Environment Agency

Towards water neutrality in the Thames Gateway

Summary report

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HM Government
Thames Gateway

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Our work includes tackling flooding and pollution incidents, reducing industry's impacts on the environment, cleaning up rivers, coastal waters and contaminated land, and improving wildlife habitats.

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Foreword

The Thames Gateway has the potential to become a fantastic place to live and work. To help achieve this we need to make sure there is enough water to support all of the different needs within the Gateway – including those of the environment – both now and over the long-term.

We jointly commissioned a study to understand better how demand for water might change, as a result of inward migration and household formation, in the Thames Gateway. Working with key stakeholders such as water companies, Ofwat and housing organisations, we investigated how far it is possible to keep the total demand for water in the Gateway the same between 2005 and 2016, despite increases in local population and the number of houses and businesses. That is, to achieve water neutrality.

With over 160,000 homes and 180,000 jobs planned for the Gateway between 2001 and 2016, we know water neutrality is an ambitious aim. But we also know, by listening to residents in the Gateway, that people care about the environment where they live, have concerns about future water resources and want to do their bit to help. The Gateway has tremendous potential to be an exemplar for sustainable development. By getting it right in the Gateway we can show others how we can act to adapt to, and to reduce, the risk of climate change and the needs of a changing society.

This study shows a number of “demand-side” pathways toward 'getting it right' for water. Moving towards water neutrality would not be simple or easy but this study shows it is potentially possible, if everyone does their bit. Achieving water neutrality would mean that we would not need to find significant new water supplies to support planned new development in the Thames Gateway. More water could stay in the environment, meaning more water for wildlife and more water for us to enjoy in our leisure time.

What we will do now is build on this support and the findings of the study. We will explore how we can make moving towards a water neutral Thames Gateway a reality by continuing to work with stakeholders and communities – many of whom were involved in the development of this study.

Sir John Harman
Chairman
Environment Agency

Rt Hon Yvette Cooper MP
Minister for Housing
Communities & Local Government

Phil Woolas MP
Minister of State for the Environment
Department for Environment,
Food and Rural Affairs

Executive summary

In November 2006, the Government began a study to explore the feasibility of achieving water neutrality in the Thames Gateway, where total water used after new development is equal to, or less than total water use in the Thames Gateway before the development. The Environment Agency, Communities and Local Government and the Department for Environment, Food and Rural Affairs (Defra) commissioned the study to inform policy based around the concept of water neutrality and inform the development of water companies' water resource management plans for 2009 and provide lessons for other significant housing growth proposals. This document summarises the findings of the study and is not a policy statement.

This report examines the concept of water neutrality and discusses the results of modelling different scenarios of water use: baseline and business-as-usual demand between 2005 and 2016 and seven scenarios involving measures to achieve water neutrality in the Thames Gateway. It also summarises the results of a survey of residents in the Gateway and explores the potential implications for different groups of moving towards water neutrality.

The challenge

Access to decent and affordable housing is a government priority. The housing green paper, *Homes for the future,* sets a target of building two million new homes by 2016 and three million new homes by 2020. Development in the Thames Gateway will help to meet this need, providing at least 160,000 new homes between 2001 and 2016. The Government's vision for the Gateway is to build a vibrant economy and create a stunning environmental setting, including and involving local communities. To help realise this vision, we need to ensure there is enough water to support all of the different needs within the Gateway – including those of the environment – both now and over the long-term.

Our aim should be to live within our environmental limits. The challenges presented by housing and population growth and the potential impacts of climate change will make this more difficult. This is particularly true for the Thames Gateway, which has low rainfall and high water use, and lies in an area considered to be 'seriously' water stressed[1]. However, the scale of development in the Gateway provides an opportunity for the area to be an exemplar for sustainable development and encourage ambitious levels of water efficiency.

This study explored what could be achieved through the management of demand for water in the Thames Gateway. The overall aim was to examine the feasibility of moving towards water neutrality in the Thames Gateway during the period to 2016. Water neutrality in the Gateway would be achieved *if the total water used after new development was equal to or less than total water use in the Thames Gateway before the development (in the baseline year of 2005/06)*.

[1] Response to consultation on identifying areas of water stress, Environment Agency July 2007

Neutrality could be achieved in a combination of ways, by:

- making new developments much more water-efficient;
- 'offsetting' new demand by retrofitting existing homes and other buildings with more efficient devices and appliances;
- expanding metering and introducing innovative tariffs for water use to encourage households to use water more efficiently.

Results

Achieving water neutrality by 2016 is technically feasible, but would be challenging for both providers and consumers.

The estimated baseline demand for water in the Thames Gateway for 2005/06 is 521 million litres per day (Ml/d). This includes all water put into supply by water companies and private abstractors, with leakage adjusted to the 2015/16 forecast level to exclude any planned leakage reductions to achieve leakage targets.

The business-as-usual demand for water is forecast to increase by eight per cent to 563 Ml/d by 2016, with new households accounting for almost all of this rise in demand. This extra volume is far from insignificant, it is approximately the same as half a million baths every day, or the volume that the proposed Broadoak reservoir in Kent is expected to deliver.

There is more than one way to achieve water neutrality. This study looked at seven pathway scenarios, modelled using different combinations of demand management measures that could be adopted across the existing and new housing stock and non-households. One scenario achieved only one-third of the savings needed to reach neutrality. The other scenarios assumed more far-reaching changes, with five scenarios achieving water neutrality and one scenario going 'beyond neutrality', achieving a further 20 per cent reduction in demand.

The proportion of savings attributable to new homes, existing homes, non-households, compulsory metering and variable tariffs varied by scenario. Non-households and existing households made up the largest proportions of water savings in all the neutrality scenarios. Non-households accounted for a third of the water saved in each neutrality scenario, and existing households accounted for between 23 and 47 percent of total water saved.

Residents in the Thames Gateway expect future water shortages due to increased demand, climate change and a failure to tackle leakage. However, the same survey of residents found them to be supportive of increasing efforts in water efficiency, as long as the effort was shared by everyone and not just households. Residents viewed water neutrality as a worthy aim.

The costs of moving towards and potentially achieving neutrality are competitive with those of other options, such as leakage management.

- The total costs for households range from £127 million to £181 million, which accounts for around two-thirds of the water savings needed to achieve neutrality. The range of costs for new homes is £275 to £765, averaged across all homes built in the Gateway between 2005 and 2016.
- The cost for existing homes (to pay for retrofitting, fitting a meter and applying tariffs where applicable) is £135 to £154 per house, with costs averaged across all existing households in the Gateway in 2005-06.

- These represent one-off capital costs for all measures except metering and tariffs, where replacement costs and operational costs are included. Costs for the non-household sector (which account for one-third of the water savings needed to achieve neutrality) are far less certain.

Some water-efficiency measures are more cost-effective, offer more certainty of water savings or are potentially less energy-intensive than others. Measures with the greatest potential for helping to achieve water neutrality include:

- **Metering:** The introduction of compulsory metering (in existing properties) was included in all pathway scenarios. A saving of ten percent on per capita average annual water demand was assumed. Metering accounted for around ten percent of all water saved in each scenario reaching neutrality. Paying for the water used provided an important financial incentive to households and was the measure that had the greatest acceptance by residents in the Gateway who were surveyed as part of this study.

- **Variable Tariffs:** One of the charging schemes explored in the study was the introduction of a 'rising block' variable tariff. Under this tariff structure, the cost for each unit of water above a certain threshold would be charged at a higher rate, encouraging consumers to use water wisely. Variable tariffs were included in three neutrality scenarios. A saving of five percent in per capita average annual demand was assumed. Variable tariffs were applied to all metered homes and accounted for 22 percent of all the water saved in those scenarios. This is a low-cost option, but a lack of evidence means the potential water savings are uncertain. Awareness of the purpose and benefits of variable tariffs amongst surveyed Gateway residents was low.

- **New homes:** Building new homes to higher water efficiency standards offers substantial water savings. In the study, this sector accounted for nine to 17 percent of the total water saved. Residents in the Gateway wanted to see all new homes built to high environmental standards.

- **Retrofitting:** The retrofitting of existing homes with simple 'fit and forget' measures such as variable flush toilet devices, low-flow showerheads and low-flow tap inserts would help to save 23 to 47 percent of the total water saved across the Thames Gateway by 2016. Retrofitting appears relatively cost-effective, with variable flush devices the most cost-effective device. The effort required to persuade householders to introduce and keep using such measures could add substantially more to the costs and uncertainty. Residents were supportive of efforts to improve the water efficiency of homes, and found 'fix and forget' solutions particularly appealing. In terms of implementing a retrofit programme, residents preferred an incentive-based approach with the distribution of free water efficiency packs, to more interventionist or regulatory-based approaches.

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- Trevor Bishop, Head of Water Resource Management, Environment Agency.
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- Yvette de Garis, Head of Environmental Sustainability, Thames Water.
- Louise Every, Sustainable Development Policy Advisor, Environment Agency.
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- Terry Keating, Water Demand Manager, Southern Water.
- Christine Ogden, Sustainable Buildings, Communities and Local Government.
- Claire Ridgewell, Demand Planning Manager, Essex and Suffolk Water.
- Philip Stables, Thames Gateway Executive, Communities and Local Government.
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- Martin Townsend, Strategic Water Resources Planning Manager, Environment Agency.
- Simon Walster, Water Services Regulation Authority (Ofwat).
- Dave Wardle, Thames Estuary Programme Manager, Environment Agency.

Contents

1 Introduction

1.1 The challenge

The Thames Gateway is Europe's largest regeneration project, stretching for 40 miles along the Thames Estuary from the London Docklands to Southend in Essex and Sheerness in Kent (Figure 1.1). It is home to 1.45 million people living in approximately 600,000 households, with 637,000 employees working in the area. In 2003, the Government's Sustainable Communities Plan envisaged 120,000 new homes would be provided for in the Gateway between 2001 and 2016 (Office of the Deputy Prime Minister (ODPM), 2003). The Thames Gateway Interim Plan identified the capacity to provide around 165,000[2] new homes and 180,000 new jobs in the Gateway between 2001 and 2016 (Communities and Local Government, 2006a).

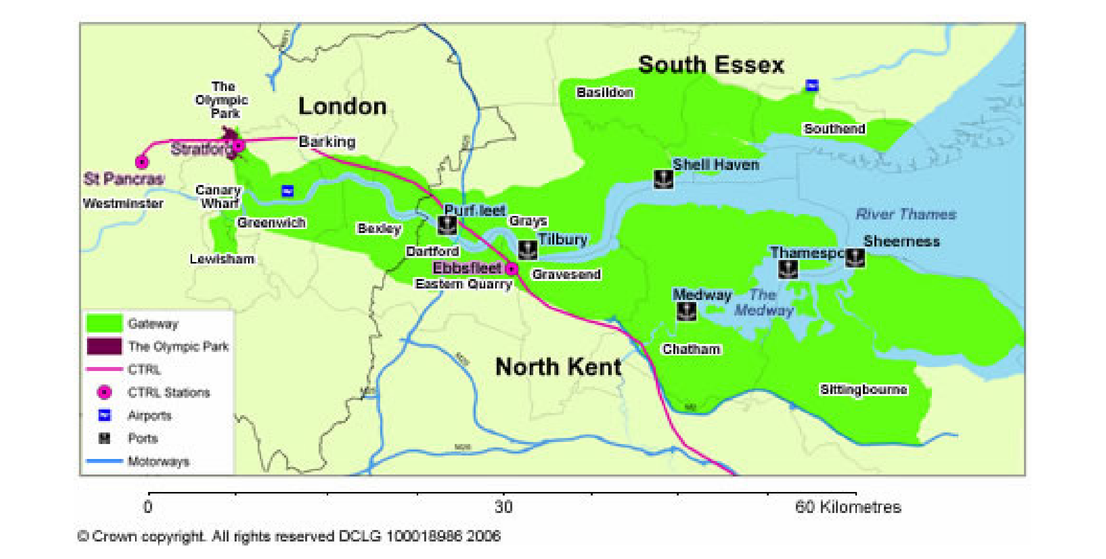


Figure 1.1: Map of Thames Gateway

In the context of the drought of 2004-06, there has been concern that levels of housing growth proposed for the Gateway may not be sustainable because of the water resource situation in the area (House of Commons Environmental Audit Committee, 2006). All things being equal the new homes, together with an expected rise in living standards and population growth, will lead to an increase in total demand for water.

The Thames Gateway lies in an area considered to be 'seriously' water stressed, indicating the need for much higher levels of water efficiency (Environment Agency, 2007). The area is characterised by low rainfall and higher than average water use, with over two-thirds of catchments classified as over-abstracted, over-licensed or with no additional water available for abstraction. This rises to three-quarters when considering groundwater, which provides the majority of water used within the Gateway (Figure 1.2). Water shortages have a detrimental impact on the environment, the economy, and our lives. Over the next few decades, climate change is predicted to accentuate the pressures on water resources in the region, with hotter, drier summers and warmer, wetter winters affecting the availability of water (Wade *et al*., 2006).

[2] The government target is for 160,000 homes to be built in the Thames Gateway between 2001 and 2016. This report uses the more precise number of 165,523 homes as outlined in the Thames Gateway Development Prospectus, which more accurately reflects the intentions laid out in local plans.

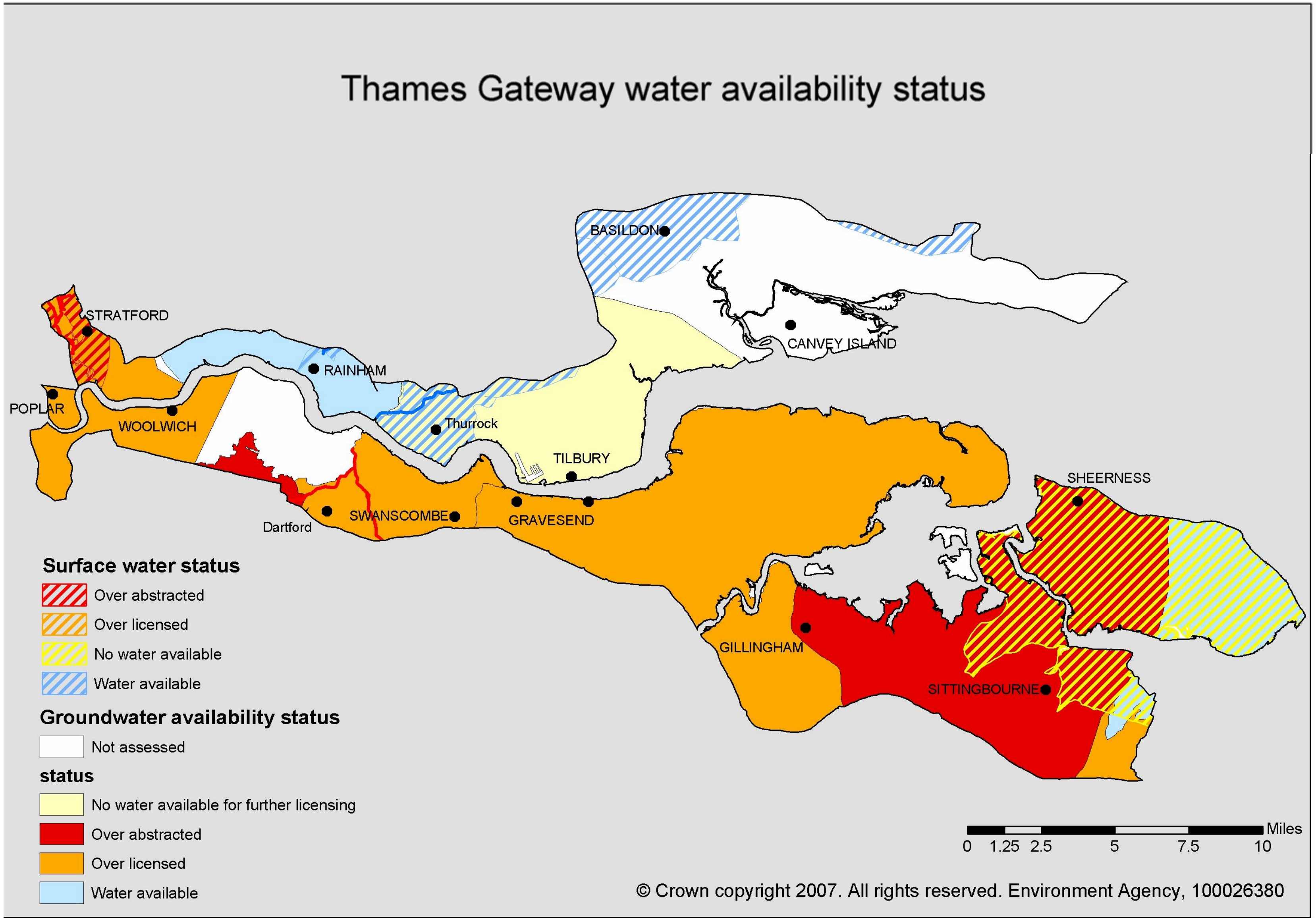


Figure 1.2: Thames Gateway water availability status (based on information available in February 2007)

The challenge is to ensure that there is enough water to support all of the different and competing needs within the Gateway - including those of the environment - both now and over the long term. Our aim should be to 'live within our environmental limits', which is one of the Government's five guiding principles for sustainable development (HM Government, 2005) and compatible with the concept of 'One Planet Living'.

In relation to sustainable water management, this goal will require much higher levels of resource efficiency, as well as changes to peoples' perceptions of water availability and attitudes towards water use. Good quality potable water, treated to high standards, should remain accessible to all (but not necessarily for all current uses, such as the unconstrained watering of gardens) and due regard should be taken of the potential impact of the processes of abstraction, treatment and supply of water on carbon emissions.

The Government has made it clear that growth areas are to be exemplars of sustainable development. The scale of development in the Thames Gateway offers the opportunity to design and plan for new development in a way that respects environmental limits and encourages higher levels of water efficiency.

1.2 Towards water neutrality in the Thames Gateway

In November 2006, the Secretary of State for Communities and Local Government (CLG) announced that her department, the Department for Environment and Rural Affairs (Defra) and the Environment Agency would "*jointly undertake a feasibility study on water demand management to consider the appropriate level of ambition, technical feasibility and cost*" to reduce the impact of new demand (CLG, 2006a). The aspirational goal of the study was to investigate the feasibility of making the Thames Gateway 'water neutral' by 2016.

The concept of water neutrality is relatively new, and there is no consensus of what it would mean in practice. This study set out to explore the notion and what it could mean for the Thames Gateway. Its definition was based on ensuring that total water use in the Thames Gateway after the development would be equal to or less than total water use before the development. There is more than one way to achieve this, by designing the new communities to be as near to water-neutral as possible combined with offsetting new demand by making existing properties, infrastructure and activities in the area more water-efficient.

This report will be of use to ministers, government departments, agencies, regulators, water companies and others interested in the study's findings. It presents an overview of the study and its policy context; an examination of the concept of water neutrality; summaries of the modelling results and the survey of Gateway residents; and potential implications of the study for these and other affected groups and organisations.

Further details of the modelling, analysis and survey can be found in the supplementary reports by Entec UK Ltd and Ipsos MORI.

1.3 Terms of reference

Water neutrality was considered here in terms of the management of demand for water within the Thames Gateway. It would not be consistent with the purpose of a water neutrality study, if total water use were higher after development in the Thames Gateway than prior to development. As a consequence, the study did not consider development of further supply-side options, other than the development of household and community-level rainwater harvesting and water reuse systems. The approach was therefore distinct from water company plans, which consider both demand and supply options in maintaining the supply-demand balance. It also did not consider water neutrality in terms of drainage (to a significant extent), flood risk, environmental water quality, or the notion of 'embedded' or 'virtual' water[3] (Zygmunt, 2007).

The geographical boundary of the study was the area known as the Thames Gateway, as defined by Communities and Local Government. This is an area that does not fit neatly within either administrative (government office) or water company boundaries. The time scale considered was from a baseline year of 2005/06 to 2016, the end date for the period of development embodied in the Thames Gateway Interim Plan.

In line with the exemplar status of the growth areas, it is emphasised that this is a 'blue skies' study, reflected in the aspirational aim of 'water neutrality'. However, the findings are grounded in terms of costs and public acceptability. The study takes into consideration the potential impact of different combinations of measures on carbon emissions and on any surge in seasonal peak demand for water.

The study aims to inform policy makers in local, regional and central government who have a role in promoting water efficiency, whether through building regulations, the planning process, public procurement or by encouraging residents and businesses to change how they use water. The study will also feed into the Thames Gateway Plan and water companies' water resource management plans for 2009, and the next water price review that covers the period from 1 April 2010 to 31 March 2015.

1.4 Aim and objectives

This study set out to explore the feasibility of what could be achieved through the management of demand for water in the Thames Gateway. The overall aim of the study was *to examine the feasibility of moving towards water neutrality in the Thames Gateway during the period to 2016.*

Water neutrality was recognised as an 'aspirational' goal. This may or may not be the optimal goal, taking into account other considerations such as technical and economic feasibility and public acceptability. Other scenarios that either fell short or went beyond neutrality were also tested.

The objectives of the study were to:

- Develop the concept of water neutrality.
- Model demand for water in water resource zones within the Gateway:
    - Determine the current baseline for water demand.
    - Forecast water demand under a business-as-usual scenario to 2016.
    - Design and model the effects of different scenarios leading towards neutrality, taking into account costs (economic and carbon). Scenarios included consideration of existing and possible future technical and policy measures such as water efficiency regulations for new homes; retrofitting options for existing buildings; metering and variable tariffs. The influence of scale (e.g. applicability at a household or community level) and development type (domestic or commercial) was also considered.

[3] Many commodities require significant volumes of water in their production. This water is referred to as 'embedded' or 'virtual' water, or the total water used in the production of a commodity (WWF, 2007).

- Survey Gateway residents to understand attitudes to water use and acceptability of water neutrality options.
- Propose workable options to achieving water neutrality in the Gateway to complements related goals such as zero/low carbon and good environmental water quality for the region.
- Identify lessons from the analysis that could be applied to other growth areas, New Growth Points, eco-towns or other new developments.

1.5 Collaborative approach

This study was funded by Communities and Local Government, Defra and the Environment Agency and managed by the Environment Agency. The study was steered by an advisory group consisting of representatives with an interest in the Thames Gateway drawn from government departments and agencies, regulators and water companies (see acknowledgements). Other representatives were involved on an informal basis.

Entec UK Ltd was commissioned to undertake the modelling work for the baseline, business-as-usual and pathway scenarios. Ipsos-MORI carried out the survey of Gateway residents.

1.6 Uncertainty

This study provides a useful indication of the extent of water savings needed to achieve neutrality, the types of measures that could be used to achieve it, and the approximate costs of different ways of doing so. However, the findings should be treated with caution, given the uncertainties in quantities and costs presented here. It is not certain that the measures outlined here will achieve the volumes of water saved within the costs indicated.

A precautionary approach was adopted for the majority of assumptions in this study. This included a more demanding business-as-usual scenario based on dry year forecasts, cautious assumptions on changes to water consumption levels, and pathway scenarios which only used measures with greater certainty of water savings (in most cases) and which assumed moderate water savings from those measures. All of the major assumptions were agreed by consensus of the project advisory group.

Because of this approach, the study is considered sufficiently useful to inform a policy debate on the extent to which water neutrality is a feasible goal for the Thames Gateway.

2 Policy context

The study is of relevance to several areas of policy, most notably housing supply and design, sustainable communities and water management. Some of these policy areas have seen significant developments recently, even during the period of completing this study. In some cases the assumptions made in this report may not have caught up with all of these developments. The purpose of this section is to outline the policy context within which this study falls and to which it may contribute.

2.1 Housing and sustainable communities

Access to decent and affordable housing is a government priority. Despite housing having improved for many people, demand for housing to rent or buy continues to outstrip supply, and it is becoming increasingly difficult for young people to secure a step on the housing ladder.

In 2007, the Government published its housing green paper, *Homes for the future*. which sets a new 2016 target for the annual rate of house building - 240,000 new homes per year by 2016 (CLG, 2007a). This will mean building a total of two million homes by 2016 and three million homes by 2020.

If this housing is built, about a third of all homes that will be standing in 2050 will have been built between now and then. The green paper recognises the need for both new and existing housing to be more sustainable, to have a declining carbon footprint, and to be resilient to the impacts of climate change.

The Government is responding to the need for greener homes through two key policy tools: building regulations and the Code for Sustainable Homes (CSH). The planning process also has a role in encouraging high environmental standards and innovative ways to develop sustainable communities.

2.1.1 Housing

Building regulations set the minimum standards for all new homes in England and Wales. In recent years, the Government has used building regulations to drive up standards in energy efficiency in new homes and major retrofits. For example, the policy statement *Building a greener future* outlines how building regulations will be progressively tightened in 2010, 2013 and 2016 to achieve zero carbon new homes by 2016 (CLG, 2007b). In July 2007, the Government outlined how it would introduce a minimum standard for water efficiency into building regulations for new homes for the first time. A calculated whole-building performance standard set at 125 litres per head per day (l/h/d) will be introduced in 2008 (CLG, 2007c).

The Code for Sustainable Homes (CSH) is intended to bring about a step change in sustainable home-building practice. It provides a national voluntary standard for sustainable homes to be used by progressive homebuilders to differentiate the performance of their homes from that of others and help inform consumers so they can make sustainable choices. Following a recent consultation on proposals for making it mandatory for new homes to be rated against the CSH, the Government will be proceeding with the implementation of mandatory rating against the CSH, and is minded to do so from April 2008 (CLG, 2007d and e).

Defra will review the Water Supply (Water Fittings) Regulations in 2008 and look at proposals for improving the requirements for water efficiency. Measures could include setting new performance standards for fittings such as toilets, urinals and washbasin taps. The proposed revisions will complement building regulations for new homes and help to discourage retrofitting of poorly performing fittings in homes, as well as ensuring minimum standards to promote greater water efficiency in the workplace (CLG, 2007a).

In addition, the water products labelling scheme recently launched by the Bathroom Manufacturers' Association aims to provide information at the point of sale to enable buyers to make decisions based on water use of appliances. This information could be useful to those specifying building design standards as well as householders replacing old fittings and will support government policy in this area.

2.1.2 Incentives for non-households

Water demand in non-domestic buildings is a mix of domestic-type consumption, water used for processing and other business operations and catering. This complex mix of potential uses and the diversity of occupiers make it difficult to predict water used solely for domestic-type uses. The public consultation on the introduction of minimum standards for water efficiency in new buildings (CLG, 2006c) was concerned only with domestic uses of water in non-domestic buildings.

The consultation responses confirmed that, in the absence of reliable data on the use of water in different settings, it would be difficult to set robust and meaningful performance standards for non-domestic buildings that would encourage more efficient use of water (CLG, 2007c). As a result, Defra and CLG decided to tackle improvements in water efficiency in new non-domestic buildings through tightening standards of individual fittings in the short term (see Section 2.1.1). As part of the Green Commercial Buildings Task Group, the Government agreed to research whether a whole-building performance standard could be developed, and possibly to establish higher water efficiency standards above that base.

2.1.3 Thames Gateway

The Thames Gateway covers 100,000 hectares, and is 40 miles long and 20 miles wide. In 2006, 1.45 million people lived in the Thames Gateway in over 600,000 households. The Gateway has the capacity to provide about 160,000 homes and 180,000 more jobs between 2001 and 2016. The Government's vision for the Gateway is to build a vibrant economy and create a stunning environmental setting, including and involving local communities. The scale of the Thames Gateway provides an opportunity to manage water supply, reduce the impact of new demand and act as an exemplar.

2.2 Water management

Most people in England and Wales, including those in the Thames Gateway, receive their water supply from water companies. Water companies are responsible for providing a safe, clean and reliable supply of water; promoting the efficient use of water by, and on behalf of their customers; producing twenty-five year water resource management plans (WRMPs) and maintaining up-to-date drought plans.

Defra has responsibility for water policy, including overseeing policy relating to the supply of drinking water and the regulation of water companies. Water companies are regulated by the Environment Agency, the Water Services Regulation Authority (Ofwat) and the Drinking Water Inspectorate (DWI), the latter of which checks that the water provided by water companies is safe to drink and meets regulatory requirements.

The Environment Agency is the environmental regulator and has a duty to conserve, augment, redistribute and secure the proper use of water resources and is responsible for long-term planning for water resources in England and Wales.

Ofwat is the economic regulator and has the duty of ensuring that the companies are able to finance properly the carrying out of their functions. Ofwat also has duties to facilitate competition, promote efficiency on the part of the water utilities, and protect the interests of consumers. The Consumer Council for Water (CC Water) provides a voice for water and sewerage consumers and has a role in promoting water efficiency.

To fulfil its duties, Ofwat conducts a price review every five years to set a 'price cap' limit on increases to water consumers. The next price review will cover the period from 1 April 2010 to 31 March 2015, but the water companies are preparing their WRMPs now for consultation in spring 2008. The WRMPs will inform the Ofwat business planning process to secure funding to ensure an appropriate balance between supply and demand through the planning period.

2.2.1 Managing demand for water

Water resources in England and Wales should be managed by following the 'twin track' approach whereby the costs and benefits of different supply and demand management options are considered as part of company's water resource planning, using the 'economics of balancing supply and demand' approach. All water companies have a duty to promote the efficient use of water and an additional duty to further water conservation in the Water Act 2003.

In October 2005, Defra set up a Water Saving Group of key representatives to work on a programme of measures to promote the efficient use of water in households in England. Its members are the Environment Agency, Ofwat, CLG, CC Water, Water UK, Waterwise and representatives from water companies.

2.2.2 Metering

Following consultation, Defra announced that from October 2007, water companies in areas of serious water stress will be required to include an assessment of the costs and benefits of compulsory water metering in their 25-year forward plans (WRMPs). The new requirement, developed by the Water Saving Group, requires compulsory metering to be assessed alongside the existing range of supply and demand options for ensuring long-term security of supply.

The Environment Agency want to see the majority of homes in seriously water stressed areas like the South East metered by 2015. However, due to the number of meters being installed, some companies may not be able to achieve this goal until 2020.

3 Water neutrality

Defining a sustainable level of resource use depends on the nature of the resource and scale and context of the situation. For resources such as carbon, the goal can be clear – to reduce emissions to a sustainable level from whatever source in whatever location.

The aim for the sustainable use of water is different for two reasons. First, as every living thing requires water to live, it is not desirable for 'zero water use' to be a goal. Second, unlike carbon emissions, it matters where water is saved (or recycled) as the effects are felt locally, not globally as with greenhouse gas emissions. This means that 'offsetting' should occur locally or within the catchment from which the water is derived.

This section explores the concept of water neutrality, its limitations and opportunities, and how the concept is applied to the Thames Gateway for the purposes of this study.

3.1 Water neutrality

'Water neutral' is a term that is beginning to be used more widely. Taken broadly, it implies that in a water neutral situation people would have a benign effect on the water environment. Such a definition could include considerations of water demand, supply, drainage, environmental water quality and flood risk. The water could be that used in a given area, and/or sourced (abstracted) from that or other areas, either directly or indirectly through imported or embedded water (Zygmunt, 2007). However, the most common understanding of water neutrality, which this study uses, relates to the use of water within a given area which Therivel *et al.* (2006) define as:

For every new development, total water use in the region after the development must be equal to or less than total water use in the region before the new development.

This definition of water neutrality entails meeting the needs of new demand through more efficient use of existing water resources. Water resources in England and Wales should be managed by following the 'twin track' approach (see section 2.21), however achieving neutrality excludes the potential contribution of new resources, such as reservoirs or additional abstraction. Exploring the feasibility of different scenarios towards water neutrality, including the costs and benefits, can help us to understand the potential that water-efficiency measures may have in the sustainable management of water resources in an area.

The goal for water neutrality is for 'no overall rise in demand', but in some cases this may not be appropriate. Issues of cost, public acceptability and the availability of supply-side options may mean less ambitious goals are more desirable. Similarly, for water neutrality to equate to sustainable water use, it assumes water use before new development is at a sustainable level. In areas where this is not the case, including much of the Thames Gateway, it may be desirable to aim 'beyond neutrality', here by including a scenario to reflect a level of water use[4] below the existing level.

Water neutrality could be achieved in a combination of ways. New developments can be made super-efficient, but will still require water to fulfil essential needs. This water can be 'offset' by retrofitting existing buildings within the area with more efficient devices and appliances; expanding metering and introducing innovative tariffs for water

[4] The Environment Agency is currently working to reach a balance between competing demands for water resources through Catchment Abstraction Management Strategies (CAMS). Moving towards or beyond water neutrality may, in some areas, make a valuable contribution to sustainable water use.

use which reward moderate water users. As well as the household sector, ways to use water more efficiently within agriculture and industry use could be developed. Water companies could reduce demand by improving their management of leakage.

3.2 A water neutral Thames Gateway

For this study, the definition of water neutrality was adapted as:

Water neutrality in the Thames Gateway would be achieved if the total water used after new development is equal to or less than total water use in the Thames Gateway before the development.

Where:

- The Thames Gateway is that area defined as such in the Thames Gateway Interim Plan (CLG 2006a).
- 'Before' refers to the baseline year of 2005/6, the most recent year for which data was available and four years after the date from which current housing projections for the Gateway are based. 'After' refers to an undefined period after new development. The study end year is 2016.
- 'Total water use' refers to total demand by all licensed abstractors, for all sectors, including the public water supply (domestic and non-domestic sectors and leakage), industrial abstractors and agriculture.
- An 'adjusted' leakage level is used in this study. Water companies forecast how they will manage leakage over time to meet regulatory requirements to reach and maintain an economic level of leakage (ELL). Thames Water's forecasts include leakage reductions to meet their ELL target in the London water resource zone (WRZ). All other water companies in the Gateway operate approximately at or below the ELL. In this study, the reduction in leakage required to achieve an ELL in the London WRZ part of the Thames Gateway is excluded. This means only leakage reductions that go beyond the levels in water company forecasts at the end of the study period (2015/16 forecast leakages) will be counted as a measure to achieve water neutrality. Actual leakage levels are identified in the baseline section of this report.
- The source of water supply is not taken into consideration, except for non-public water supply abstractors above the 20 m^3/day licensing threshold.
- Water reuse (grey water and black water) or rainwater capture and storage is not counted as an addition to 'water use' or 'demand'. This means that water use is only counted once as it enters the building (or development/ local area) from a source, regardless of how many times it is used within the site. Other non-potable supplies (directly abstracted within the Thames Gateway) are regarded as a 'new source'. The study assumes that lower carbon options are preferable to higher carbon ones, which may favour additional non-potable supplies over potable ones where drinking quality is not required.
- Total water use is on an annualised basis in million litres per day (Ml/day).
- The influence of peak demand patterns is not directly addressed in the modelling of the baseline. However, the potential impact of different water efficiency options on exaggerating the peak:average demand ratio is explicitly considered in the pathway scenarios.

- Even if water neutrality is feasible, significant parts of the Gateway are currently over-abstracted, meaning the problem of over-abstraction and the risk of more frequent seasonal shortages will remain, and may be exacerbated by climate change. Achieving water neutrality will not necessarily entail sustainable water use in all parts of the Gateway.

4 Baseline demand for water

To determine whether water neutrality is feasible in the Thames Gateway, it is necessary to estimate the baseline and future demand for water under 'business-as-usual' scenarios. The baseline demand for water represents the level of demand in 2005/06 that is met by water companies and the amounts of water taken from the environment by other abstractors, such as agriculture.

Entec UK Ltd was commissioned by the Environment Agency to undertake the modelling for this study. This section provides a summary of the approach and results.

4.1 Approach

4.1.1 Adjusted (forecast) baseline

In this section two baselines are presented. One is the forecast baseline water use, which includes the water lost through leakage from the water companies' 2005/06 forecasts. The other is an adjusted forecast baseline water use with leakage reduced to the 2015/16 forecast level (see Section 3.3). This adjusted baseline water use is used as the base year in the business-as-usual scenario.

The adjusted forecast baseline is used because the Thames Gateway is to be an exemplar development area. It would not be appropriate for any forecast leakage reductions already planned by water companies within the study period to be counted as reaching water neutrality. The Thames Gateway has unusually high leakage levels (due in part to Thames Water not operating at or below the ELL in the London zone) so 'easy wins' against the water neutrality target are possible through leakage reduction. As the majority of water companies are operating at or below the ELL, including these leakage reductions would make the study less transferable to other areas.

4.1.2 Data sources

Two main sources of data were used to estimate the demand for water in the Thames Gateway. Water company demand represents the majority of water abstracted from the environment, where this water is used for public water supply (PWS). The Thames Gateway is served by four water companies: Thames Water, Essex and Suffolk Water, Southern Water and Mid Kent Water. Water company supply areas are sub-divided into water resource zones (WRZs), as shown in Figure 4.1.

The data used to estimate demand from the public water supply was taken from projections in the water resource plans produced by water companies as part of the periodic review process in 2004 (PR04). The baseline year was taken to be 2005/06[5]. The study used PR04 dry year annual average forecast data for this year, with the exception of Thames Water. Thames Water updated its water resource plan in 2006 and this updated data was used instead.

[5] Except in the case of leakage (see Appendix 7 in the Supplementary Technical report).

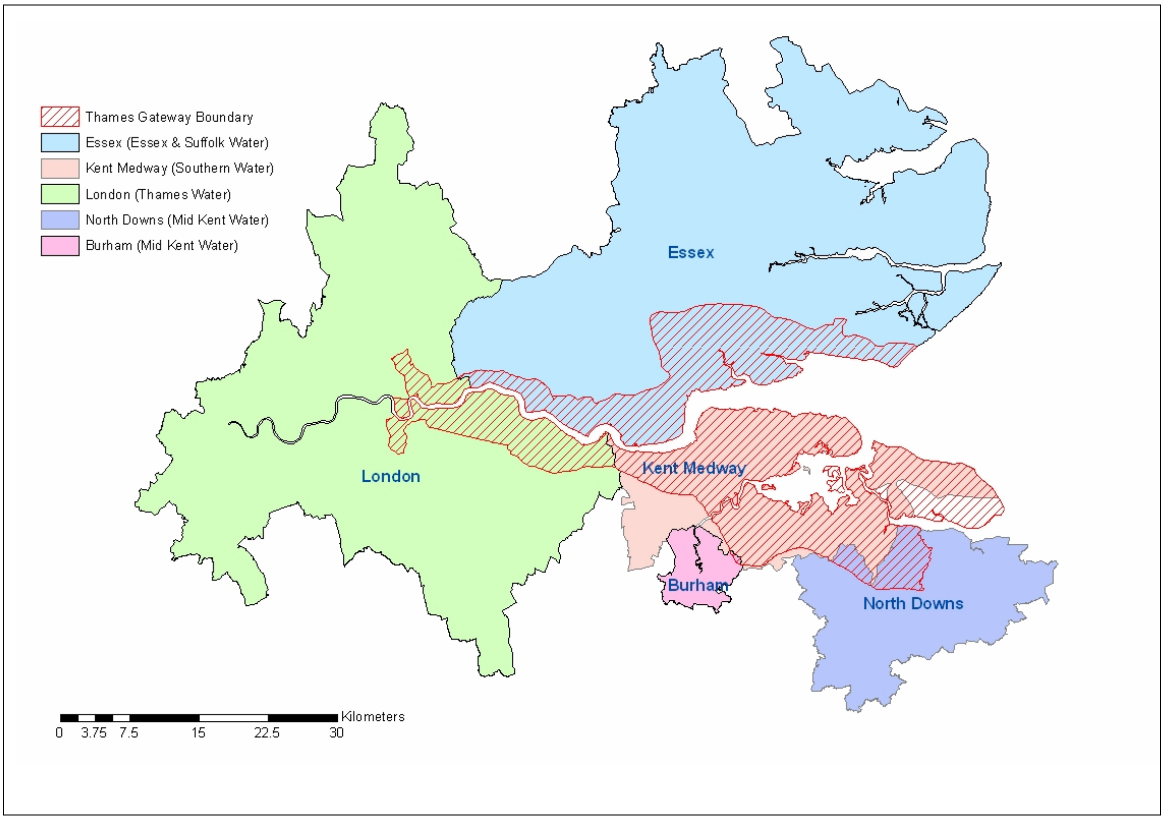


Figure 4.1: Water Company resource zones within the Thames Gateway

Dry year demand will be higher than demand in a normal year and is the level of demand that water companies plan for. Forecast rather than reported (actual) data was used here because reported demand for 2005/06 (a dry year) was influenced by water restrictions due to the prolonged dry period. The difference between forecast data for 2005/06 and the six-year average demand data from 2000/01 to 2005/06 as reported by water companies was of low significance, at under three per cent.

Water abstracted for uses other than PWS, for example for agriculture and industrial processing, was also considered using data on actual abstractions supplied by the Environment Agency. Only abstractions over 20 m^3 per day require a licence. No records are kept of abstractions smaller than this amount and so smaller abstractions were not considered. Only fresh water abstractions were included in this study. This meant that licensed abstractions in the tidal reaches of the Thames Gateway, for users such as power stations, were not included.

A basic baseline carbon assessment for the PWS was produced using data published by Water UK (Water UK, 2006). This was based on emissions produced from the supply of water and treatment of wastewater and did not include emissions associated with the energy required to heat, pump or treat water once inside buildings. While the data on carbon emissions for water companies was limited, there were even greater obstacles to assessing the carbon emissions from non-PWS uses, as no records appear to have been collected on the extent of pumping or treatment involved. Therefore, no assessment was made for non-PWS related carbon emissions.

4.2 Baseline: Results

Baseline results are summarised in Table 4.1 and Figures 4.2 to 4.4.

4.2.1 Baseline: Headline findings

i. The **(forecast) baseline for water use** is estimated as 541 Ml/day. This represents the estimated total demand for water (in a dry year) in the Gateway region in 2005/06 and includes all water put into supply by water companies and private abstractors, and 2005/06 forecast leakage levels.

ii. The **adjusted (forecast) baseline for water use** is approximately 521 Ml/day, which has leakage adjusted to the 2015/16 forecast level to exclude water companies planned leakage reductions. This adjusted baseline is the baseline referred to in the remainder of the report, unless explicitly stated.

iii. The London zone accounts for the largest portion of demand, at about 40 per cent of the total. The Kent Medway and Essex zones each account for approximately 30 per cent of total demand. The North Downs and Burham zones account for less than one per cent of the total demand, because only a small part of their boundaries fall into those of the Gateway.

iv. Water used for PWS accounts for around 89 per cent of the total demand.

v. Household consumption accounts for approximately 50 per cent of the total demand for water in the Gateway. Unmeasured household consumption is the largest overall component, at approximately 40 per cent of the total. Measured household demand accounts for nine per cent of the total, as only a quarter of dwellings are on a metered supply (Table 4.1).

vi. Average per capita consumption (pcc) (averaged for both metered and unmetered consumers) is similar across the Gateway, at around 169 litres/head/day (l/h/d). This is greater than the widely quoted average pcc for England and Wales usually in the range of 150-160 l/h/d, partly because the analysis is based on dry year annual average forecast data. The average reported pcc for the area for the period 2001/02 to 2005/06 is 163 l/h/d.

vii. Non-household demand and leakage are the next largest components with around 21 per cent and 17 per cent respectively, followed by non-public water supply abstractions at 11.5 per cent.

viii. The zone with the highest levels of leakage is London at 47.5 Ml/day; this volume represents nine per cent of total demand for water in the Gateway (leakage accounts for a quarter of demand in the London zone). Leakage in the Essex and Kent Medway zones each represent about four per cent of total water use in the Gateway. The London zone has particularly difficult circumstances such as century-old mains, clay soils, heavy traffic and a large proportion of hard surface. Thames Water is not yet operating at the ELL in the London zone, but leakage reductions needed to reach the ELL are not included in this baseline. These and other company reductions total approximately 20 Ml/day from 2005/06 to 2015/16 and are included in the (non-adjusted) forecast baseline for water use.

ix. Combined non-household demand (PWS and non-PWS) is greatest in Kent Medway at around 66 Ml/d, approximately 13 per cent of the total. Non-household demand (PWS only) is the greatest in London (45 Ml/day), making up approximately nine per cent of demand.

x. Total carbon dioxide (equivalent) emissions for the Gateway PWS for the supply of water and treatment of wastewater are estimated at 117,085 tonnes CO_2e/year. This is under three per cent of the total carbon dioxide (equivalent) emissions for the water sector (4.1 MtCO_2e) (in total the water sector contributes 0.6 per cent to total UK emissions).

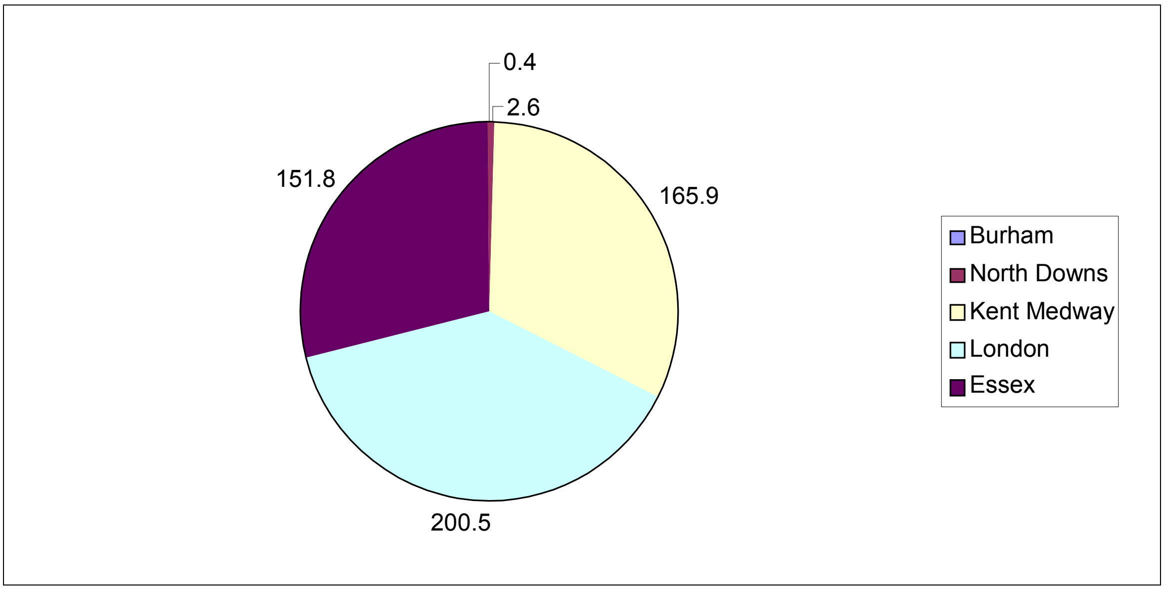


Figure 4.2: Total demand by water resource zone in the Thames Gateway (adjusted forecast baseline) (in Ml/day)

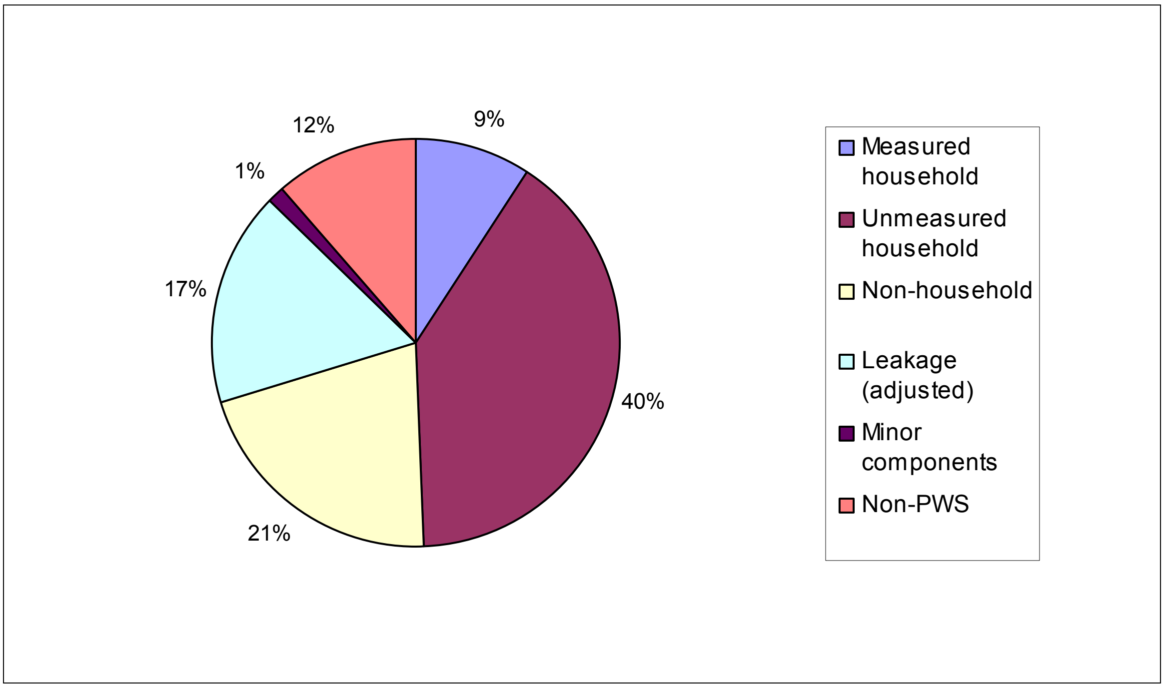
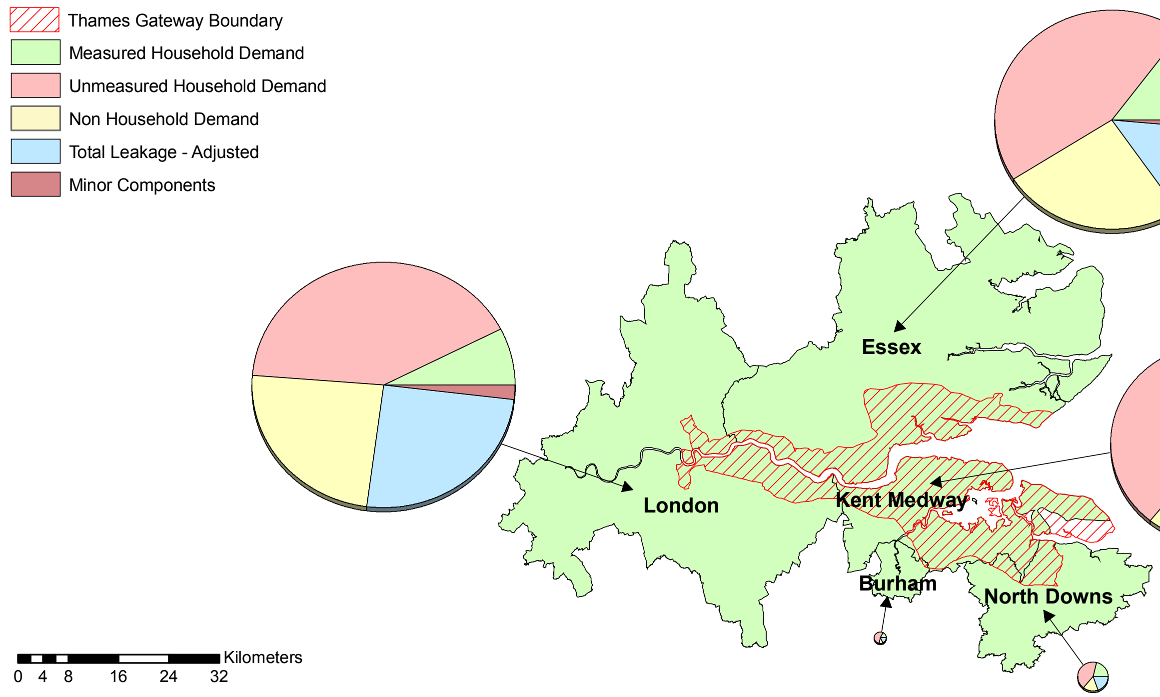


Figure 4.3: Total demand by components in the Thames Gateway (adjusted forecast baseline)

Table 4.1: Thames Gateway adjusted baseline (2005/06) expressed in Ml/d and as a percentage of total demand

Water resource zone	Measured household consumption Ml/d	Unmeasured household consumption Ml/d	Non-household demand Ml/d	Total leakage Ml/d	Minor components Ml/d	PWS total demand Ml/d	Non-PWS 2000-05 average Ml/d	Total baseline demand Ml/d
Burham	0.07	0.22	0.04	0.07	0.00	0.40	0.00	0.4
North Downs	0.53	1.09	0.42	0.49	0.02	2.55	0.00	2.6
Kent Medway	12.49	64.90	23.06	20.91	1.04	122.39	43.50	165.9
London	13.32	77.96	44.81	47.47	3.38	186.94	13.60	200.5
Essex	21.51	65.88	39.24	20.25	2.09	149.0	2.80	151.8
Thames Gateway	**47.93**	**210.04**	**107.56**	**89.18**	**6.53**	**461.24**	**60.01**	**521.25**
	Measured household consumption (%)	**Unmeasured household consumption (%)**	**Non-household demand (%)**	**Total leakage (%)**	**Minor components (%)**	**PWS total demand (%)**	**Non-PWS 2000-05 average (%)**	**Total baseline demand (%)**
Burham	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
North Downs	0.1	0.2	0.1	0.1	0.0	0.5	0.0	0.5
Kent Medway	2.4	12.5	4.4	4.0	0.2	23.5	8.3	31.8
London	2.6	15.0	8.6	9.1	0.6	35.9	2.6	38.5
Essex	4.1	12.6	7.5	3.9	0.4	28.6	0.5	29.1
Thames Gateway	**9.2**	**40.3**	**20.6**	**17.1**	**1.2**	**88.5**	**11.5**	**100.0**



TGW 2005/06 Adjusted	
Population Total	1,523,379
Household Total	613,398
Total PWS Demand (Ml/d)	461.2
Average PCC (l/h/d)	169.3
Household Metering %	25%
Non PWS (Ml/d)	60.0
Total Demand (Ml/d)	521.2

Essex 2005/06 Adjusted	
Population Total	524,439
Household Total	208,998
Total PWS Demand (Ml/d)	149.0
Average PCC (l/h/d)	166.6
Household Metering %	35%
Non PWS (Ml/d)	2.8
Total Demand (Ml/d)	151.8

London 2005/06 Adjusted	
Population Total	540,833
Household Total	220,384
Total PWS Demand (Ml/d)	186.9
Average PCC (l/h/d)	168.8
Household Metering %	17%
Non PWS (Ml/d)	13.6
Total Demand (Ml/d)	200.5

Kent Medway 2005/06 Adjusted	
Population Total	446,672
Household Total	179,951
Total PWS Demand (Ml/d)	122.4
Average PCC (l/h/d)	173.3
Household Metering %	22%
Non PWS (Ml/d)	43.5
Total Demand (Ml/d)	165.9

North Downs 2005/06 Adjusted	
Population Total	9,702
Household Total	3,314
Total PWS Demand (Ml/d)	2.55
Average PCC (l/h/d)	167.01
Household Metering %	37%
Non PWS (Ml/d)	0.03
Total Demand (Ml/d)	2.58

Burham 2005/06 Adjusted	
Population Total	1,732
Household Total	751
Total PWS Demand (Ml/d)	0.40
Average PCC (l/h/d)	168.30
Household Metering %	32%
Non PWS (Ml/d)	0.00
Total Demand (Ml/d)	0.40

Figure 4.4: Adjusted forecast baseline (2005/06)

5 Business-as-usual demand for water

The 'business-as-usual' (BAU) demand for water is a forecast of how demand is likely to change without any interventions to manage it beyond existing policy, behavioural or technological drivers. This forecast is made between 2005/06 and 2016.

A number of uncertainties will affect demand under this scenario, with a range of possible outcomes. The extreme ends of this range are an Upper Savings Scenario, which assumes the most optimistic uptake of current and expected policy tools; and a Lower Savings Scenario, which assumes the least optimistic uptake of such tools.

For water neutrality to be achieved, a volume of water equal to the difference in demand between the baseline and business-as-usual scenario needs to be saved. In line with the precautionary principle, the Lower Savings Scenario is the target volume for water neutrality, and is referred to in the results section unless stated otherwise.

This section outlines the approach taken to estimate the business-as-usual demand for water, with results. The full analysis by Entec UK Ltd is provided in a separate report.

5.1 Approach

In the BAU scenarios, water company data was used to estimate demand for water from the public water supply. This data was manipulated where appropriate and possible to account for information such as recent developments in policy. Demand forecasts were grouped into four types: demand from existing development, demand from new development, leakage (and minor components) and non-public water supply abstractions.

No allowance was made for 'headroom'. Water companies include a headroom estimate on top of their demand forecasts to allow for uncertainty. For new developments, the range is 10-20 per cent. This headroom can be met through supply or demand side measures and should be considered when reading the results.

5.1.1 Demand from existing development

Future demand from existing households was forecast using the baseline forecast of the number of homes proportioned to each resource zone in the Thames Gateway. This was multiplied by water company forecasts (for PR04) of average household size and per capita consumption to calculate total demand. Both the impact of metering on consumption and the expected growth in households moving to a metered supply (at a rate according to water company plans) were considered. These rates may be conservative in light of the outcome of the consultation on compulsory metering in water-stressed areas. There was no differentiation between Upper and Lower Savings Scenarios for existing homes.

Forecasting demand for existing non-households was based on water company data (for PR04) and proportioned to the Gateway. Future demand from individual large users was assumed to remain static. The remaining proportion of non-household consumption was based on growth forecasts by water companies, though it was difficult to establish how much the forecasts took commercial growth into consideration.

5.1.2 Demand from new development

Demand from new households

This study uses housing projections from the Thames Gateway Development Prospectus (CLG, 2006a) for just over 165,000 new homes to be built between 2001 and 2016. The capacity of housing across the Gateway is an estimate by Communities and Local Government, based on the Regional Spatial Strategies and the best available information at the time (Summer, 2007). Forecasting demand from new households (households in new homes) is subject to more uncertainty than existing homes. The number of new homes is a projection that may or may not be delivered to that planned and the average size of households that are formed in the new housing is also uncertain. Forecast demand was therefore modelled assuming a 10 per cent increase and 10 per cent decrease in the number of new homes built compared with that planned to show what impact different levels of housebuilding may have on total demand.

To reflect uncertainties in the impacts of policy currently being developed and/or implemented, two BAU scenarios were generated (see Figure 5.1). These represented an upper and a lower estimate of new household demand for water. Where a policy measure was new and there was little or no evidence to gauge effectiveness, the lower savings estimate took the most pessimistic approach and assumed no change from current practice. Expectations of the policy measure could actually be higher than this and these were reflected in the range from lower to upper savings.

Table 5.1: Comparison of Upper and Lower Savings Scenarios for new homes

BAU Upper Savings Scenario	BAU Lower Savings Scenario
30 per cent of new homes (assumed to be 'social' homes[1]) to reach an average of Level 3 of the Code for Sustainable Homes[2] (CSH) from 2008/09.	15 per cent of new homes (assumed to be 'social' homes) to reach an average of Level 3 of the Code for Sustainable Homes (CSH) from 2008/09[2].
5 per cent of new homes assumed to be privately funded to achieve CSH Level 3 from 2008/09 (CLG, 2006c)[3].	2.5 per cent of new homes assumed to be privately funded to achieve CSH Level 3 from 2008/09 (CLG, 2006c)[3].
65 per cent (the remainder) of new homes assumed to be privately funded and to achieve an assumed pcc of 120 l/h/d from 2009/10[4]. Water company-measured pcc figures in PR04 applied pre-2008.	82.5 per cent (the remainder) of new homes assumed to be privately funded and to achieve the forecast metered household pcc of 137 l/p/d in water company PR04 plans[5].

[1]All new homes built with government funding by registered social landlords, by English Partnerships or with direct funding from government programmes to comply with CSH Level 3 from 2007 (CLG, 2007c). Estimates of the number of planned homes on English Partnerships land in the Gateway were available, but none was available from the Housing Corporation at the time of writing, so a 'best estimate' of 15-30 per cent was used. A delay period of one year to account for time from design to completion was added to 2007 date.
[2] Code Level 3 requires homes to be designed to 105 l/h/d. CSH levels relate only to internal water use, so an outdoor use value was added to each CSH level using data from WRc, in the range of 11-12 l/h/d.
[3] Estimated uptake of CSH in private homes is based on the Regulatory Impact Assessment of CSH, which is in turn based on uptake rates of EcoHome standards. These are rough estimates; actual uptake may be higher when all new homes are required to have a mandatory code rating (CLG, 2007e).

[4] This represents the internal component of the new regulatory minimum standard for water use in new homes outlined in policy statement, *Water efficiency in new buildings*. New standard is 125 l/h/d, with four per cent of this volume representing a nominal amount for outdoor use. New regulation comes into force in 2008, but the modelling has allowed a one-year delay between design and occupation of a new home.
[5] We used current average pcc for new homes in the London, Essex and Kent Medway WRZs of 137 l/h/d.

Demand from new non-households

Forecasting demand for non-household buildings is subject to greater uncertainty than new households. This is because the level of demand will fluctuate depending on the types of industry or businesses located in or departing from the area, which will depend on a range of factors largely outside of government and water company control.

Plans for the Gateway include the creation of conditions for 180,000 new jobs by 2016. Stratford will host the London Olympic and Paralympic Games in 2012, with hundreds of thousands of visitors. It was not clear whether non-household forecasts in water company PR04 plans included some, all or none of the expected growth in non-household demand resulting from the Thames Gateway development. Therefore, this study estimated water use from these new jobs in addition to non-household demand forecasts in water company plans. The following broad assumptions were made:

- All new jobs are office-based, with no new demand for industrial processes.
- Daily water consumption by office workers in new buildings (in addition to household consumption) is estimated to be 20 l/h/d (CLG, 2006c) for the Lower Savings Scenario and 16 l/h/d for the Upper Savings Scenario.
- New jobs are created linearly from 2005/06 to 2015/16.

Water demand from the 10 largest non-household consumers in each WRZ in the Gateway (included in the companies' PWS allowance) was assumed to remain static throughout the planning period, as there was no data to suggest otherwise.

In addition, the announcement that London would host the 2012 Olympic and Paralympic Games was made after PR04 and was not factored into water company plans. Demand associated with the 2012 London Olympics and Paralympics (separate from the accompanying regeneration) was estimated separately for this study and an additional forecast was included (see Appendix 3 in the supplementary report).

5.1.3 Leakage

Total leakage in all the zones within the Gateway, except London, was based on the resource zone leakage per property per day PR04 forecasts over the period to 2016. Leakage in the London zone was calculated using a different method, due to the significant variation in leakage levels in different areas of the zone and the more specific data available on baseline levels of leakage. Estimates of the amount of water that would have been saved through planned leakage reductions prior to 2005/06 were identified in the baseline.

Forecasts for other components of demand (all minor) from the public water supply were taken from PR04 submissions, where they were assumed to be static.

5.1.4 Non-public water supply abstractions

Non-public water supply abstractions were assumed to remain static throughout the planning period, based on actual trends from 2000-2005 when no significant change in demand was recorded.

5.1.5 Carbon assessment

The assessment of BAU carbon emissions used the same assumptions as for the baseline. For the purposes of this study, it was assumed that CO_2e emissions to treat every million litres of water and wastewater would remain at the baseline level. This assumption was a simplification, given that energy requirements will fluctuate with changing demand, upgrades/replacements or deterioration of assets, and changes in water treatment processes. Inclusion of the water sector in the proposed Carbon Reduction Commitment should encourage reduction of the industry's carbon footprint.

Carbon emissions change with time due to the combination of sources supplying the national grid. Further changes could be expected with uptake of renewable resources, but will also depend on issues such as government policy on nuclear power generation. In the absence of information, it was assumed that emissions would remain constant.

5.2 BAU results

5.2.1 Headline findings

i. Based on 165,523 homes being built between 2001 and 2016, the net total demand for water in the Thames Gateway is forecast to increase by seven to eight per cent, to approximately 561 to 563 Ml/d in 2016 from an adjusted forecast baseline of 521 Ml/d in 2005/06 (Table 5.2, Figures 5.1 and 5.2). This is a difference of 40-42 Ml/d. The range represents the BAU lower and upper savings estimates.

ii. Modelling demand for water on the basis that 10 per cent fewer or more homes will be built than the planned 165, 523 increases the range of forecast demand to between 36 and 46 Ml/day (Figure 5.2 and Table 5.2).

iii. Of the total increase in demand of 39-42 Ml/d, new households account for between 40 to 42 Ml/d by 2016 from the 2005/06 baseline (Figures 5.1 and 5.2, Table 5.3). New households are therefore almost totally responsible for the total increase in demand.

iv. Existing homes are forecast to show a slight decrease in demand of 2 Ml/day from a baseline of 258 Ml/day.

v. Non-household demand is forecast to increase by around 2-3 Ml/day from a baseline of roughly 108 Ml/day. This demand includes an allowance of 3 Ml/day for the Olympic Games in 2012, and 0.3 Ml/d a year for each year (3 Ml/d total) of the period to 2016 associated with the 180,000 new jobs.

vi. Leakage is forecast to remain stable, where the baseline has been adjusted to remove planned leakage reductions by Thames Water to 2016.

vii. Demand from water taken unbilled, water used for maintenance purposes and non-PWS abstractions are forecast (or assumed) to remain stable.

viii. The geographical distribution of demand for water between the five water WRZs will remain roughly the same between 2005/06 and 2016.

ix. Carbon emissions from the supply of water and treatment of wastewater are forecast to increase by around nine per cent between 2005/06 and 2016, to approximately 127,110 to 127,760 tonnes CO_2e per year.

Table 5.2: Summary of demand for water under the BAU scenarios

BAU scenario	**Baseline 2005/06 (Ml/d)**	**Year 2015/16 (Ml/d)**	**Total volume (Ml/d)**
BAU Upper (- 10% housing)	521	557	36
BAU Upper	521	561	40
BAU Lower	521	563	42
BAU Lower (+ 10% housing)	521	567	46

All figures rounded to nearest whole number.

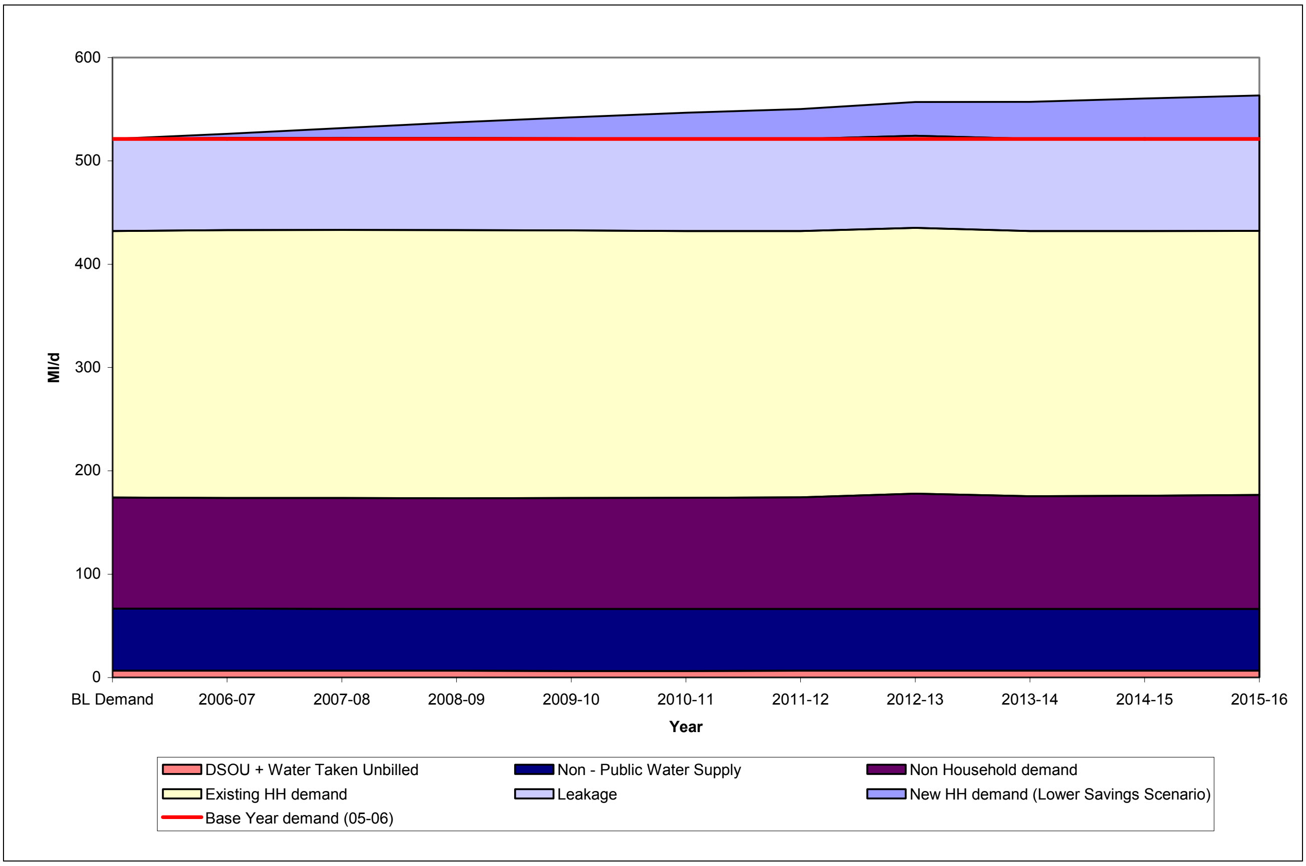


Figure 5.1: Thames Gateway demand forecast by component (BAU Lower Savings Scenario)

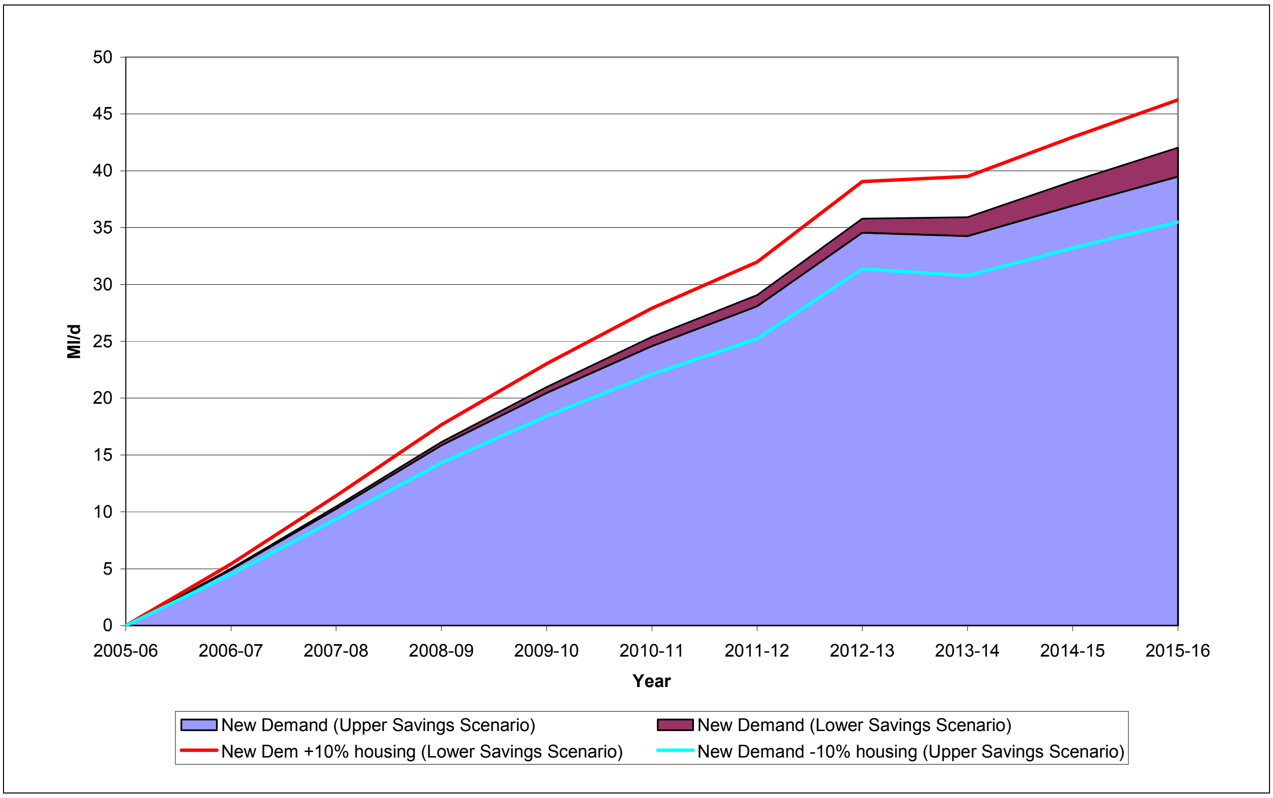


Figure 5.2 : Business-as-usual demand

5.3 Discussion of findings

The results suggest that to achieve water neutrality (based on 165,500 new homes), water savings of 40-42 Ml/d are needed above any savings estimated in the business-as-usual scenario. This level of water saving may seem low relative to current demand and the scale of development planned for the Thames Gateway. However, these findings need to be put into context.

The water neutrality target of 40-42 Ml/day is significant, roughly equal to the volume that the proposed reservoir in Broad Oak, Kent is expected to deliver. Although a precautionary approach has been taken with regard to per capita demand savings, the 40-42 Ml/day target could be considered a conservative estimate. Building 10 per cent more housing over the period to 2016 could increase demand by a further 4 Ml/day. Headroom considerations would add 10-20 per cent, increasing the estimated target to 51 Ml/day.

The growth in water demand is more or less entirely due to new household and population growth between 2005/06 and 2016 in the Thames Gateway. This is because the forecast small growth in demand from non-households is offset by the forecast decrease in demand from existing homes.

Demand from existing homes is forecast to decrease by around 2 Ml/d. This may seem counter-intuitive, given that decreasing household size and increasingly aspirational lifestyles are expected to increase household demand. The relative stability is explained by several interacting factors (see Section 4.6 in the supplementary report):

- Meter penetration in the Thames Gateway is low (relative to some other neighbouring areas and most other European countries), at around 25 per cent in the baseline year. Meter penetration is forecast to significantly increase over the ten-year period according to water company plans, with the London and Essex zones forecasting total measured household demand to be higher than unmeasured demand by 2016. Households on metered supplies have an incentive to moderate their consumption and studies have shown that metering can reduce demand by around 10-15 per cent.
- Average household size in existing homes is expected to fall overall, in line with demographic trends. Although smaller households tend to have higher pcc than large households, the overall reduction in the number of occupants should mean a reduction in total demand from those homes.
- Per capita consumption will be affected by improvements in the efficiency of appliances and devices and by policies that encourage or mandate their take-up. Water companies include some assumptions about these changes in their pcc forecasts.

Water companies estimate that the savings from these factors will more than offset any forecast increase in average pcc in existing households. However, the assumption on increasing metering rates is uncertain as it depends on companies improving penetration rates, which may not occur.

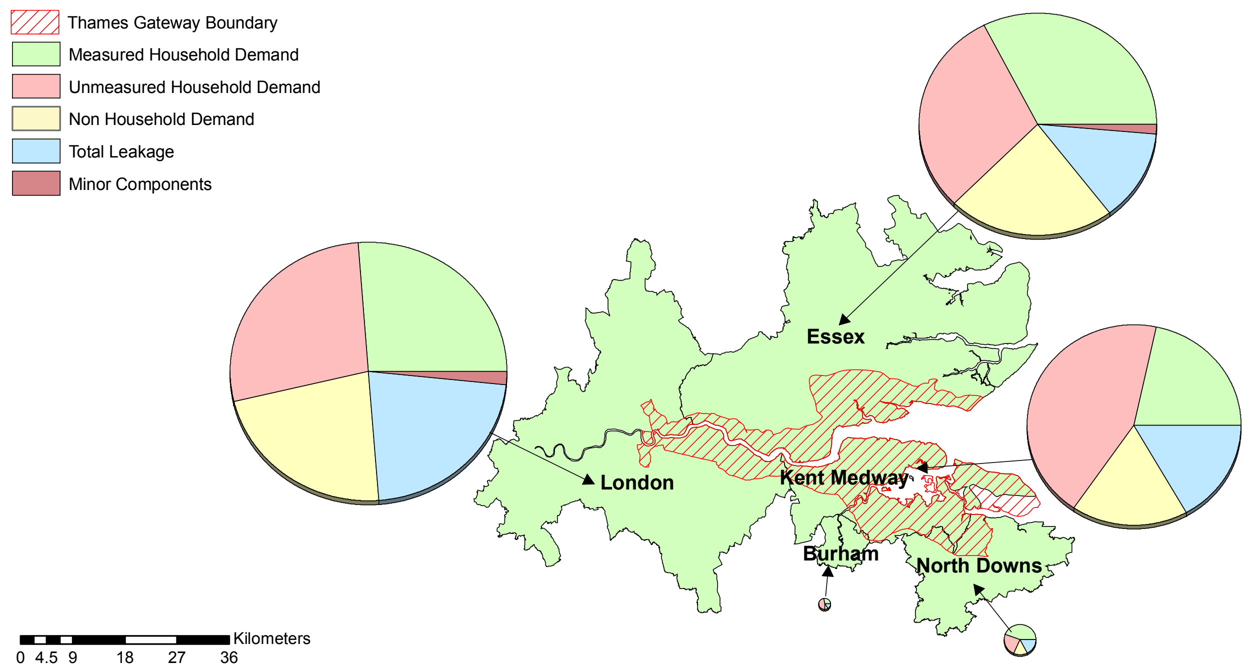
The slight increase in non-household demand is also surprising considering the job creation and Olympic plans for the Gateway, which would be expected to increase non-household demand quite substantially. However, demand is forecast to increase by only 2-3 Ml/day over the period 2005/06 to 2015/16. It is difficult to discern from the data available what factors have been considered in water company forecasts and whether they adequately account for future job creation. An allowance was made in this study for the Olympic Games and the impact of job growth on water demand.

The impact of just one or two large water users (such as a chemical plant or printing works) can be significant on (non-household) demand for water if they relocate out of, or into, the Gateway and the change is not offset by other changes in demand in the area. For example, some of the largest customers in the area use around 9-10 Ml/d.

Table 5.3: Thames Gateway BAU 2016 (Upper-Lower Savings Scenario) in Ml/day

Water resource zone	New household demand Ml/d	Measured household consumption Ml/d	Unmeasured household consumption Ml/d	Non-household demand Ml/d	Total leakage Ml/d	Water taken unbilled Ml/d	DSOU* Ml/d	PWS total demand Ml/d	Non-PWS 2000-05 average Ml/d	Total demand Ml/d
Burham	0.0	0.1	0.2	0.0	0.1	0.0	0.0	0.4	0.0	0.4
North Downs	0.3	0.9	0.7	0.4	0.5	0.0	0.0	2.8-2.9	0.0	2.8-2.9
Kent Medway	4.6-5.5	21.7	55.5	23.4-23.6	20.9	0.9	0.1	127.2-128.3	43.5	170.7-171.8
London	25.3-25	31.2	58.3	48.2-48.7	47.5	2.8	0.5	214.2-213.8	13.6	227.4-227.5
Essex	9.8-11	40.9	46.2	37.4-37.5	20.2	1.8	0.3	154.0-156.5	2.9	159.4-160.7
Thames Gateway	**40-41.9**	**94.9**	**160.8**	**109.5-110.2**	**89.2**	**5.5**	**0.9**	**500.8-503.3**	**60.0**	**560.8-563.3**

* Distributional System Operational Use



TGW 2016 Adjusted	
Population Total	1,831,379
Household Total	746,972
Total PWS Demand (Ml/d)	503.3
Average PCC (l/h/d)	162.4
Household Metering %	46%
Non PWS (Ml/d)	60.0
Total Demand (Ml/d)	563.3

Essex 2016 Adjusted	
Population Total	593,068
Household Total	240,102
Total PWS Demand (Ml/d)	157.8
Average PCC (l/h/d)	165.3
Household Metering %	53%
Non PWS (Ml/d)	2.8
Total Demand (Ml/d)	160.7

London 2016 Adjusted	
Population Total	744,814
Household Total	306,604
Total PWS Demand (Ml/d)	213.9
Average PCC (l/h/d)	153.7
Household Metering %	49%
Non PWS (Ml/d)	13.6
Total Demand (Ml/d)	227.5

Kent Medway 2016 Adjusted	
Population Total	479,958
Household Total	195,236
Total PWS Demand (Ml/d)	128.3
Average PCC (l/h/d)	172.4
Household Metering %	33%
Non PWS (Ml/d)	43.5
Total Demand (Ml/d)	171.8

North Downs 2016 Adjusted	
Population Total	11,807
Household Total	4,279
Total PWS Demand (Ml/d)	2.87
Average PCC (l/h/d)	164.53
Household Metering %	66%
Non PWS (Ml/d)	0.03
Total Demand (Ml/d)	2.9

Burham 2016 Adjusted	
Population Total	1,732
Household Total	751
Total PWS Demand (Ml/d)	0.40
Average PCC (l/h/d)	170.00
Household Metering %	37%
Non PWS (Ml/d)	0.00
Total Demand (Ml/d)	0.40

Figure 5.3: Business-as-usual demand 2016 (Lower Savings Scenario)

6 Developing the pathway scenarios

The BAU scenarios identified the extent to which the demand for water within the Thames Gateway is likely to increase, without any new interventions to manage that demand, from the baseline in 2005/06 to 2016. The most pessimistic BAU scenario (based on 165,523 new homes within the period) predicted a rise in demand of 42 Ml/d.

The purpose of the pathway scenarios was to determine whether it was technically feasible to minimise the supply-demand gap by demand management measures alone, and to identify what measures might be needed and on what scale. In developing the pathway scenarios, consideration was given to: the financial and approximate carbon cost of different options; whether a measure was likely to increase the peak:average demand for water ratio; and the results of the survey of residents.

This section outlines the approach and assumptions used in the modelling of the scenarios. A summary of the results are presented in Chapter 7. The full details of the modelling by Entec UK Ltd are provided in a supplementary report.

6.1 Approach

The broad approach to developing the scenarios was to:

- using existing evidence, make assumptions for a range of measures that could be included in scenarios (such as expected water savings and cost);
- assess the feasibility of measures or groups of measures in the modelling (for example, based on least uncertainty or public acceptability);
- define goals and strategies for different scenarios (for example, to move towards, reach or go beyond neutrality with emphasis on different sectors/approaches);
- model the scenarios and calculate costs;
- modify the scenarios following feedback from government departments, the project steering group, the survey of residents and other stakeholders including house-building representatives;
- finalise the scenarios and costs.

In developing the pathway scenarios, different sectors of demand were grouped together. However, while the BAU scenario categories were: demand from existing development, demand from new development, leakage (and minor components) and non-PWS abstractions, in the pathway scenarios only the first two categories were fully developed. There was insufficient data and/or large uncertainties around the potential future use of non-PWS abstractions and costs of further leakage reductions beyond the ELL (see Section 5.11 in the supplementary report by Entec). Demand from these sectors was assumed to be the same as in the BAU scenarios. An estimate of the potential costs of going beyond the ELL is presented in Section 7.2. The major focus of potential demand savings from existing and new development was from the household sector, although demand savings from the non-household sector were also explored.

6.2 Assessment of measures

All known, feasible water-efficiency technologies were considered and assumptions on their potential water savings, costs, current ownership and feasibility of implementation identified. Measures were assessed for their appropriateness in managing demand for water and in which setting: new or existing, homes or offices, and on what scale: individual property or at different scales within a community. The following sections outline the measures used for each sector.

6.2.1 Existing homes

Two sets of measures were applicable to existing homes only: retrofitting fittings and increasing the number of metered homes. Variable tariffs were applied to existing and new homes and are discussed separately.

Retrofit

Table 6.1 outlines the preferred retrofit measures and assumptions in the scenarios.

Table 6.1: Measures in existing homes

Appliance	Average saving (l/ household/d)	Average saving (l/head/d)	Description	Assumptions	Cost (£)
Variable flush retrofit device	24.65	10.27	Variable flush device retrofitted to existing WCs	Can only be fitted in approximately 70 per cent of WCs	8
Ultra-low flush WC replacement	53.1	22.13	WC replacement	Average usage currently 50 litres per head per day for WC flushing. If assume 4.5-litre flush at 1.5 toilets per household and only one is low flush at an average flush rate of 4.1 flushes/person/day at an average household size of 2.38, then average saving = 53.1 l/Hhold/d. Average life of toilet = 16.5 years = six per cent of toilets changed each year.	140
Low-flow showerhead	12.9	5.38	Showerhead replacement	Average shower uses 10.8 litres/minute. LF showerhead uses 9 litres/minute. Average length of shower = 5 minutes. Number of showers taken = 1.43 per day Forty-three per cent of showers suitable.	15
Low-flow taps	2.7	1.13	Tapmagic inserts	Average water usage without restrictor = 6.5 l/minute (not operated at full flow). Water usage with flow restrictor = 5 l/min Number of uses per day = 16.9. Average length of use = 6.5 seconds.	5
Installation				Installation of variable flush, showerhead and tap retrofit devices only.	72

Measures that did not pass the screening process include: sub-ultra low-flush toilets (with full flush volumes less than four litres), dry (composting) toilets, flow control measures (reducing the flow of water into a building), garden measures such as water butts, rainwater harvesting and grey water recycling and publicity campaigns.

These measures were not included in the study for reasons mainly relating to the relative uncertainty in their water savings, because their widescale implementation in the years up to 2016 would be unlikely, or because they were already at market saturation. Some or all of these measures could nevertheless be used in the Gateway to deliver further savings.

Assumptions in the unit costs of retrofitting are outlined in Table 6.1. These costs are one-off capital costs for each property in the year of retrofitting. The installation cost of £72 per property applies to variable flush retrofit devices, low-flow showerheads and low-flow taps, whether one, two or three devices are fitted. The ultra-low flush WC replacement does not have an additional cost for installation, as it is assumed to be offered as a subsidy to households who would otherwise replace their toilets.

Based on the figures given in Table 6.1, the cost per household for retrofit installation varies from £232 for a household retrofitted with an ultra-low flush WC, low-flow showerheads and taps, to £77 for a household retrofitted with just low-flow taps.

Metering

A move to compulsory metering was included in all the pathway scenarios, reflecting the water saving impact of metering and the direction of government policy for seriously water-stressed areas (see Section 2.2.2). Furthermore, the resident survey revealed that this measure had the most public support.

The reductions in water use from switching from an unmeasured to a metered supply are difficult to define in a normal situation and are further complicated by the potential impact of other measures. Values typically quoted are in the range of 10-15 per cent of average annual demand (UKWIR, 2006). For this study, compulsory metering was assumed to result in a relatively conservative 10 per cent reduction in annual average demand (per capita).

Assumptions on metering took into account the timing of the next periodic review in 2009. If compulsory metering in the Thames Gateway is decided upon, it would require several years to implement. In this study, an annual rate of meter penetration five per cent higher than the water companies allowed for in their current water resource plans was assumed, close to the rate some companies indicated for metering on change of occupancy. Metering at this rate would result in 70 per cent of domestic properties in the Gateway being metered by 2016. All meters were assumed to be standard, that is, not 'smart meters'. Smart meters would be more costly, but would offer a greater range of benefits including a wider variety of tariff options and remote billing.

Assumptions for metering costs were based on the following:

- Thirty-five per cent of households assumed to have a boundary box in place – standard meter installation £71,
- Sixty-five per cent of households assumed to have no boundary box – standard meter installation £250.
- Meters assumed to be replaced every ten years, and operating cost of £10 per meter per year assumed.

6.2.2 New homes

The pathway scenarios investigated the effects of applying lower consumption rates to larger proportions of new households than considered in the BAU analysis. A gradual move towards greater water efficiency was assumed through building regulations and take up of the Code for Sustainable Homes (CSH). For ease of understanding, most consumption rates are assumed to relate to current levels of the CSH: for example, Level 1/2 (equivalent to building regulations for new homes), 3/4, 5/6 or 120, 105 and 80 l/h/d. As with the BAU scenarios, account was taken of external water use (omitted in standard CSH figures) with an allowance of around 11.5 l/h/d additional demand.

Code Level 5/6 can only be achieved through the use of rainwater harvesting; grey water recycling was not considered feasible in all but the Beyond Neutrality Scenario (Environment Agency, 2007b). In the analysis, the scenarios also examined the implications of a pcc level of 95 l/h/d and of 62 l/h/d. It might be possible to achieve a per capita consumption level of 95 l/h/d without the use rainwater harvesting or grey water recycling. This standard is intermediate between the water efficiency standards for Code Levels 3/4 and Code Levels 5/6. It might be possible to go beyond the pcc standard for Code Levels 5/6 and achieve a pcc of 62 l/h/d, but this would require that all water used for flushing WCs and in washing machines was derived from recycled water. In dry years both rainwater and grey water would be needed, but it is uncertain whether sufficient volumes of rainwater would be available in a dry year.

The costs of installing water-efficiency measures into new homes were also based on a report commissioned by the Environment Agency (2007b). Because installation would be carried out at the time of building construction, the costs of installation (other than for rainwater harvesting or grey water systems) would be unlikely to be different to those of the base scenario and were not included. Developers do not commonly install grey water recycling or rainwater harvesting systems; however, the cost of construction into a new build would not be as significant as retrofit. Table 6.2 summarises the cost assumptions per component and Table 6.3 summarises the cost by CSH level.

Table 6.2: Cost assumptions for new homes

Water efficiency measure	Total cost per household	Cost above standard	Assumptions
6-litre flush toilet (standard)	£134	£0	Two in house (2 x £67)
6/4-litre dual-flush toilet	£240	£106	Two in house (2 x £120)
3.75-litre toilet	£240	£106	Two in house (2 x £120)
Basin taps 5 l/minute (standard)	£20	£0	Two sets in house (2 x £10)
Basin taps 3 l/minute	£40	£20	Two sets in house (2 x £20)
Basin taps 1.7 l/minute	£120	£100	Two sets in house (2 x £60)
Kitchen taps 6 l/minute (standard)	£42	£0	
Kitchen taps 3 l/minute	£60	£18	
Mixer shower 48.72 l/use (standard)	£184	£0	
Mixer shower with low-flow showerhead 31.34 l/use	£209	£25	£25 for the low-flow showerhead
Bath 80 litres (standard)	£118	£0	
Bath 60 litres	£198	£80	
Rainwater harvesting/grey water recycling (individual household)	£2,300	£2,300	50% of systems assumed to be for individual households
Rainwater harvesting/grey water recycling (communal system)	£680	£680	50% of systems assumed to be communal

Table 6.3: Estimated average cost to achieve water efficiency standards over and above the cost of a standard home

Water efficiency standard	Cost per property over and above the cost of fittings in a standard new home (£)
120 l/h/d (CSH Level 1/2)	237
105 l/h/d (CSH Level 3/4)	309
80 l/h/d (CSH Level 5/6) and 62 l/h/d	2,866
95 l/h/d	586

6.2.3 Variable tariffs

Variable tariffs can increase water savings by increasing the economic incentive to reduce demand. In this study, 'variable tariffs' refer to rising-block tariffs that have higher unit rates for each unit of water above a certain threshold. At present, variable tariffs of this type are not used in the UK for household customers. Rising-block tariffs can be implemented using standard mechanical water meters that are read manually once or twice a year.

In this study, variable tariffs were assumed to provide an additional five per cent reduction in annual average demand on top of the 10 per cent reduction that metering alone would provide (switching from an unmeasured bill to a standard domestic measured tariff). This assumption was a best working estimate and was based on limited evidence not directly relevant to Thames Gateway or the scenarios being considered. The only two studies assessing the impact of seasonal tariffs in the UK looked at the introduction of seasonal metered tariffs in homes previously billed by rateable value, and occurred in the 1980s. A reduction of 12-17 per cent in average demand was shown, with higher reductions in the summer (UKWIR, 2006). This reduction was compared to unmeasured water use and represented savings due to metering and variable tariffs.

The five per cent assumption in this study took into account how behaviour might be affected in the study area during the period in question, but savings were still uncertain.

Variable tariffs were applied within this study to both existing metered households and new metered households from 2010-11 onwards. This is the first year of the next Asset Management Plan (AMP) period, thought to be the earliest point at which variable tariffs could be implemented. It was assumed that the variable tariffs would incur an operating cost of £5 per meter. This could be an overestimate as additional reading of the meter may not be required; however, upgrades to billing systems would be needed, which over the time period could be more or less than £5 a year.

6.2.4 Non-household

Non-households include offices, retail premises, commercial and industrial premises, service sector customers, public sector buildings and general municipal use (such as parks and gardens). Many of the uses of water in these different settings are specific to the site. It is difficult to build a 'bottom-up' picture of water use in non-households without a detailed understanding of individual users, which was not possible in this study. Therefore, a 'top-down' approach to assessing potential savings from all non-households (new and existing) was taken, with straightforward percentage reductions applied to total non-household demand data provided by water companies.

These percentage reductions were based on information from the Construction Industry Research and Information Association (CIRIA) and Envirowise. The former reported that office workers typically use 20 l/h/d whilst at work and that reduction in usage to 12 l/h/d is achievable – a 40 per cent reduction. The latter estimated the potential for demand reduction in other non-households (everything except for offices) to be between 20 and 50 per cent.

The proportion of total non-household demand made up of office water use was determined using data from Southern Water. This indicated approximately five per cent of non-household demand was currently from offices. Therefore, a 40 per cent reduction in demand was applied to five per cent of non-household use in the Thames Gateway, to account for the reductions possible in existing offices. For the rest of the non-household sector, a conservative potential savings rate for this portion of non-household demand was applied. Instead of the 20 to 50 per cent suggested by Envirowise, this study assumed a 10 per cent reduction in all but the Progressive Scenario, where no reductions from non-offices were assumed.

A detailed assessment of costs was not possible for this study. Instead a high-level range of potential costs was generated, based on the number of non-household properties within the Gateway multiplied by a range of possible retrofit costs.

6.2.5 Development-scale measures

A number of measures that would be unattractive at the domestic scale could be useful at the municipal scale, such as in a housing development. Technologies involving rainwater harvesting and various methods of grey water and black water recycling were considered here.

Development-scale measures offer some advantages over household-level installations, mainly in economies of scale for infrastructure costs and the maintenance (and reliability) of systems. These advantages are particularly relevant to grey water or black water recycling, such that these technologies would only be considered at a development scale.

Over the period of this study, rainwater harvesting would be the most likely measure to be implemented at the development scale in the Thames Gateway. While technologies exist for recycling grey water and black water, and these measures could be part of a water neutral solution in the later stages of the development, they are not yet sufficiently developed or accepted by the public for widescale implementation

Rainfall volume would be the main constraint to implementing rainwater harvesting on a widespread scale. Rainfall data shows that for the long dry period from September 2004 rainfall was low, averaging 374 mm for each of the two years. Whilst this is clearly exceptional, it is useful to understand how rainwater systems might perform during drought periods. Table 6.4 illustrates how under generous assumed roof areas (up to 100 m^2/property) the average daily household yield would be around 70 l/day compared to a demand for non-potable water of over 220 l/day. This is not enough to provide sufficient volumes to meet all non-potable demand during drought periods in this particular area, but it does show that even under drought conditions, rainwater harvesting could provide around 30 per cent of average annual non-potable demand.

The pathway scenarios took account of development-scale measures by adjusting the costs of recycling technologies to reflect the assumed cost savings of implementing development-scale measures instead of household-level ones.

Table 6.4: Comparison of rainwater harvested and demand in drought periods

Roof area m^2	Occupancy (persons per house)	Non-potable water use[1] (litres per property per day)	Rainwater used (litres/year)	Rain available (litres/day)	Percentage of non-potable demand met (%)
50	4	226	13,000	36	16
100	4	226	25,000	69	31
50	2.4	140	13,000	36	26

[1] EcoHomes frequency assumptions with 6.5-litre WC, 50-litre washing machine and 10 litres per day outdoor use (N Grant, personal communication)

6.3 Modelling the scenarios

A total of seven pathway scenarios were developed following experimentation and consultation with the steering group and others. Scenarios were set at the scale of the Thames Gateway. The scenarios reached increasing levels of demand management and are grouped into three main pathways:

- Progressive
- Neutrality
- Beyond Neutrality

The Progressive Scenario was designed to indicate the upper limit of what might be achieved by building incrementally on existing approaches to demand management. This scenario did not attempt to reach neutrality. The Beyond Neutrality Scenario made extremely ambitious assumptions on measures for new and existing homes and aimed to achieve water savings beyond water neutrality.

A total of five scenarios achieved neutrality:

- Scenario 1a:Higher retrofitting
- Scenario 1b: Higher retrofitting with variable tariffs
- Scenario 2a: Ambitious CSH
- Scenario 2b: Ambitious CSH with variable tariffs
- Scenario 3: Composite scenario with variable tariffs

The scenarios give a feel for different combinations of measures that could be adopted across the existing and new housing stock to achieve neutrality. Many different permutations would be possible, and none of the scenarios represents a technical or economic optimum.

Table 6.5 summarises the approach of each scenario. All include compulsory metering. The number of retrofitted homes varied by scenario, but for modelling purposes, the rate of uptake was assumed to be evenly spread across the period. For existing homes, there would be no opportunity costs related to year of implementation, but this would not be the case for new homes. Once a house was built, the opportunity for building it to a high water efficiency standard at relatively low cost would be lost. Furthermore, because the assumed house-building rates were not equal for every year

– with rates tapering off after 2011/12 – the number of homes affected and the water savings achieved would be much greater the earlier the higher levels were met.

Where variable tariffs were applied, these were used to dampen the effect of the extreme component of the scenario. This highlighted the potential effect that tariffs could have on the extent of measures needed. The impact on scenarios is described below and the results are expanded upon in Section 7.1.2. However, in Table 6.5, 'b' scenarios do not imply that the scenario retains an emphasis on retrofitting (in the case of Neutrality 1b) or on measures for new homes (Neutrality 2b), but that tariffs were applied to their 'a' equivalent.

Table 6.5: Summary of scenario analyses

Scenario name	Approach in existing houses	Approach in new houses	Effect of variable tariffs included?	Non-household assumptions
Progressive	Step up from BAU but limited retrofit and cautious approach to uptake of CSH, reflecting upper limit of what may be possible within current and potential future regulatory framework.		No	40% savings from offices only
Neutrality 1a – Higher retrofitting	High level of retrofit uptake assumed.	More ambitious CSH glide path than Progressive Scenario.	No	40% savings from offices and 10% from other non-households
Neutrality 1b – Higher retrofitting with variable tariffs	Retrofit uptake levels reduced from 1a to reflect effect of variable tariffs.	Same as Scenario 1a.	Yes	Same as Scenario 1a
Neutrality 2a – Ambitious CSH	Retrofit uptake assumptions reduced from 1a.	More ambitious CSH uptake than Scenario 1a, such as uptake of CSH Level 5/6 earlier in the period	No	Same as Scenario 1a
Neutrality 2b – Ambitious CSH with no Level 5/6 and variable tariffs	Retrofit uptake assumptions reduced from 2a because of variable tariffs effect.	Variable tariffs used to dampen CSH Level 5/6 implementation, so CSH Level 3/4 becomes most stringent level implemented.	Yes	Same as Scenario 1a
Neutrality 3 – Composite with variable tariffs	Retrofit uptake assumptions reduced from 2a due to variable tariffs effect. Introduction of 95 l/h/d requires more retrofitting than 2b to achieve neutrality.	Replace 50 per cent of CSH Level 5/6 households from 2010/11 with pcc of 95 l/h/d.	Yes	Same as Scenario 1a
Beyond Neutrality	Maximum retrofit uptake assumptions (greater than 1a and all other scenarios).	The most ambitious CSH glide path with all new homes assumed CSH Level 5/6 (62 l/h/d) from 2013/14.	Yes	Same as Scenario 1a

Figures 6.1 to 6.6 illustrate glide paths for the assumed rate of uptake for each level of the CSH in the scenarios. All glide paths follow the BAU up to and including 2007-08. The scenarios then differ as to how far and how fast different levels of the CSH are reached. In all scenarios, it is assumed that the uptake of higher water efficiency standards will occur faster in publicly funded developments than privately funded ones.

Table 6.6 summarises the uptake rates of retrofit measures for existing homes. Table 6.7 summarises what the scenarios mean in terms of total number of homes built to different levels of the CSH or retrofitted with different types of devices by 2016. The tables are at the end of this section. Details of assumptions on the microcomponents of demand are in Chapter 5 of the supplementary report by Entec.

Progressive Scenario

Figure 6.1 illustrates the CSH glide path for the Progressive Scenario, where the assumptions are that:

- All public sector homes are currently built to CSH Level 1/2, moving to Level 3/4 as a minimum from 2008/09, with homes built to Level 5/6 increasing from 11 per cent in 2008/09 to 20 per cent in 2015/16.
- All private sector homes are built to a minimum of CSH Level 3/4 from 2010-11.
- Ten per cent of private sector homes achieve CSH Level 5/6 in 2015/16.

Table 6.6 shows that the assumed uptake rate of retrofit measures is the least ambitious of all the scenarios. However, with an estimated 21 per cent of existing homes to be retrofitted with low-flow taps, it still presents a considerable challenge. In the non-households, only water savings from offices were assumed.

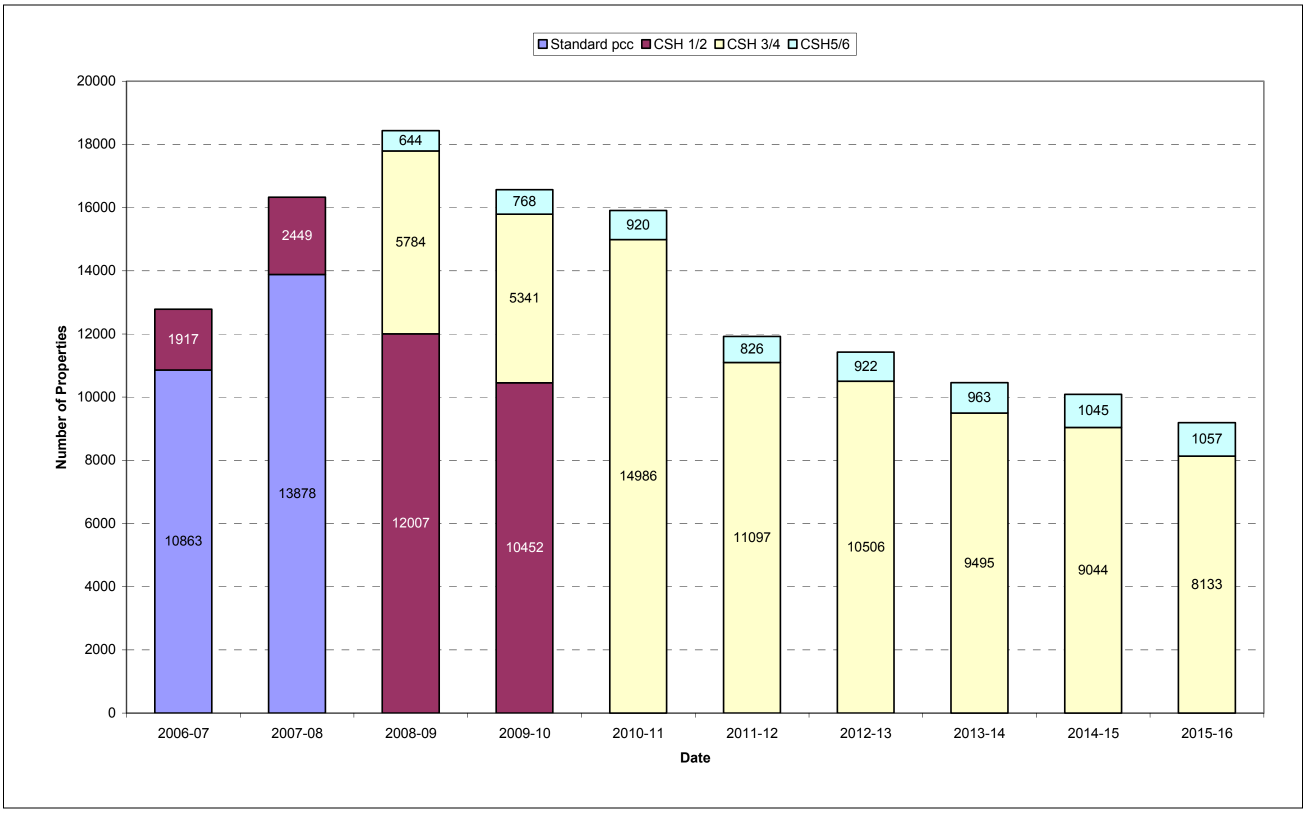


Figure 6.1: Annual new household completions by CSH consumption level – Progressive Scenario

Neutrality 1: High retrofit scenarios

The only scenarios with the same glide paths for uptake of CSH levels are the two Neutrality 1 Scenarios, 1a and 1b. This glide path is illustrated in Figure 6.2. Although the emphasis is on high levels of retrofit, the scenarios are still more ambitious on new build than the Progressive Scenario. The main assumptions are that:

- All public sector homes are currently built to CSH Level 1/2, moving to Level 3/4 as a minimum from 2008/09.
- All public sector homes achieve CSH Level 5/6 from 2011/12.
- All private sector homes are built to a minimum of CSH Level 3/4 from 2009/10.

- All private sector homes achieve CSH Level 5/6 by 2015/16. The glide path is slower for this scenario than the ambitious CSH scenarios (below); for example, by 2013/14, 50 per cent of homes are built to CSH Level 5/6.

The assumed retrofit uptake rates for Neutrality 1a are extremely ambitious, with 90 per cent of all homes in the Gateway (552,058) to be fitted with low-flow taps, 56 per cent of homes (343, 503) fitted with a variable flush toilet device and a further 18 per cent (110,412) having their toilets replaced with an ultra-low flush toilet (Table 6.6). For non-households, both water savings from offices (40 per cent) and more limited savings from the rest of the sector were assumed.

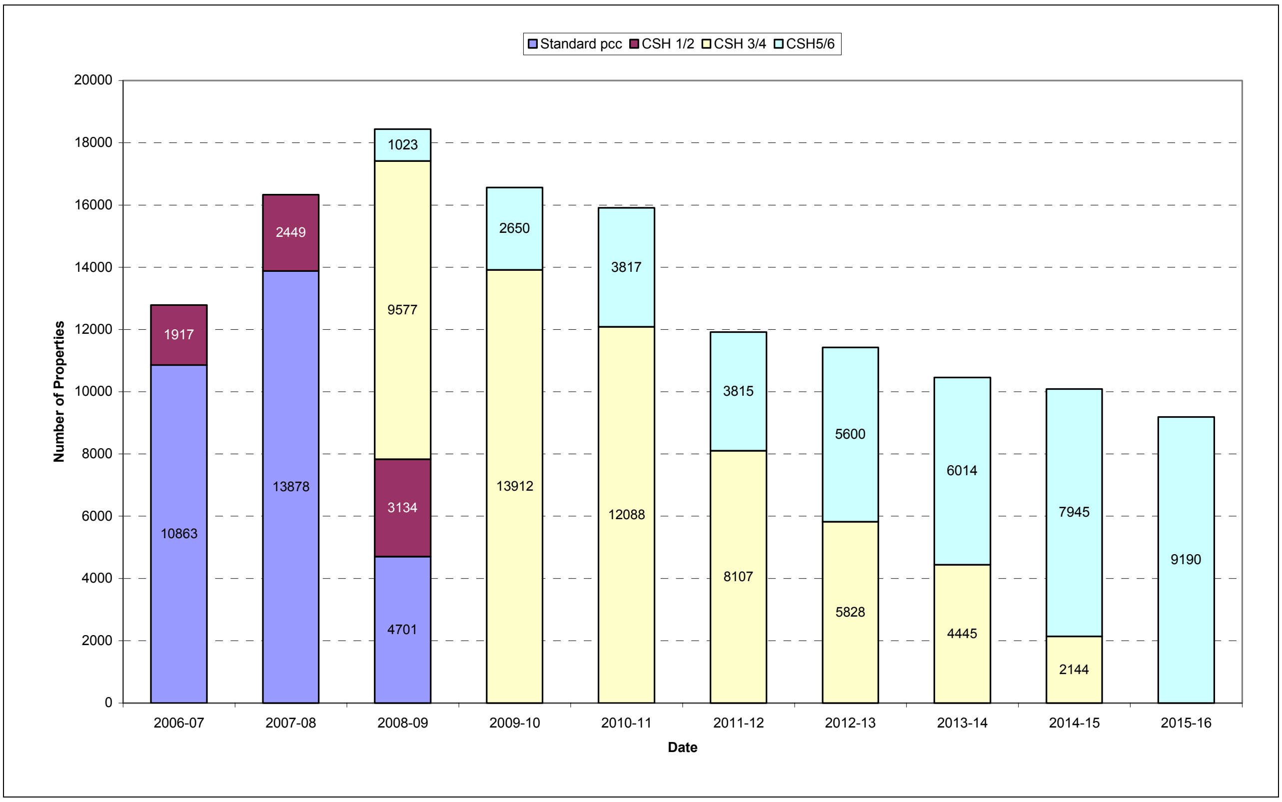


Figure 6.2: Annual new household completions by CSH consumption level – Neutrality 1a Scenario

In the Neutrality 1b Scenario, savings from the variable tariffs offset the number of retrofits required to meet neutrality, providing an easy comparator as to the impact of variable tariffs. Table 6.10 shows that the inclusion of variable tariffs reduces the uptake rates required to achieve neutrality by just under half. The number of variable flush retrofit devices decreases from 56 per cent to 34 per cent; ultra-low flush replacement from 18 to eight per cent; and the number of low-flow showerhead and tap replacements needed are halved. The assumptions on non-households are the same.

Neutrality 2: Ambitious CSH scenarios

Figure 6.3 illustrates the glide path for the Neutrality 2a Scenario. As the scenario suggests, it is the most ambitious in terms of CSH uptake. Key assumptions are that:

- All public sector homes are currently built to CSH Level 1/2, moving to Level 3/4 as a minimum from 2008/09.
- All public sector homes achieve CSH Level 5/6 by 2010/11 (a year earlier than the higher retrofit scenarios).

- All private sector homes are built to a minimum of CSH Level 3/4 from 2009/10.
- All private sector homes achieve CSH Level 5/6 by 2015/16. The glide path is faster for this scenario than the higher retrofit scenarios; for example by 2013/14, 75 per cent of homes are built to CSH Level 5/6.

The uptake of retrofit measures is also very ambitious. Even with an emphasis on high standards in new homes, the same uptake rates for low-flow taps and showerheads are assumed as for Neutrality 1a (90 per cent and 39 per cent). Lower uptake rates are assumed for both types of toilet retrofit, with 17 per cent of toilets replaced with an ultra-low flush version and 49 per cent fitted with a dual-flush mechanism. Water savings from non-households are the same as in the Neutrality 1 Scenarios.

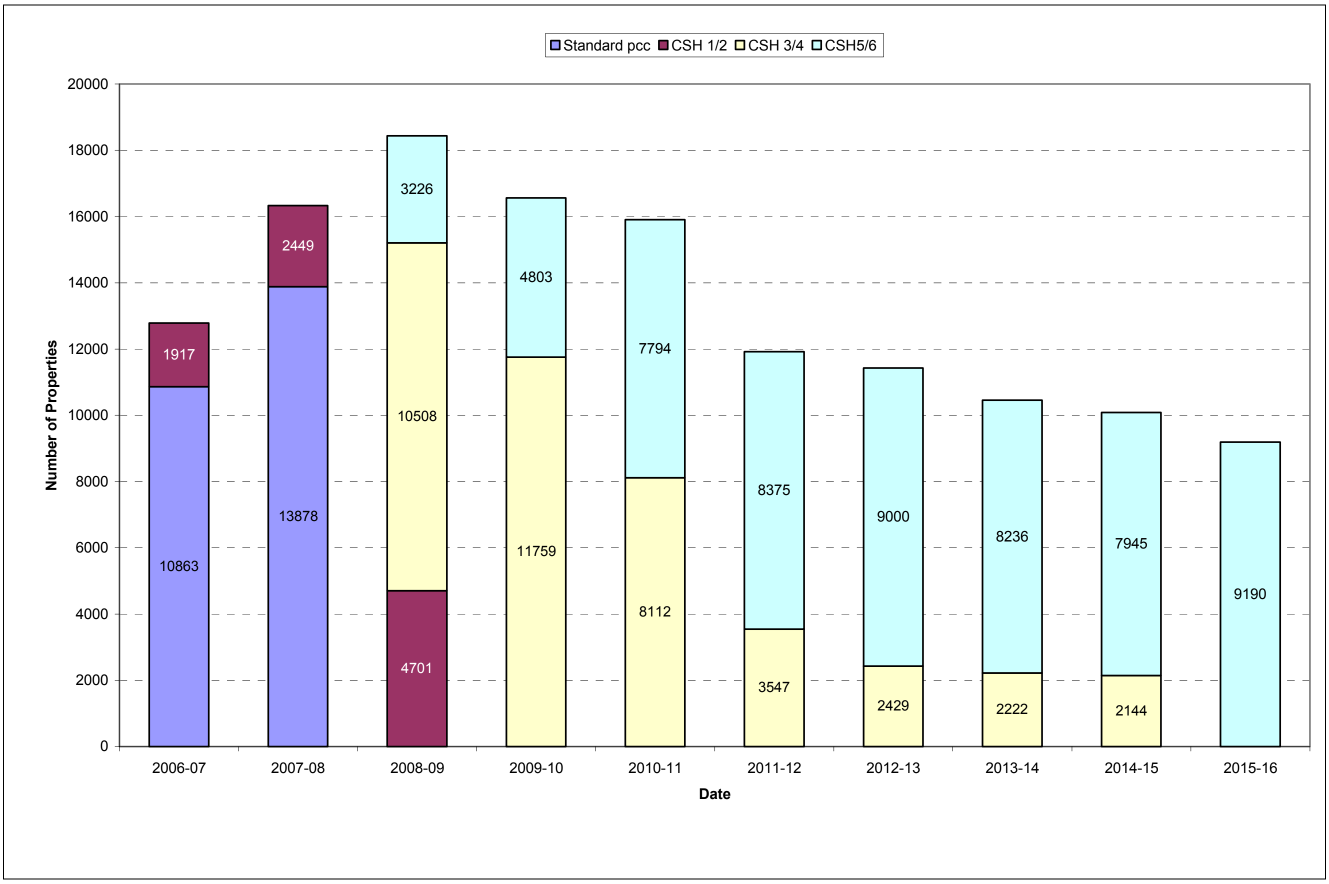


Figure 6.3: Annual new household completions by CSH consumption level – Neutrality 2a Scenario

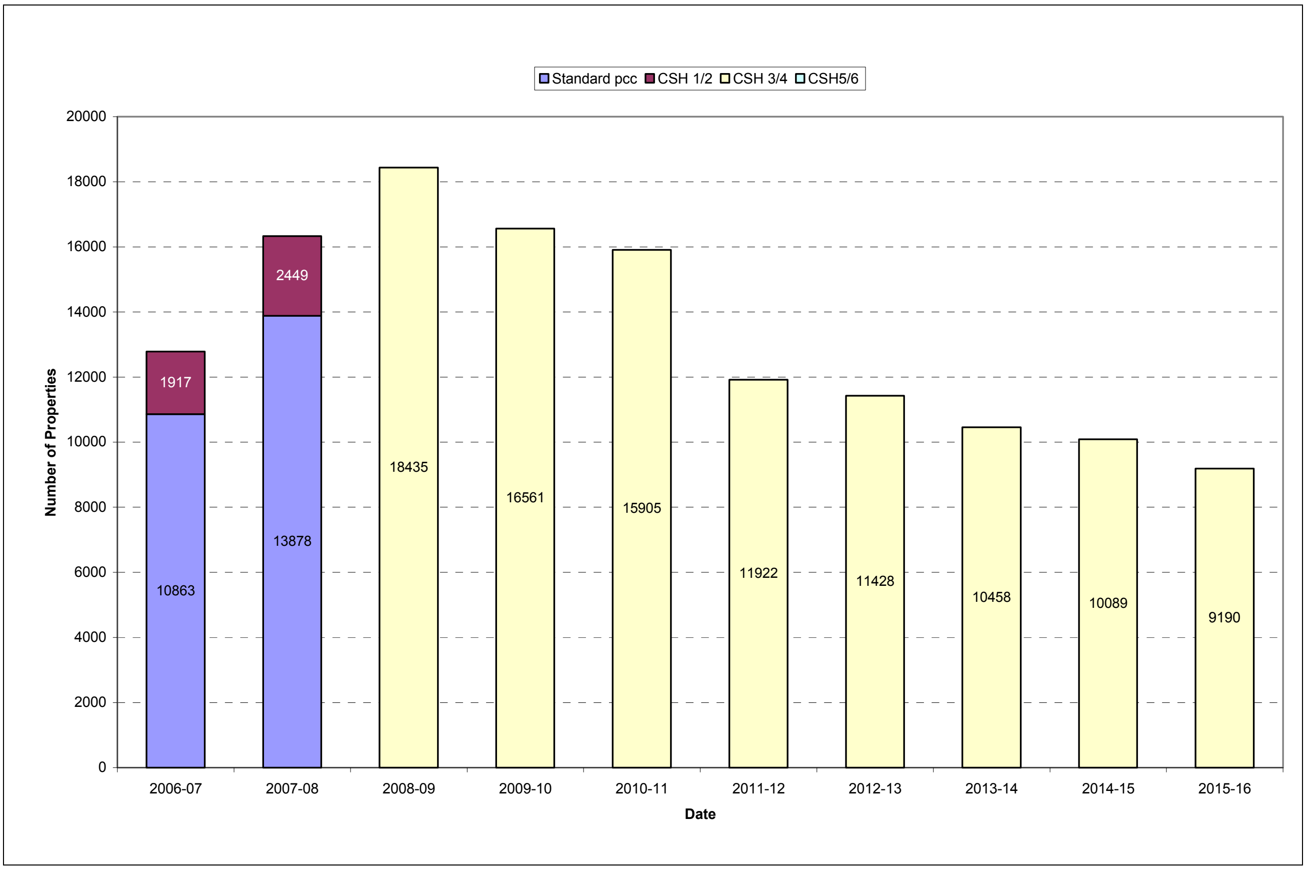


Figure 6.4: Annual new household completions by CSH consumption level – Neutrality 2b Scenario

In the Neutrality 2b Scenario (Figure 6.4), the potential impact of variable tariffs is most dramatically seen. The water savings made by variable tariffs are used to remove the need for homes to be built to the water efficiency standards of Code Level 5/6, with all new homes meeting Level 3/4 from 2008/09. The almost immediate timings of the 100 per cent jump to Level 3/4 make this very ambitious. A more feasible approach would likely involve some homes with water efficiency standards equivalent to Level 5/6. Even with this, there are still enough savings to reduce retrofit uptake rates for all measures, with lower uptake rates for variable flush toilet retrofits and ultra-low flush replacements (36 and 10 percent) and low-flow showerhead and tap replacements (21.5 and 50 per cent respectively).

Neutrality 3: Composite scenario with variable tariffs

Figure 6.5 illustrates the CSH glide path for the Neutrality 3 Scenario. This scenario includes variable tariffs and is the only scenario that looks at the impact of building new homes with a calculated building performance standard of 95 l/h/d pcc. This standard is thought to be achievable without using water recovery of rainwater harvesting and is equivalent to an ambitious CSH Level 3/4 (see Section 6.3.2). The build up to the high levels of the CSH is more gradual than in the Neutrality 2b Scenario. Some Code Level 5/6 homes are included to account for the likelihood that the Gateway would see an increasing number of exemplar developments built to this standard over the period.

The retrofit options are very similar to those for Neutrality 2b, with the same level of uptake assumed for every measure except the variable flush retrofits, where there is a slight increase of three per cent. It makes the same assumptions for non-households as the other neutrality scenarios. The key assumptions of this glide path are:

- All new households (public and private) will achieve a minimum standard of CSH Level 3/4 from 2009/10.
- By 2011/12, 10 per cent of public sector homes and two per cent of private sector homes achieve CSH Level 5/6.
- By 2011/12, 10 per cent of public sector homes and two per cent of private sector homes achieve a pcc of 95 l/p/d.
- By 2015/16, 35 per cent of private sector homes achieve CSH Level 5/6 and 35 per cent achieve a pcc of 95 l/p/d.

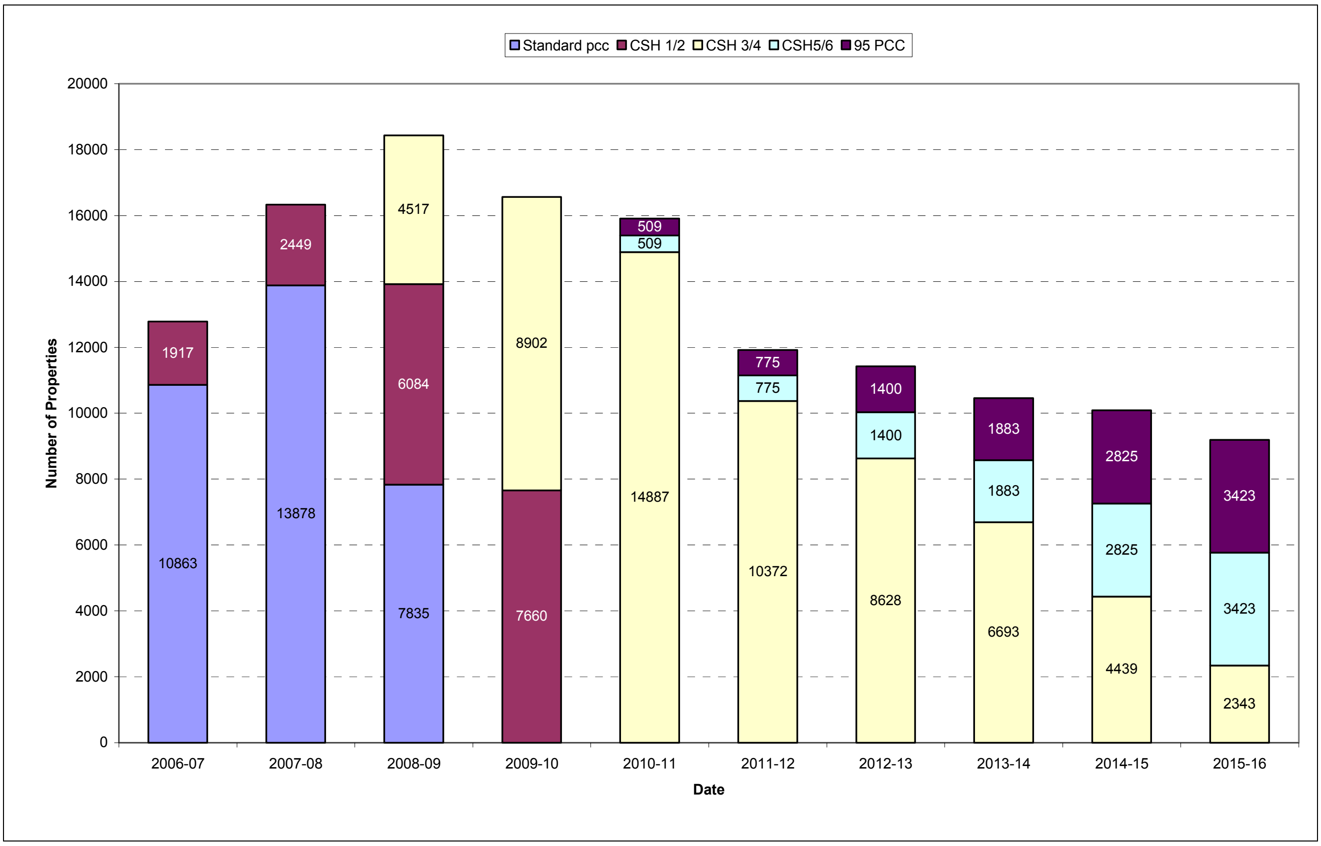


Figure 6.5: Annual new household completions by CSH consumption level – Neutrality 3 Scenario with variable tariffs

Beyond Neutrality Scenario

Finally, the CSH glide path for the Beyond Neutrality Scenario is shown in Figure 6.6. This scenario assumes the most ambitious levels of water savings through retrofitting of existing homes and very high levels of water efficiency in new homes. All CSH Level 5/6 homes assume a pcc of 62 l/h/d instead of the threshold 80 l/h/d. Code Level 5/6 homes are also assumed to have all of their garden watering met by rainwater and/or recycled water. To reach this level, it is assumed that water for toilets and washing machines is 100 per cent recycled, up from 50 per cent in the 80 l/h/d assumptions.

The retrofit programme does not include ultra-low flush (ULF) toilets but includes variable flush retrofits, because the cost of a variable flush-based programme would be less than a ULF one. It includes variable tariffs and the same level of savings from non-households as in the neutrality scenarios. The key assumptions for new homes are:

- All publicly funded development to meet standards equivalent to at least Code Level 3/4 by 2008/09 and all homes to meet this by 2010/11.
- All publicly funded development to meet a 62l/h/d water efficiency standard by 2011/12, with all homes meeting this standard by 2013/14.

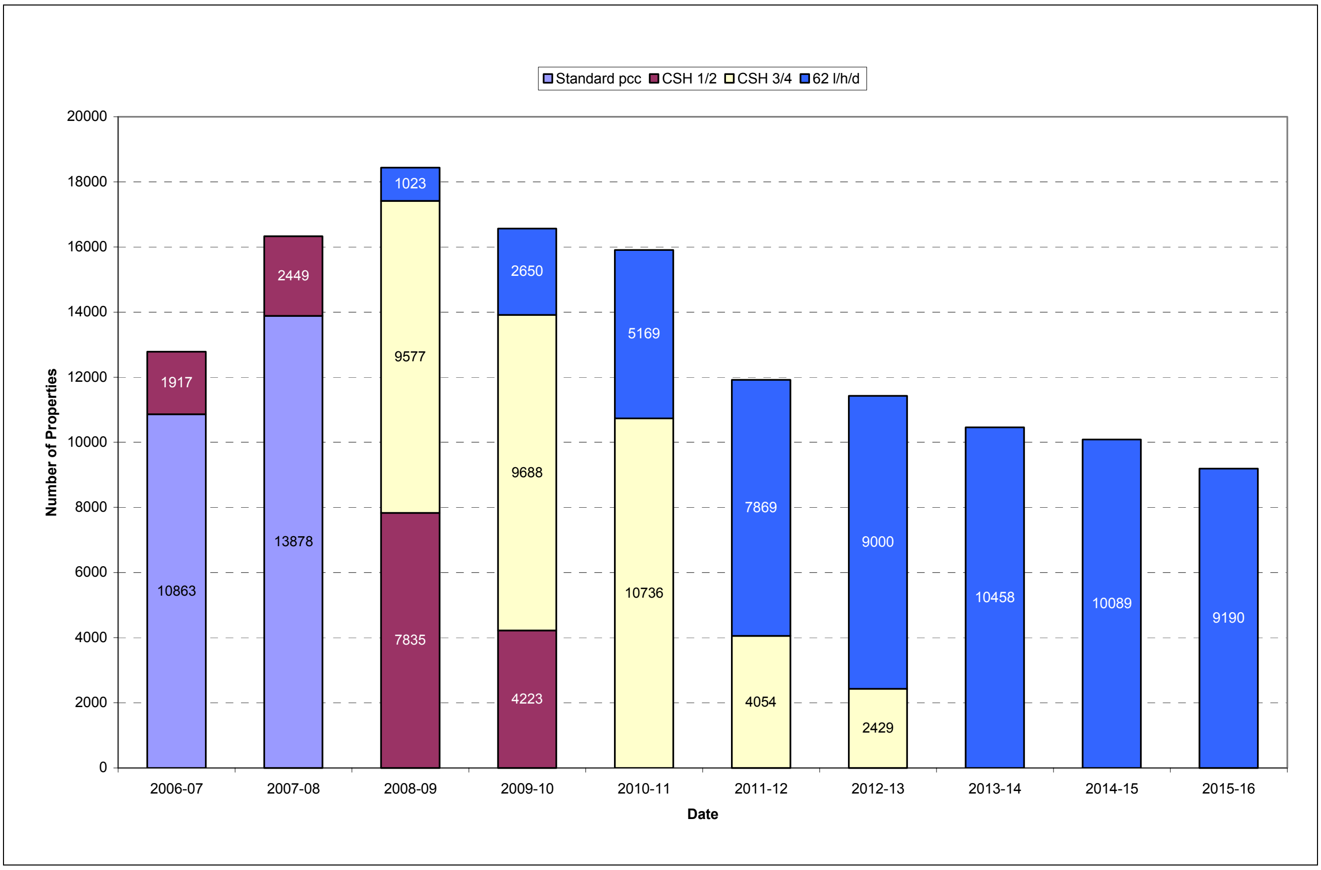


Figure 6.6: Annual new household completions by (CSH) consumption level – Beyond Neutrality Scenario

Table 6.6: Uptake of measures in existing households – summary

Measure	Feasible households (%)	Progressive		Neutrality 1a: High retrofit		Neutrality 1b: High retrofit with tariffs		Neutrality 2a: Ambitious CSH		Neutrality 2b: Ambitious CSH with tariffs		Neutrality 3: Composite scenario with variable tariffs		Beyond Neutrality	
		Net uptake rate (%)	Total households	Net uptake rate (%)	Total households	Net uptake rate (%)	Total households	Net uptake rate (%)	Total households	Net uptake rate (%)	Total households	Net uptake rate (%)	Total households	Net uptake rate (%)	Total households
Variable flush toilet retrofit	70	15	91,472	56	343,503	33.6	206,102	49	300,565	35.7	218,983	38.5	236,158	63	386,441
Ultra-low flush replacement	100	0	0	18	110,412	8	50,002	17	104,278	10	61,340	10	61,340	0	0
Low-flow showerhead replacement	43	9	56,190	38.7	237,385	19.4	118,693	38.7	237,385	21.5	131,881	21.5	131,881	38.7	237,385
Low-flow tap replacement	100	21	130,674	90	552,058	45	276,029	90	552,058	50	306,699	50	306,699	90	552,058

Table 6.7: Summary of scenario measures

		BAU Lower Savings	Progressive	Neutrality 1a	Neutrality 1b	Neutrality 2a	Neutrality 2b	Neutrality 3	Beyond Neutrality
New households constructed to standard water company pcc	Private	109,806	24,742	29,443	29,443	24,742	24,742	32,577	24,742
	Public	0	0	0	0	0	0	0	0
	Total	109,806	24,742	29,443	29,443	24,742	24,742	32,577	24,742
Total new households constructed to CSH Level 1/2	Private	1,187	22,459	3,134	3,134	4,701	0	11,739	12,058
	Public	7,131	4,366	4,366	4,366	4,366	4,366	6,370	4,366
	Total	8,318	26,825	7,500	7,500	9,067	4,366	18,109	16,424
Total new households constructed to CSH Level 3/4	Private	2,139	61,118	52,050	52,050	39,117	88,392	52,897	32,433
	Public	12833	13,268	4,051	4,051	1,603	15,598	7,885	4,051
	Total	14,974	74,386	56,101	56,101	40,720	103,990	60,782	36,484
Total new households constructed to CSH Level 5/6 (80 l/h/d)	Private	0	4,814	28,506	28,506	44,573	0	7,960	0
	Public	0	2,331	11,548	11,548	13,996	0	2,885	0
	Total	0	7,145	40,054	40,054	58,569	0	10,815	0
Total new households constructed to CSH Level 5/6 (62 l/h/d)	Private	0	0	0	0	0	0	0	43,900
	Public	0	0	0	0	0	0	0	11,548
	Total	0	0	0	0	0	0	0	55,448
Total new households constructed to 95 l/h/d	Private	0	0	0	0	0	0	7,960	0
	Public	0	0	0	0	0	0	2,885	0
	Total	0	0	0	0	0	0	10,815	0
Total new households	Total	133,098	133,098	133,098	133,098	133,098	133,098	133,098	133,098
Number of existing households retrofitted with variable flush	Total	0	91,472	343,503	206,102	300,565	218,983	236,158	386,441
Number of existing households retrofitted with ULF toilet	Total	0	0	110,412	50,002	104,278	61,340	61,340	0
Number of existing households retrofitted with low-flow showerheads	Total	0	56,190	237,385	118,693	237,385	131,881	131,881	237,385
Number of existing households retrofitted with low-flow taps	Total	0	130,674	552,058	276,029	552,058	306,699	306,699	552,058
Percentage of non-household demand assumed to be from offices (assumed reduction in office demand)		5% (0% reduction)	5% (40% reduction)	5% (40% reduct)	5% (40% reduct)	5% (40% reduct)	5% (40% reduct)	5% (40% reduction)	5% (40% reduction)
Remaining percentage of non-household demand (assumed reduction in remaining non-household demand)		95% (0% reduction)	95% (0% reduction)	95% (10% reduct)	95% (10% reduct)	95% (10% reduct)	95% (10% reduct)	95% (10% reduction)	95% (10% reduction)
Variable tariffs included?		No	No	No	Yes	No	Yes	Yes	Yes
Compulsory metering included?		No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

7 Pathway scenario results

This section presents the key results of the modelling of the scenarios, with subsections covering the assessments on water savings, costs, carbon impact and uncertainty. Detailed results are found in the supplementary report.

7.1 Water savings

7.1.1 Total water savings

Table 7.1 presents the outcome of the modelling of the seven scenarios in terms of water savings and how the end result compares to the goal to achieve 'water neutrality' by 2016. The five neutrality scenarios all achieve the goal of water neutrality. The Progressive Scenario saves 13 Ml/d, moving nearly a third of the way towards neutrality. The Beyond Neutrality Scenario achieves savings of 51 Ml/d, going beyond neutrality by approximately 20 per cent or 9 Ml/d.

Table 7.1: Progress towards neutrality in the pathway scenarios

Scenario	**Volume of water saved (Ml/d)**	**Progress to neutrality[1]**	**Progress to neutrality (%)**
Progressive	13	29 Ml/d short of neutrality	32
Neutrality 1a: High retrofit	42	Neutrality achieved	100
Neutrality 1b: High retrofit including variable tariffs	42	Neutrality achieved	100
Neutrality 2a: Ambitious CSH	42	Neutrality achieved	100
Neutrality 2b: Ambitious CSH including variable tariffs	42	Neutrality achieved	100
Neutrality 3: Combined scenario with variable tariffs	42	Neutrality achieved	100
Beyond Neutrality	51	Neutrality plus 9 Ml/d	120

[1] Under the BAU Lower Savings Scenario, neutrality would be achieved with a 42 Ml/d reduction in demand. Volumes rounded to nearest megalitre.

Figure 7.1 shows how the pathway scenarios save water over time. If the assumptions behind the Progressive Scenario were implemented, a substantial volume of water could be saved compared to the differences between the two BAU scenarios.

The graph shows that although the neutrality scenarios all reach neutrality by 2016, none follow a linear path, with some scenarios falling some 6-7 Ml/d short of neutrality in certain years. This is mainly true for scenarios that include variable tariffs (Scenarios 1b, 2b and 3 and Beyond Neutrality). Here, the potential impact of PR09 is shown most clearly, as variable tariffs cannot feasibly come in before the next price review which will conclude in 2010. The Beyond Neutrality pathway veers substantially from the path of the neutrality scenarios from 2010/11, which is when the ambitious assumptions on the Code for Sustainable Homes start.

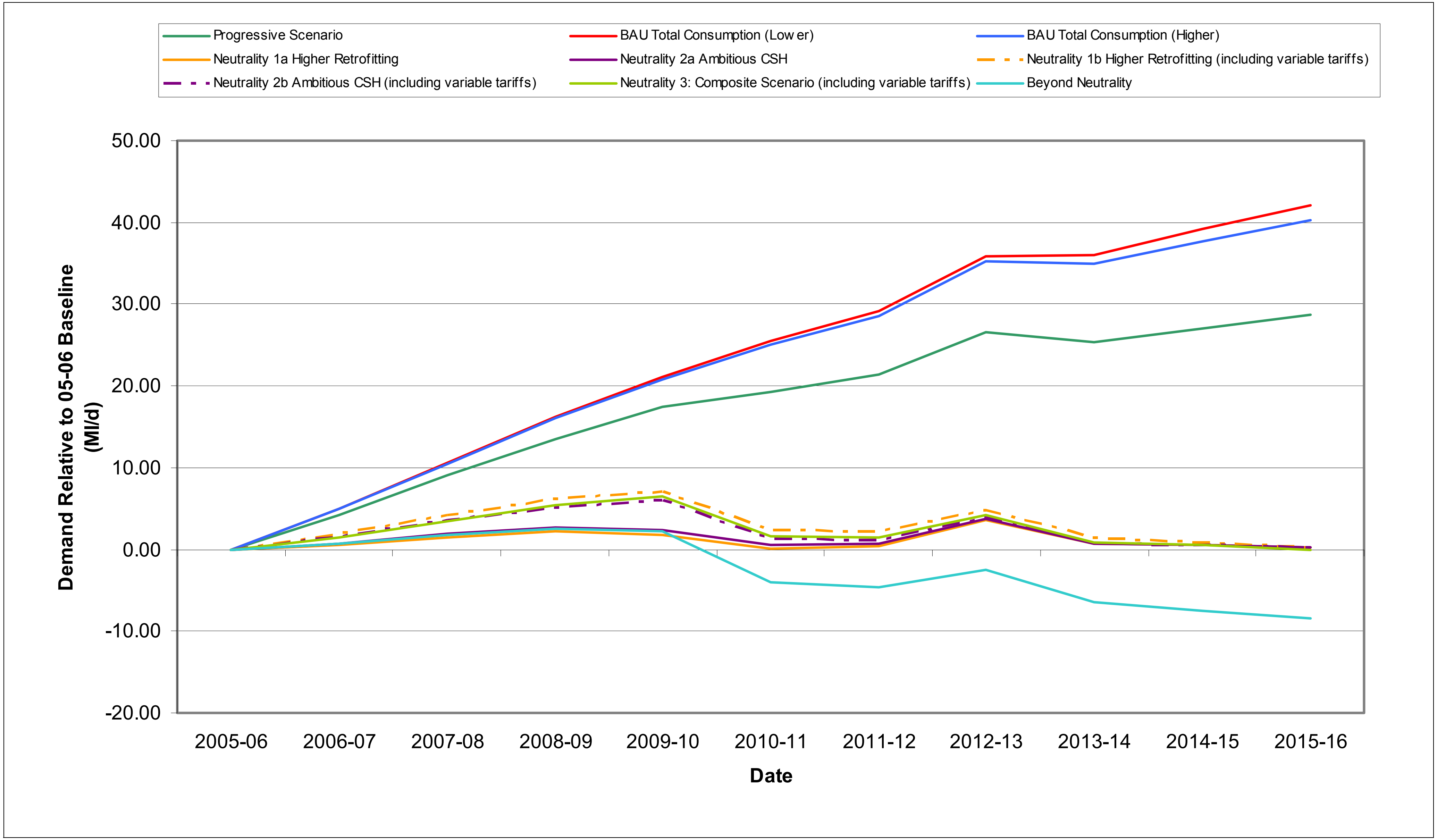


Figure 7.1: Results of the pathway scenarios over time

7.1.2 Breakdown of water savings

The total volumes of water attributable to each sector for each scenario are presented in Figure 7.2. The proportion of savings attributable to different sectors/components for each pathway scenario is illustrated in Figure 7.3. As the five water neutrality scenarios all achieve the same volume of water savings (42 Ml/d), they are easier to compare with each other than with the Progressive or Beyond Neutrality Scenarios in Figure 7.3.

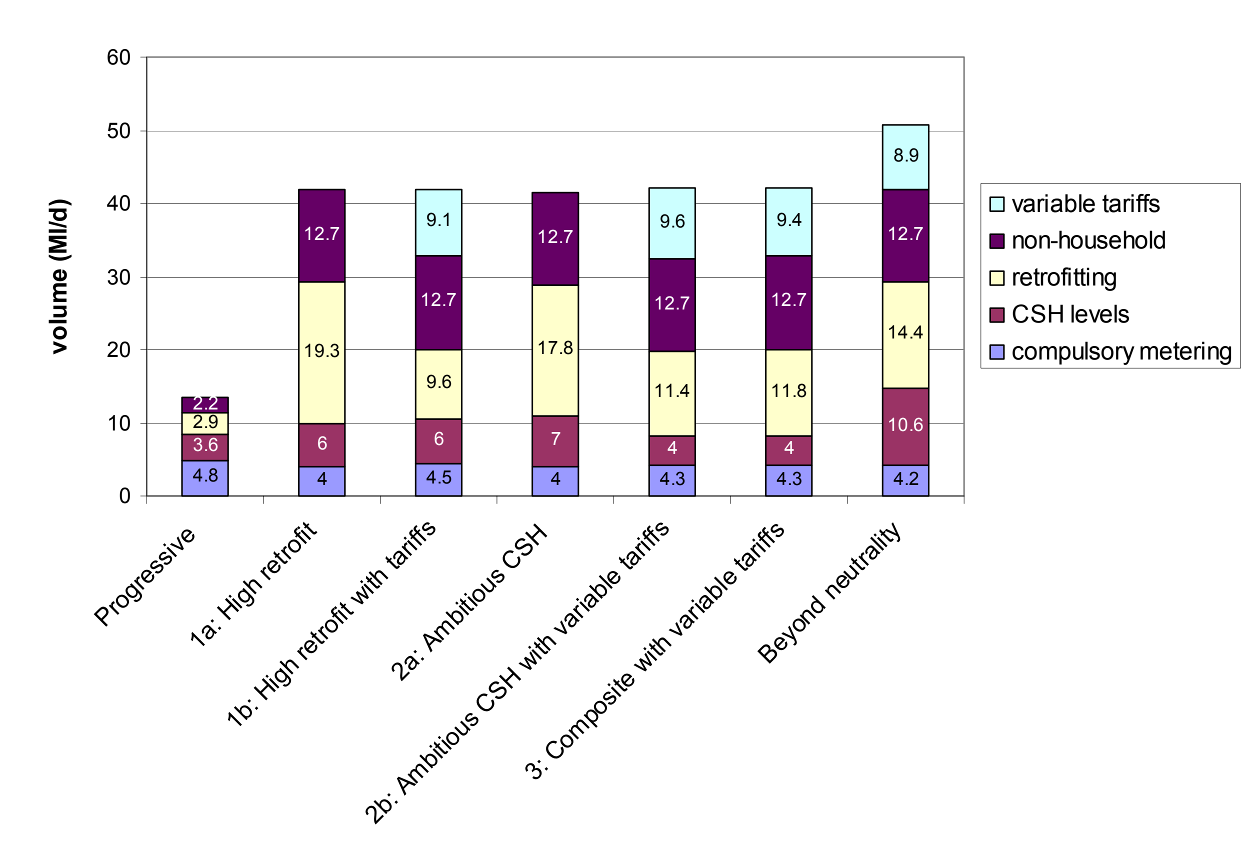


Figure 7.2: Total volume of water saved and distribution of water savings by sector/component for all pathway scenarios (Ml/d)

In both the Neutrality 1a and 2a Scenarios, the majority of savings are achieved through retrofitting - even though Neutrality 2a has an emphasis on new homes. When tariffs are added, in Neutrality 1b the effect is clearly seen on the reduced proportion of water savings from retrofit options, while in 2b the proportion of savings from new homes is reduced by around half and from retrofitting by about a third.

Neutrality 2b and Neutrality 3 have nearly identical results in terms of volumes by sector, including measures for new homes. This is somewhat surprising, as Neutrality 2b has no new homes built to Code Level 5/6 standards, whereas Neutrality 3 does. However, Neutrality 2b is more ambitious in terms of speed of take up, if not level.

Figures 7.2 and 7.3 show that variable tariffs account for a significant proportion of savings in the scenarios where they are included – just under a quarter of total savings (18-23 per cent), or double that of metering, which accounts for an average of 10 per cent of the total water savings in each of the neutrality scenarios (4.2 Ml/d).

This may seem surprising, as compulsory metering has an assumed saving of 10 per cent, while variable tariffs are five per cent. However, compulsory metering only affects households moving from an unmeasured to a metered supply. It is assumed that this progresses at a steady rate, to contribute to achieving a total of 70 per cent of households metered by 2016. The measure is not relevant to existing metered households and new households. Variable tariffs, however, apply to all homes that are new to, or are already on a metered supply.

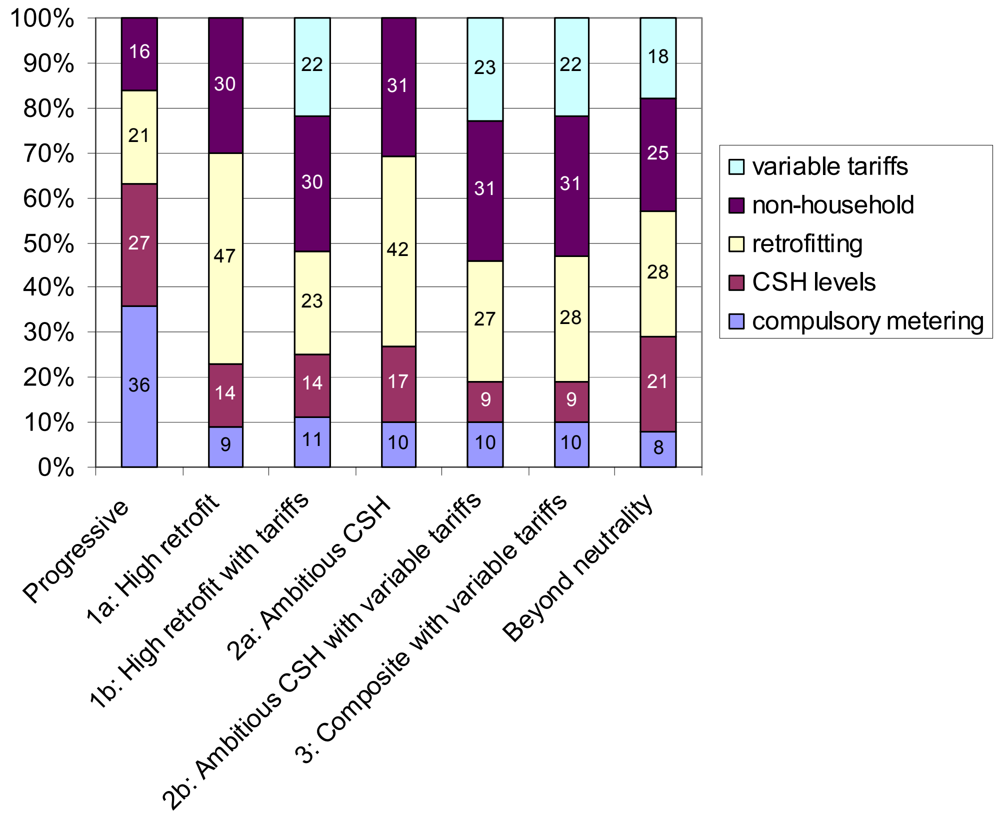


Figure 7.3: Proportional distribution of water savings by sector/component for all pathway scenarios

7.1.3 Retrofit and new property equivalence

To make this study relevant to different areas and scales than that of the Thames Gateway, it is useful to understand how many homes need to be retrofitted to offset the demand from a new home. Table 7.2 shows how many homes would need to be retrofitted, and with which retrofit package, for a home built to each CSH level (or equivalent). These figures do not include any contribution from non-households, compulsory metering or variable tariffs, and are separate from the results of the pathway scenarios.

Table 7.2: Number of existing homes that need to be retrofitted to offset demand from a single new home of a specified CSH standard

New home standard	Retrofit combination including variable flush	Retrofit combination including ultra-low flush toilet
CSH Level 1/2	7.6	4.5
CSH Level 3/4	6.8	4.0
CSH Level 5/6	5.4	3.1

The calculation assumes a household occupancy of 2.4 persons per household. For a house constructed to CSH Level 5/6, demand is calculated as 90 l/h/d (pcc for a CSH Level 5/6 house, including outdoor use). This is multiplied by the occupancy, giving a demand of 215 litres/property/day.

The savings from a retrofit combination of ultra-low flush toilet, low-flow shower and low-flow taps is 69 litres/property/day. Approximately three households would need to be retrofitted with these measures to offset the demand from one new home constructed to CSH Level 5/6 standard.

The baseline analysis shows that there were approximately 613,000 households within the Thames Gateway in 2005-06. The analysis in Table 7.2 implies that even if all 103,990 new houses constructed in the Thames Gateway from April 2008 were built to CSH Level 5/6, neutrality could only be achieved by retrofitting 322,369 or 53 per cent of existing homes within the Gateway with fittings including an ultra-low flush toilet to offset demand from the new homes.

Unless further water savings were achieved through the non-household sector or through compulsory metering and/or variable tariffs (as in the pathway scenarios) there would be insufficient building stock within the bounds of the Thames Gateway area to achieve neutrality if homes were built to lower standards of water efficiency than CSH Level 5/6. The most effective approach to achieving water neutrality is thus a concerted approach encompassing all sectors.

7.2 Costs

The assessment of costs for the pathway scenarios (over and above those associated with business-as-usual) is presented in this section. The assumptions on individual cost components for each sector (and measure) are outlined in Section 6.2.

While the assumptions on costs for new households, existing households, metering and tariffs can be presented with some certainty, this is not the case for non-households. Therefore, costs are presented as scenario costs (household costs only) and an estimate of the potential range of non-household costs is provided separately.

The total volume of water saved including non-households in each pathway scenario is compared against the total volume of water saved excluding the non-household sector in Table 7.3, as a reference to understand the relationship between the cost estimates and the volume of water saved.

Table 7.3: Total volume of water saved per year for each pathway scenario (Ml/d) – with and without the non-household sector

	Progressive	Neutrality 1a: High retrofit	Neutrality 1b: High retrofit with tariffs	Neutrality 2a: Ambitious CSH	Neutrality 2b: Ambitious CSH with tariffs	Neutrality 3: Composite with tariffs	Beyond Neutrality
With non-household	13	42	42	42	42	42	51
Without non-household	11	29	29	29	29	29	38

A further sub-section examines the potential costs of reducing leakage beyond the ELL. This measure was not included in any of the scenarios (see Section 6.2) but an indication of costs was produced as part of this work.

7.2.1 Cost calculation

Total scheme costs were assessed over a 60-year period and discounted to a present value (PV) in millions of pounds, using a 4.5 per cent discounting rate as indicated in the latest Environment Agency *Water resources planning guidelines* (Environment Agency, 2007c). Costs were also expressed as an average incremental cost (AIC) in pence per cubic metre. AICs are used in water resource planning by the water industry and regulators as a method of comparing the costs and benefits of various schemes.

- **Existing homes:** Present value of costs were calculated for existing households required to be retrofitted (see Section 6.2.1).
- **New homes:** Present value of costs were calculated for new homes built to different CSH levels for the fixtures and fittings included in these properties that would have an additional cost over and above those in a standard new home (see Section 6.2.2).
- **Metering and variable tariffs:** Cost assumptions for metering of existing properties are outlined in Section 6.2.1 and for variable tariffs, in 6.2.3.
- **Capital and operating costs:** No capital costs for replacement were assumed, with the exception of metering. Measures introduced in new and existing homes were assumed to accelerate the implementation of measures that would otherwise occur with the natural rate of replacement of household fixtures and fittings. Compulsory metering was assumed to incur replacement costs every ten years. Operating costs were only assumed for metering and for variable tariffs. No operating costs were included for other household measures, because their maintenance was assumed to be the household's responsibility.
- **Non-households**: An indicative range of potential costs is presented separately, as the costs have a high level of uncertainty. The range is based on the number of non-household properties within the Thames Gateway multiplied by a range of possible retrofit costs.
- **BAU costs:** The BAU present value of costs was calculated as £3.6 million. This was subtracted from the total scenario cost to give a present value of costs for each scenario. The BAU scenario assumed 17.5 per cent of new homes would achieve CSH Levels 3/4 with the remainder built to standard specifications, and included water company metering penetration levels as forecast in the 2004 WRPs. The BAU cost assessment did not include costs of developing additional water resources to cater for the increased demand for water.
- **Excluded costs:** No costs were included for promotional or other implementation and administrative activities necessary to reach water neutrality in the Thames Gateway.
- **Benefits:** AICs included an operational saving of 10p/m^3, which reflected the money saved by not producing the water saved in the scenario (based on existing water resources). The present value of costs did not take account of the potential economic, social or environmental benefits of reduced water consumption. This is because the distribution of costs (and benefits) were not assigned to any particular party or parties, such as a homeowner or water company.

7.2.2 Costs summary

Costs of scenarios (excluding non-households)

Tables 7.4 and 7.5 summarise the AICs and PVs for the scenarios (households only). Table A.1 in Appendix 1 gives a breakdown of PV costs by scenario and by measure.

Table 7.4: Summary of average incremental cost (AIC) by scenario

Measure	Progressive Scenario AIC		Scenario 1a AIC		Scenario 1b AIC		Scenario 2a AIC		Scenario 2b AIC		Scenario 3 AIC		Beyond Neutrality Scenario AIC	
	p/m^3	£/Ml	p/m^3	£/Ml	p/m^3	£/Ml	p/m^3	£/Ml	p/m^3	£/Ml	p/m^3	£/Ml	p/m^3	£/Ml
Variable flush retrofit	28.0	280	26.0	260	27.4	274	24.8	248	27.1	271	27.6	276	26.9	269
Ultra-low flush WC	N/a[1]	N/a[1]	64.5	645	66.8	668	64.5	645	64.5	645	64.5	645	N/a*	N/a*
Low-flow showerhead	67.3	673	65.1	650	65.1	651	65.1	651	65.1	651	65.1	651	65.1	651
Low-flow taps	3,20.7	3,207	3,14.3	3,143	3,16.2	3,162	3,13.3	3,133	3,15.7	3,157	3,16.5	3,165	3,15.5	3,155
Compulsory metering	91.2	912	91.2	912	91.2	912	91.2	912	91.2	912	91.2	912	91.2	912
Variable tariffs	N/a	N/a	N/a	N/a	67.4	674	N/a	N/a	67.4	674	67.4	674	67.4	674
CSH (and other pcc standards)	1,53.4	1,534	1,94.4	1,944	1,86.0	1,860	2,26.7	2,267	92.8	928	1,37.3	1,373	1,48.8	1,488

[1] N/a indicates where a measure was not included in the scenario.
[2] Full details of data assumptions and sources are in the supplementary report by Entec.

Table 7.4 shows the AICs of individual retrofitting measures are similar across all scenarios. This is because the volume of water saved is directly proportional to the number of retrofit measures installed (and is therefore directly proportional to the cost)[6].

The AIC for new homes (CSH levels) is determined by the number of properties constructed to each CSH level in each scenario. A scenario with a large number of CSH Level 5/6 properties is likely to have a higher CSH AIC than one with fewer of these properties, because the relatively small demand reduction from the higher CSH level homes is achieved at considerable extra cost.

Table 7.5: Summary of scenario cost data (household costs only)

Scenario	PV of total cost (£ million)	Cost per existing house[1] (£)	Cost per new house[2] (£)	Average cost per house[3] (£)
Progressive	75.8	74.2	254.1	106.3
Neutrality 1a: High retrofit	156.6	138.7	564.2	214.6
Neutrality 1b: High retrofit plus variable tariffs	173	147.9	645.1	236.6
Neutrality 2a: Ambitious CSH	181.0	134.8	765.4	247.2
Neutrality 2b: Ambitious CSH plus variable tariffs	126.7	153.0	274.9	174.7
Neutrality 3: Composite with variable tariffs	139.8	154.1	367.2	192.1
Beyond Neutrality	207.4	169.0	806.7	282.7

[1] Cost per existing house – PV of measures to existing homes in each scenario (including retrofit measures, compulsory metering and variable tariffs) divided by total number of households in the Gateway at the start of the period (613,398).

[6] In reality this relationship is unlikely to be true, as costs will be much higher as the numbers required to be fitted increase, reflecting the greater effort required to reach a larger proportion of the population.

[2] Cost per new house – PV of measures to new properties in each scenario (higher standards and variable tariffs, metering is standard and in BAU), divided by total number of new households to be built in the Gateway (133,098).
[3] Average cost per house – PV of scenario divided by total number of properties at the end of the period (746,496).

Table 7.5 shows that the PV of costs for households for each neutrality scenario range from £126 million to £181 million, which accounts for around two-thirds of the water savings needed to achieve neutrality. The range of costs for new homes is £275 to £765, averaged across all homes built in the Thames Gateway between 2005/06 and 2016. The range for existing homes (to pay for retrofitting, fitting a meter and applying tariffs where applicable) is £135 to £154 per house, with costs averaged across all existing households in the Thames Gateway in 2005-06.

Table 7.5 shows that the Progressive Scenario is the least costly of all the scenarios. This is to be expected, but the difference in costs between this and other scenarios is not as great as the difference in water saved. The Progressive Scenario saves only a third of the water of the neutrality scenarios, but costs around half as much as the Neutrality 1a Scenario, rather than a third. The remaining demand for water would need to be catered for by other supply/demand measures which would also incur costs.

Assuming costs for non-households are equal between the scenarios, the Neutrality 1a Scenario appears to be the most cost-effective combination of measures to achieve neutrality without the use of variable tariffs. This has a total PV cost of £157 million, compared to £181 million for the Neutrality 2a Scenario. However, this assessment does not include the costs to implement high numbers of retrofit schemes. These could be higher than the costs to implement high water efficiency standards in new homes.

The introduction of variable tariffs reduces the total cost in Neutrality 2b, where total cost falls by 30 per cent from £181 million to £127 million. This is because the introduction of variable tariffs has been used to remove the need to develop new homes to CSH Level 5/6, with the requirement to include rainwater harvesting/recycling systems. The resulting effect on costs is best observed by comparing AICs for the CSH (in Table 7.4), which in Neutrality 2a is 226.7 p/m^3 while in Neutrality 2b it is 92.8 p/m^3. Table A.1 also shows the difference, with a new household PV of £102 million in 2a, which drops to £37 million in 2b.

A similar result is observed in the Neutrality 3 Scenario, where half of the houses constructed to a CSH Level 5/6 consumption target of 80 l/h/d are replaced with a less stringent target of 95 l/h/d, which assumes water recycling is not needed. The AIC for new homes here is 137.3 p/m^3, which is the second lowest of all the neutrality scenarios apart from 2b. This scenario has the second lowest PV after Neutrality 2b at just under £140 million, but is arguably more feasible than 2b because it assumes a less demanding timeline for take-up of higher CSH levels.

The Beyond Neutrality Scenario has a PV that is 14 per cent higher than the Neutrality 2a Scenario (£207 million and £181 million respectively), although there is a 20 per cent difference in water savings. The Beyond Neutrality Scenario follows a similar CSH glide path to Neutrality 2a, except that Level 5/6 homes are designed to achieve a very ambitious 62 l/h/d and not the threshold standard of 80 l/h/d, through an increase in the amount of rainwater (and grey water) harvested for non-potable use. The costs to achieve this are assumed to be the same as for the 80 l/h/d and result in an AIC for new homes of 148.8 p/m^3. The scenarios also differ in terms of the extra savings from variable tariffs included in the Beyond Neutrality Scenario, but not the Neutrality 2a Scenario. The savings achieved from variable tariffs are among the lowest cost means of saving water (after variable flush retrofits and alongside ultra-low flush toilet replacements) and may have additional social benefits in terms of helping to address affordability issues. However, variable tariffs can only be applied to metered homes and the assumptions on water savings from variable tariffs are highly uncertain.

From Table 7.5, Neutrality 2a has the lowest cost per existing house due to the smaller retrofitting programme compared to Neutrality 1a. Although variable tariffs reduce the retrofitting programmes in Neutrality 1b, the additional operating cost of variable tariffs increases the cost per existing household when compared to Neutrality 1a.

A similar pattern is observed with new households. Scenarios with the greatest uptake of more efficient (and more costly) CSH levels have the highest costs per new house. Of the neutrality scenarios, Neutrality 2a has the highest cost per new house, at around £765. The lowest cost per new house is in Neutrality 2b, which is the only scenario that does not include CSH Level 5/6; variable tariffs dampen the effect here.

None of the cost ranges include the administrative and promotional costs that would be needed if a policy of reaching water neutrality were to be adopted. Furthermore, the costs are not attributed to any particular party, although Table A.1 in Appendix 1 shows how the total costs would be distributed across different sectors and measures in each scenario. While costs such as metering and tariffs would be incorporated by water companies into their business plans and therefore spread over their customer base, there are a number of potential options for other costs such as those associated with retrofitting. These are explored in Chapter 9.

None of the scenarios is intended to be the economically optimal solution. Rather, the scenarios reflect the differences in costs that are possible by pursuing different approaches to achieving water neutrality. As well as costs, other factors need to be taken into consideration, such as the public acceptability of different levels and methods of retrofitting programmes and the certainty of water savings for different measures. The economic, social and environmental benefits of reducing demand also need to be factored in, many of which are location-specific and beyond the scope of this study.

Estimated costs from non-households

While the costs from households were estimated with some certainty, it was not possible to undertake a detailed assessment of costs from non-household sectors with any certainty. A high-level assessment on the range of potential costs for retrofitting existing non-households is presented in Table 7.6. This is based on the number of non-household properties within the Thames Gateway multiplied by a range of possible retrofit costs. The total number of non-household properties within the Gateway in 2005-06 was 195,400. Due to the uncertainty over property types, these values are presented as a range determined by the cost assumptions per retrofit (£0 to £1,000).

As with household costs, the present value of costs was calculated over a 60-year life span and discounted using a factor of 4.5 per cent. No operational costs were assumed and promotional costs for the retrofits were excluded. The resultant table gives a total cost for retrofitting non-households from £0, if the costs are assumed to be accommodated as business-as-usual, to £158 million, where the average price of a retrofit 'package' is £1,000. Due to uncertainties with non-household costs, these total costs are wide-ranging and should be treated as speculative.

Table 7.6: Range of potential PV costs for non-households

Potential cost per retrofit (per non-household)	PV (total costs for all non-households)
£0	£0.00
£50	£7,890,984
£100	£15,781,968
£200	£3,563,935
£500	£78,909,838
£1,000	£157,819,677

Estimated water savings and costs from leakage

Leakage accounts for 17 per cent of the BAU demand for water. Attempts were made to include leakage reduction beyond the ELL as an option in the scenarios. This was not possible due to the limited data made available by water companies. Instead, the potential costs of additional leakage reduction beyond the ELL were assessed.

The assessment assumed further reductions in leakage (above those in current water company plans) could only be achieved through additional mains replacement. As it was not possible, based on the information available to the study, to gauge what level of water savings could be reached in the scenarios with any certainty, an indicative assessment of the cost of mains replacement is provided instead (Table 7.8).

Table 7.8: Indicative costs of leakage reduction through mains replacement

Company	Total leakage (m^3/km/day)	Assumed length of mains replaced to reduce leakage by 1 Ml/d	Assumed cost per metre of mains replaced (calculated)	Cost to reduce leakage by 1 Ml/d (calculated)	Average incremental cost for 1 Ml/d reduction (p/m^3) (calculated)
Thames Water	27.7	36 km	£300	£10.8 million	127
Essex and Suffolk water	7.9	127 km	£300	£38 million	472
Southern Water	6.9	144 km	£300	£43.5 million	543

Total leakage taken from *Security of supply, leakage and water efficiency 2005-06 (*Ofwat, 2006)

The assessment was based on average water industry costs for mains replacement of £300-£350 per metre and leakage data within the public domain. A number of assumptions were made which resulted in considerable uncertainty in the costs (see supplementary report, Section 5.11). From this, leakage reduction costs through mains replacement could be in the order of £10 million to £44 million per million litres of water saved. This suggests that achieving a further five per cent reduction in the 2016 leakage levels (to reduce leakage by 4.5 Ml/d) could cost between £49 million and £196 million. By comparison, saving 29 Ml/d through demand reduction measures in new and existing households would cost in the order of £126-181 million.

However, in water resources planning, water companies are required to investigate the relative cost-effectiveness of leakage reductions. Indicative average incremental costs for a 1 Ml/d reduction through mains replacement are shown in Table 7.4, ranging from 127 to 543 p/m^3. The incremental costs reflect uncertainties in the data. The cost per cubic metre will increase as the amount of leakage decreases, because areas of the network in worst condition will be replaced first, as more water would be saved in return for the investment. It is not appropriate to extrapolate the approximate leakage reduction cost (per megalitre of water saved) further, for example to the whole 42 Ml/d required to achieve neutrality.

7.3 Supporting objectives

The objectives of this study included consideration of how water neutrality in the Thames Gateway could be achieved in a way that complements related goals such as zero/low carbon and good environmental water quality for the region.

7.3.1 Carbon assessment

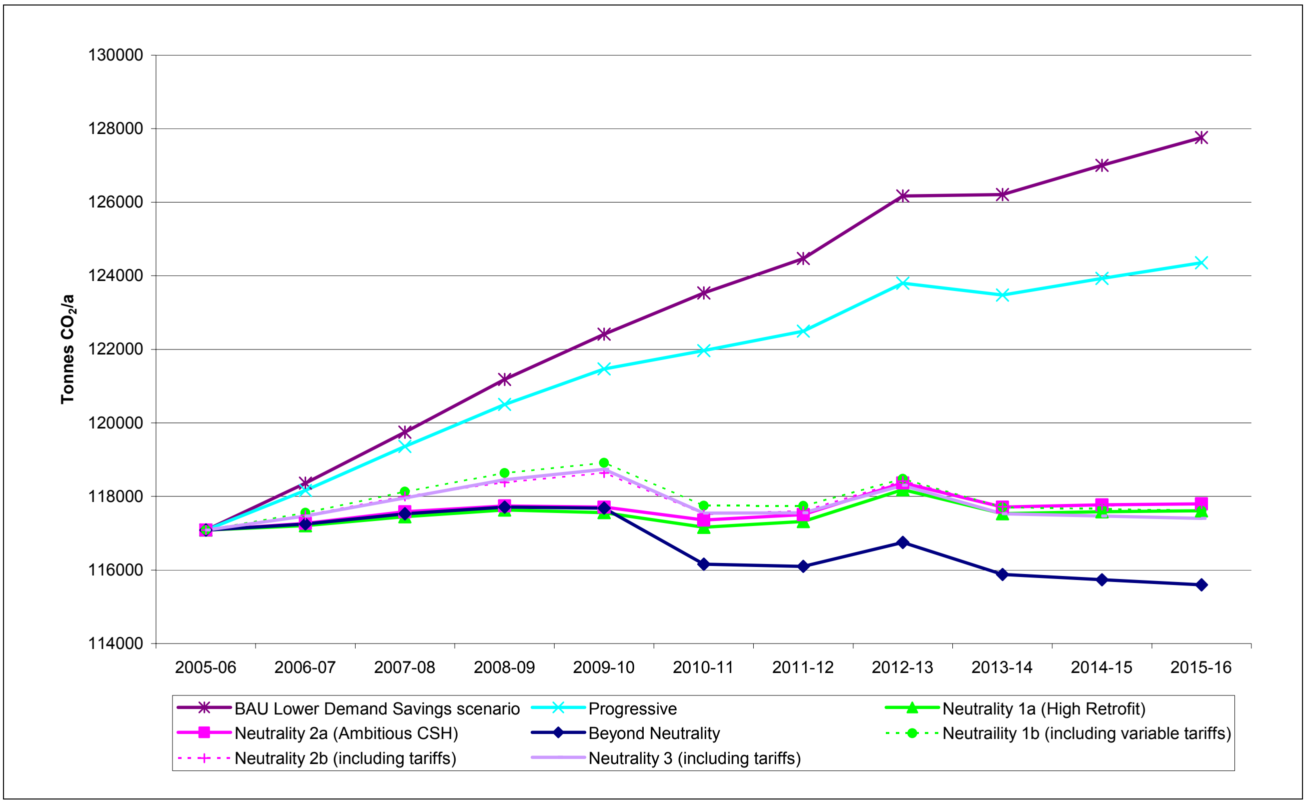


Figure 7.4: Comparison of carbon emission profiles under BAU Lower Savings Scenario to those under the pathway scenarios

The carbon assessment for the pathway scenarios builds on the baseline and BAU assessments described in Chapters 4 and 5. It uses the same simplified methodology whereby carbon savings track the level of water savings, but includes an allowance for the energy requirements associated with rainwater harvesting/recycling in homes built to Code Level 5/6. The results are presented in Figure 7.4.

The results show that under the Progressive Scenario, carbon dioxide (equivalent) emissions would be reduced by around 3,400 tonnes per annum by 2016. The greatest carbon savings would be achieved under the Beyond Neutrality Scenario, where emissions would be reduced by around 12,000 tonnes per annum over the same period. The range of reductions in all the scenarios is equivalent to 2.7 per cent and 10 per cent of emissions under the BAU scenario.

7.3.2 Other considerations

The relationships between water efficiency measures, drainage and environmental water quality are not well understood. A potential consequence of reducing demand often speculated on is an adverse impact on sewer collection systems, particularly in terms of drain and sewer blockages. A study for the Environment Agency by the WRc (Environment Agency, 2007) investigated this but found no recorded evidence of blockages occurring as a result of reducing demand for water. The study concluded that such adverse impacts would be unlikely in new developments, particularly if the design of drainage systems took into account the expected reductions in demand for water. However, there could be implications for retrofitting ultra-low flush toilets in some existing properties, particularly where a drain serves a single property or a small number of single-occupancy properties. Care may be needed to ensure that low-flush toilets are not fitted where they are likely to further reduce already low drain flows.

7.4 Uncertainty

This study highlighted the uncertainties prevalent in the assumptions of the modelling of the baseline, business-as-usual and pathway scenarios. Although the aim of water neutrality was ambitious, a precautionary approach guided the choice of assumptions in this study, for example by using the Lower Savings BAU Scenario. In selecting appropriate levels of water savings from different measures, again the same precautionary approach was adopted based on the best available evidence although for some measures, such as variable tariffs, relatively little data was available.

The cost estimates did not reflect the full potential costs of reaching water neutrality, in that they did not include the potential costs of promotional, administrative and other related implementation costs. Nor did the study consider how costs could be met and by whom. These are matters for policy and are not appropriate for inclusion in a scientific report. Further, the cost estimates do not include an assessment of the potential economic, social or environmental benefits of water neutrality. If these were to be included, the overall costs might appear even more favourable.

8 Survey of Gateway residents

Water neutrality is an ambitious aim for an area undergoing significant and rapid growth. As well as determining the technical feasibility of reaching neutrality, it is important to establish the public acceptability of more water-efficient lifestyles. Many of the measures outlined in the pathway scenarios would require not only acceptance of new fixtures and fittings and, in some cases, changes in everyday behaviour such as flushing the toilet, but also a willingness to participate.

Recent years have seen increasing interest in the 'sociology' of water use. In 2006, the Consumer Council for Water published research on attitudes to household water use and water resources for the Water Saving Group (Consumer Council for Water, 2006). Our study aimed to build upon this growing body of knowledge and explore the issues on a specific area basis.

Ipsos MORI Ltd was commissioned to undertake the survey for this study. This section summarises the approach and results. The full report by Ipsos MORI is provided separately as a supplementary report.

8.1 Approach

8.1.1 Research aims

The survey of Gateway residents had three research aims which broadly followed the modelling approach described earlier:

- **Baseline:** Gauge public attitudes and behaviours towards current water consumption and what is driving them.
- **Business-as-usual:** Explore anticipated attitudes and behaviours towards water consumption looking ahead, both *spontaneously* and *prompted* (in response to data outlining the pressures on water supply in the region such as climate change, population increases). How, if at all, does information and deliberation shift people away from their baseline attitudes and behaviours towards a more sustainable approach?
- **Scenario responses:** Gauge public appeal and feasibility of various demand reduction strategies and policy options under two scenarios provided by the Environment Agency.

8.1.2 Methodology

Ipsos MORI devised a deliberative research project to meet the research aims, consisting of four projects:

- **Desk research:** Review of research on attitudes to water and water efficiency.
- **Regional focus groups:** Six two-hour discussion groups held in three locations (Stratford, Chatham and Basildon) across the Thames Gateway. The participants recruited were broadly representative of the region. Each

group included about 10 participants and took place between 27 March and 4 April 2007.

- **Tasking phase:** Participants left the discussion groups with a task pack. This included self-fit water-saving devices and a diary to record how much water they saved through changing their behaviour or using the devices. One in three participants completed and returned their diary.
- **Water summit:** Half of the participants who attended the discussion groups were invited back to a four-hour workshop at the Design Museum in London on 21 April 2007. Those who were invited back were selected to ensure a representative sample of the Thames Gateway population.

In the first half of the workshop, participants were asked to reflect on the tasking phase and identify from their experiences those measures they felt would be most effective in reducing water use in the Thames Gateway. In the second half of the workshop, representatives from Communities and Local Government and the Environment Agency presented two possible scenarios for achieving water neutrality in the Gateway. Participants were asked to consider the pros and cons of each and arrive at what would be their preferred solution.

8.2 Summary

8.2.1 Current attitudes and behaviour: water consumption

The research showed that attitudes to water appear to be evolving. Publicity around the recent drought of 2004-06 (and previous water shortages and hosepipe bans) had challenged for some the common assumption that water is an abundant resource, at least in the South East region.

Those who were concerned about water shortages felt that more needed to be done to manage water resources, and looked for stronger leadership from the Government.

Factors that seemed to raise awareness of water use were the presence of water meters, publicity around the drought of 2004-06, negative feelings towards waste in general and a wider global perspective on how water is valued elsewhere in the world.

These factors not only raised awareness of the amount of water used, but also encouraged greater water efficiency in the home. Water meters were seen as particularly effective in that they provided people with a financial incentive not to waste water and focused people's minds on how they use water. Other factors that also played a part in encouraging water efficiency included: persistent reminders from partners or parents; concern about the environment in general; and action by local councils/water companies to make water efficiency more affordable or convenient.

In contrast, factors that discouraged water efficiency included: people's aspirations in terms of their homes or lifestyle; the presence of teenage children; lack of a sustained media campaign on water efficiency; a perceived lack of financial incentive to act; and a perceived lack of action from the Government or the water companies to make new homes more water-efficient or reduce leakage.

These factors supported the findings of the research project for the Consumer Council for Water completed in 2006 (Opinion Leader Research, 2006).

8.2.2 Scope for change in attitudes and behaviour

Participants felt that in the next 10 to 20 years, water might become scarcer. They anticipated future water shortages due to increased demand (from rising living standards and immigration). Climate change and failure to tackle leakage were identified as two other factors that might make the situation worse.

Stimulus material on the regional climate and plans for the Thames Gateway showed there was further potential to change attitudes to water as a resource. Facts about the level of rainfall in the region surprised some and encouraged them to focus on the issue. However, a sizeable minority were frustrated by the fact that additional housing was being placed in an area already recognised as water-stressed.

The majority of participants claimed to have saved water in the tasking phase. Larger savers of water tended to be single-person households, couples with no children, or those with younger children. Smaller water savers included many young couples as well as families with teenage children. Finally, those unable to save water tended to be older people with meters who felt they were already doing all they could to be water efficient.

The key factor that helped the participants to become more water-efficient was increased awareness of how much water household activities use. This was backed up by persistent reminders to other household members and simple suggestions on where savings could be made, for example, by keeping a jug of water in the fridge.

Barriers to change included concerns over the effectiveness of devices supplied in the tasking phase (both in terms of fitting them and reducing water consumption); how sustainable some of the changes were in the long run; a lack of time; and a failure to persuade teenage children to come on board. These barriers might be negotiated if the participants received more information on how the devices worked, if they concentrated on making one change at a time, or if they used fix-and-forget solutions. The latter solution would help participants who were ‘time poor’ or could not persuade other household members to change their behaviour.

8.2.3 Planning for change: responses to scenarios

Participants were presented with two possible scenarios to achieve water neutrality. These were not the pathway scenarios developed by Entec, but simplified scenarios that represented different approaches to reducing water use. The first, *Flush and Go*, focused on technology with a universal retrofit programme. The second, *Water Watch*, sought to influence behavioural change with education and information campaigns, plus compulsory water metering with variable tariffs.

Participants found technological solutions appealing because of their convenience - once in place, they would not have to think about them. This would extend water efficiency to some who did not have the time or inclination to engage. However, a universal retrofit programme was seen as too interventionist, and participants were also concerned as to who would bear the cost.

Education and information again had strong appeal, although participants argued it would have to be sustained to change attitudes and support householders policing water efficiency in the home. The view was that this should be delivered by the Government (and/or local councils) rather than the water companies.

Compulsory water meters received broad acceptance, both from those who were on meters and from those who weren’t. It was felt to be more fair than the current system, where a significant proportion of the public were on meters but had no choice in this.

However, participants raised concerns about variable tariffs. If compulsory meters were adopted, householders would pay for what they use and variable tariffs were thus seen as exploitative. However, this reaction should be noted with caution as variable tariffs were not a major focus of discussion and were not fully explained by the moderator. Many participants were more familiar with the idea of metering than of variable tariffs. More discussion of variable tariffs in the media and how they might work could shift attitudes. Indeed, a report for the Consumer Council for Water (Corr Wilbourn Research, 2007) suggests there is support for a rising block tariff.

8.3 Recommendations

8.3.1 Recommendations for preferred scenario

A third scenario emerged from the deliberations which combined the most publicly acceptable elements of Flush and Go and Water Watch. This scenario forms the main recommendations drawn by Ipsos MORI and includes:

- **Social marketing and public education on water efficiency**

The public needs to understand why water efficiency, in the context of wider water resource management, is a long-term goal and not a short-term response to the occasional severe drought. This requires some shock tactics on regional climate and water stress. However, this should be balanced with positive messages of simple steps the public can take to guard against future water shortages and more draconian restrictions.

Campaigns would also need to emphasise that the Government and water companies are taking measures to ensure new homes are more water-efficient, help existing homes to improve their efficiency and reduce the volume of leakage. The drive towards a more water-efficient society has to be a partnership between the public, the Government and the water companies.

- **Top-down measures from Government/water companies**

Participants were broadly supportive of the following top-down measures, albeit with some terms and conditions attached:

Compulsory water meters – meters were perceived as effective in changing behaviour and raising awareness of water use. However, some vulnerable groups may need to be protected from pressure to reduce water use too far.

All new homes built to a high standard – participants were accepting of new homes being built to a high standard. They felt the cost of this could be passed on to the homeowner.

Legislation to ban non-water efficient appliances – many participants expressed surprise at why non-water efficient appliances were still available, and wanted the Government to regulate more actively.

Grants and incentives to encourage homeowners to retrofit – while compulsory retrofit was seen as too interventionist and costly, it was felt that grants should be made available to encourage people to retrofit their homes.

Widespread distribution of water efficiency packs from the water companies - water efficiency should be made convenient, with the most effective devices being distributed free of charge.

In response to these measures, participants said they would look to alter their own perceptions of water as a resource, as well as police domestic water use more actively.

8.3.2 Recommendations for communications

Communications play a key role in persuading the public to become more water-efficient. The following recommendations emerged for communication:

- Shock tactics can help to raise awareness that the South East is water-stressed, but this needs to be balanced with a positive message of the simple steps we can all take to waste less water. It needs to be emphasized that collectively, households can have a measurable impact as witnessed in the public's response to the 2006 'beat the drought' campaign.
- Water neutrality needs to be carefully communicated if it is to receive buy-in. Water neutrality was seen as a worthy aim by those surveyed, but there was a lack of trust/belief that such an aim could be delivered by the Government. It was a difficult concept to sell to residents, being tied up (in this case) with the development in the Thames Gateway. The scale of development was de-motivating to some of those most willing to engage with water efficiency. It is important to emphasise the need to reduce waste as opposed to reducing water use, to safeguard future supplies in the region.
- The challenges facing the South East in terms of its climate and increased demand from lifestyle changes should be raised. References to the Thames Gateway development may incite a backlash from those most engaged with water efficiency and provide a get-out clause for those less engaged.
- Emphasise that all parties are working towards the goal of reducing wastage to safeguard future supplies. Communications need to build a sense of working in partnership if the goals are to be accepted by many of those who are able but unwilling to engage with water efficiency.

9 Conclusions

This section outlines the conclusions of the study and assesses the potential implications of moving towards a water-neutral Thames Gateway for different groups.

9.1 Moving towards water neutrality in the Thames Gateway

The overall aim of this study was to examine the feasibility of moving towards water neutrality in the Thames Gateway during the period to 2016. Water neutrality in the Gateway would be achieved if the total water used after new development is equal to or less than total water use in the Thames Gateway before the new development. The analysis showed that water neutrality in the Thames Gateway would be achieved if 42 Ml/day of water were saved between 2005/06 and 2016.

The results of the pathway scenarios show that achieving water neutrality by 2016 is technically feasible, but that water neutrality is nonetheless an ambitious aim. It may be possible to go beyond neutrality by approximately 20 per cent. In areas where water resources are seriously stressed, achieving a water supply-demand balance that goes beyond neutrality may be more desirable. The Neutrality 3 Scenario offers perhaps the most favourable scenario to achieving water neutrality. Of the scenarios modelled, it is the most feasible in terms of the speed and level of take-up of higher levels of the CSH, and the public acceptability of retrofitting to high levels. It is the second lowest cost scenario, with a present value cost of £140 million (for households). Other scenario variations not modelled, perhaps involving the use of more novel and untested measures, may be more cost-effective than this scenario.

Residents in the Thames Gateway anticipate future water shortages due to increased demand, climate change and a failure to tackle leakage. However, residents are broadly supportive of increasing efforts on water efficiency and view water neutrality as a worthy aim. Some water efficiency measures and approaches have more public support than others. These include sustained education and information campaigns, compulsory metering, building new homes to high environmental standards, using legislation to ban non-water efficient devices and offering grants and incentives to encourage homeowners to retrofit.

The costs of moving towards and achieving neutrality are competitive with those of other options, such as leakage management. Costs for households range from £127 million to £181 million, and account for 29 Ml/d of water savings – or two-thirds of the water savings. Costs for the non-household sector are far less certain.

The range of costs per new home is £275 to £765, averaged across all homes built in the Thames Gateway between 2005/06 and 2016. The cost range for existing homes (to pay for retrofitting, a meter and tariffs where applicable) is £135 to £154 per house, with costs averaged across all households present in the Gateway in 2005/06. Costs vary depending on the scenario and the number of homes and type of retrofit or new build measures included. However, neither the costs of implementing water neutrality, such as administrative and promotional costs, nor any potential economic, social or environmental benefits of achieving water neutrality are considered in this study.

Some demand management measures are more cost-effective, offer more certainty of water savings or are potentially less carbon-intensive than others. The analysis of the pathway scenarios and the survey identified the following measures as having the greatest potential for achieving water neutrality:

- **Metering:** Compulsory metering (in existing properties) is included in all the pathway scenarios, accounting for approximately 10 per cent of water saved. Paying for the water used provides an important financial incentive to households and is the measure with the greatest public acceptance.
- **Variable tariffs:** A rising block variable tariff is included in three neutrality scenarios. These are applied to all metered homes (new and existing) and account for 22 per cent of water saved in those scenarios. This is a low-cost option, but a lack of evidence in the UK means the potential water savings are uncertain. Awareness of the purpose and benefits of variable tariffs among residents in the Gateway is low.
- **New homes:** Building new homes to higher standards of water efficiency offers substantial water savings for the number of homes affected. The scenarios show that higher standards in new homes account for 9-17 per cent of the total water saved. The cost-effectiveness of building to higher standards reduces when water recycling (such as rainwater/grey water harvesting) is used in the highest levels (5/6) of the CSH. In most cases, the use of rainwater or grey water harvesting may be more energy-intensive than using the mains supply, which will make achieving zero carbon homes more difficult. Residents in the Gateway want to see all new homes built to high environmental standards
- **Retrofitting:** The retrofitting of existing homes with relatively simple packages of measures accounts for 23-47 per cent of the total water saved. Retrofitting appears relatively cost-effective, but the effort required to reach the high numbers of households needed to achieve neutrality could add substantially to the costs and the uncertainty. Residents support efforts to improve the water efficiency of homes, but prefer an incentive-based approach together with distribution of free water efficiency packs, to more interventionist or regulatory-based approaches.

Less certain are the potential water savings and costs from the non-household sector and from reductions in leakage beyond the 2015/16 ELL. A conservative estimate of potential savings from the non-household sector suggests a third of total water savings in the neutrality scenarios could be achieved by reducing demand of non-households by 10 per cent, with 40 per cent savings in offices. There is potential for additional savings from leakage reduction, but this means of water saving could be less cost-effective than other options and was not included in any scenario to achieve neutrality.

Assessing the carbon impact of different measures and scenarios proved difficult, due to the paucity of information currently available[7]. The analysis suggests achieving neutrality would have a positive effect in cutting emissions from the Gateway – a 2.5 to 10 per cent reduction from business-as-usual emissions. However, this does not include (to a significant level of detail) an assessment of carbon emissions associated with the energy required to pump, heat or treat water within the building or site.

Achieving neutrality is an ambitious aim. However, not reducing demand will also incur costs, as additional water resources will be needed to cater for the increased "business as usual" demand from new homes. This study has not considered these costs (or benefits). However, given the current pressures on the Gateway's water resources these costs are likely to be significant, both to households and to the environment. Water resources planning may establish that neutrality is the most favourable option in terms of overall costs and benefits.

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[7] This is a developing area of research which both Defra and the Environment Agency are involved in.

9.2 Implications for sectors and stakeholders

Water neutrality is an ambitious goal. Achieving it will require a significant shift in attitudes towards using water more wisely, a step-change in take-up of the water efficiency standards in the CSH and the development of policy tools and incentives.

The purpose of this study was to assess the technical feasibility and approximate cost of achieving water neutrality in the Thames Gateway. Further work is required to assess what actions and policy decisions would be needed to meet water neutrality, who would need to undertake those actions and how the cost burden would be shared.

This section of the report takes a first step in this direction by outlining, by sector, the potential implications of achieving water neutrality for different stakeholders. The stakeholders identified are generic and the actions limited by geographic extent to the Thames Gateway only.

9.2.1 New homes

Recent initiatives by Government to increase the water efficiency of new homes through building regulations and the CSH are taken into account in the BAU scenario. The study shows that new homes have the potential to make a significant contribution to the goal of water neutrality. The scenarios modelled indicate that to meet water neutrality, a level of ambition akin to the commitment to zero carbon homes by 2016 is likely to be needed for water efficiency standards in the Thames Gateway.

Policy tools for influencing the water efficiency performance of new homes are more developed compared to other sectors, and there are clearer lines of responsibility split between developers, housebuyers and the supply chain. Roles also exist for local planning authorities and water companies, which become more important at the scale of the Thames Gateway. The conditions that would be needed to achieve water neutrality and the key stakeholders involved in the new homes sector include:

- **Development sector:** all new homes to be built to at least CSH Level 3/4 from 2010 and innovations in design to achieve higher levels of water efficiency.
- **Supply chain:** continuing innovation by manufacturers to bring forward water-efficient high performance fittings and appliances.
- **Housebuyers:** to exercise influence through purchasing choices and behavioural change.
- **Government**: there is likely to be an ongoing role for government working with stakeholders to inform and educate housebuyers on the need for water efficiency and getting the best out of their new home, encourage product innovation and encourage developers to meet the challenge of building to higher levels of the CSH.

9.2.2 Existing homes

Few policy tools currently target the retrofitting of homes to improve water efficiency, in contrast to the retrofitting of energy-efficient measures. Therefore, the options proposed here are speculative.

There are currently a number of proposals and initiatives to transform the market for more water-efficient products and devices. The anticipated changes to Water Fittings

Regulations could help to discourage the retrofitting of poorly performing fittings in homes. However, the regulations and other measures, such as point-of-sale information, are not designed to achieve the high rates of retrofitting in the pathway scenarios. Furthermore, these are set at the national level and are not designed to be adapted to a regional or local level. A mix of different approaches and incentives would likely be needed to reach the required number and range of different households. Options include:

- Provision of free or subsidised retrofit packages.
- Provision of incentives to encourage improvements in water use.
- The introduction of water efficiency targets for water companies could help to incentivise companies to develop packages of measures to persuade householders to adopt water-efficiency measures. One of the most sensitive issues will be that of ‘who should pay’, to which there is not an obvious answer. The most likely case is that costs will be shared between individual householders and water companies (ultimately falling on water customers). It is also possible that some form of developer contribution could help towards the cost of retrofitting.

The following conditions are among those that may be needed to achieve neutrality:

- **Water companies:** actively engaging with their customers to promote water efficiency measures.
- **Plumbers:** raising their knowledge base and skills through skills sector curriculum design and competent persons schemes to enable them to advise on water-efficient products and design.
- **Supply chain:** continuing innovation by manufacturers to bring forward water-efficient high performance fittings and appliances. Promoting such products to consumers wanting to update their bathrooms and kitchens.
- **Households:** to exercise influence through purchasing choices and behavioural change.
- **Social housing providers:** engaging with tenants and contractors to retrofit homes with appropriate water efficiency measures and advise tenants on their use.
- **Government**: there is likely to be an ongoing role for government working with stakeholders to inform and educate households on the need for water efficiency and getting the best out of their home, encourage product innovation and encourage social housing providers to help meet the challenge of bringing up water efficiency standards in existing homes.

9.2.3 Metering

Water companies are responsible for implementing metering. The recent announcement that water companies in areas of serious water stress will be required to assess the case for compulsory metering in their 25-year WRMPs should mean that this aspect of the pathways scenarios will be considered alongside existing supply and demand measures. Costs for metering will need to be accounted for in the 2009 water price review (PR09). The implications/roles for stakeholders are:

- **Water companies:** to increase their metering programmes so an average of 70 per cent of their customers are metered by 2016. Water companies could use the opportunity provided by metering to raise customer awareness of water efficiency and potentially provide some of the means to increase it.
- **Ofwat and the Environment Agency**: the two regulatory bodies have a role in challenging water companies' water resources management plans and, where appropriate, the case for compulsory metering.
- **Households**: to respond to the financial incentive of being charged by volume for water use.

9.2.4 Variable tariffs

This study has shown that the potential benefits of variable tariffs could be significant. There is a clear need for trials of variable tariffs and research on the impact they have on water demand and on affordability issues. Trials and public awareness campaigns in the Thames Gateway would be needed to be set up quickly if water neutrality were to be achieved by 2016.

The costs of introducing and maintaining variable tariffs would fall on water companies and be spread across their customer base. Under a rising block tariff the essential use of water is charged at lower cost, with non-essential use charged in blocks of increasingly higher cost. A significant number of customers could be better off as a result. The conditions needed and implications/roles for the different stakeholders are:

- **Water companies:** to design, and submit for approval by Ofwat, appropriate variable tariff regimes in time for PR09. Water companies would also need to engage with their customers to explain how variable tariffs work, why they are needed and what the benefits are.
- **Ofwat:** has an important role in encouraging the innovative use of tariffs and ensuring that they are fair and do not create adverse effects, particularly for those on low incomes and other vulnerable groups.
- **Households:** to respond to the additional financial incentive of variable tariffs.

9.2.5 Non-households

This sector has the greatest uncertainties in potential water savings and costs, yet it is the sector where gains are potentially the greatest. There is a need for more work to examine where the most cost-effective savings could be and how those could be most effectively achieved. Through the Green Commercial Buildings Task Group the Government is already taking steps to improve the evidence base on water used for domestic purposes in non-domestic buildings, to determine whether it might be possible to set benchmarks and targets to improve water efficiency for these types of use.

Government, business representative organisations and regional and local authorities have an important role to play in raising awareness of the potential impact a reduction in water use may have on the environment and on an individual company's profits:

- **Business and industry representatives**: to actively promote water efficiency to their members and individual sectors. Key sectors and individual companies to incorporate water efficiency measures in existing and new buildings and to encourage behaviour change in their staff and visitors.
- **Water companies:** to promote water efficiency to their non-household customers.
- **Public bodies:** to incorporate water efficiency measures in their procurement procedures for new and public buildings. To consider product choices for bathroom, kitchen and outdoor watering devices and appliances; and to encourage water-efficient behaviour among staff, students and visitors of public buildings.
- **Government and government agencies:** to have an ongoing role in co-ordinating the development of the evidence base for water efficiency savings in the non-household sector. Government could also have a role in exploring implementation options with stakeholders in the Gateway.

9.3 Lessons for other areas

This study demonstrates that achieving water neutrality is technically feasible in the Thames Gateway growth area and that demand could be managed to a level beyond neutrality. There are lessons for other areas facing similar rates of growth, such as other Growth Areas, New Growth Points and Eco Towns.

The scope and cost for water efficiency improvements in the non-household sector are less well understood than in households. Nevertheless, inclusion of the non-household sector expands the scope for reductions in existing demand, Pursuing neutrality solely through the household sector means that a larger number of existing homes would have to be retrofitted to offset the demand from every new home built (see Section 7.1.3). For example, for every new home built to the new minimum regulatory water efficiency standard (equivalent to Code Level 1/2), between four and eight homes would need to be retrofitted (depending on the retrofit package). For a Code Level 5/6 home, the number of retrofits would reduce to between three and five. In some areas, there may not be a sufficient number of homes to retrofit to offset new demand in the immediate vicinity. In these cases, offsetting demand within the water catchment of the new development would achieve similar environmental benefits.

In conclusion, the best way to achieve water neutrality in the Thames Gateway and in other areas is to develop an approach based on a sharing of responsibility across different sectors. It is also important to ensure that financial incentives are in place through metering and structured tariffs to encourage efficient water use.

References

Communities and Local Government (2006a). *The Thames Gateway Interim Plan: Policy Framework*. Wetherby: Communities and Local Government Publications.

Communities and Local Government (2006b). *Low carbon Gateway feasibility study. Interim report.* Wetherby: Communities and Local Government Publications.

Communities and Local Government (2006c). *Water efficiency in new buildings. Consultation document.* Wetherby: Communities and Local Government Publications.

Communities and Local Government (2006d). *Towards a zero carbon future*. Communities and Local Government News Release 12 December 2006. Available from: http://www.communities.gov.uk/index.asp?id=1002882&PressNoticeID=2320 [Accessed 2 April 2007]

Communities and Local Government (2007a). *Homes for the future: more affordable, more sustainable.* London: The Stationary Office.

Communities and Local Government (2007b). *Building a greener future: policy statement.* London: Department for Communities and Local Government.

Communities and Local Government (2007c). *Water efficiency in new buildings*. A joint Defra and Communities and Local Government policy statement. London: Department for Communities and Local Government.

Communities and Local Government (2007d). *The future of the Code for Sustainable Homes. Making a rating mandatory.* Consultation. London: Department for Communities and Local Government

Communities and Local Government (2007e) *The future of the Code for Sustainable Homes - making a rating mandatory: summary of responses.* London: Department for Communities and Local Government.

Consumer Council for Water, in association with the Water Saving Group (2006). *Report of consumer research findings and recommendations for action.* Available from: http://www.ccwater.org.uk/server.php?show=nav.444

Corr Wilbourn Research (2007). *Deliberative research into consumer views on fair charging for the Consumer Council of Water*. February 2007. Available from: http://www.ccwater.org.uk/upload/pdf/CWRD_907_full_version.pdf

Department of Environment, Food and Rural Affairs (2007). *Government response to consultation on water metering in areas of serious water stress between 31 January to April 2007.* Available from: http://www.defra.gov.uk/environment/water/industry/water_metering/pdf/govt-response.pdf [Accessed 26 September 2007]

Environment Agency (2007a). *Identifying areas of water stress*. Consultation document. Available from: http://publications.environment-agency.gov.uk/pdf/GEHO0107BLUT-e-e.pdf [Accessed 16 March 2007]

Environment Agency (2007b). *Assessing the cost of compliance for the Code for Sustainable Homes.* Bristol: Environment Agency.

Environment Agency (2007c). *Water resources planning guidelines*. Bristol: Environment Agency.

H M Government (2005). *Securing the future – UK Government Sustainable Development Strategy.* London: The Stationery Office.

HMT (2003). *Green Book: Appraisal and evaluation in central government*. HMT: The Green Book.

House of Commons. Environmental Audit Committee (2006). *Sustainable housing – A follow up report.* Fifth report of session 2005-06. London: The Stationery Office.

Office of the Deputy Prime Minister (2003). *Sustainable communities: Building for the future.* Summary, main document and regional action plans. Available from: http://www.communities.gov.uk/index.asp?id=1163452 [Accessed 16 March 2007]

Opinion Leader Research (2006). *Using water wisely, A deliberative consultation commissioned by Consumer Council for Water.* Final report October 2006. Available from: http://www.ccwater.org.uk/server.php?show=nav.444

Therivel, R., Drury, C. and Hepburn, I. (2006). *Achieving water neutrality in the South East region.* Unpublished discussion paper available from the authors.

UKWIR (2006). *Critical review of relevant research concerning the effects of charging and collection methods on water demand, different customer groups and debt.* London. UK Water Industry Research Limited.

Wade, S., Fenn, T. and Barnett, C. (2006). *Defra research contract: Climate change impacts and adaptation – cross-regional research programme (Project C – water). Final report.* H R Wallingford. Available from: http://www.defra.gov.uk/science/project_data/DocumentLibrary/GA01076/GA01076_4034_FRP.pdf

Water UK (2006). *Towards sustainability, 2005-2006. UK Water Industry Sustainability Indicators 2005/2006.*

WWF (2007). WWF Website - Linking Futures Programme – Virtual Water [online] [Accessed 24 September 2007]. Available from World Wide Web: http://www.panda.org/about_wwf/where_we_work/africa/where/mozambique/wwf_mozambique__our_solutions/projects/index.cfm?uProjectID=8W0020

Zygmunt, J. (2007). *Hidden waters: Embedded water and our true consumption. A Waterwise briefing.* Available from: http://www.waterwise.org.uk/images/site/EmbeddedWater/hidden%20waters%2C%20waterwise%2C%20february%202007.pdf [Accessed 16 March 2007]

List of abbreviations

BAU	Business-as-usual
CIRIA	Construction Industry Research and Information Association
CLG	Department of Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
ELL	Economic level of leakage
Ofwat	Water Services Regulation Authority
SUDS	Sustainable drainage systems
WRP	Water resource plan
WRZ	Water resource zone

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.

Annual average
The total demand in a year, divided by the number of days in the year.

Average incremental social costs
The ratio of present social costs over present net value of additional water delivered or reduced demand.

Black water
Raw sewage.

Code for Sustainable Homes
A single national standard to be used in the design and construction of new homes in England, based on the BRE's EcoHomes© scheme. A set of sustainable design principles covering performance in nine key areas: energy and CO_2; water; materials; surface water run-off; waste; pollution; heath and well being; management; ecology.

Demand management
The implementation of policies or measures which serve to control or influence the consumption or waste of water (this definition can be applied at any point along the chain of supply).

Distribution system operation use (DSOU)
Water used by a company to meet its statutory obligations, particularly those relating to water quality. Examples include mains flushing and air scouring.

Economic level of leakage (ELL)
Level of leakage at which it would cost more to make further reductions than to produce the water from another source. Operating at ELL means that the total cost of supplying water is minimised and companies are operating efficiently.

Greywater
Waste water from baths, showers and washbasins. This water can be collected in a household reuse system and treated to a standard suitable for WC flushing.

Meter optants
Properties in which a meter is voluntarily installed at the request of its occupants.

Meter programme
Properties which are to be metered according to company metering policy.

Micro-component analysis
The process of deriving estimates of future consumption based on expected changes in the individual components of customer use.

Net present value
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.

Non-households
Properties receiving potable supplies that are not occupied as domestic premises, for example, factories, offices and commercial premises.

Potable/mains water
Water company/utility/authority drinking water supply.

Present value
The value of a future cost or benefit after adjusting for time preferences by discounting.

Water resource zone
The largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall.

Thames Gateway
Area comprising 10,000 hectares of land along the riverside of eight London Boroughs: Barking and Dagenham, Bexley, Greenwich, Hackney, Havering, Lewisham, Newham and Tower Hamlets.

Total leakage
The sum of distribution losses and underground supply pipe losses.

Water Regulations Advisory Service
An advisory service for and on behalf of water suppliers and for any other person or body seeking guidance on the principles of water regulations.

Appendix 1

Table A.1: Summary of present value of costs of components by scenario

	Present value of costs (£M)						
	Progressive	**Neutrality 1a**	**Neutrality 1b**	**Neutrality 2a**	**Neutrality 2b**	**Neutrality 3**	**Beyond Neutrality**
Existing households							
Variable flush retrofitting	2.9	10.8	6.7	9.1	7.1	7.7	12.4
ULF toilet retrofitting	0.0	12.2	5.4	11.6	6.8	6.8	0.0
Low-flow showerheads	1.9	8.1	4.1	8.1	4.5	4.5	8.1
Low-flow taps	3.9	17.1	8.6	17.0	9.5	9.6	17.1
Compulsory metering	36.9	36.9	36.9	36.9	36.9	36.9	36.9
Variable tariffs	0.0	0.0	29.1	0.0	29.1	29.1	29.1
Existing household total	45.5	85.1	90.7	82.7	93.9	94.5	103.6
New households							
CSH Level 1/2	5.5	1.6	1.6	1.9	1.0	3.8	3.4
CSH Level 3/4	17.2	13.9	13.9	10.2	24.8	14.5	9.3
CSH Level 5/6	11.0	59.6	59.6	89.7	-	15.5	83.9
95l/h/d pcc	-					4.4	-
Variable tariff	-	-	10.8	-	10.8	10.8	10.8
New household total	33.8	75.1	85.9	101.9	36.6	48.9	107.4
BAU costs	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total cost	75.8	156.6	173.0	181.0	126.7	139.8	207.4

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