consultation on the draft Plan.

3.9.1 Automatic Meter Reading Proposed Project in Clacton-on-Sea

VWE intends to pilot a fixed network Automatic Meter Reading project in Clacton-on-Sea, provided the Company is able to reach 90% meter penetration by 2015. This project would involve providing a fixed network AMR system for 25,000 customers in Clacton-on-Sea. This metering system would enable the Company to access household consumption data which would significantly improve understanding of consumption. This would enable the Company to identify and investigate unusually high demands and in the longer term would provide the information required to consider tariff structures.

3.10 Details of Competitors in Resource Zone

Water supply licensees do not produce Water Resource Management Plans but they do have a duty to contribute to the water undertakers' plans. There are no water supply licensees operating within the VWE Resource Zone.

3.11 Strategic Environmental Assessment

Strategic Environmental Assessment (SEA) is a process for assessing the impacts of a plan or programme of works on the environment. The concept of the environment includes ecology, the historic environment, landscape, material assets and the human population. It can play a part of the decision making process, influencing the choice of preferred outcomes where there options are being considered to overcome a supply-demand deficit.

Following the detailed work that was carried out as part of this Plan, VWE does not anticipate a supply-demand deficit during the Plan period. As a result the Company does not require any additional schemes as part of these plans to secure new water resource beyond those that are already included in the current baseline.

The Environment Agency completed the Habitats Directive review of the River Colne abstraction in March 2008 and has concluded that there is no evidence to suggest any detriment to the downstream SPA/SAC.

VWE considers that the processes and studies involved in the preparation of this final WRMP fully constitute an appropriate screening phase for SEA as there will not be any additional impacts on the environment as a result of these plans. Therefore an SEA, as defined in Statutory Instrument 1633 'The Environmental Assessment of Plans and Programmes Regulations 2004' has not been carried out.

4 Water Supply

A key term used when discussing water supply is Deployable Output. This is the sum of the amount of water each individual source (including both surface and ground water) can yield which is available to the Company for putting into supply. This takes into account licensed volumes, pump capacity, treatment and distribution constraints. It is calculated for a stress period (drought) and for both average and peak demands during this period. Outage is also calculated as part of Water Supply, it is defined as a temporary loss (less than 3 months) of Deployable Output and it can be as a result of power loss, pollution events and other reasons.

4.1 Deployable Output (DO)

The Company's raw water is derived from both its groundwater borehole sources and a shared reservoir with Anglian Water Services (AWS). The DO of the Company's sources under drought conditions were last assessed in 2003 using industry standard methodologies.

Since the previous assessment, there have been no significant periods of decreased rainfall or low groundwater levels to provide more recent data on how the Company's groundwater sources perform under such conditions. Recent pumping water levels were checked against the historic values and in all cases were above the previous deepest pumping water levels experienced in 1996. There have also been no changes to the installed pumping capability or pump depth settings. There has, however, been an improvement in the losses incurred at the Company's WTW. The reservoir capability has not changed, but there has been a change in the split in the DO with AWS. Thus, there are small changes to VWE' DO compared to that reported in 2004, as described below.

There are nine groundwater sources (eight chalk, one gravel) within VWE Water Resource Zone. However, one of the chalk sources, VLAW, and the single gravel source, VGBE, are currently not in use. There are two licensed chalk sources groups, VDED and VEBE, the water from these sources is treated at VHXI Water Treatment Works (WTW). VWE has only one surface water source at VARD which is maintained and managed by an independent committee.

As reported in the 2004 WRMP, the average DO values for each individual groundwater source remain constrained by licence. Whilst peak DO values are constrained by treatment capacity. Potential Yields are constrained by the Half Saturated Aquifer Thickness, which represents the Deepest Advisable Pumping Water Level (DAPWL). Improvements in managing waste water from the VHXI WTW have reduced the losses from 0.5Ml/d to 0.05Ml/d. This was not included in the base year but has been added to the total for the VDED Group from 2007/08 onwards.

The VDED group licence was issued in 1998 and as a result it temporarily removed a borehole from the VEBE group. In April 2008, this borehole reverted back to the group license to which it was originally assigned in 1998 and as a result reduced the Chalk groundwater DO of the other chalk source licence by 2 Ml/d at average, but not at peak, as the constraint remains as the treatment works capacity. This licence transfer actually occurred in November 2007. The WRMP tables and graphs show the impact of this in

2008/09. Even though this small change has no impact on the overall Plan, the supporting documents have been updated with this change for the final WRMP.

As mentioned previously, VARD is a shared reservoir with AWS where the share of the DO is normally a 50:50 share for each company. From 2006, VWE has entered into an agreement with AWS to change the split of the share of the DO of VARD from 50:50 to 40:60 to VWE:AWS on a temporary basis until March 2010. Despite this reduction in the percentage share, the resulting DO for VWE has increased to 10.24Ml/d at average and 14.4Ml/d at peak. This is because the overall DO of the reservoir will increase as a result of supported flow to the reservoir from a currently disused borehole, when required, that AWS have guaranteed.

Recent discussions with AWS have indicated that after March 2010 the split will change again to 70 (AWS):30 (VWE) until March 2015. The final WRMP is based on a continuation of this agreement throughout the planning period.

The total current DO figures for the base year and 2007 for the Company can be seen in Table 4.1 and have been used to populate the WRMP tables. Note Company level DO reduces from 2008/09 due a change in the chalk source group licences. It should also be noted that the DO calculation takes into account process losses at VHXI WTW.

<table>
<tr><th></th><th>Base Year
2006/07
Dry Year Ave. DO</th><th>Current Position
2007/08
Dry Year Ave. DO</th><th>Current Position
2007/08
Peak DO**</th></tr>
<tr><td>VDED Group</td><td>28.50</td><td>28.50</td><td rowspan="2">42</td></tr>
<tr><td>VEBE Group</td><td>2.00</td><td>2.00</td></tr>
<tr><td>VGBE Source</td><td>0.00</td><td>0.00*</td><td>0.00</td></tr>
<tr><td>VARD Reservoir</td><td>10.24</td><td>10.24</td><td>14.4</td></tr>
<tr><td>VHXI WTW Treatment loss</td><td>-0.5</td><td>-0.05</td><td>-0.05</td></tr>
<tr><td>Company Level</td><td>40.24</td><td>40.69***</td><td>56.35***</td></tr>
</table>

Table 4.1 Deployable Output Figures for 2007/08

* VGBE Source is not used currently and hence no DO value but license still applies
** Peak DO is not “Critical” for planning purposes. The Company’s “critical” period is the annual average for a dry year.
*** Although licence flexibility could increase the annual average DO in a dry year the lower rolling five year licensed volume has been used here.

4.1.1 Mineral Extractions and Raw Water Storage at VARD

On behalf of both VWE and AWS, the Committee who operates and manages VARD is actively promoting an increase in raw water storage. This will involve a preliminary phase of mineral extraction over 10 to 15 years. At a meeting held in March 2007, Essex County Council agreed to approve the planning application (subject to conditions). The additional storage at the reservoir does not require any increase to the abstraction licence at the point of abstraction on the River Colne. The environmental impacts at the site of the additional storage have already been fully assessed as part of the planning application process. The additional storage will provide increased yield to VWE of at least 1.5 Ml/d. This is not an option that is driven by a supply-demand deficit but the facility is expected to be available by 2025 and has therefore been included within the final planning scenario.

4.1.2 VGBE Gravel Source

VWE currently have a groundwater licence for the gravel source at VGBE for an average of 2.4Ml/d which has not been operated and used for supply since 1991 due to quality problems.

During 1997, an investigation was made to explore the possibility of bringing VGBE back into service as part of an overall drought contingency plan agreed with the Environment Agency. If the scheme were to go ahead, low-pressure reverse osmosis would be utilised to produce up to 2.55Ml/d with an estimated 1.5Ml/d average gain. The 1.5 Ml/d is lower than the 2.4 Ml/d average licence and has been arrived at by inspection of old abstraction records over sustained periods.

As a result of the expense of the treatment required and the surplus of supply, this option has not been developed but it can be considered as a future supply-demand option and has been included as a contingency measure in the Drought Management Plan for VWE.

4.1.3 Appraisal of Existing Supply Options and Policies

These sources and schemes currently operated by VWE are within the limits of the original water abstraction licences issued to the Company. No additional options were put forward in our 1999 or 2004 Water Resource Plans.

4.2 Reductions in DO (Sustainability Reductions)

The Environment Agency confirmed in its letter of the 12th March 2007 that there will be no Sustainability Reductions for VWE, in the period 2010-2015.

VWE does not have any Environment Programme schemes on going under the AMP4 National Environment Programme (NEP). However, the Company is aware of the concerns about the impact on the environment of public water supply (PWS) abstraction on the River Brett during a drought. The link between PWS abstraction and the levels in the River Brett was studied as part of the 2000-2005 NEP.

Although the study did not demonstrate a short-term link between PWS abstraction and the reduction of flow in the River Brett, the Company's groundwater sources are nevertheless sufficiently robust to augment river flows and are licensed to do so when requested by the Environment Agency. As part of the NEP work in 2004 the Company installed a pipeline from a nearby borehole to the River Brett for use during a future drought.

The new River Basin management plans are in the process of being formulated by the Environment Agency as part of the Water Framework Directive (WFD) requirements, and depending on the assessment of these, may change the need for future sustainability reductions. VWE has been advised that no such reductions will be required during the first river planning cycle (2009 to 2015), but there maybe a requirement to make such reductions in future planning cycles. It is too early to state how much or where such reductions may occur, but it is possible that studies will need to be undertaken during the AMP5 period

(2010-2015) to investigate alternative supplies or other mitigation measures if they are required. It is anticipated that any such studies will be sufficiently defined for inclusion in the final WRMP in 2009.

4.3 Outage

The outage assessment used the UKWIR 1995 methodology described in *Outage Allowances for Water Resource Planning.* This is the industry standard approach.

Assessments were completed for each source works within the supply area. Two standard pro-formas were developed for the assessments:

- **Groundwater sources**
- **Surface water abstractions**

Assessments were mainly based on interviews with operational staff experienced with each source and historical data was used as an aid to fill out the pro-formas.

The standard outage pro-forma for all groundwater sources and surface water abstractions were then applied to a Monte-Carlo based model using Crystal Ball software, which was created specifically for this outage assessment. A Monte-Carlo model was created for the single resource zone, with source outages being summed to give a total outage value for the resource zone. The outputs are shown in Table 4.2 for the base year.

Average DO (Ml/d)	Average Outage (Ml/d)	Outage as % of DO	Peak DO (Ml/d)	Peak Outage (Ml/d)	Outage as % of DO
42.24	0.66	1.6	55.90	1.59	2.8

Table 4.2 Outage for Whole Company: 95%ile

The outage in periods of average water demand was found to be 0.66 Ml/d, whilst at critical periods of water demand (assumed to be a one month period from mid-July to mid-August) the outage returned 1.59 Ml/d. This is considered to be a representative value of current conditions and although the value has marginally increased since 2004, Outage is not considered a major problem for VWE as there is a significant amount of spare capacity in the groundwater sources, combined with storage in the reservoir.

The results of the Crystal Ball Monte-Carlo modelling process list a number of different percentiles of certainty. These are then summed to find total outage at a 95% level of certainty.

The values shown in Table 4.2 apply to the base year (2006/07) and 2007/2008 but due to a license change at VLAT later this year (2008), the outage was determined to be 0.57 Ml/d at average and 1.54 Ml/d at peak periods for 2008/09 and beyond. This is reflected in the tables of the WRMP going forward from 2008/09.

4.4 Raw and Potable Water Transfers and Bulk Supplies

There are no existing transfers between the Company's Water Resource Zone and its neighbouring water companies. However, as previously mentioned in section 2.1.1, VARD is a surface water storage reservoir which supports a unique sharing arrangement between VWE and AWS. The normal arrangement is a 50:50 share of the output between VWE and AWS but for the period 2005-2010 the AWS share has increased to 60% to the benefit of the customers of both companies. This 40:60 arrangement will be maintained until March 2010 after which point the share will change to 30:70. Discussions with AWS have resulted in an agreement for planning purposes to maintain the 30:70 division of VARD DO from 2010/11 until the end of the planning period.

During the uneven split of VARD, AWS has agreed to support the River Colne using surplus ground water from one of its groundwater sources. As a consequence of this, 40% of the supported drought yield will be 10.24 Ml/d, and 30% will be 7.7Ml/d compared to 9.4 Ml/d which is 50% of the unsupported yield.

The sharing arrangement allows for more water to go temporarily to either company, by agreement, in an emergency subject to either company having sufficient water to manage their supplies. The WTW at this reservoir can provide up to 36 Ml/d total (this is not a drought yield but is available in the short run at any time and may be sustainable over many days/weeks as the reservoir holds 2,185 Ml when full). Under a under a dry year scenario supplies will be managed either to the limit of the shared arrangement (50:50) or to whatever agreement is in force at the time.

VARD WTW can also be supplied with water from Essex and Suffolk Water (ESW) if ESW are able to provide assistance whilst maintaining the supply to their own customers.

4.5 Distribution and Treatment Works Operational Use and Losses

Treatment Works Operational Use (TWOU) is negligible and has been discounted. Based on assessments, previously agreed as reasonable with the VWE Ofwat Reporter, the VWE Distribution System Operational Use (DSOU) which is included in the demand forecast is very small at around 0.02 Ml/d. Although this value may vary in individual years due to variations in levels of operational flushing, swabbing, tank cleaning and other associated activities, the actual value is not material for water resource planning purposes. Similarly water balance allowances of 0.01 Ml/d for water taken legally and illegally unbilled are assumed to be 0.01 Ml/d and zero respectively.

Treatment works losses from sludge tanks are equal to zero at VARD WTW as all losses are returned to reservoir. Treatment work losses at VHXI WTW have been assessed as 0.05 Ml/d and this has been deducted from the Deployable Output to calculate WAFU.

Based on established systematic checks no indication can be found for any significant losses from service reservoirs, treated water storage tanks, water towers or raw water trunk mains. This also applies to the Company's strategic raw water mains based on operating experience and visual inspection. A comprehensive system of meter checks is operated between borehole sources and the water treatment works (WTW), the surface water source and the nearest Distribution Input (DI) monitor. These checks confirm good agreement that there is no trunk main leakage indicated upstream of the Company's DI meters.

Metering exists at the inlet and outlet of all storage sites except at the VWE single operational water tower at VHXI , from this no storage site losses have been indicated. Storage sites are routinely subjected to static tests in conjunction with cleaning at least every five years. Further static tests would be triggered by inlet/outlet metering checks if required. Static checks are frequently done using accurate ultrasonic level readings available continuously from telemetry. No leaks have occurred in buried storage tanks. Minor leaks have occurred and have been repaired in above ground steel tanks.

4.6 Conclusion of Water Supply

In conclusion, the present Water Available for Use (WAFU), which is the value in Ml/d calculated by the deduction from deployable output of allowable outages and planning allowances in a resource zone, is 41.58 Ml/d for the base year. Future Changes in DO as a result of variations in the sharing arrangement of VARD between VWE and AWS, ground water license changes and increases associated with the gravel abstraction at VARD have all been taken into account to forecast the future WAFU which can be seen in Figures 2.1 and 2.2.

5 Water Demand

The predicted demand for water is developed using a sequence of elements as described in the section below. VWE has produced robust demand forecasts based on assumptions about how water demands will change over the next 25 years.

A model was used to generate long-term forecasts of demand components in average conditions based on assumptions about changes in population, per capita consumption, leakage rates, meter penetration, savings on metering and non-household demand.

All demand forecasts used are based on a best estimate normal year annual average daily demand year for a single set of population and properties.

The normal year scenario data for the Company's potable water and leakage information is used by Ofwat to assess companies' forecast revenue. This information is found in the WRMP tables.

5.1 Different Types of Demand Forecast

Demand forecasts have been prepared for:

- Normal year annual average
- Dry year annual average

During the record peak demand which occurred during the sustained hot summer of 1995, VWE supply/distribution system coped with a record demand of 50.9 Ml/d in 24 hours and a peak week demand of 49.1 Ml/d. Although there were no significant failures, the Company invested in some resource improvements and demand management measures to give greater margin of supply. The combined effect of these measures was to increase the peak supply to around 59.5 Ml/d and decrease peak demand to less than 42 Ml/d by 2003/04.

The peak demand did not exceed 42Ml/d on any day during the prolonged hot dry weather in July/August 2003. The critical period for VWE is, therefore, the average demand in a dry year and no separate critical period has been analysed.

2005/06 has been used to produce the baseline forecast and this is used to show how demands will change in a dry year assuming existing management and water efficiency policies.

A demand forecast is developed by using the values of the various demand drivers; population and household forecast, commercial demand forecast, micro-component forecast (which gives the Per Capita Consumption), minor-components forecasts and leakage forecasts.

A value for domestic demand is produced by multiplying the PCC by the population forecast. The total demand forecast is then the sum of the domestic demand, commercial forecast, leakage forecast and minor component forecast. Minor components include water use associated with Water Taken Unbilled and Distribution Operational Use etc.

Total Demand Forecast = Domestic Demand + Commercial Demand + Leakage + Minor components

Forecasts

The drivers for the demand change through the planning period and the way that they are predicted to change is documented in the supporting technical reports. The largest effects on demand have resulted from increased meter penetration and population growth across the forecast period. These factors have impacted demand in opposite ways. To allow for this, assumptions have to be made for individual forecast drivers, for example savings made from metering are reflected in the domestic demand.

VWE uses a “bottom up” minimum night flow (MNF) to define total leakage. The remaining unmeasured consumption is calculated as the residual in the water balance.

Unmeasured Consumption = Distribution Input - Measured Consumption - Leakage

When arriving at the best estimate normal year annual average daily demand forecast the following assumptions are made:

- The impact of climate change has not been applied directly to the demand forecast. However, its effect has been incorporated within the headroom calculation. The effect is expected to be small in the near future.
- A sustained reduction of 15% in the long-term has been assumed for the change in per capita consumption (PCC) when unmeasured customers become measured.

To derive the dry year demand pattern, historical dry demands are used. Historically 1995 was one of the hottest and driest years but the impact of the significant increases in meter penetration since 1995 and its associated constraint on demand has meant that this year no longer provides comparable data. Therefore VWE has used 2003/04 as the benchmark for derivation of the dry year demand pattern as this was a very hot year and reflects the impact on demand of meter penetration.

By comparing the base year to the bench mark 2003/04 year, a set of adjustment factors is obtained and these are then applied to the consumption for the different categories of customers to obtain the dry year demand.

5.2 Base Year Population and Properties

5.2.1 Base Year Population

The Company estimated the household population using VWE billing data to allocate the population between the various customer categories and then reconciling it to the 2001 Census Data. Metered non-household population has been allocated from the 2001 census data at Output Area Level summed up to resource zone.

Non-household population is made up of people living in farms and communal establishments such as hospitals, prisons and educational establishments. The 2001 Census data provides information on the numbers of communal establishments and their residents by local authority, from this information the metered non-household population was allocated at output area level summed up to resource zone. In this final WRMP the metered non-household population is estimated to be approximately 3350.

It can be assumed that void, zero consumption, or holiday home properties have no allocated resident population. Unmetered non-household population is assumed to be negligible. The residual population of the total population (see above) minus the metered domestic and non-household populations for the resource zone is used to calculate the unmetered domestic population.

5.2.2 Base Year Properties

The number of properties in 2006/07 has been derived from the Company's billing database for all of the property categories reported in the June Return. Historical June Return figures have been analysed to breakdown metered customers per customer type. Where there is no data simple assumptions have been used to hindcast estimated total numbers. The customer base per property type is split as shown in Table 5.1 and the population breakdown is summarised in Table 5.2.

Billing Category	Number of billed properties
Measured Households	43829
Unmeasured Households	22710
Void Properties	1127
Measured Non-Households	4089
Unmeasured Non-Households	75
Total No. Billed Properties	71830

Table 5.1 Billed Properties Breakdown by Types of Household

VWE has few remaining unmetered non-households (0.1%). These are generally small businesses with complex supply arrangements that make them difficult and expensive to meter. In some cases these may be a mixture of commercial and domestic uses.

Billing Category	Population
Measured Households	87811
Unmeasured Households	62870
Void Properties	0
Measured Non-Households	3347
Unmeasured Non-Households	0
Total Billed Population	154028

Table 5.2 Population by Billing Category

Base year population in unmeasured non-households has been determined from census estimates of communal establishment populations. No estimates have been made for population in other commercial premises not counted in the census. VWE has assumed that the low number of potentially mixed properties in the unmetered non-household category contain negligible population and have entered a zero population in this category. Metered occupancy is 2.00 persons per property and unmetered is 2.77. This differential reflects the fact that low occupancy properties gain most from switching and the large number of meter switchers that have occurred in the VWE area.

5.3 Forecasting the Potable Water Customer Base

5.3.1 Population Forecast

The population served by VWE is set to increase over the next 25 years and beyond. VWE has produced company specific population forecasts to inform the supply-demand balance and maintain continued security of supply. The material available from which to evidence this forecast is considerable, although there will always be inherent uncertainties surrounding forecasts of this nature.

To ensure a consistent methodological approach Experian (Experian Business Strategies, EBS) were commissioned to undertake a joint housing and population study for the South East on behalf of a number of water utility companies, including VWE. Experian's methodology ensured that National, Local Authority and output area estimates of population were robustly reconciled to the supply area. As a result each forecast produced was in accordance with the Environment Agency's '*Methods of estimating population and household projections'* report, as well as adhering to the Environment Agency's Water Resource Planning Guidelines. From this work three company specific forecasts were produced; a policy-based forecast (as required by the Environment Agency Water Resource Management Plan guidelines), a trend-based forecast and a 'most-likely scenario' forecast.

To support the forecasts produced by Experian, a population projection was produced based on the Company specific total-housing forecast and the occupancy forecasts provided by Tendring and Colchester Local Authorities. Further detail of how the forecasts are produced is shown below:

- *Company Specific VWE-Regional Spatial Strategies (RSS) based Forecast (2001-2035):* This forecast was produced by applying the occupancy projections for Tendring and Colchester local authority areas (sourced from the CLG) to the RSS based housing forecast produced by VWE. The potential impact of the recession on housing growth has been taken into account. This projection showed a population increase from 145,200 in 2001 to 180,961 in 2035, an increase of **35,761** people or **25%.**

- *Trend-Based population projection (2001-2035):* This was produced for each output area that made up the VWE supply area. This method utilises the 2001 Census and the most up-to-date sub-national estimates and projections from the Office of National Statistics (ONS). This method forecast a population growth from 148,691 in 2001 to 212,945 in 2035, an increase of **63,984 (43%)**

- *Policy-driven population projection (2001-2035***):*** This forecast aligns trend-based estimates with housing allocations circulated in the Regional Spatial Strategy. This forecast a population change from 148,691 in 2001 to 191,949 in 2035 increase of **43,258 (29%).**

- *A most likely scenario projection (2001-2035):* There is a divergence between the trend and policy projections documented above. The most likely scenario is Experian's subsequent 'best estimate' of the population projection, given all the available information. This indicated that the population growth will increase from 148,691 in 2001 to 206,283 in 2035, an increase of **57,592** people **(39%).**

It should be noted that part of the reason why the VWE CACI/RSS forecast originates from a value below that used by Experian (145,200 rather than 148,691) is as a result of how newly connected properties and so population increases are reported. New dwellings do not become a 'billed' property immediately. As such the reported billed properties, and hence population, will often under-record actual new-builds that would have been identified through Experian's methodology.

Overall the population forecasts produced each show that the population supplied by VWE is set to increase over the next 30 years. The difference in these forecasts is illustrated in Figure 5.1 where the red line indicates the chosen forecast.

VWE seeks to forecast the demand for water as accurately as the available data and as a Company are keen not to under-estimate future demand. The Environment Agency Water Resources Planning Guidelines recommend that each water company forecasts the growth in population supplied based on a policy-based projection.

However, due to the recent revisions made to the National Population forecasts by the ONS, the policy-based forecast is not considered an accurate reflection of the future population. Therefore the Company has consequently chosen to use *VWE-RSS Based forecast* as the most accurate population projection. This decision was made to ensure that future demand is adequately planned for, based on the best available data, as it was considered that planning for growth based on data that was known to be under-representative would have exposed the Company to greater risk to security of supply.

Following the letter received from Essex County Council regarding the Haven Gateway development in November. The figures were re-validated and revised figures were included in all of the population forecasts described above to take into account the potential increase in housing stock and population.

Since the draft WRMP was published Experian has revised its forecast using the revised ONS data. This final WRMP incorporates those updated forecasts. Future changes in national level population estimates will however be continually monitored and revisions and amendments made whenever necessary to ensure the most accurate population forecast possible.

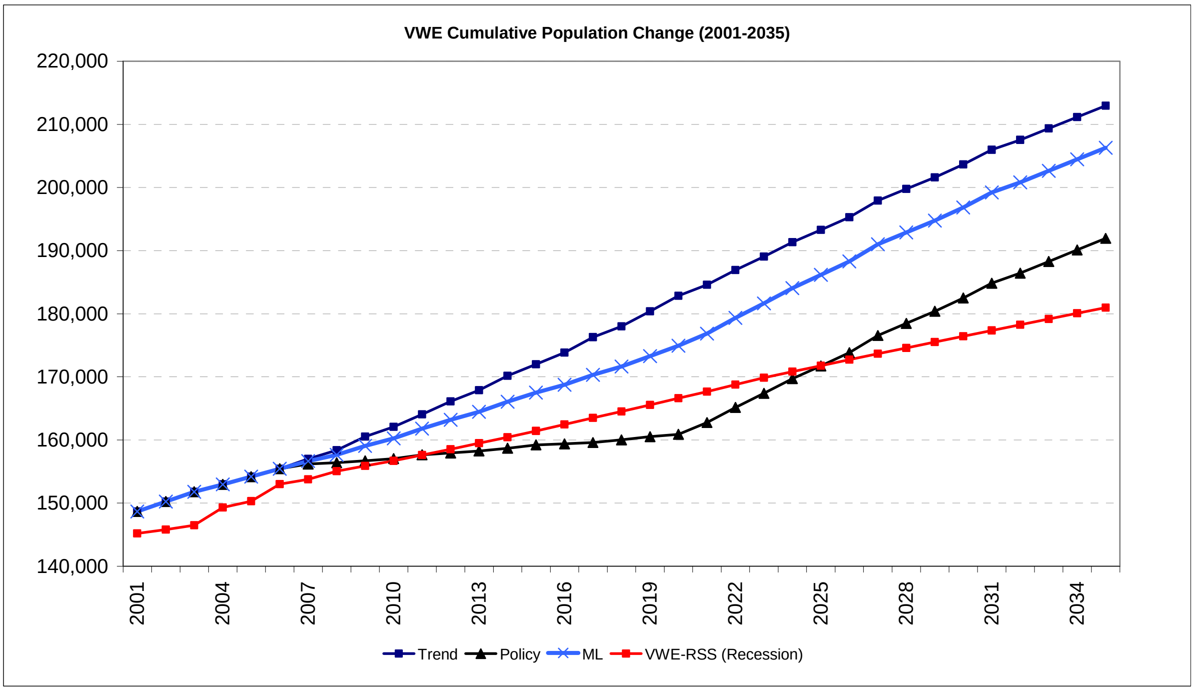


Figure 5.1 Veolia Water East Total Population Forecasts

5.3.2 Household Forecast

VWE has produced company specific housing growth forecasts in order to ensure a continued level of water supply now and in the future. These forecasts utilise best available information from a national, regional and local scale.

Often site specific knowledge is also important, for example where planned developments occur close to a supply boundary. In these circumstances closer inspection is required to assess the precise housing numbers that may fall within the Company's supply area.

To ensure a consistent methodological approach when calculating the Company's housing forecast, as with the population forecasts, Experian were commissioned to undertake a joint housing and population study for the South East. This study was carried out on behalf of a number of water utility companies, including VWE. From this work three company specific forecasts were produced; a policy-based forecast (as required by the Water Resource Management Plan guidelines), a trend-based forecast and a 'most-likely scenario' forecast.

VWE also produced a housing forecast based on a VWE-Regional Spatial Strategies (RSS) projection.

All of the housing forecasts produced each show that the number of households supplied by VWE is set to increase over the next 30 years as population increases. The main outcomes of these population projections are summarised below:

- *Company Specific VWE RSS/CACI projection (2001-2035)*: This projection was derived by weighting Tendring and Colchester Local Authorities' housing allocation based on the number of houses in each that VWE supplies. A linear forecast was subsequently produced based on the proposed annual build rates from the Revised East of England Plan. Discussion with the Haven Gateway Partnership indicated that the annual growth rate may be applicable from 2007/08 until the end of the planning period. This indicates a housing stock increase from 66,535 (2007) to 79,914 (2035), an increase of **20%**, or **13,379** dwellings.

- *The policy-driven household projection (2001-2035):* This method aligns the trend-based estimates with the housing allocations, circulated in the draft regional plans. This projection forecasts a household increase of **29,345** dwellings (**45%**) from 65,296 in 2001 to 94,641 in 2035.

- *The Trend-based household projection (2001-2035)**):*** Calculated by OA (output area) within the VWE supply area. This method utilises the 2001 Census and the most up-to-date sub-national estimates and projections from the Office of National Statistics. This forecasts an increase in housing of **39,869** dwellings (**61%**) from the 2001 level of 65,296 to 105,165 in 2035.

- *A 'most likely' scenario projection (2001-2035**):*** Given the expected divergence between the trend and policy projections the "most likely" scenario is Experian's subsequent best estimate of household projection, given all the available information. This forecasts a housing increase of **36,532** dwellings (**56%**) from 65,296 in 2001 to 101,828 in 2035.

The difference in these forecasts is illustrated in Figure 5.2 below where the chosen forecast is shown in red.

Part of the reason why the VWE CACI/RSS forecast originates from a value below that used by Experian (63,100 rather than 65,296) is as a result of how newly connected properties are reported. New dwellings do not become a 'billed' property immediately. As such the reported billed properties will often under-record actual new-builds that would have been identified through Experian's methodology.

The Environment Agency Water Resources Planning Guidelines recommend that each water company forecasts the housing number based on a policy-based projection. The housing forecast produced by VWE is closely aligned to the policy-base forecast produced by Experian. However beyond 2021 Experian's policy-based forecast is re-aligned to a trend-based projection which results in a sudden increase in the forecasted build rate. The housing projection produced by VWE maintains a linear forecast beyond the Plan period. Consequently the Company has chosen to use the Housing forecast produced by VWE:RSS/CACI to inform the demand forecast as it is considered to be the most robust available and it also produces a steady and reliable forecast.

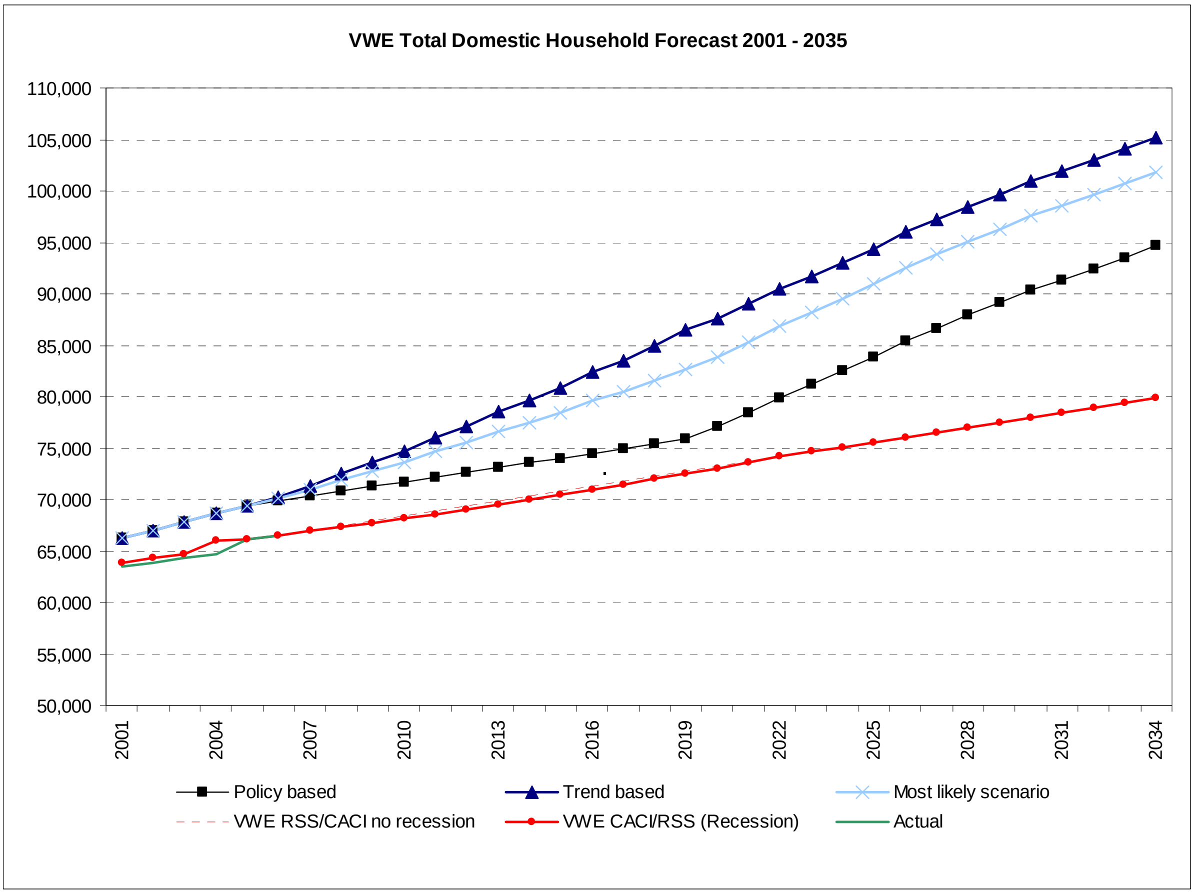


Figure 5.2 Veolia Water East Total Household Forecasts

To compliment the work undertaken by Experian and VWE, direct contact with Tendring District Council and Colchester Borough Council is important. This reaffirms confidence in the allocated housing targets and provides valuable further insight into the precise likely locations for these dwellings, further validating the procedure of re-weighting housing proposal to existing stock.

Future changes in national level estimates will be continually monitored and revisions and amendments made whenever necessary especially in the light of new information on the Haven Gateway Project.

5.4 Base Year Household Demand

A significant component of water demand is attributable to domestic use. Domestic demand for water over the Plan period is modelled by using a micro-component approach and by benchmarking the forecast assumptions to the base year per capita consumption. The micro-component method identifies the components of water use, including their levels of ownership and how often they are used. Best available data is then used to determine how projected changes in these factors may effect overall consumption in the future.

The model assumptions used within the micro-components have been based on a comprehensive customer survey carried out by VWE in 2007. This provided detailed base-year assumptions on water use that were benchmarked to the calculated unmeasured and measured PCC figures.

5.4.1 Per Capita Consumption (PCC)

The total volume of water each person uses per day is known as their PCC. The PCC value varies across the country due to factors including socio-economic breakdown, climate, metering penetration and occupancy.

VWE does not have an internal water consumption monitor study to derive the base year unmeasured PCC (uPCC). However, the Company intends to significantly reduce the number of unmeasured households via its metering programme.

The measured base-year PCC is calculated by dividing the domestic measured billed volume (minus supply pipe leakage) by the measured domestic population. The measured customer PCC projection is then forecast forward from this figure.

5.4.2 Baseline Micro-components

The Company has carried out customer surveys to better understand how water use relates specifically to VWE customers. The 2007 survey was a comprehensive questionnaire of metered and unmetered customers that returned 3,212 responses from 20,000 surveys sent out. This questionnaire sought to strengthen the Company's specific understanding of base-year water use. The number of replies received makes the results both representative and statistically significant for the Company as a whole. Each respondent was asked to provide their postcode, which enables the Company to obtain their socio-economic 'ACORN' background.

5.4.3 Base Year Assumptions

The base year used for these calculations was 2005/2006 as mentioned in section 3.2.

Toilets and personal washing

The ownership of a standard toilet was derived from the customer survey for both metered and un-metered customers. The results showed that metered ownership was 66%, with un-metered ownership at 71%. Where standard and low flush toilets were both owned, a weighted average of the two was produced to ensure that the combined ownership did not exceed 100%. The results of the survey identified that flush frequencies were 4.87 per head per day for metered customers and 4.9 per head per day for unmetered customers.

The ownership of low flush toilets is approximately 29% across the supply area. Where both dual flush and standard toilets were owned, so as to ensure ownership did not exceed 100%, the figures were reapportioned accordingly. The frequency of low flush toilet flushing was 4.94 for metered customers and 4.46 for unmetered customers.

Bath ownership in the base year was calculated as to be 29% for metered customers and 38% for un-metered customers with the base year frequency for use approximately 1.1 uses/head/day.

Power shower ownership was surveyed at being approximately 19% for metered customers and 14% for unmetered customers with the frequency of use approximately 1.2 uses/head/day for metered and 1.25 uses/head/day for unmetered customers.

Ownership of standard showers was forecast as being approximately 70%. Where it is observed that the ownership exceeded 100% (that is to say individuals owned both a power shower and standard shower) the ownership was reapportioned so as not to exceed 100%, otherwise figures were taken directly from the survey results.

Ownership of hand basin in the base year is 100%. The survey results indicate that frequency of use varies depending on whether the household is metered or un-metered. Average metered personal daily use was 3.94 with un-metered use slightly higher at 4.03 uses/head/day.

The kitchen tap ownership is considered to be 100% in the base year with a frequency of use for both metered and un-metered households of 2 uses/head/day. This reflects an estimated morning and evening use.

White goods and kitchen activities

Base year ownership of washing machines was 24% for metered and un-metered customers. The frequency of use per person per day was also calculated at being 0.24 for metered and unmetered customers.

The ‘ownership’ of being able to wash ones clothes by hand was set at 100% in the base year as everyone has the ability to wash their items in this manner. There is little evidence to suggest a frequency for this occurrence although the Market Transformation Programme suggests it might be as high as 0.07 uses/head/day. When calibrating the micro-component model to the base year it was determined that the average base year frequency is more appropriately 0.01 and 0.015 for metered and unmetered individuals respectively.

The survey undertaken showed that base year dishwasher ownership was 26% for both metered and unmetered customers. The frequency was approximately 0.26 uses/head/day for unmetered and metered customers.

Dishwashing by hand has been set at 100% in the base year as all have the ability to wash dishes in this fashion. Survey evidence has also suggested that the frequency of this washing is approximately 0.2 uses/head/day for metered and 0.25 uses/head/day for unmetered customers.

An internal review of water softener penetration indicated that ownership may range from between 5% to 10%. A frequency of use is assumed to be automatic and with modern appliances dependant of volume of water used through the softener. An estimate, based on an average PCC, forecasts a recharge rate of once a week.

Outdoor activities

The ability to wash a car using a hosepipe varies by geographical area and as such is largely a function of affluence. The average company ownership for unmetered customer is considered to be 25%, with metered customers also with 25% ownership.

The frequency of use is reflected in this difference with 0.01 uses/head/day for unmetered customers and 0.001 uses/head/day for metered customers.

It has been assumed that washing a car using a bucket is available to approximately 25% of metered and unmetered customers. The frequency of use is low with 0.001 uses/head/day for metered customers and 0.01 uses/head/day for unmetered customers.

Although sprinkler and hose pipe users are metered. Unmetered use has been considered to take account of illegal use. Sprinkler ownership in the base year is considered to be 25% for both unmetered and metered customers respectively. The frequency of use is considered small with between 0.001 and 0.01 uses/head/day for metered and unmetered customers respectively.

Base year hosepipe ownership is considered to be 25% for both metered and unmetered households respectively. Base year frequency of use is considered to be 0.001 and 0.01 uses/head/day for metered and unmetered customers.

Watering can ownership in the base year is estimated as being 25% for metered and unmetered households. Frequency of use for metered customer is considered to be 0.001 uses/head/day and for unmetered customers this rises to 0.01 uses/head/day.

Miscellaneous

A miscellaneous use is simply one that has not been sufficiently classified for in the modelling. That is to say a use that can not be easily classified based on the available literature.

The ownership of a miscellaneous event is considered to be 1 (100%) for both metered and un-metered customers as all individuals have the opportunity to generate an un-quantified use. The frequency of this miscellaneous use is considered to be low at 0.04 uses/head/day for the measured population and 1.6 uses/head/day for the unmeasured population.

5.5 Forecast Household Demand

The **micro-component model** provides an understanding of how domestic customers use water and how this use is forecasted to change in the future. The model identifies the main components of water use for a typical household.

The following equation shows how the consumption figure for each component is calculated.

Consumption (litres/person/day)= Ownership (O) * Frequency of use (F) * Volume (V)

Example for a washing machine, an assumption is made:

- How many homes own a washing machine
- How many times a day that machine is used.
- An understanding of the market penetration of certain models and using best available national data gives an average volume of water each machine consumes per use.

The full model is based on a simple concept, as seen in the consumption equation above. In its most basic form it is a series of O, F and V equations, summed to give a total PCC. This calculation is repeated year on year to produce a forecast, taking into consideration projected changes in the O, F and V estimates. The model is calibrated in the base-year (2005/06) to the PCC calculated from the water balance and the known billed metered consumptions.

The model is built around a series of spreadsheets including:

- Ownership of appliances (measured & unmeasured),
- Frequency of use of the appliances by Water Resource Zone (measured & unmeasured),
- Volume of use for each appliance
- Consumption of water (measured & unmeasured),

5.5.1 Usage Assumptions

To account for the uncertainty around the Company's 'Preferred' forecast, a 'Low' and 'High' set of forecast assumptions were also produced. These used the same base year assumptions as the 'Preferred' forecast although highlight the uncertainties behind the potential future behavioural changes.

The following sections look at the assumptions made for each component and for each of the forecast types.

Toilets and personal washing

The ownership of a 'standard' 9L toilet will decrease. Evidence suggests that the replacement rate of any given toilet is in excess of 15 years. To allow for uncertainty surrounding this figure, the Company forecasts a standard toilet ownership reduction over a 20 year period from the base year position, each standard toilet being replaced by a dual flush toilet.

For the 'Low', 'Preferred' and 'High' forecast estimates this change in ownership equated to an annual average decrease of 4.6% for both metered and unmetered customers.

In the final planning scenario the decline in ownership of standard WCs in the measured customer base is forecast to decline more rapidly from 2014-15 (6% rather than 4.6%). The water efficiency strategy includes actions to encourage customers to switch to low/dual flush toilets.

This decrease in standard toilet ownership was off-set by an increase in the ownership of low flush toilets.

The frequency of use forecasts for the standard toilet modelled no change for each forecast type as it is considered that toilet use will continue unchanged. Low flush toilet ownership was forecast to directly replace standard toilet stock. This ensured that ownership of toilets remained at 100% but simply the toilet model available for use changed. The frequency forecast remained un-changed and so was set at zero.

The 'Preferred' estimate for bath ownership also forecasted a slight decrease in bath ownership due to the evidence to suggest that showers are often being fitted in preference to baths with little evidence to suggest that bath ownership will increase. Bath ownership was shown to decrease from 29% in 2006 to around 23% in 2035.

In the 'Preferred' estimate, bath use is forecasted to decrease at 0.009 uses/person/day as showers are forecasted to become more popular. However the 'High' forecast projects an increase in bathing as there is evidence suggesting that, as bath tends towards being a means of relaxation rather than simply functional, an increase in use may be observed. For this reason the 'High' forecast estimates a personal daily increase in bathing of 0.003.

When forecasting the ownership of showers, there is evidence suggesting that power showers ownership will reach 50% by 2021. For this reason an annual increase in power showers ownership was applied so that this assumption is achieved. In order not to double count shower ownership, the standard shower ownership forecast was set to decrease at a third of this rate; simulating that one in three newly fitted showers will be standard. To make sure this forecast does not double count ownership at any point, a function was added to the calculations so that power showers are the drivers of future demand and standard showers occupy the remaining ownership (at no point exceeded a combined shower value of 100%).

In the baseline the forecast increase in ownership of power showers is estimated as 2.1% per annum throughout the planning period. However, in the final planning scenario this is forecast to reduce progressively to 1.5%, 1%, and ultimately stabilise at 50% ownership. The water efficiency strategy includes actions to encourage customers to retain or revert to standard showers.

For the frequency of use power showers were set to continue at the same rate of use in the 'Low' forecast. The 'Preferred' and 'High' forecasts both project a mild increase in shower use (0,003/person/day increase) for both shower types as personal standards of hygiene and shower availability continue to increase.

Ownership of hand basins is forecasted to remain the same at 100%. Frequency of use in the 'Low 'estimate is projected to decrease marginally by 0.001 uses/person/day to reflect an increasing consciousness of water use. The 'Preferred' and 'High' forecasts no change in the frequency of use.

White goods and kitchen activities

None of the forecast assumptions models the ownership of kitchen taps to decrease below 100% nor do they model an increase in use in the future.

An annualised growth was calculated of 0.32% increase yearly. This reflects a 10% increase in ownership over the Plan period. This figure will be continually reviewed so as to ensure the most accurate assumptions are used.

The frequency of use forecast was set at zero for the 'Low' and 'Preferred' forecasts, although a yearly projection of 0.001 uses/head/day was built into the 'High' forecast to simulate a marginal increase in use, based on a greater ownership and subsequent availability.

The forecast assumptions maintain a 100% ownership for this category across each forecast level. The 'Low' and 'Preferred' models forecast a yearly decrease of 0.001 uses/head/day to reflect the increasing functionality of modern automatic machines. The 'High' model frequency is forecasted to continue unchanged at the current rate.

Dishwasher ownership is forecasted to be 40% by 2015 given current rates in growth. To meet this produced market penetration an annual average growth rate of 2% has been projected across the Company's supply area. This linear growth was forecasted forward with an amendment in the formulae to ensure that the ownership did not exceed 100%. At this forecasted rate, dishwasher ownership would be approximately 82% by the year 2035.

The ownership for dishwashing by hand has been set at 100% for each forecast method. Each forecast assumption forecasts a reduction in dishwashing frequency as a greater number of appliances are now made to be dishwasher proof and increased dishwasher ownership and technology will increase the use of machine. The annual reduction assumptions currently modelled for the 'Preferred' forecast is for a reduction of 0.002 uses/head/day.

In the absence of reliable data there has not been a forecast change in softener ownership or frequency in any of the models.

Outdoor activities

There is less reliable information on ownership and forecast assumptions for outdoor appliances than there is for internal uses. The Code for Sustainable Homes makes little attempt to quantify external use and as such PCC calculated by this means failed to take into account this usage. The following categories were modelled, based on the best available data for external use and consumption. The ownership levels have been set not to change for each of the forecasts for all of the external components.

The 'Low' forecast assumes frequency of use of this component to decrease annually by 0.001 uses/head/day. This considers the increased use of automatic car washers. The 'Preferred' forecast forecasts no change on the current frequency of use and the 'High' forecast assumes a very moderate increase of 0.0001 uses/head/day.

The frequency is set to remain unchanged on the 'Preferred' forecast with a 0.0001 uses/head/day decrease in the 'Low' forecast and a 0.0001 uses/head/day increase in the 'High' forecast. Forecasted frequency shows a moderate decrease in the 'Preferred' forecast of 0.002 with a moderate increase / decrease of 0.0001 for the 'High' /'Low' forecasts respectively.

The hosepipe frequency of use is forecasted to decrease by 0.001 uses/day per annum in the 'Low' forecast, is unchanged in the 'Preferred' forecast and is forecasted to show a moderate increase of 0.001 for the 'High' forecast.

The frequency of use for a watering can is assumed to increase by 0.0001 use/day per annum for the 'Preferred' and 'High' forecasts and show no change for the 'Low' forecast.

Miscellaneous

The frequency of miscellaneous occurrences are forecasted to decrease slightly in the 'Preferred' and 'Low' forecasts by 0.001 uses/head/day per annum but show a moderate increase in the 'High' forecast of 0.001 uses/head/day per annum.

5.5.2 Volume Assumptions

A decision was made to keep the volume assumptions constant over the forecast period. Base-year micro-components were selected so that ownership and frequency can switch from existing models to more efficient versions if required. The following Table 5.3 summarises the micro-components used in the model and a brief summary of where the volume assumptions were derived.

Micro-component	Volume (litres per use/event)	Evidence Base
Standard WC	9	The range in WC volumes range to >13l although MTP evidence suggests that 9l WC's have the greatest market penetration at the current time.
Low Flush WC	6	Low flush WC's also vary in volume. Since 2001 guidance has been that 6l is the maximum cistern volume permitted and as such is used as the assumed volume.
Bath	80	There are a range of bath volumes in the market place. With an increasing prevalence toward much larger than standard luxury baths. However, the Market Transformation Programme (MTP) report that a standard bath volume is 88l.
Power Shower	45	The volume a shower uses is a function of time spent and flow rate, both of which vary considerably. Evidence from the Code for Sustainable Homes and MTP suggest that a flow rate of 12l/min is standard and the Environment Agency suggests that average shower times are towards 10min. Therefore, for this reason and based on supporting literature research, VWE has chosen a 5min shower time. This equates to 45l/use at 9l/min.
Standard Shower	35	As per the power shower although flow rate has been reduced to 7l which equates to a volume figure of 35l/use.
Hand Basin	2	Assumes a 2 litre volume per operation which correlates to given standard water pressures across the VWE supply area to around 30 seconds run time per use. This figure is supported by Waterwise evidence.
Kitchen Tap	2	This figure is derived from average flow rates as per the hand basin.
Washing Machine	50	Volume per use of washing machines is a factor of their age and model type. The range is varied although an agreed figure of circa 50l is broadly agreed as standard.
Clothes Washing (by hand)	32	This figure assumes that each time clothes are washed by hand it takes one full sink of water (16l) to soap them and another full sink to rinse them.
Dishwasher	30	A 2004 study by Moran *et al*. identified dishwasher consumption to be on average 30l per use. Pending further data and future penetration of more efficient designs this figure has been used.
Dish washing (by hand)	16	Assumes that on average a washing-up bowl of water (circa 8l) and approx. 1 minute 'rinse time' circa 8l per washing event.

Water Softener	12.5	An internal review of the current market penetration of washer softeners, each with varying rates of regeneration, provided an average figure of 16l per person per regeneration.
Car Washing (Hosepipe)	300	Date varies widely although a Waterwise figure of 300l per event correlated closely with an internal monitoring trial and so has been used.
Car Washing (Bucket)	35	Assumes 3-4 buckets per wash at circa 10l/bucket supported by both an internal trial and Waterwise data.
Sprinkler	1000	Waterwise data suggesting that when used a sprinkler is used for approximately 60 minutes. At 10l per minute flow rate this correlated to circa 1000l per use.
Hosepipe (watering)	300	At a flow rate of 10l per minute an average ‘plant watering event’ of 30 minutes would consume circa 300l of water.
Watering Can	8	The average volume of a watering can in 8l. This volume assumes that the watering can is filled to capacity and the water contained therein used completely.
Miscellaneous	4	Assumes a 30 second -1 minute unaccounted for daily tap run at circa 6-8l/min.

Table 5.3 Micro-components and Associated Volume Assumptions

The assumed volumes will be continually reviewed and amendments will be made where required.

5.5.3 Results

The model assumptions have been based on a comprehensive customer survey, of sufficient size to ensure that it was fully representative of the Company. This provided detailed base year assumptions on water use that were then added to, based on best available data to benchmark the base year to the calculated unmeasured and measured PCC. The results for both metered and unmetered customers are shown on Figures 5.3 and 5.4. The chosen forecast is the ‘Preferred Forecast’ and this is shown in Figure 5.5.

The forecasts are calibrated back to the base year 2005/06. It should be noted that the forecasts are different from the actual PCC data found in the June Return because they have been produced using the latest population revisions. The figures generated by the micro-component model, presented below, are applied by VWE to its customer base (with varying occupancy rates). This produces per capita consumption forecasts that are slightly higher than the model. The Company considers that given the accuracy of the data used to benchmark the base year, the ‘Preferred’ forecast projects a sound basis from which to consider future demand. The ‘Low’ and ‘High’ forecasts are also considered solid outliers from which to base the considerable uncertainty about a forecast of this type.

- Measured PCC in the base year is 118.6 l/h/day, rising to circa 131.8 l/h/day by 2035 (Figure 5.3)
- Unmeasured PCC in the base year is 134.6 l/h/day, falling to as low as 130.1 l/h/day in 2019 but then rising again to 142.4 l/h/day by 2035 (Figure 5.4)

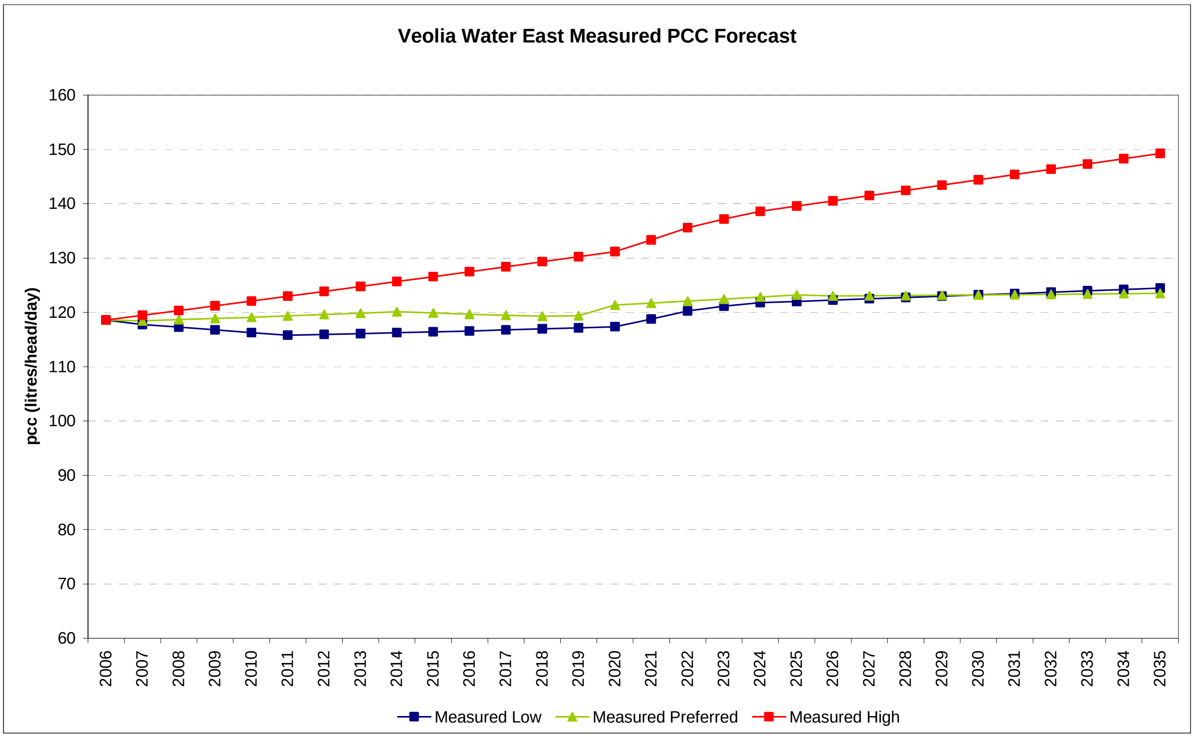


Figure 5.3 Measured PCC (mPCC) Forecast

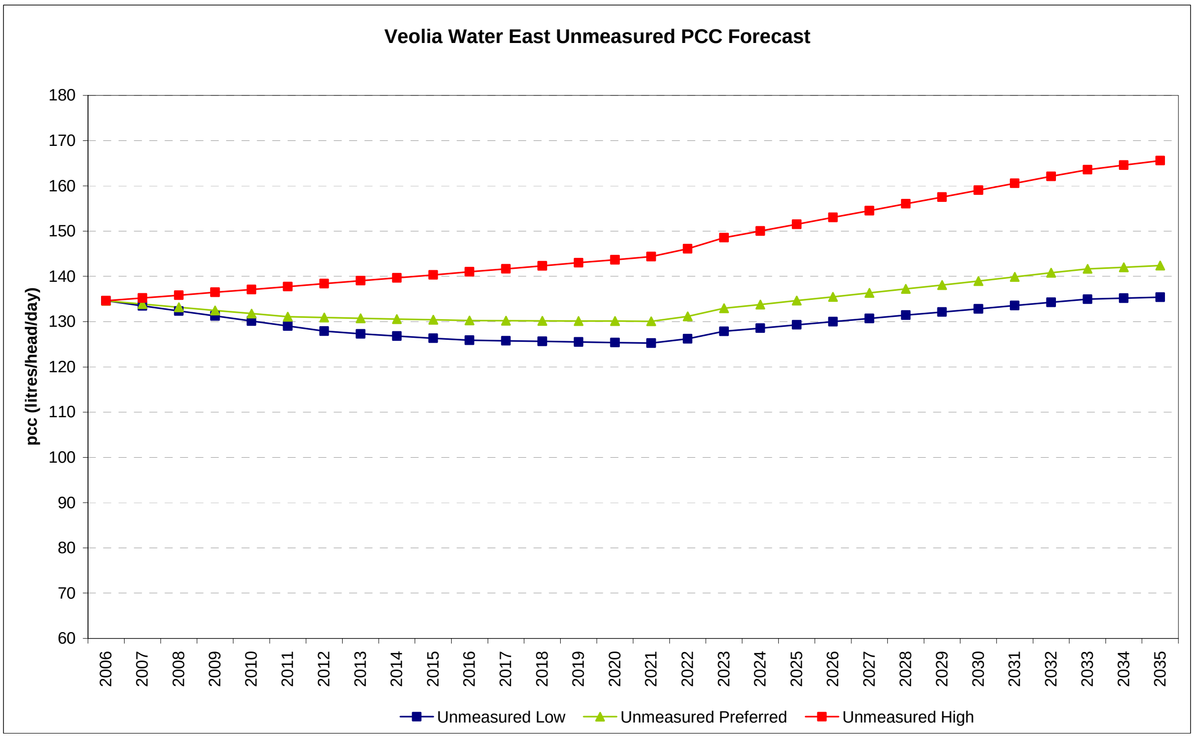


Figure 5.4 Unmeasured PCC (uPCC) Forecast

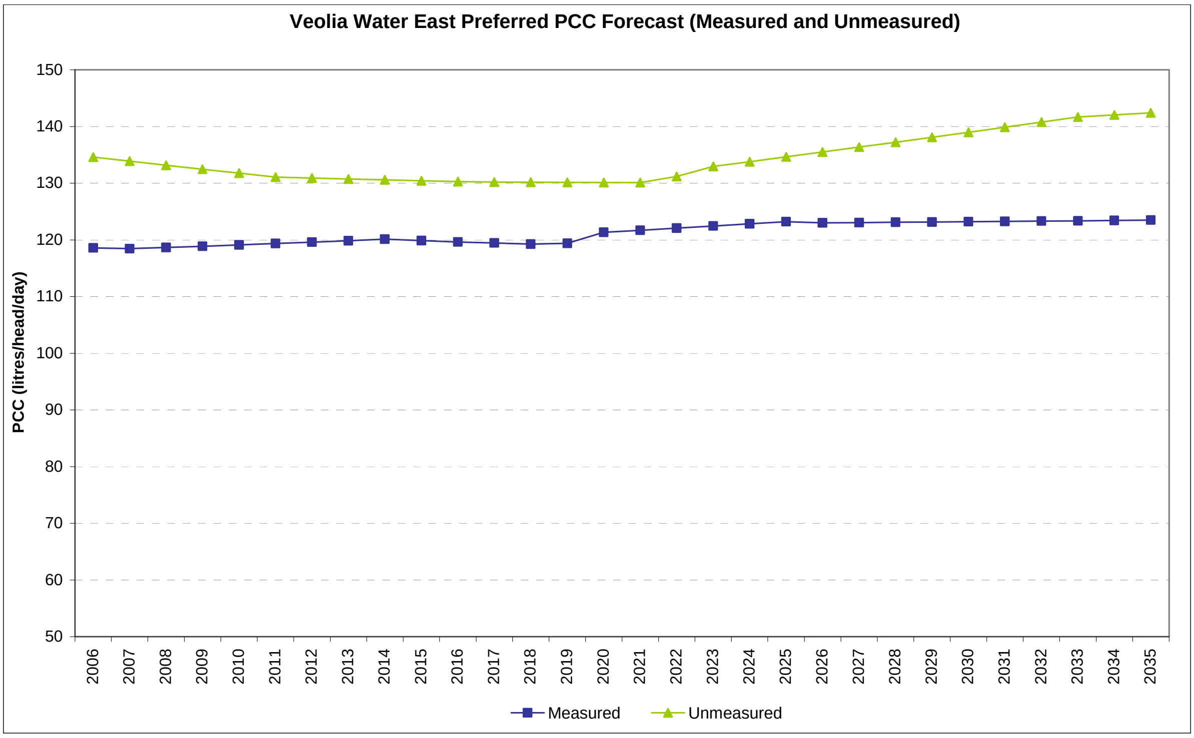


Figure 5.5 Company PCC Forecast (Measured and Unmeasured)

The increases in measured and unmeasured PCC shown in Figure 5.3 and Figure 5.4 are driven by a large increase in personal washing, and a much smaller increase in machine dish washing. Per capita consumption is forecast to rise despite a significant drop in consumption from toilet use and negligible changes within the remaining components. The dominant factor that is increasing the volume of water used in personal washing is the forecast uptake of power showers.

VWE has reviewed the Environment Agency's *Scenario Approach to Demand Forecasting, 2001* for information on likely uptake rates. The Company has assumed that ownership of power showers will reach 50% by 2021, a figure that lies between the Alpha and Beta forecasts. The customer survey indicates that approximately 19% of households contain a power shower and so VWE has forecast an increase of 2% per annum (measured and unmeasured) to reach this forecast.

The measured PCC of VWE customers is forecast to remain fairly steady at approximately 123 l/h/d until 2020-21 when it begins to increase driven by the uptake of power showers, reaching 131.4l/h/d by 2034/35. These figures are the product of integrating the micro-component model data with the actual measured consumption of VWE customers. Uptake of power showers is predicted to increase at a constant rate of 2% per annum from the start of the planning period but the micro-component data shows that its impact on PCC is masked by the declining volume in toilet use until 2020. However, once toilet use settles at approximately 29 l/h/d the continuing impact of power showers is revealed. Table 5.4 summarises the micro-component data as it is calculated in the micro-component model and Figure 5.6 illustrates these trends.

	Ownership Growth Factor	Frequency Growth Factor	Consumption (litres per head per day)			
Component		-	**2006**	**2014**	**2025**	**2034**
Toilet Standard	- 0.05	-	28.9	12.8	0.0	0.0
Toilet Dual Flush	0.05	- 0.01	8.6	19.5	29.6	29.6
Bath (standard size)	-	-	25.1	22.1	18.3	15.2
Power Shower (12 l/min for 6 mins)	0.02	-	10.3	19.9	34.0	47.6
Normal Shower (5 l/min for 6 mins)	- 0.01	-	21.7	20.6	18.0	9.4
Hand Basin		-	7.9	7.9	7.9	7.9
Kitchen Tap (cooking/cleaning/drinking)		-	6.9	6.9	6.9	6.9
Washing Machine		-	2.9	3.2	3.6	4.0
Clothes Washing (by hand)		-	0.3	0.1	0.0	0.0
Dishwasher (post 2001)	0.02	-	2.0	3.2	4.9	6.4
Dish washing (by hand)	-	-	3.2	2.9	2.6	2.3
Water Softener	-	-	0.1	0.1	0.1	0.1
Car washing (Hosepipe & Trigger nozzle)	-	-	0.1	0.0	0.0	0.0
Car washing (Bucket)	-	-	0.0	0.0	0.0	0.0
Sprinkler	-	-	0.3	0.0	0.0	0.0
Hosepipe (watering)	-	-	0.1	0.7	1.5	2.3
Watering Can	-	-	0.0	0.0	0.1	0.1
Miscellaneous Component	-	-	0.2	0.1	0.1	0.0
Total			**118.6**	**120.1**	**127.6**	**131.8**

Table 5.4 Micro-components of Measured PCC (Baseline Model)

VWE customer unmeasured PCC is forecast is forecast to decline from 141 l/h/d to a low of 135 l/h/d, after which it is forecast to increase steadily to 168 l/h/d by 2034. These figures are produced by reconciling the theoretical micro-component model data with data from the measured customer base. Again the increase in unmeasured PCC is driven by the uptake of power showers at a rate of 2% per annum. The impact of this counteracts and exceeds the positive impact on demand of switches to low/dual flush toilets and the forecast decline in bath consumption. The data summarised in Table 5.5 and illustrated in Figure 5.7 is taken from the micro-component model.

	Ownership Growth Factor	Frequency Growth Factor	Consumption (litres per person per day)			
Component		-	**2006**	**2014**	**2025**	**2034**
Toilet Standard	- 0.05	-	31.3	15.1	0.0	0.0
Toilet Dual Flush	0.05	- 0.01	6.2	16.0	26.8	26.8
Bath (standard size)	-	-	33.7	30.2	25.7	21.9
Power Shower (12 l/min for 6 mins)	0.02	-	7.9	16.4	29.0	41.2
Normal Shower (5 l/min for 6 mins)	- 0.01	-	20.7	19.6	17.9	15.0
Hand Basin		-	8.1	8.1	8.1	8.1
Kitchen Tap (cooking/cleaning/drinking)		-	6.6	6.6	6.6	6.6
Washing Machine		-	2.9	3.2	3.6	4.0
Clothes Washing (by hand)		-	0.5	0.2	0.0	0.0
Dishwasher (post 2001)	0.02	-	2.0	3.2	4.9	6.4
Dish washing (by hand)	-	-	4.0	3.7	3.4	3.1
Water Softener	-	-	0.2	0.2	0.2	0.2
Car washing (Hosepipe & Trigger nozzle)	-	-	0.8	0.2	0.0	0.0
Car washing (Bucket)	-	-	0.1	0.0	0.0	0.0
Sprinkler	-	-	2.5	0.0	0.0	0.0
Hosepipe (watering)	-	-	0.8	1.4	2.2	2.9
Watering Can	-	-	0.0	0.0	0.1	0.1
Miscellaneous Component	-	-	6.4	6.4	6.3	6.3
Total			**134.6**	**130.6**	**134.6**	**142.4**

Table 5.5 Micro-components of Unmeasured PCC (Baseline Model)

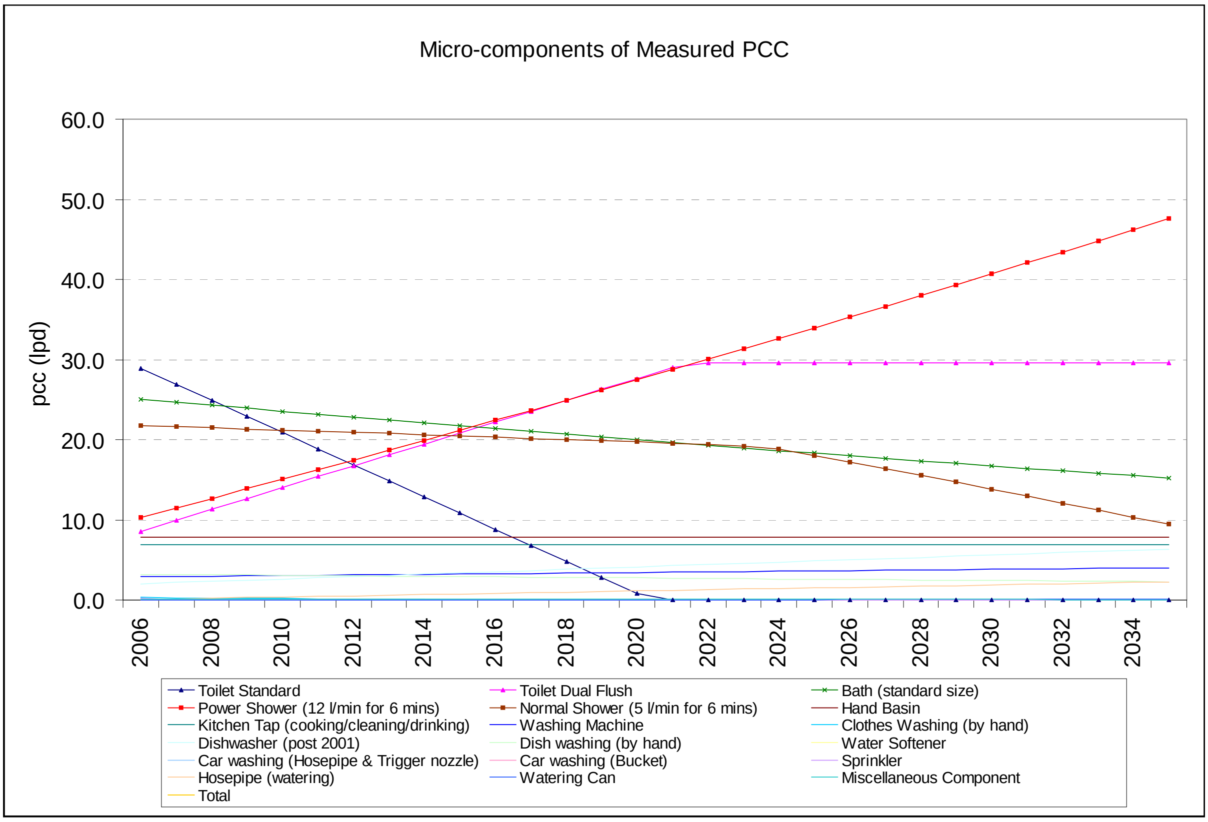


Figure 5.6 Micro-components of Measured PCC

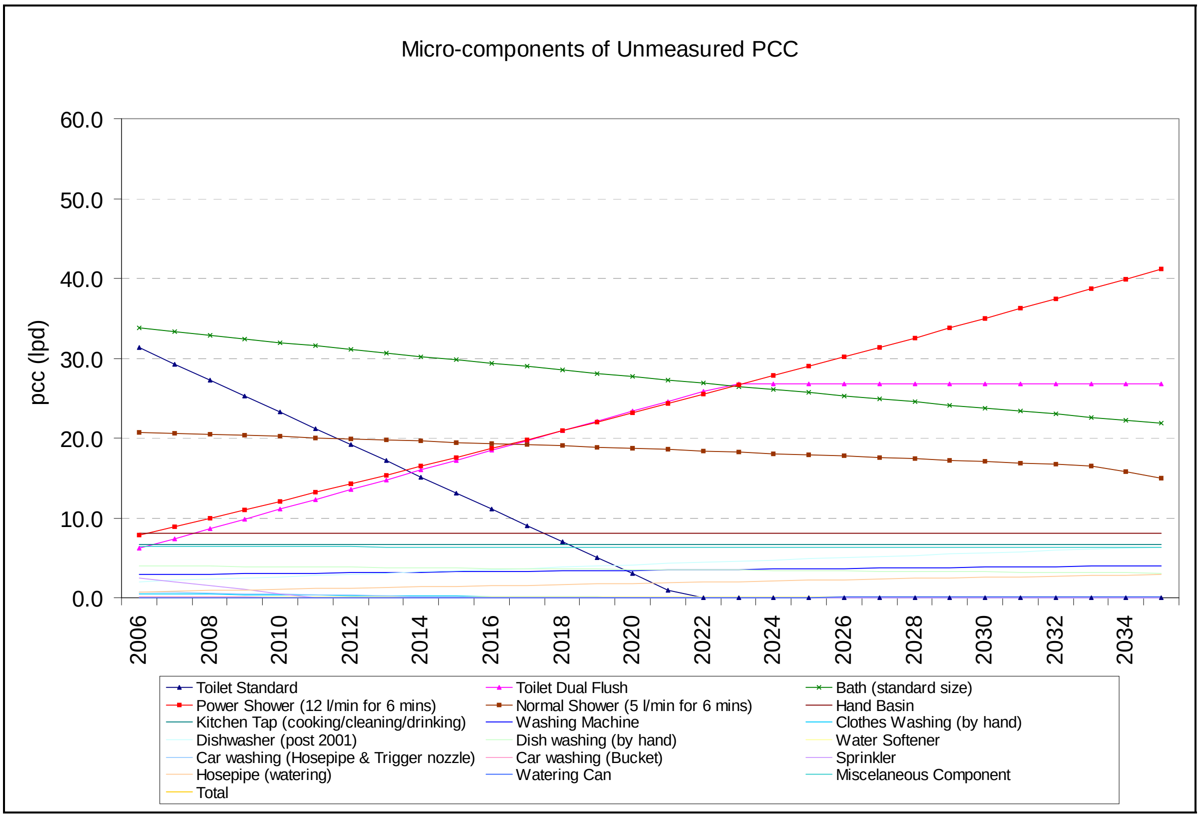


Figure 5.7 Micro-components of Unmeasured PCC

5.6 Non-Household Demand

The Company commissioned a report detailing commercial demand forecasts over a 30-year period to 2036/37, beyond the timeframe covered by this WRMP. These forecasts are provided for VWE as a whole and are also split by SIC (Standard Industrial Classification) of economic activities as follows:

- Services;
- Industry & Manufacturing;
- Detailed breakdown between all 17 WRMP8 SIC categories.

This proposed methodology follows industry best practice guidance as set out by UKWIR, and is similar to the methodology used by WS Atkins for PR04.

The forecasting methodology used is a two stage process. Firstly, regression analyses have been carried out to establish relationships between actual commercial demand and the relevant economic explanatory variables based on historic data for a period of 8 years from 1998/99 to 2005/06 inclusive. Secondly, these relationships have been extrapolated forward to forecast future demand over a 30-year period to 2036/37 based on long-term forecasts of economic growth for the Eastern region of the UK where VWE is located.

The most recent forecast data provided by Cambridge Econometrics for the East region of the UK does not take into account the downturn in the economy. VWE has estimated the potential impact that the downturn may have on the Gross Value Added (GVA) in the East of England. The Cambridge Econometrics data approximates to a long-term GVA growth of just under 3% per annum and a long-term employment growth of just under 1% per annum. The VWE revised forecast allows for a recession (-1% growth) followed by a period of no growth (0%) in AMP 4, followed by a gradual recovery reaching 3% by 2025.

Figure 5.8 shows the revised forecast of annual growth in GVA for the East region of the UK (where VWE is located) from 1999 until 2036/37. This includes both historic data from ONS and forecasts from Cambridge Econometrics. The chart reflects the significant year-to-year variability in actual growth to 2006 compared to the smoother profile of forecast growth from 2007. Figure 5.9 illustrates the decline in non-household demand in relation to the recession (downturn in GVA).

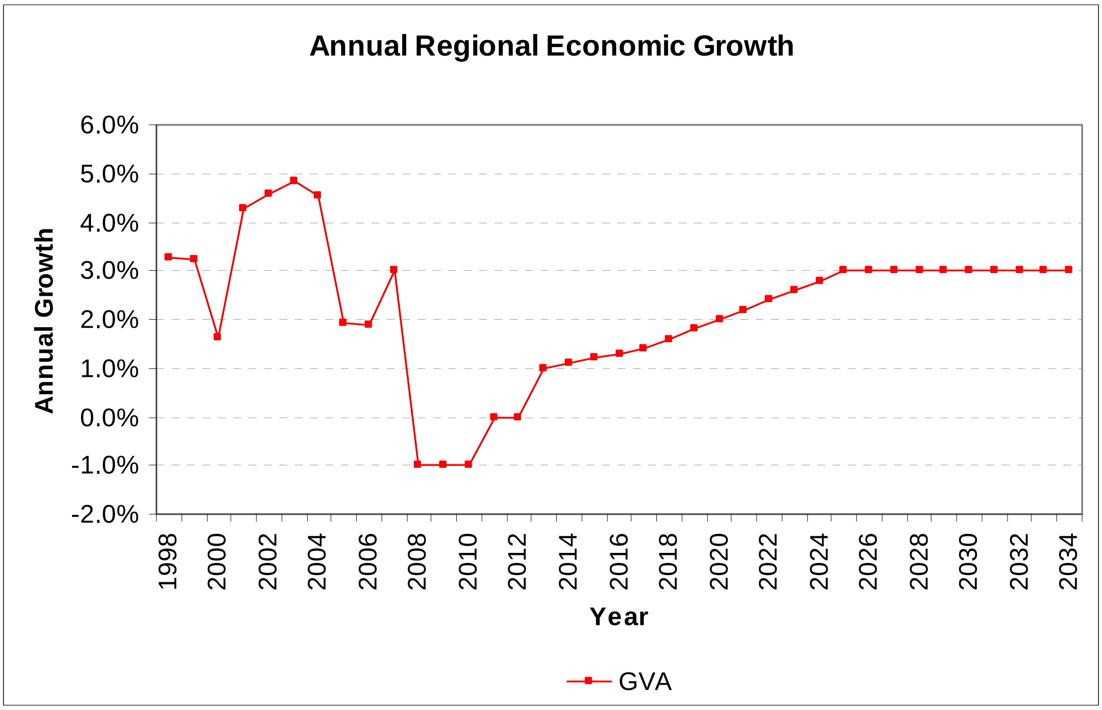


Figure 5.8 Regional Economic Growth Forecasts

The best relationships that have been established (based on the R-squared regression values) have then been used to forecast future demand through to 2036/37 based on forecasts for the underlying economic factors and shown on Figure 5.9.

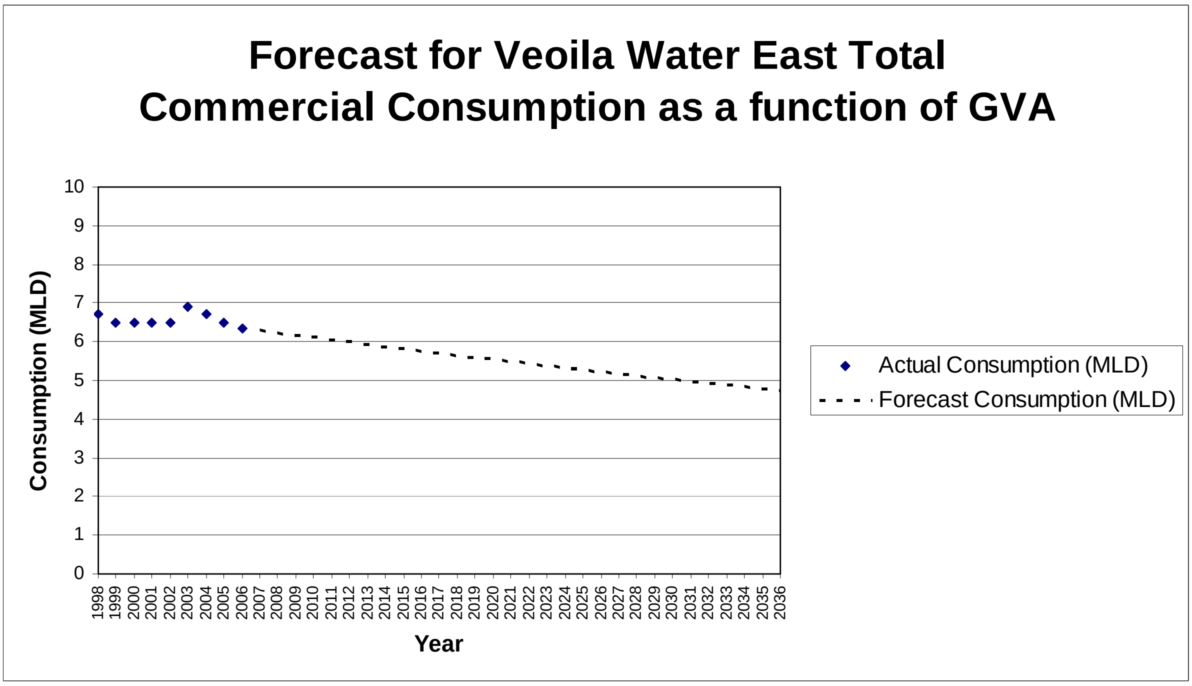


Figure 5.9 Commercial Demand Forecast

Incorporating the impact of the economic downturn within the studies of commercial water demand show that the forecast for total commercial consumption shows a reduction in demand of between 5% and 4% within AMP4, with the impact becoming less over time. This is in addition to the original studies that forecast an average reduction of 1.0% per annum. Within this, the forecast for Services consumption shows an initial reduction of just under 4% per annum moving to less than 1% by 2024. The forecast for Industry & Manufacturing consumption shows a much steeper reduction of -12% per annum early in AMP4 moving to -5.4% later in the planning period. The WRP8 table that supplements this report provides a breakdown of total non-household consumption by industry categories and their relevant SIC codes for the base year and forecast assumptions.

5.7 Water Efficiency and Metering – Reducing Demand

In 2007, 0.2 Ml/d were saved as a result of water efficiency measures. However the largest single effect on demand has resulted from increased meter penetration, which VWE has pursued with support from the Environment Agency, Ofwat and the Eastern CSC/Watervoice. The increases in meter penetration to 2002/03 and forecast to 2009/10 are summarised in Table 5.6.

	Extent of Metering	
	Household Properties	All Properties
1997/98 Actual	19.5 %	23.7 %
1999/00 Actual	33.2 %	37.5 %
2002/03 Actual	55.7%	58.8%
2004/06 Actual	61.1%	63.8%
2006/07 Actual	65.8%	67.8%
2009/10 forecast in 08	70.3%	72.1%

Table 5.6 Meter Penetration

The above figures are based on the average number of meters on-charge during the year. The future meter optant assumptions are based on experience of a large programme to date including accurately predicting optant uptake from the 2004 interim determination of prices through to 2006/07 actuals. From 2006/07, uptake is assumed to be 5% of unmeasured properties per annum.

The dramatic effect of increased meter penetration on reducing peak (and therefore dry year average) demand can be seen in the Figure 5.10 which shows the differences in Distribution Input for 1995/96 and 2000/01/02/03/04. Metering is not just useful for managing demand but it also allows us to better understand water consumption patterns, identify leakage sooner and thus minimise waste. Therefore extensive metering ensures that we can distinguish between consumption and leakage so that out reporting is accurate. These significant water savings have been achieved after the installation of standard water meters. VWE has considered the increase in savings that could be possible by switching to smart meters. However, given the savings that have already been made, the Company expects that only limited additional savings may be achieved by switching to smart meters for the rest of the metering programme.

Going forward, VWE wants to move towards 100% metering as soon as possible as a matter of policy rather than being driven by a supply-demand driver. Our proposed metering programme is the main element of our new Water Efficiency Strategy which we aim to implement to support our customers in their continuous efforts to minimise their waste of water.

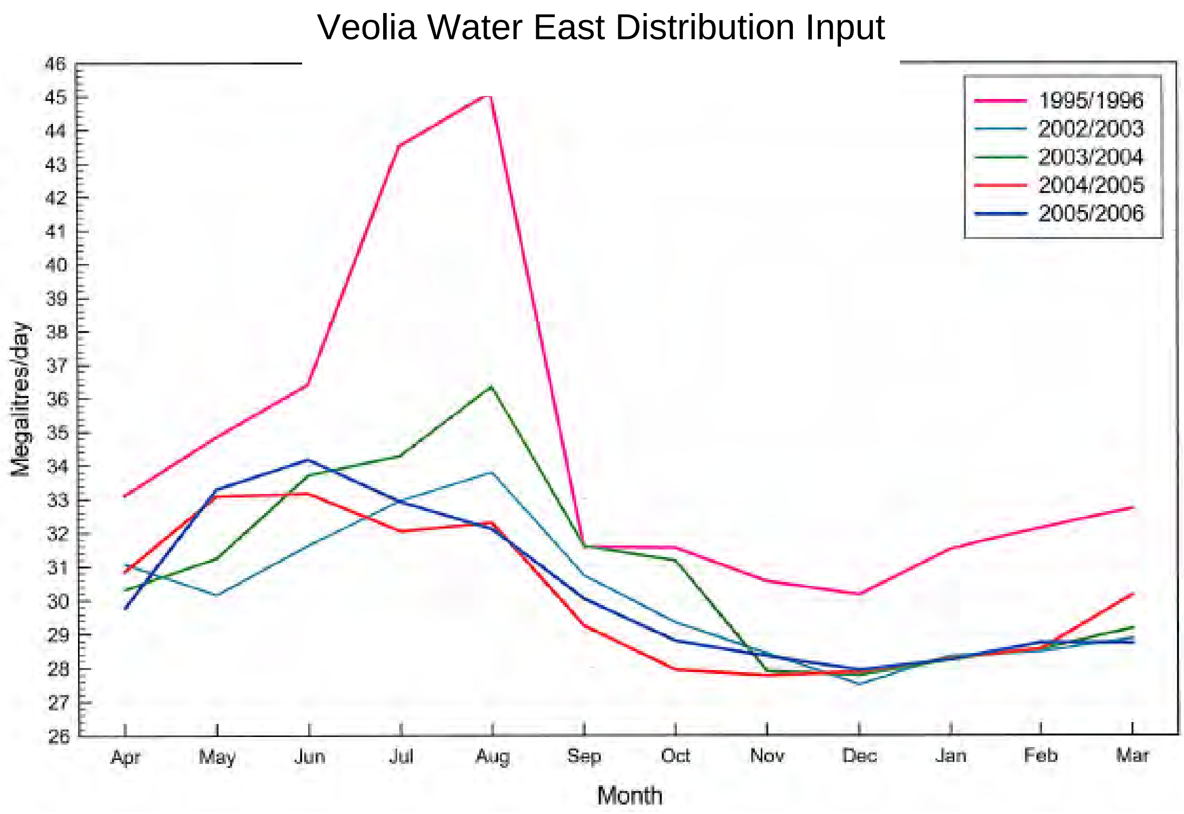


Figure 5.10 Variation in Distribution Input Since 1995

5.7.1 Water Efficiency Strategy

Our water efficiency strategy is presented in Appendix B. The water efficiency strategy will be reviewed and updated as necessary to reflect changes in our goals and aspirations and Ofwat's new water efficiency targets.

5.8 Leakage Control to Reduce Demand

As mentioned in section 5.1, loss of water put into supply as a result of leakage contributes to demand. Therefore, monitoring and controlling leakage is integral to demand management. The Company's network of just under 1,000 km of mains is highly developed and integrated and VWE reports one of the lowest levels of leakage in the industry at 70.3 litre/property/day which is approximately half of the industry average.

A continuous telemetry leakage monitor has operated since 1995 recording the minimum night flow (MNF) in l/p/h. The annual total leakage figures are derived from MNF data and are not dependent on unmeasured consumption monitors. The allocation of leakage between distribution losses and supply pipe losses is based on judgement. The allocation has proved stable during a massive increase in meter penetration. The stability of the water balance components demonstrates that the supply pipe loss assumption is reasonable. Therefore, increased metering not only reduces demand through lowering consumption but it also reduces marginally reduces leakage as a result of supply pipe leakage checks when a meter is fitted.

Even though a relatively low average zone pressure (AZP) exists naturally due to the flat low lying topography the percentage of properties subject to close control pressure reduction is currently at 93%. We base current leakage policies, which are included within the baseline demand forecast, around close control of pressures and district metering telemetry where practicable.

5.9 Conclusion of Demand

In 2006/07, metered occupancy was 2.00 persons per property and unmetered 2.77 persons per property.

The forecasts show that the population served by VWE is set to increase over the next 25 years and beyond. The forecast from 2006/07 projects an increase of 17% more people (26,928) by 2035. The household forecast indicates a housing stock increase of 20%, or 13,379 dwellings.

At the same time household demand will also increase by 2035. Breaking down the domestic demand into micro-components, generally metered customers have a lower frequency of use and water volume used for the various components considered. According to the micro-component model measured PCC in 2006/07 year is 118.6 l/person/day, rising to around 131.8 l/person/day by 2035. Unmeasured PCC in the base year is 134.6 l/person/day, falling to as low as 130.1 l/person/day in 2019 but then rising again to 142.4 l/person/day by 2035. When the modelled PCC figures are applied to the VWE customer base the output is slightly higher.

The impact of the economic downturn in addition to the longer term decline in industrial use, may result in a reduction in commercial demand of 1.4Ml/d by 2034/35. The decline is expected to be most significant within AMP 5 as a period of economic recovery is expected to follow (see Figure 5.8). Within the forecast, the greatest reductions are expected to be in the Industry & Manufacturing sector, with smaller reductions forecast for the Services sector.

In 2007, 0.2 Ml/d was saved as a result of water efficiency measures. However the largest single effect on demand has resulted from increased meter penetration. VWE aims to move towards 100% metering by 2015 and the benefits of this have been included within the baseline demand forecast for the final WRMP. VWE reports one of the lowest levels of leakage in the industry at 5.05 Ml/d, therefore continued monitoring and control of leakage is integral to the demand management focus of the strategy.

6 Climate Change

6.1 Supply

6.1.1 Surface water sources

AWS made an assessment of possible impacts of climate change on VARD and has concluded that for the median change, a total reduction of 1.42 Ml/d at average and peak could be impacted by climate change by 2035. 50% (0.71 Ml/d) of this value has been assigned to the VWE share of this water by 2035, reducing the previous assessed DO of 9.4 to 8.69 Ml/d.

6.1.2 Groundwater

The impact of climate change on groundwater is a complex issue and does not lend itself to easy solution. Of critical importance is the amount of effective rainfall that occurs over the recharge period from September to April. Generally, summer rainfall does not contribute significant volumes as recharge, thus drier summers have little impact on recharge volumes.

As most climate models indicate wetter winters and drier summers then there should be more winter recharge, thus more groundwater availability than at present. However, variability is also a significant feature of climate change, and not all winters will be higher than average, and intense summer storms may provide significant summer recharge. The increase in variability will make it more likely that an extended sequence of dry winters could occur.

All the VWE Chalk sources are from a semi to fully confined aquifer, and thus direct recharge impacts are small, as is any impact of abstraction on surface flows. From experience, the VWE groundwater sources are known to be robust to one dry winter (dry being 75-80% of long term average rainfall). Two such dry winters will result in even lower groundwater levels and reduced river flows. This is what the current drought DO scenario is based on. Three dry winters has not been experienced within the available records for groundwater levels, but has been recorded in rainfall terms in the 1890's. The impact of such a rainfall sequence on groundwater levels is unknown, but will result in lower than previously observed low river flows.

Recovery of groundwater levels following a drought is totally dependant on the volume of rainfall during the recharge period. Historically, periods of very low groundwater levels have recovered to above average levels within one year (e.g. 1992, 1998), thus re-setting levels for the next summer recession period, but these have been above average rainfall events. With average winter rainfall, it may take several years for water levels to fully recover.

Perturbing the available historical rainfall/recharge period will not simulate this extended period of below average winter rainfalls, or take into account more peaky rainfall and thus recharge in summer months. Thus the only way to do this is to generate a hypothetical rainfall sequence from a global climate model and use the output as input for an existing groundwater model. Only one groundwater model exists covering the VWE sources, and it is not considered that this is sufficiently robust to look at such impacts. Even if such a model were available, converting modelled changes in water level to changes in DO is again a complicated issue. The groundwater model would deliver a water level that is below the minimum observed in the historic record. How this translates to a change in pumping water level and thus borehole outputs is unknown. None of the current models contain source output models, and even if they did, there would be no valid calibration for such models below current lowest levels.

In the case of the VWE groundwater sources, a risk based approach has been adopted by comparing current water levels, current Deepest Advisable Pumping Water Level (DAPWL) and anticipated changes in groundwater levels. Such changes are based on work in the Chalk elsewhere[1], and have been deemed to be up to a maximum of 5 metres below current water levels for a similar source output.

Modelling work has been undertaken on behalf of Southern Water, South East Water and Veolia Water South East to examine the impact of climate change on water levels in the chalk in south east Kent[1]. The results indicate that the water level may fall to 7m below historic recorded lows in a high impact scenario, or 1.8m in the medium impact scenario. Water levels may rise in the low impact scenarios rainfall over current averages.

Even applying the maximum change (the high impact scenario) to the Tendring Chalk groundwater sources, does not reduce pumping water levels to the deepest advisable water level (DAPWL). In all the VWE Chalk boreholes, the DAPWL has been derived as 'half saturated aquifer thickness', chosen in the absence of any other information from observed source behaviour or known flow horizons. In all cases, the DAPWL is significantly greater than 5 metres from the lowest observed pumping water levels to date. This indicates that these boreholes are unlikely to be significantly impacted by additional declines in water levels.

Combined source capacity significantly exceeds treatment works capability, thus changes to individual source yields due to any climate change impact are very unlikely to result in a reduction of Deployable Output. However, we consider it prudent to allow a small reduction in DO of 1% to reflect the impact of climate change on the source outputs and the wider aquifer system. This equates to approximately 0.31Ml/d at average and 0.39Ml/d at peak. However, even this appears unduly pessimistic, especially at average, as declines in output from an individual source could be managed by increasing the take from another source less impacted and still be within current licence totals. At peak capability, the sum of the individual boreholes exceeds that of the treatment works capability by some 22Ml/d. However, these values have been used in the climate change analysis.

The only issue with such an approach, is that the Environment Agency may find that the impacts of climate change on the environment are so severe that they would either wish VWE to reduce abstraction, or for additional river support to be made. No such comments have been received from the Environment Agency.

In summary, it has been calculated that by 2035, the potential impact on VWE sources will be a reduction of 1.02Ml/d at average and 1.11Ml/d at peak. These numbers have been applied linearly throughout the 25-year period (0.04Ml/d decline in resource per year), accounting for a declining trend in available DO and hence WAFU.

[1] Climate Change Impact Assessment Final Report, Atkins June 2008

6.2 Demand

The impact of climate change on demand and hence on the supply-demand balance, has been assessed within headroom, using the 1998 UKWIR Headroom Methodology. VWE has examined the regional estimates of climate change impacts on domestic demand within *Climate Change and the Demand for Water* (Downing et al., 2003) and taken this into account when considering the impact of climate change on domestic demand in Tendring Hundred. The literature suggests that climate change may change demand by approximately 3% by the mid 2020s (Mid-High scenario). This is classified as a low impact under the UKWIR/EA headroom methodology, and has been scored accordingly in the point scoring headroom method. This method is considered appropriate for VWE as a result of the Company's supply-demand surplus. The point scoring method suggests that climate change and demand contributes 0.4Ml/d to headroom.

6.3 Impact on Supply-Demand Balance

Given that the Company has a resource surplus within the lifetime of the Plan, climate change and demand has no effect on the supply-demand balance.

6.4 Carbon Footprint

The water industry is a substantial user of energy in water treatment but particularly in pumping water to our customers. Energy consumption is closely linked with the total amount of water delivered and therefore our carbon footprint, assessed in tonnes of carbon dioxide emissions, follows a similar pattern to our forecast of distribution input within the final WRMP. This is shown in Figure 6.1 below.

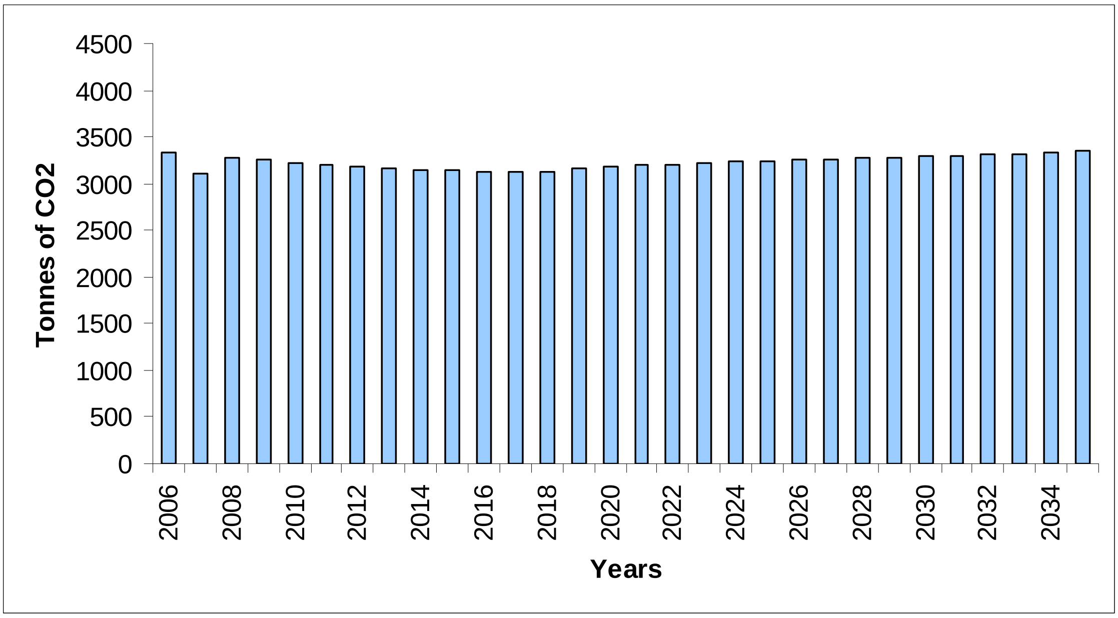


Figure 6.1 Forecast of Carbon Footprint

7 Target Headroom

Headroom is the buffer that is maintained between supply (minus outage and allowing for imports and exports) and demand to cater for uncertainties in the overall supply-demand balance.

Target headroom is defined as the minimum buffer introduced into the annual supply-demand balance to ensure that the chosen level of service can be achieved.

Available headroom is the actual difference between Water Available For Use (WAFU) and demand at any given point in time. Where available headroom falls below target headroom a supply-demand balance deficit is introduced and as a result the level of service for water resources cannot be met.

The headroom assessment has been carried out in accordance with the WR/13 A Practical Method for Converting Uncertainty into Headroom UKWIR 1998. As part of this headroom assessment the part of the calculation extended the analysis to 2036/37, which is beyond the planning period for this WRMP.

S6 Accuracy of supply-side data
S8 Uncertainty of climate change on yield
D1 Accuracy of sub-component data
D2 Demand forecast variation
D3 Uncertainty of climate change on demand

The five headroom components shown above have been considered within the target headroom assessment.

7.1 Pollution Risk for Headroom Input

The groundwater resource utilised is the confined Cretaceous Chalk aquifer which is overlain by Tertiary deposits including London Clay. The clay is an aquiVARD which isolates the aquifer from any potentially polluting land use and activities within the groundwater catchments. The pollution risks for groundwater resources are, therefore, very low.

The VARD surface water source is an impoundment reservoir drawing water from the River Colne. The Colne catchment is monitored and the VARDC has engaged in reservoir catchment stakeholder communication for a number of years. This involves Land owners and managers being aware of the proximity of the drinking water supply reservoir and land use activities being monitored. A visual catchment survey was done in 2006 and the data were transcribed to Geographical Information Systems (GIS) for input to a Drinking Water Safety Plan. The resultant pollution risk assessment of the reservoir is low.

7.2 Results

The results of the headroom analysis are summarised for selected years in Table 7.1

Target Headroom		2007	2012	2017	2022	2027	2032	2037
Company Average (Baseline)	%	3.0	3.3	3.7	4.0	4.3	4.6	5.0
	Ml/d	1.3	1.3	1.4	1.5	1.6	1.7	1.9
Company Average (Final Plan)	%	3.0	3.3	3.7	4.0	4.3	4.6	5.0
	Ml/d	1.3	1.3	1.4	1.5	1.7	1.8	1.9

Table 7.1 Target Headroom Results

The target headroom varies from 3.0% to 5.0% of WAFU from 2006/07 to 2036/37. This is very similar to the target headroom figures in 2004 as the circumstances have remained the same.

8 Baseline Supply-Demand Balance

The baseline DO of the Company's groundwater sources is 32Ml/d, plus 10.24Ml/d from surface water, giving a total of 42.24 Ml/d, which includes 0.5Ml/d losses from the VHXI WTW. The revised 2007 DO value increases by 0.45 Ml/d due to a revision in the values of these losses from 0.5 Ml/d to 0.05 Ml/d, resulting in a new DO of 42.69 Ml/d at average and 56.35 Ml/d at peak, from 2007 onwards. This then reduces to 40.69 Ml/d in 2008 at average due to the license change at VLAT. Climate change is forecast to reduce DO by 0.04Ml/d each year, a total loss of 1Ml/d by 2034/35.

The baseline Water Available For Use (WAFU) of VWE sources is 41.53 Ml/d after deducting 0.66 Ml/d for outage, and 0.05Ml/d for process losses (treatment works operational use). WAFU in future years in then adjusted to take into account known changes in the DO and outage.

Headroom has only changed marginally since the calculation made in the 2004 WRP. Figure 8.1 shows the dry year annual average headroom with the available headroom maintaining a positive difference above the target headroom indicating that the Company's current level of service can continue until 2035. Therefore, based on existing WAFU and present forecasts of demand there are no supply-demand balance drivers for substantial expenditure on resource development needed before 2034/35. This can be seen on Figures 8.2 and 8.3 at both average and peak scenarios.

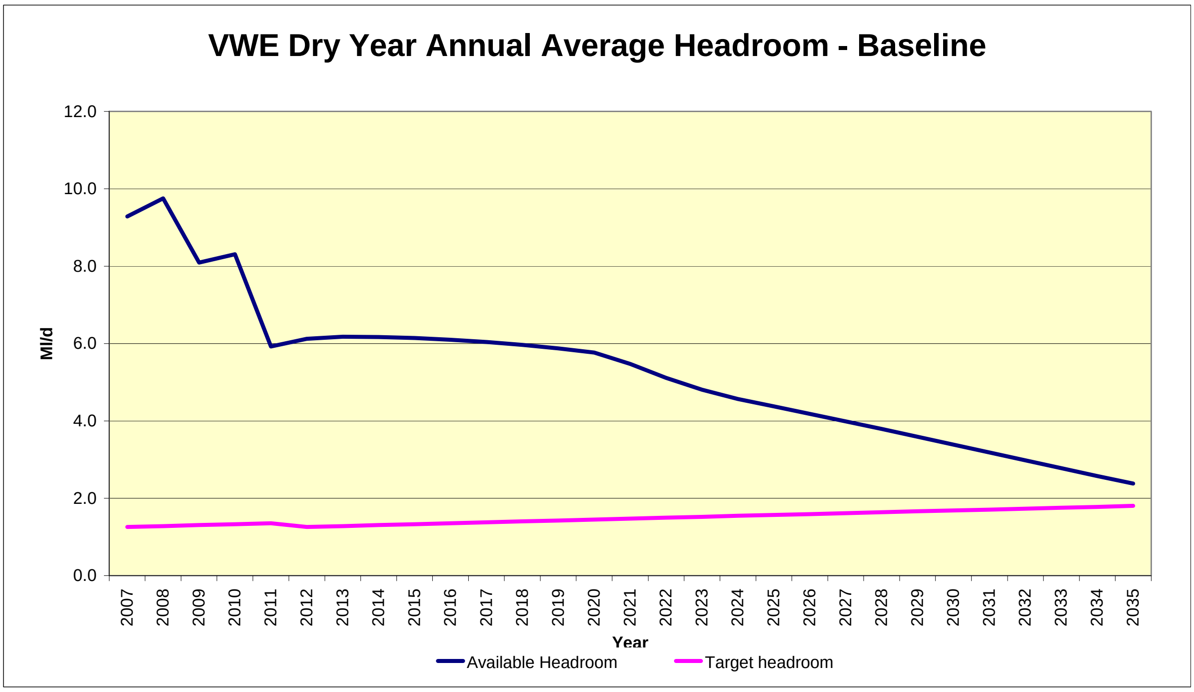


Figure 8.1 Headroom Analysis

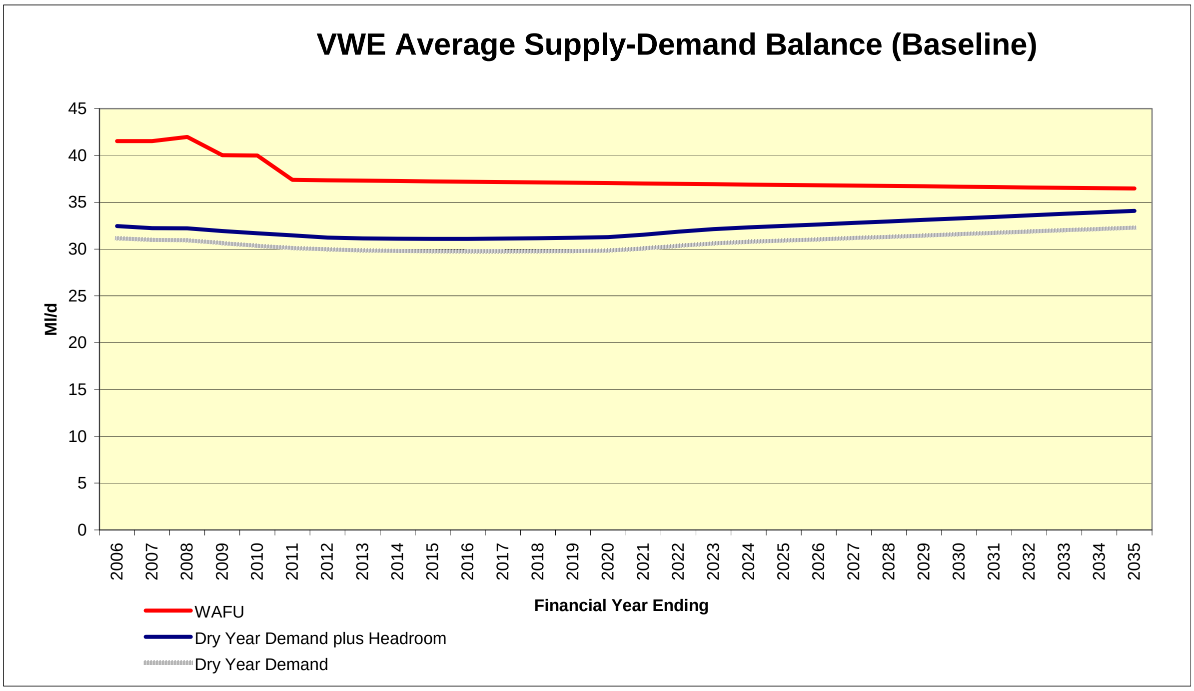


Figure 8.2 Baseline Average Supply-Demand Balance

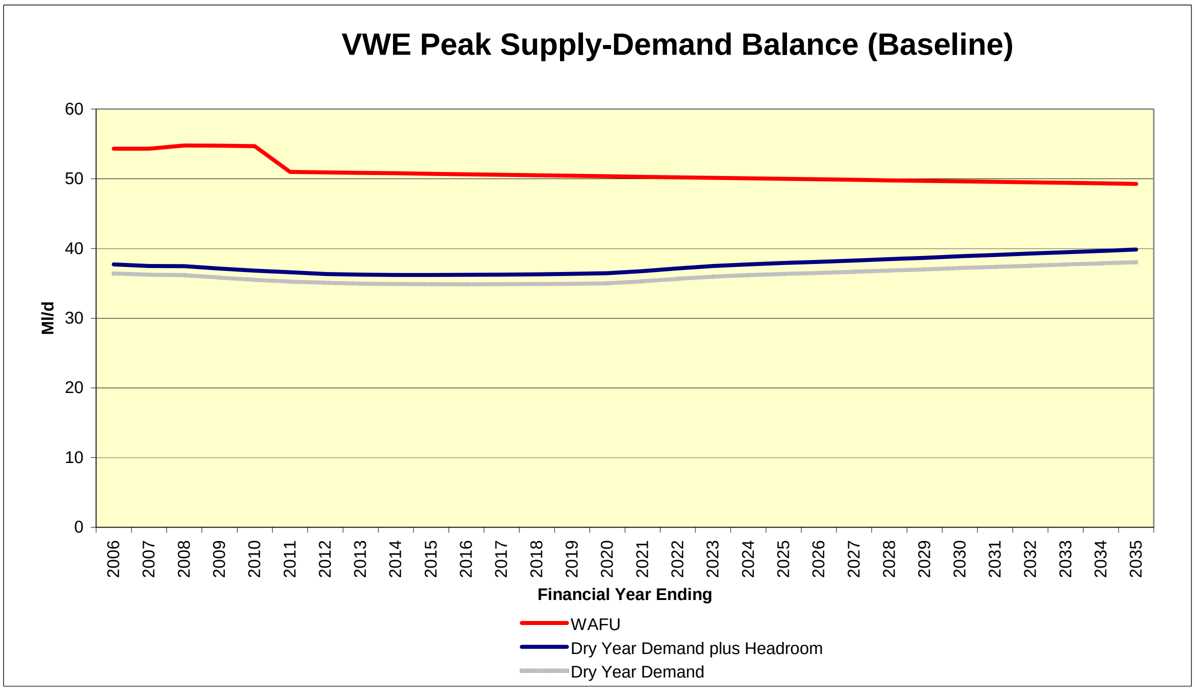


Figure 8.3 Baseline Peak Supply-Demand Balance

9 Final Water Resources Strategy

The Final Water Resources Strategy details the Company's strategy from 2010 until 2035, reflecting ongoing work that has been carried out for this WRMP. The strategy is based on VWE policies for reducing demand and optimising the use of the existing water resource base.

9.1 Overall Water Resource Strategy

Despite operating in the driest part of the driest region in the UK, VWE has progressively developed sources and managed demand to maintain a positive balance of supply over demand. The Company has never had to resort to formal restrictions in over 40 years and through several drought periods. In line with customers' expectations, the chosen level of service is for no formal restrictions on water use.

The updated supply and demand forecasts for this final Plan show that there is no supply-demand deficit driving substantial expenditure on resource development before 2034/35. However, despite the apparent satisfactory margin between supply and demand, the following policies are considered necessary, some of which do require some expenditure, in the short, medium and long term in order to improve the Company's operational efficiency and retain flexibility to meet potential unplanned challenges. The company's baseline strategy for maintaining an adequate balance of supply over demand is summarised as follows:-

- Further acceleration of metering from 2010 onwards through encouraging further optants or compulsory metering to achieve metering of greater than 90% domestic properties by 2015 having regard to impact of vulnerable groups to ensure water remains affordable.
- Maintain leakage below the economic level of leakage (ELL).
- Continued customer water efficiency from awareness of environmental/sustainability issues and gradual increases in water re-use, other conservation measures and improved appliance efficiency through our new Water Efficiency Strategy.
- Retention of the abstraction license for VGBE so that at the appropriate time seek to increase supply by re-use of the sands/gravel source based on reverse osmosis treatment for drought contingency or demand step change response.
- For longer term consideration continue to progress with the promotion of increased yield of the Ely-Ouse-Essex transfer in conjunction with Abberton raising by Essex and Suffolk Water.
- In conjunction with Anglian Water, benefit from an increase in deployable output within existing licence limits by 2025 following the construction of additional surface storage at VARD.

9.2 Future Investigations

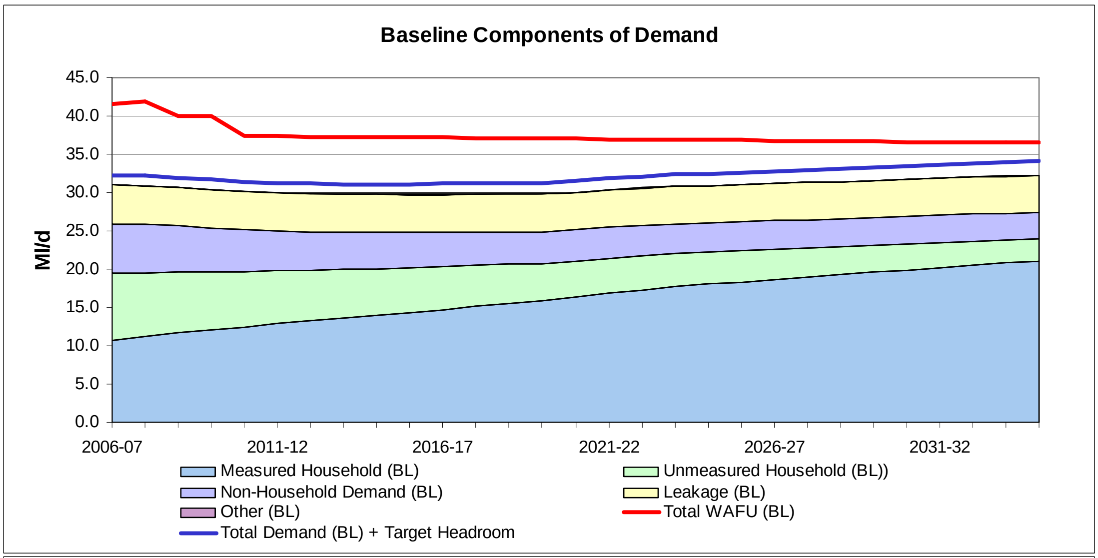
The results of the 2007 VWE customer survey will be analysed further to produce more robust micro-component analyses. In particular a demographic breakdown of varying levels of water consumption amongst VWE customers will be developed. The volumes and frequency of usage of modern water appliances will also be explored to build on existing micro-component figures.

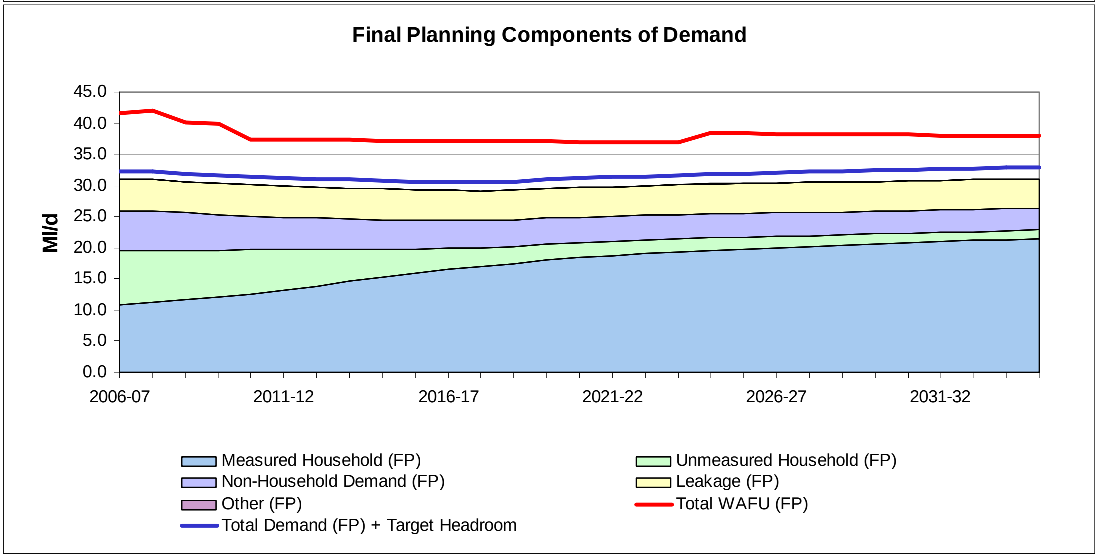
VWE plans to prepare for the challenges and further studies that the new River Basin Management Plans may require as part of the Water Framework Directive and as the Company moves closer towards the 2015 deadline for the completion of the first cycle.

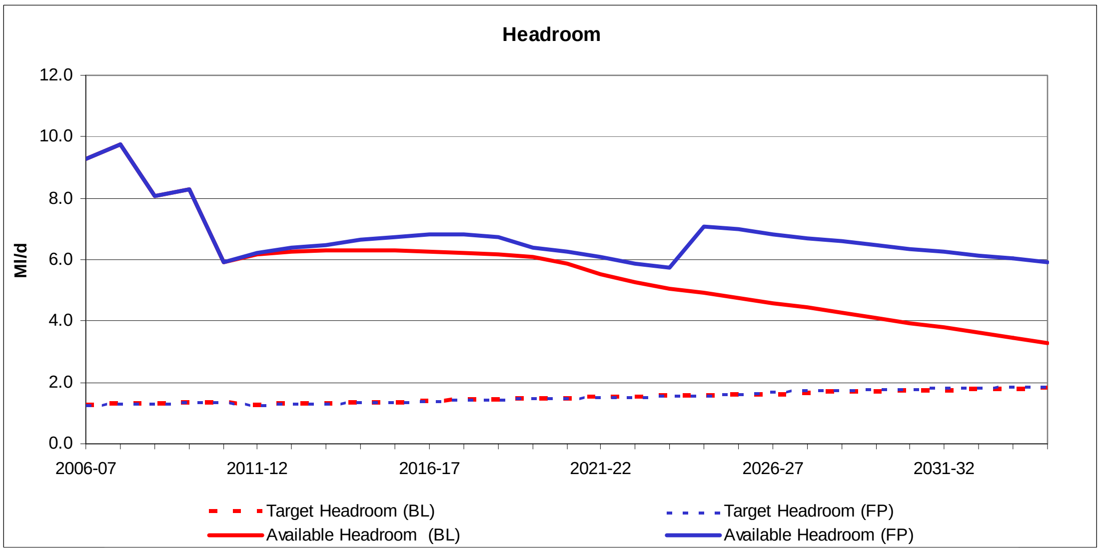
In view of the positive cost-benefit demonstrated for either compulsory metering or an accelerated metering programme we have sought stakeholders views on all the alternative approaches, including the proactive Optant metering programme. VWE will take into account concerns that have been raised that metering may impact on vulnerable customers and therefore it is important that alternative charging models are evaluated to ensure water remains affordable for all. Work on this issue will continue by considering best practice throughout the industry.

10 Summary Tables

Summary graphs relating to the Environment Agency supply-demand balance tables that were completed as part of the final WRMP are located at the end of this document. The figures illustrate the baseline and final planning balances for the dry year annual average scenario as well as the results of the headroom assessments. The detailed versions of the tables are available on the Company website.


Baseline Components of Demand
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Ml/d
2006-07
2011-12
2016-17
2021-22
2026-27
2031-32
Measured Household (BL)
Unmeasured Household (BL))
Non-Household Demand (BL)
Leakage (BL)
Other (BL)
Total WAFU (BL)
Total Demand (BL) + Target Headroom


Final Planning Components of Demand
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Ml/d
2006-07
2011-12
2016-17
2021-22
2026-27
2031-32
Measured Household (FP)
Unmeasured Household (FP)
Non-Household Demand (FP)
Leakage (FP)
Other (FP)
Total WAFU (FP)
Total Demand (FP) + Target Headroom


Headroom
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Ml/d
2006-07
2011-12
2016-17
2021-22
2026-27
2031-32
Target Headroom (BL)
Target Headroom (FP)
Available Headroom (BL)
Available Headroom (FP)

Appendix A - Glossary

Abstraction	The removal of water from any source, either permanently or temporarily.
Abstraction licence	The authorisation granted by the Environment Agency to allow the removal of water from a source.
ACORN	A classification of Residential Neighbourhoods (ACORN) is a socio-demographic classification of neighbourhoods published by CACI Ltd. The system is based on the assumption that people who live in similar neighbourhoods are likely to have similar behavioural and consumption habits.
Alleviation of Low Flow (ALF)	Predecessor to the Restoring Sustainable Abstraction (RSA). Programme looking at the impact of public water supply abstraction on low river flows.
Allowable Outage	The outage (calculated from legitimate unplanned and planned events) which affects the water available for use. An outage allowance may be made for such outages.
AMP4	Asset Management Plan for period 2005-2010.
Annual average	The total demand in a year, divided by the number of days in the year.
Annual billing run	Sending out yearly bills for the measured and unmeasured consumption.
Aquifer	A geological formation that can store and transmit groundwater in significant quantities.
Available headroom	The difference (ML/d or percent) between water available for use (WAFU) (including imported water,) and demand at any given point in time.
Average Day Peak Week (ADPW)	One seventh of total demand in the peak week in any 12-month demand period.

Baseline Forecast	A demand forecast which reflects the Company's current demand management policy but which should assume the swiftest possible achievement of the current agreed leakage target during the forecast duration, as well as implementation of the Company water efficiency plan.
Base Year	The year in which calculations commence and with which other years are compared.
Catchment Abstraction Management Strategy (CAMS)	Environment Agency strategy which sets out the new licensing policy for catchments throughout England and Wales.
Capital investment	Capital Investment refers either to money used by a business to purchase fixed assets (for example land or buildings) or to money invested in a business with the understanding that it will be used to purchase such fixed assets, rather than used to cover the business' operating expenses.
Catchment	An area of land from which precipitation and groundwater will collect and contribute to the flow of a specific river.
Catchment Protection	Policies and actions to minimise pollution within the catchment.
Carbon Footprint	The amount of carbon dioxide (tonnes) emitted as a result of actions and processes undertaken by the Company.
Change of Ownership Metering	Compulsive metering of consumption following a change of hands providing there isn't already a meter at the property.
Communication pipe	The part of a service pipe which is vested in the water supplier.
Cost-benefit	The cost of a scheme compared with all aspects of benefits that are derived from it including both direct and indirect, financial and non-financial and social and environmental benefits. The outputs of a scheme are often compared with the willingness of customers to pay for the outputs.
Consumption Monitor	A sample of properties whose consumption is monitored in order to provide information on the consumption and behaviour of properties served by a company. Applied to household and non-household customers.

Critical Period	The period of time during which the customer experiences the greatest risk of loss of supply.
Crystal ball ®	Commercially available software which undertakes complex statistical analysis such as Monte Carlo analysis.
Demand Management	An approach to reducing the consumption of water by reducing demand for it. Demand management includes educating people about how to save water, promoting the use of household and industrial appliances that use water more economically, such as dual-flush toilets, and putting a price on water that reminds people of its true value.
Deployable Output	The output of a commissioned source or group of sources or of a bulk supply as constrained by (if applicable): • Environment • Licence, if applicable • Pumping plant and/or well/aquifer properties • Raw water mains and/or aquifers • Transfer and/or output main • Treatment • Water Quality
Distribution Input (DI)	The amount of treated water entering the distribution system at the point of production.
Distribution losses	Total leakage on the distribution system minus supply pipe leakage and is made up of losses on trunk mains, service reservoirs, distribution mains and communication pipes.
Distribution System Operational Use (DSOU)	Water knowingly used by a company to meet its statutory obligations particularly those relating to water quality Example: mains flushing and air scouring.
Drought	Period of low rainfall which particularly impacts levels of groundwater recharge in the winter period and river flows and demand patterns in the summer months.
Drought management plan	Statutory plans to manage supplies during a drought period.

Drought order	An authorisation granted by the Secretary of State under drought conditions, which imposes restrictions upon the use of water and/or allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis.
Drought permit	An authorisation granted by the Environment Agency under drought conditions, which allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis.
Drought threshold levels	A groundwater level or river flow which is used to restrict raw water available from sources.
Dry year	A year of rainfall below long term average and is characterised with high summer temperatures and high demand.
Dry year Annual Average Unrestricted Daily Demand	The average amount of water supplied in a dry year made up of the level of demand, which is just equal to the maximum annual average, which can be met at anytime during the year without introduction of demand restrictions. This should be based on a continuation of current demand management policies.
Economic Level of Leakage (ELL)	*The ELL balances the costs and benefits of leakage management*. The level of leakage where the cost associated with reducing leakage further is higher than the cost of putting more water into supply. This can be calculated both on a short and long term basis and is calculated in Ml/d.
Environment Agency (EA)	The government's main statutory body with responsibility for licensing abstraction, consenting discharge in addition to advising on environmental and flood risk management policy, and setting and enforcing environmental standards in England and Wales.
Environmental Impact Assessment	Requirement under Directive 85/377 EEC (as amended by Directive 97/11/EC) to carry out an assessment of the likely significant effects of a proposed development on the environment before consent is granted. EIA must be carried out in accordance with the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999.
Forecasts / Plan Horizon	The end date of demand forecast or water resources plan (for example, 2035).

Gross Value Added (GVA)	GVA measures the contribution to the economy of each individual producer, industry or sector in the United Kingdom. It is used in the estimation of Gross Domestic Product (GDP). GDP is a key indicator of the state of the whole economy.
Groundwater	An important part of the natural water cycle present underground, within strata known as aquifers.
Group Licence	Restrictions placed on a number of licenses to constrain the total output from the group.
Habitats Directives	A collective term for Birds Directive 79/409/EEC on the conservation of wild birds and Habitats Directive 92/43/EEC on the conservation of natural habitats, wild fauna and flora.
Habitats Directive schemes	Programmes to assess and implement works in order to mitigate the impacts of abstraction on designated sites under the Habitats Directive.
Headroom uncertainty	A probability distribution that represents a likely range of values for Headroom for selected years within the planning period.
Hydrographs	Plots of water levels against time.
June Return	Appointed water companies' annual returns to Ofwat. Companies provide a framework for the submission of the majority of information that Ofwat require, enabling them to monitor progress and compare performance between companies. This information is usually placed at the Ofwat library and published on Ofwat Website
Local Planning Authority	Authority with responsibility for planning regulation and development control.
Long Run Marginal Cost (LRMC)	The change in total costs (both capital and operating costs) per unit change in output. Long Run Marginal Cost is estimated over the "long run", i.e. that time period for which all costs are variable.
Maximum Likelihood Estimation (MLE)	A statistical technique where a reconciliation item is distributed to the largest and least certain components of an estimate of the magnitude of a variable. The technique can be applied to a reconciliation of a water balance.
Mega litres Per Day (Mld)	One mega litre equals one million litres (1,000 cubic metres) per day.

Meter optants	Properties where a meter is voluntarily installed at the request of its occupants.
Micro – component analysis	The process of a deriving estimates of future consumption based on expected changes in the individual components of customer use.
Mitigation	The alteration of proposals to address specific concerns in order to achieve environmental, social or economic improvement.
Monte Carlo Analysis	A statistical evaluation technique which obtains a probabilistic approximation to the solution of a problem by using statistical sampling techniques.
Net Present Value (NPV)	The difference between the discounted sum of all of the benefits arising from a project and the discounted sum of all the costs arising from the project. Put simply it is the economic value of a project, at today's prices, calculated by netting off its discounted cashflow from revenues and costs over its full life.
Non-households	Properties receiving potable supplies that are not occupied as domestic premises, for example, factories, offices and commercial premises.
Normalisation Factor	A factor applied to bring the sum of all individual probabilities of an occurrence for an event to equal one.
Normal Year	An average year of rainfall and demand patterns.
Normal Year Annual Average Daily Demand	The total demand in the year with normal or average weather patterns, divided by the number of days in the year.
Operating Costs	Routine operating expenses comprising day to day (both planned and unplanned) costs, such as wages, power, materials and transport.
Outage	A temporary loss (less than 3 months) of deployable output. Outage can be as a result of power loss, pollution events and others.
Per Capita Consumption (PCC)	Amount of water consumed per person, it can be unmeasured (uPCC) or measured.
Point of Abstraction	The top of a borehole for ground water abstraction; the river intake for surface water abstraction to direct supply or bank side storage; the draw – off tower for a direct supply reservoir.

Point of Consumption	The point where the supply pipe rises above ground level within the property, usually inside the stopcock or an internal meter.
Point of Delivery	The point at which water is transferred from mains or pipes, which are vested in the water supplier into, pipes which are the responsibility of the customer. In practice this is usually the outside stopcock, boundary box or external meter.
Point of Production	The point where treated water enters the distribution system.
Potable Water Produced	Raw water abstracted less treatment works operational use and treatment losses.
Potable Water Exported	Potable water exports from within a defined geographical area to an area outside that defined geographical area.
Potable Water Imported	Imports of potable water from outside a defined geographical area to a defined geographical area.
"Pull" System	A system of control on pump operation based on reservoir levels.
Potential Yield (PY)	Maximum output from a source or group of sources constrained only by well and/or aquifer properties for specified conditions.
Raw Water	Water taken from rivers, ground water or reservoirs prior to treatment.
Raw water abstracted	Raw water abstracted at the point where abstraction charges are levied. It is made up of raw water retained and raw water exported.
Raw water collected	Raw water retained plus raw water imported.
Raw water exported	Raw water exported from a specific geographical area.
Raw water imported	Raw water imported from outside of a specified imported geographical area.
Raw water losses	The net loss of water to the resource system comprised of mains/aqueduct (pressure system) losses, open channel/very low pressure system losses, and losses from break-pressure tanks and small reservoirs.

Raw water operational use	Regular washing-out of mains due to sediment build-up and poor quality of source water.
Resultant Deployable Output (RDO)	The final deployable output allowing for constraints and share of group licenses which might be different to the volume on the license.
Reconciliation item	The difference between the estimates of the magnitude of a variable and the sum of the estimates of the individual components of that variable.
Regional Planning Authority	It prepares monitors and reviews the regional planning guidance for its region. In every English region this now the regional assembly.
Regional Spatial Strategy	Statutory regional spatial strategies will replace non-statutory regional planning guidance notes produced for each English region. Regional spatial strategies will be part of the development plan. As a consequence, they are likely to be more detailed and will carry much more weight in relation to determining planning applications. In London, the spatial development strategy prepared by the mayor forms the regional spatial strategy.
Resource Zone	The largest possible zone in which all resources, including external transfers, can be shared and hence the zones in which all customers experience the same risk of supply failure from a resource shortfall.
Rest Water Levels	Non pumping level of water in a borehole or well.
Return Events	An event or occurrence with the tendency to reoccur.
Return Period	The assessed frequency of occurrence of a specified return event.
Risk	A statement about the likelihood and consequence of a possible event. The statement may include judgement(s) about the (un)desirability of the event and the need to avoid its occurrence.
Retail Price Index (RPI)	A measure of the increase in price of a specified basket of goods each year related to a base year.

SAC	Special Area of Conservation – An area designated under Article 3 of the Habitats Directive for its high quality conservation status, making a contribution to the conservation of habitats and species listed in Annex I and II (amended).
Source	A named input to a resource zone. A multiple well/spring source is a named place where water is abstracted from more than one operational well/spring.
Source scale	Factors influencing individual source works.
Source works	Combination of boreholes, wells and springs providing water to a single treatment works.
Source Reliable Output (SRO)	The outcome of a source yield assessment measured as Mega litres/day and usually linked to all peak values for specified constraints (same as those for deployable output).
Source Yield Assessment	The process of understanding the volume of water that any water source can provide during a critical period. This forms the basis of deployable output.
SPA	Special Protection Area – An area classified under Article 4 of the Birds Directive.
SSSI	Site of Special Scientific Interest – An area designated under the Wildlife and Countryside Act for special interest by reason of any of its flora, fauna, or geological or physiographical features.
Strategic Environmental Assessment	A process designed to ensure that significant environmental effects arising from proposed plans and programmes and reasonable alternatives are identified, assessed, subjected to public participation, taken into account by decision makers, and monitored. SEA sets the framework for future assessment of development projects some of which require Environmental Impact Assessment (EIA).
Structural Water Loss	Water lost from structures such as water towers, reservoirs.
Supply - Demand Balance	The deficit or surplus of supply against demand taking into account risk.

Supply pipe	The service pipe which is not vested in the water supplier and is normally the length of pipe between the property boundary where the water main is laid, and any terminal fitting directly connected to it and under mains pressure e.g. taps.
Supply pipe losses	The sum of underground supply pipe losses and above ground supply pipe losses.
Sustainability	Sustainability is essentially about protecting and enhancing the environment and careful use of natural resources whilst considering today's needs and those of future generations.
Sustainability Appraisal	A process which provides for the systematic identification and evaluation of the economic, social and environmental impacts of a proposal.
Sustainability Reduction	Reductions in deployable output required by the Environment Agency to meet statutory and/or environmental requirements.
Target headroom	The minimum buffer that a prudent water company should allow between supply (including raw water imports and excluding raw water exports) and demand to cater for specified uncertainties (except for those due outages) in the overall supply-demand balance. Introducing this buffer into the overall supply-demand balance will help to ensure that the water company's chosen level of service can be achieved.
Total leakage pipe losses	The sum of losses from reservoirs, supply and communication pipes, distribution and trunk mains.
Treatment works losses	Includes treatment works operational use, structural water losses and any overflow water lost from structure overflows from reservoirs and drains.
Treatment works water operational use	Water used as part of the treatment process which is not taken into supply.
Underground supply pipe losses	Pipe losses between the water supplier's pipe work and the customers tap.
UKCIP02	The Climate Impact Programme 2002 release.
UKWIR	UK Water Industry Research

Unrestricted demand	The demand for water when there are no restrictions in place for example hose pipe bans.
Void property	A property connected to the distribution network but not charged because it has no occupants.
WRMP tables	Tables used for presenting key quantitative data associated with Water Resources Management.
Water Available For Use (WAFU)	The value in Ml/d calculated by the deduction from deployable output of allowable outages and planning allowances in a resource zone.
WATCOM	Water Consumption Monitor. A study of water consumption of unmetered consumers to evaluate how unmeasured customers utilise water.
Water Balance	A calculation of the difference between the sum of the components of water consumption and the measured Deployable Output.
Water delivered	Water delivered to the point of delivery such as the customer's tap. This includes supply pipe losses.
Water delivered billed	Water delivered less water taken unbilled. It can be split into unmeasured household, measured household, unmeasured non-household and measured non-households water delivered.
Water Framework Directive	European Legislation promoting the efficient use of water and protecting the environment from over abstraction by restoring it to a good ecological status.
Water taken	Distribution Input minus distribution losses.
Water Resources	The volume (Ml/d) of water that the company can use to meet customer demand. It can be considered on both regional and local scales.
Water Resources Zone	The largest possible zone in which all resources, including external transfers, can be shared and hence the zones in which all customers experience the same risk of supply failure from a resource shortfall.
Water Resource Management Plan (WRMP)	Water Companies' plans for supplying water to meet demand over a 25 year period.
Water treatment works	Plant where raw potable water is treated to a standard suitable for drinking. Note this is not dealing with sewerage.

White goods and appliances	Household appliances that utilise water such as fridges, freezers, dishwashers, washing machines.
WRc	Water Research Centre

Appendix B – Water Efficiency Strategy

1. Introduction

We must continue to manage demand, especially through increased water efficiency and reduced water wastage.

Defra Water Strategy, 2008

Water efficiency is one of the two key principles for our long term plans, sitting alongside the provision of a high quality service. It has been a key part of the Company's strategy over the past 10 years. Our future plans, as set out in our Strategic Direction Statement (SDS), establish a focus on the continued efficient use of water. We are committed to safeguarding our limited water resources by minimising waste ourselves and by educating and working with our consumers to do the same.

Our Water Efficiency Strategy (WES) sets out our plans and objectives for creating a water efficient culture within the Company's operations and to help our customers optimise their water usage in line with their needs.

2. Overview

2.1 Water Efficiency and Water Resources

The WES is a key element of our final Water Resources Management Plan and sets out how the Company intends to maintain sufficient water supplies to meet customers' needs from 2010 to 2035.

A key element of the Company's strategy to promote water efficiency is to increase the percentage of homes with a meter to 90% by 2015.

The final WRMP indicates a stable future situation with a small surplus of supply over demand until beyond 2035 without the need to invest in any supply side expenditure. The only supply side expenditure planned before 2035 is to increase raw water storage at VARD following mineral extraction which is expected to be available by 2025. The increase in VARD storage has been promoted for about 10 years and received planning consent in March 2007.

2.2 Part of a National Water Efficiency Strategy

"The water industry is a major energy user, and together with domestic energy use, there's a carbon impact here that simply has to be tackled"

Defra's recently published Water Strategy

VWE will demonstrate its commitment to the national strategy for demand management by meeting its leakage reduction and water efficiency targets. This runs parallel with our duty to promote the efficient use of water by our customers.

By placing these two commitments at the heart of our WES we will ensure adequate water supplies for future generations of customers as well as a reduction in carbon emissions.

2.3 Water Efficient Customers

"There's enough water to meet our water needs-but not every water want."

In recent times water has become a lifestyle product and daily domestic consumption in the UK in particular has increased substantially. Many of our customers now regularly use washing machines, dishwashers and have modern bathrooms with high flow showers.

On average our customers use less water than anywhere else in the country. Our average daily per capita consumption is around 120 litres for metered customers, compared to the average for the UK of 155 litres.

Our WES has been designed to counter the tendency for consumption to rise and to keep average consumption within the government target of 130 litres per head per day by 2030.

2.4 Summary

Our water efficiency strategy is core to what we do. It underpins our long term plans (as set out in our SDS), keeps our customers at the heart of what we do and ensures long term sustainability of our business and the natural resources on which it depends. The delivery of this strategy allows us to develop a water efficiency partnership with our customers. We cannot achieve this without them, but through consultation with our customers we recognise that they expect us to drive efficiency for them. Our customers are willing to pay for improved water efficiency. However they also expect us to advise them in what they can do. This strategy sets out how we will provide the services that our customers want.

This strategy is specific to VWE, however it can not be delivered alone and we will work with government, planners, developers, regulators and other partners to ensure it is delivered.

Our Water Efficiency Strategy represents a proactive approach to helping our customers save water whilst reducing carbon emissions.

3. Water Efficiency Strategy

Our long term vision is:

Providing a high quality, water efficient service

This Water Efficiency Strategy (WES) sets out how we will deliver a water efficient service.

The main objectives are:

1. Limiting the average per capita consumption of domestic customers to not more than the government target of 130 l/h/d by 2030. This will be achieved by supporting measured customers to save water, and increasing the number of measured customers,

2. Universal metering; 90% of homes to have a meter by 2015 and 95% by 2020.

3. To advise / educate customers and consumers on a number of specific water efficiency initiatives

4. Maintain leakage at or below the sustainable economic level.

5. Reduction in our own use of water and promotion of water efficiency within the Company

To summarise our WES covers 4 key areas:

1. Water saving initiatives
2. Water meters
3. Customer education
4. Water operation at VWE

3.1 Water Operations at Veolia Water East

Keeping our side of the partnership

Leakage
The Company will continue to monitor leakage and ensure it is maintained at a sustainable and cost efficient level.

Pressure
We will continue to maintain pressure management as a tool for minimising leakage.

Water use at operational sites
We will carry out water audits at our operational sites and set targets for water use.

Developing a water efficient culture
We will develop water awareness programmes for our employees and expect them to become water efficiency ambassadors for VWE.

Procurement
We will procure in a sustainable manner and take advantage of the Enhanced Capital Allowance (ECA) scheme which supports businesses investing in water saving equipment or water saving technologies.

3.2 Water Meters

Better informed customers make better choices, and we know that the increased use of metering is a further spur to reducing demand without compromising our quality of life.

Defra Water Strategy, 2008

90% penetration

Our target is to see 90% of households fitted with a meter by 2015. We believe that a measured bill raises customer awareness and is the fairest way to pay and provides a financial incentive for customers to reduce their water usage. Importantly, most customers that pay for water using a meter use less water than those that don't, thus reducing the average per capita consumption.

Tariffs

The introduction of Automatic Meter Reading (AMR) will allow us to give customers better information on the amount of water they consume. It will also allow us to influence consumption if we choose, through tariffs.

Metering - New Services

Metering especially in conjunction with AMR will allow us to offer new services to customers. These could include monthly consumption records for customers who want a more information on water usage.

3.3 Water Saving Initiatives

Helping our customers become more water efficient and use water wisely

Our '*Saving Water'* campaign will cover all initiatives to promote water efficiency. We have split these into three categories:

1. Water audits
2. Water efficiency products
3. Water efficiency initiatives

These will complement our customer education programme.

Water audits

We will offer free water efficiency audits to domestic and commercial customers. Following the survey advice will be given to customers on how they can save water.

We will offer additional commercial services to implement water saving measures, including

- Advice to business customers
- Schools resource pack
- Offer to install water efficient products while at property carrying out leak test/high consumption query
- Free basic repairs for elderly/vulnerable customers (leaking toilet cisterns and dripping taps) where we carry out a leak test
- Continue to offer all customers free water efficiency survey's and leak tests

Water efficiency products

We will consider a range of free and charged water efficiency products for customers. These will be offered/promoted by our water efficiency technician(s) and include:

- Cistern Displacement Devices, such as Save-a-flush-bags, or Hippos
- Tap restrictors
- Shower flow controllers
- Water efficiency home pack
- Water saving showerhead
- Water saving cistern device
- Waterbutts

Water Efficiency Initiatives

We will run a number of water efficient programmes (some already started) between 2010-2015.

- Cost benefit surveys of water efficient devices
- Water saving services, particularly to commercial and large users.
- Water efficiency product trials
- Joint company initiatives

3.4 Education and Promotion

Water companies have a duty to promote the efficient use of water by their customers.

Defra Water Strategy, 2008

Education

We will generate a structured educational programme focussed on water efficiency. We will target all customers but especially focus on measured customers and future customers by working with schools and children in particular.

We will provide information to all our customers on the benefits of switching to, or retaining more water efficient household appliances. In particular we aim to slow down take up of power showers, increase the take up of low/dual flush toilets, and increase the replacement/take up of more water efficient washing machines and dishwashers as they become available.

We aim to develop the Mirrlees pumphouse at Manningtree into a centre for education, providing a purposefully designed classroom and meeting room.

Veolia Water East Website

We will redesign our website to give customers easily accessible advice on how to save water at home and at work.

Advice campaigns

We will structure advisory campaigns to deliver specific efficiency advice within an annual programme. These will include:

- External visits
- Customer bills
- Company vehicles
- Press

4. Monitoring and Reporting

We will continue to monitor what we do and review the impact of the Water Efficiency Strategy, including a review of water savings such that we can better understand the value created for customers and the benefits derived.

We will set ourselves clear targets for water efficiency. We will monitor the impact of the initiatives described and plot progress against the target.